UNIVERSITY OF SAN FRANCISCO | College of Arts and Sciences

Department of Environmental Science

APR Self-Study 2018 - ENVS/MSEM

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1. Introduction

The Department of Environmental Science at the University of San Francisco (USF) was formally constituted in 1996. While the Department is relatively young in the history of the sciences at USF, the teaching of environmental science and, in particular, environmental management at USF has a much longer history. The Department was preceded by the graduate program in Environmental Management by nearly two decades. Currently, there are 11 full-time tenure-track faculty[1], 3 term faculty[2], and 3-10 adjunct faculty members serving 60 undergraduates in Environmental Science and 101 graduate students in Environmental Management. The department has responsibility for an undergraduate major and minor in Environmental Science and a Master's program in Environmental Management. It is also inextricably tied to an undergraduate major and minor in Environmental Studies and to the Environment and Development track in the undergraduate International Studies major. On the graduate level, faculty from the Department launched a new Master's program in Energy Systems Management in 2017.

1.1. Previous Program Review Findings

The last academic program review occurred on 10-12 April 2013 in which the BS in Environmental Science was rated as "very good" and the MS in Environmental Management was rated as, "between good and very good." Many of the recommendations of the previous academic program review were subsequently implemented or at least addressed by the department in collaboration with the administration.

Of greatest significance in response to the previous program review was the opening of the Lo Schiavo Center for Science and Innovation. This doubled the department's teaching laboratory space and provided the department with significant resources to advance existing laboratory experiences and expand lab opportunities to our undergraduate program. Additionally, the hiring of a professional laboratory coordinator and technical support staff have dramatically improved the daily operations of lab facilities. In response to greater access to facilities, the department expanded its offerings of a variety of laboratory sessions and increased the number of lab sessions for the science core course for non-majors from 3 or 4 to 8 sections per semester. Moreover, we were also able to move the laboratory session for the capstone course ENVS-410 from a research lab to a new teaching lab and laboratory sessions for the second year Air &

[1] Of the 11 full-time tenure track faculty in Environmental Science, only 7 are teaching full time during fall semester 2018. Two of the remaining tenure-track faculty teach 4 semester hours or less per academic year in Environmental Science, 1 will not be teaching in the program for at least 4 years, and 1 is on a leave of absence as the Lead Scientist for the Delta Stewardship Council Delta Science Program.

[2] Of the 3 full-time term faculty in Environmental Science, only 2 are teaching full time during fall semester 2018. The third member is the program director of the Energy Systems Management graduate program.

Water course from shared space with Chemistry to a dedicated ENVS lab. The overall result was an ability to dramatically improve upon the curriculum and support proper wet-lab experiences as appropriate for our students. Unfortunately, this expansion of course offerings has now filled our lab spaces in the new building to capacity and reinforced our need to maintain a dedicated laboratory coordinator.

Staffing to support the Master of Science in Environmental Management program also increased as a result of the last program review. Program assistant support has increased from a 25% appointment to a 50% appointment. Additionally, a professional full-time program manager was hired in 2012 and while the individual in the role has changed, the full-time position remains. This additional staffing has allowed for significant improvement in management of the program combined with growth of student numbers while maintaining academic integrity and rigor.

With the opening of the Lo Schiavo Center for Science and Innovation, additional space was made available in Harney Science Center (the old science building) to outfit the department's Geospatial Analysis Laboratory (the GsAL). The opening of this space with the hiring of a Director and a Manager of the GsAL, directly addressed the comment of the last program review that the department would benefit from additional courses in spatial and landscape analysis and geographic information systems. A Geospatial Information Science curriculum has been offered since 2015, soon after the GsAL was established. Due to the success of the program launch, the department submitted a formal certificate program for both undergraduate and graduate students to our college curriculum committee, and that is currently undergoing review. Interest in the GsAL and the associated research efforts has grown strong within the program and necessitated a request for a new tenure-track faculty line to start fall semester 2019.

Another significant comment by the previous program review was that we expand courses in the geosciences. While this is still a work in progress, the department hired Professor Calla Schmidt in January 2013, whose research focuses on the intersection of hydrology and biogeochemistry with an emphasis on projects relevant to water resource management. Her appointment and experience with the geosciences led to the development of several undergraduate labs advancing our students' knowledge of local geology as well as new courses (with corequisite labs) in hydrology and environmental geology.

Finally, the last review team was generous in stating that the department's assessment plan was reasonable and learning outcomes were clear, while also suggesting that feedback from the administration and training were needed. The department has achieved great success in this area to the point of rethinking our mission statement and program learning outcomes and then assessing these in a methodical and logical approach. One milestone resulting from these efforts was the awarding of the Assessment Star Award in 2017 by the college for submitting the best annual assessment report in the sciences. However, one major implication of these efforts was to

promote and expect time-consuming assessment service opportunities to senior faculty in the department, usually compensated as overload.

Considering the magnitude of the recommendations of the previous program review, the department is grateful of the full support received from the administration in allowing us to respond effectively and strategically to significantly grow our program. We are also excited for the opportunities that these advances have provided allowing us to continually improve our program.

1.2. Challenges Facing Us

The challenges facing the Department can be organized into four categories:

- Balancing of faculty time and expertise between programs
- Space
- Promotion of Associate Professors, and
- Collaboration within the Sciences and across campus

The greatest challenge in the past has consistently been how to increase and stabilize the undergraduate student numbers. Much effort has been expended, and in-roads have been made, as detailed in Section 3.6. That said, with the stabilization of, and increased growth in our undergraduate major student population and the large number of graduate students we support in our Environmental Management master's degree program, we still struggle to balance the number of full-time faculty involved in each program. Further complicating the situation has been the increased interest and growth in our Geospatial Information Science certificate program for both undergraduate and graduate students.

Splitting the responsibilities of administration in the department between the Chair and Graduate Program Director has worked well over the past 14+ years and has proved to be a far better situation for faculty undertaking these roles. However, the challenge now is one of communication within the Department to ensure that the needs of all programs and faculty are met. In addition, an ongoing challenge is to have the Administration recognize the efforts that all of the above requires and to provide both appropriate levels of release time for faculty who serve in these positions and sufficient office staff for daily operations. The administration has been very receptive to finding innovative ways to meet the demands of all programs serviced by the department and we are hopeful that the addition of a new tenure-track faculty member with expertise in GIS can further alleviate faculty staff allocation issues.

Space is a contentious issue at most institutions and has become increasingly more problematic for our department. Little has changed since our last program review with respect to research space for our faculty. Some of it is historical in that the Environmental Science department was established after most of the space in Harney Science Center had been allocated. Thus, the

department never had adequate teaching space, faculty offices or research laboratories not to mention needed space for student-faculty and student-student interactions. The number of teaching laboratories for Environmental Science doubled from one to two with the opening of the Lo Schiavo Center for Science and Innovation in fall 2013 and with the opening up of space in Harney, the department was able to secure space for the GsAL and new faculty offices were constructed out of existing classroom space on the 4th floor of Harney. However, the new building provided new teaching and lab prep space only. Thus, the department is still in need of adequate research space for a number of faculty some of which have given up their space to junior faculty or have consolidated space to share laboratories that need substantial renovations. Several faculty in the department also lack an appropriate space for computational research. A space where faculty could work collaboratively and with their students would be most beneficial.

A direct consequence, among other issues, of not having adequate research space for all ENVS faculty is a lack of promotion from Associate to Full professor among those eligible within the department. Since the last program review, only one associate professor was promoted to full while the remaining eligible three have not been promoted. There are a variety of reasons and thus challenges that contribute to this stagnation, but lack of effort or desire by the individuals impacted are not the reason. Major reasons which have been identified include: inadequate research space, constant teaching overloads and high service loads to both the department and college. These mid-career faculty have shouldered much of the administrative burden in the department and while they have been successful in advancing departmental and college wide goals and initiatives, it has been at the expense of their own advancement. No clear solution has emerged to address this issue.

Finally, given the variety of courses we now offer and the range of expertise of the faculty, the Department of Environmental Science is ideally placed to interact with other departments, both science and non-science, within the University. Such interaction has the potential to enrich the educational experience of both those being educated and the educators, and is clearly in line with the mission of a Jesuit liberal arts education as well as the interdisciplinary nature of the Environmental Science and Environmental Management fields. Some interaction has occurred but, with the exception of the establishment of Environmental Studies and International Studies, it has been minimal; and our relationship with the Environmental Studies Program has been challenging the past few years. The new Engineering program to be launched in 2020 will provide additional exciting opportunities for our faculty to interact and contribute curriculum which we are excited about, but our ties with existing departments such as Biology remain weak despite obvious areas where collaboration would strengthen both programs. The Department needs to come up with innovative ways to promote and increase interaction across the University, and especially with other science departments. The GsAL has helped to begin this process, and the Administration has played a key role in facilitation of such interactions, in particular with promoting GIS across the college. Efforts to create college-wide centers such as

the proposed Center for Sustainability and Social Justice and purchase of Star Route Farms will also help to achieve this goal if faculty are able to participate.

2. Departmental information

2.1. Governance

The department currently has two faculty-staffed administrative positions: The Department Chair which carries 5 units of course release and the Graduate Program Director (GPD) which carries 4 units of course release. The Department Chair is elected and functions in accordance with the USFFA-USF Collective Bargaining Agreement; the GPD is appointed by the Dean who, to date, has taken the departmental recommendation from an election. Both the Chair and GPD typically serve for a three-year term. Given the administrative complexities associated with the department and its undertakings with other programs such as Environmental Studies, International Studies, GIS Certificate Program, and Energy Systems Management, the Chair handles all matters associated with the undergraduate programs and the GsAL, while the GPD handles the graduate programs. Cooperation between the two positions is required for all issues that affect both programs, such as faculty workload, course scheduling, and laboratory space and equipment.

2.2. Department Chair

The Department Chair is responsible for the smooth running of the department and interfacing with the Dean's Office as the representative of the department. The Chair administers the undergraduate program operating budget. Together with the Graduate Program Director, the Chair has oversight of a Program Assistant, Lab Manager, Graduate Student Instructors, student employees, part-time faculty selection and supervision, workload distribution, course-scheduling, student issues, etc. The Chair coordinates department meetings approximately twice per month during the academic year. The Chair also attends the monthly meetings of College Council and COSEC (The College of Science Executive Council) and sits on the committee that evaluates science courses proposed for the University's "Core B" requirements.

It is worth noting that because we are a unionized faculty, the position of Chair does not carry the same level of authority as it does at many other universities. At USF, in most situations the Chair makes recommendations to the Dean or Associate Dean who may then choose to act on those recommendations or take other actions or no action. This can create some problems, particularly with regard to the supervision of support staff and hiring and retention of term and adjunct faculty. The Chair is in direct contact with the Program Assistant and Lab Coordinator on a daily basis and conducts the associated job performance reviews. However, the Chair has no direct authority to ensure that expectations are met, particularly with respect to term faculty. In most cases, the Chair plays an advisory role in personnel decisions in that the chair can make

recommendations on issues of hiring, performance evaluations, etc. However, it is the Dean's Office that is the direct supervisor and how that office responds to chair recommendations is dependent upon the relationship between that office and the department. The department is encouraged by the collegial relationship it has with the college administration.

2.3. Graduate Program Director

The GPD supervises the operations of the graduate program, from recruitment through graduation and the extensive work in between including the management of budget activities. The GPD is also responsible for locating from a few up to ten qualified part-time instructors to provide relevant courses to the students that cannot be provided by the full-time faculty (in terms of either expertise or available teaching load). The GPD is heavily involved in admissions for the program, and is the first point of contact for many of the students currently enrolled in the program. The GPD, in coordination with the Department Chair, is responsible for the scheduling of courses according to instructor availability and curricular needs. The GPD is in charge of the MSEM curriculum, including shepherding new classes through the approval process. The GPD basically has the same responsibilities for the graduate programs as the Chair does for the undergraduate programs including supervision and evaluation of support staff.

2.4. MSEM Program Manager

The Program Manager is in charge of most recruitment for new students. The Manger plans and holds information nights for prospective students and communicates with prospective students. The Manager, the Director, and the faculty work together to review the applications and determine which students are admitted. The Manager and the Program Assistant handle the process of sending out the admissions letters. The Manager, in conjunction with the Program Assistant, take the lead in planning events, such as social activities for students and departmental functions. The Program Manager takes the lead on communications, such as the MSEM Leaf, which is the program's newsletter.

2.5. Workload

The standard workload for all full-time faculty is 30 units per academic year, where one unit is equivalent to 3 hours of effort per week for a 15-week semester. For tenure track faculty, this is divided up into 18 units (semester credit hours) of teaching, 6 units of research and 6 units of service per academic year. For term faculty the research expectation is eliminated and those units are allocated to teaching for a total of 24 units per academic year. College policy dictates that summer course offerings are compensated with overload pay only, and cannot be part of a faculty members academic year teaching load.

2.5.1. Undergraduate Courses

All undergraduate courses in ENVS are currently 4-unit courses. Lecture only courses are credited as 4 units of faculty workload. However, since courses that also have laboratory or field components require a higher level of effort and time commitment, these courses constitute a 6-unit workload equivalent. For the variety of ways these units may mix, faculty are allotted 4 units of workload per lecture section and 2 units of workload per laboratory session taught.

2.5.2. Graduate Courses

All current courses in the MSEM programs, with the exception of the Master's Project and Thesis classes are 2 units with the number of workload units equivalent to the course units.

2.6. Faculty

The department is currently staffed by 11 full-time tenure-track faculty, 3 term faculty, and 3-10 adjunct faculty members serving 60 undergraduates in Environmental Science and 101 graduate students in Environmental Management. Unlike other science departments at USF, the majority (55%) of Environmental Science faculty identify as female. There are four full professors in the Department (Callaway, Karentz, Karney, and Siehr). All full professors provide senior leadership experience and have played important roles in the development of the department. However, at present, only one Full Professor is fully active in the Department (Siehr). Callaway is serving in a 3-year research position with the State of California. Karentz has a joint appointment with Biology that involves most of her teaching and research restricting her teaching load in ENVS to less than 6 and sometimes only 2 units per two academic year cycle. Karney is currently chair of the Chemistry Department and due to a shortage of Organic Chemists there is unlikely to teach in ENVS during the next 4 academic years. The size of the department has also dictated that recently tenured, or even junior faculty on one occasion, serve the department in leadership roles. Thus, in the last 15 years every tenured faculty member, except Karentz, has served in the capacity of Chair or Graduate Program Director (GDP). In addition, the Department has a wide range of professional and technical expertise covering a large part of what commonly falls under the umbrella of Environmental Science and Environmental Management.

2.6.1. Faculty Overview and Achievements

Current faculty have won Office of the Provost Faculty & Staff Awards:

- Deneb Karentz and John Callaway won the Distinguished Research Award in 1999 and 2013, respectively. (The Distinguished Research Award is given jointly by the USF Faculty Association and the University to a full-time faculty member whose recent research and scholarship have made an outstanding contribution to his or her academic discipline.)

- Jack Lendvay won the Sarlo Prize in 2004 (The Sarlo Prize recognizes excellence in teaching based upon the moral values that lie at the foundation of USF's identity. The awardee shall be a proven, effective full-time faculty member who through his/her teaching exemplifies the ethical principles which inform the University's Vision, Mission and Values).

Our faculty have also won a number of College of Arts & Sciences awards:

- Deneb Karentz (1993), John Callaway (2007), and Gretchen Coffman (2016) won the Arthur Furst Award for Outstanding Research for the Betterment of Humanity.
- Deneb Karentz won several additional USF awards as detailed below:
    - USF College of Arts and Sciences Dean's Scholar Award (2016),
    - USF College of Arts and Sciences Collective Achievement Award for work developing assessment plans for academic programs (2009),
    - USF College of Arts and Sciences Frank L. Beach Award for Outstanding Leadership (2008)

Significant external awards to USF ENVS Faculty include:

- Tracy Benning was a member of the Intergovernmental Panel on Climate Change that shared the 2007 Nobel Peace Prize with Albert Arnold Gore, Jr., "for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change."
- Deneb Karentz won several external awards as detailed below:
    - Selected by the Scientific Committee on Antarctic Research (SCAR) Women of the Antarctic Program (2016),
    - Lake Karentz (77°15'48"S, 161°48'30"E) was named by the United States Board on Geographic Names for achievements in Antarctic research and leadership (2005).
- Allison Luengen won external awards as detailed below:
    - Third runner up for the Best Paper of 2013 award by the journal *Environmental Toxicology and Chemistry*.
    - First Place (2012), Delta Science Video Competition, for "Mercury in the San Francisco Bay" available at http://www.youtube.com/watch?v=p8L70RneLgI&feature=plcp

Additionally, several faculty members have had success in receiving external funding. Specific details can be seen in individual CVs.

2.6.2. Faculty Biographical Sketches (Teaching, Research, Service)

Short biographical sketches are provided below for full-time tenure-track faculty, full-time term faculty, and part-time adjunct faculty that repeatedly teach in ENVS and/or MSEM.

Harry Allen, Adjunct Professor

Harry has over 16 years operations experience in large scale, interagency responses to major environmental disasters, hazardous waste sites, oil spills, radiological contamination cases and many other types of pollution events. Areas of expertise include environmental study design, contamination and exposure estimation, including characterizing plastic particle pollution in marine environments, unique application of technology solutions to oil spill monitoring, and soil remediation. Research interests include identifying and quantifying particulate pollution in soils and water. He is an alumnus of the USF MSEM program and is currently the chief of the Emergency Response Section at USEPA Region 9.

Tracy Benning, Associate Professor

Professor Benning received her PhD from the University of Colorado, Boulder in Environmental, Population and Organismic Biology in 1993. Her research interests include landscape ecology, urban ecology and resource conservation and management. Her most recent research focuses on the use of remote sensing and GIS technologies in the study of urban ecosystems, and tropical rainforest dynamics in Hawaii. She has also collaborated with public health scientists to examine spatial patterns of infectious diseases.

She teaches both graduate and undergraduate courses in the Geospatial Information Science certificate program, as well as courses in introductory environmental science, ecology and senior capstone at the undergraduate level.

John Callaway, Professor

John Callaway received his PhD in Oceanography and Coastal Sciences from Louisiana State University in 1994. Prior to his position at USF, John was the Associate Director of the Pacific Estuarine Research Laboratory (PERL) at San Diego State University.

At USF, Professor teaches undergraduate and graduate courses in introductory environmental science, applied ecology, wetlands, and restoration ecology. His research expertise is in wetland restoration, specifically wetland plant ecology and sediment dynamics. Recent research projects focus on the development of restored wetlands, including evaluations of the importance of plant species diversity and the role of physical heterogeneity in the development of ecosystem functions. His research includes projects in San Francisco Bay and Tijuana Estuary. This work has been funded by the National Science Foundation, the Environmental Protection Agency, California Sea Grant, and other agencies.

Prof. Callaway is on Academic Leave Fall 2017 - Spring 2020 to be the Lead Scientist for the California Delta Science Program. Moreover, he will be applying for sabbatical leave for the 2020-2021 academic year.

Gretchen Coffman, Associate Professor

Professor Coffman received her PhD in Environmental Health Sciences from UCLA in 2007. Dr. Coffman's current research focuses on scientific questions with high relevance to management problems, mainly related to riparian plant ecology, restoration, and invasive plant biology in wetlands and river systems of Mediterranean-type and tropical climates. Her research focuses on experimental wetland revegetation and restoration strategies, invasive plant ecology, and restoration monitoring to improve performance standards. She has on-going research projects along rivers and watersheds in coastal southern California, the San Francisco Bay Area, the Central Valley of California, and Southeast Asia.

Stephen Fowler, Adjunct Professor

Stephen Fowler has been teaching at USF as an adjunct professor since 2006. During this time, he has taught courses in business ethics at the business school and sustainable business at the college of arts and sciences. His research areas have included sustainable business practices, sustainable business indices and corporate responsibility. He has many years of experience in business as a corporate executive, entrepreneur and investor in startup companies and green building. He has degrees from Cambridge University and London Business School.

Aaron Frank, J.D., Adjunct Professor

Aaron Frank's areas of interest include Environmental Law, Environmental Ethics, and Wildlife Policy. He is the Founder and President of the California Wildlife Center and sits on the Board of the Arava Institute for Environmental Studies. In 2013, Aaron won a USF Distinguished Teaching Award.

Kathleen Jennings, Adjunct Professor

Professor Jennings' background is in water quality, human and ecological risk assessment, and wildlife ecology. She is trained in emergency response for hazardous materials releases and natural resource assessments for shoreline and biological injury.

Sam Jensen Augustine, Adjunct Professor

Sam has worked on humanitarian, research and design projects in the Caribbean, Latin America, and Asia. Sam's undergraduate degree is in Environmental and Industrial Microbiology. His interests lie at the intersection of technology, environment and social aspects of building design and performance.

He has a Master of Architecture and a Certificate of Technical Teaching in Environmental Controls Systems from the University of Oregon Sam where he received a grant to study a

combined water disinfection and thermal mass heating system. Sam was awarded the Architectural Research Centers Consortium's King Student Medal for Architectural Research.

Sam formerly worked at Siegel & Strain Architects was a Ginsberg Fellow for the U.S. Green Building Council. He currently works full time at PG&E's Pacific Energy Center.

Gordon Johnson, Adjunct Professor

Gordon Johnson is an Environmental Engineer for the Shell Oil Refinery. He has extensive experience in energy resources management including renewable energy program development, as well as drinking water and industrial wastewater treatment, groundwater and soil remediation, air pollution compliance and hazardous waste compliance.

Deneb Karentz, Professor

Deneb Karentz is a marine biologist who earned an MS in Biology from Oregon State University and a PhD from the University of Rhode Island. She had an NIH post-doctoral fellowship to train at the University of California San Francisco in the field of molecular genetics of human disease. Her research focuses on phytoplankton ecology, most specifically in relation to ozone depletion in Antarctica; but also, locally in San Francisco Bay. Her work has been funded by multiple grants from NSF. In addition to research, she is the co-director of the NSF Integrative Biology Training Program, an international field course designed to provide early career scientists with hands on experience in Antarctica. Deneb is also involved in several aspects of science and policy in Antarctica serving as a science advisor to the US State Department at the annual Antarctic Treaty System Meetings, and she is the US delegate to the Scientific Committee on Antarctic Research (SCAR).

William Karney, Professor

William Karney received his PhD in Organic Chemistry from the University of California, Los Angeles, in 1994. Prior to his position at USF he did postdoctoral work at the University of Washington and the University of California, Berkeley. At USF, William teaches organic chemistry and environmental chemistry. His research, performed in collaboration with Professor Claire Castro (chemistry), involves the use of computational chemistry to understand the structures, energetics, and properties of organic compounds and the mechanisms of organic reactions. Recent projects include the elucidation of mechanisms for dynamic processes in annulenes and the high-temperature rearrangements of polycyclic aromatic hydrocarbons (PAHs). His work is funded by the National Science Foundation.

Amalia Kokkinaki, Assistant Professor

Amalia Kokkinaki, PhD, is a hydrogeologist, with research interests in numerical modeling of contaminants in the subsurface, multiphase flow, and groundwater remediation, as well as in statistical modeling for monitoring and characterization of the subsurface. Her recent work includes applications of statistical methods for monitoring carbon storage in deep groundwater reservoirs, characterization of large-scale aquifers with limited monitoring data, and uncertainty

quantification in subsurface systems contaminated by organics. She teaches graduate and undergraduate courses in applied statistics, environmental remediation and water treatment.

Jack Lendvay, Associate Professor

John M. (Jack) Lendvay received his MSE and PhD in Environmental Engineering from the University of Michigan and is a licensed Civil Engineer with the State of California. His undergraduate studies were completed at Hiram College where he learned the value of a liberal arts education and received his BA in Chemistry. Dr. Lendvay's research interests focus primarily on the relationships between land use and water quality in coastal watersheds. He is currently working with colleagues and undergraduate students at USF and the US National Park Service to assess water quality of the Redwood Creek Watershed, Marin County, CA. Previously, Dr. Lendvay was a Fulbright Scholar in collaboration with Universidade Federal de Alagoas in Maceio, Brazil, where he pursued a research project titled, "Watersheds and Water Quality: Assessment and Management.

Allison Luengen, Associate Professor

Allison Luengen received her MS in Marine Sciences from the University of California, Santa Cruz (UCSC). She then completed her PhD in Environmental Toxicology, also at UCSC. Following her PhD, she moved to the East Coast for postdoctoral research with Dr. Nicholas Fisher in the School of Marine and Atmospheric Sciences at Stony Brook University. As a postdoc, Professor Luengen worked with radioisotopes to look at how methylmercury bioavailability to phytoplankton was affected by dissolved organic matter.

Professor Luengen's research at USF focuses on the cycling and bioavailability of trace metals. She frequently works in the San Francisco Bay and Delta, an estuary where there are elevated concentrations of many metals, including mercury. Mercury, in the form of methylmercury, biomagnifies up food chains, reaching concentrations in fish that can be a million times higher than in the water. Professor Luengen is interested in how methylmercury first enters the food chain, when it is taken up by phytoplankton. Her current research in the San Francisco Bay Delta also explores how methylmercury is transferred from phytoplankton to subsequent trophic levels. A major goal of her work is to understand metal accumulation in terms of water chemistry and mechanistic processes.

Thomas MacDonald, Associate Professor

Tom MacDonald received his PhD from Stanford University. Professor MacDonald's research focuses on designing computer simulations of problems of pollution migration and using the results to engineer systems to contain pollutants and prevent further spreading. He has also published his research on the neural network application for bioremediation. Recently he has co-authored papers dealing with environmental risk and the precautionary principle.

April Randle, Assistant Professor

April M. Randle received her MS in Zoology from University of Florida, PhD in Ecology and Evolution from University of Pittsburgh. Her research is broadly focused on how ecological factors shape the behavioral and morphological traits of species and influence species' distributions and interactions. She has conducted research on a range of taxa including: tropical trees (forest restoration), primates (foraging behavior), temperate flora (plant ecology, mating system evolution, plant-pollinator interactions), marine mammals (population size estimation of large cetaceans), tropical freshwater fish (adaptations to extreme environments), and amphibians (impacts of pesticides, toxicology). Her most recent work focuses on ecological factors that influence the evolution of plant mating systems, and how the mating system can drive species diversification and influence species distribution.

Aviva Rossi, Adjunct Professor

Aviva Rossi is an ecologist, with a focus on wildlife field studies. She has 18 years of experience working with natural resources. Ms. Rossi has worked with research institutions, non-profit organizations, and consulting firms focusing on regulated species (sensitive or invasive) and habitats in the greater San Francisco Bay Area. She has experience running successful field programs through vegetation and wildlife field surveys, habitat restoration, monitoring projects, and regulatory compliance work. She is currently completing her PhD at the University of California, Davis, on the effects of climate change on wildlife in the Sierra Nevada.

Chris Ruehl, Adjunct Professor

Professor Chris Ruehl works in the Research Division of the California Air Resources Board, studying the emissions of vehicles and off-road engines. His work has focused on both the human health and climate effects of atmospheric particulate matter. He also has experience in water quality, having studied nutrient cycling in streams draining agriculturally-impacted regions of California.

David Saah, Associate Professor and Director of Geospatial Analysis Lab

Dr. Saah has been broadly trained as an environmental scientist with expertise in a number of areas including: landscape ecology, ecosystem ecology, hydrology, geomorphology, ecosystem modeling, natural hazard modeling, remote sensing, geographic information systems (GIS) and geospatial analysis. He has used these skills to conduct research primarily at the landscape level in a variety of systems. Dr. Saah has participated in research projects throughout the United States and Internationally. His academic research uses integrated geospatial science for multi–scale mapping, monitoring and modeling of environmental spatial heterogeneity, particularly in riparian, savanna, and forest ecosystems. These efforts include quantification of change in landscape pattern, investigating the linkages between pattern and processes, and understanding the pattern–process dynamic within different environmental management regimes. To complement this, Dr. Saah's consulting research interest and experience include: developing

holistic decision support systems for resource management, assessing natural hazards, and quantifying ecosystem service valuation. In addition, all of his research addresses access, availability, and accuracy of geospatial and environmental datasets, and scale in natural resource and environmental research. Dr. Saah is committed to producing high quality research projects that integrate the most current science and technology. He is dedicated to the accurate dissemination of results from these endeavors through innovative presentations, publications, and workshops.

Calla M. Schmidt, Assistant Professor

Calla Schmidt received a PhD in Earth Science from the University of California, Santa Cruz. Her research spans physical hydrology and biogeochemistry and aims to understand the connection between hydrology and the biogeochemical cycling of nutrients. She has done research on nutrient cycling during groundwater recharge, nitrogen pollution in highway runoff and presently she is working on a project investigating the transfer of nutrients discharged by wastewater treatment plants into the base of the food–web in San Francisco Bay. Professor Schmidt's research begins in the field with the collection of water and sediment samples and other supporting environmental data. In the lab she uses a combination of chemical and isotopic techniques as well as modeling to connect the physical hydrology of a system with changes in water quality. In all of her research her goal is to use insights into fundamental processes in hydrology to help inform sustainable management of water resources.

Ken Schwarz, Adjunct Faculty

Ken conducts hydrologic and geomorphic analyses and produces watershed and stream management plans, hydrologic reports, stream assessments, sediment and erosion control evaluations, water rights petitions, restoration designs, conservation plans, and CEQA documents. Ken is an expert in environmental regulations and specializes in using his technical background to develop successful permit applications for the USACE, SWRCB, RWQCBs, CDFG, USFWS, and NMFS, as well as local county and municipal approvals. Ken has provided expert witness testimony to the State Water Resources Control Board, the California Energy Commission, and other civil trial proceedings on hydrology, river, and environmental impact issues. Ken's watershed and stream projects typically balance the needs and requirements of local government planners, regulatory agencies, and watershed stakeholders, while maintaining focus to project costs and schedules. Ken is also a highly regarded instructor. He has lectured and taught courses in hydrology, geomorphology, watershed planning, riparian processes, physical geography, and ecosystem restoration for U.C. Berkeley, UCLA, UC Davis Extension, University of San Francisco, the U.S. Army Corps of Engineers, and Lorman Educational Services. He has authored research articles and presented at several conferences.

Laura Seidman, Adjunct Professor

Laura Seidman is an independent energy efficiency consultant for building construction, retrofit and retro-commissioning. Her focus is on applying building science to identify energy-saving

and money-saving opportunities for building owners and occupants. She is certified as a BPI Building Analyst and Bau-biology practitioner, which enables her to integrate IEQ (indoor environmental quality) into her building assessments. She currently runs her own energy and design consulting company and teaches energy efficient construction and auditing for non-profits, private companies, community colleges and individuals.

Stephanie Siehr, Professor

Professor Stephanie Siehr (formerly Ohshita) works on energy–based solutions to multiple environmental problems--from local air pollution to global climate change--utilizing a mix of systems thinking, engineering, institutional and policy analysis. Her research and teaching span China, Japan, the United States, California, and international networks of cities, examining low-carbon resilient cities; energy and environmental policy; emissions inventories and climate action plans; cooperation and equity. She is also Visiting Faculty in the Energy Analysis and Environmental Impacts Division of Lawrence Berkeley National Laboratory. Prof. Siehr holds an SB in Chemical Engineering from MIT, a research certificate in Chemical and Environmental Engineering from Tokyo Institute of Technology, a black belt in Aikido, and an MS and PhD in Environmental Engineering and Policy from Stanford University. She is the author of 50+ reports, book chapters, policy briefs, and journal articles.

Maggie Winslow, Associate Professor

Professor Maggie Winslow is the Director of the Master of Science in Energy Systems Management. She received her PhD from the Energy and Resources Group at the University of California at Berkeley and Master of Science from the School of Natural Resources at the University of Michigan. She spent nine years at Presidio Graduate School in San Francisco, a sustainability focused MBA and MPA program, teaching managerial economics and macroeconomics and serving as MBA program chair and academic dean. Her work spans ecological economics, democracy, equity, and the new economy.

2.7. Staff

Short biographical sketches and responsibilities are provided below for full-time staff within the Department of Environmental Science.

Alexander Pourfard, Program Assistant

Alexander Pourfard is a recent graduate (March 2017) in Environmental Studies from the University of California, Santa Cruz, and joined our staff as the department's and MSEM Program's Program Assistant in July 2018. As an undergraduate, Alexander gained experience in conservation biology and ecology, both as a student and while interning for the UC Reserve System and NOAA Southwest Fisheries. Additionally, Alexander worked as a Peer Mentor for the University of California, Santa Cruz Learning Support Services office where he collaborated with fellow students, staff, and faculty to assist students in poor academic standing. Shortly after graduating, he joined a pollinator conservation non-profit called Pollinator Partnership as a

Program Associate. With Pollinator Partnership, Alexander managed data entry and development of incoming donations, grants, and sponsorships, and also coordinated the nonprofits events, programs, and documents. Alexander also worked as a Customer Relationship Manager for Tarim Consulting where his responsibilities included, but were not limited to managing company marketing and branding, as well as creating proposals for corporate and government organizations. With Alexander's environmental science background and experience working in administrative positions that require great attention to detail, he is able to apply a unique perspective to the tasks of Program Assistant of the Environmental Science Department.

Darin Chun, Laboratory Coordinator

Darin Chun graduated with a BS in Environmental Science from the University of San Francisco in May 2016 and joined our staff as the Laboratory Coordinator in August 2017. In the interim between graduating from college and joining our staff, Darin served as a scientist for the San Francisco Bay Regional Water Quality Control Board. Darin supervises three undergraduate laboratory assistants (undergraduate students) and is responsible for organizing setup of all our teaching laboratory exercises and care and maintenance of all our wet-lab and field facilities. He maintains and repairs of all of our laboratory equipment as needed. Moreover, he cares for camping and field equipment which is used by our department and often shared with others, especially Environmental Studies.

Megan Danielson, Geospatial Analysis Lab Coordinator/Adjunct Faculty

Megan Danielson has a B.S. in Environmental Science and a Master's Degree in Public Health from the University of San Francisco. Megan is responsible for maintaining and supporting the Geospatial Analysis Lab. In addition to her managerial duties, she also teaches graduate level courses for the GIS certificate program

2.8. Technology Resources

The ENVS and MSEM programs share the following computational and technology resources, in support of teaching and research activities:

2.8.1. Space & Facilities

Classrooms: LS 103 & LS 303 are preferred classroom spaces

There are no dedicated classrooms for ENVS or MSEM courses, but rather we utilize the university-wide scheduling system to determine where our faculty teach. Two classrooms prioritized as teaching space for the sciences include LS-103 and LS-303 in the Lo Schiavo Center for Science and Innovation. LS-103 has access to laptops that are stored in a cart in a storage room adjacent to the classroom. LS-303 is considered a college-wide computer lab and is prioritized for courses that require computer access. The room has a secured closet where laptops are stored, and used as needed by students during class time. Access to the closet is given to instructors as needed.

Wet Teaching Labs (LS-G05 & LS-G06)

LS-G05 and LS-G06 host all courses that include wet/dirty labs. The rooms are also equipped with 24 laptops that are split between G05 and G06, with 12 machines being stored in each lab, 100L instructors sometimes need to move laptops between the lab spaces. On some occasions, computers must be shared between lab rooms, particularly to support ENVS-100L sections which usually fill to a capacity of 16-18 students.

Field Processing Lab (LS-B04)

LS-B04 is a shared space for preparing field equipment and processing field samples upon return to the university. Currently ENVS and Biology are the predominant users of this space.

Geospatial Analysis Laboratory (GsAL) (HR-G24)

The Geospatial Analysis Laboratory, led by Benning and Saah, provides geospatial technology resources for research and teaching to both ENVS and MSEM (listed as ENVM in some university systems) courses. The lab consists of 24 computers with geospatial software installed, a large format plotter, a color laser printer and 20 Trimble handheld GPS units and related software (see hardware/software list below). Courses in the GIS curriculum are exclusively taught in this lab as well as college wide short GIS short courses and GIS curriculum developed for other departments and programs in the university. The lab is also utilized by students and faculty conducting geospatial related research. However, research use is limited to times when the space is not being used for classes.

Research space

Some ENVS faculty have space dedicated to their research needs which meets all or most of their research needs.

- Deneb Karentz has a dedicated wet lab with vent hood, located in HR-446 & 448. While these labs have not been renovated since the department was formed, she has worked to make use of the current facilities to stay active in her research.
- Calla Schmidt has a dedicated wet/dirty lab with vent hood, located in HR-441, this lab was built for her research needs following hire.
- Allison Luengen has a dedicated wet lab with vent hood that is acceptable for sampling Mercury contaminants, located in HR-348C, this lab was built for her research needs following hire.
- William Karney has a shared research lab within the Chemistry department that meets his research needs.
- Amalia Kokkinaki shares a computational lab with Physics professors, located in HR-G69, that meets her research needs.

The remainder of ENVS faculty share the remaining research spaces. These spaces are considered inadequate and outdated by current faculty and in need of renovation to make them

useful for current research needs. All faculty sharing these labs are willing to share future lab spaces so long as basic lab classifications can be maintained (i.e. no soil processing in a clean water quality lab, etc.)

- HR-452 has not been renovated since the department was formed but is used as a soil and plant processing lab.
- HR-445 has not been renovated since the department was formed and is used as a water quality sampling lab. While this lab has not been renovated, there have been improvements such as the installation of a safety shower and eyewash, additional electrical outlets, a Flammables cabinet, and a Milli-Q water system, but there is no vent hood.
- There is no dedicated computational research space for ENVS other than Kokkinaki's research space which is shared with Physics.

2.8.2. Computer Hardware

Supported by the college of Arts and Sciences:
Forty-eight (48) Laptop computers (MacBook Pro) stored in laptop carts stored in LS-103 and LS-303 (see section 2.8.1), and used by students in ENVS-250 (Environmental Data Analysis) and ENVA-255 (Quantitative skills for Environmental Studies). When needed for computer labs, laptops are set up in the classroom during class time by the students. One drawback is that set-up and clean-up time reduces the effective length of class time.

Supported by the department:
Twenty-four (24) laptop computers (Windows) stored in laptop carts for student and instructor use in wet labs (G05/G06) utilized in several courses including lower and upper division courses (ENVS-100, 110, 212, ENVS-210 Ecology, ENVS-410 Methods, ENVS-315 Hydrology and other courses) for laboratory data analysis.

Supported by the Geospatial Analysis Laboratory (GsAL):
The GsAL supports twenty-four (24) PC desktop computers configured for GIS applications, GPS instrumentation including Trimble GPS university toolkit with 20 handheld units and related software, HP Large format plotter/scanner shared with Art/Architecture department, and HP Color laser printer.

2.8.3. Software

The following software is utilized in ENVS and MSEM to support teaching activities and summarized in Table 1:

- XLSTAT statistical software: 60 licenses used for ENVS250/255, ENVS210 and ENVS410.
- R suite: used for GIS classes - free

- ArcGIS site license: Used in the GsAL computer lab for teaching and research and shared across campus with other departments and programs. The cost is $10,000 annually, which is shared with other departments who also use the lab.
- QT Modeler: LiDAR Software
- LASTools: LiDAR software $300/year
- Trimble suite software that goes along with GPS university toolkit described above.
- PCI Geomatics (Geomatica): Remote sensing suite. Five university lab kit licenses available, limited use due to cost.
- Ecognition: Remote sensing and LIDAR software. Three research licenses available, limited use so far due to cost.
- STELLA: system dynamics modeling tool used for environmental modeling (23 licenses, w/o support):
    - 110L: This lab runs between 1 and 3 sections each semester. A full section consists of 16 students and 1 instructor. Each semester, 110L uses it for two lessons on environmental modeling.
    - 210L: This lab runs 3 sections each spring semester. A full section consists of 16 students and 1 instructor. Each Spring, 210L uses it for one lesson.

- SimBio Virtual Labs (24 licenses):

    - 100L. This is a lab for non-majors which runs 8 sections each semester. A full section consists of 16 students and 1 instructor. Each semester, 100L uses it for one lesson on large-scale population ecology.
    - 210L*: This lab runs 3 sections each spring semester. A full section consists of 16-18 students and 1 instructor. Each Spring, 210L uses it for one lesson on large-scale population ecology.

2.8.1. Analytical Equipment

Except for analytical equipment used to analyze mercury in environmental samples, all other equipment, even that in dedicated research spaces, is generally considered available for sharing amongst the faculty to conduct research.

- GC with MS detector for sampling contaminants in air. This machine has an automated sampler for desorbing tubes (used primarily for teaching).
- Access to four GC with FID detectors for sampling volatile organics in air. These machines are owned by Chemistry but they allow us access for teaching labs (used primarily for teaching).
- One Thermo Scientific CHN Analyzer (used primarily for research)
- Four Haz-Dust EPAM-5000 particulate monitors for sampling particulate matter in air (used primarily for teaching).

Table 1: Software expenditures for ENVS courses.[3]

Software Program	Number of Licenses	Cost per License	Total Cost	Expiration Date
XLSTAT	60	N/A	$1,295.00	2/3/19
STELLA Pro w/ support*	5	$150.00	$750.00	9/21/18*
STELLA Pro w/o support**	17		N/A	
SimBio***	24	$3.50	$84.00	12/31/18
ArcGIS	Site	N/A	$10,000	3/2018
QTModeler	5		$300	11/2018
eCognition	3	$800	$2400	Expired
Geomatica	5	N/A	$2700	6/30/19
Trimble Educational Suite	20		$1295	10/7/19

- Two Perkin-Elmer Lambda 35 UV-Vis Spectrophotometers (used primarily for teaching).
- One Westco Scientific SmartChem 200 Analyzers (used primarily for teaching).
- Several Hach DR-900 handheld Colorimeters (used primarily for teaching).
- Several Hach meters capable of connecting to a variety of probes (used primarily for teaching). We currently stock probes for conductivity, pH, and LDO dissolved oxygen
- One Hydrolab MS4, multiprobe water quality sampler
- One Hydrolab MS4a, multiprobe water quality sampler
- Two Hydrolab MS5, multiprobe water quality samplers (used for teaching & research)
- Three Hydrolab DS5X, multiprobe water quality samplers (used for teaching & research)
- Four Hach 2100Q Turbidimeters (used for teaching & research)
- Two OTT MF Pro magnetic flow meters with wading rods (used primarily for teaching).
- Two SonTek Flowtracker acoustic doppler flow meters with wading rods (used for teaching & research).

2.8.2. Current needs

Permanent and dedicated computational space for research is needed to increase research opportunities for faculty and to provide space and the resources needed to support continued and high-quality student research. This dedicated computational space should be equipped with workstations and high-quality graphics monitors where specialized software can be installed and used by faculty and students. A space that allows faculty to work collaboratively with students would greatly enhance faculty research opportunities.

[3] *STELLA Pro software licenses are purchased as full, perpetual licenses that do not expire.
STELLA support: Covers company-provided technical support and software version updates. Support expires one year after initial purchase. Annual renewal of software support costs $19.00/license.
**If support for a license has lapsed, cost for support reactivation is $40.00/license, after which annual renewal fees will revert to $19.00/license.
***SimBio licenses are purchased on a per-term basis

3. Environmental Science - Undergraduate Program (ENVS)

3.1. Mission

The mission of the BS in Environmental Science is to provide an interdisciplinary and integrated science curriculum in order to develop skills for solving environmental problems in a socially just manner. The program prepares students for careers and graduate study and to be good stewards of the environment.

This mission statement was approved by the department in a general meeting on 24 April 2015.

3.2. Program Learning Outcomes

Students who complete the BS in Environmental Science will be able to:

- PLO 1 – Explain the interdisciplinary nature and complexities of environmental issues.
- PLO 2 – Apply the scientific method to environmental issues.
- PLO 3 – Skillfully communicate knowledge of environmental science.
- PLO 4 – Demonstrate knowledge of environmental conditions so as to promote active participation and social justice.

These program learning outcomes were approved by the department in a general meeting on 24 April 2015.

3.3. History

The undergraduate Bachelor of Environmental Science major commenced prior to the creation of the Department of Environmental Science as the Environmental Science program within the Department of Biology. There were three specific courses offered in environmental science (Environmental Science 110, 210 and 310); otherwise the requirements for the major reflected those of the Biology major, with some variation in the acceptable senior electives. The 110, 210, and 310 courses corresponded roughly to the current 110, Introduction to Environmental Science, 210, Ecology and Human Impacts, and 410, Methods of Environmental Monitoring courses, respectively. A capstone course for seniors at the time was an internship, which had an Environmental Science 498 designation.

When the Department was created, some curricular changes occurred, but these were minor. For all intents and purposes, the status quo remained until 1999, when the appointment of additional faculty allowed for continued development of the undergraduate programs and a subsequent thorough reworking of the degree which subsequently occurred in 2002. Notable changes were the reduction in unit requirements for the major, from 75 to 52 units (in line with other science degrees), the offering of more electives for the junior and senior year that reflected faculty expertise, and a general increase in the sense of continuity in the degree structure. Requirements

for the minor were also revised to conform to the 20-unit college standard. It should be noted that much of this change was driven by the need to make the degree more attractive to students entering USF, since the numbers entering the major declined to unsustainable levels once it was formally separated from Biology.

In addition, the University introduced Bachelor of Arts degrees in Environmental Studies (2001) and in International Studies (2004) and, as noted immediately below, the Department is also involved in delivery of these programs. (Note: Since Environmental Studies and International Studies undergo program reviews in other years, the information included in this self-study is provided only to show the considerable effort the Department of Environmental Science expends to assist these programs.)

3.4. Additional Departmental Collaborations

3.4.1. Environmental Studies

The Bachelor of Arts in Environmental Studies (ENVA) is a multidisciplinary major which consists of 58 units of required courses including a minimum of 16 units of courses taught by ENVS faculty. The Department of Environmental Science played a key role in the initial development of this major (e.g., providing resources, staffing, courses, facilities, etc.). A minor in Environmental Studies is also offered in which a variety of ENVS courses can serve as electives. The program is comprised of faculty from a variety of departments in the College of Arts and Sciences. The current program director resides in Environmental Studies, one of only four full-time faculty appointed to this program. The ENVA program does not have a dedicated department. The ENVA major underwent a major curriculum revision that was approved in the fall of 2012. While Environmental Science faculty were involved in review of the new requirements, the ENVA major now reflects more of the Arts and Social Sciences faculty influence and perspective. The current board of faculty for ENVA are considering another curriculum revision where the total number of units required is reduced. It is expected that the requirements for courses taught by ENVS will drop significantly in this curriculum revision.

3.4.2. International Studies

The Bachelor of Arts in International Studies is a multidisciplinary major which consists of 52 units of required courses. One of four possible tracks for the program is Environment and Development Track. This track includes a minimum of 4 units of courses taught by ENVS faculty, specifically ENVS-100, Understanding our Environment. Additionally, ENVS 210, Ecology and Human Impacts, and ENVS-366, Environmental Policy serve as possible electives for this track.

3.4.3. Urban Studies

The Bachelor of Arts in Urban Studies is a multidisciplinary major which consists of 44 units of required courses. This degree requires students to complete 4 elective courses of which ENVS-375, Intro to Geospatial Technologies, is one.

3.4.4. Masters of Public Health

Megan Danielson, the Geospatial Analysis Lab Manager, is currently working with the School of Nursing and Health Professions to develop appropriate GIS related courses to support the Masters of Public Health program. This is expected to be an opportunity to expand our GIS capabilities across college lines to enhance that degree program.

3.5. Curriculum

The Environmental Science Major requires 56 total units. Students are required to take 4 lower division foundational courses in the major: Introduction to Environmental Science, Ecology & Human Impacts, Air and Water, and Environmental Data Analysis. First and second year students in the major typically complete these requirements while also taking required supporting science classes (Biology for 2 semesters or 8 units, Chemistry for 2 semesters or 8 units, and/or Physics for 1 semester or 4 units). The ENVS major additionally requires 4 upper division Environmental Science electives (16 units) and completion of a capstone course: Methods in Environmental Monitoring. In addition to serving the Environmental Science major and minor, the department also offers courses for Environmental Studies majors and minors, ENVA-255. Required courses and Elective offerings are shown in Table 2.

Table 2: Course listings for undergraduate BS in ENVS. Courses labeled with an "✓" are required for the degree while courses labeled with an "✦" are elective ENVS courses. Courses labeled with an "✦" are elective support courses offered by the Environmental Studies program.

USF ENVS Course Title	BS in ENVS	University Requirement
Required ENVS Courses (20 Units)		
ENVS 110 Introduction to Environmental Science w/Lab	✓	Core B2 – Laboratory Science
ENVS 210 Ecology & Human Impacts w/Lab	✓	
ENVS 212 Air & Water w/Lab	✓	
ENVS 250 Environmental Data Analysis	✓	Core B1 – Quantitative Science
ENVS 410 Methods of Environmental Monitoring w/Lab	✓	Service Learning
Required Supporting Science Courses (20 Units)		
BIOL 105 General Biology I	✓	
BIOL 106 General Biology II	✓	
CHEM 111 General Chemistry I CHEM 112 Laboratory for General Chemistry I	✓	
CHEM 113 General Chemistry II CHEM 114 Laboratory for General Chemistry II	✓	
PHYS 100 Introductory Physics I	✓	
Elective ENVS Courses (Select 12-16 Units)		
ENVS 311 Environmental Chemistry	✦	
ENVS 315 Hydrology w/Lab	✦	
ENVS 320 Restoration Ecology w/Lab	✦	
ENVS 321 Wetlands Ecology w/Lab	✦	
ENVS 325 Field Botany w/Lab	✦	
ENVS 330 Environmental and Ecosystem Health	✦	
ENVS 335 Marine Environments: Problems and Progress	✦	
ENVS 340 Environmental Geology w/Lab	✦	
ENVS 350 Energy and Environment	✦	
ENVS 360 Climate Change: Science and Politics	✦	
ENVS 366 Environmental Policy	✦	
ENVS 370 Introduction to Landscape Ecology & GIS w/Lab	✦	
ENVS 371 Fundamentals of Ecosystem Science	✦	
ENVS 375 Intro to Geospat. Tech. w/Lab	✦	
ENVS 380 Environmental Engineering	✦	
ENVS 390 Undergraduate Special Topics w/Lab	✦	
ENVS 392 Undergraduate Special Topics	✦	
ENVS 498 Advanced Undergraduate Research	✦	Service Learning
Elective Additional Support Courses (Select 0-4 Units)		
ENVA 360 Global Environmental Politics	✦	
ENVA 363 Environmental Law	✦	
ENVA 366 Environmental Policy	✦	
ENVA 367 Environmental Justice	✦	
ENVA 404 Environmental Ethics	✦	Core D3 – Ethics

3.5.1. ENVS Required Courses

The course descriptions for required and elective ENVS courses are listed below.

110 – Introduction to Environmental Science w/ Lab (4) – a laboratory science Core Curriculum course

This course serves as an introduction to and covers broad aspects of environmental science and environmental studies. For all cases, the resulting environmental impacts are studied in detail. Specifically, this course examines the risks associated with growth in a developing world; environmental impact of population growth on natural resources; mineral and resource extraction; water resource uses; and renewable and non-renewable sources for power generation. Emphasis is placed on a holistic approach to environmental science using laboratory exercises, environmental surveys, and class discussions to reinforce scientific principles.

210 – Ecology and Human Impacts w/Lab (4)

Prerequisite: ENVS – 110. This course introduces students to biological and ecological aspects of environmental science. The course includes lectures, laboratory, and field exercises that emphasize basic ecology principles. The goal of the course is to give the student an overview of basic ecology, ecological management issues, and ecosystem policy with special emphasis on local issues in the San Francisco Bay Area.

212 – Air and Water w/Lab (4)

Prerequisite: ENVS – 110 and Math 104 or the equivalent. This course covers broad physical and chemical aspects of the atmosphere and water resources. Specifically, this course considers atmospheric composition, weather processes, and air pollution; water resources, regulations, and defining water quality based on intended use. For all cases, the resulting environmental impacts are studied in detail. Emphasis is placed on a holistic approach to environmental science using field trips and sampling exercises, laboratory exercises, environmental surveys, and class discussion to reinforce scientific principles.

250 – Environmental Data Analysis (4) – a quantitative science Core Curriculum course

Prerequisite: ENVS 110 and Math 104 or the equivalent. This course provides students with foundations in quantitative analysis methods used to analyze environmental data. These methods are applied to real-world cases, and students conduct a full analysis and prepare a professional report as part of a group process.

410 – Methods of Environmental Monitoring w/Lab (4) – a Service Learning Course

Prerequisites: ENVS – 110, 210, 212 and ENVS – 250. This course is a senior- level environmental science methodology class that presents a hands-on approach to environmental field sampling, laboratory analyses, data analyses and data presentation in the context of environmental monitoring. Students work in teams to study and collect data on selected physical, chemical and biological features of a watershed. Students learn to analyze and interpret the data and present results in a professional meeting format.

3.5.2. Elective ENVS Courses

The courses listed in this section are designed to provide a diverse selection of elective offerings. In general, the department offers 2-3 electives per semester and rarely offers any one of these courses more than once in a 2-year period.

311 – Environmental Chemistry (4)

Prerequisites: CHEM – 113 with a grade of C- (1.7) or higher, and one of the following: ENVS 212, CHEM 230, or CHEM 236. This course provides in-depth coverage of major topics in the chemistry of the environment, including tropospheric chemistry and air pollution, stratospheric ozone depletion, aquatic chemistry, water pollution and water treatment, soil chemistry, and synthetic organic compounds.

315 – Hydrology w/Lab (4)

Hydrology is the study of the waters of the earth including water in the atmosphere, on the earth's surface and underground. In this course we will explore the components of the hydrologic cycle including processes such as precipitation, evaporation, transpiration, infiltration, groundwater flow, surface runoff and stream flow. For each component of the hydrologic cycle we will study the physical process and explore the methods used to measure or estimate rates for that process. We will use case studies to explore human interactions with hydrologic processes throughout the course.

320 – Restoration Ecology w/Lab (4)

Prerequisite: ENVS – 210. An overview of concepts and practices in restoration ecology. Emphasis is on the application of ecological principles to restoration design, implementation, and monitoring. Two lectures and one laboratory session each week.

321 – Wetland Ecology w/Lab (4)

Prerequisite: ENVS – 210 or permission of instructor. This upper-division lecture and laboratory course reviews basic concepts of ecology as they apply to wetland ecosystems. Major course topics include: wetland hydrology and soils, wetland biota and their adaptations, wetland types, and policies for wetland management.

330 – Environmental and Ecosystem Health (4)

Prerequisite: CHEM – 113. Environmental health is the study of how physical, biological and chemical pollutants affect the environment and, in turn, human health. Impacts such as cancer and feminization of males draw widespread media attention and remain one of the rallying cries for the environmental movement. Despite these worries, there have been around 100,000 new chemicals approved for commercial use in United States over the last 30 years. How do we decide which ones to worry about? This class will introduce some of the basic principles of toxicology to lay the groundwork for evaluating hazards, exposure, and risk. We will apply

these principles through reading and analyzing some of the controversies in the scientific literature, such as the impacts of pesticides on amphibians and the effects of eating seafood containing mercury. A major goal will be to learn to critically read and analyze the scientific literature. Students will also discuss the spread of disease, endocrine disruptors, heavy metals, pesticides, and radiation.

335 – Marine Environments: Problems & Progress (4)

Prerequisite: ENVS 212 with C or higher. This elective introduces the biological, chemical, and physical processes that shape marine environments. It explores how these processes are impacted by anthropogenic activities, such as overfishing, eutrophication, ocean acidification, climate change, and pollution.

340 – Environmental Geology (4)

This course is for students interested in learning about environmental issues related to earth science. The course is comprised of three modules. Module one serves as an introduction to earth materials and processes. Module two explores geologic hazards and the ways that human activities amplify or mitigate the risks of geologic hazards such as earthquakes, volcanoes, and landslides. Module three focuses on how mineral resources are formed and extracted. Module three also covers the ways in which extraction of mineral resources is causing changes to the earth system at a global scale, ushering in a new geologic era: the Anthropocene.

350 – Energy and Environment (4)

Prerequisites: ENVS - 212 and ENVS - 250. In this course, students examine energy production and consumption as an underlying cause of multiple environmental problems. Beginning with an overview of energy-environment connections, the course covers major fuel types and energy sources--from coal and natural gas to solar and advanced energy carriers and storage systems (e.g., hydrogen and fuel cells).

360 – Climate Change: Science and Policy (4)

Prerequisites: ENVS - 210, ENVS - 212 and ENVS - 250. In this course, students will develop a deeper understanding of the greenhouse effect and human influences on the Earth's climate. Building on this scientific base, the course will emphasize climate change mitigation--options for changing human activities and reducing emissions of greenhouse gases to avert negative climate change impacts.

366 – Environmental Policy

Prerequisite: ENVS 110. This course examines the effectiveness and shortcomings of mechanisms in US and California environmental policies from physical, ecological, institutional, and other perspectives. Engages students in policy analysis and exploration of emerging approaches based on a systems' view, life-cycle analysis, and collaboration.

370 – Introduction to Landscape Ecology and GIS w/Lab (4)
Prerequisites: ENVS – 100 or 110, and ENVS – 210. This course serves as an introduction to environmental remote sensing and Geographic Information Systems (GIS). It is designed to provide students with basic concepts, principles and applications of Landscape Ecology and GIS and their use in natural resource management. This course has a co-requisite laboratory.

In addition to the courses listed above, the department is also teaching upper division special topic courses called "California Ecosystems and Environmental Geology. These courses will be added to our curriculum following curriculum review.

371 – Fundamentals of Ecosystem Science
Prerequisites: ENVS 110, 210 and 250. Ecosystem Science has developed into a major part of contemporary ecology and is now applied to diagnose and solve a wide range of important environmental problems and issues. Ecosystem science can be used to assess, compare and contrast, and to quantify ecosystem structure and function. This course is designed to introduce students to critical topics and approaches employed with ecosystem science as well as provide an opportunity for students to engage in a detailed study of an ecosystem of interest using historical datasets and primary literature.

375 – Introduction to Geospatial Technology w/Lab
This class combines both theoretical coverage and hands-on lab work, to introduce geographic information systems (GIS), global positioning systems (GPS) and remote sensing science. Lab activities will utilize both widely available freeware and ArcGIS, introducing the GIS industry standard software. Course and lab examples and applications will be drawn from many fields across environmental science disciplines and thus stimulate spatial thinking as it relates to environmental issues. Students will gain sufficient knowledge of geospatial technologies and a diverse array of application areas enabling them to integrate spatial thinking and analysis into their research and careers /or pursue further training in GIS, GPS or remote sensing.

380 – Environmental Engineering
Prerequisite: ENVS 212. Environmental Engineering develops engineering problem solving skills. Students apply their skills to real-world issues including pollution migration, wastewater treatment, hazardous waste treatment, and green engineering and pollution prevention.

3.6. Students

Between 1996 and 2018, the number of environmental science majors ranged from a low of 16 majors in 2005 to 60 in 2018 (Figure 1). The average number of majors during this period was 34 students and the median value 28 students. The majority of our majors do not enter as freshmen (Figure 2); but rather join our program after completing part of a different degree program at USF or transferring into USF from another institution. The exact number of these is difficult to determine.

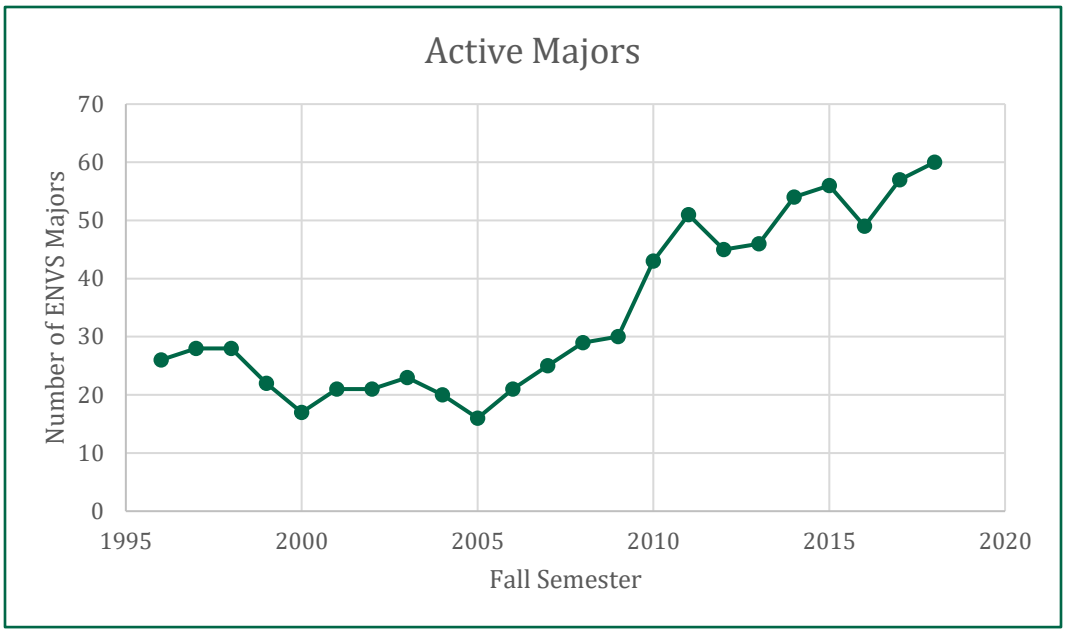

Figure 1: Environmental Science Majors between 1996 and 2018.

The Environmental Science department includes a diverse mixture of students (Figure 3) which reasonably reflect the diversity of the undergraduate population in the various science departments (Figure 4). However, it should be noted that there is room for improvement. Between 2013 and 2017 the ENVS major had a higher proportion of white students than the university as a whole (40% of majors identify as white compared to 30% of all students), and the percentage of ENVS majors that identify as Asian or international students are both 8% lower than total student population at USF.

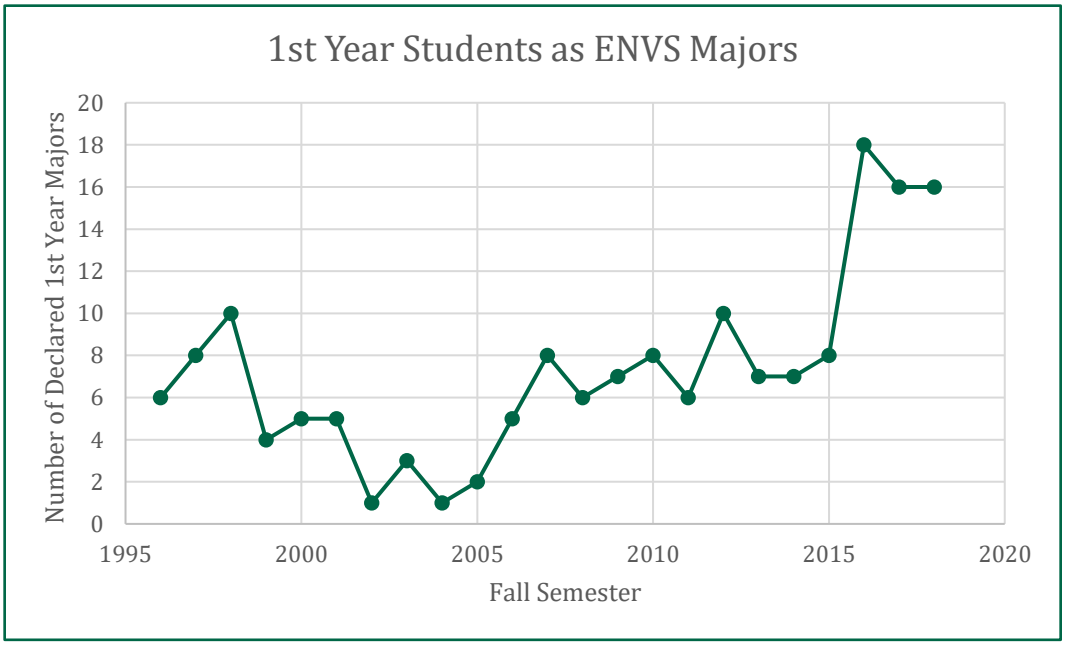

Figure 2: Number of Environmental Science majors that entered as 1st Year Students between 1996 and 2018.

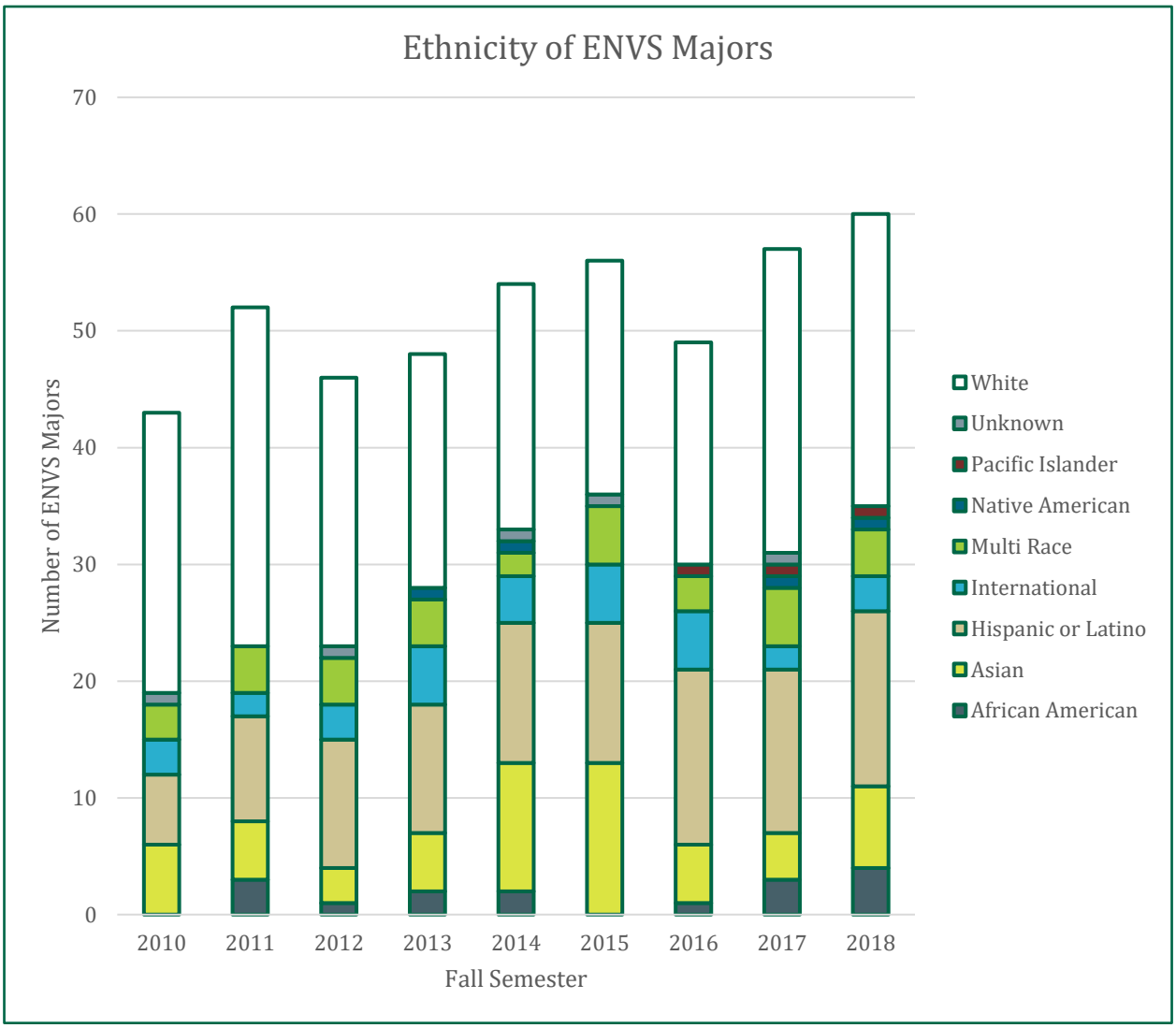

Figure 3: Comparison of self-reported ethnicity of environmental science majors at USF. All available data is presented.

Between fall 2010 and spring 2017, 106 environmental science majors graduated from USF (Figure 5). This compares favorably to the previous years that the degree was offered. Retention data is limited to only those students who enter USF as a declared ENVS major. Given that our entry rates are low and that our graduate numbers are dependent upon those who transition into ENVS from other programs such as Biology or Environmental Studies, this data is relatively meaningless. Attrition from our major comes in two forms, those that transfer to other majors (predominantly Environmental Studies) and those who leave the university to either quit college or transfer to another institution. Data is not available for us to determine how the ENVS major compares with USF averages.

The best data that can be presented for our major is from students who entered in fall 2010. Of the 9 declared ENVS majors, 3 had graduated with a BS in ENVS from USF by spring 2015, 5 graduated from USF with a degree other than a BS in ENVS, and 1 had not registered after their

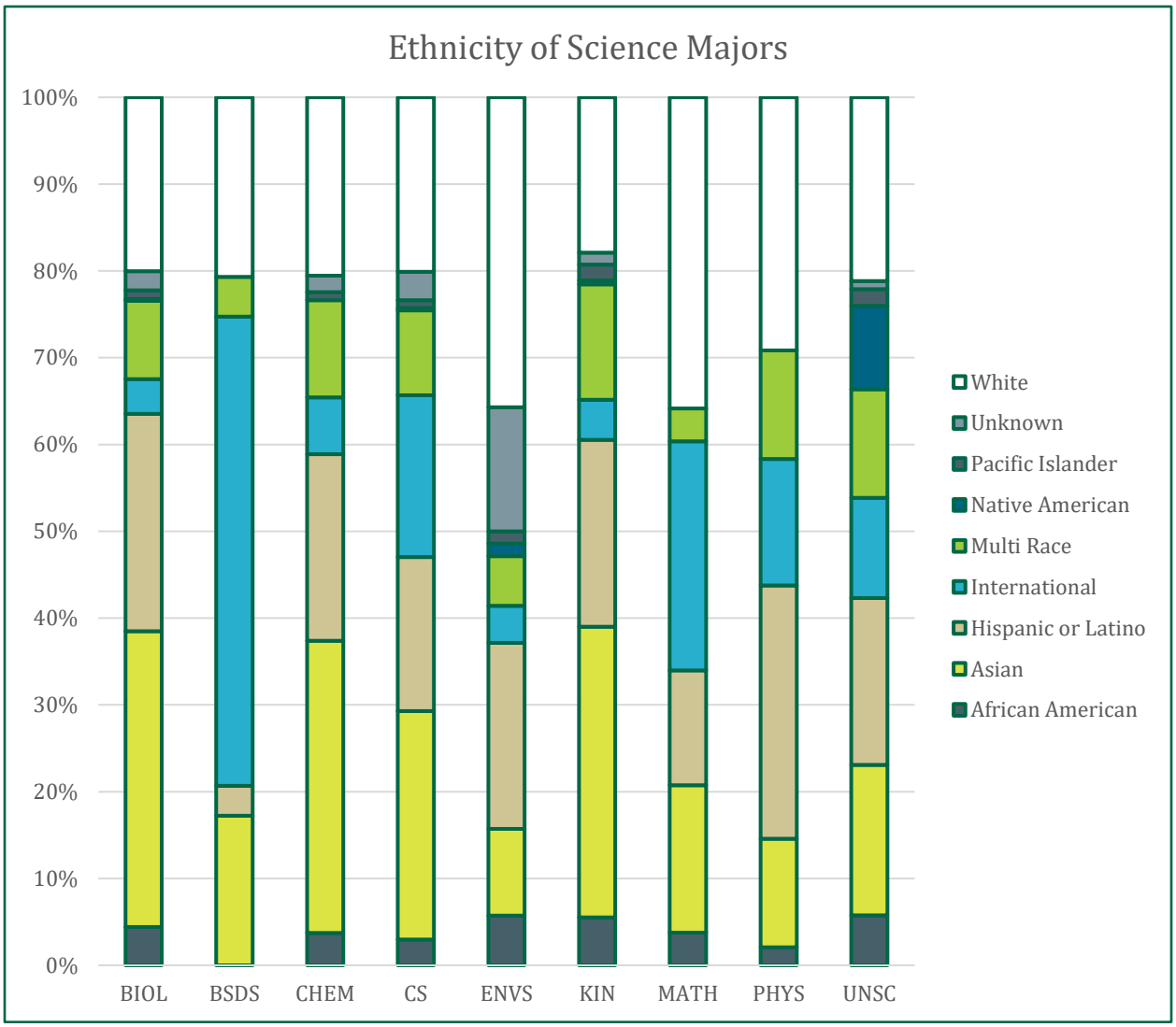

Figure 4: Comparison of self-reported ethnicity of environmental science majors compared to the entire USF student population.

first academic year. The problem is that we only had 8 declared 1st year ENVS majors registered in fall semester 2010, yet we awarded 17 students a BS in ENVS during the 2014-2015 academic year. So, unfortunately, no conclusions can be drawn from these numbers. Of course, now that this self-study has elucidated this important data gap, we are requesting that the university provide us with a more meaningful report and will hope to make that report readily available for review in future.

The Department carefully tracks the performance of its students through close advising and department chair oversight. Those who do not meet the 2.0 GPA major requirements are notified, both orally and in writing, that the Department is concerned about their ability to graduate in environmental science.

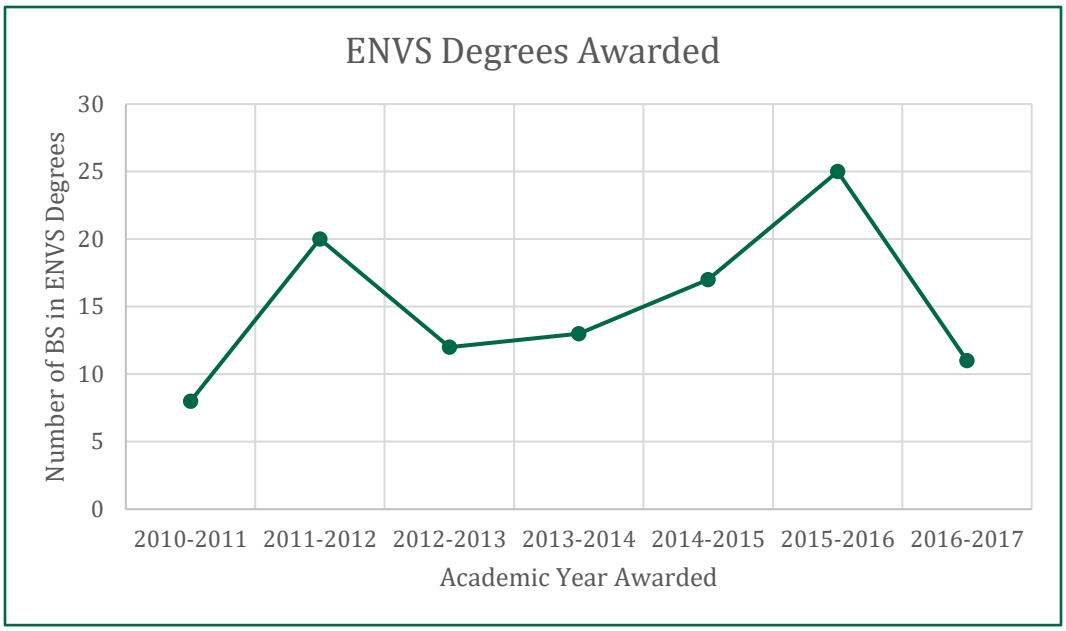

Figure 5: BS in ENVS Degrees awarded between 2010-2011 academic year and the 2016-2017 academic year.

Students who do not seem to have the academic strength to complete the program successfully are encouraged to find a different major program by either the Chair or primary advisor in consultation with the Chair. Faculty members also personally encourage students to engage in research through our advising process, through opportunities advertised by other universities and formally in our own laboratories in the form of independent study (ENVS-498). As a result, each year many of our majors participate in supervised research projects. Upon review of faculty CVs, it is clear that undergraduate students contribute substantially to faculty research and in cases are listed as co-authors of peer reviewed scientific publications.

The academic quality of our majors has been uneven. Some have difficulty passing through the program while others show a remarkable aptitude for the course material. The mean SAT score for new 1st year students has ranged from 1070 to 1190. Nonetheless, the quality of our top students is excellent. For example, our students receive competitive scholarships (e.g. ARCS, Barry Goldwater Scholar, etc.), get placed in competitive internships (e.g. REUs, California Water Board, EPA, National Park Service), and co-author peer-reviewed papers with faculty. Our graduates are frequently accepted into excellent graduate schools and professional programs (e.g. UC Berkeley, University of Washington, Stanford, Yale, etc.), and many of our recent graduates get jobs as environmental scientists at environmental consulting firms, as well as local, state, and federal government agencies.

3.7. Course Instruction

3.7.1. Instructors

Full Time Faculty

The Department of Environmental Science strives to utilize full-time faculty as much as possible to teach all lecture and lab sections for our undergraduate majors.

Adjunct Professors

Qualified adjunct faculty are utilized as needed in ENVS, when required course loads exceed faculty capacity (e.g., sabbatical or family leave), or when specialized expertise is desired for an ENVS elective course (e.g., Environmental Law). When adjunct faculty are utilized, they are always given explicit syllabi and provided with a faculty mentor, usually the chair or another full-time faculty member that either has significant experience with the topic or more often is teaching another section of that course. The non-majors' course, Understanding our Environment with Lab (ENVS-100), meets the University Core-B2 Curriculum requirements for a Laboratory Science, and thus often requires several sections per semester to meet student demand. This course always fills to capacity and we often field requests from students to join full classes but are limited by either classroom size, the number of laboratory sessions we can fit into a day, or both. Because of the student diversity and level of material covered, we can utilize adjunct faculty to teach this course with a standard syllabus, and lecture materials developed over the years by most of our faculty. At times, we can utilize adjunct faculty in this course to supplement and expand the variety of expertise and experiences that allow one to teach this very broad and introductory course well. To be clear, even when adjunct faculty are utilized to teach this course, we strive to have at least one section taught by a full-time faculty member who can then serve as a mentor for adjuncts or who adjuncts can shadow if agreeable and desired.

Graduate Student Instructors

Graduate students from the MSEM program are hired as formal instructors to teach Laboratory sections that accompany some lower division ENVS courses. This is accomplished using a formal application process that is evaluated by the chair and the full-time faculty member who coordinates the laboratory sessions. Given that our graduate program is typically two years, this allows us the opportunity to employ 1st year graduate students to teach approximately half of the lab sections, and experienced 2nd year students the other half of the sections. Such a rotation allows for development and sharing of pedagogical techniques and teaching experiences between the instructors who meet weekly with the lab coordinator to review the lab, pre-lab lectures, and to complete the lab themselves prior to teaching it. Besides paying them just over $3,000 per lab section taught (a paltry sum but relatively high compared to adjunct salaries in the Bay Area, equating to approximately $20.05/hour), they also gain valuable teaching experience and formal teaching evaluations to add to their dossiers.

In occasional instances, the department may utilize experienced graduate student instructors to teach an additional lab section of a course that filled beyond the capacity of the lab sections taught by full time faculty. Since the last program review, we have utilized graduate student instructors to teach laboratory sections of ENVS-110, 210, and in one case 212 and 410. Our options were either to limit class size, meaning that we would slow our student's progress towards on-time graduation, hire an adjunct not experienced in this course (usually at the last minute before classes start), or a graduate student instructor who had demonstrated solid teaching skills in previous lab sections and would be closely supervised by the full-time instructor. In such cases, we explicitly mandate the graduate student instructor sit in on the lab section taught by a full-time faculty member before they teach their own section.

Diversity and Internationalization

The full-time faculty in the ENVS department has the following demographics. There are nine faculty who identify as female (64%) and 5 who identify as male (36%). With regards to race and ethnicity, only 1 full-time faculty member is not white (7%), she is African American. One faculty member is international (Kokkinaki), having been born and raised outside of the United States, but now a US citizen.

3.8. Research

Many of the Department of Environmental Science faculty involve our undergraduate students in laboratory, field and computational research. Research disciplines include: geospatial analysis, restoration ecology, landscape ecology, oceanography, organic and environmental chemistry, hydrology, and biogeochemistry. Students help collect data in the field, run experiments, analyze samples in the lab, run simple statistics, make GIS maps, and run computational models. Students who take a directed study class and work on a research project with a professor are assessed at the end of the semester using the criteria established in their research proposal. Students who work on research with a faculty member over the summer or during the academic year and do not earn university credit are not systematically assessed.

3.9. Assessment Plan

3.9.1. Brief Summary of Assessment Plan

The BS in Environmental Science is assessed using final presentations in the form of oral or poster formats. Students were evaluated by course instructors as well as several faculty within the department using standardized rubrics for assessing progress relative to program learning outcomes addressed by the specific course. The courses in which assessment was performed were Air & Water w/Lab (ENVS-212 & ENVS-212L) and Methods of Environmental Monitoring (ENVS-410 & ENVS-410L). These courses were chosen because the former is typically taken by students during the fall semester of their second year and the latter is the senior capstone course taken during spring semester of the final year of study. By selecting these

two courses we expect to be able evaluate progress to program learning outcomes as the degree progresses and also at its culmination.

Three program learning outcomes are addressed in these two courses, PLO1, PLO2, and PLO3 (Table 3). Since this was an evaluation by faculty as students presented their work, it was a direct assessment of student capabilities. As defined by the curricular map, Table 3, PLO1 and PLO2 were expected to be developing upon completion of the Air & Water course, ENVS-212, and PLO3 was expected to be at the introductory level upon completion of that course. All three PLOs were expected to be mastered upon completion of the degree as measured by the senior capstone course, Methods of Environmental Monitoring, ENVS-410.

3.9.2. Assessment Methods

Final presentations in the form of oral or poster formats were evaluated by course instructors as well as several faculty members within the department using standardized rubrics (Table 4) for assessing progress relative to program learning outcomes addressed by the specific course. The courses in which assessment was performed were Air & Water w/Lab (ENVS-212 & ENVS-212L) and Methods of Environmental Monitoring (ENVS-410 & ENVS-410L). These courses were chosen because the former is typically taken by students during the fall semester of their second year and the latter is the senior capstone course taken during spring semester of the final year of study. By selecting these two courses we expect to be able evaluate progress to program learning outcomes as the degree progresses and also at its culmination.

3.9.3. Results of Assessment

Program learning outcomes 1-3 were evaluated at the completion of ENVS-212, Air & Water, and ENVS-410, Methods of Environmental Monitoring. These PLOs were evaluated by department faculty observing presentations of posters in ENVS-212 and oral (conference-style) presentations in ENVS-410. In each case, all departmental faculty were invited to attend and evaluate student efforts and many were able to attend at least some of the student presentations. A total of seven different faculty evaluated some or all of the student presentations for each course.

The results of this direct evaluation are show in Figure 6. The values presented were defined in a grading rubric that was identical for both courses ranging from a score of 1 (Inadequate Knowledge) to a score of 4 (Mastery of Knowledge), as defined in Table 4. Faculty were instructed to assess student performance on their presentations by giving them a score for each learning outcome listed as described within the rubric. Faculty were further instructed to compare the students' level of knowledge with what would be expected of that student upon graduation with a BS in Environmental Science.

Table 3: The curricular map below describes when and how each learning outcome is introduced, developed, or mastered as a student progresses through various courses within the B.S. in ENVS degree. I = Introduced, D = Developed, M = Mastered.

Program Learning Outcomes / Course	PLO 1 – Explain the interdisciplinary nature and complexities of environmental issues.	PLO 2 – Apply the scientific method to environmental issues.	PLO 3 – Skillfully communicate knowledge of environmental science.	PLO 4 – Demonstrate knowledge of environmental conditions so as to promote active participation and social justice.
110 Introduction to Environmental Science (LAB)	I	I	I	I
210 Ecology & Human Impacts (LAB)	D	D	I	I
212 Air & Water (LAB)	D	D	I	
250 Environmental Data Analysis	I	D	I	
410 Methods of Environmental Monitoring (FIELD/LAB)	M	M	M	M
311 Environmental Chemistry	D		D	
320 Restoration Ecology (FIELD/LAB)	D	D	D	I
321 Wetland Ecology (FIELD/LAB)	D	D	D	I
325 California Ecosystems (LAB)	D	D	D	D
330 Environment & Ecosystem Health	M		M	I
335 Marine Environments (LAB)	D	D	D	
350 Energy & Environment	D	D	D	D
360 Climate Change: Science & Policy	D	D	D	D
366 Environmental Policy	M	D	D	D
370 Intro to Landscape Ecology & GIS	D	D	M	D
380 Environmental Engineering	I		D	

Table 4: Scoring rubric used to evaluate student progress towards mastering various PLOs.

Program Learning Outcome	Mastery of Knowledge Score = 4	Developing Knowledge Score = 3	Introductory Knowledge Score = 2	Inadequate Knowledge Score = 1
PLO 1 – Explain the interdisciplinary nature and complexities of environmental issues	Relationship between the study conducted and complexities of environmental issues are well explained. Student uses anecdotal evidence & examples in a robust and meaningful way.	Student has a solid understanding of the complexities of environmental issues. Explanations of interdisciplinary connections are at a basic level and are relevant to the topic.	Student has a limited understanding of how their topic relates to other environmental issues. They are not able to describe meaningful interdisciplinary connections.	Student has a little to no understanding of how their topic relates to other environmental issues. When asked how their presentation relates to other environmental topics they are not able to respond.
PLO 2 – Apply the scientific method to environmental issues	Student utilizes the scientific method associated with their presentation in a clear and logical fashion.	Student correctly utilizes the scientific method at a basic level or higher. Explains aspects of the scientific method that relate to the project.	Understands the elements associated with the scientific method and a rudimentary understanding of how those elements are connected.	Understands some but not all of the elements associated with the scientific method and lacks a rudimentary understanding of how those elements are connected.
PLO 3 – Skillfully communicate knowledge of environmental science	Student fully understands the scientific context and implications of the material presented. They are able to highlight examples of their project with anecdotal evidence & examples in a robust and meaningful way.	Student presents a problem statement and solution. Knowledge expands upon the information in the presentation with multiple external examples. Level of knowledge exceeds a basic level.	Student presents a problem statement and solution. Knowledge is limited to the information in the presentation with few external examples and in limited context. Level of knowledge exceeds a basic level.	Student fails to clearly present a problem statement and result. Knowledge is limited and some information presented is not understood.

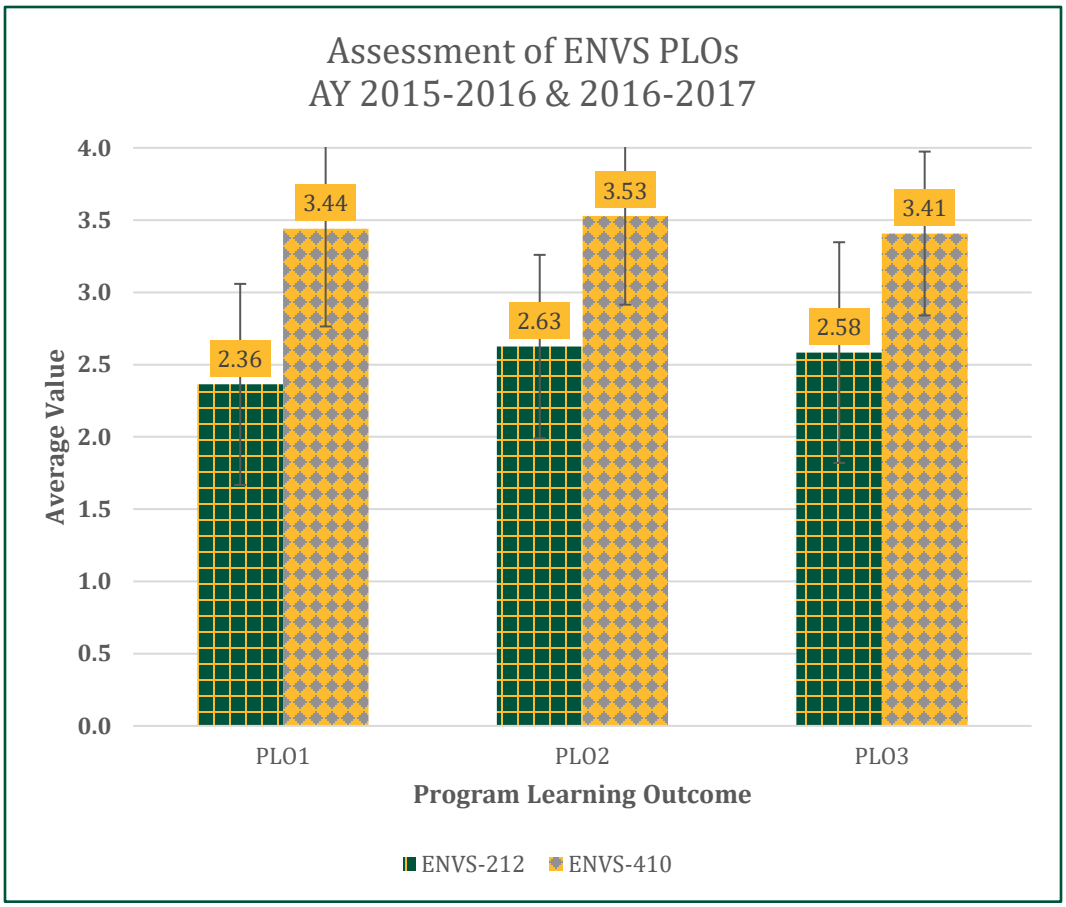

Figure 6: Results of assessing PLOs 1-3 of the BS in ENVS Degree over two academic years.

3.9.4. Achievement of Program Learning Outcomes

The results clearly demonstrate with scientific validity that students completing ENVS-212, Air & Water, have introductory to developing knowledge of program learning outcomes 1-3. Similarly, the results demonstrate that upon completion of ENVS-410, Methods of Environmental Monitoring, students have between developing and mastery of all three program learning outcomes. These results align with the expectations of our curricular map, Table 3, for each of these two courses. Moreover, given that mastery of each program learning outcome measured falls within one standard deviation of the average of our data, we can conclude that graduating seniors do master program learning outcomes 1-3 upon completion of the senior capstone course.

Following the first year of this assessment plan, one concern about the evaluation system was clear. Our departmental faculty are not experienced at comparing a student's progress to a learning outcome. So, upon reflection and discussion following the evaluations, it became clear that many were effectively grading the presentations rather than comparing the student's progress to what would be expected to issue that student a bachelor of science degree. This

effect could potentially lower the overall score for students. Some faculty were even comparing the oral presentations in the senior capstone course to what they would expect at a national conference where research is presented by graduate students and postdoctoral scholars. Therefore, we closed the loop in the first year by reflecting on the process in an open discussion during a department meeting in fall 2016. We also decided to conduct the same data collection for a second year to verify our results. This was acceptable to the administration because three PLOs were being simultaneously evaluated.

Following a second year of data collection using the same rubric, it was clear from the results that the faculty reflection of the previous year's results appeared to effectively eliminated falsely low ratings. In 2016, 5 groups were given a rating of 2 (Introductory Knowledge) by three faculty for the ENVS-410 project presentations. In 2017, only 1 group was rated at 2 by only one faculty member for their project presentation. Obviously, there could be many reasons for this change, but a more clearly calibrated faculty is one of the potential reasons. From the two years of assessment results for three PLOs, it is clear that we are graduating Environmental Scientists with at least developing knowledge in all three PLOs assessed and are trending toward Mastery of the PLOs. For PLO 1, 6 of the 13 project groups scored 3.5 or higher; for PLO 2, 9 of the 13 project groups scored 3.5 or higher; and for PLO 3, 4 of the 13 project groups scored 3.5 or higher. It would likely be helpful to further assess PLO 3 via another assessment process to determine if remedial actions are required to strengthen this PLO prior to graduating our seniors. Such actions will be considered as we advance our assessment plan.

3.9.5. Annual Assessment of Program Learning Reports

Excerpts from Annual Assessment of Program Learning Reports were used to provide the analysis above. Complete reports are available from the Dean's office or the College of Arts & Sciences' Curriculum Effectiveness website.

3.9.6. Assessment Responsibilities

The instructors of record alongside additional full-time faculty collectively assess student oral and poster presentations in both the ENVS-410 and 212 classes. The Department Chair is responsible for analyzing these data and presenting the results to the department for discussion and action.

3.9.7. Communication of Results to Students

We communicate our mission and PLOs to the students through our syllabi and orientation meetings. Moreover, our annual reports are published on the USF website and we do often discuss assessment results with subsequent classes, especially with the capstone course as their project presentations are evaluated at multiple points as they develop their project. However, we have not yet established a formal process for communicating specific assessment results to our undergraduate students as a population. Based on this self-study, the department will work

toward developing such a formal process and seeks advice from the administration and reviewers on the best processes to accomplish this goal.

3.10. Assessment of Core Areas

The Department of Environmental Science has participated extensively in the assessment of Core Areas B1 and B2, quantitative science and laboratory science, respectfully. Tracy Benning has previously served as the Core area chair for the sciences and represented the sciences on the Core Advisory Committee. More recently she has served and chaired the Core Area Working Group, a select group of senior faculty trained on core assessment techniques and then tasked with developing, implementing, and reviewing the Core Assessment Plan. Jack Lendvay has also previously served as the Core area chair for the sciences and represented the sciences on the Core Advisory Committee. He is also the Faculty Director for Curricular Development for the Sciences, a position in which he trains and assists science faculty in assessment of a variety of areas including the core and their degree programs. Amalia Kokkinaki and Tracy Benning have both served as evaluators for the science core courses.

The expertise within the department and the department's attention to preparations and implementation of core assessment is evident in its performance of attaining the Core Learning Outcomes relative to other science departments, Table 5. Environmental Science ranked first among all science departments in achieving the most effective delivery of each criteria evaluated.

3.11. Budget

The department budget for general operating expenses is presented in Figure 7. It is clear from the budget data, that the department received a significant increase in budget following the last program review in Spring 2013 and again in the 2016-2017 fiscal year when the college audited department budgets against needs and determined that Environmental Science needed an increase. However, since that point in time, our budget has not grown and in fact has been cut several times as a new administration in the President and Provost's office has determined that budget cuts were necessary university-wide. The department appreciates that our budget has

Table 5: Core Area B2, Laboratory Sciences, Assessment Report. Data show that the department of environmental science performed better than the average science department in delivering the core learning outcomes to students.

Criteria	Percentage of Students Scoring 3 or Above for B2 Criteria	
	Overall	Environmental Science
1	82.4	95.5
2	74.7	77.3
3	63.7	68.2

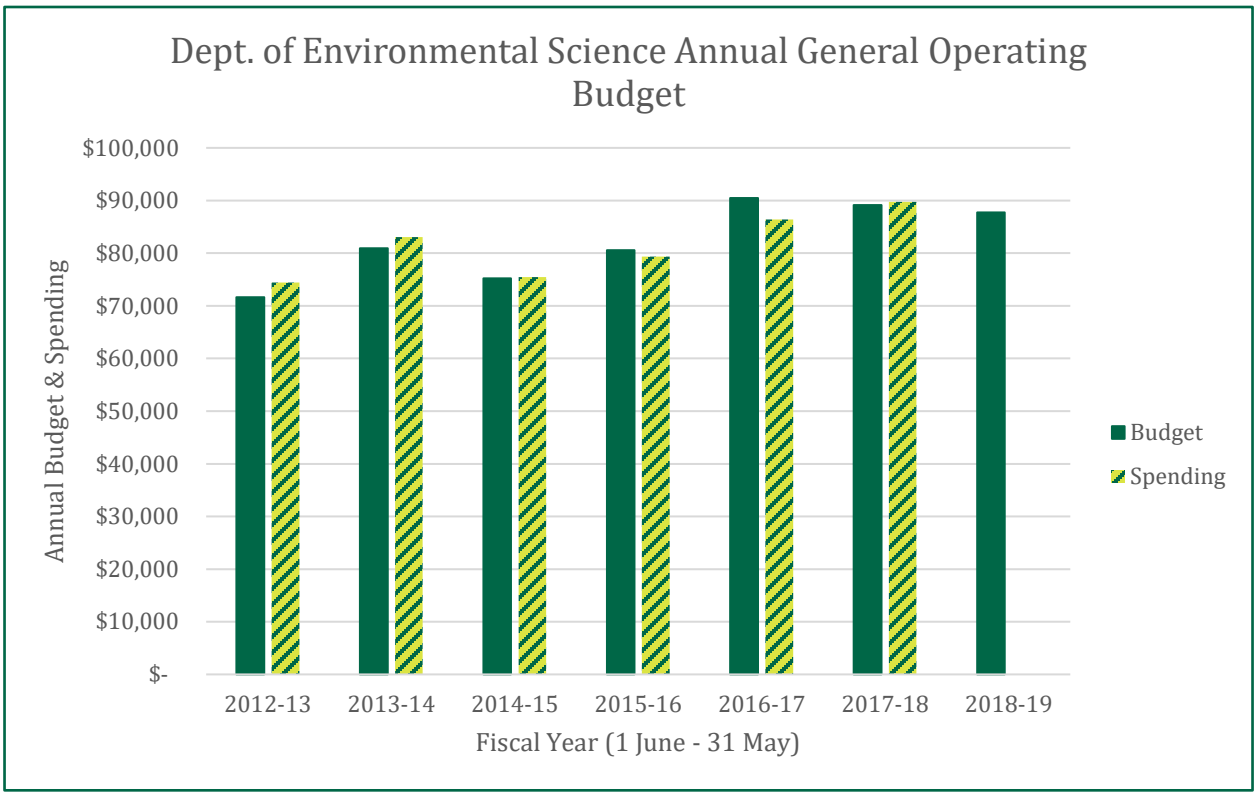

Figure 7: Department of Environmental Science Annual Budget for Fiscal Years 2011-2012 through 2018-2019.

always been reasonable and capable of supporting our needs, however, we are concerned, after three years of budget stagnation and indications that continued budget cuts will be in order for the next several years, that we may no longer be able to support our basic needs.

One caveat about these budget numbers is that we did not present the costs charged to our operating expense budgets of temporary agency help to staff our program assistant position during transition periods between permanent program assistants. In the 2016-2017 & 2017-2018 fiscal years, these costs were $22,895 and $11,073, respectively. So, in fact, we were significantly over budget both years.

Of most significant concern for our budget is the ever-increasing costs of laboratory and classroom supplies, Figure 8. In the 2017-2018 fiscal year, laboratory supplies totaled $24,322, instructional supplies, $11,129, and office supplies $6,965. Combined these accounts for 49% of our total budget. Other significant expenses include duplicating and copying, transport for field trips, and maintenance contracts.

3.11.1. Needs

There are two areas of concern regarding the budget. First is that it has been stagnant for the past three years while our expenses are subject to inflationary increases plus the fact that the number of students enrolled in our courses is increasing. Second, the administration has a habit of giving

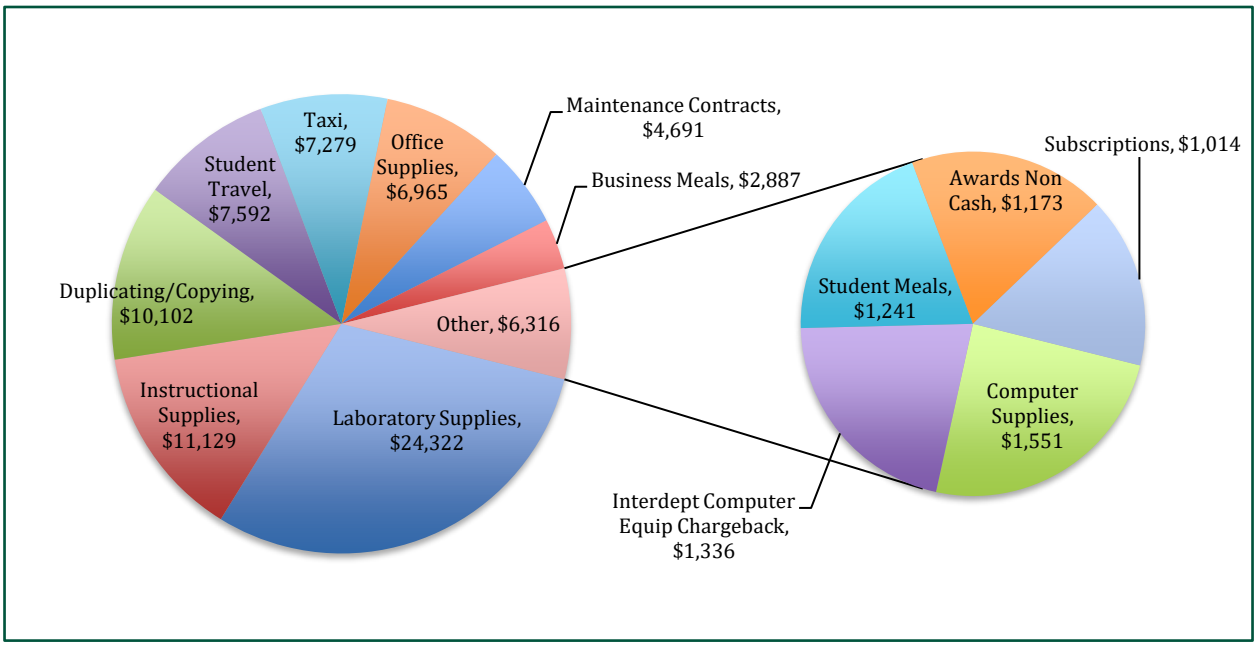

Figure 8: Expenditure categories for the ENVS operating budget during fiscal year 2017-2018. Categories totaling less than $1,000 are not shown to enhance detail of predominant expenses.

us one number and then telling us we have to cut the budget sometimes more than once in an academic year. These university-wide budget cuts suggest that the administration is incapable of predicting revenues until after they deposit in their accounts. Thus, we have the stress and uncertainty that accompanies uncertain budgetary times. We are also being told to expect such budget cuts and trends to continue for the next several years.

4. Environmental Management - Graduate Program (MSEM)

4.1. Mission

The MSEM program is aimed at working professionals in the environmental field, broadly defined. The goal is to give the students the skills they need to advance their professional careers without having to quit their jobs. Students come from a wide variety of backgrounds; while some have undergraduate degrees in the sciences, others do not. Most, however, are currently working in some part of the environmental field. Classes are accordingly taught on weekends and weekday evenings. Adjunct faculty are an important component of the program because they bring in real-world experience.

4.2. History

The MSEM program is celebrating its 40th birthday this year, and as such, is one of the oldest environmental management programs in the country. Joe Petulla was the founding director. In the department, Tom McDonald, John Callaway, Stephanie Ohshita, and Allison Luengen have all served as Graduate Program Directors.

Recent changes to the program (within the last 5 – 8 yrs.) include the development of 4 concentrations: Water, Health and Hazards, Ecology, and Climate and Energy. Within the last few years, the GsAL has been established with David Saah as its director and there is now a substantial curriculum associated with that certificate program. A new required course (Quantitative methods) has also been added to the program to address student deficiencies in statistics and quantitative methods.

Within the last few years, the curriculum has also been expanded and stabilized. Many new courses have approved through the curriculum committee and officially added to the rotation of courses taught in the program. We have also been able to offer courses on a more consistent rotation (e.g., Environmental Law is typically now taught every Fall). The required Environmental Chemistry course is now offered twice (one in the A-term and once in the B-term, designations for half-semester periods), thus giving students more flexibility for choosing electives. The most recent additions (Spring 2018) include the following: Environmental Finance, Sustainable Business, Conservation Biology, Field Botany, Field Survey Management, Introduction to Hydrology, Sustainable Design, Urban Resilience in Climate Change, Advanced GIS, and Water and Wastewater Treatment. The expanded curriculum was also accompanied with a renumbering of the courses, to allow courses in the same concentrations to be grouped together.

4.3. Program Structure (Administration)

The Program is administered by the Graduate Program Director (GPD) and Graduate Program Manager (GPM), see sections 2.3 and 2.4. Allison Luengen is the current GPD and Sindy Vela is the current GPM. The GPD is a full-time faculty member, who receives 4 units of course release per semester, while the GPM is a full-time staff position. One recent concern, is that over the past year and a half, there have been four different GPDs as a result of maternity, medical, and professional leave requirements, so considerable effort is expended to bring the program back up to speed following such rapid leadership changes. The upside, is that Allison Luengen is slated to remain GPD until her term expires in June 2021.

4.4. Curriculum

<u>Foundation Courses</u>

MSEM has always had a strong foundation in natural science. There are three required courses, *Environmental Chemistry, Ecology, and Quantitative Methods*, to give all students a common foundation for their graduate studies in environmental management. Students with extensive prior coursework or professional experience in those topics may be granted a waiver, so they can pursue other coursework. These three courses are required foundation courses that students take in their first semester to provide them fundamental knowledge and skills needed by professionals and to prepare them for later science classes in the program.

Management in the Curriculum

The program recognizes that environmental problems we strive to address require not just a solid science background, but also an understanding of the human issues that impact the environment. Therefore, the management component of MSEM turns to the management of human activities, with curriculum including environmental policy, law, economics, communications, and ethics.

Skills and Methods

To better prepare MSEM students for their Masters Project research, we've added courses in Research Methods. Many students now incorporate GIS into their MS Projects.

Overview of MSEM Elective Courses

The MSEM program still includes curriculum on end-of-pipe environmental problems like wastewater treatment, contaminated soil treatment, risk assessment, and emergency response to accidental release of hazardous materials. These problems are still with us, a toxic legacy of the industrial economy, and the curriculum prepares graduates to ameliorate and prevent further harm.

Master's Project

The required capstone of the program, the *Master's Project*, is an in-depth analysis of an environmental management issue of the student's choosing. Students utilize existing literature (secondary sources) to conduct research for the Project. Students present their research findings and management recommendations in a written report and oral presentation. A thesis option is available for those wishing to pursue primary research in conjunction with a faculty member's research efforts.

New Curriculum

As our understanding of environmental problems develops, so does our MSEM curriculum. Incorporating more systems-oriented courses and problem solving at the source, our newest curriculum examines climate change in multiple ways: science of the climate system and ecological impacts, climate considerations in restoration and water management, urban adaptation to climate change impacts, and mitigation strategies to reduce greenhouse gas emissions. Other new curriculum includes: environmental economics, natural resource economics, energy auditing, green building and sustainable design, sustainable business, sustainability leadership, and environmental finance.

Find out more about MSEM courses and current program structure at: http://www.usfca.edu/artsci/msem/program/.

4.4.1. Degree Requirements

The two-year, 30-unit program consists of 13 courses (2 units each, for 26 units of coursework) and a 4-unit Master's Project. Students typically take four courses per semester and one course and the Master's Project in the final semester. The schedule allows students to work full-time

during their studies, with classes on Saturdays and weeknights. Through conferral with their academic advisor, students may spread out their studies beyond two years to balance time demands.

Students must achieve a minimum grade point average of 3.0 to graduate.

4.4.2. Curriculum Structure and Scheduling

A defining feature of the MSEM program is a structure geared to students who are working, and to instructors who are practicing professionals. Courses are offered during the fall and spring semesters, and each semester is sixteen weeks. Individual courses are held in eight-week sessions (Session A & B within each semester). There are two 8-week sessions in a semester, making the graduate program semester one week longer than the undergraduate semester of 15 weeks. Most students take two courses in each session for a total of four courses (8 units) within each semester.

Most courses are held on Saturdays, with a few courses on weeknights. Each course in the curriculum is 2 units. Each Saturday course lasts for eight weeks, meeting on four alternating Saturdays, six hours per meeting, for 24 hours of total meeting time per course. Weeknight courses meet for three hours per week during the 8-week session, for 24 hours of total meeting time.

The required Masters Project is an exception to this schedule, counting for 4 units and meeting semester-long. Occasionally, jointly-taught graduate and upper- division undergraduate courses are also offered as semester-long courses for the MSEM program.

Required courses are offered every year, while elective courses are typically offered once every two years. Recent course schedules are posted on the MSEM internal website (in Canvas) and on the program public website.

We have tried many permutations and combinations, and overall the structure and scheduling are working well at this time. The GPD puts in a great deal of work recruiting faculty to teach at the timing sequence needed for the curriculum, considering prerequisites, faculty availability, and student interests. That being said, it can be hard to offer enough courses in each concentration, so we try to guide the students in choosing courses for their concentrations, if they decide to choose a concentration.

The class times can pose difficulties for faculty teaching in the program. While the intensive Saturday courses may allow faculty to have larger block of time for research during the week, they take away from family time. Also, if the faculty member has a mix of undergraduate and graduate courses (which is very typical), the resulting schedule can be challenging.

4.4.3. Credit Hour Policy Compliance

The graduate MSEM courses meet the University's policy for credit hours, in a format tailored for our working students and mix of full-time faculty and practitioner instructors. Our graduate 2-unit courses each have 24 hours of seat time, compared to the typical 26.5 hours of undergraduate seat time. The MSEM courses have higher expectations for study outside of class time, 90 hours per each 2-unit course. The 4-unit MSEM Masters Project has less seat time and more independent work and one-on-one conferrals with the faculty project advisor.

4.5. The Graduate Student

The incoming MSEM graduate student cohort over the last five years has been comprised of students that range broadly in their exposure to the field of environmental management. A significant portion 80% of our incoming students are already working in fields related to environmental management and are seeking to advance their career or expand their knowledge base. Approximately 20% of our students have had little prior experience in environmental management and are seeking new career opportunities. The diversity in experience of incoming MSEM students is one challenge the MSEM program seeks to address with a broad range of course offerings. A majority of our incoming MSEM students have full or part-time job commitments.

4.5.1. Enrollment and Retention

The MSEM program has enrolled approximately 100 students per term over the last 5 years (mean =95, range 82-101). This has been steadily increasing, and is significantly greater than the average of 59 (range 36-82) reported in the 5 years prior to our last self-study (2002-2006). Each year the program accepts, on average, 73 students, 43 of which are retained. The majority of the students retained complete their degree in 2 (70%) or 3 (30%) years. A small percentage of students that begin the program fail to graduate (2%).

4.5.2. Demographics, Diversity, and Internationalization

The demographic breakdown of students in the MSEM program from Fall 2013 to Fall 2017 is shown in Figure 9. The program over the last five years is skewed toward students that identify as female 67%, and the majority of the students self-identify as white (**Error! Reference source not found.**). International students comprise between 6-10% of our student body, and hail from a diversity of countries including (Brazil, France, India, Madagascar, Mexico, Nigeria). African Americans comprise from 1-3% of our student body. This is a demographic that the MSEM program would benefit from reaching out to and recruiting. Most domestic students are from California (80%), but our program also includes students from other states.

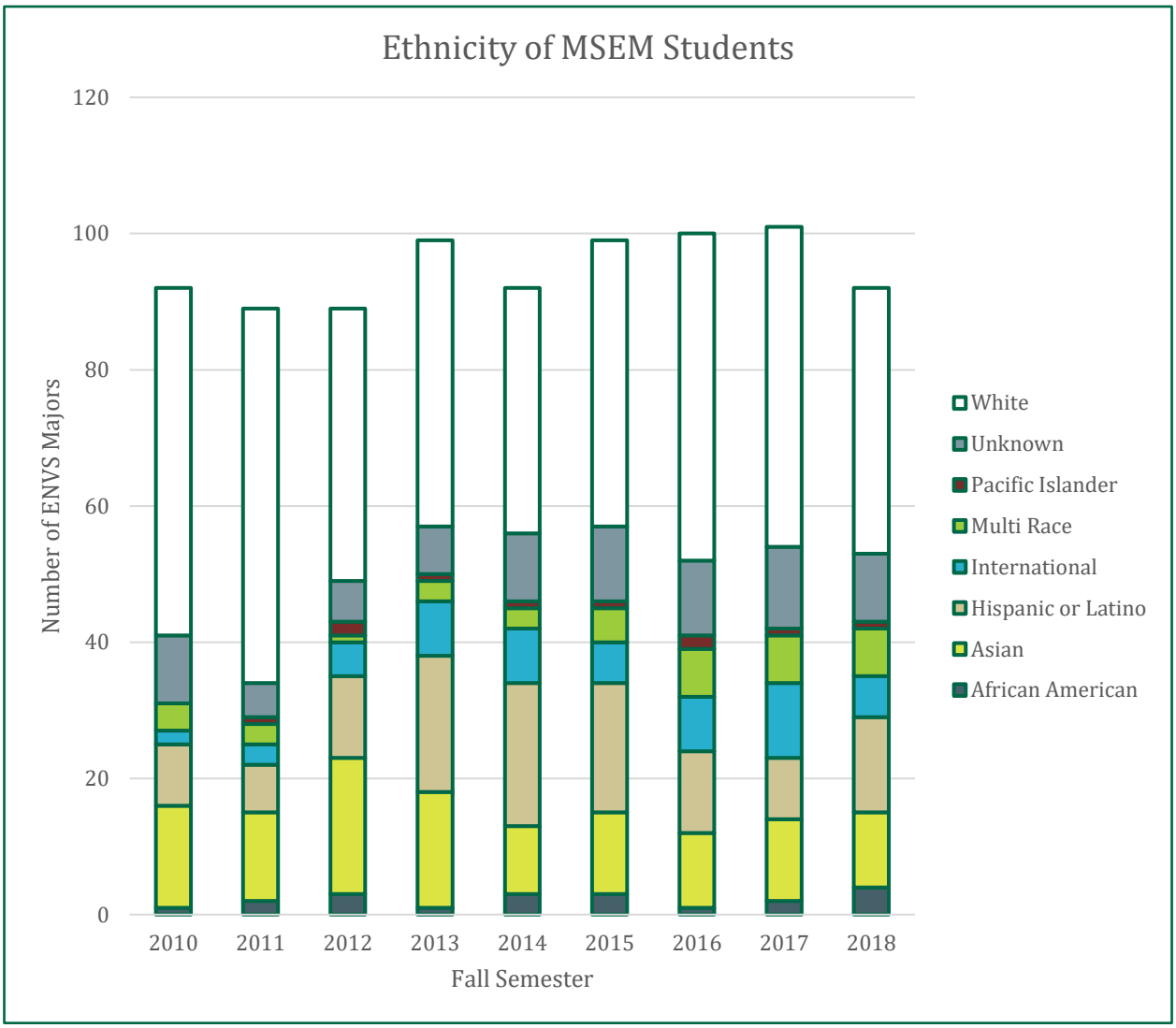

Figure 9: The percentage of self-identified ethnicities of students in the MSEM program from Fall 2013 to Fall 2017. These data also show the percentage of international students.

4.5.3. Recruitment

In the last five years, the program has stepped up its attempt to reach prospective students. As part of this effort, the MSEM program developed new banner ads and the tagline "*Where Science Meets Management*". The program has been advertised in a variety of print sources, including: Environmental Leader and Triple Pundit and a print ad in Sierra Magazine. In addition to print ads, in summer 2017 the department created posters that were sent to colleges across the country. We would like to continue to reach out to prospective students and alumni with a weekly news feed via our program website, but the current website platform does not support this effort. Finally, we hold various MSEM information sessions and participate in the Graduate Admission Open Houses held in November and January. Last year we added Facebook and Google ads to our recruitment efforts.

4.5.4. Intellectual and social climate

The MSEM program conducts an annual exit survey to gauge climate and learning outcomes. MSEM students form lasting relationships with their peers. These relationships seem particularly significant around career networking, where it is clear that students in the program are helping other students find jobs in their companies. That being said, the weekend/weekday evening structure of the program can make it hard for the students to feel connected with the larger campus community. MSEM students are frequently not available to come to campus during the week and find it hard to drop in to office hours. This lack of interaction is also true among the faculty in the MSEM program that includes many adjunct faculty that rarely have an opportunity to meet as a group.

4.6. Course Instruction

Instructors are previously listed and discussed in Section 2.6.

Because adjunct faculty are such an important part of the program, it should be noted here that many of them have great, long-standing relationships with the program. For example, Gordon Johnson, who teaches Energy Resources and the Environment and Renewable Energy, has taught in the program for over 20 years at USF. Other especially long-standing faculty include Harry Allen (Emergency Response, teaching over 16 years at USF) and Aaron Frank (Environmental Law, teaching over 15 years at USF). These long-standing relationships have allowed the GPD to work with the adjunct faculty to help ensure that the courses fit with the needs of the program and conform to program expectations in terms of rigor and grading. Currently, we have a pool of adjunct faculty who consistently teach in the program and are known to be good instructors. They both add a lot to the students' experience and can provide career networking or directly hire students. For example, Ken Schwarz, who regularly teaches hydrology, has hired many MSEM graduates into his consulting firm. Harry Allen (EPA) has channeled students into our program.

4.7. Research

Many MSEM students do not have time to conduct research because they are engaged in outside employment. That being said, there are exceptions. The GIS lab has provided research opportunities to students. Allison Luengen has worked with two MSEM students who have published or are in the process of getting research published. Amalia Kokkinaki, Gretchen Coffman, Tom MacDonald, and John Callaway have also worked with MSEM Students to publish research.

4.8. Assessment

The MSEM program recently submitted an Assessment Report to the Office of Academic Effectiveness. The report included recent updates to our program learning outcomes completed in 2016. These include the following:

Students graduating from the MSEM program will be able to:

1. Demonstrate an interdisciplinary approach in analysis of environmental issues and management strategies.
2. Utilize both theory and applied knowledge to evaluate and recommend management strategies for environmental issues.
3. Choose and apply appropriate tools, techniques, and technologies to analyze environmental issues.
4. Skillfully communicate environmental management issues through written reports and oral and visual presentations.

These are carefully assessed through our exit survey completed by at least 88% of students graduating from the program.

In AY 2015-16, capstone Master's Project Presentations were assessed for PLO #4 by 7 reviewers. There was a total of 31 presentations, of which 28 presentations received at least one assessment and 49 total reviews were completed. Reviewers were open to which presentations they reviewed. The average was 18.02 out of 20 suggesting that students largely obtained the expected learning outcome based on their presentations.

In AY 2016-17, capstone Master's Project reports were to have been assessed for PLO #1 and #2. Based on a very small sample, PLO #2 was largely achieved, with an average score of 88% (17.7 out of 20). However, due to the small number of assessments completed, we cannot draw any strong conclusions. Furthermore, PLO #1 was not assessed. The shortcomings in carrying out assessment were due to staffing challenges for the GPD position during the 2017-2018 academic year as previously discussed. Attention was focused on maintaining high quality operation of the program.

Table 6: Exit Survey Results (Fall 2016 – Spring 2017), To what extent do you think you attained the following MSEM Learning Outcomes.

New PLO	Old PLO		Fully	Quite a bit	Somewhat	Not at all	#
			%	%	%	%	#
1	A	Demonstrate an understanding of an interdisciplinary approach to the study of the relationships and interactions of human beings with the natural world.	43%	50%	7%	0%	30
2	B	Utilize principles and processes of the natural sciences, social sciences and the humanities to provide both theoretical and applied understanding of managing environmental issues.	52%	41%	7%	0%	29
3	C	Demonstrate understanding of environmental management tools, techniques, and technologies designed to meet the demands of industry, government, and the consulting sector regarding the protection of the environment and the fulfillment of environmental regulations.	52%	39%	6%	3%	31
4	D	Communicate skillfully through written reports and oral presentations of environmental management issues.	62%	28%	10%	0%	29
2	E	Critically analyze impacts, both actual and potential, of human activity on the environment and their prevention and mitigation.	62%	31%	7%	0%	29
		TOTAL AVG	54%	38%	7%	1%	29

4.9. Budget

The MSEM program budget is more structured since the last Program Review. The program is now able to allocate a $300 to $400 class budget to every MSEM course offered in the academic year. This line of the budget was created to allow instructors to invite guest lecturers to their classes and or support additional field trips. We have received feedback from faculty indicating that their class budget is definitely key in bringing practicing professionals to the classroom.

We have also increased our student support in the form of graders, teaching assistants, office assistants, and most recently peer mentors. The need for funding continues to grow as more students join the program each year. Student support is strongly required in courses, such as Environmental Chemistry, Quantitative Methods, and a few field-courses. Previously, the instructor, single-handedly graded and tutored all Environmental Chemistry students. This task became impossible as enrollment grew. Therefore, we decided to use a portion of our budget to fund teaching assistants and graders to assist our instructors and provide additional support to our students.

The program also launched a pilot program of peer mentors; these were staffed by four outstanding MSEM students that served as peer mentors to current students and ambassadors to prospective students. The peer mentors were instrumental during the fall semester, in helping first-year students navigate their first year in the program, and during recruitment season, in sharing about their experience in the program with prospective students.

The MSEM program collaborates with the undergraduate environmental science program in sharing the costs of student office assistants. The department office hires two student workers, with the costs split evenly between the MSEM and ENVS budgets. For field and laboratory MSEM courses, the costs of sampling supplies and equipment is covered by the ENVS budget.

The ENVS undergraduate program in collaboration with the MSEM program hire, train, and manage Graduate Student Instructors to teach 8-10 undergraduate laboratory sections each semester, see section 3.7.1. This provides many MSEM students with some income and significant teacher training.

This year, the MSEM program started to work on student and alumni enrichment events. This includes three large social events per semester in which students have the opportunity to network with alumni, faculty and their colleagues in their current cohort. The MSEM program has never done this before, and we hope that we succeed by providing a better student experience to our students. The rest of the budget is allocated to software licenses, administrate costs (e.g., copying), transportation for field course field-trips, and catering for running events (e.g., Orientation, Panels and MS Project presentations).

The MSEM scholarship budget has increased significantly since 2013. Merit scholarships are a key indicator in retaining our top-ranked applicants. This is important for us since the reputation of our program grows due to the quality of our graduates in the workplace. These merit scholarships also help us attract more students to apply to our program. With a recent increase in our merit scholarship, the program can allocate a partial scholarship to at least 60% of the entire incoming class. Although these awards only cover a small fraction of total tuition, and we don't have sufficient budget to provide anyone with a full scholarship, the awards make a big difference. Prospective students who decline our offer of admission most often cite "better funding" or "no graduate housing, housing too expensive" as their reason for choosing another university. Thus, maintenance of the scholarship funding level is crucial for the program.

4.10. Needs

The MSEM budget has been sufficient for the last academic year, but we have shifted our program expenses to a new level. The implementation of social events or peer mentors have never been part of our budget. We hope to continue to grow these areas in the program but would need an increased budget to support them successfully. Students have given us feedback

that they would like more opportunities to network within their cohort so these social events would help support that.

The Office of Graduate Admissions supports us with marketing materials for our program, but we also allocate a significant portion of our budget for print and online advertisements. The program also allocates funds to cover all costs for the production of our semester newsletter as well as recent photoshoots for our program. We would like to increase our internal budget to market the program in a more strategic way across the bay area, but it is difficult to fund larger campaigns such as SF MUNI ads, different magazines in the environmental field, search engines, radio among others. The university continues to ask us to attract more students, but costs for advertising the program effectively is exceeding funding resources.

In addition to student enrichment events, we would like to hold research talks for our students, as well as specific panels by bringing in external guests or alumni to the program. We would also like to fund students that are attending conferences relevant to their area of study. We understand that the College's travel fund is competitive and funds are not sufficient for all students applying. Therefore, we would like to have funds that are strictly for student professional development opportunities.

5. Future Goals and Strategic Planning within the MSEM Program

5.1. Development of Faculty and Staff

One goal is to get all of the faculty (including adjuncts) who teach in the program together regularly. Such a meeting has been hard to coordinate because it depends both on the availability of adjuncts to make time for such a meeting and on the GPD to have time to coordinate this meeting. One goal for the next meeting is to have a chance for all faculty who teach in a particular concentration to come together and talk about how the concentration courses fit together and what (if any) required components it should have.

5.2. Development of Students and Alumni

The MSEM Program holds a panel in the environment every fall and spring semester. Last year, MSEM collaborated in the Schmidt Foundation Panel on Human Rights and Environmental Justice where many MSEM alumni and current students joined to network and collaborate on current research. The implementation of the College's Alumni Mentor Program (AMP) has enabled current MSEM students to connect with MSEM alumni from across the state for career advancement, community building and to share career opportunities. Our goal is to continue to develop our semester panels and additional workshops where we can bring in alumni to share with current students.

5.3. Curricular Development

Advisory Board - One goal is to develop an advisory board that can help the director identify directions in which the program should move.

MS Project - Another goal is to refine and update the expectations for the MS Project. Expectations for the project have grown over time, and students are incorporating more data and more quantitative analysis into their projects. However, the supporting structure has not kept pace, and some of these projects are taking substantial additional faculty time. However, despite this time involvement, very few of these projects result in publications. The 1-semester time-frame for the project is simply not enough to get a publication ready, and most students do not retain interest after graduating.

GIS - The GIS curriculum has grown significantly over the last couple of years. Unfortunately, demand is now so great in this area that faculty who have GIS expertise have a hard time finding the units to teach other types of courses. For example, MSEM students have expressed interest in Wildlife Ecology, which is a course that is within the repertoire of Tracy Benning and David Saah, but they have no units left to teach it.

Concentrations - Need all faculty who teach in them to come together and discuss the required and optional components of the concentration and which new courses should fall under which concentration.

5.4. Research and Facilities Development

As mentioned previously, MSEM students are not typically involved in faculty research because they work full time in outside employment. One of the challenges of the department is how to conduct research without a pool of graduate students to help. Although many faculty involve undergraduates, and occasionally graduate students do become involved in research, graduate student involvement in faculty research is somewhat unusual. One exception to this may be the GIS lab, where students build up the skills during the classes that are needed to actually be able to do the research.

In contrast, laboratory and field research with MSEM students is more challenging. If they are working full-time, the only time the students have available is weekends. When faculty are also teaching on Saturdays, coming in Sunday to train graduate students is not a feasible option. Faculty working with research students spend a lot of time training those students in techniques that would have been covered by coursework in a more research-focused institution.

5.5. Outreach and Collaboration

The GPM is taking lead on recruitment and admissions, developing alumni outreach, and fostering a greater community and professional networking. Our current progress includes our

semester newsletter geared toward prospective students and alumni. A redesigned website with social media channels allows us to communicate updates on the program and current student highlights. The program collaborates with different offices on campus to provide support with career counseling, job interviewing and resume building skills. This semester, the Career Center launched a new position that aims to focus on our graduate student population. The MSEM program is working out a career, resume, and LinkedIn workshop for current students to be held in Spring 2019. The program also collaborates with the Office of Development in planning for its annual Schmidt Foundation panel every fall. We aim to continue to advertise the program to prospective students who are already in the environmental field and continue to foster relationships with alumni to build bridges for career advancement for current and future MSEM students.

5.6. Synergies

Two years ago, Maggie Winslow (formerly the MSEM program manager) created a new program in Energy Systems Management. This program has been a complicated issue for the MSEM program. While there are opportunities for synergism, there are also problematic areas. Last year, 4 MSEM students switched from MSEM to Energy, which is a large chunk of our student body. Many of the MSEM adjunct faculty were then pulled into the Energy program. A committee (Allison Luengen, David Saah, Stephanie Siehr, and Maggie Winslow) has been formed to explore Energy/MSEM relationships.

There are some synergies with other campus programs. Students are allowed to take up to 4 units at USF outside of the MSEM program. Students with interests in sustainability or business or non-profits often find an appropriate course in the MBA program or other graduate programs at USF. There is a joint course on sustainable design offered in conjunction with the Art and Architecture department.

6. Summary and Conclusions

The ENVS and MSEM programs have experienced substantial growth and have achieved significant outcomes since our last program review six years ago. Writing this self-assessment leaves the authors amazed at just how much we have achieved and excited and energized to move into the future. Because of the continued support of the administration, the expansion of facilities, the appropriate staffing of our lab and program managers and assistants, we have grown into a strong and sustainable department. Of course, we have faced challenges and will continue to do so, but the willingness of our faculty to step up, take on the challenges, and advance our programs in support of our students is simply put, amazing.

6.1. Current State & Successes

In addressing this topic, it is likely best to start by recognizing all that we have achieved since our last program review.

- Undergraduate declared majors have increased by 33% and the number of MSEM students have increased by 60%.
- The College of Sciences has opened a new state-of-the-art building and the department moved into this facility, doubling our teaching space, outfitting the facility with state-of-the-art equipment and doubling the number of lab sections offered in a given semester.
- The GsAL was built, opened, staffed, and become fully functional since our last program review. As a result, the exposure of our students to geographic information sciences has dramatically increased and is now gaining further momentum as students realize the benefits of such a facility.
- A full-time program manager was hired for the MSEM program in 2012 that has provided the resources for substantive improvement of the management of the program as evidenced by larger student numbers and also by the significant increase in quality of incoming students.
- The support staffing for the department and programs has increased with the addition of a full-time laboratory coordinator, a lab manager for the GsAL, and increasing program assistant support for both the department and MSEM program.
- The ENVS program has expanded the expertise of its faculty with the hire of Calla Schmidt, Amalia Kokkinaki, and David Saah.
- Finally, the department advanced its assessment plan and procedures from near non-existence to winning the award for the best annual assessment report in the sciences in 2017 and being ranked by peer professors as being the most effective program in the sciences to teach the Core-B2 learning outcomes.
- The MSEM program has undergone significant curricular changes to update the degree looking forward into the 21st century while maintaining and improving upon its 40+ year history.
- With our added administrative support in the MSEM program, we now have the opportunity to look forward as to how we might further improve our programs by scheduling social events that bring current students together with alumni, faculty, and business professionals.

Reflecting upon our many accomplishments since our last program review and realizing that there is so much more to share and tell about our department, we are excited to share our experiences with an outside review team.

6.2. Challenges, Needs, and Priorities

Of course, challenges remain. Some are quite significant and will require much or perhaps more effort. The following is a list of those challenges that have been illuminated by this self-study.

- One of the most pressing needs of the department is for high quality specialized research space. Most faculty recognize the need to consider shared space as a realistic approach to providing effective research labs. Some faculty work on projects that do not lend themselves to shared space and that should be understood as we consider how to move forward with renovation of Harney Science Center. That said, a thorough review of what space we have and a creative lens to how that space may be effectively utilized is extremely important for the future of our department and programs.
- Balancing of faculty time and expertise between programs is another critical challenge. Every faculty member was hired to teach in the department and all of its associated programs, and each member is committed to this reality. However, because of a variety of interests demanding faculty time, that balance sometimes falters, leaving the department short of faculty time to meet all of its commitments, this can lead to an unequal sharing of faculty time amongst the various courses to be taught and administrative tasks to complete.
- Another concern is the expectation that we continually do more with shrinking budgets. As stated, our programs have grown substantially, but in some instances, the budgets to administer the programs have not grown at the same pace. This compounded with the uncertainty associated with future budgets and expectations that there will be future cuts has increased the stresses that we face when trying to administer our programs.
- Related to all of the above issues is the lack of promotion of Associate Professors to the rank of full Professors. This is a complex issue that relates to all of the concerns above but also to our need to request faculty overload teaching to meet our scheduling demands. Some of our courses are not easily staffed with adjuncts and so some full-time faculty, wanting to do what they can to support the department, take on the teaching overloads at the expense of other demands required for promotion. Some faculty are consumed by the massive variety of service opportunities within the college and university again at the expense of their demands that would improve promotion. In some cases, appropriate and adequate research resources are not made available, sometimes because the research is not a good fit for an institution such as USF, requiring the faculty member to find new avenues of research productivity that vary from their previous foci. Regardless, the lack of promotion is not due to a lack of effort or commitment.
- Finally, as our programs grow and receive recognition for their successes, we have an opportunity to develop collaborations within the Sciences and across campus. This issue has lingered from our first program review in 2005-2006. At that time, faculty in some of the other science degrees openly stated their lack of support and frankly lack of respect for our programs. Since then, we have grown our program into a respected and

significant contributor to the college and university. Thus, we now have an opportunity to expand upon these issues and develop collaborations with other science departments to improve upon and expand the breadth of our offerings to our students. With other collaborations such as that with Environmental Studies or the building of the GsAL, we have a unique opportunity to develop ties to other non-science programs. Moreover, the start of the engineering program in fall 2020 will give us the opportunity to work with our colleagues to develop a new school with a focus on engineering in the 21st century, that considers the social aspects of the field and the need to incorporate sustainability, pollution prevention, and collaborative project work to solve huge, real-world problems. Our department because of its history, diversity of individuals and expertise is uniquely suited to contribute to the success of that new program.

6.3. Some Specific Requests

- Hire a tenure-track faculty member with GIS expertise.
- Develop adequate and sufficient research spaces so that all ENVS faculty can succeed in their research whether wet labs, field labs, or computational space.
- Work toward a better balance of faculty time in teaching, service, and research and striving to minimize teaching overloads.
- Consider ways to make Master's Project research more publishable. Currently, faculty are advising students about their projects in the semesters prior to their taking this class, thus having to count this commitment as service.
- Thinking about how the concentrations within the MSEM degree fit together has a whole.
- Reviewing and further developing the undergraduate ENVS curriculum to improve our student's understanding and retention of basic scientific principles.
- Improve our outreach to prospective students and alumni with a weekly news feed via our program website.