Snow Meltwater Pollutants and Treatment Measures

Because of the cold climate, amount of snow and lack of available snow storage along the roadways in Juneau, snow from roadways and residential zones must be moved to a disposal site in order to melt in the spring. In most areas, due to high fuel costs, allowing the snow to melt at a disposal site is a less expensive option than forced snow melting. Either method of snow removal typically requires a discussion on water quality impacts.

A number of pollutants can be found in urban areas and urban runoff. However some pollutants that are common in most American cities should not generate major concerns in Alaska snow disposal sites, especially for mostly non-urbanized communities. After an extensive five year study of pollutants found in snow disposal, the Municipality of Anchorage Watershed Management Services (WMS) (Wheaton et al. 2002) has outlined several pollutants of concern for snow disposal sites.

- <u>Sediment</u> – Sediment is a common pollutant at snow disposal sites since sand is applied to roadways for better traction during snow events.
- <u>Chloride</u> – Chloride is another common pollutant and usually comes from sand that is applied to the roadways (WMS Reports). Typically chloride concentrations are low at the end of a snowmelt period, but concentrations depend on factors such as snowpack chloride concentration, snowmelt rate, and snowpack height. In the Anchorage, the chloride concentration in the snowpack typically ranges from 1000 mg/l to 3000 mg/l (WMS).
- <u>Metals</u> – Hazardous heavy metals including chromium, arsenic, copper, lead, and zinc were tested in snowpacks but they were consistently far below hazardous levels for ADEC standards (WMS).
- <u>POLs and PAHs</u> – POLs (petroleum/oil/lubricants) and PAHs (polynuclear aromatic hydrocarbons) were both far below hazardous levels according to ADEC (Hart Crowser 2000).
- <u>Cyanide</u> – Cyanide concentrations have been undetectable in meltwater (WMS 2000). Ferrocyanide can be added to granular salt as a fluidizer but when exposed to light, the compound can be converted to free cyanide. Free cyanide concentrations are typically low due to its ability to rapidly volatize.

- Coliform – Fecal coliform is typically low according to ADEC standards and are mostly non-human in origin. They are usually much higher in residential areas than on arterial streets.

Pollutant concentrations and the height of the snow pack are highly variable from year to year as demonstrated by Wheaton (2008). In winter 1999-2000 the stored snow depth for the Anchorage was 8 to 10 feet with a Chloride concentration of 340 – 410 mg/l (1998 Snow Disposal Data Report, APr98001). But in the winter of 1997-1998 the snow was 30 to 50 feet deep with a peak chloride concentration of 9000-10000 mg/l (2000 Snow Disposal Data Report, APr00004). In addition sediment has a median concentration of 93.3 gm/sft but ranges from 87.7 to 1288 gm/sft.

The Wheaton et al. (2002) snow disposal study also looked at how snowpack pollutants impacted ground and surface water quality, and found the following results.

For Groundwater:

- Chloride – Non-potable groundwater systems can be used to dilute water with chloride. These systems can exist in old glacial outwash channels. The soil largely consists of glacial till and would likely have a low permeability. Low permeability would prevent meltwater from reaching deep aquifers.
- POLs and PAHs – These pollutants have low solubility in water and are often absorbed by vegetation. If soils are highly organic they will absorb more POLs and PAHs, preventing infiltration.
- Metals – Typically metals are low relative to water quality standards, but lead and copper have been found to be at higher concentrations when salt concentrations are higher. However, concentrations of heavy metals were taken before infiltration or dilution occurred. Reducing salt usage in order would reduce metal concentrations.
- Coliform – Bacteria concentrations are typically low and will likely be filtered out by minerals and organic compounds in the ground.

For Surface Water:

- Sediment – When properly designed, snow disposal sites are very efficient at preventing the mobilization of sediments in meltwater and retaining the sediments on-site. This includes the design of V-swales for meltwater runoff and the dilution ponds.
- Chloride – Chloride concentrations in meltwater can be high for short periods but given that the melting rate of snowpacks is typically low (< 0.5 cfs during peak chloride release), concentrations of chloride in meltwater typically decrease as the melt season progresses.
- POLs and PAHs – These are typically not mobile and are very insoluble in water. Concentrations are even lower with higher chloride concentrations.
- Metals – Metals like copper and lead can be higher than water quality standards allow when salt concentrations are high. However, the higher concentrations are often short lived and will only marginally be higher than the water quality standards.

- Cyanide – This has been undetectable in snow disposal meltwater.
- Coliform – Bacteria can be high at snow disposal sites but with proper design measures, concentrations will be low in meltwater.

Concentrations of pollutants in snow disposal meltwater can be reduced and mitigated, assuming the disposal site is built properly. Several siting, design, and operational guidelines from Wheaton and Rice (2003) are outlined below.

Siting Criteria:

- Avoid meltwater discharge to potable water aquifers, closed lakes and wetlands, and to streams with winter base flows less than 85 L/sec.
- Avoid reduction of functionality for receiving wetlands.
- Optimize opportunities for infiltration to shallow non-potable ground water systems and for a site orientation sloping from south to north.

Design Criteria:

- The site should drain into a V-swale, which should be at least 45-meters wide crest-to-crest with a 2% side slope and 1-2% longitudinal slope.
- The V-swale should be oriented so that the longitudinal axis points downhill from south to north.
- Flag setbacks should be established from the swale crests and facility perimeter.
- Armor swale troughs and crests and all facility drainage channels and containment berms.
- Trackwalk and vegetate all non-armored pad surfaces with a mix resistant to an annual 2-5 cm sediment burial.
- Construct dry detention ponds or other treatment to control chloride and sediment releases (mean chloride release per: 1 day ≤ 3600 mg/L, 30 day ≤ 1200 mg/L, and season ≤ 300 mg/L; sediment removal at ≥ 95% of 100 μm particles).
- Install flow dispersion and energy dissipation controls at all outfalls to receiving waters.

Operational Criteria

- Place hauled snow over the full width of the V-swale.
- Sequence the placement of snow starting at the downslope side and working upslope.
- Maintain snow in a compact mass with 1:1.5 side slopes or steeper.
- Maintain the setback from all containment berms and the discharge end of V-swales.
- Maintain pad vegetative cover and re-grade only to ensure V-swale functionality.
- Restrict access and prohibit off-season traffic and non-snowy uses.

With proper siting, design, and operation water quality problems from snow melt can be minimized to levels that are safe for the general public.