The Department of Environmental Resources Engineering (ERE) offers M.P.S., M.S., and Ph.D. programs in Environmental Resources Engineering. This curriculum proposal adds six new options to our graduate programs, removes one M.P.S. option, and clarifies the language in the Catalog related to the graduate programs in ERE.

- We request to offer an M.P.S. degree to our graduate options. At present, ERE offers M.S. and Ph.D. degrees in Environmental Resources Engineering within the options of Ecological Engineering, Geospatial Information Science and Engineering, and Water Resources Engineering. To make better use of our faculty expertise and increase ERE’s graduate enrollment, we are proposing to offer M.P.S. degrees in the options of 1) Ecological Engineering; 2) Geospatial Information Science and Engineering; and 3) Water Resources Engineering. In addition, we are proposing to remove the Mapping Science option, which only offered a M.P.S. only degree. We expect students interested in that option will now enroll in the new M.P.S. degree in the Geographic Information Science and Engineering option.

- We also propose a new option—Environmental Resources Engineering—offering M.P.S., M.S., and Ph.D. degrees to support the growing interest of prospective graduate applicants in the general area of environmental resources engineering. When our Department was named Forest Engineering, we had a Forest Engineering Option. This general ERE option emphasizes the resource focus of environmental engineering. It is aimed at potential graduate students who have a multidisciplinary educational background or interdisciplinary work experience, or seek an interdisciplinary approach to environmental resource engineering issues.
### Institutional Impact:

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
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<tr>
<td>Anticipated Enrollment: 6-9 per semester</td>
<td>Change from existing condition: Add six new options to ERE's graduate programs, and remove one option.</td>
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<tr>
<td>New Faculty or Staffing Requirements:</td>
<td>0</td>
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<tr>
<td>New Technology and Classroom Resource Demands:</td>
<td>0</td>
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<td>New Computing Resources Requirements:</td>
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<td>New Accreditation Requirements:</td>
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<td>New Assessment Requirements (explain &amp; describe):</td>
<td>0</td>
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<td>New Library Resources Requirements:</td>
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<td>New Transportation Requirements:</td>
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<td>New Forest Properties or Field Practicum Facilities Required:</td>
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</table>

**Impacts on other Departments at ESF (please obtain and attach response from affected departments):**

The six new options have similar mastery course requirements to ERE’s existing graduate programs of study. A minimum of 15 credit hours of engineering and applied science courses is required in each option, plus additional courses determined by the student's steering committee. The ERE Department maintains a list of graduate courses for each competence area, which are mostly offered by the ERE Department or distributed over several other departments. No considerable impacts on any individual department at ESF are anticipated.

**Impacts on Admissions (particularly transfer requirements and articulation agreements; please obtain and attach response from Admissions if an impact is anticipated):**

We anticipate recruiting 2-3 graduate students per year in each new option. Prior applicants to the M.P.S. option of Mapping Sciences will move to the new M.P.S. option of Geographic Information Science and Engineering.
List courses taught outside the Department at ESF: None required

List courses taught outside the Department at SU:
- Accessory Instruction credit hours at SU required per student in this curriculum:
  - 0
- Accessory Instruction credit hours required per semester by this curriculum:
  - 0
- Change in Accessory Instruction needs over current programs and curricula:
  - None
Graduate Programs

Graduate studies and research are primarily concerned with environmental and resource-related problems. Students with a bachelor of science degree in engineering or in environmental sciences, physics, or mathematics have the opportunity to design an individual program of graduate study. Applicants to all programs of study are required to have a bachelor’s degree in science or engineering and are expected to have completed at least one 3-credit course in physics, one 3-credit course in statistics, and two 3-credit courses in calculus. Students admitted without necessary background are required to take additional prerequisite courses required by the Department and the following areas of study.

The M.P.S. degree requires the successful completion of a minimum of 30 credits at the graduate level, of which at least 24 must be in coursework. A comprehensive project or practicum completes the M.P.S. degree requirements. The M.S. degree requires the successful completion of a minimum of 30 credits at the graduate level, of which at least 18 must be in coursework and a minimum of six credits for the thesis. The Ph.D. degree requires the successful completion of a minimum of 60 credits at the graduate level, of which 30–48 are for coursework and 12–30 credits are for dissertation. All graduate degrees in ERE require completion of at least 15 credit hours of graduate coursework in environmental and applied science courses. A departmental seminar is also required.

Facilities

The teaching and research facilities in Baker Laboratory were renovated in 2008 and support graduate study and research with modern laboratories and instrumentation. We have dedicated laboratories for ecological engineering, geospatial engineering, and water resources engineering research and instruction, supported by campus staff: in the wood and machine shops, and as well as Analytical and Technical Services. Research and analysis is facilitated by a powerful range of computing platforms and software. Off-campus facilities include the extensive ESF properties, and numerous field sites supported by an array of field equipment for environmental resource engineering measurements.

The Department of ERE program in Environmental and Resources Engineering offers graduate options in: Ecological Engineering (M.P.S., M.S., Ph.D.) Participating Faculty: DALEY, DIEMONT, ENDRENY, KROLL, SHAW, TAO

Ecological Engineering is the design of ecosystems for the mutual benefit of humans and the environment. Ideal design considers humans to be part of nature rather than apart from nature. At SUNY–ESF we believe that ecological engineering education and research should meet local to global needs. We teach and research sustainable solutions and approach ecological engineering broadly, working in many areas of the world and in most major areas of ecological engineering. Graduates from the ecological engineering option commonly find employment or continue their advanced graduate education in any of the following areas of practice:

- Ecosystem restoration, including watershed, river, forest and wetland restoration
- Design of sustainable systems for wastewater treatment and stormwater management
- Environmental remediation
- Urban ecosystem design and development
- Industrial ecology, life cycle analysis and sustainability analysis

Ecological Engineering emphasizes engineering design of ecosystems consistent with ecological principles of natural, self-organizing, self-maintaining systems. This interdisciplinary field incorporates knowledge in engineering, ecology and social sciences to produce energy- and information-efficient solutions to environmental problems. Public policy, ethics and values are considered in the decision-making process. Students select between alternative solutions to ecological resource problems, in recognition of environmental, economic, legal, social and managerial constraints.

Program prerequisite or co-requisite courses beyond the departmental requirement include at least one semester of study in thermodynamics, fluid mechanics, or statics; probability and statistics; ecology; and hydrology. Applicants are required to have a bachelor’s degree in science or engineering with one year of study in calculus and at least one semester of study in computing methods, chemistry, and biology.
Program mastery courses beyond the departmental requirement include at least one course (3+ credit hours per course) in each of the 4 areas of competence listed below (illustrative courses are listed in parenthesis).

- Ecosystem Restoration (e.g., Ecosystem Restoration Design, Sustainability Analysis, Sustainable Engineering, River Form and Process, Ecological Engineering in the Tropics)
- Pollutant Treatment (e.g., Methods in Ecological Treatment, Ecological Engineering for Waste Management, Water Quality Improvement, Stormwater Management)
- Modeling (e.g., Hydrologic Modeling, Systems Engineering, Engineering Hydrology & Hydraulics)
- Ecosystem Sciences (e.g., Microbial Ecology, Ecosystems, Systems Ecology, Tropical Ecology, Ecological Biogeochemistry, Plant Ecology and Global Change, Aquatic Ecosystem Restoration, Limnology, Environmental Chemistry)

At least 15 credit hours of graduate coursework must be completed in engineering and applied science courses. Research credits complete the degree requirements.

Environmental Management (M.P.S.)
Participating Faculty: DALEY, ENDRENY, IM, KROLL, QUACKENBUSH, SHAW

Environmental Management combines environmental engineering with environmental and business management to provide breadth and perspective for the student aspiring to managerial responsibility in public or private employment. Student coursework is designed to enhance technical and problem-solving skills to meet contemporary needs of environmental managers. Illustrative areas in this option include, but not limited to:

- Engineering management
- Sustainable development
- Brownfield development
- Hazardous and solid waste management
- Solid waste management
- Energy resources management
- Water resource management

Environmental Management combines environmental engineering with environmental and business management and environmental law or policy to provide breadth and perspective for the student aspiring to managerial responsibility in public or private employment. Student coursework is designed to enhance technical and problem-solving skills to meet contemporary needs of environmental managers.

Program prerequisite or co-requisite courses beyond the departmental requirement include at least six three 3-credit undergraduate courses from at least three of the following fields: chemistry, physics, geographic measurements, calculus, statistics, engineering mechanics, ecology, computer science, and economics.

Program mastery courses beyond the departmental requirement include at least 15 credit hours of graduate coursework completed in engineering and applied science courses, 3-6 credit hours in natural sciences; and 3-6 hours in resource management. A minimum of three credit hours of coursework in each of the following areas:

- Project Management (e.g., cost engineering, principles of management, engineering economics, resource economics, engineering management, systems engineering)
- Environmental Policy (e.g., environmental law, environmental impact analysis)
- Environmental Resources Management (e.g., solid or hazardous waste management, watershed management, sustainable design, sustainable development)

A comprehensive project or practicum completes the M.P.S. degree requirements. Study programs are flexible and are tailored to the interests and strengths of individuals.
Environmental Resources Engineering (M.P.S., M.S., Ph.D.)
Participating Faculty: DALEY, DIEMONT, ENDRENY, IM, KROLL, MOUNTRAKIS, QUACKENBUSH, SHAW, TAO

Environmental Resources Engineering takes an interdisciplinary approach to solve environmental and resource-related problems. Emphasis is placed on applying science and engineering to the conservation, restoration, holistic development, and improved utilization of the natural environment and its related resources. Student’s program of study may be tailored to systems and processes at different geospatial scales, from biomolecules to planetary, and employing various tools and techniques such as biomolecular techniques, remote sensing, hydrodynamic modeling, and systems analysis. Illustrative areas in this option include, but not limited to:

- Alternative energy systems
- Environmental remediation
- Resource recovery from wastes
- Sustainable technologies
- Climate change mitigation and adaptation

Environmental Resources Engineering takes an interdisciplinary approach to solve environmental and resource-related problems. Emphasis is placed on applying science and engineering to the conservation, restoration, holistic development, and improved utilization of the natural environment and its related resources. Student’s program of study may be tailored to systems and processes at different geospatial scales, from biomolecules to watersheds, and employing various tools and techniques such as biomolecular techniques, remote sensing, hydrodynamic modeling, and systems analysis.

Program prerequisite or co-requisite courses beyond the departmental requirement include at least one semester of study in thermodynamics, fluid mechanics, or statics; hydrology, chemistry, or biology; and computing methods.

Program mastery courses beyond the departmental requirement are arranged to meet the objectives of the individual student program. A student’s program of study in this option may combine some competence areas in the other ERE options, or introduce new competence areas.

Geospatial Information Science and Engineering (M.P.S., M.S., Ph.D.)
Participating Faculty: IM, MOUNTRAKIS, QUACKENBUSH

Geospatial Information Science and Engineering is designed for specialized study in spatial information acquisition, analysis, modeling and applications. This includes theoretical and applied projects in sensing systems and the location, measurement, analysis and description of ground features and earth resources. It also includes use of geographic information systems (GIS) to incorporate spatial data into a wide range of environmental and engineering problems. Illustrative areas in this option include, but not limited to:

- Remote sensing and digital image/video analysis
- Geographic information systems (GIS)
- Spatial and spatiotemporal databases
- Artificial intelligence/machine learning in spatial analysis and modeling
- Environmental resources monitoring, modeling and assessment

Geospatial Information Science and Engineering is designed for specialized research study in spatial information acquisition, analysis, modeling and applications. This includes theoretical and applied study projects in sensing systems and the location, measurement, analysis and description of ground features and earth resources. It also includes use of geographic information systems (GIS) to incorporate spatial data into a wide range of environmental and engineering problems.

Program prerequisite or co-requisite courses beyond the departmental requirement include at least one year of physics and calculus, one course in statistics, and one engineering science course in surveying, numerical methods, or computer science.
Program mastery courses beyond the departmental requirement include at least one course (3+ credit hours) in each of the four Geospatial Information Science and Engineering areas (illustrative courses are listed in parenthesis):

- Remote sensing (e.g., Principles of Remote Sensing, Remote Sensing of the Environment)
- Geographic information systems (e.g., Introduction to Spatial Information, GIS for Engineers, GIS-Based Modeling, Introduction to Global Positioning Systems,
- Spatial analysis and programming (e.g., Spatial Analysis, Digital Image Analysis, Numerical and Computing Methods, Systems Engineering, Design and Analysis of Algorithm, Introduction to Artificial Neural Networks, Introduction to Database Management Systems, Data Mining, Artificial Intelligence)
- Statistics (e.g., Statistical Analysis, Multivariate Statistical Methods, Nonparametric Statistics, Analysis of Variance, Regression Analysis, Map Accuracy Assessment, Sampling Methods)

Ph.D. students will take an additional course in at least two of these areas (6+ credit hours total). These areas of competence form the basis for your graduate coursework and are supplemented by studies in systems analysis, environmental sciences and management, and geography. Study programs are flexible and are tailored to the interests and strengths of individuals. Departmental and other seminars are also required. Of the total graduate coursework, at least 15 credit hours must be completed in engineering and applied science courses. Research credits complete the degree requirements.

Mapping Sciences (M.P.S.)
Participating Faculty: IM, MOUNTRAKIS, QUACKENBUSH

- Geographic information systems (GIS)
- Global positioning systems (GPS)
- Analytical and digital photogrammetry
- Remote sensing and image processing

Mapping Sciences covers the development and practice of mapping technologies for environmental and engineering applications. Technologies used include GIS and GPS, as well as remote sensing and image processing tools.

Program prerequisite or co-requisite courses include at least one year of both physics and calculus, one course in statistics, and one course in either surveying or computer science. Students admitted without necessary background would be required to take additional prerequisite courses.

Program mastery courses are taken so students upon completion demonstrate competency in spatial data acquisition and fundamental spatial analysis concepts. This is typically achieved through completion of fundamental courses in remote sensing, geographic information systems, spatial analysis, and statistics. Students may specialize by taking advanced courses in the mapping sciences, statistics, computing, environmental sciences and management, or other fields.

A comprehensive project or practicum completes the M.P.S. degree requirements. Study programs are flexible and are tailored to the interests and strengths of individuals.

Water Resources Engineering (M.P.S., M.S., Ph.D.)
Participating Faculty: DALEY, ENDRENY, KROLL, SHAW, TAO

Water Resources Engineering deals with analysis and design of water resource systems through field, laboratory, and computer methods. Emphasis is placed on coordinating engineering to reduce impacts on human and natural systems. Students select among alternative solutions to water resource problems, in recognition of environmental, economic, legal, social and managerial constraints. Laboratory equipment includes soil columns, a river table and two tilting and sediment circulating flumes, all supported by monitoring sensors. Analytical techniques using statistics, numerical analyses, and computer applications are emphasized. Modeling efforts include computational fluid dynamics, GIS, and remote sensing applications, distributed and real-time models, and model calibration and validation. Illustrative areas in this option include, but not limited to:
Watershed hydrology monitoring, modeling, management  
Hydrologic and hydraulic experimentation and analysis  
Water resource systems engineering  
Stochastic and deterministic modeling  
Pollutant fate and transport  
River and watershed restoration  

Water Resources Engineering deals with analysis and design of water resource systems through field, laboratory, and computer methods. Emphasis is placed on coordinating engineering to reduce impacts on human and natural systems. Students select among alternative solutions to water resource problems, in recognition of environmental, economic, legal, social and managerial constraints. Laboratory equipment includes soil columns, a river table and two tilting and sediment circulating flumes, all supported by monitoring sensors. Analytical techniques using statistics, numerical analyses, and computer applications are emphasized. Modeling efforts include computational fluid dynamics, GIS, and remote sensing applications, distributed and real-time models, and model calibration and validation.

Program prerequisite or co-requisite courses beyond the departmental requirement include probability and statistics, fluid mechanics, computing methods, and engineering hydrology. Applicants are required to have a bachelor’s degree in science or engineering with one year of study in calculus and one semester of study in computing methods.

Program mastery courses beyond the departmental requirement include at least one course (3+ credit hours) in each of the four areas of competence listed below (illustrative courses are listed in parenthesis). These areas of competence form the basis for your graduate coursework. Departmental and other seminars are also required.

- Environmental Hydraulics (e.g., Engineering Hydrology and Hydraulics, Open Channel Hydraulics, Transport Processes, Environmental Sediment Transport)
- Water Resources Modeling (e.g., Hydrologic Modeling, Systems Engineering, Groundwater Modeling)
- Hydrologic Zones and Fluxes (e.g., River Form and Process, HydroMeteorology, Vadose Zone Physics, Limnology, Hydrogeology)
- Water Quality (e.g., Water Pollution Engineering, Ecological Biogeochemistry, Environmental Chemistry; Environmental Aqueous Geochemistry)

At least 15 credit hours of graduate coursework must be completed in engineering and applied science courses. Research credits complete the degree requirements.