Environmental Engineering
ABET Evaluation Summary
2015-2016

This document describes the evaluation of ABET Program Educational Objectives (PEOs) and Student Outcomes for the Environmental Engineering undergraduate program for 2015-16. Data were collected throughout the year and evaluated by the CEE Assessment Committee (Drs. Barr, Dupont, McNeill, and Tullis) in January and May 2016.

Program Educational Objectives

The Environmental Engineering (EnvE) Program Educational Objectives (PEOs) are reviewed by each of the program's three constituencies (Table 1).

Table 1: PEO Review Process and Schedule for EnvE Program Constituency

Constituency	Review opportunity	Frequency	Most recent reviews	Date of next review
Students	Freshman Orient. (CEE 1880)	Every freshman class (Fall and Spring)	Spring semester 2016	Fall semester 2016
	Junior design course (CEE 3880)	Every junior class (Spring)	Spring 2016	Spring 2017
	Senior exit interview	Every graduating class (Spring)	April 2016	April 2017
Employers	Advisory Board meeting	Annually (typically late Fall)	November 2015	November 2016
Faculty	CEE Faculty Retreat	Annually (August)	August 2015	August 2016

Students: The PEOs are introduced to the freshman class in CEE 1880 as part of a lecture on the accreditation and licensing processes (see the slides in Appendix A). PEOs are again shown to the juniors in CEE 3880. This reminds continuing students about the PEOs and allows transfer students (who typically do not take CEE 1880) to see the PEOs. Finally, as part of the senior exit interview process, graduating seniors are given an opportunity to review the PEOs in an effort to establish some big picture career goals. No feedback was received from students related to the PEOs.

CEE Advisory Board: The CEE Advisory Board met on November 3, 2015 (see Appendix B for meeting minutes). The PEOs were reviewed and discussion included the desire for the program to encourage students to improve their communication skills (PEO1) and support for including "sustainability considerations" in PEO2. The Advisory Board unanimously approved keeping the current PEOs. The PEOs will continue to be reviewed and discussed at all future annual Advisory Board Meetings.

Program Faculty: The PEOs are reviewed and discussed with the program faculty at the annual faculty retreat, which takes place every August just prior to the Fall semester. The faculty unanimously approved keeping the current PEOs during the 2015 faculty retreat (see Appendix C for meeting minutes). The PEOs will continue to be reviewed and discussed at all future annual faculty retreats.

Student Outcomes

Evaluation of the Student Outcome attainment is conducted by the CEE Assessment committee on a specified schedule with approximately one-third of the Student Outcomes assessed every year (Table 2). When deficiencies are identified, recommendations are made to fix specific problems and support continuous improvement.

Table 2: Evaluation Schedule for Student Outcomes

Evaluation Date	School Year	Outcomes evaluated
May 2015	2014-15	a, b, c, d
May 2016	**2015-16**	**e, f, g**
May 2017	2016-17	h, i, j, k
May 2018	2017-18	a, b, c, d
May 2019	2018-19	e, f, g
May 2020	2019-20	h, i, j, k

The assessment process uses data from three sources: student coursework, FE Exam results, and senior exit interviews. The 2015-16 Assessment of Student Outcomes includes data from Fall 2015 and Spring 2016.

Student Coursework: Outcomes e, f, and g were reviewed in 2015-16 (Table 2). Assessment data are summarized in Table 3 and Figure 1; detailed evaluation of each outcome is presented in Appendix D. Student assignments are evaluated on a 0-1-2 scale, which corresponds to the student's performance not meeting, partially meeting, and meeting the Outcome Objective, respectively. The EnvE program has two goals for student performance:

- Goal 1: a minimum of 70% of the students will perform at a 2 level
- Goal 2: a minimum of 80% of the students will perform at the 1 or 2 level.

Both goals were met for the three outcomes assessed this year. Note the "sample size" in Table **3** refers to the number of individual examples of student work that were assessed for each outcome, not the number of students.

Table 3: Aggregated Assessment Results for EnvE Classes, Fall 2015 and Spring 2016

Outcome	Sample size	2	1	0	Sum of 1&2 ratings
e	426	84%	10%	6%	94%
f	322	75%	23%	2%	98%
g	517	80%	16%	4%	96%

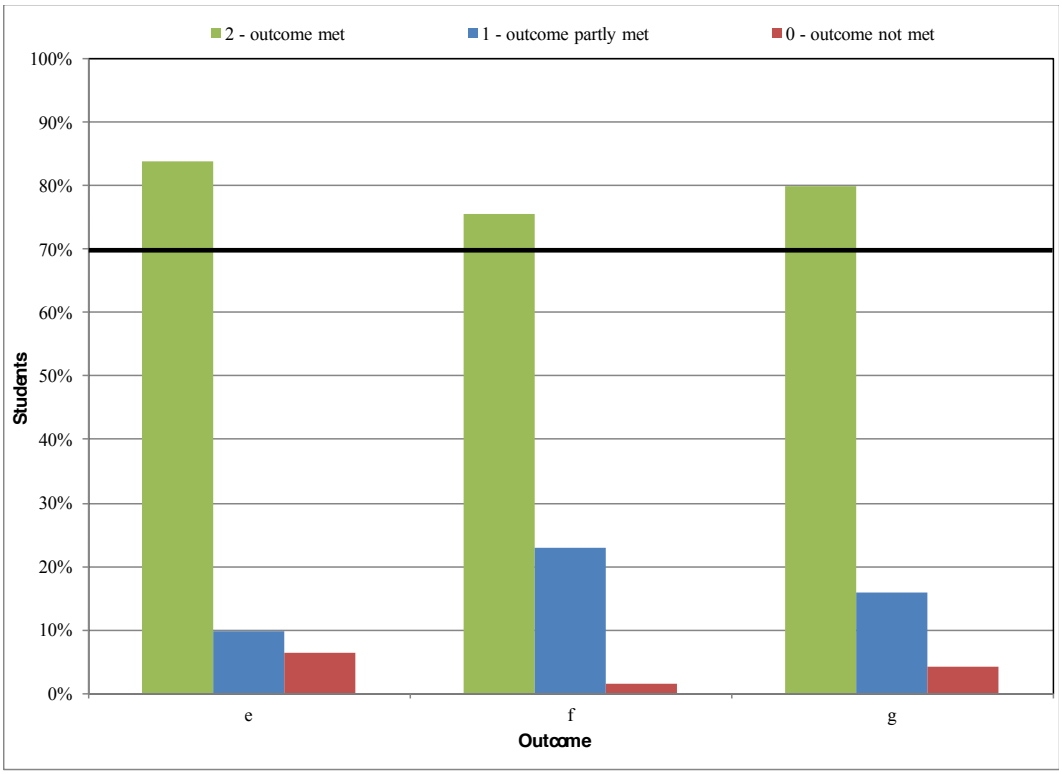


Figure 1: Aggregated Assessment Results for EnvE Classes for Fall 2015 and Spring 2016

Fe Exam: Our goal is to have 100% pass rate on the FE exam; our minimum acceptable level of performance is a pass rate at or above the national average. Table 4 summarizes the FE results for the past six years, including the percentage of students who had passed the FE exam by the time of graduation. The USU EnvE pass rate has been either 100% or comparable to the national average (considering the small number of USU EnvE graduates).

Table 4: EnvE Graduates Passing FE Exam vs. National Pass Rate

	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
USU EnvE graduates	6	10	4	5	2	9
USU EnvE pass rate at graduation	100%	80%	100%	100%	100%	89%
National EnvE pass rate	85%	83%	88%	84%	77%	76%

FE Exam performance by first-time test takers for various engineering topics is summarized in Figures 2, 3, and 4. The uncertainty ranges are relatively large given the small number of students taking the exam, and the trend is skewed by the one high-performing student who took the exam in Spring 2015. Nevertheless, during the Fall 2015 and Spring 2016 testing periods, USU EnvE students performed at or above the national average on all engineering topics (including the uncertainty range) except for the water resources section in Spring 2016. Overall, the fact that nearly all EnvE students continue to pass the FE exam is a strong, independent, external indicator for meeting Student Outcomes e and f. It is also a strong indication of a good foundation for life-long (independent) learning skills.

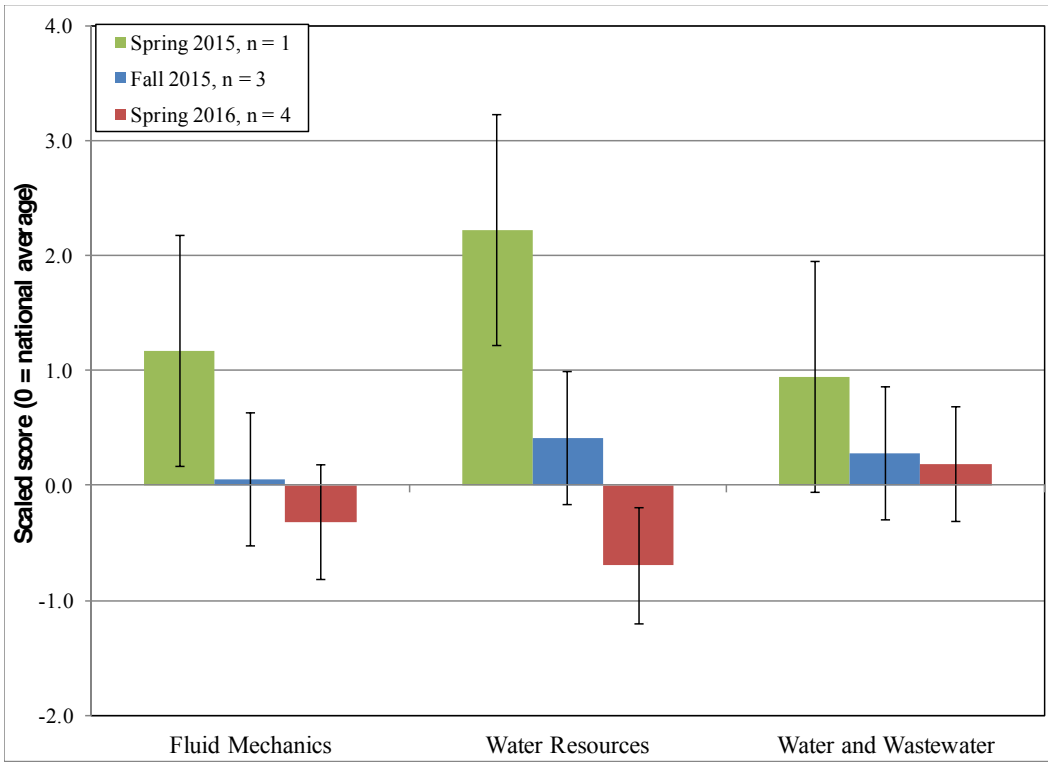


Figure 2: Scaled Fe Exam results (fluid mechanics, water resources, and water/wastewater). Error bars represent uncertainty range for scaled scores.

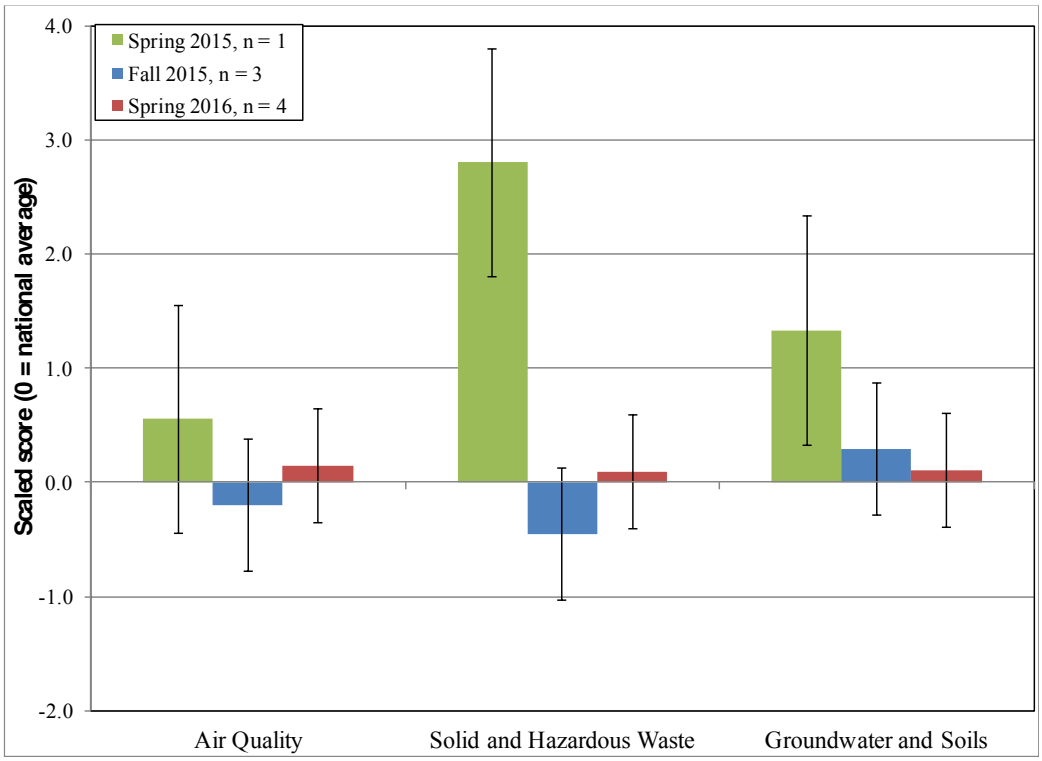


Figure 3: Scaled Fe Exam results (air quality, solid/hazardous waste, groundwater/soils). Error bars represent uncertainty range for scaled scores.

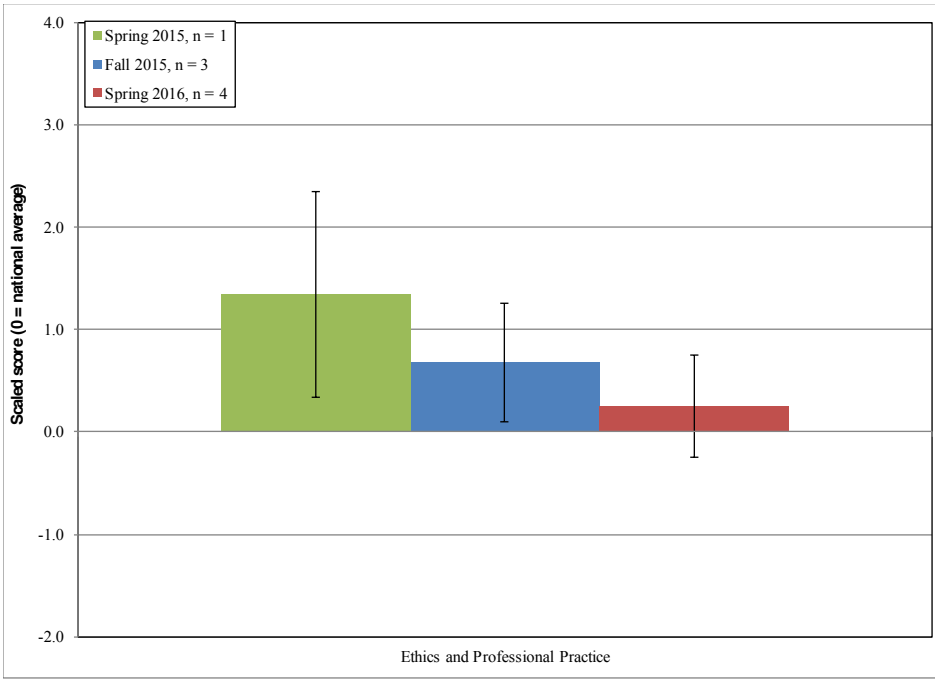


Figure 4: Scaled Fe Exam results (ethics and professional practice). Error bars represent uncertainty range for scaled scores.

Senior exit interview: Graduating seniors complete an anonymous online exit interview to provide feedback about the EnvE program. The performance goal is to have at least 80% of the students rating their attainment as "fully met" (2) or "partly met" (1), which was achieved with 83% of students rating Outcome e as "fully met" and 17% as "partly met" for a total of 100% for all three outcomes (Figure 5). Acknowledging that this is a subjective self-evaluation, these exit interview results are taken as a general indication that students feel they are meeting the outcome.

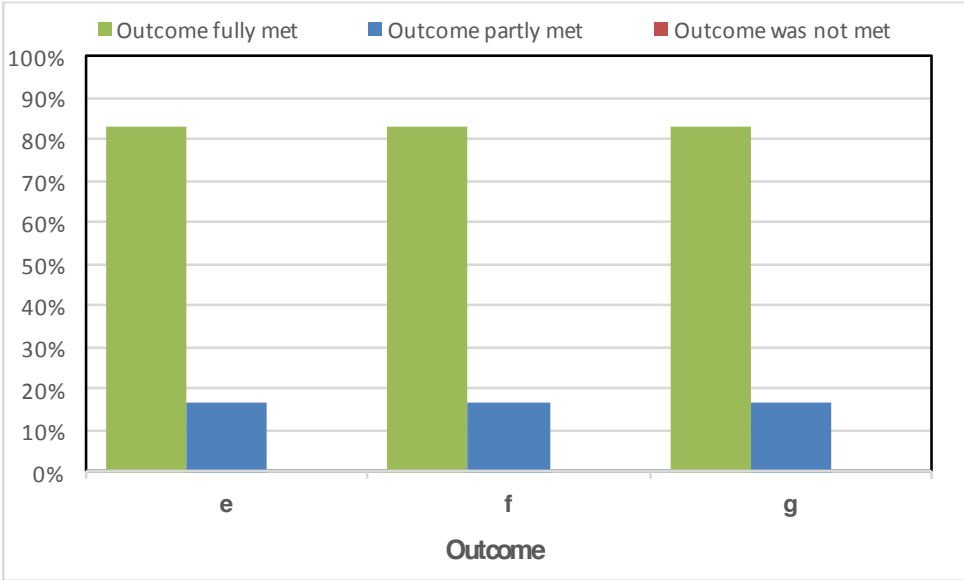
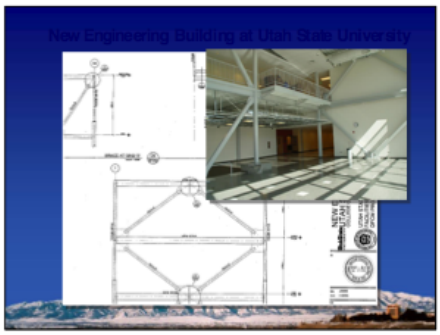


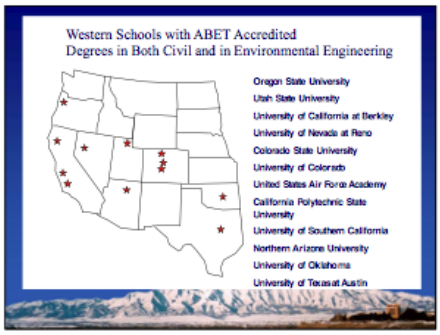
Figure 5: Student exit interview ratings of progress on Outcomes e, f, and g

Summary: The CEE Assessment Committee met in January and May 2016 and evaluated all of the assessment data presented herein.
The evaluation of student work, FE Exam results, and senior exit interviews indicates that Outcomes e, f, and g are being met.

Recommendations
Evaluate Outcomes e, f, and g as planned during the 2018-19 school year. Monitor performance on the Water Resources section of the FE Exam and adjust curriculum if necessary.

Appendix A
Slides from CEE 1880
(introducing freshmen students to ABET PEOs and outcomes)





ABET

ABET is a nonprofit, non-governmental organization that accredits college and university programs in the disciplines of applied science, computing, engineering, and engineering technology. ABET accredits over 3,300 programs at more than 680 colleges and universities in 24 countries. ABET provides specialized, programmatic accreditation that evaluates an individual program of study, rather than evaluating an institution as a whole.

ABET accreditation, which is voluntary and achieved through a peer review process, provides assurance that a college or university program meets the quality standards established by the profession for which the program prepares its students.
ABET is recognized by the Council for Higher Education Accreditation (CHEA).

Utah State University Mission Statement

The mission of Utah State University is to be one of the nation's premier student-centered land grant and space-grant universities by fostering the principle that academics come first, by cultivating diversity of thought and culture, and by serving the public through learning, discovery, and engagement.

College of Engineering Mission Statement

The mission of the USU College of Engineering is to foster a diverse and creative learning environment that will empower students and faculty with the necessary knowledge and facilities to be international leaders in creating new technologies and services that will improve

Program Educational Objectives

Program educational objectives (PEOs) are broad statements that describe what graduates are expected to attain within five years of graduation.

The PEOs for the Civil Engineering Program are that within five years of graduation:

PEO 1: Graduates will be successfully employed in civil engineering or related careers and will become independent thinkers and effective communicators, team members, and decision makers.

PEO 2: Graduates will incorporate economic, environmental, social, ethical, and sustainability considerations into the practice of civil engineering and will promote public health and safety.

PEO 3: Graduates will engage in life-long learning by pursuing advanced degrees or additional educational opportunities through coursework, professional conferences and training, or participation in professional societies.

PEO 4: Graduates will pursue professional licensure or other appropriate certifications.

Program Educational Objectives

Program educational objectives (PEOs) are broad statements that describe what graduates are expected to attain within five years of graduation.

The PEOs for the Environmental Engineering Program are that within five years of graduation:

PEO 1: Graduates will be successfully employed in environmental engineering or related careers and will become independent thinkers and effective communicators, team members, and decision makers.

PEO 2: Graduates will incorporate economic, environmental, social, ethical, and sustainability considerations into the practice of civil engineering and will promote public health and safety.

PEO 3: Graduates will engage in life-long learning by pursuing advanced degrees or additional educational opportunities through coursework, professional conferences and training, or participation in professional societies.

PEO 4: Graduates will pursue professional licensure or other appropriate certifications.

Student Outcomes

The Civil Engineering and Environmental Engineering Programs use 11 student outcomes to prepare graduates of the programs to attain the program educational objectives. By the time of graduation, students will have:

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs

(d) an ability to function on multi-disciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ABET Accreditation at Utah State University leads to proficiency in at least 4 areas of Civil and Environmental Engineering

- Structural Engineering
- Geotechnical Engineering
- Hydraulics and Fluid Mechanics
- Water Resources
- Transportation Engineering
- Environmental Engineering

Most USU graduates will achieve proficiency in 5 to 6 areas

Code of Ethics (from ASCE)

Fundamental Principles

Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

- using their knowledge and skill for the enhancement of human welfare and the environment;
- being honest and impartial and serving with fidelity the public, their employers and clients;
- striving to increase the competence and prestige of the engineering profession; and
- supporting the professional and technical societies of their disciplines.

Fundamental Canons (from ASCE)

- Engineers shall hold paramount the safety, health and welfare of the public and shall strive to comply with the principles of sustainable development3 in the performance of their professional duties.
- Engineers shall perform services only in areas of their competence.
- Engineers shall issue public statements only in an objective and truthful manner.
- Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.
- Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.
- Engineers shall act in such a manner as to uphold and enhance the honor, integrity, and dignity of the engineering profession.
- Engineers shall continue their professional development throughout their careers, and shall provide opportunities for the professional development of those engineers under their supervision.

And after graduation, becoming a Licensed Professional Engineer

Graduation with a Bachelors of Science in Civil and / or Environmental Engineering from an **ABET accredited degree program**

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FE (Fundamentals of Engineering) exam

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Experience working for a licensed engineer

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PE exam (Professional Engineer) Given by the state where you will practice

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Licensed Professional Civil Engineer

Appendix B
Minutes of the CEE Advisory Board Meeting
Nov 3, 2015

Hardcopy of meeting minutes is available in the ABET Binder

Appendix C
CEE Annual Faculty/Staff Retreat Minutes
August 19, 2015

Hardcopy of meeting minutes is available in the ABET Binder

Appendix D
Detailed Evaluation for Outcomes b, e, f, and g

Hardcopies of evaluations are available in the ABET Binder