HSU Academic Department Reports - Engineering
October 10, 2008 - Program Prioritization

The departmental reports provide context for the academic programs administered by the department, and will be considered in conjunction with the program reports for final program ranking. This report is to be completed by September 30. Use 12-point Times New Roman with 1.5 line spacing.

I. Departmental History, Mission, and Goals

MISSION STATEMENT

The mission of the ERE program is to prepare engineers to solve complex environmental resources problems. The program strives to educate leaders who will sustain, restore and protect our natural resources and the environment.

PROGRAM OBJECTIVES[1]

The ERE faculty considered the input from the ERE Advisory Committee and developed the following Program Objectives.

1. ERE graduates will effectively apply engineering analysis and design to solve environmental resource problems and to restore and sustain the global environment.
2. ERE graduates will practice engineering according to the highest professional standards, demonstrating respect for social, ethical, cultural, environmental, economic, and regulatory concerns.
3. ERE graduates will work successfully on interdisciplinary teams.
4. ERE graduates will communicate effectively in written, spoken, and visual formats with technical, professional, and broader communities.
5. ERE graduates will pursue life long learning opportunities including continued education, challenging professional experiences and active participation in professional organizations.
6. ERE graduates will be prepared to pursue professional licensure.

[1]The ERE Department uses the term Program Objectives to be consistent with the terms used by the Accrediting Board for Engineering and Technology.

HISTORY

In addition, provide a brief (2 page limit) overview of the departmental history with emphasis on the last 5 years.

The first program in engineering at HSU was developed in the late 1930's. It incorporated mathematics, surveying and drafting, and provided much the same function as a two-year community college pre-engineering program does today. In 1960, a four-year Civil Engineering (CE) program was approved. In 1968 a state commission was formed to study CSU engineering programs for technical and economic viability, and HSU's Civil Engineering program was one of three CSU programs identified as candidates for elimination. However, because of its excellent programs in Natural Resources, HSU was encouraged to develop a unique engineering program focusing on natural resource issues.

A committee, chaired by Whitney Buck, Dean of Undergraduate Studies developed the first draft of the new program, originally titled Natural Resources Engineering. Milo Bell, Professor of Fisheries Engineering at the University of Washington, was hired to review the draft program and suggest improvements. The new program was approved in 1969 and was titled simply Engineering. In 1972 the program was renamed Environmental Resources Engineering (ERE). This first ERE program required course work in mathematics, chemistry, physics and engineering, with approved elective course work in natural resources, engineering design, and related science fields.

The first significant ERE program change came in 1977 when a 15-unit Major Emphasis Program and a culminating Senior Project were introduced as degree requirements. By 1980, the ERE faculty had expanded to a multidisciplinary group capable of teaching and research over the full range of environmental resources engineering topics. ERE faculty and students became involved in a wide range of local, regional, national, and international resource management and environmental protection issues. In 1981 ERE became the sixth undergraduate environmental engineering program in the U.S. accredited by the Accreditation Board for Engineering and Technology (ABET). The program is one of approximately 50 undergraduate programs in the nation currently accredited by ABET under its Environmental Engineering criteria.

The ERE Department has maintained the base ERE degree elements introduced in 1977 refined with periodic curricular modifications in response to changes in environmental engineering practice, ABET accreditation standards and University policies. Significant changes since 1977 include: more comprehensive coverage of air, water, land and energy resources issues in lower division engineering courses, replacing the major emphasis program with a selection of design electives, creating a Capstone

Design Project course to replace the required Senior Project with, and reducing the minimum number of units for an ERE degree from 140 to 133.

In the last 10-15 years, the ERE Department has had significant turnover in faculty. Professors Al Burrows, Ron Chaney, Mac McKee, Derek Baker, Robert Gearheart and Mike Anderson have resigned, retired or FERP'ed. The Department has hired five replacements Margaret Lang, Elizabeth Eschenbach, Eileen Cashman, Arne Jacobson and Dustin Poppendieck. Through these hires the Department has maintained most of its prior capabilities and coverage of required materials with the exception of geo-environmental engineering topics. New faculty have also brought additional capabilities and coverage in the areas of renewable energy systems, air quality and air pollution control, engineering education and hydraulic engineering.

The ERE Department has two prominent affiliated programs, the Arcata Marsh and Wildlife Sanctuary and the Schatz Energy Research Center.

Arcata Marsh and Wildlife Sanctuary (AMWS)

ERE faculty were instrumental in development of the internationally-renowned Arcata Marsh and Wildlife Sanctuary. Coming online in 1984, the AMWS is a unique constructed wetland treatment facility providing wastewater treatment for Arcata and wetland wildlife habitat. The AMWS provides mutually beneficial research opportunities for ERE students and faculty, and the City of Arcata. AMWS affiliation with the ERE department is formalized through an allocation of laboratory space and annual grant funding from the City of Arcata for directed projects to study the performance of the constructed wetlands treatment system, and evaluate and propose design process improvements.

Schatz Energy Research Center (SERC)

SERC was established in 1989, thanks to generous funding from Dr. Louis W. Schatz former president of General Plastics Manufacturing Company of Tacoma, Washington. SERC works to establish clean energy technologies, specializing in renewable energy, energy efficiency, and hydrogen energy systems. This work involves research and development, technology demonstration, project development, energy systems analysis, and education and training. SERC provides a rare opportunity for undergraduate and graduate engineering students to acquire hands-on experience with cutting-edge energy technologies.

II. Departmental Faculty and Staff

Engineering Dept Instructors -- AY Average Count of Appointments facpos_ENGR report generated: 22-FEB-08						
Appt Category	**AY 02/03**	**AY 03/04**	**AY 04/05**	**AY 05/06**	**AY 06/07**	**AY 07/08**
Lecturer	6	2	7	6	5	3
Assist Prof	2	1	1	2	2	2
Assoc Prof	1	2	3	0	1	1
Professor	8	6	4	7	6	6
Teach Assoc	2	2	0	1	0	3
Volunteer	3	5	5	4	3	1
Total	**20**	**18**	**20**	**20**	**17**	**15**

Engineering AY average FTEF (time base totals) facpos_ENGR report generated: 22-FEB-08						
Appt Category	**AY 02/03**	**AY 03/04**	**AY 04/05**	**AY 05/06**	**AY 06/07**	**AY 07/08**
Lecturer	1.33	.51	2.37	1.83	1.44	1.10
Assist Prof	1.50	1.00	1.00	2.00	2.00	2.00
Assoc Prof	1.00	2.00	3.00	.00	1.00	1.00
Professor	6.50	6.00	4.00	6.67	5.17	4.67
Teach Assoc	.46	.54	.00	.14	.00	.40
Volunteer	.35	.91	.99	.42	.09	.03
Total	**11.14**	**10.95**	**11.35**	**11.05**	**9.70**	**9.19**

Engineering department release/assigned time facpos_ENGR report generated: 22-FEB-08						
Assignment Description	**AY 02/03**	**AY 03/04**	**AY 04/05**	**AY 05/06**	**AY 06/07**	**AY 07/08**
Excess Enrollment (=>75)	.00	.03	.00	.00	.00	.03
New Preparations	.00	.00	.00	.13	.00	.00
Instr Experimt Innov/Research	1.32	1.06	1.45	.10	.00	.00
Advising Responsibilities	.06	.00	.00	.00	.00	.00
Accrediation Responsibilities	.07	.00	.00	.07	.00	.00
Dept Chair AY, Leaders/Dir.	.00	.00	.00	.40	.73	.00
Dept Chair - 12mo	.50	.50	.50	.50	.50	.50
Proj/Prog Leaders, Dir., Coord	.00	.00	.00	.00	.13	.18
Other State Funds	.00	.00	.00	.79	.00	.94
NOT USED - Grant	.00	.00	.00	.00	.20	.00
Grant: Academic	.00	.00	.00	.00	.10	.10
External non-State Funds	.00	.00	.00	.00	.00	.13
Total	**1.95**	**1.59**	**1.95**	**1.98**	**1.66**	**1.88**

ERE Personnel with Appointments of 0.5 FTE or higher

Name	**Position**	**Description of Specialty and Key Contributions (no more than 100 words per person)**
Dr. Mike Anderson	FERP Professor	Air Quality/Mechanical Engineering *Subjects*: Engineering science - statics, dynamics and mechanics of materials *Research Interests*: Engineering problem solving with applications in engineering mechanics.
Dr. Eileen Cashman	Associate Professor	River Morphology/Sediment Transport *Subjects*: Hydraulics, water quality, design process, water resources and computational methods. *Research Interests*: Aquatic restoration design, sediment transport, quantification of bedload transport through experimental flume studies, 2D-hydraulic modeling of river systems, design of fish passage structures, engineering education.
Dr. Charles Chamberlin	Professor	Environmental Microbiology/Public Health Engineering *Subjects*: Probability analysis, data collection and analysis, transport phenomena, environmental health, and thermodynamics. *Research Interests*: design, development, and operation of hydrogen fuel cells and renewable energy technologies.
Dr. Elizabeth Eschenbach	Professor	Water Resources/Engineering Education *Subjects:* Introduction to environmental engineering, introduction to the design process, probability, computational methods, water resources planning and management, environmental impact assessment, hydrology and systems engineering. *Research Interests:* Policy development for watershed restoration, water resources planning and management, engineering education including K-12 involvement in engineering and inclusive pedagogy.

Name	Position	Description of Specialty and Key Contributions (no more than 100 words per person)
Dr. Brad Finney	Professor	Water Quality/Water Resources Engineering *Subjects*: Computational methods for engineers, probability analysis, hydrology, water quality, water and wastewater treatment. *Research Interests*: Water and wastewater treatment, constructed wetlands for wastewater treatment, wetland restoration, river basin planning, water resources planning and management.
Dr. Robert Gearheart	Emeritus Professor	Water and Wastewater Engineering *Subjects:* Water and wastewater treatment, water reuse, constructed wetlands/wetland restoration, international development technology. *Research Interests:* Klamath Lake and Upper Klamath watershed restoration, constructed wetland technology-municipal wastewater, storm water, mining discharges, contaminated groundwater, perchlorate remediation, international water quality management, water quality impact/chemistry, eutrophication management, blue-green algae toxicity.
Mr. Lonny Grafman	Instructor	Appropriate Technology/Engineering Design Teaches ENGR's GE courses ENGR 114, 305 and 308 and lower division engineering science and design.
Dr. Arne Jacobson	Assistant Professor	Renewable Energy/ Energy Policy *Subjects*: Thermodynamics, renewable energy systems, energy policy, international development. *Research Interests*: Solar energy, biomass energy, climate change policy, energy and international development, energy access and affordability for low income people, Africa, Latin America.

Name	Position	Description of Specialty and Key Contributions (no more than 100 words per person)
Dr. Margaret Lang	Professor	Water Quality/Water Resources Engineering *Subjects:* Water quality, fluid mechanics, hydrology, transport phenomena, hydraulics, computational methods. *Research Interests:* Fish passage, natural systems hydraulics and watershed restoration.
Dr. Peter Lehman	Professor	Alternative Energy Engineering *Subjects*: Thermodynamics, renewable energy systems, fuel cells, appropriate technology. *Research Interests:* Design and installation of fuel cell and renewable energy systems, energy education and outreach.
Dr. Dustin Poppendieck	Assistant Professor	Indoor Air Quality *Subjects:* Air quality, water quality, building energy, transport phenomena, introduction to environmental engineering. *Research Interests:* Indoor air quality, exposure assessment, particle emissions from fuel based lighting, building decontamination, hazardous waste technologies.
Ms. Mary Jo Sweeters	ASC (I)	Engineering Department ASC Runs the Engineering office and provides ENGR faculty support.
Dr. Robert Willis	Professor	Operations Research/Water Resources Engineering *Subjects:* Water resources systems, environmental systems analysis, groundwater hydrology, *Research Interests*: development of large-scale groundwater optimization methodologies, development and application of mathematical models for reservoir operation, conjunctive use, and subsurface flow and transport, optimal control of saltwater intrusion
Mr. Colin Wingfield	ISA II	Technician Laboratory technician for Engineering (65%) and Geology (35%)

III. Recruitment and Retention

Describe any specific actions (other than HOP or similar standard efforts) the department has taken to recruit and/or retain students, particularly diversity students and/or students who are underrepresented in your discipline. What have been the results of those actions?

The ERE Department has implemented a number of recruiting and retention efforts. Many of these are not standard HSU practices but have been adopted or modified from practices of other departments. These efforts include:

- Increased contact with community college engineering instructors and students.
  The department conducts an annual mailing of program information to targeted instructors at California community colleges. This effort was recently expanded in 2007 to include the WUE states, Oregon and Washington, and expanded in 2008 to include all WUE states. The ERE Department also maintains contact with engineering instructors at California community colleges through the Engineering Liaison Committee (ELC) and its mailing list. The ELC is a state-wide group of representatives from UC, CSU and community college engineering programs that meets each semester.

- Extensive use of DEMJOBS and HSU contact databases for both potential and accepted ERE students.
  Any student expressing interest in ERE is automatically contacted electronically and mailed an up-to-date program description packet. Accepted students receive an additional mailing that includes more detailed information about the program and student activities including materials prepared by the ERE student clubs for incoming students

- Complete overhaul of the Department webpage.
  The ERE webpage was updated in 2007 to a modern look and contains extensive information about the program for current and potential students. Incoming student and parent feedback indicates that this effort successfully attracts students to the ERE program.

In addition to the recruitment and contact efforts described above, the ERE department also operates programs to enhance retention and several specifically targeted to recruitment and retention of under-represented students. These programs are described below.

<u>Scientific Leadership Scholars Program</u>

The National Science Foundation awarded a half-million dollars in scholarship funds for 30 students to study Computer Science, Environmental Resources Engineering, or Mathematics at Humboldt State

University. Applications from Native American students and students whose parents never attended college have first priority. These students receive annual scholarships of more than $3,600 as part of their total financial aid package. An extensive recruiting effort for these scholarships occurred during AY 2006-07 and is ongoing via the DEMJOBs emails and ERE letters as well as the SLS website http://www.humboldt.edu/~sls. SLS students study together in small classes featuring hands-on learning, including opportunities to solve relevant problems in local Native American communities. Students also receive leadership training, career counseling, and access to Humboldt State's landmark Native American support programs. The SLS student pool has a much higher proportion of underrepresented students than is observed in the general HSU population in CS, ERE and Math.

North Coast Engineering Academies

The North Coast Engineering Academies was introduced in 2008 and is part of a California State University-wide effort to encourage the teaching of engineering concepts in the North Coast's K-12 schools, with a focus on high schools. The partnership includes HSU faculty in Environmental Resources Engineering, engineers from local consulting firms and public agencies as well as local teachers. This summer, 15 regional secondary science and math teachers from Hoopa High, Fortuna High, McKinleyville High, South Fork High, Zoe Barnum, Zane, Toddy Thomas and Hoopa Elementary participated in the Design Your Future Teacher Institute to learn and develop lessons for teaching more engineering in their classrooms. These teachers are now also more familiar with the ERE program at HSU.

In conjunction with North Coast Engineering Academies, Hoopa High School is offering the Humboldt State University course ENGR 215, Introduction to Design, for CSU college credit this fall semester. Sixteen Hoopa High School students will receive ENGR 215 course content online and complete course work at their Hoopa campus. This model is also used at CSU Sacramento and CSU Northridge. Fortuna High School plans to offer a similar course in Fall 2009.

ERE Freshman Interest Group

The ERE Department has included a Freshman Interest Group (FIG) since 2004. This FIG started as a combined FIG for both Environmental Resources Engineering and Environmental Science Freshman. Beginning in Fall 2008, enrollment is limited to only ERE majors in response to growing ERE enrollment and changes in the course requirements for Environmental Science majors. The FIG fulfills three academic requirements for Environmental Resources Engineering majors: a math course, ENGR 115 - Introduction to Environmental Resources Engineering, and COMM 100. The FIG Seminar

explores career paths available to ERE majors, provides support in the development of computer and study skills, and encourages team building between ERE freshmen.

ERE Student Clubs Outreach Activities

In addition to official programs, the four ERE student clubs regularly organize or participate in programs and activities aimed at introducing elementary and junior high students to engineering and science. Example activities include participation in Expanding Your Horizons and one-day, hands-on science activity day for junior high girls, class room visits, MathCounts, and presentations to scout troops.

IV. Learning, Curriculum, and Assessment.

List the student learning outcomes for your academic programs. Then for each learning outcome that has been assessed, provide a summary paragraph that includes the methodology and results of the assessment.

The ERE Department has 12 learning outcomes. These outcomes are aligned with outcomes required by the program's external accrediting body the Accreditation Board for Engineering and Technology (ABET).

I. ERE graduates will be able to apply the tools and concepts of mathematics, basic sciences, and engineering science in engineering practice.

II. ERE graduates will be prepared and understand the need to continue their life-long education in mathematics, basic sciences, and engineering science, design, and practice.

III. ERE graduates will have developed an understanding and an appreciation for contemporary issues and the historical, social and political context of the environmental resources problems that will engage them in their careers

IV. ERE graduates will be able to effectively and professionally communicate ideas and technical information to the public and to fellow and other professionals in written and oral reports.

V. ERE graduates will have the ability to design systems, components, processes and procedures to meet specified objectives, with an emphasis on designs for managing environmental resources.

VI. ERE graduates will have the opportunity to test their talents and expand their understanding and appreciation for literature, the visual and performing arts, history and foreign languages in and of themselves and how they relate to being effective as an engineer.

VII. ERE graduates will be able to work effectively in multi-disciplinary teams and, when necessary, to pro-actively resolve problems with team dynamics.

VIII. ERE graduates will be prepared for graduate school based upon their experience with independent research, technical writing, statistical analysis, and computational methods.

IX. ERE graduates will be prepared to assume a leadership role in the profession based upon their engineering science and design experience with traditional and nontraditional solutions to environmental problems.

X. ERE graduates will have a professional attitude and ethical responsibility to their client and their community in terms of the legal, economic, technical, and the environmental aspects of their role.

XI. ERE graduates will be literate in the range of laboratory, field and computational tools that are in common use in environmental engineering practice.

XII. ERE graduates will have the ability to identify, formulate, and solve engineering problems.

In Spring 2007, the ERE faculty assessed program outcomes III, IV, and V using an evaluation matrix completed during the final presentations in ENGR 492 - Senior Capstone Design. The ENGR 492 final presentations consist of a 20 minute presentation followed by a poster session for more detailed question and answer by the audience. All project team members contribute to the oral presentations. The final presentations in ENGR 492 are evaluated by department professors not instructing the course and outside professionals; each assessor receives an evaluation matrix. Evaluation matrices from Spring 2005 through Spring 2007 were considered for the assessment.

The assessment results for the design project presentations revealed that:

- Economics, Environmental Awareness/Protection and Manufacturability were strongly included in all projects.
- Public Health and Safety was weakly included in all projects.
- Sustainability, Ethical Responsibility, Social Awareness and Political Awareness were either weakly included or not clearly included in all projects.

Overall, the quality of the oral presentations was rated as very good to excellent with a few exceptions noted. In each of the evaluation categories above, the scores are consistent over time, averaging between 1.6 and 2.0. Almost all components of the design process were evaluated as strongly included by the assessors. The one exception was the Fall 2005 presentation Description of Criteria score of 1.44. This result is likely due to the nature of the project (an energy and water management

plan for a local manufacturer) and the client presenting a moving target with respect to the project goals and objectives.

In evaluating the assessment results for ERE Outcome III for Spring 2005 through Fall 2006, the ERE faculty determined that important content (Sustainability, Ethical Responsibility, Social Awareness and Political Awareness) for the design project were not regularly included in the design projects or not clearly conveyed in the design project presentations. ENGR 492 instructors decided to put greater emphasis on these aspects of the ENGR 492 design project beginning in Fall 2007. The ERE faculty also decided that evaluating the design project technical reports would be a better indicator of the design project contents than the design project presentation due to format and time constraints. The design content evaluation was moved to the assessment matrix for the design project technical reports.

Overall, the ERE faculty were pleased with the ability of ERE graduating seniors to make technical presentations (ERE Outcome IV). Assessing the quality of the presentations would be improved if the scoring criteria were more clearly defined. Numeric scores defined as 0 - inadequate or unacceptable, 1 - meets minimum expectations, and 2 - exceeds expectations were proposed for the next assessment cycle. The department anticipates that overall scores will be lower for presentations evaluated on this scale compared to the previous one but that the data will better differentiate between the average and excellent abilities of students.

In Spring 2008, the ERE faculty reviewed the ERE Exit Interviews from 2004-2008 to assess all program outcomes covered by the Exit Interview questions. At the end of each semester, ERE faculty meet with individual ERE students enrolled in the ENGR 492 capstone course and complete an Exit Interview. The questions on the Exit Interview are designed to assess students' perceptions of the degree to which certain ERE outcomes as well as ABET required outcomes are addressed by the ERE program. ERE faculty worked in pairs and reviewed a subset of the 20 questions on the Exit Interview. For each exit interview question, the ERE faculty pairs addressed the following questions:

1. Which ERE Outcomes are addressed by this question?
2. Which ABET Environmental Engineering criteria are addressed by this question?
3. After reviewing the responses to the question, what did you learn about the ERE program?
4. After reviewing the responses to the question, what suggestions do you have for improving the ERE program?
5. After reviewing the responses to the question, what suggestions do you have for improving the exit interview?

The Department Chair then summarized the ERE faculty pair reports and the ERE faculty reviewed that summary. On August 26th, 2008, the ERE faculty prioritized the results for questions 4 and 5 and

decided which actions to pursue to improve both the ERE program and the ERE Exit Interview. All ERE outcomes, except Outcome VI are addressed by the survey.

In general, ERE students are quite satisfied with their education at HSU. Most students find the program very valuable and like it ("fun" was often seen). One student suggested that our program have the motto "Come learn the power of a good idea". Multiple students commented on how much this program had changed their life for the better. Some of the most common comments included (n = 66):

- Relationships/Community/cooperation/atmosphere: teacher-student (n=32), student-student(n=28), Shared values (n=4)
- Small class sizes (n=23)
- People, teachers (n=24), professor availability(n=13) courses(n=2),
- Learned a lot – math, people skills, skills (n=3), information/knowledge (n=11), analysis
- Intellectual challenge(n=7)
- Labs and projects (n=7) Rube-Goldberg
- Modeling (n=5)

About 20 possible future actions were suggested by the ERE faculty. At the August 26th meeting, ERE identified the top three actions to pursue during 2008-2009. Those actions are:

- Re-visit the mapping of pre and post-requisite knowledge, skills and attitudes for ERE courses. We have an older version of this information from the late 1990s but our curriculum has recently changed to reduce total major units. We also have new faculty that need to become more familiar with the ERE curriculum.
- Evaluate the mapping developed above to verify that required ABET topics as well as important ERE topics are reinforced throughout the curriculum. In addition, we want to include more professional ethics case studies in upper division coursework.
- Pursue additional reduction in required units to graduation by providing evidence that AREA E requirements are addressed in the ERE curriculum.