Impact of, and Response to, Flooding of Vermont Farms in 2023

Compiled by Vern Grubinger. Updated 2/25/24.

Extreme rainfall in 2023

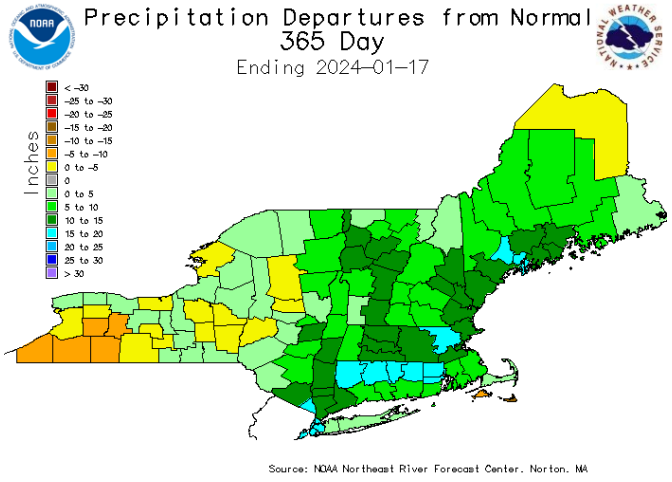
According to the National Weather Service, significant flood damage occurred as a result of heavy rainfall on July 10-11, 2023, when 3 to 9 inches of rain fell across the state. The highest 48-hour rainfall total was 9.20" in Calais, with rainfall reports of 4 to 8 inches in communities along the spine of the Green Mountains. Damage from this event rivaled or exceeded that from Tropical Storm Irene in August 2011.

Heavy rainfall before July 10-11 resulted in high soil moisture content and increased runoff when the heaviest rain arrived. June rainfall had been 1-2 inches above average in central and southern Vermont, and on July 7, 2-4 inches of rain fell across central Vermont. Thus, abnormally high soil moisture contributed to flooding on July 10-11, just as it had with Irene. Only the Great Flood of 1927 exceeded the impact of the 2011 and 2023 flooding events in the past century.

Flooding was not limited to July 10-11. Significant rainfall occurred in many areas of the state in the weeks that followed, unlike Tropical Storm Irene, when conditions rapidly dried out following the storm. For example, on July 14, 3.42" of rain fell in Ripton, Vermont resulting in flooding of the Middlebury River. On July 16, 3+" of rain fell in much of Chittenden and Caledonia counties. On August 3, over a period of 3 to 4 hours, 3” to 6” of rain fell in central Vermont, primarily in Addison County.

The National Weather Service reported that departure from normal precipitation in Vermont’s counties ranged from 3.98” to 7.68” inches in July 2023 and from 0.53” to 4.11” in August 2023.

Most of the Northeast experienced excessive rainfall in 2023.
Seven of Vermont’s counties had rainfall of 10”to 15” above normal.



Losses reported by farms

To assess losses experienced by farms, the Vermont Agency of Agriculture, Food and Markets (VAAFM) conducted a survey of businesses, organizations, and individuals who raise animals and/or grow crops for anyone beyond their immediate family. The survey was open from July 30 to August 28. Losses were reported in every county. **A total of 264 farms reported aggregate losses of $16.1 million with 27,318 acres impacted.**

The average respondent had 103 acres impacted and $61,000 in damages. Loss of crops meant for feed was the most frequently reported type of damage (34%) followed by loss of crops for sale (29%), and damage to soil or land (16%). On average, respondents lost 28% of their annual income due to severe weather and flooding; 58% of respondents said their cash flow would be negative in the next year as a result. Seventy percent of respondents had no crop or livestock insurance; 14% were enrolled in NAP.

Financial aid to farms

The Northeast Organic Farming Association of Vermont's Farmer Emergency Fund offered grants up to $5,000 to organic farms affected by flooding, and severe weather. Funds were awarded to 215 farms in the first round of grants, totaling $1,029,077 with an average award of $4,786 per farm. A second round of grants was made to 120 of those same farms, for a total of $531,715 with an average award of $4,431 per farm. Thus, the total amount awarded was $1,560,792. Of the farms that applied for the second round, which opened in December, the average remaining loss reported (after insurance/BEGAP/VCF/Federal funds) was $49,712.

The Intervale Farmers Recovery Fund was created in 2011 to help farms located in Burlington's Intervale recover from Tropical Storm Irene. In July 2023, the Intervale's 122 acres of vegetable, flowers, tree stock and other perennials were again inundated by flood waters. The first round of funds was distributed in early August with a second round in early September. A total of $357,000 was awarded to five participating farms, as well as producers that are part of the New Farms for New Americans.

The Vermont Community Foundation's Farm Disaster Relief Grant Program awarded nearly $1.5 million to 157 Vermont farmers that suffered financial losses due to storms and flooding between July 7 and July 18. Up to $10,000 per farm could be requested. VCF created the Farm Disaster Relief Grant Program in August, as part of their larger VT Flood Response & Recovery Fund.

The Vermont Farm Fund's Emergency Loan Program offered up to $15,000 to farms affected by flooding as a zero-interest loan payable over 36-48 months, with an option to defer payments for up to 12 months.

State of Vermont Business Emergency Gap Assistance Program (BEGAP) provided $20 million in grants to businesses affected by flooding, of which $3.7 million was allocated to agricultural businesses. Eligible applicants were allowed to request up to 30% of net uncovered physical damages. The agricultural BEGAP recipients reported physical damages totaling roughly $20 million, with additional economic injury and revenue losses experienced above and beyond those levels.

USDA Farm Service Agency (FSA) of Vermont has paid quarter of a million out so far under the Non-Insured Crop Disaster Assistance Program (NAP), for both free/basic level and buy-up coverage. There are a lot of pending claims still to pay as some crops have to wait until the end of the growing season, and staffing continues to be a challenge for FSA amid unprecedented workload.

USDA Natural Resources Conservation Service (NRCS) of Vermont set aside $4 million in federal financial assistance on August 11 to help Vermont's agricultural producers recover from flooding. The deadline to apply was September 1. There were seven eligible practices that must have been previously installed under the NRCS EQIP program: Cover Crop; Critical Area Planting; Fence; Pasture and Hay Planting; Mulching; Residue and Tillage Management, Reduced Till; Feed Management.

Farm First Vermont is a free, Vermont-based program providing farmers and their families with support, resources and information to reduce stress. They served 30 flood impacted clients; 17 were focused on livestock disease/injury, harvesting and crop losses due to moisture and disease, and/or loss of feed sources; 10 were focused on immediate crop/livestock losses due to flooding/contamination, structural/landscape damage; and 3 were focused on immediate, high-level threat to well-being e.g. loss of housing, near complete destruction of the farm, exposure of septic creating major disease risks.

Soil testing for contaminants after flooding

With funding from an expedited Specialty Crop Block Grant provided by the VAAFM, and UVM Extension funds, 166 soil tests were conducted at no cost by the UVM Agricultural and Environmental Testing Lab (AETL), plus an additional 28 soil tests were conducted by the University of Maine soil test lab. Standard soil test results (normally $17 each) plus a heavy metal screen (normally $10) were provided to commercial farms, community gardens, and some gardeners across Vermont. Producers were able to assess macro and micro-nutrient levels, soil pH, and heavy metal levels on at least 391 acres of flooded soils.

The purpose of free flooded soil testing was to inform replanting decisions by growers. Given the lack of unflooded soil samples as controls, one cannot determine if flooding was the cause of any "abnormal" soil test results.

Most of the flooded soil samples (81%) had a soil pH in the range adequate for crop growth (5.5-7.5) but 12 soil samples were below pH 5.5 and 19 samples were above pH 7.5.

Most samples showed no sign of heavy metal contamination, though a small number had elevated levels. Soil test levels of micronutrients that suggest toxicity to crops are not well established. In general, crops can tolerate levels significantly above what's recommended, and excess levels are typically associated with very high or very low soil pH.

Five of the 166 samples had aluminum levels above 100 ppm, with one outlier at 220 ppm; these samples could be cause for concern. Nine samples had boron levels above 1 ppm, with one outlier at 5.6 ppm, which could be cause for concern.

Three samples had copper levels above 1 ppm, with one outlier at 4.75 ppm. Eleven samples had iron levels above 70 ppm, with two outliers at ~155 ppm. Two samples had lead levels above 5 ppm, both at ~6 ppm.

Seven samples had manganese levels above 100 ppm, with one outlier at 177 ppm, which could be cause for concern. Seven samples had Zn levels above 10 ppm, with one outlier at 125 ppm which could be cause for concern.

To inform re-planting decisions, UVM Extension personnel developed a soil sampling protocol to compare flooded and non-flooded fields on vegetable farms, with funding from the VAAFM and UVM's OVPR Rapid Response Program. Soil samples were collected approximately 30 and 60 days after flooding from 9 farms across Vermont. Samples were taken on the same day and in the same manner from flooded and non-flooded fields on 8 of the farms, and from a flooded field only on one farm where there was no control (unflooded) field.

Soil samples were analyzed for generic e. coli and total petroleum hydrocarbons by Endyne Labs in Williston. Subsamples from the same fields were also analyzed by the UVM AETL for soil pH, soil moisture, plant nutrient content, and heavy metals. Results were shared with the participating farms to help inform replanting decisions, which are not stipulated by FDA.

Generic E. coli was found in both flooded and non-flooded fields. The highest levels were in non-flooded fields. Twelve samples (12.5%) were above 10 MPN/g. Levels generally reduced over time. For reference, the Vermont agricultural irrigation water limit is 236 MPN/g, and guidance from CA research is not to exceed 10 MPN/g in soil for replanting.

Generic e. coli levels measured in soil (MPN/g). Compiled by Chris Callahan.

Farm	At 21-24 Days						At 64-70 Days					
	Flooded			Not Flooded			Flooded			Not Flooded		
	F1	F2	F3	N1	N2	N3	F1	F2	F3	N1	N2	N3
B	<1	9.7	4.9	29.5	326.0	7.8	<1	<1	<1	1.4	<1	<1
C	10.4	1.8	<1	26.7	57.4	28.5	1.4	1.3	<1	<1	<1	<1
D	1.0	<1	<1	<1	5.2	<1	<1	<1	<1	<1	<1	<1
E	6.7	7.4	72.4	<1	<1	6.1	<1	<1	2.0	<1	<1	<1
F	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
G	1.9	3.8	10.2	1.0	2.9	<1	3.5	<1	3.2	<1	84.8	<1
H	1.9	5.1	1.0	<1	<1	1.0	<1	<1	<1	<1	<1	<1
I	3.9	15.2	42.4	2.8	7.3	1.9	5.6	6.2	10.1	<1	<1	<1

We had samples analyzed by Endyne Labs in Williston, Vermont, for Total Petroleum Hydrocarbon as Diesel Range Organics (TPH as DRO). This included compounds in and around the diesel range with C7-C40 molecular structure. This analysis extracts semi-volatile petroleum hydrocarbons from soil using a solvent.

Results showed widespread, low levels of 'heavier' hydrocarbons, in the range of hydraulic and lubricating oils, in both flooded and non-flooded soils, with higher levels of hydrocarbons measured at the first sampling date.

There was one sample containing a high level of diesel fuel range hydrocarbons (329 mg/kg). The farmer related that a tractor was left in that (flooded) field, so that is a possible explanation as to a source of the hydrocarbons. The field was re-sampled three weeks later, and TPH measurements were at or near non-detectable levels, in three separate samples tested. Five weeks after the initial sampling, TPH remained non-detectable.

In general, TPH levels were reduced over time on all farms. For reference, there is no TPH standard for agricultural soil in Vermont. The limit for TPH in residential soil is 96 ppm (mg/kg).

Petroleum (TPH DRO) measured in soil (mg/kg = ppm). Compiled by Chris Callaham

Farm	At 21-24 Days								At 64-70 Days							
	Flooded				Not Flooded				Flooded				Not Flooded			
	TPH	C7-C10	C10-C28 (DRO)	C28-C40	TPH	C7-C10	C10-C28 (DRO)	C28-C40	TPH	C7-C10	C10-C28 (DRO)	C28-C40	TPH	C7-C10	C10-C28 (DRO)	C28-C40
A*	329	<17.2	256	72.3	--	--	--	--	<3.3	<3.3	<3.3	<3.3	--	--	--	--
B	18.9	<3.1	7.0	11.9	11	<3.2	3.7	7.3	<3.2	<3.2	<3.2	<3.2	<3.3	<3.3	<3.3	<3.3
C	19.1	<3.5	8.0	11.1	8.5	<2.9	4.2	4.3	<3.4	<3.4	<3.4	<3.4	<3.0	<3.0	<3.0	<3.0
D	11.3	<3.3	3.5	7.8	12.7	<3.1	3.1	9.6	<3.5	<3.5	<3.5	<3.5	3.5	<3.2	<3.2	<3.2
E	10.7	<3.3	<3.3	8.3	5.2	<3.0	<3.0	4.0	<3.4	<3.4	<3.4	<3.4	<3.0	<3.0	<3.0	<3.0
F	8.9	<2.9	<2.9	2.9	10	<2.9	<2.9	8.4	<2.9	<2.9	<2.9	<2.9	<3.0	<3.0	<3.0	<3.0
G	9.3	<3.3	<3.3	6.0	8.6	<3.2	<3.2	5.9	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4
H	6.3	<3.2	<3.2	6.3	9.5	<3.1	3.9	9.5	<3.2	<3.2	<3.2	<3.2	4.9	<3.3	3.3	<3.3
I	9.7	<3.4	4.3	5.4	10.4	<3.3	<3.3	7.3	<3.4	<3.4	<3.4	<3.4	<3.2	<3.2	<3.2	<3.2

* Farm A had no control (non-flooded) field

Selected educational resources developed

Frequently Asked Questions about Handling Flooded Produce. UVM Extension

Flood-Recovery Guidance for Lawns & Gardens. UVM Extension

Managing Flood Damaged Crops and Forage. UVM Extension

After the Flood: Tips on Edible Garden Plants. UVM Extension

Improving our response to agricultural flooding and other disasters

There are lessons to be learned from our collective response to the statewide freeze in May 2023, the statewide flooding in July, and previous events such as Tropical Storm Irene in August 2011.

Here are some areas where improvement is needed, and some options to consider.

1. A more coordinated effort is needed around dissemination of information to farmers. The goal should be to provide consistent guidance and updates to all affected sectors, including home gardeners, community gardens, and farms of all types—while avoiding redundant communication.

2. A clear, easy to use, and unified method for farmers to report data on disaster impacts is needed. The goal should be to avoid multiple requests for the same information.

3. A substantial amount of emergency funding should be kept on hand to provide rapid, short-term support to farms that experience significant economic loss. This would help farmers make payroll, purchase feed and supplies, etc., when they have little or no available funds but need to keep their business operating in order to obtain revenue.

4. A coordinated plan to obtain and distribute significant philanthropy would be beneficial. A uniform application for grant funds could be shared by funders. That would reduce the need for already stressed farmers to provide the same information to each potential funding source.

5. Clear and simple explanations of existing insurance products and programs, and how they differ, are needed. Examples of typical or historical costs and payments should be provided for each. Collaborative education is needed to facilitate farm enrollment when that makes economic sense.

6. Some new form of crop insurance appears to be needed that meets the needs of Vermont's diversified agriculture, including fruit, livestock, maple, ornamentals, vegetables, other commercial agricultural products, and combinations of enterprises.

7. A method for using realistic prices for products is needed to support viable crop insurance programs. Anecdotal information suggests that payment to farmers for loss of high value crops is often just a small fraction of the actual loss.

8. Plans and funding should be ready to support rapid sample collection and analysis from farms (animals, crops, soil, water, etc.) to provide information about contaminants and quality that can support decision making about use of products and resources.

9. A compensation fund is needed for farms that are required to destroy products based on food safety regulations. This is done to protect the public, even when common sense says the risks are low (e.g. produce that will be peeled and cooked prior to consumption). It costs a small number of farmers a lot of money (and stress).

10. Additional applied research is needed relative to potential and actual contamination risk to food crops because of flooding, and informed decision making around replanting risks.