
GRADUATE STUDENT HANDBOOK

Department of Soil, Water and Environmental Science
The University of Arizona, Tucson, Arizona
<http://swes.cals.arizona.edu>

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DEPARTMENT OF SOIL, WATER, &
ENVIRONMENTAL SCIENCES

*Education,
Research, and
Extension:*

*Innovative
environmental
solutions for soil
and water
management*

College of Agriculture and Life
Sciences

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INTRODUCTION

The Department of Soil, Water and Environmental Science (SWES) brings together a faculty of outstanding scientists, distinguished by their understanding of soil, water, and the environment, and their ability to carry out research and planning towards the solution of environmental and resource use problems. The department offers graduate work leading to the Master of Science and Doctor of Philosophy degrees in Soil, Water and Environmental Science, with focal areas in either Environmental Science, or Soil and Water Science. In addition, we offer an accelerated Master of Science degree in Soil, Water and Environmental Science and dual Master of Science degrees in Journalism and Soil, Water and Environmental Science, and in Business Administration and Soil, Water and Environmental Science. Approximately 60 graduate students and 200 undergraduate students are continuously enrolled in our programs.

Graduate study in the SWES Department is open to students with undergraduate preparation in biological, chemical, physical, earth, or engineering sciences. Students with other backgrounds may be accepted into the program, with course deficiencies noted.

Students with a graduate degree from the SWES Department are highly employable, pursuing careers in academia, the public sector (e.g., consulting), with state, federal and international agencies (USDA, USGS, USFC, NASA, FAO, etc.), and NGOs.

The total enrollment at the University of Arizona is over 40,000, a size that offers a wide range of academic and extra-curricular programs. Tucson is a metropolitan area of about 1,025,000 people situated in a desert valley surrounded by mountains which rise to elevations of 3,000 meters.

The University of Arizona is an equal opportunity employer authorized to provide research, educational information and other services only to individuals and institutions that function without regard to race, color, sex or national origin. For more detailed information about the University of Arizona please visit: <http://www.arizona.edu/about>

MAJOR PROGRAM AREAS

(Instruction, Research, and Extension)

SWES Department research activities are focused around three main areas:

- 1) Environmental science, with emphasis on contaminant transport and fate, water quality, waste management/reuse, soil/groundwater remediation, and ecosystem restoration;
- 2) Critical zone science, with emphasis on physical, chemical, and microbiological processes;
- 3) Soil, plant, atmosphere systems, with emphasis on climate science, soil-water-plant relations, soil genesis, morphology and pedology, and aquaculture.

The specific program areas in the department include:

Aquaculture	Freshwater and marine systems; aquaponics; integrated farming systems
Climate Science	Applied climatology; global change; physical and environmental geography; environmental monitoring
Contaminant Hydrology	Transport and fate of contaminants (organic/inorganic chemicals, pathogenic organisms, and pharmaceuticals) in soil and groundwater; transport modeling
Ecosystem Restoration	Phytoremediation; salt-tolerant plants; re-vegetation
Environmental Chemistry	Analytical methods; sorption of chemicals; phase partitioning
Environmental Microbiology	Biodegradation of organic compounds; molecular/genetic techniques; microbial ecology of stressed environments
Environmental Pedology	Pedogenesis; soil forming processes; response of soil systems to climate change
Soil and Environmental Physics	Study of physical, hydraulic and thermal critical zone properties and processes applicable to natural and managed ecosystems
Soil and Groundwater	Innovative site characterization methods; innovative remediation technologies for remediation of groundwater, source zones, and vadose zones
Soil-Water-Atmosphere Relations	Evapotranspiration; irrigation; leaching; plant water stress; crop production research; spatial variability; water use efficiency
Soil and Water Quality	Hazardous-waste chemistry; salinity; soil/groundwater contamination; water-borne pathogens
Soil Biology and Biochemistry	Molecular approaches to microbial ecology; pathogen detection; rhizosphere biology; N ₂ - fixation
Soil Fertility and Plant Nutrition	Plant-soil-nutrient interactions; nutrient transformations, cycling, and behavior in soils; water and fertilizer use efficiency
Soil Morphology, Genesis, Classification and Survey	Micromorphology; soil mineralogy; soil mapping; soil erosion; GIS; remote sensing in soil surveys
Vadose Zone Hydrology	Infiltration and redistribution of water; characterizing permeability
Waste Disposal and Management	Land treatment; land reclamation; waste-water reuse; waste management; air-pollution abatement

DEPT OF SOIL, WATER AND ENVIRONMENTAL SCIENCE FACULTY

Faculty	Research Interests
Artiola, Janick Associate Research Scientist Associate Professor jartiola@cals.arizona.edu	Soil, water, and waste; analytical and environmental chemistry; water quality, and land use of wastes and biochar
Brown, Paul Assoc. Director Ext. Ag. and Nat. Res. Programs, Extension Specialist, Research Scientist pbrown@ag.arizona.edu	Agricultural meteorology; biometeorology, evapotranspiration; crop water use; heat units; agricultural weather information
Brusseau, Mark Professor brusseau@ag.arizona.edu	Contaminant transport and fate; mass-transfer processes; modeling; soil/groundwater contamination and remediation
Chief, Karletta Assistant Professor Assistant Specialist kchief@email.arizona.edu	Impacts of fire on watersheds; measuring and modeling environmental processes in arid soils; climate change impacts on water resources and indigenous people
Chorover, Jon Professor and Department Head chorover@ag.arizona.edu	Biogeochemistry of soil, sediment and water; reactions controlling fate of carbon and contaminants
Crimmins, Michael Associate Extension Specialist Associate Professor crimmins@u.arizona.edu	Applied climatology; global change; physical and environmental geography; environmental monitoring
Curry, Joan Associate Professor curry@ag.arizona.edu	Soil physical chemistry; surface chemistry; molecular modeling
Fitzsimmons, Kevin Research Scientist/Professor Director, Intl Programs kevfitz@ag.arizona.edu	Aquaculture; reuse of effluents for crop irrigation; international economic development
Gerba, Charles Professor gerba@ag.arizona.edu	Environmental microbiology: gene probes, water reuse, bio-colloid transport in the subsurface, virology, parasitology, risk assessment
Hawes, Martha Professor mhawes@u.arizona.edu	Crop protection in arid environments by exploiting natural plant root disease and drought resistance mechanisms

Jacobs, Kathy

Professor

jacobsk@email.arizona.edu

Water policy; connecting science and decision-making; stakeholder engagement; use of climate information for water management applications; climate change adaptation and drought planning

Kahn-Rivadeneira, Paula

Assistant Specialist

pkrivadeneira@email.arizona.edu

Microbial food safety; One Health; wildlife: domestic interfaces; wildlife management in agricultural environment, environmental microbiology.

Maier, Raina

Professor

rmaier@ag.arizona.edu

Microbial ecology of stressed environments (caves, deserts, dust); bioremediation and reclamation of mining sites; biosurfactant discovery and characterization

McLain, Jean

Associate Director, Water Resources Research Center

jmclain@cals.arizona.edu

Soil and Water Microbiology related to public health and food safety; microbial source tracking of soil and water contamination; development of microbial antibiotic resistance in response to contamination pressures

Megdal, Sharon

Director, Water Resources Research Center, Extension Specialist, Professor

smegdal@ag.arizona.edu

Water management, policy, and governance in water-scarce regions; water recharge and banking; groundwater governance; water pricing; environmental water; international comparative analysis; trans-boundary aquifer assessment

Pepper, Ian

Professor, Director ERL

ipepper@ag.arizona.edu

Soils and human health; potable water quality including real-time sensors for microbial and chemical contaminants; fate of emerging microbial and biological contaminants; water and wastewater reuse

Ramirez-Andreotta, Monica

Assistant Professor

mdramire@email.arizona.edu

Community-engaged research, citizen science, environmental risk, communication, environmental health literacy, risk assessment, exposure assessments, phytotechnologies, soil/groundwater contamination and food quality.

Rasmussen, Craig

Associate Professor

crasmuss@ag.arizona.edu

Pedogenesis; soil forming processes; response of soil systems to climate change

Rock, Channah

Associate Specialist in Water Quality, Associate Professor

channah@cals.arizona.edu

Molecular pathogen detection; water quality

Schaap, Marcel

Associate Professor

schaap@cals.arizona.edu

Environmental physics; measurements and computer modeling of physical transport processes in the environment

Tuller, Markus

Professor

mtuller@cals.arizona.edu

Greenhouse gas emissions from natural and managed ecosystems; electromagnetic characterization and physical reclamation of mine tailings; X-Ray Computed Tomography; modeling of evaporation and hydraulic behavior of soils and porous media

Walworth, James

Ext. Soils Specialist Professor

walworth@ag.arizona.edu

Soil fertility and nutrient management; plant nutrition; nutrients in bioremediation; salt and water management

GRADUATE PROGRAM DESCRIPTIONS

The SWES Department currently offers five graduate degree programs:

- Doctoral (PhD) Degree in Soil, Water and Environmental Science
- Master of Science (MS) Degree in Soil, Water and Environmental Science
- Accelerated Master of Science (MS) Degree in Soil, Water and Environmental Science
- Dual Doctoral (PhD) Degree in Soil, Water and Environmental Science and Master of Business Administration (MBA) from the Eller College of Management
- Dual Master of Science (MS) Degree in Soil, Water and Environmental Science and Master of Arts Degree in Journalism

In addition we offer a *Graduate Certificate in Aquaculture* and jointly administer a *Graduate Certificate in Water Policy*.

Master of Science (MS) and Doctoral (PhD) Degrees in Soil, Water and Environ. Science

The SWES MS and PhD programs are designed to be highly flexible, providing opportunity to be tailored to each student's specific needs and career goals. Two tracks are currently offered, "Environmental Science" and "Soil and Water Science". This two-track system, which was implemented in the mid 1990's, reflects the fact that Environmental Science is a major component of the SWES Department. The graduate program is designed to represent the multi-disciplinary and inter-disciplinary nature of the department. A small set of core courses is required for all students following either track. The Environmental Science track consists of an Environmental Chemistry course, and Environmental Biology/Microbiology, and an Environmental Physics/Hydrology course. These three courses comprise a comprehensive integration of the chemical, biological, and physical principles and factors that govern environmental processes. These courses provide a common body of education for all Environmental Science graduate students and serve as a framework for their future course work and research. A separate set of core courses (four selected from Soil Chemistry, Soil Morphology, Soil Physics, Soil/Plant Relationships, and Environmental Biology) exists for the Soil and Water Science graduate students. The average time to degree for PhD students who graduated in years 2001 to 2008 was 4.9 years based on a departmental evaluation of student data. For MS students the average time to

degree for this same time span is 2.6 years. Based on the National Research Council data the time to degree for SWES students compares well with other UA programs

Expected Learning Outcomes

The SWES graduate program is grounded in a strong natural science curriculum that represents the foundation for focused studies in environmental physics, chemistry and/or biology. It is designed to train and educate the future generation of environmental scientists, land and water resource managers, engineers, agricultural producers, and policy makers to provide them with the necessary skills to address a wide range of issues facing environmental systems and their intersection with human health and well-being. Graduates should be highly employable in academia, the private sector (e.g., consulting), state, federal and international agencies (USDA, USGS, USFC, NASA, FAO, etc.) and NGOs, and should be well prepared to lead productive lives and confidently pursue their passions. They should be able to address societal needs pertaining to problems of agricultural production, water quality, natural resource management, and environmental remediation, in a rapidly changing world.

Within this context, expected learning outcomes for both MS and PhD students are:

1. Graduates should possess sound foundational knowledge in the biological, chemical, earth, and physical sciences enabling them to synthesize complex environmental and agricultural problems, formulate problem statements, design experiments, test hypotheses, and provide state-of-the-art solutions in a systematic, creative, and reflexive fashion.
2. Graduates should possess the intellectual flexibility required to view environmental questions from multiple perspectives and be prepared to adjust their understanding as they gain new knowledge.
3. Graduates should be able to actively research data, concepts, histories, and narratives required to address issues that lie beyond their current knowledge base and if necessary consult with scientists from other disciplines.
4. Graduates should be able to lead and function in an interdisciplinary environment and efficiently communicate with biologists, chemists, geologists, physicists, anthropologists, economists, engineers, medical professionals, and sociologists to develop holistic problem solving frameworks.
5. Graduates should be able to communicate in a precise and effective manner and possess comprehensive rhetorical skills in writing, speech, and in digital media.
6. Graduates should be able to understand global issues and learn from and work with people from diverse cultures and other nations.

In addition, PhD students are expected to:

1. Gain a deeper understanding of contemporary research methods and tools to be able to independently conduct cutting-edge scientific research and publish findings in top-tier peer refereed journals.
2. Be capable of teaching formal courses and translating research results for public information.
3. Be able to develop sound proposals for scientific research and design experiments, models or field-based inquiry to develop and test hypotheses.
4. Participate constructively in professional activities such as manuscript and proposal review, organizing working groups or symposia, and communicating effectively across disciplinary lines.

ADMISSION POLICIES

Application for Admission

All applications must be submitted online through the UA Graduate College admissions portal at <https://apply.grad.arizona.edu>. A processing fee is required for each application. Domestic applications are due by June 1 for the Fall Semester, and October 1 for the Spring Semester. International student applications are due by December 1 for the Fall Semester of the following year, and June 1 for the Spring Semester of the following year.

Admission

Acceptance into the SWES Department is granted to a student based on the availability of a faculty supervisor; graduate students are not admitted without formal commitment of a faculty member to supervise the student. Qualified applicants should hold a bachelor's degree from the University of Arizona or from a college or university that grants degrees acknowledged by the University of Arizona Graduate College.

- a) Regular Graduate Status:** Students who meet all admission requirements may be admitted to Regular Graduate Status to undertake work leading to an advanced degree.
- b) Admission with Deficiencies:** An additional number of undergraduate courses may be required when previous work does not meet the general requirements to pursue an advanced degree in the SWES Department.
- c) Conditional Admission:** International students who meet all requirements except English proficiency (TOEFL or IETLS) may be recommended for conditional admission. Conditional admission requires that students apply to and enroll at the UA Center for English as a Second Language (CESL) at their own cost (or their sponsor's) with the expectation of achieving English proficiency within one year. Once CESL certifies that the student has achieved English proficiency, he or she will be formally admitted to pursue graduate studies. The actual semester of admission will be determined by submission of a minimum TOEFL score of 79 (iBT) to the Graduate Admissions Office, or successful completion of the CESL program. The University of Arizona's code for the TOEFL test is 4832.

- d) **Graduate Non-Degree Status:** Individuals holding a bachelor's degree, or its equivalent, may attend graduate-level courses without being admitted to a graduate degree program. Note that a maximum of 12 units of course work taken while in this status may be applied to the graduate degree with approval of the department. International applicants requiring a student visa are not eligible for graduate non-degree admission.

Evaluation for Admission

The Graduate Program Director, a faculty member appointed by the Department Head, will review all applications. The academic record of each applicant will be reviewed by an ad hoc committee of at least three faculty appointed by the Director. A Major Professor must be identified in order for a student to be accepted to the SWES graduate program. Admission is competitive. No candidate with a grade point average below 3.00 over the last 60 units of course work will be considered. The GRE is recommended but not a requirement for admission. Proof of English proficiency is required for admission for all applicants whose native language is not English. Applicants must submit a minimum TOEFL (Test of English as a Foreign Language) score of 79 internet based (iBT), 550 paper based (PB), or IELTS (International English Language Testing System) composite score of 7 (no subject area below a 6). The Graduate Program Director will ultimately give a recommendation to the Department Head on the applicant's suitability for graduate work. Any course deficiencies will be noted. Admission is also subject to the availability of space and facilities.

PREREQUISITES and DEFICIENCIES

The minimum undergraduate preparation for admission into the SWES graduate program includes the following courses (or equivalent):

Course Descriptions*

UA Course Numbers

General Chemistry I - (Lecture & Lab)	CHEM 151
General Chemistry II - (Lecture & Lab)	CHEM 152
Introductory Physics I (Lecture & Lab)	PHYS 102/181 or PHYS 141
General Microbiology (Lecture), or Introductory Biology I	MIC 205 A or MCB 181R
Calculus I	MATH 122A/B or 125
Statistics	MATH 263 or Math 363 or MGMT 276 or SBS 200
Physical Geology (Lecture), or Soil Science (Lecture)	GEOS 251 or ENVS 200

***Note: Soil and Water Science (SWS)** students must complete both GEOS 251 and ENVS 200. **Environmental Science (ES)** students may choose either GEOS 251 or ENVS 200.

Students who lack some prerequisites, but who are otherwise qualified, may be admitted with the missing courses listed as deficiencies. These deficient courses must be completed early in their program. It is advantageous to take immediate steps toward removing any noted deficiencies within the first two semesters. A higher-level course may be used to satisfy a prerequisite with prior approval of the Graduate Program Director. A grade of "B" or better must be obtained to satisfy deficiency requirements.

GENERAL DEPARTMENT POLICIES AND PROCEDURES

Graduate Students are expected to follow the policies and procedures for both the UA Graduate College and for the Department of Soil, Water and Environmental Science. Policies are updated frequently and it is the student's responsibility to comply with current policies.

Graduate College policies can be viewed on-line at <http://grad.arizona.edu/new-and-current-students>; university policies can be found at <http://catalog.arizona.edu/>.

Students have the right to formally request exceptions to department policies and procedures or formally appeal department decisions by submitting a SWES Petition to the SWES Director of Graduate Studies (<https://swes.cals.arizona.edu/system/files/SWES%20Petition.pdf>).

SWES graduate students are subject to annual evaluation for satisfactory progress based on their grade point average and overall progress towards completion of degree requirements. The SWES Graduate Student Progress Report form (annually due June 15th), the Satisfactory Progress Policy and other forms, are readily available on the SWES website or from the SWES Graduate Advisor.

Progress Report Form:

https://swes.cals.arizona.edu/system/files/SWES_Annual_Progress_Report_Form_11_25_2014_0.pdf

Satisfactory Progress Policy:

https://swes.cals.arizona.edu/system/files/SWES_Graduate_Progress_Policy_11_25_2014.pdf

SWES graduate students are expected to enroll in and attend ENVS 595 Colloquia every regular semester and are expected to participate in the SWESx annual spring seminar.

General graduate student concerns should be directed to one of the graduate student department representatives or to the SWES Director of Graduate Studies for specific concerns or questions. Graduate representatives are listed on the SWES website: <https://swes.cals.arizona.edu/graduate-program/current-students>.

New and continuing graduate students are expected to get together frequently with their major professor, individually or during lab meetings, to discuss their research and academic progress.

All SWES theses and dissertations must be formatted and submitted to the UA Graduate College for archiving as part of the degree completion process.

Course Loads

The minimum load for full-time graduate students is nine units of graduate credit per semester. For graduate students who receive College of Agriculture and Life Sciences funding, the required

minimum is ten units, six of which must be graduate level. Undergraduate course work may be necessary to meet program deficiencies, but will not be accepted towards the master's or doctoral degree program.

Grades

The Graduate College has specific regulations on grades necessary for continuing in a degree program and additional scholarship requirements. Please carefully read the current UA Graduate Catalog (<http://grad.arizona.edu/new-and-current-students>). The SWES department adheres to these regulations. Should the grade point average fall below 3.00, the student will be placed on probation. If at the end of the following semester the cumulative average is still less than 3.00, the Graduate College will automatically disqualify the student from the program. Disqualified students may apply for admission as a non-degree seeking student. Credit earned in non-degree seeking status will be computed into the cumulative graduate GPA. According to departmental policy, a student on academic probation cannot hold a scholarship, fellowship, assistantship, or an associateship during the period of probation.

Students earning a grade of Incomplete, "I" for a course should submit a completed Report of Incomplete Grade form to the SWES Graduate Advisor for inclusion in their academic record. <http://registrar.arizona.edu/grade政策/incomplete.htm>. Incomplete grades should be completed in a timely manner and are submitted at the discretion of the course Instructor.

Continuous Enrollment

The Graduate College Continuous Enrollment Policy can be found on the Graduate College website: <http://grad.arizona.edu/policies/enrollment-policies/continuous-enrollment>.

If the student fails to obtain a **Leave of Absence** or maintain continuous enrollment, he or she will be required to apply for re-admission.

All international students are required to maintain full time status while studying in the US. To avoid violating current visa requirements international students should consult with the University of Arizona Office of Global Initiatives regarding enrollment requirements. Further information can be accessed at <http://global.arizona.edu/international-students/maintaining-status> and <http://global.arizona.edu/international-students/summer-enrollment>.

Graduate Assistantships (GA) and Student Worker positions

A comprehensive Graduate College GA Manual is posted on-line at <http://grad.arizona.edu/funding/ga> and the UA Student Employment Manual is on-line at <https://financialaid.arizona.edu/types-aid/work-study/student-employment-manual>.

SWES PROGRAM REQUIREMENTS FOR A MASTER OF SCIENCE DEGREE

Major Professor – Master's Committee

The Major Professor is a faculty member within the student's general area of study. With the help of the Major Professor, the student will identify additional members from appropriate areas to complete the student's Master's Committee. The Master's Committee is responsible for guiding each student's academic program, including all examinations.

The Master's Committee consists of at least three members. The Major Professor and at least one additional member must be tenure-track; the third member may be an approved special member. Special committee members must be pre-approved by the Dean of the Graduate College. At least two must hold faculty appointments in the SWES Department. The student may also have a co-director or committee member outside the SWES Department, provided that he or she has credentials acceptable to the SWES Department and the Graduate College.

General Requirements

The SWES Department Master of Science degree requires a minimum of 30 units of graduate credit, including thesis units. There must be 15 units in the major field, and at least 15 units must be from courses in which letter grades of A and B have been earned. In cases in which a thesis is part of the degree program, not more than 8 thesis units (ENVS 910) may count toward the degree. A minimum of 24 units must be non-thesis units. All units of coursework for a graduate degree must be in 500-level courses or above. During the last semester of the student's study, the student must be enrolled in the department seminar (ENVS 696A).

Use of prior credit is limited. Students who wish to transfer credit must submit a Transfer Credit form in GradPath before the end of their first year of study.

General limits on the 12 units taken prior to acceptance into the program

- No more than 12 units of coursework taken in graduate non-degree seeking status may be used toward a master's degree.
- Transfer from another institution may not exceed six units of credit.
- Transfer credit can be applied to an advanced degree only upon satisfactory completion of deficiencies as prescribed by the SWES Department Head.
- Transfer of credit will not be made unless the grade earned was A or B, and unless it was awarded graduate credit at the institution where the work was completed.
- Grades of transfer credits are not used in computing the student's grade-point average.
- Credit for correspondence or on-line courses from other institutions will not be accepted for graduate credit.

SWES Master of Science Core Course Requirements

Two MS majors are offered, Environmental Science (ES) and Soil and Water Science (SWS). The ES major requires completing one course from each of the three categories (9 units); The SWS major requires completion of four of the five courses (12 units).

Environmental Science (ES) Core Courses

Environmental Biology and Microbiology

ENVS 525 Env Microbiology
ENVS 574 Aquatic Plants & the Env
WSM 552 Dryland Ecohydrology and
Vegetation Dynamics

Environmental and Soil Chemistry

ENVS 564 Env Chemistry
ENVS 562 Env Soil & Water Chemistry

Soil and Water Science (SWS) Core Courses

ENVS 525 Env Microbiology
ENVS 502 Nutrient Dynamics in Soils
ENVS 531 Soil Morphology
ENVS 562 Env Soil & Water Chemistry
ENVS 570 Soil Physics

Environmental Physics and Water Science

ENVS 520 Env Physics

ENVS 570 Soil Physics

Note: There are no exceptions from the courses listed above. It is the student's responsibility to ensure that they complete the required core courses.

Additional Course Work Requirements

For each major area additional courses may be selected with the guidance and approval of the student's Master's Committee to meet the minimum total credit requirement.

Thesis

Evidence of academic and research abilities are verified by presenting research results in a formal Master's thesis to the SWES department. By the end of the second semester in residence, a research topic should be chosen by the student in consultation with their Master's Committee. From two to eight units of ENVS 910 (Thesis) can be earned for the preparation of the thesis, which are counted as part of the 30 minimum units required for the MS degree.

Non-Thesis option for MS students

Students may meet requirements for the MS degree by submitting a report in lieu of a thesis; all other requirements are the same as for the thesis option. The student's report will comprise a professional report in the field of environmental or soil science. The report must be approved by the student's Master's Committee and the department head. The student should register for 1-2 credits of ENVS 909 (Master's Report) in the semester in which she/he completes the report. Students must also present a seminar to the department. Additional requirements include a total of 30 units of course work, one semester of seminar, and any additional requirements specified by the Master's Committee.

Summary of Master of Science degree requirements

Core courses: 9 units (ES major) or 12 units (SWS major)
Additional Major course work completed at UA: 3 units (ES major)
Elective course work: 9 – 15 units
SWES Colloquia: 1 unit each semester
ENVS 696A: 1 unit
ENVS 910: 2 – 8 units
Total: minimum 30 units

Plan of Study

Each student is responsible for submitting a Responsible Conduct of Research form, and in conjunction with their Major Professor, for developing a written Plan of Study. The Plan of Study is to be submitted to the Graduate College by the end of the second semester in residence. The Plan of Study must identify:

1. Courses the student intends to transfer from other institutions
2. Courses already completed at The University of Arizona that the student intends to apply toward the graduate degree
3. Additional courses the student plans to complete to fulfill degree requirements

Students using transfer coursework should submit the Transfer Credit Form to the Graduate College prior to submitting the Plan of Study. One unit of ENV5 595 may be applied to the SWES Master's degree requirements. Approval for the Plan of Study is routed for review starting with the SWES Major Professor, and then to the Director of SWES Graduate Programs. The Graduate College grants final approval. Plans that are denied will need to be updated and re-submitted.

Master's Final Examination and Completion of Degree Requirements

The Master's final exam in the SWES Department involves a defense of the thesis to the Master's Committee, and Departmental submission of the Master's Completion of Degree Requirements form. If the candidate fails the final exam, a second exam may be granted no sooner than four months from the date of the first exam.

All requirements for the Master's degree must be completed within six years. Time-to-degree begins with the earliest course to be applied toward the degree, including credits transferred from other institutions. Work more than six years old is not accepted toward degree requirements.

SWES PROGRAM REQUIREMENTS FOR A PHD DEGREE

Major Professor and Required Committees

A student's Major Professor will be the faculty supervisor who has accepted the student into his/her program. Graduate students must have a major professor to be making satisfactory progress. The two advisory committees with which the student will interact are the Comprehensive Examination Committee and the Dissertation Committee.

The Comprehensive Examination Committee consists of at least four members (three for the major, one for the minor), and should be formed by the end of the first year in consultation with the Major Professor. The purpose of this committee is to conduct the Comprehensive Examination (see below).

The Dissertation Committee should be formed by the time the results of the Oral Comprehensive Examination form are submitted to the Graduate College; earlier formation is encouraged. The purpose of the Dissertation Committee is to help supervise the student's research, and to conduct the Final Oral Defense examination. It consists of four members, the Major Professor and at least two additional members must be tenure-track faculty from the major; the fourth member may be an approved special member. It may include members from the Comprehensive Examination committee. Special committee members must be pre-approved by the Dean of the Graduate College. Generally, a majority of the committee must be faculty members in the SWES Department, with expertise in the immediate field of research. The student may also have a co-director or committee member outside the department, provided that he or she has credentials acceptable to the SWES Department and the Graduate College.

Credit Requirements and Transfer Credits

The equivalent of at least six semesters of full-time graduate study is required for the PhD program. A minimum of **66** total units is required for the PhD; at least 36 units of course work in the area of the major subject, a minimum of 9 units in the minor subject, and 18 units of dissertation (ENVS 920) must be completed. At least one half of these units must be from courses in which letter grades have been earned. Graduate credit earned at other approved institutions, if accepted by the SWES Department and the Graduate College and with a grade of A or B, may be counted toward the requirements of this degree, but will not be calculated in the University of Arizona grade point average. Students who wish to transfer credit must submit a Transfer Credit form in GradPath before the end of their first year of study. All required units of credit must be at the **500-level** or above at The University of Arizona (or, in the case of transfer units, their equivalent at other institutions). A minimum of 12 units of regular grades taken at the University of Arizona are required to establish a University of Arizona GPA. Credit for correspondence or on-line courses or extension work obtained at other institutions will not be accepted for graduate credit.

At least two full-time semesters (i.e., at least 10 units each semester), and at least 30 credits of graduate work must be completed at the University of Arizona. For students holding graduate assistantships, the residence requirement can be met by four semesters during each of which they register for six or more units of graduate credit. Graduate credit for which a grade of A or B was obtained during a prior program at the UA may be used to meet the credit requirements upon approval of the Major Professor and Dissertation Committee. In addition, graduate credit for which a grade of A or B was obtained may be transferable from other institutions with the approval of the Major Professor and the Graduate College. SWES graduate students are expected to enroll and attend each SWES Colloquium every semester.

Minors

A minor course of study is required; this constitutes at least nine units. SWES students have two options for completing their minor:

Intradepartment – In recognition of the diversity of the SWES Department, students whose major department is SWES can also obtain their minor within the SWES Department if they so desire. In this case, the faculty acting as the major Comprehensive Examination Committee and Dissertation Committee members must be distinguished from minor committee members.

Twelve credits are required for the minor. The set of courses used to satisfy the minor should comprise a topic area that is clearly distinguishable from the major. For example, a student majoring in Environmental Microbiology could complete an intradepartmental minor in Environmental and Soil Chemistry. The specific courses used to complete the minor will be selected in consultation with the Minor Professor (tenure-track faculty from the minor area of study) who has final approval.

Interdepartment – Students may also obtain a minor from another department. In this case the requirements of that department must be followed.

Minimum Course Requirements

The minimum course requirements for the PhD with majors in Environmental Science or Soil and Water Science are as follows:

- Completion of the core-course requirements.

Environmental Science (ES) Core Courses	Soil and Water Science (SWS) Core Courses
Choose one from each category.	Choose four of five designated courses.
<i>Environmental Biology and Microbiology</i>	ENVS 525 Env Microbiology
ENVS 525 Env Microbiology	ENVS 502 Nutrient Dynamics in Soils
ENVS 574 Aquatic Plants & the Env	ENVS 531 Soil Morphology
WSM 552 Dryland Ecohydrology and Vegetation Dynamics	ENVS 562 Env Soil & Water Chemistry
<i>Environmental and Soil Chemistry</i>	ENVS 570 Soil Physics
ENVS 564 Env Chemistry	
ENVS 562 Env Soil & Water Chemistry	
<i>Environmental Physics and Water Science</i>	
ENVS 520 Env Physics	
ENVS 570 Soil Physics	

Additional course work in Major 24 – 27 credits

- Total Major course work = 36 credits minimum.
A minimum of 18 units are required in graded (A,B) lecture-based courses. The remaining units may comprise credits from non-dissertation research courses.
- SWES Colloquia: 1 unit each semester
- Two credits of Seminar
Seminar requirement may be met by selecting one of the following options:
 - a. Two semesters of SWES seminars (ENVS 696A)
 - b. One semester of ENVS 696A, plus one semester as a teaching assistant (GTA) or proctor
 - c. One semester of ENVS 696A plus one semester of seminar from another department
 - d. One semester of ENVS 696A plus one semester of GRAD 697C “Workshop for Teaching at the College Level”
- Minor: The SWES department requires 12 units for the minor. Since requirements vary by department, students should check with their minor department if it is not SWES. The Graduate College requires a minimum of 9 units for all minor programs.
- 18 units of dissertation (ENVS 920)
- Total Credits required = 66

Foreign Language Requirement

The SWES Department recommends, but does not require proficiency in a foreign language.

Doctoral Plan of Study

By the end of the first semester, students should develop a list of courses for their PhD graduate program in conjunction with the student's Major Professor and Dissertation Committee. Suitable courses from other departments can be included in the major program. Up to two units of ENV5 595 SWES Colloquia may be applied to the Doctoral Plan of Study. The student is responsible for submitting the Plan of Study. The Doctoral Plan of Study requires approval by the Major Professor, Minor Professor, the SWES Graduate Program Director, and the Graduate College. Denied plans need to be updated and re-submitted for approval.

The Doctoral Plan of Study should identify:

1. Courses the student intends to transfer from other institutions
2. Courses already completed at the University of Arizona that the student intends to apply toward a graduate degree
3. Additional courses the student plans to complete to fulfill degree requirements

Each student is also responsible for submitting a Responsible Conduct of Research form.

Prospectus

The University of Arizona Graduate College mandates that every student in a doctoral program has an approved dissertation prospectus or proposal on file with their department. As soon as the student has an approved prospectus/proposal on file with the department, the department's Graduate Coordinator will submit the prospectus/proposal confirmation form in GradPath on behalf of the student.

Doctoral candidates should submit a final prospectus to their Dissertation Committee for review soon after advancement to candidacy, and prior to writing the dissertation. The prospectus should be approved a minimum of six months before scheduling the Final Oral Defense. The prospectus provides a preliminary description of the proposed dissertation and should include:

Title Page

- Title
- Name, Program, Student ID

Problem Statement (1-2 pages)

- Argument to address the gap in research literature in terms of relevance to the discipline
- Evidence (citations) providing justification that this research is meaningful
- Purpose of study
- What needs to be studied, describing variables and conjectured relationships among them

Research Question (which will be the foundation for the generation of hypotheses)

Significance (1-2 paragraphs)

Background (literature search supporting assertions in the problem statement)

Framework (identifies research design decisions: method of inquiry, data collection and analysis)

Other Information (e.g., challenges or barriers that may need to be addressed)

References

Comprehensive Examination

The Graduate College policy on the Comprehensive Exam can be located at <http://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#comprehensive-exam>

When the student has an approved Doctoral Plan of Study on file with the Graduate Degree Certification Office, has satisfied all course work and residence requirements, and passed the written and oral portions of the Comprehensive Examination their bursar account will be billed the fee for candidacy and dissertation processing. This is a one-time fee and the student will not be billed again if they change their anticipated graduation date. Copyrighting is optional and carries an additional fee.

Doctoral Dissertation Committee Appointment

The Doctoral Dissertation Committee Appointment form should be filed with the Graduate College no later than **six months** before the student schedules the Final Oral Examination (i.e. defense). This will notify the Graduate College of the student's intended semester of graduation, title of dissertation, and diploma mailing address. An approved Dissertation Committee Appointment form must be on file with the Graduate College before scheduling the Final Oral Examination. Prior to, or at this time, the student should select the members of the Dissertation Committee, who will also serve as the Final Oral Examination Committee. It is recommended that this committee be constituted as soon as possible.

Final Oral Defense Examination

Upon the completion of the dissertation, the candidate must have a Final Oral Defense Examination. A student must be in good academic standing to schedule the defense. The examination focuses on the dissertation itself but can include general questions related to the field(s) of study within the scope of the dissertation.

The date, time, and location of the final examination must be scheduled with the Graduate College in advance using the Announcement of Final Oral Defense form in GradPath. This form should be submitted far enough in advance of the examination that all approvers can grant their approval in time for the form to reach the Graduate College one week prior to the exam.

The Graduate College will place an announcement on the UA master calendar to invite the public to attend the candidate's presentation of his or her work. Final Oral Examinations should be scheduled during days when the university is in session and during normal business hours. Permission to hold examinations during university holiday closures or outside of normal university business hours may be granted by Graduate College.

The Major Professor presides over the examination. The initial seminar portion during which the student presents the dissertation and entertains questions is open to the public. The Dissertation Committee's deliberation is closed to the public. There is no minimum time limit for the Final Oral Examination, but the entire proceedings may not exceed three hours. Members of the Doctoral Dissertation Committee must be present for the entire examination. All committee members must participate for the entire oral examination. If a committee member is participating remotely, that member needs to be able to communicate with the candidate and other committee members during the entire defense. If more than one member of the committee, or the student, is participating

remotely, Graduate Student Academic Services needs to be informed prior to the exam for approval. If there are three committee members then all three members must pass the student in order for that student to pass the final defense. If there are more than three committee members then there may be only one negative vote (Fail or Abstain) for the student to pass.

If the Dissertation Committee requires revisions, those must be done in a timely manner, not to exceed one year, and agreed upon by the committee. If the revisions are not completed by the dissertation submission deadline for the term when the student defends, the student will be required to register for the next semester and will graduate in the semester when the revisions are completed and approved. If revisions are not done by the end of the time to degree period, the student will have to retake comprehensive examinations to demonstrate up-to-date knowledge.

Time Limitations

Students entering the PhD program must complete their degree within five years after taking the Oral Comprehensive Examination. Students may petition for an extension of time to complete their PhD degree, if they are only slightly past the five-year timeframe.

GradPath

GradPath is the UA Graduate College’s nearly paperless degree audit process that tracks and monitors student progress. Students are able to fill in and submit forms online through UAccess Student. GradPath can notify students when there is a problem with their forms (e.g. courses outside the time limit), and link to relevant policy.

From UAccess Student, click the dropdown menu in the Student Center section and select “GradPath forms” to see a list of forms specific to your degree program. The following example includes the forms for a PhD student in SWES; MS students would only see the forms listed under MS – Soil, Water & Environ Sci (Active in Program).

Welcome to your GradPath forms! The forms listed under your degree or certificate are required forms. Other forms are available for your use if needed.

IMPORTANT: You do NOT need to re-do any forms in GradPath that you already completed on paper. GradPath does not contain any paper forms you have submitted, but they are on file with the Graduate College. Later forms are made available based on the steps you have already completed in GradPath or on paper. (Note that you must first submit the Responsible Conduct of Research form before other required forms will be available.)

If you have questions about your GradPath forms, please contact your degree counselor. To identify your counselor, see <http://grad.arizona.edu/academics/degree-certification/find-auditor>. (30018,57)

MS - Soil, Water & Environ Sci (Active in Program)		
Responsible Conduct of Research Statement (SWESMS)	View Current	
Plan of Study (SWESMS)	View Current	
Master's/Specialist Committee Appointment Form (SWESMS)	View Current	
Master's/Specialist Completion Confirmation (SWESMS)	View Current	
PHD - Soil, Water & Environ Sci (Active in Program)		
Responsible Conduct of Research Statement (SWESPHD)	View Current	
Plan of Study (SWESPHD)	View Current	
Comp Exam Committee Appointment Form (SWESPHD)	View Current	
Announcement of Doctoral Comprehensive Exam (SWESPHD)	View Current	
Results of Comprehensive Exam (SWESPHD)	View Current	
Doctoral Dissertation Committee Appointment (SWESPHD)	View Current	
Prospectus/Proposal Confirmation (SWESPHD)	View Current	
Announcement of Final Oral Defense (SWESPHD)	View Current	
Results of Final Oral Defense (SWESPHD)	View Current	
Other forms		
Transfer Credit Form	View Current	

Contact Kathleen Landeen, klandeen@email.arizona.edu in the SWES office if you have questions or need assistance. **Other forms:** *Change of Program; Distribution Right; Graduate Petition; Leave of Absence; Dissertation Formatting Guide* forms are available at <https://grad.arizona.edu/forms/gsas> or the SWES advising office.

REGULAR SWES COURSES

ENVS 501. Sustainable Management of Arid Lands and Salt-Affected Soils (3) Principles and practices of soil, water and crop management under arid and semiarid conditions, the use of diagnostic procedures for evaluating soils and waters, reclamation, and economics of irrigation project development. Walworth, Artiola

ENVS 502. Nutrient Dynamics in Soils (3) Principles of soil solution and colloid chemistry, soil-water relationships, soil microbiology, and plant physiology and metabolism applied to processes of soil nutrient cycling, nutrient availability and plant growth. Walworth

ENVS 505. Modeling of Mass and Energy Flow in Soils (3) Water flow in soils; closely related problems of solute, pollutant, and heat transfer; emphasis on current concepts and research, and on mathematical descriptions. Schaap, Tuller

ENVS 508. Scientific Writing for Environmental, Agricultural and Life Sciences (3) This course will aid students in developing the writing and organizational skills needed to produce effective technical reports, theses, dissertations and journal articles. Glenn

ENVS 515. Translating Environmental Science (3) In this course students learn journalism techniques to translate environmental science topics into language a layperson could appreciate. Lenart

ENVS 518. Introduction to Human Health Risk Assessment (3) The purpose of this course is to enhance students' knowledge and skills related to risk characterization and environmental risk assessment, including hazard, exposure, toxicity, and risk assessments. Graduate-level requirements include conducting a case study that will require them to collect secondary data in the field. Reynolds

ENVS 520. Environmental Physics (3) Physical principals used in assessment, prevention or reduction of environmental problems. Main themes include energy sources; energy and mass transport; and pollution within soil, water, and air. Schaap

ENVS 525. Environmental Microbiology (3) Current concepts in water quality, aerobiology, and microbial biogeochemistry. Maier, Rich

ENVS 526. Environmental Microbiology Laboratory (2) Basic techniques for isolation and characterization of environmental soil and water microflora including methods for enumeration and measurement of physiological activity. Pepper, Gerba

ENVS 530R. Environmental Monitoring and Remediation (3) SWES 530L (1) Lab. Basic statistics, data quality, field surveying, near-surface air measurement, automated data acquisition;

soil, vadose zone and groundwater sampling and monitoring; soil and water biological properties, including pathogen monitoring and remote sensing. Artiola

ENVS 531. Soil Genesis, Morphology, and Classification (3) Theory and practice of describing characteristics of soils; principles of soil classification and the classification systems; making soil interpretations for selected land uses. Field trips. Rasmussen

ENVS 540. Biodegradation of Pollutants in Soil and Groundwater (3) Description of modern pollution problems and potential biological remediation techniques focusing on the chemistry, biochemistry and molecular biology of biodegradation of hazardous and toxic compounds. Maier

ENVS 541. Advanced Soil Genesis (3) Physical and chemical processes and mineralogy of weathering and soil formation; quantitative pedology; the soil as part of the ecosystem. Field trips. Rasmussen

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ENVS 546. Environmental Biotechnology (2) Molecular methods for detection of microorganisms in the environment; fate and survival of introduced organisms in the environment; molecular mechanisms of microbial inactivation in waste treatment systems and microbial risk assessment. Faculty

ENVS 553. Remote Sensing of the Environment (3) Remote sensing techniques and applications for improved natural resource utilization of soils, water, grasslands, and forest; fundamental energy-matter interactions that influence the spectral characteristics of vegetation, soil, and water. Field trips. Faculty

ENVS 554. Water Harvesting (3) Focuses on water harvesting principles and techniques. Faculty

ENVS 561. Soil and Water Conservation: Environmental Field Experience (3) Field and laboratory experience in environmental monitoring and characterization relative to water and soil conservation, water reuse, water quality, environmental pollutants, and transport and control of pollutants in the environment. Offered during Pre-session. Field trips. Artiola, Gerba

ENVS 562. Environmental Soil and Water Chemistry (3) An introduction to the principal chemical constituents and processes occurring in soils and sediments. Chorover

ENVS 563. Advanced Soil and Water Chemistry (3) Fundamentals of aqueous surface and colloid chemistry through lecture and assigned readings. Chorover

ENVS 564. Environmental Organic Chemistry (3) Physical and chemical processes influencing the behavior of contaminants in the subsurface environment; equilibrium and kinetic theory of solubilization-dissolution, volatilization, sorption, hydrolysis, photolysis, surface catalysis, and radioactive decay. Curry

ENVS 565. Contaminant Transport in Porous Media (3) Transport of contaminants in the subsurface environment; effects of dispersion, interphase mass transfer, transformation reactions, and porous-media heterogeneity on transport; aqueous (dissolved) and multiphase (immiscible liquid, gas) systems. Brusseau

ENVS 566. Soil and Groundwater Remediation (3) Methods for remediating contaminated soil and groundwater; factors influencing efficacy of remediation systems. Brusseau

ENVS S 568. Molecular Biogeochemistry. (2) Reading and discussion of papers in the emerging field of environmental molecular biogeochemistry. Through reading and discussion, experiments and models designed to understand coupled biotic-abiotic (e.g., biomineralization, oxidation-reduction) processes in environmental systems will be explored. Chorover

ENVS 570. Soil Physics (3) Theoretical and practical bases for understanding and quantifying physical and hydrological properties of soils; hydro-physical processes taking place near the Earth's surface emphasizing mass and energy exchange, and transport processes in saturated and partially-saturated soils at multiple scales; coupling of the atmosphere and the role of plants in the hydrological cycle; modern measurement methods and analytical tools for hydrological data collection and interpretation. Tuller

ENVS 572. Interfacial Chemistry of Biomolecules in Environmental Systems (3) Introduction to the chemical and adhesive properties of macromolecules at interfaces and inter-particle adhesion. Curry

ENVS 574. Aquatic Plants and the Environment (4) The role of riparian areas, estuaries, and constructed wetlands in the environment; emphasis on plants as wildlife habitat, nutrient cycling, and bioremediation. Fitzsimmons

ENVS 575. Freshwater and Marine Algae (4) Systematics, ecology, and evolution of planktonic and benthic species; field techniques and lab culture. Graduate-level requirements include a special topic report on an aspect of freshwater algae. Fitzsimmons

ENVS 595. Colloquia (1) The exchange of scholarly information and/or secondary research. Instruction often includes lectures by several different persons. Tuller

ENVS 596B. Arizona Water Policy (1-3 units) This seminar 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. The faculty draw upon their and guest-lecturers' experiences to demonstrate the development, analysis and implementation of real-world water policy. Megdal

ENVS 665. Advanced Contaminant Transport (3) Transport and fate of contaminants in subsurface systems; critical, detailed analyses of case studies of actual contaminant transport problems providing an opportunity to develop skills necessary to evaluate real systems. Brusseau

ENVS 696A. Seminar (1) Topics in Soil, Water and Environmental Science. Development and exchange of scholarly information, usually in a small group setting; the scope of work shall consist of research by course registrants, with the exchange of the results of such research through discussion, reports/or papers. Faculty

INDIVIDUAL STUDIES:

ENVS 599 Independent Study (1-4 units per semester), **699** (1-6 units per semester) Qualified students working on an individual basis with professors who have agreed to supervise such work. Grades available: S/P, C, D, E, I, W. (Graduate students doing independent work which cannot be classified as actual research will register for credit under course number 599, 699).

ENVS 900. Research (1 – 6 units per semester) Individual research, not related to thesis or dissertation preparation, by graduate students. Grades available: S/P, C, D, E, K, W.

ENVS 909. Master's Report (1-9 units per semester) Research for master's program. Grades available: S/P, E, K, W.

ENVS 910. Thesis (1-8 units per semester) Research for the master's thesis (whether library research, laboratory or field observation or research, artistic creation, or thesis writing). Maximum total credit permitted varies with the major department. Grades available: S/P, E, K, W.

ENVS 920. Dissertation (1 to 9) Research for the doctoral dissertation (whether library research, laboratory or field observation or research, artistic creation, or dissertation writing). Grades available: S/P, E, K, W.

NOTE: All Individual Studies units require enrollment through the SWES Department. Please submit an Individual Studies Proposal form to Kathleen Landeen in Shantz 429F for registration. DGS advance approval is required to apply Individual Studies credits to the Master Plan of Study.

GLOSSARY

Deficiency: Prerequisite coursework for the major that must be completed before the end of the first year of graduate study.

Major Professor: Tenure track, or tenure equivalent, faculty supervisor who accepts a graduate student into their field of research and acts as their mentor.

Minor Professor: Tenure track faculty from the minor area of study who is a member of the Dissertation Committee.

Core Courses: Classes in the major that all SWES student must complete from the program curriculum.

Elective Courses: Addition courses in the major that apply directly to the program curriculum.

GradPath: The UA Graduate College's paperless degree audit process accessed via UAccess Student and allowing tracking and monitoring of student progress. Required graduate forms are filled submitted on line.

Plan of Study: Comprehensive list of curriculum required for by the degree program, that include transfer coursework and UA coursework in the major. The Plan of study is developed in consultation with the Major Professor and is submitted in GradPath.

Transfer Courses: Graduate courses taken at another institution of higher education that will be included in the Plan of Study. Transfer courses must be pre-approved by the UA Graduate College during a student's first year in residence.

APPENDIX I - Guidelines for Theses and Dissertations

All students earning a master's or doctoral degree in SWES are expected to submit an electronic copy of their dissertation, thesis or report to the Department no later than the Graduate College's semester graduation requirement deadline; deadlines are posted on-line and are available from the SWES advising office.

Theses and dissertations may be completed using one of two formats: (1) traditional or (2) journal publication. The guidelines for preparing a traditional thesis or dissertation may be found in the Graduate College Manual for Thesis and Dissertations (<http://grad.arizona.edu/degrecert/dissertations-theses>). The SWES department guidelines for preparing a thesis or dissertation following the journal-publication format are given below.

Alternative Thesis and Dissertation Format: Inclusion of Journal Manuscripts

It is the policy of the Department to allow a thesis or dissertation to contain one or more papers prepared for submission, submitted, or accepted for publication. The thesis or dissertation must adopt the format described in the Graduate College's Dissertation Formatting Guide. In addition, to ensure that a student has made a significant contribution to papers in the thesis or dissertation, the following rules must be met in order to use the journal-publication format.

1. The student must be the primary author on at least one paper for a MS thesis, and at least two papers for a PhD dissertation subject to the criteria outlined below.
2. If a paper that has already been published is used in the thesis or dissertation it must have been published in a refereed journal.
3. Papers that have been submitted (but not yet accepted) to a refereed journal can be used as a part of the dissertation.
4. Papers that have been prepared for submission, but have not yet been submitted, are also acceptable so long as the paper has been prepared for eventual submission to a refereed journal.
5. All co-authors will be listed on the cover page of each paper. In cases where multiple authors appear on one or more papers, it must be clear what the responsibilities of the various authors were in completing that work, and that the student completed a significant portion of that work. The student will indicate responsibilities for his or her work in the thesis/dissertation body, and acceptance of this explanation by the Dissertation Committee constitutes their acceptance of the author's explanation. A specific, separate section in the body of the thesis/dissertation will be included, wherein the contributions of the student and of all other co-authors will be clearly delineated.

6. In cases where members of the Doctoral Dissertation Committee are co-authors, the remaining members can vote to exclude papers that they do not feel meet the requirement that the student has contributed enough to the research to be listed as senior author.
7. A summary of the methods, results, and conclusions for each paper will be included in the body of the thesis/dissertation.
8. The student will be expected to defend all of the thesis/dissertation, even in cases where multiple co-authors are included.

Note: Student who will be publishing their research should request an Embargo on their thesis or dissertation from the UA Library Campus Repository upon submission to the SWES office.

APPENDIX II - Facilities and Resources

Arizona Laboratory for Emerging Contaminants (ALEC)

The Arizona Laboratory for Emerging Contaminants is located at the University of Arizona to assist faculty, student and staff researchers working in the field of water sustainability to detect, quantify and speciate organic and inorganic micro-pollutants--including dissolved and nanoparticulate components in complex environmental matrices.

website: www.alec.arizona.edu/index.html

Jon Chorover Co-Director, 520-626-5635 chorover@cals.arizona.edu
Shane Snyder Co-Director 520-621-2573 snyders2@email.arizona.edu
Gould-Simpson Building
Rooms 828, 848
1040 East 4th Street
Tucson, AZ 85721

Campus Agricultural Center Karsten Turfgrass Research Facility

The 7.5 acres of turfgrass research plots features five United States Golf Association specification putting greens, two-4-meter deep lysimeters, and a weather station based computer controlled irrigation system. The primary irrigation source is tertiary effluent from the city of Tucson. website: <http://turf.arizona.edu/karsten.htm>

2101 E. Roger Rd Tucson, AZ 85719
520.318.7142
dkopec@cals.arizona.edu

Center for Environmental Physics and Mineralogy (CEPM)

CEPM provides high quality physical and mineralogical characterization of earth surface and other porous materials. Capabilities include qualitative and quantitative identification of mineral phases, thermal analysis of mineral and organic materials, particle and pore size distributions, surface area, liquid adsorption and retention properties, and saturated and unsaturated hydrodynamic properties. website: <http://ag.arizona.edu/swes/CEPM/>

Dr. Craig Rasmussen CEPM Acting Director, Assistant Professor of Environmental Pedology
(520) 621-7223

crasmuss@cals.arizona.edu

Shantz 38, Room 520

University of Arizona

Tucson, AZ 85721

Maricopa Agricultural Center (MAC)

A 2,100-acre research farm within The College of Agriculture & Life Sciences. Our goal is to develop and deliver the best integrated agricultural technologies for problems faced by Arizona consumers and producers. Research focuses on cotton, small grains, alfalfa, and new specialty crops that could be used to provide fibers, oils and pharmaceuticals. The Center also supports extension outreach programs, such as Ag-Ventures, various University classes, and Ag-Literacy for all age groups. Website: <http://cals-mac.arizona.edu/>

(520) 374-6380 | F: (520) 374-6394

37860 W. Smith-Enke Rd.

Maricopa, AZ 85138-3010

Superfund Research Program, the University of Arizona

The theme of the University of Arizona Superfund Research Program (UA SRP) is “Hazardous Waste Risk and Remediation in the Southwest.” Our goals are to address the health effects of contaminants of concern in the U.S. Southwest (and Mexico border), and to characterize, contain, and remediate hazardous waste sites. website: superfund.pharmacy.arizona.edu/

Raina Maier, Director, Investigator (520) 621- 7231

rmaier@ag.arizona.edu

FCS 322/302/303

Gould-Simpson Building

Tucson, AZ, 85721

Water and Energy Sustainable Technology Center (WEST)

The WEST Center is a world renowned venue focused on water and wastewater treatment and monitoring, alternative energy and related technologies. WEST is co-located with the Pima County, brand new 21st Century Water Reclamation Facility, “Agua Nueva.” WEST is also adjacent to reclaimed water recharge basins and constructed wetlands, all of which is part of a Water Reclamation Campus. website: <http://west.arizona.edu/>

Dr. Ian Pepper, Co-Director (520) 626–3328

ipepper@ag.arizona.edu

Dr. Shane A. Snyder, Co-Director

snyders2@email.arizona.edu

2955 W. Calle Agua Nueva

Tucson AZ 85745

Water Resources Research Center (WRRC)

The University of Arizona Water Resources Research Center (WRRC) promotes understanding of critical state and regional water management and policy issues through research, community outreach and public education. website: <http://wrrc.arizona.edu/>

Sharon Megdal, WRRC Director (520) 621-9591
smegdal@cals.arizona.edu
350 North Campbell Ave. Tucson, AZ 85719