MEMORANDUM

DATE: November 8, 2005

TO: Diane Horgan  
Associate Dean, Graduate College

FROM: David E. Cox  
Associate Dean of Academic Programs

SUBJECT: Proposed Graduate Certificate Programs in Aquaculture and Water Policy

The College of Agriculture and Life Sciences Curriculum Committee, the Office of Academic Programs and the Department of Soil, Water, and Environmental Science have jointly approved and submit the attached proposals for the establishment of a Graduate Certificate Program in Water Policy and a Graduate Certificate Programs in Aquaculture. We support the founding of these programs and find that the department of Soil, Water, and Environmental Science has the resources to sustain them.

The attached documentation details the rationale for the proposed programs. We particularly, strongly support the interdisciplinary nature of the Graduate Certificate Program in Water Policy. Interdisciplinary curriculum is of vital importance for our students.

If specific questions arise regarding the proposals please contact La Tanya S. Autry in the Office of Academic Programs at 621-3613, lautarys@cal.arizona.edu.

Thank you.

cc: Eugene G. Sander, Vice Provost and Dean  
Jeffrey Silvertooth, Department Head, Soil, Water and Environmental Sciences

DE: Cia
UNIVERSITY OF ARIZONA
PROPOSED GRADUATE CERTIFICATE IN WATER POLICY

Introduction

With the assistance of the Water Resources Research Center (WRRC), the Departments of Geography and Regional Development (GRD) and Soil, Water and Environmental Science (SWES) are proposing an academic Post-Baccalaureate Certificate in Water Policy. To obtain the Certificate, students must complete a 12-unit program of study that includes core and thematic courses. Core courses focus on the policy aspects of water, while thematic courses focus on water resource management and related social scientific aspects. The program is designed for students to begin in the fall and complete in one to two academic years. Students will be able to complete the Certificate in conjunction with a graduate or professional degree program or as a stand-alone certificate.

Administration

The Program will be administered by a to-be-named Executive Committee and liaison faculty comprising an Advisory Committee drawn from the College of Social and Behavioral Sciences, the College of Agriculture and Life Sciences, the College of Science, the College of Engineering, the Mel and Enid Zuckermans College of Public Health, the Eller College of Management, and the James E. Rogers College of Law. Primary administrative and signature responsibility will be housed in the Department of Geography and Regional Development. The Executive Committee will, in conjunction with the Advisory Committee, make admission recommendations and establish policy. Staff in SWES and GRD will coordinate recruiting efforts, student selection, and paperwork leading to certification. A schematic of the cooperative program we have in mind is shown in Figure 1 below.
Thematic Courses
Students will normally complete six additional units from the thematic courses shown below. These represent coursework from which a student can draw to customize a curriculum to meet her or his interests.

**ABE 555** (also C E 555) – Soil and Water Resources Engineering (3 units) Spring. Introduction to soil and water relationships, irrigation systems, irrigation water supply, and irrigation management; basic designs.


**ARL 565** (also GEOG 565) – Physical Aspects of Arid Lands (3 units) Fall. Interdisciplinary course covering the physical aspects of arid lands, including geology, geomorphology, climate, hydrology, and landscape ecology. Time-space interrelationships of environmental systems are also covered.

**C E 523** (also ARL 523, HWR 523) – Hydrology (3 units) Fall. Discussion and analysis of major topics of the hydrologic cycle and their interrelationship, such as rainfall, infiltration, evaporation, and runoff. Statistical and probabilistic methods in water supply and flood hydrology.

**CPH 553** (also PCOL 553) – Toxicology and Chemical Exposures (3 units) Fall. Covers the fundamentals of toxicology and the derivation of regulatory limits and guidelines. Evaluates the impact of specific chemicals and chemical classes on organ systems and the diseases resulting from exposure.

**GC 597A** – Global Change Workshop (3 units) Fall. Spring. Integrative experience for natural and social science students with focus on local and regional consequences of global change.

**HWR 500** (also PLN 500) – Ecosystemology for Urban Planning (3 units) Fall. Introduction to conceptual tools used in complex ecosystems, particularly cities and urban areas; integration of human residents with larger natural systems (human ecology); environmental impact assessment (EIA) and statement (EIS). Water resource planning and impact on regional ecosystems; technical, legal, ethical dimensions of water transfer.

**HWR 515** (also GEOG 515) – Introduction to Water Resources Policy (3 units) Spring. Water resources policy including the identification of regional problems of water use, the elements of water planning, water rights, and a consideration of institutional structures and processes.
WS M 568 – Wildland Water Quality (3 units) Spring. Introduction to water quality and its influences in natural environments. Interactions with land management and relationships to the larger issues of environmental quality.

Sample Schedule

We anticipate completion of the program in 2 years at the rate of one course a semester. Students can complete the program in as little as one semester with a four course load. Core and thematic courses can be taken in any order, though the normal schedule would be as follows:

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Student Learning Objectives

Upon completion of the Certification program, students will:

- Understand, from the international, national, state, and local levels, the legal and policy contexts and associated regulatory regimes affecting the supply, demand, distribution, and quality of water as it varies across the earth’s surface.
- Understand the basic issues of water management as well as the institutional structures and procedures in place to deal with one or more of the following issues:
  1. water demand and scarcity
  2. water policy analysis
  3. applied aspects of water resources
  4. public health, safety, and security
  5. water control and pricing
  6. socio-economic drivers of change
  7. public and private decisionmaking
  8. floodplain management
  9. water conflict resolution
  10. international transboundary water issues

Audience, Need, and Recruitment Strategies

There are two primary audiences for the Certificate in Water Policy. First, there are many students who apply to our MS, PhD, and graduate professional programs with an interest in issues related to water, especially in light of the international reputation of the University of Arizona as “the World’s Water University.” At present, however, there is no interdisciplinary certificate related to water that students can acquire in conjunction
community whose potential demand for the program was not formally surveyed. In summary, we believe that there is a demonstrated interest in and demand for the proposed certificate.

The second survey was sent to members of the Water Resources Research Center External Advisory Committee. Ten responses were received. Respondents included representatives of state and federal water agencies, regional water providers, a private hydrology consulting firm, and a non-governmental organization (NGO). The cover letter to the short questionnaire contained information about the proposal to establish a graduate certificate in water policy, although the draft proposal itself was not circulated. Most reacted positively to the concept; none responded negatively. There was perceived value for both current and prospective employees, although several members of the Advisory Committee responded that they were uncertain about the value for either of these categories of individuals. Several offered questions/comments. Some thought the idea was excellent and could help alleviate the need to provide on-the-job training. The importance of connecting science and policy was noted. Others saw the value depending on the actual course content and overall program. Some respondents included in-depth comments on course/program content. One suggested that, because employees in Phoenix could not get time away from work for such a program, that short courses would be helpful. Overall, reaction was positive. The detailed comments show high interest in water resources curriculum that is connected to real-world water policy.

Application and Selection Process

Students must formally apply to the Water Policy Certification Program. Admission materials will include a Program Application, past transcripts of all previous university coursework, a one page statement of background and goals. Students will designate on their application form whether they are pursuing the certificate: (a) in conjunction with a regular graduate academic or professional degree program, or (b) independently without concurrent status as a regular student in another program. Students in the second category will be required to register through the University of Arizona’s Office of Continuing Education and Academic Outreach.

Selection of participants will be based on submitted materials (per above). The Executive Committee or a designated sub-committee will be responsible for admitting students to the program. Students are admitted to the Water Policy Certification Program only. While we expect most of our students will be local residents, we will not preclude non-residents from participating.

Advising

Advising will be decentralized among members of the Executive Committee, which will include representatives from each of the seven participating colleges. The Executive Committee can also designate the student’s primary advisor in a degree program to serve as the certificate advisor. The advisor’s primary responsibility is to assist the student in determining an appropriate selection of courses based on her/his interests and in filing a
We will take a multi-faceted approach to assessment, including informal feedback and formal assessment instruments. Each year Executive Committee or a designated sub-committee shall meet annually to review:

- recruitment strategies and publicity
- program curriculum in light of Student Learning Objectives (see above), faculty resources, and student needs
- student exit surveys that identify program strengths and weaknesses in light of the student's academic and professional goals

**Resource Needs and Expected Demand**

The University of Arizona is positioned uniquely to offer the proposed Certification Program. As the "World's Water University," it houses the strongest collection of faculty with expertise in the area of water and its myriad environmental, technical, social, and legal-policy dimensions. The University has far and away the necessary faculty resources to enable students to complete the Program in a timely manner, either alone or in combination with a regular graduate degree program. We therefore anticipate no needed expansion of the faculty as a result of this program. The Program will require a modest level of operational funds, as discussed below in the section on "Funding".

As a land grant university with a significant extension component, we have contacts with numerous agencies and organizations that have a demonstrated interest in providing their employees with educational opportunities to promote career growth. In addition, we already attract a great many students who recognize the importance of water in scholarly, applied, and policy domains. In combination with regular graduate students and outside professionals, we expect that in any given semester some 20 students will be taking classes in the Program by the beginning of the third year of operation.

Particularly compelling to the development of this Certificate Program is the partnership among many units and colleges. The proposed curriculum has been designed by the heads of SWES and GRD, the Director of the Center, and interested faculty representing five other colleges, many of whom are listed below.

**Anticipated Contributors**

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Fees

At this stage, we do not envision assessing fees for participating in this program (beyond those collected by the University of Arizona Continuing Education and Academic Outreach unit).

Funding

As it draws upon already existing and anticipated faculty resources in the area of water on this campus, the proposed Program is relatively light on resource demands. There will, however, be staff and operational expenses associated with administrative recordkeeping and the development and dissemination of web and print materials. These costs are estimated as follows:

- Graduate Certificate Program Coordinator (0.25 FTE) $12,000 (incl. ERE)
- Web, print, and other office expenses $3,000

In the short run while the program is in its early stages, these costs of personnel and supplies will be jointly covered, in-kind, by SWES and GrD. As the program develops and attracts professional students pursuing the Certificate through the Office of Continuing Education and Academic Outreach, returned tuition will be used to provide
UNIVERSITY OF ARIZONA

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Curriculum Overview

Students will be required to take 12 units of course work, consisting of at least two courses selected from a core curriculum focused on the policy aspects of water, and two courses drawn from a longer list of thematic courses. All courses in the curriculum are taught at the University of Arizona; none are offered through distance learning. We anticipate that new courses will be added in conjunction with new faculty hires, and these will soon be processed through University channels. Additionally, courses currently on the list may be removed. The determination of approved courses is at the discretion of the Executive Committee, which will seek the advice of the Advisory Committee.

Students must take all course work for a letter grade. Students may, in conjunction with their Certificate or regular-degree advisor, petition the Executive Committee for substitutions in the proposed general course of study outlined below.

Core Curriculum

The core curriculum consists of at least six credit hours of regular classroom instruction. Additional courses selected from the core may be used to satisfy thematic course requirements. The core curriculum is designed to provide students with a solid background in water policy. Students will select two courses from the following offerings:

AREC 575 (also HWR 576, ECON 576, RNR 576) – Economics of Natural Resource Policy (3 units) Spring. Theory and application of economic concepts needed to evaluate resource laws and policies; including welfare economics, externalities, public goods and valuation methodologies. Case studies focus on the American West and include federal and state environmental, water, and land policies.

LAW 641 – Water Law (3 units) Fall. Emphasis on state and federal laws that govern rights to surface and ground water throughout the country; additional understandings developed around social, political, economic, environmental aspects that intersect with water law doctrines.

PA 581 (also POL 581, HWR 581, RNR 581) – Environmental Policy (3 units) Spring. Role of government in management of energy, natural resources and environment; process and policy alternatives; special attention to the Southwest.

SWES 596B – Arizona Water Policy (3 units) Spring. This course focuses on current Arizona water policy from a multi-disciplinary perspective. Through readings, research, discussion and presentations, the student is exposed to current water resource issues facing Arizona and other parts of the West and policies to address them. (This is currently a temporary course but it will be converted to a regular offering.)
Thematic Courses
Students will normally complete six additional units from the thematic courses shown below. These represent coursework from which a student can draw to customize a curriculum to meet her or his interests.

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**ARL 565** (also **GEOG 565**) – *Physical Aspects of Arid Lands* (3 units) Fall. Interdisciplinary course covering the physical aspects of arid lands, including geology, geomorphology, climate, hydrology, and landscape ecology. Time-space interrelationships of environmental systems are also covered.

**C E 523** (also **ARL 523, HWR 523**) – *Hydrology* (3 units) Fall. Discussion and analysis of major topics of the hydrologic cycle and their interrelationship, such as rainfall, infiltration, evaporation, and runoff. Statistical and probabilistic methods in water supply and flood hydrology.

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**HWR 515** (also **GEOG 515**) – *Introduction to Water Resources Policy* (3 units) Spring. Water resources policy including the identification of regional problems of water use, the elements of water planning, water rights, and a consideration of institutional structures and processes.
HWR 520 – Water Resources Management, Planning, and Rights: A Policy Approach (3 units) Spring. An introduction to basic concepts and issues of water resources management and administration, emphasizing water law and rights, water resources planning, institutional and organizational arrangements, and policy processes such as adjudication and rule-making.

HWR 543 – Environmental Risk and Economic Analysis in Water Resources (3 units) Fall. Environmental risk analysis, environmental economics, and quantitative benefit-cost-risk planning and regulation applied to water resources.

LAW 625 – American Legal History (The Colorado River) (2 units) Fall
The focus of this course is the Colorado River. After examining the geology of the Grand Canyon and the use made of the River and its resources by Native peoples, the class examines the exploration of the Colorado River and its canyons by John Wesley Powell and other early European explorers. The main theme of the course is the important role that the water of the Colorado River has played in the Southwest.

LAW 669 – Environmental Law (3 units) Spring. Survey course covering the major environmental statutes, including the Endangered Species Act, the National Environmental Policy Act, Superfund, the Toxic Substances Control Act, the Safe Drinking Water Act, the Clean Air Act, and the Clean Water Act.

LAW 6961 – International Environmental Law (3 units) Fall. Analyzes the international regulation of the environment, including regional and international regulations of air and water pollution, the protection of animal life, and the relationships between environmental issues and those associated with the economy and protection of the "global commons".

PA 517 (also PLN 517) – Public Policy Analysis (3 units) Fall. Introduction to theory and practice of public policy analysis.

PLN 559 (also GEOG 559) – Land Use and Growth Controls (3 units) Spring. Current planning and legal issues dealing with regulation of growth, the sequence of growth, and the limiting of growth are analyzed. Issues of equity in controlling land use are also explored.

SWES 544 – Applied Environmental Law (3 units) Fall. A guided journey through real world environmental law; U.S. legal system, major environmental laws-criminal and civil; common marketplace problems and solutions; high profile cases; essential professional skills.

WS M 562 – Watershed Management (3 units) Spring. Evaluating hydrologic impacts of management activities on watersheds to include silviculture, range, mining, and recreation use.
WS M 568 – Wildland Water Quality (3 units) Spring: Introduction to water quality and its influences in natural environments. Interactions with land management and relationships to the larger issues of environmental quality.

Sample Schedule

We anticipate completion of the program in 2 years at the rate of one course a semester. Students can complete the program in as little as one semester with a four course load. Core and thematic courses can be taken in any order, though the normal schedule would be as follows:

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Upon completion of the Certification program, students will:

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Audience, Need, and Recruitment Strategies

There are two primary audiences for the Certificate in Water Policy. First, there are many students who apply to our MS, PhD, and graduate professional programs with an interest in issues related to water, especially in light of the international reputation of the University of Arizona as the “World’s Water University.” At present, however, there is no interdisciplinary certificate related to water that students can acquire in conjunction
with their pursuit of traditional academic degrees. We believe there is a demand for focused, graduate level training in water policy, and that, moreover, that this topical focus will attract in near equal amounts a wide range of students across the environmental sciences, social sciences, engineering, and professions. Second, we anticipate a demand on the part of degree holding professionals in both government and private industry in the state of Arizona. These professionals will be attracted to the Certificate’s focus on acquiring a deeper understanding of and skill sets related to the legal and policy dimensions that affect water, especially insofar as these issues are regionally connected to the US Southwest and the US-Mexico international border. As this will be a 12 unit, four course certificate program that can be completed in one semester given the availability of sufficient core and thematic courses, we also anticipate a number of students who will obtain certificates in conjunction with short professional sabbaticals or educational release programs in government and industry.

We will advertise this program through appropriate UA web pages, contacts with current and prospective graduate students and graduating seniors, and professionals in the water and other resources management community in Arizona and other states. We will distribute promotional materials to our contacts with local government and non-government agencies and organizations, and across campus.

The Executive Committee undertook two surveys to gauge the level of potential demand for the Certificate and to ascertain its likely reception within the professional water community in Arizona. The first survey consisted of an email questionnaire sent to the heads of 45 degree-granting units. Of those, 17 responded to the survey. The email questionnaire contained a summary, but not a copy, of the proposal, which was still in development at the time of the survey. Responses indicated a wide range of interest in the program. Some units expressed doubt that any of their graduate students would complete the certificate, but most of the heads reported at least some level of interest. Heads reported relatively uniform levels of interest in each of eight areas below:

<table>
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<th>Areas of concentration</th>
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Finally, the survey asked the following question: “... in relation to a typical incoming class of graduate or professional students, how many do you think would elect to pursue the certificate alongside their regular degree program?” The total number in response was 31, or 1.8 students per unit. This number probably inflates somewhat the annual new enrollment in the certificate, but it also undercounts two other sources of demand: first, those students in units whose heads did not respond, and second, the professional
community whose potential demand for the program was not formally surveyed. In summary, we believe that there is a demonstrated interest in and demand for the proposed certificate.

The second survey was sent to members of the Water Resources Research Center External Advisory Committee. Ten responses were received. Respondents included representatives of state and federal water agencies, regional water providers, a private hydrology consulting firm, and a non-governmental organization (NGO). The cover letter to the short questionnaire contained information about the proposal to establish a graduate certificate in water policy, although the draft proposal itself was not circulated. Most reacted positively to the concept; none responded negatively. There was perceived value for both current and prospective employees, although several members of the Advisory Committee responded that they were uncertain about the value for either of these categories of individuals. Several offered questions/comments. Some thought the idea was excellent and could help alleviate the need to provide on-the-job training. The importance of connecting science and policy was noted. Others saw the value depending on the actual course content and overall program. Some respondents included in-depth comments on course/program content. One suggested that, because employees in Phoenix could not get time away from work for such a program, that short courses would be helpful. Overall, reaction was positive. The detailed comments show high interest in water resources curriculum that is connected to real-world water policy.

Application and Selection Process

Students must formally apply to the Water Policy Certification Program. Admission materials will include a Program Application, past transcripts of all previous university coursework, a one page statement of background and goals. Students will designate on their application form whether they are pursuing the certificate: (1) in conjunction with a regular graduate academic or professional degree program, or (2) independently without concurrent status as a regular student in another program. Students in the second category will be required to register through the University of Arizona’s Office of Continuing Education and Academic Outreach.

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Advising

Advising will be decentralized among members of the Executive Committee, which will include representatives from each of the seven participating colleges. The Executive Committee can also designate the student’s primary advisor in a degree program to serve as the certificate advisor. The advisor’s primary responsibility is to assist the student in determining an appropriate selection of courses based on her/his interests and in filing a
corresponding Plan of Study with the Graduate College. Although advising will be on a case-by-case basis, in general, students pursuing degrees in policy related fields will be encouraged to take at least two thematic courses, while those in areas where thematic courses dominate will be encouraged to have a larger share of their Certificate-related coursework in the core curriculum. Students concurrently enrolled in the Certificate Program and a regular degree program will work with their regular advisory committee to ensure that the certificate does not interfere with their progress at the University. Admitted students will be made aware of the list of potential advisors, and will be assigned an initial advisor according to their interests. We are in the process of finalizing a list of college liaisons to serve on the Executive Committee. A list of possible affiliated faculty, including potential members of the Executive Committee and Advisory Committee, appears later in this document.

Policies

Completion of certification requirements at the undergraduate level
Students may not earn certification as undergraduates. The certification program is designed to be a post-baccalaureate experience. Graduate level courses require greater depth of understanding and more sophisticated application of the principles covered.

Transfer Course Work
Students may transfer, from another accredited academic institution, up to three units of related graduate course work to be applied to the Certificate Program. Course work must be approved by the Executive Committee.

Application of Certification to a Graduate Degree
Students in the Program who wish to apply to a regular degree program must follow the regular University and program admissions policies. Students will be allowed to use up to 12 units of the course work earned in the Certification Program toward their advanced degrees, but the decision to accept those credits lies solely with the degree granting unit.

Minimum GPA required
Students must pass each class in the curriculum, including transfer or undergraduate course work, with a B or better to receive certification.

Student Benefits
Students will receive a University of Arizona Certification in Water Policy, as well as a document from the Departments of Geography and Regional Development and Soil, Water, and Environmental Sciences that describes the participant's curriculum and the objectives achieved by it. Program participants may receive Graduate Tuition Scholarships (GTSs) if they are out-of-state.

Assessment
We will take a multi-faceted approach to assessment, including informal feedback and formal assessment instruments. Each year Executive Committee or a designated sub-committee shall meet annually to review:

- recruitment strategies and publicity
- program curriculum in light of Student Learning Objectives (see above), faculty resources, and student needs
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**Resource Needs and Expected Demand**

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Fees

At this stage, we do not envision assessing fees for participating in this program (beyond those collected by the University of Arizona Continuing Education and Academic Outreach unit).

Funding

As it draws upon already existing and anticipated faculty resources in the area of water on this campus, the proposed Program is relatively light on resource demands. There will, however, be staff and operational expenses associated with administrative recordkeeping and the development and dissemination of web and print materials. These costs are estimated as follows:

- Graduate Certificate Program Coordinator (0.25 FTE) $12,000 (incl. ERE)
- Web, print, and other office expenses $3,000

In the short run while the program is in its early stages, these costs of personnel and supplies will be jointly covered, in-kind, by SWES and GRD. As the program develops and attracts professional students pursuing the Certificate through the Office of Continuing Education and Academic Outreach, return tuition will be used to provide
staff and operations funding. Those funds derived from courses taken by CEAO enrollees will be distributed by the Executive Committee in ways that support and enhance the Program.

We anticipate a high level of interest in the Certificate on the part of the professional community in southern Arizona. We also anticipate moderate to modest interest on the part of professionals in the rest of the state and in other states, as well as Mexico. As part of their application process, these students will be directed and required to register through the Office of CEAO. These students pay the regular tuition rate, which in the Fall 2006 semester will be $253/credit hour. Under current policy, 70 percent of that revenue is returned to the sponsoring unit(s). Thus, in a hypothetical course enrolling five professional (CEAO) students, the yield would be:

\[253 \times 3 \times 5 \times 0.70 = 2657\]

Over the course of a single CEAO-registered student’s enrollment in the 12 hour certificate, the return would be:

\[253 \times 12 \times 0.70 = 2125\]

Under this scenario, the Program will need to certify between seven and eight professional (CEAO registered) students annually to be self-supporting. We anticipate that, as the Certificate program grows and becomes more attractive to professionals seeking additional knowledge, revenues will be able to cover expenses.

Letters of Support (forthcoming)

Ed Donzerstein, Dean, College of Social and Behavioral Sciences
Toni Massaro, Dean, College of Law
H. Brinton Milward, Associate Dean, Eller College of Management
Tom Peterson, Dean, College of Engineering
Joaquin Ruiz, Dean, College of Science
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