A SUMMARY REPORT ON THE PRELIMINARY FINDINGS OF THE STATEWIDE GROUNDWATER MONITORING PROJECT

January, 1978

PROGRAM ON ENVIRONMENTAL CANCER AND TOXIC SUBSTANCES

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INTRODUCTION

The Program on Environmental Carcinogens and Toxic Substances of the New Jersey Department of Environmental Protection has received the initial set of results from the statewide groundwater monitoring project. The purpose of the project is to obtain an assessment of the degree of contamination of the state groundwater supplies by selected toxic and carcinogenic compounds. It is one of several projects being conducted by the Cancer Program aimed at identifying the presence of toxics and carcinogens in the New Jersey environment.

The wells being monitored in this project have been selected to include all counties in the state. They represent an equal distribution of private and public drinking supply wells, along with industrial sites and wells located in the vicinity of landfills.

The project is being conducted in coordination with the Division of Water Resources. All laboratory work is being performed by the Department of Environmental Sciences of Rutgers University.

The substances which are being looked for in the investigation are:

Group I - Volitile Organics

Methylene Chloride
Methyl Chloride
Methyl Bromide
Chloroform
Bromoform
1,1,2-Trichlorethylene
1,1,2,2-Tetrachloroethane
Dibromochloromethane
Trifluoromethane
Carbon Tetrachloride
1,2-Dibromoethane
1,2-Dichloroethane
1,1,1-Trichloroethane
Vinyl Chloride
1,1,2,2-Tetrachloroethylene
o,m,p-Dichloro-Benzene
Trichloro-Benzene
Diiodomethane

and measuring the extent of groundwater contamination by a wide range of toxic contaminants. Because of the non-routine nature of this project, newly developed, highly sensitive analytical techniques are being used. The techniques include gas chromatoraphy, liquid chromatography, mass spectometry and high sensitivity atomic absorption. They are capable of measuring contamination as low as ten parts per trillion. This level of contamination has been compared to a cupful of contaminant in an ocean of water. Unfortunately, as the sensitivity of an analytical techniques increases so does the probability of error. When analyses are being conducted in the parts per trillion range there is an ever present possibility of sample contamination, in addition to instrument and observer variability. In order to control for this variability, a cut-off value of .1 parts per billion has been established. Thus, any contaminants found in detectable concentrtions below .1 parts per billion reported as <.1 ppb. All non-detectable results are reported "ND". By using this reporting system it is hoped that the probability of reporting erroneous low level values will be greatly reduced.

A summary chart of all findings is attached. (Appendix A) This chart indicates the ranges of contamination along with the average and median values for each compound.

RESULTS

The initial data contains the results from 250 wells located in ten counties: Bergen, Cumberland, Essex, Hudson, Hunterdon, Monmouth, Morris, Passaic, Salem and Warren. The following are summaries of the findings for each of the three groups of compounds.

Group 2

Pesticides & Related Compounds

- Polychlorinated Biphenyls (PCBs)
- pp'DD
- Heptachlor
- Methoxychlor
- Toxaphene
- DDT and associated compounds
- Endrin
- Lindane
- Aldrin
- Diekdrin
- Heptachlor Epoxide
- Mirex

Group 3

Heavy Metals

- Arsenic & compounds
- Beryllium & compounds
- Cadmium & compounds
- Chromium & compounds
- Copper & compounds
- Lead & compounds
- Nickel & compounds
- Selenium & compounds
- Zinc & compounds

These substances have been identified by the Program on Environmental Cancer and Toxic Substances along with federal agencies as potential hazards to the environment and human health.

LIMITATIONS OF MEASUREMENT

Although the problem of environmental contamination by toxic chemicals has existed for decades, it has only recently been given national attention. Developments such as the discovery of high incidences of a rare liver cancer among vinyl chloride workers, the finding of widespread contamination of the Hudson River by toxic polychlorinated biphenyls (PCBs), and a statistical study linking elevated cancer rates to toxic contamination of the Mississippi River have spurred legislators and environmentalists into investigating the far-reaching effects of toxics in the environment.

This investigation by the Department of Environmental Protection is the first project in the country aimed at identifying

Group I - Organic

Laboratory analyses revealed widespread presence of a small number of organics. The most often found compounds were chloroform, carbon tetrachloride, trichloroethylene and trichloroethane. These are common solvents which are widely used in industry.

The presence and concentration of organic contamination varies according to land use. The highest values wre found in heavily industrialized areas, while rural and agricultural areas yielded low or non-detectable results. A total of seven wells exceeded the 100 parts per billion standard for organics recently proposed by the U.S. Environmental Protection Agency. All of these wells were located on or near industrial sites and are not used for drinking purposes. Follow-up monitoring is now being planned to insure that contamination from these sites does not threaten any nearly drinking water aquifers.

A large percentage of the wells tested contained very lor or non-detectable concentration of the organic compounds. In most cases the levels detected were less than 100 times smaller than the proposed safe drinking water standard, and in no case was a well found to pose any immediate danger to human health.

Group II - Pesticides

As was the case the organics (group 1), the presence and concentration of pesticides in the groundwter varies with land use. These compounds were most commonly found in the agricultural areas of the state. Pesticide contamination of groundwater was virtually

non-existant in the heavily populated and industrialized areas which were monitored.

The most commonly occuring pesticides are tindane, heptachlor and DDT. The use of lindane and heptachlor is currently restricted in New Jersey, and DDT is banned. The presence of these compounds in the groundwater was not entirely unexpected since all three have been used extensively in the past to control soil insects, flies, mosquitoes and household pests.

The levels of pesticide contamination were very low. The mean values of all the compounds excepting DDT were below the .1 parts per billion cut-off point. Only three wells exhibited pesticide values exceeding recommended standards for safe drinking water. Follow-up monitoring at two of these wells, which are used for potable purposes failed to detect any pesticides. It is therefore presumed that the initial samples were contaminated in some way and do not reflect the true quality of the groundwater. The third violating well is located at an industrial site and is not used for drinking purposes. Follow-up monitoring at this site has not yet been completed.

Group III - Heavy Metals

Virtually every well tested contained detectable levels of all ten heavy metals. This is due, in part, to the fact that many of the metals occur naturally in groundwater. However, the widespread presence of metals such ad cadmium and chromium, which are rarely found in natural waters, would indicate the seepage of heavy metals into groundwater aquifers.

Although the metals do not follow a well defined land use pattern, the results indicate that it is responsible for much of the groundwater contamination. A total of ten wells inhibited heavy metal values exceeding recommended standards. Seven of these wells were located at industrial sites, and two of the remaining three were located at landfills which receive industrial waste.

The overwhelming majority of the sampels exhibited very low concentrations of metals. Most wells were in the range of 1 part per billion or below. These levels are well below the recommended standards. In no case was a domestic or public supply well found to contain concentrations of heavy metals which pose any immediate dange to human health.

HEALTH EFFECTS

All of the compounds and substances being analyzed for in this project are toxic, and many are recognized carcinogens. They have been selected from the joint Environmental Defense Fund and Environmental Protection Agency list of toxic substances, and the New Jersey DEP list of selected environmental carcinogens. Most of what is known about the health effects of these substances has been learned from animal tests and high dose occupational exposures. Very little is known of the effects of long term low dose exposure to these toxics. Recently there have been a number of statistical studies which have linked toxic contamination of drinking wter to increased rates of cancer mortality. These studies are far from definitive, however, and much additional research must be undertaken before the health effects of low level environmental contamination can be understood.

The following is a short summary of the current information on the health effects of those substances which have been found in the State's groundwater.

Group I - Volitile Organics

Little is known about the toxic effects of low level exposure to these compounds. For this reason, safe drinking water standards have not yet been adopted. Recent studies have linked the presence of chlorinated organics in drinking water to elevated rates of cancer mortality. However, these studies involve chlorinated surface water supplies which contain levels of organics well agove those found in the groundwater supplies of this investigation.

Three of the four compounds most often found in this investigation have shown to cause cancer in animal tests. Carbon tetrachloride, chloroform and trichlorothylene have each produced tumors in laboratory animals.

At high doses these compoounds have been shown to have toxic effects in man ranging from nausea to liver damage and death. However, virtually no data is available on the human health effects of how level exposure. It is hoped that current research utilizing animal testing and epidemological studies of exposed human populations with soon provide a better understanding of the role of these compounds in human disease.

Group II - Pesticides

The major pesticides have been used for at least three decades, and there are still no definite conclusions regarding the long term lose dose human health effects of these compounds. Because of their

chemical stability, several of the pesticides, if absorbed into the human body, are not metabolized rapidly but are stored in the fatty tissues. It is this bioaccumulation property along with high dose toxic effects, which has led to the banning or strict control of several of these compounds. At high doses organic pesticides have effects ranging from headaches and dizziness to convulsions and death.

Recent research has found that many of the pesticides produce cancer in test animals. DDT and lindane, which were among the most commonly found pesticides in this investigation, are on the DEP list of suspected environmental carcinogens and have both produced cancer in test animals.

Available animal testing fails to provide adequate information on the long term effects of these compounds in humans. Much research is needed before the effects of minute amounts of pesticides in drinking water are known.

Group III - Heavy Metals

The effects of the heavy metals monitored in this project ranges from being essential and beneficial to human health to being carcinogenic. Copper and zinc, in small amounts, are necessary in human metabolism. On the other hand, arsenic, beryllium, cadmium, chromium leand and nickel have all demonstrated carcinogenic potential in laboratory animals and, all of these metals, excepting lead, have been linked to increased cancer incidence in cases of occupational exposure.

Since most of these metals occur naturally in the environment, the recommended standards for safe drinking water are an order of magnitude higher than those for pesticides. Although the high dose toxic effects of metals are well understood, the effects of long term low level exposure are unknown. The presence of cadmium and selinum in drinking water has been linked to cardiovascular disease, particularly hypertension. However, there is no evidence that non-occupational exposure to these metals constitutes a cancer hazard.

FUTURE PLANS OF THE PROGRAM ON ENVIRONMENTAL CANCER AND TOXIC SUBSTANCES

This statewide survey of groundwater marks the beginning of a multi-year effort to identify and eliminate those toxic substances which are contaminating the state groundwater supplies. This information ained from this initial phase of the project will be used to identify those areas where more extensive monitoring of groundwater is needed. Follow-up monitoring will be aimed at defining the extent and eliminating the sources of groundwater contamination in order to insure the safety of all underground drinking water supplies.

In addition to testing groundwater, the Program on Environmental Cancer and Toxic Substances will soon be monitoring air, drinking water and surface water fro the presence of toxics and carcinogenic compounds. The Program is also utilizing short term biological tests in order to measuring the cancer causing potent[illegible] of environmental samples.

All information gained from these monitoring projects will be mapped in order to define those areas of the state which are contaminated by toxic substances and to identify those populations which may be exposed to potential cancer causing agents. The information will than be statistically related to cancer mortality rates in order to determine if the geographic distribution of cancer is related to the geographic distribution of environmental contamination. It is through this type of environmental monitoring, coupled with geographic and statistical analyses, that the Program on Environmental Cancer and Toxic Substances hopes to identify those environmental contaminants which may be related to the high incidence of cancer in New Jersey.

Ugle Organics	Number of wells in designated range (ppb)						
	7100	100-10	10-1	.9-.1	<0.1	Mean	Median
Methylene Chloride	0	0	0	0	237	<0.1	<0.1
Methyl Chloride	0	0	0	0	237	<0.1	<0.1
Methyl Bromide	0	0	0	0	237	<0.1	<0.1
Chloroform Bronodichlor-othethane	3	4	48	79	166	5.2	0.2
Bromoform	0	1	2	14	216	0.2	<0.1
1,1,2-Trichlo-roethylene	2	12	21	49	153	5.7	<0.1
1,1,2,2-Tetra-chloroethane	0	0	1	22	211	<0.1	<0.1
1,1,2-Trichlorethane	0	0	15	23	199	1.0	<0.1
Dibromochloro-methane	0	0	1	18	208	<0.1	<0.1
Trifluoromethane	0	0	0	0	237	<0.1	<0.1
Carbon Tetrachloride	1	1	8	35	190	1.0	<0.1
1,2-Dibromoethane	0	3	2	8	224	0.5	<0.1
1,2-Dichloroethane	0	1	4	4	228	0.1	<0.1
1,1,1-Trichloro-ethane	3	20	97	69	48	8.9	1.0
Vinyl Chloride	0	0	0	0	237	<0.1	<0.1
1,1,2,2-Tetra-chloroethaylene	0	12	15	42	168	2.1	<0.1
o,m,p-Dichloro-Benzene	0	0	1	0	236	<0.1	<0.1
Trichloro Benzene	0	0	0	0	237	<0.1	<0.1
Diiodomethane	0	0	2	43	192	<0.1	<0.1

Ugle
ppb

Pesticides	Recommended drinking water standards (EPA)	Number of wells in designated range (ppb) 7100	100-10	10-1	.9-.1	<0.1	Mean	Median
Polychlorinated Bi phenyls Arodor 1254	1 ppb	0	0	0	0	250	<0.1	<0.1
BHC	none	0	0	0	1	250	<0.1	<0.1
Lindane	4 ppb	0	0	0	1	249	<0.1	<0.1
Aldrin	1 ppb	0	0	0	4	246	<0.1	<0.1
Dieldrin		0	0	0	9	233	<0.1	<0.1
Heptachlor	0.1 ppb	0	0	0	1	248	<0.1	<0.1
Heptachlor Epoxide	0.1 ppb	0	0	0	2	249	<0.1	<0.1
Toxaphene	5 ppb	0	0	0	0	250	<0.1	<0.1
pp'DDE	50 ppb	0	0	0	9	243	<0.1	<0.1
op'DDT	50 ppb	0	0	0	13	236	<0.1	<0.1
Methyoxychlor	1000 ppb	0	0	0	0	250	<0.1	<0.1
Mirex	none	0	0	0	1	249	<0.1	<0.1
Endrin	0.5 ppb	0	0	0	7	244	<0.1	<0.1
Chordane	3 ppb	0	0	0	4	246	<0.1	<0.1
pp'DDD	50 ppb							

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Metals mg/l ppm	Recommended drinking water standards (EPA)	Number of wells in designated range (ppb)						
	EPA	7100	100-10	10-1	.9-.1	<0.1	Mean	Median
Arsenic	0.05 ppm	0	0	1	1	249	0.01	0.001
Berryllium	none	0	0	0	0	251	0.001	0.001
Cadmium	0.01 ppm	0	0	0	1	250	0.004	0.001
Copper	1.0 ppm	0	0	0	8	243	0.02	0.003
Chromium	0.05 ppm	0	0	0	2	249	0.01	0.002
Nickel	none	0	0	0	1	250	0.01	<0.01
Lead	0.05 ppm	0	0	0	4	242	0.01	<0.001
Selenium	0.01 ppm	0	0	0	0	251	0.004	<0.002
Zinc	5.0 ppb	0	1	7	38	205	0.2	0.02

DEFINITIONS

Recommended standards - these are the recommended safety limits for each compound. The values have been arrived at through extensive biological testing procedures. Concentrations at this level or below in drinking water have been shown to pose no threat to human health. A significant margin of safety has been calcualted into these values to minimize any risk of harmful effects.

ppb - stands for parts per billion. This is a standard unit of measure for water sampling. A contamination value of 1 ppb would mean one part of contaminant for every billion parts of water.

Mean value - this value is the average for each compound of the observed levle's in all the wells including any zero readings. Because zero readings were used in the calculations the means occasionally resulted in values less than the detection limit.

Median value - the median value is the middle number in a ranked group of observations. In this case, since there are 250 observations, the median was completed by averaging the 125th and 126th observations.

Organics a class of chemicals containing carbon and hydrogen atoms, not necessarily obtained form living organisms. Many organics are artificially synthesized and are widely used in industry.

Pesticides - a group of chemicals, often organics, used to control noxious or unwanted species of plants or insects.

Heavy Metals - a group of chemical elements with large atoms containing many particles which possess the characteristics of all metals. These characteristics are: shiny luster, good reflectors of ligh and high ability to conduct electricity.