

# Water Resources and Climate Change FY23

Status: APPROVED

## Project Director

Christine Hatch

## Organization Project Number

## Organization

University of Massachusetts

## Accession Number

7002180

## Start & End Date

10/01/2020

## To Project / Program

"Water Resources and Climate Change"

## Primary Critical Issue

Environmental Stewardship

## Fiscal Year

2023

---

### In 2-3 sentences, briefly describe the issue or problem that your project addresses.

As the Extension *Water Resources and Climate Change* Liaison, I have identified a few key areas where my focused attention and facilitation has the potential to affect change and aid decision-making regarding water resources and climate in the Commonwealth. Predictions for future climate in Massachusetts include two parameter shifts that are likely to have a significant impact on how water resources are managed in the state: the entire northeast region is likely to receive more total precipitation, more of which will come as rain instead of snow, and summers are likely to be warmer and drier. Both of these phenomena have already been observed in the climate record, managers are interested in planning for the future, and I can help by forming the link between the science and policy. I focus my efforts in three programmatic areas where the issues are timely, actionable, and have great potential for impact and benefit to Massachusetts:

(a) Establishing a Fluvial Geomorphological Assessment (FGM) protocol in Massachusetts: Learning how to give rivers room to be rivers while living beside them.

(b) Communities facing change: Think watershed, manage locally, and

(c) Maintaining resilient stream ecosystems in a changing climate

### Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

(a) Establishing a FGM protocol in Massachusetts: Learning how to give rivers room to be rivers while living beside them.

**Summary:** We need to change the way Massachusetts looks at rivers and manages river corridors: more specifically, this initiative aims to design and implement a system of fluvial geomorphological assessment in the state; meaning, literally: *fluvia*= river, *geo*=land, *morph*=form, *-ology*= study of; or, including the study of river form and process in the landscape in evaluation of land use practices and prediction of potential erosion hazards.

### Activities:

- This year we worked with an interdisciplinary team including a civil engineer, human geographer, physical geographer, and fluvial geomorphologist to explore the social vulnerability and understand flood risk factors in Massachusetts. We completed an Institute of Diversity

Sciences (IDS) seed grant, featured prominently in their web and video promotions of the program, and used this seed funding to submit an National Science Foundation (NSF) proposal that was not funded. Our PhD student on the project defends her dissertation today!

- The Commonwealth of Massachusetts has been conducting some work in the Environmental Justice space as well, incorporating the identifying and serving these communities explicitly in many of its hazard, planning, and resource work. We have been welcome collaborators for the Water Resources Commission Division of Conservation and Recreation and Office of Water Resources (DCR/OWR) staff Nadia Madden, Floodplain Management Specialist and Joy Duperault, Director, Flood Hazard Management Program on their new and ongoing work mapping the overlapping hazard of EJ and flooding in Massachusetts.
- This year we have been testing the completed River Corridor delineation method on previously generated test map areas to ensure usability by a GIS user with some experience. One Master's student in the GIST program has been exploring this deeply and has made some major advances in (a) simplifying the tool, (b) making an exportable user-friendly tool that non-experts could use, (c) trouble shooting, documentation, (d) incorporating alternative data into the tool in places where FEMA maps don't work or are absent. He will complete his project in June.
- Participated with the Massachusetts chapter of the Association of Floodplain Managers (MassFM). This group is well-connected and especially interested in RiverSmart on-the-ground practice. In addition, it connects us with other practitioners elsewhere outside of Massachusetts (including Colorado and Vermont) to share strategies for using these approaches for managing their rivers, and acquiring funding through mutual partners!!!
- Planned and executed *two* (four-weeks each) Educational Stream Table Demonstrations: at local public schools (K-12) in Connecticut and Massachusetts. Worked with teachers to provide educational curriculum. These have been expanding over the years as teachers modify their curriculum and plan more involved activities. MassDOT continues to use our model to train thousands of DPW workers across the state. These are all part of the RiverSmart Project's long-term goal of experiential environmental education program, participant discussions while using the table focus on learning about (a) fluvial geomorphology, (b) human land use, infrastructure, and especially the interaction between roads, crossings and rivers, (c) flood hazards, dynamics and safety, and (d) aquatic, riparian and floodplain ecology.
- Helped the Amherst Fort River Elementary School apply for an get a grant to purchase an Educational Stream Table and helped with the professional development of the teachers who will use the table to (a) learn to use it, (b) acquire supplies for it, and (c) incorporate it meaningfully into their curriculum.

**(b) Communities facing change:** Think watershed, manage locally, and **(c) Maintaining resilient stream ecosystems in a changing climate**

**Summary:** Despite the fact that the anthropogenic causes of climate change are global in nature require solutions derived from grand scale international cooperative efforts, many of the effects are felt locally. A microcosm of the climate change problem can be found on the watershed scale as well, in the form of upstream causes and downstream effects. In both cases, perspective about the larger context and understanding of the issues at hand can help forge good management decisions that help bolster resilience on the local level and contribute rather than damage the watershed as a whole.

#### **Activities:**

- Appointed by Governor Charlie Baker to the Water Resources Commission, which is responsible for developing, coordinating, and overseeing the Commonwealth's water policy and planning activities to ensure that Massachusetts will have plentiful water to support health, safety, economic development, and ecological vitality for generations to come. The 12-seat governor-appointed Commission includes appointees from 7 state agencies and five public members. (12 meetings)

- Flood and Drought (invited) interactive conversation with CISA Farmers (20 participants)
- Fort River Clean-up (Fort River Watershed Association) with the Connecticut River Conservancy (200 participants in our chapter, many more watershed-wide)
- Fort River Emily Dickinson Trail Renovation (Fort River Watershed Association) with generous sponsorship from the Massachusetts Environmental Trust, and support from the Town of Amherst and Amherst College. Trail was repaired and educational signage drafted and installed to educate visitors about fluvial processes, landuse, historical context (including the poet herself) and natural features. Planned and held a launch event with local politicians and luminaries.
- Appointed **Associate Director of Academics** for the Integrated Concentration in STEM (iCons) Program at UMass Amherst, overseeing, among other things, the launch of a **Food, Water, Climate** track. There are many expected synergies between this program and UMass Extension, especially in the hands-on practicum and laboratory sections.

**Briefly describe how your target audience benefited from your project's activities.**

- Trained 4 teachers and over 200 K-12 children in FGM concepts with the hands-on stream table
- MassDOT has gone on to hold over 300 Rivers and Roads Training for DPW workers (thousands trained to date!) across Massachusetts based on these principles, and is currently planning more! This detailed knowledge of river processes is of critical importance for the health of our rivers, as well as our resilience to extreme floods (for human infrastructure and beyond
- *Franklin Regional Council of Governments* continues to push River Corridor initiatives for individuals and agencies to think about flooding risks.
- *Franklin Regional Council of Governments* has passed a zoning bylaw that protects a river corridor from development along rivers. This is the first legislation of its kind in Massachusetts that specifically addresses geomorphic hazards. (The River Protection Act covers much of this same land but was not initially intended for this purpose, and usually exempts urban or impervious areas).
- *Practitioners in Franklin County, MA* have begun to apply these principles of River Corridor delineation at select sites.
- *The Franklin Regional Council of Governments* is approaching watershed management for the whole (Deerfield) watershed together, taking into account upstream-downstream issues, fluvial hazards, and flood mitigation.

**Briefly describe how the broader public benefited from your project's activities.**

- In 2021, the Town of Amherst asked if I would assist quantifying streamflow in the very small, very urban Tan Brook in the middle of town. We formed a partnership where UMass students can get hands-on experience making hydrologic measurements and interact with real-world water management issues first hand, in exchange for data, expertise, and reporting. I have provided the town with 6 reports and counting, and met with citizen groups and town officials to discuss the stream and data (15 meetings, 6 reports, 30 total participants not including 6 students).

- The MVP program and MassDER's Culvert replacement program have directed funds toward 4 key culvert replacements (where Hurricane Irene damage was greatest) in Franklin County with structures that are both Aquatic Organism Passage friendly and more resilient to flood flows

- Coordination of educational efforts on river process, flood literacy, and issues surrounding road-stream crossings dovetail nicely with the newly developed MA DOT tool. We see opportunities to reach out to communities to help assess crossings and integrate the results into Hazard Mitigation Plans.

- Funding for the initial FM has been leveraged many times over for additional related grants and initiatives

- *Other practitioners in Franklin County, MA and elsewhere outside of our projects and UMass (including Colorado and Vermont) are already using these approaches for managing their rivers, and acquiring funding through mutual partners!!!*

- Database of Fluvial Geomorphology-based assessment methods continues to be accessed for educational purposes

- Coordination of projects within network of fluvial geomorphology work in and around the local (Deerfield) watershed

### **Comments (optional)**

- Deerfield CRC 10th Anniversary Event - 150 participants

- Retired (2015) cranberry bog has completed restoration to a freshwater wetland (Currently the Foothills Preserve (Town of Plymouth))

- We continue to monitor streamflow, water levels in 18 piezometers across the site(s) weather at our permanent weather station with soil moisture sensors, collect water isotope samples (from precipitation), and measure soil moisture along transects and at observation sites across two restorations. - 2 participants

- Began Special Editorship of a journal edition dedicated to **Groundwater Dependent Ecosystems** in *Frontiers*.

- Wetland Policy Meetings - 2 Participants

- CAFÉ Summer Scholars Welcome Virtual Event - 90 participants

- MassFM (Floodplain Managers) Event; Floodplain design, construction and impacts, river corridors - 25 Participants

**Products/ Citations:**

- \$12,000. Institute of Diversity Sciences (IDS) seed grant: “Assessing Social Vulnerability and Understanding the Flood Risk Factors in Massachusetts” 4/15/2021 – 11/1/2022. PI: Christian Guzman, Co-PI’s: Seda Salap-Ayça, Christine Hatch, Eve Vogel, Cielo Sharkus. UMass 105234 51342
- UMass ADVANCE Collaborative Research Seed Grant, “Mapping fluvial erosion risks and policy development under climate change” supported by the NSF ADVANCE Program. PI: Christine Hatch, Co-PI’s: Christian Guzman, Seda Salap-Ayça, Christine Hatch, Eve Vogel. \$15,000 Submitted 9/14/2022
- USDA-NIFA McIntire-Stennis MAS00040, CAFE Summer Scholars Program: “Nature’s Filter: Wetland water quality before and after restoration in Plymouth, MA” \$6,500 5/22/2022 - 9/3/2022. PI: Christine E. Hatch, Scholar: Emma Cady
- USDA-NIFA McIntire-Stennis MAS00040, CAFE Summer Scholars Program: “Nitrogen Cycling in Wetland Plant Leaves: A Spectral Experiment” \$5,200 5/17/2021 - 8/31/2021. PI: Christine E. Hatch, Scholar: Catherine Buttiker <https://ag.umass.edu/cale/students/catherine-buttiker>
- Water Resources Research Center (USGS) Water Resources Institutes Program section 104b: “Nature’s Filter: Wetland water quality before and after restoration in Plymouth, MA” \$14,980 (\$18,041 match) 9/1/2021 – 8/30/2022. PI: Christine Hatch
- Water Resources Research Center (USGS) Water Resources Institutes Program section 104b: “Testing the River Process Corridor in the Deerfield River Watershed, Massachusetts” \$9,760 (\$19,520.54 match) 3/1/2020 – 2/29/2021 (extended to 9/12/31/2021). PI: Christine Hatch
- Warner\*, Benjamin P., Vogel, Eve, and Hatch, Christine (2022). Exactly where does the river need space to move? Seeking participatory translation of fluvial geomorphology into flood management, JAWRA, <https://doi.org/10.1111/1752-1688.13049>
- Hatch, Christine E. (2022), Groundwater-Surface Water Exchange. Groundwater, 60: 709-709. <https://doi.org/10.1111/gwat.13247>
- Rosenberry, D. O., Engesgaard, P., and Hatch, C. (2021). Hydraulic conductivity can no longer be considered a fixed property when quantifying flow between groundwater and surface water. Hydrological Processes, 35 (6), e14226. <https://doi.org/10.1002/hyp.14226>
- Hatch, Christine E. (2022) Earth Matters: Falling for cedars. Daily Hampshire Gazette. Earth Matters. Northampton, MA. September 29, 2022. URL: <https://www.gazettenet.com/earth-matters-sept-30-48197512>
- Hatch, Christine E. (2022) Earth Matters: Shed a little light on your local stream. Daily Hampshire Gazette. Earth Matters. Northampton, MA. May 27, 2022. URL: <https://www.gazettenet.com/Earth-Matters-May-28-46501955>
- Hatch, Christine E. (2022) Earth Matters: Relishing the unexpected in field research. Greenfield Recorder. Greenfield, MA. February 19, 2022. URL: <https://www.recorder.com/Earth-Matters-Relishing-the-unexpected-in-field-research-44876857>

- Hatch, Christine E. (2022) Beavers offer lessons about managing water in a changing climate, whether the challenge is drought or floods. The Conversation. January 20, 2022. Beavers in our landscapes have great potential to provide small-scale adaptations to climate change – if humans can figure out how to live with them. <https://theconversation.com/beavers-offer-lessons-about-managing-water-in-a-changing-climate-whether-the-challenge-is-drought-or-floods-168545>
- Hatch, Christine E. (2021) Earth Matters: Are beavers to blame for flooding damage? Hitchcock Center for the Environment Blog. Amherst, MA. August 6, 2021. URL: <https://www.hitchcockcenter.org/earth-matters/are-beavers-to-blame-for-flooding-damage/>
- Hatch, Christine E. (2021) Earth Matters: Stunning perspectives now democratized by drones. Daily Hampshire Gazette. Earth Matters. Northampton, MA. February 9, 2021. URL: <https://www.gazettenet.com/Earth-Matters-Seeing-Earth-from-above-no-airplane-required-38642944>
- Christine E. Hatch, assisted by William Clement, and students Lyn Watts, James Rigney and Michael Wilkinson (2022) Streamflow in Tan Brook. May 16, 2022. Available at: [https://www.amherstma.gov/DocumentCenter/View/61903/Streamflow-in-Tan-Brook-2022\\_05\\_16](https://www.amherstma.gov/DocumentCenter/View/61903/Streamflow-in-Tan-Brook-2022_05_16)
- ***Living Observatory 2021 Spring Summit***. Session 1: New Wetland Restoration on Cranberry Farms: Conservation Incentives & Climate Vulnerability, Christine Hatch, The Hydrologic Understory at Foothills Preserve... tales of the emergent wetland. Session 2: Designing Wetland Restoration on Former Cranberry Farms for Watershed Resilience. Alyssa Chase\*, Glacial and Anthropogenic Tales Told by a Sediment Core on its way to Becoming a Wetland (and Other from Time Zero), Erika Ito\*, Assessing the potential impact of the pit and mound wetland restoration technique using Groundwater Models. Session 3: Technologies for Tracking the Arc of Change. Lyn Watts\*, Thermal Imaging to Map Groundwater Seeps at Foothills, Jeron LeBlanc\*, The Importance of Microtopography in Wetland Ecosystems: A View from Above.
- Hatch, Christine E.; John D. Gartner\* and Eve Vogel (2021) Developing and mapping the River Corridor in the Northeastern U.S., Invited Oral Presentation, Session 25: Freedom Space for Rivers. July 26-29, and August 2-5, 2021, The National Conference on Ecosystem Restoration (NCER). Virtual.
- Geagan\*, Clarke and Hatch, Christine E. Using COSMOS to measure progress in wetland restoration. 2022 National Soil Moisture Workshop. August 9-10, 2022 Ohio State University, in Columbus, OH.
- Hatch, Christine E. Arc of Change: Soil Moisture Increases in a Restored Wetland (Invited). 2022 National Soil Moisture Workshop. August 9-10, 2022 Ohio State University, in Columbus, OH