Groundwater, Turf Management and Public Perception

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Groundwater is defined as any water which occurs beneath the surface of the earth in a saturated geological formation of rock or soil. It accounts for the drinking water of half the total United States population and 95 percent of the rural populations. At one time, groundwater was generally thought to be protected from contamination by impervious layers of subsoil, clay, rock and the soils' own degradation process. However, in 1979 the pesticide Aldicarb was found in wells on Long Island and in Wisconsin. This, along with detection of nitrate in groundwater, forced groundwater contamination to become the top environmental issue.

The primary sources of groundwater contamination can be classified as either point of source or nonpoint source contamination.

Point source contamination can be traced back to a specific source. In 1988, the U.S. Environmental Protection Agency reported that deficient septic tanks, leaking underground storage tanks and agricultural activities (i.e. fertilizer application) were the most frequently cited sources of groundwater contamination.

A nonpoint source of contamination is one that cannot be traced back to a specific source. In water that did not meet state use designations by the EPA, nonpoint sources of pollution were cited as the cause of water quality, degradation in 76 percent of lake acres, 65 percent of stream miles and 45 percent of estuarine water. Examples of nonpoint sources of contamination include agricultural fertilizer and pesticide runoff, agricultural fertilizer and pesticide movement through the soil, and sediment from construction sites.

Factors Influencing Contamination

Understanding the soil type, solubility of chemicals, water table depths, topography and vegetation can assist in the site evaluation for groundwater protection.

Soils that have higher infiltration and percolation rates are more susceptible to groundwater contamination. Sandy soils, modified sand golf greens and modified sand athletic fields are examples of areas having high percolation rates. With the exception of native sandy soils, these areas are constructed in a 12 to 24-inch soil profile with water diverted from the modified soils to soils with lower percolation rates. However, native sandy soils can be found in most states. These areas are highly susceptible to groundwater contamination.

The solubility of pesticides can directly influence groundwater contamination. The EPA has identified several turfgrass pesticides as having potential for leaching into the groundwater. They are Carbaryl, Chlorothalonil, 2, 4-D, DCPA, Dicamba, Fenamiphos, and Trifluralin. Only a few of these products actually remain soluble in water. The Farm Chemical Handbook provides information on pesticide solubility.

Fertilizer sources also vary in their rate of solubility. Nitrogen is more likely to move into the groundwater when present in the soil in a soluble form. Soluble forms of nitrogen include synthetic nitrogen sources (ammonium nitrate, ammonium sulfate, calcium nitrate) and urea. Slow-release nitrogen sources have a lower water solubility than the soluble forms of nitrogen. Within the slow-release nitrogen group, some slow release nitrogen sources are more soluble than others. For example, ureaform and milorganite are less soluble than short chain methylene urea.

Nitrogen Sources

Slow Release	Water Soluble
Natural Organics	Synthetic Inorganics
• Milorganite	• Ammonium Nitrate
• Sustane	• Ammonium Sulfate
• Restore	• Calcium Nitrate
Synthetic Organics	Synthetic Organics
• Ureaform	• Urea
• Methylene Urea	
• Sulphur Coated Urea	

The depth of the water table directly affects the susceptibility of the groundwater to contamination. Shallow water tables are more likely to be contaminated than deep aquifers. In Iowa, much of the drinking water is from shallow water sources.

The topography of the site also influences the movement of fertilizers and pesticides. Heavily sloped areas are more likely to lose water, nutrients and pesticides through runoff. All other conditions being the same, it stands to reason that the greater degree of slope, the greater the water loss due to the increased velocity of water flow. The length of the slope also influences the movement of fertilizers and pesticides. The greater the extension of the sloped area, the greater the concentration of the flooding water.

The presence of vegetation on the soil surface will greatly affect the loss of fertilizers and pesticides through both runoff and leaching. The kind of grass, the thickness of the stand and the vigor of its growth greatly affect runoff and are of great importance in the control of pesticide and fertilizer movement. A thick, healthy stand of cultivated turfgrass is much less susceptible to runoff than are pastures. Pastures are more compacted and are not as thickly vegetated as lawns. In research conducted at Penn State, nutrient loss through runoff was greater on seeded sites than on sodded turfgrass sites. The loss of water by percolation is also less on vegetated lands than bare soil. The

(Continued on Page 32)

Groundwater, Turf Management And Public Perception —

(Continued from Page 30)

roots of a turfgrass plant will be in the upper 8 to 12 inches of the soil profile. These roots are excellent extractors of soil water.

In summary, sandy turfgrass sites treated with soluble chemicals are more prone to leaching loss, whereas heavy clay turfgrass sites on sloped areas are more prone to runoff loss.

Management Practices That Protect Groundwater

The manager of a turfgrass site has ultimate control on protecting the groundwater. This is especially true for sandy turfgrass sites. Thus the nitrogen source, nitrogen application rates, timing of nitrogen application and irrigation practices can directly influence groundwater contamination on sandy sites.

As stated previously, slow-release nitrogen sources have a lower solubility than inorganic nitrogen sources. Slow-release nitrogen sources are recommended for use on sandy soils. Research has shown that nitrate leaching is less when applied as a natural organic form (Milorganite) or a synthetic organic form (ureaform).

If soluble nitrogen sources are preferred, rates should be adjusted to prevent movement through the soil profile into the groundwater. For example, nitrogen applications with urea on high sand content golf greens should be at a rate of .1 to .25 lb. N/1000 sq. ft. per application. Anything greater may leach below the root zone. Once this occurs, the nitrogen is no longer available for plant use. However, if slow-release nitrogen sources with a high water insoluble nitrogen ratio are used, N rates can be as high as 2 lb. N/1000 sq. ft. per application on Kentucky bluegrass.

Certain types of weather will favor nitrogen leaching. For instance, cool rainy weather favors the movement of nitrogen beyond the root zone into the groundwater. Increased leaching potential occurs because cool temperatures decrease denitrification, volatilization, microbial activity and plant nutrient uptake. Thus, application of high rates of nitrogen on sandy sites during the late fall, winter or early spring can lead to nitrate movement into the groundwater.

Irrigation practices that result in water movement below the root system will increase potential nitrogen and pesticide leaching. Irrigation on a daily basis during cool months will increase leaching losses. On the other hand, infrequent deep irrigation to well below the root system will more than likely move nutrients with the water. Irrigation should only be provided to replace what water has been removed by plant uptake and evaporation.

—*Source: NYSTA Spring 1990 Bulletin 138*