

## The School of Environmental Studies (SOES)

**Academic Year:** 2018-2019

**Program:** Professional Science Master's with a Concentration in Environmental Informatics

**College; School:** Interdisciplinary Studies; Environmental Studies

**Submission Date:** January 2020

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### I. Program Mission and History

**School of Environmental Studies Mission:** The School of Environmental Studies (SOES) will foster in students the desire to lead purposeful professional lives through the application of scientific principles to environmental issues within the social, political, and economic framework of our society.

#### **Professional Science Master's with a Concentration in Environmental Informatics**

**Program:** The PSM-EI program, started in Fall 2013, focuses on analytical and computer-based methods in the study and management of natural resources and the environment. The degree program provides students with a business background and concepts that are applicable across fields as diverse as sociology, public policy analysis, business, sustainable systems, and terrestrial/aquatic ecosystem management. The program provides connections to potential employers through internships and allows professionals the flexibility to earn their degree while working full-time. In 2017-2018 we received approval to offer the program fully online, while retaining the option of completing some or most courses on ground. The 100% online option resulted in an increase in enrollment the past two academic years (Table 1), with several new students joining the PSM-EI program while working full time for government agencies such as Tennessee Department of Environment and Conservation. As of Fall 2019, 18 students are currently enrolled and a grand total of 16 students have graduated from the program (Table 1).

**Table 1.** Enrollment and graduation data for the PSM-Environmental Informatics degree program from 2013-2019.

Enrollment data		Graduation data	
Fall semester	Number enrolled	Academic year	Degrees conferred
2013	3	2013-2014	2
2014	5	2014-2015	0
2015	9	2015-2016	3
2016	7	2016-2017	5
2017	8	2017-2018	2
2018	13	2018-2019	4
2019	18	2019-2020	(to be determined)

## II. Program Goals and Student Learning Outcomes

**Program Goal 1:** Prepare students who possess the mathematical and scientific knowledge to analyze and manage spatially distributed data needed to obtain sustainable solutions for complex, real-world environmental problems.

***Learning Outcome 1.1:*** Students will have the ability to apply GIS and statistical tools to manage spatially distributed environmental data to aid in decision making.

**Assessment Tools:** Internship report by student; internship supervision evaluation.

***Learning Outcome 1.2:*** Students will demonstrate the skills to understand, analyze, and interpret data independently.

**Assessment Tools:** Internship report by student; internship supervisor evaluation.

**Program Goal 2:** Prepare students who have the business fundamentals, project management and communication skills necessary to become leaders in their chosen fields.

***Learning Outcome 2.1:*** Students will demonstrate the ability to integrate business management concepts with environmental information to manage environmental systems.

**Assessment Tools:** Internship report by student; internship supervisor evaluation.

***Learning Outcome 2.2:*** Students will communicate effectively in oral and written formats.

**Assessment Tools:** Internship report by student; internship supervisor evaluation.

## III. Assessment Methods

**Internship Written Report by Student:** During the internship, students will be working in an industry, utilizing knowledge and concepts learned from the curriculum to produce deliverables, which will be presented in writing and during an oral examination. The oral examination and written report will be evaluated by the graduate student's advisory committee to assess whether the student has mastered program and concentration learning outcomes.

**Internship Supervisor Evaluation:** Internship employers will provide a written evaluation of respective intern's performance in achieving designated deliverables.

## IV. Rationale for Outcomes and Assessments (Process for Data Analysis)

**Internship Written Report by Student:** The student will develop better communication skills and will be encouraged to integrate all aspects of the program's core areas (GIS, statistics, business) by writing an internship project report. The report will be evaluated by the industry

employer and the student's graduate advisory committee to ensure that it meets satisfactory standards as judged by the committee.

**Internship Supervisor Evaluation:** The evaluation of student and program performance will be aided by external industry reports on student activities during the internship. The industry supervisor evaluation will be reviewed by the student's major professor (who is also the instructor for the ESS 6910 internship course) and also by the PSM Program Director.

## V. Results

A total of six students graduated from the PSM-EI program in 2017-2018 and 2018-2019. Therefore, we have six internship reports and six supervisor reports from which to gather results of program effectiveness. The titles of the six internship reports are given in Table 2, along with the industry or agency that sponsored/hosted the internship project.

**Table 2.** Titles of internship reports from six PSM-Environmental Informatics students who graduated during academic years 2017-2018 and 2018-2019.

Internship Report Title	Industry Sponsor/Host
Maximum entropy species distribution modelling: Predicting suitable habitat for Short's Bladderpod	U.S. Fish and Wildlife Service
Characterizing landscapes versus Northern Bobwhite Quail using Fragstats	Tennessee Wildlife Resources Agency
Utilizing innovative methods to monitor and control the rapid expansion of Japanese Honeysuckle ( <i>Lonicera japonica</i> )	Plant Control, Inc.
Resolving small-scale features on Mars: Lessons from coordinated high-resolution mapping, Xanthe Terra, Mars	Tennessee Tech University Mars Research Group / U.S. Geological Survey
Developing a Web-based geodatabase for data sharing and collaboration within the Falling Water River watershed	Tennessee Tech University Center for the Management, Utilization and Protection of Water Resources
Verification and validation of geospatial structure detections generated by deep learning: A model for automated quality control	Oak Ridge National Laboratory

Industry supervisor evaluations were received for all six students enrolled in the capstone internship. A summary of the evaluations is provided in Table 3.

**Table 3.** Summary of industry supervisor evaluations for six PSM-Environmental Informatics students who completed their capstone internships during the 2017-2018 and 2018-2019 academic years.

Intern attribute	Number of ratings per category (out of 6 total)				
	Excellent	Very good	Average	Below average	Very poor
Attitude	2	4			
Initiative	4	1	1		
Maturity and poise	1	5			
Ability to learn	4	2			
Quality of work	4	2			
Quantity of work	4	1	1		
Dependability	3	3			
Relations with others	2	4			
Judgment	3	2			
Attendance	6				
Punctuality	6				
Overall performance	4	2			

For all the intern attributes, their supervisors gave them ratings in the top two categories. Some of the attributes relate directly to student learning outcomes. In addition, the supervisors provided written comments to lend insight into our progress on student learning outcomes. Examples are provided for each student learning outcome below.

**Outcome 1.1** (use GIS and statistical tools to manage spatially distributed environmental data): The industry supervisor evaluations generally indicated good student mastery of GIS and statistical tools. For example, one evaluation stated that the student “accepted constructive comments freely and adapted development of his GIS model with consideration for that input,” and another praised the student’s “abilities to delicately balance research, development, and practical implementation of novel...approaches.”

**Outcome 1.2** (analyze and interpret data independently): Supervisor evaluations indicated that the students were able to work independently. One question on the evaluation asked the supervisors to rate their level of agreement on a series of statements regarding student performance. For the following statement, “Demonstrate an ability to work independently,” five of six supervisors strongly agreed while the sixth agreed. For example, one supervisor stated that the student “was given a very tough assignment and tackled it exceptionally well with very little guidance.” Another supervisor commented on the student’s “excellent creative analytic thinking skills,” while another described the intern as a “motivated, exceptional leader [who] independently pursued answers.” In the ratings provided in Table 3, four of six supervisors described their interns as having excellent initiative and able to proceed well on his/her own.

**Outcome 2.1** (integrate business management concepts with environmental information): As part of the internship course, one student created a mock business model, including a detailed

financial prospectus, for a private company focused on control of invasive plant species. This creative approach effectively integrated concepts and applications from the business courses into the capstone presentation and written report. The students' advisory committees were glad to see that the students involved business components to the internship projects, which is a required component of the final report and capstone presentation to which all students must adhere.

**Outcome 2.2** (effective oral and written communication skills): The six graduating students defended and presented their internship projects to their graduate advisory committees and other stakeholders, including internship supervisors and other personnel from the internship agencies. The students also completed written internship project reports. All six students passed their internship "defenses" and their committees approved their project reports, generally indicating successful communication skills. Supervisors were asked to rate their level of agreement regarding intern performance on the following two statements, "Produce effective written communications" and "Deliver effective oral presentations". For written communications, three of six supervisors strongly agreed, one agreed, and two were neutral; for oral presentations, two strongly agreed, two agreed, one was neutral, and one was unknown. One supervisor commented that, despite an otherwise outstanding evaluation, the student intern "needs to focus on improving written communication skills."

## **VI. Modifications and Continuing Improvement: Program Changes Due to Assessments**

Based on meetings with the PSM-EI Industrial Advisory Board as well as meetings with faculty involved in teaching courses in the PSM-EI degree program, the following changes were initiated due to program assessments. First, the faculty realized that while oral communications were generally good, there was often a need to improve writing skills of the students. Therefore, the program director worked with faculty advisors to encourage selected students (those who needed to improve writing skills) to consider taking EVS 7900 Scientific Writing and Grantsmanship as their elective course. The program director and associated faculty agree to accept this course on student programs of study, and to make course substitutions in selected cases. Second, the faculty realized that we were not following up with alumni to seek their input in how to improve the curriculum and any other aspects of the degree program. Therefore, we designed and implemented a 10-question alumni survey in Fall Semester 2019. To date, eight of our 16 alumni have completed the survey (50% response rate) and we are in the process of collecting and evaluating the survey results. A preliminary scan of the survey responses revealed many good suggestions for program improvement. The survey questions are provided in Table 4 on the following page.

**Table 4.** Survey questions distributed to the 16 alumni of the PSM-Environmental Informatics degree program during Fall 2019.

1. What year did you graduate from the PSM-EI program and what is your current job title and employer?
2. Did the program's curriculum prepare you for your current or past jobs? Please describe your answer in detail.
3. Did the Capstone Internship experience help you with the skills and knowledge required for your career? If so, in what ways?
4. What courses were most helpful for your current profession?
5. What courses were the least helpful for your current profession?
6. Did you find any courses less beneficial or perhaps redundant?
7. What courses would you have liked to see in the program (if any)?
8. What elective courses might be useful in statistics, business, spatial analysis, or professional development in general?
9. What can the PSM-EI program improve in the future?
10. Overall, how satisfied are you with the PSM-EI program at Tech?