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REPORT TO THE 113TH MAINE STATE LEGISLATURE
ENERGY AND NATURAL RESOURCES COMMITTEE:
Pesticides in Ground Water Study

by

The Maine Geological Survey
Department of Conservation
in cooperation with
Department of Agriculture, Food and Rural Resources
Department of Human Services
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State Planning Office
U.S. Geological Survey, Water Resources Division

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EXECUTIVE SUMMARY

In 1985, the State of Maine began a three year evaluation of agricultural practices on ground water quality. In the first two years of this project, water samples were collected from 59 overburden and 26 bedrock wells in areas heavily used for potato, blueberry, market crop, and apple production.

Results from the first two years of the study indicate that while pesticide residues are present in the ground water in some areas of Maine, concentrations are low. Of 188 samples taken in the study to date, only one contained pesticide (dinoseb) concentrations above an established health standard (2 ug/l), and only three exceeded statistically sound levels of detection. Because the samples were chosen to define the "worst case" situation, pesticide residues do not appear to be a widespread threat to ground water quality in Maine at this time.

Preliminary interpretation of the data suggests that conclusions drawn from studies in other states may not be entirely valid in Maine. Research in Wisconsin, California and Massachusetts indicated that ground water in sand and gravel deposits was most vulnerable to contamination from pesticides; Maine's study shows that bedrock wells may be more at risk.

Thirty-seven percent of the wells sampled in potato areas have had detectable pesticide levels. Pesticides detected include methamidophos, metribuzin, dinoseb, endosulfan, ETU, dicamba, chlorothalonil, and pichloram. Methamidophos was most frequently found (10 wells), and was found in the highest concentration, 0.09 to 10.5 micrograms per liter (ug/l).

Hexazinone (7 and 9 ug/l) was found in 2 wells in blueberry areas; arsenic (0.037 mg/l) was found in an orchard well; and alachlor (0.19 ug/l) and atrazine (0.4 ug/l) were found in different wells near market gardens. No other pesticides were detected in these areas.

Nitrate levels exceeding 10 mg/l (as N) were found in 19 of the 85 wells sampled. Mean nitrate levels were highest in market garden areas (8 mg/l), and lowest in areas used for blueberry cultivation (0.1 mg/l).

Pesticides were detected in 58 percent of the bedrock wells sampled; only 20 percent of the overburden wells had detectable pesticide contamination. Bedrock wells also had higher mean nitrate levels than overburden wells (8.6 mg/l vs. 4.3 mg/l). A higher percentage of wells with detectable pesticide levels were found in areas overlain by till than were found in sand and gravel areas.

The sampling program for the third year of the study will concentrate in potato growing areas in northern Maine. Careful time series sampling of two wells found to have a problem in the past will be carried out. More emphasis will be given to sampling bedrock wells, and an attempt will be made to sample adjacent wells screened in bedrock and surficial deposits. A conceptual hydrogeologic model will be developed to explain the differences found in the pesticide levels of bedrock and surficial wells. This work will be used to confirm the preliminary results, and to answer some of the questions raised by this study to date.

Introduction

The investigation of the impact on ground water of agricultural practices in Maine was prompted by the detection of chemicals used for agricultural purposes in the ground water in other states. In a survey begun in 1983 (Scarano, 1985), 25% of wells sampled in potato growing areas of Massachusetts showed detectable levels of the pesticide aldicarb (Temik), which is commonly used in Maine. The Connecticut Department of Environmental Protection conducted a study beginning in late 1983 in which over 2500 water supply wells were tested for the soil fumigant ethylene dibromide (EDB); 321 of these wells were found to be contaminated at a level greater than 0.1 ppb, the Connecticut drinking water standard for EDB (Marin and Droste, 1986). In California, more than 50 different pesticides have been found in ground water basins throughout the state (Litwin et al., 1983).

Early studies in Maine also indicated a need for further investigation. Since 1980 the Union Carbide Agricultural Products Company, Inc. has collected water samples from 274 sites selected for their proximity to areas where the pesticide aldicarb (Temik) was used. Forty-nine percent of these sites showed detectable levels of the pesticide (Jones, pers. comm., 1987). A 1982 study by researchers at the University of Maine at Orono detected the pesticide azinphos methyl (Guthion) in ground water from the blueberry growing regions of Washington and Hancock Counties (Bushway et al., 1982). A study in Carleton County, New Brunswick, Canada, immediately adjacent to the potato growing region of northern Maine, showed residues of aldicarb (Temik) and elevated nitrate levels in agricultural areas (Ecobichon et al., 1985). Also detected was ethylene thiourea (ETU), a breakdown product of the chemicals mancozeb and maneb, which are the most widely used agricultural chemicals in Maine.

To determine the extent of the ground water contamination problems in agricultural areas of Maine, the Ground Water Policy Review Committee of the Land and Water Resources Council recommended to former Governor Joseph E. Brennan in December, 1984, that a state-wide project investigating the impact of agricultural practices on ground-water quality be conducted. Governor Brennan and the Legislature accepted the recommendation and directed the Maine Geological Survey, Department of Conservation, to coordinate an inter-agency, three year investigative study, with annual progress reports to the Legislature's Energy and Natural Resources Committee. Participants in the study include representatives of the Maine Geological Survey, Department of Conservation; Bureau of Agriculture and Rural Resources and Pesticides Control Division, Department of Agriculture, Food and Rural Resources; Water Quality Control and Oil and Hazardous Materials Bureaus, Department of Environmental Protection; Environmental Health Unit, Health Engineering, and Public Health Laboratory, Department of Human Services; Location and Environment Unit, Department of Transportation; Natural Resources Division, State Planning Office; and the Maine office of the Water Resources Division, U.S. Geological Survey.

Analytical Methods

In 1985 a pesticide ranking matrix, a screening process to determine which pesticides were most likely to be found in ground water, was developed. A discussion of the factors and the ranking procedure is presented in the attached "Pesticides Selection Project" report (Appendix A). The ranking depends on available data from other state and national studies, as well as Pesticide Control Board records. It has been updated to reflect recent improvements in analytical techniques and the results from the first two years of this study.

All samples were analyzed by the Maine Public Health Laboratory using gas chromatograph methods developed by the Public Health Laboratory, Maine Department of Human Services. Most of the chemicals can be found by one of two "screens" (class I or II screens) that detect a wide spectrum of organic chemicals. Other chemicals can be detected by special tests if their presence is suspected (see Table 1). Problems with certain analytical methods encountered during 1985 have been corrected for this year's study.

The class I screens in 1986 were performed by a new solid phase method (Baker, 1986). Class I screens in 1985 were done using an ether extraction method (USEPA, 1982) that presented health risks to lab personnel. Results from the two methods are similar.

In 1985, results from the special test for methamidophos (Monitor) were not reported because breakdown of the chemical in the sample bottles yielded unrealistically low values. Studies conducted during the winter 1985-86 led to improved recovery rates for methamidophos. Results for methamidophos are presented in Table 2, although the amount detected from 1985 samples may have been lower than the true concentration.

Results from the special test for ethylene thiourea (ETU) have been reported in 1986 but must be viewed with caution. The method to detect ETU was adapted from a study presented by the Iowa Pesticide Hazard Assessment Program (1981). Recovery studies showed the method to be unsatisfactory. Even though quantitative results are reported, findings should be thought of as positive or negative. A method for detecting ETU was not available in 1985.

Results for the special test for aldicarb (Temik) have been reported for nine samples. Generally, however, samples collected for this study have not been analyzed for Temik. An extensive ground water sampling program conducted by the Union Carbide Agricultural Products Company (Jones, 1987) concentrated on Temik use areas in Maine.

Sampling Plan

Sampling locations were chosen to provide information on pesticide concentrations in various types of aquifers, as well as to cover different agricultural areas of the State. Only wells adjacent to fields where pesticides are used were selected. Based on results from the 1985 Pesticide Program, however, 1986 sampling was concentrated in potato growing areas in Aroostook County, where agricultural chemical use is the highest.

METHODS FOR PESTICIDE ANALYSES USED BY THE MAINE PUBLIC HEALTH LABORATORY

CHEMICALS	SYNONYMS	METHOD	PPB MLD	MAX. EXPOSURE GUIDLELINE (PPB)
Alachlor		II	1.25	200
Aldicarb	Temik	Sp-2	1.00	2
Atrazine		II	3.00	43
Azinphos'methyl	Guthion	II	5.00	25
Butylate	Sutan	II	2.30	
Captan		II	1.25	100
Carbaryl	Sevin	II	50.00	164
Carbofuran	Furadan	II	6.00	
Chlorothalonil	Bravo	II	1.25	
Chlorpyrifos	Dursban	II	1.25	
Cyanazine		II	19.00	
2,4-D		Ia*	1.25	100
2,4,5-T		Ia*	1.25	
2,4,5-TP	Silvex	Ia*	.25	1
Diazinon		II	1.25	4
Dicamba	Banvel	Ib	1.25	9
Difolitan		II	1.25	
Disulfotan	Disyston	II	6.00	
DNBP	Premerge, Dinoseb	Ib	1.25	2
Endosulfan	Thiodan	II	1.00	
Endrin		II	.50	.2
Eptam	EPTC	II	1.25	
ETU	Maneb, Mancozeb**	Sp-1	60.00	4.4
Imidan	Phosmet	II	12.50	
Lindane		II	.50	4
Linuron	Lorox	II	12.00	40
Malathion		II	1.25	50
Methomyl	Lannate	Sp-3	6.00	100
Methoxychlor		II	1.50	
Methyl Parathion		II	.60	
Metribuzin	Sencor	II	0.25	
Methamidophos	Monitor	Sp-4	10.00	
PCNB	Terraclor	II	1.50	71
Pichloram	Tordon	Ib	1.25	
Simazine		II	8.00	300
Triclopyr	Garlon	Ia*	.50	
Trifluralin	Treflan	II	.60	200
Hexazinone	Velpar	II	20.00	

METHOD: I and II are general screens. Special tests (Sp-#) are run for aldicarb, ETU, methomyl and methamidophos.

MLD: "Minimum Level of Detection" of the analysis under our conditions for which statistically sound recovery data is available.

*Compounds detected in a "Ia" screen will also be detected in a "Ib" screen and should have similar detection limits. In general, a "Ib" screen is more effective.

**ETU is actually a breakdown product of maneb and mancozeb.

Blanks in the column for Maximum Exposure Guideline indicate that no guideline has been developed.

SPECIAL NOTE: This information effective 2/25/87. It will be updated as lab techniques and needs change.

Whenever possible, monitoring wells installed by the Maine Geological Survey (MGS), Maine Department of Environmental Protection (MDEP), and U.S. Geological Survey (USGS) cooperative Aquifer Mapping Project were sampled, as were similar wells from the USGS-MGS Saco River Valley study. Use of these wells minimized uncertainty about well construction and logistical sampling problems.

In areas where monitoring wells were not available, private household wells were sampled. Private wells were used mostly in Aroostook County, and in orchard sampling in central Maine. Seven monitoring wells, installed in Aroostook County as part of the Aquifer Mapping Project, were sampled to supplement the private well Aroostook County data base.

Sample locations were chosen to assess worst case situations. It was assumed, based on the results and sampling plans from other states (Litwin et al., 1983; Cohen et al., 1984; Goethel et al., 1984; Deubert, 1985; Corte-Real, 1986) that ground water in sand and gravel deposits would be most vulnerable to contamination, and that ground water from till and bedrock would be less vulnerable. Thus, a majority of the samples were collected from surficial wells in sand and gravel aquifers. A breakdown of wells by geologic setting and crop type is shown below.

Crop Type	Sand and Gravel	Till	Bedrock
Potatoes	28	9	22
Orchard	0	3	2
Forage Crop/Market Garden	9	0	2
Blueberries	10	0	0

Sampling Methods

Sampling of wells was conducted during the growing season, from mid-June to early November, with most wells sampled more than once during this period. All wells that tested positive for pesticides in 1985 were re-sampled in 1986.

Samples from monitoring wells were collected using a gas bladder portable pump. To ensure that samples were representative of the local ground water quality, at least 3 well volumes were pumped before sampling. Conductivity and water temperature were measured during pumping, and samples were taken once these two parameters stabilized.

Samples from monitoring wells were filtered to remove sediment. In 1985, filtering was done using 0.45 micron membrane filters with paper pre-filters. Recovery tests run by the Public Health Laboratory following the 1985 sampling showed that certain groups of chemicals were adsorbed to the paper and membrane filters. To overcome this adsorption problem, 1.6 micron fiberglass filters were used in 1986.

Samples from private wells, since they are sediment free, were not filtered. The tap was allowed to run until the conductivity and temperature stabilized before sampling. All samples were refrigerated and delivered to the Public Health Laboratory as soon as possible after collection.

Results

Sixty-two samples, collected from 45 wells, were analyzed in 1985. These results are discussed in the First Annual Report - Pesticides in Ground Water Study (Tolman, 1986). Samples analyzed in 1986 include 105 from wells near potato fields, 6 from wells in blueberry barrens, 5 from wells near forage crop/market gardens, and 4 from wells in orchards. In 1986 only 17 samples gave positive results for pesticides; all of them from potato growing areas. Combined results of the chemical analyses from 1985 and 1986 are presented in Table 2 at the back of this report, and are summarized in Table 3.

Nitrate and dinoseb were the only substances found in concentrations exceeding health advisories or proposed recommended maximum concentration levels in drinking water. Thirty samples representing 19 wells exceeded the nitrate standard of 10 mg/l as nitrogen (Maine Department of Human Services, 1983). The dinoseb level in well 37 (June 17, 1986 sample) was 2.3 ug/l, which exceeds the Recommended Maximum Exposure Guideline of 2 ug/l (Maine Department of Human Services, 1986). Twenty-eight of the 46 chemicals of concern to this study have no Maximum Exposure Guideline developed for them.

All other pesticide concentrations were at trace levels (Table 2 at back of report). Dinoseb was detected in the early season sampling of wells 37 and 75, and the late season sampling of well 33. Metribuzin was detected in the early and late season sampling of well 75. Chlorothalonil was detected in the early season sampling of well 65. Endosulfan was found in the early season sample from well 33. Methamidophos was detected in the late season sample from wells 31, 53, 58, 70 and 76. Ethylene thiourea (ETU), a breakdown product of the most widely used agricultural chemicals, maneb and mancozeb, was detected in late season samples from wells 51, 59 and 71.

Traces of two non-agricultural chemicals, dicamba and pichloram, were also detected in 3 wells. Dicamba was found in wells 63 and 76, pichloram in well 68.

Interpretation of Results

The Pesticide Project was designed to investigate potential pesticide contamination in worst case situations, specifically, intensely farmed areas in the most geologically sensitive environments. Originally, ground water in sand and gravel deposits was thought to be the most sensitive to contamination, with water from till somewhat less at risk, and water from bedrock fractures the least vulnerable. Preliminary analysis of the combined data from 1985 and 1986 does not corroborate this assumption.

Of 88 samples from wells in sand and gravel overburden, 9 (10%) gave a positive result for some pesticide. Of 26 samples from wells in till overburden, 3 (12%) gave a positive result for some pesticide. Of 68 samples from bedrock wells, 20 (31%) gave a positive result for some pesticide.

TABLE 3

SUMMARY OF RESULTS

A. Percentage of wells having detectable levels of pesticides in at least one sampling period; by well and crop type.

	Well Type				
Crop Type	Sand & Gravel	Till	Bedrock	All Well Types	Number of Wells by Crop Type
Potato	18%	33%	64%	37%	59
Orchard	a	0%	50%	20%	5
Blueberry	20%	a	a	20%	10
Market Garden/ Forage Crop	20%	a	0%	18%	11
All Crop Types	19%	25%	58%	32%	
Number of Wells by Well Type	47	12	26		85

B. Percentage of samples with detectable pesticide levels; by sample and crop type.

	Sample Type				
Crop Type	Sand & Gravel	Till	Bedrock	All Well Types	Number of Samples by Crop Type
Potato	9%	15%	31%	20%	142
Orchard	a	0%	33%	11%	9
Blueberry	13%	a	a	13%	15
Market Garden/ Forage Crop	13%	a	0%	13%	16
All Crop Types	10%	12%	31%	18%	
Number of Samples by Sample Type	88	26	68		182

Table 3 Summary of Results (cont.)

C. Percentage of wells with nitrate levels exceeding drinking water standards in at least one sampling period; by well and crop type.

	Well Type				
Crop Type	Sand & Gravel	Till	Bedrock	All Well Types	Number of Wells by Crop Type
Potato	14%	11%	45%	25%	59
Orchard	a	0%	0%	0%	5
Blueberry	0%	a	a	0%	10
Market Garden/ Forage Crop	30%	a	100%[b]	36%	11
All Crop Types	15%	8%	42%	22%	
Number of Wells by Well Type	47	12	26		85

D. Percentage of samples with nitrate levels exceeding drinking water standards; by sample and crop type.

	Sample Type				
Crop Type	Sand & Gravel	Till	Bedrock	All Well Types	Number of Samples by Crop Type
Potato	12%	5%	28%	18%	142
Orchard	a	0%	0%	0%	9
Blueberry	0%	a	a	0%	15
Market Garden/ Forage Crop	20%	a	100%[c]	25%	16
All Crop Types	11%	4%	28%	16%	
Number of Samples by Sample Type	88	26	68		182

[a] No wells fall into this category.

[b] There was only one bedrock well in this category.

[c] There was only one sample in this category.

In the two years of the study, a total of 59 wells have been tested for the suite of pesticides used on potatoes. Of 22 bedrock wells that have been tested, 14 (64%) have had at least one positive pesticide sample. Of the 9 overburden wells in till, 3 (33%) had at least one positive pesticide sample. Out of 28 overburden wells in sand and gravel, 5 (18%) have had at least one positive pesticide sample.

This trend is also apparent for nitrate. Eleven (45%) of the 26 bedrock wells tested had at least one sample exceed the drinking water standard for nitrate. Eight (14%) of the 59 overburden wells tested had at least one sample exceed this limit. In samples from potato growing areas, 10 (46%) of 22 bedrock wells and five (14%) out of 37 overburden wells tested had at least one sample exceed the limit for nitrate.

These results must be considered preliminary, since only a limited number of samples have been analyzed, and the sampling plan was not designed to be statistically random. However, in contrast to studies in other states, these data suggest that bedrock wells may be more susceptible to contamination from agricultural practices than overburden wells. The data also indicate that overburden wells from till areas may be more susceptible to contamination than overburden wells in sand and gravel areas. Further studies are needed to determine the cause of these unexpected findings, and the 1987 sampling program will be adjusted to take this into account.

There is an apparent correlation between time of sampling and the percentage of samples giving positive results. The percentage of the samples yielding detectable levels of pesticides is higher in June (25%), July (28%), and August (22%) than in later months (0% to 15%), but this may be due to sampling bias. A monthly sampling of individual wells will be needed to confirm this trend.

Analysis of the first two years' data indicates that chemicals applied to potatoes pose the greatest threat of contamination to ground water. Of 16 samples from blueberry growing areas of Washington and Hancock Counties, mostly on sandy glacial deltas, only two samples showed traces of one chemical, hexazinone. Nine samples from the orchards of central Maine had no detectable levels of organic compounds; one had trace levels of arsenic. Sixteen samples from forage crop/market garden areas in the glacial deposits of the western Maine valleys gave two positive results, one for the herbicide atrazine and one for the herbicide alachlor. One-hundred-forty-eight samples have been taken from a variety of geologic environments in the potato growing areas of northern and western Maine; 27 of these have had detectable levels of chemicals. Eight different chemicals have been detected in potato growing areas; methamidophos, metribuzin, dinoseb, endosulfan, ethylene thiourea, chlorothalonil, dicamba and pichloram.

Summary

Results from the first two years of the study indicate that while pesticide residues are present in the ground water in some areas of Maine, concentrations are low. Of 188 samples taken in the study to date, only one contained pesticide (dinoseb) concentrations above an established health standard (2 ug/l), and only three exceeded statistically sound levels of detection.

Preliminary interpretation of the data suggests that conclusions drawn from studies in other states may not be entirely valid in Maine. Research in Wisconsin, California and Massachusetts indicated that ground water in sand and gravel deposits was most vulnerable to contamination from pesticides; Maine's study shows that bedrock wells may be more at risk.

The sampling program for the third year of the study will concentrate in potato growing areas in northern Maine. Careful time series sampling of two wells found to have a problem in the past will be carried out. More emphasis will be given to sampling bedrock wells, and an attempt will be made to sample adjacent wells screened in bedrock and surficial deposits. A conceptual hydrogeologic model will be developed to explain the differences found in the pesticide levels of bedrock and surficial wells. This work will be used to confirm the preliminary results, and to answer some of the questions raised by this study to date.

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TABLE 2 : PESTICIDES IN GROUND WATER STUDY : 1985 + 1986 SAMPLING RESULTS

WELL #	CROP TYPE	TOWN	GEOLOGIC SETTING	WELL TYPE	DEPTH TO WATER (FT)	DATE SAMPLED	NITRATE (mg/l)	PESTICIDES DETECTED	FILTERED	TESTS RUN
1	BLUEBERRIES	T19M BPP	S & G	OVB	47'	10/02/85	0	NONE	YES[1]	II,AS,NO3
						07/31/86	< .2	NONE	YES	II,I,NO3
2	BLUEBERRIES	COLUMBIA	S & G	OVB	16'	10/03/85	0	NONE	YES[1]	II,AS,NO3
						09/04/86	.23	NONE	YES	II,I,NO3
3	BLUEBERRIES	COLUMBIA	S & G	OVB	22'	10/03/85	0	NONE	YES[1]	II,AS,NO3
4	BLUEBERRIES	COLUMBIA	S & G	OVB	30'	10/03/85	0	7PPB(hexazinone)	YES[1]	II,AS,NO3
						09/04/86	< .2	NONE	YES	II,I,NO3
5	BLUEBERRIES	T18MD BPP	S & G	OVB	21'	10/03/85	0	NONE	YES[1]	II,AS,NO3
						09/04/86	< .2	NONE	YES	II,I,NO3
6	BLUEBERRIES	DEBLOIS	S & G	OVB	13'	10/04/85	< .2	9PPB(hexazinone)	YES[1]	II,AS,NO3
						09/04/86	.22	NONE	YES	II,I,NO3
7	BLUEBERRIES	AURORA	S & G	OVB	49'	10/01/85	0	NONE	YES[1]	II,AS,NO3
8	BLUEBERRIES	WHITNEYVILLE	S & G	OVB	4'	09/26/85	0	NONE	YES[1]	II,AS,NO3
9	BLUEBERRIES	NORTHFIELD	S & G	SPR	0'	09/26/85	0	NONE	NO	II,AS,NO3
10	BLUEBERRIES	MEDDYBEMPS	S & G	OVB	5'	09/25/85	< .2	NONE	YES[1]	II,AS,NO3
11	BLUEBERRIES	DEBLOIS	S & G	OVB	15'	09/04/86	.21	NONE	YES	II,I,NO3
12	ORCHARD	NEWPORT	TILL	BR	--	07/15/85	0	.037 mg/l(arsenic)	NO	II,DITH,NO3,AS,CU
13	ORCHARD	GREENE	TILL	OVB	1'	09/13/85	1.2	NONE	NO	II,NO3,CU,AS
						10/07/86	1.5	NONE	NO	II,NO3,CU,AS
14	ORCHARD	TURNER	TILL	OVB	--	07/10/85	.64	.05 mg/l(copper from piping)	NO	II,DITH,NO3,AS,CU
						10/09/86	.47	NONE	NO	II,NO3,CU,AS
15	ORCHARD	TURNER	TILL	BR	--	07/10/85	.25	NONE	NO	II,DITH,NO3,AS,CU
						10/09/86	.2	NONE	NO	II,NO3,CU,AS
16	ORCHARD	TURNER	TILL	OVB	--	07/10/85	.82	.07 mg/l(copper from piping)	NO	II,DITH,NO3,AS,CU
						10/09/86	1.11	NONE	NO	II,NO3,CU,AS
17	FORAGE CROP/ MARKET GARDEN	CHINA	S & G	OVB	14'	07/09/85	16.2[3]	NONE	NO	II,METH,AS,NO3
						09/16/86	1.47	NONE	YES	II,NO3
18	FORAGE CROP/ MARKET GARDEN	NORRIDGEWOCK	S & G	OVB	7'	07/11/85	1.82	.19PPB(alachlor)	YES[1]	II,NO3
					10'	09/17/86	<.2	NONE	YES	II,NO3
19	FORAGE CROP/ MARKET GARDEN	FRYEBURG	S & G	OVB	10'	09/18/86	.22	NONE	YES	II,NO3

TABLE 2 : PESTICIDES IN GROUND WATER STUDY : 1985 + 1986 SAMPLING RESULTS (cont'd)

WELL #	CROP TYPE	TOWN	GEOLOGIC SETTING	WELL TYPE	DEPTH TO WATER (FT)	DATE SAMPLED	NITRATE (mg/l)	PESTICIDES DETECTED	FILTERED	TESTS RUN
20	FORAGE CROP/ MARKET GARDEN	FRYEBURG	S & G	OVB	11'	07/23/85	3.47	NONE	YES[1]	II,METH,NO3
21	FORAGE CROP/ MARKET GARDEN	FRYEBURG	S & G	OVB	5'	07/23/85	0	NONE	YES[1]	II,METH,NO3
22	FORAGE CROP/ MARKET GARDEN	FRYEBURG	S & G	OVB	13'	07/23/85	6.94	NONE	YES[1]	II,METH,NO3
	POTATO					09/18/86	7.14	NONE	YES	II,I,NO3
23	FORAGE CROP/ MARKET GARDEN	FRYEBURG	S & G	OVB	12'	07/24/85	7.68	NONE	YES[1]	II,METH,NO3
						11/21/85	4.41	NONE	YES[1]	II,I,AS,NO3
						09/18/86	1.06	NONE	YES	II,I,NO3
24	FORAGE CROP/ MARKET GARDEN	FRYEBURG	S &G	OVB	13'	07/24/85	0	NONE	YES[1]	II,NO3
25	FORAGE CROP/ MARKET GARDEN	UNITY	S & G	OVB	16'	07/09/85	12.4[3]	NONE	NO	II,AS,NO3,METH
26	FORAGE CROP/ MARKET GARDEN	CANTON	S & G	OVB	15'	07/10/85	41.5[3]	.4PPB(atrazine)	NO	II,AS,NO3,METH,TEM
27	FORAGE CROP/ MARKET GARDEN	PITTSFIELD	TILL	BR	--	08/01/85	24.8[3]	NONE	NO	II,NO3
28	POTATO	WOODLAND	TILL	BR	--	07/16/85	1.67	NONE	NO	II,I,TEM,AS,NO3
						09/18/85	1.51	NONE	NO	II,I,MON,NO3
29	POTATO & PEAS	PRESQUE ISLE	TILL	BR	--	07/16/85	2.67	1.33PPB(methamidophos)	NO	II,I,MON,AS,NO3
						09/18/85	3.40	NONE	NO	II,I,MON,NO3
30	POTATO	FT.FAIRFIELD	S & G	OVB	~20'	07/16/85	5.85	.09PPB(methamidophos)	NO	II,I,MON,AS,NO3
						09/17/85	5.17	NONE	NO	II,I,MON,NO3
						07/08/86	4.99	NONE	NO	II,I,NO3
						09/25/86	5.58	NONE	NO	II,I,MON,NO3
						10/29/86	--	NONE	NO	I
31	POTATO & PEAS	LIMESTONE	TILL	BR	--	07/17/85	12.4[3]	.06PPB(metribuzin)	NO	II,I,AS,NO3
						09/17/85	9.5	NONE	NO	II,I,MON,NO3
						06/17/86	10.9[3]	NONE	NO	II,I,NO3
						09/17/86	10.4[3]	8PPB(methamidophos)	NO	II,MON,ETU,NO3
						10/15/86	--	NONE	NO	I
32	POTATO & VEGETABLES	PRESQUE ISLE	TILL	BR	--	07/17/85	5.55	.007PPB(metribuzin) .81PPB(dinoseb)	NO	II,I,AS,NO3
						09/18/85	4.26	NONE	NO	II,I,MON,NO3
						06/18/86	4.88	NONE	NO	II,I,NO3
						09/25/86	5.22	NONE	NO	II,I,MON,ETU,NO3
33	POTATO	PRESQUE ISLE	TILL	BR	--	07/16/85	22.2[3]	.01PPB(metribuzin)	NO	II,I,AS,NO3
						09/17/85	11.28[3]	NONE	NO	II,I,MON,NO3
						06/17/86	19.7[3]	.22PPB(endosulfan)	NO	II,I,NO3
						09/25/86	11.52[3]	.83PPB(dinoseb)	NO	II,I,MON,NO3
						10/16/86	--	NONE	NO	I
34	POTATO	MAPLETON	TILL	BR	15'	07/17/85	4.63	.22PPB(dinoseb)	NO	II,I,AS,NO3
						09/18/85	6.8	NONE	NO	II,I,MON,NO3

TABLE 2 : PESTICIDES IN GROUND WATER STUDY : 1985 + 1986 SAMPLING RESULTS (cont'd)

WELL #	CROP TYPE	TOWN	GEOLOGIC SETTING	WELL TYPE	DEPTH TO WATER (FT)	DATE SAMPLED	NITRATE (mg/l)	PESTICIDES DETECTED	FILTERED	TESTS RUN
34 (con't)	POTATO	MAPLETON	TILL	BR	15'	06/19/86	5.95	NONE	NO	II,I,NO3
						09/24/86	10.6[3]	NONE	NO	II,NO3
						10/14/86	—	NONE	NO	I
35	POTATO	PRESQUE ISLE	TILL	BR	--	07/17/85	5.75	NONE	NO	II,I,AS,NO3
						09/17/85	4.26	NONE	NO	II,I,MON,NO3
36	POTATO	BRIDGEWATER	TILL	BR	12'	07/17/85	4.61	10.5PPB(methamidophos) 0.38PPB(dinoseb)	NO	II,I,MON,AS,NO3
						09/18/85	4.6	NONE	NO	II,I,MON,NO3
						06/18/86	7.48	NONE	NO	II,I,NO3
						09/26/86	6.70	NONE	NO	II,I,MON,NO3
						10/16/86	--	NONE	NO	I
37	POTATO	FT.FAIRFIELD	TILL	BR	--	07/16/85	10.20[3]	0.59PPB(dinoseb)	NO	II,I,AS,NO3
						09/17/85	11.00[3]	NONE	NO	II,I,MON,AS,NO3,CU
						06/17/86	7.88	2.3PPB(dinoseb)	NO	II,I,NO3
						09/25/86	8.28	NONE	NO	II,NO3
38	POTATO/ FORAGE CROP	PITTSFIELD	TILL	BR	--	08/01/85	10.1[3]	0.08PPB(methamidophos)	NO	II,I,MON,AS,NO3,CU
39	POTATO	PITTSFIELD	TILL	BR	--	08/01/85	9.5	0.13PPB(methamidophos) 0.06PPB(dinoseb)	NO	II,I,MON,AS,NO3,CU
40	POTATO/ MARKET GARDEN	PITTSFIELD	TILL	BR	—	08/01/85	24.8[3]	NONE	NO	II,NO3
41	POTATO	FRYEBURG	S & G	OVB	16'	07/23/85	17.2[3]	0.40PPB(endosulfan)	YES[1]	II,I,NO3,AS
						09/13/85	15.2[3]	NONE	YES[1]	II,MON,NO3,AS
						11/22/85	19.16[3]	NONE	YES[1]	II,I,NO3,AS
42	POTATO	FRYEBURG	S & G	OVB	13'	07/24/85	2.56	NONE	YES[1]	II,I,NO3,AS,TEM
43	POTATO	FRYEBURG	S & G	OVB	17'	07/25/85	0	NONE	YES[1]	II,I,NO3,AS,TEM
						09/12/85	0.16	NONE	YES[1]	II,MON,AS,NO3
44	POTATO	FRYEBURG	S & G	OVB	18'	07/24/85	7.17	NONE	YES[1]	II,I,AS,NO3
						09/12/85	6.82	NONE	YES'	II,MON,AS,NO3
45	POTATO/ BEANS	FRYEBURG	S & G	OVB	14'	07/23/85	0.63	NONE	YES[1]	II,TEM,I,NO3,AS
						09/12/85	0.43	NONE	YES[1]	II,MON,AS,NO3
46	POTATO/ BEANS	FRYEBURG	S & G	OVB	10'	07/23/85	0	NONE	YES[1]	II,I,NO3,AS,TEM
	POTATO					11/21/85	--	NONE	YES[1]	II,I,AS.NO3
	FORAGE CROP	FRYEBURG				09/18/86	0.22	NONE	YES	II,NO3
47	POTATO/ BEANS	FRYEBURG	S & G	OVB	16'	07/25/86	1.33	NONE	YES[1]	II,I,NO3,AS,TEM

TABLE 2 : PESTICIDES IN GROUND WATER STUDY : 1985 + 1986 SAMPLING RESULTS (cont'd)

WELL #	CROP TYPE	TOWN	GEOLOGIC SETTING	WELL TYPE	DEPTH TO WATER (FT)	DATE SAMPLED	NITRATE (mg/l)	PESTICIDES DETECTED	FILTERED	TESTS RUN
48	POTATO	BRIDGEWATER	S & G	OVB	—	08/26/86	0.70	NONE	NO	II,I,NO3
						09/26/86	<.2	NONE	NO	II,I,MON,NO3
49	POTATO	FT.FAIRFIELD	S & G	OVB	—	07/31/86	7.13	NONE	NO	II,I,NO3
						09/17/86	7.16	NONE	NO	II,ETU,NO3
						10/15/86	—	NONE	NO	I
50	POTATO	FT.FAIRFIELD	S & G	OVB	—	07/31/86	7.09	NONE	NO	II,I,NO3
						09/25/86	12.83[3]	NONE	NO	II,I,MON,NO3
						10/29/86	—	NONE	NO	I
51	POTATO	FT.FAIRFIELD	TILL	BR	—	07/30/86	3.78	NONE	NO	II,I,NO3
						09/18/86	4.16	4.1PPB(ethylene thiourea)	NO	II,NO3,ETU
52	POTATO	FT.FAIRFIELD	TILL	BR	—	07/31/86	8.31	NONE	NO	II,I,NO3
						09/17/86	—	NONE	NO	I
53	POTATO	CARIBOU	S & G	OVB	—	08/12/86	7.37	NONE	NO	II,I,NO3
						09/17/86	8.40	5PPB(methamidophos)	NO	II,MON,NO3
						10/14/86	—	NONE	NO	I
54	POTATO	FT.FAIRFIELD	S & G	OVB	--	10/30/86	11.0[3]	NONE	NO	II,I,MON,ETU,NO3
55	POTATO	FT.FAIRFIELD	TILL	OVB	—	07/08/86	7.72	NONE	NO	II,I,NO3
						09/17/86	8.02	NONE	NO	NO3,ETU
56	POTATO	WOODLAND	S & G	OVB	—	06/19/86	4.67	NONE	NO	II,I,NO3
						09/18/86	--	NONE	NO	II,MON,NO3
						10/14/86	--	NONE	NO	I
57	POTATO	CARIBOU	TILL	OVB	—	08/09/86	1.82	NONE	NO	II,I,NO3
						10/29/86	1.73	NONE	NO	II,I,NO3,MON
58	POTATO	CHAPMAN	TILL	OVB	3'	08/25/86	1.42	NONE	NO	II,I,NO3
						09/24/86	0.67	7PPB(methamidophos)	NO	I, MON, NO3
						10/14/86	--	NONE	NO	I
59	POTATO	CARIBOU	TILL	OVB	—	07/29/86	7.74	NONE	NO	II,I,NO3
						09/18/86	8.23	3.1PPB(ethylene thiourea)	NO	II,MON,ETU,NO3
						10/29/86	--	NONE	NO	I
60	POTATO	WASHBURN	S & G	SPR	0	07/27/86	0.2	NONE	NO	II,I,NO3
						09/24/86	0.53	NONE	NO	II,I,MON,ETU,NO3
						10/14/86	—	NONE	NO	I
61	POTATO	PRESQUE ISLE	TILL	BR	—	08/12/86	6.67	NONE	NO	II,I,NO3
						09/25/86	10.5[3]	NONE	NO	II,I,MON,NO3
						10/30/86	—	NONE	NO	I
62	POTATO	FT.FAIRFIELD	S & G	OVB	—	08/12/86	6.88	NONE	NO	II,I,NO3
						09/18/86	7.07	NONE	NO	II,ETU,NO3
						10/29/86	—	NONE	NO	I

TABLE 2 : PESTICIDES IN GROUND WATER STUDY : 1985 + 1986 SAMPLING RESULTS (cont'd)

WELL #	CROP TYPE	TOWN	GEOLOGIC SETTING	WELL TYPE	DEPTH TO WATER (FT)	DATE SAMPLED	NITRATE (mg/l)	PESTICIDES DETECTED	FILTERED	TESTS RUN
63	POTATO	FT.FAIRFIELD	TILL	BR	—	07/08/86	5.26	NONE	NO	II,I,NO3
						09/17/86	4.89	NONE	NO	II,MON,ETU,TEM,NO3
						10/15/86	—	0.27PPB(dicamba)[2]	NO	I
64	POTATO	FT.FAIRFIELD	S & G	OVB	—	07/08/86	4.99	NONE	NO	II,I,NO3
						09/25/86	5.58	NONE	NO	II,I,MON,NO3
						10/29/86	—	NONE	NO	I
65	POTATO	FT.FAIRFIELD	S & G	OVB	—	08/26/86	2.22	0.02PPB(chlorothalonil)	NO	II,I,NO3
						09/17/86	2.21	NONE	NO	II,MON,ETU,NO3
						10/15/86	—	NONE	NO	I
66	POTATO	LIMESTONE	S & G	BR	—	07/30/86	12.2[3]	NONE	NO	II,I,NO3
						09/17/86	9.79	NONE	NO	II,ETU,NO3
67	POTATO	WASHBURN	S & G	OVB	—	08/11/86	<.2	NONE	NO	II,I,NO3
						09/24/86	<.2	NONE	NO	II,ETU,NO3
68	POTATO	WASHBURN	TILL	BR	—	07/29/86	7.63	1.4PPB(pichloram)[2]	NO	II,I,NO3
						09/24/86	7.56	NONE	NO	II,I,MON,ETU,NO3
						10/14/86	—	NONE	NO	I
69	POTATO	CARIBOU	TILL	OVB	—	06/19/86	1.70	NONE	NO	II,I,NO3
						09/18/86	1.67	NONE	NO	II,NO3
70	POTATO	FT.FAIRFIELD	TILL	OVB	—	07/08/86	5.21	NONE	NO	II,I,NO3
						09/17/86	3.72	10PPB(methamidophos)	NO	II,MON,ETU,TEM,NO3
						10/15/86	—	NONE	NO	I
71	POTATO	FT.FAIRFIELD	S & G	OVB	—	07/30/86	5.30	NONE	NO	II,I,NO3
						09/18/86	5.47	4.6PPB(ethylene thiourea)	NO	II,I,MON,ETU,NO3
						10/29/86	—	NONE	NO	I
72	POTATO	FT.FAIRFIELD	S & G	OVB	—	07/31/86	13.72[3]	NONE	NO	II,I,NO3
						09/25/86	12.7[3]	NONE	NO	II,NO3
73	POTATO	CARIBOU	TILL	OVB	—	08/11/86	8.25	NONE	NO	II,I,NO3
						09/18/86	8.93	NONE	NO	II,ETU,NO3
						10/14/86	—	NONE	NO	I
74	POTATO	FT.FAIRFIELD	TILL	STR	0	08/12/86	1.04	NONE	NO	II,I,NO3
						09/18/86	1.98	NONE	NO	II,MON,ETU,NO3
75	POTATO	WOODLAND	TILL	BR	—	08/11/86	17.0[3]	0.16PPB(metribuzin) 0.28PPB(dinoseb)	NO	II,I,NO3
						09/24/86	21.2[3]	0.02PPB(metribuzin)	NO	II,NO3
						10/14/86	—	NONE	NO	I
76	POTATO	CARIBOU	TILL	BR	—	08/09/86	7.66	NONE	NO	II,I,NO3
						09/18/86	8.6	6PPB(methamidophos)	NO	II,MON,ETU,NO3
						10/30/86	—	1.1PPB(dicamba)	NO	I

TABLE 2 : PESTICIDES IN GROUND WATER STUDY : 1985 + 1986 SAMPLING RESULTS (cont'd)

WELL #	CROP TYPE	TOWN	GEOLOGIC SETTING	WELL TYPE	DEPTH TO WATER (FT)	DATE SAMPLED	NITRATE (mg/l)	PESTICIDES DETECTED	FILTERED	TESTS RUN
77	POTATO	FT.FAIRFIELD	S & G	BR	--	08/27/86	4.79	NONE	NO	II,I,NO3
						09/17/86	5.37	NONE	NO	II,ETU,NO3
						10/15/86	--	NONE	NO	I
78	POTATO	FT.FAIRFIELD	S & G	OVB	10'	10/31/86	2.87	NONE	YES	II,I,NO3,ETU
79	POTATO	WASHBURN	S & G	OVB	8'	10/31/86	1.85	NONE	YES	II,I,NO3
80	POTATO	GRAND ISLE	S & G	OVB	24'	11/12/86	<.2	NONE	YES	II,I,MON,ETU,NO3
81	POTATO	PRESQUE ISLE	TILL	OVB	--	11/12/86	11.37[3]	--	YES	NO3
82	POTATO	PRESQUE ISLE	TILL	OVB	--	11/12/86	5.50	NONE	YES	II,I,MON,ETU,NO3
83	POTATO	PRESQUE ISLE	S & G	OVB	--	10/30/86	<.2	NONE	YES	II,I,NO3,ETU
84	POTATO	PRESQUE ISLE	TILL	BR	--	08/09/86	14.4[3]	NONE	NO	II,I,NO3
						09/25/86	16.88[3]	NONE	NO	II,NO3
						10/29/86	--	NONE	NO	I
85	POTATO	MASARDIS	S & G	OVB	7'	10/30/86	<.2	NONE	YES	II,I,NO3
86	POTATO/ MARKET GARDEN	FT.FAIRFIELD	S & G	OVB	19'	11/12/86	0.47	NONE	YES	II,I,MON,ETU,NO
87	POTATO	FRYEBURG	S & G	OVB	--	11/27/85	<.2	NONE	YES[1]	II,I,AS,NO3
88	POTATO	FRYEBURG	S & G	OVB	--	11/22/85	<.2	NONE	YES[1]	II,I,AS,NO3

KEY

GEOLOGIC SETTING

S & G = SAND AND GRAVEL
TILL = TILL

WELL TYPE

OVB = OVERBURDEN WELL
BR = BEDROCK WELL
SPR = SPRING/SEEP
STR = STREAM/SEEP

TESTS RUN

SCREENS

I = I SCREEN
II = II SCREEN
AS = ARSENIC
CU = COPPER
NO3 = NITRATE

SPECIAL TESTS

DITH = DITHIOCARBAMATE
METH = METHOMYL
TEM = TEMIK
MON = MONITOR
ETU = ETHYLENE THIOUREA

NOTES:

1 - CERTAIN PESTICIDES WERE FILTERED OUT WITH THE FILTERS USED.
2 - NOT AN AGRICULTURAL CHEMICAL. USED AS A RIGHT-OF-WAY HERBICIDE.
3 - EXCEEDS THE STATES' DRINKING WATER STANDARD OF 10.0 mg/l FOR NITRATE.

ALL PESTICIDE RESULTS ARE AT TRACE LEVELS (BELOW LABORATORY MLD) EXCEPT:
WELL # 36 (7/17/85 SAMPLE)
WELL # 37 (6/17/86 SAMPLE)
WELL # 70 (9/17/86 SAMPLE)

APPENDIX A

Pesticide Selection Project:

Pesticide in Ground-Water Group

Contributors:

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October 30, 1985

Overview

The ongoing Maine Pesticides Study was recommended by the Ground-Water Policy Review Committee. The recommendation was endorsed by then governor Joseph E. Brennan and funding for analytical costs of the study was provided by the Legislature. The study was planned and is being executed by an inter-agency Pesticides in Ground-Water Group with representation from the Maine Department of Agriculture, Pesticides Control Board; Maine Department of Environmental Protection; the Department of Human Services, Drinking Water Program, State Public Health Lab; and the U.S. Geological Survey. The Maine Geological Survey was directed to coordinate the project.

The project is to be conducted over a three-year period, with 1985 as the first year. Because the recommendation was not accepted until the spring of 1985, a quick start was mandatory. The group resolved both to narrow the field of investigation and to utilize the work already done in other states (notably Wisconsin and California) as an aid to design the study.

All the scoring and ranking was performed based on data available from existing studies and records. The amount and reliability of data varied among both pesticides and categories. For example, the quantity sold is known much more accurately than the leachability of a particular pesticide. Similarly, one pesticide can be used as either a foliar spray or applied to the soil, with different ground-water contamination potentials.

In developing the rankings and selecting sampling locations, a conservative approach was adopted: the "worst case" for any given element was used in the ranking, and wells in the most geologically sensitive locations were selected for sampling. However, new data are being developed by EPA and pesticides manufacturers, particularly on leachability, which may make the rankings less reliable.

The quantity, application, and leachability scores were each developed separately and then combined to yield a total score. The development of each score is explained separately. Quantity and application scores were developed primarily by Pesticides Control Board Staff, and Leachability scores primarily by the Drinking Water Program.

As the Pesticides Work Group began to function, it immediately became clear that there was a need, due to time and financial constraints, to focus our attention on those pesticides that were both commonly used in Maine and that posed the greatest threat of contamination of ground water. We therefore scored and ranked commonly used, registered pesticides on three attributes: quantity of pesticide sold, method of pesticide application, and the leachability of the pesticide in soils.

Upon completion, the matrix listed 44 pesticides. All 44 were considered for the first round of samples, after which the matrix and analyzed list will be refined.

Quantity Sold

The quantity of pesticide sold was categorized on a scale of 1-10 as follows:

1 =	0 - 5,000 lbs. sold	6 =	30,000 - 40,000 lbs. sold
2 =	5,000 - 10,000 lbs. sold	7 =	40,000 - 50,000 lbs. sold
3 =	10,000 - 15,000 lbs. sold	8 =	50,000 - 60,000 lbs. sold
4 =	15,000 - 20,000 lbs. sold	9 =	60,000 - 300,000 lbs. sold
5 =	20,000 - 30,000 lbs. sold	10 =	> 300,000 lbs. sold

The quantity sold and scoring for each pesticide are shown below:

1984 Maine Agricultural Pesticide Sales

Generic Name of Pesticide	Lbs. of Active Ingredient Sold in 1984	Score	Principal Uses
maneb (F)	500,000±	10	Potatoes, apples, broccoli, vegetables, dried beans
mancozeb (F)	581,987	10	Potatoes, apples, broccoli, vegetables, dried beans
dinoseb (H, TK)	323,224	10	Potatoes, peas, dried beans, vegetables
chlorothalanil (F)	129,959	9	Potatoes, broccoli
disulfoton (SI)	58,576	8	Potatoes
phosmet (I)	57,910	8	Apples, potatoes, vegetables
atrazine (H)	54,974	8	Forage corn, sweet corn
methamidophos (I)	47,604	7	Potatoes
captan (F)	37,920	6	Apples, seed treat potatoes, vegetables strawberries, peas
hexazinone (H)	33,540	6	Blueberries
dalapon (H)	32,437	6	Potatoes
metribuzin (H)	24,980	5	Potatoes
linuron (H)	23,825	5	Potatoes
azinphos-methyl (I)	18,033	4	Blueberries, apples, potatoes
diquat (TK)	17,980	4	Topkill potatoes
metolachlor (H)	14,242	3	Forage corn, sweet corn
PCNB (STF)	13,059	3	Seed treat potatoes
aldicarb (SI)	12,906	3	Potatoes
E.P.T.C. (H)	12,847	3	Potatoes, dried beans,

			beans
carbaryl (I)	12,145	3	Vegetables, sweet corn, potatoes, apples
carbofuran (SI)	12,291	3	Forage corn, potatoes, vegetables
metalaxyl (F)	11,899	3	Potatoes
cyanazine (H)	10,684	3	Forage corn, sweet corn
butylate (H)	10,645	3	Forage corn, sweet corn
alachlor (H)	10,250	3	Forage corn, sweet corn
demeton (I)	9,888	2	Oats, potatoes, apples
glyphosate (H)	9,572	2	Apples, sweet corn, beans, vegetables
endosulfan (I-SI)	8,420	2	Potatoes, apples, vegetables
dodine (F)	7,341	2	Apples
thiabendazole (STF)	6,429	2	Potatoes-seed treatment
simazine (H)	5,985	2	Apples, forage corn, Christmas trees
dichlone (F)	4,855	1	Apples
napropamide (H)	4,734	1	Broccoli, strawberries, vegetables
copper sulfate (F)	4,729	1	Apples
trifluralin (H)	3,848	1	Peas, broccoli, dried beans, vegetables
cupric hydroxide (F)	3,455	1	Apples, dried beans
dicamba (H)	3,100	1	Corn, Row
benomyl (F)	2,597	1	Blueberries, apples, dried beans, strawberries
oxydemeton-methyl (I)	2,340	1	Potatoes, vegetables
diazinon (I)	2,205	1	Vegetables

KEY:

F = fungicide
H = herbicide
I = insecticide

SI = soil incorporated granular insecticide
STF = seed treatment fungicide
TK = topkill

It should be noted that the top six pesticides are all used on potatoes, and that only 16 of this list are <u>not</u> used on potatoes.

Application Method

The application method and timing is an important variable in determining the likelihood of ground-water transport. Clearly, a foliar application during July, a normally dry season, has less chance of reaching ground water than a spring soil injection of the same material. A rating key for pesticide application methods is shown below:

RATING KEY

APPLICATION METHOD	TIMING	DOSE (in maximum number of lbs acre/year)
4 = Soil incorporated	3 = Spring	3 = 8 and above
3 = Applied to soil	2 = Fall	2 = 3 - 8
2 = Seed treatment	1 = Summer	1 = 0 - 3
1 = Foliar application		

Each chemical was ranked based on its dominant use. The highest score would be generated by a soil incorporated pesticide (4) applied in the spring, during recharge (3) at a rate of 8 or more pounds per acre (3) for a total of 10. The lowest rating would be achieved by a foliar application (1) during the summer (1) at a rate of less than 3 lbs/acre (1); for a score of 3. The results of the application rating are as follows:

PESTICIDE APPLICATION RATING

PESTICIDE	APPLICATION METHOD	TIMING	DOSE	SCORE
dalapon	3	3	3	9
E.P.T.C.	4	3	2	9
disulfoton	4	3	1	8
carbofuran	4	3	1	8
cyanazine	3	3	2	8
butylate	3	3	2	8
alachlor	3	3	2	8
aldicarb	4	3	1	8
napropamide	4	3	1	8
trifluralin	4	3	1	8
PCNB	2	3	3	8
dinoseb	2	2.5	3	7.5
hexazinone	3	3	1	7
metribuzin	3	3	1	7
linuron	3	3	1	7
metolachlor	3	3	1	7
glyphosate	3	3	1	7
simazine	3	3	1	7
atrazine	3	3	1	7
captan	1	3	3	7

thiabendazole	2	3	1	6
maneb or mancozeb	1	1	3	5
phosmet	1	1	3	5
copper sulfate	1	1	3	5
chlorothalanil	1	1	3	5
carbaryl	1	1	3	5
azinphos-methyl	1	1	2	4
diquat	1	2	1	4
methamidophos	1	1	2	4
endosulfan	1	1	2	4
dodine	1	1	2	4
dichlone	1	1	2	4
benomyl	1	1	2	4
metalaxyl	1	1	1	3
demeton	1	1	1	3
cupric hydroxide	1	1	1	3
oxydemeton	1	1	1	3
diazinon	1	1	1	3
pichloram	1	1	1	3
dicamba	1	1	1	3

Leachability

The leachability score is subdivided into four parts. First, pragmatically, the pesticide was scored on whether it had been found in ground water. A pesticide found in ground water in Maine, or on EPA's list of mobile pesticides received a 3.

Secondly, the pesticides were rated on laboratory water solubility on an exponential scale, with those soluble at greater than 300 ppm scored as 2. Thirdly, they were scored on their affinity for organic matter in soils, with a low affinity given 1 point. Finally, they were scored on their stability in the soil system. Sub-components of this score were soil degradation, hydrolysis and photo degradation, and laboratory or field half life. The maximum score was 4. The leachability criteria and ratings are shown below:

CRITERIA FOR RATING LEACHABILITY

(1) Found in ground Water — MAX Score=3

1 - Not found in groundwater, but has high leaching potential
2 - Found in groundwater
3 - On EPA known "leachers" list or has been found in ground water in Maine.

(2) Solubility in water — MAX Score=2

0 - Less than 30 PPM
1 - Greater than 30 PPM
2 - Greater than 300 PPM

(3) Affinity for organic matter MAX Score=1

Kd (Soil/water adsorption coefficient) is less than 5 and usually less than 1 or 2.
Koc (Kd divided by soil organic carbon content) is less than 300-500.

(4) Stability of pesticides

Soil degradation MAX Score=2
1 - Soil half life is greater than 2 to 3 weeks but less than 6 months.
2 - Soil half life is greater than 6 months.

Hydrolysis and photodegradation: MAX Score=1
Hydrolysis half life is greater than 6 months or Photolysis half life is greater than 2 - 3 weeks.

Laboratory/field half life: MAX Score=1
Greater than 2 - 3 weeks

LEACHABILITY RATING

Pesticide Name	found in groundwater	solubility in water	stability in soils	affinity for organic mater	Total
1. Aldicarb	3	2	4	1	10
2. Carbofuran	3	2	4	1	10
3. Metribuzin	3	2	4	1	10
4. Atrazine	3	1	4	1	9
5. Metholachlor	2	2	4	1	9
6. Pichloram	3	2	4	-	9
7. Dinoseb	3	1	3	1	8
8. Alachlor	3	1	3	1	8
9. Simazine	3	0	4	1	8
10. Hexazinone	3	2	2	1	8
11. Azinophos-methyl	3	1	3	0	7
12. Thibendazole	1	2	4	0	7
13. Maneb	3*	1	2	1	7
14. Mancozeb	3*	1	2	1	7
15. Dicamba	3	2	2	-	7
16. Linuron	0	1	4	1	6
17. Paraquat	0	2	4	0	6
18. Endosulfan	3	1	2	0	6
19. Methamidophos	3	1	1	1	6
20. Dalapon	0	2	2	1	5
21. Metalaxyl	0	2	2	1	5
22. Butylate	0	1	3	1	5
23. Glyphosate	0	2	3	0	5
24. Chlorothalinil	3	0	2	0	5
25. E.P.T.C.	0	2	2	0	4
26. Carbaryl	0	1	2	1	4
27. Cyanazine	0	1	2	1	4

PESTICIDE IN GROUND WATER RANKING MATRIX

k	Pesticide Name	Quantity	How Applied	Leachable	Score	Testable
1	dinoseb	10	7.5	8	8.50	yes
2	atrazine	8	7	9	8.00	yes
3	carbofuran	3	8	10	7.00	yes
4	aldicarb	3	8	10	7.00	yes
5	metribuzin	5	7	9	7.00	yes
6	dalapon	6	9	5	6.67	yes
7	mancozeb	10	5	4	6.33	yes
8	maneb	10	5	4	6.33	yes
9	alachlor	3	8	8	6.33	yes
10	metolachlor	3	7	9	6.33	?
11	linuron	5	7	6	6.00	yes
12	disulfoton	8	8	2	6.00	no
13	hexazinone	6	7	5	6.00	yes
14	simazine	2	7	8	5.67	no
15	butylate	3	8	5	5.33	yes
16	E.P.T.C.	3	9	4	5.33	yes
17	chlorothalonil	9	5	2	5.33	yes
18	azinphos-methyl	4	4	7	5.00	yes
19	cyanazine	3	8	4	5.00	?
20	PCNB	3	8	4	5.00	yes
21	thiabenzadole	2	6	7	5.00	yes
22	glyphosate	2	7	5	4.67	no
23	methamidophos	7	4	3	4.67	yes
24	captan	6	7	0	4.33	yes
25	phosmet	8	5	0	4.33	yes
26	napropamide	1	8	4	4.33	no
27	carbaryl	3	4	4	3.67	yes
28	metalaxyl	3	3	5	3.67	?
29	trifluralin	1	8	2	3.67	yes
30	dicamba	1	3	7	3.67	yes
31	endosulfan	2	4	4	3.33	yes
32	dodine	2	4	4	3.33	no
33	diquat	4	4	2	3.33	no
34	pichloram		3	9	3.00	yes
35	diazinon	1	3	4	2.67	yes
36	oxydemeton	1	3	4	2.67	?
37	paraquat	1		6	2.33	no
38	benomyl	1	4	2	2.33	no
39	demeton	2	3	2	2.33	no
40	dichlone	1	4	2	2.33	no
41	copper sulfate	1	5		2.00	yes
42	endothal	1		4	1.67	no
43	malathion	1		4	1.67	yes
44	permethrin	1		3	1.33	no
45	cupric hydroxide	1	3		1.33	yes
46	methomyl	1		2	1.00	no