

Characteristics of Urban Snow from the Village of Cooperstown As Represented by a Repository At Fairy Springs, Otsego County, N.Y.

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[Ed. Note: These two contributions were submitted as prepublications to Village officials (A in March 1993, B in August 1993). As of this date (January 5, 1994) the Fairy Springs area is no longer utilized for snow storage.]

A. CHARACTERISTICS OF THE VILLAGE OF COOPERSTOWN'S SNOW REPOSITORY AT FAIRY SPRINGS, OTSEGO COUNTY, NEW YORK March 1993

INTRODUCTION

It has been the ongoing practice of the Village of Cooperstown, in an attempt to maintain safe road conditions throughout the winter months, to move excess snow from the village to a site just north of the village across from Fairy Springs. Due to the close proximity of this site to Otsego Lake, concern about the water quality of the melt water from this snowpile, and its potential impact on Otsego Lake, has surfaced. In response to this concern, a study was undertaken by the Biological Field Station to ascertain the amount of water contained within the snowpile and its physical and chemical properties, so that potential loading rates of certain pollutants to the lake could be calculated. Parameters investigated in this study included suspendable and non-suspendable solids, chlorides, and total phosphorus.

The solid component of the snow is of concern as it may contribute to the filling in process of the lake and serve as a vehicle for nutrient transport. The accumulation of fine sediments also provides an ideal medium for the growth of nuisance aquatic weeds. These fines have occasionally become mixed throughout the water column following periods of high northerly or westerly winds, particularly if such conditions prevail during spring or fall turnover. This situation may result in increased nutrient availability to algae, thus encouraging unwanted localized blooms. The turbidity associated with sediment mixing also presents a problem with the quality of the potable water supplying the Village of Cooperstown, as the water intake line to the Water Treatment Plant lies at a depth of approximately 40 feet in the southern end of the lake. In December of 1992, an event similar to that outlined above occurred, resulting in turbidity levels above that deemed acceptable by state and federal limits. The public was encouraged to boil all drinking water until turbidity levels dropped within acceptable limits.

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Chlorides, if present in excess, will exhibit a toxic effect on aquatic organisms and jeopardize the lake as a public water supply. The average mid-lake chloride levels are currently in the order of 6.5 mg/l, well below the limit recommended by the U.S. Public Health Service of 250 mg/l for drinking water (Hanes et al., 1978). Concentrations at the south end of the lake are generally 1-2 mg/l higher than at mid-lake. Historical data indicates that chloride levels have increased constantly since the mid 1940's (coinciding with the onset of road salting (Peters, 1986)). This increase seemed to taper off in the 1980's, when the Village of Cooperstown discontinued its practice of road salting. In recent years, however, data indicate that chloride levels are again on the rise. Data also indicate a chloride to sodium ratio of 1.63 (Harman et al., 1981), compared to a ratio of 1.55 in NaCl, suggesting that road salt is, indeed, the main source of chlorides in the lake. Although many studies have been conducted on the toxicity of chlorides in freshwater environments (ie. Molles, 1980, Hanes et al., 1970, etc.), no all-encompassing definitive safe standards for such systems have been set. While baseline lake concentrations are well within safe levels, regional areas adjacent to high chloride sources may exhibit temporarily high and potentially toxic concentrations. It would seem reasonable to state that in order to preserve the complex ecosystem that Otsego Lake currently enjoys, chloride levels must be maintained at a point below that which the most susceptible organisms will be adversely impacted.

Total phosphorus, being the limiting nutrient in Otsego Lake, is of utmost concern as its introduction will contribute to the process of eutrophication, thereby degrading Otsego Lake's status as a potable water supply, its cold water fishery, and its recreational and aesthetic values.

METHODS

Snow volume was determined by measuring the dimensions of the pile. Length and width were measured, and height was estimated from the slope. Volume was calculated to be 66300 cubic feet (1878 cubic meters). Sample volumes were .66, .79, and .71 cubic feet of snow and melted down to 8.2, 10.0, and 7.8 liters respectively.

Three composite samples were collected in order to characterize the pile in a representative manner. Sample #1 was collected on the south slope (containing the most recently added snow) approximately 4 feet above the base. Snow was collected from the surface to a depth of approximately 30 inches. Sample #2 was collected from the center of the top of the pile from the surface to a depth of approximately 30 inches. Sample #3 contained surface and sub-surface samples from 15 randomly selected sites across the top and slopes of the pile.

After samples were completely melted, each was passed through a 30 mesh screen to remove the coarse fraction of particulate matter. This non-suspendable solid component was placed in a porcelain pan, dried at 105 degrees C for 24 hours, weighed, and reported as milligrams non-suspendable solids per liter.

Each screened sample was then shaken vigorously to resuspend remaining material and subsampled for suspended sediment analysis. Twenty ml of each

sample was passed through a pre-weighed glass fiber filter. Filters were dried at 105 degrees for 24 hours, allowed to cool, and weighed. Sediment was determined and reported as milligrams suspended sediment per liter.

Subsamples were used to determine total phosphorus. One ml from each sample was diluted to forty ml with distilled water. 0.4 g potassium persulfate and .4 ml strong acid solution were added to each of the samples, which were digested for 40 minutes in an autoclave. Digested samples were centrifuged to remove suspended matter and were further diluted 1:4 with distilled water. Total phosphorus content was determined using the ascorbic acid technique and was reported as milligrams per liter P-TPO4.

One ml each sample was diluted to one hundred ml with distilled water for chloride analysis. Mercuric nitrate method was used, and chloride content was reported as milligrams per liter.

RESULTS AND DISCUSSION

By comparing the snow volumes of collected samples to the resulting volume of meltwater, water volume:snow volume ratios were calculated to be 12.42, 12.66, and 10.99 liters per cubic foot of snow. The total volume of water contained within the snowpile was determined by multiplying the measured snow volume (66300 cubic feet) by the average water volume:snow volume ratio (12.02 liters per cubic feet). The total water volume was thus estimated to be 797000 liters.

Table 1 summarizes the results of analysis in units per liter for each parameter tested. Total volumes of suspendable sediment, non-suspendable sediment, total phosphorus, and chlorides, summarized in Table 2, were determined by multiplying units per liter by the number of liters of water contained within the snowpile. Results were expressed in pounds to ensure public understanding of these data. It should be noted that these mass volumes do not reflect annual totals, but rather the volume of pollutants present at the time of sampling.

In recent years, phosphorus loading has been regarded as the most pressing threat that Otsego Lake faces. Since the trophic status of Otsego is so dependent upon the availability of phosphorus, any unnatural additions will accelerate the eutrophication process. The impacts of this process include increased aquatic weed growth, nuisance algae blooms, decreased water clarity, decrease in potable water quality for public use, low late season oxygen levels, and a general degradation of aesthetic qualities of the area. Total phosphorus levels in Otsego Lake are currently .009-.010 mg/l. Figure 1 compares total phosphorus values of Otsego Lake water, sewage effluent after tertiary treatment, raw sewage (Vesilind et al., 1990) and meltwater from the village snowpile in an attempt to demonstrate the potential severity of the snowpile as a phosphorus source.

Several studies have addressed the water quality of runoff from urban snowmelt. Generally, such studies have focused primarily on the pollution problems related to deicing chemicals in catchment areas. This has been in response to sharp, and often exponential, increases of chloride levels in natural water bodies (Judd, 1970, Sharp, 1971, etc). In some instances, the increase has been severe enough to induce chemical stratification (Bubeck et al., 1971).

TABLE 1

Snowmelt Characteristics of Village Snow Depository
at Fairy Springs, Feb. 12, 1993

		SAMP 1	SAMP 2	SAMP 3	AVG
Sus. Solids	(mg/l)	48330	43720	10230	36760
Non-sus. Solids	(mg/l)	169400	151200	82100	134230
Total Solids	(mg/l)	217730	194920	100330	170990
Chloride	(mg/l)	1800	1000	900	1233
Total Phosphorus	(mg/l)	22.23	22.28	13.58	19.36
Conductivity	(us/cm)	4780	2790	3350	3350
Water:Snow	(1/cu ft)	12.42	12.66	10.99	12.02

TABLE 2

Mass Pollutant Loadings at Village Snow Depository
Feb. 12, 1993 (pounds)

Sus. Solids	64633.80
Non.-Sus. Solids	236017.68
Total Solids	300651.48
Chlorides	2168.53
NaCl Equivalent *	3571.70
Total Phosphorus	37.44

* assuming NaCl is sole Cl source

More recently, attention has been paid to other potential pollutants contained within in such snowmelt. Table 3 summarizes selected data from three studies on urban snowmelt. These studies, including data collected at Brucewood, North York (Weatherbe, 1977), Barrington, East York (Mills, 1974), and Boulder, Colorado (Battaglia, 1977), all involved the sampling and analysis of meltwater collected from urban stormsewers at or near the sewer outfall. The study conducted in Cooperstown, New York was distinctly different in that sampling was conducted directly on snowpiles, rather than on the resulting meltwater. The focus here was therefore on the total volume of pollutants that were present at a specific time which could potentially enter, and thereby impact, a lake system.

The variations in results between the data presented in Tables 1 and 3 may be due to several factors. Reported chloride levels were significantly lower in this study than in the others. This undoubtedly is largely a reflection of the Village of Cooperstown's policy, initiated in 1988, to limit the use of salt on its highways, instead relying more heavily upon the use of abrasives. By contrast, the levels of both sediments and total phosphorus were much higher in this study. The differences in methodologies used, as described above, may be responsible for these variations. Meltwater collected some distance downstream from the source of snow would likely be free of most of the particulate matter, as well as the accompanying sorted phosphorus, due to sedimentation. This sediment may or may not be removed from the system, thus preventing its passage to receiving waters.

The results of this study reflect the mass volumes of several parameters, which are generally regarded as being pollutants to lake systems, that exists in a snowpile in close proximity to the shores of Otsego Lake. While it cannot be ascertained with complete certainty what fraction of these pollutants are destined to end up in the lake, it seems that the potential threat warrants a review of possible alternatives to snow storage at this site.

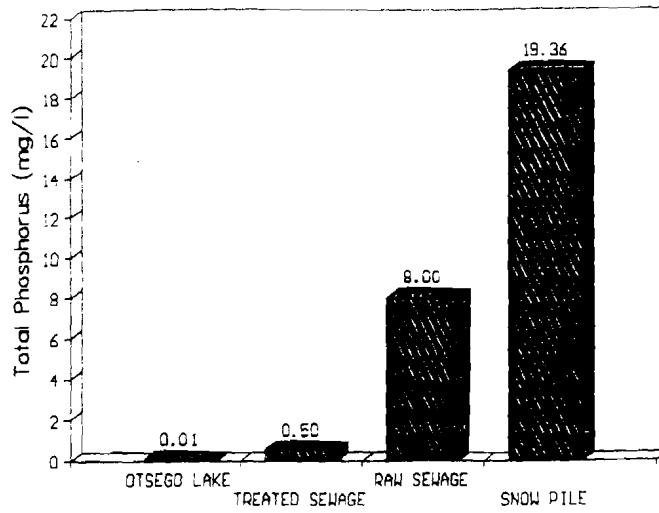


Figure 1: Concentrations of total phosphorus in snow from village depository compared to raw and treated sewage and Otsego Lake water

TABLE 3

Comparisons of peak snowmelt levels observed in other studies
(modified from Kronis, 1978)*

	Brucewood, North York (Weatherbe, 1977)	Barrington, East York (Mills, 1974)	Boulder, Colorado (Battaglia, 1976)
Sus Solids	502	1570	1229
Total Phosphorus	0.95	1.80	3.34
Chlorides	2090	5980	3185

* all data in mg/l

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