MESM: Wetland, Watershed, and Ecosystem Science

This specialization focuses on the science and management of ecosystems at all scales from landscape to interstitial.

Students may concentrate studies
• in the ecology, management, and conservation of inland or coastal wetlands, streams or lakes
• in watershed science and management, particularly land use-water resource interactions;
• in the ecology and management of forests for human use and biodiversity;
• or in soil ecology, including bioremediation of organic
Program Overview

• Students take courses from natural science: ecosystem science and management; earth science, water resources, hydrology, soils, and spatial analysis. In addition coursework can include statistics environmental planning, policy, law, and economics.

• Track Chair: Dr. Art Gold
  http://nrs.uri.edu/people/faculty/gold.html
Ecosystem Science and Management

Conceptual framework of the Ecosystem Management Programme

Schematic representation of the conceptual framework of the Ecosystem Management Programme. Technological progress – e.g., out-of-soil production of biofuels (algae culture in containers) – may directly contribute to human well-being (the diagonal arrow) and indirectly through improved ecosystem service delivery (less pressure). Other short-term improvements can come in the form of policies directly affecting direct drivers such as habitat change, invasive species and pollution.

UNEP: United Nations Environmental Programme
Scale ranges from microbial to watershed and global

Areas of Interest:
• Environmental monitoring and mapping
• Ecohydrology
• Ecosystem services
• Pollution assessment/abatement
• Lake and estuarine eutrophication
• Habitat and hydrologic restoration
• Watershed dynamics of flow and nutrients
• Climate change adaptation
Potential Focus Areas

- Green Infrastructure (LID)
- Wetlands assessment and management
- Water Quality Monitoring
- Watershed management
- Stream flow/continuity/environmental flows
- Soil Interpretations – Soil certification possible
- Groundwater Protection
- Pollution abatement strategies
Private sector opportunities within WWE track

Environmental Sciences

From wetland mitigation to habitat restoration, VHB has a proven track record successfully completing projects that involve complex environmental challenges. VHB evaluates project constraints to develop environmentally sensitive solutions, offering innovative answers that address each project’s unique conditions.

[ Environmental Sciences Services ]

<table>
<thead>
<tr>
<th>GIS</th>
<th>Wildlife and Vegetation Assessment and Habitat Restoration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogeologic Evaluation</td>
<td>Shoreline Assessment and Stabilization</td>
</tr>
<tr>
<td>Stream Assessment and Restoration</td>
<td>Wetland Permitting and Compliance Monitoring</td>
</tr>
<tr>
<td>Water Supply Technical Support and Permitting</td>
<td>Aquatic Ecology and Water Quality Evaluation</td>
</tr>
<tr>
<td>Watershed Planning and Stormwater Management</td>
<td>Historical and Archaeological Survey</td>
</tr>
</tbody>
</table>

Natural Resources

Several major environmental disasters in the United States along with a strong environmental movement started in the 1960s sparked the creation of numerous laws and regulations at the federal, state, and local levels that are now protecting natural resources. Up until that time, environmental protection was not a priority for development projects. The Natural Resources Practice was developed immediately following the enactment of the Federal Clean Water Act in the early 1970s. These two landmark pieces of legislation, along with the Federal Endangered Species Act, set the stage for all subsequent regulations that have come to be and are still evolving today.

GZA advises clients using the “Avoidance, Minimization, Mitigation” hierarchical approach adopted by numerous federal and state regulatory agencies. We have secured permits and provided environmental solutions for thousands of projects throughout our tenure as a company.

GZA has the experience and skills for providing the necessary natural resource expertise for a variety of land & water development projects as well as conservation management efforts for non-profit conservation organizations.

Services include:

- Wetlands & Soils
- Streams, Lakes & Coastal
- Wildlife & Rare Species
- Botanical Services
- Resource Planning
- Federal, State & Local Permitting
Track Requirements

Core courses (21-25 credits), including:

**Natural Sciences** (12-16 credits)
- Ecosystem Science & Management (at least 6 credits)
- Earth Science, Soils & Spatial Analysis (at least 3 credits)

**Social Sciences** (6 credits)

**Quantitative Methods** (3 credits)

**Elective courses** (6-10 credits)

**Independent study** (3 credits: EVS 597)

**Graduate seminar** (2 credits)
### Natural Science Core Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRS 406</td>
<td>Wetland Wildlife</td>
<td>4 cr.</td>
</tr>
<tr>
<td>NRS 423</td>
<td>Wetland Ecology</td>
<td>4 cr.</td>
</tr>
<tr>
<td>NRS 525</td>
<td>Wetland Field Investigations</td>
<td>1 cr</td>
</tr>
<tr>
<td>NRS 426</td>
<td>Microbial Ecology</td>
<td>3 cr.</td>
</tr>
<tr>
<td>NRS 450,452</td>
<td>Soil Conservation and Land Use</td>
<td>4 cr.</td>
</tr>
<tr>
<td>NRS 461</td>
<td>Watershed Hydrology &amp; Management</td>
<td>4 cr.</td>
</tr>
<tr>
<td>NRS 471</td>
<td>Soil Morphology &amp; Mapping</td>
<td>3 cr.</td>
</tr>
<tr>
<td>NRS/BIO 585</td>
<td>Salt Marsh Ecology</td>
<td>3 cr.</td>
</tr>
<tr>
<td>NRS 501</td>
<td>Restoration Ecology</td>
<td>4 cr.</td>
</tr>
<tr>
<td>NRS 518</td>
<td>Ecohydrology</td>
<td>3 cr.</td>
</tr>
<tr>
<td>NRS 526</td>
<td>Microbial Ecology of Soils and Sediments</td>
<td>3 cr.</td>
</tr>
<tr>
<td>GEO 484</td>
<td>Environmental Geohydrology</td>
<td>3 cr.</td>
</tr>
<tr>
<td>GEO 482</td>
<td>Innovative Subsurface Remediation</td>
<td>3 cr.</td>
</tr>
</tbody>
</table>

### Social Science Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community Planning (CPL)</td>
<td></td>
</tr>
<tr>
<td>Environmental Law</td>
<td></td>
</tr>
<tr>
<td>Writing and Rhetoric!!!</td>
<td></td>
</tr>
<tr>
<td>NRS 555 Applied Coastal Ecology</td>
<td></td>
</tr>
<tr>
<td>Hazwopper course</td>
<td></td>
</tr>
<tr>
<td>ENRE MAF courses</td>
<td></td>
</tr>
<tr>
<td>MAF – 465 GIS Applic in Coastal and Marine Envir.</td>
<td></td>
</tr>
</tbody>
</table>

Plus GIS courses and possible certificate
Internship and Major Paper Opportunities – NRS dept

• **CE WQ**
  – **NEMO**: Nonpoint Education for Nonpoint Education
    • Publications
    – Storm water Training Manual
    • Workshops
  – **Home-A-Syst**: Pollution Prevention at the Household Scale
    • Private Wells (workshops)
    • Source water protection
    • Landscaping for Water Res Protection
  – **Watershed Watch**: Volunteer Water Quality Monitoring
    • Program Info
    • Water Quality Fact Sheets
    • Monitoring Data
  – **Onsite Wastewater Training Center**
    • Course Schedule
    • Innovative and Alternative Systems
    • (Creating a Mgmt Plan)
Internship and Major Paper Opportunities – NRS dept

• Management of RI Forests for Wildlife Habitat
• Conservation Stewardship
Internships and Opportunities with NRS Faculty labs

- URI Watershed Hydrology Lab
- The Laboratory of Soil Ecology and Microbiology
- Laboratory of Pedology and Soil Environmental Science
- Wetland Ecology Lab
Internships and Opportunities with URI Partners

• URI Outreach Center
  – Landscape Restoration - Coastal Buffers
  – Environmental Ed
  – Sustainable Systems – Rhody Native

• URI Coastal Resources Center

• URI Coastal Institute
  – Narr Bay Watershed Counts
Internships and Opportunities with State, Federal and NGO Partners

- RI DEM – Office of Water Resources
- EPA Atlantic Ecology Lab
- Save the Bay
- NRCS- RI
Potential Focus Areas

- Green Infrastructure (LID)
- Wetlands assessment and management
- Water Quality Monitoring
- Watershed management
- Stream flow/continuity/environmental flows
- Soil Interpretations
- Groundwater Protection
- Pollution abatement strategies
# Past Major Paper Topics

<table>
<thead>
<tr>
<th>Name</th>
<th>Topic</th>
<th>Audience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patricia Hickey</td>
<td>Mapping onsite wastewater treatment needs, risks, and management options</td>
<td>EPA; State and Local Officials</td>
</tr>
<tr>
<td>Rob Hancock</td>
<td><em>Sea Level Rise Impacts on Salt Marshes</em></td>
<td>Local Officials, Conservancies</td>
</tr>
<tr>
<td>Caitlin Chaffee</td>
<td>Benthic Indices of Biota Integrity</td>
<td>Volunteer, Local and State Water Quality Assessment Programs</td>
</tr>
<tr>
<td>Matt Deane</td>
<td>RI Stormwater Mgmt: Current Status and Tools for Program Improvement</td>
<td>State and local officials</td>
</tr>
</tbody>
</table>
Patricia Hickey, Stewardship Director for Marin Agricultural Land Trust

- 40,000+ acres in Land Trust: Habitat restoration; nutrient mgmt, easements; carbon sequestration
- Recommended Courses: GIS/RS; Wetlands, Soils, Hydrology and Community Planning
- Interned with CRC and URI NEMO
- Major Paper: Guidance document on community-based wastewater mgmt -- EPA
National Decentralized Water Resources Capacity Development Project

Wastewater Planning Handbook
Mapping Onsite Treatment Needs, Pollution Risks, and Management Options Using GIS

University of Rhode Island Cooperative Extension
Kingston, Rhode Island
February 2004
Rob Hancock, VP, Education and Public Engagement, Coalition for Buzzards Bay

- Duties: Youth education; workshops for decision-makers; manages education centers (New Bedford, Woods Hole); coordinates all communications and media relations – will host MESM Interns
- Recommended Courses: Watershed Hydrology; GIS; Wetlands; Landscape Ecology, Coastal Zone Law
- Part-time student; worked with STB
- “My major paper, Sea Level Rise Impacts on Salt Marshes, didn't directly lead to my job but it provides credibility. I can address issues on several levels”
- Advice: Start Major Paper early, define and refine your topic
Caitlin Chaffee, Coastal Policy Analyst, RI CRMC

www.crmc.ri.gov

- Coastal habitat and restoration; stormwater mgmt; shoreline buffers – **CRMC will host interns**
- Courses: Watershed Hydrology, GIS, Wetlands, Envir. Law
- Interned with CE Water Quality program. First job after MESM was with URI Outreach Center to improve mgmt of shoreline buffers
- Major Paper: Temporal variability and subsample size on macroinvertebrate indices of stream quality
- “My MESM major paper helped me with statistical methods, and how to write a major research paper – the subject was less important. I would recommend a topic with greater implications for management.”
Matt Deane, MESM 2013
Wetland Scientist at
GZA GeoEnvironmental

Out of class experiences during MESM

• RIPDES Stormwater Permitting Volunteer at Rhode Island Department of Environmental Management

• Low Impact Development Atlas Manager at URI Non-point Education for Municipal Officials Program

• Director of Water Resource Programs at Southern Rhode Island Conservation District
Matt Deane’s MESM Program

- Ecohydrology
- Wetland Ecology
- Wetlands and Land Use
- Soil Conservation and Land Use
- Applied Coastal Ecosystems
- Hydrogeology
- Environmental Planning
- Environmental Law
- Fundamentals of GIS
- GIS Analysis of Environmental Data
- Concepts of GIS in Environmental Science
- Statistical Methods in Research
- HAZWOPER

Major Paper:
State and Municipal Stormwater Mgmt in Rhode Island: Current Status and Tools for Program Improvement
Eivy Monroy, Environmental Scientist/Engineer; Southern RI Conservation Districts

- Recommended Courses: Watershed Hydrology; GIS; Wetlands; Ecohydrology, Soils.

- Suggestions for Major Paper
  - Find a tractable question. The topic does not set your professional direction
  - If it requires data, it would be better these data are readily available
  - Communicate with adviser as much as possible to clarify objectives and deliverables
  - Focus on why is this important and why others should care?

Major paper, *Water Use Conflicts in East Africa*, used an existing UN model to analyze a multi-faceted problem.
Careers

Graduates find employment with federal and state resource management and regulatory agencies, municipal government, nongovernmental conservation organizations, and private environmental consulting firms.

- State Agencies – Department of Environmental Management; Coastal Resources Management Council
- Federal Agencies – United States Geologic Survey; Natural Resources Conservation Service
- Private Consulting Firms – Geospatial Information Systems; Soils; Wetlands; Hydrology expertise often sought
- NGOs – Conservancies; Watershed Councils