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

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

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>
<thead>
<tr>
<th>Evaluation Date</th>
<th>School Year</th>
<th>Outcomes evaluated</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2015</td>
<td>2014-15</td>
<td>a, b, c, d</td>
</tr>
<tr>
<td><strong>May 2016</strong></td>
<td><strong>2015-16</strong></td>
<td><strong>e, f, g</strong></td>
</tr>
<tr>
<td>May 2017</td>
<td>2016-17</td>
<td>h, i, j, k</td>
</tr>
<tr>
<td>May 2018</td>
<td>2017-18</td>
<td>a, b, c, d</td>
</tr>
<tr>
<td>May 2019</td>
<td>2018-19</td>
<td>e, f, g</td>
</tr>
<tr>
<td>May 2020</td>
<td>2019-20</td>
<td>h, i, j, k</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Outcome</th>
<th>Sample size</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>Sum of 1&amp;2 ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>e</td>
<td>426</td>
<td>84%</td>
<td>10%</td>
<td>6%</td>
<td>94%</td>
</tr>
<tr>
<td>f</td>
<td>322</td>
<td>75%</td>
<td>23%</td>
<td>2%</td>
<td>98%</td>
</tr>
<tr>
<td>g</td>
<td>517</td>
<td>80%</td>
<td>16%</td>
<td>4%</td>
<td>96%</td>
</tr>
</tbody>
</table>
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>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>USU EnvE graduates</td>
<td>6</td>
<td>10</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>USU EnvE pass rate at graduation</td>
<td>100%</td>
<td>80%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>89%</td>
</tr>
<tr>
<td>National EnvE pass rate</td>
<td>85%</td>
<td>83%</td>
<td>88%</td>
<td>84%</td>
<td>77%</td>
<td>76%</td>
</tr>
</tbody>
</table>

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 is a non-profit, non-governmental organization that accredits college and university programs in the disciplines of applied science, computing, engineering, and engineering technology. ABET's mission is to improve the quality of education in engineering, computing, technology, and applied science by maintaining standards and promoting educational excellence in these fields. The ABET accreditation is voluntary and achieved through a peer review process of a self-study report and a site visit by an evaluation team. The outcome of the review is based on the fulfillment of the criteria established by the organization for which the program is accredited.

Program Educational Objectives:
- Prepare students to practice professional engineering in a manner that demonstrates ethical conduct, respect for diversity, and commitment to the public welfare through the application of their knowledge and skills.
- Provide a broad education background in the natural and physical sciences, mathematics, and technical areas appropriate to professional engineering.
- Develop the ability to analyze and solve professional engineering problems using appropriate engineering tools and methods.
- Foster the ability to communicate effectively, both orally and in writing, and to work effectively in a team environment.
- Promote the ability to apply knowledge of mathematics, science, and engineering to the design of systems, components, and processes.
- Encourage the continuous development of knowledge through life-long learning.

Market Outcome:
The Civil Engineering and Environmental Engineering Programs at the University focus on providing a comprehensive education that prepares students for careers in the field. Graduates are expected to demonstrate a broad understanding of the field, technical skills, and the ability to apply knowledge in a variety of contexts. They are encouraged to pursue lifelong learning and professional development.

ABET Accreditation at Utah State University:
- Structural Engineering
- Geotechnical Engineering
- Hydraulics and Fluid Mechanics
- Water Resources
- Transportation Engineering
- Environmental Engineering

In addition to the core disciplines, Utah State University graduates are expected to achieve proficiency in at least four areas of Civil and Environmental Engineering.
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;
- Acting honorably and impartially and serving with fidelity the public, their employers and clients;
- Advancing the competence and prestige of the engineering profession; and
- Supporting the professional and technical activities of their discipline.

And after graduation, becoming a Licensed Professional Engineer

- How to obtain a license in Colorado:
  - Complete the Professional Engineer Exam
  - Meet the requirements of the state

- Professional Engineer License
  - Civil Engineering
  - Structural Engineering
  - Environmental Engineering
  - Licensed Professional Civil Engineer

Fundamental Canons (from ASCE)

- Engineers shall hold paramount the safety, health and welfare of the public and shall be guided by the public interest in the performance of their professional duties.
- Engineers shall perform services only in areas of their competence.
- Engineers shall be independent and impartial in the preparation and presentation of reports and shall present opinions or conclusions only in matters of which they have been made aware.
- Engineers shall use their professional judgment on the merit of their services and shall not accept activities with them.
- Engineers shall be such as to demand and maintain honor, integrity, and dignity of the engineering profession.
- Engineers shall uphold their professional development throughout their careers.

Civil Engineer License:

- Civil Engineering
- Structural Engineering
- Environmental Engineering
- 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