FRESNO STATE

Lyles College of Engineering

14 February, 2013

To: University Graduate Committee
University Budget Committee
California State University, Fresno

From: Ram Nunna
Dean, Lyles College of Engineering

I am writing in support of the proposal to create a new masters level degree option in Water and Environmental Engineering in the Civil Engineering program.

The proposed degree option is aligned with California State University, Fresno's Plan For Excellence Theme 3: Transformational Scholarship (Build capacity and partnerships in areas of emerging and vital importance, to include water (quality, resources, and management), atmospheric pollution and health disparity).

The Civil Engineering faculty members have developed a strong program with extensive input from industry, employers, alumni, and current students. Feedback from industry is that the proposed program is consistent with industry needs and that there is industry interest in such programs. The Civil Engineering Program already has a rich set of courses relating to water and environmental engineering that the program has been offering on a regular basis. The proposed effort is to create a package of courses that would result in a formal degree option, thereby giving the students taking the option a stronger identity as specialists in water and environmental engineering. The proposed program is very different from the Professional Science Masters in Water Resources that is also under development at the University. The PSM program focus appears to be water science, policy and management, whereas the proposed engineering option is 'engineering and design' focused.

The proposed effort is also consistent with the Lyles College of Engineering's vision to focus on critical areas of regional significance such as water, energy, infrastructure, and manufacturing. The water option will be primarily supported by three Civil Engineering tenured and tenure track faculty members who all have extensive experience in research and industry. Students taking this option will also have the opportunity to take a broad set of courses from both within the Lyles College of Engineering and from other programs at Fresno State in addition to the core water related courses. The College is also in the process of upgrading the Water Quality Laboratory and the Environmental Engineering Laboratory. Faculty and students will also have access to research facilities in the California Water Institute and the WET Laboratory.

Please let me know if I can provide any further information.

Lyles College of Engineering
California State University, Fresno
2320 East San Ramon Avenue M/S EE94 • Fresno, California 93740
P 559.278.2500 **F** 559.278.4475 ***www.FresnoState.edu/engineering/***

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Lyles College of Engineering

14 February, 2013

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CALIFORNIA STATE UNIVERSITY, FRESNO

MEMORANDUM

February 19, 2013

To: Ram Nunna,
Dean, Lyles College of Engineering

From: J. Larralde, Chair
Civil and Geomatics Engineering Department

Re: Support of Water Resources and Environmental Engineering Option in the MSCE

I enthusiastically support the proposal submitted by Faculty in the Civil and Geomatics Engineering Department, under the leadership of Dr. William F. Wright, Dr. Lubo Liu, and Dr. Fayzul Pasha, to create an option within the Master of Science in Civil Engineering with concentration in Water Resources and Environmental Engineering. This option in graduate studies responds to the recognition that water will play a critical role in the infrastructure and economic development in California. "Our ability to meet water needs in the future as our population expands will depend on how well we manage our dwindling supplies of good quality fresh water, and the progress we make in developing the extensive network of water storage, transportation, and treatment systems that will be needed to manage and distribute those supplies. Due to their technical complexity, water resource management and infrastructure development requires a highly educated workforce with expertise in engineering analysis, innovation, and design, as well as expertise in other areas. This workforce is necessary to achieve long-term sustainability and reliability in water services, and to ensure that the water is kept safe and wholesome."

This option in the MSCE will prepare very well trained engineering professionals who will be able to effectively participate in research and development, as well as in design, construction and maintenance of the systems and infrastructure needed in the 21st century to provide a sustainable water-resources environment. I wholeheartedly support the creation of the Water Resources and Environmental Engineering option in the MSCE.

Lyles College of Engineering
Dept. of Civil & Geomatics Engineering
2320 E. San Ramon Ave. M/S EE94
Fresno, CA 93740-8030
559.278.2889
Fax 559.278.7002

Proposal for a

Water Resources and Environmental Engineering Option in the Civil Engineering Graduate Program

Submitted by the

Department of Civil and Geomatics Engineering
Lyles College of Engineering
California State University Fresno

William Wright, PhD, PE
Associate Professor of Civil Engineering
Graduate Program Coordinator

Lubo Liu, PhD, PE
Assistant Professor of Civil Engineering

Fayzul Pasha, PhD, PE
Assistant Professor of Civil Engineering

February 9, 2013

(Minor revisions made March 14, 2013)

Table of Contents **Section** **Subsection**

Proposal for a

Water Resources and Environmental Engineering Option in the Civil Engineering Graduate Program

1.1.	**Requesting College/ Dept.**:	Lyles College of Engineering/ Civil & Geomatics Engr.
	Proposed Option:	Water Resources and Environmental Engineering
1.2.	**Degree major program:**	Civil Engineering Graduate Program
	Existing options, conc., emphases:	None
	Dept. to offer the option:	Civil & Geomatics Engineering
	Other Dept.s supplying courses:	Up to 6 units of approved out-of-program upper division elective courses are permitted in our existing program. This will apply to the WREE Option.

1.3. **Purpose of the proposed aggregate of courses:**

A. To formalize and brand in existing area of study within the master's program that has been gaining interest on and off campus for several years (see Item 1.5 below).

B. Equip students with knowledge and skills needed to solve critical needs related to water and the environment that exist locally, regionally, nationally and globally.

C. Use the WR&EE brand to recruit new students and garner support and recognition from industry, government agency employers, and research grant program managers.

1.4. **Student learning outcomes.**

Students graduating from the WREE Option will be able to:

1. Adhere to principles of professional ethics, personal responsibility, and environmental stewardship.
2. Describe and explain the major scientific principles that underlie the hydraulic analysis of systems associated with water supply and distribution, storm drainage management and flood control, wastewater collection, water storage, water and wastewater pumping, water/ wastewater treatment, and environmental protection and remediation.
3. Describe, explain, and employ modern procedures for the analysis and design of the systems and facilities identified in Learning Outcome 2 above.
4. Identify major regulations, codes, and specifications applicable to the planning and design of the systems and facilities identified in Learning Outcome 2 above, and be able to specify where they can be obtained.
5. Solve advanced problems in engineering analysis and design through the use of mathematical analysis, differential equations, least square errors, and other numerical methods.
6. Proficiently use modern computer software for analysis and design of the systems and facilities identified in Learning Outcome 2 above.
7. Exhibit excellence in writing technical documents, research reports, and proposals.
8. Exhibit excellence in oral and public presentations in front of technical and non-technical audiences.

1.5. **Need for the proposed aggregate of courses.**

Fresno State Perspective: A few years ago Fresno State, recognizing that the availability of good quality water often determines the quality of life possible for people and communities throughout the world, made a commitment to focus on "water" as a strategic focal area. As a result the campus began developing extensive capability in water-related areas by hiring more faculty members with expertise in water and promoting the expansion of water-related curriculum, research, and programs (e.g., CGE's online Professional Science Master's in Water Resource Management). These actions have placed the campus in an excellent position to address critical water needs at local, regional and global scales.

CSU Perspective: Fresno State's focus on water is consistent with actions taken by the CSU Chancellor's office a few years ago when they established the system-wide Water Resources and Policy Initiatives to "help achieve a long-tem, sustainable water supply for California through education, research and policy development while balancing the needs of urban, agricultural and environmental concerns" (Draft WRPI Strategic Plan, Article III. WRPI Vision, http://www.icwt.net/wrpi/plan.pdf). Their stated mission is as follows:

> The Water Resources and Policy Initiatives (WRPI) is designed to target the capabilities and resources within the twenty-three California State University campuses to provide academic preparation, applied research and policy development that addresses all aspects of water use. WRPI serves to focus synergistically with the many centers and programs of excellence within the CSU on water issues. The scope of WRPI activities include:
>
> - Provide critical faculty and staff based expertise to support California's need for appropriate and sustainable water resources in the 21st century;
> - Promote the need for education, training and professional capacity development with the water industry, governmental agencies, and the wider community;
> - Support the development of new and advanced water technologies and services that will help drive economic development and job creation.

Regional, State, and National Need: Throughout our nation water agencies are confronting dwindling water supplies, degrading source water quality, rising energy costs, growing populations, complex security concerns, and the need for sustainable environmental stewardship. In areas with an arid climate, such as in the California Central San Joaquin Valley, solutions to this challenge will include development of new technologies for producing waters of different quality for use in different applications (e.g., drinking vs irrigation), accessing water from underutilized sources (e.g., from treated wastewater streams), and reducing energy requirements for both water production and delivery. Due to technical complexity, water resource management and infrastructure development requires a highly educated workforce with expertise in engineering analysis, innovation, and design, as well as expertise in numerous other disciplines. This workforce is necessary to achieve long-term sustainability and reliability in water services, and to ensure that the water is kept safe and wholesome. These well-trained professionals will themselves play a critical role in California's future as custodians of California's most valuable asset-- our water.

Global Perspective: Evidence of the need for more professionals with expertise in water and environmental engineering exists in every society on Earth. Water is essential for survival and prosperity; its distribution, quality, quantity, and mode of occurrence are highly variable from one location to another; and the global surge in population has strained water supplies and threatened the ecology of the earth. The seriousness of the situation is evidenced by the fact that in the year 2000, 1.1 billion people globally did not have access to clean drinking water, 2.4 billion did not have access to adequate sanitation services, and approximately 6000 people

(primarily children under the age of five) died each day from water-related diseases (Viessman Jr., et al., 2009; Metcalf & Eddy, 2007; United Nations 2003). While the water-related challenges we face locally, regionally, and throughout our nation are generally not as dire as they are in developing nations, serious and unacceptable conditions do exist in some communities, particularly in rural economically disadvantaged communities.

Evidence of Need Literature Review & Surveys: Interest in establishing an option in Water Resources and Environmental Engineering was gauged locally and regionally by assessing the level of interest among our civil engineering student body and among employers of water resources and environmental engineering professionals in the Central San Joaquin Valley, and by reviewing literature on industry demand. Results of these investigations can be found in the following sections of this proposal:

Section 3: Student Interest Report	Section 5: Industry Demand Report
Section 4: Employer Interest Report	Section 6: Industry Letters of Support

1.6. **List of required and elective courses.**

The option curriculum is shown below. Course titles are provided on the next page. Admission criteria is summarized in Item 1.9.

Plan A *(Thesis)* ***Units***

a. Core: CE 210, 240, 241, and 242 ……12
b. 200-series: Select from CE 206, 245, 246A, 246B, 247, and 290 ……....0-6
c. 100-series: Select from CE 140, 141, 144, or 146[1] ……....0-6 } (Max. 6 units of 100-series)
d. 100 or 200-series outside of the department[2]:…… ……..……..6 }
e. Thesis ……..…..6
Total ……..30

Plan B *(Project)* ***Units***

a. Core: CE 210, 240, 241, and 242 ……12
b. 200-series: Select from CE 206, 245, 246A, 246B, 247, and 290 ……3-9
c. 100-series: Select from CE 140, 141, 144, or 146[1] ……....0-6 } (Max. 6 units of100-series)
d. 100 or 200-series outside of the department[2]:…… ……..……..6 }
e. Project ……....3
Total ……..30

Plan C *(Comprehensive Exam)* ***Units***

a. Core: CE 210, 240, 241, and 242 ……..12
b. 200-series: Select from CE 206, 245, 246A, 246B, 247, and 290 ……..6-12
c. 100-series: Select from CE 140, 141, 144, or 146[1] ……....0-6 } (Max. 6 units of 100-series)
d. 100 or 200-series outside of the department[2]:…… ……..……...6 }
e. Comprehensive Exam.…… .0
Total ……..30

Notes:

1. Select up to a total of 6 units of 100-series courses excluding courses previously taken and counted towards another degree.
2. Select one approved course in (a) business or public administration and (b) another field that supports professional practice in the WR&EE option area. Example subject areas include geochemistry, hydro geochemistry, agricultural water use, water rights, water policy, GIS, statistics, microbiology, and biochemistry.

200-Series Course Titles

CE 206 Engineering Environmental Impact
CE 210 Research Methods
CE 240 Engineering Hydrology
CE 241 Contaminant Fate & Transport Engineering (Proposed in AY 2012-13)
CE 242 Urban and Industrial Water Systems (Proposed in AY 2012-13)
CE 245 Geoenvironmental Engineering
CE 246A Advanced Water Quality (chemical, physical processes)
CE 246B Advanced Water Quality (biological processes)
CE 247 Solid Waste Engineering
CE 290 Independent Study (Max. 6 units)

100-Series Course Titles

CE 140 Hydrology
CE 141 Water Resources Engineering
CE 144 Design of Water Quality Control Processes
CE 146 Urban Stormwater Management

1.9. Admission, classified standing, continuance in program/ option.

Admission to the program option would use the same criteria that are currently in effect for the Civil Engineering Graduate Program, and those requirements are as follows:

Criteria	**Value**
1. General:	Meet campus minimum requirements for admission.
2. Classified Standing:	
A. At time of admission to program:	
Degree	B.S. in Civil or Geomatics Engineering or related field from an ABET accredited program.
GPA (4.0 scale)	3.00 in last 60 semester-units of engineering courses attempted or approval of the CGE Dept. Graduate committee.
GRE, Quantitative Sec.	550 (146 Revised Test) or greater
Language (Intern. Students)	
IELTS	6.5
TOEFL	80

B. After admission to program with conditional classified standing: Criteria vary based on student's undergraduate degree, GPA, GRE Quantitative score, and other factors. See also Criteria 3 Conditional Admissions below (next page).

Low GPA (4.0 scale)	Grade of "B" or better in each of the first 3 courses to be counted towards the graduate degree; other requirements may be specified depending on the student's academic preparation.
Low GRE Quantitative score	Attain score of 550 (146 Revised Test) or greater
Non CE/GME/ Accredited degree	Prerequisite courses. Typical requirements are shown below.

continued

Prerequisite courses: Pass with an average grade of B or higher (In some cases prerequisite coursework may be modified or waived by the senior faculty responsible for the course area of study):

a) **Core prerequisite courses:** CE 20, CE 121, CE 121 L, CE123, CE123L, CE128, CE129, CE130, CE 132, CE142, CE150, and one 100-level technical elective design course in the water resources or environmental engineering area of study.

b) **Prerequisites to core prerequisite courses listed above:** Prerequisites to core courses include the first three semesters of calculus (MATH 75, 76, & 77), the first semester of calculus-based physics (PHYS 4A), and other courses that will vary according to the student's academic background.

3. Conditional Admissions (subject to approval of the department Graduate Committee):

Degree	All
GPA (4.0 scale)	Meet campus minimum requirements for consideration
GRE, Quantitative Sec.	No minimum, but less likely to be admitted when below 500 (144 Revised Test).
Language (Intern. Students)	
IELTS	No minimum, but less likely to be admitted when below 5.
TOEFL	No minimum, but less likely to be admitted when below 70.

4. Continuance in program:

GPA (4.0 scale)	3.00 or greater; Acad. probation if cumulative post-bac. GPA < 3

1.10. **Graduate writing requirement.**

The graduate writing requirement will be the same as that of the Program (see Catalog Statement Revision Request, Page 303 of the markup, left column, and Insert B).

The requirement is as follows: Satisfactorily complete a written examination (typically administered in CE 210).

1.11. **Catalog copies.** See attachments/ Section8: Catalog Statement Revision Request (copy)

1.12. **New course requests.** See attachments/ Section 9: New Graduate Course Requests (copies)

CE 241 Contaminant Fate & Transport Engineering

CE 242 Urban & Industrial Water Systems

1.13. **Present faculty members who would teach in the proposed program option.**

Dr. William Wright, Associate Professor.
Expertise: Environmental Engineering; Hydraulics

Dr. Lubo Liu, Assistant Professor.
Expertise: Water Resources/ Hydrologic Engineering; Environmental Engineering

Dr. Fayzul Pasha, Assistant Professor.
Expertise: Water Resources/ Hydraulic Systems Engineering; Environmental Engineering

1.14. **Additional instructional resources needed to implement and sustain the program option.**

We do not anticipate needing additional instructional resources during the next five years. The subject is discussed in more detail below.

- **Faculty:** The courses would be taught by existing faculty. The majority of the courses in the proposed are currently being taught on a regular basis. The two new courses proposed (CE 241 and CE 242) are currently being taught as topics courses, and two additional new courses are planned in AY 2013-14. The latter will be accommodated by utilizing our new faculty member Dr. Pasha and offering two of the existing courses on a 3-semester rotation rather than every two semesters. <u>All of these courses are planned to be taught in the near future regardless of whether or not the proposed option is created</u>.
- **Lecture Room Capacity:** We anticipate a gradual but steady increase in graduate student enrollment over time as a result of the establishment of a WR&EE option. This growth in enrollment can be accommodated without the need for opening new course sections because a sufficient numbers of seats are available in the classrooms (current enrollment ranges from 5 to 15 graduate students per course section and more than 30 seats are available in the classrooms).
- **Laboratory Space & Equipment Storage:** All department laboratories have received major upgrades in equipment during the past three years, including the three existing WR&EE laboratories. One of these labs will undergo major renovation in 2013. An additional space of about 200 ft^2 in EE is expected to be repurposed for water related research and, when the Jordan Research Building comes on line, there additional laboratory resources will become available to support water quality research and projects. Equipment and instrumentation worth over $100,000 was procured for the WR&EE laboratories in 2012 using private funding.

  WR&EE laboratory facilities located within the Lyles College of Engineering are summarized below. The list includes the 200 ft^2 of additional space in EE that is expected to be repurposed for WR&EE research (fourth bullet).

  - **Water Quality Teaching Laboratory (EW 136):** New equipment has been purchased and the entire lab (1,200 ft^2) is scheduled for major structural and component renovation in 2013.
  - **Hydraulics/ Fluids Laboratory (EW 130):** New equipment has been purchased for the lab and a large-scale (10 ft) research flume is under construction.
  - **Environmental Quality Research Wet Laboratory (EE 186):** New equipment has been purchased and the deionized water system and walk-in constant temperature room are being renovated.
  - **Environmental Quality Research Dry Laboratory (EE 187):** This room/lab is scheduled to be used as a dry lab and for storage of field equipment used in water resource research beginning in Spring 2013.

  Together, these labs and the equipment therein will strongly support the proposed curriculum. Furthermore, for specialized research projects, LCOE expects to have access to California Water Institute and WET lab facilities, providing many opportunities for student and faculty research.

1.15. **Option Vision.**

The Civil Engineering Program faculty at California State University Fresno has recognized that while populations increase, natural resources do not, and, consequently, the use and management of these resources must be sustainable. The Faculty has also recognized the critical role that water will play in California's future, impacting both quality of life and economic growth. Our ability to meet water needs in the future will depend on how well we manage this precious resource now, and on how intelligently we develop water infrastructure going forward.

It is imperative that the integrity of our water supplies be maintained for future generations and that water supplies are distributed in an equitable and sustainable manner, both locally and regionally. The water systems of tomorrow will entail an extensive network of water conveyance, storage, treatment, and distribution infrastructure. This infrastructure must be planned, engineered, operated, and maintained in an intelligent manner, bringing water to where it is needed, when it is needed, and with the appropriate quality. With sufficient planning and foresight today, water systems of tomorrow can be made to support a thriving economy, healthy environment, and an extraordinary quality of life for all.

Due to their technical complexity, water resource management and infrastructure development requires a highly educated workforce. Creation of this this workforce represents one of the major challenges of our time. The Civil Engineering Program faculty is committed to making a significant contribution towards meeting this challenge by preparing students for professional practice in Water Resources and Environmental Engineering. These well-trained professionals will play a critical role in California's future as custodians of California's most valuable asset -- our water.

FRESNO STATE

Lyles College of Engineering

Designing and Building the Future

Department of Civil and Geomatics Engineering

Master of Science in Civil Engineering

Water Resources & Environmental Engineering Option

STUDENT OUTCOME ASSESSMENT PLAN SUPPLEMENT

2012-13

(Last revised 3/13/14)

Prepared by

William Wright

Contents

Mission of the MSCE Program

The mission of the MSCE Program at CSU Fresno is to educate engineers who, entrusted by society, will create a sustainable world and enhance the quality of life during the 21st century as planners, analysts, designers, constructors, and operators of the built environment. The basic tenet of their formation is the instilling of the professional rectitude of intention. As professionals, using the principles of mathematics and the natural sciences, they will use economically the materials and forces of nature for the progressive well-being of society in the following activities: creating, improving, and protecting the environment; planning, designing, and building facilities and structures for community living, industry, and transportation.

Our program is designed for students who wish to gain additional technical depth and educational experience geared toward professional practice, through creative instruction and research.

MSCE Program Goals

The overall goal of the MSCE program is to prepare the MSCE students for professional practice and further advanced study. Upon completion of the graduate program of study in Civil Engineering, the competent student will successfully attain the knowledge and skills necessary to:

- Embrace principles of professional ethics, personal responsibility, and environmental stewardship.
- Describe and explain, beyond the undergraduate level, the scientific principles involved in the mapping, or analysis, or design of the built environment.
- Evaluate and employ advanced concepts and methodologies for the design of the built infrastructure and for mapping and measuring it.
- Evaluate and employ advanced techniques of analysis, including mathematical analysis and modeling, numerical techniques, and professional software for analysis and design in civil and geomatics engineering.
- Exhibit excellent communication skills in writing, oral, graphical, and public speaking.

WREE Option Student Learning Outcomes

Students graduating from the Water Resources & Environmental Engineering (WREE) Option will be able to:

1. Adhere to principles of professional ethics, personal responsibility, and environmental stewardship.
2. Describe and explain the major scientific principles that underlie the hydraulic analysis of systems associated with water supply and distribution, storm drainage management and flood control, wastewater collection, water storage, water and wastewater pumping, water/ wastewater treatment, and environmental protection and remediation.
3. Describe, explain, and employ modern procedures for the analysis and design of the systems and facilities identified in Learning Outcome 2 above.
4. Identify major regulations, codes, and specifications applicable to the planning and design of the systems and facilities identified in Learning Outcome 2 above, and be able to specify where they can be obtained.
5. Solve advanced problems in engineering analysis and design through the use of mathematical analysis, differential equations, least square errors, and other numerical methods.
6. Proficiently use modern computer software for analysis and design of the systems and facilities identified in Learning Outcome 2 above.
7. Exhibit excellence in writing technical documents, research reports, and proposals.
8. Exhibit excellence in oral and public presentations in front of technical and non-technical audiences.

Relationship between Program Goals and Outcome Measurement Instruments

The relationship between MSCE Program goals and outcome measurement instruments are summarized in Table 1. Three program goals are currently assessed using two instruments, the Graduate Writing Exam and CE 298 Project or CE 299 Thesis. Use of addition al instruments and assessment of all goals is planned in the future. Data on student assessment of their own level of attainment of goals is collected via the exit survey (and in the future by the alumni survey). However, this data is considered to be non-objective and therefore those instruments have been omitted from Table 1.

Table 1. Relationship between program goals and outcome measurement instrument.

	Outcome Measurement Instrument			
	1	**2**	**3**	**4**
Program Goals: The overall goal of the MSCE program is to prepare the MSCE students for professional practice and further advanced study. Upon completion of the graduate program of study in Civil Engineering, the competent student will successfully attain the knowledge and skills necessary to:	Graduate Writing Requirement	Culminating Experience (Project or Thesis)	*Employer Survey (future)*	*Advisory Council Survey (future)*
Embrace principles of professional ethics, personal responsibility, and environmental stewardship.	X *	X *	*X*	*X*
Describe and explain, beyond the undergraduate level, the scientific principles involved in the mapping, or analysis, or design of the built environment.	X*	X	*X*	*X*
Evaluate and employ advanced concepts and methodologies for the design of the built infrastructure and for mapping and measuring it.		X	*X*	*X*
Evaluate and employ advanced techniques of analysis, including mathematical analysis and modeling, numerical techniques, and professional software for the analysis and design in civil and geomatics engineering.		X	*X*	*X*
Exhibit excellent communication skills in writing, oral, graphical, and public speaking.	X	X	X	X

* Attainment of specific goals vary with topic, scope, objectives of the activity.
Shading represents instruments that are planeed for implementation in the future.

Relationship between Program Goals, WREE option Learning Outcomes, and Courses

The relationship between MSCE Program goals and student learning outcomes, and the relationship between MSCE Program courses and student learning outcomes, are articulated below. Instruments used to assess attainment of program goals were provided in Table 1 above. Details of how the instruments are used and the frequency of their use can be found below in the assessment section of this SOAP.

Relationship between Program Goals and WREE Option Learning Outcomes

The relationship between MSCE Program goals and WREE option student learning outcomes are summarized in Table 2. Some program goals are represented in one or a few learning outcomes, while others have been articulated in several outcomes. For example, the first program goal, student embracement of professional ethics, personal responsibility, and environmental stewardship, is represented by Learning Outcome 1 and considered to have been achieved only to the degree that Outcome 1 has been achieved. In contrast, several learning outcomes are used to assess how well the second program goal is achieved.

Table 2. Relationship between Program Goals and WREE Option Student Learning Outcomes.

	WREE Option Student Learning Outcomes: Students graduating from the MSCE program will (according to their area of concentration) be able to:							
	Outcome 1	**Outcome 2**	**Outcome 3**	**Outcome 4**	**Outcome 5**	**Outcome 6**	**Outcome 7**	**Outcome 8**
Program Goals: The overall goal of the MSCE program is to prepare the MSCE students for professional practice and further advanced study. Upon completion of the graduate program of study in Civil Engineering, the competent student will successfully attain the knowledge and skills necessary to:	Adhere to principles of professional ethics, personal responsibility, and environmental stewardship	Describe and explain the major scientific principles that underlie the hydraulic analysis of systems associated with water supply and distribution, storm drainage management and flood control, wastewater collection, water storage, water and wastewater pumping, water/ wastewater treatment, and environmental protection and remediation.	Describe, explain, and employ modern procedures for the analysis and design of the systems and facilities identified in Learning Outcome 2.	Identify major regulations, codes, and specifications applicable to the planning and design of the systems and facilities identified in Learning Outcome 2, and be able to specify where they can be obtained.	Solve advanced problems in engineering analysis and design through the use of mathematical analysis, differential equations, least square errors, and other numerical methods.	Proficiently use modern computer software for analysis and design of the systems and facilities identified in Learning Outcome 2.	Exhibit excellence in writing technical documents, research reports, and proposals	Exhibit excellence in oral and public presentations in front of technical and non-technical audiences
Embrace principles of professional ethics, personal responsibility, and environmental stewardship.	X							
Describe and explain, beyond the undergraduate level, the scientific principles involved in the mapping, or analysis, or design of the built environment.		X	X	X	X	X		
Evaluate and employ advanced concepts and methodologies for the design of the built infrastructure and for mapping and measuring it.			X		X	X		
Evaluate and employ advanced techniques of analysis, including mathematical analysis and modeling, numerical techniques, and professional software for the analysis and design in civil and geomatics engineering.		X	X		X	X		
Exhibit excellent communication skills in writing, oral, graphical, and public speaking.							X	X

Relationship between Program Courses and WREE Option Learning Outcomes

The relationship between MSCE Program courses and WREE option student learning outcomes are summarized in Table 3. Information on whether the learning outcome was introduced, reinforced, or advanced in the course is indicated by the letters I, R, and A, respectively.

Table. 3. Relationship between WREE Option Courses and Student Learning Outcomes.

Course	Student Learning Outcomes							
	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Outcome 5	Outcome 6	Outcome 7	Outcome 8
CE 206 Engr Env Impact	A			A				
CE 210 Research Methods	Outcomes depend on topic selected by student and/or instructor						A	A
CE 240 Engr Hydrology	R	A			A	A		
CE 241 Cont. Fate & Transport Engr.	R	A			A	A		R
CE 242 Urban & Indust. Water Syst.	R	A			R		R	
CE 245 Geoenv Engr	A	A	A	A	R	A		
CE 246A Adv Wat Qual (Phys/Chem)	R		A	A	R			
CE 246B Adv Wat Qual (Biol)	R		A	A	R			
CE 247 Solid Waste Engr	R		A	A			A	A
CE 290 Independent Study	Outcomes depend on topic selected by student and/or instructor						A	
CE 291T Topics in Engr	Outcomes depend on topic selected by student and/or instructor							
CE 298 Project	Outcomes depend on topic selected by student and/or instructor						A	A
CE 299 Thesis	Outcomes depend on topic selected by student and/or instructor						A	A

Assessment

Assessment of student learning outcomes is achieved through formative instruments to measure students' progress while going through the program, and with summative instruments to measure the students' level of achievement at the end of the program. The use of alumni surveys after graduation, employer surveys, and Advisory Council surveys is planned in the future. The assessment activities are summarized as follows:

Direct Measures:

1. **Students' scores on specific final exam questions in specific MSCE courses *(formative)***
2. **Students' performance in writing and in oral presentations in CE 210 *(formative)***
3. **Students' performance in the culminating experience *(summative)***

Indirect Measures:

1. **Student Exit Surveys *(summative)***
    a. **Administered by MSCE Program**
    b. **Administered by Office of Institutional Effectiveness (when available)**
2. ***Planned:* Alumni Surveys, Employer Surveys, Advisory Council Surveys *(summative)***

Students' scores on specific final exam questions

Outcomes 1through 6, which assess ethics (Outcome 1) and technical knowledge and skills (Outcomes 2-6), are assessed by statistical analysis of student scores on one (or more) questions on final exams that every student is required to answer. Efforts will be made to locate these questions at the front of exam and to use the same or similar question in future exams when possible. Outcomes 1 through 6 are rotated in pairs each year (identified with a check mark). Outcomes 7 and 8, which assess written and oral communication skills, respectively, are assessed every year. Since all these courses are offered either, once a year or once every three semesters, the aggregate of student results is used for assessment. Outcomes assessed in past years or expected to be assessed in the in current assessment year are identified by pattern fill in the box.

The MSCE curriculum currently includes four clearly defined areas of specialization within civil engineering, namely: environmental/ water resources, geotechnical, geomatics, and structural. Students graduating with the MSCE degree will have a level of preparation that is unique to the individual area of concentration and thus not all MSCE students will take all the courses that are designated as assessment instruments. The courses used for outcomes assessment in the various specializations within the program are shown in Table 4, along with an implementation schedule.

Students' performance in writing and in oral presentations

The writing component of course CE 210 *Research Methods* is the primary instrument used for determining whether or not a student passes the Graduate Writing Requirement, which is a required for Advancement to Candidacy. At present the Program Qualifying Exam requirement is automatically met when the student passes the Graduate Writing Requirement; however, the following change has been proposed in 2013:

> "A student must pass CE 210 with a grade of 'B' or higher and satisfactorily complete a written examination (typically administered in CE 210) before being eligible for Advancement to Candidacy; this satisfies both the university's graduate writing requirement and demonstrates the student has sufficient technical proficiency to continue in the program."

The two main objectives of CE 210 are to prepare the students to undertake the culminating experience in the form of master's project or thesis, and to develop their communication skills. Students in this course are graded for the general performance in the course and graded separately for their writing and oral presentation competency. A student may pass the course satisfactorily but not the writing component. In that case the student is allowed to pursue the completion of the writing requirements independently from the course and in collaboration with his/ her graduate advisor, as indicated in the CE 210 syllabus. The communication skills component of CE 210, in writing, graphical, and oral presentations, is strong, and the overall performance of students in the writing and oral presentation components are used for assessment purposes. The rubrics to assess the writing component are given in the syllabus of the CE 210 course. Assessment is conducted annually each time the course CE 210 is taught.

Table 4. Implementation schedule for formative assessment via student scores on final exam questions.

	Area of Specialization				Implementation Schedule[1, 2]									
					2012-13					2013-14				
Course	Environmental & Water Resources	Geotechnical	Geomatics	Structures	Taught?[3]	5	6	7	8	Taught?[3]	1	2	7	8
CE 205 Comp in Engr Analysis		X	X	X	Y	√	√					√		
CE 206 Engr Env Impact	X				Y						√			
CE 210 Research Methods	Note 4				Y		√	√	√				√	√
CE 240 Engr Hydrology	X				Y	√	√					√		
CE 242 Urban & Indust. Water Syst.	X				Y	√		√			√	√	√	

[1] Course Learning Outcomes: a) are identified in the table with a check mark; b) are shown even if they were not measured; and c) measured outcomes are indicated by dot pattern fill around the check mark.

[2] Outcomes that are not measured occur due to the course not being offered during the year shown or due to extenuating circumstances.

[3] A blank box indicates that the course was not taught during the academic year indicated.

[4] Area depends on topic selected by student.

Students' performance in the culminating experience

The MSCE program offers three culminating experience plans to complete the program, namely: (A) CE 299 Thesis, (B) CE 298 Project, or (C) Comprehensive Exam. All students following plans (A) and (B) are required to make a final oral presentation/ defense of their project or thesis work and submit a final report. Currently students who select Plan A (Comprehensive Exam) are not required to make a final oral presentation/ defense of their work, and their culminating experience is not part of the program assessment. This topic will be discussed further within the MSCE Program. The rubrics used to evaluate and score projects can be found in Appendix A. Initially only Outcomes 7 and 8 will be assessed, based on the total score from Rubric I (written report) and Rubric II (oral presentation), respectively. Parts of Rubrics I and II have the potential to be used as assessment tools for Outcomes 1through 6, and that possibility is being discussed within the MSCE Program. A set of rubrics for CE 299 Thesis has not been developed and some members of the graduate faculty think that one is not necessary. This topic will also be discussed further within the MSCE Program.

Exit Surveys

All students graduating from the MSCE program are asked to complete a program exit survey (on a voluntary basis), and that may occur either at the end of fall or spring semesters. For students completing a thesis or project in the summer semester, the survey is administered in the spring immediately preceding the graduating summer. The exit survey is shown in Figure 1. In addition to the program-administered exit survey, the campus Office of Institutional Effectiveness collects survey data from graduating students and, when data specific to the MSCE program can be identified, the data is requested for use in assessment.

Alumni, Employer, and Advisory Council Surveys

Surveys of prior graduates of the MSCE Program, who have been working at least one year, are planned for implementation in the near future. The proposed survey instrument is shown in Figure 2. Also planned are surveys for employers of program graduates and the Civil Engineering Advisory.

Timeline and Responsibilities

Timelines and responsibilities for collecting assessment data are summarized in Table 5.

MSCE Program

Graduating Student Feedback

Date_____ Graduation: Spring [ ] Fall [ ] Summer[ ] Year:_____

Under which plan did you complete the MSCE Thesis [ ] Project [ ] Comp. Exam [ ]

Did you work off campus while pursuing your MSCE ? Full-time [ ] Part-time [ ] No [ ]

Do you have a full-time job offer? Yes [ ] No [ ] N/A [ ]

If you had a job offer, what is the starting salary (voluntary) ? [_____]

What was the best thing you remember about the MSCE Program?

What is the worst thing you remember about the MSCE Program?

Based on your experience through the MSCE program, provide your assessment as how the program fulfills its goals as follows:
(Use a numerical rating from 1 through 4, where 1.0 = inadequately and 4.0 = excellently)

Goal	Scale 1.0 through 4.0
Did the MSCE program help you to better understand, beyond the undergraduate level, of the scientific principles involved in the analysis of, or mapping of, the built environment, including, structures, water supply and water treatment facilities, and geotechnical structures (as applicable in your area)?	[ ]
Did the MSCE program help you to know the methodologies for the design of the built infrastructure or know how to map and measure it (as applicable in your area)?	[ ]
Did the MSCE program help you to know advanced techniques of analysis, including mathematical analysis and modeling, numerical techniques, and know the use of professional software for analysis and design in civil or geomatics engineering (as applicable in your area)?	[ ]
Did the MSCE program help you to have excellent communication skills in writing, oral, graphical, and public speaking?	[ ]
Did the MSCE program help you to understand and adopt principles of professional ethics, personal responsibility, and environmental stewardship?	[ ]

Figure 1. MSCE Program Student Exit Survey form.

Table 5. Assessment time table and action plan.

Assessment Activity	How Often	Who	How	
Student scores on final exam problems in selected MSCE courses	In accordance with Table 4	Course instructor provides summary to Graduate Coordinator	Graduate coordinator compiles information and summarizes it every year	Graduate coordinator compiles and summarizes information. Course of action is suggested by Graduate coordinator and Graduate Faculty and decided by the majority in the graduate faculty.
Student performance in oral presentation and writing in CE 210	After each time the course is taught	Course instructor provides summary of results to Graduate Coordinator	Graduate coordinator compiles information and summarizes it every year	
Student performance in culminating experience	After each student presentation	Advisor provides summary of results to Graduate Coordinator	Graduate coordinator compiles information and prepares a summary every year	
Exit Surveys	At graduation of each student	Graduate coordinator asks graduating students to complete the form and return it to the Dept. Administrative Assistant anonymously.	Graduate coordinator compiles results and prepares a summary every year.	
Alumni, Employer, & Advisory Council Surveys	Continuous solicitation from alumni, Advisory Board, and employers *(planned)*	Graduate coordinator requests surveys	Graduate coordinator compiles information every two years	

Evaluation, Curriculum Adjustment, and Reporting (Closing the Loop)

The MSCE Program WREE Option SOAP will be reviewed annually, and modifications made when warranted. Assessment data will be collected on a continuous basis throughout the academic year. Data analysis, evaluation, and reporting will be conducted on an annual basis, after the conclusion of the spring semester. Summary results will be reported to the department faculty and chair, college dean, and campus Office of Institutional Effectiveness for inclusion in the Annual Report to the Provost. Findings that suggest that there may be a need for curriculum adjustment will be brought to the attention of graduate faculty for discussion and resolution.

Alumni Survey
MSCE Program
Lyles College of Engineering

1. When did you complete your MSCE degree?
(month. year) _____

2. Current job title: _____
Current Salary (optional) _____
Name and Address (optional) _____
_____
_____

3. Current employer: _____

4. In what field do you work?
_____ Industry
_____ Government
_____ Private Practice/consulting
_____ Education
_____ Construction
_____ Other: _____

5. Indicate your present employment status:
_____ Employed full-time
_____ Full-time graduate student
_____ Temporarily not employed
Reason: _____
_____ Working in another field
Reason: _____
Do you intend to return to your field?
___ Yes ____ No ____ Not sure
_____ Other, please explain:
_____

6. Please rank your professional success level:
_____ Very successful
_____ Successful
_____ Average
_____ Unsuccessful
Please explain briefly: _____
_____
_____

7. As you compare yourself to other beginning professionals in your field, how do you rate the quality of your educational preparation through the MSCE program?

_____ Far higher than average
_____ Higher than average
_____ Average
_____ Lower than average
_____ Far lower than average

8. Using the following scale, please rate the following items relative to your education in the MSCE program

	weak --> strong 1	2	3	4
Overall quality of your MSCE education				
Support, assistance, and general help from the Civil Engr. Office				
Support, assistance and general help you received from faculty in the MSCE program				
How confident and prepared you felt in handling professional tasks when you completed the MSCE				
How confident and prepared you feel in handling professional tasks now				

Figure 2. MSCE Program proposed Alumni Survey form (Page 1of 2).

9. Using the following scale, please indicate the degree to which your MSCE education provided you with the ability to:

	weak --> strong 1	2	3	4
understand, beyond the undergraduate level, the scientific principles involved in the analysis of structures, water supply and water treatment facilities, and soil structures				
know the methodologies for design of the built infrastructure and to know how to map and measure it (as applicable)				
Know advanced techniques of analysis, including mathematical analysis and modeling, numerical techniques, and know the use of professional software for the analysis and design in civil and geomatics engineering				
Have excellent communication skills in writing, oral, graphical, and public speaking				

10. Do you think that any aspects of the MSCE program at CSU-Fresno should be modified?

____ yes ____ no

If yes, explain:

11. What changes do you foresee in your field in the next ten years? How might the MSCE program address these changes?

12. Please identify the areas in your MSCE program of study that contributed **LEAST** to your professional development. Such areas might include a specific course or specific course content, specific lab or field experience, specific instructional equipment, etc. Please explain.

13. To follow up on question 14, please identify the areas in your program of study that contributed **MOST** to your professional development.

Figure 2.b. MSCE Program proposed Alumni Survey form (Page 2of 2).

Appendix A

Learning Outcomes Rubrics to assess student performance in the CE 298 Project culminating experience

Rationale

Similarly to the thesis, the work performed in the CE 298 Project option must show evidence of originality, organization, clarity of purpose, critical analysis, accuracy, completeness, and quality of writing consisting with the standards appropriate for publication in the scholarly journals of the field. Additional insight on the nature of the project can be found in California's Title 5 (Education Code) as follows:

A project is a significant undertaking appropriate to the fine and applied arts or to professional fields.

It evidences:

1. originality and independent thinking
2. appropriate form and organization, and
3. a rationale.

It is described and summarized in a written abstract that includes the project's:

1. significance
2. objectives
3. methodology and
4. a conclusion or recommendation.

An oral defense of the project shall be required.

Although the Final Project Report does not have to comply with the datelines and format requirements of the thesis option, it is highly recommended that the format and deadlines are followed as guidelines in the preparation and submittal of the Final Project Report. The following content and organization guidelines for projects have been approved by the University Graduate Committee (11/9/10):

1. Title Page
2. Personal Responsibility Statement[1]
3. Signature Page
4. Table of Contents
5. Abstract
6. Introductory Statement
7. Literature Review
8. Data Collection/Analysis/Project Documents
9. Conclusions/Recommendations
10. References
11. Appendixes

The project option is completed when the graduate advisor submits the final grade for the project and the student has successfully made an oral presentation summarizing the importance, approach, and findings of his/her research project. It is required that this final oral presentation be made before all interested faculty and students and be appropriately announced by the student (e.g., via e-mail, flyers, or other effective advertisement) ahead of time.

---

[1] The following statement shall be included at the center of the Personal Responsibility Page *(scheduled to be implemented beginning in AY 2012-13)*:

"Personal Responsibility Statement:
I have completed this work under the direction of my faculty advisor _____*(add name)* and all results presented are my original work, or otherwise explicitly acknowledged in writing within this report. The conclusions and recommendations therein are based on my best assessment of the obtained or experimentally developed evidence.

Signed _____"

Grading

The grade in the CE 298 Project option is thus calculated based on the following two parts:

Part I.-Nature, merit, quality, completeness of the work performed and correctness, quality, clarity, and organization of the written report.

See attached Rubrics: **Points: 160**

Part II.-Clarity, correctness, completeness, and effectiveness of oral presentation.

See Oral Presentation Rubrics: **Points: 100**

Total Points: 260

Grade Scale:	**A:**	**> 240**
	B:	**> 214 ≤ 240**
	C:	**> 202 ≤ 214**
	D:	**≥ 170 ≤ 202**
	F:	**< 170**

Part I Rubric (Project Content and Written Report)

Student's name _____

Abstract	**(10)**
a. project/problem statement	_____ out of 3 points
b. A brief statement of the merit of the study	_____ out of 2 points
c. A brief summary of results and conclusion	_____ out of 3 points
d. 3-5 Key Words	_____ out of 2 points
Introduction	**(30)**
e. format/grammar	_____ out of 5 points
f. Description of the importance of the project	_____ out of 5 points
g. Literature Review, including:	
i. pertinent background knowledge and technology	_____ out of 5 points
ii. similar works done by others	_____ out of 3 point
iii. reference citations	_____ out of 2 points
h. Project statement and objectives	_____ out of 5 point
i. Tasks and hypothesis	_____ out of 5 points
Data Acquisition	**(30)**
j. format/grammar	_____ out of 5 points
k. List of data types, names and meanings and sources	_____ out of 5 points
l. list of the names of equipment, software and parameters	_____ out of 3 points
m. data acquisition procedures	_____ out of 6 points
n. evaluation of the quality of each type of data	_____ out of 6 points
o. lists of any uncertain or unexpected factors	_____ out of 5 points
Results and Discussion	**(50)**
p. format/grammar	_____ out of 5 points
q. logic of content	_____ out of 5 points
r. proper tables and figures, including:	
i. proper figures and tables with captions	_____ out of 10 points
ii. consistent format of the tables and figures	_____ out of 5 points
s. interpretation and inclusion of all data, tables and figures	_____ out of 15 points
t. discussion of the uncertainty and reliability of the data	_____ out of 5 points
u. final results	_____ out of 5 points
Conclusion	**(30)**
v. format/grammar	_____ out of 5 points
w. summary of project results and findings	_____ out of 15 points
x. the impact of results on the project's objective	_____ out of 5 points
y. recommendation for future study	_____ out of 5 points
References	**(5)**
z. follows ASCE Journal Paper format	_____ out of 5 points
Acknowledgement, Appendices, Electronic Documents	**(5)**
aa. acknowledgements (funding, contributors)	_____ out of 2 points
bb. Appendix(es) and electronic attachments	_____ out of 3 points

Part I Score _____ out of 160 points or _____ %

Part II Rubric (Project Oral Presentation)

Student's name _____

Delivery

Was the presenter enthusiastic about the presentation
1 through 5 (5 = best) [ ]

Was the voice clear, audible, and understandable
1 through 5 (5 = best) [ ]

Did the presenter use proper terminology and grammar
1 through 5 (5 = best) [ ]

Did the presenter introduced her/himself and the topic concisely [ ]
1 through 5 (5 = best)

Was there an outline of the presentation given at the beginning [ ]
1 through 5 (5 = best)

Did the presenter summarize the presentation at the end [ ]
1 through 5 (5 = best)

Did the presenter allow for questions at the appropriate time [ ]
1 through 5 (5 = best)

Was time allotted used appropriately [ ]
1 through 5 (5 = best)

Delivery Subtotal (out of 40): _____

Content

Were the objectives of the research topics clearly presented?
1 through 10 (10 = best) [ ]

Was the State-of-the-Art presented factually, quantitatively, precisely?
1 through 10 (10 = best) [ ]

Were the Research Needs presented clearly as a natural continuation of the State-of-the-Art?
1 through 10 (10 = best) [ ]

Was the Methodology presented clearly and convincingly?
1 through 10 (10 = best) [ ]

Was the analysis presented clearly and quantitatively as appropriate
1 through 10 (10 = best) [ ]

Were the conclusion presented succinctly, and clearly supported by the data and analysis
1 through 10 (10 = best) [ ]

Content Subtotal (out of 60): _____

Part II Score _____ out of 100 points or _____ %

Report on Student Interest in a

Water Resources and Environmental Engineering Option in the Civil Engineering Graduate Program

By

The Department of Civil and Geomatics Engineering
Lyles College of Engineering
California State University Fresno

William Wright, PhD, PE
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Assistant Professor of Civil Engineering

February 6, 2013

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Student Interest in a Water Resources and Environmental Engineering Option in the Civil Engineering Graduate Program

California State University Fresno

Abstract

Interest among students in Fresno State's Civil Engineering program for creating a graduate program option in Water Resources and Environmental Engineering (WR&EE) is strong. Preference for WR&EE areas of practice have increased five-fold during the past five years among students enrolled in CE 180A Project Design, and a survey conducted in December of 2012 reveals that potential enrollment in a WREE graduate program would be significant. The vast majority of senior-level students who completed the survey (70 of 105) would like to be kept informed if the WR&EE program moves forward and 60 of them indicated that they would enroll. However, the survey also indicated that a large percentage of the students would need financial support and, therefore, students' ability to secure funding would be a major factor in actual enrollment. Details of the study are presented below.

C.E. Program

For decades Fresno State has offered programs of study in Civil Engineering at the undergraduate and graduate levels (B.S. and M.S.). The undergraduate curriculum is wide-ranging, covering quantitative/ technical subject areas in math, science, and engineering, and various qualitative/ less technical subjects in general education. Students are introduced to several interrelated specialty areas within civil engineering during their junior year: hydraulics, environmental/ water resources, soils (geotechnical), structural, and transportation engineering. Following completion of the introductory course students can take technical elective courses in the specialty area. Design concepts are emphasized in most of the electives courses. Students undergo a culminating experience in their senior year in which they must demonstrate competency by completing a two-course sequence of capstone courses – CE 180A Project Design and CE 180B Senior Project. Historically employment prospects have been very good for program graduates in terms of salary, diversity in types of work and geographic location, and demand. The percentage of graduates who secure employment in positions that are directly related to their degree is among the highest of all majors on campus.

Assessment Methodology

CE 180A Project Design Interest Trend Investigation: Each student in CE 180A Project Design selects a preference for one of four specialty areas for which they will demonstrate competency in technical in CE 180A and CE 180B. This data was analyzed to investigate trends during the past five years as an indicator of potential student interest in the proposed WR&EE graduate program option.

Senior & Graduate Student Survey Investigation: In December of 2012 students in senior and graduate level courses were surveyed to determine their level of interest in a proposed option.

Results

CE 180A Project Design Interest Trend Investigation

Seniors in the CE 180A Project Design course make known their preference for which technical area of civil engineering design they wish to work in during that course and the one that follows (CE 180A Senior Project). This technical area preference data was collected for the past 5 years and analyzed for use in this study.

Results of that analysis are shown in Figure 1. Inspection of the figures reveals a trend in which preference for the WR&EE area was relatively low five years ago (10 %) and has been increasing since to approximately 50 % in the Fall of 2012. The trend represents a significant five-fold increase in preference for the WR&EE area.

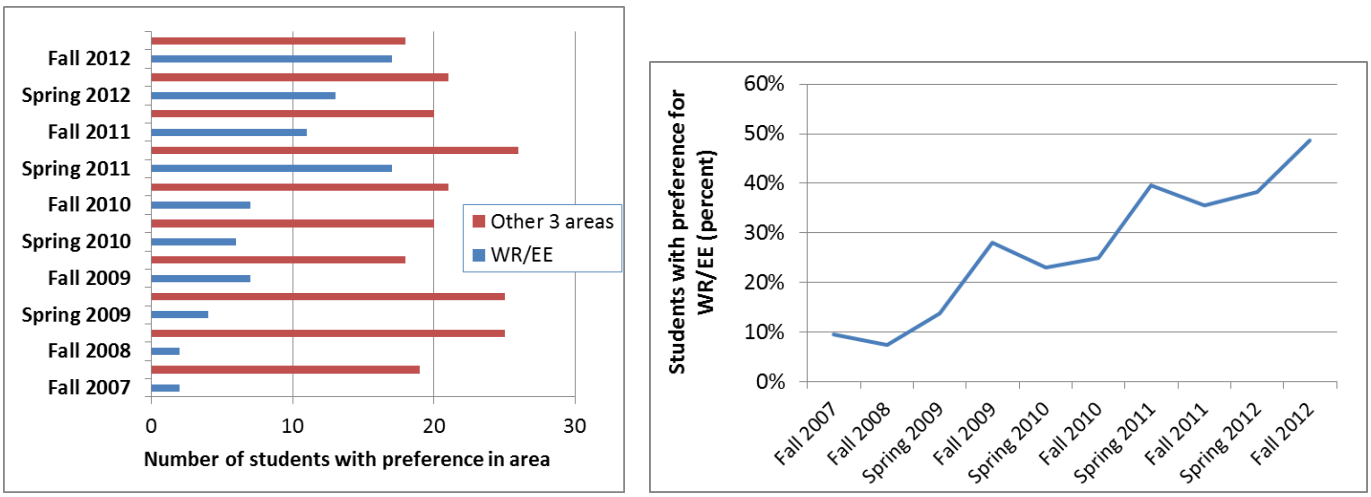

Figure 1. CE 180A student preference for WR&EE vs all other technical areas of civil engineering design during the last 5 years (Left: Number of students; Right: Percent of all students).

Senior & Graduate Student Survey

Students in senior and graduate level courses were surveyed in December of 2012 to determine their level of interest in a proposed option. The survey administered to students in senior-level courses yielded 105 undergraduate student responses (13 juniors in senior-level courses and 92 seniors). Graduate student responses were 27, bringing the total number of all student responses to 132.

Survey Questions 1 through 5 related to the student's profession, job title, employer and location, degree program, grade level, and grade point average. Responses to these questions are not included in this report but may be made available upon request. Responses to all other questions (6- 19), organized by survey question, are presented below.

Extent of interest in pursuing graduate studies

Student interest in pursuing graduate studies was assessed by asking the question "To what extent are you interested in pursuing studies toward a Graduate Degree (either the proposed WREE degree or some other one)?" The results are shown in Fig. 2. Inspection of Fig. 2, left, reveals that 81% (84) of the 104 senior responses show either moderate interest (51%) or great interest (30%) in pursuing graduate studies. Of the 26 graduate student responses 88% showed great interest in pursuing graduate studies, 4% moderate interest, and 8% no interest (Fig. 2, right). The latter group may consist of students who are nearing completion of their master's degree.

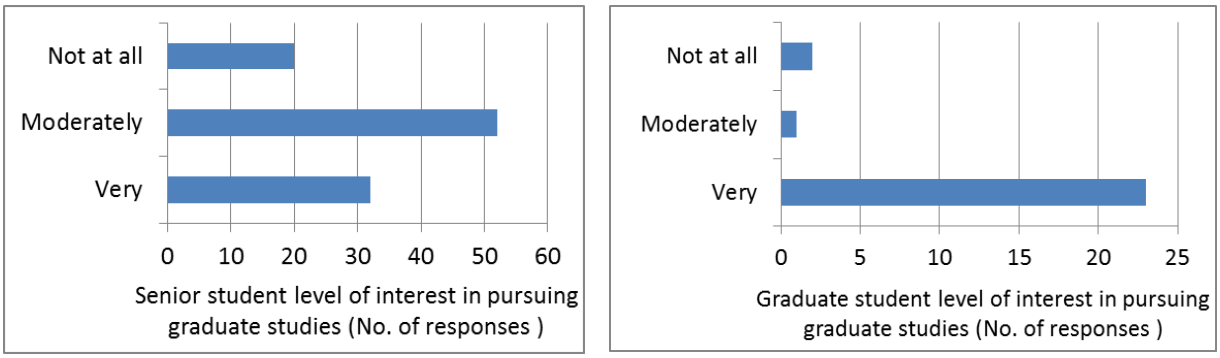

Figure 2. Extent of interest in pursuing studies toward a Graduate Degree (Left: Seniors; Right: Grad. students).

What students would you hope to gain from completing a graduate program.

Students were asked "What would you hope to gain from completing a graduate program?" The results are shown in Fig. 3. Inspection of Fig. 3, left, reveals that "upgraded knowledge" and "additional personal development" received the greatest number of responses. The remaining choices, "upward mobility in current employment," "new position with another employer," and "increased research experience," received a significant response. Graduate student response (Fig. 3, right) closely paralleled that of the seniors. Students were given an opportunity to write in other motivations for graduate studies and the response is as follows:

Seniors: "MBA," "pay raise," "find job," and "Pay raise; less time for P.E."

Grad. Students: "Getting any CE job," and "Current application of methods."

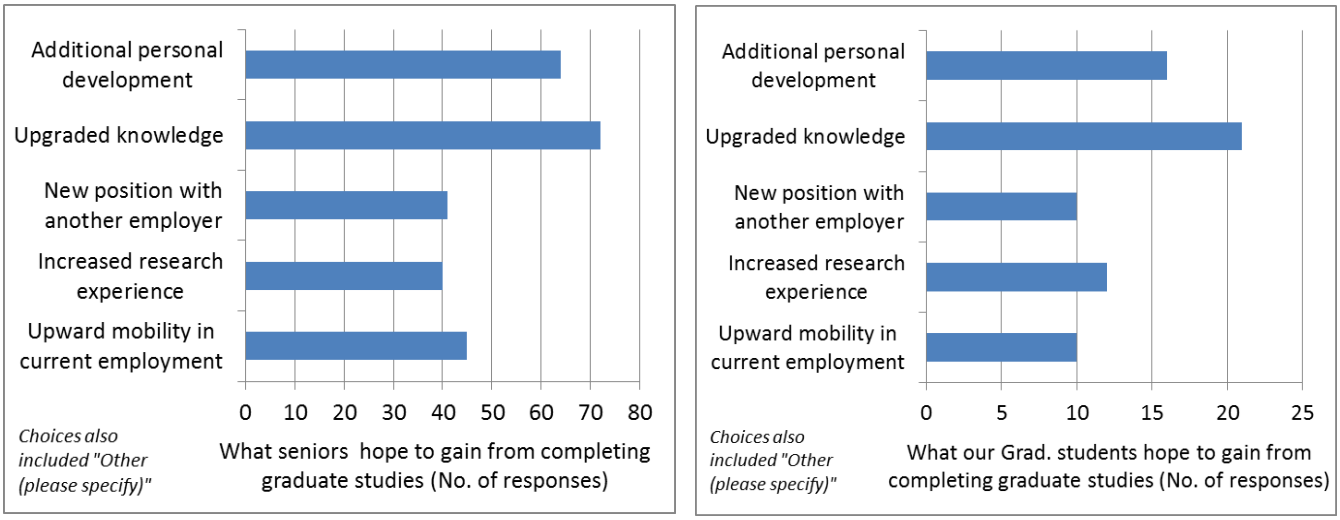

Figure 3. What students would you hope to gain from completing a graduate program (Left: Seniors; Right: Grad. students).

Would students enroll in the proposed WREE Graduate Program?

Responses to the question of "Would you enroll in the proposed WREE Graduate Program if one were to be established in the next _*(see below)* years" are shown in Fig. 4. Data used in Fig. 4 excludes responses from those who responded "not at all" to the question above of whether or not they were interest in pursuing graduate studies (Fig. 2).

Inspection of Fig. 4, left, reveals that a significant interest in a WE&EE graduate program if it were to be offered within the next 7 years, and that there is a strong preference for the program to be offered earlier in that period. After accounting for multiple "yes" responses, 60 of the 105 seniors (57%) indicated at least one "Yes" answer. It should be pointed out that many of these students would need financial support to enroll (see further below). Graduate student response (Fig. 4, right) indicated that 9 students would likely enroll in the new program.

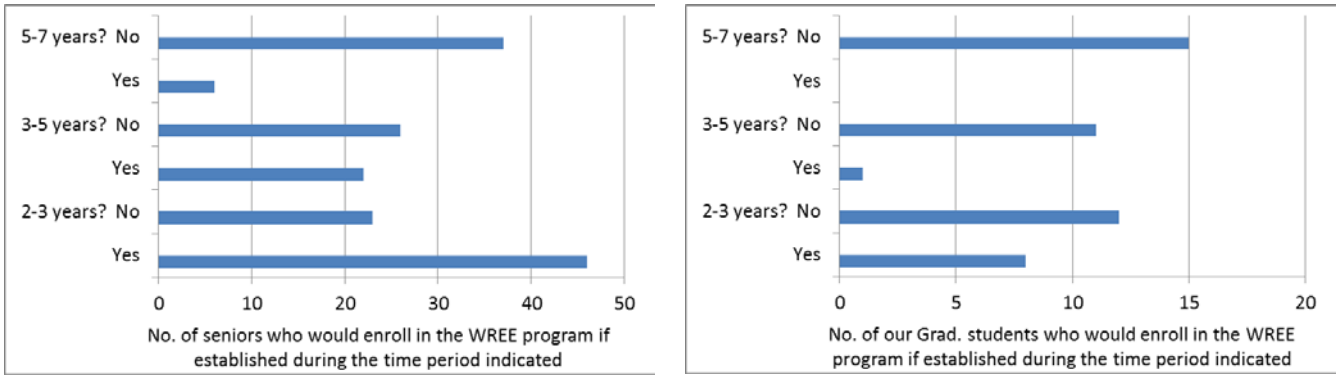

Figure 4. Response to the question of "Would you enroll in the proposed WREE Graduate Program if one were to be established in the next _(see figure) years?" (Left: Seniors; Right: Grad. students).

Full-time vs part-time preference

Responses to the question of "If your answer to #7 was "yes," would you attend part-time or full time?" are shown in Fig. 5. Inspection of Fig. 5 reveals that 63-percent of seniors and 78-percent of graduate students have a preference for part-time studies.

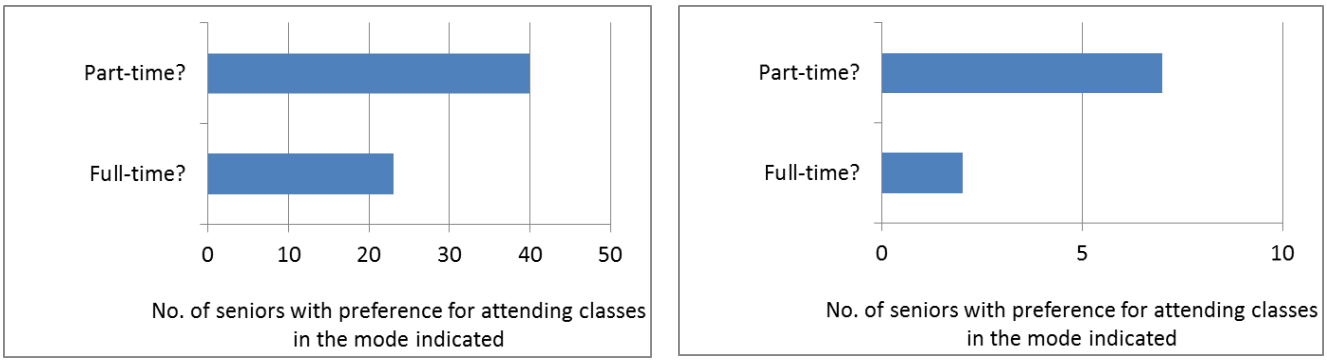

Figure 5. Response to the question of "If your answer to #7 was "yes," would you attend part-time or full time"(Left: Seniors; Right: Grad. students).

Mode of availability to participate in classes

Responses to the question of "Indicate your availability to participate in classes: … *(see choices in the figure)*" are shown in Fig. 6. Inspection of Fig. 6 reveals that senior and graduate students both have a preference for evening classes. Following that, there is substantial support for attending courses both in a daytime/ evening combination and in an electronic access (online) mode.

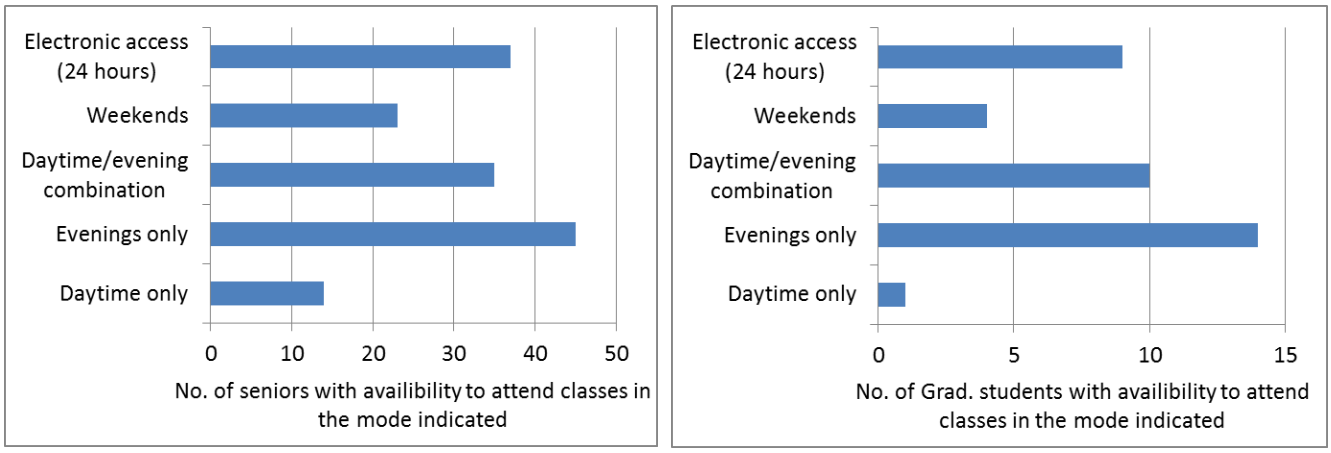

Figure 6. Response to the question of "Indicate your availability to participate in classes:" (*see choices in the figure*) (Left: Seniors; Right: Grad. students).

Preference for course duration

Responses to the question of "Indicate your preference for courses that can be completed in: … *(see choices in the figure)*" are shown in Fig. 7. Inspection of Fig. 7 reveals that senior and graduate students both have a strong preference for course durations of a full semester.

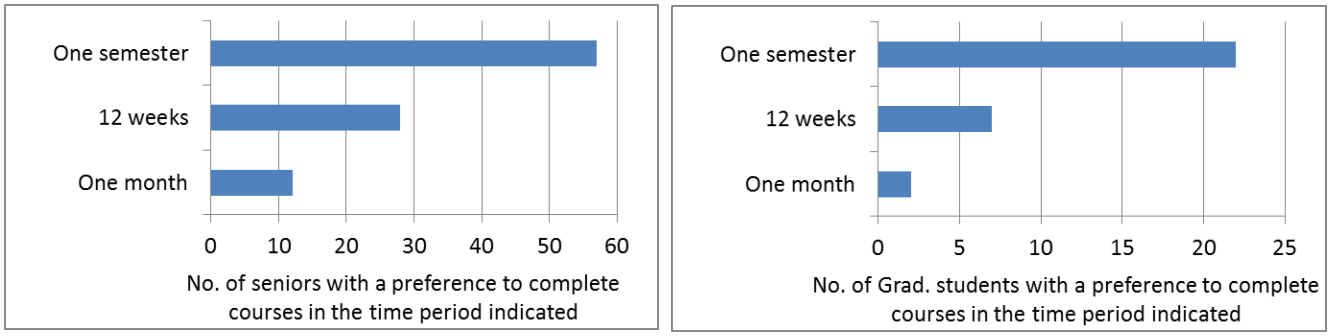

Figure 7. Response to the question of "Indicate your preference for courses that can be completed in:" (*see choices in the figure*) (Left: Seniors; Right: Grad. students).

Preference for program duration

Responses to the question of "What period of time would you be able to commit in completing this program" are shown in Fig. 8. Inspection of Fig. 8 reveals that senior and graduate students as a group have a strong preference for a program of study that can be completed in one to two years, and secondary preferences for "two to three years" time period and for "whatever time it takes." Programs of study that go beyond three years have very little support.

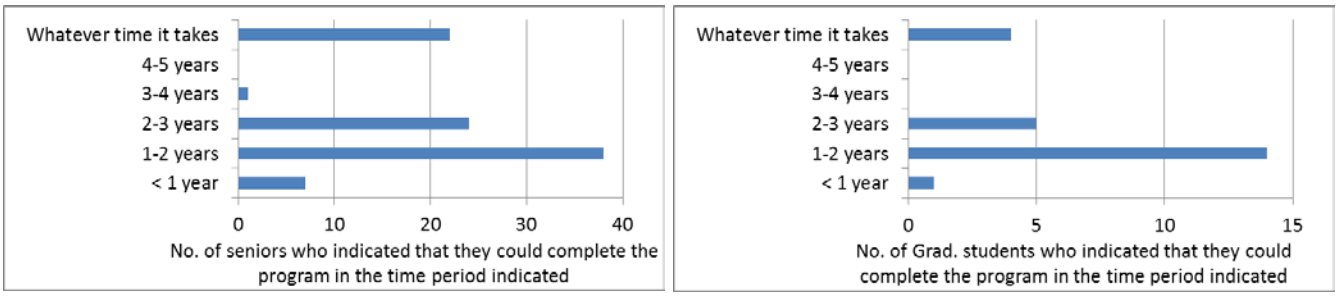

Figure 8. Response to the question of "What period of time would you be able to commit in completing this program?" (Left: Seniors; Right: Grad. students).

Employer support for graduate studies

Responses to the question of "Would your current employer provide any of the following? *(Check all that apply)*" are shown in Fig. 9. Inspection of Fig. 9 reveals that senior and graduate students largely indicated that the question was not applicable to their situation. As for the other responses, the greatest response was for "release time to attend classes" (14 seniors and 4 graduate students). There was modest support in the form of "research facilities" and "mentored support." Particularly important are the graduate student responses in which not one student indicated that they could receive support from their employers in the form of tuition and fees. Relevant is the fact that 15 of the 27 graduate students who participated in the survey indicated that they were working --12 working in engineering (4 are research assistants, 8 work off-campus) and the other 3 work in non-engineering areas (off campus).

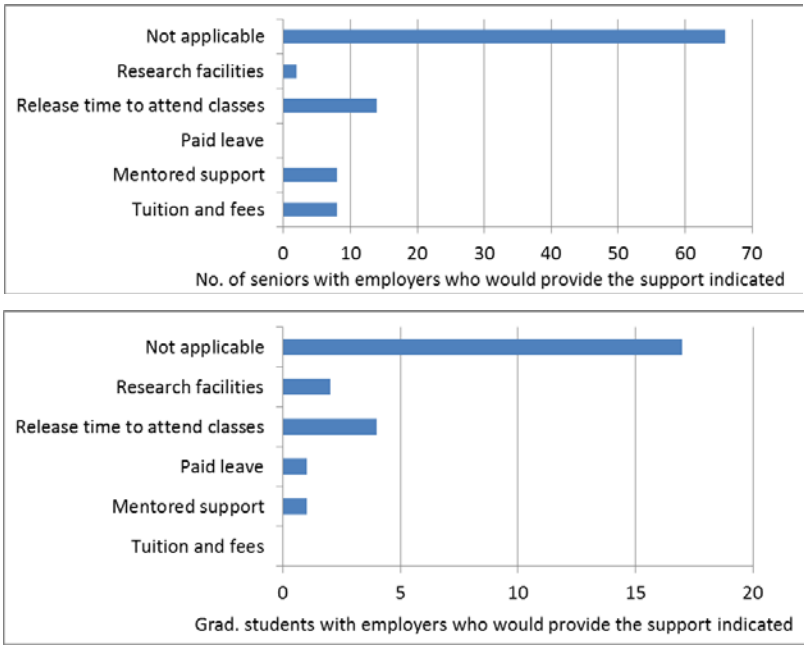

Figure 9. Response to the question of "Would your current employer provide any of the following? (Check all that apply)" *(see figure for choices)* (Top: Seniors; Bottom: Grad. students).

Preference for mode of course delivery

Responses to the question of "What would be your preference as to how courses are delivered? (Check all that apply) *(see choices in the figure)*" are shown in Fig. 10. Inspection of Fig. 10 reveals that senior and graduate students both have a preference for traditional courses delivered at the university, and online instruction is a close second among seniors (for graduate students it is much lower). In addition, laboratory-based instruction was well supported.

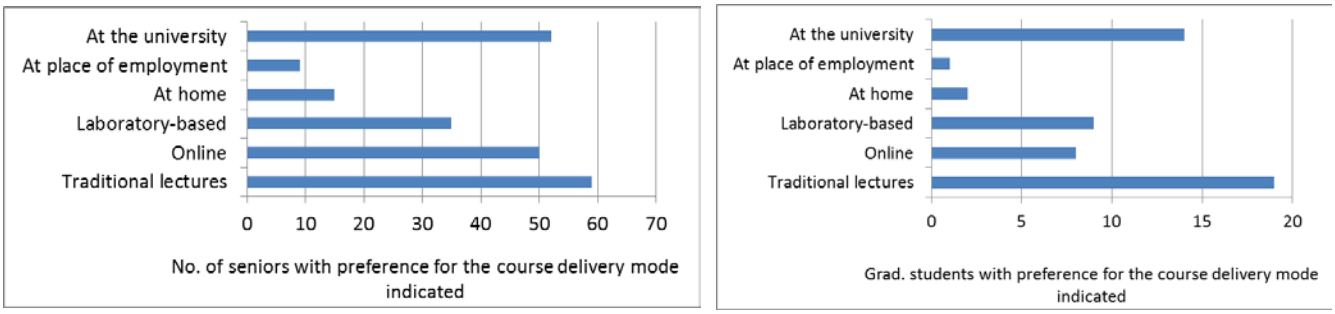

Figure 10. Response to the question of "What would be your preference as to how courses are delivered? (Check all that apply)" (*see choices in the figure*) (Left: Seniors; Right: Grad. students).

Computer-based educational technology literacy

Responses to the question of "Would your computer knowledge/ability allow you to use computer-based technology for educational purposes?" are shown in Fig. 11. Inspection of Fig. 11 reveals that nearly all senior and graduate students believe that they have sufficient computer knowledge/ ability to use computer-based technology for educational purposes.

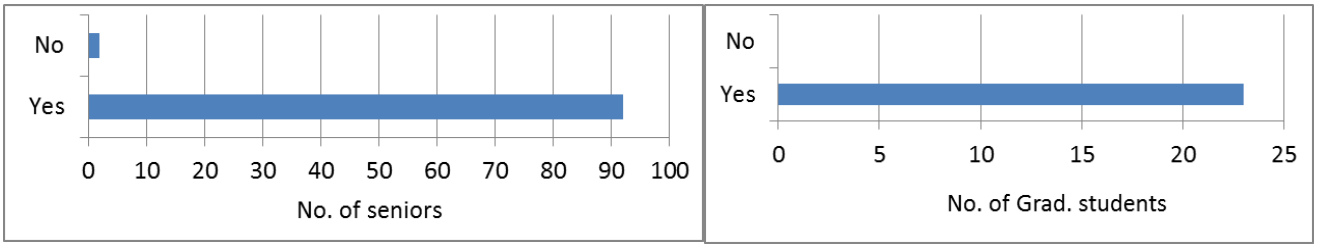

Figure 11. Response to the question of "Would your computer knowledge/ability allow you to use computer-based technology for educational purposes?" (Left: Seniors; Right: Grad. students).

Access to equipment for distance learning mode of instruction

Responses to the question of "Would you have access to the required equipment if the program is offered through distance learning? (Check all that apply) *(see choices in the figure)*" are shown in Fig. 12. Inspection of Fig. 12 reveals that senior and graduate students have access to a wide variety of equipment if the program is administered through distance learning mode.

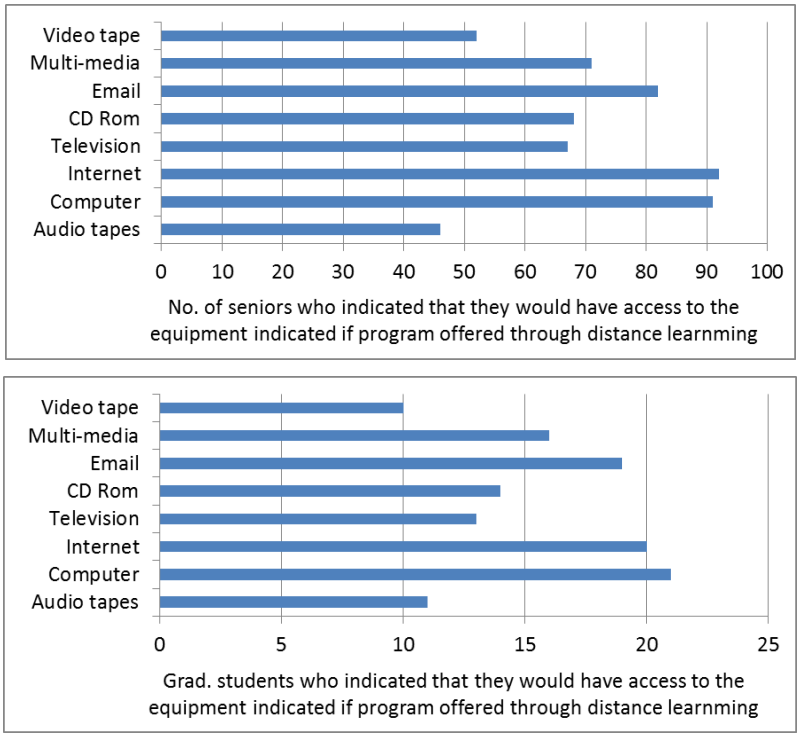

Figure 12. Response to the question of "Would you have access to the required equipment if the program is offered through distance learning? (Check all that apply) *(see choices in the figure)*" (Left: Seniors; Right: Grad. students).

Financial aid assistance required?

Responses to the question of "Would you require university financial assistance to pursue this degree?" are shown in Fig. 13. Responses shown include only the students who indicated that they would enroll in the proposed WREE Graduate Program. Inspection of Fig. 13 reveals that 77-percent of seniors and 73-percent of graduate students would need financial assistance to pursue the WR&EE degree. Therefore, students' ability to secure funding would most certainly be a major determinant of actual enrollment.

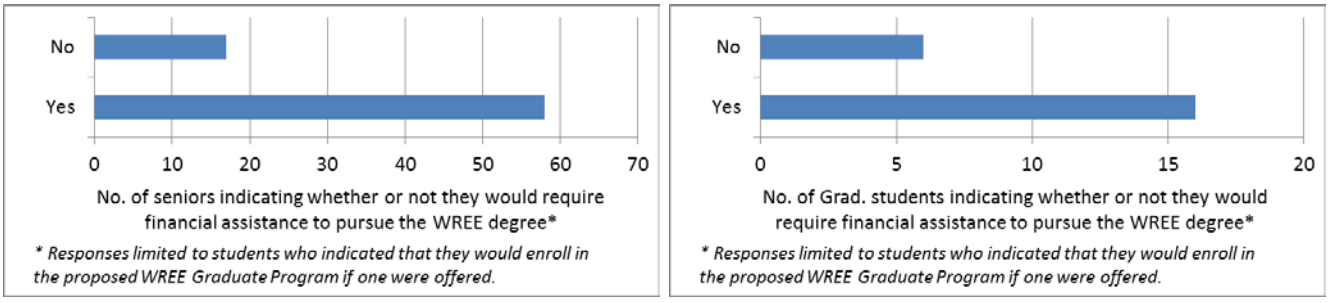

Figure 13. Response to the question of "Would you require university financial assistance to pursue this degree?" (Left: Seniors; Right: Grad. students).

Would the student like to be kept informed if the WR&EE program moves forward?

Responses to the question of "If this program moves forward, would you like to be kept informed?" are shown in Fig. 14. Inspection of Fig. 14 reveals that the vast majority of senior-level students (70 of 105) would like to be kept informed if the WR&EE program moves forward, and that just under half of the graduate students would like to be kept informed. Some of the graduate students would be near graduation and others are specializing in areas outside of WR&EE and therefore it is not surprising that the percentage is lower in that group.

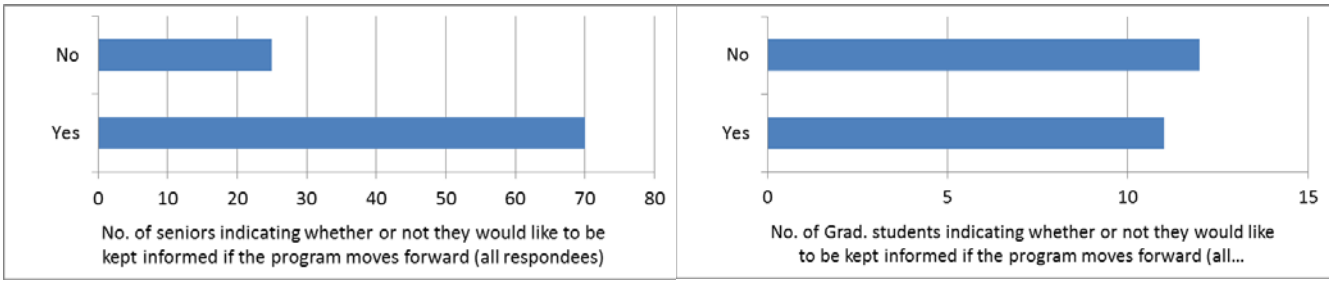

Figure 14. Response to the question of "If this program moves forward, would you like to be kept informed?" (Left: Seniors; Right: Grad. students).

Students' comments or suggestions regarding this proposed graduate program

Students taking the survey were given an opportunity to make any comments or suggestions regarding this proposed graduate program. The responses, grouped by program and by subject (major thrust of comment), are summarized below.

Student comments are largely supportive of the creation of a WR&EE option in the MSCE graduate program. Concern exists among some undergraduate seniors that existing courses are not being offered with sufficient frequency, that the creation of a new WR&EE program option would make this situation worse, and that any new faculty or resources should be used instead to mitigate this problem. These comments are based on two mistaken notions as follows: (1) that undergraduate courses would be offered less frequently if the WR&EE were to be created, and (2) that new faculty or resources would be necessary (and made available to) the proposed WR&EE program. Our best assessment of the issues is that neither of the concerns noted above would occur. The rational/ basis for this statement can be found in the WR&EE Option Proposal, section 1.15. "Additional instructional resources needed to implement and sustain the program."

Student comments:

C.E. Seniors:

A. Creation of a WR&EE Program (support, criticism, other):

1. Supportive:

a) Specializing in Environmental under Civil. I'd like a grad program for this.
b) I am interested in this graduate program. wesleyzimmerer@gmail.com
c) Sounds very interesting, would like to know more about the program
d) Must be stablish, there is a lot of students graduating each semester
e) It would be the leading school in the Central Valley.
f) It should make a good program for unemployed graduates and also enhance their skills.
g) Would like to see WREE degree
h) I would really love to keep studying in case there are no jobs open
i) It will be a great opportunity for me since my emphasis in civil engineering is water resources and environmental engineering.

2. Critical:

a) Make sure to open necessary courses in order to graduate in the first place. Worry about the graduate program in the future. Open more class sections, hire more professors, offer courses more frequently - not every 2 semesters.
b) Increase the number of instructors instead to provide more than one course and/or instructor per semester.

3. Other:

a) What is WREE?
b) Its easy. *[WW -Intent not clear]*
c) Its just too bad it is being offered now vs being offered previously, only due to my grade level *[WW comment - this senior may think that WREE is a B.S. degree?]*

B. <u>Program/Course Structure, Curriculum, Mode of Course Delivery</u>:

1. Partership with EWB or Peace Corps
2. Make it available for everybody that want to pursue a degree in civil engineering
3. Evening & on-line courses would be a plus; counting some undergraduate Courses towards the units would be nice.
4. Have less Powerpoint and get students involved with written examples
5. See comment A.2.a. above.
6. Perhaps emphasis on the environmental side, like air quality for example.
7. Would like to see local issues covered such as: Irr. System efficiency, Rural distribution system.

M.S.C.E. (Graduate) Students:

A. <u>Creation of a WR&EE Program (support, criticism, other)</u>:

1. Supportive:

a) Sounds like it would be great for some people, just not myself.
b) I am interested because if I were to work for the public sector I would benefit from this degree.
c) I hope this moves forward, it sounds great.
d) This is a great program. The instructors are very knowledgable about the subjects.
e) If the program was available a previous semester I would have enrolled. However, I will be graduating soon.

2. Critical:

See comment 3.a. below *(possibly a criticism of the WR&EE option idea).*

3. Other:

a) Create a M.S. in Structural Engineering Program!
b) I thought we already had a WREE in CE.

B. <u>Program/Course Structure, Curriculum, Mode of Course Delivery</u>:

1. Profession oriented; practical, updated curriculum.
2. Advanced fluid mechanics and hydraulics structures classes .. Please!!!

Students' thoughts on what relevant skills/ experience they possess

Responses to the question of "What relevant skills/experience do you have?" are provided below

C.E. Seniors: U. Courses
ArcGIS, AutoCAD, M.S. Office; Fluent in Spanish
Computers; Problem solving.
CalTrans volunteer
Database management
Educational experience
Almost done w/ BS
Water well drilling (reverse-rotary)/ rehab/ testing; Interned at Provost & Pritchard; Some experience w/ water resources engr. programs (EPANET, Flowmaster, HEC-RAS, etc..)
A little ArcGIS, WaterGEMS, SewerCAD
General knowledge on different computer applications used in this area (AutoCAD, SewerGEMS, WaterGEMS, EPANET, etc..)
Preparatory requirements for environmental, many design projects in water/structures.
Build up on wastewater Phase II Fresno & Injection gas facility in Madera
AutoCAD, WaterGEMS, CE Water classes/ design courses.
Wastewater treatment plant, natural gas injection plant.
Environmental
BS Civil engr.
Standard BS curriculum
BSCE curriculum
2 years internship at BRA; BS curriculum
6 months internship Ground water analysis; water resources; BS.
Tri-lingual; employed in a field of emergency for 2+ years.
Some research experience; Prof. engr. experience
Work experience, BS degree.
5 years
6 months internship (Engr.) Water CMP design
CAD, MS Office, ArcGOS, Sourfire
Plan review, 2010 building codes, CRC, CBC, CMC, CEC, ADA
Chemistry minor; Water emphasis in BS program
AutoCAD, StormCAD, WaterCAD, SewerCAD, Salesperson, managing business.
Four summer internships.
[not legible]
Practical experience including WDS Analysis with Bentley software & EPANET.
Worked for private consulting firm and Regional Water Quality Control Board
Just the basic information in water. Everything
Extensive background in water resources topics
CE 141, EPANET, SewerCAD, other W.R. programs [software]
Knowledge of engineering fundamentals
1.75 years of internships.

MSCE Stud.: 4 years in Air Force as a Civil Engineer
BS in CE (structures+Geotech), AutoCAD, Microsoft Office software.
BS in water resources/ environmental engineering
None for WREE save for MSCE & BS water courses.
computer application
Engr. Student Assist. For Dept. Water Resources; HEC-RAS modeling, San Joaquin and Merced River Restoration studies.
Working with DWR Just school
Bentley software, Excel, AutoCAD, worked at the RWQCB as an intern.
Survey, Construction, Musician
Worked at @ DTSC CAD, Design, Visual Basic programming.

Report on Employer Interest in a

Water Resources and Environmental Engineering Option in the Civil Engineering Graduate Program

By

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Assistant Professor of Civil Engineering

February 11, 2013

Table of Contents

Attachment: Survey Monkey Summary Report (Feb. 5, 2013)

Employer Interest in a Water Resources and Environmental Engineering Option in the Civil Engineering Graduate Program

California State University Fresno

Abstract

Interest among employers in the Central San Joaquin Valley for creating a graduate program option in Water Resources and Environmental Engineering (WR&EE) is strong. A survey conducted in January of 2013 reveals that employers by a large margin support the idea of establishing a WR&EE graduate program at Fresno State. These employers indicated the following:

- A need for graduates from such a program is significant.
- They have current and planned future employees that would benefit from such a program.
- They would support their employees enrolling in such a program at Fresno State
- They have employment positions for graduates of the program.

C.E. Program

For decades Fresno State has offered programs of study in Civil Engineering at the undergraduate and graduate levels (B.S. and M.S.). The undergraduate curriculum is wide-ranging, covering quantitative/ technical subject areas in math, science, and engineering, and various qualitative/ less technical subjects in general education. Students are introduced to several interrelated specialty areas within civil engineering during their junior year: hydraulics, environmental/ water resources, soils (geotechnical), structural, and transportation engineering. Following completion of the introductory course students can take technical elective courses in the specialty area. Design concepts are emphasized in most of the electives courses. Students undergo a culminating experience in their senior year in which they must demonstrate competency by completing a two-course sequence of capstone courses – CE 180A Project Design and CE 180B Senior Project. Historically employment prospects have been very good for program graduates in terms of salary, diversity in types of work and geographic location, and demand. The percentage of graduates who secure employment in positions that are directly related to their degree is among the highest of all majors on campus.

Assessment Methodology

In January of 2013 an invitation was sent out to employers of water resources and environmental engineering professionals in California's Central San Joaquin Valley to take an online survey (http://www.surveymonkey.com/s/CY9NYJK) to gauge their level of interest in establishing a WR&EE graduate degree option at Fresno State, and to solicit their input on the proposed curriculum and program structure. Those who entered the survey Web site were given an opportunity to view another Web page that described the proposed program and curriculum before taking the survey (http://zimmer.csufresno.edu/~wfwright/FresnoStateCivilEngrWREE_Option.htm). Selected results are presented below and a more complete summary of the results generated by Survey Monkey are attached to this report.

Results

Detailed results of the employer survey can be found in the attached Survey Monkey summary report of February 5, 2013. In excess of 100 survey entries were logged, and this represents a good sample size for the study. Results that are most pertinent to the proposal for establishing a WR&EE graduate program at Fresno State are discussed below. The full set of results from the survey will be evaluated further during the next few months.

In your opinion, is there a need for a Water Resources and Environmental Engineering (WREE) Graduate Degree at Fresno State?

Employer response to Question 5 "In your opinion, is there a need for a Water Resources and Environmental Engineering (WREE) Graduate Degree at Fresno State)?" are shown in Fig. 1. Inspection of Fig. 1 reveals that near half of the responders believe that there is a "strong need" for the proposed WREE program and a majority of the remaining responders believe that there is a "moderate need". Taken together, 88-percent of the responders believe that the need is either strong or moderate with strong need being the dominant response.

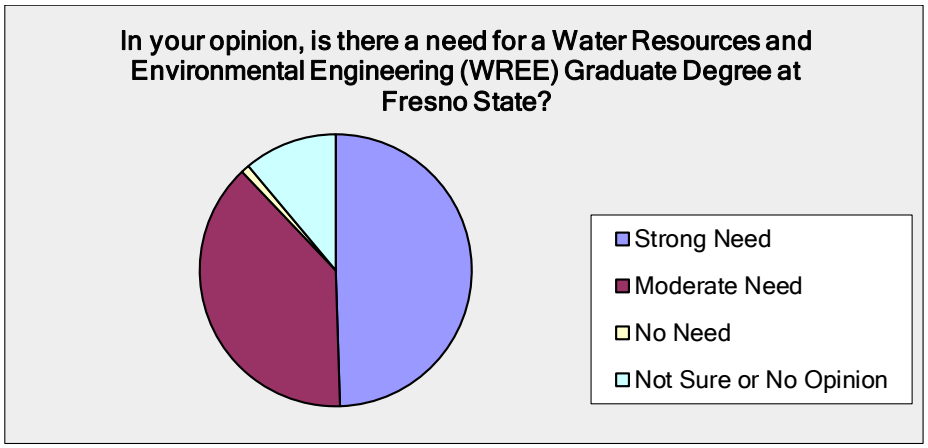


Figure 1. Need for a Water Resources & Environmental Engineering graduate degree at Fresno State.

What aspects of the proposed WREE program option are of greatest importance to you and what changes would you recommend be made in the proposed WREE program?

Employer response to Question 6 "What aspects of the proposed WREE program option are of greatest importance to you and what changes would you recommend be made in the proposed WREE program?" are shown in Fig. 2 (selections on importance) and in Table 1 (comments on recommended changes). Three additional comments were received via email as follows:

- "Two fields of study that I see becoming more necessary in the future are Fluvial Geomorphology, and Hydromodification. With the new requirements for fish passage there is need to analyze the stream both hydraulically and geologically. With the emphasis being placed on low impact development a greater understanding of mitigation measures for hydromodification will be required."
- "…a more advanced WREE program at CSU Fresno would be of great benefit to the Central Valley. In the future, CSUF WREE graduates could play a very important role through their interactions with California's natural resources. Given the current trends in many technical disciplines, I would recommend emphasizing computer-aided modeling, analysis of large environmental datasets, and water-related policy."

- *Regarding inclusion of two advanced water quality courses as required coursework rather than as electives:* "I think both courses are important for Env. Engineer, can't do without either one of them. But for WR they don't need this. Maybe you can let them to choose these two (for EE) or choose 240 and another water resource related course (for WR), how about some agricultural water use, water rights and water policy topic?"

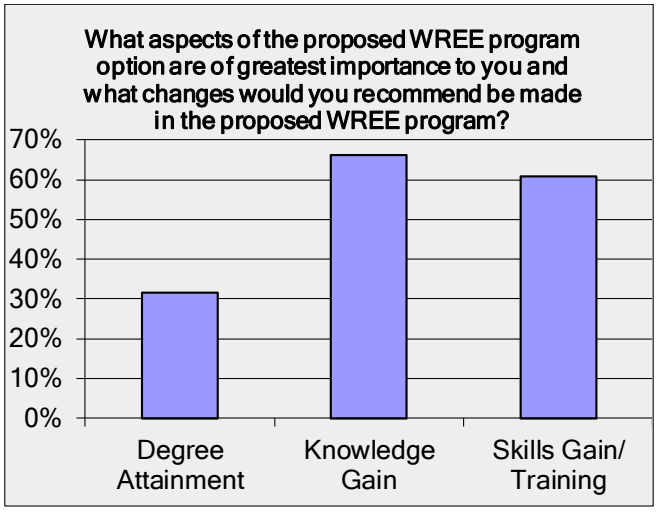


Figure 2. Aspects of the proposed WREE program option that are of greatest importance and what changes would be recommended.

Inspection of Fig. 1 reveals that "Knowledge Gain" was selected by 2/3 of the responders as being most important and "Skills Gain/ Training" was a close second at 60-percent. Recommended changes to the program as proposed in Table 1are varied and insightful. A few observations on the comments are provided below.

- The first comment is a strong warning about the need for educating students about "real world applications." Variations of that sentiment or the need for "hands on" or "field experience" were expressed in three other comments (Responses 4, 5, and 16).
- The second comment speaks to the demand for graduates with a WREE degree. That sentiment was expressed in Response 7.
- The vast majority of comments offered suggestions on subjects that should be included in the curriculum.
    - Parts of nine comments relate to the need to cover topics in **water resources, hydrologic systems, or W.R. management and/or planning** (Responses 3, 6, 9, 12, and 17 through 21).
    - Parts of six comments relate to **environmental engineering, water quality, chemistry, water treatment, or wastewater treatment or recycling** (Responses 6, 7, 9, 12, 18, and 19).
    - Three comments mention **computer modeling** (Responses 15, 20, and 21).
- One comment relates directly to the culminating experience (Response 8) and three other comments may also apply to the subject (Responses1, 5 and 16)
- Several other topics were covered as well.

Table 1. Recommended changes to the proposed WREE program (verbatim).

1. turing our a bunch of degreed people that don't know about real world application has a negative impact on the drinking water industry. After all, that is what populates the EPA, right?
2. I have 167 Continuing Education Units with Water Programs from CSU Sacramento. The State of California Water Resources Environmental Engineer wanted to hire me based on my experience, but due to civil service requirements I was not hired because I did not have a WREE Degree.
3. Research of ground water and intake studies
4. Construction and plan reading knowledge/ experiance
5. "One issue is that while learning the aspects is very important, learning the practicality is equally. Leaving scvhool with a degree then sitting in front of an autocadd computer the rest of your career doesn't make you a good engineer. Take ont he field assignmetns, and accept projects that aren't ""cook book"" but take some thinking."
6. Our engineers and geologists in water resources need to have a better understanding of the hydrologic systems in our valley, trends in water quality/quantity, and the history of projects and behaviors and their outcomes.
7. The proposed curriculum looks very good and fits with Grundfos needs especially in the Environmental Engineering emphasis areas (e.g. Environmental Chemistry, Water Quality, etc.).
8. I would require the thesis option. I don't consider the comprehensive exam option to be worthy of a masters degree.
9. Env. Eng. course in wastewater recycling. In my opinion, this will be a huge part of water resources in the future as water becomes more scarce, which is a question of not if but when. How weather affects not only water resource management but water/wastewater treatment as well (think: potable water conservation affecting wastewater treatment; Orange Cove's recent water and sewer problems because their primary source of drinking water was unavailable - why didn't they have a backup plan?)
10. Environmental Laws/Regulations
11. I would recommend having a class on big data as it applys to water, a class on prototying or 3d printing, and/or alternate/decentralized wastewater treatement.
12. Greater emphasis on biology than civil engineering. Moving water is less of a concern that purifying and re-using water.
13. It's not interdisciplinary enough
14. Would like to have classes stress presentation skills such as public speaking and powerpoint presentations.
15. "Add a course in computational fluid dynamics. Validation and design through the use of CFD is very useful."
16. More hands on work with different agencies. Projects where the students can work with the different agencies on real life problems (Hands on Field experience).
17. Not sure of any changes, but a well rounded skill set in hydraulics, groundwater, hydrology, etc. is good.
18. Well rounded education in geology, hydrogeology, surface water hydrology, soils, chemistry, physics
19. A water chemistry course should be a core requirement. Without a solid understanding of chemistry, water/WW treatment design, pipeline design, etc. concepts are too "black box".
20. Hydrologic and Hydraulic Modeling
21. Incorporate more cources for hydraulic modeling for the purpose of planning and constructing infrastructure, engineered hydraulic structures that include fish passage structures and other surface water/transfer management structures, and environmental restoration design and construction.

What academic skills should WREE program option graduates have as they enter the job market that they would typically not possess after earning their BSCE or equivalent degree? Check up to 3?

Employer response to Question 7 "What academic skills should WREE program option graduates have as they enter the job market that they would typically not possess after earning their BSCE or equivalent degree? Check up to 3" are shown in Fig. 3.

"Advanced technical analysis" was selected by nearly 80% of the responders and "advanced technical design" and "compute modeling" each received more than 60%. Also important were written and oral communication.

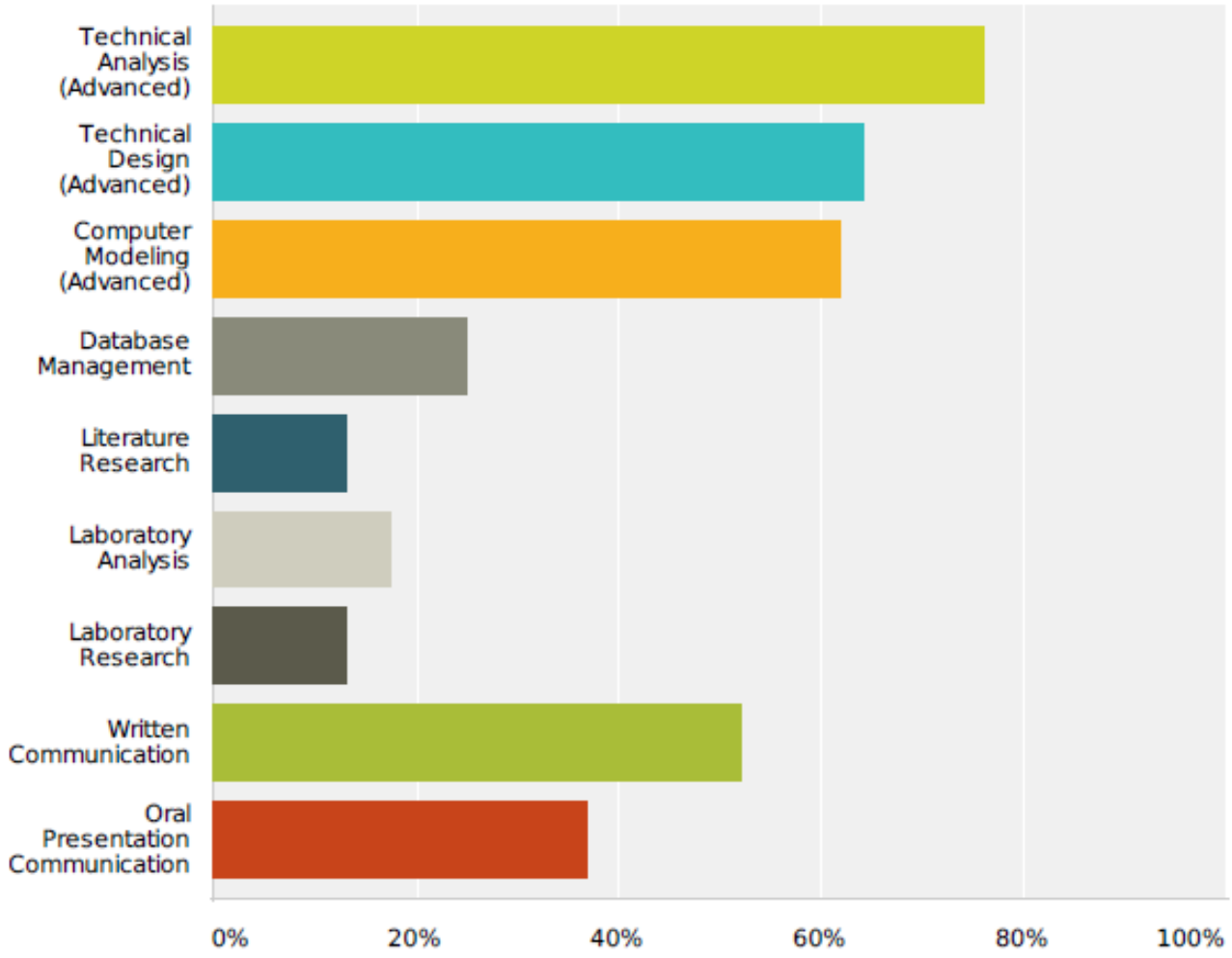


Figure 3. Academic skills WREE program option graduates should have as they enter the job market that they would typically not possess after earning their BSCE or equivalent (Check up to 3).

Would current employees who perform WREE-related work but do not have a WREE-related graduate degree benefit from having one in terms of their ability better serve the needs of your company/ dept.? Would you support their enrollment in the proposed 30-unit WREE program? Would you support their enrollment in a shorter (15 unit) Water Engineering Graduate Certificate program? If no to the above, would you support their enrollment if the courses were offered online rather than in classroom except for a two-week intensive laboratory activity (6 - 8 hours per day for 10 work days)?

Employer responses to Question 8 (compound question; see above) are shown in Fig. 4. It can be seen in Fig. 4 that employers believe that current employees would benefit from enrolling in the proposed program and a vast majority of these employers are supportive of their employees enrolling in the program.

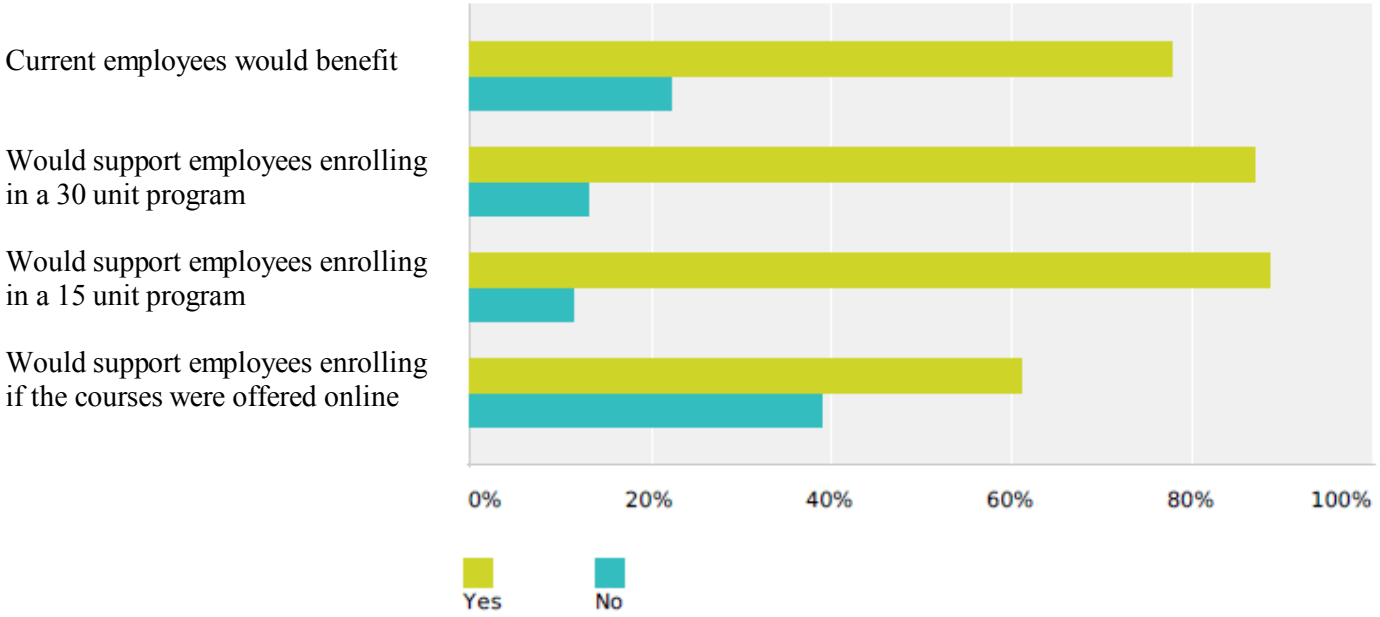


Figure 4. Whether current employees who perform WREE-related work but do not have a WREE-related graduate degree benefit from one, and whether employers support their employees enrolling in the program.

Indicate the number of (a) individuals in your firm/agency with a BSCE or equivalent could benefit from the proposed WREE program and (b) positions in your firm/ agency that could be filled by WREE program graduates?

Employer responses to Question 9 (compound question; see above) are shown in Table 2 where it can be seen that employers have varying numbers of employees could benefit from the proposed program, and have varying number of positions that could be filled by graduates of such a program. The data reflects a wide range of size in company and agency.

Overall the data indicates that graduates of the proposed program are likely to find jobs here in the Central Valley, which is consistent with the previous result that showed there was a great need for a WR&EE program.

Table 2. Number of (a) individuals in firm/agency with a BSCE or equivalent that could benefit from the proposed WREE program and (b) positions in firm/ agency that could be filled by WREE program graduates.

Answer Options	0	1 - 2	3 - 5	6 - 8	> 8	ResponseCount
	Number of responses					
Number of individuals with a BSCE or equivalent who could benefit:	10	33	24	7	15	89
Number of positions that could be filled by WREE graduates:	10	48	11	3	12	84
					Answered Question	90
					Skipped Question	19

What is your overall assessment of this proposed program? Does it make sense? What are its strengths/ limitations?

Employer responses to Question 10 "What is your overall assessment of this proposed program? Does it make sense? What are its strengths/ limitations?" are shown in Table 3. The responses are verbatim, grouped by subject (major thrust of comment), and generally are presented in the order received within each topic area. Yellow highlight and, in some cases, underline or bold, have been added to identify important content related to curriculum. Subject areas are as follows:

A. Creation of a WR&EE Program (support, criticism, other)
   1. *Generally Supportive (subject to some interpretation)*
   2. *Critical or will not applicable to their needs*
   3. *Other*

B. Program/Course Structure, Mode of Course Delivery:

C. Program Curriculum:

As was the case for the responses in Table 1 (Recommended changes to the proposed WREE program), responses in Table 3 are varied and insightful. Employer comments are largely supportive of the creation of a WR&EE option in the MSCE graduate program. These results will be evaluated over time and the results ued to improve the WREE program structure, content, and mode of delivery.

Table 3. Responder's overall assessment of the proposed WREE program, whether it makes sense, and its strengths and limitations (verbatim; grouped by subject).

A. <u>Creation of a WR&EE Program (support, criticism, other)</u>:

1. Generally Supportive (subject to some interpretation):

a) There will continue to be a high demand for this area since water is a depleting limited resource.

b) "I sounds like a good idea given the importance of water for CA. Program needs to be rigerous and provide practical/applied experience. Would need to include knowledge about NEPA/CEQA and if students don't have a chemistry background they would need a course with lab."

c) My perspective is limited. The degree would help in all water resource related fields, especially if there is active collaboration between the academic program developers and the water resources community. It does make sense but it appears there is, at this time, a limited demand in the private sector. If properly designed and evolved It could become or facilitate a "focus group" of sorts on developing water issues.

d) I think it is good and the more understanding of the water systems the better

e) This program appears to be a much needed course of education to prepare for work in a field that will only continue to grow for the forseeable future.

f) offers specialized training in water resources engineering and would be very relative to what we do in the DWP. A specialized degree allows the students to come out with a specific skill set.

g) Yes it makes sense

h) There is a lack of well-trained workforce for the water and wastewater Industry. This sound like a great program and is much needed.

i) I think this is a much needed program which would help satisfy a need.

j) It sounds like it would be very exiting

k) From what I understand it could be good.

l) State of California Water Resources Control Board is always sending me emails asking me to apply and then I get disqualified because I don't have an actual WREE degree.

m) Yes - It would be of value in the market place.

n) CT has a Stormwater branch, this program might benefit those folks and some in the Environmental Department.

o) Great idea.

p) Recommendable for future water resources engineering services

q) This program is highly needed. Many federal and state agencies are in need of students who know the watershed system of the state for future growth.

r) Water resources and the issues that come with water will continue to need to be addressed by engineers. The WREE program will help ensure the engineering community is populated with water specialists. In addition to BSCE graduates, the WREE grads are the type of graduates that a firm with water/wastewater departments may prefer to recruit from.

s) I would hope a focused degree would open doors for qualified indiviuals; however, an MSCE with water/environmental emphasis might do the same. I do think the focused degree could be a draw for potential students, which would help the university. There is such a growing concern about these resources globally - hopefully there is funding that will be growing to support the work also.

t) The proposed inclusion of a WREE program could act as a great strength for Fresno State. Being in the middle of such a large agricultural area as the San Joaquin Valley, there is a great need for a degree program emphasizing water and environmental aspects of engineering. Bear in mind if/when developing the syllabus, the only opportunity most of the students going into a WREE field will have to study structures, dynamics, etc. (areas heavily emphasized on the PE exam) will be through education. They will also utilize many of these skill sets when working in the public or private sectors as agencies will rely on their own engineers to design the majority of in-house construction projects. Lack of knowledge in any one of these areas will need to be supplemented with the ability for a young engineer to know how and where to find the material they need.

u) Yes it would provide additional option to specialize in. Also it would impart the necessary modeling and design skills that employers are looking for.

v) More specifics about the topics that will be covered but otherwise seems like a program Fresno State needs to have in the future

w) It probably makes sense, just not so much for those who work in my particular field.

x) Yes

y) The program seems to address needs of the valley as it relates to domestic water supply, waste water, storm water and environmental impacts.

z) In my experience, civil engineering students leaving Fresno State don't seem to have a good grasp of **water quality concepts, regulations and policy, GIS, modeling, or hydrology in general**. I think the program could address this and provide us with informed staff and future leadership to get us through tough times ahead. I think the program could be very successful as long as you find folks who would be qualified to present this information to students.

aa) The WREE program sounds like it would be a great program. However, my coworkers and I do not need such a degree in addition to or outside of a BSCE to do our job. I think Fresno State should still persue the program, because other engineering firms/agencies could use individulas with this kind of knowledge.

bb) The proposed program looks very strong as mentioned earlier. It would be important to identify the right courses in the Craig School of Business and the Ag department. This program would fit a strategic need in this region and for the future growth direction for Grundfos. We are currently building a team in Fresno and the Bay area focused on Water Treatment technologies related to research and commercial viability.

cc) With water resources becoming more and more critical with each passing year, it makes sense to emphasize research and forward thinking planning in these areas at our universities. Current engineering programs do not delve deep enough into these areas with current curriculum.

dd) "This program is needed by our area. A few general comments:

-it appears that statistics courses are available, I would make at least one course in **statistics** mandatory

-encouragement to step out to take a course in water rights, policy, or business is a great idea

-it's not clear how much writing and speaking will be required. We value grads that start out writing and presenting well."

ee) Yes, in this water short valley it very much is needed so more people can receive an understand the future of water needs.

ff) Yes. It's an excellent step toward placing Fresno State at the center of water research, policy, education and technology.

gg) Water quality protection is our mission; an advanced environmental engineering curriculim focusing on **water quality impacts** owuld be most useful to our organization.

hh) This program is a great idea. It may foster innovation

ii) In theory this sounds like a worthwhile program. It is important to provide **real world advanced design problems** for the program participants.

jj) The program makes sense. It will be difficult to hire or get financing for current employees to take classes for 3 to 5 years.

kk) Good idea, and a good starting point for further expansion.

ll) Overall, the proposed program makes sense. It should include develpment of relationships (working with groups), communication, presentations, and working with computer models.

mm) Water resources management will be an ever-increasing area of concern and focus as various global trends progress (population growth, urbanization, growing middle class, climate change, etc.). A workforce conditioned and trained to manage these topics will be essential in the future.

nn) Good start and it makes sense

oo) Defnitely makes sense

pp) I think that the WREE program would meet the needs of a number of consulting firms and government agencies that deal with water resource issues in the valley/state.

qq) Great idea and is needed. Sign me up!

rr) Would be a positive addition to the School of Engineering. Hope that there will be funding available

ss) It seems like it would be a good addition to the curriculum and would provided needed skills to graduates in this geographic area.

tt) make sense

uu) I like this program a lot. I wish it had been in place when I graduated in May 2012 from FSU. I have a MSCE from FSU and in reality I feel that this new M.S. in WREE is much more appropriate for what I learned in my graduate program. My MSCE seems to portray an inaccurate picture of my educational background in my opinon, For the work I do the M.S.WREE would provide a better picture of my educational background and skill set.

vv) It makes sense. I think it is a great idea

ww) Looks like a good start. May need to have additonal courses as program matures.

xx) I think it is greatly needed because there is a lack of knowledgeable engineers in the Central Vally in the water quality and treatment fields.

yy) I think it very beneficial.

zz) Good competition for Cal Poly's program. Water is critical in the Valley and we need engineers now and in the future who can address these needs/issues.

aaa) CSUF NEEDs a program like this, but it is very important that you look at other academic institutions and evaluate what works and what does not work in terms of research and job creation for the graduates. There needs to be jobs on the back-end and CSUF is competing with other institutions. I suggest **strong focus on research** which can lead to prototyping, proof of concepts and hopefully some start-up company creation as well in the broader field of water tehnology

bbb) makes sense

ccc) The program looks very promising.

ddd) It is beneficial to have the option and emphasis available since water resources continues to become more important over time.

eee) Yes, it makes a lot of sense... We are spending an average of 5%-10% per project in **Storm Water retention, and decontamination** per project. Therefore, you looking an average of $50-100 million dollars per year State wide.

fff) Environmental Engineering in regards to CEQA is a definite need for engineers working in California.

ggg) "makes sense

hhh) is needed

iii) would provide better skills and knowledge in local area"

jjj) I am excited and look forward to it happen.

kkk) This type of program makes sense, especially since FSU is in the heart of the Central Valley. The demands on our water infrastructure and resources such as the local rivers and groundwater, will only increase over the next decade. Personally, I see **infrastructure rehabilitation, groundwater management and improved access to water resources** as being in the forefront of the next decade. Currently I'm aware of similar programs only at Cal Poly SLO and UC Davis. Many Fresno State graduates we interview have a very limited knowledge of the **irrigation district level work in the area and how it relates to the Valley**. We spend a considerable amount of time to train people on **ag irrigation districts and how they relate to the regional water picture.** I would suggest any program include coursework related to **irrigated agriculture**.

lll) Overall would benefit the valley engineers, but there appears to be more of a sanitary/civil works engineering focus and lacks **environmental restoration and water resources planning courses**

mmm) The program makes sense for our area. The program should **emphasis how to reuse surface water** as the underground supply is limited and being depleted.

nnn) This program will prove very beneficial for public works and their supporting consutl

ooo) yes, it makes sense as these are becoming ncreasingly more important

2. Critical or will not applicable to their needs:

a) Our firm sells pumps & pump systems to engineering firms. WREE program seems better suited to people who want to become consulting engineers.

b) We do limited work in WEWW

c) I'm not sure why the more specialized program is necessary.

d) Not Needed

e) It is unlikely that the proposed graduate program will better prepare new graduates to work at our firm. The University would be better served by increasing the number of hands-on laboratories and activities in the basic BSCE program to better prepare students for the real workforce. I have a graduate degree, but in our hires have found a low correlation between the possession of a graduate degree and the ability to perform in the real world work environment. The University needs to focus its efforts on a stronger BS program.

f) Limitation is that it is a 2 hour drive from Bakersfield. Bakersfield residents would benefit more if Cal State Bakersfield had a similar program.

g) Fine idea whos time has come

3. Other:

a) I think it makes sense, but I am unsure if there is enough jobs to support it.

b) Water quality and reclmation is paramount here in the valley

c) There is a need for removing the political manipulation in the water/sewer industry. The need to close the loop between production and waste is here, now.

d) I am not an engineer, therefore I can only state that any program which emphasizes wastewater issues would be useful to someone entering the wastewater field as an engineer.

e) Any educational opportunities than enhance the ability of operations would be benifitual. Each facility has it's specific requirements but overall are basically the same and would require internship as part of the educational process.

f) I am in favor of both the 30 and 15 unit courses

g) yes

h) Would be another option available

i) The program would be most useful in the northern part of California as of now. In later years the rest of California could benefit. Most important is to train students to preserve without hindering construction and social development.

j) Not knowing the curricula, I couldn't say.

k) It would be most useful for larger design firms and metropolitan areas. Bakersfield, Visalia, Fresno & Modesto.
l) Agricultural emphasis is not going to increase pay. If you want to encourage enrollment, you need to demonstrate it is worth the investment in substantially increased salary capability.
m) Few "water engineers" actually know how to purify water. This is the 21st century... it appears that the ancient Romans knew more than most engineers involved in water. We need to teach simple basics and how to solve problems.
n) It sounds like a valuable program, but we wouldn't be able to tell until we assess the graduates on the job.
o) Its nice but may take to long and may be to expensive with all the cost increases that have occurred in the last 3-4 years. Maybe have half the classes online would make it more attractive. Also there is going to be a Professional Masters in Water on Fresno State campus, you may want to incorporate this into that.
p) WE NEED TRAINED PEOPLE IN THE INDUSTRY AND DO NOT SEE THEM IN THE MARKET
q) This is a resurrection of sorts. I obtained a master's in civil engineering with an emphasis in water resources from Fresno State in 1992. The curriculum was developed by Karl Longley for my water resources background and desires and was very similar to what is proposed.
r) We all need to increase our knowledge and keep up to date on information.
s) Any program with water training of any kind would be helpful in the water industry.

B. Program/Course Structure, Mode of Course Delivery:

1. See above comments A.1., Parts b, c. aaa,
2. See above comments A.3., Parts e, f, o,
3. Would need to shadow or be mentored by water industry experts.
4.

C. Program Curriculum:

1. See highlighted comments above.
2. I think the CE246 courses should be combined into one; I don't really see a need to go too much into each type of treatment that two courses are needed. Environmental Chemistry is feeling the same way. Bbased on no available course description, I don't see a need to go into Env Chem for 16 weeks. It's not clear the purpose for taking a course from the Craig School of Business. Will this be tied with the PSM in Water Resource Management (i.e., will students be allowed to take classes offered under the PSM)? Overall, I think the **Env. Eng. aspect of this program could be improved with different course offerings**. Environmental engineering **isn't just water/wastewater treatment**.
3. must be grounded in real world application; not academic principles.
4. we need to ability to think big picture. how supply and quality work together, and the political and econimic drivers or impedences. instead of a course from Craig school of business, **perhaps a course for the Public Administration (MPA) program**
5. Not sure I have enough info to assess, but water and groundwater are growing issues in the valley and state....we anticipate continuing to grow in this area.

_____

End (as of February 4, 2013)

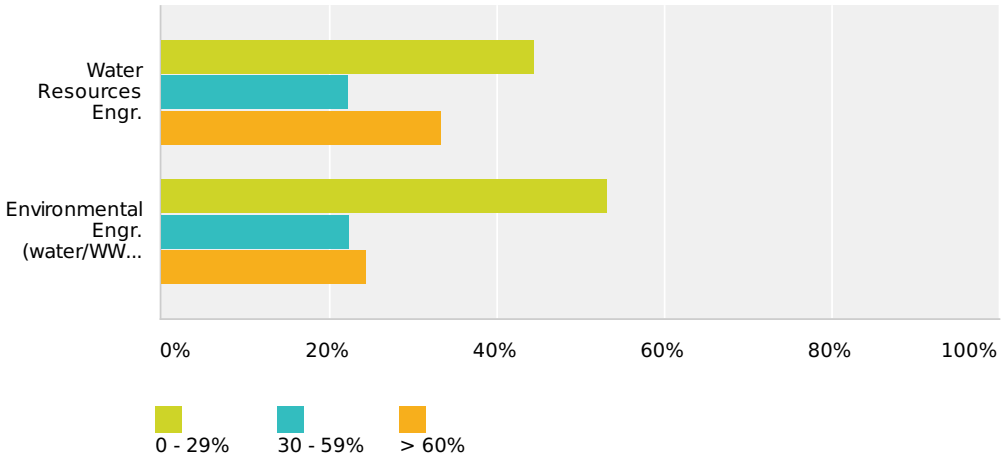
Q1 Biographical Information:

Answered: 99 Skipped: 10

Answer Choices	Responses	
Company or Institution name?	**98.99%**	98
Type of Industry(Ag./Irrig. Water District, Flood Control District, Federal/State/Local-Water Resources, Municipal Potable Water, Municipal Wastewater, Federal/State/Local-Water Pollution Control, Design Consulting, Envir. Impact Consulting, Utility Masterplan Consulting, Groundwater Remediation, Manufacturing, Hydrologic Model Consulting, Other):	**91.92%**	91
Title:	**94.95%**	94
Total Respondents: 99		

Q2 What percentages of the following types of work are routinely fulfilled in your firm/dept.?

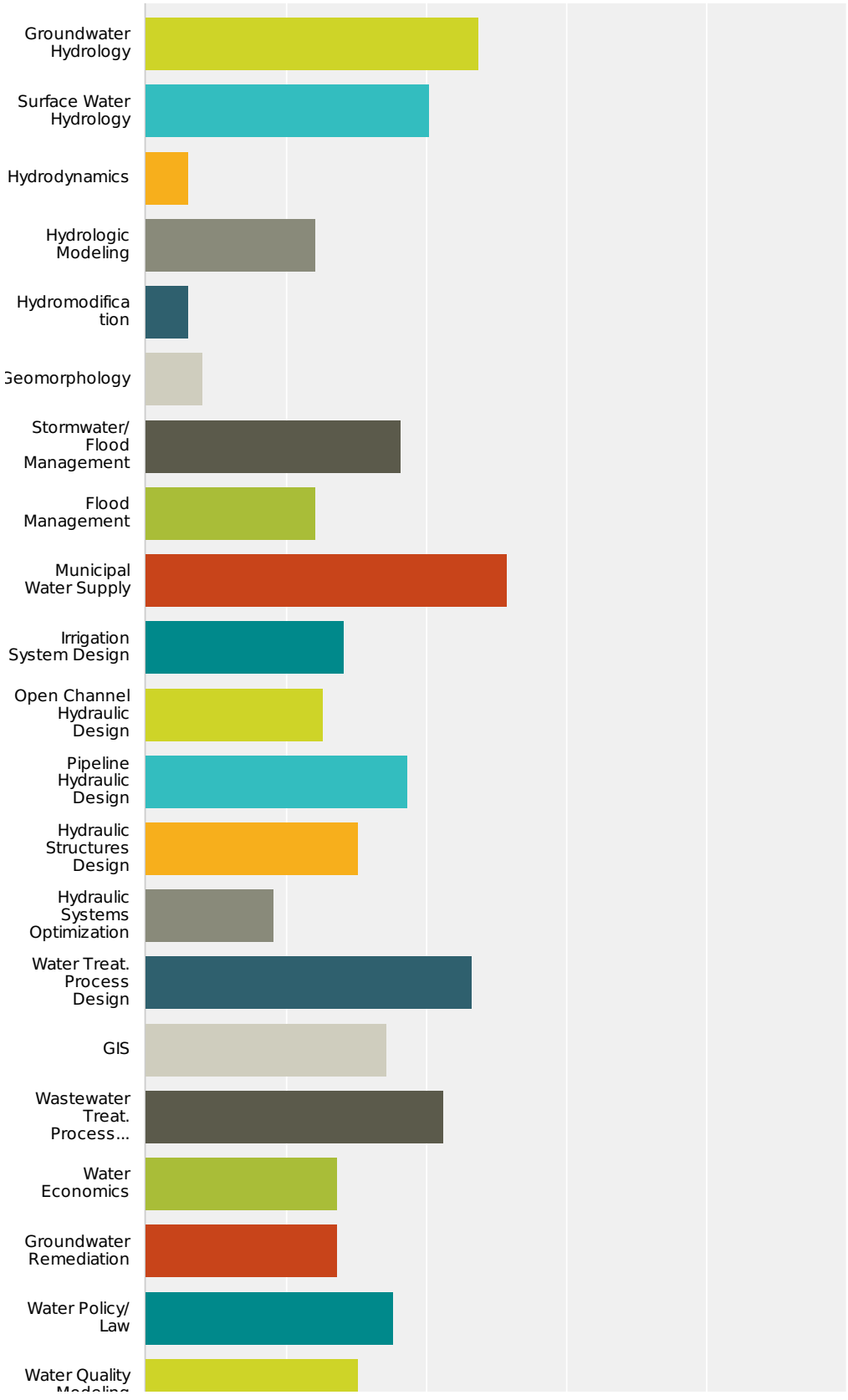
Answered: 97 Skipped: 12

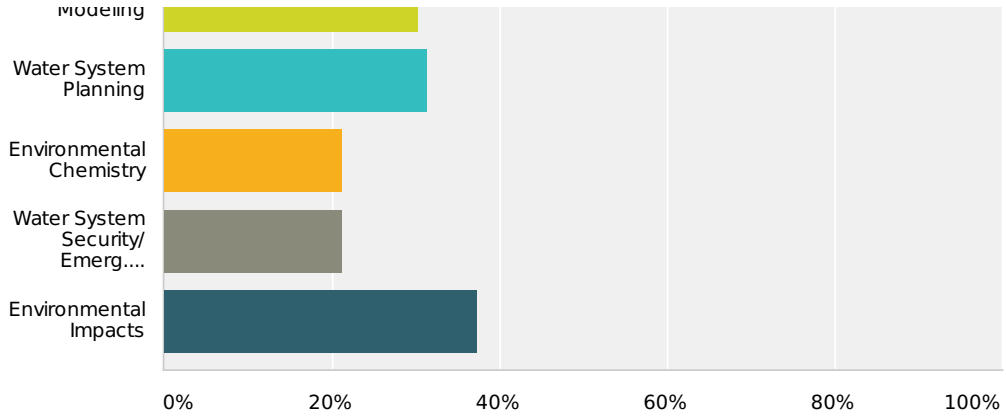


	0 - 29%	30 - 59%	> 60%	Total Respondents
Water Resources Engr.	**44.44%** 40	**22.22%** 20	**33.33%** 30	90
Environmental Engr. (water/WW treatment, Envir. Impacts; etc...)	**53.19%** 50	**22.34%** 21	**24.47%** 23	94

Q3 Identify those areas of professional knowledge or skill that will be most important for your organization in the next decade. Choose up to 3.

Answered: 99 Skipped: 10

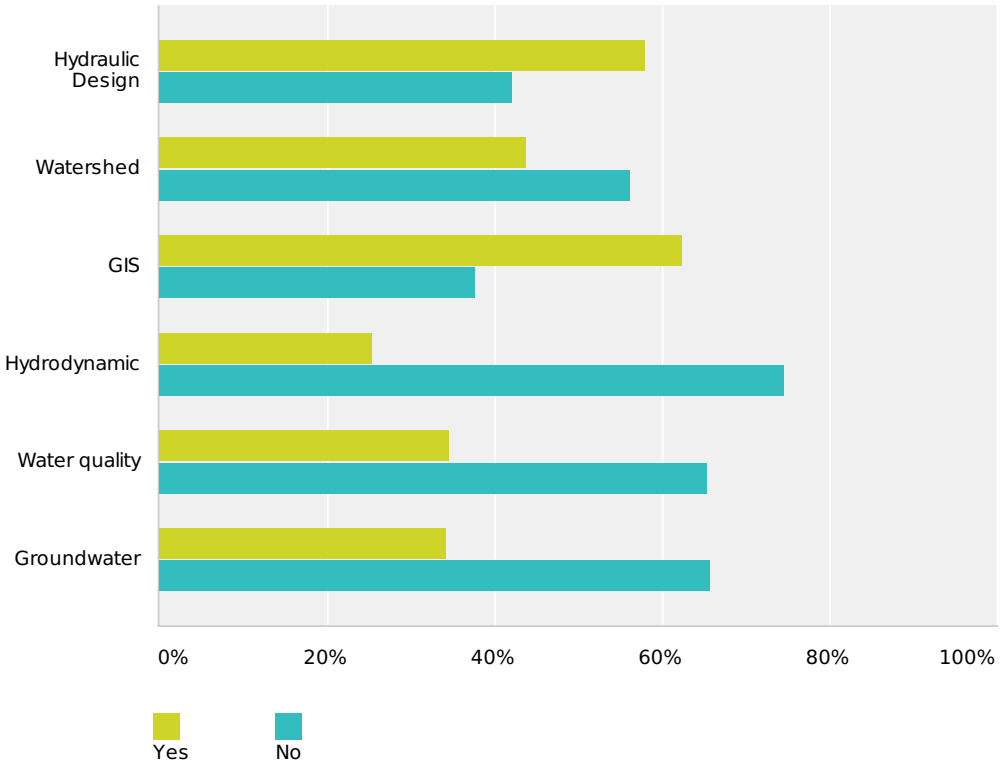




Answer Choices	Responses	
Groundwater Hydrology	**47.47%**	47
Surface Water Hydrology	**40.40%**	40
Hydrodynamics	**6.06%**	6
Hydrologic Modeling	**24.24%**	24
Hydromodification	**6.06%**	6
Geomorphology	**8.08%**	8
Stormwater/ Flood Management	**36.36%**	36
Flood Management	**24.24%**	24
Municipal Water Supply	**51.52%**	51
Irrigation System Design	**28.28%**	28
Open Channel Hydraulic Design	**25.25%**	25
Pipeline Hydraulic Design	**37.37%**	37
Hydraulic Structures Design	**30.30%**	30
Hydraulic Systems Optimization	**18.18%**	18
Water Treat. Process Design	**46.46%**	46
GIS	**34.34%**	34
Wastewater Treat. Process Design	**42.42%**	42
Water Economics	**27.27%**	27
Groundwater Remediation	**27.27%**	27
Water Policy/ Law	**35.35%**	35
Water Quality Modeling	**30.30%**	30
Water System Planning	**31.31%**	31
Environmental Chemistry	**21.21%**	21
Water System Security/ Emerg. Management	**21.21%**	21
Environmental Impacts	**37.37%**	37
Total Respondents: 99		
Other (please specify) (7)		

Q4 Does your firm/agency currently use water resources/environmental engineering modeling software?

Answered: 94 Skipped: 15

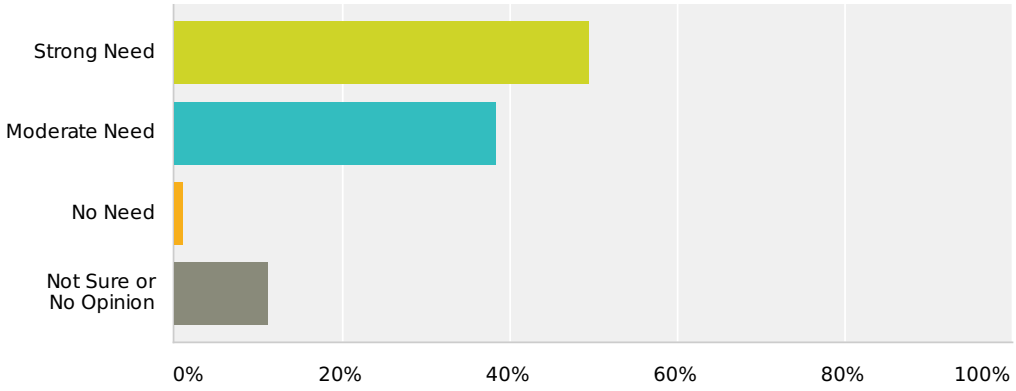


	Yes	No	Total
Hydraulic Design	**57.95%** 51	**42.05%** 37	88
Watershed	**43.75%** 35	**56.25%** 45	80
GIS	**62.35%** 53	**37.65%** 32	85
Hydrodynamic	**25.37%** 17	**74.63%** 50	67
Water quality	**34.57%** 28	**65.43%** 53	81
Groundwater	**34.25%** 25	**65.75%** 48	73

Other (please specify) **(5)**

Q5 In your opinion, is there a need for a Water Resources and Environmental Engineering (WREE) Graduate Degree at Fresno State?

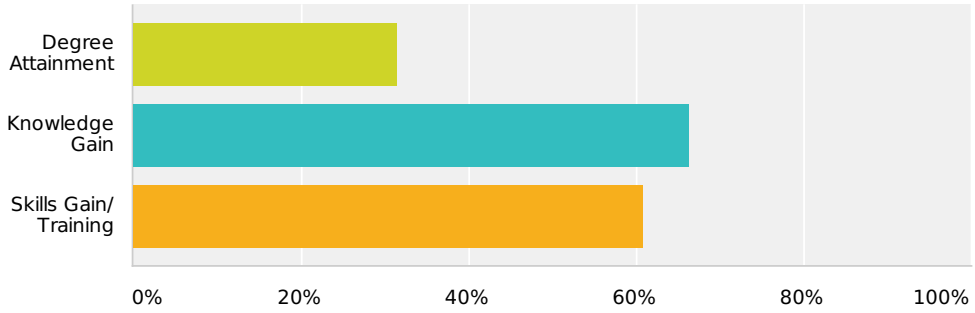
Answered: 99 Skipped: 10



Answer Choices	Responses	
Strong Need	**49.49%**	49
Moderate Need	**38.38%**	38
No Need	**1.01%**	1
Not Sure or No Opinion	**11.11%**	11
Total		99

Q6 What aspects of the proposed WREE program option are of greatest importance to you and what changes would you recommend be made in the proposed WREE program? http://zimmer.csufresno.edu/~wfwright/FresnoStateCivilEngrWREE_Option.htm

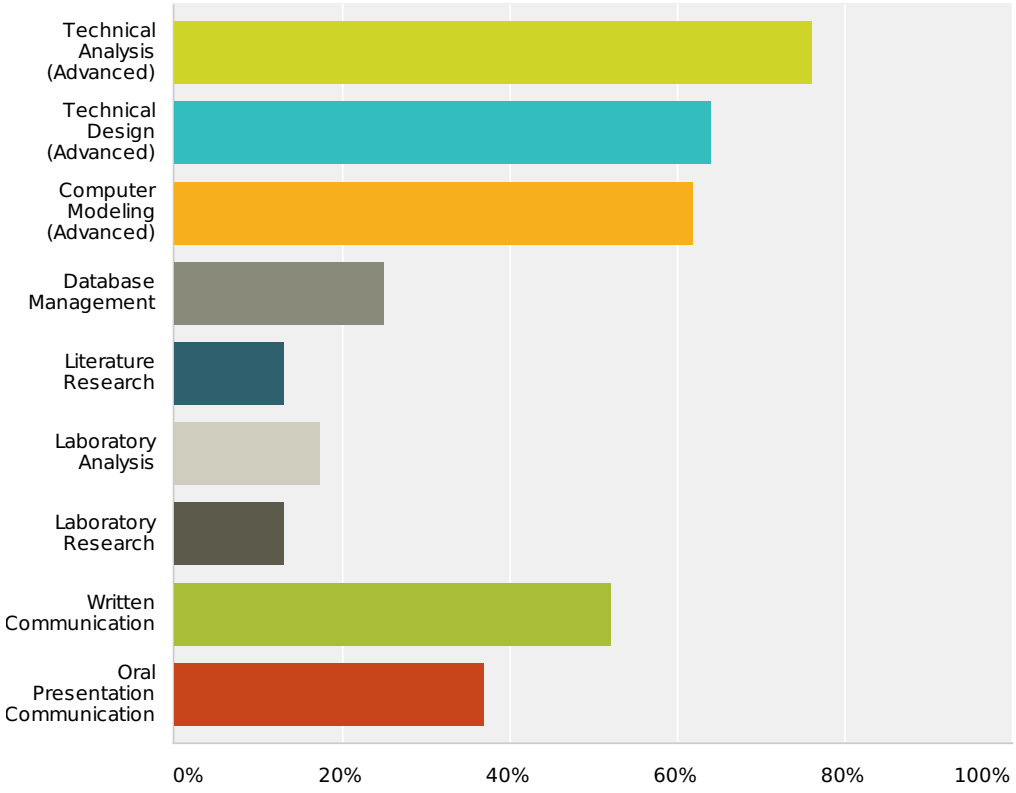
Answered: 92 Skipped: 17



Answer Choices	Responses	
Degree Attainment	**31.52%**	29
Knowledge Gain	**66.30%**	61
Skills Gain/ Training	**60.87%**	56
Total Respondents: 92		
Recommended changes to the WREE program (21)		

Q7 What academic skills should WREE program option graduates have as they enter the job market that they would typically not possess after earning their BSCE or equivalent degree? Check up to 3

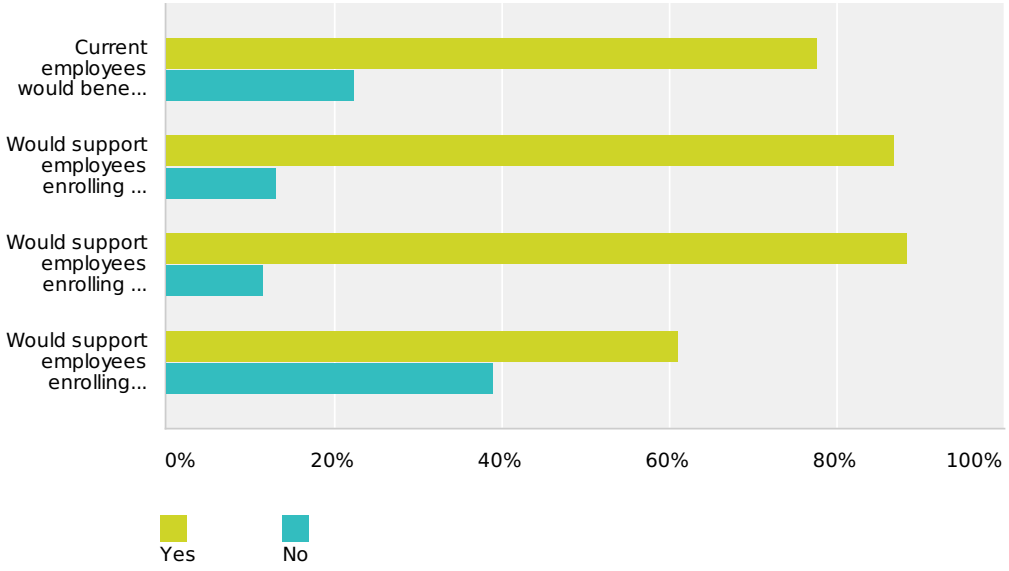
Answered: 92 Skipped: 17



Answer Choices	Responses	
Technical Analysis (Advanced)	**76.09%**	70
Technical Design (Advanced)	**64.13%**	59
Computer Modeling (Advanced)	**61.96%**	57
Database Management	**25%**	23
Literature Research	**13.04%**	12
Laboratory Analysis	**17.39%**	16
Laboratory Research	**13.04%**	12
Written Communication	**52.17%**	48
Oral Presentation Communication	**36.96%**	34
Total Respondents: 92		
Other (please specify) (6)		

Q8 Would current employees who perform WREE-related work but do not have a WREE-related graduate degree benefit from having one in terms of their ability better serve the needs of your company/ dept.? Would you support their enrollment in the proposed 30-unit WREE program? Would you support their enrollment in a shorter (15 unit) Water Engineering Graduate Certificate program? If no to the above, would you support their enrollment if the courses were offered online rather than in classroom except for a two-week intensive laboratory activity (6 - 8 hours per day for 10 work days)?

Answered: 92 Skipped: 17

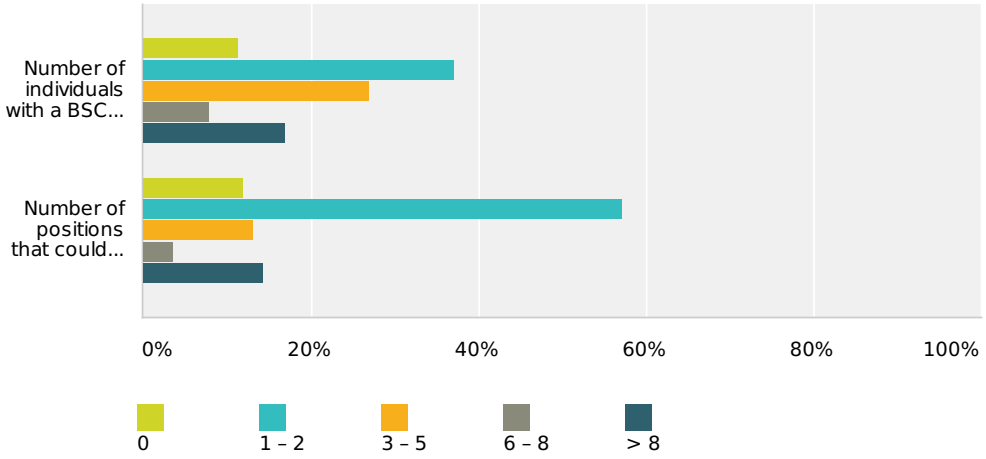


	Yes	No	Total
Current employees would benefit from having a WREE master's degree	**77.65%** 66	**22.35%** 19	85
Would support employees enrolling in the proposed WREE program	**86.90%** 73	**13.10%** 11	84
Would support employees enrolling in a 15 unit certificate program	**88.51%** 77	**11.49%** 10	87
Would support employees enrolling only if courses were largely on-line	**61.04%** 47	**38.96%** 30	77

Comments: **(** 10 **)**

Q9 Indicate the number of (a) individuals in your firm/agency with a BSCE or equivalent could benefit from the proposed WREE program and (b) positions in your firm/ agency that could be filled by WREE program graduates

Answered: 90 Skipped: 19



	0	1 – 2	3 – 5	6 – 8	> 8	Total
Number of individuals with a BSCE or equivalent who could benefit:	**11.24%** 10	**37.08%** 33	**26.97%** 24	**7.87%** 7	**16.85%** 15	89
Number of positions that could be filled by WREE graduates:	**11.90%** 10	**57.14%** 48	**13.10%** 11	**3.57%** 3	**14.29%** 12	84

Q10 What is your overall assessment of this proposed program? Does it make sense? What are its strengths/ limitations?

Answered: 99 Skipped: 10

#	Responses	Date
1	Would need to shadow or be mentored by water industry experts.	2/2/2013 9:31 PM
2	N/A	2/1/2013 10:00 AM
3	There will continue to be a high demand for this area since water is a depleting limited resource.	1/31/2013 12:46 PM
4	I sounds like a good idea given the importance of water for CA. Program needs to be rigerous and provide practical/applied experience. Would need to include knowledge about NEPA/CEQA and if students don't have a chemistry background they would need a course with lab.	1/30/2013 4:35 PM
5	My perspective is limited. The degree would help in all water resource related fields, especially if there is active collaboration between the academic program developers and the water resources community. It does make sense but it appears there is, at this time, a limited demand in the private sector. If properly designed and evolved It could become or facilitate a "focus group" of sorts on developing water issues.	1/30/2013 12:15 PM
6	I think it is good and the more understanding of the water systems the better	1/29/2013 12:00 PM
7	This program appears to be a much needed course of education to prepare for work in a field that will only continue to grow for the forseeable future.	1/29/2013 9:36 AM
8	I think it makes sense, but I am unsure if there is enough jobs to support it.	1/29/2013 7:48 AM
9	offers specialized training in water resources engineering and would be very relative to what we do in the DWP. A specialized degree allows the students to come out with a specific skill set.	1/28/2013 1:48 PM
10	Yes it makes sense	1/28/2013 12:08 PM
11	There is a lack of well-trained workforce for the water and wastewater Industry. This sound like a great program and is much needed.	1/28/2013 12:04 PM
12	I think this is a much needed program which would help satisfy a need.	1/28/2013 8:45 AM
13	Water quality and reclmation is paramount here in the valley	1/28/2013 8:28 AM
14	There is a need for removing the political manipulation in the water/sewer industry. The need to close the loop between production and waste is here, now.	1/28/2013 8:18 AM
15	I am not an engineer, therefore I can only state that any program which emphasizes wastewater issues would be useful to someone entering the wastewater field as an engineer.	1/28/2013 7:24 AM
16	It sounds like it would be very exiting	1/28/2013 6:52 AM
17	Any educational opportunities than enhance the ability of operations would be benifitual. Each facility has it's specific requirements but overall are basically the same and would require internship as part of the educational process.	1/27/2013 4:47 PM
18	From what I understand it could be good.	1/26/2013 5:27 PM
19	I am in favor of both the 30 and 15 unit courses	1/26/2013 8:18 AM
20	State of California Water Resources Control Board is always sending me emails asking me to apply and then I get disqualified because I don't have an actual WREE degree.	1/25/2013 11:55 PM
21	yes	1/25/2013 6:00 PM
22	Our firm sells pumps & pump systems to engineering firms. WREE program seems better suited to people who want to become consulting engineers.	1/25/2013 5:27 PM
23	Yes - It would be of value in the market place.	1/25/2013 10:01 AM
24	CT has a Stormwater branch, this program might benefit those folks and some in the Environmental Department.	1/24/2013 9:26 AM
25	Great idea.	1/24/2013 8:03 AM
26	Recommendable for future water resources engineering services	1/23/2013 2:18 PM
27	This program is highly needed. Many federal and state agencies are in need of students who know the watershed system of the state for future growth.	1/23/2013 10:47 AM
28	Would be another option available	1/23/2013 7:41 AM

#	Responses	Date
29	Water resources and the issues that come with water will continue to need to be addressed by engineers. The WREE program will help ensure the engineering community is populated with water specialists. In addition to BSCE graduates, the WREE grads are the type of graduates that a firm with water/wastewater departments may prefer to recruit from.	1/23/2013 6:52 AM
30	We do limited work in WEWW	1/22/2013 7:23 PM
31	The program would be most useful in the northern part of California as of now. In later years the rest of California could benefit. Most important is to train students to preserve without hindering construction and social development.	1/22/2013 5:03 PM
32	I would hope a focused degree would open doors for qualified indiviuals; however, an MSCE with water/environmental emphasis might do the same. I do think the focused degree could be a draw for potential students, which would help the university. There is such a growing concern about these resources globally - hopefully there is funding that will be growing to support the work also.	1/22/2013 4:59 PM
33	The proposed inclusion of a WREE program could act as a great strength for Fresno State. Being in the middle of such a large agricultural area as the San Joaquin Valley, there is a great need for a degree program emphasizing water and environmental aspects of engineering. Bear in mind if/when developing the syllabus, the only opportunity most of the students going into a WREE field will have to study structures, dynamics, etc. (areas heavily emphasized on the PE exam) will be through education. They will also utilize many of these skill sets when working in the public or private sectors as agencies will rely on their own engineers to design the majority of in-house construction projects. Lack of knowledge in any one of these areas will need to be supplemented with the ability for a young engineer to know how and where to find the material they need.	1/22/2013 4:20 PM
34	Yes it would provide additional option to specialize in. Also it would impart the necessary modeling and design skills that employers are looking for.	1/22/2013 4:03 PM
35	More specifics about the topics that will be covered but otherwise seems like a program Fresno State needs to have in the future	1/22/2013 3:42 PM
36	It probably makes sense, just not so much for those who work in my particular field.	1/22/2013 3:27 PM
37	Not knowing the curricula, I couldn't say.	1/22/2013 3:20 PM
38	Yes	1/22/2013 3:09 PM
39	The program seems to address needs of the valley as it relates to domestic water supply, waste water, storm water and environmental impacts.	1/22/2013 10:55 AM
40	In my experience, civil engineering students leaving Fresno State don't seem to have a good grasp of water quality concepts, regulations and policy, GIS, modeling, or hydrology in general. I think the program could address this and provide us with informed staff and future leadership to get us through tough times ahead. I think the program could be very successful as long as you find folks who would be qualified to present this information to students.	1/22/2013 10:28 AM
41	It would be most useful for larger design firms and metropolitan areas. Bakersfield, Visalia, Fresno & Modesto.	1/22/2013 9:36 AM
42	The WREE program sounds like it would be a great program. However, my coworkers and I do not need such a degree in addition to or outside of a BSCE to do our job. I think Fresno State should still persue the program, because other engineering firms/agencies could use individulas with this kind of knowledge.	1/22/2013 9:31 AM
43	The proposed program looks very strong as mentioned earlier. It would be important to identify the right courses in the Craig School of Business and the Ag department. This program would fit a strategic need in this region and for the future growth direction for Grundfos. We are currently building a team in Fresno and the Bay area focused on Water Treatment technologies related to research and commercial viability.	1/21/2013 4:12 PM
44	With water resources becoming more and more critical with each passing year, it makes sense to emphasize research and forward thinking planning in these areas at our universities. Current engineering programs do not delve deep enough into these areas with current curriculum.	1/21/2013 9:24 AM
45	This program is needed by our area. A few general comments: -it appears that statistics courses are available, I would make at least one course in statistics mandatory -encouragement to step out to take a course in water rights, policy, or business is a great idea -it's not clear how much writing and speaking will be required. We value grads that start out writing and presenting well.	1/20/2013 3:55 PM
46	I think the CE246 courses should be combined into one; I don't really see a need to go too much into each type of treatment that two courses are needed. Environmental Chemistry is feeling the same way. Bbased on no available course description, I don't see a need to go into Env Chem for 16 weeks. It's not clear the purpose for taking a course from the Craig School of Business. Will this be tied with the PSM in Water Resource Management (i.e., will students be allowed to take classes offered under the PSM)? Overall, I think the Env. Eng. aspect of this program could be improved with different course offerings. Environmental engineering isn't just water/wastewater treatment.	1/19/2013 7:07 PM
47	must be grounded in real world application; not academic principles.	1/19/2013 12:05 PM
48	Yes, in this water short valley it very much is needed so more people can receive an understand the future of water needs.	1/18/2013 5:31 PM

#	Responses	Date
49	Yes. It's an excellent step toward placing Fresno State at the center of water research, policy, education and technology.	1/18/2013 2:10 PM
50	Water quality protection is our mission; an advanced environmental engineering curriculim focusing on water quality impacts owuld be most useful to our organization.	1/18/2013 1:42 PM
51	This program is a great idea. It may foster innovation	1/18/2013 10:26 AM
52	In theory this sounds like a worthwhile program. It is important to provide real world advanced design problems for the program participants.	1/18/2013 9:44 AM
53	The program makes sense. It will be difficult to hire or get financing for current employees to take classes for 3 to 5 years.	1/18/2013 8:47 AM
54	Agricultural emphasis is not going to increase pay. If you want to encourage enrollment, you need to demonstrate it is worth the investment in substantially increased salary capability.	1/17/2013 7:37 PM
55	Few "water engineers" actually know how to purify water. This is the 21st century... it appears that the ancient Romans knew more than most engineers involved in water. We need to teach simple basics and how to solve problems.	1/17/2013 3:40 PM
56	none	1/17/2013 3:35 PM
57	I'm not sure why the more specialized program is necessary	1/17/2013 3:17 PM
58	Good idea, and a good starting point for further expansion.	1/17/2013 2:49 PM
59	Overall, the proposed program makes sense. It should include develpment of relationships (working with groups), communication, presentations, and working with computer models.	1/17/2013 2:37 PM
60	It sounds like a valuable program, but we wouldn't be able to tell until we assess the graduates on the job.	1/17/2013 2:13 PM
61	Water resources management will be an ever-increasing area of concern and focus as various global trends progress (population growth, urbanization, growing middle class, climate change, etc.). A workforce conditioned and trained to manage these topics will be essential in the future.	1/17/2013 2:09 PM
62	Good start and it makes sense	1/17/2013 1:45 PM
63	Not Needed	1/17/2013 1:44 PM
64	Defnitely makes sense	1/17/2013 1:42 PM
65	Its nice but may take to long and may be to expensive with all the cost increases that have occurred in the last 3-4 years. Maybe have half the classes online would make it more attractive. Also there is going to be a Professional Masters in Water on Fresno State campus, you may want to incorporate this into that.	1/17/2013 1:37 PM
66	WE NEED TRAINED PEOPLE IN THE INDUSTRY AND DO NOT SEE THEM IN THE MARKET	1/17/2013 1:36 PM
67	I think that the WREE program would meet the needs of a number of consulting firms and government agencies that deal with water resource issues in the valley/state.	1/17/2013 1:28 PM
68	Great idea and is needed. Sign me up!	1/17/2013 1:19 PM
69	Would be a positive addition to the School of Engineering. Hope that there will be funding available	1/17/2013 1:15 PM
70	This is a resurrection of sorts. I obtained a master's in civil engineering with an emphasis in water resources from Fresno State in 1992. The curriculum was developed by Karl Longley for my water resources background and desires and was very similar to what is proposed.	1/17/2013 1:14 PM
71	It seems like it would be a good addition to the curriculum and would provided needed skills to graduates in this geographic area.	1/17/2013 1:11 PM
72	make sense	1/17/2013 1:10 PM
73	I like this program a lot. I wish it had been in place when I graduated in May 2012 from FSU. I have a MSCE from FSU and in reality I feel that this new M.S. in WREE is much more appropriate for what I learned in my graduate program. My MSCE seems to portray an inaccurate picture of my educational background in my opinon, For the work I do the M.S.WREE would provide a better picture of my educational background and skill set.	1/17/2013 12:10 PM
74	Looks like a good start. May need to have additonal courses as program matures.	1/17/2013 12:06 PM
75	It makes sense. I think it is a great idea	1/17/2013 12:06 PM
76	I think it is greatly needed because there is a lack of knowledgeable engineers in the Central Vally in the water quality and treatment fields.	1/17/2013 11:19 AM
77	I think it very beneficial.	1/17/2013 10:58 AM
78	Good competition for Cal Poly's program. Water is critical in the Valley and we need engineers now and in the future who can address these needs/issues.	1/17/2013 10:12 AM

#	Responses	Date
79	CSUF NEEDs a program like this, but it is very important that you look at other academic institutions and evaluate what works and what does not work in terms of research and job creation for the graduates. There needs to be jobs on the back-end and CSUF is competing with other institutions. I suggest strong focus on research which can lead to prototyping, proof of concepts and hopefully some start-up company creation as well in the broader field of water tehnology	1/17/2013 9:58 AM
80	It is unlikely that the proposed graduate program will better prepare new graduates to work at our firm. The University would be better served by increasing the number of hands-on laboratories and activities in the basic BSCE program to better prepare students for the real workforce. I have a graduate degree, but in our hires have found a low correlation between the possession of a graduate degree and the ability to perform in the real world work environment. The University needs to focus its efforts on a stronger BS program.	1/17/2013 9:12 AM
81	makes sense	1/17/2013 8:21 AM
82	The program looks very promising.	1/16/2013 3:45 PM
83	It is beneficial to have the option and emphasis available since water resources continues to become more important over time.	1/16/2013 3:09 PM
84	Yes, it makes a lot of sense... We are spending an average of 5%-10% per project in Storm Water retention, and decontamination per project. Therefore, you looking an average of $50-100 million dollars per year State wide.	1/16/2013 12:12 PM
85	Environmental Engineering in regards to CEQA is a definite need for engineers working in California.	1/16/2013 11:49 AM
86	makes sense is needed would provide better skills and knowledge in local area	1/16/2013 11:29 AM
87	I am excited and look forward to it happen.	1/16/2013 11:04 AM
88	This type of program makes sense, especially since FSU is in the heart of the Central Valley. The demands on our water infrastructure and resources such as the local rivers and groundwater, will only increase over the next decade. Personally, I see infrastructure rehabilitation, groundwater management and improved access to water resources as being in the forefront of the next decade. Currently I'm aware of similar programs only at Cal Poly SLO and UC Davis. Many Fresno State graduates we interview have a very limited knowledge of the irrigation district level work in the area and how it relates to the Valley. We spend a considerable amount of time to train people on ag irrigation districts and how they relate to the regional water picture. I would suggest any program include coursework related to irrigated agriculture.	1/16/2013 11:01 AM
89	Overall would benefit the valley engineers, but there appears to be more of a sanitary/civil works engineering focus and lacks environmental restoration and water resources planning courses	1/16/2013 10:57 AM
90	.	1/16/2013 10:56 AM
91	The program makes sense for our area. The program should emphasis how to reuse surface water as the underground supply is limited and being depleted.	1/16/2013 10:54 AM
92	we need to ability to think big picture. how supply and quality work together, and the political and econimic drivers or impedences. instead of a course from Craig school of business, perhaps a course for the Public Administration (MPA) program	1/16/2013 10:34 AM
93	Limitation is that it is a 2 hour drive from Bakersfield. Bakersfield residents would benefit more if Cal State Bakersfield had a similar program.	1/16/2013 9:26 AM
94	This program will prove very beneficial for public works and their supporting consutlants	1/15/2013 1:03 PM
95	Not sure I have enough info to assess, but water and groundwater are growing issues in the valley and state....we anticipate continuing to grow in this area.	1/15/2013 11:35 AM
96	yes, it makes sense as these are becoming ncreasingly more important	1/15/2013 10:42 AM
97	We all need to increase our knowledge and keep up to date on information.	1/15/2013 10:38 AM
98	Any program with water training of any kind would be helpful in the water industry.	1/15/2013 10:22 AM
99	Fine idea whos time has come	1/14/2013 5:17 PM

Enrollment, Graduates, & Employment in Water Resources & Environmental Engineering

Literature Review by

The Department of Civil and Geomatics Engineering
Lyles College of Engineering, California State University Fresno

Fayzul Pasha, PhD, PE
Lubo Liu, PhD, PE
William Wright, PhD, PE

January 13, 2013

Among many other professionals' water resources and environmental engineers play a key role in sustainable water infrastructures design, construction, operation, maintenance, and developing best water resources management practices. Potential employers of these water resources and environmental engineers are diverse and extensive, ranging from local, regional, and state governments up through national governments, and from small start-up companies to major companies in the Dow Jones Industrial Average index. The scope of water and environmental engineering projects are likewise diverse and extensive with scales that span local, regional, national to international levels. Numerous fields of work will require more water resources and environmental engineers in the future, including, river restoration, environmental remediation, hydropower production, water supply and distribution systems, water treatment, and storm water management to name a few. With the advancement of the idea of green technology, the need of water resources and environmental engineers is greater than ever before. To cope with these needs the universities are offering new programs specializing in water resources and environmental engineering. The complex interaction of different components of natural and man-made hydro systems also requires engineer to have an advanced degree in specialized area to fully understand the complexity and to apply the principles for design, construction, operation, and management purposes.

The National Center for Education Statistics (2012) reported that the graduate enrollment in engineering and science programs increased from 101,148 in 1997 to 144,677 in 2009. The increment is about 43% in 12 years. A similar trend has been observed in civil engineering graduate programs, which includes the water resources and environmental engineering option (along with other specialization areas), where enrollment has increased from 17,193 in 1997 to 18,638 in 2009.

The need to extend engineering education beyond a 4-year Bachelor's has been recognized by the professional engineering community for many years with the explosion in

modern technology, and the requirement of an ever-broader education for engineering practice (Dorato and Lyons, 2002). The master's degree are increasingly proposed to be considered as the first professional engineering degree due to the insufficient accommodation of the typical engineering baccalaureate degree to the academic development now required for professional engineers (Goktas and Rogers, 2010; the National Academy of Engineering, 2005). Students are also becoming more aware of the importance of the engineering graduate degree (Goktas and Rogers, 2010). Consequently, the number of applications to U.S. engineering graduate programs increased annually by an average of approximately 4 percent over the period 1997 to 2007 (Bell, 2008). Trend analysis in degree-conferred shows that the number of graduates in engineering and engineering technology from 1949 to 2011 increases significantly. While the number of graduates with Master's degree in engineering and engineering technology in 1949-50 is 4,496 the number in 2010-11 is 43,234 with about 860% percent increase (National Center for Education Statistics, 2012). It is understood that the needs in 2010 is much higher than that in 1950. However, comparing the data from 2000 to 2010 same trend is also observed. In 2000-01 the number of graduates with Master's degree in engineering and engineering technology is 27,187 and that in 2010-11 is 43,234 with an increase of about 59%. The percent changes in the graduates from 2000-01 to 2005-06 and from 2005-06 to 2010-11 are respectively 22.8% and 29.5% (National Center for Education Statistics, 2012) which clearly shows the trend of increase in the graduates with Master's degree in engineering and engineering technology.

Similar trend is also observed in graduates with Masters' degree in civil engineering program alone. While in 1970-71 the number of graduates is 2,425 the number in 2010-11 is 4,860 (National Center for Education Statistics, 2012). The percent change in graduates with Master's degree in civil engineering program[1*] from 2000-01 to 2005-06 is 13.8% and from 2005-06 to 2010-11 is 29.0%. The trends in enrollment and graduation in civil and other engineering graduate programs are increasing and the rate of increment is found significantly highin the last decade. Similar trend (about 34% increment) in graduates from 2009-10 to 2021-22 from Master's programs was also reported for the next decade by the Hussar and Bailey (2013):.

Bureau of Labor Statistics (2012a) projects 10.4% increase in architecture and engineering occupations from 2010 to 2020. The education requirements for these jobs will generally be higher. It is projected that the Master's degree requirement for these jobs will increase 21.7% from 2010 to 2020 (Bureau of Labor Statistics, 2012a). While civil engineering employment is projected to increase 19% from 2010 to 2020, environmental engineering employment is projected to increase 22% for the same time period (Bureau of Labor Statistics,

2012b). Since civil engineering generally includes environmental engineering and other options in civil engineering it is anticipated that the rate of job increase in environmental engineering is significantly faster than general civil engineering. Bureau of Labor Statistics (2012b) projects 18% increase in hydrologist job. This job will generally require Master's degree. While nationwide, the employment in the area of water resources and environmental engineering is projected to grow at a higher rate in the current decade, similar trend is also observed in the county of Fresno. It is projected that there will be 7.5% increase in general engineering jobs from 2008 to 2018 in the county of Fresno (California Employment Development Department, 2013). While the increase in civil engineering jobs will be 4.7%, the increase in environmental engineering job will be 11.1% in the county of Fresno.

1*: Masters in civil engineering includes water resources and environmental engineering with other options.

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AKEL
ENGINEERING GROUP, INC.

Smart Planning Your Water Resources

February 15, 2013

California State University Fresno
Lyles College of Engineering, M/S EE94
Attention: Dr. Ram Nunna, Dean
2320 East San Ramon
Fresno, CA. 93740

Subject: Support for the WREE Option - Civil Engineering Graduate Program

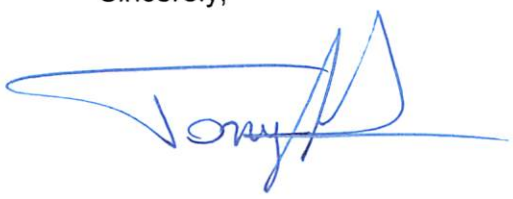
Dear Dr. Nunna:

It is with great enthusiasm that I support the relentless efforts by CE faculty in their quest to add the Water Resources and Environmental Engineering Option (Option) to the Civil Engineering Graduate Program.

I personally think the new Option will add significant benefits and enhanced graduates to the Civil Engineering industry, as well as more prestige and great opportunities to LCOE and the university.

I also commend the vision and efforts of CE water resources faculty under the leadership of Dr. Wright, and the strong guidance and encouragements from the Program Chair, Dr. Larralde. They are definitely pushing hard to enhance the student educational experience at LCOE and for better preparing and positioning graduates for current trends in the job market.

Sincerely,



Tony Akel, P.E.
President

cc: Dr. William Wright

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CALIFORNIA
Water Boards

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MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

Central Valley Regional Water Quality Control Board

1 March 2013

Dr. Ram Nunna, Dean
Lyles College of Engineering, M/S EE 94
2320 East San Ramon
Fresno, CA 93740

Dear Dr. Nunna,

WATER RESOURCES AND ENVIRONMENTAL ENGINEERING GRADUATE PROGRAM

It has been brought to my attention that the Lyles College of Engineering at California State University Fresno (CSUF) is considering adding a graduate program with emphasis in Water Resources and Environmental Engineering. I support this effort and belief it could have long-term benefits to the people of the Central Valley.

I serve as the Central Valley Water Board's executive officer. The Central Valley Water Board currently has 230 full time employees combined between its three offices in Redding, Rancho Cordova, and Fresno. The Fresno office currently has 52 full time employees: mostly water resource control engineers and engineering geologists. Over half (28) of the Fresno staff graduated from the CSUF, and ten of these are from the College of Engineering. Four of the staff engineers have master degrees from the College of Engineering and one individual is currently enrolled. Several additional individuals have taken graduate level classes in the college to improve skill and knowledge. Graduates from the California State University Fresno are the heart of the staff in the Fresno office, and I believe the same is true of sister state agencies like the Department of Water Resources and Department of Public Health.

A graduate level program with its emphasis on water resources and the environment would serve the Central Valley Water Board well. Our mission is to protect the quality of ground and surface waters in the Central Valley. With several staff approaching retirement and a growing emphasis on the water quality issues in the southern part of the San Joaquin Valley like regulation of irrigated agriculture, the Central Valley Water Board in general, and its Fresno office in particular, is expected to need high quality candidates in the future.

The other opportunity the program presents is for individuals currently employed by the Central Valley Water Board to enroll in the program for their personal goals of improving their knowledge and skills.

Finally, high quality water is the life blood to the Central Valley. It is necessary to sustain the agricultural industry and well as the residents in our growing communities. Even if graduates from this program are not eventually employed by the Central Valley Water Board, competent and knowledgeable individuals will be needed by other federal and state agencies, local governments, and consulting firms to address the many challenges we will all face in the future.

I hope the University will consider this letter in the important decision it has to make as to whether the program should be expanded to include this master program. Lonnie Wass, a Supervisory Engineer in the Fresno Office, serves on the College's Civil Engineering Advisory Committee and may be reached at (559) 445-6051 if you need any other information about the Central Valley Water Board.

Sincerely,

Clay L. Rodgers

for Pamela C. Creedon
Executive Officer

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February 15, 2013

Dr. Ram Nunna, Dean
Lyles College of Engineering, M/A EE 94
2320 East San Ramon
Fresno, CA 93740

Re: Water Resources & Environmental Engineering in LCOE's MSCE Program

Dear Dr. Nunna,

Provost & Pritchard Consulting Group ("Provost & Pritchard") is supportive of the proposal for the establishment of the Water Resources and Environmental Engineering Option in the Civil Engineering Graduate Program ("WREE"). Provost & Pritchard has the largest number of engineers in the Fresno area, providing engineering, planning, surveying, and environmental services to public and private clients throughout Central California. We employ a staff of approximately 120 in six offices in the San Joaquin Valley. Water resources are fundamental to most of our services, including water supply, water and wastewater treatment, distribution, and reuse in both the municipal and agricultural markets.

Water quality, both surface water and groundwater, is a critical component effecting water usage and water sustainability. An increased awareness and local expertise are needed for the improvement of local and regional water supplies and environmental stewardship. The proposed WREE program directly addresses the urgent requirements for future water supplies and distribution both locally and regionally.

We support the WREE program and look forward to the potential to work closely with the WREE program to help with the development of their system engineering research towards solutions most important for the water industry. The WREE is designed to fulfill a need for a highly educated workforce to plan, engineer, operate, and maintain an overall water infrastructure. As a consulting firm that relies on qualified staff to solve the ever-increasing water-related issues of our service area, we welcome and encourage the additional education, training, and resources that the WREE could provide.

Respectfully,

Dale K. Melville, P.E.
President

Copy: William Wright, Ph.D., P.E., CSUF

\\superior\docs\Employee Correspondence\Melville\Correspondence\Graduate Program - Water Resources and Env Eng Option.docx

CITY OF CLOVIS

PUBLIC UTILITIES DEPARTMENT
155 N. SUNNYSIDE AVENUE
CLOVIS, CA 93611

February 14, 2013

Dr. Ram Nunna, Dean
Lyles College of Engineering
M/S EE94
2320 East San Ramon
Fresno, CA 93740

Dear Dr. Nunna,

It is my pleasure to submit this letter of support for the establishment of a new Water Resources and Environmental Engineering (WREE) Option in the Civil Engineering Graduate Program.

The efficient use of water resources is critical to both economic prosperity and environmental sustainability in the Valley, in California, and worldwide. Water providers, such as the City of Clovis, along with our consultants, deal daily with the complex issues surrounding the competing demands for this finite resource. These issues are growing more complex as population and demand increase and more attention is paid to the environmental impacts of water policies. Additional professionals with expertise in this field are needed to address these issues, and the proposed WREE Option is an excellent means of preparing these individuals to meet the industry's demands. The proposed WREE Option is also complementary to Fresno State's other Water Programs, and is consistent with the California State University's Water Resources and Policy Initiatives.

In conclusion, I fully support the Water Resources and Environmental Engineering Option in the Civil Engineering Graduate Program. I believe the students that participate in the program would be valuable to water suppliers and consultants, and will further Fresno State's reputation as a leader in the field.

Sincerely,

Luke Serpa, P.E.
Interim Public Utilities Director

March 8, 2013

Dr. Ram Nunna
Dean, Lyles College of Engineering (M/S EE 94)
2320 East San Ramon, Fresno CA, 93740

Dear Dean Nunna:

It is my pleasure to write the letter in support of the proposal for a **Water Resources and Environmental Engineering (WREE) Option in the Civil Engineering Graduate Program at California State University Fresno.** California's Central San Joaquin Valley is well suited for agricultural production and habitation with its large expanses of rich soil and mild climate. However, full utilization of this richness depends on the development and maintenance of extensive and reliable water systems. This is particularly important in our region as arid conditions, exacerbated by climate change, renders the land hot and water-starved for long periods of time, and great distances separate major surface water sources from locations where water is needed. The climate necessitates the construction of massive water storage, transportation, and treatment systems, and the efficient use and reuse of all water resources.

Programs like these are crucial in the sustainability of water resources in SJV and the continued growth of the economy. Educating the next generation in our life giving force of water is key in unlocking the potential if our local ecosystem spearheading motivated students, faculty and hopefully create new start-ups and jobs for the future.

Long-term sustainability depends on having sufficient quantities of high quality water. California's water systems of the future will need to efficiently utilize existing water supplies as well as increase the use of non-traditional water sources, including agricultural, industrial, and domestic wastewaters. As such, people will increasingly be consuming water from these non-traditional sources. This will require the development of new treatment and monitoring technology to manage both conventional and new (emerging) contaminants in public drinking water supplies. To develop and manage California's massive water infrastructure, to achieve sustainability and reliability in water services, and to protect the public from contaminants of concern, a highly educated workforce with water-related expertise will be needed.

The WREE Option will be offered through the Department of Civil and Geomatics Engineering. After reviewing the proposed curriculum, I believe the proposed program will develop student understanding of water management infrastructure; modern design, testing, and analysis techniques; and cutting-edge technologies. Furthermore, the curriculum with evening offerings will allow students to select courses best suited to their industry, governmental or academic focus, and to complete the degree while maintaining current employment or other commitments.

In conclusion, I fully support the efforts of the Department of Civil and Geomatics Engineering as they develop the WREE program to meet local and regional needs, and the needs of communities beyond.

Sincerely,

Henrik Skov Laursen

Director, GRUNDFOS, Silicon Valley / Chairman, BlueTechValley committee

February 15, 2013

Back2Earth Technologies, LLC
699 Moraga Way
Orinda, CA 94563

Dr. Ram Nunna, Dean
Lyles College of Engineering, M/S EE 94
2320 East San Ramon
Fresno, CA 93740

Dear Dr. Nunna,

Back2earth Technologies, LLC, a bio-chemical engineering company, most enthusiastically endorses the creation of the proposed Environmental and Water Resources Engineering option within the Civil Engineering Graduate Program.

We see the need for engineering talent to serve the water-energy-food nexus and whole heartedly endorse your proposal.

Your vision of expanding your graduate studies offering is exactly on target and will clearly benefit the economics and societal goals of the region.

Sincerely,

David B. Miles

David B. Miles, CEO
Back2Earth Technologies

FRESNO STATE
Discovery. Diversity. Distinction.

February 28, 2013
Dr. Ram Nunna
Dean, Lyles College of Engineering (M/S EE 94)
2320 East San Ramon, Fresno CA, 93740

Dear Dean Nunna:

I am very happy to see that the faculty after these many years has a very viable proposal for a Water Resources and Environmental Engineering (WREE) Option in the Civil Engineering Graduate Program at California State University Fresno. The economy of the California's San Joaquin Valley is tied to both the quality and availability of water whether it is water for agricultural and other industries, water for protecting environmental resources, or water for domestic consumption. Because of the importance of water in the San Joaquin Valley there is a high demand and employment and many employment opportunities for engineers with a solid background in environmental and water resources engineering. Yet, California State University, Fresno despite strong efforts in the past by a number of faculty, including myself, has not taken a leadership role in providing the future leaders in the fields of environmental and water resources engineering in the San Joaquin Valley.

The related technical areas of environmental and water resource engineering requires a highly educated workforce as can be provided if the Water Resources and Environmental Engineering (WREE) Option in the Civil Engineering Graduate Program at California State University Fresno is adopted. The individuals who would be graduated from this program would be prime candidates to fill professional positions within private industry, local government including water districts, and federal and state agencies including the Central Valley Regional Water Quality Control Board, an organization employing many environmental and water resources engineers and for which I am board chair.

I strongly urge that Water Resources and Environmental Engineering (WREE) Option in the Civil Engineering Graduate Program at California State University Fresno be adopted.

Sincerely,

Dr. Karl Longley, PE, BCEE
Professor Emeritus, Lyles College of Engineering
Water Resources Engineer, California Water Institute
California State University, Fresno

WATER, ENERGY & TECHNOLOGY CENTER

Lyles College of Engineering, M/S EE 94
2320 E San Ramon
Fresno, CA 93740
Dr William Wright

To Whom it May Concern;

Please accept this letter of support for your developing degree option in Water Resources and Environmental Engineering in the Civil Engineering Graduate Program.

As the General Manager of the Water, Energy and Technology Center on the Campus of Fresno State, I am elated to learn about the program and the intended outcomes of this new program. At the WET Center, we are geared to support these students as they venture forth with this degree in hand, in seeking out and developing solutions to the ever-present and changing problems our world is facing relative to water and energy.

The WET Center depends on the quality of students and the education they receive at Fresno State to ensure that our region has the knowledge and talent to manage the current water-flow strengths of our as well as the capacity to see the future opportunities to develop practices and technologies that will address both current and future issues.

We believe that this program is an important and vital step in this process. Having worked with Dr. Nunna in the past, we believe he is an exemplary advocate for the needs and opportunities in our region, and we support him and this effort.

I would be happy to provide additional information on our organization, or in ways we believe we can continue to support and benefit from this program.

Thank you for your consideration,

Helle Petersen

February 18, 2013

Dr. Ram Nunna
Dean, Lyles College of Engineering (M/S EE 94)
2320 East San Ramon, Fresno CA, 93740

Dear Dean Nunna:

It is my pleasure to write the letter in support of the proposal for a **Water Resources and Environmental Engineering (WREE) Option in the Civil Engineering Graduate Program at California State University Fresno.** California's Central San Joaquin Valley is well suited for agricultural production and habitation with its large expanses of rich soil and mild climate. However, full utilization of this richness depends on the development and maintenance of extensive and reliable water systems. This is particularly important in our region as arid conditions, exacerbated by climate change, renders the land hot and water-starved for long periods of time, and great distances separate major surface water sources from locations where water is needed. The climate may necessitate the construction of cost effective water storage (surface and groundwater), conveyance, and treatment systems, and the efficient use and reuse of all water resources. The organizations that we represent extend from the valley floor to the upper headwaters of important watersheds in the Sierra Nevada range including irrigated, range and forest lands – and supports these types of efforts based upon financial, environmental, resiliency and other merits – as well as the testing and deployment of water-use efficiency technologies in all sectors of the economy.

Long-term sustainability depends on having sufficient, reliable and secured quantities of high quality water. California's water systems of the future will need to efficiently and efficiently utilize existing water supplies as well as increase the use of non-traditional water sources, including agricultural, industrial, and domestic wastewaters. As such, people will increasingly be consuming water from these non-traditional sources. This will require the development of new treatment and monitoring technology to manage both conventional and new (emerging) contaminants in public drinking water supplies. To develop and manage California's massive water infrastructure, to achieve sustainability and reliability in water services, and to protect the public from contaminants of concern, a highly educated workforce with water-related expertise will be needed.

The WREE Option will be offered through the Department of Civil and Geomatics Engineering. After reviewing the proposed curriculum, I believe the proposed program will develop student understanding of water management infrastructure; modern design, testing, and analysis techniques; and cutting-edge technologies. Furthermore, the curriculum with evening offerings will allow students to select courses best suited to their industry, governmental or academic focus, and to complete the degree while maintaining current employment or other commitments.
In conclusion, I fully support the efforts of the Department of Civil and Geomatics Engineering as they develop the WREE program to meet local and regional needs, and the needs of communities beyond.

Please let me know if I may be of further assistance. I may be reached via the following: 559.970.6320 / SteveHaze@hughes.net .

Sincerely,

Steve Haze

Executive Director / 1st Vice President – Yosemite / Sequoia Resource Conservation and Development Council
Program Manager – Sierra Resource Conservation District, Eastern Fresno County
Program Director – San Joaquin Valley Leadership Forum (501c3 Non-Profit)

GRADUATE PROGRAM Copy

(master's degree, doctoral degree, certificate of advanced study, credential requiring graduate-level course work)

CATALOG STATEMENT REVISION REQUEST

Return original to:

Division of Graduate Studies
Harold H. Haak Administrative Center
4th Floor, Henry Madden Library
Mail Stop ML51

Graduate Program: Civil Engineering
Department: Civil & Geomatics Engineering
Contact Person: William Wright
Phone: (559) 278-5591
E-mail: wfwright@csufresno.edu
Catalog pg. # 303 & 306

PURPOSE OF FORM: To propose revision of a graduate program catalog statement (program description and/or requirements) as it appears in the University Catalog. The proposed program changes if approved will be binding on students who are advanced to candidacy under the new catalog statement. NOTE: Revisions in graduate courses and proposals for new graduate courses are submitted on separate forms available through the Division of Graduate Studies, phone 8-2448.

INSTRUCTIONS: Use attachments to this sheet to indicate the changes that you propose. Make changes as space allows directly on a 8.5" x 11" xerographic copy of the entire page(s) of your graduate program statement (description/requirements) as it appears in the most recent University Catalog, including page numbers. Use "mock-up" style: cross out wording to be deleted; type new language in margins. If there is not sufficient space in the margins to type lengthy additions, designate inserts (a, b, c, etc.). Attach fully typed language for each insert on additional sheets. Address questions on these instructions to the Dean, phone 8-2448.

Routine proposals for graduate program changes are reviewed by the Graduate Curriculum Subcommittee. Extensive, substantive changes are reviewed by the University Graduate Committee.

Those planning to propose a new or extensively revised graduate program (master's, doctoral, or certificate of advanced study), including a proposal for a revised or an additional option under an existing graduate degree, should schedule a meeting with the Graduate Dean.

JUSTIFICATION: Explain why the proposed changes in the graduate program are needed. Attach additional pages as necessary. Special justification and approval are required for proposals to increase master's degree program units above 30 units in academic fields, and 60 units in professional fields. Such justification must include comparative information concerning similar programs at representative universities, and outline adherence to accreditation standards if applicable. Document the impact of the proposed change and/or any increased program units on program students and department

CONSULTING SIGNATURES (if required)

In an effort to avoid misunderstandings, signatures must be obtained from those **departments potentially affected** by proposed change(s).

I have read the catalog statement revision request and support the proposed change(s).

Yes ☐ No ☐

If no, please explain your concern(s):

_____

_____

_____

Department Chair (of department being consulted)

Department	Department
Department Chair (typed name)	Department Chair (typed name)
Department Chair Signature	Department Chair Signature
Date	Date

REQUIRED SCHOOL SIGNATURES (verifies proposal has been approved)

Graduate Program Coordinator

Dr. William F. Wright	W William F Wright	2/4/13
Typed Name	Signature	Date

Department Chair

Dr. Jesus Larralde	J. S. Larralde	2/5/13
Typed Name	Signature	Date

School Curriculum (or Credential) Committee Chair (if applicable)

Dr. Jesus Larralde	J. S. Larralde	2/15/13
Typed Name	Signature	Date

School Dean

Dr. Ram Nunna	R Nunna	15 Feb 2013
Typed Name	Signature	Date

- For committee use only -

UNIVERSITY GRADUATE COMMITTEE/GRADUATE CURRICULUM SUBCOMMITTEE REVIEW RECOMMENDATION:

☐ **Request Approved**

☐ **Request Denied**

☐ **Request Deferred**

_____
Date of Action

Explanation:

_____

_____

_____

Recommendation approved by:

Dean, Division of Graduate Studies/or designee

Sharon Brown-Welty _____ _____
Typed Name Signature Date

Provost/Vice President for Academic Affairs/or designee

William Covino _____ _____
Typed Name Signature Date

Rev. 12/11

geomatics engineering. The program's mission is to offer a curriculum that combines preparation for professional practice as well as preparation for research and further advanced studies.

Admission. The requirements for graduate admission to California State University, Fresno must be met. Also, applicants should possess a bachelor's degree in civil engineering, geomatics engineering, or a related field from an institution accredited by the Accreditation Board for Engineering and Technology and must have a 3.0 grade point average in the last 60 semester-units of engineering courses attempted, on the basis of 4.0 being *A*, or the approval of the Graduate Committee of the Department of Civil and Geomatics Engineering. If an applicant's preparation is deemed insufficient by the Graduate Committee of the Department of Civil and Geomatics Engineering, the applicant is required to take additional courses which are specified in writing to remove the deficiency. Such courses, taken as an unclassified student, are in addition to the minimum of 30 semester hours credit for the master's degree in engineering. The department graduate program coordinator shall appoint an interim graduate adviser for each student when that student is accepted into the graduate program. The coordinator will take into account student interests and correlated faculty interests when making this appointment.

Insert A

A student must satisfactorily complete a written examination ~~administered by the department~~ before being eligible for Advancement to Candidacy; this satisfies both the university's graduate writing requirement and demonstrates the student has sufficient technical proficiency to continue in the program.

Insert B

Continuation in the Program. Prior to being admitted to classified standing, a student is required to take the Graduate Record Examination. The minimum grade considered passing is quantitative 550.

The student then should select a graduate adviser before completing 12 units of graduate study and advancing to candidacy. Other members of his or her graduate committee shall be selected in consultation with the graduate adviser if the student has selected Plan A. This committee shall consist of a total of three members, two of whom must be tenure/tenure track faculty. The graduate student shall notify the department's Graduate Committee with a letter signed by both the student and the graduate adviser of the membership of the students' Graduate Committee. This letter shall be placed in the student's academic folder.

A graduate student may change graduate advisers but such change must be approved by the department's Graduate Committee. The student, together with his or her graduate adviser, completes a contract program within his or her first semester of coursework taken for graduate credit. This program must be approved by the department's Graduate Committee. A minimum of 12 semester hours must be earned before the average is determined.

~~Campus graduate disqualification procedures shall be enforced by the department graduate program coordinator if the GPA drops below 3.0 (4.0 scale) each semester and cumulatively throughout all graduate program coursework~~. Any semester for which the grade point average falls below 3.0 shall result in placing the affected graduate student on probation. ~~Normally,~~ a second consecutive offense shall lead to disqualification. ~~Such probation shall be for at least one semester or shall continue until the cumulative grade point average has again been raised above 3.0~~.

Insert C

Program. Each master's degree student selects, as early as possible during the first semester of attendance, and upon consulting with and securing the approval of the graduate adviser, a program best suited to the student's interests and objectives.

The M.S. in Civil Engineering requires the completion of 30 units following one of three programs of study.

See the catalog website for civil engineering and geomatics engineering technical area courses that may be applied to the program at *www.csufresno.edu/catoffice/current/engcivprog.html.*

Plan A (Thesis)	*Units*
a. 200-series CE courses[1]	**12-24**
b. 100-series CE or GME technical area courses[2]	**0-6**
c. Courses outside the department[3]	**0-6**
d. Thesis	**6**
Total	**30**

Plan B (Project)	*Units*
a. 200-series CE courses[1]	**15-27**
b. 100-series CE or GME technical area courses[2]	**0-6**
c. Courses outside the department[3]	**0-6**
d. Project	**3**
Total	**30**

Plan C (Comprehensive Exam)	*Units*
a. 200-series CE courses[1]	**18-30**
b. 100-series CE or GME technical area courses[2]	**0-6**
c. Courses outside the department[3]	**0-6**
Total	**30**

Advising Notes

1. Graduate courses in civil engineering — select from CE 205, 206, 210, 220, 223, 225, 230, 232, 233, 235, 236, 237, 239, 240, 245, 246A, 246B, 247, 251, 261, 271, 280, 283, 285, 286, 290, and 291T.
2. 100-series technical area courses in civil and geomatics engineering — select from CE 125, 131, 134, 136, 137, 141, 144, 151, 153, 191T; GME 125, 126, 135, 145, 152, 153, 161, 174, 175, 191T; and ME 144.

Insert D

3. 100-series and 200-series courses outside civil and geomatics engineering are in disciplines best suited to the students graduate program as approved by the program adviser. This includes mathematics, statistics, management, business, geology, physics, chemistry, health science, and biology.

Insert E

Insert F

COURSES

Civil Engineering (CE)

CE 20. Engineering Mechanics: Statics (3)
Prerequisites: MATH 77 or concurrently; PHYS 4A. Analysis of force systems, equilibrium problems, section properties; graphic, algebraic, and vector methods of problem solution. FS

CE 29. Engineering Mechanics (3)
(See ME 29.) FS

CE 85. Introduction to Civil Engineering (3)
The civil engineering profession and its role in society; creative thinking and critical thinking as integral parts of the engineering decision process; engineering methods of analysis; problem solving; computer drafting; career opportunities. (Field trips required) FS

CE 110. Computer Applications in Civil Engineering (3)
Prerequisites: MATH 76 or concurrently. Use and modification of existing programs. Creation of new programs. Use of structured language, spreadsheets, and numerical solutions CAD. Term projects. FS

CE 237. Dynamics of Structures (3)
Analysis of structural members and systems subject to dynamic loads. Basic theory for single-degree-of-freedom and multi-degree-of-freedom analytical models; free vibration, harmonic and transient excitation, response spectrum, LaGrange's equations, earthquake analysis.

CE 239. Advanced Reinforced Concrete Theory (3)
Background and origin of modern reinforced concrete theory and procedures. In-depth and critical review of current design specifications and code. Projection to anticipated future changes in design and construction practices. Application and extension of theory to include new and future construction materials such as high performance concrete and fiber reinforced polymers. (Formerly CE 291T)

CE 240. Engineering Hydrology (3)
Prerequisites: CE 128, 140. Analysis of the physical and stochastic processes governing the occurrence and movement of water in its natural environment. Applications to hydraulic engineering practice.

Insert G & H

CE 245. Geoenvironmental Engineering (3)
Prerequisite: BIOL 10, CHEM 3A, CE 123, CE 128, CE 129, CE142, or with approval of the instructor. Topics covered include basic soil physics, principles of groundwater flow, mass transport and transfer in soils, non-aqueous phase liquid in soils, geosynthetics, basic soil microbiology and biochemistry, environmental regulations, solid waste landfills, site contamination and treatment techniques. (Formerly CE 291T)

CE 246A. Advanced Water Quality (3)
Prerequisite: CE 142 or permission of instructor. Theory and practice of physical/chemical processes for controlling water quality, including chemical equilibrium and kinetics; mass transfer mechanisms; physical separation processes; adsorption, exchange, and membrane-based processes; disinfection.

CE 246B. Advanced Water Quality (3)
Prerequisites: CE 142 or permission of instructor; CE 246A recommended. Theory and practice of biological processes for controlling water quality, including suspended growth systems; attached growth systems; ponds; land treatment. Also sludge treatment processes, including biological stabilization, thickening, and dewatering; sludge disposal.

CE 247. Solid Wastes Engineering (3)
Planning and design of waste collection and disposal systems. Waste segregation and energy impact related to recovery and recycling practices. Environmental impact and institutional issues related to solid and hazardous waste systems.

CE 251. Advanced Boundary Law (3)
Prerequisite: GME 151 or equivalent. Land and water boundary legal issues, both historical and new. Case investigations.

CE 261. Geoprocessing (3)
Prerequisite: GME 173 or equivalent. Integration of computer technologies for gathering, analyzing, and displaying data associated with the earth's spatial features. Engineering design problems dependent on competing factors.

CE 271. Geodetic Systems Optimization (3)
Prerequisite: GME 108 or equivalent. National geodetic networks; planimetric and vertical control systems; geodetic control densification; network optimization criteria and methodology.

276. GPS Theory and Application (3)
Operational theory of Global Positioning Systems (GPS) and Global Navigation Satellite Systems (GNSS). Applications to engineering practice.

CE 280. Geomatics Engineering Seminar (1; max total 3)
Prerequisite: graduate standing. Current California State University, Fresno surveying engineering research presented and discussed by faculty and graduate students. Oral presentation and written report documenting ongoing research activities required.

CE 283. Digital Remote Sensing (3)
Prerequisite: GME 140 or equivalent. Quantitative approach in remote sensing; digital image characteristics, error correction, registration; geometric and radiometric image enhancement; image classification; system design; remote sensing and GIS.

CE 285. Advanced Analytical Photogrammetry (3)
Prerequisite: GME 125 or equivalent. Mathematical models in photogrammetry; bundle block adjustment, self-calibration; close-range photogrammetry; real time photogrammetry and data snooping. System design; hardware and software considerations in photogrammetry.

CE 286. Geographic Information Systems Design (3)
Prerequisite: GME 173 or equivalent. Data structures and algorithms, databases for GIS, error modeling and data uncertainty, visualization, data exchange and standards, the multipurpose cadaster, advanced analysis techniques.

CE 290. Independent Study (1-3; max total 6)
Prerequisite: graduate status in engineering. See *Academic Placement — Independent Study*. Approved for *RP* grading. FS

CE 291T. Topics in Engineering (1-3; max total 6)
Prerequisite: permission of instructor. Investigation of selected engineering topics. May be offered with a lab.

CE 298. Project (3; max total 3)*
Prerequisite: graduate status in engineering. See *Criteria For Thesis and Project.* Independent investigation of advanced character such as analysis and/or design of special engineering systems or projects; critical review of state of the art of special topics, as the culminating requirement for the master's degree. Abstract required. Approved for *RP* grading. FS

CE 299. Thesis (2-6; max total 6)*
Prerequisite: See *Criteria For Thesis and Project.* Preparation, completion, and submission of an acceptable thesis for master's degree. Approved for *RP* grading. FS

* For 298C and 299C courses, see *Graduate Studies.*

IN-SERVICE COURSES

(See *Catalog Numbering System.*)

Civil Engineering (CE)

CE 311. Professional Examination Review (2; may be repeated in different fields)
Prerequisite: bachelor's degree in engineering or eligibility to take state registration examinations. Review of engineering fundamentals for those qualified to take the state examination for certification as engineer-in-training; or review in a specific field (civil, electrical, mechanical, or other) for those preparing to take the examination for registration as professional engineer.

CE 321. Professional Engineering Seminar (1-3; may be repeated in different fields)
Prerequisite: bachelor's degree in engineering or related field, or experience as a professional engineer. Latest developments in various specialized areas of professional engineering practice; new materials, design and construction methods, equipment, devices, and procedures.

INSERTS & JUSTIFICATIONS – Civil Engineering Graduate Program Catalog Change

Insert A: " pass CE 210 with a grade of "B" or higher and "

Justification: *CE 210 will serve the same purpose as a qualifying exam. It will require the student to demonstrate proficiency in research methods as well as written and oral communication.*

Insert B: " (typically administered in CE 210) "

Justification: *The graduate writing requirement is administered to most all students in CE 210. It is administered outside of CE 210 if CE 210 is not available to the student when needed, or an alternative assignment is required as a result of the student failing to pass it in CE 210.*

Insert C: "For additional information please refer to the Division of Graduate Studies section of this Catalog, Administrative Academic Probation subsection, Academic Disqualification paragraphs."

Justification: *The language now conforms to DGS/ university policy.*

Insert D: "A minimum grade of B is required. Similar courses previously taken and counted towards another degree are excluded."

Justification: *Our graduate faculty agreed that it was not appropriate to count towards the master's degree an undergraduate level course in which the student earned a grade of "C." Second sentence: Prevents double counting.*

Insert E: "A minimum grade of B is required. Similar courses previously taken and counted towards another degree are excluded."

Justification: *Our graduate faculty agreed that it was not appropriate to count towards the master's degree a course from outside of our program in which the student earned a grade of "C." Second sentence: Prevents double counting.*

Insert F: "*Water Resources & Environmental Engineering (WREE) Option*

For the Water Resources & Environmental Engineering Option select CE 210, 240, 241, and 242; Select 6 units of approved 100 or 200-series WREE-related courses outside of the program, excluding EES 267, and including 3 units in business or public administration; and select CE 140, 141, 144, 146, 206, 245, 246A, 246B, 247, 290, and 298, 299 or comprehensive exam to total 30 units (max 6 units from 100 series).

[Note to Catalog Editor: Font size and style for the title to be the same as for the "*Advising Notes*" title; font size and style for the paragraph to be the same as for the three advising note paragraphs]

Justification: *Refer to the New Graduate Program Option Proposal/ Request.*

Continued

Insert G: "CE 241. Contaminant Fate & Transport Engineering (3)

Introduction to contaminants migration in the environment, risk assessments and engineering remediation methods. Understanding the factors controlling multimedia contaminants transport; quantifying transport rate; predicting and reducing resulting concentrations in air, water, and soil. Mathematical knowledge beyond the elementary level is required. (Formerly CE 291T)"

Justification: *Refer to the CE 241 New Graduate Course Request.*

Insert H: "CE 242. Urban & Industrial Water Systems (3)

This course introduces water management systems in urban and industrial settings. Water infrastructure master planning and the basics of water occurrence, use, transport, quality, treatment, and disposal are included. (Formerly CE 291T)"

Justification: *Refer to the CE 242 New Graduate Course Request.*

NEW GRADUATE COURSE REQUEST
GRADNEW.ITP (on Informed Filler)

Return original and 10 copies to:

Division of Graduate Studies
Thomas Administration Building, Room 132
Mail Stop TA 51

Graduate Program: Civil Engineering
Department: Civil and Geomatics Engineering
Contact Person: Lubo Liu
Phone: 8-5634
E-mail: LLUBO@CSUFRESNO.EDU
Catalog pg. # _____

Use this form if your course is: (*please select the box below that best describes your course*)

- ☐ **(a) new (never has been taught before)**
- ☒ **(b) conversion (break-out of a "topics" course as a new course)**
- ☐ **(c) significant change to an existing course**
- ☐ **(d) other** _____

NOTE: If the changes you make on this form are different from what you submitted on your mock-ups to catalog, then you **must** revise your mock-ups and resubmit them to the catalog office.

If you wish to delete or make minor revisions to an existing graduate course, use the "Graduate Course Change or Deletion" form (GRADCHG.ITP on Informed Filler).

1. NEW COURSE:

Prefix/ Subject CE | Catalog Number 241 | Long Course Title Contam Fate & Transport Eng | Units Max/Total 3

Con Fate & Trans (Short Title (16 spaces maximum) for Printing) | Letter (Grading Basis (Letter, CR/NC, SP, Mixed))

Course Classification (C/S#) C/S 02

Note: If the proposed course has been offered previously as a topics course or is the expansion of an existing course, complete the following for the previous course:

Prefix/ Subject CE | Catalog Number 291T | Long Course Title ContamTransprt & Fate in Environ Eng | Units Max/Total 3

Catalog Description of New Course: (40 words only, excluding prerequisite, lecture-lab hours)

Introduction to contaminants migration in the environment, risk assessments and engineering remediation methods. Understanding factors controlling multimedia contaminants transport; quantifying transport rate; predicting and reducing resulting concentrations in air, water, and soil. Mathematical knowledge beyond the elementary level is required.

2. NEW COURSE QUESTIONS:

(Each item **must** be addressed; attach additional sheet(s) as needed.)

A. How frequently is the new course expected to be offered? Every 2-3 semeters

B. What is the expected enrollment? 10-15

C. What is/are the mode(s) of course delivery (e.g., lecture, seminar, supervision, distance learning)? **Please see the attached "Definitions of Graduate Level Instruction in the CSU."**

Lecture/seminar/computer modeling lab/field trip

D. Identify all new resources (special facilities, library resources, technical assistance, etc.) needed to institute the course.

N/A

E. Is this course required or elective? Elective for MSCE, required for WREE option

F. Is there another course(s) covering similar subject matter:

- within your department? No ☒ Yes ☐ (if yes, complete section 4)
- at California State University, Fresno? No ☒ Yes ☐ (if yes, complete section 4)

G. Has this course been previously offered as a topics course? Yes ☒ No ☐
If yes, how many times? 2

H. Justification for New Course: (Please attach an explanation detailing the need for this new course.)

3. Please attach a course outline/syllabus that:

- Follows the guidelines stated in the **"Policy on Course Syllabi and Grading"** (June 1997) as published in the Academic Policy Manual (pg. 241-1, 241-2, 241-3).
- Illustrates how the course meets the criteria described in **"Definitions of Graduate Level Instruction in the CSU"** (see attached).

NOTE: Proposed Topics (T) courses should include a sample course outline/syllabus that follows the above guidelines and includes criteria by which the department will select future topics courses.

4. CONSULTING SIGNATURES (if required)

In an effort to avoid course duplication and misunderstandings, signatures must obtained from those departments potentially affected by proposed changes.

I have read the new graduate course proposal and support the offering of this course.

Yes ☐ No ☐

If no, please explain your concern(s):

_____

_____

_____

Department Chair (of department being consulted)

Department	Department
Department Chair (typed name)	Department Chair (typed name)
Department Chair Signature	Department Chair Signature
Date	Date

5. REQUIRED SCHOOL SIGNATURES (verifies proposal has been approved)

Graduate Program Coordinator

William Wright	William E Wright	2/4/13
Typed Name	Signature	Date

Department Chair

Jesus Larralde	J. S. L.	2/8/13
Typed Name	Signature	Date

School Curriculum (or Credential) Committee Chair (if applicable)

Jesus Larralde	J. S. L.	2/15/13
Typed Name	Signature	Date

School Dean

Ram Nunna		2-15-2013
Typed Name	Signature	Date

- For committee use only -

UNIVERSITY GRADUATE COMMITTEE/GRADUATE CURRICULUM SUBCOMMITTEE REVIEW RECOMMENDATION:

- ☐ **Request Approved**
- ☐ **Request Denied**
- ☐ **Request Deferred**

_____
Date of Action

Explanation:

_____

_____

_____

Recommendation approved by:

Dean, Division of Graduate Studies/or designee

Sharon Brown-Welty	_____	_____
Typed Name	Signature	Date

Provost/Vice President for Academic Affairs/or designee

William Covino	_____	_____
Typed Name	Signature	Date

Attachment
Rev. 12/11

DEFINITIONS OF GRADUATE LEVEL INSTRUCTION IN THE CSU

A. The Graduate Course

1. It is assumed that students who enroll in graduate courses possess:

   a. Maturity, responsibility, and scholarly integrity appropriate to study beyond the baccalaureate level.
   b. A broad base of knowledge, usually represented by the possession of the bachelor's degree.
   c. Competence in the specified field, usually represented by a substantial body of upper-division study in the field or in a closely related field.
   d. A command of basic techniques and skills essential for independent, self-directed study in the field.

2. The graduate course deals with more complex ideas, materials, techniques or problems than the undergraduate course, and demands searching and exhaustive analysis.

3. The graduate course requires:

   a. The identification and investigation of theory or principle.
   b. The application of theory to new ideas, problems, and materials.
   c. Extensive use of bibliographic and other resource materials with emphasis on primary sources of data.
   d. Demonstration of competence in the scholarly presentation of the results of independent study.

4. Satisfactory completion of a graduate course requires more creative thinking than an upper-division course.

5. Performance expectations for graduate student enrolled in undergraduate-level courses normally are such that students complete at least one additional assignment. The quality of their written and oral performance in the course normally would be at least one grade point higher than that of an undergraduate. Performance expectations for undergraduate students enrolled in graduate-level courses are such that where campus policy permits undergraduate enrollment in a graduate course, the quality of the written and oral performance of undergraduates in the course normally would be at least half a grade point higher than that of an undergraduate enrolled in an undergraduate course.

B. Lecture-Discussion

The lecture-discussion course conforms to the criteria for graduate courses in general, and

1. Is an organized course with regularized content.
2. Is a combination of lectures and group discussion, based on specialized studies and research.
3. Involves consideration of a series of vital problems, reviews trends, examines different points of view, and interprets issues.
4. Involves problem analysis, research, and high level participation in discussion.
5. Involves the use of a wide variety of material and resources which provide a range and depth beyond that obtainable through a single textbook, although the use of a basic textbook may be appropriate in some lecture-discussion courses.
6. Provides an opportunity for synthesis and analysis through scholarly writing and through course examination that go beyond simple recall of fact.

C. Seminar

The seminar conforms to the criteria for graduate courses in general, and

1. Is organized around a series of related problems significant to the discipline.
2. May have a focus which varies from semester to semester within the framework of the general objectives.
3. Limits the lecture, when it does occur, to setting the stage and clarifying issues.
4. Requires that students assume primary responsibility for an investigation that will contribute to the objectives of the seminar and that they report, interpret, and defend their findings orally as well as in writing.
5. Within the framework of general goals, may allow student participation in course planning and in course evaluation.
6. Has class meetings primarily to develop, share, and critically examine independent investigations by members of the group. Time devoted to individual or small-group conferences under the direction of the professor may on occasion replace general class meetings.

D. Laboratory

Laboratory coursework conforms to the criteria for graduate courses in general and focuses on data gathering and analysis, with an emphasis on research and investigation rather than on laboratory techniques. Its chief distinguishing characteristic is the use of specialized facilities and relatively independent investigation.

E. Field Work and Clinical Practice

Field work and clinical practice require that

1. The students have a high level of theoretical competence and a mastery of the basic skills necessary to perform professional duties with a minimum of direction.
2. The selection of experiences provides opportunity for the student to

    a. Bring to bear and apply a high level of theoretical knowledge.
    b. Exercise judgment of a high order.
    c. Assume responsibility for determining procedures as well as for implementing them.
    d. Report the experience to a supervising instructor in such a way as to point out its significance, to explain the rationale behind his/her major decisions, and to evaluate their adequacy.

F. Graduate Independent Study

At the graduate level independent study is based upon the assumptions set forth in part in the section above entitled, "The Graduate Course." Furthermore, such independent study

1. Has a specific objective related to the student's educational goals and to a graduate program.
2. Is precisely defined as a result of joint planning by the professor and the student.
3. Required periodic and final demonstration of competence in scholarly presentation of the result of the independent study.

Source: Office of the Chancellor, California State University

CE241: Contaminant Fate and Transport Engineering

Course Classification: Graduate (Civil Engineering - CE)

Instructor/proposer: Lubo Liu, Ph.D., PE

CATALOG DESCRIPTION

Introduction to contaminants migration in the environment, risk assessments and engineering remediation methods. Understanding factors controlling multimedia contaminants transport; quantifying transport rate; predicting and reducing resulting concentrations in air, water, and soil. Mathematical knowledge beyond the elementary level is required. (3 hours lecture)

JUSTIFICATION FOR COURSE

Large quantities of contaminants are released in our environment. Fate and transport of contaminants in three major environmental media (surface waters, subsurface including soil and groundwater, and atmosphere) are very important to a variety of disciplines (such as biology, toxicology, climatology, ecology, geology etc.), especially in the areas of environmental engineering and water resources engineering. In the central valley area even throughout the entire California, surface and subsurface water remediation is a very critical issue, which need the knowledge contained in the proposed course as necessity.

This course provides essential knowledge for environmental engineers, scientists and others who are concerned with cleanup of contaminated sites and minimizing risk to human and the environment. It helps students understand how contaminants are mobilized, the processes involved in their transport and the physical, chemical and biological transformations they undergo. As a graduate level course, it facilitates students to better explain how a contaminant got where it is, to predict how it will move or change temporally and spatially through an environment compartment in the future, to assess its potential risk to human health and the environment, and to remedy the polluted waters.

TECHNICAL CONTENTS

This course covers basic principles of contaminants behavior in the environment and some engineering methods for remediation. The goals are: 1) to understand the physical properties that govern the behavior, fate and transport of contaminants released into the environment (air, surface and subsurface water, soil); 2) to apply the principles and theories of fate and transport of contaminants to work on practical, quantitative problems dealing with environmental chemicals in environmental engineering and water Resources Engineering. Topics include mass balance, chemical equilibria and kinetics, environmental transport, site assessment, pollution remediation (Surface water and

groundwater). Advanced topics include surface/subsurface water transport and fate modeling, and atmospheric transport of contaminants.

SUSTAINABILITY

The proposed 241 course has been offered as a topics course two times since Spring 2011. The course was very well evaluated by students (4.67/5 in Spring 2011) and positive feedback has been received. The average enrollment number was 9 for Spring 2011 and Spring 2012.

The adoption of the proposed course will deepen and broaden students' knowledge and understanding in contaminants removal and water remediation. It also will strengthen the growing graduate program in the areas of water resources and environmental engineering.

Prepared by Dr. Lubo Liu

SYLLABUS: CE 241 Contaminant Fate and Transport Engineering
Spring 2013 (1/17/13-5/8/13)
Time: (Wed 8:00 am – 10:50 am)
Engineering East Bldg RM 388

Credit Units:	3 Credit Units
Catalog Description	Introduction to contaminants migration in the environment, risk assessments and engineering remediation methods. Understanding factors controlling multimedia contaminants transport; quantifying transport rate; predicting and reducing resulting concentrations in air, water, and soil. Mathematical knowledge beyond the elementary level is required.
Course Content	This proposed course is a graduate level course and the goal is to introduce an interdisciplinary graduate student to the concepts of how chemicals migrate in the environment and how this migration is estimated in risk assessments. This course is to provide an understanding of the factors controlling multimedia contaminant transport, how to quantify the rate of transport, and how to predict resulting concentrations in air, water, and soil. Mathematical treatment beyond the elementary level (up to partial different equations) is presented with the intent of pushing students with greater interest or more complete backgrounds toward more complete understanding.
Instructor:	Name: Dr. Lubo Liu Room: Engineering East Bldg RM172 Email: llubo@csufresno.edu Phone: 559-278-5634
Office Hours:	**M: 11:00 am – 2:00 pm; Tu: 8:15 am – 10:15 am or by appointment.**
Required Textbook:	1. Fate and Transport of Contaminants in the Environment, John C. Walton, ISBN: 1-932780-04-1. 2. Practical Design Calculations for Groundwater and Soil Remediation, Jeff Kuo, ISBN:1-56670-238-0
Course Learning Outcomes:	At the end of this semester, the following learning outcomes should be achieved: 1) Understanding the physical properties that govern the behavior, fate and transport of contaminants released into the environment (air, surface and subsurface water) 2) Applying the principles and theories of fate and transport of contaminants to work on practical, quantitative problems dealing with environmental chemicals.

Course Topics & Tentative Schedule:

(**Subject to change with advance notice**)

Course Topic/Activity	Date	Week
- **Introduction to the course**	Jan 17	1
- **Topic I: (Basic Concepts of Fate and Transport** **I-1: Mass Transfer**		
- **Topic I: Concepts of Fate and Transport** **I-1: Mass Transfer**	Jan 24	2
- **Topic I: Concepts of Fate and Transport** **I-2: Energy and Mass Conservation**	Jan 31	3
- **Topic I: Concepts of Fate and Transport** **I-3: Control Volume Method**	Feb 7	4
- **Topic II: Diffusion and Dispersion** (1. Introduction; 2. Fick's Law; 3. More complex D & D eqns)	Feb 14	5

-	**Topic III: Interphase Mass Transfer and Partitioning**	Feb 21	6
-	**Topic IV: Low-concentration Particle Suspensions and Flows**	Feb 28	7
-	**Topic V: Site Characterization and Remedial Investigation**	Mar 6	8
-	**Mid-term Exam**	Mar 13	9
-	**Topic VI: Mass Balance Models**	Mar 20	10
-	**Topic VII: Groundwater Modeling**	Mar 27	11
-			
-	**No Class Spring Break**	Apr 3	12
-	**Topic VII: Groundwater Modeling**	Apr 10	13
-	**Topic VIII: Groundwater Remediation**	Apr 17	14
-	**Topic VIII: Vadose Zone Soil Remediation**	Apr 24	15
-	**Topic VIII: Surface Water Modeling**	May 1	16
-	**Project Presentation**	May 8	17

Course Assessment and Grading Criteria:

Your overall grade will be determined by your performance on Student Learning Tasks summarized below.

Homework assignments	10%	(10 points)
Quizzes	20%	(15 points)
Mid-term Exam	20%	(20 points)
Team Project	25%	(30 points)
Final Exam	25%	(25 points)

The following grade scale will be used to determine the semester grade:
A: ≥ 90.0; B: 80.0 – 89.9; C: 70.0 – 79.9; D: 60.0 – 69.9; F: < 60.0

Homework Homework assignments will make up 10% of the overall course grade. Homework will be collected at the beginning of the class. Homework should be turned in by the due date. Homework that is turned in within 48 hours after the due date can be graded but only **half** credits can be received. No homework is accepted after 48 hours. Homework must be neatly prepared using standard sized 81/2" x 11" paper. This requires good organization, well-

developed discussion that features complete sentences, and clearly boxed answers when numerical results are presented. Homework submissions that are illegible or otherwise difficult to follow will not be reviewed or graded.

Quizzes Quizzes will be given randomly and make up 20% of the overall grade. You will have 30 to 45 minutes for each quiz. Quizzes usually cover basic concepts and simple calculations.

Exams There will be one mid-term exam and one comprehensive final exam and will account for 20% and 25% of the total grade, respectively.

Project Each student will choose a topic focusing on transport of one specific species in surface water, groundwater or air. Project topic aligning to your MS thesis/project is **HIGHLY** recommended. The project will consist of a written report to be handed in and an oral presentation for active class discussion. The project will account for 25% of the overall grade. The written report will be double-spaced. The first part should concisely describe the nature of the problem that will be addressed. Finally, you may comment or suggest alternative approaches. The oral presentation will be modeled on the written report and will consist of a 15 minutes presentation to the class. Following this will be up to 5 minutes class discussion. During the discussion, all members should be at the front of the class and are expected to participate.

Course Policies: Quizzes are randomly arranged to ensure regular attendance. Attendance is required for exams. Assignments in this course require individual attention and effort. Whereas, you may discuss and exchange ideas with other class members. You should never copy others' assignments, which is considered to be plagiarism and constitutes theft of intellectual property. This will result in a grade of zero and is subject to CSU Fresno Academic Honor Code.

Make-up Examination

Make-up examination is Permitted for a student only when his/she is justified by illness, conflicting with examinations, or for certain emergencies. However, he/she should inform the instructor or the secretary at the civil engineering, department before and or the same date of the scheduled examination.

Class attendance

Students are required to attend all the class sessions. Failure to be in the 'quiz/ exercise' day will result in an 'F' for the quiz/exercise. All quiz/exercise will be kept by the instructor as the attendance evidence.

Policy on Cheating and Plagiarism: Students are required to follow the code of CSU Fresno. The relationship between students and instructors is based upon trust, and the continued maintenance of this trust is necessary for education to be successful. Students need to trust that the instructor has made appropriate judgments as to the content and structure of the course. Instructors need to trust that the work turned in by students represents their own effort. Violation of this trust undermines the educational process. Cheating is dishonest and it will not help anybody toward his/her final goal, which is to become a competent engineer. Cheating implies taking credit for somebody else's work. Cheating on exams and other acts of academic dishonesty will not be tolerated and will be dealt with at the instructor's discretion. Severe violations may (and will) be punished with a failing grade in the course. Please refer to student handbook of CSU Fresno for more information.

Students with Disabilities: The instructor will accommodate any student with disabilities. Students with disabilities needing academic accommodations should bring a letter to the instructor from the university indicating a need for academic accommodations. This should be done within the first week of class. For more information about services available to students with disabilities, please contact Services to Students with Disabilities in Henry Madden Library, Room 1202 (278-2811).

Honor Code Members of the CSU Fresno academic community adhere to principles of academic integrity and mutual respect while engaged in university work and related activities. Students should:

a) Understand or seek clarification about expectations for academic integrity in this course

(including no cheating, plagiarism and inappropriate collaboration)
b) Neither give nor receive unauthorized aid on examinations or other course work that is used by the instructor as the basis of grading.
c) Take responsibility to monitor academic dishonesty in any form and to report it to the instructor or other appropriate official for action.

Computers

"At California State University, Fresno, computers and communications links to remote resources are recognized as being integral to the education and research experience. Every student is required to have his/her own computer or have other personal access to a workstation (including a modem and a printer) with all the recommended software. The minimum and recommended standards for the workstations and software, which may vary by academic major, are updated periodically and are available from Information Technology Services (http://www.csufresno.edu/ITS/) or the University Bookstore. In the curriculum and class assignments, students are presumed to have 24-hour access to a computer workstation and the necessary communication links to the University's information resources."

Disruptive Classroom Behavior

"The classroom is a special environment in which students and faculty come together to promote learning and growth. It is essential to this learning environment that respect for the rights of others seeking to learn, respect for the professionalism of the instructor, and the general goals of academic freedom are maintained. ... Differences of viewpoint or concerns should be expressed in terms which are supportive of the learning process, creating an environment in which students and faculty may learn to reason with clarity and compassion, to share of themselves without losing their identities, and to develop and understanding of the community in which they live . . . Student conduct which disrupts the learning process shall not be tolerated and may lead to disciplinary action and/or removal from class."

Copyright Policy

Copyright laws and fair use policies protect the rights of those who have produced the material. The copy in this course has been provided for private study, scholarship, or research. Other uses may require permission from the copyright holder. The user of this work is responsible for adhering to copyright law of the U.S. (Title 17, U.S. Code). To help you familiarize yourself with copyright and fair use policies, the University encourages you to visit its copyright web page: http://www.csufresno.edu/library/about/policies/docs/copyrtpolicyfull.pdf

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This syllabus is a guide for the course and is subject to change with advanced notice.

Prepared by: Dr. Lubo Liu.

Copy

NEW GRADUATE COURSE REQUEST
GRADNEW.ITP (on Informed Filler)

Return original and 10 copies to:

Division of Graduate Studies
Thomas Administration Building, Room 132
Mail Stop TA 51

Graduate Program: Civil Engineering
Department: Civil & Geomatics Engineering
Contact Person: William Wright
Phone: (559) 278-5591
E-mail: wfwright@csufresno.edu
Catalog pg. # 303 (number) and 306 (No. & description)

Use this form if your course is: (*please select the box below that best describes your course*)

- ☐ **(a) new (never has been taught before)**
- ☒ **(b) conversion (break-out of a "topics" course as a new course)**
- ☐ **(c) significant change to an existing course**
- ☐ **(d) other** _____

NOTE: If the changes you make on this form are different from what you submitted on your mock-ups to catalog, then you **must** revise your mock-ups and resubmit them to the catalog office.

If you wish to delete or make minor revisions to an existing graduate course, use the "Graduate Course Change or Deletion" form (GRADCHG.ITP on Informed Filler).

1. NEW COURSE:

Prefix/ Subject: CE | Catalog Number: 242 | Long Course Title: Urban & Industrial Water Systems | Units Max/Total: 3

Urb Ind Wat Sys
Short Title (16 spaces maximum) for Printing

Letter
Grading Basis (Letter, CR/NC, SP, Mixed)

Course Classification (C/S#): C-02

Note: If the proposed course has been offered previously as a topics course or is the expansion of an existing course, complete the following for the previous course:

Prefix/ Subject: CE | Catalog Number: 291T | Long Course Title: Urban & Industrial Water Systems | Units Max/Total: 3

Catalog Description of New Course: (40 words only, excluding prerequisite, lecture-lab hours)

This course introduces water management systems in urban and industrial settings. Water infrastructure master planning and the basics of water occurrence, use, transport, quality, treatment, and disposal are included. (3 hours lecture,or ~~fully online, or~~ hybrid of lecture and online)

Correction made by William Wright 3/14/13)

2. NEW COURSE QUESTIONS:

(Each item **must** be addressed; attach additional sheet(s) as needed.)

A. How frequently is the new course expected to be offered? every 2 or 3 semesters

B. What is the expected enrollment? 8-15

C. What is/are the mode(s) of course delivery (e.g., lecture, seminar, supervision, distance learning)? **Please see the attached "Definitions of Graduate Level Instruction in the CSU."**

Lecture, fully online, or a hybrid of the two.

D. Identify all new resources (special facilities, library resources, technical assistance, etc.) needed to institute the course.

None.

E. Is this course required or elective? Elective

F. Is there another course(s) covering similar subject matter:

- within your department? No ☒ Yes ☐ (if yes, complete section 4)
- at California State University, Fresno? No ☐ Yes ☒ (if yes, complete section 4)

G. Has this course been previously offered as a topics course? Yes ☒ No ☐
If yes, how many times? Once

H. Justification for New Course: (Please attach an explanation detailing the need for this new course.)

3. Please attach a course outline/syllabus that:

- Follows the guidelines stated in the **"Policy on Course Syllabi and Grading"** (June 1997) as published in the Academic Policy Manual (pg. 241-1, 241-2, 241-3).
- Illustrates how the course meets the criteria described in **"Definitions of Graduate Level Instruction in the CSU"** (see attached).

NOTE: Proposed Topics (T) courses should include a sample course outline/syllabus that follows the above guidelines and includes criteria by which the department will select future topics courses.

4. CONSULTING SIGNATURES (if required)

In an effort to avoid course duplication and misunderstandings, signatures must obtained from those departments potentially affected by proposed changes.

I have read the new graduate course proposal and support the offering of this course.

Yes ☒ No ☐

If no, please explain your concern(s):

Department Chair (of department being consulted)

Earth & Environmental Sciences	
Department	Department
Dr. Stephen Lewis	
Department Chair (typed name)	Department Chair (typed name)
Department Chair Signature	Department Chair Signature
2/27/13	
Date	Date

5. REQUIRED SCHOOL SIGNATURES (verifies proposal has been approved)

Graduate Program Coordinator

William Wright		
Typed Name	Signature	Date

Department Chair

Jesus Larralde		
Typed Name	Signature	Date

School Curriculum (or Credential) Committee Chair (if applicable)

Jesus Larralde		
Typed Name	Signature	Date

School Dean

Ram Nunna		
Typed Name	Signature	Date

4. CONSULTING SIGNATURES (if required)

In an effort to avoid course duplication and misunderstandings, signatures must obtained from those departments potentially affected by proposed changes.

I have read the new graduate course proposal and support the offering of this course.

Yes ☐ No ☐

If no, please explain your concern(s):

Note by William Wright: This course is similar to EES 267, and I am the author/ creator and instructor for both courses. EES 267 will be offered to PSM Program Students via Continuing & Global Education whereas CE 242 will be offered to MSCE Program students via regular offering.

Department Chair (of department being consulted)

(See note above)	
Department	Department
Department Chair (typed name)	Department Chair (typed name)
Department Chair Signature	Department Chair Signature
Date	Date

5. REQUIRED SCHOOL SIGNATURES (verifies proposal has been approved)

Graduate Program Coordinator

William Wright	William E Wright	2/4/13
Typed Name	Signature	Date

Department Chair

Jesus Larralde	J. S. Larralde	2/5/13
Typed Name	Signature	Date

School Curriculum (or Credential) Committee Chair (if applicable)

Jesus Larralde	J. S. Larralde	2/05/13
Typed Name	Signature	Date

School Dean

Ram Nunna		2/5/2013.
Typed Name	Signature	Date

- For committee use only -

UNIVERSITY GRADUATE COMMITTEE/GRADUATE CURRICULUM SUBCOMMITTEE REVIEW RECOMMENDATION:

- ☐ **Request Approved**
- ☐ **Request Denied**
- ☐ **Request Deferred**

_____
Date of Action

Explanation:

_____

_____

_____

Recommendation approved by:

Dean, Division of Graduate Studies/or designee

Sharon Brown-Welty		
Typed Name	Signature	Date

Provost/Vice President for Academic Affairs/or designee

William Covino		
Typed Name	Signature	Date

Attachment
Rev. 6/25/03

DEFINITIONS OF GRADUATE LEVEL INSTRUCTION IN THE CSU

A. The Graduate Course

1. It is assumed that students who enroll in graduate courses possess:

   a. Maturity, responsibility, and scholarly integrity appropriate to study beyond the baccalaureate level.
   b. A broad base of knowledge, usually represented by the possession of the bachelor's degree.
   c. Competence in the specified field, usually represented by a substantial body of upper-division study in the field or in a closely related field.
   d. A command of basic techniques and skills essential for independent, self-directed study in the field.

2. The graduate course deals with more complex ideas, materials, techniques or problems than the undergraduate course, and demands searching and exhaustive analysis.

3. The graduate course requires:

   a. The identification and investigation of theory or principle.
   b. The application of theory to new ideas, problems, and materials.
   c. Extensive use of bibliographic and other resource materials with emphasis on primary sources of data.
   d. Demonstration of competence in the scholarly presentation of the results of independent study.

4. Satisfactory completion of a graduate course requires more creative thinking than an upper-division course.

5. Performance expectations for graduate student enrolled in undergraduate-level courses normally are such that students complete at least one additional assignment. The quality of their written and oral performance in the course normally would be at least one grade point higher than that of an undergraduate. Performance expectations for undergraduate students enrolled in graduate-level courses are such that where campus policy permits undergraduate enrollment in a graduate course, the quality of the written and oral performance of undergraduates in the course normally would be at least half a grade point higher than that of an undergraduate enrolled in an undergraduate course.

B. Lecture-Discussion

The lecture-discussion course conforms to the criteria for graduate courses in general, and

1. Is an organized course with regularized content.
2. Is a combination of lectures and group discussion, based on specialized studies and research.
3. Involves consideration of a series of vital problems, reviews trends, examines different points of view, and interprets issues.
4. Involves problem analysis, research, and high level participation in discussion.
5. Involves the use of a wide variety of material and resources which provide a range and depth beyond that obtainable through a single textbook, although the use of a basic textbook may be appropriate in some lecture-discussion courses.
6. Provides an opportunity for synthesis and analysis through scholarly writing and through course examination that go beyond simple recall of fact.

C. Seminar

The seminar conforms to the criteria for graduate courses in general, and

1. Is organized around a series of related problems significant to the discipline.
2. May have a focus which varies from semester to semester within the framework of the general objectives.
3. Limits the lecture, when it does occur, to setting the stage and clarifying issues.
4. Requires that students assume primary responsibility for an investigation that will contribute to the objectives of the seminar and that they report, interpret, and defend their findings orally as well as in writing.
5. Within the framework of general goals, may allow student participation in course planning and in course evaluation.
6. Has class meetings primarily to develop, share, and critically examine independent investigations by members of the group. Time devoted to individual or small-group conferences under the direction of the professor may on occasion replace general class meetings.

D. Laboratory

Laboratory coursework conforms to the criteria for graduate courses in general and focuses on data gathering and analysis, with an emphasis on research and investigation rather than on laboratory techniques. Its chief distinguishing characteristic is the use of specialized facilities and relatively independent investigation.

E. Field Work and Clinical Practice

Field work and clinical practice require that

1. The students have a high level of theoretical competence and a mastery of the basic skills necessary to perform professional duties with a minimum of direction.
2. The selection of experiences provides opportunity for the student to

    a. Bring to bear and apply a high level of theoretical knowledge.
    b. Exercise judgment of a high order.
    c. Assume responsibility for determining procedures as well as for implementing them.
    d. Report the experience to a supervising instructor in such a way as to point out its significance, to explain the rationale behind his/her major decisions, and to evaluate their adequacy.

F. Graduate Independent Study

At the graduate level independent study is based upon the assumptions set forth in part in the section above entitled, "The Graduate Course." Furthermore, such independent study

1. Has a specific objective related to the student's educational goals and to a graduate program.
2. Is precisely defined as a result of joint planning by the professor and the student.
3. Required periodic and final demonstration of competence in scholarly presentation of the result of the independent study.

Source: Office of the Chancellor, California State University

Proposed new Course: CE 242 Urban and Industrial Water Systems

Justification:

Currently our curriculum does not include a course that:

1) provides an overview of water transport and treatment systems that exist in urban and suburban communities and in industrialized areas; the purpose and characteristics of each system; characteristics of the water they carry and the needs they serve; and factors that must be considered in the design and operation of each system; and

2) explores how these systems are interrelated and how the design and operation of one system can affect the others and impact the needs they serve.

The proposed course meets these needs.

SYLLABUS FOR CE 242 URBAN & INDUSTRIAL WATER SYSTEMS

Spring 2013 **California State University, Fresno**

Delivery Mode: Web-enhanced.

Course Description: This course introduces water management systems in urban and industrial settings. Water infrastructure master planning and the basics of water occurrence, use, transport, quality, treatment, and disposal are included.

Time: Online component: Participation in the online component is asynchronous except for online office hours (see Office Hours).

Classroom meetings: Classroom meetings will be held weekly for quizzes, exams, and discussion of assignments and their solutions.

Day: Thursday

Time: 5:00-6:00 PM (non-exam days)
5:00-7:50 PM (midterm exam)

Location: EE 120

Quizzes/Exams: **S**tudents will be required to take quizzes and exams as follows:

- Approx. 12 to 14 quizzes, either in-class or online as directed by the instructor.
- Two exams in the specified classroom or pre-approved testing center as follows (tentative):

  Midterm: Th. Mar 21, 2013, 5:00-7:50 PM
  Final: Th. May 16, 2013, 5:45-7:45 PM

Units: 3

Instructor: William Wright

Office Number: Engineering East 170

Telephone: (559) 278-5591

E-Mail: wfwright@csufresno.edu

Students should expect to receive a reply within 2 regular instruction days.

Office Hours: Online office hours will be held using Bb Collaborate each *Tuesday from 12:00 Noon to 1:00 pm*. Students may also visit or telephone the instructor during in-person office hours as follows:

Mon. & Wed.: 2:30-4:00 PM
(2:30-3:00 PM on Senior Project Pres. Days)

Website: To access the course login to Blackboard (http://blackboard.csufresno.edu) using your Fresno State username and password.

For help with Blackboard contact: Technology Innovations for Learning and Teaching at 278-7373 or send an email to dcfeedback@csufresno.edu

Course Delivery, Description, Relationship to Other Curriculum, Importance

Summary of Topics: Course material is organized into the subject categories indicated below. Additional detail on course content and organization can be found elsewhere in the syllabus.

- Importance of water and water resource planning & management.
- Water sources and quantity, availability, and quality considerations.
- Global, national, and regional water use.
- Urban & Industrial (U&I) water use, trends, and forecasting; U&I water reuse & disposal.
- Water infrastructure master planning and phases of a water infrastructure project.
- Basic hydraulic principles of water transport system analysis and design.
- Water quality basics (assessment, standards, chemistry)
- Statistical characterization of flowrate, constituent concentrations, & constituent loading.
- Process analysis (material balance, ideal flow in tanks, chemical kinetics, reactors; mass transfer).
- Modification of water quality (water & wastewater treatment, process train selection).
- Contemporary issues in the planning, design, operation, and maintenance of U&I water systems.

Relationship to Other Curriculum: This course and a similar course offered in the Department of Earth and Environmental Sciences (EES 267 Urban & Industrial Water Use) complement courses in two graduate programs at California State University Fresno -- the Master of Science in Civil Engineering (MSCE) and the Professional Science Master's (PSM) in Water Resources. This course has been tailored to meet the needs of students in the MSCE program and is not intended for students in the PSM Program.

Importance: The availability of water of suitable quality often determines the quality of life possible for people and communities throughout the world, and creation and maintenance of infrastructure for the sustainable provision of water is one of the more difficult challenges faced in modern times. The challenge is manifold due to complexities associated with the acquisition of sufficient water supplies to meet societal needs; the modification and maintenance of its quality after its acquisition; hydraulic systems used for its transport and distribution; the manner in which it is used; and its collection, treatment and reuse or disposal after use. In addition to the challenges noted above, concern over the adequacy of current stormwater management practices is increasing, particularly with respect to contaminants that it acquires and negative impacts that they have on receiving waters and potential beneficial uses.

Throughout our nation water agencies are confronting dwindling water supplies, degrading source water quality, rising energy costs, growing populations, complex security concerns, and the need for sustainable environmental stewardship. In areas with an arid climate, such as in the California Central San Joaquin Valley, solutions to this challenge will include development of new technologies for producing waters of different quality for use in different applications (e.g., drinking vs irrigation), accessing water from underutilized sources (e.g., from treated wastewater streams), and reducing energy requirements for both water production and delivery. Although water recycling/ reuse could be developed to provide a significant percentage of the water needed, at present this type of water represents a small fraction of the total water needs of society. Another part of the solution will be a movement towards distributed water treatment, which is expected to decrease conveyance (and, thus, energy) costs, and increase levels of water reclamation, recycling, and reuse. Due to technical complexity, water resource management and infrastructure development requires a highly educated workforce with expertise in engineering analysis, innovation, and design, as well as expertise in numerous other disciplines. This workforce is necessary to achieve long-term sustainability and reliability in water services, and to ensure that the water is kept safe and wholesome. These well-trained professionals will themselves play a critical role in California's future as custodians of California's most valuable asset-- our water.

Assessment: Assessment of student learning will be done through a mixture of assignments, quizzes and exams. It is essential that students master Blackboard (Bb) 9.1 and other Bb tools (e.g., Bb Collaborate) before beginning the course, and that they thoroughly understand the course syllabus. Students are strongly encouraged to take the Fresno State Blackboard 9.1 orientation and receive a certificate of completion.

Prerequisites

None

Textbooks and Materials

Required: W. Viessman Jr., M. J. Hammer, E. M. Perez, P. A. Chadik (2009) *Water Supply and Pollution Control,* 8th Ed. Pearsons Education, Inc., New York. ISBN: 0-13-233717-7

Current versions of MS Word, Excel, PowerPoint; Adobe Acrobat; internet browser.

Recommended: Davis, M.L. and S.J. Masten. (2009 or 2012) Principles of Environmental Engineering and Science. McGraw Hill, 2nd or 3rd ed., ISBN: 978-0-07-312235-9 (2009 version).

Other Suggested References

- Sawyer, C.N., P.L. McCarty, and G.F. Perkin (2003) *Chemistry for Environmental Engineering*, 5th ed., McGraw Hill, New York.
- Haestad Methods (2007) *Computer Applications in Hydraulic Engineering*, 7th Edition; software (CD is included with the textbook). ISBN-13 Number: 9780971414165.
- Finnemore, J. and Franzini, J. (2002) *Fluid Mechanics with Engineering Applications* 10th ed. McGraw Hill. ISBN: 0-07-243202.
- MWH - Montgomery Watson Harza (2012) *Water Treatment: Principles & Design*, 3rd ed. John Wiley & Sons.
- American Water Works Association (2010) *Water Quality and Treatment, 6th ed.* McGraw-Hill Book Company, New York. ISBN 0071630112 / 9780071630115
- Reynolds, T.D. and P.A. Richards (1996) *Unit Operations and Processes in Environmental Engineering*, 2nd ed., PWS Publishing Company, Boston, MA.
- Metcalf & Eddy, Inc. (2003), *Wastewater Engineering: Treatment and Reuse* 4th ed., McGraw Hill Book Company, New York.
- Asano, T., F. Burton, H. Leverenz, R. Tsuchihashi, G. Tchobanoglous (2007) Water Reuse: Issues, Technologies, and Applications, Metcalf & Eddy/ AECOM, McGraw-Hill book Company, New York.

Course Organization

This course is organized into modules and students will proceed through the modules sequentially. In general, each module takes one week to complete. Modules are posted in Course Documents on Blackboard. Each module typically contains reading, viewing, and homework assignments, a reminder to take the Blackboard Quiz (if given online), Discussion Board, and tasks. Students should proceed through the course sequentially because later chapters build on material presented in earlier chapters.

Discussion Board entries will be used for recording student thoughts after reviewing assigned readings and video viewings, and for assessment of class participation. Entries in the Discussion Board are viewable by all, so this is where the "netiquette" practices described in your orientation as well as below are important. Homework and other assignments will be submitted in the "Assignments" folder under "Course Documents." Homework, quizzes, and exams are discussed below.

Examinations, Quizzes, and Homework

Exams: The course exams consist of one midterm exam (approximately 90-min.) and a cumulative final exam (approximately 110-min.). Exams will be given in the classroom at the start of the course meeting period. Material for exams will be drawn from lectures, readings, and assignments. Exams are closed to books and lecture notes and typically will be administered in two parts with different formats as follows:

Part 1: Calculators and electronic devices are not allowed. Questions will include true/false, multiple choice, fill-in-the-blank, essay, and simple calculation.

Part 2: Calculators are needed, and the model must be among those that have been approved for use*. Questions typically require multi-step solutions consisting of multiple calculations, short explanations of approach, and essay discussion of the results. Students can bring **<u>one</u>** ***hand-written*** crib-sheet for use on Part 2 of the midterm exams and **<u>three</u>** ***hand-written*** crib-sheets for use on Part 2 of the final exam. Crib sheets will be 8.5"x11", one sided. Crib sheets are to be stapled to the exam at the instructor's desk. You will not be allowed to keep your graded final exam but it will be made available to view in the instructor's office.

* To protect the integrity of its exams, the only calculator models acceptable for use during the exam are as listed at the National Council of Examiners for Engineering and Surveying (NCEES) calculator policy web page (http://www.ncees.org/Exams/Exam-day_policies/Calculator_policy.php).

Exams will be given at Fresno State in the classroom at the pre-arranged/ announced times. Make-up tests are generally not given and therefore it is essential that students take the exam at the specified time. Exceptions will be considered at the discretion of the instructor on a case-by-case basis, and only with prior arrangement or in the event of a documented, excused absence (e.g., hospitalization, death in the immediate family, etc.).

Quizzes: Quizzes will be given on Blackboard or in the classroom on a weekly basis as determined by the instructor and announced to students in advance. Quizzes are designed to enhance student familiarity with assigned readings and viewings (e.g., videos). Each quiz will be worth 10 points. Students will be allowed one attempt to take each quiz. When quizzes are administered via Blackboard, the instructor will make each quiz available from **8:00 pm** through **8:30 pm** on the **Monday** of the week it is shown in the schedule. Failure to complete a given quiz in the allotted time frame will result in a score of zero for that quiz. No make-up quizzes will be given. The lowest two scores will be thrown out in computing the final grade.

Homework: Homework assignments will usually be given on a weekly basis, excluding the week in which the midterm exam is administered, typically during the weekend. Homework submittals will be due on Sunday (midnight) of the following weekend (i.e., approximately 7 days later). Homework assignments are worth 10 points each. The lowest score will be thrown out in computing the final grade. Late homework assignments will be accepted through Wednesday of the week following its due date, but they will receive up to half credit.

Homework must conform strictly to the attached format guidelines and failure to do so may result in the homework being returned ungraded. Students are encouraged to work in groups on homework as a forum to exchange ideas on how to approach the problems after independently attempting all of the problems first, however, you may not consult the written work of your fellow students and the final product must be an individual effort (i.e., the original work of the student submitting the assignment). Homework submittals that appear to be similar to each other will, at the instructor's discretion, be marked zero. The policy includes parts of submittals such as graphs produced using a computer.

Student Preparation

Don't get behind. Learning a complex subject results from numerous sequential efforts, rather than from just a few long study session efforts. Trying to "cram" this week to make up for what you didn't do last week is not an effective way of learning and will make your future progress difficult. The instructor is here to help you learn about urban and industrial water systems and help you to achieve your academic goals. Take advantage of online office hours.

If you have concerns about the class or your progress talk to your instructor as soon as possible. Be proactive and seek help before you feel overwhelmed. If you need additional help sign up consider forming a study group and doing additional reading from the list of suggested reference books (check to see if they are in the library and, if not, use interlibrary loans to obtain one from another library).

For free tutoring on campus for basic subjects (and some advanced material), contact Pathways in the Lyles College of Engineering or the Learning Center in the Collection Level (basement level) of the Henry Madden Library. You can reach the latter by phone at 278-3052 or visit The Learning Center website (www.csufresno.edu/learningcenter).

Participation Standards

Students must complete weekly assignments as given on Blackboard and deliver the work products to the instructor by the due date shown in each of the course modules (see Course Organization and Assignments as described above). Participation points will be assigned based on the following:

1. **(50% of participation score):** Discussion Board assignments require posting at least one original thread and responding to at least two others. Grade will be based on content (relevancy to the topic; importance; insight and creativity; length); on quality of writing; and on degree of interaction with other students.
2. **(50% of participation score):** Completion of all assignments on time (including Discussion Board).

Participation standards and grading are subject to change and any changes will be posted in Blackboard Announcements.

Grading

Module content will be available from the time of original posting until the end of the semester. Students not participating in a given module are responsible for finding out what transpired for that module. The student has the responsibility to check announcements posted on Blackboard. If students miss a week of class they also should check with classmates to be up to date with course requirements.
The point value of each of the grading elements, and the grading scale, are as follows:

Grading Element	**Value**	***Final Grading Scale***
Midterm Exam	20 %	**A** = 90 to 100
Quizzes	20 %	**B** = 80 to 89
Final Exam	30 %	**C** = 70 to 79
Homework Assignments	20 %	**D** = 60 to 69
Participation/discussion	10 %	**F** = 59 and below
Total	**100 points**	

Course Goals and Primary Learning Outcomes

Course Goals: The overall course goals are to give the successful student the ability to understand the purpose, function, characteristics, and interconnectedness of water systems in urban and industrial settings; the origin, quality characteristics, transport, and fate of water in each system; and issues related to the planning, design, construction, operation, and maintenance of these systems. This will be achieved through the following learning outcomes:

Primary Learning Outcomes:

1. Ability to identify and intelligently describe:
   a. The importance of water to society.
   b. Urban water systems, their purpose/ function, events that led to their development.
   c. The essence of water resource planning & management.
   d. Water sources, quantity, availability, & quality considerations; Alternative water sources.
   e. Characteristics of global, national, and regional water use; types of water use.
   f. Urban & Industrial water use (uses, amounts used, trends, forecasting), and the fate of used water.

g. Water infrastructure master planning and phases of a water infrastructure project.

h. Components of water transmission and distribution systems, wastewater collection systems, and stormwater collection and transport systems.

i. Basic hydraulic principles of water transport (conservation of mass and energy; headloss; design of gravity-flow water conveyance systems; design of pressurized water conveyance systems; design of pumps and pump systems).

j. Water quality basics (assessment, standards, chemistry):

--Impurities of concern commonly found in ground waters, surface waters, urban stormwater, drinking water, and in raw and treated wastewater.

--Water quality goals and regulatory requirements associated with drinking water, urban stormwater, and treated wastewater.

k. Steps in the material balance technique

l. Unit operations and processes used in the treatment of water, wastewater, and stormwater, and how each operation and process fits into an overall treatment system..

m. Contemporary issues in the planning, design, operation, and maintenance of urban and industrial water systems.

2. Develop sensitivity to the interaction of global and societal issues within the fields of water resources and environmental engineering.

3. Ability to apply hydraulic principles in the analysis and design of water distribution, wastewater collection, and pump station systems. In doing so, expand abilities to apply basic science knowledge to the design of water resource infrastructure.

4. Be able to solve a wide variety of water chemistry problems including the determination of molarity, normality, pH, alkalinity, hardness, and accuracy of water quality data.

5. Improve ability to work in groups in a fully on-line collaboration environment (Blackboard) via active participation a small group research assignment.

6. Be able to function in an ethnically diverse multicultural environment (in the classroom and online).

Subject to Change Statement

This syllabus and schedule are subject to change in the event of extenuating circumstances. If you are absent from class, it is your responsibility to check on announcements made while you were absent.

Course Policies & Safety Issues

All online communications for this course will reflect netiquette, especially those that are viewable by all course participants (e.g., Discussion Boards). In addition, the university policy on disruptive behavior also applies, even though this class does not meet in person in a physical classroom.

Plagiarism Detection. The campus utilizes the SafeAssign plagiarism prevention service through Blackboard. In this course, students will be required to submit major written assignments to SafeAssign. Submitted work will be used by SafeAssign for plagiarism detection and for no other purpose. The student may indicate in writing to the instructor that he/she refuses to participate in the SafeAssign process, in which case the instructor can use other electronic means to verify the originality of their work. SafeAssign Similarity Reports (that give a numeric rating of the percent of a student's paper that is similar to other published work) will be available for student viewing. The instructor will set up draft SafeAssign assignments so that students can obtain feedback on the originality of their writing prior to formally submitting assignments for grading.

University Policies

Students must be familiar with university policies on students with disabilities, honor code, cheating and plagiarism, use of computers, disruptive classroom behavior, and copyright.

Students with Disabilities: Upon identifying themselves to the instructor and the university, students with disabilities will receive reasonable accommodation for learning and evaluation. For more information, contact Services to Students with Disabilities in the Henry Madden Library, Room 1202 (278-2811).

Honor Code: "Members of the CSU Fresno academic community adhere to principles of academic integrity and mutual respect while engaged in university work and related activities." You should:

a) understand or seek clarification about expectations for academic integrity in this course (including no cheating, plagiarism and inappropriate collaboration).
b) neither give nor receive unauthorized aid on examinations or other course work that is used by the instructor as the basis of grading.
c) take responsibility to monitor academic dishonesty in any form and to report it to the instructor or other appropriate official for action.

Cheating and Plagiarism: "Cheating is the actual or attempted practice of fraudulent or deceptive acts for the purpose of improving one's grade or obtaining course credit; such acts also include assisting another student to do so. Typically, such acts occur in relation to examinations. However, it is the intent of this definition that the term 'cheating' not be limited to examination situations only, but that it include any and all actions by a student that are intended to gain an unearned academic advantage by fraudulent or deceptive means. Plagiarism is a specific form of cheating which consists of the misuse of the published and/or unpublished works of others by misrepresenting the material (i.e., their intellectual property) so used as one's own work." Penalties for cheating and plagiarism range from a 0 or F on a particular assignment, through an F for the course, to expulsion from the university. For more information on the University's policy regarding cheating and plagiarism, refer to the Class Schedule (Legal Notices on Cheating and Plagiarism) or the University Catalog (Policies and Regulations). As described above, this course will use SafeAssign for analysis of the original content of all major writing assignments.

Computers: "At California State University, Fresno, computers and communications links to remote resources are recognized as being integral to the education and research experience. Every student is required to have his/her own computer or have other personal access to a workstation (including a modem and a printer) with all the recommended software. The minimum and recommended standards for the workstations and software, which may vary by academic major, are updated periodically and are available from Information Technology Services (http://www.csufresno.edu/ITS/) or the University Bookstore. In the curriculum and class assignments, students are presumed to have 24-hour access to a computer workstation and the necessary communication links to the University's information resources."

Disruptive Classroom Behavior: "The classroom is a special environment in which students and faculty come together to promote learning and growth. It is essential to this learning environment that respect for the rights of others seeking to learn, respect for the professionalism of the instructor, and the general goals of academic freedom are maintained. Differences of viewpoint or concerns should be expressed in terms which are supportive of the learning process, creating an environment in which students and faculty may learn to reason with clarity and compassion, to share of themselves without losing their identities, and to develop and understanding of the community in which they live. Student conduct which disrupts the learning process shall not be tolerated and may lead to disciplinary action and/or removal from class."

Copyright policy: Copyright laws and fair use policies protect the rights of those who have produced the material. The copy in this course has been provided for private study, scholarship, or research. Other uses may require permission from the copyright holder. The user of this work is responsible for adhering to copyright law of the U.S. (Title 17, U.S. Code). To help you familiarize yourself with copyright and fair use policies, the University encourages you to visit its copyright web page (http://www.csufresno.edu/library/about/policies/docs/copyrtpolicyfull.pdf)

TILT course web sites contain material protected by copyrights held by the instructor, other individuals or institutions. Such material is used for educational purposes in accord with copyright law and/or with permission given by the owners of the original material. You may download one copy of the materials on any single computer for non-commercial, personal, or educational purposes only, provided that you (1) do not modify it, (2) use it only for the duration of this course, and (3) include both this notice and any copyright notice originally included with the material. Beyond this use, no material from the course web site may be copied, reproduced, re-published, uploaded, posted, transmitted, or distributed in any way without the permission of the original copyright holder. The instructor assumes no responsibility for individuals who improperly use copyrighted material placed on the web site.

Students can also refer to the Required Syllabus Policy Statement (http://www.csufresno.edu/academics/policies_forms/instruction/syllabus.shtml)

Tentative Course Schedule

The schedule and procedures for this course are subject to change due to this being a new course and due to extenuating circumstances that may arise during the semester.

Course Schedule (Tentative; Expect Changes)

Spring 2013

Weekly Modules

Module	Start Date	Module Topics	Quizzes, Exams, Assignments
Module 1	Th. Jan. 17	First Day —Review syllabus; Intro. / course overview; Book –Importance of water; Historical Development of Urban Water Systems; Overview of water resource planning & management.	Complete Blackboard Orientation; Read Ch. 1 & Ch. 2, PP; View video; Online discussion; Homework 1.
Module 2	Th. Jan. 24	Water sources, quantity, availability, & quality considerations; Alternative water sources --Conservation, Reuse, etc..	Quiz 1 Read Ch. 3.0-8 &13-20, Ch. 4, PP; View video; Online discussion; Homework 2.
Module 3	Th. Jan. 31	Global, national, and regional water use; Types of Water use	Quiz 2 Read Ch. 4 & Ch. 5.0-2, PP; View video; Online discussion; Homework 3.
Module 4	Th. Feb. 7	Urban & Industrial Water Use I Urban & Industrial water use; Water use trends, forecasting	Quiz 3 Read Ch. 4, Ch. 5, PP; View video; Online discussion; Homework 4.
Module 5	Th. Feb. 14	Urban & Industrial Water Use II Water reuse & disposal. Water infrastructure master planning	Quiz 4 Read Ch. 4, Ch. 5, Ch. 7.15-18, Ch. 12.33-34, Ch. 14.15-24, PP; View video; Online discussion; Homework 5.
Module 6	Th. Feb. 21	Basic Hydraulic Principles I Design of free-surface water conveyance systems.	Quiz 5 Read Ch. 6.0-4, PP; View video; Online discussion; Homework 6.
Module 7	Th. Feb. 28	Basic Hydraulic Principles II Conservation of mass and energy; headloss in pipes; Analysis and design of pressurized water conveyance pipes and pipe network systems (Part 1).	Quiz 6 Read Ch. 6.4.B-6.8, PP; View video; Online discussion; Homework 7.
Module 8	Th. Mar. 7	Basic Hydraulic Principles III Analysis and design of pipe network systems (Part 2).	Quiz 7 Read Ch. 6.8-10, PP; View video; Online discussion; Homework 8.
Module 9	Th. Mar. 14	Basic Hydraulic Principles IV Analysis and design of pump systems. ***Half-semester review; Exam preparation***.	Quiz 8 Read Ch. 6.11-16, Ch. 7.8, PP; View video; Online discussion. ***Study for exam*** (no homework).

Module	Start Date	Module Topics	Quizzes, Exams, Assignments
Module 10	Th. Mar. 21	Water Management Systems -- Modeling & Design: Components, modeling, and design of potable water, stormwater, and wastewater management systems.	**Midterm Exam** Review Ch. 1-6, Read Ch. 7, PP; View video; Online discussion; Homework 10 (Pump systems).
Module 11	Th. Apr. 4	Water quality assessment & Chemistry: Characterization & measurement; Standards. Basic water chemistry; Chemical Equilibria; Kinetics (reaction rates).	Quiz 9 Read Ch. 8, Ch. 11.0-6, PP; View video; Online discussion; Homework 9.
Module 12	Th. Apr. 11	Process Analysis I Material balance; Modeling ideal flow in tanks; Reaction. Reactors; Mass transfer.	Quiz 10 Read Ch. 11.6-10, Ch. 11.40-44, PP; View video; Online discussion; Homework 11.
Module 13	Th. Apr. 18	Process Analysis II Statistical characterization of flowrate, constituent concentrations, & constituent loading; Water & Wastewater Treatment I Water & Wastewater Treatment overview; Common water and wastewater treatment trains.	Quiz 11 Read Ch. 9, Ch. 12.10-11, PP; View video; Online discussion; Homework 12.
Module 14	Th. Apr. 25	Water & Wastewater Treatment II Process train selection; Treatment plant design.	Quiz 12 Read Ch. 9, PP; View video; Online discussion; Homework 13.
Module 15	Th. May 2	Contemporary issues encountered in the planning, design, operation, and maintenance of urban and industrial water systems	Quiz 13 Read Ch. 2; Ch. 4; Ch. 5; Ch. 7.15, 18, & 19; Ch. 8.7; Ch. 9.6; Ch. 11.25, 26; Ch. 14.15; PP; View video; Online discussion; Homework 14.
Module 16	Th. May 9	Consultation Day (serves as our final day of instruction) Course review, evaluation	Review for Final Exam

Final Exam Preparation & Faculty Consultation Days:	Thursday & Friday	May 9 - 10
Final Semester Examination	Thursday	May 16, 5:45 PM

Homework Solution Requirements

Submittal Requirements:

1. HW solutions are to be submitted in a single PDF document. Current versions of MS Word allow saving of files in .pdf format (using the "save as" command).
2. Include your name, date, and assignment number at the top of the first page.
3. Include problem number and problem statements
4. The file name is to begin with your last name: *YourLastName*_HW_*X*_CE292_*TheSemester*, where *X* is the module number and LastName is the student's last name.
5. The file is to be uploaded to the same assignment folder that the assignment was given in.

Format and Content Requirements:

- Use engineering paper. Exception: Computer-generated sheets
- Use one side (the front) of the paper only
- Use a staple or binder clip if more than one page
- Solutions must be well organized and logical with sequential steps from top to bottom
- Use sketches when necessary (which is most of the time)
- Graphs in landscape format are to have the top side bound (Graphs are to be read from the right/long side of your sheet)
- Show all formulas in variable form before inserting values; Use Equation Editor or equivalent for formulas
- Use superscript and subscript
- Define all terms
- State all assumptions
- Show (carry) units for every calculation
- Use the appropriate number of significant figures
- Underline intermediate quantities
- Box or double underline final answer
- Separate problems with a horizontal line

Always do the following:

1. Provide a problem statement (Given, required) or attach the assignment sheet or a photocopy of the problem from the textbook (up to 20% off or returned ungraded)
2. Provide a sketch (if not already given) (up to 10% off)
3. Explain each step of the solution; state the method used; if not common, provide a complete reference (authors, title, edition, publisher) (up to 20% off or returned ungraded)
4. Provide equations in variable form; if not common, provide a complete reference (up to 10% off)
5. Define all variables (up to 10% off)
6. State assumptions. (up to 10% off)
7. Show at least one sample calculation for each type of calculation (up to 10% off)

Excel/ Spreadsheet Requirements:

When submitting Excel Spreadsheet solutions, provide the formula and a sample calculation (including units) for each type of calculation done in the Excel program.

Example Hand-Written Calculation-Based Assignment Format

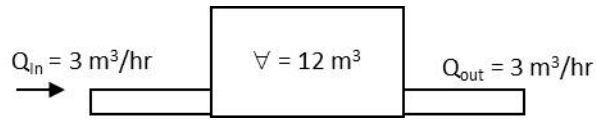
HW # 1, Prob. 1.1, 1.2, 1.3	CE 242 9-4-12	Last name, First name 1/3

Problem 1.1

Given: Water flowing through a 12 m^3 tank at a rate of 3 m^3/hr.

Find/required: Average residence time in the tank.

Solution:



Assumptions: Ideal flow through tank (no dead volume or short-circuiting)

Retention time, $\theta = \forall/Q$

Where:

∀ = tank volume

Q = volumetric flowrate

$$\theta = \frac{12\ \mathrm{m}^3}{3\ \mathrm{m}^3/\mathrm{hr}} = 4\ \mathrm{hours}$$

Problem 1.2