**MS WSP Course Requirements** (last updated March 6, 2014)

Requirements:

The MS WSP degree requires completion of 32 units, distributed as follows:

- **Core Courses**: 12-13 units
- **Water, Society and Policy Seminar**: 2 units
- **Electives**: 12-14 units
- **Master's Project**: 6 units

**Core classes (12-13 units)**
(Note: These may be taken as electives if they are not chosen for the core.)

**Policy Core- Choose any 3 of the following 4 courses (9 units):**

- **AREC 575 - Economic Evaluation of Water and Environmental Policy (Fall)**
  Theory and application of economic concepts needed to evaluate water and environmental laws and policies, including benefit cost analysis, externalities, public goods and valuation methodologies. Case studies include federal, state, tribal and international water and environmental policies.

- **SWES 596B - Arizona Water Policy (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.

- **GEOG 569 - Water Resource Assessment (beginning Spring 2015)**
  Focuses on watersheds, aquifers, and river basins as sources of water to meet human and environmental demands. Methods include watershed delineation, water budget and safe yield calculation, and water quality assessment. Models and decision support systems are reviewed.

- **GEOG 596I - Comparative and International Water Policy (Intermittent)**
  This course examines major issues in comparative and international water policy, including water markets, privatization, dams and river basin management, environmental flows, social equity, and water governance. The course is interdisciplinary and builds on law, geography, political economy, and institutional economics.

- **GEOG 596J - Water Management and Policy (Intermittent)**
  Management and policy challenges driven by surface water and groundwater scarcity will be assessed for the Southwest US, Mexico, and globally. Critical review of institutions coupled with assessment of emerging management systems will lead to consideration of policy alternatives.
GEOG 6960 - Adaptation & Resilience in Water Resources Systems (Intermittent)
Climate change, urban growth, energy demand, and global food trade alter water in coupled
human-natural systems. This seminar addresses adaptation and resilience using material on
river basins, aquifers, infrastructure, policy, and institutions from Southwest U.S.,
transboundary U.S.- Mexico, and international cases.

LAW 641 – Water Law (Fall and Spring; no description available)

RNR 540 - Climate Change Adaptation (Spring)
Much of modern society's experience of managing resources and protecting people and
infrastructure has occurred during a period of relatively stable climate. In the most recent
decades in the Southwest, we have observed a cascade of impacts associated with temperature
increases, including changes in snow hydrology, in phenology, and in the severity of drought
impacts. Projected future climate changes and impacts may lie outside the range of climate
variation that we have observed and may have more serious consequences for society and the
environment. Anticipating projected changes will allow society to identify response options
across a range of vulnerabilities and manage the risks associated with projected climate
changes. In the best possible cases, these actions or adaptations, may provide economic and
other benefits to society.
In this 3 credit course, we will examine actions to reduce vulnerabilities or increase resilience to
the potential impacts of climate change. While the general focus will be on impacts and
responses in the arid Southwest (water, fire, species, ecosystems), we will also investigate the
philosophies and frameworks for advancing action and incorporation of adaptation planning at
the regional, national and international scale.

Science Core - Choose 1 of the following 4 courses (3-4 units):
WS M 552 - Dryland Ecohydrology and Vegetation Dynamics (Fall)
Overview of ecological and hydrological interrelationships and associated vegetation
dynamics for water-limited, dryland ecosystems.

WS M 560 - Watershed Hydrology (Fall)
Application of fundamental principles to quantifying the basic hydrologic processes occurring
on watersheds.

WSM 568 - Wildland Water Quality (Spring)
Introduction to water quality and its influences in natural environments. Interactions with land
management and relationships to the larger issues of environmental quality. Graduate-level
requirements include a class report and presentation on a negotiated topic of interest.

CHEE 525 - Emerging Issues in Water Quality (Spring)
This course will investigate, discuss, and debate major emerging water quality issues
which threaten our water sustainability and the regulatory paradigms to address these
challenges.
HWRS 517A – Fundamentals of Water Quality (Fall)
Introduction to chemical processes affecting the behavior of major and minor chemical species in the aquatic environment. Physical, equilibrium, inorganic/organic, and analytical principles as applied to natural waters. Graduate-requirements include writing a review paper and oral presentation, differential problem sets for homework and exams.

Elective Courses (12 units minimum)
ARL 642 - Use and Management of Arid Lands (Intermittent)
Major issues surrounding land uses in the world's arid and semi-arid zones. Examination of issues which will determine the future of land management in much of the arid and semi-arid lands of the western United States. The debate over the management of lands in relation to ownership, tenure, and access; intergenerational transfers, and the economic, environmental, and social consequences of proposed changes in current arrangements.

GEOG 503—Applications of Geographic Information Systems (Fall, Spring, Summer)
General survey of principles of geographic information systems (GIS); applications of GIS to issues such as land assessment and evaluation of wildlife habitat; problem-solving with GIS. Graduate-level requirements include completion of a project on the use of GIS in their discipline or an original GIS analysis (100 points) in coordination with the instructor.

LAW 603J - Sustainability and Environmental Policy (Spring)
Over the past twenty years “sustainability” (or “sustainable development”) has emerged as a central goal of environmental policy making. Contemporary tools of environmental policy including ecosystem management, adaptive management, and restoration have been displaced by what seems like a clearer goal that captures ends as well as means. Sustainability has moved from the work of scholars and activists to laws and administrative regulations. The language of sustainability has extended to the world of business and commerce.

LAW 625B - The Colorado River in American History (Fall and Spring)
The focus of the course is the Colorado River. Using the work of the New West historians as a framework, we shall examine the role of the Colorado River in American History. After examining the geology of the Grand Canyon and the use made of the River and its resources by Native peoples, we shall examine the exploration of the Colorado River and its canyons by John Wesley Powell and other early European explorers.

LAW 669 - Environmental Law (Spring)
A survey course covering major environmental statutes and common law doctrines. Topics include the Clean Air Act, Clean Water Act, National Environmental Policy Act, CERCLA, regulatory takings, standing in environmental cases, the law of nuisance, and the public trust doctrine.

LAW 696I - International Environmental Law (Fall)
This course analyzes the expanding framework of and the legal process leading to international regulation of the human environment, including regional and international regulation of air and water pollution and the protection of marine mammals and endangered species; the relationship between environmental and trade issues; protection of the "global
commons”; conflicts between protecting the environment and economic development; enforcement of international environmental obligations by the United States and other nations; and regional regulation of environmental matters, including the NAFTA and the North American Agreement on Environmental Cooperation.

**RNR 517 - Geographic Information Systems for Natural and Social Sciences (Fall and Spring)**
Introduction to the application of GIS and related technologies for both the natural and social sciences. Conceptual issues in GIS database design and development, analysis, and display.

**RNR 580 - Natural Resources Policy and Law (Spring)**
This course examines the natural resource and environmental policy formulation process, the participants in that process and the policies themselves. The course emphasizes public policy as it applies to federal lands. However, the principles apply to state lands and policies as well.

**RNR 585A - Natural Resources Economics and Planning (Fall)**
This course examines methods for planning and decision-making in the management of renewable natural resources on public lands. The course topics are: economic welfare and market failure, cost-benefit analysis, market and non-market valuation, linear programming, input-output analysis, multi-criteria decision methods, and timber harvest scheduling. The renewable natural resources considered are water, timber, wildlife, wilderness, fisheries, range and recreation.

**ENVS 554 - Water Harvesting (Spring)**
Course focuses on water harvesting principles and techniques. Students will learn how to apply concepts at their own residences and participate in applying them on the UA campus. Graduate-level requirements include working with other graduate students to evaluate water harvesting practices on campus. Two examples of good & poor water harvesting on campus plus two sites that might be considered for future harvesting must be surveyed with results posted on website.

**ENVS 474 - Aquatic Plants and the Environment (Fall)**
The role of riparian areas, estuaries, and constructed wetlands in the environment. Emphasis on plants as wildlife habitat for nutrient cycling and bioremediation.

**WFSC 541 – Limnology (Fall)**
Study of lakes and streams; biological characteristics, as related to physical, chemical, geological, and historical processes operating on fresh waters. Graduate-level requirements include a report that synthesizes literature on a research issue of current concern, an in-class presentation and several discussion meetings.

**ENVS 571 - Stream Ecology (Intermittant)**
This course will examine the structure and function of stream ecosystems with emphasis on the interaction of physical and biotic elements of streams in arid regions. We will examine the role of natural and anthropogenic stressors in shaping aquatic assemblages in streams. Quantification of impairment of stream structure and function requires a thorough understanding of fundamental ecological concepts of natural streams; this will be a major focus. Also, students will learn to use current methods to assess stream condition and signs
of impairment. Graduate-level requirements include additional essay questions on exams and graduate student must meet with the instructors to discuss selected research articles. Presentations will be longer than undergraduates.

**WS M 544 - Applied Environmental Law (Fall)**
A guided journey through real world environmental law; U.S. legal system, major environmental laws-criminal and civil; common 5 marketplace problems and solutions; high profile cases; essential professional skills.

**WS M 562 - Watershed Management (Spring)**
Evaluating hydrologic impacts of management activities on watersheds to include silviculture, range, mining, and recreation use.

**RNR 909 - Master's Report (Fall, Spring, Summer)**
Students are required to complete a major project for the MS WSP degree. The topic of the project will be selected during the first year of study by the student in consultation with his/her advisor. It should focus on a water policy issue of importance, ideally in a semi-arid environment. The student will prepare for the advisor’s approval a brief (2 to 3 pages) proposal outlining the objectives of the project, work plan, and deliverables. The project may stem from an internship; however a formal internship is not required. The time and effort invested should represent six-units of academic credit. According to the Arizona Board of Regents, each unit awarded should represent 45 hours of study. However, the acceptability of the final project is the decision of the advisor. The final deliverables are for the student and the advisor to determine. However, at a minimum a written report and an oral presentation are required. The project is to be completed by the end of the second year of study or by the expected graduation date, whichever comes later.

**Seminar RNR 696W (Fall and Spring)**