

# Freeze Crystallization of Wastewater in Maine

Air & Waste Management Association New England  
Framingham, MA  
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# Overview

- Background and History
- System Requirements
- System Benefits (disinfection and nitrogen reduction)
- Review of WWTP in Rangeley, Maine
- Industrial Application in Mars Hill, Maine
- Conclusions

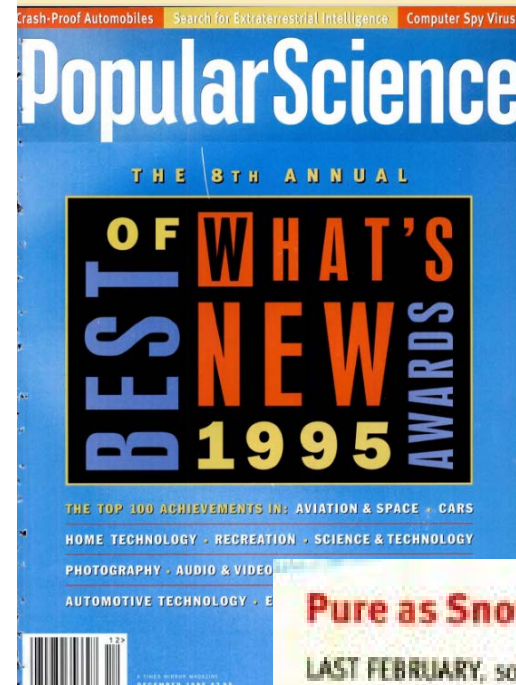
# Background History

Snowfluent™ or “Atomizing Freeze Crystallization™ (AFC) developed in Canada. ATC developed 20 years ago by Delta Engineering and Ontario Ministry of the Environment

-Voted Best of What’s New by Popular Science in 1995. Used for Wastewater treatment and to lesser extent industrial wastewater.

*“It treats sewage to the highest possible level, which even the wealthiest municipalities cannot afford in traditional systems”*

-Jeff White



## Pure as Snow

LAST FEBRUARY, some snow-making equipment in Carrabassett, Maine, wasn't putting the usual white stuff on the slopes. Instead, it was purifying wastewater. Snowfluent, a clever system developed by Delta Engineering of Ottawa, Ont., freezes impurities out of effluent, eliminating costlier chemical treatments [see Science and Technology Newsfront, this issue]. Pressurized wastewater sprayed into cold air crystallizes—killing bacteria and separating out contaminants like nitrogen and phosphorus; these elements become fertilizer when the snowpack melts. Versions of the system are also being tested in Canada and a community near the Arctic Circle.

# Background and History in Maine

## **Municipal Wastewater Treatment Plants**

- Carrabasset Valley Sanitary District –54 MG, 1995
- Chick Hill Pollution Control Facility, Rangeley - 29 MG, 1996
- Mapleton Sewer District- 24 MG, 1997
- Moosehead Sanitary District, Greenville- 61 MG, 2009

## **Industrial Food Manufacturing**

- Naturally Potatoes, Basic American Foods Division LLC – 24 MG, 2004
- Pineland Farms Creamery, Gray Maine, 2013

Sites in colder regions of country, land for spray irrigation when not making snow

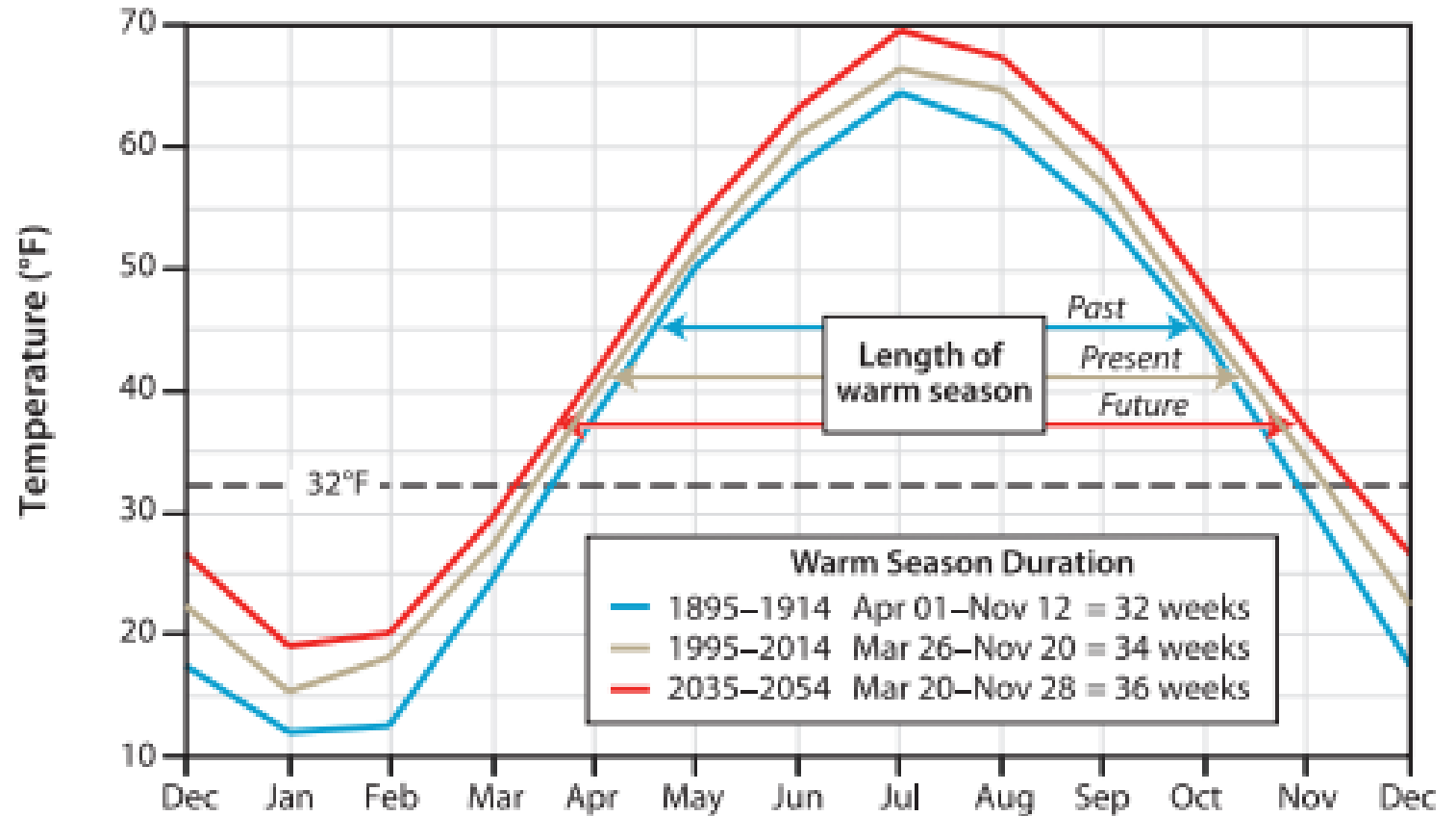
## System Requirements Temperature

*"Global Climate models predict that the warm season will increase by an additional two weeks over the next 50 years. Winter is warming at a faster rate than summer"*

- Graph and quote from University of Maine's Climate Future 2015 Update

Wet Bulb Temperature **must be  $\leq 27$  F**, which can occur at air temperatures up to 37 F if humidity is low.

### Maine's Changing Seasons



**Figure 3.** Mean monthly temperature averaged across Maine for historical (1895–1914), recent (1995–2014), and future (2035–2054) time periods. Historical and recent data from the U.S. Climate Divisional Dataset ([ncdc.noaa.gov/monitoring-references/maps/us-climate-divisions.php](https://ncdc.noaa.gov/monitoring-references/maps/us-climate-divisions.php)), and future prediction from an ensemble simulation of the IPCC emissions scenario A2.

## System Requirements Temperature

Maine Winter humidity  
typically in 70s

Not making Champaign Snow

Sites in Maine experience  
periods where wet bulb  
temperature is above 27F

Storage is important

# SNOWathome.com

## Wet-Bulb Temperature Chart

### Fahrenheit

Humidity	Good Snow Quality					Poor Snow Quality					No Snowmaking								
	100%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
20	14	14	14	15	15	15	16	16	16	17	17	18	18	18	19	19	19	20	20
21	14	15	15	16	16	16	17	17	17	18	18	19	19	19	20	20	21	21	21
22	15	16	16	17	17	17	18	18	18	19	19	20	20	21	21	22	22	22	22
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27	19	20	20	21	21	21	22	22	22	23	23	24	24	25	25	26	26	26	26
28	20	21	21	22	22	22	23	23	23	24	24	25	25	26	26	27	27	27	27
29	20	21	21	22	22	22	23	23	24	24	25	25	26	26	27	27	27	27	27
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35	25	26	26	27	27	27	28	28	29	29	30	30	31	31	32	32	33	33	33
36	25	26	27	27	28	28	29	29	30	30	31	31	32	32	33	33	34	34	34
37	26	27	27	28	28	28	29	29	30	30	31	31	32	32	33	33	34	34	34
38	27	27	28	28	28	29	30	30	31	31	32	32	33	33	34	34	35	35	35
39	27	28	28	29	29	29	30	30	31	31	32	32	33	33	34	34	35	35	35
40	28	28	29	29	29	30	30	31	31	32	32	33	33	34	34	35	35	35	35

Wet bulb temperature is the lowest temperature that can be obtained by evaporating water into the air at a constant pressure. The term comes from the technique of wrapping a wet cloth around a mercury bulb thermometer and blowing air over the cloth until the water evaporates. The wet bulb temperature is always lower than the dry bulb temperature, but will be identical with 100% relative humidity. This wet bulb temperature is what snowmakers use to know when they can make snow. You can see it is possible to make snow when the temperatures are above freezing but only with very low humidity.

Plot your current temperature (red numbers on the left) to the % of humidity (blue numbers on the top) and where they meet the (black numbers) is your current wet bulb temp.  
Any time the wet bulb number is below 20 degrees Fahrenheit (Blue shaded area) snowmaking is at its best... nice dry snow. You can make snow from 21 degrees to 27 degrees wet bulb (purple shaded area) but the snow will be wet.

# System Benefits

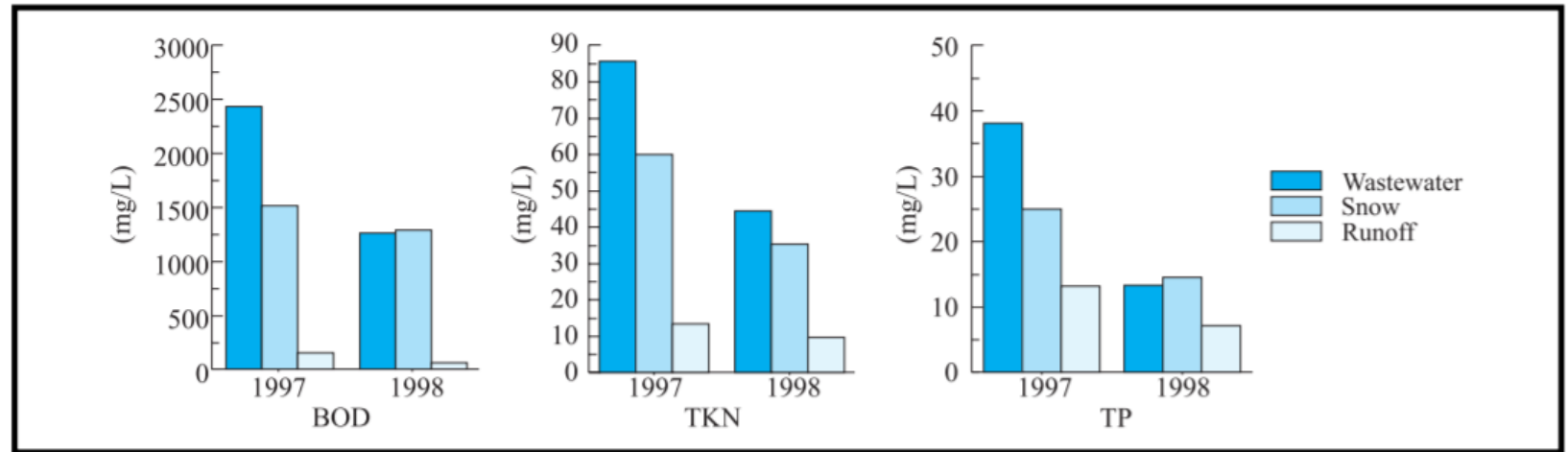
## Nitrogen Reduction:

- Ammonia released to atmosphere during spray snow
- Canadian Pilot study in 1997 found 88% reduction in nitrogen found in runoff as compared to wastewater effluent (reductions from snow making, from sublimation, infiltration to ground)

## Controlled Runoff (ME DEP estimate at one site)

- 15% snow is lost to evaporation during snow making;
  - 20% through sublimation
  - melting over time: March (5%), April (15%), May (30%), June (40%), July (10%)
- BOD reduction
  - Return of nutrients to land

Graphs illustrate processes that occur within the snow piles



**BOD and contaminant reductions during different phases of the Snowfluent process - 1997 and 1998 tests**



# Chick Hill WWTP

April 15 – November 15 spray irrigation (2.65 MGW on 27 acre field)

Nov 15 – April 30 snow; 29 MG per season on or two 40 acre fields

Raw Sewage flows to aerated lagoons (2.5 MG each) then to a 27 MG storage lagoon

7 snow guns in two fields  
combined spray capacity of 250 gpm

Monitoring to ensure groundwater meets Class GW-A standards



# Chick Hill WWTP

75 HP compressor

75 HP Vertical Turbine pump

Air dryer and air filters

Kilowatt Consumption varies – roughly  
6.5 Kilowatts per 1,000 gallons  
converted to snow



## Pineland Farms Naturally Potatoes, Mars Hill Maine



Recycling waste water through our snow making process

Licensed in 2004 when owned by Basic American Foods Division LLC

- Processes 700,000 to 1,000,000 lbs. of potatoes a day (200 million pounds per year)
- 40,000 gpd to 50,000 gpd wastewater generated from washing and processing
- Process wastewater separated from sanitary wastewater which is sent to the WWTP
- Two aerated lagoons, each with 500,000 gallon capacity (average flow is 125,000 gpd for 4 day detention)
- Storage lagoon is 3 acres and 20 ft. deep for 10 million gallons or 80 days
- Spray irrigation from May through November – up to nine fields with total of 176 acres – but four fields typically used.
- Snow making November through March on a 7.5 acre field; 24 Million gallons per winter; 4 mobile guns

Benefits:

Zero Discharge  
Sustainable



1.800.393.8126

OUR STORY

OUR PRODUCTS

NEWS & EVENTS

FAQ

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*Respect for the past  
Innovation for the future*



How Pineland Farms is  
sustaining an economy  
– and a way of life.



### SUSTAINABILITY

At Pineland Farms Potato Company we strive to enrich the environment through good stewardship practices that will benefit future generations. We have reduced our carbon footprint by purchasing locally and using renewable energy sources. Constantly striving to achieve conservation leadership, we were the first refrigerated potato company to use its pre-treated wastewater to make snow in the winter. During the summer months our wastewater is used for irrigating crops and the disposal of our by-products feeds local livestock.

Procured through the Sustainable Forestry Initiative Program and Certified Fiber Sourcing, our product packaging is 100% recyclable. Our facility also has a comprehensive recycling program for paper, plastics, cans, used ink cartridges, office equipment, fluorescent bulbs, batteries and oil.

Through the Pineland Farms and Libra Foundation initiatives, we continuously support our community and help promote the Maine economy. Our charitable efforts include supporting a variety of local activities, events and donations to food banks.



Recycling waste water through our snow making process

# Conclusions

- Additional Benefits
  - Industrial sites can meet zero discharge goals which are being built into sustainability plans.
  - Recognition that wastewater has beneficial uses for irrigation.
  - Nutrient capture on land as opposed to treatment and release to surface waters where plants struggle with spikes in flows
  - Functions in cold climates where other technologies have reduced effectiveness
  - Eliminates bacteria with no chemicals
  - Relatively low operating costs

Not for everyone! Need land and correct climate