FARM INPUTS

Water

How are food system activities affecting Vermont's water bodies? What is being done to reduce water pollution caused by food system activities?

Agricultural activities account for 80% of freshwater consumption in the United States.[110] Several agricultural areas across the country face major water issues, from depletion of the Ogallala aquifer in the Midwest, to droughts and multiple competing uses in the desert Southwest and California. In contrast, Vermont's relative abundance of freshwater is a vital asset of our local food system. It is important that food production and processing activities, especially dairy production and processing, animal feed production, and livestock production, slaughtering, and processing facilities, adopt best practices to protect water quality.

CURRENT CONDITIONS

Water Use

According to the *U.S. Geological Survey* (USGS), Vermont has 22,680 miles of streams and rivers and 820 lakes or ponds covering about 555 square miles. The USGS calculates that approximately 440 million gallons of water were withdrawn every day in Vermont in 2005. About 88% of water withdrawals came from surface water sources, while 12% were from groundwater sources. The cooling of the Entergy Vermont Yankee nuclear reactor accounts for about 78% (340 million gallons per day) of daily water withdrawals. If Entergy Vermont Yankee were excluded from the USGS analysis, water withdrawals would be about 100 million gallons per day. **Water for livestock (including dairy animals) made up about 1% (4.2 million gallons per day) of total daily withdrawals. About 74% of these withdrawals were from groundwater sources, and 16% came from surface water sources. Water withdrawals for irrigation (e.g., for growing crops or pasture as well as irrigation for golf courses) were estimated at 1.9 million gallons per day.** The USGS estimates that freshwater extraction will increase from 440 million gallons a day to 450 million gallons a day by 2020, but this estimate does not account for the possible shutdown of *Entergy Vermont Yankee*.[111]

In June 2008, the Vermont Legislature adopted *Act 199*, which declared Vermont's groundwater a public trust and set up a permitting process for large water withdrawals. The Act requires that anyone withdrawing more than 200,000 gallons of water per day on a single tract of land or place of business must file a report with the *Agency of Natural Resources* (ANR). The Act also stipulates that anyone withdrawing more than 57,600 gallons of water per day must get a permit from ANR. The Act provides permitting and reporting exemptions for farming and dairy processing.

Water Use and Food Processing: The USGS provides a median value of 469 gallons of water used per employee per day for food processing facilities in the United States, the third highest value for water use at industrial facilities after petroleum refining and paper-making. We estimate that Vermont has at least 456 food processing establishments with at least 4,346 employees. Applying this median value to our estimate of food processing employees, we arrive at a value of a little over 2 million gallons of water used per day by food processing facilities in Vermont.

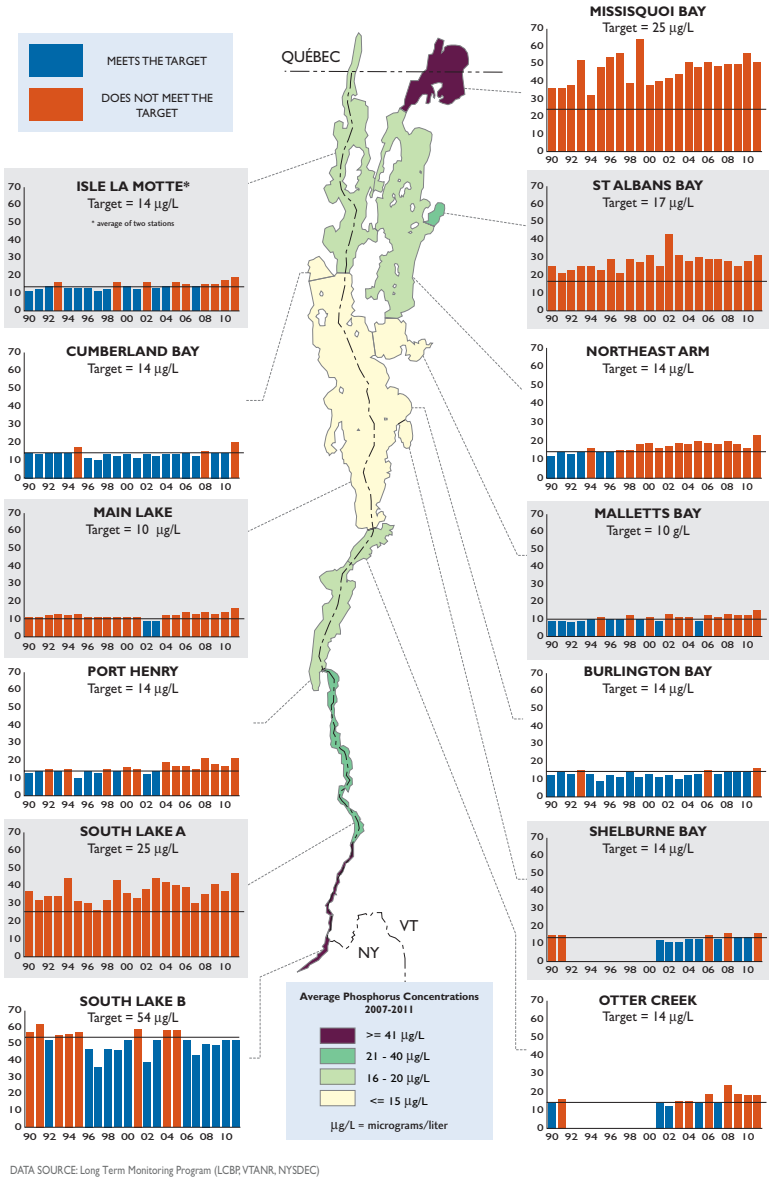
Water Pollution

According to the *USGS*, widespread application of artificial nutrients—nitrate, ammonia, total nitrogen, orthophosphate, and total phosphorus—and livestock manure has polluted more than 90% of 190 sampled streams draining agriculture and urban watersheds in the United States. High levels of phosphorus or nitrogen can lead to algal blooms and accelerated plant growth that depletes available oxygen, squeezes out fish and other aquatic species, and can pose a risk to human health (the *dead zone* in the Gulf of Mexico, which can cover between 6,000 to 7,000 square miles, is the poster child for excess nutrient runoff).[112]

The *Lake Champlain Basin Program* (LCBP), a multi-agency, multi-state (and Quebec) effort to protect Lake Champlain, monitors pollution levels from wastewater treatment plants and nonpoint sources. The LCBP reports that the 96 wastewater treatment facilities (60 of which are in Vermont) in the Lake Champlain Basin account for 10% of the phosphorus entering the lake. The remaining 90% is generated from nonpoint sources: Urban and suburban development (e.g., increased impervious surfaces, pet waste, and over-fertilizing of lawns and gardens) accounts for 46% of total nonpoint phosphorus pollution. Agricultural activities (e.g., soil erosion, manure and fertilizer runoff, livestock access to waterways) account for 38% of total nonpoint phosphorus pollution, while forestry activities (e.g., harvesting and road construction) are estimated to add 15%.[113]

LCBP has measured considerable variation in phosphorus levels and pollution sources in various sections of the lake. For example, northern sections (Missisquoi Bay, St. Albans Bay) and southern sections of Lake Champlain were eutrophic (i.e., excessive

Figure 3.2.21: Lake Champlain Phosphorus Concentrations by Lake Segment



Source: Lake Champlain Basin Program, State of the Lake and Ecosystem Indicators Report, 2012, *www.lcbp.org/PDFs/SOL2012-web.pdf*.

algae growth and low water visibility) and exceeded water quality criteria every year from 1990 to 2003. Most of the rest of the lake was mesotrophic (i.e., moderate algae growth and water visibility), while only Mallets Bay was considered oligotrophic (i.e., low algae growth and high water visibility) from 1990 to 2003. According to LCBP, agricultural activities are responsible for a majority of phosphorus runoff into Missisquoi Bay, a portion of the southern lake, and around Isle La Motte, while the urban and suburban landscape is responsible for most phosphorus runoff for every other section of the lake (Figure 3.2.21).[114] A recent *study* of the Missisquoi Bay Basin found that pasture or fields planted in permanent corn, corn-hay rotations, and permanent hay were predominantly responsible for phosphorus loading in "Critical Source Areas" flowing into the lake.[115]

A wide variety of other toxins, including mercury, polychlorinated biphenyls, road salt, pesticides, pharmaceutical products, and fire retardants, are also found in Lake Champlain. **Vermont farmers spent $5.9 million on chemicals in 2007, up from $5.7 million in 1997.** The 2007 Census of Agriculture estimates that

- 521 farms treated 37,597 acres with chemicals for insects;
- 871 farms treated 86,442 acres for weeds, grass, or brush;
- 26 farms treated 1,819 acres for nematodes;
- 219 farms treated 4,096 acres with chemicals for diseases in crops and orchards; and
- 79 farms used chemicals on 2,042 acres of crops to control growth, thin fruit, ripen fruit, or defoliate.[116]

Other pathogens, including fecal coliform from animal waste, are found in the lake and sometimes cause beach closures.

LCBP's management plan, *Opportunities for Action*, sets the stage for basin-wide goals, objectives, and strategies for protecting Lake Champlain. LCBP has identified four priority goals for addressing the health of Lake Champlain:

1. Reduce phosphorus inputs to Lake Champlain to promote a healthy and diverse ecosystem and provide for sustainable human use and enjoyment of the lake.
2. Reduce toxic contamination to protect public health and the Lake Champlain ecosystem.
3. Minimize the risks to humans from water-related health hazards in the Lake Champlain Basin.
4. Control the introduction, spread, and impact of nonnative nuisance species to preserve the integrity of the Lake Champlain ecosystem.

Nonagricultural activities are the largest source of phosphorus inputs to Lake Champlain. But, as noted earlier, several sections of Lake Champlain are eutrophic, and agricultural runoff in these sections has been identified as the major source of phosphorus inputs. The Clean Water Act requires that states develop a *Total Maximum Daily Load* (TMDL) plan for water bodies not meeting federal standards. The *Ecosystem Restoration Program*, formerly the Center for Clean and Clear, is ANR's program for addressing TMDL and other water issues. Over $100 million in state and federal funds was allocated for the Center for Clean and Clear's activities. The *Ecosystem Restoration Program* has developed a *website* that depicts various projects underway to manage Vermont's waterways, but the *agriculture projects* section of the website was incomplete as of August 2012.

VAAFM does organize and implement *at least ten programs* to reduce food system pollution:

- *Accepted Agricultural Practices* set baseline practices that all farms in Vermont must comply with (e.g., setbacks around surface water and wells, manure management). VAAFM reports that the majority of complaints received are related to manure, although the number of violations identified by on-farm investigations has remained pretty low (about 20 a year), while the number of investigations has increased.
- The *Best Management Practices Program* provides farmers with technical assistance, including engineering assistance, for constructing manure storage facilities, fencing, and leachate treatment systems. The USDA Natural Resources Conservation Service's *Environmental Quality Incentives Program* (EQIP) provides federal funding for Best Management Practices infrastructure.

- The *Conservation Reserve Enhancement Program* (CREP) provides funding and technical assistance to encourage farmers to install conservation buffers around streambanks.
- The *Alternative Manure Management Program*, a joint effort of VAAFM and the NRCS office, provides funding and technical assistance for anaerobic digester projects. Vermont ranks fourth in the nation for installed digesters.
- The *Large Farm Operation Program* (LFO) requires farms with more than 700 dairy cows, 1,000 beef cattle or cow/calf pairs, 1,000 youngstock or heifers, 500 horses, 55,000 turkeys, or 82,000 laying hens to have structures in place for manure management and nutrient management plans for dealing with this manure. Each LFO must receive a permit from VAAFM, and LFO regulations are stronger than Medium Farm Operation regulations. To date, VAAFM staff has visited all 16 LFOs in the state for compliance.
- The *Medium Farm Operation Program* (MFO) requires farms with 200-699 mature dairy cows, 300-999 cattle or cow/calf pairs, 300-999 youngstock or heifers, 150-499 horses, 16,500-54,999 turkeys, and 25,000-81,999 laying hens to have structures in place for manure management and nutrient management plans for dealing with this manure. At least 185 farms in Vermont qualify as MFOs, and very few notices of alleged violations and corrective action letters have been issued to date.
- The *Nutrient Management Grant Incentive Program* provides financial and technical assistance for nutrient management plan development and implementation (up to $14,000). All MFOs and LFOs are required to have a nutrient management plan. VAAFM has provided at least 249 grants so far, covering more than 134,000 acres statewide.
- The *Farm Agronomic Practices Program* provides financial and technical assistance for soil conservation practices, such as cover cropping and crop rotation.
- The *Vermont Agricultural Buffer Program* takes CREP one step further to allow for harvestable grasses to be used as buffers around croplands.
- The Pesticide and Groundwater Monitoring Program takes samples from wells on farms and tests for contamination from pesticides. VAAFM reports that elevated nitrate levels at wells sampled are decreasing statewide.

In addition, the Vermont NRCS office provides a wide range of technical assistance, education, and financing programs for manure management and soil conservation activities. The *Vermont Association of Conservation Districts*, representing 14 Natural Resources Conservation Districts, also provides technical assistance and education to farmers and landowners, including the *Agricultural Resource Specialist program*, which provides technical assistance for manure management and water quality management.

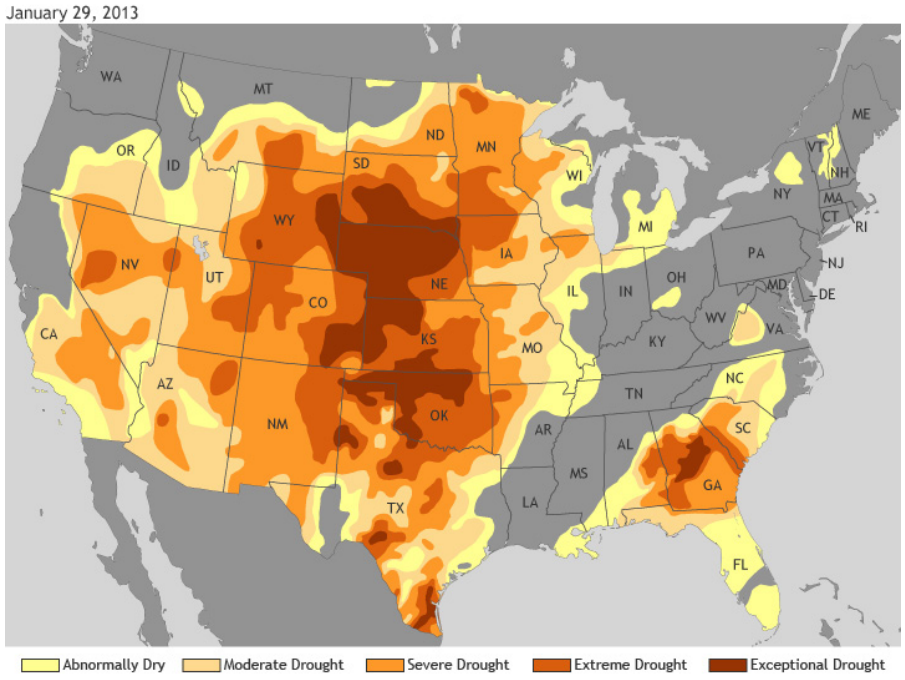
Vermont has at least one nonprofit organization that works with dairy farmers to address environmental issues. The *Franklin and Grand Isle Farmer's Watershed Alliance* was established to support farmers in improving farm practices to minimize runoff from farm fields adjacent to the Missisquoi watershed. The organization provides farm assessments to develop water quality protection plans.

☼ Climate Change Impacts on Precipitation

Many parts of the country are currently experiencing long-term (i.e., greater than 6 months) *extreme*, *severe*, and *exceptional* droughts (Figure 3.2.22).[117] While Vermont consumers will likely be impacted by the decreased availability and increased costs of food from regions of the United States impacted by water shortages (i.e., fruit and vegetable production in from California), Vermont is likely to experience *more* precipitation in the years ahead. The *U.S. Global Change Research Program* predicts that climate change in the Northeast will lead to the following:

- Increased heavy precipitation
- Less winter precipitation falling as snow and more as rain
- Reduced snowpack
- Earlier breakup of winter ice on lakes and rivers
- Earlier spring snowmelt resulting in earlier peak river flows.[118]

Figure 3.2.22: Continental U.S. Drought Monitor, January 2013



Source: ClimateWatch Magazine, January 29, 2013, *http://www.climatewatch.noaa.gov/article/2013/drought-impacts-continue-to-pile-up*.

In 2011, Tropical Storm Irene flooded 20,000 acres of farmland—ruining crops in the field, spoiling harvested animal feed, and drowning animals—and caused upwards of $1 billion in damage to the state of Vermont. The cumulative effect of an increase in extreme weather events such as Tropical Storm Irene can rapidly strain the resources of a small state like Vermont, while erratic weather and increased rainfall intensity can lead to unpredictable harvests from year-to-year.

ANALYSIS

Food system activities withdraw a relatively small percentage of Vermont's freshwater supply (even if *Entergy Vermont Yankee* is excluded), but they are estimated to contribute 38% of nonpoint source phosphorus to Lake Champlain. Although the magnitude of other chemicals from agricultural runoff (e.g., pesticides) reaching water bodies is not known, it is expected that agricultural runoff and urban runoff may contribute significant amounts of toxic chemicals. Mutually agreed upon goals for improving the health of Lake Champlain have been established by LCBP and the *Ecosystem Restoration Program*. Over $100 million has been invested in Lake Champlain cleanup over the past decade, and a number of programs and organizations exist to manage nutrient flows, conserve soils, and protect waterways. However, the *Environmental Protection Agency* recently disapproved Vermont's 2002 water quality plan on the grounds that its levels for phosphorus reduction do not satisfy the Clean Water Act.[119] The *Vermont Agency of Natural Resources* had prepared a revised implementation plan for phosphorus TMDL in 2010 that included many priority strategies (with estimated costs),[120] and the EPA has pledged to work with regional stakeholders to develop a new TMDL for phosphorus. Climate change is likely to exacerbate erosion and runoff into Lake Champlain unless careful mitigation efforts are put in place.

Technical Assistance and Business Planning

A growing number of farmers are using technical assistance and cost-share programs offered by the *Ecosystem Restoration Program*, NRCS, *Natural Resource Conservation Districts*, the *Farmer's Watershed Alliance*, and others. The 2010 update of Vermont's implementation plan for phosphorus TMDL recommended increasing the number of VAAFM and *UVM Extension* specialists, Agricultural Resource Specialists, and other personnel (engineers, soil scientists) available for on-farm technical assistance, education, and support at a cost of $500,000 annually.

Economic development and food system support organizations should investigate opportunities to advance the development of new enterprises that make products or provide services in support of agricultural best practices—for example, the production of burlap-wrapped compost products for lining riparian buffers with tree stakes, or the

expansion of *Intervale's Conservation Nursery*, which markets native trees and shrubs for riparian restoration especially adjacent to farm fields.

Financing

The 2010 update of Vermont's implementation plan for phosphorus TMDL recommended providing financial incentives to achieve a minimum width (10 feet) of buffer zone along intermittent streams and ditches that pass through annual cropland and for installing fencing (temporary and permanent), watering systems, and stream crossings to improve the management of animals in and around streams and rivers (at a total cost of $700,000 annually).

Research has shown that every dollar invested in watershed protection saves tens to hundreds of dollars in water treatment costs.[121] A water quality trading program, in which water quality implementation projects on non-point source farmland are funded by issuing tradable permits to point source polluters that have an allotted cap to fulfill (i.e., through reductions or credits), could be piloted in Vermont. Alternatively, a "Payment for Ecosystem Services" program (PES), where state government, federal government, or other sources pay farmers for the net environmental benefits they can provide to water quality (i.e., by avoiding externalized clean-up costs) by implementing soil enhancement and erosion control best practices could also be piloted in Vermont. Water quality trading programs and PES programs have been initiated in Chesapeake Bay, New York City, and the Ohio River Valley, and Vermont may be well positioned to advance a similar initiative.[122]

GETTING TO 2020

The health of Lake Champlain is a major concern and Vermont's food system organizations need to do their part to reduce water pollution. The EPA's recent disapproval of Vermont's 2002 water quality plan on the grounds that its levels for phosphorus reduction do not satisfy the Clean Water Act opens the door to improvements in technical assistance programs, financing strategies, and regulations. The *Vermont Agency of Natural Resources* has already prepared a revised implementation plan for phosphorus TMDL that includes recommendations for expansions of technical assistance programs, new positions at VAAFM and *UVM Extension*, as well as financial incentives.

Table 3.2.18: Objectives and Strategies for Mitigating Food System Based Water Pollution

OBJECTIVE	STRATEGY
Research Strategies	
To help Vermont farmers and technical assistance providers adapt to climate change.	Climate change means increased precipitation and extreme weather events in Vermont. Increased precipitation can lead to increased soil erosion, while unpredictable weather can impact crop and livestock production. Farmers and technical assistance providers (including educational institutions) should begin exploring the adoption of *fluvial erosion hazard areas*, buffers, and so on.
Technical Assistance and Business Planning Strategies	
Support and evaluate ongoing state, federal, and other technical assistance programs to ensure the adoption of best practices.	Expand the Farm Agronomic Practices and Nutrient Management Programs to support the increased use of soil erosion reduction practices and alternative manure application techniques, such as soil aeration.*
	Increase the number of VAAFM and UVM Extension specialists, Agricultural Resource Specialists, and other personnel (engineers, soil scientists) available for on-farm technical assistance, education and support.*
Encourage entrepreneurial activity to develop products or provide services that minimize water pollution from food system activities.	Research and inventory innovative products or services used in other parts of the world to minimize water pollution from food system activities. Provide technical assistance to organizations looking to develop those products or services in Vermont.
Financing Strategies	
Support and evaluate ongoing state, federal, and other cost-share and financing programs to ensure the adoption of best practices.	Provide financial incentives to achieve a minimum width (10 feet) of buffer zone along intermittent streams and ditches that pass through annual cropland.*
	Provide financial and regulatory incentives to install fencing (temporary and permanent), watering systems, and stream crossings to improve the management of animals in and around streams and rivers.*
	Broaden the conservation purposes of and annually expend all funds made available through the Wetland Reserve Program (WRP) and Farmland Protection Program (FRPP) to permanently protect and restore wetlands and stream corridors.*
Investigate the potential to reduce water clean-up costs by developing a water quality trading program or PES program.	Develop a water quality trading program or PES program that would finance nutrient management, soil conservation, and other agricultural activities to avoid larger water clean-up costs. Municipalities, state government programs and agencies, and water quality organizations would pay farmers in high-risk watersheds who meet soil quality performance standards. Payment would be based on the value of the environmental service, (i.e., the cost savings from pollution prevention and minimizing the need for mechanical or chemical treatment to clean water).

* These goals were developed by the Agency of Natural Resources. Source: Vermont Agency of Natural Resources, Revised Implementation Plan: Lake Champlain Phosphorus TMDL, pp. 3-4 (2010), available at *www.leg.state.vt.us/reports/2010ExternalReports/252919.pdf*.