



COLLEGE OF AGRICULTURE & LIFE SCIENCES

Environmental Science

GRADUATE STUDENT HANDBOOK

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More Information

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Graduate Student Handbook

Department of Environmental Science

College of Agriculture and Life Sciences

The University of Arizona

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1 Introduction

This handbook is prepared for the benefit of graduate students enrolled in the graduate program of the Department of Environmental Science (ENVS), as well as those interested in matriculating into this program. The purpose of this document is to provide useful information about the procedures followed for admission and matriculation, and to clearly outline the Department's expectations for a successful completion of graduate degrees.

The Department of Environmental Science brings together a community of distinguished scientists, knowledgeable staff, and motivated students who all strive to further their understanding of soil, water, and the environment, and carry out research, policy development, advising and planning towards the solution of today's environmental and resource-use challenges. Under the leadership of the ENVS Department Head, Dr. Jon Chorover, the ENVS community consists of 31 faculty, 38 researchers, 12 staff, and 22 joint, adjunct, or emeritus faculty, 60 graduate students and nearly 200 undergraduate students.

The mission of the ENVS Department is to be a premier center for learning, research and outreach that finds solutions to diverse environmental challenges to improve the quality of all life. We educate and train future generations to solve environmental issues at the intersection of biology, chemistry, physics and social sciences. We collaborate with industrial and professional partners to identify and apply practical and scientific solutions to current and emerging human-environmental challenges. We engage the community, including under-served populations, through extension services and citizen science. Housed in the College of Agriculture and Life Sciences at the University of Arizona, our faculty and research covers the full breadth and depth of environmental sciences, with strong expertise in arid and water-limited regions.

The ENVS Department is a key member of The University of Arizona's School of Earth and Environmental Sciences (SEES), which also includes the [College of Science](#) Departments of [Hydrology and Atmospheric Sciences](#), [Geosciences](#), [the Laboratory of Tree-Ring Research](#), [the Accelerator Mass Spectrometry Laboratory](#), and the [College of Agriculture and Life Sciences' School of Natural Resources and the Environment](#). SEES produces new knowledge about earth and environmental processes and human-environment interactions at all geographic and temporal scales, provides the scientific basis for environmental and climate policy, trains the next generation of earth and environmental scientists, and disseminates knowledge and solutions for the benefit of students and society. The combination of field, instrumental, computational, and modeling approaches in the earth and environmental sciences within one unit is a major strength. SEES facilitates interdisciplinary research, teaching, and outreach/extension activities across the six departments and laboratories. Graduate students feature

prominently in SEES as manifested in the campus-wide student-organized EarthWeek symposium which features the latest environmental science advances researched by Graduate Students.

The total enrollment at the University of Arizona exceeds 45,000 (including nearly 10,000 graduate students), a size that offers a wide range of academic and extra-curricular programs. Tucson is a diverse metropolitan area of over a million 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>.

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2 Overview of the ENVS Graduate Program

The ENVS Graduate Program is grounded in a strong natural science curriculum that represents the foundation for focused studies in environmental physics, chemistry and/or biology. Graduate study in the ENVS Department is open to qualified 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. The ENVS Graduate program 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 and NGOs, and should be well prepared to lead productive careers 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. Description of major research thrusts within the Department, as well as brief descriptions of research, education and extension interests of the faculty appear in the appendices. The appendices also hold a listing of our current state-of-the-art graduate courses.

The ENVS Department offers Master of Science (MS) and Doctor of Philosophy (PhD) degrees with a Major in Environmental Science with subplans (or tracks) in either Environmental Science (ES) or Soil and Water Science (SWS). The ENVS MS and PhD programs are designed to be flexible, and provide ample options to meet each student's specific needs and career goals. The graduate program is designed to represent the multi-disciplinary nature of the department. Both tracks require a small set of core courses to ensure foundational knowledge that will serve as a framework for their future course work, research, and professional career paths.

The MS and PhD degree programs are offered in curricula that allow well-prepared students to graduate in two or five years, respectively. Integration with undergraduate education is tight. In fact, the Department offers an accelerated master's program (AMP) that allows motivated and well-prepared undergraduate students to obtain a MS degree with one year of graduate work after obtaining a Bachelor of Science. The MS obtained through the AMP track is fully equivalent to the MS obtained through the traditional two-year MS program. Additionally, the Department offers dual Master of Science degrees in Journalism and Environmental Science, and in Business Administration and Environmental Science. Many of our MS students continue to earn PhD degrees in our department, or elsewhere.

The ENVS Department currently offers four graduate degree programs:

- Doctoral (PhD) Degree in Environmental Science
- Master of Science (MS) Degree in Environmental Science
- Dual Master Degrees in Environmental Science and Master of Business Administration (MBA) from the Eller College of Management (<https://eller.arizona.edu/programs/masters/dual-degrees>)
- Dual Master of Science (MS) Degree in Environmental Science and Master of Arts Degree in Journalism (<https://journalism.arizona.edu/node/745>)

In addition, we offer Graduate Certificates in:

- Aquaculture
- Graduate Certificate in Water Policy (jointly administered with the School of Geography and Development)

These certificates can be obtained by completing their respective course requirements (listed later in this document) while enrolled as a graduate student working toward a MS or PhD degree. Certificate units may be applied to the ENVS Graduate Program MS or PhD degree requirements where consistent with other degree requirements. It is also possible to enroll as a non-degree seeking student (NDS), for example to take specific graduate courses, or to obtain one of the Graduate Certificates. Note that only 12 units may be applied to a major (please see <https://grad.arizona.edu/admissions/types/non-degree-seeking-students> for guidelines and restrictions).

2.1 Expected Learning Outcomes

Expected Program Learning Outcomes (PLO) for both MS and PhD students in the ENVS Graduate Programs are listed below.

- Graduates should possess sound foundational knowledge in the biological, chemical, earth, and physical sciences as related to environmental systems.
- Graduates should demonstrate critical thinking skills necessary to evaluate the scientific literature essential for their research area(s) and articulate how this research fits into and/or advances the discipline.
- Graduates should demonstrate development of creative and innovative research ideas and approaches.
- Graduates use multiple research approaches to collect scientific data related to his/her research area, and can interpret, analyze and critique his/her data.

- Graduates communicate his/her research (importance, approaches taken, summary and interpretation of results) effectively through oral presentation.

Individual Course Learning Outcomes (CLOs, which should be listed in course syllabi) may expand upon these or list additional criteria. The program learning outcomes are evaluated each semester through a variety of methods, including (but not limited to): exam scores in selected core courses, thesis or dissertation quality, student performance at (comprehensive and final) exams, oral and student presentations at the annual ENViSion component of EarthWeek, as well as student self-reporting at exit surveys after the final defense/presentation. These surveys do not affect the student's grades in any way, but are intended to evaluate the quality of the ENVS Graduate Programs by semester, and provide avenues of corrective action should performance not meet the standards set by the ENVS Assessment Committee appointed by the Department head.

In addition to the above program learning outcomes, PhD students are expected to:

- 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.
- Be capable of teaching formal courses and translating research results for public information.
- Be able to develop sound proposals for scientific research and design experiments, models or field-based inquiry to develop and test hypotheses.
- Participate constructively in professional activities such as manuscript and proposal review, organizing working groups or symposia, and communicating effectively across disciplinary lines.

2.2 Program Governance and Student Engagement

Day-to-day business of ENVS graduate program is administered by the ENVS Graduate Program Coordinator (PC, Ms. Kathleen Landeen) the ENVS Director of Graduate Studies (DGS, Prof. Marcel Schaap), under guidance of Department Head Prof. Jon Chorover. Changes in ENVS graduate program policies are discussed within the ENVS Graduate Program Committee (which -in addition to the DGS and PC- includes three ENVS faculty members, and two graduate students). Major policy changes are discussed and approved by vote during ENVS faculty meetings or bi-annual faculty retreats.

A vibrant departmental community can only be maintained by student inclusion and involvement. To this end, the PC and DGS organize orientation meetings for new graduate students in the week prior to the start of the fall and spring semester. In addition, we also organize a general assembly of all ENVS

graduate students at the start of the fall semester. At this meeting, graduate student representatives are chosen for several important one-year term functions:

- Research-group representatives (typically one student for each research-group/Major Professor).
- Two representatives for the ENVS Graduate Program Committee (preferably one MS and one PhD student).
- Two co-chairs for social events (annual departmental social events, and weekly social hours for students and faculty).
- Three co-chairs to organize and coordinate ENViSion portion of EarthWeek (an interdisciplinary campus-wide environmental symposium fully organized by graduate students).

Research-group representatives are usually identified in discussions among students and their respective Major Professors. Representatives for the Graduate Program Committee and co-chairs for the social and EarthWeek events usually self-nominate. The Research-group and Graduate Committee representatives serve as important liaisons between the students and faculty of the Program. The representatives and co-chairs are responsible for organizing graduate student participation in Program endeavors and social events. Each student should seriously consider active involvement in an effective student voice in graduate program affairs.

3 Graduate Program Policies and Procedures

3.1 Admission Policies and Procedures

3.1.1 Before You Apply

Before starting an application to the ENVS graduate program it is recommended to review the major research areas active within ENVS, as well as the research, education and extension interests of individual ENVS faculty. Both types of information can be found as appendices to this document, or on the ENVS website (<https://environmentalscience.cals.arizona.edu/>) and ENVS faculty pages linked from there. Interested students should consider contacting ENVS faculty directly if they would like to know more about their research programs and how these align with their own interests. However, individual faculty cannot formally “offer” admission to the ENVS graduate program. Formal admission is accomplished after a departmental review process that is started once a complete application is submitted online through the UA Graduate College admissions portal at <https://apply.grad.arizona.edu>.

3.1.2 Application for Admission

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. During the online application at <https://apply.grad.arizona.edu>, the applicant will be asked for several types of data, including biographic and application information, and educational transcripts. Applicants must also:

- provide their undergraduate GPA, and (if applicable) graduate GPAs,
- identify whether they can support themselves financially *or* whether departmental financial support is needed,
- identify a Major track (Environmental Science or Soil and Water Science),
- state their research interests (select up to three),
- identify a preferred Major advisor (select up to three) or a joint faculty member,
- state whether they meet individual program prerequisites (see later in this document for more specifics),
- provide a CV,
- write a motivational statement of purpose,

- and provide the names and contact information of persons (references) who can write letters of recommendation.

It is important to note that letters of recommendation should be submitted in a timely fashion because the ENVS Graduate Program cannot start the application review process without these (see also <https://grad.arizona.edu/admissions/procedures/application-deadlines>). Although the references may receive automated reminders from UA's Graduate College, it is recommended that the applicants independently notify their references of a pending application to the ENVS Graduate program at the University of Arizona. Delayed reviews of an application may cause departmental, college or university funding, faculty research grant funding, or departmental space to be no longer available. The ENVS Graduate Program considers an application to be "complete" if letters of recommendation have been received.

No candidate with a grade point average below 3.000 over the last 60 units of course work will be considered (for details, see <https://grad.arizona.edu/admissions/admin/gpa-and-file-evaluation>). 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 and we refer to the rules and metric of the Graduate College at the University of Arizona for English proficiency requirements (<https://grad.arizona.edu/admissions/requirements/international-applicants#english-proficiency>).

Domestic application deadlines are June 1st for the Fall Semester, and October 1st for the Spring Semester. International student applications are due no later than December 1st for the Fall Semester of the following year, and June 1st for the Spring Semester of the following year. The ENVS Graduate Program recommends submission of application by December 1st for all Fall applicants. We note that university funding is rarely available for Spring admissions. A non-refundable processing fee for degree-seeking domestic applications is \$85, the fee for international applications is \$95, while the fee for domestic, non-degree seeking applications is \$45. Costs are subject to change and up-to-date information can be obtained at: <https://grad.arizona.edu/funding/costs>.

In most cases, the ENVS review process is started well before the June 1st and October 1st deadlines, once complete applications become available (i.e. we have letters of reference). We make a final sweep though all pending applications shortly after the domestic deadlines. At that point, evaluation of incomplete applications *may be delayed* to the next domestic deadline. This procedure is intended to streamline our workflow, but is not intended to be inflexible. We will definitely work with applicants if the ENVS review process must be completed before a particular external deadline. A typical example is deadlines associated with the award of stipends or other types of external funding that depend on the applicant being admitted to a graduate program. If these deadlines occur before our deadlines, we can of course expedite the evaluation process. However, it is imperative that the applicant (or their

prospective faculty advisor) contact the ENVS Program Coordinator in such cases because we cannot track external deadlines ourselves.

3.1.3 Evaluation of Applications

The text below is to outline the general evaluation procedure of applications to the ENVS graduate program and is *for informational purposes only*. Details of actual departmental and faculty evaluations will *not* be provided to the applicants. Instead, applicants will receive a final notification (admit or decline) and other pertinent information from the UA Graduate College, and a message from the ENVS Graduate Program Coordinator.

The ENVS Graduate Program Coordinator and the ENVS Director of Graduate Studies will make an initial screening of all applications. Once an application is complete (including letters of recommendation), it will be reviewed by an *ad-hoc* Admissions Review Committee of at least three faculty appointed by the Program Director. This committee typically consists of the potential Major advisors that selected by the applicant during the application process. However, the Director of Graduate Studies may ask one or more additional faculty members to evaluate the application if this is deemed necessary. Each of the committee's members are asked to provide answers to the following questions:

1. Would you be willing to serve as the faculty adviser for this applicant?
2. Would you be willing to serve on this applicant's committee?
3. Do you have funding for this applicant? Please indicate type of funding.
4. Please note any comments you have.
5. Do you recommend admittance?

It is important to note here that the decision by the ENVS Graduate Program to recommend admission is based primarily on the response from the *ad-hoc* committee. Essentially, the members of the committee are evaluating the strength of various aspects of the application. In practice, this means that the committee evaluates whether the application is suitable for the ENVS Graduate Program and if one or more faculty have space and funding for the applicant in their respective research or extension programs.

Faculty members usually have limited project-based graduate student funding and often have to make time-sensitive judgments regarding which of several prospective applicants can be supported. Likewise, the ENVS Department also has a limited funding for teaching or research assistantships that has to be distributed among current and new graduate students. Members of the evaluation committee may therefore state that they are willing to serve as the faculty advisor (Question 1), but at

the same time also indicate that they have no available funding (Question 3), even if the applicant stated that funding was needed. Admission into the ENVS Graduate Program is therefore competitive. Applicants who are either self-funded or have verifiable financial support through granting organizations (e.g. for opportunities see <https://grad.arizona.edu/funding>) are not as subject to faculty or departmental financial constraints as are applicants who request financial support. Applicants should contact the ENVS Graduate Program Coordinator if they have any questions regarding financial support.

The ENVS Graduate Program does not admit applicants without a graduate advisor. This means that a Major advisor must be identified during the evaluation process in order for an applicant to be accepted to the ENVS Graduate Program. It may occur that none of the members of the evaluation committee can serve as advisor but they may still recommend admission. In such cases, the ENVS Director of Graduate Studies may request review by other faculty members with research or extension profiles that match those of the applicant's interests. We will typically notify the applicant in such cases and recommend some form of communication between the applicant and potential advisor. If no advisor is found we must, unfortunately, reject the application. Rejection of an application by the ENVS Graduate Program does therefore not necessarily reflect negatively on the application itself.

Past experience has shown that the chances of admission to the ENVS Graduate Program can be improved (but not guaranteed) by:

- Submitting a complete application *well before* the formal deadline.
- Strong letters of recommendation.
- Submitting a high-quality application with a strong statement of purpose.
- Establishing some prior contact between applicant and potential ENVS faculty advisor(s).
- Applications with a verifiable level of self-funding.

3.1.4 Admission

A recommendation to admit an applicant into the ENVS Graduate Program is accomplished upon favorable review by the ENVS DGS and the *ad-hoc* review committee. Applicants are recommended for admission only if there is a commitment of an ENVS faculty member to supervise the applicant. The ENVS Graduate Program typically admits students only if a funding source can be identified (from faculty research grants, or department, college, or university funds, or by self-funding by the applicant from private funds or grants/stipends). Only in rare cases will applicants be recommended for admission without funding and in such cases the admission letter will explicitly state that no future departmental funding will be available to the applicant. Acceptance into the program with faculty, department, college or university funding does not guarantee that such funding will be available in the

future. The ENVS Graduate Program recommendation of admission (or rejection) is forwarded to UA's Graduate College and the applicant is notified by letter and e-mail by the ENVS Graduate Program Coordinator.

A formal offer of admission is made by means of a letter from the Graduate College of the University of Arizona. Applicants must decide whether to accept or reject the offer letter. If accepted, applicants enter the ENVS Graduate Program as a graduate student in one of the following statuses:

1. **Regular Graduate Status:** Students who meet all admission requirements may be admitted to Regular Graduate Status to undertake work leading to an advanced degree.
2. **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 ENVS Department. See next section for a more detailed discussion.
3. **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. There is no GPA requirement for graduate Non-degree seeking students. Please see <https://grad.arizona.edu/admissions/types/non-degree-seeking-students> for guidelines and restrictions.
4. **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 score as specified by the Graduate Admissions Office (<https://grad.arizona.edu/admissions/requirements/international-applicants#english-proficiency>), or successful completion of the CESL program.

New graduate students will be contacted by the ENVS Program Coordinator (Ms. Kathleen Landeen) to arrange for the necessary actions needed to enter the ENVS Graduate Program. It is further highly recommended that the new graduate student contacts the faculty advisor(s) as soon as possible to make arrangements for a smooth transition into their research programs.

3.1.5 Program Prerequisites and Deficiencies

The ENVS Graduate Program is an interdisciplinary program that relies on students knowing the fundamentals of Chemistry, Physics, Math, Statistics, and Geoscience. The minimum undergraduate preparation for admission into the ENVS Graduate Program includes the following courses (or equivalent if transferred in):

Prerequisites for the ENVS Graduate Program	
Course Descriptions	UA Course Numbers
General Chemistry I - (Lecture & Lab)	CHEM 141 or 151 or 161
General Chemistry II - (Lecture & Lab)	CHEM 142 or 152 or 162
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 122B or MATH 125
Statistics	ENVS 275 or MATH 263 or MATH 363 or MGMT 276 or SBS 200
Additional Prerequisites for the <i>Environmental Science Track</i>	
Physical Geology (Lecture), or Soil Science (Lecture)	GEOS 251 or ENVS 200
Additional Prerequisites <i>Soil and Water Science Track</i>	
Physical Geology (Lecture), and Soil Science (Lecture)	GEOS 251 and ENVS 200

Students who lack some program prerequisites, but who are otherwise qualified, may be admitted with the missing courses listed as deficiencies. *Remediation of these program deficiencies is enforced by the ENVS Graduate Program. Deficient courses must be completed during the first two semesters of graduate enrollment.* A higher-level course may be used to satisfy a prerequisite with prior approval of a petition to the ENVS Graduate Program, which will be evaluated by the ENVS DGS. *A grade of "B"*

or better must be obtained to satisfy deficiency requirements. Note that the table above provides ENVS *Program* requirements; individual graduate level courses (typically outside the ENVS Department) may impose additional *course* requirements.

3.2 General ENVS Graduate Program Policies and Procedures

3.2.1 Introduction

In this section we will discuss the policies and procedures that apply to all graduate students enrolled in the ENVS Graduate Program. Procedures specific to the MS and PhD degrees are discussed in subsequent sections. Should there be any questions for matters related to the ENVS Graduate Program, please contact Ms. Kathleen Landeen for further information.

3.2.2 Policies and Procedures

Graduate Students are expected to be knowledgeable of and comply with all policies and procedures for both the UA Graduate College and for the ENVS Department. Policies are updated and announced frequently and it is the student's responsibility to comply with current policies, even if these are changed after initial enrollment as a graduate student.

Graduate College policies can be viewed online at <https://grad.arizona.edu/policies> university policies can be found at <https://catalog.arizona.edu/policy-audience/graduate> All ENVS theses and dissertations must be formatted and submitted to the UA Graduate College for archiving as part of the degree completion process.

All graduate students are expected to take initiative regarding all aspects of their graduate studies. This includes getting together frequently with their advisor(s), individually or during lab meetings, and to plan and discuss their research and academic progress. Students should also take the initiative to arrange annual meetings (or more often when needed) with the ENVS Graduate Program Coordinator to plan coursework and to verify that graduate program requirements are being met. Our Graduate Program Coordinator also has access to a wealth of information that will facilitate a student's success in the graduate program. Again, we stress the importance of the graduate student's individual responsibility to be "in charge" of their program. Frequent contact with research and program advisors minimizes the chance of unexpected (and possibly expensive) delays.

ENVS graduate students are required to develop a Plan of Study by the end of the first semester and to submit this plan by the end of the second (MS) or third (PhD) semester. It is highly recommended to discuss the Plan of Study (and any subsequent modifications thereof) with the ENVS Program Coordinator (Ms. Kathleen Landeen) for verification with ENVS Graduate program and Grad College requirements. Graduate students are further subject to annual evaluation for satisfactory progress based on their grade point average and overall progress towards completion of degree requirements. The ENVS Graduate Student Progress Report form (annually due June 15th), the Satisfactory Progress Policy and other forms, are readily available on the ENVS website or from the ENVS Graduate Program Coordinator.

Plan of Study:

Gradpath: <https://grad.arizona.edu/gsas/gradpath>

Departmental forms and documents, including Progress Report Form, and Satisfactory Progress Policy are available at:

<https://environmentalscience.cals.arizona.edu/graduate-general-policies-procedures-and-forms>

Plan of Study and Progress Reports are reviewed by the ENVS Program Coordinator and ENVS Director of Graduate Studies. Non-compliant Plans of Study or Progress Reports will be denied by the Director of Graduate Studies. Approved Plans of Study are forwarded to the Graduate College for further verification and approval.

ENVS graduate students are expected to enroll in and attend ENVS 595 Colloquium every regular semester and are expected to present at ENViSion, which is the *student-organized annual departmental component of the University-wide EarthWeek symposium*, which usually occurs in March or April. A poster or oral presentation of planned or ongoing research is mandatory and a good practice of the student's presentation skills. It is also highly recommended to participate in the *organization* of ENViSion or Earthweek, and each year several students function in different roles, such as (co-)chair, room scheduling, organization of catering, collection and distribution of poster and oral program, etc., as well as interfacing with organizers from other departments and sponsors of awards.

3.2.2.1 Independent Studies

All Independent Studies units require enrollment through the ENVS Department. Please submit an Independent Studies Proposal form to Kathleen Landeen in Shantz 429F for registration. DGS pre-approval is required to apply Independent Studies credits to the Plan of Study.

3.2.2.2 GradPath and Timelines

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 ENVS; 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)	<input type="button" value="View Current"/>	
Plan of Study (SWESMS)	<input type="button" value="View Current"/>	
Master's/Specialist Committee Appointment Form (SWESMS)	<input type="button" value="View Current"/>	
Master's/Specialist Completion Confirmation (SWESMS)	<input type="button" value="View Current"/>	

PHD - Soil, Water & Environ Sci (Active in Program)		
Responsible Conduct of Research Statement (SWESPHD)	<input type="button" value="View Current"/>	
Plan of Study (SWESPHD)	<input type="button" value="View Current"/>	
Comp Exam Committee Appointment Form (SWESPHD)	<input type="button" value="View Current"/>	
Announcement of Doctoral Comprehensive Exam (SWESPHD)	<input type="button" value="View Current"/>	
Results of Comprehensive Exam (SWESPHD)	<input type="button" value="View Current"/>	
Doctoral Dissertation Committee Appointment (SWESPHD)	<input type="button" value="View Current"/>	
Prospectus/Proposal Confirmation (SWESPHD)	<input type="button" value="View Current"/>	
Announcement of Final Oral Defense (SWESPHD)	<input type="button" value="View Current"/>	
Results of Final Oral Defense (SWESPHD)	<input type="button" value="View Current"/>	

Other forms		
Transfer Credit Form	<input type="button" value="View Current"/>	

Please note that after the student submits a form through GradPath portal there is a chain of approvers. There are several within the department (e.g. major professor, minor professor, Graduate Program Coordinator, Director of Graduate studies) and several more in the UA Graduate College. This is a university-wide system over which the ENVS Graduate Program has little control. Because every approve needs time to review information and decide to approve, **it may take several days to weeks before final approval is granted by the Graduate College.** For reasons of efficiency, the ENVS Graduate Program often processes approvals in “batches”, usually once per week. It is therefore imperative that graduate students submit forms on time, i.e. well before deadlines. For example, an approved Doctoral Plan of Study must be in place *before* the form for Announcement of Comprehensive Exam can be submitted. The latter form must be approved *before* the date of the comprehensive exam itself. Submission of approval forms after-the-fact may result in extra review and denial by the graduate college. We strongly recommend that students meet with the ENVS Graduate Program Coordinator well before any deadline to avoid any delays. Emergencies happen, but it is ultimately the graduate student’s responsibility that GradPath forms are submitted on time.

Important Degree Dates and Deadlines imposed by The Graduate College, as well as some the general steps necessary to complete a degree may be found at:

- <https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines>
- <https://grad.arizona.edu/gsas/degree-requirements>

Other forms that are sometimes necessary such as

- 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 ENVS advising office. Contact Kathleen Landeen, klandeen@email.arizona.edu in the ENVS office for questions or assistance.

3.2.2.3 Responsible Code of Conduct

Fostering a culture and expectation of responsible and ethical conduct of research is a critical component in the advancement of knowledge through research and scholarship. It is also a key element in the maintenance of public trust in the research enterprise. Given that ethical issues emerge when conducting research and scholarship across disciplines of all kinds, UA is committed to providing high quality instruction in responsible conduct of research to the entire campus community (<https://rgw.arizona.edu/research-compliance/rcr>).

Each student is responsible for submitting a Responsible Conduct of Research form to GradPath upon enrollment.

3.2.2.4 Exceptions, Suggestions and Concerns

Students have the right to formally request exceptions to department policies and procedures or formally appeal department decisions by submitting an ENVS Petition to the ENVS Director of Graduate Studies:

https://environmentalscience.cals.arizona.edu/sites/swes.cals.arizona.edu/files/data/ENVS_Petition_Form.pdf

ENVS Graduate Program petitions are processed by the Department; petitions to the Graduate college must be submitted through GradPath (see previous example). Please see the ENVS Program Coordinator for more information.

General graduate student concerns should be directed to one of the graduate student representatives, who can aggregate concerns to ENVS Graduate Program Coordinator, or to the ENVS Director of

Graduate Studies. Graduate representatives are listed on the ENVS website:

<https://environmentalscience.cals.arizona.edu/graduate-students>

Specific or personal concerns regarding the student's graduate program can be discussed directly with the ENVS Graduate Program Coordinator, or in more serious cases the ENVS Director of Graduate Studies. When needed and possible, they will treat communications with confidentiality*. In exceptional cases, it may be necessary to discuss matters with the ENVS Department Head (Dr. Jon Chorover), the Graduate College, or other University of Arizona offices.

*Please note that University of Arizona Employees have certain mandatory reporting requirements (for example: https://www.titleix.arizona.edu/reporting_responsibility_for_employees)

3.2.2.5 Course Loads

The minimum load for full-time graduate students is nine units of graduate credit per semester, 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 **or course load**. Remediation of ENVS Program course deficiencies must occur during the first two semesters of graduate enrollment.

3.2.2.6 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 ENVS department adheres to these regulations and further requirements for MS and PhD students are provided later in this document. 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.

A grade of Incomplete (letter grade "I") is discouraged at the graduate level. Students earning an "I" for a course should submit a completed Report of Incomplete Grade form to the ENVS Graduate Advisor for inclusion in their academic record (<http://registrar.arizona.edu/gradepolicy/incomplete.htm>). Specific rules apply for assigning an incomplete, and a pertinent part of the prior link states:

"The grade of I may be awarded only at the end of a term, when all but a minor portion of the course work has been satisfactorily completed. *The grade of I is not to be awarded in place of a failing grade or when the student is expected to repeat the course; in such a case, a grade other than I must be assigned.* Students should make arrangements with the instructor to receive an incomplete grade before the end of the term.

Instructors are encouraged to use the Report of Incomplete Grade form (<https://registrar.arizona.edu/sites/registrar.arizona.edu/files/documents/Incomplete%20Grade%20Report%205-5-14.pdf>) as a contract with the student as to what course work must be completed by the student for the I grade to be removed and replaced with a grade. On the form, the instructor states: (1) which assignments or exams should be completed and when; (2) how this work will be graded; and (3) how the student's course grade will be calculated. Both the instructor and student sign this agreement and both should retain copies."

The text in italics is our emphasis. Students taking courses should take the initiative to closely monitor their own performance and respond to the instructor's queries regarding progress in a timely manner. We understand that there may be issues of a personal (or other) nature that make it difficult for a student to work effectively. However, such issues can only be dealt with effectively if identified early. Again, the student's initiative is important here and affected students should contact the instructor and/or the ENVS Program Coordinator if they have concerns about their performance or have concerns about their ability to complete coursework.

After the course work is completed, the instructor should assign the appropriate grade on the UAccess grade roster. Incomplete grades should be completed in a timely manner and are submitted at the discretion of the course instructor.

3.2.2.7 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>.

3.2.2.8 Graduate Assistantships

A comprehensive Graduate College GA Manual is posted online at <http://grad.arizona.edu/funding/ga> and the UA Student Employment Manual is online at <https://financialaid.arizona.edu/types-aid/work-study/student-employment-manual>. **We note here that as of Fall 2020 a mandatory Expectation Form will come into effect that must be signed by both the student as well as supervisor/instructor.** This document spells out responsibly, student tasks, and workload. This is a university policy with additional CALS Teaching Assistant Guidelines. As of this writing the final version of the forms are not yet available.

3.3 ENVS Program Requirements for a Master Of Science

3.3.1 General Information

The ENVS Graduate Program offers a Master of Science (MS) Degree with a Major in Soil, Water and Environmental Science*. MS students follow one of two tracks with different core requirements: Environmental Science (ES) or Soil and Water Science (SWS). The ES track has a broader environmental science focus, while the SWS track is targeted towards those students who would like to develop specific expertise in soil and water science. ES and SWS tracks have different course requirements (“core”) and students choose electives that suit their research and/or career goals. The ENVS MS degree is designed such that it is possible for well-prepared students to obtain a MS degree in two academic years.

*** In the near future this will be changed to “Environmental Science”**

3.3.1.1 Accelerated Masters

The ENVS Accelerated Master’s Program (AMP) is for undergraduate students enrolled in the ENVS BSES program (Bachelor of Science in Environmental Science). This mechanism feeds into ENVS MS program and allows well-prepared students to complete an ENVS MS with one extra year of graduate work after the successful completion of a BS. While still at the undergraduate level, these students find a Major advisor and initiate a research project and take part of their course work at the graduate level. This is possible because many of the ENVS “400” undergraduate-level courses are also offered at the graduate (500) level (e.g., the core courses listed below). These courses then “count” for the ENVS BSES as well as the ENVS MS. *It is important to note that courses taken at the undergraduate (“400”) level cannot be converted to graduate-level courses.* Therefore, undergraduate students who are considering the AMP ENVS MS should discuss this early with the ENVS (Under) Graduate Program Coordinator and enroll in relevant courses at the graduate-level. A MS degree obtained through the AMP is fully equivalent to the “traditional” MS degree.

3.3.1.2 Continuing to a PhD

The core-requirements for the ENVS MS are almost identical to those of the ENVS PhD. Many students enrolled in the ENVS MS Graduate program advance into the ENVS PhD program (or PhD programs elsewhere) which has additional requirements as defined later in this document.

3.3.2 Major Professor and Master's Committee

A student's Major Professor will be the faculty member who has agreed to supervise the student. 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 Major Professor is typically the student's thesis advisor and chair of the Master's Committee and is usually the faculty member identified during the admission of the student to the ENVS program. However, in some cases (and for a variety of reasons) it may be necessary to change Major Professor during the course of a student's MS program. Please contact the ENVS Program Coordinator for assistance, if needed.

The Master's Committee is responsible for guiding the student's research 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 tenured or tenure-track faculty; 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 ENVS Department. The student may also have a co-chair or a committee member outside the ENVS Department, provided that he or she has credentials acceptable to the ENVS Department and the Graduate College.

A common role of the Major Professor and Master's Committee is to suggest relevant courses for the student's Plan of Study. It is important to verify that the Plan of Study complies with the requirements of the ENVS MS program; non-compliant Plans of Study will be rejected by the ENVS DGS or the Graduate College. Please meet with the ENVS Graduate Program Coordinator (Ms. Kathleen Landeen) for more information.

3.3.3 Minimum Requirements for an ENVS Master of Science

The ENVS Department Master of Science degree requires a minimum of 30 units of graduate credit, including thesis units. There must be 15 or 18 units in the Major field (ENVS, for the thesis and non-thesis option, respectively), and at least 15 units must be from courses in which letter grades of A and B have been earned. All units of coursework for a graduate degree must be in 500-level courses or above.

Required course work for the ES and SWS tracks is provided in the table below. Numbers in parenthesis are the number of units for each course. It is the student's responsibility to ensure that they complete the required core courses.

Both tracks require ENV5 508 (Scientific Writing for Environmental, Agricultural and Life Sciences), ENV5 696A or ENV5 697 (Seminar or Seminar and Professional Development, respectively), and ENV5 595 (Colloquium). These courses are intended to expose students to a range of *soft or career skills*. It is recommended to take ENV5 508 in the first or second semester since it practices the student's writing skills necessary for other activities (e.g. reports for other courses and thesis or master's report). ENV5 696A and ENV5 697 practice public speaking, CV preparation, and job-search related activities (ENV5 697). It is recommended to take one of these courses in the last or second to last semester. ENV5 595 exposes the students to presentations of a wide variety of professional presentations in Earth, and Environmental Science.

The ES track requires nine units of core courses (three or four units each from biology, chemistry, and physics/water science). The SWS track requires 12 units from a list of six core courses. The core courses provide the student with a broad interdisciplinary foundation in either Environmental Science or Soil and Water Science. Some courses are shared among the ES and SWS tracks.

Students have two options to complete an ENV5 MS Degree: a thesis-based MS, and a non-thesis MS (also called a Master's Report). The main difference between the two is that the thesis-based MS includes more research units. A Master's obtained through the non-thesis option is equivalent to the thesis-based MS and typically pursued by those for whom a career with a continued record of publications is not important. Most students pursuing an ENV5 MS choose the thesis option instead, especially if they are interested in continuing their career with a PhD. Some Major professors may prefer a thesis-based MS because these are more likely to result in publications or can be used to fulfill research project objectives. Master's Thesis and Master's Report options both require a minimum of 30 units.

Required Coursework	
Career Skills	
ENVS 508 Scientific Writing for Environmental, Agricultural and Life Sciences (3)	
ENVS 595 Colloquium ¹ (1)	
ENVS 696A Seminar (1) or ENVS 697 Seminar and Professional Development (1)	
Core Courses	
ES Track (select one in each category)	SWS Track (select four)
<i>Environmental Biology and Microbiology</i>	ENVS 502 Nutrient Dynamics in Soils (3)
ENVS 525 Environmental Microbiology (3)	ENVS 525 Environmental Microbiology (3)
ENVS 574 Aquatic Plants & the Environment (3)	ENVS 531 Soil Morphology (4)
ENVS 577 Principles of Ecotoxicology (3)	ENVS 562 Environmental Soil & Water Chemistry (3)
WSM 552 Dryland Ecohydrology and vegetation Dynamics (4)	ENVS 570 Soil Physics (3)
<i>Environmental and Soil Chemistry</i>	ENVS 580 Environmental Assessment for Contaminated Sites (3)
ENVS 562 Environmental Soil & Water Chemistry (3)	or
ENVS 564 Environmental Chemistry (3)	ENVS 582 Reclamation and Redevelopment of Impacted Lands (3)
<i>Environmental Physics and Water Science</i>	
ENVS 520 Environmental Physics (3)	
ENVS 570 Soil Physics (3)	
Notes: ¹ Although MS students are required to enroll for ENVS 595 each semester, only one unit of ENVS 595 will count toward the ENVS MS degree.	

3.3.3.1 Master's Thesis

By the end of the second semester in residence, a research topic should be chosen by the student in consultation with their Major Professor and Master's Committee. Two to six units of ENV5 910 (Thesis) can be earned for the preparation of the thesis. A minimum of 24 units must be non-thesis units. There must be 15 units in the ENV5 Major, and at least 15 units must be from courses in which letter grades of A and B have been earned. Independent study units (ENV5 599, or ENV5 699) must be identifiably distinct from activities performed under ENV5 910 and be pre-approved by the ENV5 DGS. Activities carried out under ENV5 599 or ENV5 699 should not appear in the Master's Thesis.

The final product of a thesis-based Master's is typically a manuscript that is submitted to a peer-reviewed scientific journal or a traditional chapter-based MS thesis. The exact nature of the final product is discussed with the Major professor, but is subject to Graduate College rules regarding formatting and submission.

3.3.3.2 Master's Report

A Master's Report (or non-thesis option) requires 1-2 units of ENV5 909 (Master's report). The scope of this Master's report is typically smaller than the thesis-based MS (decided by the student's Major Adviser but usually limited to, for example, a literature review or a limited-scope lab experiment instead of a larger research project). A minimum of 28-29 units must be non-report units, including 18 units in the ENV5 Major. This implies that a student who chooses to do a Master's report must complete more units of regular course-work than a student who pursues a thesis-based MS. Independent study units (ENV5 599, or ENV5 699) must be identifiably distinct from activities performed under ENV5 909 and be pre-approved by the ENV5 DGS. This implies that activities carried out under ENV5 599 or ENV5 699 should not appear in the student's Master's Report.

3.3.4 Plan of Study

With advice from their Major Professor, the student is responsible for *developing* a written Plan of Study by the end of the first semester. The plan of study must identify:

1. Courses the student intends to transfer from other institutions (if any).
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 the degree requirements.

A new plan of study must be submitted as soon as possible when the student chooses to enroll for courses other than those listed under item 3. Approval of an updated plan of study is usually a

formality, as long as it complies with the ENVS MS degree requirements. We highly recommend consulting with the ENVS Graduate Program Coordinator.

Below we list a general non-specific plan of study for both ES and SWS tracks with MS thesis and non-thesis (Master’s Report) options. It is up to the student to choose the appropriate electives while observing the ENVS MS degree requirements for a MS thesis or a MS report. The Plan of Study is to be *submitted* to GradPath by the end of the second semester in residence.

	ES Track		SWS Track	
Career skills				
ENVS 508	3		3	
ENVS 595 ¹	1		1	
ENVS 696A or 697	1		1	
Total	5		5	
Core courses²	9		12	
	Thesis	Report	Thesis	Report
ENVS 910 Thesis	2 to 6		2 to 6	
ENVS 909 Master’s Report		1 to 2		1 to 2
Minimum Electives ^{3,4}	10 to 14	14 to 15	7 to 11	11 to 12
Minimum number of units^{4,5}	30	30	30	30
Notes:				
¹ Although students are required to enroll for ENVS595 each semester, only one unit of ENVS 595 will count toward the ENVS MS degree. ² See previous table with specific requirements for the ES and SWS tracks. The number of units may be higher if a core course requires 4 units instead of the “standard” 3 units (e.g. ENVS 531, WSM 552). ³ The number of units in electives must be sufficient to reach the 30-unit <i>minimum</i> required for a MS degree. ⁴ Bear in mind that 15 or 18 units <i>must</i> be in the ENVS Major for the Thesis or Report options, respectively. ⁵ At least 15 units must be from courses in which letter grades of “A” and “B” have been earned.				

Transfer of units to the ENV5 MS degree requirements is limited and subject to the following conditions:

- Students who wish to transfer credit must submit a Transfer Credit form in GradPath before the end of their first year of study.
- 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.
- 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 online courses from other institutions will not be accepted for graduate credit.

3.3.5 Time Limits

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.

3.3.6 Master's Final Exam and Master's Final Report Presentation

A Master's final exam in the form of a presentation of a student's Master's Report (non-thesis option) or a Master's thesis defense (thesis option) is an integral part of the ENV5 MS Degree requirement. This is where the student has the opportunity to demonstrate their research, writing and presentation skills to the department and, for final examination, to the Master's Committee. A successful defense or presentation results in a 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.

Prior to the exam the student must:

- Complete the research and writing activities required by the Major Professor under ENV5 909 or 910. Past experience indicates that frequent meetings with the Major professor and occasional meetings with the Master's committee are beneficial for an efficient completion of the required work.

- Plan the defense (thesis option) or presentation date (report option) well in advance. With their Major Professor, the student should discuss which should be the final semester. It is recommended to schedule the actual defense/presentation date well (months) in advance and to make sure that the committee is indeed available on this date (reminders are very useful). Students should be aware that faculty have limited availability during the summer months and other periods of the year with extended periods during which classes are not in session. Also be aware of Graduate College hard deadlines (<https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines>). Considering that many theses or reports require small or, sometimes, significant modifications before a Major professor will “sign off” on the completion form, *it is not recommended to plan defenses/presentations close to their Graduate College deadlines.*
- *Students are required to discuss a planned defense date with the ENVS Graduate Program Coordinator at least three weeks in advance (but preferably earlier). This has several reasons:*
 - the defense must be announced to the Department.
 - the defense must be entered into GradPath.
 - the Graduate Program Coordinator can verify that the student indeed fulfilled all ENVS MS Degree requirements. This helps to mitigate any unforeseen problems.
 - the Graduate Program Coordinator can assist the student with room scheduling.
 - the Graduate Program Coordinator will ask the student to fill out an ENVS Graduate Program Exit Survey which is invaluable for improving the ENVS Graduate Program.
- Submit a well-written thesis or Master’s Report to the Master’s committee which adheres to academic standards. Formatting requirements are available at: <https://grad.arizona.edu/gsas/dissertations-theses/dissertation-and-thesis-formatting-guides>. Additional help with writing and structuring can be obtained at the Graduate Writing Institute (<https://wsip.arizona.edu/graduate-writing-institute>). It is recommended that the student discusses the thesis or report with their Major Professor prior to sending it to the Master’s committee and make relevant alterations and improvements as requested. *The student should submit the final version of the thesis or report to the Master’s committee no later than two weeks prior to the defense or presentation.*

3.3.6.1 Master’s Thesis

Students who choose the Thesis option will experience a full Master’s defense that consists of a public presentation and an exam by the committee behind closed doors without the public. The presentation is approximately 30 minutes long and should cover the student’s research. The public is

permitted to ask questions after the presentation; the committee does not usually ask questions at this point. The public question session is ended in a timely manner and the audience is asked to leave.

The student is asked to leave the room for a few minutes to allow the committee to discuss procedural and housekeeping matters (e.g. the order in which questions will be asked). The student is readmitted to the room and the committee commences with the question session. The questions should primarily cover the student's Thesis but may also cover broader topics related to the research, if relevant. Committee members typically get of slot of time (e.g., 20 minutes) in which they ask their questions, though this may vary by committee. A general suggestion is that a MS defense should not take longer than two hours, including the public part.

After the question-response session is over, the student is asked to leave the room again and the committee confers about pass or fail and whether additional modifications or alterations of the student's Thesis are needed. The student is called back in and the pass/fail is communicated. If any further alterations are required, clear instructions should be given to the student as to what alterations should be made (e.g. in the form of an annotated Thesis) and in what time frame these alterations are expected.

If modifications are requested, both the student and Major adviser should be committed to time-efficient completion. Depending on the scope of the modifications, these can take days to several months. To avoid lengthy revisions, the ENVS Program recommends that the student works closely with the Master's committee prior to submitting the final version for the defense. The student should also avoid scheduling the defense too close to the deadline by which a final version of the Thesis must be submitted to the Graduate College.

3.3.6.2 Master's Report

The Graduate College requires a "synthesizing experience" for students who choose to pursue a Master's Report (<https://grad.arizona.edu/gsas/degree-requirements/masters-degrees#final-exam>). ENVS Graduate students who choose the Master's report option must submit their report for review to the Master's committee and carry out a public presentation of their work. The Master's Report *must* be approved by the committee *before* the presentation. If the committee requests changes, these must be made before the final oral presentation can be held. The entire committee is required to be present at this presentation which is announced to the Department. The presentation is open to the public with time allocated for questions from the public and/or the committee (a suggestion is no more than 20 to 30 minutes). After the presentation, the committee meets in private and a pass/fail is communicated to the student by the Major Professor. Since the report is already approved, this pass/fail primarily judges the quality of the presentation. Should the student fail, another presentation

should be scheduled for a later date. This second presentation can be done behind closed doors if deemed necessary.

3.3.6.3 Food and Drink at Defenses or Presentations

There is absolutely no requirement or expectation by the ENVS Department for graduate students to provide food or drink for faculty members at meetings or defenses—or any other time for that matter. Should there be issues regarding this CALS policy, please contact the ENVS Director of Graduate Studies.

3.4 ENVS Program Requirements for a PhD Degree

3.4.1 General Information

The ENVS Graduate Program offers a PhD Degree with a Major in Soil, Water and Environmental Science*. PhD students choose one of two tracks with different core requirements: Environmental Science (ES) or Soil and Water Science (SWS). The ES track has a broader environmental science focus, while the SWS track is targeted towards those students who would like to develop specific expertise in soil and/or water science. ES and SWS tracks have different core course requirements and students choose electives that suit their research or career goals.

In addition to the ENVS Major, PhD students must also complete a Minor which can be completed intra-department (i.e., within the ENVS Department) or at another department. A more detailed discussion of minor requirements will appear later in this document.

We recommend that graduate students enrolled in the ENVS PhD program first obtain an ENVS MS (that is: if they don't already have an ENVS MS or acceptable equivalent obtained elsewhere) before continuing with the ENVS PhD. Many of the requirements of the ENVS MS also apply to the ENVS PhD program and a substantial amount of course work earned during the ENVS MS can be used for the PhD degree requirements. The ENVS PhD degree is designed such that it is possible for well-prepared students to obtain a PhD degree in four academic years (that is: including the ENVS MS).

*** In the near future this will be changed to "Environmental Science"**

3.4.2 Major Professor and Required Committees

A student's Major Professor will be the faculty member who has agreed to supervise the student. The Major professor will direct the student's research and provides advice regarding the student's coursework. The Major Professor is usually the faculty member identified during the admission of the student to the ENVS PhD program. However, in some cases (and for a variety of reasons) it may be necessary to change Major Professor during the course of a student's PhD program. Please contact the ENVS Program Coordinator for assistance, if needed.

With the help of the Major Professor, the student will identify members for two committees: the Comprehensive Examination Committee and the Dissertation Committee. The Comprehensive Exam Committee is a separate entity from the Dissertation Committee, though faculty members can serve in both committees as long as some requirements are met for the comprehensive committee (as described later).

3.4.2.1 Comprehensive Exam Committee

The purpose of the Comprehensive Examination Committee is to examine whether the student displays a broad knowledge of the chosen field of study and sufficient depth of understanding in the areas of specialization. The Comprehensive Exam consists of two parts: a written exam with individual assignments from committee members and an oral exam during which the entire committee meets with the student. The comprehensive exam should not take place until the student has completed all, or almost all, of the coursework but at least a semester before the final defense of the student's dissertation.

3.4.2.2 The Dissertation Committee

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.

3.4.3 Minimum Credit Requirements for an ENVS PhD

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 coursework 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 the units must be from courses in which letter grades of A and B have been earned. All units of coursework for a graduate degree must be in 500-level courses or above.

At least two full-time semesters (i.e., at least 9 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. ENVS graduate students are expected to enroll and attend each ENVS Colloquium every semester.

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 online courses or extension work obtained at other institutions will not be accepted for graduate credit.

Required course work for the ES and SWS tracks is provided in the table below. Numbers in parenthesis are the number of units for each course. No exceptions will be allowed and it is the student's responsibility to ensure that they complete the required core courses. Please consult with the ENVS Program Coordinator if there are any questions.

Both tracks require ENVS 508 (Scientific Writing for Environmental, Agricultural and Life Sciences), two units of ENVS 696A, ENVS697, or equivalent (note that this is one unit more than the ENVS MS), and ENVS 595 (Colloquium). These courses are intended to expose students to a range of *soft* or *career skills*. It is recommended to take ENVS 508 in the first or second semester since it practices the student's writing skills necessary for other activities (e.g., reports for other courses, the written part of the comprehensive exam and the dissertation). ENVS 595 exposes students to presentations of a wide variety of professional presentations in Earth, and Environmental Science. PhD students should enroll for ENVS 595 in each semester, but only two units of ENVS 595 will count toward the ENVS PhD degree requirements.

As mentioned above, two units of ENVS 696A (Seminar) or ENVS 697 (**Seminar and Professional Development**) or equivalent are required. These courses practice public speaking, teaching, CV preparation, and/or job-search related activities (ENVS 697). It is recommended to take one of these courses in the last, or second to last, semester. Seminar requirements may be met by selecting one of the following options:

- Two semesters of ENVS seminars (ENVS 696A or ENVS 697).
- One semester of ENVS 696A or ENVS 697, plus one semester as a teaching assistant (GTA).
- One semester of ENVS 696A or ENVS 697, plus one semester of seminar from another department.
- One semester of ENVS 696A or ENVS 697, plus one semester of GRAD 697C "Workshop for Teaching at the College Level"

The ES track requires nine units of core courses (three or four units each from biology, chemistry, and physics/water science). The SWS track requires 12 units from a list of six core courses. The core courses provide the student with a broad interdisciplinary foundation in either Environmental Science or Soil and Water Science. Some courses are shared among the ES and SWS tracks.

Required Coursework	
Career skills	
ENVS 508 Scientific Writing for Environmental, Agricultural and Life Sciences (3)	
ENVS 595 Colloquium ¹ (2)	
Two units of ENVS 696A Seminar (1) or ENVS 697 Seminar and Career Workshop (1) or equivalent (1).	
Core Courses (ENVS Major)	
ES Track (select one in each category)	SWS Track (select four)
<i>Environmental Biology and Microbiology</i>	ENVS 502 Nutrient Dynamics in soils (3)
ENVS 525 Env. Microbiology (3)	ENVS 525 Env. Microbiology (3)
ENVS 574 Aquatic Plants & the Environment (3)	ENVS 531 Soil Morphology (4)
ENVS 577 Principles of Ecotoxicology (3)	ENVS 562 Environmental Soil & Water Chemistry (3)
WSM 552 Dryland Ecohydrology and vegetation Dynamics (4)	ENVS 570 Soil Physics (3)
<i>Environmental and Soil Chemistry</i>	ENVS 580 Environmental Assessment for Contaminated Sites (3)
ENVS 562 Environmental Soil & Water Chemistry (3)	or
ENVS 564 Environmental Chemistry (3)	ENVS 582 Reclamation and Redevelopment of Impacted Lands (3)
<i>Environmental Physics and Water Science</i>	
ENVS 520 Environmental Physics (3)	
ENVS 570 Soil Physics (3)	
Minor	
Intra-Departmental (ENVS) Minor (12) or Inter-Departmental (non ENVS) Minor (9 or greater)	
1 Although PhD students are required to enroll for ENVS 595 each semester, only two units of ENVS 595 will count toward the ENVS PhD degree.	

3.4.3.1 Minor

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

- *Intradepartment* – In recognition of the diversity of the ENVS Department, students whose major department is ENVS can also obtain their minor within the ENVS 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 of coursework are required for the intradepartment 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. For the intradepartmental minor, all twelve units must be from the ENVS Graduate Program course listing.

- *Interdepartment* – Students may also obtain a minor from another department. In this case the requirements of that department must be followed. The Graduate College requires that a Minor is at least 9 units, but some departments require substantially more units in their Minor.

A cross-listed course can be counted only once. It cannot be used for both the Major and Minor.

3.4.3.2 Plan of Study

With advise from their Major Professor, the student is responsible for *developing* a written Plan of Study by the end of the first semester. The Plan of Study must identify:

1. Courses the student intends to transfer from other institutions (if any).
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 the degree requirements.

A new plan of study must be submitted as soon as possible when a student chooses to enroll in courses other than those listed under item 3. Approval of a new Plan of Study is usually a formality, as long as it complies with the ENVS PhD degree requirements. We highly recommend consulting with the ENVS Graduate Program Coordinator.

Below we list a general, non-specific Plan of Study for both ES and SWS tracks in the ENVS PhD. It is up to the student and the Major professor/committee to choose the appropriate electives while observing the degree requirements. The Plan of Study is to be *submitted* to GradPath by the end of the third

semester in residence. The Doctoral Plan of Study requires approval by the Major Professor, Minor Professor, the ENVS Director of Graduate Studies, and the Graduate College. Denied plans need to be updated and re-submitted for approval.

	ES Track	SWS Track
Career skills		
ENVS 508	3	3
ENVS 595 ¹	2	2
Seminar (see text)	2	2
Total	7	7
Core courses²	9	12
ENVS 920 Dissertation	18	18
Minor ³	12	12
Minimum Electives ^{4,5,6}	20	17
Total	50	47
Minimum number of units⁶	66	66
Notes:		
1 Although students are required to enroll for ENVS 595 each semester, only two units of ENVS 595 will count toward the ENVS PhD degree.		
2 See previous table with specific requirements for the ES and SWS tracks. The number of units may be higher if a core course requires 4 units instead of the “standard” 3 units (e.g. ENVS 531, WSM 552).		
3 We assumed that the minor has 12 units, such as is the case for the ENVS intradepartmental minor. For extramural minors a different number of units may be required, but not less than 9 units. In the case of a 9-unit Minor, the minimum number of total units is 63.		
4 The number of units in electives must be sufficient to reach the 66-unit <i>minimum</i> required for a PhD degree.		
5 Bear in mind that 36 units <i>must</i> be in the ENVS Major.		
6 At least half of the 66 units <i>must</i> be from courses in which letter grades of “A” and “B” have been earned.		

3.4.3.3 Transfer of Credit

Graduate credit earned at other approved institutions, if accepted by the ENVS 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 maximum of 30 units, all having grades of A or B, may be transferred.

3.4.3.4 Time Limits

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.

3.4.4 Comprehensive Examination for Advancement to Candidacy

3.4.4.1 General

Before admission to candidacy for the doctoral degree, the student must pass a written and an oral Doctoral Comprehensive Examination. This examination is intended to test the student's comprehensive knowledge of the major and minor subjects of study, both in breadth across the general field of study and in depth within the area of specialization. The examination, therefore, should not take place until the student has completed all, or almost all, of their coursework. The student must be in good academic standing to sit for the comprehensive exam

(<https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#comprehensive-exam>)

The Comprehensive Examination is considered a single examination, although it consists of written and oral parts. The minor department controls the minor portion of the written examination and may waive it at their discretion. A student will pass the written portion before sitting for the oral portion. Normally, the written and oral portions of the Comprehensive Examination should take place at least a semester prior to that in which the Final Oral Examination (defense of dissertation) is scheduled. The written and oral parts should be conducted within the same semester, or no more than four months. The exact time and place of the Oral Comprehensive Examination must be scheduled with the department and announced in GradPath using the Announcement of Doctoral Comprehensive Exam form before the exam can take place. Please contact the ENVS Program Coordinator (Ms. Kathleen Landeen) several weeks before the exam is to take place.

We emphasize that the *Announcement of Doctoral Comprehensive Exam form must be submitted before the oral exam takes place for two reasons*. Firstly, there is a graduate college policy that states that "The examination should not take place until the student has completed all, or almost all, of their coursework." The ENVS Graduate Program interprets this as 3 units of coursework, or less. Secondly, if the form is submitted too late, then the approval will be at the discretion of the Dean of

the Graduate College whether to allow the results to stand (i.e. it may be approved, but the exam could also be denied).

Upon successful completion of the written portion of the examination, the Oral Comprehensive Examination is conducted before the examining committee of the faculty. The oral examination is the occasion when faculty committee members have both the opportunity and obligation to require the student to display a broad knowledge of the chosen field of study and sufficient depth of understanding in areas of specialization. The oral portion of the examination must cover both the major and the minor. The Oral Comprehensive Examination should last for at least an hour but must not last more than 3 hours. Remote participation by one or more committee member by video or phone conference is permitted on the condition that the student and all committee members can effectively communicate. All members must participate in the entire examination.

The ENVS Graduate Program recommends (but does not require) that the student gives a brief (20 minute) presentation of the (planned) dissertation research. Discussion of proposed dissertation research may be included in the oral exam, but should not take the majority of the time. The examining committee must attest that the student has demonstrated the professional level of knowledge expected of a junior academic colleague. The Graduate College allows no more than one re-take of the oral exam.

A secret vote is completed by the committee (possible votes: Pass, Fail, and Abstain) and the outcome of that vote determines whether or not the student passes the oral comprehensive exam. More than one negative vote (Fail and Abstain are negative votes) will result in failure of the exam. Votes are tallied by the committee chair, who informs the committee, and ultimately the student, whether the vote resulted in a Pass or Fail decision. The identities of persons voting one way or the other should not be revealed to the student.

The committee chair is responsible for submitting the Results of Oral Comprehensive Exam form in GradPath. The chair will receive an email reminder, with a link to the form in the email, to submit the Results of Oral Comprehensive Exam form once the Announcement for the exam is approved by the Graduate College; alternatively, the chair can open the Results form from the GradPath Pending Transactions list. The chair reports the results in GradPath - if a failed first exam, the chair notes whether the committee has recommended a second exam for the student (in accordance with program and Graduate College policy). Regardless of the outcome of the Oral Comprehensive Examination, the chair must report results.

Emergency Line – (520) 621-5128. The Graduate Student Academic Services office maintains a telephone line for the Committee serving on Oral Comprehensive Examinations. Please feel free to use this number for questions concerning examinations or for emergencies which arise before or during

examinations. If there is any change to the committee on the examination day, please contact the Graduate College before beginning the exam.

When the student has passed the written and oral portions of the Comprehensive Examination, and the Graduate Student Academic Services office has confirmed completion of the required courses on the approved doctoral Plan of Study, the student will advance to doctoral candidacy. The student will be billed the graduate candidacy fees and will be notified by e-mail of the advancement and fees. The candidacy fees are one-time fees and the student will not be billed again if the reported graduation date is changed.

3.4.4.2 Composition of the Comprehensive Committee

The Comprehensive Exam Committee is a separate entity from the Dissertation Committee and consists of a minimum of four members. More members are permissible, but more than four members may increase the difficulty of scheduling the oral exam and may pose an additional burden on the student because each additional member may require a written portion of the Comprehensive Exam. The Major Advisor and two additional members must be current tenured, or tenure-track faculty members, or approved tenure equivalent. The fourth member may be tenured or tenure-track, or an approved special member. Special members must be pre-approved by the Dean of the Graduate College. Any members beyond the fourth can also be current tenured or tenure-track faculty members, or approved special members.

The Oral Comprehensive Exam must cover both the Major and the Minor and for this reason the ENVS Department has some requirements regarding the composition of the Comprehensive Exam Committee. Committee members have the obligation to require the student to display a broad knowledge of the chosen field of study and sufficient depth of understanding in the areas of specialization. *For students in the Environmental Science (ES) Track* this requires that *three* committee members are chosen from the following four areas in ENVS:

Environmental Biology and Microbiology

Environmental Soil and Water Chemistry

Environmental/Soil Physics, or Water Science

Environmental Assessment, Communication, or Policy

The first three topic areas represent the ENVS core and test for “broad knowledge”. The fourth topic was included to meet the diversity of the SWES faculty and provide some flexibility to represent the student’s advisor and/or the student’s research interests. The *fourth* member of the Comprehensive Exam Committee must represent the minor area of study.

For students in the Soil and Water Science (SWS) Track, *three* committee members are chosen from the following six areas in ENVS:

Environmental Biology or Microbiology

Environmental Soil and Water Chemistry

Soil Morphology or Nutrient Dynamics

Soil Physics or Water Science

Environmental Assessment

An academic area within ENVS relevant for the student's research.

The first four topic areas represent the ENVS core and test for "broad knowledge". The fourth topic was included to meet the diversity of the ENVS faculty and provide some flexibility to represent the student's advisor and/or the student's research interests. The *fourth* member of the Comprehensive Exam Committee must represent the minor area of study.

Multiple ENVS faculty members are available for each topic area as indicated in one of the appendices. The student should query faculty members for availability before submitting the Comprehensive Exam Committee Appointment Form to GradPath.

While the above composition of the ES and SWS comprehensive committee will work effectively for most students, some exceptions may be necessary in particular cases. It is suggested that students discuss the comprehensive committee with the ENVS Program Coordinator or Director of Graduate Studies at an early stage of selection. In general, however, *it is undesirable to have two or more committee members asking questions with the same limited scope* (e.g. two members asking solely about a narrow topic in soil physics, environmental microbiology, or environmental chemistry).

To avoid having the student to know "everything" about a certain topic area, and allow the student to focus regarding "what to review", each member of the committee shall provide a clear indication on which *general* area the student can expect questions at the oral examination. These suggestions should not have a narrow focus, but should be formulated like: "I will ask you about atmospheric systems & processes that are particularly relevant for environmental impacts" -or- "My questions will focus on the primary processes that influence the transport and fate of contaminants in the environment" -or- "I intend to ask you questions regarding the mechanisms behind global climate change." Committee members may additionally ask follow-up questions about the student's written exam.

It is the student's responsibility to query each committee member regarding the general focus of the questions well in advance of the oral examination. A suggestion is to notify the entire committee of the focus of each member's questions.

3.4.4.3 Practical Guidelines for Oral Comprehensive Exam

Many ENVS PhD students wonder what to expect at an oral comprehensive exam. This section provides some practical guidelines based on past oral comprehensive examinations in the ENVS department. These are guidelines, and the exact format should be confirmed with the Major Professor (or Chair of the Comprehensive Committee if this is not the Major Professor).

Prior to the Oral Comprehensive Exam:

- Make sure that the exam is scheduled well in advance (months) and that all committee members can be present. If one committee member must participate remotely, make sure that it can be done through a suitable video+audio connection (Skype and Zoom currently work well). If a presentation is given by the student, it may be necessary to share the computer's screen through the video link (Zoom works well for this purpose). Contact Departmental IT well in advance to arrange things, if needed.
- Contact the ENVS Graduate Program Coordinator well in advance. The Oral Exam must be announced in GradPath using the Announcement of Doctoral Comprehensive Exam form before the exam can take place.
- Query each Comprehensive Exam Committee member regarding the general focus of the questions. Students should do this well in advance (days!) to allow for sufficient time for review.
- There is absolutely no requirement or expectation by the ENVS Department for graduate students to provide food or drink for faculty members at meetings or defenses—or any other time for that matter. Should there be issues regarding this CALS policy, please contact the ENVS Director of Graduate Studies.
- It has happened that Committee members forgot a scheduled exam. Please send a reminder to the entire committee in the week before the defense. This also allows more effective actions should a member's availability have changed.

At the Oral Comprehensive Exam:

- The exam is not open to the public.

- Please arrive early and make sure that all required technology is working (computers, cameras, audio, projectors). Contact Departmental IT if there is an issue (i.e., the student should know how to contact the IT person).
- Once the entire committee is present, the student may be asked to leave the room for a few minutes. The chair of the Comprehensive Exam Committee will address some procedural matters with the committee. After this, the student is invited back into the room.
- Usually, the student will give a brief (20 minute) presentation about their (planned) Dissertation research. The committee may follow up with some questions regarding the presentation.
- Usually, the Comprehensive Exam Committee will ask questions about the topic areas: each member of the committee is given some time to ask questions (20-30 minutes, though it varies from committee to committee). Other members of the committee may be allowed to ask follow-up questions. Sometimes the committee will go through additional cycles of questions.
- It is OK to ask a committee member to repeat a question.
- The student is often asked to use a white board to write text, draw conceptual diagrams, equations and chemical reactions. *Please make sure that the room has erasable markers that work*, as well as an eraser. Multicolored markers may be handy and are stocked in the ENVS main office.
- The examination should be at least an hour, but not more than three. At the end of the examination the student is asked to leave the room again. The committee discusses the exam and the student's performance and each member decides upon pass/fail. The student is called back in and the committee chair informs the student of the result.

3.4.5 Doctoral Committee

When the student has an approved doctoral Plan of Study on file, has satisfied all course work, language, and residence requirements, and passed the written and oral portions of the Comprehensive Examination, he or she must file a Committee Appointment form. Any changes to the committee should be reported to the Graduate Student Academic Services office. Under normal circumstances, submission is expected at least six months before the Final Oral Examination (i.e., Defense). Deadlines for the submission of paperwork pertaining to doctoral programs are available online at <https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines>

The Committee Appointment form reports the student's planned dissertation committee, dissertation title (subject to change) and the expected graduation term. It requires approval from the Major Professor and the ENVS DGS, as well as the Minor department. The approval signature from the minor

department on this form indicates both approval of the reported dissertation committee and confirmation that the student has satisfied all requirements for the minor.

The student should query faculty members for availability before submitting the Appointment Form to GradPath.

3.4.5.1 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 (<https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#dissertation-prospectus>). 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

The *Background, Framework, and Other Information* sections are intentionally vaguely worded as these vary from student to student and may depend on the requirements by the Major Professor. From the perspective of the ENVS Graduate Program, however, these sections should not be excessively long. For example, they should *not* be draft chapters of the dissertation. Rather, these sections should be no more than a few pages in total or as long as needed to provide the Doctoral Committee (and the DGS) sufficient information about the viability of the student's research program and scope of dissertation and whether these can be completed within a reasonable amount of time. Should the student already have draft chapters of the dissertation then it is more appropriate to provide summaries/abstracts here. The time investment in preparing the prospectus should be much smaller than writing the dissertation itself.

3.4.5.2 Final Oral 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 the 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 proceeding is suggested not to 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.

3.5 Graduate Certificate in Aquaculture

3.5.1 Description

The University of Arizona Graduate Certificate in Aquaculture supports research, development and training in aquatic food production systems with special interest in arid environments and developing countries. Current research includes rearing fish and shrimp in irrigation systems, fish and shrimp nutrition and pathology, re-use of effluents as fertilizers for field crops and improving soils with fish wastes, and sustainable systems including aquaponics and integrated multi-trophic aquaculture. The certificate is especially designed for working professionals and international students who may want additional graduate experience on a flexible or reduced time scale.

All students must submit a formal application to the UA Graduate College to be considered for admission to the SWES Graduate Certificate in Aquaculture. Further details about this graduate certificate including its admission requirements may be obtained at:

<https://grad.arizona.edu/catalog/programinfo/AQCCRTG>,

or by contacting the ENVS Graduate Program Coordinator:

Kathleen Landeen
520-621-1606
klandeen@email.arizona.edu

3.5.2 Certificate Requirements

The Graduate Certificate in Aquaculture requires completion of a minimum of 16 units of graduate credit. Courses may be added or removed from this list over time. Students should confirm that a particular course will be offered in a particular semester by checking the University of Arizona's Schedule of Classes. Certificate units may also be applied to degree programs; and up to six units of transfer credit may be used.

Code	Units	Course Title
Required course work (11 units):		
VSC 556	3	Aquaculture
ENVS 575	4	Freshwater and Marine Algae
VSC 565	3	Shrimp Pathology
ENVS 900	3	Research (Aquaculture)– Internship
Electives (3-4 units)		
ECOL 582	3	Ichthyology
ENVS 574	4	Aquatic Plants and the Environment
ENVS 525	3	Environmental Microbiology
XXX YYY	3	Other approved elective

3.6 Graduate Certificate in Water Policy

3.6.1 Description

The University of Arizona's Graduate Certificate in Water Policy offers breadth and depth of education. The Certificate is intended for two different and complementary groups of people who want to build their expertise in water policy: working professionals pursuing the Certificate only and UA graduate students concurrently enrolled in a graduate degree program. There is flexibility in both course selection and schedule, to meet the specific needs and interests of a variety of students. The program is interdisciplinary. Although there are some administrative details that differ between working professionals and UA graduate students, all people admitted to the program must fulfill the same substantive requirements.

To earn the Water Policy Certificate, students must successfully pass 12 units of graduate credit, which is typically equivalent to four semester-long courses. These courses can be taken during a single semester of full-time study or spread out over two or three years. Much of the course-work emphasizes local and regional water policy issues in Arizona and the Southwestern U.S. However, students can also focus on broader national and international issues.

All students must submit a formal application to the UA Graduate College to be considered for admission to the ENVS Graduate Certificate in Water Policy. Further details about this graduate certificate including its admission requirements may be obtained at:

<https://geography.arizona.edu/about-graduate-certificate-water-policy>,

or by contacting the ENVS Graduate Program Coordinator:

Kathleen Landeen
520-621-1606
klandeen@email.arizona.edu

3.6.2 Certificate Requirements

The Graduate Certificate in Water Policy requires completion of a minimum of 12 units of graduate credit as provided at <https://geography.arizona.edu/about-graduate-certificate-water-policy>. Courses may be added or removed from this list over time. Students should confirm that a particular course will be offered in a particular semester by checking the University of Arizona's Schedule of Classes. Certificate units may also be applied to degree programs; and up to six units of transfer credit may be used.

4 Glossary

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

Major: When MS and PhD degree requirements are fulfilled, ENVS students will obtain a MS or PhD degree in Environmental Science.

Major Professor: Tenure track, or tenure equivalent, ENVS 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.

Career Courses: Required classes that all MS and PhD students must complete to fulfill the ENVS MS or ENVS PhD requirements.

Core Courses: Classes in the Major Track that all ENVS students must complete from the program curriculum.

Elective Courses: Additional 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 out and submitted online.

Plan of Study: Comprehensive list of curriculum required for by the degree program, that includes 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.

5 Appendix I. ENVS Major Program Areas

Critical Zone Science

Earth's critical zone is the “heterogeneous, near surface environment in which complex interactions involving rock, soil, water, air, and living organisms regulate the natural habitat and determine the availability of life-sustaining resources”. A healthy critical zone supports productive ecosystems that produce the food we eat, provides natural pollution control, and nourishes natural resources upon which our economy depends. ENVS has strong research programs in Critical Zone Science that broadly encompass subsurface processes and ecosystem-climate interactions. A sample of research areas and associated faculty include:

- Biogeochemistry and Pedology ([Janick Artiola](#), [Joey Blankinship](#), Mark Brusseau, [Jon Chorover](#), [Joan Curry](#), [Katerina Dontsova](#), [Martha Hawes](#), [Craig Rasmussen](#), [Malak Tfaily](#), [James Walworth](#))
- Subsurface Hydrology and Soil Physics (Mark Brusseau, [Karletta Chief](#), [Marcel Schaap](#), [Markus Tuller](#))
- Geomicrobiology ([Albert Barberan](#), [Paul Carini](#), [Raina Maier](#), [Julie Neilson](#), [Ian Pepper](#), [Malak Tfaily](#))

Microbial Ecology

Microorganisms in soil, water and air represent nearly all of the biodiversity on the planet. Known collectively as Earth’s microbiome, they exert strong control over climate and biogeochemical cycles. ENVS researchers are addressing the urgent need to understand the composition and function of this microscopic world and their global impacts. Doing so is enabling better prediction of the effects of land use and climate change, and it is laying the groundwork for new environmental biotechnologies. A sample of research areas and associated faculty include:

- Multi-Omics Analysis (*genomics, proteomics, metabolomics*) ([Albert Barberan](#), [Paul Carini](#), [Raina Maier](#), [Julie Neilson](#), [Ian Pepper](#), [Malak Tfaily](#))
- Microbial Physiology ([Paul Carini](#), [Raina Maier](#), [Julie Neilson](#), [Ian Pepper](#), [Malak Tfaily](#))
- Plant-Soil Microbial Feedbacks ([Albert Barberan](#), [Joey Blankinship](#), [Raina Maier](#), [Julie Neilson](#))
- Microbial Pathogens and Antibiotic Resistance in Soil and Water ([Chuck Gerba](#), [Jean McLain](#), [Ian Pepper](#), [Channah Rock](#))

Climate Change and Drought Impacts

Arid and semi-arid lands, such as those in Arizona, occupy more than 40% of the Earth’s land surface. These landscapes contain forests, grasslands, agricultural, and built environments that may be affected by increased temperature and prolonged drought. Faculty in the ENVS department conduct research to understand climatic impacts on (semi-) arid ecosystems, and to

increase the resilience of these systems to potential effects. A sample of research areas and associated faculty include:

- Regional Meteorology and Climatology ([Paul Brown](#), [Karletta Chief](#), [Mike Crimmins](#), [Craig Rasmussen](#), [Marcel Schaap](#))
- Arid Zone Hydrology (Karletta Chief, [Marcel Schaap](#), [Markus Tuller](#))
- Drought Resiliency Planning ([Paul Brown](#), [Karletta Chief](#), [Mike Crimmins](#))
- Energy Balance and Soil/Ecosystem Response ([Paul Brown](#), [Mike Crimmins](#), [Craig Rasmussen](#), [Marcel Schaap](#))
- Dust Production and Human Exposures ([Joey Blankinship](#), [Jon Chorover](#), [Monica Ramirez-Andreotta](#), [Raina Maier](#), [Jim Walworth](#))

Water Quality, Security and Sustainability

Liquid water is essential to planetary life as we know it, and its availability limits the growth of ecosystems and societies. Here, in the desert southwest, we are keenly aware of the need for a sustainable supply of high quality water to support our agricultural activities and metropolitan areas. A sample of research areas pertaining to water sustainability and associated faculty include:

- Arid Lands Water Policy (Kathy Jacobs, [Sharon Megdal](#))
- Wastewater Reuse ([Charles Gerba](#), [Jean McLain](#), [Channa Rock](#), [Ian Pepper](#))
- Water Distribution Systems ([Charles Gerba](#), [Ian Pepper](#), [Kerry Schwartz](#))
- Groundwater and Well Water Quality ([Janick Artiola](#), Mark Brusseau, [Jon Chorover](#))
- Water Quality Chemistry (Leif Abrell, [Jon Chorover](#), [Chuck Gerba](#), [Jean McLain](#), [Ian Pepper](#), [Channah Rock](#))

Arid and Semi-Arid Agriculture

Agricultural production in arid regions of the world has unique characteristics that require particular management approaches including optimized irrigation systems, soil fertility strategies, and food safety controls. ENVS research is developing the requisite foundation for the successful future of agricultural production in arid landscapes. A sample of research areas and associated faculty include:

- Agricultural Production Systems for the Southwest ([Jim Walworth](#))
- Crop Water Use Efficiency ([Mike Crimmins](#), [Charles Sanchez](#), [Markus Tuller](#))
- Food Safety ([Jean McLain](#), [Paula Rivadeneira](#), [Channa Rock](#))
- Soil Fertility ([Joey Blankinship](#), [Charles Sanchez](#), [Jim Walworth](#))

Pollution Dynamics

Contaminants enter the environment through both natural and anthropogenic processes. Development of a predictive understanding of their transport, transformation, and fate requires an

integration of physical, chemical and biological studies and expertise. Pollutants of concern include toxic metals or metalloids, xenobiotic organic compounds, and pathogenic microorganisms. A sample of research areas and associated faculty include:

- Contaminant Transport ([Janick Artiola](#), Mark Brusseau, [Jon Chorover](#), [Katerina Dontsova](#), [Charles Gerba](#), [Channa Rock](#), [Ian Pepper](#))
- Emerging Organic Contaminants (Leif Abrell, Mark Brusseau, [Jon Chorover](#), [Joan Curry](#), [Katerina Dontsova](#), [Channah Rock](#))
- Biodegradation (Mark Brusseau, [Raina Maier](#), [Jim Walworth](#))
- Chemical Speciation in the Environment (Leif Abrell, [Jon Chorover](#), Rob Root)

Remediation, Reclamation, and Restoration

Hazardous pollution is not distributed uniformly across the landscape, but rather it is frequently localized in “hot spots” of industrial activity (e.g., mining, organic solvent usage, leaking underground storage tanks). Even in the absence of contamination, landscapes (e.g., rangeland or agricultural land) can be degraded by inappropriate management practices. ENVs research is focused on developing science-based remediation, reclamation and restoration methods to transform such impacted lands into productive ecosystems. A sample of research areas and associated faculty include:

- Remediation of Contaminated Soil and Groundwater ([Janick Artiola](#), Mark Brusseau, [Jon Chorover](#), [Katerina Dontsova](#), [Raina Maier](#))
- Reclamation and Restoration of Disturbed Lands ([Joey Blankinship](#), Mark Brusseau, [Raina Maier](#), [Monica Ramirez-Andreotta](#), [Craig Rasmussen](#), [Jim Walworth](#))
- Characterization and Monitoring of Polluted Environments ([Janick Artiola](#), Mark Brusseau, [Monica Ramirez-Andreotta](#))

Environmental Quality, Justice and Health

Our quality of life depends on the quality of the environment that we inhabit. The latter varies because of the health risks from exposure to contaminated water, soil and air. Communities of lower socio-economic status are often disproportionately affected by polluted lands, which raises questions of environmental justice, whereby all people should have access to fair and equal treatment with respect to environmental regulations. ENVs researchers are engaging impacted communities in scientific research to answer the questions communities have about the environments in which they live. Citizen scientists work with ENVs personnel to collect data and translate findings for affected communities. A sample of research areas and associated faculty include:

- Community-Engaged Pollution Research ([Monica Ramirez-Andreotta](#), [Paula Rivadeniera](#), [Channah Rock](#), [Ian Pepper](#))

- Risk Assessment, Communication, and Research Translation (Mark Brusseau, [Chuck Gerba](#), [Raina Maier](#), [Monica Ramirez-Andreotta](#), [Channah Rock](#), [Paula Rivadeniera](#))
- Environmental Justice (Mark Brusseau, [Monica Ramirez-Andreotta](#), [Paula Rivadeniera](#), [Channah Rock](#))

6 Appendix II. ENVS Faculty

Faculty	Research, Education and/or Extension Interests
<p>Artiola, Janick</p> <p>Associate Research Scientist Associate Professor jartiola@cals.arizona.edu</p>	<p>Soil, water, and waste; analytical and environmental chemistry; water quality, and land use of wastes and biochar</p>
<p>Barberan, Albert</p> <p>Assistant Professor barberan@email.arizona.edu https://barberanalbert.wixsite.com/labpage</p>	<p>Role of microorganisms in the environment; arid ecosystems; plant-soil interactions; effect of urbanization on soil microbial communities; microbial dispersal</p>
<p>Blankinship, Joseph</p> <p>Assistant Professor jblankinship@email.arizona.edu</p>	<p>Soil ecology; soil biogeochemistry; soil health; ecosystem responses to climate change; soil nutrient and water management; soil greenhouse gas dynamics; soil organic matter; biochar; biocrusts; dust mitigation; arid land ecological restoration</p>
<p>Brown, Paul</p> <p>Assoc. Director Ext. Ag. and Nat. Res. Programs Extension Specialist Research Scientist pbrown@ag.arizona.edu</p>	<p>Agricultural meteorology; biometeorology, evapotranspiration; crop water use; heat units; agricultural weather information</p>
<p>Brusseau, Mark</p> <p>Professor brusseau@email.arizona.edu http://www.u.arizona.edu/~brusseau/</p>	<p>Contaminant transport and fate; mass-transfer processes; modeling; soil/groundwater contamination and remediation</p>
<p>Carini, Paul</p> <p>Assistant Professor paulcarini@email.arizona.edu http://www.carinilab.com</p>	<p>Microbial physiology, microbial cultivation, microbial evolution, environmental microbiology; oligotrophic ecosystems; plant-soil interactions; bioremediation; microbial ecology</p>

<p>Chief, Karletta</p> <p>Associate Professor & Extension Specialistt kchief@email.arizona.edu https://swes.cals.arizona.edu/people/faculty/karletta-chief</p>	<p>Impacts of fire on watersheds; measuring and modeling environmental processes in arid soils; climate change impacts on water resources and indigenous people</p>
<p>Chorover, Jon</p> <p>Professor and Department Head chorover@email.arizona.edu https://swes.cals.arizona.edu/chorover_lab/Home.html</p>	<p>Biogeochemistry of soil, sediment and water; reactions controlling fate of carbon and contaminants in the critical zone</p>
<p>Cowell, Scott</p> <p>Assistant Professor of Practice cowell@email.arizona.edu</p>	
<p>Crimmins, Michael</p> <p>Professor Extension Specialist crimmins@email.arizona.edu https://cals.arizona.edu/climate/</p>	<p>Applied climatology; climate and natural resources management; climate extremes - droughts/floods/wildfires; global change</p>
<p>Curry, Joan</p> <p>Professor curry@ag.arizona.edu</p>	<p>Soil physical chemistry; surface chemistry; molecular modeling</p>
<p>Dontsova, Katerina</p> <p>Associate Professor dontsova@email.arizona.edu http://biosphere2.org/research/directory/katerina-dontsova</p>	<p>Soil chemistry, dissolution, precipitation, and sorption reactions, including weathering, soil formation, mineral-organic interactions and fate and transport of organic contaminants.</p>
<p>Fidel, Rivka</p> <p>Assistant Professor of Practice rfidel@email.arizona.edu https://www.researchgate.net/profile/Rivka_Fidel2</p>	<p>Soil chemistry and biogeochemistry; use of biochar for soil carbon sequestration; soil greenhouse gas emissions; nitrogen cycling</p>
<p>Fitzsimmons, Kevin</p> <p>Professor kevfitz@ag.arizona.edu https://cals.arizona.edu/azaqua/</p>	<p>Aquaculture; reuse of effluents for crop irrigation; aquaponics; tilapia, shrimp, seaweeds and multi-trophic systems; sustainable feeds; international economic development</p>

<p>Gerba, Charles</p> <p>Professor gerba@ag.arizona.edu</p>	<p>Environmental microbiology: gene probes, water reuse, bio- colloid transport in the subsurface, virology, parasitology, risk assessment</p>
<p>Haverland, Arin</p> <p>Assistant Professor of Practice arin@email.arizona.edu</p>	
<p>Jacobs, Kathy</p> <p>Director Center for Climate Adaption Science and Solutions jacobsk@email.arizona.edu</p>	<p>Water policy; connecting science and decision-making; stakeholder engagement; use of climate information for water management applications; climate change adaptation and drought planning</p>
<p>Maier, Raina</p> <p>Professor rmaier@ag.arizona.edu https://cals.arizona.edu/swes/maier_lab/</p>	<p>Microbial ecology of stressed environments (caves, deserts, dust); bioremediation and reclamation of mining sites; biosurfactant discovery and characterization</p>
<p>Maximillian, Jacqueline</p> <p>Assistant Professor of Practice maximillianj@email.arizona.edu</p>	
<p>McLain, Jean</p> <p>Research Scientist Asst. Dean for Faculty Advancement, CALS mclainj@email.arizona.edu website: https://wrrc.arizona.edu/jean-mclain</p>	<p>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</p>
<p>Megdal, Sharon</p> <p>Professor Specialist smegdal@email.arizona.edu https://wrrc.arizona.edu/director</p>	<p>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</p>

<p>Pepper, Ian</p> <p>Professor Director WEST Center ipepper@ag.arizona.edu https://west.arizona.edu/</p>	<p>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</p>
<p>Ramírez-Andreotta, Mónica</p> <p>Assistant Professor mdramire@email.arizona.edu https://ramirez-andreotta.faculty.arizona.edu/</p>	<p>Community-engaged research, citizen science, environmental risk, communication, environmental health literacy, risk assessment, exposure assessments, phytotechnologies, soil/groundwater contamination and food quality.</p>
<p>Rasmussen, Craig</p> <p>Professor crasmuss@cals.arizona.edu</p>	<p>Pedogenesis; soil forming processes; soil carbon cycling; mineral weathering; soil-landscape evolution</p>
<p>Rivadeneira, Paula</p> <p>Assistant Specialist pkrivadeneira@email.arizona.edu</p>	<p>Microbial food safety; One Health; wildlife: domestic interfaces; wildlife management in agricultural environment, environmental microbiology.</p>
<p>Rock, Channah</p> <p>Professor Extension Specialist crock@email.arizona.edu</p>	<p>Molecular pathogen detection; water quality</p>
<p>Sanchez, Charles</p> <p>Professor sanchez@ag.arizona.edu</p>	<p>Plant nutrient utilization, soil and water management, salinity, and fate and transport of agriculturally derived chemicals and environmental toxins</p>
<p>Schaap, Marcel</p> <p>Professor ENVS Director of Graduate Studies mschaap@cals.arizona.edu</p>	<p>Environmental physics; soil-water-atmosphere processes, measurements and computer modeling of physical transport processes in the environment, climate and climate change, estimation of global soil transport properties.</p>

<p>Schwartz, Kerry</p> <p>Associate Specialist kls4@email.arizona.edu https://arizonawet.arizona.edu/</p>	<p>STEM literacy, K-12 education, systems thinking through DSRP (Cabrera, 2015), project-based learning, student-directed learning, & real-world and relevant application, using different facets of water resources and stewardship as integrating concepts.</p>
<p>Tfaily, Malak</p> <p>Assistant Professor tfaily@email.arizona.edu https://malaktfaily.wordpress.com/</p>	<p>Soil organic matter composition; controls on organic matter transformation and degradation; Biotic (microbial) and abiotic factors; greenhouse gas emissions</p>
<p>Tuller, Markus</p> <p>Professor mtuller@cals.arizona.edu</p>	<p>Remote sensing of land surface processes; environmental sensors; soilless greenhouse plant growth; x-ray computed tomography of soils</p>
<p>Walworth, James</p> <p>Professor walworth@ag.arizona.edu</p>	<p>Soil fertility and nutrient management; plant nutrient requirements; water management and soil salinity in irrigated agriculture</p>

7 Appendix III. ENVS Comprehensive Exam Topic Area Selection List

	Env. Bio/Micro.	Env. Soil+Wat. Chem.	Env/Soil Phys./Water	Assesm./Pol./Comm.	Soil Phys./Water Sci.	Soil Morp./Nutr. Dyn.
Artiola, Janick		x	x		x	
Barberan, Albert	x					x
Blankinship, Joseph	x				x	x
Brown, Paul			x			
Brusseau, Mark		x	x	x	x	
Carini, Paul	x					x
Chief, Karletta			x	x	x	
Chorover, Jon		x				x
Cowell, Scott						
Crimmins, Michael			x	x		
Curry, Joan		x				
Dontsova, Katerina		x				x
Fidel, Rivka		x				x
Fitzsimmons, Kevin	x		x			
Gerba, Charles	x		x			
Haverland, Arin						
Hawes, Martha	x					
Jacobs, Kathy				x		
Maier, Raina	x			x		
Maximillian, Jacqueline						
McLain, Jean	x			x		
Megdal, Sharon			x	x	x	
Pepper, Ian	x	x	x		x	
Ramírez-Andreotta, Mónica	x			x		x
Rasmussen, Craig		x				x
Rivadeneira, Paula	x					

Rock, Channah	x	x				
Sanchez, Charles		x			x	x
Schaap, Marcel			x		x	
Schwartz, Kerry				x		
Tfaily, Malak	x	x				x
Tuller, Markus			x		x	
Walworth, James					x	x

8 Appendix IV. Regular ENVS Graduate Courses

This list is for informational purposes only. For an accurate listing of courses, semester offered and instructor, and prerequisites, please see:

https://uaccess.schedule.arizona.edu/psp/pubsaprd/UA_CATALOG/HRMS/h/?tab=DEFAULT

(select ENVS)

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. Spring semester. **Walworth, Artiola**

ENVS 502. Nutrient Dynamics in Soils (3) Nutrient uptake by plant roots, soil microbial ecology, and soil chemical reactions affecting nutrients will be discussed and applied to environmental challenges related to nutrient cycling in arid land soils. Fall semester. **Walworth**

ENVS 506. Modeling of Mass and Energy Flow in Soils (3) Water flow in soils; closely related problems of solute, pollutant, and heat transfer. Fall semester. **Tuller**

ENVS 508. Scientific Writing for Environmental, Agricultural and Life Sciences (3) This course will cover in-depth technical writing skills needed for scientific writing success, ranging from how to perform comprehensive reviews of the scientific literature, to performing peer reviews of the writing of fellow students. Spring semester. **Mclain**

ENVS 510. Microbial Biogeochemistry and Global Change (3) In this interdisciplinary undergraduate and graduate class we will cover major microbial biogeochemical cycles, and how these cycles are impacted by, and feedback to, global change. Spring semester. **Tfaily**.

ENVS 515. Translating Environmental Science (3) In this course students learn journalism techniques to translate environmental science topics into language a layperson could appreciate. Spring semester. **Ramirez-Andreotta**

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

ENVS 520. Environmental Physics (3) This course emphasizes conceptual understanding of mechanisms, data sets and modeling techniques and uses elementary math and physics principles

to guide student to a comprehensive, but practical, understanding of the physical aspects of the environment of planet Earth. Fall and Spring semester. **This course has an online section.** **Schaap**

ENVS 525. Environmental Microbiology (3) Current concepts in water quality, aerobiology, and microbial biogeochemistry. Fall semester. **Carini**

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. Fall semester. **Pepper, Gerba**

ENVS 528R Microbial Genetics (3) ENVS 528R Laboratory (2). Prokaryotic gene structure and function; methods of gene transfer and mapping, DNA structure, replication, transcription, and translation. Hands-on computer analysis of DNA sequences and gene cloning strategies. Principles of regulation of gene expression. Graduate-level requirements include a DNA sequence of an entire operon from any one of a variety of bacteria and additionally analyze one product from the operon using several GCG protein analysis programs plus an extensive exam. Fall semester, **Cooper**

ENVS 530R. Environmental Monitoring and Remediation (3) ENVS 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. This course focuses on hands-on, laboratory and field experiences design to help the student better understand the principles of and the tools necessary for environmental monitoring. Fall and Spring semester. **Artiola**

ENVS 531R. Soil Genesis, Morphology, and Classification (3) ENVS 531L (1) Lab. 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. Fall semester. **Rasmussen**

ENVS 531A Traditional Ecological Knowledge (3)An introduction to the growing literature on traditional ecological knowledge and its relationships to the ecological and social sciences. Graduate-level requirements include preparing for and leading a class discussion on a specific topic. Fall semester, **Trosper**

ENVS 536A Fundamentals of the Atmospheric Sciences. (3) Broadly covers fundamental topics in the atmospheric sciences. Topics include composition of the atmosphere, atmospheric thermodynamics, atmospheric chemistry, cloud physics, radiative transfer, atmospheric dynamics, and climate. Graduate-level requirements include additional questions on homework and exams plus a term paper on a specialized research topic. Spring semester, **Castro.**

ENVS 541. Soils and Landscapes of Arizona/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. Spring semester (odd years only). **Rasmussen**

ENVS 541A Natural Resource Management in Native Communities. (3) This course is a survey of basic issues and concepts in natural resource management and the environment in Native communities using integrated case studies that survey all the major varieties of environmental issues in Indian Country in the 21st century. A central theme will be developing tribally-specific solutions to rebuilding the resiliency of degraded ecosystems. We will consider particular case studies such as: tribal sovereignty, land tenure, reserved rights and Native claims; Native knowledge systems and Western science; co-management and restoration; water; fish and wildlife; agriculture and rangeland management; energy, mining and nuclear waste; and global climate change. Graduate-level requirements include Increased length of writing assignments. Fall and Spring semesters, **Colombi, Richard**

ENVS 550. Green Infrastructure (3) The course provides an overview as well as more in-depth coverage of the science, practical context, and creation of Green Infrastructure. The built environment of arid regions is emphasized, with Tucson Case Studies providing practical focus to content and learning objectives. Fall semester. **McCormick**

ENVS 554. Water Harvesting (3) Focuses on water harvesting principles and techniques at a variety of scales and settings. Students participate in hands-on implementation of water harvesting projects on the UA campus. Spring semester. **Schwartz, McCormick**

ENVS 561. Soil and Water Conservation (3) Consideration of major world soil and water conservation problems and solutions; principles of soil and water degradation by erosion, ground water overdraft, chemical transport in surface and ground water and their effects on world food production and environmental problems. Offered during Pre-session. Field trips. **Walworth, Cowell**

ENVS 562. Environmental Soil and Water Chemistry (3) An introduction to the principal chemical constituents and processes occurring in soils and sediments. The objective of the course is to provide students with a conceptual framework for understanding chemical reactions in heterogeneous natural systems. Spring semester. **Dontsova**

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. Fall semester. **Dontsova**

ENVS 565. Contaminant Transport in Porous Media (3) The emphasis is on developing a thorough understanding of the critical processes and factors that influence transport and fate, including advection, dispersion, interphase mass transfer, transformation reactions, and physical and biogeochemical heterogeneity of porous media. Spring semester (odd years only). **Brusseau**

ENVS 566. Soil and Groundwater Remediation (3) This course examines the characterization and remediation of contaminated hazardous waste sites. The course is focused on the scientific and

engineering principles supporting site characterization and remediation activities. Spring semester (even years only). **Brusseau**

ENVS 567 Introductory Statistics and Multivariate Statistics with R. (3) The course (3 unit class) will teach the fundamentals of coding and programming using the R language (<https://www.r-project.org/>). The students will use code examples and practice problems to understand the statistical as well as the scientific viewpoint. Using R, students will explore and visualize real-world data and derive meaningful interpretations. The course will cover introductory statistics (descriptive statistics, hypothesis testing, t-test, ANOVA, correlation, regression) and multivariate statistics with a focus on ecological analyses (diversity, cluster analysis, unconstrained ordination, constrained ordination). Spring, **Barberán**

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. Spring semester. **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. Topics such as surface tension, self-assembly, adsorption of polymers and biomolecules, and bacterial cell adhesion will be discussed with emphasis on environmental applications. Spring semester (even years only). **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. Spring semester. **Walker**

ENVS 575. Freshwater and Marine Algae (4) Systematics, ecology, and evolution of planktonic and benthic species; field techniques and lab culture. Spring semester. **Walker**

ENVS 577 Principles of Ecotoxicology, (3) Ecotoxicology is the study of the biochemical and molecular effects of chemical toxicants and non-chemical stressors, singly or in mixtures, on biological organization ranging from the individual to assemblages and ecosystems. Some of the detrimental effects of toxicants and stressors are acute causing immediate ecological and physiological harm, while many others are insidious and chronic causing long-term damage to populations over multiple generations. This course will provide knowledge to students of the very broad range of anthropogenic stressors and toxicants as well as their physiological and sometimes, behavioral, effects on individuals and populations of organisms.

Ecotoxicology is a multidisciplinary endeavor involving ecology, biology (anatomy, physiology, genetics, microbiology), chemistry (inorganic, organic, biochemical, analytical), epidemiology, statistics, soil, water and atmospheric sciences. The goal of this course is to provide requisite tools for students to gain insight into understanding such a complex discipline as ecotoxicology. Specifically, this course will describe some known environmental toxins and their effects, methods to study the nature, extent, movement, and exposure routes of environmental contamination, and techniques to quantify toxicant effects on individual organisms and populations. This course will also describe the current regulatory framework that governs contaminants as well as tools used by scientists, managers, and regulators. Spring semester, **Walker**

ENVS 579 Boundary Layer Meteorology & Surface Processes, (3) Designed for students in the atmospheric sciences, hydrology and related fields. It provides a framework for understanding the basic physical processes that govern mass and heat transfer in the atmospheric boundary layer and the vegetated land surface. In addition to the theoretical part of the course, there is a strong focus on modeling and students will be required to program numerical codes to represent these physical processes. Spring semester (even years only), **Zeng**.

ENVS 580. Environmental Assessment for Contaminated Sites (3) Advances students' knowledge of various concepts and methods used in assessing human-impacted resources such as contaminated sites, waste places, and disturbed sites to ensure efficient and effective remediation and restoration programs. Fall Semester. **Maximilian**

ENVS 582. Reclamation and Redevelopment of Impacted Lands (3) Introduces the concepts and methods governing the sustainable management, restoration, and redevelopment of human-impacted lands. The topics covered include: soil quality concepts; the energy-water-food nexus; redevelopment of brownfields and other impacted lands; reclamation of mining and other resource-extraction sites; natural-disaster cleanup; urban agriculture and community gardens. Spring semester. **Brusseau, Ramirez-Andreotta**

ENVS 583 Geographic Applications of Remote Sensing. (3) Use of aircraft and satellite imagery for monitoring landforms, soils, vegetation and land use, with the focus on problems of land-use planning, resource management and related topics. Graduate-level requirements include the completion of a project report. Main campus: Spring Online campus: Spring semester, **van Leeuwen**

ENVS 590 Remote Sensing for the Study of Planet Earth. (3) Remote Sensing for the Study of Planet Earth introduces basic and applied remote sensing science as a means to explore the diversity of our planetary environments (biosphere, atmosphere, lithosphere and hydrosphere) within the radiometric, spectral, spatial, angular and temporal domains of remote sensing systems. This survey course strikes a balance between theory, applications and hands-on labs and assignments. We explore how you can download, process, analyze and interpret multi-sensor data and integrate online remotely sensed data sources/products into your research of interest. Fall semester, **Smith**.

ENVS 595. Colloquium (1) The exchange of scholarly information and/or secondary research. Instruction often includes lectures by several different persons. Fall and Spring semester. **Ramirez-Andreotta**

ENVS 596B. Water Policy In Arizona and Semi-arid Regions (3) This course focuses on current water policy in Arizona, the Colorado River Basin, and other semi-arid regions from a multi-disciplinary perspective. Through readings, research, discussion and presentations, the student is exposed to major, current water resource issues and policies to address them. Spring semester. **Megdal**

ENVS 641 Water Law. The course in Water Law traditionally emphasizes state law rules that govern rights to use surface water and groundwater throughout the country. Although we will give ample attention to the prior appropriation doctrine, riparian water rights, and various systems for regulating groundwater use, this course will also emphasize how federal law may impact water rights. Increasingly, environmentalists and others claim that there are public rights to water that may take precedence over rights under the prior appropriation system. Spring semester, **Glennon**.

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. Fall and Spring semester. **Faculty**

ENVS 696N Indigenous Food Energy Water Security and Sovereignty Seminar (1) discuss research and extension on tribal lands. Additional faculty working on tribal natural resources challenges will be invited as needed. This seminar will be live-streamed to Diné College and NTU. First year PhD trainees will discuss preparation strategies for internships. Topics include career paths, Indige-FEWSS internship opportunities, written and oral mechanisms of scientific communication to reach disciplinary, cross-disciplinary and lay audiences, and work place expectations. Second year PhD trainees will prepare to work with Diné College and NTU faculty and teach FEWS modules. Topics include: inquiry based Fall and Spring semesters. **Chief**.

ENVS 696P Hazardous Waste Risk and Remediation in the US Southwest (1), Interdisciplinary trainees who participate in a colloquium, professional development activities and research translation/community engagement activities. Fall and Spring semesters, **Ramirez-Andreotta**.

ENVS 697. Graduate Seminar and Professional Development (1) SWES graduate students will develop and practice oral and poster presentations in front of an audience (and camera), practice chairing a session of a professional meeting, and develop a relevant resume/CV appropriate for a professional career in their field. Students will appraise and critique the presentations of their fellow students. Students will also practice a simulated job interview, based on the CV they develop. **Schaap**

Individual Studies

ENVS 593/693 Internship, (1-3) Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment. Fall, Spring, Summer. **NOTE:** All Internship units require enrollment through the ENVS Department. Please submit an Individual Studies Proposal form to Kathleen Landeen in Shantz 429F for registration. DGS advanced approval is required to apply Independent Studies credits to the Master Plan of Study.

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

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.