MINIMIZING THE ENVIRONMENTAL IMPACT FROM SNOW DISPOSAL

Guidance for Municipalities

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Introduction

Snow can function as a significant source of water pollution since it accumulates a variety of contaminants from the atmosphere and roadways. As such, the intention of this document is to provide guidance to municipalities to minimize water pollution from snow disposal activities. Specifically, the proper location and treatment of snow which is stored in piles for disposal is addressed. In addition, salt and salt-sand pile storage is discussed.

Snow and Nonpoint Source Pollution

Nonpoint source water pollution is defined as human-induced pollution originating from diffuse sources such as agricultural, silvicultural and urban activities. Nonpoint source pollution does not result from a single definable location, such as an industrial discharge pipe, but rather results from land runoff, precipitation, atmospheric deposition, or percolation. Exceptions are irrigation return flows and urban stormwater flows which are deemed nonpoint sources.

Snow functions as a nonpoint source of pollution since it accumulates a variety of contaminants from the atmosphere, motor vehicles and roadways. These contaminants include salts and salt additives, heavy metals, asbestos, petroleum products such as oil and grease, nutrients, bacteria, organic chemicals such as pesticides and PCBs, soil materials and litter. Although snow meltwater typically contains lower contaminant concentrations than rainfall runoff (Bennett, 1981), contaminant loads generated from urban roadways and carried in runoff and snow meltwater is of the same magnitude as that of raw sewage (Novotny, 1981). In addition, the solid materials such as sand and other soil particles, which accumulate in roadway removed snow, act as contaminants by filling in streams, lakes and navigation channels. Therefore, snow meltwater can be a serious pollution threat to the environment.

Environmental Impacts

In the state of South Dakota, the most obvious environmental impacts from snow disposal activities are related to sediments, organic solids, salts, and salt additives.

Direct disposal of snow into lakes and streams damages both the physical and biological environment. Soil materials such as sand can accumulate in snow and cause sedimentation of lakes and streams. Sedimentation can accelerate lake filling and eutrophication, choke navigation channels, smother fish spawning grounds, and destroy fisheries habitat.

Solid organic debris such as grass and leaves, also become a significant component of snow. When dumped directly into a lake or stream, these solids undergo biodegradation by bacteria. As a result of the degradation process, the dissolved oxygen concentration in the water decreases. Low concentrations of dissolved oxygen cause fish kills of game species and cause destruction of bottom dwelling fish forage.

Salt is used for winter street deicing and becomes a component of roadway removed snow and the resulting meltwater. Dissolved in the meltwater, the salt ions chloride and sodium, can flow into surrounding surface waters and infiltrate into groundwater. In lakes, salt contamination can cause increased density in the lower lake strata preventing normal mixing (Judd, 1970). Decreased mixing of the lake can result in degraded lake conditions. Increased chloride and sodium concentrations may contribute to excessive growth of undesirable blue-green algae in lakes (EPA, 1971) and can be harmful to aquatic life in both lakes and streams.

Salt contamination of soil and groundwater can result in vegetation stress and decreased productivity. Sodium ions can displace essential plant nutrients in the soil. Soils can erode more readily due to a lack of healthy vegetation.

A variety of salt additives, such as sodium ferrocyanide and chromates, are used as anti-caking agents and corrosion inhibitors. Upon dissolving in water, these chemicals become toxic to aquatic life by the formation of cyanide and chromium ions (EPA, 1971).

Some of the other environmental impacts of snow disposal include those related to nutrients and metals. Nutrient inputs to surface waters can stimulate excessive aquatic plant and algae growth causing impairment of recreational potential. Excessive nutrient concentrations in groundwater used for wildlife and livestock watering can be unhealthy.

Toxic metals can accumulate in soils making them unsuitable for crop production. Metals do not commonly contribute to groundwater contamination since they become bound to the overlying soil particles.

Human Health Considerations

Automobile emissions are still considered the primary source of lead contamination in snow even though lead concentrations in gasoline have decreased in recent years (WIDNR, 1987). Snow disposal into lakes and streams can result in lead contamination of the sediments and accumulation in tissues of plants and animals. Humans may in turn ingest lead through contaminated fish. Human exposure to low concentrations of lead can cause impaired neurological and immune system functions, especially in children. Increased exposure can lead to more severe damage to major organ systems (Sax, 1989).

In some states, road salt runoff has contaminated drinking water supplies leading public health officials to close wells due to the health threat. Excessive sodium consumption causes an increase in blood pressure (Sax, 1989) which can contribute to heart disease and hypertension.

Other contaminants associated with snow meltwater, such as organic chemicals, salt additives, and bacteria, are also potentially hazardous to human health especially if present in drinking water supplies.

Snow Disposal

Contaminants in snow can have potentially harmful impacts on lakes, streams and groundwater resources. Therefore, disposing of snow in a manner that causes degradation to the water resources of the state of South Dakota is considered a violation of state law (South Dakota Codified Law 34A-2-21).

Land disposal is generally preferred since sediments and litter can be collected, some metals can be filtered out by the underlying soils, and meltwaters can either evaporate or enter a surface water gradually thereby diluting and biodegrading the contaminants as they enter.

In areas where there is significant potential for contamination of groundwater which is utilized for drinking water supply, disposal of snow into surface water bodies may be the only viable disposal alternative. However, prior to disposal, the snow should be treated for solids removal.

Disposal Site Selection

Soils and Geology

Snow disposal sites should be located in areas where there is an adequate depth of top soil (approximately 2 feet) between the ground surface and water table, to act as a filter. Fine-grained loamy soils with a sufficient organic content will filter and retain potential contaminants, such as metals. Areas with sandy soils are less desirable for disposal sites due to the poor filtering capacity of these soils. Areas with fractured bedrock present near the surface should not be used as disposal sites due to the potential for direct groundwater contamination.

Location and Design

A disposal site which drains to a surface water body, should allow meltwater to drain first to a shallow detention basin, then through a gravel and rock type filter berm, and finally to the surface water body. Meltwater should cross a gravel or erosion resistant buffer zone between the filter berm and surface water. The entire site should be enclosed with snow fencing to contain litter and debris (Fig. 1). The site should be located far enough away from a surface water body to provide for installation and effective functioning of the described structures. A

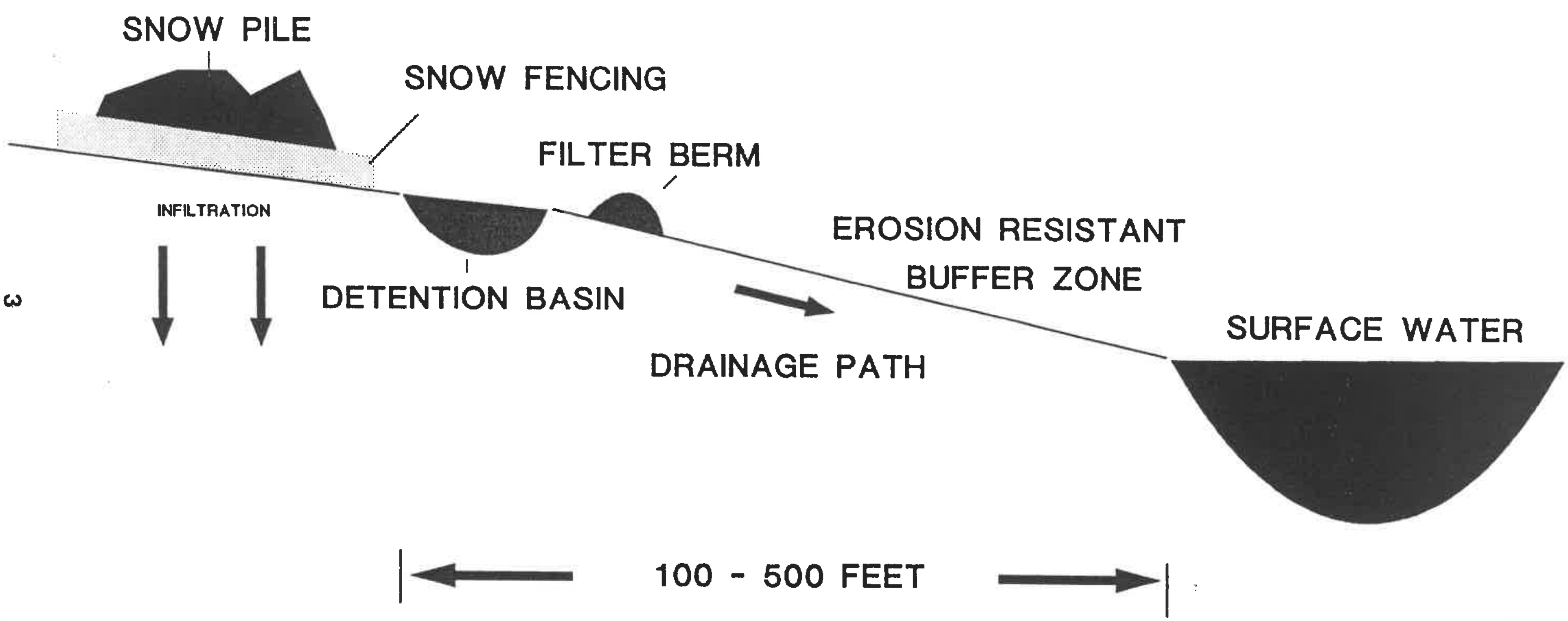

Figure 1. Disposal site draining to surface water.

minimum distance of approximately 100 to 150 feet is recommended. Where possible, a distance of 500 feet is preferred.

Detention basins and filter berms function in settling out and trapping sediments, organic solids, and debris. Basins are recommended to have a minimum depth of approximately 2 feet. Berms are recommended to have a minimum height of 1.5 to 2 feet.

Buffer zones function in reducing soil erosion and snow fencing functions in trapping litter and debris. Litter and debris from the site should be removed by the municipality after the spring snowmelt is complete.

Disposal sites which do not drain directly to a surface water body, but rather drain predominantly by groundwater infiltration and evaporation, do not need to have a detention basin or filter berm. The site should, however, be enclosed with snow fencing. An example of this type of disposal site would be a field or a gravel parking lot which does not have storm sewer drainage.

Sites which will not directly drain to surface water but do drain to a storm sewer, need to be contained by a snow fence, filter berm, small detention basin and buffer zone (between the filter berm and storm sewer). An example of such a site might be a gravel parking lot which has sewer drainage (Fig. 2).

Disposal sites should not be located upgradient of existing wells. Where wellhead protection areas have been defined for public water supply wells, disposal sites should not be located in the protection area. Meltwater can contaminate the groundwater in downgradient wells. Disposal sites must be located downgradient of wells. Wellhead protection areas for public water wells vary from 500 feet for confined aquifers to 1 mile for unconfined aquifers. Disposal sites must be located downgradient of wells irrespective of distance. In areas where wellhead protection areas are not designated, such as near private wells, it is recommended that disposal sites be located at least 1000 feet downgradient of the wells.

Disposal sites should not be located in areas that are susceptible to erosion, such as steep slopes, in order to avoid soil erosion by meltwater.

Disposal sites should not be located in sections of parks or playgrounds that will be used for direct contact recreation after the snow season. Since the underlying soils will accumulate toxic metals and other potentially dangerous debris, human exposure to the sites should be minimized. As discussed previously, accidental ingestion of soils contaminated with metals such as lead, can be detrimental to human health especially in children. In addition, debris accumulated at the site, such as pieces of metal and glass, can be potentially dangerous. Areas in parks, such as parking lots, which are not used for public recreation, can serve as disposal sites.

Sanitary landfills should not be used for the direct disposal of snow. Such a practice would increase the leachate production from the landfill thus causing potential groundwater and surface water contamination. Litter and debris collected from a disposal site after the snowmelt, should be disposed of into a sanitary landfill.

Wetlands should never be used for snow disposal sites since the meltwater will cause accelerated contamination of soils, water resources, and wildlife habitat.

Quarries, which have areas of fractured bedrock, should not be used for snow disposal due to the potential for direct groundwater contamination.

Assimilation

A surface water body can assimilate a limited amount of meltwater contaminants depending upon the quality of the meltwater and the size of the receiving water body. The amount of snow disposed of at a site should therefore be based upon estimates of those factors. Contaminant loads can be calculated based upon meltwater analysis and volume estimates. Ideally, in areas of large snowfall amounts, several disposal sites should be identified which impact either different surface waters or are dispersed along a single

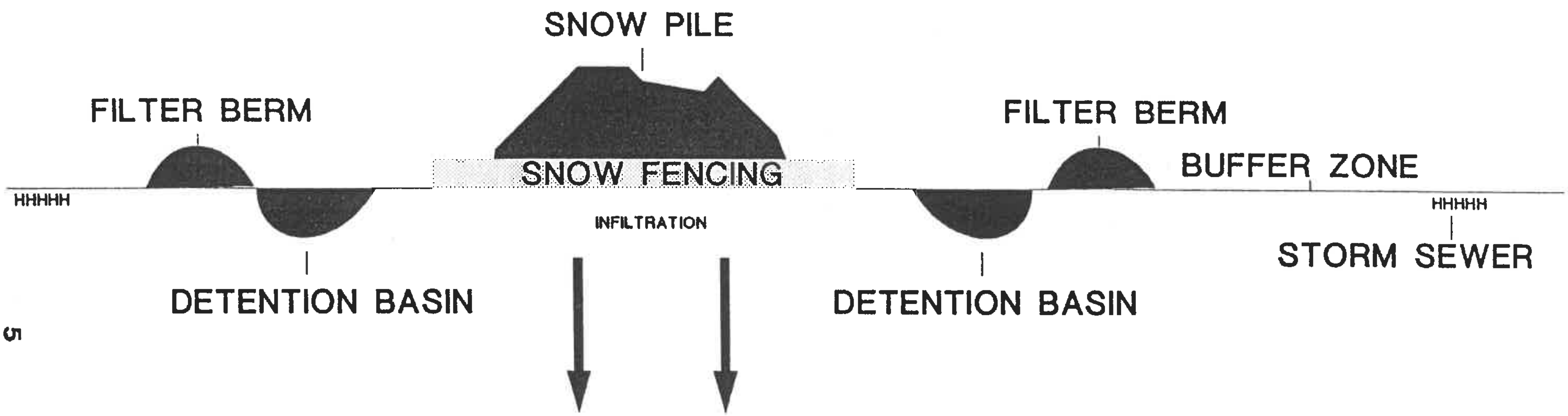

Figure 2. Disposal site draining by groundwater infiltration, evaporation and flow to storm sewers.

surface water body to allow effective dilution and assimilation.

Proper Storage for Deicing Chemicals

Salt and salt-sand pile storage locations should be in areas that protect groundwater and surface water. Particularly do not locate storage sites in areas of groundwater recharge where salt seepage may contaminate wells or in areas where seepage will directly enter a water body.

Ideally, salt should be stored in an enclosed building with a foundation. The foundation should be higher than the surrounding terrain in order to prevent surface water from seeping into the building. The floor should be made of impervious material and should be strong enough to withstand the weight of the loading equipment. A floor constructed with a 6 inch compacted gravel base and covered with either 6 inches of concrete or 4 inches of asphalt is recommended. Use of lighter equipment may allow for thinner floor construction. Brine runoff from the storage building should be contained in a lined collection basin for later removal to areas where environmental impact will be minimal.

Minimally, outdoor salt stockpiles should be protected from direct precipitation with a cover made out of canvas, heavy tarpaulin or other protective material. Preferably, the piles should be placed on crowned storage pads to enable drainage away from the pile on all sides. If pads are not used, storage piles should have runoff diverted around them and should be contained within prescribed bounds by using berms. Drainage ditches, pipes or tiles may be necessary to prevent contamination of water resources. Lined impoundment basins may also be needed to contain salt drainage.

Properly designed storage buildings are the recommended storage option. Other storage methods such as covered piles and converted grain silos have demonstrated problems. Brine runoff is difficult to control with covered piles. Silos have limited storage capacity and experience mechanism jamming from salt caking (U.S.EPA, 1974).

Salt Minimization/Alternatives

Salt and salt additives can be harmful contaminants to our environment and in addition cause costly corrosion to vehicles and roadway structures. Salt use can be minimized by more frequent plowing and use of salt alternatives such as sand.

Alternative deicing compounds, such as urea, various chloride compounds of magnesium, potassium, aluminum and lithium, ammonium acetate, methyl and ethyl alcohol, ethylene glycol, and glycerol have been used to meet special conditions such as airport runway deicing. These chemicals have been more expensive than rock salt and the environmental impacts from them are not well documented (EPA, 1971).

A relatively new alternative deicer which is reported to be have less environmental impact is calcium magnesium acetate (CMA), which is made from limestone and acetic acid. CMA is reported to be biodegradable, to have no toxic effects on terrestrial or aquatic animals, and to have no negative impacts on soils or vegetation (Wyatt, 1989). Although CMA is many times more expensive than salt, the costs of roadway structural damage caused by salt may make the use of CMA economical for larger metropolitan areas.

Assistance

For assistance in planning a snow disposal program please contact your regional Department of Water & Natural Resources Office or the Nonpoint Source Program Office.

Rapid City Regional Office

Department of Water & Natural Resources
36 East Chicago
Rapid City, SD 57701-1568
605-394-2385

Sioux Falls Regional Office

Department of Water & Natural Resources
1108 West Bailey
Sioux Falls, SD 57104-1375
605-339-6697

Watertown Regional Office

Department of Water & Natural Resources
123 East Kemp, #5
Watertown, SD 57201-3641
605-882-1390

Nonpoint Source Program Office

Department of Water & Natural Resources
Joe Foss Building
523 East Capitol
Pierre, SD 57501-3181
605-773-4216

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