

Toxic Fairways

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Toxic Fairways: Risking Groundwater Contamination From Pesticides on Long Island Golf Courses

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Original Printing: July 1991
Revised: Feb. 1994, Dec. 1995

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Toxic Fairways:

Risking Groundwater Contamination From Pesticides on Long Island Golf Courses

This report examines the extent of pesticide use on Long Island golf courses and the potential for groundwater contamination and the resulting environmental harm and health risks. It includes findings from the first comprehensive survey of actual pesticide use on golf courses on Long Island. Before explaining why Long Island was chosen as the focus for this study, it is important to understand how pesticides are

used on golf courses and what dangers such use poses.

Introduction

In recent years, many Americans have asked questions about the safety of pesticides not only in our foods, but also in and around our homes and workplaces. Although pesticides permeate our everyday lives, we don't know enough about the dangers of pesticide exposure. The U. S. Environmental Protection Agency (EPA), which regulates pesticides, is currently reviewing the data on the health and environmental effects of some pesticides to decide whether these products should be continued to be used. In the meantime, thousands of pesticides still under review are freely marketed--unless the EPA decides to restrict or eliminate their use. So far, only one of the 34 most commonly used pesticides for turf and lawn care has completed this review.

The bottom line is that consumers do not know all the questions associated with pesticide use. Most important, no one has all the answers--not the manufacturers, not the EPA.

In fact, when the EPA permits a pesticide to be sold in the United States, the Agency does not decide that the product poses no environmental or health threats. The federal pesticide law, known as the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) which gives the EPA authority over pesticides, requires the EPA only to decide that the pesticide poses "no *unreasonable* risk" (emphasis added) to public health or the environment, based on its perceived economic, social and environmental costs and benefits. Before the EPA may register a pesticide and allow it onto the market, the agency must first determine that the risks are worth the benefits. But as more and more is learned about the extent of these risks--including the groundwater threat--this balancing act may tilt in the opposite direction, against the use of certain pesticides.

Unfortunately, it may be quite a while before the EPA restricts or bans certain pesticides that do pose an "unreasonable" risk. The EPA is requiring pesticide companies to supply additional data on potential risks of their products. The Agency will review the adequacy of this data as part of the pesticide re-registration process and this will most likely continue into the next century. An example of the new data requirement came in response to a 1987 petition submitted jointly by several environmental groups, the New York State Attorney General's Office and others, requesting EPA to perform tests for the neurotoxic effects (effects on the nervous system) of some pesticides. The EPA is now planning to require that pesticide manufacturers conduct such tests but it may be years before the public knows the full neurotoxic potential of pesticides now in use.

Several pesticides on the market have been identified as probable human carcinogens and some have been linked to birth defects, nervous system disorders and reproductive problems. In addition, as this report will discuss, pesticide use has the potential to threaten wildlife and contaminate natural resources. People can be exposed to pesticides in the water they drink, or through direct skin contact, inhalation or in the food they consume.

Although the risks of using pesticides to grow food crops may be worthwhile to ensure a continuing food supply, most people would agree that the benefits of pesticides used merely to produce green lawns and turf are far less. Despite the relatively limited benefits of turf and lawn care pesticides, three to six times as much pesticides are used per acre on home lawns than to grow the food we eat.⁽¹⁾As shown later in this report, golf courses on Long Island use almost four to seven times the average amount of pesticides used in agriculture, on a pound per acre basis.

In order to maintain the greens and fairways, many golf course managers apply huge amounts of pesticides following a pre-determined "recipe" of repeated applications, rather than customized treatments addressing actual problems. Many pesticides are used preventively, not in response to specific problems. Ironically, this can eventually turn into a pesticide addiction, which may require increasing amounts or different types of pesticides to produce the same results. Increased application rates further contribute to the potential threats to public health and the environment.

Who can be exposed to pesticides used on golf courses? Anyone on the golf course or nearby is at risk. Pesticide applicators, either professional contractors or golf course workers, can be exposed to these poisons during storage, mixing and application. Golfers, often playing shortly after pesticides have been applied, can be exposed directly to the pesticides on the turf, as well as to pesticide vapors and mists. People living near a golf course may be affected by sprays and dusts blown from the golf course onto their property and into their homes. Finally, pesticides applied to the turf may run off into surface waters or leach down to groundwater, which can then expose people to contaminated drinking water. These people may live far from the place where pesticides were used.

Unfortunately, neither the state or federal government require advance notification to the public of all pesticide applications, so that people can be exposed to pesticides without their knowledge.

In 1979, high levels of the pesticide aldicarb (Temik) were found in public and private drinking water wells in Suffolk County. The manufacturer provided wellhead treatment to remove the pollution. After a persistent degradation product of an herbicide called Dacthal

(chlorthaldimethyl) or DCPA) was recently applied on Long Island, the chemical was detected in drinking water wells at levels 20 times above the State safe drinking water standards. In addition to Dacthal and Temik contamination, by 1988, 9 other pesticides or their degradation products had been detected in Long Island's groundwater. Two of these pesticides (chlorothalonil and Dacthal) are frequently used in turf care. Another 13 have been detected intermittently and more testing is necessary to verify their continuing presence in groundwater.⁽²⁾ Temik can no longer be used in Suffolk County. In 1988, one Dacthal manufacturer (ISK Biotech) voluntarily restricted its Dacthal products from use in Suffolk County; however, other companies have not. This restriction should be extended to all products containing Dacthal.

WHY LONG ISLAND?

The Attorney General's office decided to examine pesticide use on Long Island golf courses because pesticides pose special risks on the Island. Long Island's nearly three million people depend on groundwater as their only source of drinking water. This irreplaceable resource is vulnerable to contamination by surface-applied pesticides. Large areas of the island's groundwater lie beneath a sandy, porous surface soil layer with little organic matter to adsorb pesticides. This type of soil provides little if any barrier against contaminants reaching the groundwater.

Currently, groundwater monitoring for pesticides in Suffolk County is limited primarily to those pesticides used in agriculture. In Nassau County however, which has very little agricultural acreage, there is no comparable monitoring program for agricultural pesticides. All public drinking water supplies in New York State (including those in Long Island) must be tested regularly for the pesticides endrin, lindane, toxaphene, 2,4,5-TP, 2,4-D and methoxychlor. In Nassau and Suffolk counties, public drinking water supplies are also routinely tested for aldrin, dieldrin, DDT, chlordane, heptachlor, and heptachlor epoxide. In addition, Suffolk tests regularly for alachlor, aldicarb and several other related pesticides, EDB, endosulfan and 1,2-dichloropropane. Most of these pesticides are either no longer in use or have severely restricted uses. Apart from 2,4-D, they are not used in turf care. The EPA has recently conducted a "National Survey of Agricultural Pesticides in Groundwater" but only eight water samples were taken from Nassau County and none from Suffolk. Two of the eight samples contained residues of chlorthaldimethyl (Dacthal).

However, there is no comprehensive and targeted program for monitoring Long Island's groundwater for the vast majority of turf care pesticides used on Long Island. As a result, there is no way to determine whether contamination may have reached the aquifer in some locations.

This survey provides the first report on the extent of pesticide use in one specific area, golf courses, and also offers the first estimates of the potential for harm to the groundwater from golf course pesticides. No conclusions are drawn concerning any *present* danger to consumers of the groundwater. There is no reason to believe that any water now supplied to Long Island exceeds safe drinking water guidelines for any pesticides. The purpose here is to show the potential for damage to the groundwater resource due to long-term use of pesticides in sensitive areas, which may at some time affect the drinking water of Long Island's nearly three million people.

Although Long Island's geology and the dependence of such a large population on a single source of drinking water is unusual, groundwater quality in other areas of the state may also be jeopardized by pesticide use. Thus, the concerns raised in this report could apply to several other parts of the state where turf care pesticides are heavily used over aquifers.

Survey Methods

The Attorney General's survey of pesticides used on Long Island golf courses provides the basis for an initial evaluation of potential impacts on groundwater. In 1990, the Attorney General's office surveyed 107 private and public golf courses in Nassau and Suffolk counties (as listed in the *Glasheen 1989 Golf Course Guide for the New York City Area*) to determine the identity, amounts and patterns of use of pesticides on golf courses. After the initial mailing, follow-up mail and telephone inquiries were made to increase responses. A total of 58 surveys were returned but six responses were incomplete and unusable. (Table 1 on the next page provides a list of the 52 golf courses providing usable responses.)

TABLE 1:

TOTAL PESTICIDE USAGE BY 52 LONG ISLAND GOLF COURSES

(1989 unless indicated)

| PRIVATE GOLF COURSES | | | | PUBLIC GOLF COURSES | | | |
|----------------------|-------------|-------|--------|---------------------|-------------|-------|--------|
| MAP | GOLF COURSE | TOTAL | POUNDS | MAP | GOLF COURSE | TOTAL | POUNDS |

| NO.* | | ACRES | APPLIED | NO.* | | ACRES | APPLIED |
|------|-------------------------------------|-------|---------|--------------------|----------------------------------|-------|---------|
| 15 | Nassau Golf Course | 180 | 2386 | 30 | Eisenhower Park | 300 | 1492 |
| 25 | Woodcrest Club | 122 | 2333 | 29 | Bethpage | 875 | 1480 |
| 21 | Mill River CLub | 125 | 2299 | 64 | Hauppague Country Club | 135 | 1341 |
| 24 | Tam O'Shanter Golf Course | 169 | 2081 | 104 | Montauk Downs Golf Course (1988) | 254 | 989 |
| 88 | National Golf Links | 165 | 2070 | 46 | Jones Beach | 130 | 574 |
| 48 | Huntington Country Club | 90 | 2064 | 44 | Lido Golf Course | 144 | 490 |
| 53 | Southward Ho Country Club | 151 | 1983 | 83 | Indian Island | 157 | 472 |
| 4 | North Hills Country Club (1988) | 148 | 1721 | 62 | Brentwood Country Club | 110 | 385 |
| 6 | IBM Country Club** | 210 | 1707 | 56 | Crab Meadow Country Club | 79 | 377 |
| 20 | Old Westbury Golf&Country Club | 198 | 1696 | 13 | Glen Cove Golf Course | 122 | 345 |
| 49 | Cold Springs Country Club | 135 | 1647 | 78 | Swan Lake Country Club | 144 | 293 |
| 11 | Engineers Country Club | 122 | 1614 | 61 | Hamlet Golf&Country Club | 180 | 268 |
| 23 | Muttontown Golf&Country Club | 140 | 1611 | 67 Timber Point | 239 | 192 | |
| 40 | Rockaway Hunting | 200 | 1587 | 82 | Sandy Pond | 75 | 177 |
| 22 | Pine Hollow Country Club | 160 | 1525 | 47 | Peninsula Golf Course (1990) | 50 | 172 |
| 36 | Inwood Country Club | 164 | 1446 | 63 | Robert Moses | 18 | 169 |
| 8 | North Hempstead Country Club (1990) | 110 | 1403 | 93 | Poxaboque Golf Course | 82 | 131 |
| 34 | Hempstead Golf Course | 120 | 1381 | 69 | West Sayville | 250 | 95 |
| 18 | Brookville Country Club | 116 | 1326 | 45 | Merrick Rd. Park | 61 | 88 |
| 71 | St. George's Golf&Country Club | 100 | 1176 | 51 | Bergen Point | 240 | 53 |
| 38 | Lawrence Village Golf Course | 120 | 1119 | 98 | Cedars Golf Club (1990) | 27 | 15 |
| 100 | Gardiners Bay Country Club | 118 | 1028 | 94 | Sag Harbor Golf Course | 68 | 0 |
| 1 | Lake Success | 120 | 857 | | | | |
| 43 | Middle Bay Country Club | 120 | 792 | | | | |
| 17 | Cedarbrook Country Club (1990) | 120 | 474 | | | | |
| 90 | Southampton Golf Course | 130 | 404 | | | | |

| | | | |
|-----|-------------------------------|-----|-----|
| 105 | Blue Ridge Golf Course | 32 | 297 |
| 86 | Westhampton Country Club | 120 | 212 |
| 102 | Hay Harbor Golf Course (1990) | 45 | 102 |
| 87 | Quogue Field Club | 82 | 93 |

* Corresponds to location shown on map, page 11.

** IBM Country Club reported treating 210 acres of which 60 comprised its golf course.

The Attorney General's office determined the identities and concentrations of "active" ingredients in each of the products used. The "active" ingredients are the chemicals in the product intended to kill pests. Pesticide manufacturers must identify the chemicals used as active ingredients on the product label, as well as their concentration. Since other ingredients, known as "inert" ingredients, are generally not identified, our calculations of pesticide use refer only to the active ingredient portion of the pesticides applied to the golf courses. "Inert" components are not necessarily non-toxic, nor can they be assumed to pose no threat to groundwater quality. Because their identity is treated as confidential business information by the EPA, their potential to contaminate groundwater cannot be evaluated.

Summary of Survey Results

The 52 golf courses reported using a total of approximately 200,000 pounds of bulk dry products and close to 9,000 gallons of bulk liquid formulations in one year. This included 192 different pesticide products containing 50 different active ingredients which totalled more than 50,000 pounds. (Table 2 on the next page provides the names and amounts of the active ingredients reported.)

If these 50,000 pounds were applied evenly across the total area of the 52 golf courses, it would amount to an average of 7 pounds of pesticides per acre annually. By comparison, a national average of 1.5 pounds of pesticides per acre are applied in agriculture annually.^{<(3)} The actual rate of golf course pesticide use may be much higher than seven pounds per acre, since the playing surfaces that are treated make up only a portion of the golf courses' total acreage. A comparison of pesticide usage in agriculture and golf course maintenance which is based on the acreage actually treated with pesticides is even more alarming. Based on responses to our survey, pesticides were applied to only about 50 percent of the total acreage of Long Island golf courses. By contrast, pesticides are applied to about 62 percent of all agricultural land. Using these figures, the average golf course application rate increases to 18 pounds of pesticides per treated acre per year, about seven times the agricultural rate of 2.7 pounds per treated acre per year.^{<(4)} Thus, between four and seven times as much pesticides are used on Long Island golf courses than are applied on food crops. (On the average, public golf courses used far less pesticides than private golf courses and fungicidal pesticides were far more heavily used than either herbicides or insecticides.)

By comparison, when homeowners follow the directions for various annual do-it-yourself lawn care programs, they may apply from 3.2 to 9.8 pounds of pesticide per acre annually. Thus, homeowners may apply up to 3.6 times as much pesticides as is typically used in agriculture. Even at that level, they apply less pesticides than golf courses.

TABLE 2:

PESTICIDES USED BY 52 LONG ISLAND GOLF COURSES

| ACTIVE INGREDIENTS | TRADE NAMES | # OF USERS | PESTICIDES APPLIED (LBS.) |
|--------------------|----------------------------|------------|---------------------------|
| FUNGICIDES | | | |
| chlorothalonil | Daconil 2787 | 37 | 8768 |
| anilazine | Dyrene | 27 | 4733 |
| iprodione | Chipco 26019 | 40 | 3491 |
| mancozeb | Fore,Dithne,Manzate 2000DF | 19 | 3008 |

| | | | |
|---------------------|------------------------|----|---------------|
| propamocarb HCL | Banol | 24 | 2219 |
| triadimefon | Bayleton | 47 | 1875 |
| benomyl | Tersan 1991 | 32 | 1746 |
| metalaxyl | Subdue | 27 | 1427 |
| PCNB | Turfcide | 10 | 1419 |
| fosetyl-Al | Aliette | 9 | 965 |
| chloroneb | Tersan SP, Terremec SP | 8 | 633 |
| thiram | Spot-Trete | 11 | 591 |
| maneb | Tersan LSR | 8 | 549 |
| propiconazole | Banner | 13 | 509 |
| thiophanate-methyl | 3336 | 12 | 330 |
| fenarimol | Rubigan | 22 | 174 |
| vinclozolin | Vorlan | 6 | 127 |
| captan | Captan | 2 | 28 |
| cadmium chloride | Caddy | 7 | 22 |
| cycloheximide | Act-Dion T6F | 1 | 0 |
| TOTAL | | | 32,614 |
| HERBICIDES | | | |
| bensulide | Betasan | 30 | 2174 |
| chlorthalidimethyl | Dacthal | 12 | 1789 |
| glyphosate | Roundup, Rodeo | 12 | 496 |
| 2,4-D acid | Trimec | 28 | 461 |
| mecoprop | MCPP, Mecomex | 24 | 365 |
| benfluralin | Balan, Team 2G | 17 | 364 |
| siduron | Turpersan | 5 | 323 |
| paclobutrazol | Scotts PCA | 6 | 150 |
| trifluralin | Team 2G | 10 | 121 |
| 2,4-D amine salt | Trexsan, Trimec Bent | 3 | 107 |
| pendimethalin | Scotts Weed Control | 4 | 79 |
| dicamba | Banvel | 22 | 71 |
| oxadiazon | Ronstar | 7 | 65 |
| oryzalin | Surflan | 2 | 54 |
| prometon | Pramitol 25E | 2 | 32 |
| fenoxypop-ethyl | Acclaim | 13 | 18 |
| diquat | Diquat | 2 | 17 |
| dichlobenil | Dyclomec | 2 | 10 |
| 2,4-Dp | Chipco Weedone | 1 | 6 |
| melfluidide | Embark | 3 | 5 |
| ethofumesate | Prograss | 3 | 5 |
| TOTAL | | | 6,712 |
| INSECTICIDES | | | |
| bendiocarb | Turcam | 25 | 3371 |
| trichlorfon | Dylox, Proxol 80SP | 26 | 2793 |

| | | | |
|---------------------------|--------------|----|--------|
| chlorpyrifos | Dursban | 42 | 2006 |
| isofenfos | Oftanol | 24 | 1739 |
| carbaryl | Sevin | 18 | 776 |
| DDVP | Dursban plus | 4 | 13 |
| propoxur | Baygon | 1 | 11 |
| disulfoton | Disyston | 1 | 2 |
| TOTAL | | | 10,710 |
| TOTAL COMBINED PESTICIDES | | | 50,035 |

Several of the pesticides (or their degradation products) applied on golf courses on Long Island in 1989 were then classified as probable or possible carcinogens:

Six pesticides (propoxur, DDVP, oryzalin, trifluralin, fosetyl-AI and chlorothalonil), totalling 9,932 pounds or 19.8 percent of the total active ingredients applied, were classified by the EPA as possible or probable human carcinogens.⁽⁵⁾ (Chlorothalonil is the most heavily used fungicide on Long Island golf courses and has also been detected in Long Island's groundwater.)

Another three (trichlorfon, mancozeb, maneb), totalling 6,350 pounds or 12.7 percent of the total active ingredients applied, naturally break down in the environment into various compounds including substances the EPA classifies as probable human carcinogens.

One active ingredient, Dacthal, with 1,789 pounds used or 3.6 percent of the total active ingredients applied, has been found by the EPA to be contaminated with traces of dioxin, a probable human carcinogen. (Dacthal was the second most heavily used herbicide on Long Island golf courses responding to the survey and its persistent degradation product has also been detected in Long Island's groundwater)

Five more (oxadiazon, benomyl, metalaxyl, pentachloronitrobenzene, captan) totalling 4,685 pounds or 9.4 percent of the total active ingredients applied, were being reviewed by the EPA for carcinogenicity.

Long-term, low-level exposure to many of the pesticides used by Long Island golf courses is associated with a variety of other health problems. This is the type of exposure generally resulting from drinking contaminated groundwater. According to the EPA, some of these chemicals can impair the nervous system, while others may damage the kidneys, liver, thyroid and adrenal glands, and the blood. Some cause degeneration of the testes, decreased sperm counts, reduction in weight of the uterus, and decreased birth weight. (Table 3, on the next page, lists some of the known long-term health effects associated with some of the pesticides applied on Long Island golf courses.)

Since the health risks of chronic, long-term exposure to many pesticides are not fully understood, any discussion of these effects will be incomplete. It may take many more years of research before the full range of these effects is known.

The potential for these health effects depend on whether, and how, people are exposed to these pesticides. Many of the pesticides used can contaminate the groundwater which in turn may end up as drinking water.

TABLE 3: Selected Health Effects of Active Ingredients of Pesticides Applied on Long Island Golf Courses

| Active Ingredient | Potential Health Effects* |
|-------------------|---|
| Benfluralin | Decreases red blood cell count and hemoglobin concentration |
| Benomyl | Causes low birth weight |
| Chlorpyrifos | Impairs nervous system function |
| Dicamba | Toxic to fetus |
| Diquat | Causes cataracts |
| Disulfoton | Impairs nervous system function;causes optic nerve degeneration |

| | |
|--------------------|---|
| Pendimethalin | Toxic to liver |
| Propoxur | Impairs nervous system function |
| Thiophanate-methyl | Decreases sperm formation, causes hyperthyroidism |
| Thiram | Toxic to nervous system |
| Triadimefon | Decreases red blood cell count |

* These are some health effects identified by the EPA that can result from sufficient oral exposure to the pesticides listed, including exposure from drinking water. Exposure to these pesticides by inhalation or direct contact and/or at higher concentrations could cause more severe health problems. (Source: Oral Reference Doses, Integrated Risk Information System, U. S. Environmental Protection Agency, 1991)

According to a 1991 report on pesticides in groundwater by the U.S. General Accounting Office, the investigative arm of Congress, at least six of the pesticides used by Long Island golf courses are already known to be capable of contaminating groundwater after normal applications following label directions. These six pesticides are: chlorothalonil, Dacthal, dicamba, 2,4-D, prometon and trifluralin. They accounted for 11,349 pounds or 22.6 percent of the pesticides used by the 52 golf courses in the survey. By 1988, the degradation products of two of these (chlorothalonil and Dacthal) had been detected in Long Island groundwater at the highest levels anywhere in the country.

Long Island's groundwater aquifers are replenished in the deep flow recharge areas. It is in these areas that precipitation infiltrates and trickles down through the soil and replenishes the Magothy and Lloyd aquifers, upon which the residents of Long Island depend for their drinking water supplies. An estimated 53 golf courses covering 7,294 acres are located within these deep flow recharge areas. Another 54 golf courses are estimated to cover 6,286 acres outside the deep flow recharge areas (see map on page 11, and map key in the Appendix). Although pesticide use by golf courses outside the recharge areas are less likely to affect the two deeper drinking water aquifers, it may contaminate the Upper Glacial aquifer which is used for both shallow private wells and even a few public supply wells.

Pesticides, like other chemicals, may vary in their potential to leach, or to migrate through soils. In the absence of groundwater monitoring studies, this potential can still be estimated. Table 4 presents estimates of this potential, based on a leachability rating system adopted by the U.S. Soil Conservation Service. The "leachability" ratings in this table consider pesticide persistence and mobility, and represent different probabilities for groundwater contamination. Pesticide applicators can use Table 4 as a guide for selecting pesticides that pose the least risk of groundwater contamination. This information can also be used to decide which pesticides should be monitored in groundwater.

The actual impact of the pesticide on groundwater is influenced by several additional factors including the type and thickness of the surface soil in the area where the pesticide is applied. As noted earlier, Long Island's soils are generally a poor barrier to contaminant migration. Long Island's vulnerability to groundwater contamination by pesticides is perhaps best illustrated by the fact that degradation products two of the pesticides (chlorothalonil and Dacthal) that are rated in Table 4 as having a "small" leaching potential have nevertheless already reached Long Island's groundwater (see discussion on page 3).

TABLE 4

Pesticide Leaching Potential

| LARGE | MEDIUM | SMALL | VERY SMALL |
|--------------|------------------|----------------|-----------------|
| dicamba | 2,4-D amine salt | 2,4-D acid | diquat |
| dichlobenil | bendiocarb | 2,4-DP | glyphosate |
| ethofumesate | chloroneb | anilazine | propamocarb HCL |
| fenarimol | isofenfos | benfluralin | vinclozolin |
| metalaxyl | propiconazole | benomyl | |
| prometon | siduron | bensulide | |
| propoxur | triadimefon | captan | |
| trichlorfon | | carbaryl | |
| | | chlorothalonil | |
| | | chlorpyrifos | |
| | | Dacthol | |
| | | disulfoton | |

| |
|--------------------|
| fosetyl-Al |
| iprodione |
| mancozed |
| maneb |
| oryzalin |
| oxadiazon |
| PCNB |
| pendimethalin |
| thiophanate-methyl |
| thiram |
| trifluralin |

Source: SCS/ARS/CES Pesticide Properties Database, U.S.D.A. Soil Conservation Service, 1991

Other Potential Dangers of Golf Course Pesticides

Unfortunately, the potential adverse impacts of pesticides heavily applied on golf courses are not limited to the possibility that they may contaminate underground water supplies. People and the environment are not immune to many effects of pesticides. Millions of Americans may be sensitive to pesticides. Some of those afflicted with such reactions go to extraordinary lengths--greatly disrupting their lives--to avoid even the slightest chance of unwitting exposure. And still people continue to be poisoned by pesticides at work, at play and in the comfort of their own homes.

In addition to long-term health effects of pesticides like cancer, recently there have been various reports of people suffering immediate health problems after exposure to pesticides. In one extremely unusual case in 1982, Navy Lieutenant George Prior died two weeks after he spent three consecutive days playing golf at the Army Navy Country Club in Arlington, Virginia. His doctor, an expert forensic pathologist, reported that Prior suffered a severe reaction to chlorothalonil, a pesticide used weekly on the golf course.

In 1990, workers at Cornell University suffered attacks of vomiting, blurred vision, and headaches after the building where they were working was sprayed with an insecticide. Because of the growing number of these reports, last year New York State instituted a toll-free pesticide poisonings registry to keep track of these incidents. Pesticide poisonings must now be reported to the Department of Health's Pesticide Poisoning Registry at 1-800-322-6850.

Pesticides have also hurt the environment. Several years ago, more than 700 Brant geese were killed after absorbing diazinon from a Long Island golf course. Shortly after, New York State forbade the use of diazinon on golf courses.

Recommendations

If there is any doubt that Long Island's groundwater needs special protection, the fate of groundwater in Brooklyn and Queens is an unfortunate reminder of the consequences of inaction and neglect. All of Long Island (Brooklyn, Queens, Nassau, Suffolk) shares the same regional groundwater aquifer system. Groundwater in Brooklyn and Queens was a source of drinking water from colonial times until well into this century. Yet because the vulnerability of this resource was not understood, it was not protected from the ravages of commercial and industrial development and burgeoning population growth. For example, an underground pool of about 10 million gallons of oil and gasoline under the Greenpoint section of Brooklyn has contaminated the Upper Glacial aquifer. Today, except for the groundwater under a small section of southeastern Queens, the groundwater in Brooklyn and Queens is not used for drinking water.

Despite this sobering lesson, government has yet to address groundwater contamination by pesticides *before* it happens. Instead, pesticide contamination has been responded to--after the fact--with band-aid measures that only address the immediate problem, not its source.

Contaminated water has been replaced with bottled or tank-truck water or individual households have received drinking water filters that require ongoing maintenance. Affected public supply wells have been closed or fitted with expensive filters. Temik and Dacthal were banned for use in Suffolk County only after widespread contamination had occurred. However, such measures are no substitute for keeping groundwater clean by preventing future pesticide contamination. Yet the federal EPA, the agency with primary regulatory authority over pesticides, has made only limited prevention efforts. It has recognized that pesticide applications can jeopardize water quality and recently announced that it will take action to reduce the threat. However, the Agency has reviewed only about one-third of the studies submitted on the leaching characteristics of 16 pesticides *known* to contaminate groundwater. The EPA has determined that 40 percent of the studies are inadequate and must be supplemented or repeated. It will be years before the EPA has the full data requested in order to evaluate the threat of groundwater contamination. Until the data is complete and fully evaluated, the EPA should take interim action to prevent further groundwater contamination.

The State Legislature has already acted to protect Long Island's groundwater from some threats by ordering all landfills to close because of the danger they posed by leaking contaminants. The Legislature also enacted legislation banning certain septic tank cleaners on Long Island. But further action is needed.

To protect the public health and natural resources like Long Island's groundwater from the risks of pesticide contamination, the following measures should be taken in several areas.

Reducing Pesticide Hazards

The use of pesticides containing known or probable carcinogens for aesthetic purposes such as golf courses or lawn care should be eliminated. The risks posed by these carcinogens are not outweighed by the benefits of an aesthetically pleasing green lawn.

Pesticide users, particularly golf course management, both public and private, should consider the leachability and toxicity of pesticides they apply and avoid those with significant potential toxic effects.

Efficacy should not be the only reason for choosing a pesticide.

Groundwater quality should be monitored for pesticide contamination, particularly in groundwater recharge areas where pesticides are known to be applied in large quantities, such as Long Island golf courses.

As suggested by the GAO, the EPA should require groundwater advisories on the labels of pesticides known to cause widespread groundwater contamination.

The GAO also suggests that the EPA prohibit the use of pesticides known to leach into groundwater wherever groundwater is particularly vulnerable to pesticide contamination.

The GAO further suggests that the EPA permit only certified pesticide applicators to use those pesticides that leach into groundwater.

Minimizing Pesticide Use

All pesticide applicators, including golf course managers and homeowners, should use less toxic alternatives and "Integrated Pest Management" (IPM) practices to minimize the amounts of toxic chemicals applied.

Pesticide applicators should advise consumers that reduced or non-chemical alternatives to pesticides are available, so that consumers may choose to use such alternatives.

Full Disclosure

Pesticide labels should inform users that any pesticide use may pose potential health and environmental risks.

Pesticide labels should state clearly that registration is not a guarantee that pesticide use is free from risk.

The public should receive advance notice of pesticide applications in public buildings and places such as golf courses. Then people can make their own, informed choices about whether they want to risk exposure.

Implementing these recommendations cannot reverse past pesticide contamination. However, protection of our drinking water resources today will help ensure a continuing and safe water supply for future generations.

Endnotes:

1. Time Magazine, June 3, 1991
2. Status: Pesticide Sampling Programs, 1980-1988, Suffolk County Department of Health Services, July 1989.
3. D. Pimentel et al., "Environmental and Economic Impacts of Reducing U.S. Agricultural Pesticide Use," *Handbook of Pest Management in Agriculture*, 2nd edition, edited by David Pimentel, CRC Press, Boca Raton, Florida, 1991, page 679.
4. D. Pimentel et al., op cit.
5. As of August 1995, each of these active ingredients was still classified as a possible or probable carcinogen by EPA.
6. As mentioned earlier, one Dacthal manufacturer has voluntarily restricted its Dacthal products from use in Suffolk County. However, products containing Dacthal made by other companies or stocks purchased before the restriction took effect in 1988 can still be used in Suffolk County.
7. As of August 1995, EPA's Office of Pesticide Programs listed captan as a probable carcinogen and oxadiazon, benomyl and pentachloronitrobenzene as possible carcinogens. Metalaxyl was listed as having evidence of "noncarcinogenicity for humans."

Credits

This report was originally prepared by Environmental Scientist Patricia Primi, Chief Scientist Michael H. Sorgan, Ph.D., Assistant Attorneys General Deborah I. Volberg and James A. Sevinsky and other staff of the Environmental Protection Bureau.

Appendix

| KEY TO NASSAU COUNTY GOLF COURSES | | | | | |
|-----------------------------------|-----------------------|-----------------|-------|-------|----------------|
| Loc. # | Name | Town | Holes | Acres | Public/Private |
| 1 | Lake Success | Great Neck | 18 | 120 | private |
| 2 | Fresh Meadow | Great Neck | 18 | 140 | private |
| 3 | Deepdale | Manhasset | 18 | 150 | private |
| 4 | North Hills | Manhasset | 18 | 148 | private |
| 5 | Sands Point | Sands Point | 18 | 130 | private |
| 6 | IBM | Port Washington | 9 | 60 | private |
| 7 | Plandome C.C. | Plandome | 18 | 110 | private |
| 8 | North Hempstead | Port Washington | 18 | 110 | private |
| 9 | Christopher Morley Pk | North Hills | 9 | 43 | public |
| 10 | Wheatley Hills | East Williston | 18 | 120 | private |
| 11 | Engineers C.C. | Roslyn Harbor | 18 | 122 | private |
| 12 | North Shore C.C. | Glen Head | 18 | 150 | private |
| 13 | Glen Cove | Glen Cove | 18 | 122 | public |
| 14 | The Creek Club | Locust Valley | 18 | 90 | private |
| 15 | Nassau C.C. | Glen Cove | 18 | 180 | private |
| 16 | Glen Head C.C. | Glen Head | 18 | 168 | private |
| 17 | The Cedar Brook Club | Old Brookville | 18 | 120 | private |
| 18 | Brookville C.C. | Glen Head | 18 | 116 | private |
| 19 | Piping Rock Club | Locust Valley | 18 | 178 | private |
| 20 | Old Westbury | Old Westbury | 27 | 198 | private |

| | | | | | |
|----|------------------------|----------------|----|-----|---------|
| 21 | Mill River Club | Oyster Bay | 18 | 125 | private |
| 22 | Pine Hollow C.C. | East Norwich | 18 | 160 | private |
| 23 | Muttontown | East Norwich | 18 | 140 | private |
| 24 | Tam O'Shanter | Brookville | 18 | 169 | private |
| 25 | Woodcrest Club | Syosset | 18 | 122 | private |
| 26 | Meadow Brook Club | Jericho | 18 | 125 | private |
| 27 | Glen Oaks | Old Westbury | 27 | 250 | private |
| 28 | Cantiague Park | Hicksville | 9 | 42 | public |
| 29 | Bethpage State Park | Farmingdale | 90 | 875 | public |
| 30 | Eisenhower Park | East Meadow | 54 | 300 | public |
| 31 | Garden City C.C. | Garden City | 18 | 150 | private |
| 32 | Garden City G.C. | Garden City | 18 | 112 | private |
| 33 | Cherry Valley | Garden City | 18 | 143 | private |
| 34 | Hempstead | Hempstead | 18 | 120 | private |
| 35 | Rockville Links | Rockville Ctr. | 18 | 180 | private |
| 36 | Inwood | Inwood | 18 | 164 | private |
| 37 | North Woodmere Park | N. Woodmere | 9 | 50 | public |
| 38 | Lawrence | Lawrence | 18 | 120 | private |
| 39 | Woodmere | Woodmere | 18 | 110 | private |
| 40 | Rockaway Hunting Club | Cedarhurst | 18 | 200 | private |
| 41 | Seawane Club | Hewlett Harbor | 18 | 130 | private |
| 42 | Bay Park | E. Rockaway | 9 | 50 | public |
| 43 | Middle Bay C.C. | Oceanside | 18 | 120 | private |
| 44 | Lido Golf Club | Lido Beach | 18 | 144 | public |
| 45 | Merrick Rd. Park | Merrick | 9 | 61 | public |
| 46 | Jones Beach State Park | Wantagh | 18 | 130 | public |
| 47 | Peninsula | Massapequa | 9 | 50 | public |

| KEY TO SUFFOLK COUNTY GOLF COURSES | | | | | |
|---|-----------------------|-----------------|--------------|--------------|-----------------------|
| Loc. # | Name | Town | Holes | Acres | Public/Private |
| 48 | Huntington C.C. | Huntington | 18 | 90 | private |
| 49 | Cold Spring C.C. | Cold Sprng Hrbr | 18 | 135 | private |
| 50 | Huntington Crescent | Huntington | 18 | 190 | private |
| 51 | Bergen Point C.C. | Babylon | 18 | 240 | public |
| 52 | Cedar Beach | Babylon | 9 | 20 | public |
| 53 | Southward Ho | Bayshore | 18 | 151 | private |
| 54 | Half Hollow Hills | Dix Hills | 9 | 41 | public |
| 55 | Dix Hills | Dix Hills | 9 | 30 | public |
| 56 | Crab Meadow | Northport | 18 | 79 | public |
| 57 | Northport VA Hospital | Northport | 9 | 28 | public |
| 58 | Indian Hill | Northport | 18 | 143 | private |
| 59 | Sunken Meadow | Kings Park | 27 | 250 | public |

| | | | | | |
|-----|---------------------|----------------|----|-----|---------|
| 60 | Dix Hills Park | Dix Hills | 9 | 36 | public |
| 61 | The Hamlet | Commack | 18 | 180 | public |
| 62 | Brentwood C.C. | Brentwood | 18 | 110 | public |
| 63 | Robert Moses | Babylon | 9 | 18 | public |
| 64 | Hauppague | Hauppauge | 18 | 135 | public |
| 65 | Smithtown Landing | Smithtown | 27 | 40 | public |
| 66 | Colonie Hill | Hauppauge | 18 | 90 | private |
| 67 | Timber Point | Great River | 27 | 239 | public |
| 68 | Nissequogue | St. James | 18 | 125 | private |
| 69 | West Sayville | West Sayville | 18 | 250 | public |
| 70 | Island Hills C.C. | Sayville | 18 | 110 | private |
| 71 | St. Georges | Stony Brook | 18 | 100 | private |
| 72 | Heatherwood | Centereach | 18 | 70 | public |
| 73 | Harbor Hills | Port Jefferson | 18 | 40 | private |
| 74 | Bellport | Bellport | 18 | 98 | public |
| 75 | Tall Tree | Rocky Point | 18 | 146 | public |
| 76 | Spring Lake | Middle Island | 27 | 260 | public |
| 77 | Middle Island | Middle Island | 27 | 226 | public |
| 78 | Swan Lake | Manorville | 18 | 144 | public |
| 79 | Pine Hills | Manorville | 18 | 133 | public |
| 80 | Rock Hill | Manorville | 18 | 125 | private |
| 81 | Fox Hill | Baiting Hollow | 18 | 140 | private |
| 82 | Sandy Pond | Riverhead | 9 | 75 | public |
| 83 | Indian Island | Riverhead | 18 | 157 | public |
| 84 | Hampton Hills | Riverhead | 18 | 60 | private |
| 85 | L.I. Wyandanch Club | Eastport | 9 | 63 | public |
| 86 | Westhampton | Westhmptn Bch. | 18 | 120 | private |
| 87 | Quogue Field Club | Quogue | 9 | 82 | private |
| 88 | National Golf Links | Southampton | 18 | 165 | private |
| 89 | Shinnecock Hills | Southampton | 18 | 96 | private |
| 90 | Southampton | Southampton | 18 | 130 | private |
| 91 | Noyac | Sag Harbor | 18 | 102 | private |
| 92 | Bridgehampton | Bridgehampton | 9 | 66 | private |
| 93 | Poxabogue | Bridgehampton | 9 | 82 | public |
| 94 | Sag Harbor | Sag Harbor | 9 | 68 | public |
| 95 | Maidstone | East Hampton | 27 | 120 | private |
| 96 | South Fork | Amagansett | 9 | 40 | private |
| 97 | North Fork | Cutchogue | 18 | 130 | private |
| 98 | Cedars | Cutchogue | 9 | 27 | public |
| 99 | Shelter Island | Shelter Island | 9 | 61 | public |
| 100 | Gardiners Bay | Shelter Island | 18 | 118 | private |
| 101 | Islands End | Greenport | 18 | 108 | private |
| 102 | Hay Harbor | Fishers Island | 9 | 45 | private |
| 103 | Fishers Island | Fishers Island | 18 | 130 | private |

| | | | | | |
|-----|-----------------|---------------|----|-----|---------|
| 104 | Montauk Downs | Montauk | 18 | 254 | public |
| 105 | Blue Ridge | Medford | 9 | 32 | private |
| 106 | Gull Haven | Central Islip | 9 | 60 | private |
| 107 | Leisure Village | Ridge | 9 | 60 | private |