The following is a primer in the toxicity (poison) of landfills. The toxic leachate when entered into water supplies can be fatal to human beings wildlife.

Municipal Landfills as Toxic as Hazardous Waste Dumps

A study done in 1991, entitled "Acute and Genetic Toxicity of Municipal landfill Leachate", concludes that municipal solid waste landfills are as toxic or more toxic than hazardous waste facilities. Professors Brown, Schrab, and Donnelly of Texas A&M Univesity. Their report No. 153 to the Texas Water Resources Institute concludes in the abstract that, "All four leachate samples exhibited acute toxicity in the Microtox test. Leachate from landfills representative of both an old unlined landfill and a new operating landfill receiving waste contained concentrations of some priority pollutants in excess of promulgated standards for drinking water. *Chemical based risk assessments for these same two leachates showed them to have mean and 98th percentile cancer risks of 1 in a thousand(10 3) which is greater that both leachate from a Superfund landfill and leachate from the Love Canal landfill.*

Chapter 2
The Decomposition of Waste:
Understanding Biological and Chemical Processes in Landfills

The decomposition of waste in landfills is a complex and highly variable process. Since the principal products of waste decomposition --leachate and methane gas -- may be problematic for surrounding communities, an elementary understanding of the degradation process is advantageous to citizens who are participating in local municipal landfill debates. The following section provides a brief description of how waste decomposes in landfills.

Once waste is deposited in a landfill, biological and chemical processes act to change its structure and characteristics. This process of waste decomposition or biodegradation is a natural and inevitable process; waste that is in contact with oxygen and moisture will eventually break down into simpler components. The time frame for waste composition varies greatly depending upon the nature of the waste (its physical and chemical composition) as well as the conditions present in the landfill.

The process of waste degradation produces byproducts that, if not properly controlled, can endanger the health of humans and the environment. Naturally occurring microorganisms such as bacteria biologically break down some waste components,

emitting methane, other gases and chemical byproducts in the process. As precipitation falls upon and percolates through the landfill, the flowing water dissolves some materials and picks up a variety of chemicals. Moving toward the bottom or sides of the landfill, this liquid mixture is called " leachate."

GLOSSARY OF TERMS

Table 3.1 Terms That Define The Health Effects of Chemicals	
Toxic	Upon exposure, toxic chemicals produce detrimental effects in living organisms. There are four categories of toxicity.
Acute Toxicity	An immediate effect from a short term exposure to a chemical substance. Some of these effects include injury to the lungs, liver, kidneys or immune system, and neurological damage.
Subchronic Toxicity:	An effect produced by a prolonged and continuing exposure to a chemical substance. The effects are the same as those incurred from exposure to acutely toxic chemicals.
Chronic Toxity	An effect produced by a prolonged and continuing exposure to a chemical substance. Such effects include delayed toxic reactions, progressive degeneration, tissue damage, reproductive toxicity and cancer.
Environmental Toxicity	A toxic effect on fish, birds or other non-human organisms.
Carcinogenic:	Upon exposure, carcinogenic chemicals can cause uncontrolled cell growth, producing tumors, leukemias and other forms of cancer. An initial exposure to the carcinogenic chemicals may slightly alter the genetic structure of a cell yet begin the sequence of events leading to cancer. Many experts believe there is no threshold or safe level of exposure to a carcenogen. Since the length of time between exposure to a carcinogenic chemical and the diagnosis of cancer in humans may be 20-40 years, it may be impossible to link the cancer to a specific chemical.
Mutagenic:	Upon exposure, mutagens can permanently change an organism's genetic material, DNA. If reproductive organs are exposed, the damaged genes may then be passed on to the person's offspring.
Teratogenic:	Upon exposure to the mother, teratogrens can cause nonhereditary birth defects in the unborn fetus.

SOURCES: *Environmental Politics and Policy, 3rd Edition* (Rosenbaum, Walter A., Congressional Quarterly 1995.)

Chapter 3
Leachate

Leachate forms when liquid originating from rain, melted snow, or waste itself percolate through landfill cells and moves to the bottom or sides of a landfill. Flowing through the wasteleachate transports a wide variety of chemicals to the extremities of a landfill.

The quantity of leachate produced by a landfill is highly correlated with the amount of precipitation around the landfill. In areas with high precipitation rates the production of leachate can be greater than in drier areas since much of the precipitation percolating through the landfill becomes leachate. The amount of liquid in landfilled waste also affects the amount of leachate the landfill generates.

There is also a correlation between landfill size and amount of leachate produced – large landfills generate greater volumes of leachate than small landfills. According to EPA estimates a 100-acre landfill in the northeastern United States can produce 57 million gallons of leachate every year. The largest landfill in the world – Fresh Kills, in Staten Island, NU – is over 2965 acres, and produces 4 million gallons of leachate per day, or 1.5 billons gallons per year.

Materials in landfills were combined to characterize landfill leachate. The studies reported finding 82 chemicals in landfi11 1eachate, including 63 types of organic chemicals.

In the 70 landfill studies, concentrations of VOCs in leachate varied widely, but the researchers were able to calculate a median concentration for each chemical by averaging all of the data. Of the 14 chemicals whose median concentrations exceeded federal drinking water standards, 12 are known or probable carcinogens, and 2 are considered toxic to humans (See Table 3.2 for a list of common VOCs and their health effects). Median values for some of the carcinogenic chemicals were so high that those leachate samples would have to be diluted over 1000 times to reach an “acceptable” level.

Other studies have also found instances where municipal landfills contaminated groundwater with volatile organics. In a Wisconsin Department of Natural Resources study, leachate- contaminated groundwater samples were taken from 19 of the state's municipal landfills and tested for VOCs. Even in the diluted samples, 9 VOCs frequently exceeded Wisconsin's groundwater quality standards. The VOCs most commonly found in the study(benzene, tetrachloroethylene, trichloroethylene and vinyl chloride) were also the most toxic.

The findings of the Wisconsin study are confirmed by a study of Florida's municipal landfills. There, researchers found that various VOCs, especially forms of benzenes and xylenes, contaminated the groundwater near landfills. In 100 percent of the samples, benzene exceeded federal drinking water standards.

VOCs are particularly problematic when they reach groundwater supplies because they are highly mobile and can travel with groundwater far beyond the borders of an landfill. For example, the Florida study found that some chlorinated benzenes had migrated with

the groundwater 800 meters (872 yards) away from the landfill without being naturally degraded. This is especially significant in states where groundwater provides much of the population with its drinking water; in Florida, 90 percent of the people rely on groundwater for household consumption.

Table 3.2 Health Effects of Selected Volatile Organic Chemicals Found in Landfill Leachate	
Benzene	Human carcinogen, mutagen, and possible teratogen; central nervous system (CNS) peripheral nervous system, immunological and gastrointestinal effects; blood cell disorders; allergic sensitization; eye and skin irritation
Chloroform	Probable human carcinogen and possible teratogen; CNS and gastrointestinal effects; kidney and liver damage; embroyotoxic; eye and skin irritation
1, 1-dichlorethane	Embryotoxic; CNS effects; kidney and liver damage
Ethylbenzene	CNS effects; kidney and liver damage; upper respiratory system, eye and skin irritation
Methylene Chloride	Possible carcinogen; CNS, lung/respiratory system, and cardiovascular effects; blood disorders; eye and skin irritation
Tetrachloroethylene	Probable carcinogen; CNS and lung/respiratory effects; embroyotoxic; kidney and liver damage; upper respiratory tract and eye irritation
Touluene	Possible mutagen and carcinogen; CNS and cardiovascular effects; kidney and liver damage; upper respiratory tract, eye and skin irritation; and allergic sensitization
Trichloroethylene	Possible carcinogen and teratogen; CNS, kidney, liver, cardiovascular system, and lung/respiratory system effects; blood cell disorders; skin, eye, and upper respiratory irritation
1, 1, 1-trichloroethylene	Carcinogenic, mutagenic; CHS and lung/respiratory effects; kidney and liver damage; eye and skin irritation
Vinyl Chloride	Carcinogenic, mutagenic; possible teratogen; CNS effects; kidney and liver damage; blood

Metals occur naturally in the environment. Along with nutrients, minerals, and salts, meals are termed “inorganic” chemicals since they are not based on carbon and hydrogen structures. Metals are used in many industrial and manufacturing processes, such as the making of alloys and metal products; in electroplating; and in products like paint, glass, plastic, and pesticides. Common items made of metal include cars, appliances, aluminum foil and other household goods. Most metals are not carcinogenic when consumed in drinking water, but they produce other serious toxic effects.

When deposited into the ground, metal particles frequently find to the soil and do not easily dissolve or migrate with water. In the acidic conditions of a landfill, however, metals such as cadmium, copper, iron, manganese, and lead can dissolve and migrate

with leachate. Other chemical reactions in a landfill can also change the state of metals, allowing them to attach to other particles and travel with leachate.

In 1988 U.S. EPA study that consolidated leachate data from 70 municipal landfills calculated median values for metals in the samples. Several metals that cause a variety of healthy effects exceeded drinking water standards, including antimony, beryllium, cadmium, lead, mercury, nickel and thallium. Table 3.3 presents the health effects of some of the metals found in the survey, and of other metals found in landfill leachate.

Table 3.3 Health Effects of Selected Metals Found in Landfill Leachate	
Arsenic	Carcinogenic; potential teratogen; cardiovascular, peripheral nervous system, reproductive and lung/respiratory effects; liver and skin damage
Cadmium	Probable carcinogen and teratogen; embryotoxic; CNS, reproductive and lung/respiratory effects; kidney damage
Chromium	Carcinogenic, probable mutagen, lung/respiratory effects, allergic sensitization, eye irritation
Lead	Probable teratogen, kidney and brain damage, CNS and reproductive effects, blood cell disorders
Mercury	Teratogenic (organic mercury substances), CNS, cardiovascular and lung/respiratory effects; kidney and visual damage
Nickel	Probable carcinogen, possible teratogen, lung/respiratory effects, allergic sensitization, eye and skin irritation, liver and kidney damage.

Source: New Jersey Fact Sheets (from Right-to-Know Network)

Numerous other landfill studies have found meals in migrating leachate. For example, a 1988 study on four municipal landfills in southern Ontario, Canada that examined leachate for inorganics discovered that concentrations of cadmium exceeded Ontario's drinking water standard of 0.005 milligrams per liter (mg/l). Cadmium is acutely toxic to animals, indicating the potential health risks posed by leachate contamination in groundwater supplies.

General Water Quality Parameters

A set of general water quality parameters can be used to roughly determine if leachate has contaminated ground water. Parameters such as pH, total dissolved solids, and conductivity reveal high or low amounts of acids, dissolved materials, and charged ions, respectively, which may indicate contamination. Increased levels of these parameters occurring in the ground water near a landfill than in neighboring areas may signify leachate migration.

Other Chemicals Found in Leachate

Leachate and groundwater samples taken near landfills are frequently tested for volatile organic compounds, metals and general water quality parameters. Other chemicals in landfills such as synthetic organic compounds (SOCs), however, may also pose threats to human and environmental health.

SOCs are human-made chemicals based on a carbon and hydrogen structure that, unlike VOCs, do not volatilize in the air. These chemicals are common in agricultural applications such as pesticides, herbicides and fungicides. Many SOCs are probable or known carcinogens, and some cause toxic effects to the liver, lungs and kidneys, central nervous systems or reproductive system. Drinking water standards have been created for only a small number of SOCs, including 2, 4-D, endrin, lindane, pertachlorophenol and toxaphene. Table 3.4 summarizes the health effects of some common SOCs.

Table 3.4 Health Effects of Selected Synthetic Organic Chemicals Found in Landfill Leachate

2,4-D	Mutagenic; possible carcinogen and teratogen; reproductive, nerve, liver and kidney damage; lung/respiratory effects; skin and eye irritation
Lindane	Reproductive, nerve and liver damage; possible carcinogen
Pentachlorophenol	Possible mutagen and teratogen; eye, skin and lung/respiratory irritation; liver and kidney damage

Source: *New Jersey Fact Sheets* (from Right-to-Know Network)

In the 1988 EPA consolidation of leachate data from 70 municipal landfills, some studies analyzed five synthetic organics. In these studies, researchers found that the average concentrations of two SOCs, pentachlorophenol and 2,4-D, exceeded federal drinking water standards. The studies also indicated that SOCs may be found most often in landfill leachate originating from agricultural areas, since these landfills are likely to contain equipment coated with pesticide resdues or the empty containers of SOC-containing agricultural chemicals.

Alcohols are other contaminants found in landfill leachate. Some alcohols, including methanol and ethanol, are produced by biological activities in the landfill. Others, such as butanol, ethanol, propanol, and phenols, are found in industrial solvents and household products. Through they are usually volatile organic compounds, alcohols are not often listed with the other VOCs because different laboratory tests are used to determine their presence and concentration.

One study of leachate from two municipal landfills concluded that alcohols posed a greater health risk than any other leachate chemicals. The health effects associated with some of the alcohols found in landfill leachate are presented in Table 3.5.

Table 3.5 Health Effects of Selected Alcohols Found in Landfill Leachate

Ethanol	Mutagenic, carcinogenic, causes birth defects

1-propanol/prophl	Possible carcinogen
2-propanol/ isopropyl alcohol	Possible carcinogen; eye, skin and upper respiratory irritation; possible CNS effects
4-nitrophenol	Possible mutagen and carcinogen, blood cell disorders, skin and upper respiratory irritation, CNS effects

SOURCE: Brown, K.W., and K.C. Donnelly. "An Estimation of the Risk Associated with the Organic Constituents of Hazardous and Municipal Waste Landfill Leachates" *Hazardous Waste and Hazardous Materials* 1988 v. 5, n. 1

Leachate and Groundwater

Though new landfills must be build with liners that act as temporary barriers to leachate migration, the vast majority of landfills built before 1993 do not have such liners. In such unlined landfills, or in landfills with leaking liners, gravity causes leachate to move through the landfill, out the bottom and sides, and through the underlying soil until it reaches the groundwater zone or aquifer (Figure 3.3). There, the leachate mixes with and travls with the groundwater along its underground path.

An aquifer is a zone of underground soil or rock that is saturated with groundwater. Within the aquifer, groundwater fills the spaces or pores between the soil and rock particles (Figure 3.4), flows slowly down a gradient that is determined by underground geology, and eventually resurfaces into a lake, stream, wetland or coastal water.

THE TWO PROPOSED LANDFILLS IN KANKAKEE COUNTY ARE IN THE WORST POSSIBLE LOCATION. THEY WILL EVENTUALLY PERCOLATE TOXIC CHEMICALS INTO OUR WATER SUPPLY AND PERMANENTLY CONTAMINATE IT. BUT YOUR ELECTED COUNTY AND CITY OFFICIALS HAVE SOLD OUT THE FUTURE HEALTH AND WELFARE OF OUR COUNTY FOR A FEW UP FRONT BUCKS. REMEMBER THEIR ACTIONS AT THE NEXT ELELCTION.