

Proposed Graduate Certificate Program

Certificate Title: Water Resources Science and Management

Contact Information:

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1. Rationale for certificate program (target audience)

The State of Washington Water Research Center (WRC) is developing educational programs that align with the WSU Grand Challenges Sustainable Resources Initiative, and will foster water-related learning and expertise across the WSU campus. As part of this initiative, the WRC seeks to create and co-administer interdisciplinary graduate certificates in water resources using primarily existing disciplinary courses and curricula.

This certificate is aimed at **graduate students** from all colleges and disciplines who are interested in freshwater resources. The primary objective is to provide students with an interdisciplinary understanding of the physical, social and cultural drivers that shape how water is managed within the larger environmental and human landscape. Water is an important resource for maintaining both the health and integrity of our natural and social systems, and therefore must be managed carefully. Threats to freshwater resources come from a diversity of sources, often encompassing not a single issue, but a series of interlinked problems with common themes. Managing for water sustainability in the face of these complex problems requires a broad understanding both the physical water system and the short- and long-term impacts our decisions about water will have on populations, economies and ecosystems. Our goal is to provide students with the breadth of knowledge required to critically understand these freshwater issues.

Certificate requirements will be consistent with WSU guidelines and make the most effective use of existing water-related curriculum. The proposed certificates will require graduate students to complete coursework within a core curriculum of currently existing, freshwater-related classes that span four major themes: 1) Subsurface and Surface Hydrology, 2) Water Chemistry/Ecology/Biology, 3) Water Methods & Analysis, and 4) Water Policy & Management. In addition, a set of Immersive Experiences (Section 5), which may include participation in a capstone course, must also be completed by the student.

This certificate will help focus water resources education and research at WSU with minimal initial investment, while providing a platform to develop demand in water resource scholarship and foster interdisciplinary collaboration between academic units at WSU. Given WSU's continued focus on the development of water-related courses and research (e.g. Grand Challenges), we anticipate that a broad pool of faculty and students will interested in supporting and participating in this certificate. As such, we expect that 5-10 students would be interested in the certificate within the first year. As the program gains familiarity among faculty and students, we would anticipate that this number



would grow in subsequent years. This certificate would be available to students on any WSU campus that could implement the required components.

2. Student Learning Objectives

Since this certificate program will build almost exclusively on pre-existing WSU curricula, we anticipate that WSU Student Learning Objectives will already be incorporated into the individual classes offered within this certificate. At the programmatic level, students earning this certificate will be able to:

- Utilize fundamentals of the physical sciences to broadly understand the hydrologic cycle and how human management of water influences this cycle.
- Display a broad knowledge of the social, legal, and institutional environment surrounding water resources and management.
- Demonstrate a conceptual understanding of the interdisciplinary and often co-evolving science and policy advances for addressing freshwater issues.
- Broaden their professional and social networks to enhance their disciplinary understanding of water and water management.

The Learning Objectives for the capstone class will include those *Critical and Creative Thinking*, *Quantitative Reasoning*, *Scientific Literacy* and *Informational Literacy* components through an indepth, interdisciplinary study of freshwater issues, science and management. In this hands-on class, students will gain valuable experience working in teams, researching and presenting material about freshwater issues in both written and oral formats, and refining their scientific communication skills to reflect clear and succinct ideas (for additional information, please see the Course Syllabus- Section 11).

3. Admission Requirements

Graduate students from any WSU department or college will be eligible to participate in this certificate program. Students can apply during any phase of their training, as long as they will have sufficient time to meet all of the requirements. Interested individuals will need to submit a letter of support from their major advisor along with a copy of their most recent transcript and other relevant academic information to be admitted into the program. Upon admission, students will also be required to identify which water cluster area (see Section 1) their proposed research most closely aligns with. This will be recorded as their "primary focal area" (relevant to Section 4). The Committee (see Section 6) will review student applications and make admission decisions once per semester. Upon preparing to graduate, each student must submit an exit application to the SoE *at least one semester before* the semester of their expected graduation verifying that all requirements have been, or will be, met before they graduate. Certificate of Completion fees may apply as dictated by the WSU Registrar's Office.

4. Course Requirements

All graduate students participating in this certificate program will be required to complete a minimum of 9 credit hours by taking at least one course from the three water cluster areas not identified by the student as their primary focal area. The four water cluster areas are: 1) Subsurface and Surface Hydrology, 2) Water Chemistry/Ecology/Biology, 3) Water Methods & Analysis 4) Water Policy & Management. A tentative list of courses available within each cluster can be found in the Supporting Documents (Section 10). To ensure an interdisciplinary experience,



the classes chosen by the student must represent at least two different academic units. Some courses represent a hybrid of two or more cluster areas- while they may be listed under more than one cluster area, a class will not count towards two cluster areas simultaneously. Students must take a different course in each cluster area. A minimum grade of 2.0 will need to be achieved for the course to count as progress towards completing the certificate, and a minimum grade of 3.0 must be maintained for the program as a whole. The WRC will be responsible for maintaining and updating the list of classes available within each cluster area. Students may petition the WRC to include classes they believe are relevant and appropriate towards their required certificate credit hours, including petitions to accept transfer credits from other universities. Petitions will be reviewed and approved by the Committee on a per-request basis.

5. Immersive Experiences

In addition to a course component, three types of experiences meant to engage students in diverse ways of learning and provide opportunities to meet other students and faculty who are interested in integrated water resources issues and management will be required. These experiences include 1) attending bi-annual meetings/socials (fall and spring semesters), 2) attending invited guest lectures hosted by the Certificate Program and 3) participating in either an internship experience <u>or</u> the capstone class SOE 535.

<u>Bi-annual meetings.</u> The bi-annual meetings/socials will bring together students participating in the undergraduate and graduate certificates with those faculty and staff interested in water resource issues. These meetings will serve as convenient ways to keep students and faculty updated on program news, and allow students and faculty to interact and network in a less formal setting.

<u>Guest lectures.</u> The program will identify <u>two</u> invited guest lecturers each year who provide outside knowledge and expertise on interdisciplinary water-related research and policy. Students in the program would be expected to attend at least one of these lectures per year. Guest lecturers can either be nominated by faculty or students, or will be selected by the program Committee.

Capstone Class/Internship Experience. The capstone class, SOE 535 Interdisciplinary Water Resources Science and Management, is a 3-credit interdisciplinary course designed to explicitly provide students with an overview and broad understanding of the complex freshwater issues that exist and the policy and science required to manage them. To facilitate a truly interdisciplinary experience, this course is co-instructed by faculty from different disciplines and utilizes a case-based approach to study watersheds that illustrate a particular freshwater issue and the science and management that co-evolve around complex water problems. Offered once a year in Spring, students opting to take this class (rather than pursue an internship experience) would be expected to complete this requirement before graduating. For more information on the class content and expectations, see Section 11.

Students looking for a more practical, hands-on experience have the option of completing an internship that relates to freshwater science or policy. This certificate would leverage the emerging WSU-PNNL Distinguished Graduate Program to place graduate students in



water-related internships, as well as WRC's close ties with individual researchers and staff at the Pacific Northwest National Laboratory (PNNL), the United States Geological Society (USGS) Washington Water Science Center, and the WA Department of Ecology (Note: students would still have to apply and be accepted to any of these institutions). To count towards the certificate, the internship would need to last a minimum of six weeks and have a water-related science or policy component. Students pursuing this option must notify the WRC in advance to ensure it meets the certificate program requirements.

6. Additional Resources for Students

By pursuing this certificate, students will receive additional resources in the form of a subscription to the WRC list-serve, access to additional student-faculty interactions through other social events and hydrologic sciences seminars, as well as administrative support and faculty guidance for those choosing to pursue a water-related internship experience.

7. Administration and Oversight

This certificate is designed to deliver an interdisciplinary overview of water resources science and management by partnering with over 30 classes spanning 3 Colleges across WSU. The WRC would take responsibility for ensuring that the certificate is advertised broadly and within targeted audiences, and would be the primary contact point for interested students. The School of the Environment (SoE) will formally house the certificate program. While the faculty and departments whose classes are associated with this certificate are expected to be indirectly involved in this certificate, the program will have a guiding Committee consisting of a core group of faculty. Permanent faculty on this Committee will include the Director of the WRC as well as one faculty representative from the School of the Environment. Other members will be added as needed to ensure all three colleges are represented. The first Committee will be comprised of:

- <u>Committee Chair</u>: Julie Padowski, CEREO & WRC, School of the Environment (affiliate)
- Director, WRC: Jonathan Yoder, School of Economic Sciences, CAHNRS
- Graduate Committee Chair (SoE): Matt Carroll, School of the Environment, CAHNRS/CAS
- Faculty Member: Jennifer Adam, Civil and Environmental Engineering, VCEA
- Faculty Member: Alex Fremier, School of the Environment, CAHNRS/CAS

Together, this Committee will carry out the administration of the certificate, act as liaisons with instructors of approved courses, update courses based on their availability and relevance, review any requested exceptions or substitutions to the established course requirements, assist in approving experiential activities, and assess the overall effectiveness of the program on an annual basis. The Committee Chair will serve as the contact person for the certificate program.

8. Advertisement

Advertising by the WRC will occur via the existing list-serv, website and social media outlets. However; it is anticipated that additional advertising will be provided by the School of the Environment, faculty participating in this program, and the WSU Graduate School. In addition, the WRC will ask each of the three Colleges and any other appropriate units to also distribute advertisements for the certificate among their faculty and students.

9. Assessment



The assessment plan for this interdisciplinary program will be created and approved by the Committee, who will represent their respective Colleges (i.e., CAHNRS, VCEA and CAS). Due to the straight-forward, course-based nature of this program, it is anticipated that this assessment will be fairly simple- at minimum tracking the number of students applying for and completing the certificate each year, the courses chosen by each student, the diversity of colleges and departments represented by students, and how many students take internships, and with whom. For students choosing an internship experience, WRC will survey both the student and internship host after each experience to obtain feedback on its successfulness.

10. Supporting Materials

Graduate courses by water cluster area that would count toward certificate completion. Undergraduate classes (400 level or below) listed in the undergraduate version of this certificate program may also count towards this program pending approval from the student's home department. An asterisk (*) denotes a class that has prerequisites.

Subsurface and Surface Hydrology

BSYSE 558 Groundwater Flow and Contaminant Transport

CE 517 Mechanics of Sediment Transport

CE 550 Hydroclimatology

CE 551 Open Channel Flow

CE 560 Advanced Hydrology

CE 562 Advanced Subsurface Flow and Transport

SOE 577 Advanced Environmental Hydrology

SOIL SCI 513 Environmental Soil Physics

SOIL SCI 514 Environmental Biophysics

SOIL_SCI 521 Physical Chemistry of Soils

SOIL_SCI 533 Advanced Vadose Processes

Hydrologic Chemistry/Ecology/Biology

BIOLOGY 544 Nitrogen Cycling in the Earth's Systems

BIOLOGY 562 Community Ecology

BIOLOGY 568 Conservation Ecology

BIOLOGY 569 Ecosystem Ecology and Global Change

BSYSE 554 Aquatic System Restoration*

BSYSE 555 Natural Treatment Systems

BSYSE 557 Nutrient Cycling and Transport

BSYSE 560 Aquatic Chemistry

CE 555 Natural Treatment Systems

CE 583 Aquatic Chemistry

CE 585 Aquatic System Restoration*

SOE 512 Global Biogeochemistry

SOE 516 Soil Processes in the Earth's Critical Zone

SOE 562 Watershed Biogeochemistry

SOIL_SCI 521 Physical chemistry of soils

SOIL_SCI 533 Advanced Vadose Processes

Hydrologic Methods & Analysis

BIOLOGY 540 Stable Isotope Theory and Methods BSYSE 550 Soil and Water Conservation Engineering BSYSE 556 Surface Hydrologic Processes and Modeling

CE 515 Environmental Measurements*

CE 540 Instrumental Analysis of Environmental Contaminants*

CE 541 Physiochemical Water and Wastewater Treatment

CE 542 Biochemical Wastewater Treatment

SOE 516 Soil Processes in the Earth's Critical Zone

SOE 544 Environmental Assessment

SOE 577 Advanced Environmental Hydrology

SOIL_SCI 508 Environmental Spatial Statistics*

Water Policy & Management

ECONS 581 Natural Resource Economics*

ECONS 582 Environmental Economics*

ECONS 583 Public Sector Economics*

HISTORY 521 The American West

HISTORY 522 History of the Pacific Northwest

SOE 544 Environmental Assessment

SOE 555 System Dynamics Models of Environmental

Systems

SOE 594 Environmental and Natural Resources Issues and Ethics



Section 11. Capstone Course Syllabus (Approved)

SOE 535: Interdisciplinary Water Resources Science and Management

Credits: 3 | Seats open: 25 | No pre-requisites required

Location: TBD Email: alex.fremier@wsu.edu

Office Hours: Mon 9-10, Tue 1-2 **Office**: PETB 356 **Phone**: 509-335-8689

Course Overview: Water is an important resource for maintaining both the health and integrity of our natural and social systems, and therefore must be managed carefully. Threats to freshwater resources come from a diversity of sources, often encompassing not a single issue, but a series of interlinked problems with common themes. Managing for water sustainability in the face of these complex problems requires a broad understanding of the physical water system and the short- and long-term impacts our decisions about water have on populations, economies, and ecosystems.

Our goal is to provide students with the breadth of knowledge required to understand these freshwater issues. Over the course of the semester, students will learn about the physical, social, economic and cultural aspects and issues of water, and discuss current research that builds an integrated under-standing of water resources systems. In this team-taught class, instructors will introduce each topic with a lecture and the class will review current papers in a student-led discussion format. Over the course of the semester, student will form groups, each choosing a watershed to evaluate from an inter-disciplinary perspective. Students will deliver short oral presentations and a final paper on these watershed projects.

This class will also serve as the capstone class for the (proposed) Integrated Water Science and Management Certificate program, providing an interdisciplinary experience that explicitly provides students with an overview and broad understanding of the complex freshwater issues that exist and the policy and science required to manage them.

Course Learning Goal:

Students will demonstrate in written and oral formats the ability to 1) understand and think critically about the diversity of water resources issues that exist, 2) apply an interdisciplinary understanding to specific watersheds to identify where issues exist and why, 3) effectively communicate interdisciplinary ideas to peers and other researchers.

Learning Outcomes:

Critical and Creative Thinking: Students will develop a deeper understanding for the breadth of water resources issues. They will use this knowledge to guide their interdisciplinary analysis of an individual watershed over the course of the semester.

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Quantitative Reasoning: Students will be exposed to models, theories and quantitative water-related research during the course. They will learn to identify and discern between the variety of methods, practices, and analyses used in water resources systems.

Information Literacy: Students will demonstrate literacy across a wide range of disciplines and develop the skills necessary to find and evaluate different types of water-related information. Students will use these skills to inform the watershed analyses over the course of the semester.

Communication: Students will learn to communicate effectively in discussions about water resources, and will use oral/visual and written media to present their own ideas to the class.

Scientific Literacy: Students will actively engage in the course by integrating and translating information from scientific and historical domains into information that supports and frames their final projects.

Course Learning Goals and Activities:

	At the end of this course, students will be able to:	This objective will be evaluated primarily by:	Course topics (& dates) that advance these learning goals are:
LG1	Understand and think critically about the diversity of water resources issues that exist	Attendance of weekly lecturesActive participation in weekly discussionsWeekly writing assignments	- Jan-May: Attend weekly lectures - Jan-May: Weekly discussions - Jan-May: Weekly reading assignments
LG2	Develop expertise collecting data and understanding methods used by different disciplines	- Oral presentations of physical/natural, social and cultural components in watershed projects	 - Jan-Feb: Physical/natural science lectures and discussions - Feb-Mar: Social science lectures and discussions - Mar-Apr: Cultural perspectives lectures and discussions
LG3	Effectively communicate ideas to peers and other researchers	- Active participation in weekly discussions - Oral and written presentations of watershed project	- Jan-May: Take turns leading discussions on water issues - Jan-May: Orally present findings on watershed projects to the class -May: Submit a final written report of watershed project

Evaluation Criteria:

Attendance (10%) If you do have to miss a class, please provide a written explanation of the absence at least 4 hours in advance, accept in special circumstances such as emergencies. There are on 32 class periods. We will grade absences out of 30 (for example, missing four class period will equate to 30/32 (94%) for attendance. For an overview of what are allowable absences, see Section 73 of the WSU Academic Regulations: http://registrar.wsu.edu/academic-regulations/

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Weekly Written Assignments (15%) Each week you will be assigned <u>two</u> journal articles to read. A one-page written summary of these readings will be handed in at the end of class on Thursday. <u>Each summary should include the following components: 1) brief description of the readings, 2) two questions you have based on what you read.</u>

Class Discussion (25%) Guest lecturers will present topical material each Tuesday. Each Thursday we will discuss two peer-reviewed journal articles or other relevant reading material. Each paper is assigned a REVIEWER and a DISCUSSION LEAD at the beginning of the semester. Discussions each week will be led by the assigned reviewers and discussion leads. *Turn in a separate set of notes to the instructor(s) before class for grading.*

REVIEWER: The Reviewer's job is to review the article at the beginning of class by summarizing the main points (5 minutes maximum). This is not a review of the paper in full but should rather answer these four questions, and more, if desired:

- 1. What is this paper responding to in the literature?
- 2. What is the main [thesis] of the paper?
- 3. What is the main [finding]? (the main finding, not the many smaller findings)
- 4. What is the main [implication] of this finding? (not an exhaustive list, but the top impact)

DISCUSSION LEAD: Discussion Lead's job is the lead the class through the paper making sure the discussion stays on track and covers the main points of the paper. The discussion lead should prepare 5-7 questions to start the discussion and keep it going if it stops. The questions should not be simple (e.g. what is the title of this paper?), but highlight key concepts, confusing terminology (not terms that could be easily defined) or potential flaws in the papers.

Watershed Projects (50%) At the beginning of the semester, students will form teams (3-4 students per team) and select a watershed to study as an interdisciplinary case study over the course of the class. Each team will use existing data and information to identify and assess the prominent freshwater issues in their watershed through 1) biophysical, 2) social and 3) cultural assessments. Teams will orally present these assessments at the end of each unit. Each team's oral presentation should include active participation from each member, and last a total of approximately 25 minutes. The oral presentations will total 25% of the final grade. A teamwritten report detailing the findings from all three assessments, as well as a team-developed overview of future directions for sustainable basin management (15-20 pages, single-spaced, excluding references) will be due at the end of the semester and will be worth 25% of the final grade.

Late Assignments: Points (20% per day) will be deducted for assignments submitted after the due date. *Assignments* > 1 week late will receive a 0.

Materials and Resources: Reading assignments will be made available to students via email and on the course webpage the week before written summaries of the material are due. This course has no textbook; however supplemental resources will be recommended to students seeking more information upon request.

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Grading System: Grades will be awarded based on the following percentage scale. It is theoretically possible for everyone to get an A (or an F). Your performance depends on how well you do, not on how everyone in the class does. While this class encourages working and discussing ideas with your fellow classmates, **working together does not mean turning in duplicates of the same assignment unless specified in the assignment instructions.** *Turning in duplicate assignments is considered plagiarism* (see Academic Integrity). Borderline grades will assigned by rounding up to the nearest integer.

94-100%A	77-79%C+
90-93%A-	73-76%C
87-89%B+	70-72%C-
83-86%B	60-69%D
80-82%B-	< 60%F

Use of Electronics: We strive to be respectful to our classmates and faculty. As such, the <u>use of computers and/or cell phones will not be permitted during class unless specified by the instructor.</u>

Weekly Overview & Schedule- lecturers subject to change based on availability

Week	Topic	Proposed Lecturer	Assignments
1	Course Overview- IWRM	Core Instructor(s)	
	Intro. to interdisciplinary work	Core Instructor(s)	
2	Watershed hydrology	Jan Boll- <i>Civil</i> &	Writing Assignment 1
	Discussion: 2 topical papers	Environmental Engineering	
3	Groundwater	Kent Keller – School of the	Writing Assignment 2
	Discussion: 2 topical papers	Environment	
4	Ecological processes	Alex Fremier – School of	Writing Assignment 3
	Discussion: 2 topical papers	the Environment	
5	Student group watershed	Core Instructor(s)	Biophysical
	presentations		presentations
6	Human adaptations for water	Julie Padowski- <i>WA Water</i>	Writing Assignment 4
	security	Research Center	
	Discussion: 2 topical papers		
7	Economics and water markets	Jonathan Yoder- School of	Writing Assignment 5
	Discussion: 2 topical papers	Economic Sciences	
8	Eco-social transformations in	Emily Huddart-Kennedy-	Writing Assignment 6
	water	Sociology	
	Discussion: 2 topical papers		
9	Student group watershed	Core Instructor(s)	Socio-economic
	presentations		presentations
10	SPRING BREAK		
11	Water, gender and politics	Patricia Glazebrook- <i>School</i>	Writing Assignment 7
	Discussion: 2 topical papers	of Politics, Philosophy &	
		Public Affairs	
12	Water rights & governance	Barbara Cosens- College of	Writing Assignment 8
	Discussion: 2 topical papers	Law, UI	

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13	Collaborative management	Allyson Beall-King- School	Writing Assignment 9
	Discussion: 2 topical papers	of the Environment	
14	Student group watershed	Core Instructor(s)	Policy-cultural
	presentations		presentations
	_		
15	International Water Issues	Aaron Wolf- <i>Geography,</i>	Writing Assignment 10
15	International Water Issues Discussion: 2 topical papers	Aaron Wolf- <i>Geography,</i> OSU	Writing Assignment 10
16		0 1 2	Writing Assignment 10 Final Written Reports

Required Readings: The readings required for this course will be peer-reviewed or other relevant journal articles selected by the guest lecturers. Each set of readings will be made available to the students at least one (1) week before they are to be discussed. The book *Sustainability of Integrated Water Resources Management* by Shimelis Gebriye Setegn and Maria Concepcion Donoso (eds.) 2015 (ISBN: 9783319121949), is recommended for students seeking additional background reading, but is not required for the course. This book is available in print and e-book formats via the WSU library.

Workload Statement: For every equivalent lecture credit students are expected to spend at least two hours per week on work outside the classroom. This work may be in the form of homework, writing assignments, take-home exams or any other work associated with the duties of the course. Thus, for a standard 3 credit lecture based course, the student should expect *at least* 6 hours of work per week outside the classroom.

Academic Integrity: Academic integrity is the cornerstone of higher education. As such, all members of the university community share responsibility for maintaining and promoting the principles of integrity in all activities, including academic integrity and honest scholarship. Academic integrity will be strongly enforced in this course. Students who violate WSU's Academic Integrity Policy (identified in Washington Administrative Code (WAC) 504-26-010(3) and -404) will receive a zero on the assignment, will not have the option to withdraw from the course pending an appeal, and will be reported to the Office of Student Conduct.

Cheating includes, but is not limited to, plagiarism and unauthorized collaboration as defined in the Standards of Conduct for Students, WAC 504-26-010(3). You need to read and understand all of the definitions of cheating: http://app.leg.wa.gov/WAC/default.aspx?cite=504-26-010. If you have any questions about what is and is not allowed in this course, you should ask course instructors before proceeding. If you wish to appeal a faculty member's decision relating to academic integrity, please use the form available at conduct.wsu.edu.

Students with Disabilities: Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center on your campus to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center. For more information contact a Disability Specialist on your home campus.

Pullman or WSU Online: 509-335-3417, Washington Building 217; http://accesscenter.wsu.edu, Access.Center@wsu.edu

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WSU Safety Statement: Classroom and campus safety are of paramount importance at Washington State University, and are the shared responsibility of the entire campus population. WSU urges students to follow the "Alert, Assess, Act," protocol for all types of emergencies and the "Run, Hide, Fight" response for an active shooter incident. Remain ALERT (through direct observation or emergency notification), ASSESS your specific situation, and ACT in the most appropriate way to assure your own safety (and the safety of others if you are able). Please sign up for emergency alerts on your account at MyWSU. For more information on this subject, campus safety, and related topics, please view the FBI's Run, Hide, Fight video and visit the WSU safety portal.