

## **Program Mission: Professional Science Master's (Environmental Informatics)**

### **Providing Department:**

Environmental Informatics PSM

### **Department/Unit Contact:**

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### **Mission/Vision Statement:**

**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 three 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 2020, 19 students are currently enrolled and a grand total of 21 students have graduated from the program (Table 1).

**Table 1.** Enrollment and graduation data for the PSM-Environmental Informatics degree program from 2013–2020.

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	5
2020	19	2020–2021	(to be determined)

## **Program Goal 1 / Outcomes 1.1, 1.2**

### **Define Goal:**

**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.

### **Intended Outcomes / Objectives:**

#### **Student Learning Outcomes:**

*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 written report (both student and industry).

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

Assessment Tools: Internship written reports (both student and industry).

## **Program Goal 2 / Outcomes 2.1, 2.2**

### **Define Goal:**

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

### **Intended Outcomes / Objectives:**

#### **Student Learning Outcomes:**

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

Assessment Tools: Internship written reports (both student and industry).

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

Assessment Tools: Internship written reports (both student and industry).

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RELATED ITEM LEVEL 1

## **Assessment Method for Program Goals 1 & 2: Internship Written Report**

### **Frequency of Assessment:**

Annual

### **Rationale:**

#### **Assessment Methods: Outcomes 1.1, 1.2**

**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.

#### **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.

#### **Assessment Methods: Outcomes 2.1, 2.2**

**Internship Written Report by Industry:** Internship employers will provide a written evaluation of respective intern's performance in achieving designated deliverables.

#### **Rationale for Outcomes and Assessments (Process for Data Analysis):**

**Internship Written Report by Industry:** The evaluation of student and program performance will be aided by external industry reports on student activities during the internship. The industry report 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.

RELATED ITEM LEVEL 2

**Results: Outcomes 1.1, 1.2, 2.1, and 2.2**

**Results:**

Five students completed internship projects and graduated from the PSM-EI program in 2019-2020. The titles of the internship reports are given in Table 2, along with the industry or agency that sponsored/hosted the internship project. Industry supervisor evaluations were received for all five graduating students enrolled in the capstone internship. A summary of the evaluations is provided in Table 3.

**Table 2.** Titles of internship reports from PSM-Environmental Informatics students who completed internship capstone projects during academic year 2019-2020.

Internship Report Title	Industry Sponsor/Host
Adventures in troubleshooting: Creating a model in ArcMap 10.5 to locate vegetated swales	Tennessee Tech University
The relationship between pilot operating handbook performance charts and aged training aircraft	Hixson Aviation
Aiding in the production of a regional guide to Iceland	Global Treks and Adventures
LiDAR data for assessing the impact of hurricanes and heavy storms	U.S. Fish and Wildlife Service
Brain drain: An analysis of human capital flight in the Cumberland Plateau	City of Cookeville, Tennessee

**Table 3.** Summary of industry supervisor evaluations for five PSM-Environmental Informatics students who completed their capstone internships during the 2019-2020 academic year.

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

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 was “always striving to learn and help others in the office solve problems with GIS,” and another commented on the student’s excellent workplace skills related to “ad hoc database design/organization as a project progresses.”

**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,” all five supervisors strongly agreed. For example, one supervisor stated that the student “works well independently but [is] not afraid to ask questions.” Another supervisor commented that the student “excelled at working independently” and “completed her work ahead of time with little aid from us.” In the ratings provided in Table 3, all five supervisors described their interns as having excellent initiative and able to proceed well on his/her own. This represents a higher percentage compared to the previous two years, when only four of six supervisors rated student initiative as excellent.

**Outcome 2.1** (integrate business management concepts with environmental information): One student assisted in the production of a tourism guide to Iceland which involved understanding what factors are desirable for tourists, including creating maps of hiking trails and associated distribution of flora and fauna. Another student analyzed why more highly educated citizens might be leaving smaller towns to migrate to larger cities, which entailed understanding the associated impacts on local capacity for economic growth. The supervisor for a third student was impressed with the student’s client-relation skills and commented that interactions “with our customers was always positive.” 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 five 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 five 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, four of five supervisors strongly agreed and one agreed, representing an improvement compared to the previous two years when three of six supervisors strongly agreed, one agreed, and two were neutral. For oral presentations, three strongly and two agreed, again representing an improvement compared to previous years when two strongly agreed, two agreed, one was neutral, and one was unknown.

**Attachments:**

RELATED ITEM LEVEL 3

**Modifications and Continuing Improvement: Program Changes Due to Assessments****Program Changes and Actions due to Results:**

The PSM-EI program had its first external program review during the 2019-2020 academic year. A self-study report was written (see attached file) and submitted to an external reviewer from a similar degree program in North Carolina. The reviewer's site visit in Spring 2020 was converted to a virtual/remote format due to the Covid-19 pandemic. The reviewer produced an excellent and thorough report (see attached file) that was used by PSM-EI program faculty to discuss changes and modifications that could be made for improvements. In addition, our Industrial Advisory Board met during Fall 2020 to discuss and make recommendations for program changes.

Based on PSM-EI Industrial Advisory Board recommendations, the external reviewer report, and faculty involved in teaching courses in the PSM-EI degree program, the following changes were initiated due to program assessments. The external reviewer recommended that we provide more flexibility in the curriculum to allow students to develop technical skills that could boost their ability to analyze spatial data (see Outcomes 1.1 and 1.2 above). A desire for more technical courses was also expressed in the alumni surveys (see attached self-study report). Following on these suggestions, the advisory board recommended reducing the business course requirements to allow more technical courses to be taken. One course that has the lowest priority for retaining is the accounting course, according to the advisory board and faculty attending the board meeting. Therefore, we will create a proposal for the TTU Graduate Studies Executive Committee during 2021 to request approval to make the curricular changes to better prepare the students for the technical aspects of their careers.

We also noticed improvements in supervisor ratings on written communication skills this year. The faculty agreed to keep the EVS 7900 Scientific Writing and Grantsmanship course as an elective in the new curriculum, and PSM-EI students are actively enrolling in the class. We will continue to emphasize the importance of written and oral communication skills to the students in the capstone internship course, and by encouraging them in advising sessions to take EVS 7900 if their writing skills are in need of improvement.

**Link to Assessment:**

Attached are the self-study report and external review