

UTC RECORDS

NOV 14 2008

09-040

REGISTRATION

UNDERGRADUATE CURRICULUM PROPOSAL COVER SHEET (original and 1 copy)

Title of Proposal: ESC- Revise Environmental Science Geography Concentration, GIS Minor and associated courses

Check One: Full Proposal Information Item

Effective Date for Curricular Offering: August 2009

FROM: Thomas P. Wilson, Biological and Environmental Sciences, 226 Holt Hall, 425-4713, Thomas-wilson@utc.edu; and Brad Reynolds, Biological and Environmental Sciences, 108 Holt Hall, 425-2247, bradley-reynolds@utc.edu; (proposal originator: include spokesperson's name, office number, telephone, e-mail)

Does this require new resources from the originating department or other department?
No

Faculty of the originating department approved this proposal on 11/7/08 (date),
by a vote of 16 aye votes; 0 nay votes; 0 abstentions; 1 eligible voting members absent.

The following have examined this proposal:

Dept Head/Director: John C Tucker John Tucker
11/12/08 Signature Approve neutral disapprove*

College Curriculum Committee Date: _____ Vote: _____ Signature of Chair _____

Spokespersons for Affected Departments:

Hable Georgia Church 11/2/08 Geddy
(name, department, date) Signature Approve neutral disapprove*

[Signature] 11/12/08 [Signature]
(name, department, date) Signature Approve neutral disapprove*

[Signature] 11/13/08 Comp Sci Eng
(name, department, date) Signature Approve neutral disapprove*

(name, department, date) Signature Approve neutral disapprove*

Dean/Director: H. Barbenn H. Barbenn
(name, department, date) Signature Approve neutral disapprove*

University Registrar: Linda Orth Linda Orth Comments _____
Signature

Provost: Phil Oldham 1-21-0 [Signature]
Signature Approve neutral disapprove*

*Those who disapprove may attach an explanation.

ESC 492 LAB FEE APPROVED DENIED₁

• PROVOST PHIL OLDHAM 1-21-0

ACTIONS on this proposal:

Curriculum Committee

Faculty Senate

Date the proposal was considered

Vote of the body:

Accepted as information item
(*indicate date*)

Approved as submitted
(*indicate date*)

Approved with amendments
(amendments indicated and transmitted
to all signatories above, date):

Signature of Chair:



To Curriculum Committee Chair

From: Thomas P. Wilson, Bradley Reynolds (Dept. Biology and Environmental Sciences) and Andrew Carroll (ARCS)

RE: Concerning *Integrated Geospatial Sciences* within the Environment Science Program (i.e., course prerequisite changes, a proposed new course, revisions to the concentration in ESC-Geography, and revision to the ESC-GIS Minor).

Date: October 30, 2008

Preamble

During the last fifteen years, the Department of Biological and Environmental Sciences has developed a solid foundation in Geographic Information Sciences (GIS). With substantial support from the Center of Excellence for Computer Applications (CECA), Academic and Research Computing Services (ARCS), and the National Science Foundation, the department has developed courses, acquired hardware and software, provided training for hundreds of UTC students, and provided GIS research services to area non-profit organizations and government agencies. To this end, UTC has made strong progress toward encompassing a rigorous program by the active establishment of a GIS minor and spatial science curriculum. However, because GIS is a rapidly changing and dynamic field, we need to keep the momentum moving forward in order to avoid stagnating. Specifically, we request to change the prerequisites and other components of select spatial science courses, create a new spatial science course, and revise both the current ESC-Geography Concentration and ESC-GIS Minor. The need for our students to excel in these fields is paramount, and can only be achieved by a complete restructuring of the current curriculum. Furthermore, the aforementioned changes are not without precedents. The current National and Global trend in the usage of Geospatial technology and information is increasing all over the World; therefore, the Department of Biological and Environmental Sciences requests that the changes in the curriculum be revised and accepted in their entirety and anything less will fail to meet the needs of prospective students, area employers, and the community at large.

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To Curriculum Committee Chair

From: Thomas P. Wilson, Bradley Reynolds (Dept. Biology and Environmental Sciences) and Andrew Carroll (ARCS)

RE: Concerning Prerequisite Changes for BIOL 416, ESC/GEOG 465, ESC/GEOG 466

Date: October 30, 2008

The Biological and Environmental Sciences Department requests to change the prerequisites for the following courses: Biogeography (BIOL 416), Remote Sensing (ESC/GEOG 465), and Introduction to GIS (ESC/GEOG466). This request is done in response to making our Minor in Geographic Information Science and the ESC concentration in Geography more relevant to the spatial sciences, and to provide our students with the necessary frame work to excel in this field of study.

A1) Biology 416 Biogeography

Current Catalog Description: **416 Biogeography (3)**

A study of the distribution of plants and animals from a climatic and historical perspective. Fall semester. *Prerequisite: Biology 122 with a minimum grade of C.*

Previous Prerequisites: *Biology 122 with a minimum grade of C.*

Proposed Prerequisites: *Biology 122 or ESC 151 with a minimum grade of C and Junior Standing*

B1) Rationale:

In Biology 416, students are introduced to concepts of biogeography relevant to various applications of remote sensing and GIS. This course was originally intended for biology majors seeking a 400 level course. However, the applicability of this course to the spatial sciences creates the need for familiarity of concepts of biogeography among non-biology majors, specifically for those environmental science majors pursuing a concentration in Geographic and Cartographic sciences. It is therefore proposed that Biology 416 be opened to environmental science students. All students taking this course must also have junior standing in order to ensure that they already have some experience with upper-level courses. Junior standing essentially ensures that they will be better equipped to deal with the rigor of Biology 416.

C1) Consequences of this Proposal:

The addition of non-biology majors into this course may increase roster size. However, the Department of Biological and Environmental Sciences has agreed to open the class to non-biology major students in this concentration. Students and advisors must work closely to ensure that the appropriate requirements are completed and junior standing is achieved prior to enrollment in this course.

D1) Impact on Other Departments:

There are no anticipated impacts on other departments based upon the change in prerequisites.

A2) ESC/GEOG 465 Remote Sensing and Imagery Analysis**Current Catalog Description: 465 Remote Sensing and Imagery Analysis (3)**

Principles of aerial and satellite photography and infrared, multispectral, and microwave sensing. Interpretation of remotely sensed data, including application to problems in a variety of environmental sciences. Every fourth semester. Lecture 2 hours, laboratory 2 hours. *Prerequisites: Geography 221. May be registered as Environmental Science 465. Credit not allowed in both Geography 465 and Environmental Science 465. Laboratory/studio course fee will be assessed.*

Previous Prerequisites: Geography 221. May be registered as Geography 465. Credit not allowed in both Geography 465 and Environmental Science 465.

Proposed Catalog Description: 465 Remote Sensing and Imagery Analysis (3)

Principles of aerial and satellite photography and infrared, multispectral, and microwave sensing. Interpretation of remotely sensed data, including application to problems in a variety of environmental sciences. Lecture 2 hours, laboratory 2 hours. *Geography 221; completion of the general education natural science requirement and the fulfillment of the general education statistics requirement; Math 131 or math placement level 30; Computer Science 150; Junior Standing. May be registered as Geography 465. Credit not allowed in both Geography 465 and Environmental Science 465. Laboratory/studio course fee will be assessed.*

Proposed Prerequisites: Geography 221; completion of the general education natural science requirement and the fulfillment of the general education statistics requirement; Math 131 or math placement level 30; Computer Science 150; Junior Standing. May be registered as Geography 465. Credit not allowed in both Geography 465 and Environmental Science 465. Laboratory/studio course fee will be assessed.

B2) Rationale:

Obviously, Geography 221 (Maps and Map Interpretation) is an appropriate prerequisite, since it is in Geography 221 that students learn basic mapping. In Geography 221, students are likewise introduced for the first time to the basic concept of remote sensing. In addition to Geography 221, students should also have one year of science, an approved math course for the major, and an approved course in statistics. Much of remote sensing relies upon mathematical computation. Remote sensing also requires independent, analytical thought on the part of the practitioner; therefore, it is very important that incoming students have a solid foundation in both math and science. It has been noted that in past semesters, students enrolled in ESC/Geog 465 were lacking in both areas and subsequently struggled with the topics covered in the class. This prerequisite change attempts to address that deficiency. Students in ESC/Geog 465 have also historically struggled with basic computing. Remote Sensing is a computer-driven technology; therefore, it is proposed that incoming students also have Computer Science 150 as a

prerequisite. Junior standing ensures that students that enroll in ESC/Geog 465 will be better equipped to deal with the rigor of the course.

C2) Consequences of this Proposal:

A change in prerequisites will not impact course enrollment, so no additional sections, space, or staff will be required. The course is taught every fourth semester. Students and advisors must plan accordingly to ensure that the course is completed in an appropriate and timely manner, since the addition of these prerequisites will require students to be more cautious with scheduling. The Department of Biological and Environmental Sciences has agreed upon and recommends the prerequisite changes described above.

D2) Impact on Other Departments: There are no anticipated impacts on other departments. The course will continue to be cross-listed with Geography.

A3) ESC/GEOG 466 Geographic Information Systems

Current Catalog Description: **466 Geographic Information Systems (3)**

Introduction to fundamental principles of geographic information systems (GIS). Applications, data structures and basic functions of GIS. GIS computer programs are used to demonstrate basic GIS functions. Every fourth semester. Lecture 2 hours, laboratory 2 hours. *Prerequisite: Geography 221. May be registered as Environmental Science 466. Credit not allowed in both Geography 466 and Environmental Science 466. Laboratory/studio course fee will be assessed.*

Previous Prerequisites: *Geography 221. May be registered as Environmental Science 466. Credit not allowed in both Geography 466 and Environmental Science 466.*

Proposed Catalog Description: **466 Geographic Information Systems (3)**

Introduction to fundamental principles of geographic information systems (GIS). Applications, data structures and basic functions of GIS. GIS computer programs are used to demonstrate basic GIS functions. Lecture 2 hours, laboratory 2 hours. *Prerequisite: Environmental Science/Geography 465. May be registered as Environmental Science 466. Credit not allowed in both Geography 466 and Environmental Science 466. Laboratory/studio course fee will be assessed.*

Proposed Prerequisites: *Environmental Science/Geography 465*

B3) Rationale:

Remote sensing is the data platform for GIS. A solid understanding of remote sensing is therefore crucial for the successful completion of the GIS course. It has been noted in past semesters that students enrolled in ESC/Geog 466 without first having ESC/Geog 465 struggled with the topics covered in the class. They also had great difficulty in understanding the connection between the two technologies and how the one builds upon the other. The proposed prerequisite change described above attempts to address this problem. Requiring the students to take ESC/Geog 465 prior to ESC/Geog 466 will enhance not only their understanding but also their chances for success. Most students will be required to take both courses anyway, so

insisting that they take the courses in sequence will not produce any additional burden. It should be noted that pure geography students may choose to take only ESC/Geog 465 and not ESC/Geog 466. This is acceptable as well.

C3) Consequences of this Proposal:

A change in prerequisites will not impact course enrollment, so no additional sections, space, or staff will be required. The course is taught every fourth semester. Students and advisors must plan accordingly to ensure that the course is completed in an appropriate and timely manner, since the addition of this prerequisite will require students to be more cautious with scheduling. The Department of Biological and Environmental Sciences has agreed upon and recommends the proposed prerequisite change.

D3) Impact on Other Departments:

There are no anticipated impacts on other departments. The course will continue to be cross-listed with Geography.

To Curriculum Committee Chair

From: Thomas P. Wilson, Bradley Reynolds (Dept. Biology and Environmental Sciences) and Andrew Carroll (ARCS)

RE: Advanced Applications of Remote Sensing and Geographic Information Systems

Date: October 30, 2008

The Biological and Environmental Sciences Department requests to offer a new course, ESC 492 (Advanced Applications of Remote Sensing and Geographic Information Systems) for undergraduate students.

a) **Current Catalog Description:** Not Applicable

a) **Proposed New Catalog Description:**

ESC 492 Advanced Applications of Remote Sensing and Geographic Information Systems (2)

Applications of geographical research tools and techniques in conjunction with faculty instruction and supervised research that includes the processing of geographic data for use in a wide variety of environmental scenarios. The student will be responsible for the processing of research data sets and a class project. Emphasis will be placed on methodological practice and documentation of procedures. Students will have opportunities for interaction with guest speakers, and learn the hands-on methods involving collection of field data. *Lecture 1 hour, laboratory 2 hours. Prerequisites: 90 hours and ESC/GEOG 466. Laboratory/studio course fee will be assessed.*

b) **Course Objectives:**

This is an applied course in geospatial technology with a focus on ESRI's ArcGIS and Leica's Photogrammetry Suite and ERDAS Imagine software. The core subject areas of the course are: spatial database development and management, metadata, editing, automated geoprocessing, and advanced analytical techniques. The course is designed for upper-level undergraduate students who are presently working on a project with a GIS focus and/or who envision using Remote Sensing and GIS in their professional careers. The course expands upon the knowledge students gained in previous spatial science courses, serves to hone their spatial science skills, and advance their understanding of geospatial technology.

Each week the structure will be as follows: (1) Review the homework assignment that is due (2) Weekly topic(s) (3) Review the homework assignment for next week (4) Homework/project help

c,d) Model Syllabus/Student Evaluation

Course Information

Fall 2010

ESC 492- Advanced Applications of Remote Sensing and Geographic Information Systems

Description: Applications of geographical research tools and techniques in conjunction with faculty instruction and supervised research that includes the processing of geographic data for use in a wide variety of environmental scenarios. The student will be responsible for the processing of research data sets and a class project. Emphasis will be placed on methodological practice and documentation of procedures. Students will have opportunities for interaction with guest speakers, and learn the hands-on methods involving collection of field data. *Lecture 1 hour, laboratory 2 hours. Prerequisites: 90 hours and ESC/GEOG 466. Laboratory/studio course fee will be assessed.*

Format: Each week the structure will be as follows: (1) Review the homework assignment that is due (2) Weekly topic(s) (3) Review the homework assignment for next week (4) Homework/project help

Credits: 2 (Lecture 1 hour; Laboratory 2 hours)

Prerequisite(s): 90 hours, ESC/GEOG 466

Instructor

Name: Dr. Thomas P. Wilson

Email: Thomas-Wilson@utc.edu

Office location: Holt 226

Office hours: MW 10-1100 and other hours by appointment, but always feel free to stop by

Phone: 423-425-4713

Policies

Attendance is mandatory and students are expected to arrive on time and contribute.

Student Behavior- Students are expected to adhere to the UTC Code of Ethics and follow all university procedures printed in syllabus, catalog and handbook.

Make-up policy: No make-up exams are given without prior approval of instructor.

If you are a student with a disability (e.g., physical, learning, psychiatric, vision, hearing, etc.) and think that you might need special assistance or a special accommodation in this class or any other class, call the Office for Students with Disabilities/College Access Program at 425-4006 or come by the office -110 Frist Hall.

- Assignments:**
- 1) Assisting other students with homework assignments is not permitted.
 - 2) For the project, students may provide help, in the form of advice (e.g. don't process someone else's data), to other students.
 - 3) Late assignments will not be accepted. The due date for each homework assignment is listed on Blackboard.
 - 4) Students are expected to make full use of the resources (e.g. [ESRI Support Center](#)) available to them prior to asking questions.
 - 5) Questions regarding homework assignments should be posted to the course's Blackboard discussion forum.

Grading system: Grades are awarded based on the percentage of points earned in the homework assignments and final project.
Homework - 60 points (10 assignments, 6 points each)
Project - 40 points (1st milestone = 2.5 points, 2nd milestone = 2.5 points, final submission = 35 points)

Letter grades:

- 100% - 90% = A
- 89% - 80% = B
- 79% - 70% = C
- 69% - 60% = D
- <60% = F

Final Exam

About: Final exam attendance is mandatory. Projects are due at the start of the final exam. Graduate students will be required to present their projects during the final exam period.

Day: See Schedule

Time: See Schedule

Location: TBA

Materials

Text: There is no formal text for this course.

On-line resources: [ArcGIS Desktop Help](#) [ESRI Support Center](#) [Vermont GIS Listserv](#)
[ERDAS Support Site](#)
[KML Reference](#)
[Google Earth Outreach](#)

Software used: ArcGIS 9.3
Google Earth 4.3
ERDAS IMAGINE 9.2
Note: it may not be possible to complete all homework assignments using previous versions of the software listed above.

Recommended purchases: Students are highly encouraged to purchase a portable external hard drive (>50GB in size) for use in this course. This will assist in overcoming some of the network issues associated with large geospatial datasets. External hard drives are known to be unreliable so please be sure to back up any data stored on an external drive on a regular basis.

Projects

Requirement: Undergraduate students in the course are required to complete a service learning project or a research project. All projects must be approved by the instructor.

Grading: The project is worth a total of 40 points, five of which are split between the first two milestones. Projects will be graded based on a criteria composed of difficulty and quality. Thus, it will be possible to receive a low grade if a difficult project is of poor quality and high grade if the project is not extremely difficult, but is of very high quality. The highest marks will be awarded to those projects that exceed the requirements in terms of difficulty and quality.

Milestones: The milestones serve to help you, the student, focus your project. The first milestone is the project proposal. The project proposal should, at a minimum, state the purpose of the project, the desired end state including any deliverables, and consists of detailed methods section that outlines the steps you will perform to achieve the end state. The methods section is the most important part of the proposal, it should serve to help you focus how to apply the knowledge learned in the course to the project in addition to identifying any gaps in that knowledge.

The second milestone is a one-on-one session with the instructor. At this milestone it is required that you have all data needed to complete the project assembled and pre-processed. This session will help to insure that your project is on track and to identify any gaps in your knowledge base as it related to the project.

Tips for success:

- 1) Ask questions...lots of questions
- 2) Have the instructor review your project prior to the due date.
- 3) Plan on your project taking you 3-4 times the amount of time you thought it would.
- 4) Save your data early, save often, save multiple versions, and save it in multiple locations.
- 5) Do not leave it until the last minute.
- 6) Consult with your partner on a regular basis.

Lesson Plan

Week 1

Lesson:

Course overview, GIS/RS at UTC, and projection issues.

Objectives

Overview of the course, GIS resources at UTC, and dealing with datasets that have no defined coordinate system.

Topics:

- 1) Course overview
- 2) Lab overview
- 3) Course resources
- 4) Data sources
- 5) Data formats
- 6) Unknown coordinate systems

Readings:

[Identifying an unknown coordinate system](#)

Assignment(s):

Homework #1 - Determining an unknown coordinate system

Week 2

Lesson:

Spatial data management

Objectives

Students will be able to successfully design a geodatabase; making use of feature datasets, domains, feature classes, and topology.

Topics:

- 1) Creating geodatabases
- 2) Feature datasets
- 3) Domains
- 4) Feature classes
- 5) Topology
- 6) XML workspaces

Readings:

ESRI Documentation - Building a Geodatabase, [An overview of the Geodatabase](#), [ESRI Shapefile Technical Description](#)

Assignment(s):

Homework #2 - Geodatabase design

Week 3

Lesson:

Editing

Objectives

Students will be able to edit point, line, and polygon features within a geodatabase, and correct topology errors.

Topics: 1) Editing features 2) Editing topology

Readings: [Creating lines and features](#), [Editing features in a topology](#) ESRI Documentation - (1) Editing in ArcMap, (2) Geodatabase Workbook (chapter 3)

Assignment(s): Homework #3 - Editing
Week 4

Lesson: Metadata

Objectives Students should be able to interpret, import, export, and create metadata.

Topics: 1) FGDC metadata 2) Metadata formats 3) Importing 4) Exporting 5) Creating 6) Templates

Readings: [Editing metadata](#), ESRI Documentation - Using ArcCatalog (Chapter 9)

Assignment(s): Homework # 4 - Metadata
Week 5

Lesson: Raster data

Objectives Students will understand how raster data is structured, the advantages/disadvantages of various formats, and how to manipulate raster data.

Topics: 1) Raster formats 2) Raster overlays 3) Neighborhood and zonal functions 4) Clipping rasters

Readings: [About raster data in Spatial Analyst](#), [Performing analysis in Spatial Analyst](#)

Assignment(s): Homework #5 – Raster processing
Week 6

Lesson: Managing large imagery and LIDAR datasets

Objectives Students will understand the format and structure of LIDAR and how terrains can be used to store and manage LIDAR. Students will be familiar with the process of using geodatabases to manage raster datasets.

Topics: 1) LIDAR structure 2) Terrains
3) Geodatabase management of rasters

Readings: [An overview of terrains](#), [Why store rasters in a geodatabase](#)

Assignment(s): None
Week 7

Lesson: Image interpretation and preprocessing

Objectives Students will understand the formats used to store imagery and how to apply preprocessing steps in ERDAS IMAGINE and to prepare imagery for GIS-based analysis.

Topics: 1) Imagery formats 2) Interpreting imagery 3) Enhancing 4) Clipping imagery 5) Mosaicing imagery 6) Assisted digitizing

Readings: ERDAS Documentation - Tour Guide (Chapter 1 - GLT Viewer, Chapter 11, Chapter 12)

Assignment(s): Homework #6 - Imagery data prep
Week 8

Lesson: Raster processing - hydrologic modeling

Objectives: Students will be able to employ hydrologic modeling techniques to delineate watersheds.

Topics: 1) Hydrologic modeling theory 2) DEM preparation 3) Flow accumulation & flow direction 4) Watershed delineation

Readings: [Hydrologic analysis sample applications](#), [Hydro Data Model \(ESRI Support page\)](#)

Assignment(s): Homework #7 - Watershed delineation
Week 9

Lesson: Automating geoprocessing tasks, part 1

Objectives: Students will be able to link geoprocessing tasks in the Model Builder environment.

Topics: 1) Geoprocessing settings 2) Toolboxes, toolsets, models, & scripts 3) Building a model

Readings: [An overview of ModelBuilder](#), ESRI Documentation - Geoprocessing in ArcGIS (Chapters 6, 8, & 9)

Assignment(s): Project Milestone #1 - Project proposal
Week 10

Lesson: Automating geoprocessing tasks, part 2

Objectives: Students will be able to build fully functional, user-friendly models in ArcGIS.

Topics: 1) Model Builder tips and tricks 2) Trouble shooting 3) Creating documentation 4) Distributing models

Readings: [Controlling the flow of processing](#), [Model iteration](#), ESRI Documentation - Geoprocessing in ArcGIS (Chapters 8, & 9)

Assignment(s): Homework #8 - Model Builder
Week 11

Lesson: Advanced field calculations and labeling using VBA and VBScript

Objectives: Students will understand the basic syntax of Visual Basic for Applications (VBA) and Visual Basic Script (VBScript) and how to use these languages in field calculations and labeling respectively.

Topics: 1) Using VBA in field calculations. 2) Advanced labeling with VBScript.

Readings: [Making field calculations](#), [Building label expressions](#), [Microsoft Developer](#)

	Network (MSDN) article
Assignment(s):	Homework #9 - VBA
	Week 12
Lesson:	KML
Objectives	Students will familiarize themselves with the process of exporting data from traditional GIS formats to KML and learn how to serve up KML data on the WWW.
Topics:	<ol style="list-style-type: none"> 1) KML structure 2) Network links 3) Time series data 4) ArcGIS to KML 5) Sharing KML on the WWW
Readings:	KML in ArcGIS , KML Reference , KML Tutorial
Assignment(s):	Homework #10 – Create a web map
	Week 13
Lesson:	The GeoWeb
Objectives	Students will understand the basic structure of the GeoWeb and become familiar with web-based geospatial data viewers and web centric GIS data formats.
Topics:	<ol style="list-style-type: none"> 1) The GeoWeb, an overview 2) Data viewers – Google Earth, Google Maps, Leica TITAN, ArcGIS Explorer, Virtual Earth 3) GeoWeb formats – ArcIMS, WMS, WFS, WCS, GeoRSS, KML
Readings:	Citizens As Sensors: The World of Volunteered Geography (Goodchild)
Assignment(s):	None
	Week 14
Lesson:	Final Exam
Notes:	Final exam attendance is mandatory.
About:	Projects are due at the start of the final exam. Graduate students will be required to present their projects during the final exam period.
Day:	TBA
Time:	TBA
Location:	TBA
Closing Comments	This document is a tentative syllabus and the course schedule is subject to change. It is the responsibility of the student to keep informed of changes, new materials, missed content, and so on.

e) Rationale:

This proposed course will serve as the capstone course for the ESC Geographic and Cartographic sciences concentration. It will prepare students for real world problem solving, project management, and geospatial research. A thorough comprehension of image analysis, remote sensing, and geographic information systems concepts and techniques are required for the practical application contained within this course. Specifically, students should maintain a working knowledge of the principles of aerial and satellite photography and infrared, multispectral, and microwave sensing. This includes the ability to interpret remotely sensed data and implementing results in environmental problem solving scenarios. Students must also be familiar with industry standard GIS software platforms, data structures, and basic functions. Students should be familiar with common application of GIS technologies among multiple professional disciplines and fields of study. These subjects are thoroughly covered in ESC 465 (Remote Sensing and Imagery Analysis) and ESC 466 (Geographic Information Systems) and should be the required prerequisites to an applications/practicum course. In addition to the above spatial science courses a working knowledge of computer science (CPSC 150), mathematics (131) and statistics (Math 210) is also required. Furthermore, by offering this course on a routine basis, our department will be one course closer to preparing our students to become certified Geoscience Professionals (GISP).

f) Consequences of this Proposal:

The proposed change will offer a capstone applications course to the revised ESC: Geographic and Cartographic Sciences concentration and GIS minor. ESC 492 will be added to the senior experience category of the ESC core, and as mentioned above, students will learn valuable skills that are relevant to this growing profession. There are no anticipated consequences based on prerequisites alone. The proposed course will require students to have senior standing (90 hours), and ESC/GEOG 466. Due to the course offering rotation and timing students will be advised to carefully plan concentration requirements during sophomore standing. The anticipated course offering and prerequisites will make this course only available to students with senior standing; but, by having the course listed in the undergraduate catalog, our students will be able to plan to take the course during their senior year, having little or no impact on their ability to graduate in a timely manner.

g) Impact on Other Departments: The change should have no effect on other departments other than offering students in the Environmental Science program a new option for their senior experience core requirement.

To Curriculum Committee Chair

From: Thomas P. Wilson, Bradley Reynolds (Dept. Biology and Environmental Sciences) and Andrew Carroll (ARCS)

RE: A Revision of Requirements for the Geography Concentration for the Bachelor of Science in Environmental Science

Date: October 30, 2008

The Department of Biological and Environmental Sciences requests to change the current ESC Geography concentration to a concentration that focuses on Geographic and Cartographic Sciences (i.e., geosciences in the form of spatial and landscape ecology, biogeography, GIS, GPS and Remote Sensing). Specifically, this request is done in response to making our program (Concentration, GIS Minor and Courses) more relevant to the spatial sciences, and in order to provide our students with the necessary frame work to excel in this field of study.

A Revision of Requirements for the Geography Concentration for the Bachelor of Science in Environmental Science

All students in pursuit of the Bachelor of Science in Environmental Science at the University of Tennessee at Chattanooga must complete not only the core requirements for the degree, they must also complete the requirements for one of the following concentrations: Biology, Chemistry, Engineering Science, Mathematics, Sociology-Anthropology, Geology, or Geography. The Biological and Environmental Sciences Department requests a major change in one of the concentrations currently offered as a part of the Bachelor of Science in Environmental Science Degree. Specifically, the Biological and Environmental Sciences Department desires to change the Geography concentration as currently offered to a concentration in Geographic and Cartographic sciences.

a) Catalog Description of the Current Geography Concentration

Sociology 151, 209, 314

Geology 111/181, 112/182

21 hours from Geography, 9 of which must be at the upper level. These hours are additional to any geography hours taken as part of the 30 hours required of all ESC majors. With the approval of the Biology/Environmental Science department head, Geo 307 or Biology 416 or an upper level ESC course may be substituted for 3 hours.

a) The Proposed Geographic and Cartographic Sciences Concentration

Geography 101, 103,

One course from Geology 108, Geography 206, Astronomy 101/181, or ESC/Geology 225/226

Three courses from Geography 303, 304, 305, 306, 307
Geology 111/181
Computer Science 150
Biology 416
ESC 340, ESC/Geography 465, ESC/Geography 466
ESC 492 (see below and attached proposal)

b) A Rationale for the New Geographic and Cartographic Sciences Concentration

The Department of Biological and Environmental Sciences (with the assistance of the Department of Sociology, Anthropology, and Geography) currently offers a Bachelors of Science in Environmental Science with a concentration in what is essentially classic geography. While a working knowledge of classic geography is important, in recent years, the national and global trend has been towards the usage of Geospatial technology and information and also towards the usage of computer-based Geographic Information Science. Other current trends include an enormous demand for GIS professionals and an impressive increase in the availability and utilization of Geospatial data related to the Earth. As a result, the Department of Biological and Environmental Sciences desires to incorporate more Geospatial technologies into the environmental science curriculum. The Department of Biological and Environmental Sciences believes that a more modern concentration in Geographic and Cartographic Sciences (as opposed to a more classic concentration consisting of traditional geography) will be of greater value to our majors and will more effectively meet the needs of prospective UTC environmental science students. Environmental Science majors that complete the requirements for this new concentration will be able to more effectively meet the needs of area employers and the community at large. In short, the demand for Geospatial professionals in this region, nationwide, and internationally is already very high and will no doubt continue to rise in the future. The Biological and Environmental Sciences Department must make this change in order to be competitive, current, and relevant.

Therefore, we propose that Sociology 151 (Introduction to Sociology), Sociology 209 (Population and Society), and Sociology 314 (Research Methods) no longer be required in the new concentration. The Biological and Environmental Sciences Department recognizes that the sociology courses are excellent courses and that sociology is valuable; we believe, however, that these courses should be absent from the new concentration because they are simply not relevant to spatial science. The deletion of Sociology 209 from the concentration can additionally be justified due to the fact that it is no longer even offered at UTC. Not only is the course no longer offered at UTC, there are additionally no plans to offer Sociology 209 at any time in the immediate future.

A second justification also exists for deleting Sociology 314 from the new concentration. Sociology 314, in addition to possessing no true relevance to spatial science, is in actuality the first part of a two-part sequence. Previously, ESC majors with a Geography Concentration were required to take only Sociology 314. In Sociology 314, students learn about research and research techniques and design a research proposal.

Although ESC majors with a Geography Concentration do currently have to take Sociology 314, they are currently NOT required to take Sociology 414. In Sociology 414, students actually carry out the projects designed in Sociology 314. To take the first course in the sequence without also taking the second has over the years proven to be both awkward and of limited value to environmental science majors. We therefore propose that a different methods course be added to replace Sociology 314. We would like to add a methods course that would likely be of greater value to environmental science majors interested in spatial science. We propose the addition of ESC 340 (Environmental Survey Methods) which addresses a variety of field survey methods and data collection techniques and at the same time has a strong spatial analysis component as a replacement for Sociology 314.

We also recommend that the new concentration include Geology 111/181 (Physical Geology) but not Geology 112/182 (Historical Geology). Again these recommendations are based on relevance. Geology 111/181 stresses in part the study of certain geological land forms crucial to a more complete understanding of spatial science. Geology 112/182, on the other hand, focuses primarily on the geologic history of the earth, geologic time, and the fossil record as it relates to the evolution of life. We assert that our environmental science majors (regardless of concentration) already adequately cover this subject matter in other classes as part of the core requirements for the degree. Those environmental science students selecting a concentration in Geographic and Cartographic Sciences would address these topics even further in Biology 416 (Biogeography). We strongly recommend that Biology 416 be included in the revised concentration since Biology 416 addresses the distribution of plants and animals from a climatic and historical perspective. The distribution of plants especially holds significance for both aerial photography and remote sensing. We also assert that Biology 416 would be especially useful for our environmental science majors, since in addition to possessing a strong spatial component, it also has direct ties with environmental conservation and is firmly grounded in the disciplines of biology, environmental science, and geography. Biology 416 is therefore a perfect addition to the proposed Geographic and Cartographic Sciences concentration.

Although we recommend the deletion of Geology 112/182, it is our intention to replace it with one course of the student's choice from an Atmosphere, Weather and Climate Block: Geology 108 (Geomorphology), Geography 206 (Atmosphere, Weather, and Climate), Astronomy 101/181 (Introduction to Astronomy - The Solar System), or Environmental Science/Geology 225/226 (Oceanography). It should be noted that all of these courses have great relevance to spatial science. Geology 108, for example, addresses the general configuration of the Earth's surface and the evolution of land forms. Weather, climate, atmospheric conditions, and atmospheric pollution greatly impact and sometimes interfere with satellite imagery and remote sensing technology, so clearly Geography 206 is relevant to the Geographic and Cartographic Sciences Concentration as well. Astronomy 101 covers the night sky, the Earth-Moon system, planets and their satellites, and the Sun. Astronomy 101/181 would of course (along with the Geology courses) add yet another opportunity for Geographic and Cartographic Sciences students to study a physical science. The world's oceans and ocean currents have a great impact on

both weather and climate, thereby influencing satellite imagery and remote sensing technology, so ESC/Geology 225/226 is likewise an appropriate option.

A variety of options are permitted within this Atmosphere, Weather, and Climate Block in order to allow each student the flexibility to gravitate towards the course most in line with his or her career aspirations and interests.

As previously stated, a working knowledge of classic geography is important. Geography 101 (Physical Geography) is a classic geography course, but it also possesses some relevance for the spatial sciences. Geography 101 focuses on the physical environment and on those processes that influence the distribution and patterns of landforms, water, climate, vegetation, and soil. Such distributions and patterns are of great importance within the field of remote sensing and also within the field of GIS. We would therefore like to include Geography 101 within the Geographic and Cartographic Sciences concentration. The possibility exists that some of the students pursuing a concentration in Geographic and Cartographic Sciences might have a desire to apply their skills towards the study of a particular region. For this reason (and also because we recognize the worth and value of classic geography), we would like for students pursuing a concentration in Geographic and Cartographic Sciences to take three more geography courses. We would like to have each Geographic and Cartographic Sciences student take Geography 103 (World Geography) and then to select three courses from the following Regional Geography Block: Geography 303 (Geography of North America), 304 (Geography of Latin America), 305 (Geography of Asia), 306 (Geography of the Southeast United States), and 307 (Geography of Europe).

All environmental science students are required to take Geography 221 (Maps and Mapping). For students pursuing the Geographic and Cartographic sciences Concentration, we would require those students to also take ESC/Geography 465 (Remote Sensing and Imagery Analysis) and ESC/Geography 466 (Geographic Information Systems) in sequence. These courses obviously have the most relevance and the most value within the proposed Geographic and Cartographic sciences Concentration. ESC/Geography 465 covers various principles of aerial and satellite photography and microwave sensing. This course focuses in part on the interpretation of remotely sensed data. ESC/Geography 466 introduces the fundamental principles of GIS and helps familiarize students with GIS computer programs and basic GIS functions. It is within ESC/Geography 465 and ESC/Geography 466 that students begin to learn about these important technologies in greater depth. It is within these two courses that students will begin to build a solid foundation for the development of useful and marketable spatial science skills. Therefore, more than any other, these two courses are crucial for the proposed Geographic and Cartographic sciences Concentration.

Of course, for students to have the background to succeed in ESC/Geography 465 and ESC/Geography 466, it would be helpful for each student to be comfortable with computers and competent with computer software. Remote sensing and GIS are of course both computer-driven technologies; therefore, a working knowledge of computers and computer software is crucial. With that in mind, we would like to add Computer Science

150 to the Geographic and Cartographic sciences Concentration. Students that take Computer Science 150 prior to taking ESC/Geography 465 and ESC/Geography 466 will find both courses much more manageable and understandable. The instructors that teach ESC/Geography 465 and ESC/Geography 466 will no doubt benefit by the students having to take Computer Science 150 as well. Instructors teaching ESC/Geography 465 and ESC/Geography 466 to students that have had some computer experience will simply have more time in class to cover key remote-sensing and GIS concepts as opposed to having to use valuable class time to instead teach basic computing skills.

Finally, we would like to add (primarily for students in the proposed Geographic and Cartographic sciences concentration) a new senior experience option to the core environmental science requirements. All environmental science students are required to complete two hours of a senior experience. This senior experience has traditionally consisted of an internship, an independent study, senior-level research, or a senior-level seminar. We propose adding to this list of options two hours of senior experience that would essentially serve as a capstone applications course for spatial science students. This new senior experience option would be entitled Applications of Remote Sensing and Geographic Information Systems (ESC 492). In ESC 492, students that have successfully completed ESC/Geography 465 and ESC/Geography 466 would be able to apply their new real-world skills to actual environmental problems and scenarios. Senior level students would be challenged to actually use aerial photography and digital data for practical applications and the analysis of local environments. This course would basically simulate what it would be like to use remote sensing and GIS within the professional world. ESC 492 would serve to strengthen the students' newly acquired spatial science skill sets even further. In addition to the hands-on field collection of spatial data and the subsequent analysis of that data, relevant field trips and appropriate guest speakers will play a central role in the course. This course would be open to all senior environmental science students with the necessary prerequisites (UTC Math Placement 30 or Math 131, Math 210, Geography 221, Computer Science 150, ESC/Geography 465, ESC/Geography 466, ninety hours, and one year of science), but once again, it would be primarily for students in the Geographic and Cartographic sciences Concentration, and GIS Minor. In fact, it would be the required senior experience course for all environmental science students with a Geographic and Cartographic sciences concentration.

c) Analysis of the Economic/Pedagogical Consequences of the Proposed Concentration

Pedagogically speaking, the proposed change in concentration will make available to those students pursuing a BS Degree in Environmental Science yet another option, one that is in many ways superior to the current Geography concentration. Environmental Science students that select Geographic and Cartographic sciences as their focus of study could be confident that they are pursuing a useful and modern concentration. They could be confident that the skills they are developing in the pursuit of the concentration will serve them well should they venture into the professional world in order to find employment within the field of Geospatial technology. Not only will the Geographic and Cartographic sciences concentration make our students more technologically savvy and

more competitive, it will of course at the same time still allow them to take a traditional sampling of courses from geography. It should be noted that the proposed Geographic and Cartographic sciences concentration is based upon a collection of courses currently supporting degree programs in Environmental Science, Biology, Geology, Geography, Astronomy, and Computer Science. Therefore, there should be minimal changes (if any) to the economics of the various departments involved.

The new concentration would not have any impact on the ability of students to complete the degree requirements in a timely manner. The current Geography concentration requires 38 hours of course work in addition to the basic core classes required of all concentrations. The proposed Geographic and Cartographic sciences concentration would require 39-40 hours of course work, depending on the option selected within the Atmosphere, Weather, and Climate Block. It is possible that students could finish with 40 hours due to the fact that Astronomy 101/181 is a four-hour lecture and lab combination. Although there is no appreciable difference in the total number of hours required, it is essential, due to the technical nature of several of the courses, that some of the courses in the proposed concentration be taken in the appropriate sequence (with the appropriate prerequisites fulfilled). As with any of the concentrations, proper planning on the part of the students and their advisors will be crucial to a timely completion of an Environmental Science degree with a Geographic and Cartographic sciences concentration. Because so many of these courses must be taken in order, this does admittedly limit the flexibility of the last two years of the program.

For those students that desire more courses in traditional geography than what would be allowed within this new concentration, the Geography Minor is always an option. The same is true for those students whose primary interest is in Sociology. Earlier it was suggested that the Sociology courses be removed from the Geographic and Cartographic sciences concentration due to lack of relevance. For students desiring to take more sociology courses, the Sociology Minor is always an option. The Sociology Minor could of course be used by those students pursuing a BS in Environmental Science with a Geographic and Cartographic sciences Concentration to add to the breadth and depth of their experience. As always, a BS degree in Environmental Science with a Sociology and Anthropology Concentration remains an option as well. No doubt Sociology 151 will continue to be a popular choice among all students as a general education requirement for the Behavioral and Social Sciences. Basically, we do not anticipate the overall enrollment of the geography courses or the sociology courses will be adversely affected by the proposed concentration change. In short, changing the concentration from Geography to Geographic and Cartographic sciences would not prevent students from studying either Geography or Sociology. The change in concentration would simply make it possible for Environmental Science to attract an entirely new set of students, students that are primarily interested in both Geography AND Geospatial science.

d) Impact on other Departments

How will this new concentration potentially affect other departments and programs? Obviously, several other programs will be somewhat affected and all to varying degrees.

Department of Sociology, Anthropology, and Geography

Because of a lack of relevance, it has been proposed that the three sociology courses from the Geography concentration be deleted from the Geographic and Cartographic sciences concentration. Sociology 151 is of course a general education option under the Behavioral and Social Sciences category, so once again, we are certain that enrollment in this course will not be affected by the proposed changes. Sociology 209 is, as previously mentioned, no longer offered at UTC, so this will obviously not affect the Sociology Department or its enrollment at all. Sociology 314 might see an initial drop in enrollment, but it is possible that the overall enrollment in Environmental Science with a Sociology/Anthropology Concentration may actually increase, because this will be the only option available that is not heavily grounded in classic natural science or spatial science. For those majors that have less of an interest in the natural sciences and the spatial sciences and more of an interest in the social sciences and in administration and policy, the Sociology/Anthropology Concentration would be the obvious option. If this is indeed the case and enrollment in the Sociology/Anthropology Concentration increases, then there will be a jump in enrollment for not only Sociology 314 but Sociology 414 as well (Sociology 414 although not required in the current Geography concentration is required in the Sociology/Anthropology Concentration). We do not anticipate that additional sociology sections will be required; therefore, the Sociology Department will not be burdened with any significant increase in terms of the need for additional space or additional personnel.

As for Geography, we anticipate that there will be very little change in terms of overall enrollment. Currently, students with a concentration in Geography are required to take 21 hours from Geography with at least 9 hours at the upper level (in addition to Geography 221, required of all environmental science majors). With the new proposed concentration, the same students will still be required to take Geography 221 and they will likewise still be required to take exactly 21 hours of Geography and possibly 24 hours of Geography if they select Geography 206 as an option (Geography 101, 103, 206, three courses from Geography 303, 304, 305, 306, and 307, ESC/Geography 465, ESC/Geography 466). Because the total number of geography hours required will not be altered significantly (if at all), we anticipate that any effect on enrollment within geography will be negligible. A reasonable amount of geography would still be required; the emphasis within the concentration would simply be more modern and more technology-based. We do not anticipate that any additional geography sections will be required; therefore, the Geography Department will not be burdened with any significant increase in terms of the need for additional space or additional personnel. In fact, the burden for teaching the key spatial science courses cross-listed as both ESC and Geography (465, 466, 561 and the ESC capstone course numbered 492) will fall solely the Environmental Science Department. Dr. Tom Wilson is of course one of the authors

of this curriculum proposal and obviously is aware that he will primarily be responsible for teaching several of these courses (although Dr. Gary Litchford, professor emeritus, could teach the courses as well, along with at least two other members of the Biological and Environmental Sciences Department). It should also be noted that any additional space or equipment demands will be greatly alleviated by ARCS (Academic and Research Computing Services). ARCS provides the leadership, support, and assistance necessary to help UTC faculty, students, and staff make effective and secure use of technology in their teaching and research and is responsible for maintaining the GIS servers and GIS labs. ARCS also ensure the availability of current software and mapping data and makes GIS software available across campus. The ARCS Department is aware of and supports this proposed change.

The only other potential impact would be for the Geography minor. Specifically, students pursuing a minor in geography are required to take 9 hours at the 300-400 level. By placing additional prerequisites in ESC/GEOG 465 and 466 courses some students may not have the required math and computer skill sets, and prevent them from enrolling in these courses. However, we find this negligible because those students interested in more classic geography will still have 24 hours of courses at the 300-400 level to choose from and satisfy the requirements for the minor. Also, it should have no impact on those geography minors interested in the spatial sciences because they will want to have the necessary prerequisites to successfully enroll and complete these courses.

Department of Physics, Geology, and Astronomy

The current concentration requires Geology 111/181 and 112/182. The proposed concentration would only require Geology 111/181, but it would allow the students to select (based on their interests) Geology 108 or ESC/Geology 225/226 as an option. Students would essentially go from taking 8 hours of Geology to taking up to 7-8 hours of Geology within the proposed new concentration. We anticipate that any effect on overall geology enrollment will be negligible. It should be noted that the option of completing a Geology Minor still exists for all interested students as does the option to pursue a degree in Environmental Science with a Geology Concentration. We do not anticipate that any additional geology sections will be required; therefore, the Geology Department will not be burdened with any significant increase in terms of the need for additional space or additional personnel.

Department of Computer Science and Engineering

The addition of Computer Science 150 to the proposed concentration should boost enrollment in the course by no more than 5-10 students per year, initially. It is not anticipated, however, that additional sections will be required; therefore, this department, like the other departments, will not be expected to provide additional space or additional personnel. Additionally, we understand that the mathematics requirement for CPSE 150 is UTC Math Placement 30 or Math 131 or Math 144. To alleviate concerns from

Computer Science and Engineering, we will require our student to meet this requirement prior to enrollment in CPSE 150 as explicitly stated in the catalog.

Table 1. Current and Proposed ESC core and Geographic and Cartographic Sciences Concentration

Current BS degree in ESC with a Concentration in Geography	<i>Proposed BS degree in ESC with a Concentration in Geographic and Cartographic Sciences</i>
<p>English 278 Mathematics 131 and 136 ESC 150, 151, 410, 484 Bio 306 and 307 Geography 221</p> <p>(Select 1) ESC 407, 430, Soc 209, Communications 410, or Economics 430</p> <p>(Select 1) Bio 251, ESC 240, 250, 406, 440, 460, ESC/Geology 225, Geology 436, or Geology 445</p> <p>(Select 1) ESC 340, 360, Environmental Engineering 431, Geography 465, or Geography 466</p> <p>Senior Experience (2 credit minimum): ESC 480, 490, 491r, 495r, 496r, 497r, 498r</p> <p>Three lab courses above the 100 level from either the core or concentration requirements</p>	<p>English 278 Mathematics 131 and 136 ESC 150, 151, 410, 484 Bio 306 and 307 Geography 221</p> <p>(Select 1) ESC 407, 430, Soc 209, Communications 410, or Economics 430</p> <p>(Select 1) Bio 251, ESC 240, 250, 406, 440, 460, ESC/Geology 225, Geology 436, or Geology 445</p> <p>(Select 1) ESC 340, 360, Environmental Engineering 431, Geography 465, or Geography 466</p> <p>Senior Experience (2 credit minimum): ESC 480, 490, 491r, 492, 495r, 496r, 497r, 498r, (ESC 492 is required for all students selecting a concentration in Geographic and Cartographic sciences)</p> <p>Three lab courses above the 100 level from either the core or concentration requirements</p>
<u>Current Concentration in Geography</u>	<i><u>Proposed Concentration in Geographic and Cartographic sciences</u></i>
<p>Sociology 151, 209, 314 Geology 111/181, 112/182</p> <p>21 hours from Geography, 9 of which must be at the upper level. These hours are additional to any geography hours taken as part of the 30 hours required of all ESC majors. With the approval of the Biology/Environmental Science department head, Geology 307 or Biology 416 or an upper level ESC course may be substituted for 3 hours.</p>	<p>Geography 101, 103 (Select 1) Geology 108, Geography 206, Astronomy 101/181, or ESC/GEOL 225/226 (Select 3) Geography 303, 304, 305, 306, 307 Geology 111/181 Computer Science 150 Biology 416 ESC 340 ESC/Geography 465, ESC/Geography 466</p>

To Curriculum Committee Chair

From: Thomas P. Wilson, Bradley Reynolds (Dept. Biology and Environmental Sciences) and Andrew Carroll (ARCS)

RE: A Revision of Requirements for the Geographic Information Science Minor in Environmental Science

Date: October 30, 2008

The Department of Biological and Environmental Sciences requests to change the current ESC Geographic Information Science minor to include computer science, statistics and mathematics. Specifically, this request is done in response to making our Minor more relevant to the spatial sciences and one that provides a broad foundation in quantitative skill sets. Upon approval of the requested change our students will have access to the necessary frame work to excel in this field of study.

A Revision of Requirements for the Geographic Information Science Minor in
Environmental Science

a) Catalog Description of the Current Geographic Information Science Minor

18 hours not applicable toward a major in Environmental Science including Geography/Environmental Science 465, 466; one course from Biology 216, Mathematics 210, or Psychology 201/204, and remaining hours from Environmental Studies 498r, Geography 221, Geology 454.

Minimum 8 hours at the 300-400 level

Minimum 2.0 average in courses attempted for the minor.

a) The Proposed Geographic Information Science Minor

Mathematics 136

Computer Science 150

Geography 221

ESC/Geography 465, ESC/Geography 466

ESC 492 (see below and attached proposal)

Minimum 2.0 average in courses attempted for the minor.

b) A Rationale for a Revised Geographic Information Science Minor

The Department of Biological and Environmental Sciences currently offers a Minor in Geographic Information Science that needs to be updated. Specifically, we do not require any mathematical or computer based skills beyond what most students attain as part of their General Education requirements, and in order to be successful a working knowledge of mathematics and computer science is essential to mastering the geospatial technologies. In recent years, the national and global trend has been towards integrating

our daily lives with the usage of geospatial related technologies and geographic information which relies heavily on the use of computer-based programs and models (e.g., Arc/GIS, ERDAS Imagine, and SAS just to name a few). Other current trends include an enormous demand for GIS professionals and an impressive increase in the availability and utilization of Geospatial data related to the Natural World. As a result, the Department of Biological and Environmental Sciences desires to incorporate more mathematics and computer science into the current GIS Minor. The Department of Biological and Environmental Sciences believes that a more quantitative curriculum emphasizing mathematics and computer science as a part of the Geographic Information Science Minor will be of greater value to our students and they will more effectively meet the needs of prospective employers and post-graduate programs. In short, the demand for Geospatial professionals nationwide, and internationally is already very high and will no doubt continue to rise rapidly in the near future. The Biological and Environmental Sciences Department must make this change in order for our students to be competitive, current, and relevant.

Therefore, we propose that Geology 454 (Geologic Mapping) no longer be required in the revised minor. We recognize that this course is valuable; however, deletion of this course can be easily justified because it has not been taught in the last eight years and there are no plans to offer Geology 454 at any time in the near future. We also request that the statistics requirement be deleted from the language contained within description of the current minor. Specifically, we feel that this language is redundant because all students are required to take at least one approved course in statistics as part of their General Education Requirements; by deleting this language it allows us to substitute the statistics requirement for an additional course in mathematics (e.g., MATH 136).

Of course, for students to have the background to succeed in the Geospatial Sciences, it would be helpful for each student to be comfortable with computers and competent with computer software. Remote sensing and GIS are both computer-driven technologies; therefore, a working knowledge of mathematics, computers, and computer software is crucial. With that in mind, we would like to add Mathematics 136 and Computer Science 150 to the Geographic Information Science minor. Students that take Mathematics 136 and Computer Science 150 prior to taking ESC/Geography 465 and ESC/Geography 466 will find both courses much more manageable and understandable. The instructors that teach ESC/Geography 465 and ESC/Geography 466 will no doubt benefit by the students having to take these courses. Specifically, instructors teaching ESC/Geography 465 and ESC/Geography 466 to students that have had some additional mathematics and computer experience will simply have more time in class to cover key remote-sensing and GIS concepts.

Finally, we would like to delete Environmental Studies 498r from the current language and propose a new course (see attached) to replace ESC 498r. This new course would essentially serve as a capstone applications course for the GIS minor, and it would be entitled “Applications of Remote Sensing and Geographic Information Systems” (ESC 492). In ESC 492, students will be able to apply their new real-world skills to actual

environmental problems and scenarios. Senior level students would be challenged to use aerial photography and digital data for practical applications. This course would basically simulate what it would be like to use remote sensing and GIS within the professional world. ESC 492 would serve to strengthen the students' newly acquired spatial science skills even further. In addition to the hands-on field collection of spatial data and the subsequent analysis of that data, relevant field trips and appropriate guest speakers will play a central role in the course. This course would be open to all students meeting the necessary prerequisites (Math 136, Math 210 (or similar), Geography 221, Computer Science 150, ESC/Geography 465, ESC/Geography 466, 90 hours, and one year of science).

c) Analysis of the Economic/Pedagogical Consequences of the Proposed Concentration

Students that select the revised GIS Minor would be confident that they are pursuing a curriculum that is both relevant and current in focus. They would be confident that the skills they are developing in the pursuit of the concentration will serve them well should they venture into the professional world in order to find employment within the field of Geospatial technology. Not only will the GIS minor make our students more technologically proficient, they would be more competitive for the growing job market.

The revised Minor would not have any impact on the ability of students to complete the degree requirements in a timely manner. The current Minor requires 18 hours of course work and there is no difference in the total number of hours required for the revised Minor; however, we are adding Mathematics 136, Computer Science 150 and ESC 492 to the required list of courses. Although there is no difference in the total number of hours required, it is essential, due to the technical nature of several of the courses, that some of the courses in the revised Minor be taken in the appropriate sequence with the appropriate prerequisites fulfilled. As with any Minor, proper planning on the part of the students and their advisors will be crucial to a timely completion of an Environmental Science Minor in Geographic Information Science.

d) Impact on other Departments

How will this new concentration potentially affect other departments and programs? Obviously, several other programs will be somewhat affected and all too varying degrees.

Department of Sociology, Anthropology, and Geography

As for Geography, we anticipate that there will be very little change in terms of overall enrollment. Currently, students with a minor in GIS are required to take 18 hours including Geography 221, ESC/Geography 465, and 466. Because the total number of geography hours required will not be altered, we anticipate that any effect on enrollment within geography will be negligible. We do not anticipate that any additional geography sections will be required; therefore, the Geography Department will not be burdened with any significant increase in terms of the need for additional space or additional personnel. In fact, the burden for teaching the key spatial science courses cross-listed as both ESC

and Geography (465, 466, 561 and the spatial science capstone course numbered ESC 492) will fall solely the Environmental Science Department. Dr. Thomas P. Wilson is of course one of the authors of this curriculum proposal and is already responsible for teaching several of these courses (although Dr. Gary Litchford, professor emeritus, could teach the courses as well, along with at least two other members of the Biological and Environmental Sciences Department). It should also be noted that any additional space or equipment demands will be greatly alleviated by ARCS (Academic and Research Computing Services). ARCS provides the necessary support and assistance to aid UTC faculty, students, and staff make effective and secure use of GIS related technology in their teaching and research. The ARCS Department is aware of and supports this proposed change.

Department of Mathematics

The addition of Mathematics 136 to the revised minor should boost enrollment in this course. However, it is not anticipated that additional sections will be required. We believe that this department, like the other departments, will not be expected to provide additional space or additional personnel.

Department of Computer Science and Engineering

The addition of Computer Science 150 to the proposed concentration should boost enrollment in the course by no more than 5-10 students per year, initially. It is not anticipated, however, that additional sections will be required; therefore, this department, like the other departments, will not be expected to provide additional space or additional personnel. Additionally, we understand that the mathematics requirement for CPSE 150 is UTC Math Placement 30 or Math 131 or Math 144. To alleviate concerns from Computer Science and Engineering, we will require our student to meet this requirement prior to enrollment in CPSE 150 as explicitly stated in the catalog.

Department of Physics, Geology, and Astronomy

We propose that Geology 454 (Geologic Mapping) no longer be required in the revised minor. We recognize that this course is valuable; however, deletion of this course can be easily justified because it has not been taught in the last eight years and there are no plans to offer Geology 454 at any time in the near future.

Table 2. Current and Proposed changes to the ESC minor in GIS.

<u>Current Minor in Geographic Information Science</u>	<u>Proposed Revisions for the Geographic Information Science Minor</u>
<p>18 hours not applicable toward a major in Environmental Science including Geography/Environmental Science 465, 466; one course from Biology 216, Mathematics 210, or Psychology 201/204, and remaining hours from Environmental Studies 498r, Geography 221, Geology 454. Minimum 8 hours at the 300-400 level Minimum 2.0 average in courses attempted for the minor.</p>	<p>Mathematics 136 Computer Science 150 Geography 221 ESC/Geography 465, ESC/Geography 466 ESC 492 (see below and attached proposal) <i>Minimum 2.0 average in courses attempted for the minor.</i></p>

Table 3. Proposed (recommended) student schedule concerning courses required for the revised ESC-GECA concentration and ESC-GIS minor.

<p><u>FALL 2009</u> GEOG 221(Every Semester) GEOG 101 (Every Semester)</p>	<p><u>SPRING 2010</u> MATH 210 (Every Semester) GEOG 103(Every Semester)</p>
<p><u>FALL 2010</u> MATH 136 (or MATH requirement for respective major and concentration) Atmospheric, Weather, Climate Block (GEOG 206, ASTR 101/181, GEOL 108, ESC/GEOL 225/226) or during SPRING 2011 GEOL 111/181 (or Spring 2011)</p>	<p><u>SPRING 2011</u> CPSC 150 GEOL 111/181 (or GEOL 111/181) Atmospheric, Weather, Climate Block (GEOG 206, ASTR 101/181, GEOL 108, ESC/GEOL 225/226) or during FALL 2010</p>
<p><u>FALL 2011</u> ESC 465 GEOG Elective 300-400 ESC 340</p>	<p><u>SPRING 2012</u> ESC 466 GEOG Elective 300-400</p>
<p><u>FALL 2012</u> ESC 492 GECA Practicum (Senior Year) BIOL 416 (Every Fall Semester)</p>	<p><u>SPRING 2013</u></p>
	<p>GEOG Elective 300-400</p>