Proposed Bachelor of Science in Sustainability Science

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Motivation

A sustainable world is often described as one capable of meeting the needs of the present generation, as well as those yet to come. UN Secretary-General Ban Ki-moon states that defining what such a world should look like and developing strategies to create such a world is the "central challenge of our times"—a challenge that encapsulates many of the most pressing threats facing humans and the planet. Climate change, access to sufficient food, clean water, healthy air, safe and reliable energy, long-term economic wellbeing, equity, responsibility to other species, and conflict over limited resources are all central to the concept of sustainability.

While sustainability is a laudable goal, it raises many complex questions. How, for example, do we define "need"? Is it simply what humans need to survive: water that is safe to drink, air that is safe to breathe, and sufficient food? Is there a "quality of life" threshold that must be met? Is "need" universally defined or does it vary by place, time, and culture? How can we know what will be "needed" by future generations? What decisions do we make to produce sustainable outcomes and how do we measure success?

To meet the sustainability challenge, we need to produce scientists and leaders who can address these questions. These individuals must be able to 1) understand the complex processes that connect humans to natural systems, 2) analyze the potential impact of decisions given competing information, perceptions and goals, and 3) communicate the importance of sustainability science and management to leaders and the public.

We propose a new major in Sustainability Science that

- **is built at the intersection of existing strengths in human-environmental interaction, decision-making, and spatial analysis, and**
- **complements existing programs in Environmental Sciences, Environmental Policy and Planning, Geography and Environmental Engineering.**

Guiding principles

In the most general sense, a sustainable world is one in which key environmental, social, and economic systems remain vital and productive through time—the so-called triple bottom line of sustainability. Through a sustainability lens, managers recognize and seek to support the interdependency of these systems, as well as the need for equity and respect among diverse cultures and regions. Sustainability science is, therefore, the study of complex interacting processes that operate across time and space and directly impact the long-term well-being of humankind. This is a challenging science indeed. However, even at the undergraduate level we can prepare students to enter a world that increasingly recognizes and prioritizes sustainable outcomes.

The proposed sustainability major will be interdisciplinary and focused on the complex connections that link humans to the biophysical systems on which we rely. It will be taught as a systems science, thus providing the pedagogical framework needed to understand complex interactions among system components. While the program will grow and evolve with the science and the profession of sustainability, it will consistently meet the growing demand for students trained to: 1) address the complex problems emerging from growing populations and increasingly stressed resources, 2) adapt and flourish in a rapidly changing world, and 3) work toward a better tomorrow. As a major university in the twenty-first century we must evolve to meet this demand. While traditional disciplines provide the footings on which academic institutions are built, bridging infrastructure is needed to tie disciplines, people, and knowledge together in new and flexible ways; in this case, in ways that reflect the system connections that drive sustainability science. Similarly, this proposed major will begin to build bridges between academia and on-the-ground systems management, an area of critical need if we are to implement sustainability in real-world settings.

Intended Audience—Ambassadors for the Future

In a 2005 interview the one time UI Writer's Workshop instructor Kurt Vonnegut noted that *"one thing that no cabinet had ever had, is a Secretary of the Future"* (http://www.pbs.org/now/transcript/transcriptNOW140_full.html).
He went on to discuss the irreparable damage we are causing to the earth as a life support system for humans and, thus, failing to ensure the wellbeing of future generations.

Through this program we seek to cultivate students who are forward thinking, able to envision a future with equity, high environmental quality, and economic opportunity, and have the drive and ability to work toward that future. Upon completion of the Sustainability Science major, students will be well equipped to be UI's ambassadors for the future.

These students must be able to work across the social, physical, and mathematical disciplines, making the interdisciplinary sustainability science program challenging, but also important and rewarding. The program seeks motivated, high-achieving students who want to have a positive impact on science and humanity. This program will offer students relevant real-world experiences (e.g., study abroad, community outreach) as well as an academically rigorous curriculum. The program is designed to provide a solid foundation for sustainability related fields and, while not required, it is expected that many students will go on to graduate school and, perhaps, specialize in one of the fields of focus in this program.

Estimating demand is challenging, particularly when considering a program in an area that is still emerging, like sustainability science. The rapid rise in the UI certificate, as well as the number of new sustainability programs at peer institutions illustrates significant interest in such programs. While we are not expecting that this program will necessarily evolve into a huge new environmental degree program, we do believe that it will: 1) fill an important educational niche statewide, 2) produce students capable of having positive impacts on society, and 3) grow and adapt in response to interest in sustainability science. Estimated enrollment is as follows:

Undergraduate	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Majors	15	25	30	35	40	50	50

Relation to other UI programs and salience to the institution

There are several other programs concerned with environmental topics on the UI Campus. These include: The Environmental Sciences baccalaureate degree, focused on natural processes, the Environmental Policy and Planning (EPPL) baccalaureate degree, focused on human processes, the Geography: Environmental Studies track baccalaureate degree, focused on human-environmental interaction, and the Sustainability Certificate, presenting a broad survey of related issues and concepts from a range of perspectives.

This proposed major goes directly at the core of sustainability through a STEM-based approach focused at the intersection of natural and human processes. It will be highly integrative, systems-based, forward looking, problem-driven and designed for students who plan to attend graduate school. Particularly at the beginning, the program will be small by design.

Quantifying the relations among programs is challenging because of the way in which required and elective courses enter into degree requirements. For example, two programs that share the same required course can be considered to have more in common, in practice, than two where the common course is an elective offered as an option among two choices. The overlap further decreases when the course in common is selected from a set of 20 elective course (i.e., the probability of overlap decreases with the number of options offered). To evaluate the relation between the proposed program and existing programs, as well as that among existing programs, we conducted an analysis with these challenges in mind. The results are presented in Appendix B. From this analysis we can conclude that the degree of overlap between the proposed program and existing programs is essentially the same as that which occurs among exiting programs. It is not surprising that some overlap exists because these programs share a common foundation in environmental processes. The number of required courses in common is quite low, however, and much of the overlap that does exist is in electives where the set of common courses is small compared to the number of options (i.e., the probability of actual overlap is low). Looking more closely at the courses that comprise these programs we see a continuum from, for example, the Environmental Science- Chemistry track, which is highly focused on natural science, to the EPPL-Policy track, which is highly focused on social science. The Sustainability Science major lies squarely in the middle as a rigorous STEM-based degree that integrates the natural and social sciences. Of the degrees listed above the new program will be most similar to Geography's Environmental Studies track, but it will have a significantly greater focus on STEM, research experience, and systems-based science.

The University of Iowa is uniquely positioned as an institution to support an interdisciplinary major in sustainability for the following reasons:

1. The University of Iowa recently completed a cluster hire in the area of water sustainability. This program brought ten highly qualified early and mid-career faculty to campus in a variety of disciplines. This community of faculty, together with existing faculty in multiple departments interested in sustainability issues, provide a solid foundation on which to build sustainability programs.

2. The University of Iowa has a long history of expertise and innovative research in the area of geographic information science and spatial decision support. This expertise provides students with an opportunity to learn about and apply cutting edge computer technology directly to sustainability and environmental problem solving.
3. The University of Iowa houses the Water Sustainability Initiative, Iowa Flood Center, Iowa Informatics Initiative, and the Iowa Initiative for Sustainable Communities, all of which provide unique opportunities for students to participate in outreach and sustainability research.
4. The University of Iowa Office of Sustainability and the Environment was recently moved to the College of Liberal Art and Sciences to provide a campus hub for sustainability education, research, and outreach and to help establish UI as a national leader in sustainability science. The Office offers a unique opportunity to coordinate and grow related programs.
5. The University of Iowa has many faculty conducting basic research in areas of sustainability science. Participating faculty are engaged in externally funded projects related to urban systems, natural systems, and coupled human and natural systems. Again, providing exciting opportunities for students to participate in basic and applied research.

Relation to programs at other Iowa universities and peer institutions

No Regent university currently offers an undergraduate bachelor's degree in sustainability. Iowa State University offers MS and Ph.D. degrees in sustainable agriculture, a Master of Design in Sustainable Environments degree, and an interdisciplinary minor in sustainability. The University of Northern Iowa offers a concentration in Environmental Systems and Sustainability within the Geography BA major as well as a sustainability certificate.

Thirteen of the state's 34 not-for-profit private universities have environmental studies or environmental science programs. Only one, Drake University, has developed a major specifically in sustainability. Drake's Sustainability and Resilience major is described as an interdisciplinary, system-based and problem oriented approach. There are three elements that will set our proposed program apart from Drake's:

1. An emphasis on a STEM-based, quantitative analysis of complex problems. GIS, statistics, and computer modeling are integral to the program.
2. A connection to ongoing sustainability related research conducted by UI faculty.
3. A connection to the outstanding outreach being conducted by the Iowa Institute for Sustainable Communities (IISC). This provides exciting opportunities for students to engage in applied research and make a valuable contribution back to Iowa on issues related to sustainability.

While few options exist in Iowa to major in the area of sustainability, several notable peer institutions have recently added similar programs. Examples include:

1. UIUC, BS in Earth, Society, and Environmental Sustainability
2. Ohio State University, BA in Environment, Economy, Development, and Sustainability
3. Michigan State University, Environmental Studies and Sustainability

4. Arizona State University, BA and BS in Sustainability
5. Penn State University, BA and BS in Energy and Sustainability
6. Columbia University, BA in Sustainable Development
7. Colorado State University, BS in Ecosystem Science and Sustainability
8. McGill University, BA and BS in Sustainability, Science, and Society
9. Johns Hopkins, BA in Global Environmental Change and Sustainability
10. University of Texas at Austin, BA in Sustainability Studies
11. University of Florida, BA in Sustainability Studies
12. Cornell University, Environmental and Sustainability Sciences
13. Washington University, BS in Sustainability
14. Oklahoma University, BA and BS in Environmental Sustainability

Other peer institutions are following this trend as well. For example, the School of Natural Resources and Environment at the University of Michigan was recently renamed the School for Environment and Sustainability, and the University of Minnesota and University of Wisconsin have developed sustainability certificates. A common theme among these programs is that they are interdisciplinary and systems-based.

Workforce development and career opportunities

In Iowa, we have known challenges associated with water quality, habitat diversity, air quality, a changing climate, and struggling rural communities, but we also have significant opportunities in the area of renewable energy, reconnecting farm and community, and the development of more sustainable urban communities. A knowledgeable workforce is needed to address challenges as well as capitalize on opportunities. This degree is designed to provide students with the knowledge and skills needed to help build a better, more sustainable future in Iowa, the U.S. and the world.

According to the Bureau of Labor Statistics employment opportunities for individuals with training in the environmental area will grow by 11% between 2014 and 2024, faster than the national average. This degree also provide entry into related careers, as such urban and regional planning (projected growth of 6%, as fast as average), conservation (projected growth of 7%, as fast as average), and geospatial technologies (projected growth of 29%, much faster than the national average). Increasingly, an advanced degree is needed for employment or advancement in many of the above occupations. The proposed program is designed to provide a solid foundation of theoretical knowledge, analytical ability, and problem solving experience on which a successful graduate program of study can be built. We expect that many students who complete this degree will proceed onto a graduate program in a related field (e.g., geography, ecology, resource economics, law, sustainability science).

Administration

Environmental and sustainability issues cut across disciplinary boundaries. To produce students capable of addressing associated challenges faculty from multiple departments at The University of Iowa are working together to develop a coordinated approach to environmental

and sustainability education and, thus, leverage campus-wide expertise. The Environmental Sciences and EPPL degrees, and the Sustainability Certificate are products of this joint effort. Through such cooperation our goal is to strengthen UI's position as a national leader in sustainability and environmental education and research.

As we move forward, continued coordination and collaboration will be critical to: 1) insure each program fills an important and unique educational niche, 2) collectively, we meet the educational needs of environmental and sustainability sciences students in the most efficacious manner possible, and 3) make effective use of faculty time.

The Environmental Sciences and EPPL programs provide a blueprint for the administration of the Sustainability Science major. For these programs, advisory committees comprised of faculty representatives from participating departments oversee curricular matters. Suggested changes to the curriculum are reviewed and, if deemed practicable, implemented by the administrative home department. The Environmental Sciences program also convenes an executive committee comprised of DEOs from participating departments. An advisory and executive committee will be formed to coordinate departments participating in the Sustainability Science major.

The Department of Geographical and Sustainability Sciences administers the EPPL program and the Department of Earth and Environmental Sciences administers the Environmental Science program. The Department of Geographical and Sustainability Sciences will be the administrative home for the new major. Initial participating departments include Geographical and Sustainability Sciences, Earth and Environmental Sciences and Biology.

Advising

Upon entering the program, students will be advised by a CLAS professional advisor. This advisor will meet with sustainability science students at least once per semester to help in course selection and ensure they stay on track for graduation in eight semesters. Preferably, the same advisor would also assist EPPL, Environmental Sciences, and Geography majors to help students understand the differences and similarities among the environmentally focused majors and, thus, make more informed decisions.

A faculty mentor will be appointed to students based on their interests within sustainability. Interaction with this mentor will be encouraged but voluntary up to 75 s.h. After the first semester of their 3rd year advice concerning career and graduate school options become particularly important. For this reason, students will be required to meet with their mentors at least once each semester before registration for the subsequent semester will be authorized.

Outcomes assessment

As suggested above, the grand challenges facing humankind are increasingly complex and those who strive to address them must possess knowledge that crosses traditional disciplinary bounds as well as the ability to integrate and adapt concepts and techniques, think critically,

solve problems, communicate well in written and verbal form, and learn throughout their careers. This is a lot to roll into one undergraduate major. We will lay the foundation on which to build such individuals. This will occur through a balance of theory, active learning opportunities, concepts and applied methods and tools. In addition to traditional readings and lectures, students will confront (near) real-world problems through laboratories exercises as well as internships and projects that require discussion and engagement with peers and members of the community. Student success and progress will be monitored by the advisor, mentors, and the Advisory Committee. Evaluation at the programmatic level is the responsibility of the Advisory Committee. Learning outcomes include:

1. A foundational understanding of human system dynamics
2. A foundational understanding of natural system dynamics
3. A foundational understanding of the linkages between 1 and 2
4. A foundational understanding of analytical techniques used to study issues related to sustainability
5. Demonstrated ability to synthesize understanding from 1-4, think critically and problem solve
6. Demonstrated ability to communicate complex ideas and tasks

Success in coursework provides an initial evaluation of learning outcomes for 1-4. To evaluate success in meeting desired outcomes 5 and 6, mentors will provide an assessment of student portfolios produced as part of the Sustainability Science Seminar. These assessments will be reviewed by the Advisory Committee who will use the information generated as they evaluate curricular needs.

Duplication of credentials and credit hours

Students earning a degree in Sustainability Science may earn a second degree in EPPL, Environmental Sciences, or Geography. However, no more than 6 sh may double count for majors, or 3 sh for minors (General Education courses not included). Students earning a Sustainability Science major will not be eligible for a Sustainability Certificate.

Honors in the major

A BS with honors in Sustainability will be offered. This would require a 3.33 UI and major GPA, 6 sh of research/internship hours, and the successful completion of an honors thesis (document and presentation).

Four-year graduation plan

The Sustainability Science major will participate in the four-year graduation plan. Appendix A presents an example course sequence that ensures completion in eight semesters.

BA and minor

A BA degree is not suitable for this major. A minor is not requested at this time but may be considered in the future.

PROPOSED CURRICULUM

A total of 67-69 semester hours (sh) are required to complete this major.

CORE COURSES (minimum of 28-30 sh)

At the core of the degree is a suite of nine courses that introduce students to key elements of sustainability science.

Sustainability science

SUST:2013	Intro to Sustainability Science (currently GEOG)	3 sh
GEOG:3340	Ecosystem Services	3 sh
SUST:NEW	Sustainability as a System Science	3 sh
OR		
CEE:4410	Sustainable Systems	3 sh

Natural systems

CHEM:1070	General Chemistry 1	3 sh
OR		
CHEM:1110	Principles of Chemistry	4 sh
EES:1085	Foundations of Env Sci	4 sh
OR		
GEOG:1020	Global Environment	3 sh
BIOL:2673	Ecology	3 sh
OR		
SUST:3NEW	Ecosystem Ecology	3 sh

Human systems

GEOG:2100	7 Billion & Counting: Intro Pop Dynamics	3 sh
GEOG:3800	Environmental Economics and Policy	3 sh
GEOG:4770	Environmental Justice	3 sh
OR		
POLI:2417	Contemporary Environmental Policy	3 sh

Sustainability Sciences Seminar

SUST:3NEW	Sustainability Science Seminar (potentially merged or co-taught with ENVS:3001)	1 sh

ANALYTICAL TOOLS (a minimum of 13 sh)

Solid analytical skills are needed to address sustainability problems.

All of the following:

GEOG:1050	Foundations of GIS	3 sh
STAT:2010	Statistical Methods and Computing	3 sh

STAT:3200	Applied Linear Regression	3 sh

And one of these:

CS:1210	Computer Science I: Fundamentals	4 sh
CS:2110	Programming for Informatics	4 sh
MATH:1460	Calculus for the Biological Sciences	4 sh
MATH:1380	Calculus and Matrix Algebra for Business	4 sh

COMMUNICATION (a minimum of 2 sh)

One of the following:

JMC:3185	Risk Communication	3 sh
JMC:NEW	Intro to Science and Env Communication	3 sh
WRIT:2600	Science Communication I: Fundamentals of Science Communication	2 sh
WRIT:2601	Science Communication II: Science Outreach and Engagement	2 sh
CNW:2730	The Art and Craft of Science Writing	3 sh
CNW:2740	The Art and Craft of Writing about the Environment	3 sh
CNW:3664	Writing About Science	3 sh
POLI:3107	Writing in Political Science: Writing for "Science" and for "Politics"	3 sh

RESEARCH/INTERNSHIP EXPERIENCE (a minimum of 3 sh)

This requirement can be met through active participation on research with faculty, an internship at a public or private agency, or an honors thesis. An additional 3 sh of research experience can be applied to the ***Electives*** requirements.

EQUITY/ETHICS/EQUALITY (a minimum of 3 sh)

One of the following:

GEOG:4770	Environmental Justice	3 sh
SOC:1219	Big Ideas: Equality, Opportunity, & Public Policy	3 sh
SOC:1022	Social Justice and Social Welfare in US	3 sh
PHIL:2402	Introduction to Ethics	3 s.h

ELECTIVES (a minimum of 18 sh)

The required core courses insure breadth across concepts relevant to sustainability science. Through the selection of elective requirements students can gain depth in areas of interest or continue to build a strong broad platform on which to build subsequent academic or professional careers. Students must take at least 12 hours of course work >=3000 level. Students may choose to take 12 sh in one of the following four focal areas or develop their own plan of study. By generating their own plan of study, students have the flexibility to customize the program to meet their educational goals. Students must consult with their faculty mentor as they develop

and fine tune their plan of study. The original plan, as well as subsequent changes, must be approved by the Sustainability Advisory Committee.

Natural systems

GEOG:2374	Biogeography	3 sh
BIOL:2673	Ecology	3 sh
GEOG:3310	Landscape Ecology	3 sh
GEOG:4010	Field Methods in Physical Geography	3 sh
IALL:XXXX	Approved Lakeside Lab courses	3 sh
ENVS:3095	Field Ecology	3 sh
EES:4700	Evolution of Ecosystems	3 sh
GEOG:3350	Urban Ecology	3 sh

Human systems

POLI: 2417	Contemporary Enviro Policy	3 sh
GEOG:4770	Environmental Justice	3 sh
ANTH:2100	Anthropology and Contemporary World Problems	3 sh
URP:3001	Planning Livable Cities	3 sh
GEOG:3780:	U.S. Energy	3 sh
GEOG:4750	Environmental Impact Analysis	3 sh
ECON:3650	Policy Analysis	3 sh
POLI: 3126	Environmental Policy	3 sh
ENTR:3700	Sustainable Product Innovation & Management	3 sh

Integrated natural and human system

GEOG:2950	Environmental Conservation	3 sh
GEOG:2930	Water Resources	3 sh
ANTH:2261	Human Impacts on the Environments	3 sh
GEOG:3331	Human Dimensions of Climate	3 sh
GEOG:3760	Hazards and Society	3 sh

Analytical methods and decision support

CS:1110	Introduction to Computer Science	3 sh
CS:1210	Computer Science I: Fundamentals	4 sh
CS:2110	Programming for Informatics	4 sh
CS: 2230	Computer Science II: Data Structures	4 sh
CS:3210	Programming Languages and Tools	3 sh
MSCI:4480	Knowledge Discovery	3 sh
CS:4720	Optimization Techniques Programming	3 sh
MSCI:3005	Information Systems	3 sh
MSCI:3200	Database Management	3 sh
MSCI:3800	Optimization and Simulation Modeling	3 sh
GEOG:3540:	Introduction to Revisualization	3 sh
GEOG:3500	Introduction to Environ Remote Sensing	3 sh

GEOG:3520	GIS for Environmental Studies	3 sh
GEOG:4150	Health and Environment: GIS Applications	3 sh
GEOG:4580	Introduction to Geographic Databases	3 sh
GEOG:4650	Simulation in Environmental Geography	3 sh
GEOG:NEW	Programming for GIS	3 sh

Appendix A: Example Plan of Study

Sustainability BS, Sample Plan of Study		
Year 1, Fall Semester		**Hours**
GEOG:1070	Contemporary Environmental Issues (GE International and Global Studies)	3
FREN:1007	Nature/Ecology French Philosophy & Fiction (GE Interpretation of Literature)	3
CHEM:1070	General Chemistry I (GE Natural Sciences without lab)	3
HIST:1040	The Modern World (GE Historical Perspectives)	3
SPAN:1003	Elementary Spanish Review (GE World Languages)	5
	Hours	17

Sustainability BS, Sample Plan of Study		
Year 1, Spring Semester		**Hours**
GEOG:2110	7 Billion and Counting (GE Social Sciences)	3
GEOG:1020	Global Environment (GE Natural Sciences with lab)	4
SPAN:1501	Intermediate Spanish I (GE World Languages)	5
RHET:1030	Rhetoric (GE Rhetoric)	4
	Hours	16

Sustainability BS, Sample Plan of Study

Year 2, Fall Semester		Hours
SUST:2013	Introduction to Sustainability Science	3
MATH:1460	Calk for the Biological Sciences (GE Quantitative or Formal Reasoning)*	4
GEOG:1050	Foundations of GIS	3
SPAN:1502	Intermediate Spanish II (GE World Languages)	5
	Hours	15

Sustainability BS, Sample Plan of Study

Year 2, Spring Semester		Hours
JMC:3185	Risk Communication	3
STAT:2010	Statistical Methods and Computing	3
BIOL:1411	Foundations of Biology	4
POLI: 2417	Contemporary Enviro Policy	3
GEOG:2950	Environmental Conservation	3
	Hours	16

* Assumes ALEKS score >= 55

Sustainability BS, Sample Plan of Study

Year 3, Fall Semester		Hours
GEOG:4770	Environmental Justice	3
GEOG:3340	Ecosystem Services	3
STAT:3200	Applied Linear Regression	3
BIOL:1412	Diversity of Form and Function	4
GEOG:3520	GIS for Environmental Studies	3
	Hours	16

Sustainability BS, Sample Plan of Study

Year 3, Spring Semester		Hours
GWSS:1002	Diversity and Power in the US (GE Values and Culture)	3
BIOL:2673	Ecology	3
GEOG:3800	Environmental Economics and Policy	3
CEE:4410	Sustainable Systems	3
GEOG:3540	Introduction to Geovisualization	3
SUST:NEW	Sustainability Science Seminar	1
	Hours	16

Sustainability BS, Sample Plan of Study

Year 4, Fall Semester		Hours
GEOG:3350	Urban Ecology	3
GEOG:3760	Hazards and Society	3
ARTH:1030	Art of Africa (GE Literary, Visual, and Performing Arts)	3
GEOG:NEW	Environmental Economics II	3
GEOG:3992	Research/Internship	3
	Hours	15

Sustainability BS, Sample Plan of Study

Year 4, Spring Semester		Hours
URP:3001	Planning livable cities	3
SUST:NEW	Ecosystem Ecology	3
POLI:1800	Introduction to the Politics of Class and Inequality (GE Diversity and Inclusion)	3
GEOG:392	Research/Internship	3
	Elective	3
SUST:NEW	Sustainability Science Seminar	1
	Hours	16

Appendix B. Comparison to other UI programs

To evaluate how the proposed sustainability major compares to existing UI CLAS programs we constructed a series of cross-tabulations based on common coursework. We assumed that: 1) common required courses created the most programmatic overlap, 2) overlap decreased as the number of elective courses needed in a particular elective group decreased and the number of options in that group increased (e.g., an elective that required students to take 3 course out of a set of 8 options, presented a greater opportunity for overlap than an elective that required students to take 1 class out of a set of 11 options), and 3) 1st year courses (i.e., 1000 level) are largely taken as general education courses and did not contribute to overlap at the major level. We present the tables for those programs where overlap was greatest with the sustainability program. To assess the relative importance of this overlap we present analogous tables looking at the overlap among some of the existing programs. From these tables we see that the overlap in required course is quite low and that the overlap between the proposed major and existing majors is similar to that of the existing programs.

	Environmental Science: Green track					
		Required	Elective Grp 1 3 of 8*	Elective Grp 2 1 of 9	Elective Grp 3 1 of 6	Elective Grp 4 2 of 18
Sustainability	Required			1	1	
	Core (1 out of 2 options)			1		
	Elective (6 out 38 options)	1	3	1		2

* 3 of 8 means 3 elective must be selected out of a set of 8 alternatives

	Geography: Environmental Studies track				
		Required	Elective Grp 1 1 of 7	Elective Grp 2 1 of 11	Elective Grp 3 4 of 22
Sustainability	Required				1
	Elective (6 out 38 options)		1	1	10

	EPPL: Planning		
		Required	Elective Grp 1 3 of 11
Sustainability	Required		1
	Core (1 out of 2 options)		1
	Elective (6 out 38 options)	2	4

	Environmental Science: Green track					
		Required	Elective Grp 1 3 of 8	Elective Grp 2 1 of 9	Elective Grp 3 1 of 6	Elective Grp 4 2 of 18
Geography: Enviro Studies	Required					
	Elective 1 of 7		1			
	Elective 1 of 11		1			
	Elective 4 out 22 options)	1	1	4		3

	EPPL: Planning		
		Required	Elective Grp 1 3 of 11
Geography: Enviro Studies	Required		
	Elective 1 of 2		1
	Elective 1 of 11	1	1
	Elective (4 out 22 options)		6