(21)

Freeze Survey Summary Report
Onsite Wastewater Treatment Systems
Winter 1999-2000

by

Jane Reed, Barbara McCarthy, Jerry Henneck, Richard Axler
Natural Resources Research Institute
University of Minnesota, Duluth

Jeff Crosby
St. Louis County Health Department
Duluth, Minnesota

Heidi Bauman
Minnesota Pollution Control Agency
Duluth, Minnesota

March 2001
NRRI/TR-2001/12

Natural Resources Research Institute
University of Minnesota, Duluth
5013 Miller Trunk Highway
Duluth, Minnesota 55811

This report was prepared for:

Sewage Technical Committee
Iron Range Resources and
Rehabilitation Board

Introduction

This report summarizes the results of an informal survey mailed to pumpers and contractors of onsite wastewater treatment systems in northern Minnesota in the spring of 2000. The survey was developed jointly by the Sewage Technical Committee (TC) of the Iron Range Resources and Rehabilitation Board and Northern Lights Tourism Alliance (IRRRB/NLTA). The purpose of the survey was to determine, in general, the types of freezing problems associated with onsite systems during the winter of 1999-2000.

There were numerous reports of frozen systems throughout the region during the winter of 1999-2000, and it was perceived as more of a problem than in recent years. Several long-time contractors in the region indicated that a similar winter occurred about 20 years ago, when an unusual number of onsite systems had freezing problems. In an attempt to understand what might have occurred during the past winter, an informal survey was developed by the TC and mailed out to pumpers and contractors by counties in north central and northeast Minnesota. This effort was done in coordination with staff from NRRI and the MPCA so that the survey responses could be tabulated and summarized in this summary report.

The winter of 1999-2000 was a unique weather year because of warm temperatures and lack of snowfall. Winter maximum daily temperatures were an average of 4.9° F above normal at the Duluth International Airport (October 1 - April 30), while snowfall was 24.6 inches below normal. Although temperatures were above normal during the winter, temperatures as cold as -15°F occurred in December 1999, -17°F in January 2000, and -11°F in February 2000.

During the winter 1999-2000, there was no snow to only a few inches of snow on the ground (Figure 1). The 50-year average snowfall in Duluth is 80 inches and an average snow depth of 13 inches (from Dec-Mar). In 1999-2000, total snowfall was less than 60 inches and the average snow depth was only 3-4 inches. Typically, snow accumulates on the ground in early to mid-December and stays through March. In 1999-2000, there was no snow cover until January 2000. This unusual weather extended throughout northern Minnesota.

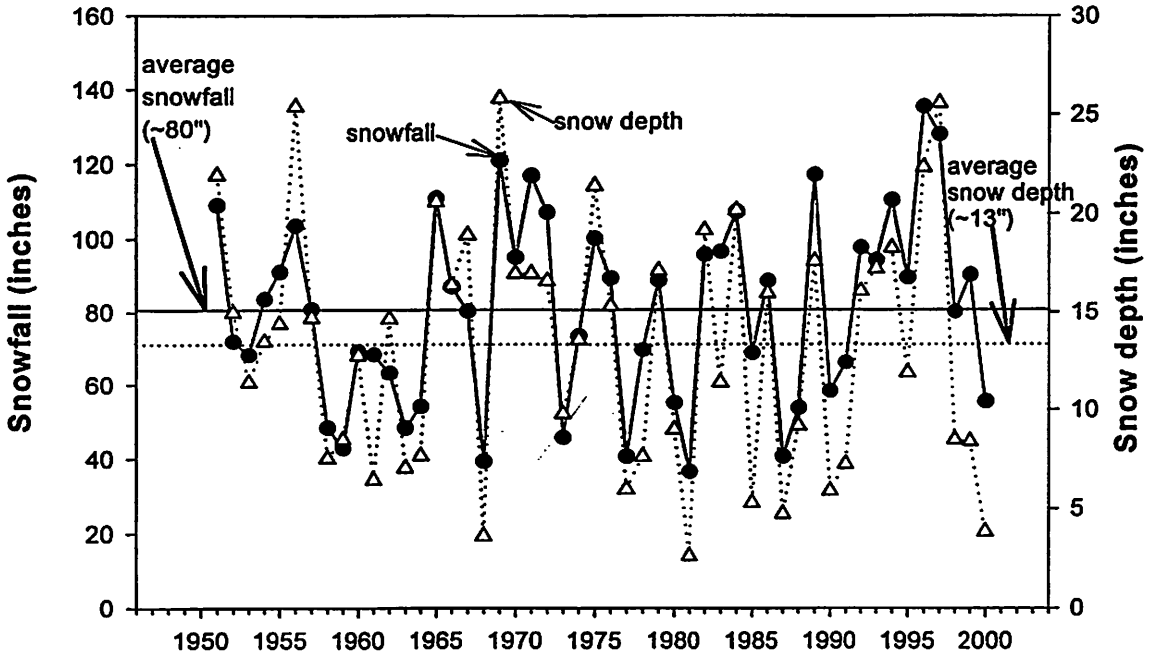
Survey Results

The survey developed by TC members and mailed to area-wide pumpers and contractors is shown in Appendix 1. The form requested general information about the number of frozen systems encountered, estimated age of those systems, location of freezing, suspected reasons for freezing, methods used to fix frozen systems, and suggestions for avoiding future problems. The survey was informal, and the actual number of systems with freezing problems may be higher than reported (due to lack of response) or lower because of double counting (due to anonymity). Nevertheless, some general observations from the responses are presented.

The total number of surveys returned, grouped by county, are listed in Table 1. Survey responses were received from contractors working in 16 counties in the northern portion of Minnesota.

A total of 92 surveys were returned. The tabulated results indicated that 444 onsite wastewater systems had some type of freezing-related problem during the winter of 1999-2000. The greatest number of returned surveys were from individuals working in St. Louis County, which indicates a good response from contractors in the area. It does not necessarily mean that St. Louis County had the biggest problem with freezing systems in comparison to other counties included in the survey. More people simply responded to the survey that repaired systems in St. Louis County.

Figure 1. Total yearly (Nov-Apr) snowfall and average (Dec - Mar) snow depth as recorded at the Duluth International Airport for the period 1950-2000.



A tabulation of the survey results are presented in Table 2 which lists the following information: (1) the number of systems with freezing problems, by age, for each county or group of counties, (2) the location of freezing, (3) reasons for freezing, and (4) how the frozen systems were fixed. Some of the respondents did not identify the age of systems, so the age estimates of some onsite systems is unknown. Overall, the results indicate that freezing problems were prevalent with all types of systems, and that newly constructed systems (those less than 1-year old) tended to have a greater incidence of freezing problems as compared to systems used for some time.

Table 1. Freeze survey returns grouped by county[1].

County	Number of surveys returned	Percent of the total returned surveys
Aitkin	5	6
Benton	1	1
Carlton	8	10
Cass	4	5
Cook	1	1
Crow Wing	10	13
Itasca	1	1
Kenebec	1	1
Lake	5	6
Mille Lacs	2	3
Morrison/Stearns	3	4
Pine	7	9
Todd /Wadena	2	2
St. Louis	31	39

[1] Some of the returned surveys indicated that the freezing problems that contractors fixed were located in more than one county.

About 20% of the systems (75 out of 369) with freezing problems were new construction; 37% of the systems (137 out of 369) ranged between 1-5 years old; 25% of the systems (92 out of 369) were between 5-10 years old; and 18% of the systems (65 out of 369) were greater than 10 years old. The results suggest that systems less than one-year old had a higher freezing rate as compared to systems used for more than one year. In the industry, it is generally recognized that new installations, especially those installed late in the construction season, have a greater tendency to freeze during their first winter of operation as compared to systems used by homeowners for several years.

Cold septic tanks may contribute to freeze problems on some new construction, especially when wastewater flows from the home are low or sporadic. The cold, disturbed soils, and less than adequate grass cover over a newer system, likely contributes to the problem. Both grass and snow

cover help to insulate the ground and the onsite system components. When disturbed soil is placed onto a newly installed system, and the re-establishment of a grass cover is not complete, the frost depth can be quite extensive, especially in years with minimal snow cover.

Table 2 also tabulates survey results by location of freezing within systems. The most common location for freezing was in sewer piping, both the building sewer (from the house to the septic tank) or in piping from the septic tank to lift stations or to the soil treatment area. Sewer pipes installed to drain out and not hold wastewater have a tendency to sag in disturbed soils over time, which results in wastewater collecting in that portion of the pipe and freezing during the coldest months. Some clean-outs in the building sewer were suspected as locations of freezing, especially when water use was low and/or fixtures were leaking.

Freezing problems were identified in all types of onsite systems, and the specific type of system did not appear to matter. Both trenches and mounds, as well as "advanced" technologies, experienced freezing problems. Freezing occurred not only in sewer pipes, but in the vicinity of pump chambers, pump lines, and within soil treatment systems. One consequence of shallow tank placement appears to be a greater susceptibility of these systems to freezing.

Although not reported directly in the survey, there were at least 10 drip systems with freezing problems in the northern part of the state, while other drip systems operated successfully during the winter. Five of the 10 drip systems were constructed in 1999, while the remaining drip systems had been operational for two years or more. Freezing was observed at numerous locations on the drip systems, including the supply piping, air-relief valves, and in the drip tubing itself. Lessons are being learned on the winterization needs of drip systems in low-snow years.

The suspected reasons for freezing identified by the respondents are also listed in Table 2. The largest suspected cause of freezing reported by the respondents (~40%) was related directly to a lack of snow cover during the winter of 1999-2000. The respondents suspected that slow drips (i.e.: leaky faucets and toilets and furnace condensate) likely contributed to some of the freezing problems. Seasonal dwellings were identified as having some freezing problems, most likely related to their sporadic use during the winter months. Other problems were attributed to the lack of vegetative cover on new systems. Still other problems were related to a variety of "activities" on systems, including plowing over the system for parking and/or walking, snowmobiling, ice skating on a rink built over a drainfield, and deer feeding. Exposed manholes and clean-outs were other suspected sources of freezing problems.

The most common methods reported to fix the systems were steaming, using hot water, heaters, or insulating the system with straw. Steaming lines and letting the water build up in the pump chambers were reported to be effective thawing techniques. After the systems were thawed, straw or other types of insulation were often added to avoid additional freeze problems. Others pumped the tanks while some homeowners simply waited for the spring thaw.

Table 2.–Tabulation of the survey results from the winter of 1999-2000.

County	# frozen systems	Age of system				Freeze location and number				soil treatment area							Freeze reasons										Fix problem						
		new	1-5 years	5-10 years	> 10 years	building sewer	in septic/holding tank	line to lift station or to soil treatment area	in lift station	pressure trench	gravity trench	pressurized bed	gravity bed	mound	drip disposal	at-grade	drainfield	Seasonal dwelling (not enough use)	manhole cover exposed/uninsulated	sidewalk/roadway over part of system that froze	vehicle/snowmobile traffic over system	new system, vegetation not yet established	leaking faucets, toilet or furnace condensate line	lack of snowcover	leaking septic tank	high winds	deer fed on drainfield	other	steam/ hot water	insulation/straw	install heater	pump tank	wait for spring	repair leak	other
Aitkin	4		3	1					2				1				1	1					2										
Aitkin, Kenebec	3	1	2										3								1		1					1					
Benton	3	3						1	1		1						1	1			1		1										
Carlton	9	5	4				1	2	2		1	1		3			3	1		1	2		3					1			2		
Carlton, Pine	62	9	6	1		2	3	5	6		2	1	1	9			6	3	1	2	2	3	5					3	1		2		
Cass																																	
Cass, Crow Wing	49		22	24	3	46		3						1			2		4	2		40	42					42	41				
Cook	2		1	1				1						1									2						1				
Crow Wing	12	4	3	4	1	2	4	2			4			2			2			1	2	1	3				1			2			1
Itasca	1	1					1																				1						1
Lake	8	1	1	2	4	2	1	1								4	2						7					1	1		1			
Mille Lacs, Aitkin	20	1	1	1				1						1						1							1	1					
Mille Lacs, Crow Wing, Morrison	20	5	5	5	5	5	5	5						2			5		2	2			10				2	1					
Morrison	25		25			15	10															10	15					1			1		
Morrison, Todd, Crow Wing, Cas	19	2	7	10		11	2				2	2	3		12				2	6	1	6	3				2	1					
Pine	18	5	11	2		4	3				22		2				4					1	1				1	2		1		1	
St. Louis	156	29	41	34	50	9	17	45	6			6	22	2		55	18	5	16	15	14	1	75	7	2	8	2	9	8	2	7	4		9
St. Louis, Aitkin	12	1	1											1							1		1				1						1
St. Louis, Itasca	1	1			1	1	1							1						1	1	1	1										
St. Louis, Lake	8	5	1	2		1		5									4				1	2	3				2				1		1
Stearns	5	1		4				2				1			2				1								5	1		3	1		
Stearns, Morrison	3		1	1	1	2							1						1								2				3		
Todd	3	1	1		1		1		1				1					2			1		1					1			1		
Wadena	1		1			1																					1	1					
Total	444	75	137	92	65	101	42	86	18	0	30	11	5	47	4	14	59	48	13	27	31	26	65	176	7	2	8	21	66	54	4	19	11	1	13

General Recommendations

Some of the specific suggestions made by the respondents to prevent onsite systems from freezing are tabulated in Appendix 2. Protection from the cold is an obvious solution to the problem and a normal year of snow cover in northern Minnesota typically provides much of the needed insulation. But in winters with no snow cover until late December or early January, it may be wise to provide additional insulation for system components, especially those installed at shallow depths. Although insulation adds cost to a system, it might be money well spent in those years when snow cover is minimal. Straw placed over the system at least 12 inches deep is typically effective at minimizing frost depths.

Keeping wastewater in the septic tank and pump chamber as warm as possible may help in avoiding freezing problems in tanks, discharge piping, and perhaps in the soil treatment system. These structures, as well as manhole covers and clean-outs that extend to the surface, are recommended to be insulated with underground rated insulation. Particularly susceptible areas to freezing include the pump chamber and the pump line out to the soil treatment area (ie: mound or pressure trenches). This piping is typically installed for complete drainback after each wastewater dose. Contractors may also consider burying pump lines 5 feet deep and not use drainback on sites with flat runs or in possible traffic areas. Approximately 15% of the systems reported traffic over the piping which likely contributed to some freezing problems

Animal packing by deer and dogs is another real concern and homeowners should be aware to keep animals (and other foot traffic) off their systems. Don't feed deer near the system is good advice to homeowners. The use of straw instead of hay to insulate systems is recommended because deer are more likely to be attracted to hay for feed.

Leaking faucets and furnace condensate were cited as common freeze problems in the building sewer from the house to the septic tank, probably as a result of laminating ice created by a steady trickle. Homeowners should be aware that these seemingly insignificant 'drips' can lead to freezing in pipes (and hydraulic over-load to the soil treatment area) and that all leaks should be promptly repaired. Another suggestion was that furnace condensate should be routed into the sump pump basin rather than into the onsite system. Sewer lines may be also be insulated in cases where trickle flow will likely occur.

Seasonal systems or systems with low or sporadic use were also identified as a problem. The seasonal properties may not be set up for cold weather operation and perhaps should not have been in use. To minimize freezing on seasonal properties, tanks should be insulated to help retain heat. Septic tanks should <u>not</u> be pumped out in the fall to maintain biological activity (and some heat), to avoid cracking in tanks, and to prevent flotation when high groundwater is a problem. The low water use problem is not easily resolved, although the insulation of the building sewer line, septic tank, pump tank, and pump lines may help minimize the problem when low water use occurs. The addition of straw over these systems in low-snow years is also prudent protection.

Summary and Conclusions

In summary, the winter of 1999-2000 was a tough year on some onsite treatment systems. In many of the cases reported by survey respondents, a lack of snow cover was recognized as the leading cause for freezing-related problems with onsite systems. But even in the difficult conditions encountered during the winter of 1999-2000, the majority of onsite systems in use (>99%) did not report any freezing problems.

The reported freezing problems occurred in all different types of onsite systems, both new construction and older systems. There was no particular type of onsite systems more prone to freezing, although the most commonly reported location for freezing was in sewer piping from the house to the septic tank and in pump lines. A lack of snow cover and leaky faucets, toilets, and furnace condensate were likely major reasons for this type of problem. Some homeowners have inadvertently contributed to freezing their systems through improper activities like deer feeding, plowing the area, and even flooding the area for ice skating over the system. In many cases, the systems could be thawed out by steaming.

In those winters that lack a consistent snow cover (perhaps every 10 years), keeping wastewater in onsite systems as warm as possible by insulating tanks with foam, polystyrene, and/or straw is a wise investment. Straw should be placed over the onsite system before excessive frost penetration occurs (around mid-December). Using good workmanship in laying pipes and, when warranted, placing pump lines deeper and insulating lines (or both), is prudent to minimize these types of freeze problems in winters with limited snow cover. Finally, onsite systems should be protected from all types of activities that disturbs the area, including vehicle traffic, snow removal, snowmobiling, animals (deer feeding, dog kenneling), and children's play (skating and sleeding).

Appendix 1. Freeze survey sent to septic pumpers and contractors throughout northern Minnesota.

Winter 2000 Freeze-up Survey

1. How many system freeze-up's did you encounter this winter (Nov 99 - April 00)? _____

2. Of those systems how many were in the following age brackets?
_____ new system _____1-5 years _____5-10 years _____greater than 10 years

3. Where in the frozen systems did the freezing occur (number of systems in each category)?
_____ building sewer (pipe from house to tank)
_____ in septic tank/holding tank
_____ line to lift station
_____ line to soil treatment area
_____ in lift station
_____ soil treatment area (of those how many were in the following types?)
- _____ pressure trench
- _____ gravity trench
- _____ pressurized bed
- _____ gravity bed
- _____ mound
- _____ drip disposal
- _____ at-grade
- _____ specify type _____

_____ other _____

4. What do you suspect the reasons for the freeze-up's were (total number)?
_____ seasonal dwelling (not enough use)
_____ manhole cover exposed/uninsulated
_____ sidewalk/walkway over part of system that froze
_____ vehicle/snowmobile traffic over system
_____ new system, vegetation not yet established
_____ leaking faucets or furnace condensate line
_____ lack of snowcover
_____ leaking septic tank
_____ other _____

5. County/counties and townships where freeze-up's occurred?

6. What did you do to correct problems/thaw the systems?

7. What do you suggest to avoid future problems?

Appendix 2.–Comments provided by survey respondents (winter 1999-2000).

ID #	Suggestions for avoiding future problems, comments
1	Insulation
3	Fix faucets, more usage
4	More snow or insulate treatment area
5	More ground cover on line, faster drain back?, more slope?
6	Insulate pipe line
9	More insulation
10	Put hay or straw on system for 1st year
11	Do not let 90%+ furnaces discharge gravity into septic. More use on large drainfield mound.
14	Cover tank in fall with hay or leaves
15	Keep carpenters from flushing insulation down toilet. More use of the system.
16	Put tanks deeper
17	Heat tape or more ground cover
19	Use cover hay for insulation when snow not on ground
20	Insulate manholes, quality work
21	Stop feeding deer on mound and line to mound
23	Bury deeper or insulate
24	Try to tell customers not to take the low bidders. We do a better job.
25	Disconnect furnace line, no traffic over sewer lines, make sure pressure line from pump to mound has no low spots in it for water to stand.
26	Cover tank with hay or leaves in the fall.
27	Decent snow cover!
29	Drainfield systems are marginal in the dryest weather. Need to upgaye to mound or higher ground. Many are waiting for the inevitable "city sewer".
33	More cover over pipe, and grass cover.
36	Keep vehicles off area.
38	Insulate manholes, quality workmanship
40	Cover with hay.
41	If snow is light or late in coming, cover danger areas with hay.
42	Don't plow snow off line.
43	Sand backfill.
47	Cover snow with matting to stop deer, educate plumbers on septic systems.
50	Put a piece of foam inside the manhole cover when no snow is present.
54	Stay off areas with lines; cover with foam or hay. People just need to be a little smarter when it comes to our winters.
55	Try to design around fancy timers and alternators
59	Drip systems may be used seasonally. In winter months use gate valve and use voiding tank.
60	Seasonal use systems should be pumped in the fall. Stay off tank and drainfield areas
62	Insulated covers, nanivold, minimum 12" cover material (soil), air releases/ air vacuum reliefs, etc., and if that doesn't work everyone move south for the winter.
64	Don't walk on tanks or feed animals around tank. Put hay on them and put a snowfence around tank.
66	Insulate over top of tank, insulate covers
67	More top cover; possibly fabric over drip to help break frost line.
68	Cover line from pump station to mound and mound with at least a foot of straw before freeze up and leave undisturbed until spring thaw.
69	Insulate line to mound over areas that may be driven over. Don't put furnace condensation line into septic drain if seasonal dwelling.
71	Cover with hay or leaves.
72	Pump it out regularly and check faucets for dripping
73	Cover mounds and manholes with hay or straw
74	More pitch for drain back and more snow or leaves
78	Put in sump pumps instead of having furnace drip into sewer line
79	Insulate manhole
80	Styrofoam tanks and pressure lines
81	Make sure water had no leaks. Place straw over drainfield if lack of snow.
82	Don't drive on drain field. Don't build hockey rink on drain field. Use more water.
83	Homeowner education
86	Plenty of cover on system
87	Clean and check pumps in exterior lift station in fall
88	New drainfield
89	Better insulation from lift station to mound
91	Insulate
92	Homeowner installed systems