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Cover Sheet for In-State Institutions
New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	Towson University

Each action below requires a separate proposal and cover sheet.

- (●) New Academic Program
- ( ) New Area of Concentration
- ( ) New Degree Level Approval
- ( ) New Stand-Alone Certificate
- ( ) Off Campus Program
- ( ) Substantial Change to a Degree Program
- ( ) Substantial Change to an Area of Concentration
- ( ) Substantial Change to a Certificate Program
- ( ) Cooperative Degree Program
- ( ) Offer Program at Regional Higher Education Center

Payment Submitted: (●) Yes ( ) No Payment Type: (●) R*STARS # JC089736 ( ) Check # JC089736 Payment Amount: $850 Date Submitted: 6/17/2024

Department Proposing Program	Environmental Science and Studies Program	
Degree Level and Degree Type	Doctor of Philosophy (Ph.D.)	
Title of Proposed Program	Sustainability and Environmental Change	
Total Number of Credits	60	
Suggested Codes	HEGIS: 420.02	CIP: 3.0103
Program Modality	(●) On-campus ( ) Distance Education (fully online) ( ) Both	
Program Resources	(●) Using Existing Resources ( ) Requiring New Resources	
Projected Implementation Date (must be 60 days from proposal submisison as per COMAR 13B.02.03.03)	(●) Fall ( ) Spring ( ) Summer	Year: 2024
Provide Link to Most Recent Academic Catalog	URL: https://catalog.towson.edu/graduate/	
Preferred Contact for this Proposal	Name: Rhodri Evans	
	Title: Assistant Provost for Assessment, Accreditation and Compliance	
	Phone: (410) 704-3312	
	Email: rhodrievans@towson.edu	
President/Chief Executive	Type Name: Mark R. Ginsberg	
	Signature: [signature]	Date: 06/17/2024
	Date of Approval/Endorsement by Governing Board:	

Revised 1/2021

TOWSON UNIVERSITY

Mark R. Ginsberg, Ph.D.
President

Office of the President
8000 York Road
Towson, MD 21252-0001

June 7, 2024

Sanjay Rai, Ph.D.
Secretary of Higher Education
Maryland Higher Education Commission
6 N. Liberty Street
Baltimore, MD 21201

Dear Dr. Rai:

Towson University seeks your review and approval to offer a **Doctor of Philosophy (Ph.D.) in Sustainability and Environmental Change** in accordance with the Code of Maryland Regulations (COMAR) 13B.02.03.06.

Please note that this program proposal was originally submitted to MHEC for review in 2023. At the request of MHEC, we subsequently withdrew the original proposal on July 31, 2023. TU now wishes to resubmit the program proposal. The curriculum in the attached proposal remains unchanged from the earlier 2023 proposal; however, other sections have been revised to clarify the distinct nature of TU's program.

The proposed program builds on TU's expertise in environmental science and studies and meets the need articulated in the University System of Maryland's Vision 2030 strategic plan to "advance our leadership in environmental sciences and deepen our international reputation for climate change and sustainability research."

If you have any questions or require additional information, please contact Rhodri Evans, Assistant Provost for Assessment, Accreditation and Compliance, at rhodrievans@towson.edu or by phone at 410-704-3312.

Thank you in advance for your review.

Sincerely,

Mark R. Ginsberg, Ph.D.
President

MG/rjme
cc: Dr. Candace Caraco, Associate Vice Chancellor for Academic Affairs, USM
Dr. Melanie L. Perreault, Provost and Executive Vice President for Academic Affairs
Dr. Clare N. Muhoro, Associate Provost for Academic Affairs
Dr. Sidd Kaza, Associate Provost for Research and Dean of Graduate Studies
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TOWSON UNIVERSITY

A PROPOSAL FOR A PH.D. IN
SUSTAINABILITY AND ENVIRONMENTAL CHANGE
AT TOWSON UNIVERSITY

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A. Centrality to Institutional Mission Statement and Planning Priorities

A1. Program Description and Alignment with Institutional Mission

Towson University (TU) proposes to create a Doctor of Philosophy (Ph.D.) in Sustainability and Environmental Change (SEC) degree to be housed in the Environmental Science and Studies Program (ENVS), which is an entity within the Jess and Mildred Fisher College of Science and Mathematics (FCSM). The new Ph.D. degree will draw on existing faculty expertise from the FCSM, the College of Liberal Arts, the College of Health Professions, and the College of Business and Economics. Since 1997, the ENVS Program has offered a Bachelor of Science (B.S.) in Environmental Science and Studies degree and a Master of Science (M.S.) in Environmental Science degree. The ENVS Program is inter- and multi-disciplinary, leveraging courses and faculty expertise from the aforementioned colleges at TU. The Ph.D. degree will build upon the success and expertise of our existing bachelor's and master's ENVS Program, amplifying TU's interdisciplinary research focus by addressing the most pressing environmental problems in the region and around the world.

The Ph.D. in SEC is a research program that will strengthen students' skills and deepen their understanding of sustainability issues and help generate novel solutions to environmental challenges. Students pursuing the Ph.D. will work closely with their faculty advisors and will become proficient in research methods and analyses relevant to their dissertation topics while also gaining exposure to diverse perspectives pertinent to addressing complex environmental problems. Students will engage with faculty and environmental professionals in identifying and pursuing research projects aimed at understanding how anthropogenic environmental change and sustainability practices are impacting both human and ecological systems.

The proposed Ph.D. in SEC will contribute to TU's momentum in centering diversity, equity, and inclusion at the core of our mission and will promote our goal of inclusive excellence through the development of academic programs that reflect the diversity of our student body, that of the state of Maryland, and the nation. This program will provide opportunities for students from groups historically underrepresented in the field of environmental sustainability and will create an inclusive learning and research environment in which all students thrive.

TU has demonstrated progress toward increasing diversity in environmental education, with 30 percent of ENVS undergraduates currently being from groups underrepresented in this field, while the proportion of ENVS master's students from underrepresented groups has increased from 8 percent to 19 percent over the last five years. These numbers are substantially above the national average of students from groups historically underrepresented in the environmental sciences and geosciences workforce, which was approximately 11 percent in 2017.[1] TU's goal for the proposed program is to build on these gains with the aim of enrolling students, notably through a pipeline from our undergraduate program, who better reflect the demographics of TU's student body, which is representative of Maryland's demographic population.

[1] Taylor. D.E., 2018, Enhancing racial diversity in the Association for Environmental Studies and Sciences, *Journal of Environmental Studies and Sciences,* volume 8, pp 379–384: https://link.springer.com/article/10.1007/s13412-018-0518-1.

The proposed Ph.D. degree will require a minimum of 60 credits, including nine credits of foundation courses, three credits of seminar courses, at least 24 credits of electives, three credits of dissertation proposal, and at least 21 credits of dissertation research. Students with a master's degree in a related field or with relevant graduate coursework can transfer up to 24 credits of coursework (typically as electives) into the Ph.D. degree; all transfer credits must be approved by the SEC Graduate Program Director. While coursework is foundational, the core component of a Ph.D. program is the student-research advisor relationship. The pursuit of a Ph.D. is analogous to an apprenticeship-like endeavor with students selecting a program and faculty research advisor based on the advisor's research program and expertise. Under the mentorship of their research advisor and dissertation committee, students will complete comprehensive examinations and defend a dissertation proposal, typically by the end of their second year of study. Given the core focus of the program is sustainability, the dissertation proposal and the dissertation must articulate how the research informs our understanding of environmental sustainability. The dissertation must be a significant contribution to knowledge and suitable for publication in one or more peer-reviewed outlets (e.g., journals and/or book chapters).

This doctoral program in Sustainability and Environmental Change seeks to address one of the most critical grand challenges facing humanity this century. Indeed, one of the United Nations 17 sustainable development goals (#11) focuses on sustainability with an emphasis on making human settlements inclusive, safe, resilient, and sustainable. Solutions to the climate change and environmental degradation crises of the 21st century require collaborative thinking and "all hands on deck" approaches. The proposed program is committed to interdisciplinarity and its "all hands" approach is evident by the program drawing upon faculty expertise from across all six of TU's academic colleges.

With its rigorous curriculum and strong research focus, the proposed Ph.D. in SEC fully aligns with TU's mission, which aims to foster "intellectual inquiry and critical thinking, preparing graduates who will serve as effective leaders for the public good." Moreover, the SEC doctoral program would meet the needs identified by the University System of Maryland (USM) in its current ***Vision 2030 strategic plan***, which states that USM institutions should seek to "advance our leadership in environmental sciences and deepen our international reputation for climate change and sustainability research." In a February 2024 opinion piece, the USM Chancellor stated that the USM has "committed to developing and modeling innovation-driven sustainability; improving environmental science communication, policymaking and education; and growing students' opportunities in field and lab research, internships and community engagement."[2] In support of these USM goals, the Ph.D. in SEC will contribute to "the number of cross-institutional, interdisciplinary, and interprofessional research collaborations among USM universities and centers," beginning with a partnership with the University of Maryland Center for Environmental Science (UMCES).

A2. Strategic Goals Alignment and Affirmation of Institutional Priority

The proposed Ph.D. in SEC fully aligns with all six core goals outlined in Towson University's

[2] Source: https://marylandmatters.org/2024/02/04/commentary-we-cant-fight-our-environmental-crisis-without-more-environmental-scientists/.

2020-2030 strategic plan: educate, innovate, engage, include, support, and sustain. The institution's "sustain" goal (whereby the institution will act as a leader "in advancing sustainability of all resources—environmental, human, and financial") is most pertinent to the SEC program. It is well-recognized that anthropogenic impacts on the environment are having, and will continue to have, strong, negative effects on human and ecological systems. This research-intensive doctoral program will help by addressing critical research needs now while also educating, training, and inspiring the next generation of environmental leaders for the public good. As such, this Ph.D. in SEC embodies TU's commitment to academic excellence and inquiry, interdisciplinary study, and dedication to student (and faculty) intellectual and personal growth, as well as supporting the university's focus on diversity, equity, inclusion, and justice issues.

The introduction of this doctoral degree will enhance TU's research capacity and reputation as a national leader in higher education and will draw on existing strengths and position TU in the R2 Carnegie classification. The program builds on a strong history of environmental researchers at TU, as evidenced by three USM Board of Regents Faculty Awards for Scholarship and Creative Activity in recent years being awarded to TU faculty whose research focuses on environmental issues and sustainability.

The proposed Ph.D. in Sustainability and Environmental Change is considered a priority by TU's leadership and, by design, is poised to create a multiplier effect on recent State-supported investments on TU's campus. The program, housed in the successful interdisciplinary ENVS Program, directly supports TU's goal to capitalize on new, state-of-the-art facilities in STEM and health professions by taking advantage of the new Science Complex (completed 2021) and the new College of Health Professions (completed 2024). These new facilities and additional investments from TU will attract talented and interested faculty and professionals; enhance competitiveness for extramural funding, which, in turn, will bolster the program's research and educational offerings; and help ensure that students in the program are successful and well-trained. In turn, SEC Ph.D. graduates will pursue careers in the academic, public, and private sectors, helping to identify, understand, and resolve critical environmental problems that impact human and ecological systems.

It is important to note that the proposed SEC doctoral program will advance objectives outlined in the USM strategic plan, which acknowledges that "higher education is essential to solving the greatest challenges of our age – crises of poverty and inequality, racial and social injustice, population health and health disparities, climate change and environmental degradation, civic disengagement and a weakened democracy." While the focus of the Ph.D. in SEC is clearly on climate change and environmental degradation, students will explore and be exposed to a wide array of issues related to poverty and inequality, racial and social injustice, and population health and health disparities through the environmental lens.

A3. Five-year Funding Plan

This Ph.D. program will be funded with TU R2 investment funding and reallocated support from across the university, as this program is built primarily on existing graduate courses and faculty expertise. Five new faculty will be hired to support and enhance the program. During the internal university review and approval process for new academic programs, funds were

committed by the Divisions of Academic Affairs and Administration and Finance, and the resources and expenditures anticipated for the first five years are presented in Section L**, Tables 7 and 8**. Graduate student stipends, modest library and operational support, and five new faculty lines will be dedicated to the growth and development of this program during the initial five years. As faculty and student research grows, significant external funds are expected to supplement university funding and will be re-invested in the proposed program.

A4. Institutional Commitment

The proposed doctoral degree is integral to the university's mission and strategic plan. The addition of the Ph.D. in SEC will bolster faculty research productivity and will provide added capacity to mentor undergraduate and master's-level students in TU's existing programs. TU's financial commitment to the program is evidenced by the allocated funding for the establishment and projected growth of the program over a five-year period (see Section L for further details).

The ENVS Program is housed administratively within the FCSM, and the current Director is a faculty member in FCSM. The Assistant Director for the ENVS Program is a faculty member in the College of Liberal Arts and there are more than 40 faculty members from across TU's six colleges affiliated with the ENVS program (see Section I1 for a detailed listing). Administrative support for the Ph.D. in SEC will be provided by a new administrative assistant working through the existing ENVS Program, and staff and faculty in the program are familiar with managing graduate education and the needs of graduate students. TU's Office of Graduate Studies will support administrative and operational needs for the proposed Ph.D. in SEC by providing guidance and helping with reviewing student progression and success, graduate faculty status designations, and marketing.

TU's Office of Technology Services will provide support for general computing needs. More specialized technical support will come directly from the relevant colleges involved in the program, all of which have dedicated staff for computer technology needs, classroom support, and website development. This program will benefit from the laboratory and analytical facilities housed in the new 320,000 square foot Science Complex, access to specialized software such as ArcGIS (through the College of Liberal Arts), and through new state-of-the-art facilities with the completion of a new building for the College of Health Professions. See Section K for more details about physical facilities and infrastructure available to support the program.

TU is committed to student success and students admitted to the Ph.D. in SEC will be provided with sufficient time for program completion and financial support in the form of graduate assistantships. Degree completion for most full-time Ph.D. students is expected within four-to-five years of matriculation. Nevertheless, doctoral students are allocated up to 10 years, if necessary, to complete their degree.

B. Critical and Compelling Regional or Statewide Need as Identified in the State Plan

B1. Program Demand and Need

The United Nations recognizes climate change as one of the major challenges of our time.

The World Health Organization pointedly states that "the environmental crisis is a health crisis," while the USM strategic plan, as previously indicated, calls for action to address climate change and environmental degradation. These are not abstract concerns but are issues that directly affect Marylanders. Regionally, Maryland and the Mid-Atlantic are located in the Chesapeake Bay watershed, and restoration and sustainability of the Chesapeake Bay has been an important national and regional environmental issue for decades.

While environmental issues including the climate crisis are widely recognized as one of the most important and costly challenges facing the world (see **Figures 1 & 2** below), the burden and costs of these impacts is disproportionally felt by economically disadvantaged groups at multiple scales. Hence, there is a clear, unequivocal societal need to prepare researchers, policy makers, educators, and professionals, who are representative of the diversity of the state and nation, to work toward addressing these pressing environmental challenges. The complex, multi-faceted nature of environmental problems necessitates a rigorous, interdisciplinary understanding of environmental and social science research methods to fuel future research, inform environmental policy, and educate future generations. TU's proposed SEC program would equip graduates to respond to these local, regional, national, and global needs.

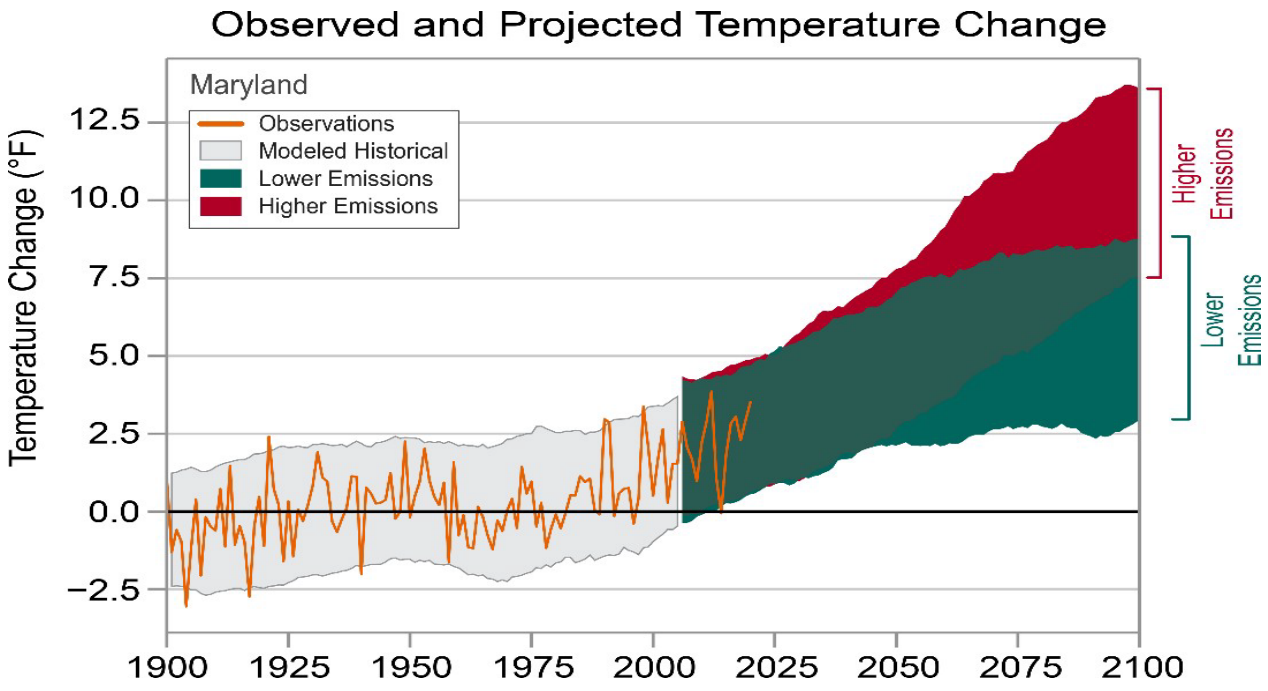

Figure 1: Observed and projected changes (compared to 1901-1960 average) near-surface air temperature for Maryland from NOAA National Centers for Environmental Information.

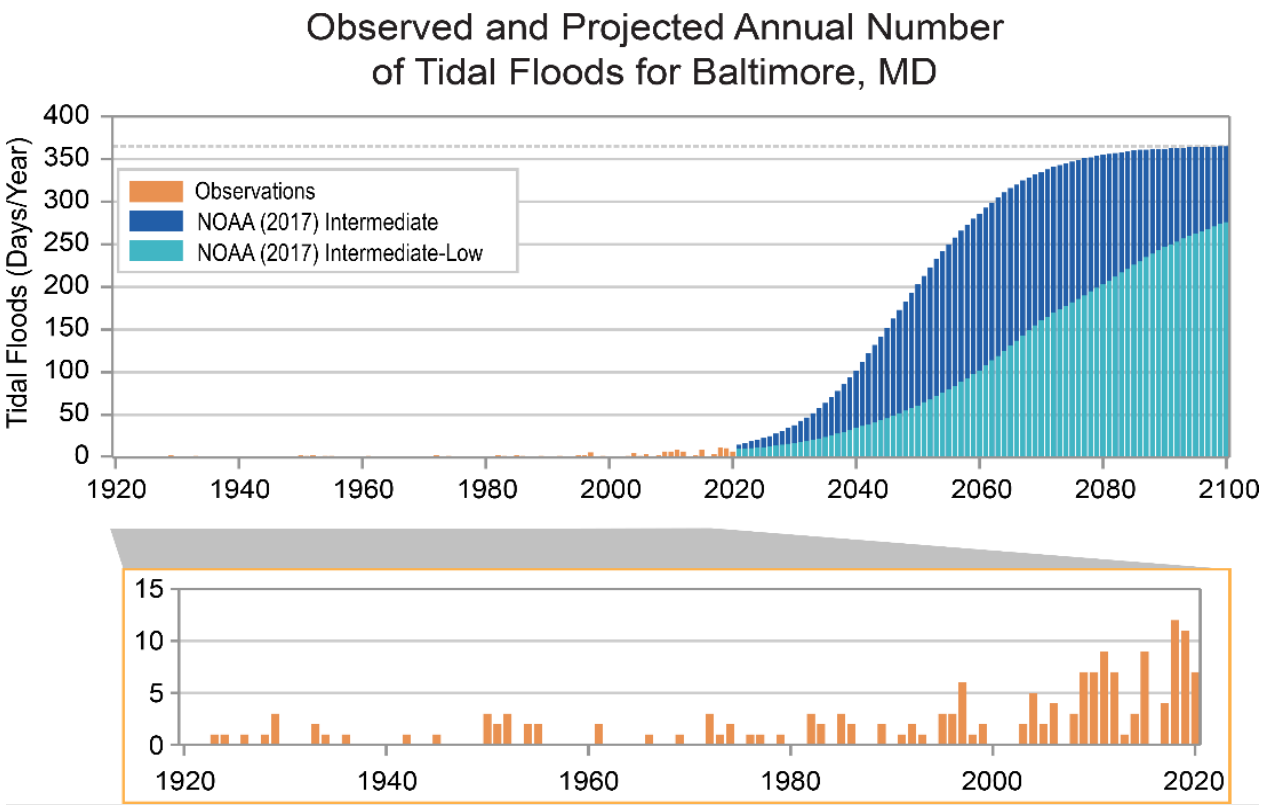

Figure 2: Observed and projected changes in annual number of tidal floods in Baltimore, Maryland from NOAA National Centers for Environmental Information.

B2. Alignment with Maryland State Plan for Higher Education

The Student Success and Innovation goals outlined in the 2022 Maryland State Plan for Higher Education are especially relevant to the proposed SEC program. Priorities 5-7 under the Student Success goal seek to maintain a commitment to higher-quality postsecondary education (Priority 5), improve timely completion of programs (Priority 6), and enhance postsecondary education to promote lifelong learning (Priority7). All of these priorities are embodied by the spirit and practice of the SEC program. Faculty participating in the SEC degree are committed to providing students in the program with an outstanding Ph.D. experience that recognizes student success as the most important measure of the program's overall success.

Priority 8 under the Innovation goal aims to promote a culture of risk-taking. Here, we recognize that solving the region's and world's most important and pressing problems requires risk, which is inherent to all research. The SEC program will push and support students to pursue challenging problems and to grow as professionals prepared to take on important issues. The SEC program will draw students from a broad range of postsecondary bachelor's and master's programs such as environmental science, environmental studies, the classical sciences (biology, chemistry, physics), geography, economics, social sciences, and human sciences. The interdisciplinary structure of the SEC program will provide students

with an excellent foundation for their research and graduate studies, while benefitting from the cross fertilization of ideas and perspectives from a diverse array of students, faculty, and collaborators.

C. Quantifiable and Reliable Evidence and Documentation of Market Supply and Demand in the Region and State

C1. Pipeline and Employment Opportunities

As indicated above, there is an overwhelming need for environmental sustainability professionals. Although doctoral programs exist in Maryland that provide students with the opportunity to conduct research focused on environmental issues, there are none that explicitly require the concept of sustainability in coursework and none that require students to address the implications of their research on sustainability.

Due to the specialized nature of the positions for which applicants with the proposed doctoral degree would be suitable, representative data for these professional subsets are difficult to obtain. However, **Table 1** below shows a sampling of potential occupations for which graduates of the proposed Ph.D. program would be compatible. As a research doctoral program, the expectation is that graduates will be prepared for senior-level research and related positions. As an example, it is common for new employees with a Ph.D. to be hired as senior scientists or senior managers in regional environmental consulting firms, to enter the academic profession, or to work for government and non-governmental organizations.

Table 1. Projected Growth of Select Occupations Related to the Sustainability and Environmental Change Ph.D. in Maryland from 2020-2030

Occupation	2020-2030 Projected Growth	2020-2030 Projected Annual Openings
Environmental Science Teachers, Postsecondary	15.9%	160
Environmental Scientists and Specialists, including Health	9.8%	2,867
Forestry and Conservation Science Teachers, Postsecondary	20.7%	35
Geoscientists	3.3%	433
Hydrologists	3.2%	65
Life Scientists	7.0%	17,447
Natural Science Managers	3.5%	4,349
Soil and Plant Scientists	8.6%	680
Urban and Regional Planners	12.8%	1,169
Zoologists and Wildlife Biologists	8.8%	435

Source: Maryland Department of Labor, Maryland Occupational Projections – 2020-2030 – Workforce Information and Performance.

Jobs in the field of sustainability and environmental change do not neatly map onto job categories analyzed by the U.S. Bureau of Labor Statistics (BLS). Information about green jobs, of which many or most fall into the category of sustainability, were collected from 2010-13, but then data collection was stopped in 2013 due to spending cuts in federal funding.

Individuals working in SEC jobs come from a diverse set of backgrounds. Those working in science and science-related fields, as graduates from this program would do, often need more than a Bachelor of Science degree to "conduct research or develop new products." Relevant categories for sustainable jobs related to this Ph.D. (could) include chemists and material scientists, conservation scientists, environmental scientists, natural science managers, and soil and plant scientists. Sustainability positions also fall into several other categories such as managers for operations and those working on economics or logistics. Graduates of this Ph.D. program will be particularly well situated to work with and communicate and/or serve multiple sustainability roles.

For the period 2022-2032, job growth in the various relevant categories relating to environmental and sustainability occupations is projected to be close to the national average (five to six percent) according to BLS. As an example, the number of conservation scientist positions is projected to grow by four percent during this period, while the number of environmental scientist positions is projected to grow by six percent. However, growth in Maryland and the Mid-Atlantic is likely to be higher than the national average, given the focus on Chesapeake Bay restoration as well as other regional environmental issues. Further, the U.S. produces relatively few environmental science degrees at the undergraduate level (7,400 in 2021[3]), let alone at the doctoral level, thus presenting a challenge to prepare enough qualified graduates to meet the projected job growth.

C2. Market Demand

See **Table 1** for expected growth in careers aligning with the research and professional training entailed in the proposed Ph.D. in Sustainability and Environmental Change. All selected occupations are projected to show positive growth, with several exceeding the projected Maryland average growth rate of 9.5 percent between 2020 and 2030.

Additionally, data from the U.S. Bureau of Labor show convincingly that employees with a Ph.D. have higher earning potential and lower unemployment compared to other categories (see **Figure 3**). Interestingly, the demand for tenure-track faculty positions with a Ph.D. degree in fields related to SEC is expected to grow, on average, by greater than 10 percent.

It is an unfortunate reality that as the climate crisis continues, the workforce need for advanced-level education and training in sustainability and environmental change will increase. It is also important to note that there are likely high-level research, management, administrative, and leadership positions in environment-relevant fields that graduates from the SEC program would be well-equipped to perform. The program is designed to provide an in-depth educational experience in SEC while also providing the tools to successfully design methodological approaches to obtain robust data and information, conduct statistical analyses, synthesize and present information, and manage complex projects. These skills translate well to a wide array of professions across academic, government, NGO, and private institutions. One of the strengths of this proposed Ph.D. program is that it can provide opportunities for graduates through the close relationships that TU faculty have established

[3] Source: https://marylandmatters.org/2024/02/04/commentary-we-cant-fight-our-environmental-crisis-without-more-environmental-scientists/.

with regional collaborators such as the U.S. Geological Survey, U.S. Department of Defense, EA Engineering, Science, and Technology, the Maryland Stream Restoration Association, Maryland Department of the Environment, Ecotone, and a host of others.

C3. Anticipated Vacancies and Training Needs

The proposed Ph.D. program is designed to produce graduates with distinctive skills from multiple disciplines and prepared to work on issues related to sustainability and environmental change, including extensive training in high-level research methods.

Graduates will be well positioned for employment across a range of industries in Maryland, the Mid-Atlantic, and beyond. Table 1 illustrates the projected higher than average growth in positions as well as projected annual openings for environmental scientists. Graduates also would be well prepared to pursue positions in state and federal scientific or regulatory agencies such as the Maryland Department of Environment or U.S. Environmental Protection Agency; environmental consulting firms; academic positions; and program administration positions. Individuals holding doctoral degrees have the second highest weekly earnings and the lowest unemployment rates in the U.S. (see **Figure 3**).

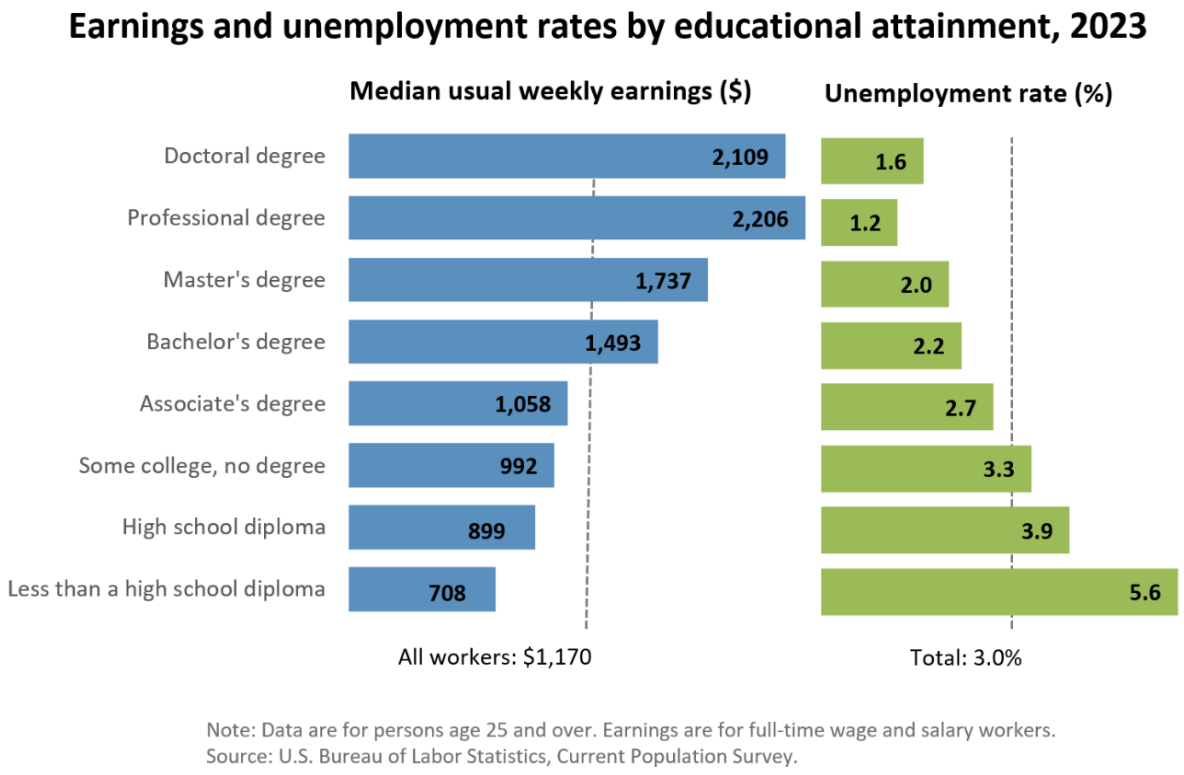

Figure 3. Earning and Unemployment Rates by Education Attainment, U.S. Bureau of Labor Statistics

C4. Projected Supply of Prospective Graduates

While there are few Ph.D. programs in the state that focus specifically on sustainability and environmental change, many programs at the bachelor and master's level provide the

education and training necessary for prospective doctoral students in this field. According to MHEC enrollment data, there is evident demand for programs related to sustainability and environmental science/studies and enrollment has remained steady over the period 2019-2023 (see **Table 2**). In addition to these programs, prospective graduate students may also be recruited from cognate programs in biology, ecology, geography, earth sciences, various health sciences, political science and other social sciences, and urban studies or planning. Many such programs are offered across the state and enjoy strong levels of historical enrollment.

Table 2. Enrollment Trends in Bachelor's and Master's Degree Programs in Environmental Science/Studies, Sustainability, and Related Fields at Maryland Institutions (2019-2023)

INSTITUTION	DEGREE LEVEL	PROGRAM NAME	2019	2020	2021	2022	2023
Frostburg State University	Bachelors	ENVIRONMENTAL SCIENCE	0	0	0	0	4
Frostburg State University	Masters	ENVIRONMENTAL MANAGEMENT IN SUSTAINABILITY	0	0	0	0	2
Goucher College	Bachelors	ENVIRONMENTAL STUDIES	22	21	23	19	14
Goucher College	Masters	ENVIRONMENTAL SUSTAINABILITY AND MANAGEMENT	2	1	0	0	5
Hood College	Bachelors	ENVIRONMENTAL SCIENCE & POLICY	11	13	15	18	18
Hood College	Bachelors	SUSTAINABILITY STUDIES	0	0	1	8	6
Hood College	Masters	ENVIRONMENTAL BIOLOGY	41	28	26	23	16
Johns Hopkins University	Bachelors	ENVIRONMENTAL ENGINEERING	44	43	41	35	32
Johns Hopkins University	Bachelors	ENVIRONMENTAL SCIENCE	19	21	16	22	31
Johns Hopkins University	Bachelors	GLOBAL ENVIRONMENTAL CHANGE & SUSTAINABILITY	9	9	8	7	5
Johns Hopkins University	Masters	ENVIRONMENTAL ENGINEERING AND SCIENCE	59	62	51	37	38
Johns Hopkins University	Masters	ENVIRONMENTAL HEALTH	45	57	50	53	45
Johns Hopkins University	Masters	ENVIRONMENTAL PLANNING & MANAGEMENT	28	33	37	33	31
Johns Hopkins University	Masters	ENVIRONMENTAL SCIENCES AND POLICY	248	283	254	270	239
Johns Hopkins University	Masters	GEOGRAPHY & ENVIRONMENTAL ENGINEERING	75	58	60	56	45
Johns Hopkins University	Masters	SUSTAINABLE ENERGY	0	16	41	50	42
Loyola University Maryland	Bachelors	SUSTAINABILITY MANAGEMENT (B.B.A.)	0	0	16	26	36
Maryland Institute College of Art	Bachelors	ECOSYSTEMS, SUSTAINABILITY, AND JUSTICE	0	0	0	2	2
McDaniel College	Bachelors	ENVIRONMENTAL STUDIES	35	35	34	43	31
Mount St. Mary's University	Bachelors	ENVIRONMENTAL SCIENCE	10	15	14	15	11
Salisbury University	Bachelors	ENVIRONMENTAL STUDIES	168	147	113	93	95
St. Mary's College of Maryland	Bachelors	ENVIRONMENTAL STUDIES	73	99	83	86	91
St. Mary's College of Maryland	Bachelors	MARINE SCIENCE	0	0	7	22	69
Stevenson University	Bachelors	ENVIRONMENTAL SCIENCE	25	39	25	27	32
Towson University	Bachelors	ENVIRONMENTAL SCIENCE AND STUDIES	208	192	182	164	147
Towson University	Bachelors	GEOGRAPHY & ENVIRONMENTAL PLANNING	65	61	65	51	38

INSTITUTION	DEGREE LEVEL	PROGRAM NAME	2019	2020	2021	2022	2023
Towson University	Masters	ENVIRONMENTAL SCIENCE	23	22	22	31	37
Towson University	Masters	GEOGRAPHY & ENVIRONMENTAL PLANNING	14	13	13	11	12
University of Baltimore	Bachelors	ENVIRONMENTAL SUSTAINABILITY	28	21	14	9	12
University of Maryland - Baltimore	Masters	MARINE-ESTUARINE-ENVIRONMENTAL SCIENCES (W/UMBC,UMCP,UMES)	0	0	1	1	0
University of Maryland - Baltimore County	Bachelors	ENVIRONMENTAL SCIENCE	5	3	6	2	5
University of Maryland - Baltimore County	Bachelors	ENVIRONMENTAL SCIENCE AND GEOGRAPHY	134	124	119	148	164
University of Maryland - Baltimore County	Bachelors	ENVIRONMENTAL STUDIES	5	1	3	0	0
University of Maryland - Baltimore County	Bachelors	GEOGRAPHY AND ENVIRONMENTAL STUDIES	53	64	53	55	53
University of Maryland - Baltimore County	Masters	ENVIRONMENTAL ENGINEERING	4	3	8	7	3
University of Maryland - Baltimore County	Masters	GEOGRAPHY & ENVIRONMENTAL SYSTEMS	12	14	27	29	24
University of Maryland - Baltimore County	Masters	MARINE-ESTUARINE-ENVIRONMENTAL SCIENCES (W/UMAB,UMCP,UMES)	2	3	5	6	6
University of Maryland - College Park	Bachelors	ENVIRONMENTAL SCIENCE & TECHNOLOGY	192	173	172	151	155
University of Maryland - College Park	Bachelors	ENVIRONMENTAL SCIENCE AND POLICY	283	270	280	286	273
University of Maryland - College Park	Masters	ENVIRONMENTAL HEALTH SCIENCES	2	3	4	3	1
University of Maryland - College Park	Masters	ENVIRONMENTAL SCIENCE & TECHNOLOGY	15	14	12	17	19
University of Maryland - College Park	Masters	MARINE-ESTUARINE-ENVIRONMENTAL SCIENCES (W/UMAB,UMBC,UMES)	47	43	33	37	31
University of Maryland - Eastern Shore	Bachelors	ENVIRONMENTAL SCIENCE	38	33	39	40	49
University of Maryland - Eastern Shore	Masters	MARINE-ESTUARINE-ENVIRONMENTAL SCIENCES (W/UMAB,UMBC,UMCP)	8	8	9	10	11
University of Maryland Global Campus	Bachelors	ENVIRONMENTAL HEALTH AND SAFETY	391	411	386	376	369
University of Maryland Global Campus	Masters	ENVIRONMENTAL MANAGEMENT	195	176	184	161	136
Washington College	Bachelors	ENVIRONMENTAL SCIENCE	48	46	39	57	59
Washington College	Bachelors	ENVIRONMENTAL STUDIES	0	0	22	16	21
TOTALS			**2,686**	**2,678**	**2,613**	**2,613**	**2,565**

Source: Trends in Fall Enrollment by Program 2013-2023, MHEC

D. Reasonableness of Program Duplication

D1. Similar Programs

The proposed Ph.D. in SEC does not substantially overlap with any other doctoral program in Maryland. The interdisciplinary focus and approach of the proposed program, incorporating both the science of environmental change and the study of sustainability, differentiates the TU program from others. None of the existing environmental doctoral programs in Maryland incorporate perspectives from such a broad range of faculty (in the sciences, social and health sciences, economics, humanities, arts and design, etc.). This interdisciplinary focus is exemplified by the program drawing upon faculty from across all six TU colleges, not just the Fisher College of Science and Mathematics (see Section I1 for a detailed listing). Specifically, integrated training in social sciences along with environmental sciences will provide SEC students with a combination of skills in critical and analytical thinking and professional

competencies that are critical for addressing complex problems. The SEC doctoral program will build on the strength of the undergraduate ENVS program at Towson, which currently enrolls 182 students, and which also includes classes and instructors from four of TU's six academic colleges.

In reviewing other environmental doctorates offered in Maryland, the following four programs—the Environmental Science and Technology Ph.D. at the University of Maryland–College Park, the Marine Estuarine Environmental Sciences (MEES) Ph.D. across multiple USM campuses, the Bio-Environmental Sciences Ph.D. at Morgan State University (MSU), and the Geography and Environmental Systems Ph.D. at the University of Maryland–Baltimore County (UMBC)—appear, in contrast to TU's proposed program, to be strongly focused on the scientific study of environmental systems (see Appendix A for a more detailed review). For example, MSU's Bio-Environmental Sciences Ph.D. is heavily focused on the biological sciences, with additional electives in chemistry and physics. And while UMBC's Geography and Environmental Systems Ph.D. addresses issues in sustainability and ecology, it includes a stronger emphasis on spatial science and geographic information systems (GIS) than TU's proposed program. There are other doctoral programs that include "environmental" in their degree title, but these programs focus on areas such as environmental engineering or environmental health, which are specialized fields unrelated to TU's proposed program.[4]

TU's proposed Ph.D. in SEC will be listed under the Classification of Instructional Programs (CIP) code 03.0103 Environmental Studies, which is intended to capture the interdisciplinary nature of TU's program, indicating that it goes beyond a primarily science-based focus. No other doctoral degree program in Maryland uses this same CIP code designation. For example, of the four doctoral programs referenced above, three are classified under CIP codes that are reflective of doctoral programs that are predominantly science-based—the University Maryland-College Park's Environmental Science and Technology Ph.D. (03.0104 Environmental Science), USM's MEES Ph.D. (26.1302 Marine Biology and Biological Oceanography), and MSU's Bio-Environmental Sciences Ph.D. (26.1305 Environmental Biology)—whereas UMBC's Geography and Environmental Systems Ph.D. uses the 45.0701 Geography CIP code.

The substantial number of undergraduate degrees currently conferred in environmental science and studies in Maryland (see Table 2) would likely serve as a pipeline into the Ph.D. in SEC. Graduates of the program would meet the work force demand in the state and the Mid-Atlantic region for those trained in environmental issues. Further, given the program's unique interdisciplinary nature and distinction, the SEC program is likely to draw students from other parts of the country who would otherwise not move to Maryland in pursuit of a graduate degree.

The vital work of addressing problems and developing solutions to climate change and environmental degradation benefits from cooperative and collaborative efforts amongst

[4] TU notes that Capitol Technology University recently launched a Ph.D. in Sustainability, but the program webpage states that, "This degree is not an environmental science degree or environmental in focus" (source: https://www.captechu.edu/degrees-and-programs/doctoral-degrees/sustainability-phd).

individuals, disciplinary expertise, and institutions. The proposed Ph.D. in SEC provides added momentum to TU's commitment to the public good and is an excellent opportunity to engage with other state institutions to effect meaningful change. To this end, leadership in TU's ENVS Program reached out to the Director of MSU's Bio-Environmental Science Ph.D. program on April 21, 2023, to notify MSU of our interest in developing a new doctoral program in SEC, discuss any potential concerns regarding TU's proposal, and explore possible areas for future collaboration. Following this initial communication, both institutions agreed to continue discussions for collaborative opportunities and further campus visits that would strengthen both programs.

As well as engaging with Morgan State University, TU communicated with sister USM institutions during the development of the Ph.D. in SEC proposal. In particular, TU and UMCES engaged in fruitful discussions with both institutions recognizing the critical need for broad, collaborative approaches to tackling the climate crisis. As a result of these exchanges, UMCES enthusiastically supports TU's application for a new program in SEC (see attached letter of support from UMCES, Appendix D) and plans to partner with TU to explore a dual-degree program upon approval of the SEC program. Through such collaborations, TU envisions the proposed doctoral program as a potential driving force for empowerment of the region's research and education engine to generate a well-trained, collaborative, and connected sustainability workforce.

D2. Program Justification

In the 21st century, Maryland, the Mid-Atlantic, and beyond are faced by "wicked" and complex environmental issues such as climate change, environmental degradation, and restoration of the Chesapeake Bay. The USM Vision 2030 strategic plan highlights the need for advancing leadership in environmental sciences and deepening the system's reputation for climate change and sustainability research under Priority 4 (Research). The Ph.D. in SEC will graduate individuals with interdisciplinary training and research at a high level that encompasses the natural sciences, social sciences, and beyond. These graduates will be particularly well poised to help address these issues through research, management of relevant scientific and management programs, and effective problem-solving and communication.

E. Relevance to High-demand Programs at Historically Black Institutions (HBIs)

Neither Bowie State University nor Coppin State University offer doctoral degree programs in this field. As outlined in section D1, both the MEES Ph.D. program, which the University of Maryland Eastern Shore (UMES) supports (along with other non-HBI USM institutions), and MSU's Bio-Environmental Sciences Ph.D. program are more science focused than TU's proposed program. Therefore, we conclude that there is not substantive curricular overlap between these programs and TU's proposed SEC doctoral degree.

UMES also offers a corresponding MEES program (again in collaboration with other non-HBI USM institutions) at the master's level, but no other HBI currently offers an environmental-related master's degree. TU anticipates that graduates of the MEES master's degree from UMES who are interested in pursuing a doctoral degree specializing in marine and estuarine

environmental science will naturally gravitate toward UMES's MEES doctoral program, and therefore we do not foresee that TU's proposed program will impact enrollments at UMES.

F. Relevance to the Identity of Historically Black Institutions (HBIs)

MSU's mission commits the institution "to addressing societal problems, particularly those prevalent in urban communities," while UMES's mission commits it "to serving first-generation and underserved students." In contrast, TU's mission seeks to prepare students for careers in high demand today and in the future "through a commitment to academic excellence, interdisciplinary study, research and public service." TU's mission also commits its graduate students and faculty "to advance the knowledge base that will drive the workforce" through "critical research." The proposed Ph.D. in SEC is informed by and aligns with TU's mission, which is distinct from the stated missions and identities of MSU and UMES.

Further, in response to USM's Vision 2030 strategic plan which charges USM institutions to "advance our leadership in environmental sciences and deepen our international reputation for climate change and sustainability research," TU's proposed program would contribute to increasing "cross-institutional, interdisciplinary, and interprofessional research collaboration among USM universities and centers," as evidenced by our proposed collaboration with UMCES.

G. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes

G1. Program Development and Faculty Oversight

The curriculum for the Ph.D. in SEC was developed by faculty from multiple colleges, principally the Fisher College of Science and Mathematics and the College of Liberal Arts, drawing upon faculty members' expertise in environmental science, environmental studies, human-environment interactions, and environmental sustainability. Through an iterative and collaborative process, program requirements, courses, and milestones were discussed by the interdisciplinary team and reviewed for alignment with the proposed degree program and learning outcomes. Faculty members who will oversee the program are identified in Section I1; they are tenured and tenure-track faculty with diverse research and pedagogical expertise in sustainability, environmental change, and related disciplines.

G2. Educational Objectives and Learning Outcomes

The principal educational objective of TU's proposed Ph.D. in SEC is to train graduate students to become interdisciplinary scholars and independent researchers, with depth and breadth of knowledge commensurate with a doctoral-degree holder. Under the mentorship of their dissertation committee, recipients of the Ph.D. in SEC will have made substantial contributions to new knowledge by producing publication-quality research. Moreover, students earning the Ph.D. in SEC will be ready to solve complex environmental problems while forging cross-disciplinary collaborations.

The following are the proposed learning outcomes for students who enroll in the Ph.D. in SEC. Upon completion of the program, students will:

1. Obtain a depth of understanding and technical knowledge in the area(s) of study.
2. Devise novel research questions and design logical approaches to answer these questions.
3. Master methodologies for data collection and analysis necessary for independent research.
4. Generate publication-quality results from their dissertation research.
5. Communicate research findings and sustainability implications efficaciously to diverse audiences.

G3. Assessment and Documentation of Student Learning Outcomes

TU's Office of Assessment within the Division of Academic Affairs coordinates the assessment of student learning outcomes. Assessment of student learning occurs at the course, program, and institutional levels. Assessment includes academic and co-curricular activities. The Office of Assessment works collaboratively with faculty and staff to support analysis and research of TU's curriculum, courses, departments, and programs to improve student learning through effective, faculty- and staff-driven assessment of academic programs and student learning outcomes achievement.

Specifically, the Office of Assessment provides information and resources for assessment, maintains the technological infrastructure to support academic assessment, supports faculty and programs through workshops and consultation, and assists with collection, analysis, and distribution of institutional and programmatic assessment data.

The proposed Ph.D. in SEC will employ a variety of assessment measures appropriate at the doctoral level to assess student learning, including (but not limited to) course papers, presentations, course examinations, and comprehensive examinations. Additional assessment tools include the preparation and defense of a dissertation proposal and, ultimately, a dissertation. **Table 3** summarizes the program's learning outcomes and assessment methods.

Table 3. Learning Outcomes and Assessment Methods

Learning Outcome	Assessment Methods
1. Obtain a depth of understanding and technical knowledge in the area(s) of study.	*Measure 1A: Grade in ENVS 701 Science of Environmental Change* *Measure 1B: Grade in ENVS 702 Sustainability in a Complex World* *Measure 1C: Successful completion of comprehensive exams*
2. Devise novel research questions and design logical approaches to answer these questions.	*Measure 2A: Grade in a research methods course* *Measure 2B: Successful preparation and defense of a dissertation proposal*

Learning Outcome	Assessment Methods
3. Master methodologies for data collection and analysis necessary for independent research.	*Measure 3A: Successful completion of comprehensive exams* *Measure 3B: Successful preparation and defense of a dissertation*
4. Generate publication-quality results from their dissertation research.	*Measure 4A: Successful preparation and defense of a dissertation* *Measure 4B: Publication of at least a portion of the dissertation within 12 months of the dissertation defense*
5. Communicate research findings and sustainability implications efficaciously to diverse audiences.	*Measure 5A: Inclusion of sustainability implications within the dissertation proposal and the dissertation* *Measure 5B: Discussion of sustainability implications within the dissertation proposal defense and the dissertation defense*

Achievement of student learning outcomes will be documented in a variety of ways. For example, grades earned at the course level will be archived on student transcripts by TU's Office of Records and Registration. Successful preparation and defense of dissertation proposals and dissertations, as well as performance on comprehensive exams, will be documented by the SEC Graduate Program Director and associated academic staff.

Additionally, the final approved version of the dissertation will be submitted to the Office of Graduate Studies and archived in TU's library. More generally, assessment data will be recorded, archived, and tracked over time by the SEC Graduate Program Director, who will also draw on the expertise and resources of TU's Office of Assessment for assistance.

Each year, assessment data will be disseminated to and discussed with affiliated faculty and the Associate Dean in FCSM, who has overall responsibility for assessment within the college. Assessment data will drive discussions of programmatic improvement and enhancement by program leaderships and affiliated faculty.

G4. Program Requirements

This Ph.D. degree is a 60-credit, in-person program designed to be completed primarily via full-time study. Students may matriculate into the program after completing either a bachelor's or a master's degree in a discipline related to SEC (e.g., environmental science/studies, biology, chemistry, geography, geology, and health sciences, among others). Students with a master's degree may transfer up to 24 credits of relevant coursework into the Ph.D. program; transferred credits are subject to the approval of the SEC Graduate Program Director and will typically count as electives. Courses will be taught predominantly in-person on the main TU campus. Admitted students will be offered financial support in the form of a fellowship, research assistantship, and/or teaching assistantship so they can focus on their academic development throughout the degree program.

Program requirements include three foundation courses (nine credits), three semesters of the seminar course (three credits), elective courses (≥ 24 credits), a dissertation proposal (three credits), and dissertation research (≥ 21 credits). See below for a program outline, with course descriptions included in Appendix B and a year-by-year example program of study in Appendix C.

- **Seminar Course** (three credits): *ENVS 600 Environmental Science and Sustainability Colloquium* (one credit, must be repeated at least three times)
- **Foundation Courses** (nine credits): These courses cover fundamental scientific and social principles of SEC, as well as research tools germane to Ph.D. students.
  - **Scientific Principles** (three credits; *ENVS 701 Science of Environmental Change*)
  - **Social Principles** (three credits; *ENVS 702 Sustainability in a Complex World*)
  - **Research Methods** (three credits; see Appendix B for course options)
- **Elective Courses** (at least 24 credits with six to eight credits of broadening coursework; see Appendix B for course options)
- **Dissertation Proposal** (three credits): *ENVS 990 Dissertation Proposal)*
- **Dissertation Research** (at least 21 credits): *ENVS 997 Dissertation Research)*

Students will each identify and secure the commitment of a faculty mentor to serve as the dissertation advisor, who will also chair the student's dissertation committee. Dissertation committees will consist of a minimum of four faculty members, including the dissertation advisor. At least one member of the dissertation committee must have a primary appointment in a different college from that of the dissertation advisor; this requirement can be satisfied by having a dissertation committee member from another institution. All members of the dissertation committee must have graduate faculty (or associate graduate faculty) status as prescribed by the TU Office of Graduate Studies.

Dissertation committees will evaluate student performance regarding the preparation and defense of the dissertation proposal and the dissertation, in addition to the comprehensive exams. Upon successful completion of the dissertation proposal, the dissertation committee is required to meet at least once every 12 months with the Ph.D. candidate. In addition to offering guidance to the Ph.D. candidate to promote timely degree completion, the dissertation committee is also charged with ensuring that the Ph.D. candidate receives satisfactory mentoring and guidance from the dissertation advisor.

G5. General Education Requirements

Not applicable.

G6. Specialized Accreditation and Certification

Not applicable.

G7. Outside Contracts

Not applicable.

G8. Program Information Assurances

A handbook will be provided to all incoming Ph.D. students outlining program policies, program curriculum and requirements, student expectations, technology requirements, campus supports and resources, and financial aid information. Students will provide a

signature assuring their review and comprehension of the handbook's contents prior to the start of coursework. This handbook will be reviewed and updated on a regular basis to reflect changes in the program, supports and resources, etc. For prospective students, the current version of the handbook will also be available on the program website.

G9. Advertising, Recruiting, and Admissions Materials Assurances

TU regularly reviews its advertising, recruiting, and admissions materials to ensure that they clearly and accurately represent programs and services available, and that there is consistency across different modes of communication such as the TU website, the academic catalog, other print and online promotional materials, etc. More specifically, a tenured or tenure-track faculty member will be appointed as SEC Graduate Program Director by the Dean of FCSM. Working in collaboration with the Office of Graduate Studies, the SEC Graduate Program Director will oversee recruitment, communicate with prospective students, supervise academic advising of enrolled students, and monitor student progress during their time in the program. As noted above, a student handbook will be available on the website to provide clear and accurate program information. An admissions committee of interdisciplinary faculty members will conduct annual evaluation of applications and issue admissions decisions using a pre-established, wholistic review framework based on existing doctoral program guidelines at TU.

H. Adequacy of Articulation

Not applicable.

I. Adequacy of Faculty Resources

I1. Quality of Program Faculty

TU's Environmental Science and Studies Program currently has an interdisciplinary leadership/administrative team that consists of four faculty (**Table 4**), a cadre of nine "guidance" faculty who are actively engaged in program leadership and well positioned to mentor doctoral students (**Table 5**), and 30 additional affiliated faculty across six colleges at the university who teach program-relevant courses and advise undergraduate and graduate ENVS students (**Table 6**). None of these faculty is appointed to the ENVS Program full-time, and all but the leadership team offer courses and advise students with the support of their home departments.

ENVS faculty include some of the most productive at the institution, in terms of both external grants and publications, and enjoy a long history of interdisciplinary collaboration in the program. **Tables 4-6** list all current full-time ENVS-affiliated faculty, along with their home department, rank, and field of study. All tenured and tenure-track faculty have a doctoral degree (or other terminal degree) in relevant disciplines and conduct research in areas related to sustainability and/or environmental change. All faculty are eligible to serve as mentors and/or dissertation committee members. Due to most courses in the Ph.D. in SEC being either electives and/or housed administratively in other TU colleges, at this time it has yet to be determined which specific courses will be taught by individual faculty members.

Despite this sizable pool of faculty expertise, development of faculty resources to support the

doctoral program is necessary. ENVS currently has zero contracted faculty lines, apart from administrative appointments among the leadership team. This proposal therefore includes a request for five new full-time faculty lines across ENVS-affiliated departments and colleges at TU, reflecting a minimum of 2.5 new faculty FTEs (five faculty with a 50 percent commitment to SEC), plus a full-time lecturer, that will be reallocated from existing resources (see Adequacy of Financial Resources below). These faculty would directly support, or indirectly offset, existing faculty workload for new course development, research enhancement, and mentoring of doctoral students. New faculty lines would reflect both internal demand and the projected supply of prospective doctoral students (see above) with targeted hires in the Fisher College of Science and Mathematics, the College of Liberal Arts, and the College of Health Professions. Faculty hires will occur during Years 2 through 4 of the proposed program.

Table 4. ENVS Leadership Team

Faculty Name and Highest Degree Earned	Home Department	Rank and Program Title	Field of Study
Chris Salice, Ph.D.	Dept. of Biological Sciences	Professor Director, Environmental Science & Studies Interim Dean, Fisher College of Science & Mathematics	Applied ecology; ecotoxicology; population dynamics
Joel Moore, Ph.D.	Dept. of Physics, Astronomy & Geosciences	Professor Interim Director, Environmental Science & Studies	Climate and the Earth's surface; carbon sequestration, soil and water quality; ecosystem sustainability
Sya Buryn Kedzior, Ph.D.	Dept. of Geography and Environmental Planning	Associate Professor Assistant Director, Environmental Science & Studies	Political ecology; environmental social movements; environmental knowledge studies
John Sivey, Ph.D.	Dept. of Chemistry	Professor Director, Environmental Science Graduate Programs	Analytical chemistry; aquatic chemistry; environmental organic chemistry

Table 5. ENVS Guidance Faculty

Faculty Name and Highest Degree Earned	Home Department	Rank	Field of Study
Michael Allen, Ph.D.	Dept. of Geography and Environmental Planning	Assistant Professor	Climatology; meteorology; public health cognate
Vanessa Beauchamp, Ph.D.	Dept. of Biological Sciences	Professor	Plant community ecology; wetland ecology; restoration; invasive species
Ryan Casey, Ph.D.	Dept. of Chemistry	Professor	Environmental chemistry; environmental toxicology; impacts of urban stormwater

Faculty Name and Highest Degree Earned	Home Department	Rank	Field of Study
Nicole Fabricant, Ph.D.	Dept. of Sociology, Anthropology, and Criminal Justice	Professor	Political economy; race/ethnicity and class; social movements; resource politics
Brian Fath, Ph.D.	Dept. of Biological Sciences	Professor	Systems ecology; network analysis; sustainability; environmental assessment
Jillian Fry, Ph.D.	Dept. of Health Sciences	Assistant Professor	Sustainable and healthy food systems; environmental health and environmental justice; public health policy
Sarah Haines, Ph.D.	Dept. of Biological Sciences	Professor	Science education; environmental education
Martin Roberge, Ph.D.	Dept. of Geography and Environmental Planning	Professor	Physical geography; hydrology; geomorphology; environmental applications of GIS
Jeremy Tasch, Ph.D.	Dept. of Geography and Environmental Planning	Professor	Political ecology of resource development

Table 6. ENVS Affiliated Faculty

Faculty Name and Highest Degree Earned	Home Department	Rank	Field of Study
Harald Beck, Ph.D.	Dept. of Biological Sciences	Professor	Mammal-plant interactions; tropical ecology
Alice Besterman, Ph.D.	Dept. of Biological Sciences	Assistant Professor	Coastal ecology
John Bullock, Ph.D.	Dept. of Political Science	Lecturer	Community development; public policy and planning
Michelle Casey, Ph.D.	Dept. of Physics, Astronomy and Geosciences	Assistant Professor	Invertebrate paleontology; conservation paleobiology
Caitlin Ceryes, Ph.D.	Dept. of Health Sciences	Assistant Professor	Environmental health and exposure sciences; environmental sustainability
Jacqueline Doyle, Ph.D.	Dept. Of Biological Sciences	Associate Professor	Conservation and population genetics
Natalia Fath, Ph.D.	Dept. of Geography and Environmental Planning	Lecturer	Landscape responses to climate and land-use/land cover changes; human dimensions of climate change
Laura Gough, Ph.D.	Dept. of Biological Sciences	Professor	Plant ecology
Sarah Gunning, Ph.D.	Dept. of English	Associate Professor	Technical writing; science writing
David Hearn, PhD.	Dept. of Biological Sciences	Associate Professor	Evolutionary, developmental, and ecological processes responsible for land plant diversity
Kimberly Hopkins, M.F.A.	Dept. of Art + Design, Art History, Art Education	Assistant Professor	Graphic design; materials
Kathryn Kautzman, Ph.D.	Dept. of Chemistry	Associate Professor	Analytical chemistry; atmospheric chemistry
Todd Kenreich, Ph.D.	Dept. of Secondary and Middle School Education	Professor	Environmental education; geographic education

Faculty Name and Highest Degree Earned	Home Department	Rank	Field of Study
John LaPolla, Ph.D.	Dept. of Biological Sciences	Professor	Systematics and taxonomy of ants
Kang Shou Lu, Ph.D.	Dept. of Geography and Environmental Planning	Professor	GIS; land use modeling; urban and regional planning
James Manley, Ph.D.	Dept. of Economics	Professor	Development economics; natural resource economics; health economics
Clare Muhoro, Ph.D.	Dept. of Chemistry	Professor	Environmental organic chemistry; science policy
Jay Nelson, Ph.D.	Dept. of Biological Sciences	Professor	Evolutionary physiology; physiological ecology of fishes
Karen Oslund, Ph.D.	Dept. of History	Professor	Environmental history; history of science and technology
David Ownby, Ph.D.	Dept. of Chemistry	Professor	Environmental chemistry; ecotoxicology
Makmiller Pedroso, Ph.D.	Dept. of Philosophy and Religious Science	Associate Professor	Philosophy of science; philosophy of biology
Thomas Rhoads, Ph.D.	Dept. of Economics	Professor	Applied microeconomics; environmental economics
Robert Rook, Ph.D.	Dept. of History	Professor	Environmental history, diplomatic and military history
Wilbur (Will) Ryan, Ph.D.	Dept. of Biological Sciences	Assistant Professor	Evolutionary ecology; climate change effects in marine invertebrates
Stephen Scales, Ph.D.	Dept. of Philosophy and Religious Science	Professor	Ethics; philosophy of science
Shannon Stitzel, Ph.D.	Dept. of Chemistry	Associate Professor	Analytical chemistry
Paporn Thebpanya, Ph.D.	Dept. of Geography and Environmental Planning	Professor	Physical geography; map design; applied GIS
David Vanko, Ph.D.	Dept. of Physics, Astronomy and Geosciences	Professor	Igneous and metamorphic petrology; public policy surrounding high-volume hydraulic fracturing and climate change
Chuyuan Wang, Ph.D.	Dept. of Geography and Environmental Planning	Assistant Professor	Remote sensing; GIS applications; urban climate and environment
Donn Worgs, Ph.D.	Dept. of Political Science	Professor	American politics; urban politics; community development

I2. Ongoing Faculty Training

The Faculty Academic Center of Excellent at Towson (FACET) is Towson University's faculty development center. FACET's mission is to support an inclusive and collaborative faculty community and foster a culture of excellence in scholarship and teaching. FACET supports faculty through a combination of programs, resources, funding, and access to partners across campus. All faculty have access to programs, workshops, meetings, and conferences to support pedagogy that meets the needs of students. Working in collaboration with the

Office of Technology Services, FACET also recommends, reviews, and provides programs to support faculty development and advancing skills with Blackboard, TU's learning management system. FACET provides one-on-one or small group, virtual or face-to-face meetings with an instructional design team, who also perform course reviews. Faculty may attend open meetings as well as request consultation from FACET staff.

J. Adequacy of Library Resources

Resources available through TU's Cook Library are sufficient to meet the needs of students and faculty in the proposed program. The library houses an extensive collection of materials, including more than 500,000 print and electronic volumes. In addition to a dedicated subject librarian, team of research librarians, and subject-specific research guides, the library provides access to 19 environmental science and studies subject-specific databases, such as GreenFILE, Scopus, ScienceDirect, JoVE Science Education Unlimited, JSTOR, and SpringerLink. Cook Library also houses computer workstations with specialty software for data analysis, data visualization and mapping, as well as a dedicated reading room for graduate students.

In addition to Cook Library, faculty and students have access to materials through reciprocal agreements at nearby Baltimore institutions and across USM-affiliated institutions. Materials from other libraries across the country can be requested for loan through standard interlibrary loan (ILL) services. As part of this service, faculty and students have access to RAPID ILL, a service customary at high research activity institutions. The current turnaround time for article requests is typically less than 48 hours.

K. Adequacy of Physical Facilities, Infrastructure, and Instructional Equipment

K1. Assurance of Physical Facilities, Infrastructure and Equipment

TU's existing physical facilities, infrastructure and instructional equipment are sufficient to support the needs of the program. The proposed Ph.D. program will be administratively housed in the Fisher College of Science and Mathematics. TU opened the 320,000 square foot Science Complex building in 2021. The Science Complex includes new research laboratory facilities and instrumentation for analysis of environmental samples, ecotoxicological experiments, DNA analysis, and much more that will support Ph.D. students whose research includes experimental approaches. Additionally, TU has invested in expanded staff support by hiring five new positions to oversee research and teaching instrumentation and facilities. These new staff join the long-term staff position and cross-department support of research through the facilities of the Urban Environmental Biogeochemistry Laboratory.

Faculty involved in the program residing in other colleges are housed in modern facilities well suited for support of Ph.D. students--for example, the College of Liberal Arts building (completed in 2012) and the new College of Health Professions building ($185 million, 240,000 square foot building completed in 2024). Additionally, the Smith building, the former home of the ENVS and other natural sciences programs and departments, has substantial renovations planned (scheduled for completion in 2025) that will include some facilities and space that will support the Ph.D. in SEC, particularly related to the space formerly occupied

by the Urban Environmental Biogeochemistry Laboratory (~$2 million space completed in 2012 that was partially funded with $1.3 million in federal grants).

K2. Assurance of Distance Learning Resources

The proposed program is designed to be delivered in-person via traditional modes of face-to-face instruction. In the event that distance learning resources are required, whether in an individual course or at a broader scale, TU is well positioned to provide adequate support.

The Faculty Academic Center of Excellence at Towson (FACET) offers training and certification programs for online and hybrid/blended instruction, Universal Design for Learning (UDL), and effective pedagogical approaches for enriching distance learning (including the Quality Matters Rubric). Both students and faculty can enroll in training modules that provide instruction in university-sponsored distance learning technologies, including Blackboard, WebEx, Zoom, and Panopto. Technology support is available online, as well as via email, text, phone and on a walk-in basis at Student Computing Services and the Office of Technology Services.

L. Adequacy of Financial Resources with Documentation

Towson University is investing in doctoral research programs in areas of faculty specialization and research. The Ph.D. in SEC has adequate resources to meet the needs of starting this interdisciplinary program but will also require new faculty lines to provide necessary course content and, especially, mentoring and research enhancements. This degree program will be funded with existing resources, new graduate student funding, university R2 investment funds, and reallocated faculty effort from FCSM, the College of Liberal Arts, and the College of Health Professions. The majority of graduate courses already exist in focused areas such as ecology, environmental geography, sustainability, and research methods. A minimum of three existing faculty FTEs (~12 faculty with a 25 percent commitment to SEC), a Graduate Program Director, and administrative staff support will be reallocated from existing funds to support this program (**Table 7**).

Expenditures for the program include 3.5 faculty FTEs, including five tenure-track research faculty (with a 50 percent commitment to SEC) and one lecturer who will support research faculty teaching in the program. Administrative support is also needed to be hired in year 2 to provide support to faculty, students, and SEC leadership. Faculty hires will occur during Years 2 through 4 of the proposed program. In addition to faculty resources, graduate assistantships for full-time doctoral students, library resources, operating, and faculty scholarship travel funds are requested (**Table 8**). As the program unfolds, TU anticipates the university's commitment to and investment in the strategic goal of achieving R2 Carnegie Classification, tuition and fees, and grant/fee-for-service activities, to provide adequate funding support.

TOWSON UNIVERSITY

Table 7. Programmatic Resources

Resources Categories	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
1. Reallocated Funds	**$509,730**	**$611,634**	**$687,998**	**$703,979**	**$720,440**
a. Reallocated Funds-Faculty Support[1]	$354,450	$456,354	$532,718	$548,699	$565,160
b. Reallocated Funds-Admin Staff Support[1,2]	$5,280	$5,280	$5,280	$5,280	$5,280
c. Reallocated Funds-University R2 Investment[3]	$150,000	$150,000	$150,000	$150,000	$150,000
2. Tuition/Fee Revenue[3,4]	**$46,224**	**$107,124**	**$183,892**	**$265,171**	**$299,135**
Number of Full-time Students	4	9	15	21	23
In-State	4	9	15	21	23
Out of State	0	0	0	0	0
Annual Tuition Rate In-State[5]	$9,558	$9,845	$10,140	$10,444	$10,758
Subtotal Tuition	$38,232	$68,913	$101,401	$104,443	$107,576
Student Fees	$12,312	$21,546	$30,780	$30,780	$30,780
3. Grants, Contracts & Other Sources	**$0**	**$0**	**$0**	**$0**	**$0**
4. Other Sources	**$0**	**$0**	**$0**	**$0**	**$0**
TOTAL (Add 1 - 4)	**$560,274**	**$702,093**	**$820,179**	**$839,202**	**$858,796**

[1] Re-allocated funds are based on incumbent faculty FTEs dedicated to the proposed program with salary and fringe rates. Salary and fringe rates increase by three percent annually.
[2] This is a Graduate Program Director position.
[3] University funds will be reallocated and invested in this program to support of the TU strategic priority to achieve R2 Carnegie Classification.
[4] Student enrollments are calculated at 100 percent in-state because all students in the program will be research or graduate assistants. It is anticipated that all students will enroll on a full-time basis.
[5] Tuition and fees increase by three percent annually.

Please note that Tables 7 and 8 project that the proposed program will operate with small deficits in Years 3 through 5, which is not an uncommon scenario for Ph.D. programs. TU recognizes that the establishment of this research program will require upfront investment. The university plans to support the program continually with designated strategic R2 investment dollars and anticipates that, once established, the program will draw indirect costs from extramural grants. These two additional revenue streams should ensure that the program operates at a minimum on a revenue-neutral basis and remains financially viable after Year 5.

Table 8. Programmatic Expenditures

Expenditure Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Total Tenure Track Faculty Expenses (b + c below)	**$0**	**$111,200**	**$229,072**	**$294,930**	**$303,778**
a. #FTE	0	1	2	2.5	2.5
b. Total Salary[1]	$0	$80,000	$164,800	$212,180	$218,545
c. Total Benefits (39% fringe rate)	$0	$31,200	$64,272	$82,750	$85,233

Expenditure Categories	Year 1	Year 2	Year 3	Year 4	Year 5
2. Total Lecturer Expenses (b + c below)	**$73,670**	**$75,880**	**$78,157**	**$80,501**	**$82,916**
a. #FTE	1	1	1	1	1
b. Total Salary[1]	$53,000	$54,590	$56,228	$57,915	$59,652
c. Total Benefits (39% fringe rate)	$20,670	$21,290	$21,929	$22,587	$23,264
3. Admin Support (b + c below)	**$0**	**$69,500**	**$71,585**	**$73,733**	**$75,945**
a. Admin salary[1]	$0	$50,000	$51,500	$53,045	$54,636
b. Admin Benefits (39% fringe rate)	$0	$19,500	$20,085	$20,688	$21,308
4. Equipment	**$0**	**$0**	**$0**	**$0**	**$0**
5. Library[2]	**$30,000**	**$30,000**	**$30,000**	**$30,000**	**$30,000**
6. New or Renovated Space	**$0**	**$0**	**$0**	**$0**	**$0**
7. Other Expenses (a + b + c + d below)	**$171,704**	**$297,427**	**$451,066**	**$608,090**	**$665,593**
a. Travel	$10,000	$10,000	$10,000	$10,000	$10,000
b. Program Support/Operating	$25,000	$25,000	$25,000	$25,000	$25,000
c. Tuition Waiver	$34,704	$80,427	$138,066	$199,090	$224,593
d. Student Stipends[3]	$102,000	$182,000	$278,000	$374,000	$406,000
TOTAL (1-7)	**$275,374**	**$584,007**	**$859,880**	**$1,087,254**	**$1,158,232**

[1] Salaries increase by three percent per year.
[2] Yearly ongoing subscriptions of $30,000.
[3] Doctoral student assistantships (two doctoral scholars; remaining research assistantships per program cohort – this represents a high-end estimate as TU anticipates some students will be supported from external funding).

M. Adequacy of Provisions for Evaluation of Program

M1. Procedures for Evaluating Courses, Faculty and Student Learning Outcomes

Course evaluation begins during the initial development of the course in the curricular review process. Course proposals are evaluated for:

- Appropriateness of course difficulty and workload.
- Effective assessment and grading practices in the course.
- Course syllabus consistency with the guidelines established by TU, which reflect best practices in course development.

These elements of a course are reviewed by the program, the FCSM curriculum committee, and the University Curriculum Committee. The primary focus at the program level is to ensure course content accuracy and program alignment, the focus at the college and university level is to facilitate the production of quality course proposals. In addition, college and university level review includes addressing any resource issues, determining if conflicts exist between departments/colleges.

Existing courses are evaluated through regular review by program faculty and student evaluations. Faculty regularly review courses to determine if the course is meeting overall program objectives. Additionally, instructors are observed by peers on a routine basis, with

more frequent observations if faculty are new to a course or the university. If a course review indicates concerns or problems with a course, faculty work to develop strategies for addressing/rectifying problems. Student course evaluation takes place at the end of every semester. Using a tool developed by TU faculty that allows for quantitative and qualitative feedback, students give feedback on instructors (e.g., ability to communicate clearly; quality of student- instructor interaction; preparedness) and suggest "improvements" for a course.

Evaluation of faculty takes place using policies and procedures established by TU's promotion and tenure/reappointment committees and merit evaluation process. This evaluation occurs at the department, college, and university level. The main areas of evaluation include teaching, scholarship, and service. Tools used as part of the annual evaluation process include review of the individual's portfolio that includes, but is not limited to, the following:

- Evidence of scholarship (e.g., articles in scholarly journals; presentations at scholarly meetings).
- Service work.
- A synopsis of teaching related-activities (e.g., courses taught; new instructional procedures; interdisciplinary, diversity, international, and technology-related projects).
- Review of course syllabi.
- Peer teaching observation reports.
- Quantitative and qualitative student evaluation of instruction.

Section G3 outlines the various assessment measures that will be employed throughout the program and shows their alignment with specific student learning outcomes. For the dissertation research courses, student achievement is assessed via the preparation and oral defense of the dissertation proposal and dissertation, whereas in the traditional instructor-led courses, assessment measures exist for each learning outcome. On an annual basis, specific learning outcomes are identified for assessment purposes. The SEC Graduate Program Director, with the support of TU's Office of Assessment, will oversee the processes involved in the assessment of student learning outcomes, including collection and analysis of data, and creation of action plans, as necessary.

M2. Evaluation of Program Educational Effectiveness

The assessment of this program will be guided by the university's Office of Assessment, following established TU policies and procedures, including review of the program's assessment plan to ensure that learning outcomes remain appropriate, and students are meeting expectations. The program will work closely with multiple units within TU, such as the Office of the Provost, Enrollment Services, Student Services, etc., to review data on a regular basis (e.g., each semester or annually) and, when needed, develop action steps or plans to improve the program. Effectiveness will be assessed in relation to student retention, progress toward degree completion, career outcomes for graduates, student and faculty satisfaction, cost-effectiveness, and other key performance indicators.

Additionally, TU will conduct a comprehensive evaluation of the Ph.D. program every seven years as part of the USM-mandated Periodic Review of Academic Programs process. The purpose of the review is to promote continuous program improvement and ensure that the needs of students are being met. Each program will prepare a self-study, engage an external reviewer to evaluate the program and identify strengths and areas for improvement, and submit a final report to the USM Board of Regents for review and approval.

N. Consistency with the State's Minority Student Achievement Goals

TU has a strong record of a commitment to diversity, equity, and inclusion principles. This is evidenced by the fact that Towson is only one of a handful of universities in the country to have no achievement gap, meaning that underrepresented student groups achieve the same or better academic success as the entire student population. In 2020, the university introduced its inaugural Diversity Strategic Plan. The plan, "*A More Inclusive TU: Advancing Equity and Diversity (2020–25)*," which is firmly grounded in the premise that TU's ongoing success is dependent on the university's capacity to shift perspectives and approaches and strategically place diversity, equity, and inclusion at the core of its mission. Diverse faculty recruitment is a TU institutional goal and faculty recruitment at the University is designed to reach and attract a diverse pool of candidates. Through diverse faculty recruitment, TU strives to foster a learning community that reflects the population of our campus, region, and state, and supports recruitment and retention of a diverse student population along with academic achievement of students from minority and underrepresented backgrounds.

The proposed Ph.D. in SEC aligns with TU's Diversity Strategic Plan by providing opportunities for students and faculty to address diversity, equity, inclusion, and justice (DEIJ) in the curriculum, through interdisciplinary studies, and through engagement with the complex challenges associated with sustainability and environmental change. In the curriculum, the required core course *ENVS 702: Sustainability in a Complex World* would explore human responses to environmental change and human dimensions of sustainability, including differential impacts and responsibilities borne by individuals and communities in the pursuit of sustainability. Other courses include a significant DEIJ-related focus or emphasis, including graduate seminars and electives like *GEOG 624: Geographies of Consumption and Waste* or *WMST 545: Women, Environment and Health*. The ENVS Program boasts more than 40 affiliated faculty across all TU colleges and represents a significant spectrum of expertise and approaches related to the study of sustainability and environmental change. These faculty respond to Goal 3.1.2 from the Diversity Strategic Plan to "foster a spirit of collaboration across units."

As an interdisciplinary program targeted at students with academic backgrounds in the natural, physical, and social sciences, the Ph.D. in SEC would be well positioned to recruit students interested in studying sustainability from a variety of perspectives and pursuing research-related careers in a wide range of fields. The program anticipates recruiting students into the doctoral program from TU's diverse undergraduate population and from institutions across and outside of the state. Indeed, the SEC program will be well positioned to help diversify the regional environmental workforce which, historically, is racially homogenous.

Maryland's HBIs offer a number of master's-level programs graduating students prepared for entry into the proposed Ph.D. program, including the M.S. in Applied Molecular Biology and Biochemistry at Coppin State University, the Master's in City and Regional Planning (MCRP) and Master of Public Health (MPH) at Morgan State University, and the M.S. in Marine-Estuarine-Environmental Sciences at the University of Maryland Eastern Shore, in addition to other undergraduate programs across the HBIs. Collaboration between TU and Maryland's HBIs in advertisement and recruitment for the proposed program will enhance the diversity of the program's student body and aligns with the state's goal to increase minority student achievement, as well as fostering collaboration among institutions.

O. Relationship to Low Productivity Programs Identified by the Commission

Not applicable.

P. Adequacy of Distance Education Programs

Not applicable. The majority of courses will be delivered on the main TU campus via face- to-face instruction. Following the COVID-19 pandemic, some classes have been offered with hybrid components, with some sessions scheduled on campus and others delivered synchronously or asynchronously online. Should faculty develop new hybrid courses, the Faculty Academic Center for Excellence at Towson (FACET) has both training and certification processes in place to assure that courses meet quality standards and faculty maintain access to updated evidence-based resources and techniques for designing and delivering effective online and hybrid courses.

Appendix A. Relevant Program Summaries

University System of Maryland (University of Maryland College Park, University of Maryland Center for Environmental Science, University of Maryland Eastern Shore, University of Maryland at Baltimore, and University of Maryland, Baltimore County)

Doctorate in Marine, Estuarine, and Environmental Science (MEES)

The MEES program is an interdisciplinary environmental science program supported by multiple partner campuses across the University System of Maryland. Aimed toward graduate students with research interests in fields of study that involve interactions between biological, physical, and chemical systems in the marine, estuarine, freshwater, or terrestrial environments, the MEES curriculum is designed around four interdisciplinary foundational areas: (1) environment and society; (2) earth and ocean sciences; (3) ecological systems; and (4) environmental molecular science and technology. Most classes in the 36-credit doctoral curriculum are offered via distance using interactive video technology.

Morgan State University

Doctorate in Bio-Environmental Sciences

The doctoral program in bio-environmental sciences examines the interactions between biological systems and the environment and emphasizes the use of innovative applied research tools and fundamental research. Curriculum in the program's standard track requires 60 credits, while the accelerated track (for students who already possess a master's degree) requires 36 credits, with core courses in bioenvironmental sciences, biotechnology, bioethics, and chemistry/biochemistry. The program's course electives are in subject areas such as environmental biology, environmental chemistry, environmental ecology, environmental health science, environmental biophysics, and bioinformatics and computational biology.

University of Maryland, Baltimore County

Doctorate in Geography and Environmental Systems (GES)

The GES doctoral program works at the interface between natural science, social science, public policy, engineering, and information technology. The curriculum for the 44-credit doctoral program includes required courses in geography and environmental systems, research methods, GIS, statistics, and a department seminar, along with electives in social science methods, remote sensing, computation methods and modeling, or environmental science field and laboratory methods.

University of Maryland, College Park

Doctorate in Environmental Science and Technology (ENST)

The ENST doctoral program allows students to work in one of four areas of specialization: soil and watershed sciences, ecological technology design, wetland science, and ecosystems health and natural resource management. The doctoral program requires completion of 50 credits beyond the bachelor's degree, as well as additional statistics and seminar courses beyond those required in the master's program.

Appendix B. Descriptions of Course Options in Program Outline

LIST OF REQUIRED COURSES

ENVS 600 ENVIRONMENTAL SCIENCE AND SUSTAINABILITY COLLOQUIUM (1)

Current and emerging issues at the nexus of environmental science, sustainability, and policy. Professional development and career advancement skills will be covered.

ENVS 701 SCIENCE OF ENVIRONMENTAL CHANGE (3)

Examination of physical, chemical, and biological processes causing environmental change. Overview of scientific approaches used to understand impacts to ecological and human systems.

ENVS 702 SUSTAINABILITY IN A COMPLEX WORLD (3)

Examination of social dimensions of sustainability and environmental change. Interdisciplinary survey of key issues and approaches from geography, political science, economics, and health sciences for understanding human impacts and responses to environmental change.

ENVS 990 DISSERTATION PROPOSAL (3)

Preparation and defense of a doctoral dissertation proposal under the guidance of the dissertation advisor.

ENVS 997 DISSERTATION RESEARCH (1-6)

Independent research guided by the dissertation advisor. May be repeated up to a total of 21 units.

LIST OF EXISTING GRADUATE-LEVEL RESEARCH METHODS COURSES

Students select one course from the following options. Students without previous coursework and/or experience in research design should enroll in GEOG 621.

BIOL 603 DATA ANALYSIS AND INTERPRETATION FOR BIOLOGISTS (3)

Information, techniques, and skills useful in gathering, analyzing, and interpreting data in the Biological Sciences. Topics include introduction to the role of statistical analysis in the biological sciences, hypothesis testing, experimental design, and current controversies in use of statistics in the biological sciences.

BIOL 609 COMMUNITY ANALYSIS AND BIOASSESSMENT (3)

Principles of design of environmental sampling studies, statistical analysis of data composed of multiple species, and environmental variables. Use of statistical software for data analysis projects. Emphasis on application of these methods in bioassessment of aquatic ecosystems, as well as community ecology and evolution.

GEOG 516 QUANTITATIVE METHODS IN GEOGRAPHY (3)

Focus on statistical problems associated with the analysis of geographic data. Emphasis on the unique spatial problems of point pattern analysis, aerial association, and regionalization.

GEOG 523 GIS APPLICATIONS (3)

Geographic information systems for solving real-world problems; vector-based GIS software, microcomputers for development of a GIS application.

GEOG 583 FIELD GEOGRAPHY (2-6)

Practical laboratory experience in techniques in the collection and analysis of data by observations, measurement, mapping, and photographic records. Such techniques are to be applied to selected geographic problems.

GEOG 587 ENVIRONMENTAL IMPACT ANALYSIS (3)

The collection and analysis of physical, social, biological, and economic information for the preparation of environmental impact statements (EIS).

GEOG 620 QUALITATIVE METHODS (3)

Exploration of qualitative methods in geography. Basic principles of research design, ethical and procedural considerations.

GEOG 621 RESEARCH DESIGN (3)

Reviewing the literature, formulating a research question, and finding appropriate methodology to generate data and answer the research question.

GEOG 622 PROBLEMS AND ANALYSIS IN GEOGRAPHY (3)

Application of research methods to the analysis of geographic problems.

GEOG 631 ADVANCED REMOTE SENSING: DIGITAL IMAGE PROCESSING AND ANALYSIS (3)

Satellite sensors, satellite data acquisition, field data collection and measurements, and the processing and analysis of various types of remotely sensed digital imagery.

HLTH 625 RESEARCH METHODS IN HEALTH (3)

Study of research and statistical designs in health science and allied health disciplines.

SOCI 582 RESEARCH METHODS (3)

A consideration of methodology of sociological research; the various steps in conducting research projects, from statement of the problem to final analysis of data.

LIST OF EXISTING GRADUATE-LEVEL ELECTIVE COURSES [a]

Students will complete a minimum of 24 units of electives, selected in consultation with the dissertation advisor and/or the Graduate Program Director. At least two courses (6-8 credits) must be broadening courses that are selected from subject areas outside the student's main field of research.

BIOL 502 GENERAL ECOLOGY (4)

Effects of the abiotic and biotic environment on distribution and abundance of organisms: organization of biological communities, ecosystems, evolution of different reproductive

strategies and application of ecological principles to natural resource conservation.

BIOL 506 LIMNOLOGY (4)

Physical, chemical, and biological factors that affect fresh-water organisms, and some of the standard methods used to analyze these factors.

BIOL 510 CONSERVATION BIOLOGY (4)

Application of ecological theory to conservation of biological diversity. Exploration of past and present processes leading to and maintaining diversity and how such processes are impacted by human disturbance.

BIOL 518 MICROBIOLOGY (4)

Biology of micro-organisms with emphasis on bacteria. Microbial morphology, physiology and genetics, and the role of micro-organisms in natural processes and disease. Laboratory will include methods of observing, isolating, and identifying bacteria.

BIOL 519 ENVIRONMENTAL MICROBIOLOGY (3)

Biology and ecology of microorganisms in natural and anthropogenic environments. Culture-based and molecular methods for detection, evaluation, and manipulation of microorganisms and their metabolism.

BIOL 532 VASCULAR PLANT TAXONOMY (4)

A study of the history and principles of vascular plant systematics with laboratory time devoted to collection and identification of plants in the local flora.

BIOL 535 PLANT ECOLOGY (4)

Environmental factors and processes which control plant distribution, plant communities and vegetational biomes of North America.

BIOL 546 TROPICAL ECOLOGY AND CONSERVATION (3)

Evolution and ecology of tropical ecosystems. Mechanisms that maintain tropical diversity, species interactions, anthropogenic impacts, and conversation strategies.

BIOL 547 TROPICAL FIELD ECOLOGY (4)

Field course set in the tropical rainforest. Includes exploration of different tropical ecosystems and training in techniques to carry out field research. Students will develop a research proposal and conduct their independent research projects including data collection, statistical analyses, write up, and an oral presentation of results.

BIOL 552 WETLAND ECOLOGY (4)

Wetland ecology and wetland management, with special focus on wetland of the Mid- Atlantic

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[a] With advance permission of the SEC Graduate Program Director, Graduate Special Topics, Directed Reading, and Independent Study courses in BIOL, ECON, GEOG, GEOL, HUMA, HLTH, IHSM, POSC, SOCI, and WMST may also be counted for elective credit, depending on the course theme or sub-topic.

region. Emphasis is on biological, physical, chemical, and ecological aspects of wetlands. Course also deals with valuation, classification, delineation, and management of wetlands for biotic resources and water management.

BIOL 555 FISH BIOLOGY (4)

Introduction to the evolutionary history, functional biology, ecology, and conservation of fishes. Laboratory experiences emphasize both identification of fishes and experiments designed to understand their functional biology.

BIOL 556 ORNITHOLOGY (4)

Evolutionary history, morphology, physiology, behavior, and ecology of birds.

BIOL 561 ENTOMOLOGY (4)

Laboratory and field course in insects. Identification and recognition of the more common families and orders and a study of their structure, behavior, ecology, economic importance, and control.

BIOL 567 HERPETOLOGY (4)

Systematic survey of the modern reptiles and amphibians. Emphasis is placed on the evolution of morphological and behavioral traits which have enabled the reptiles and amphibians to successfully exploit their individual habitats. Laboratory includes systematic classification, student seminars and field work.

BIOL 584 SEMINAR IN ECOLOGY, EVOLUTION AND BEHAVIOR (1)

Discussion and analysis of current research in ecology, conservation biology, environmental science, evolution, and animal behavior.

BIOL 610 POPULATION AND COMMUNITY BIOLOGY (3)

Processes in biological populations, including population growth, competition, and predation, analyzed by the use of conceptual-systems models and simple mathematical models.

BIOL 611 GLOBAL CHANGE BIOLOGY (3)

An investigation of global change with an emphasis on biological responses. Interdisciplinary exploration includes climate change, other human activities contributing to global change, climate policy, and mitigation.

BIOL 619 ENVIRONMENTAL MICROBIOLOGY (3)

Topics to be covered include: the historical importance of environmental microbiology, the different methods of molecular genetic analysis, microbially mediated biogeochemical cycles and their global importance, the adaptability of microorganisms to different environments, microbial functional metabolic plasticity facilitating xenobiotic compound degradation, and the use and importance of metagenomics in environmental microbiology.

BIOL 654 LANDSCAPE ECOLOGY (3)

Spatial and temporal landscape heterogeneity; how it arises, its quantification and its

influence on population, community, and ecosystem dynamics over multiple scales.

ECON 505 MICRO ECONOMICS (1.5)

Covers comparative advantage, supply and demand, elasticity, opportunity cost, competition and monopoly, and externalities. Emphasizes understanding concepts that are useful in making effective choices in a variety of economic and managerial situations.

ECON 506 MACRO ECONOMICS (1.5)

Covers economic growth, monetary and fiscal policy, inflation, and unemployment. Emphasizes understanding concepts, such as Federal Reserve policy, that are useful for managerial decision-making.

ENVS 582 ENVIRONMENTAL EDUC & SERVICE LEARNING IN THE TROPICS (3)

Designed for those majoring in the sciences or education fields with an interest in environmental education. Coursework will take place largely in the tropics of Costa Rica. Emphasis will be placed on the application of forest ecology concepts to PreK-12 environmental education and human use and management of natural resources in the tropics.

ENVS 601 TOPICS IN ENVIRONMENTAL GEOLOGY (4)

Geological concepts related to developed and developing areas; topics include earth materials, soils and soil formation, hydrological cycle, and waste management; water management; and geological issues in land-use decision making.

ENVS 602 ENVIRONMENTAL CHEMISTRY (4)

Principles of chemistry applied to environmental pollutants; physio-chemical processes controlling pollutant transport, fate, and distribution; partitioning of water, soil, and air as they relate to biotic systems.

ENVS 603 ENVIRONMENTAL LAW AND REGULATIONS (3)

Operation of the American legal system as it functions to control and remediate environmental problems; emphasis on the law and legal processes which govern environmental disputes; function of legal institutions in these disputes; role of regulations in environmental protection.

ENVS 604 ECOSYSTEM ECOLOGY (4)

Principles of ecosystem ecology; factors controlling ecosystem structure and function; energy balance and biogeochemical cycles. Emphasis on ecological impacts of human alterations and urbanized ecosystems. Development of student capacity for "systems thinking" via modeling in field and laboratory based investigative projects. Implications for environmental management from local to global scale.

ENVS 611 WATER POLICIES OF THE UNITED STATES (3)

History and application of the Clean Water Act, including ongoing actions and case studies.

ENVS 620 ENVIRONMENTAL POLICY AND SUSTAINABLE MANAGEMENT (3)

Analysis of the scientific approach to solve environmental problems within the socioeconomic concerns involved in formulating and administering environmental policy. Energy, management, policy, and sustainability are considered.

ENVS 625 SCIENCE AND POLICY OF THE CHESAPEAKE BAY RESTORATION (3)

Will provide students with a basic understanding of the key physical, chemical, and biological processes taking place in America's largest estuary. The class will explore how an understanding of these important ecosystem components has informed scientists, managers, legislators, and other stakeholders about the causes of the Bay's degradation and has provided insight into the formulation of a strategy for its protection and restoration. In addition to class lectures, projects and possibly in-field experiences, regional Chesapeake Bay experts from the academic, political, and regulatory sectors will provide students with a "real world" perspective on both the opportunities and obstacles in the effort to "Save the Bay."

ENVS 630 CONCEPTS OF ENVIRONMENTAL ENGINEERING (3)

Introduction to the principles and concepts of environmental engineering for non-engineers; review and discuss methods of assessment and design; modeling methods used; critical assessment of design and different design paradigms; problem solving approaches.

ENVS 635 WETLANDS IDENTIFICATION, CONSERVATION AND DELINEATION (4)

The ecological, chemical, and physical principles of wetlands biology; characterization, description, and mapping of wetland habitats. Wetlands regulations and their ecological basis including hydric soil field indicators, interrelationship of landscape, vegetation, and soils. Use of topographic maps, aerial photography, National Wetland Inventory maps and simple survey techniques.

ENVS 640 ECOTOXICOLOGY (3)

Fate, activity, and dose-response relationships of organisms to environmental toxicants; their absorption, distribution, metabolism, and excretion; evaluation of physical, chemical, and biological factors that influence toxicity. Quantitative methods and models used in acute and chronic toxicity studies.

ENVS 645 FLUVIAL GEOMORPHOLOGY AND HYDROLOGY (4)

Hydrologic and morphologic characteristics of streams and valley floors; landscape evolution by stream erosion and deposition, rainfall runoff relationships. Field exercises include quantitative analysis of fluvial processes, channel forms, mapping, topographic surveying, report writing.

ENVS 650 AQUEOUS GEOCHEMISTRY (4)

Application of thermodynamics, mass balance, systems science, and kinetics to understanding mineral-water-contaminant interactions in natural and impacted aquatic systems on a variety of spatial and temporal scales.

ENVS 670 INDEPENDENT STUDY IN ENVIRONMENTAL SCIENCE (1-3)

Studies in selected content areas tailored to student needs.

ENVS 680 SELECTED TOPICS IN ENVIRONMENTAL SCIENCE (1-4)

Topics in environmental science will be chosen. Course content and field exercises will be determined as to complement course offerings in environmental science.

GEOG 502 ENERGY RESOURCES (3)

Spatial patterns of traditional and alternative forms of energy will be analyzed. The many facets of the energy problem will be analyzed including physical deposits, economic variables, public policy implication and geographical patterns.

GEOG 503 SOILS AND VEGETATION (3)

A resource study of the world's soils and plant formations with emphasis placed upon their genesis and spatial differentiations.

GEOG 504 INTRODUCTION TO REMOTE SENSING AND PHOTOGRAMMETRY (3)

Fundamentals and the development of remote sensing, the nature of the electromagnetic radiation and its interaction with the atmosphere and surface objects, photographic systems, aerial photography, and photogrammetry basics.

GEOG 510 HISTORICAL GEOGRAPHY OF URBANIZATION (3)

Spatial and temporal development of urbanization and urban morphology from the rise of civilization in the ancient Near East to the contemporary post-industrial city. The entire scope of urban functions is surveyed, with the emphasis on the city as a man-made environment.

GEOG 512 ECONOMIC GEOGRAPHY (3)

Designed to explain the location of economic activities through a series of principles and theories. Emphasis on the various sectors of the economy, transportation, and economic development.

GEOG 515 CLIMATOLOGY (3)

Character, causes and distribution of climatic types. Emphasis upon world pattern.

GEOG 517 METEOROLOGY (3)

Examines the composition and structure of the atmosphere, thermodynamic processes, forces and related small- and large-scale motions, air masses, fronts, tropical cyclones, solar and terrestrial radiation, general circulation, and weather forecasting.

GEOG 519 POLITICAL GEOGRAPHY (3)

Effect of political groupings upon human's use of the world and the influence of the geographic base upon political power.

GEOG 520 POPULATION GEOGRAPHY (3)

General population theory, data sources for population geographers and the processes of

fertility, mortality, and migration. Patterns of population growth and change viewed from both temporal and geographical perspectives.

GEOG 522 URBAN SYSTEMS I (3)

Survey of the structure, functions, forms, and development of urban units. Emphasis upon the locational features of social, economic, and cultural phenomena; fieldwork required.

GEOG 526 FEMINIST GEOGRAPHIES (3)

Exploration of the intellectual foundations of the feminist critique; geographies of women and gender; influence of feminism across the discipline of geography.

GEOG 552 SEVERE AND HAZARDOUS WEATHER (3)

Examines the complexities and power of severe and hazardous weather, providing an understanding of the way events, such as thunderstorms, tornadoes, and hurricanes, develop and evolve within the atmosphere. Topics include the descriptions and physical explanations of the types of severe and hazardous weather along their societal and political implications.

GEOG 553 COMPREHENSIVE PLANNING (3)

The integration of separate urban systems into the comprehensive design of an urban region. Special emphasis will be placed on neighborhood, community, and town planning.

GEOG 557 STUDIES IN NATURAL HAZARDS (3)

The nature, frequency of occurrence and distribution of environmental hazards and their impact on humans.

GEOG 587 ENVIRONMENTAL IMPACT ANALYSIS (3)

The collection and analysis of physical, social, biological, and economic information for the preparation of environmental impact statements (EIS). Prerequisite: 6 hours of geography or consent of instructor.

GEOG 624 GEOGRAPHIES OF CONSUMPTION AND WASTE (3)

Introduction to geographic relationships associated with contemporary consumption and waste disposal activities.

GEOG 625 PLANNING FOR A SUSTAINABLE REGION (3)

The theory and practice of comprehensive regional planning as well as methods for assurance sustainability.

GEOG 652 GEOGRAPHIES OF HEALTH (3)

Interrelationship between health and our social and physical environments. Emphasis on geographic approaches to inequalities in health, well-being, and care.

GEOG 654 CLIMATE CHANGE: SCIENCE TO POLICY (3)

A survey of past, current, and future climate change. Emphasis on Earth's radiation balance, causes of climate change, observed and predicted signals of climate change, and impacts

and mitigation of climate change.

GEOG 683 SEMINAR: ENVIRONMENTAL PROBLEMS IN MARYLAND (3)

Individual research on a selected environmental problem in Maryland.

GEOL 515 HYDROGEOLOGY (4)

Geologic aspects of ground water; origin, occurrence, and movement.

GEOL 557 PHYSICAL OCEANOGRAPHY (3)

Physical, chemical, and geologic characteristics of ocean basins, boundaries and sea water including origin and behavior of waves and currents.

HUMA 612 ENVIROHUMANITIES (3)

Graduate seminar addressing the intersection of the humanities and the environment in a range of disciplines, including geographic, literary, artistic, architectural, and historic perspectives.

HUMA 613 DISEASE, LIFE, AND DEATH (3)

Graduate seminar discussing global views and perceptions of disease, life, and death.

HUMA 615 POWER (3)

Graduate seminar interrogating global perceptions, views, instances, implications, and implementations of power.

HLTH 551 INTRODUCTION TO ENVIRONMENTAL HEALTH (3)

Examination of the interrelationships between humans and their environment. Emphasis is placed upon health aspects of pollution, housing, sanitation, radiation, behavioral disorders, and epidemiology.

HLTH 618 INTRODUCTION TO PUBLIC HEALTH (3)

Study of disease prevention and health promotion with a focus on community efforts to improve the public's health.

IHSM 633 DISASTER RESPONSE AND COMMUNITY HEALTH (3)

Addresses the need for professionals to incorporate an all-hazards approach for disaster management and community health. Students will identify key international and national policies and their impact upon community health and national security. Students will be engaged in field work with the community of their choice to plan, implement, and evaluate a project designed to actively involve community members in some aspect of disaster preparedness.

POSC 504 POLITICS OF METROPOLITAN GROWTH AND CHANGE (3)

Examination of the political economy of metropolitan growth; role of federal, state, and local actors and policies in shaping development.

POSC 505 URBAN GOVERNMENT AND POLITICS (3)

The political history of American cities from the 18th century through the recent reform movement. City charters, home rule, types of executives, political machines, and the metropolitan area.

POSC 507 CONTEMPORARY INTERNATIONAL POLITICS (3)

Computer simulation (conducted jointly with colleges and universities throughout the world) used to study formulation and implementation of contemporary international politics.

POSC 521 POLITICS AND ENVIRONMENTAL POLICY (3)

Analysis and investigation of U.S. environmental problems from a political perspective.

POSC 539 POLITICS OF THE DEVELOPING WORLD (3)

An examination of the causes of poverty in the developing world. Particular attention given to the roles of the international system, domestic politics, and the natural world.

SOCI 529 DEMOGRAPHY (3)

Social, economic, and political problems related to changes, distribution, and movement of population; analysis of contemporary population trends in the United States and the world.

WMST 545 WOMEN, ENVIRONMENT AND HEALTH (3)

Relationships between economic development, health, and the environment from a global perspective with a focus on women's roles in environmental management; how women's activism effects social and public policy agendas.

WMST 550 B-MORE: BALTIMORE AND URBAN COMMUNITIES (3)

Analyzes significant political, economic, and cultural issues facing Baltimore and other urban communities including poverty, discrimination, economic development, and the criminal justice system, with special attention to gender, race, class, and youth activism.

WMST 613 WOMEN AND HEALTH (3)

An interdisciplinary study of women's health from a holistic perspective that builds on socioeconomic, political, and biological aspects of women's health.

Appendix C. Example Program of Study [a]

Year	Fall	Spring	Summer	Credits
1	• **ENVS 600 Environmental Science and Sustainability Colloquium (1)** • **ENVS 701 Science of Environmental Change (3)** • *Elective (3)*	• **ENVS 702 Sustainability in a Complex World (3)** • **Research Methods Course (3)** • **ENVS 997 Dissertation Research (1)** (Identify Topic, Literature Review) • *Elective (3)*	Dissertation Research Continues	17
2	• **ENVS 600 Environmental Science and Sustainability Colloquium (1)** • **ENVS 997 Dissertation Research (2)** (Literature Review, Research) • *Elective (3)* • *Elective (3)*	• **ENVS 990 Dissertation Proposal (3)** (Literature Review, Proposal) • *Elective (3)* • *Elective (3)*	Comprehensive Exams and Proposal Defense	18
3	• **ENVS 600 Environmental Science and Sustainability Colloquium (1)** • **ENVS 997 Dissertation Research (3)** (Research, Analysis, Writing) • *Elective (3)*	• **ENVS 997 Dissertation Research (3)** (Research, Analysis, Writing) • *Elective (3)*	Dissertation Research Continues	13
4	• **ENVS 997 Dissertation Research (6)** (Research, Analysis, Writing)	• **ENVS 997 Dissertation Research (6)** (Analysis, Writing)	Dissertation Defense	12
			TOTAL CREDITS	60

[a] Required foundation, seminar, and dissertation courses are in bold; electives are in *italics;* degree milestones are in plain text. For lists of research methods and electives courses, see Appendix B.

Appendix D. Letter of Support from University of Maryland Center for Environmental Science

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

Office of the President

2020 Horns Point Road
Cambridge, MD 21613
410-221-2000
dennison@umces.edu
www.umces.edu

June 4, 2024

Secretary Sanjay Rai, Ph.D.
Maryland Higher Education Commission
6 North Liberty Street
Baltimore, MD 21201

Dear Secretary Rai,

The University of Maryland Center for Environmental Science (UMCES) - a USM institution, enthusiastically supports Towson University's (TU) application for a new Ph.D. program in Sustainability and Environmental Change.

UMCES leads the way toward better management of Maryland's natural resources and the protection and restoration of the Chesapeake Bay. It is clear to us that we need more environmental scientists to guide our state, our region, and the world toward a more sustainable future.

Echoing the Vision 2030 USM Strategic plan, USM Chancellor Jay Perman stated in an opinion piece in Maryland Matters (February 4th, 2024) that our universities are critical in producing the environmental workforce and we will need not just scientists, but policymakers and activists to make a difference. This is one of the reasons that the proposed Ph.D. program at TU is important because it looks at the climate change challenges broadly and encourages interdisciplinary work -- with coursework and research not just limited to the physical sciences.

At UMCES, we work with USM institutions and already have strong partnerships with the University of Maryland College Park, University of Maryland Baltimore, University of Maryland Baltimore County, University of Maryland Eastern Shore (through the Marine Estuarine Environmental Science program) and Frostburg State University (through a joint Masters for Environmental Management for Sustainability program). Once this program is approved, we plan to partner with Towson University to explore a dual-degree program with UMCES.

Thank you for your consideration.

Sincerely,

William C. Dennison

Dr. William C. Dennison
Interim President, The University of Maryland Center for Environmental Science