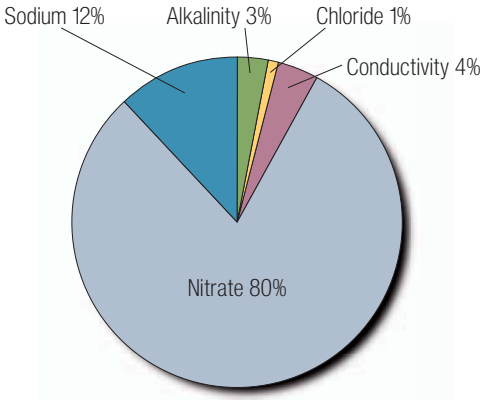

Figure 5. *Percentage of Water Quality Parameters Exceeding Levels of Concern in Morrison Cove Streams*

MACROINVERTEBRATES

The macroinvertebrate populations that commonly are found in limestone streams or limestone influenced streams have unique characteristics. These populations are often abundant, dominated by a few taxa such as *Ephemerella* (mayfly), Amphipoda (freshwater crustacean), Isopoda (freshwater crustacean), and Chironomidae (midges), but do not usually have many stonefly taxa. Limestone streams tend to be low gradient and are characterized by constant temperatures, high alkalinity, and an abundance of aquatic plants. The limestone streams in Morrison Cove tended to be dominated by *Ephemerella*, *Gammarus* (Amphipoda), *Baetis* (mayfly), and Chironomidae. Stoneflies were sparse in the limestone sections of the streams, although healthy populations of stoneflies existed in the tributaries that originated on the ridges. Due to the slope and rockiness of the ridges, these streams had more riffles and aeration of the water, which is a habitat characteristic favorable to stoneflies. Due to the low diversity and dominance by a few taxa in these streams, all the taxa were accounted for in each sample in order to discriminate further between streams.

By comparing the stream sites in Morrison Cove to the reference stations chosen within the watershed, there were 12 nonimpaired stations (54.5 percent), nine slightly impaired stations (41 percent), one (4.5 percent) moderately impaired station, and no severely impaired stations. A comparison to the sampling results from the Year-1 study (LeFevre, 2005) indicated that six of the eight sites sampled for that report were different in their biological conditions categories. Furthermore, these differences were consistently showing better conditions during this Year-2 study period than noted by LeFevre (2005). This phenomenon was likely due to the inclusion of additional taxa in the sub-sampling of the April 2005 samples and may also be due to comparison to reference sites only within the Morrison Cove area. Another potential factor that may have caused differences between the results of the Year-1 and Year-2 study was a dramatic difference in flow. The six stream locations that were sampled both years had an average of 40 percent less flow in 2005 than they did in 2004 during the same season.

Since many of the streams sampled were limestone or limestone-influenced and had similar macroinvertebrate composition, the number of mayfly and stonefly taxa present were used to differentiate between similar sites. The sites with six or seven mayfly taxa included one of the unnamed tributaries to Halter Creek (T2), the tributary to Plum Creek (T3), the mouth of Clover Creek (C1), a middle reach site on Halter Creek (H5), and three sites in the Yellow Creek basin: the downstream site on Yellow Creek, Potter Creek and Hickory Bottom Creek (Y6, Y3, and Y1, respectively). All these sites also had stoneflies present. Although, stoneflies are generally either present in low numbers or absent from limestone streams, the tributaries from the forested ridges that surround Morrison Cove served as sources of stoneflies for these streams. Both tributaries coming from the ridge to Halter and Plum Creeks (T2 and T3) had three or more stonefly taxa, as did the mouth of Clover Creek (C1), a middle reach of Halter Creek (H4) and the downstream site on Yellow Creek (Y6).

WATER QUALITY

Excess nitrates can reach groundwater or surface water by leaching through the soil and running off the land surface. The rate at which the nitrates leach is affected by factors including the type of soil, the amount of rainfall, and type of plant cover. Excess nitrates in groundwater and surface water are undesirable because of their adverse impacts on the environment, as well as their potential to be detrimental to human health (Grossman, 2000). The environmental effects of excess nitrate include eutrophication, which is an overabundance of nutrients that results in increased algal growth, depleted oxygen levels, and a decline in aquatic life. In this study, total nitrate-n exceeded the level of concern 101 times, which accounted for 80 percent of the total exceedances. The values set for nitrate-n (1.0 mg/l) are based on natural background conditions as opposed to aquatic life tolerances. Therefore, values greater than 1.0 mg/l suggest the presence of anthropogenic nitrate sources such as agriculture, fertilizers, or failing septic tanks. Nutrient standards or levels of concerns for aquatic life have not yet been developed in Pennsylvania.

There are also significant human health effects associated with drinking water that contains high levels of nitrate, especially for children and pregnant women. The current USEPA standard for nitrate concentration in drinking water is 10 mg/l. Morrison Cove, specifically the Martinsburg area, currently is facing some of the problems and complications that stem from excess nitrates in the local groundwater system (for more information, see Lindsey and Koch, 2004). The entire Morrison Cove region is primarily made up of agriculture and low-density residential land uses. As a result, fertilizers, animal manure and on-lot septic systems are all potential

A study by the Pennsylvania Department of Agriculture reported that about 35 percent of the wells sampled in the Morrison Cove valley had nitrate levels exceeding the MCL of 10 mg/l.