VT Envirothon 2017 Current Issue
Agricultural Land and Water Conservation Stewardship

Welcome to the 2017 VT Envirothon Current Issue

Welcome to the 2017 VT Envirothon Current Issue. This year's topic is *Agricultural Land and Water Conservation Stewardship*. In the course of your work on it, you will learn about work being done on farms throughout Vermont to protect and enhance the quality of our water. You'll learn about recent legislation addressing this subject, various agricultural conservation practices, their costs and benefits and how soil sampling can help identify resource concerns. You'll look at one farm in your community and learn from the farmer about the conservation practices employed there. Focusing on one conservation practice that seems particularly useful, you'll develop a plan to help address water quality concerns on this farm and in the larger area.

I. Introduction

Water Quality is definitely a topic of current interest in Vermont. High quality water is crucial to Vermont whether your lens is environmental, social or economic. It helps define our environment, our economy and in some ways, us as a state. Clean water is the basis for a healthy environment and healthy people. Water-oriented recreation is a huge part of Vermont's economy. The clarity of Lake Champlain is responsible for hundreds of millions of dollars annually from tourism, recreation and taxes on lakeside properties; the economic value of these properties is very important to their owners as well as to municipal coffers. Studies from UVM and Dartmouth show that the economic value of Lake Champlain to Vermont would increase if the lake's water quality issues, especially with regards to clarity, were improved. Similarly, the lake's value to the state would decrease if the clarity decreases. A similar economic effect is true in towns near rivers, streams and lakes throughout Vermont. There are many factors that help determine the quality of our waters; the most important is the amount of nutrients such as phosphorus and nitrogen that get into them. Agriculture, forestry, industry, municipal sewage treatment plants, parking lots, roads and even our own yards and driveways all contribute pollutants to our lakes and rivers. And there is evidence that, at least in many areas, pollution is rising and water quality decreasing. Excess nutrients come from many sectors and sometimes are directly attributable to a specific discharge point like a pipe. More often, it's harder to pinpoint an exact location causing the pollution; this is termed nonpoint source pollution (NPS). Phosphorus and nitrogen, used as fertilizers and also occurring naturally and in manure, bind to soil particles in our fields, lawns, forests and dirt roads; when there is run-off, some of the soil ends up in waterways where it releases the nutrients it is carrying. In water, as on land, these chemicals spur plant growth – but we don't want extra plants/algae growing in our rivers and lakes. They decrease water clarity, change the usual composition of species, and can disrupt

the habitat and health of many things, including people and our pets. Certain types of algae, like blue-green algae, produce toxins that can be dangerous to us in high concentrations. The blue-green algae blooms in certain parts of Lake Champlain are caused, at least in part, by phosphorus-laden runoff. Different environments respond differently to phosphorus and to nitrogen. Freshwater systems react mostly to phosphorus while salt water or marine systems like the Atlantic Ocean react mostly to nitrogen.

TMDLs and Act 64

Vermont's Agency of Natural Resources is required by federal law to set water quality standards – the level of a pollutant that can occur in water and still allow us to use the water as we want, such as for swimming, fishing and drinking. Two of the pollutants that we evaluate are phosphorus and nitrogen, things that are beneficial for aquatic ecosystems, but in excess, create problems.

When the level of a pollutant like phosphorus exceeds water quality standards, federal law requires that a pollution budget, called a TMDL, be developed. TMDL stands for Total Maximum Daily Load and it establishes the maximum amount of a given pollutant that can be in a water body. TMDLs must account for point and nonpoint pollution from all sources combined. Created in the US Clean Water Act of 1972, TMDLs are usually written by the state where the waterbody is located but sometimes the federal Environmental Protection Agency (EPA) writes them. If the maximum amount of pollution entering a waterbody exceeds the state's standards, the state must develop the TMDL budget, provide plans that demonstrate that it will be able to reduce the excess, and identify from which sources these reductions will occur.

In Vermont, almost the entire state is under a nutrient TMDL. Lake Champlain and Lake Memphramagog and their source watersheds have phosphorus TMDLs. The entire eastern half of Vermont is under a TMDL for nitrogen because the Connecticut River flows into saltwater Long Island Sound. Since excess nitrogen is a problem there, the nutrient needs to be limited all along the source watersheds. Although these TMDLs are for nutrients, their best management practices differ slightly because of the way the two nutrients act. P tends to binds to soil particles and is transported to streams in eroded sediment while N tends to move downward into groundwater and then into streams through the groundwater. BMPs for phosphorus generally focus on erosion and runoff issues while those for nitrogen focus more on infiltration issues.

The most well known TMDL is the one for phosphorus in Lake Champlain where phosphorus levels are higher than allowed by Vermont's water quality standards and are not decreasing, despite work that has been done in the past 20 years to lower them. A small percentage of this phosphorus comes from point-source contributors, mostly sewage treatment plants. Under the TMDL, they have to cut their discharge of this pollutant. Although hugely expensive and thus very difficult for a municipality to do, the results are easily measurable. Unfortunately, most of the phosphorus in Lake Champlain is from NPS – which makes cleanup much harder and more difficult to

quantify. Nonpoint sources include agriculture, forestry, eroding backroads, construction runoff, runoff from lawns and roads and other areas

In 2015, the Vermont legislature passed Act 64, the Vermont Clean Water Act, to help enhance water quality and to help meet the goals of the TMDL. The State's Clean Water Initiative, a partnership of many agencies, organizations and municipalities, is implementing the requirements of Act 64 and the TMDL, with revisions and updates of regulations for many sectors, including roads, wastewater treatment facilities, developed lands including paved roads, forest lands, unpaved roads, river corridors and floodplains, wetlands and agricultural lands.

IMPORTANT NOTE: *Although agriculture is only one of the many contributors to water quality issues in Vermont, it is the only one we are focusing on in this year's Current Issue. This matches the 2017 North American Envirothon Current Issue topic: Agricultural Land and Water Conservation Stewardship. Like the rest of Vermonters, farmers are concerned about water quality and most are working very hard to insure a minimal impact on the waterways near their farms.*

RAPs and BMPs

In response to Act 64, the Vermont Agency of Agriculture, Farms and Markets (AAFM) updated rules concerning the impact farms can have on water quality. Reducing erosion and reducing runoff of manure and fertilizer from fields and barnyards are among the aims; the rules will help decrease the amount of phosphorus and other nutrients entering our waterways.

One of the changes AAFM made in the updated rules was to rename and revise what used to be called Accepted Agricultural Practices (AAPs). These are now called Required Agricultural Practices or RAPs. The revised RAPs include requirements for: small farm certification, nutrient storage, soil health, buffer zones, livestock exclusion and nutrient management. The use of RAPs will protect water quality, no matter where the farm is situated. However, farms in the Missisquoi Bay drainage area, where there is strong concern about phosphorus pollution, may be required to use the RAPs as well as further conservation measures called Best Management Practices (BMPs). While BMPs are voluntary, they are often needed to meet the RAPs. Farmers are eligible for technical and financial assistance to implement the BMPs that will help limit nonpoint pollution from leaving the farm. A place to start looking at BMPs is a document written by the VT Association of Conservation Districts called Conservation in Vermont. It is accessible starting here: http://www.vacd.org/introduction.

Another result of the new rules is the way farms are classified by size. Vermont now has five size categories of farms: Large Farm Operations (LFOs), Medium Farm Operations (MFOs), Certified Small Farm Operations (CSFOs), Small Farm Operations (SFOs) and the smallest sized farms which are called Non-RAP Operations (sometimes called NROs). All farms but the Non-RAP farms need to meet the RAPs and are regulated by AAFM. NROs will be regulated on the municipal level, primarily because

they are so small and usually have far less of an impact on water quality. However, any NRO that is negatively impacting water can be called under the state regulations and be required to implement BMPs to correct the issues. Information about what constitutes each size category can be found at: http://agriculture.vermont.gov/node/1322.

Water quality issues on farms

RAPS are designed to protect and conserve water quality. BMPs help farms comply with and go beyond these rules to address water quality concerns on their farms. Both focus on specific farming techniques that directly relate to improving on-farm water quality through managing non-point source runoff. Since each farm is unique, water quality concerns and location vary but generally, water quality issues are broken into two areas: Production Area and Field Management.

The Production Area is where the main farm activities occur, such as feed storage, animal housing, milking, process centers, manure storage, compost sites, farm stands, etc. This area may have water quality concerns depending on proximity to surface water and management techniques. A few examples of where water quality risks might exist in a production area include: barnyards with a lot of runoff, not enough area to store manure for the winter (there's a ban on winter spreading) resulting in overflows or leaks, compost areas not managed properly, no collection or treatment system for wash water or milkhouse waste, or no rain water diversions resulting in storm water flowing through barnyards, heavy use areas, or manure stacks.

Field Management includes techniques that farmers use to grow their crops or graze their livestock. Some field management techniques can help farms improve soil health, increase crop yields, and protect water quality. Alternatively, some management techniques can create water quality concerns. A few examples of where water quality risks might occur in fields and pastures include; livestock access to streams, streambank erosion and bank instability, field erosion and soil loss on cropland, or over-application of manure and nutrients compared to soil tests and recommendations.

Some Common Conservation Practices

In the production area, BMPs include, but are not limited to:
- Curbs around barnyards
- Vegetative buffer/treatment areas
- Clean water diversions, such as roof gutters and drains
- Collection systems for nutrient runoff around feed storage areas
- Storage structures for manure, compost and waste

In fields and pastures, BMPs include, but are not limited to:
- Livestock exclusion from surface waters
- Alternative livestock watering systems
- Prescribed crop rotations
- Winter cover crops

- Minimal tillage practices
- Vegetative buffers on annual cropland
- Nutrient Management Planning

Since many of these practices involve changing structures or systems, implementing RAPs and BMPs can be expensive as well as technical! There are state and federal cost-share programs to help, but in most cases, the farmers still have to spend a lot of money to put these practices into use. Your local Natural Resources Conservation District office can give you more information about conservation practices and some of the programs available to give farmers technical and financial assistance.

Soil Sampling

One crucial part of limiting the runoff of nutrients into waterbodies is nutrient management planning. AAFM defines this as "the management of the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments." One key part of nutrient management planning is soil sampling. Soil sampling:

- helps inform farms what the soil health is, including the amount of phosphorus and nitrogen already in the soil
- informs how much manure and nutrients should be applied to the field based on crop type
- can help farms improve crop yields based on nutrient application recommendations
- informs appropriate manure spreading rates (based on the soil tests and recommendations) which reduces excess nutrients leaving the field in surface runoff

Fields receiving mechanical application of nutrients have to be tested every three years (if CSFO, MFO or LFO) or every five years (if SFO). Soil samples have to be collected and prepared according to UVM guidance or standard industry practice. At a minimum, the soil sample is tested for available phosphorus, reactive aluminum and pH. All of these measures are crucial to understanding how much of a nutrient is present, available and able to affect water quality.

II. Your Challenge

(Note – a large part of this work should be completed over the winter. Your research on the various topics, selecting a farm and talking with the farmer about water quality can all take place when it's still too early for you to accompany the farmer on the farm to see the areas of concern. Please do not wait until spring to initiate your work. The farmer will probably have more time to talk with you during winter than spring but their time is limited even in winter.)

1. What is the definition of poor water quality and how is it determined? Learn what the water quality issues are in VT, in your watershed and in your community. There are

some resources to help with this in the Resource Section but the best way will be to reach out to a local watershed group. What are the environmental, economic and social costs associated with poor water quality? How does the quality of water affect the four Envirothon areas – wildlife, aquatics, forests and soils? Learn what RAPs and BMPs are and how their conservation practices help address water quality. Learn about some of the costs/benefits associated with them and some of the funding available to help farmers put them into effect.

2. Choose a farm in your community to work on for this topic -- can be any kind of farm, not just dairy. If you don't know a farmer, your local NRCD office can help you find one to work with.

3. Work with the farmer to assess water quality and resource concerns on their farm and learn about what they are already doing to improve water quality. What are some specific obstacles in the way of solving some of these concerns (economic, social, personal, infrastructure-related, etc.)? Find out a bit about the farm's history and the farmer's workload on a daily and seasonal basis. Talk to the farmer about the impact they believe their farm has on water quality. Which RAP Farm-size Category is your farm? How does that affect the farm and its operations? Has the farmer recently adopted some conservation practices? If so, what were they? How have they helped with water quality on the farm?

4. With the farmer, identify a part of the farm operation that could be improved to positively affect water quality. This can be in a field or in a production area. Identify the opportunities that exist. You can use on-line tools like the Agency of Natural Resources Atlas to map the farm, its proximity to surface water and your areas of interest for this inquiry.

5. With the help of UVM Extension, your local NRCD, NRCS or an agronomist, learn about soil sampling techniques and testing procedures. Take three soil samples on the farm, at least one near the area you identified and at least one in a field. Get these soil samples analyzed. Although the details still need to be worked out (as of late December), you will not need to pay for these samples yourselves. More information about the payment/processing will be sent to you in February or March. The samples take about 4 weeks for analysis so you'll want to do your sampling soon after the ground thaws. If you don't have enough time to use the samples you collect, use soil samples/analyses the farmer has had done in the past. Use the analysis of your samples or the prior samples as a tool while identifying and developing conservation practices that could be used to help resolve the identified Water Quality improvement possibility. What are some conservation practices that could be used? Think about pros and cons of each; select the one you think is best.

7. Focus on this one conservation practice. Consider its costs/benefits, both short term and long term. Consider the costs/benefits to the farmer as well as the environmental, economic and social costs. Consider any challenges that might impact the implementation of the practice. Be able to justify and communicate why you think this is

the best method and how the challenges to the implementation of the practice might be overcome.

6. Present a plan to the farmer (Envirothon judges). Explain what the issues are, what you have considered to be appropriate conservation practices and why you chose the one you did. How will your plan help with water quality, both on the farm and in the greater community?

III. On the day of the Envirothon

On the day of the Envirothon, your team will have 20 minutes in front of a panel of judges: 15 minutes for you to present your work followed by five minutes of questions from the panel. Everyone on your team should help present your work and be able to answer questions. Although you can't use any electronics while presenting, you can use them, if you want, in preparing your map and any other displays. A month or two before the Envirothon, your team will receive a copy of the rubric the judges will use to assess your work. This will help you fine-tune your efforts – but don't wait for it before you start!

Your presentation should include:
A. Information from your research on water quality concerns in Vermont, specifically with regards to agriculture. Include information from your research on AAFM's rules on RAPs and BMPs, how they address water quality issues and some of the programs available to help farmers employ them.

B. A description and assessment of your farm and the family who farms it. Where are the potential water quality issues on the farm? Where did you do your soil tests? What did the results tell you? (Were you able to use the results from your own tests or did you have to use results from previous tests?) Why did you decide to focus on the site you chose for further study? Is phosphorus or nitrogen more of a concern on your farm?

C. What conservation practices you considered, their costs/benefits financially, environmentally and socially. Explain why you chose the option you did.

D. Your plan, including the costs, benefits and challenges of using this conservation practice both to the environment and to the farmer.

E. A map of your farm with special emphasis on areas of water quality and the site you chose for your work. The map should show where/how the farm might be impacting water quality and how your plan will promote water quality. Showing the farm in context of the larger watershed would also be useful.

Resources to get started - don't limit your research to these!

VT Association of Conservation Districts (VACD)

Find your local Natural Resources Conservation District
http://www.vacd.org/contacts

Info on VACD's program, "Conservation in Vermont: Best Management Practices for Farm and Forest Owners". http://www.vacd.org/agriculture and https://www.youtube.com/watch?v=Z0S94k-2FCI

Natural Resources Conservation Service
https://www.nrcs.usda.gov/wps/portal/nrcs/site/vt/home/

Vermont Agency of Agriculture Food and Markets – Water Quality Page
http://agriculture.vermont.gov/water-quality

Info on RAPs Final Rule http://agriculture.vermont.gov/water-quality/regulations/rap

http://agriculture.vermont.gov/water-quality/regulations/rap/archive - Q16
Download the two-page RAP proposed rule summary Factsheet

Farm Size info and factsheet: http://agriculture.vermont.gov/node/1322

Vermont Clean Water Initiative http://dec.vermont.gov/watershed/cwi

UVM Extension

Crops, Soil, Pasture Home Page:
http://www.uvm.edu/extension/agriculture/crop_soil_pasture

Champlain Valley Crop, Soil Pasture Page (Soil health conservation articles, workshops, resources): http://www.uvm.edu/extension/cvcrops

Soil, nutrient, and manure management:
http://pss.uvm.edu/vtcrops/?Page=nutrientmanure.html#VDFSP
(A couple of good resources here if students want to really get into this aspect: "Nutrient Recommendations for Field Crops in Vermont" - what the lab uses to make recommendations - and "Digging In- A Nutrient Management Course for Farmers".)

UVM Extension FAQ for soil sampling:
http://pss.uvm.edu/ag_testing/?Page=soil_test_FAQs.htm

How to take a soil sample:
http://pss.uvm.edu/ag_testing/?Page=soil_test_FAQs.htm

Monitoring data for major tributaries to Lake Champlain from 1990 to 2015:
https://anrweb.vermont.gov/dec/_dec/LongTermMonitoringTributary.aspx

Monitoring data for lakes since 1979:
https://anrweb.vermont.gov/dec/dec/LayMonitoring.aspx

Vermont Agency of Natural Resources Atlas – Mapping tool to find data (soil types, topography, environmental resources, etc.) and to make maps of practice locations.
http://anr.vermont.gov/maps/nr-atlas

Fish & Wildlife Resources:
http://www.vtfishandwildlife.com/common/pages/DisplayFile.aspx?itemId=111147

http://www.vtfishandwildlife.com/get_involved/partner_in_conservation/eqip_for_wildlife_habitat

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/initiatives/?cid=stelprdb1046975

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/vt/energy/?cid=nrcs142p2_010526

http://vt.audubon.org/conservation/working-lands/landing/working-lands-0