2020 Mass Envirothon Current Issue

Sustainable Safe Water Supply

Background and Strategies for Community Research 1.0*

The Massachusetts Envirothon Current Issue challenges your team to investigate an important environmental issue as it occurs in your community, to develop recommendations, and to present your findings to a panel of judges at the Envirothon competition. Use the background and links on these pages as a starting point for your research into the natural and human infrastructure that supplies water to your community. Through your research you are likely to encounter people and organizations who are working hard to ensure a sustainable, safe water supply. Finding a way that you can help them in that work can be the best part of your Envirothon experience.

A commitment to provide a safe, adequate, reliable water supply – particularly drinking water – has been a hallmark of modern societies. However, development pressure on ecosystems, new kinds of pollution, a changing climate, and a fraying social contract are combining to pose increasing water supply challenges for the 21st century. At the same time, innovative use of green infrastructure, new technologies, and growing concern for climate justice offer the potential for more resilient systems.

In 2020, Mass Envirothon teams will investigate water supply issues – and the potential for solutions that increase resilience – in their home communities.

Perhaps more than any other environmental activity, water supply is characterized by precise, technical language and seemingly bureaucratic distinctions. This can be bewildering and off-putting to the uninitiated. It is important to request definitions and explanations. This helps our own understanding and also helps the system exercise its openness to the public.

* This document will be updated! See https://massenvirothon.org/areas-of-learning/current-issue/.

Our water supply as part of the water cycle – some key facts and definitions

- Water supply involves diverting water from its natural pathways for our own purposes.
- We use water for many purposes: drinking, washing, waste disposal, heating and cooling, recreation, and emergencies (e.g. firefighting).
- Leaks from water supply systems are also counted as a use.
- Some of these uses involve little change, some involve significant changes to quality of the water and the paths it takes.
- Water is rarely returned to the watershed without changes to the water quality.
- A large portion of our water use is associated with energy and food production and waste management. These parts of our water footprint do not necessarily take place in Massachusetts watersheds.

- Common technical terms to be familiar with include:
  - Withdrawal describes the amount of water withdrawn from a surface water or groundwater source.
  - Consumption is the portion of the withdrawn water permanently lost from its source. This water is no longer available to us in that place.
- **Energy use.** Energy and water use are connected in what is sometimes called the Water-Energy Nexus: When we use water, we are using energy. Energy is required to extract, treat, distribute, and heat water of appropriate quality, and then to treat wastewater before it is returned to the environment. Conversely, water is used in all phases of energy production and electricity generation (from fracking for natural gas extraction, to hydropower dams, to cooling towers for thermal power production). When we conserve water, we conserve energy. Reducing our water use footprint may be significant for slowing and reducing climate change. **A review of the water-energy nexus may be found at** https://www.sciencedirect.com/science/article/pii/S1364032116303471

What kind of water supply should we aim for in the 21st Century?

Safe – The Safe Drinking Water Act (SDWA) was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply. Under the original law, the focus was technical: primarily on setting standards for drinking water to protect against both naturally-occurring and human-made contaminants that may be found in drinking water by providing appropriate water treatment.

Sustainable – Sustainability emerged as a goal in the 1980s and 90s, recognizing three dimensions of development issues - ecological, economic, and social – enabling a broader understanding of issues and potential solutions. 1996 amendments greatly enhanced the Safe Drinking Water Act by recognizing the importance of source water protection, and public information to safe drinking water. "Sustainability" connotes stability and balance for the long run.

Resilient – Resilience is the capacity of a system to cope with change. The term has become popular, even overused, probably because it seems more appropriate to an era when climate change is shifting the foundations of our ecological and social systems. We live in an era of unprecedented environmental and social change. Unpredictable challenges, particularly extreme weather, but also stressed ecosystems, failing infrastructure, new health threats, contamination incidents, and potential cyberattacks, are surprising us at every turn. Resilience in the water supply system is a high priority.

But resilience can take different forms. If resilience is defined narrowly as a community's capacity to "bounce back" after disaster, we may find ourselves bouncing back to a status quo that degrades the environment, and undermines our ability to cope with in the longer term. On the other hand, if resilience is understood as an opportunity to "bounce forward", it can become motivation for important positive action. Resilience, in the context of "bouncing forward", can be defined as the capacity of a community not only to anticipate, plan for, and mitigate the risks associated with environmental and social change, but to seize opportunities for ecologically sound, economically viable, socially just development.

Water Infrastructure may present an important opportunity for the "bouncing forward" type of resilience. Much 20th century water infrastructure is nearing the end of its useful life, but will be enormously expensive to rebuild. Green infrastructure offers a host of technologies and strategies that partner with natural systems, from permeable pavement and rain gardens to building healthy soil, for lower cost, lower carbon footprint options. One of the most important new ideas may be that if our whole participation in the water cycle - water supply, stormwater management, and wastewater treatment - are considered together, creative solutions may emerge. Green infrastructure is a win-win-win solution: it prevents sewer overflows, minimizes flood risk, protects water quality, and improves public health.

Similarly, while conventional large scale agriculture is one of the largest users of water (for irrigation) and is often pointed to as a pollution source, sustainable local agricultural practices that build soil organic matter on agricultural lands can not only sequester carbon, but increase soil water holding capacity, reducing the need for irrigation and increasing groundwater recharge. https://pubs.er.usgs.gov/publication/70205916

Massachusetts Water supply infrastructure – green and gray

How the system works and what is required for good stewardship
Water-related ecosystem services
How do forests and soils actually improve water quality and quantity?
Source protection – wells and surface water
Drinking water testing and treatment
Distribution systems up to the house
Water distribution in households

Water Supply Policy, Law, and Regulation in Massachusetts

Policy. A policy is a general statement of principles and goals, aimed at guiding decisions and actions. Policies can also clarify definitions, set standards, and make recommendations.

> In Massachusetts, the Water Conservation Standards set statewide goals for water conservation and water use efficiency and provide guidance on effective conservation measures. Water conservation is defined as any beneficial reduction in water loss, waste, or use, and water efficiency is defined as the accomplishment of a function, task, process, or result with the minimal amount of water feasible. The Standards also provide a vehicle to educate Massachusetts' citizens about the importance of water conservation, its crucial link to our natural resources, and how all consumers can use water more efficiently.
> https://www.mass.gov/files/documents/2018/09/11/ma-water-conservation-standards-2018.pdf

Law. Laws are formal written rules stating activities that are required or prohibited, and typically provide an enforcement measure that includes penalties. Laws are established by government through a formal legislative process. At the federal and state levels, laws are called Acts or Statutes. At the municipal level, laws are called ordinances and bylaws. Laws only apply to the geographic area (e.g. town or state) where that governmental unit has jurisdiction. A federal law applies in all states. A municipal bylaw does not apply in other towns, and must conform to relevant state and federal laws.

> The Safe Drinking Water Act (SDWA) is the federal law that protects public drinking water supplies throughout the nation. Under the SDWA, the U.S. Environmental Protection Agency, working with state partners (in Massachusetts, the Department of Environmental Protection), sets standards for drinking water quality and implements various technical and financial programs to ensure drinking water safety.
> https://www.epa.gov/sdwa/overview-safe-drinking-water-act

> The Water Management Act (M.G.L. c. 21G) became effective in March 1986. The Act authorizes MassDEP to regulate the quantity of water withdrawn from both surface and groundwater supplies. The Water Management Act (WMA) consists of a few key components, including a registration program and a permit program.

> Under Massachusetts General Law (MGL Ch.111 s.122), local Boards of Health (BOHs) have primary jurisdiction over the regulation of private wells. The local BOH is empowered to adopt a Private Well Regulation that establishes criteria for private well siting, construction, water quality and quantity.
> https://www.mass.gov/service-details/faqs-private-wells

Regulation. A regulation is a rule spelling out how a law will be implemented. When a legislative body passes a law, it often leaves details up to administrative agencies. This is because certain decisions require expertise that may exist in the administrative agency but not in Congress. Rules have the force of law for both those engaged in the regulated activity and the agencies which generated the rules. For example: The U.S. Environmental Protection Agency makes regulations to implement the Safe Drinking Water Act. At the state level, the Massachusetts Department of Environmental Protection makes regulations to implement the Water Management Act.

Roles and Responsibilities in the Water Supply System

Local/Municipal

- The Board of Water commissioners is the sole governing municipal body with the responsibility for ensuring that a water system has all the required technical, managerial and financial resources for complying with Massachusetts Drinking Water Regulations. This means providing all the necessary resources for sustaining the water supply system from the source to the tap in perpetuity. Depending on the town, they may be elected or appointed. https://www.mass.gov/service-details/water-commissioners-and-local-boards-roles-and-responsibilities-for-drinking-water.

Other municipal boards can play specific roles in water resource decisions:
- Conservation Commission
- Board of Health
- Planning Board
- Open Space Committee
- Agriculture Commission

Other local entities
- Department of Public Works
- Water Department
- Water Supply Districts
- Private water supply companies

Regional

- Massachusetts Water Resources Authority (water and sewer services for metropolitan Boston) http://www.mwra.com/04water/html/wat.htm
- Regional Planning Agencies. Through these regional organizations, a regional community can pool its resources to meet challenges involving issues like solid waste, water and wastewater systems,https://www.apa-ma.org/resources/massachusetts-regional-planning-agencies/
- Watershed Councils and Associations http://www.commonwaters.org/   http://massriversalliance.org/about/
- Land trusts http://massland.org/

State

Department of Environmental Protection
- **Guidelines for Public Water Systems** https://www.mass.gov/water-supplier-operations
- Drinking Water Program https://www.mass.gov/water-supplier-operations
- **Water Management Act (WMA) Permitting** https://www.mass.gov/lists/water-management-act-wma-permitting ;

Department of Conservation & Recreation –
- Division of Water Supply Protection https://www.mass.gov/orgs/dcr-division-of-water-supply-protection
- Office of Watershed Management https://www.mass.gov/orgs/dcr-office-of-watershed-management

Department of Agricultural Resources

Mass Audubon

Federal

- U.S. Environmental Protection Agency (US EPA, Region 1, Boston)
- U.S. Department of Agriculture/Natural Resources Conservation Service (USDA/NRCS)

Water Supply Issues and Topics in Massachusetts communities

We tend to think about water supply issues as disconnected, fragmented problems. What are their connections? In particular, how do they fit into a sustainability/resilience framework? Where is climate change adaptation and prevention a factor in these concerns?

- Infrastructure – replacing aging/deteriorating systems, new technologies, climate change adaptation, opportunities for green infrastructure, funding concerns
- Source protection – quantity and quality, watershed management, role of forests, soils, wetlands
- Water rates – Are charges reasonable? Are costs distributed fairly?
- Safe yield for ecosystems. Accounting for ecosystem impact when permitting water withdrawals (e.g. DEP Sustainable Water Management Initiative)
- Emergency preparedness (Climate Change Municipal Vulnerability) – drought, storms, floods, protection of key water infrastructure
- Private well ownership and protecting public health (Boards of Health regulate private wells)
- Privatization of water supplies – pros and cons
  https://commonwealthmagazine.org/economy/private-management-of-water-systems-can-pay-off/
  https://www.inthepublicinterest.org/wp-content/uploads/Trends-in-Water-Privatization.pdf
  https://www.corporateaccountability.org/wp-content/uploads/2014/11/CAI_TroubledWaters_Web-rev-2_FINAL.pdf
- Emerging contaminants
  - Pharmaceuticals
  - Personal Care Products
  - PFOAs and PFAs
  - Microplastics
  - Cyanobacteria
- Bottled water – pros and cons
- Rain barrels and other water harvesting systems for urban areas
- Agriculture – depending on agricultural practices (e.g. tilling, fertilizing, irrigating, applying pesticides) farming can have a net positive or negative impact on water resources
- Roads – snow removal and salt (water supply vs. public safety?)

Getting Started on Your Community research

Find fun warm-up activities to connect classroom chemistry/physics/biology with real world water supply issues.

- U.S. Geological Survey's (USGS) Water Science School. https://www.usgs.gov/special-topic/water-science-school
- Water Pollution: Everything You Need to Know https://www.nrdc.org/stories/water-pollution-everything-you-need-know
- Conduct your own water quality tests

Map your water supply. Where does the water you use come from? What protections are provided around wells and surface waters? What's the natural landscape where it originates? What landscapes and green and gray infrastructure does it pass through? How far does it travel on its way to your faucet?

Quantify your water use. Can you use your household water bill to analyze your water use? What large scale water uses happen in your community? How much do they use, and how do you know? What unconventional units can you use to dramatize water amounts that will surprise and educate people in your community?

Meet your water supply system up close. Arrange a visit to part of your water supply system. Interview someone whose job is to help provide your water supply.

Read a recent Consumer Confidence Report (CCR) for your water supply. A CCR is an annual report on drinking water quality that community public water suppliers must deliver to their customers.
What questions does this answer? What further questions does it suggest?
https://www.mass.gov/service-details/faqs-consumer-confidence-reports-ccr

Investigate your school's water system: Sources, distribution system(s), quality and quantity, health & safety concerns, tests (when and for what?), educational opportunities

Water quality testing – Who tests what water in your community? What are they testing for? What are the protocols? Talk with your watershed association and asking to visit their lab and see how they test, OR set this up through your water supplier

People in the Water Supply System
- What roles and responsibilities are involved?
- What knowledge and skills are required?
- What perspectives do they bring to the work? What details do they pay attention to?
- What values do they bring to the work? What do they care about?
- What do they think is needed, and how would they propose that we get there?

- Town administrator
- Water Commissioners
- Conservation Commissioners
- Board of Health members
- Planning Board members
- Citizen Advisory Committees
- Scientists

- Engineers
- Water system operators
- DPW director
- Natural resource managers – conservation agents, watershed managers, foresters, wildlife managers

Many Envirothon teams have had positive experiences attending municipal board meetings, then staying afterwards to ask questions of the board. It helps to let them know that you are coming, and what your interests are.

The 2019 Current Issue Problem

In mid-March, your team will receive the 2020 Current Issue Problem, which will provide the specific questions that you will need to address in your Current Issue presentation at the May Envirothon. You will also receive a copy of the scoring sheets that judges will use to score your presentation.

How the Current Issue presentation works:
- Five (and only five) members of your team will make your presentation to a panel of five to eight judges. Your coach and other team members will be able to observe but not participate. The judges' job is to listen, ask good questions, assess your work, and give you feedback on your research, your recommendations, and your presentation.
- You have 15 minutes for your presentation, followed by a 10 minute period when the judges can ask questions. You will be allowed to use posters, maps, and other visual aids, but no electricity is provided or allowed.
- The Current Issue Presentation score is 20% of your team's total Envirothon score.

Current Issue guidance and resources, including this document, are assembled and updated for Mass Envirothon by Will Snyder, Extension Educator for UMass Extension's 4-H Youth Development Program. See more Current Issue information, including links to workshop presentations, at https://massenvirothon.org/areas-of-learning/current-issue/.

This guide will be updated! Please call or write with your questions: Will Snyder at wsnyder@umext.umass.edu or 413/545-3876.