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Performance of Stormwater Ponds and Wetlands in Winter

by Gary Oberts, Metropolitan Council, St. Paul, MN

Stormwater ponds and wetlands are common practices for treating stormwater runoff in northern regions. Until recently, however, very little winter monitoring data was available. Oberts and his colleagues sampled four stormwater ponds in Minnesota during both rainfall and snowmelt conditions. They found that ponds were generally effective in removing pollutants during non-winter conditions. However, there was a marked reduction in the performance of stormwater ponds in treating snowmelt runoff. Most ponds did a fair job of removing sediment and organic matter in the winter, but were mediocre at removing nutrients and lead (Figure 1).

There are several reasons for the poor performance of stormwater ponds in winter. One primary reason is the thick ice layer that can form, sometimes reaching three feet in depth. This ice layer can effectively eliminate as much as half of the permanent storage volume needed for effective treatment of incoming runoff. In this case, the first increment of meltwater runoff entering the pond dove beneath the ice layer and created a turbulent, pressurized condition that scoured and resuspended bottom sediments in the pond.

Once the available pool volume under the ice was filled, meltwater runoff was forced to flow over the top of the ice. This further reduced performance, since the settling depth above the effectively impermeable ice layer was minimal. Pollutants that settled on the ice were easily resuspended during the next melt or runoff event. In addition to the physical limitations of settling, biological activity in the pond was also greatly reduced during the winter.

The same forces working against wet ponds in winter also work against wetland systems. In fact, wetland efficiency may drop even further because wetlands are shallower, have larger amounts of detritus available for re-suspension, and are biologically dormant during winter.

Research on a wetland in Minnesota shows how pollutants can pass through a stormwater wetland system, even when it appears as though the system might be working. The pollutant removal performance during snowmelt and for the first two rainfall events after snowmelt in a six-acre, six-chambered, lowhead wetland treatment system is presented in Figure 2. The wetland outlet was frozen for the entire winter and was thus effectively closed. This resulted in the formation of a thick ice layer and subsequent deposition and accumulation of all small midwinter events and baseflow in the final wetland chamber (approximately 2.5

Figure 1: Average Effectiveness of Four Stormwater Ponds (Oberts *et al.*, 1989)