SECTION IV

WATER QUALITY ASSESSMENT

A. Natural Groundwater Quality Factors

Data regarding natural water quality were obtained primarily from discussion with the Bucks County Health Department (BCHD) which reviews public water supply wells within the Pennridge Study Area. Prior to permitting a community water supply well, a comprehensive list of chemical parameters is tested to ensure adequate drinking water quality. A secondary source of information is the experience of project hydrogeologist, Phillip Getty, having worked 20 years in the area on groundwater and soil contamination cleanup projects.

Most of the natural contaminants affecting groundwater quality are nuisance pollutants. They are generally not a health problem but can affect the esthetic aspects of water use.

The most common natural water quality problem in the area is “hard water.” Minerals that are dispersed or interwoven as veins within the rocks dissolve to produce mineral-laden groundwater, referred to as “hard water.” Hard water consists primarily of calcium carbonate. It is common throughout the area but is usually not removed from community water supplies during treatment. Thus, individual homeowners and businesses perform the removal of hardness (calcium carbonate) by the installation and operation of a water softener. Water softeners reduce hardness so that they may improve the cleaning power of soap and alleviate the potential for pipes becoming clogged with minerals.

Manganese, found as a dissolved metal in some groundwater wells, has been known to exist within the groundwater in the study area. Manganese can cause a black stain and is generally not a health concern. Similarly, sulfate minerals can be found in some wells at levels that may impart a sulfur odor. In some instances, the sulfur odor is formed from the growth of iron bacteria that can be present in wells.

The majority of minerals found in the Pennridge Area tend to be most commonly found in aquifers having low permeability and/or deeper confined aquifers. In both situations, flushing of the aquifer with relatively clean natural precipitation waters does not readily occur, allowing the minerals to accumulate.

One toxic metal, arsenic, is found in some of the wells in the Pennridge Area. Currently, the arsenic cleanup limit is 50 parts per billion (ppb) or micrograms per liter. There are considerations being made by the U.S. EPA to reduce the safe drinking water limit to somewhere between 3 and 20 ppb. Under this potential scenario, a number of public wells have been found to be at risk in the Pennridge Area. The wells are predominantly located along the north edge of the study area. The arsenic may be associated with the hornfels rock aquifers that border the south edge of the diabase bedrock. The arsenic is most likely from a natural source. At-risk wells were found in Sellersville Borough, Perkasie Borough, and Hilltown Township (near Perkasie).

B. Anthropogenic Groundwater Quality Issues

1. Organic

Anthropogenic, i.e., man-made, organic water quality issues generally involve petroleum-derived substances such as gasoline, oil, solvents, and pesticides.

The most widespread contamination has resulted from the organic solvent trichloroethylene (TCE). It has contaminated groundwater in the industrialized portions of the study area such as Dublin, Sellersville, and Perkasie boroughs. Contamination in most cases resulted from improper storage and handling of the solvent from 1945 to 1980. Air stripping towers are being used to cost- effectively remove the contamination. The extent of contamination does not appear to be expanding because of better control of the substance that prevents its escape into the groundwater.

Sporadic, smaller scale contamination has occurred from leaking underground fuel storage tanks. Leaking and/or spilled gasoline has been the most pervasive problem, occurring at a few locations around the study area. Most such problems have been controlled by the removal of the older tanks and replacement with newer leak detecting and/or double walled tanks. One recent problem that has been noticed is the presence of methyl tertiary butyl ether (MTBE), an antiknock agent in gasoline. MTBE is difficult to remove from drinking water and may be released into the environment from motor vehicles, lawn mowers, and service station spills, as well as storage tank leaks. MTBE was recently discovered in wells near the gasoline station at the corner of Routes 313 and 113 in Bedminster and Hilltown Townships.

Above-ground and underground fuel oil tanks, used for private home heating, as well as small private underground gasoline tanks, are dispersed through the Pennridge Area. Leaks and spills from these tanks are common. Usually the extent of contamination is localized but can result in adverse conditions and expensive cleanup. Over time, most of the underground tanks are being replaced with above-ground tanks.

Old farm dumps, scattered through the area, may be a source for localized contamination of the groundwater via improper disposal of partially full pesticide containers. Generally, surface application of pesticides to crops has not affected the groundwater although there are some studies that suggest that massive application of herbicides for no-till farming may enter the groundwater system.

There had also been a localized contamination problem at the former Blooming Glen Landfill or Horn Quarry, located within the central portion of Hilltown Township. The contamination appears to be leachate that emanates from the landfill waste. Typically, private wells that become contaminated will be connected to a public water supply to protect public health.

2. Nitrate

Nitrate is the natural end product from the breakdown of plant matter. It is water soluble and easily assimilated by plants as they grow. Most naturally occurring nitrate either is reabsorbed by growing plants or dissipates into the air. Nitrate is a naturally occurring compound, commonly found in groundwater at levels of less than one part per million (ppm).

Unnatural accumulations of plant material occur in the form of manure. Fertilizers are concentrated forms of nitrate. High concentrations of nitrate are not easily filtered by the soil and will thus enter the groundwater. Excessive nitrate levels in the groundwater may cause health problems if nitrate exceeds the safe drinking water limit of 10.0 ppm.

The breakdown of nitrogen-rich plant materials in sewage results in a nitrate-rich effluent. Thus, all sewage effluent, whether treated in a community treatment plant or an on-site house septic system, contains high levels of nitrate. It is possible to remove some of the nitrogen by denitrification, although this process is expensive and not typically performed on smaller sewage systems. Spraying the treated effluent onto fields and removing the plants that have absorbed the nitrate into their leaves and stems can also remove nitrate. This can cause a problem wherever the plant material is taken to a central site, such as a cattle yard, where concentrated animal wastes from the plants can contaminate the groundwater. Farm barnyards and areas where large amounts of manure and fertilizer have been applied are also prone to nitrate groundwater contamination problems.

Most of the nitrate that enters the groundwater from on-site septic disposal systems dissipates through dilution as the nitrate mixes with natural precipitation waters that enter the aquifer. A concern rises when housing developments that use individual or community on-site sewage systems create a density of treated sewage effluent that may overload the dilution effect of groundwater recharge. Analyses of nitrate buildup are sometimes required by the DEP for permitting of septic systems. Usually, these studies are requested for community systems or large, high-density housing developments.

Another form of nitrate pollution that is not readily identifiable is through the common use of lawn fertilizers. The practice of fertilizing lawns is contributing to nitrate loading of the groundwater. Usually the effect of lawn fertilizers is not considered when estimating the nitrate loading of groundwater by on-site sewage systems.

Vegetated stream (riparian) buffer zones have been shown to absorb nitrate-laden groundwater before it enters the stream through baseflow. This may help to reduce the adverse effects of nitrate that may occur during low streamflows when the nitrate may contribute to the eutrophication process as aquatic plants overproduce and rob the water of oxygen as they decay. Vegetated stream buffers are also beneficial to physically filter and absorb nitrate and phosphate fertilizers as they flow off farm fields.

Currently, there are no reports of nitrate groundwater problems in the Pennridge Area. However, it should be noted that testing for nitrate is not usually performed on a well after a home is constructed.

C. Indirect Effect Of Groundwater Baseflow On Surface Water Quality

Water temperature is an important parameter that influences the health of a stream. Cold water fisheries are generally considered higher quality waterways than warm water fisheries. This is often because cooler water temperatures allow more oxygen to be held in the water than warm water. The cooler the water, the more oxygen that can be dissolved for use by fish and macroinvertebrate life and thus the healthier the conditions for aquatic life.

Groundwater in the Pennridge Area is generally at a constant temperature of 55 degrees Fahrenheit. Thus, groundwater baseflow into any stream in the area is usually 55 degrees. What creates a warm water stream is a low stream baseflow input relative to a stream's surface area and the amount of stream surface exposed to sunlight. A wide shallow stream flowing through a grassed cattle pasture is much more likely to be warmer than a narrow fast moving stream within a woodland.

In addition to the temperature effect that stream baseflow has on oxygen levels, baseflow also helps to dilute pollutants. Again, a good stream baseflow rate will flush and dilute natural and man-made pollutants from a stream to improve water quality. An example is a farm pond that has very little inflow of spring water. Manure from cattle or geese that enter the pond remain to cause vegetation blooms that can diminish oxygen and reduce the quality of aquatic life.

Overall, stream baseflow is the primary factor determining the quality of life in a stream. This effect becomes most critical during droughts when surface water runoff is minimal and stream baseflows diminish. Reduction or removal of stream baseflow during droughts can cause the death of high quality aquatic life leaving poor quality life such as mosquitoes, gnats, and flies to thrive. Thus, stream baseflow should be considered a fundamental surface water quality parameter to protect.

National Pollution Discharge Elimination System (NPDES) permits that regulate discharge of treated wastewater into streams commonly use the "Q 7-10" stream low flow as their lower limit to regulate the input of residual wastes present in the wastewater. The Q 7-10 is defined as the lowest flow that occurs in a stream over seven consecutive days within a ten-year study period. The use of this value for defining a low flow to protect a stream is not based on aquatic life data. While Q 7-10 flows are statistically low flows, they should not be considered to have the full support from an aquatic biologist's perspective.

During droughts, any reduction in natural baseflow will have an effect on stream life. Models are available to estimate the degree of effect that will occur to aquatic life. These aquatic models more appropriately describe the changes a proposed reduction in a stream's total flow will have on aquatic life than a generalized approach such as the NPDES/Q 7-10 method.