Water-Level Monitoring, Bellingham Frozen Foods
September 14 through December 9, 1993
Bellingham, Washington

by
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Environmental Investigations and Laboratory Services

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INTRODUCTION

This technical document describes the methods and results of the water level monitoring we conducted at Bellingham Frozen Foods. Bellingham Frozen Foods (BFF) applies vegetable processing wastewater to about 215 acres near the Nooksack River. Land application at the facility is subject to State Waste Discharge Permit requirements. One requirement of the permit is that land application of wastewater is not allowed when the unsaturated zone (the interval between the ground surface and the water table) is less than three feet. The permit requires that the depth to water be measured weekly during the application season from April 15 to November 15. Ecology's Water Quality Section at Northwest Regional Office requested that EILS monitor water levels continuously near the end of the wastewater application season to determine when the unsaturated zone is less than three feet.

METHODS

Water levels were measured at 1-hour intervals in three wells (MW2, MW3, and MW5) and at 30-minute intervals in one well (MW1) using pressure transducers and data loggers. Pressure transducers were installed September 14 and removed December 9. The transducers were installed at appropriate depths so that water levels three feet below ground surface were within the measurement range. The transducers are vented so that no barometric correction was needed. Table 1 lists pressure transducer ranges and depths for each well.

Data were stored in 64K byte Unidata data loggers. Data loggers were downloaded September 15, September 29, November 5 and December 9. Water levels were measured at each well using electric well probes during site visits. These water level measurements were used to adjust for transducer drift. Transducer data were adjusted mathematically assuming transducer drift was linear between electric probe measurements.

ACKNOWLEDGEMENTS

Many people contributed to the Agricultural Chemicals Pilot Study. Although it is not possible to acknowledge all participants, I would like to thank major contributors. Tony Barrett, formerly with Ecology's Water Quality Program, provided the original impetus for the project. Dale Norton, Laura Chern, and Randy Coots with Ecology's Environmental Investigations provided able assistance obtaining and handling samples. David Nash, Department of Health, prepared in timely fashion the health affects information for well owners. Barbara Stuart, Water Quality Program Ground Water Unit, worked tirelessly to prepare notification packages for well owners and public information releases. Julie Zalikowski, project manager for Montgomery Laboratories, was instrumental in maintaining the technical adequacy of the pesticide analyses. Pam Berns typed the manuscript and demonstrated great patience during the review cycles. And especially, I would like to thank the well owners who allowed us to sample their wells and make the project possible.

ABSTRACT

The Washington State Agricultural Chemicals Pilot Study provides reconnaissance information on the presence and concentration of pesticides in Washington's ground water. The study consists of sampling ground water from three areas, each considered susceptible to ground water contamination from agricultural chemicals. The study areas range in size from 10 to 35 square miles and are located in Whatcom, Franklin, and Yakima Counties. Twenty-seven shallow wells in each study area were tested for 46 pesticides.

The preliminary findings of the Pilot Study, based on one round of samples from each study area, indicate that pesticide residues have migrated to shallow ground water in these areas. Of the 81 wells sampled, 23 wells showed at least one pesticide.

The pesticides detected and the number of detections by study area are listed as follows:

Study Area	Pesticide	Number of Detections
WhatcomCounty	1,2-Dichloropropane	9
	Dibromochloropropane	1
	Ethylene Dibromide	2
	Carbofuran	1
	Prometon	2
Franklin County	Dacthal	7
	1,2-Dichloropropane	2
	Bromacil	1
Yakima County	Atrazine	1

The number of pesticide detections is highly variable between the study areas. Nearly all detections were observed in the Whatcom and Franklin study areas. A single detection was observed in the Yakima study area.

Observed concentrations were below those known to cause non-carcinogenic adverse human health affects. However, concentrations exceeded proposed Maximum Contaminant Levels (MCLs) in five wells for 1,2-dichloropropane, one well for ethylene dibromide, and one well for dibromochloropropane. All wells that exceeded proposed MCLs are located in the Whatcom County study area.

Nitrate/nitrite (as nitrogen) was detected in 61 of the 81 wells sampled at concentrations ranging from 0.10 to 24.4 mg/L. The Primary Maximum Contaminant Level of 10 mg/L was exceeded in 18 wells.

A final report which will include full results and data interpretations is scheduled for publication in December 1989.

INTRODUCTION

The use of agricultural chemicals in Washington State is widespread. However, the effects of these chemicals on the state's ground water quality are largely unknown. As of 1986, 17 pesticides had been found in the ground water of 23 states as the result of agricultural uses (Cohen, *et al*, 1986). In Washington, ethylene dibromide (EDB), a soil fumigant used to control nematodes, has been found in drinking water wells in Skagit, Thurston, and Whatcom Counties (DSHS, 1985). The 1987 Washington State Legislature funded the Department of Ecology to begin investigating the effects of agricultural chemicals on ground water quality in Washington. The Agricultural Chemicals Pilot Study is an initial step toward defining these effects.

Objectives

The primary objective of the Agricultural Chemicals Pilot Study is to provide reconnaissance information on the presence and concentration of pesticide residues in ground water of selected areas of Washington State.

Secondary objectives are:

- To evaluate the effectiveness of potential indicator parameters (nitrate/nitrite, total phosphorous, total organic carbon, total organic halogens, potassium, and dissolved solids) for identifying wells to be tested for pesticides.

- To correlate, where possible, site conditions and pesticide usage with any observed ground water contamination.

Purpose of Interim Report

The purpose of this interim report is to present the results of the first sampling round for pesticides and nitrate/nitrite. A final report will be prepared that describes all water quality results including a second round of verification sampling and quality assurance samples, land use for each study area, an analysis of the correlation of indicator parameter results with pesticide occurrences, and final findings and recommendations. The final report is scheduled to be completed in December 1989.

METHODS

Study Area Selection Process

To provide a statewide perspective, three agriculturally diverse and geographically separated study areas were chosen. Small study areas (six to thirty square miles) were chosen to allow hydrogeologic characterization and to provide a sufficient density of wells to define ground water quality.

On a statewide basis, general locations for potential study areas were identified using EPA's Designation of Areas Vulnerable to Pesticide Contamination (U.S. EPA, 1986). Refinement of the study area locations was based on review of statewide, regional, and local geologic and hydrogeologic reports, county soil reports, well log reports, as well as information from local health departments, regional Ecology offices, and the Washington State University Cooperative Extension Service. The three study areas selected (shown in Figure 1) are located in Whatcom, Franklin, and Yakima Counties. Characteristics used to select the areas were as follows:

- Presence of irrigated agriculture.
- Variety of crop types.
- Shallow ground water (less than 50 feet).
- Unconfined aquifer with porous media flow.
- Permeable, well-drained surficial soils.
- Available well information and an adequate number of shallow wells for sampling.
- Known occurrence of ground water contamination from agricultural chemicals.

Well Selection Criteria

Twenty-seven wells were selected for sampling in each study area. Criteria used to select wells were as follows:

- Proximity to agriculture practices.
- Ease of access.
- Availability of well construction information and stratigraphic logs.
- Shallow well intake interval, that is, depth interval from which the well draws water.
- Smaller well diameters were preferred because of the shorter purging time required prior to sampling.
- Newer wells were selected because of improved well construction practices in recent years and less time for deterioration of casing and well seal materials.
- Information about previous samples from the well particularly if data indicated contamination.

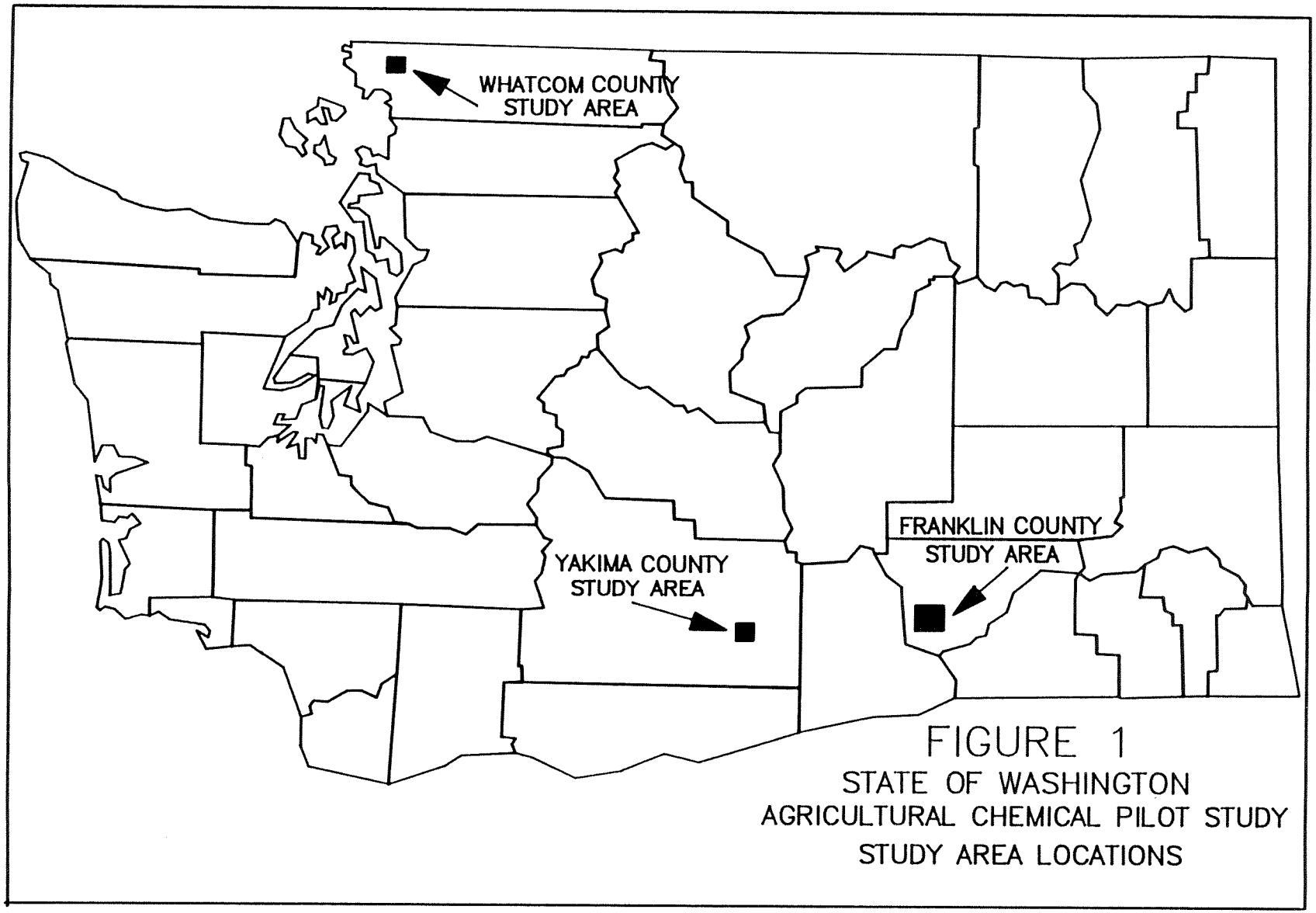

FIGURE 1
STATE OF WASHINGTON
AGRICULTURAL CHEMICAL PILOT STUDY
STUDY AREA LOCATIONS

- A spatial distribution that fairly represented shallow ground water quality for the study area.

- Wells not influenced by potential point sources such as pesticide mixing areas.

Sampling and Analysis

The initial round of sampling was conducted between August and October 1988. Eighty-one wells were sampled of which 67 were domestic wells, two were public water supply wells, seven were irrigation wells, and five were piezometers originally constructed for water-level measurements.

Most samples were obtained from private and public wells using existing installed pumps and piping. Sampling protocols are listed as follows:

- Water levels were obtained prior to and during purging.

- Wells were pumped until indicator parameters of temperature, specific conductance, and pH stabilized. A minimum of three casing volumes were purged from the well prior to sampling.

- Samples were obtained as close to the well head as possible before the water entered pressure tanks or was treated.

- All samples were stored on ice ($4^{o}C$) prior to delivery to the appropriate laboratory. Pesticide samples were shipped to the laboratory within 48 hours of collection.

- Five U.S. Bureau of Reclamation piezometers in the Franklin study were purged and sampled using teflon bailers. All bailers were precleaned with a LiquiNox wash, deionized water rinse, nitric acid rinse, methylene chloride rinse, and acetone rinse.

Table 1 lists the 46 pesticides targeted for analysis. Thirty-three were derived from EPA's list of leachable pesticides. These compounds have properties conducive to migration through soil to ground water (Cohen, 1985). Originally, 36 leachable pesticides which are now or have been registered for use in Washington State were targeted for analysis (U.S. EPA, 1986). Three of these, butylate, disulfoton, and maleichydrazide, could not be detected reliably with the analytical methods used. EDB, DBCP, and 2,4-D were added to the target list because of their known use in Washington State. Aldicarb sulfoxide and aldicarb sulfone were targeted because they are readily formed metabolites of alidcarb. An additional eight pesticides were added to the target list because laboratory test methods could identify them with little additional effort or cost.

Table 1. Pesticides, Test Methods, and Minimum Reporting Limits for the Agricultural Chemical Pilot Study.

Pesticide	Test Method*	Minimum Reporting Limit, ug/L
Acifluorfen	NPS 3	0.20
Alachlor	NPS 1	1.0
Aldicarb	NPS 5 & EPA 531	1.5
Aldicarb Sulfone	NPS 5 & EPA 531	1.0
Aldicarb Sulfoxide	NPS 5 & EPA 531	1.0
Ametryn	NPS 1	0.30
Atrazine	NPS 1	0.20
Baygon	NPS 4 & EPA 632	1.1
Bentazon	NPS 3	0.50
Bromacil	NPS 1	2.2
Carbufuran	NPS 4 & EPA 632	0.50
Carboxin	NPS 1	1.0
Chloramben	NPS 3	0.50
Cyanazine	NPS 4 & EPA 632	0.80
Cycloate	NPS 1	0.40
Dalapon	NPS 3	5.0
Dibromochloropropane	EPA 504 (Modified)	0.01
DCPAs (Dacthal)	NPS 3	0.20
Dicamba	NPS 3	0.20
Dichloroprop	NPS 3	0.50
Dinoseb	NPS 3	2.5
Diphenamide	NPS 1	0.40
Diuron	NPS 4 & EPA 632	0.50
Ethylene Dibromide	EPA 504 (Modified)	0.01
Fenamiphos	NPS 1	0.30
Hexazinone	NPS 1	0.30
Methomyl	NPS 4 & EPA 632	0.50
Metolachlor	NPS 1	1.5
Metribuzin	NPS 1	0.40
Oxamyl	NPS 4 & EPA 632	0.60
Pentachlorophenol	NPS 3	0.20
Picloram	NPS 3	1.0
Prometon	NPS 1	0.30
Propazine	NPS 1	0.20
Propham	NPS 4 & EPA 632	0.50
Silvex	NPS 3	0.20
Simazine	NPS 1	0.80
Tebuthiuron	NPS 1	0.40
Terbacil	NPS 1	3.50
1,2-Dichloropropane	EPA 501	0.20
2,4,5-Trichlorophenoxyacetic Acid	NPS 3	0.20
2,4-D	NPS 3	0.50
2,4-DB	NPS 3	2.0
3,5-Dichlorobenzoic Acid	NPS 3	0.60
4-Nitrophenol	NPS 3	5.0
5-Hydroxy Dicamba	NPS 3	0.20

*NPS 1 - Determination of N and P-containing pesticides by GC.
NPS 3 - Determination of chlorinated acids by GC with electron capture detector.
NPS 4 - Determination of pesticides in water by HPLC with UV.
NPS 5 - Measurement of N-Methyl Carbomoyloximes and N-Methyl Carbamates by direct aqueous injection HPLC with post-column derivitization.

Sources: U.S. EPA (1984), U.S. EPA (1987), and Montgomery Laboratories (1988)

The laboratory support for the first round of sampling is summarized in Table 2.

Table 2. Laboratory Support for the First Sampling Round of the Agricultural Chemical Pilot Study.

Laboratory	Analytes	Location
Montgomery Laboratories	Pesticides	Pasadena, CA
Columbia Analytical	Metals (except mercury)	Longview, WA
Aquatic Research Lab	Total phosphorous and nitrate/nitrite	Seattle, WA
Ecology/EPA Region X Lab	Major anions, indicator parameters, and mercury	Manchester, WA

Pesticide analyses were conducted by Montgomery Laboratories Inc, of Pasadena, California. In addition to method blanks and standard EPA contract laboratory instrument calibration requirements, quality assurance procedures included analysis of the following sample types: field replicates, transport blanks, transfer blanks, standard samples, and laboratory duplicates and spikes. Standard samples, consisting of known concentrations of selected pesticides, were prepared by Oregon State University. For pesticide analyses the level of effort (the ratio of QA samples to total samples) for replication, precision, and accuracy was about 30 percent.

An independent quality assurance review of all pesticide data was conducted by Ecology and Environment, Inc. of Seattle, Washington. All data presented in this report are considered acceptable for use.

In addition to pesticides, other parameters listed in Table 3 were measured. These results, which will be presented in the final report, will be used to define the general ground water quality of the study areas or will be evaluated as potential indicators of pesticide contamination. Six wells in each study area were tested for major cations/anions and trace metals. Metals (except for mercury) were analyzed by Columbia Analytical Services, Inc., of Longview, Washington. Nitrate/nitrite and total phosphorous analyses were conducted by Aquatic Research Incorporated of Seattle, Washington.

All other laboratory tests were conducted at the Ecology/EPA Region X Laboratory in Manchester, Washington.

Table 3. Non-Pesticide Parameters, Analytical Methods, and Detection Limits.

Parameter	Method of Analysis*	Reference	Detection Limit
Field Parameters:			
Water Level	Slope Indicator Well Probe	NA	NA
pH	Beckman pH Meter	NA	NA
Specific Conductance	Beckman RC-15C Conductivity Bridge	NA	NA
Temperature	Precision Thermometer	NA	NA
Indicator Parameters:			
Total Dissolved Solids	EPA #160.1	U.S. EPA (1983)	NA
Nitrate/Nitrite	EPA #353.2	U.S. EPA (1983)	.01 mg/L
Total Phosphate	EPA #365.1	U.S. EPA (1983)	.001 mg/L
Potassium	EPA #200.7	U.S. EPA (1983)	.01 mg/L
Total Organic Halides	EPA #450.1	U.S. EPA (1983)	5 ug/L
Total Organic Carbon	Std. Methods #505	U.S. EPA (1983)	.1 mg/L
Major Cations:			
Sodium	EPA #200.7	U.S. EPA (1983)	.01 mg/L
Calcium	EPA #200.7	U.S. EPA (1983)	.01 mg/L
Magnesium	EPA #200.7	U.S. EPA (1983)	.01 mg/L
Major Anions:			
Chloride	EPA #300.0	U.S. EPA (1983)	.1 mg/L
Carbonate	Std. Methods #406C	APHA (1985)	1 mg/L
Bicarbonate	Std. Methods #406C	APHA (1985)	1 mg/L
Sulfate	EPA #200.7	U.S. EPA (1983)	.1 mg/L
Metals (Total Recoverable):			
Arsenic	EPA #206.2	U.S. EPA (1983)	0.2 ug/L
Cadmium	EPA #200.7	U.S. EPA (1983)	0.2 ug/L
Chromium	EPA #200.7	U.S. EPA (1983)	5 ug/L
Copper	EPA #200.7	U.S. EPA (1983)	5 ug/L
Iron	EPA #200.7	U.S. EPA (1983)	10 ug/L
Lead	EPA #239.2	U.S. EPA (1983)	5 ug/L
Manganese	EPA #200.7	U.S. EPA (1983)	10 ug/L
Mercury	EPA #245.1	U.S. EPA (1983)	.06 ug/L
Nickel	EPA #200.7	U.S. EPA (1983)	10 ug/L
Selenium	EPA #270.2	U.S. EPA (1983)	1 ug/L
Zinc	EPA #200.7	U.S. EPA (1983)	5 ug/L

* Huntamer (1986)
NA = Not Applicable

Data Limitations

A summary of the limitations of the pilot study water quality results are as follows:

- The relative vulnerability of the ground water of Washington State has not been defined in a comprehensive or consistent manner. Study areas selected for this project are considered to be susceptible to ground water contamination from agricultural chemicals based on limited data. It is not known whether these areas represent the most susceptible conditions or to what extent these areas are representative of ground water vulnerability for other areas of the state.

- Pesticide use information for each of the study areas was limited or unavailable. This prevented optimal selection of sampling wells.

- Samples were obtained from water-supply wells using existing pumps and plumbing. Water-supply well intakes are commonly installed within the most productive portions of aquifers which may not be the most susceptible portion of the aquifer to contamination. Also, pumps used for water supply are commonly not optimal for sampling ground water and can be responsible for altering water quality samples (for instance, stripping volatile organics or increasing concentrations of some metals).

- Samples probably represent the quality only of the water in close proximity to the well intake.

- Sampled wells are widely spaced and were not selected based on specific agricultural practices.

- The results represent a one-time sampling event. Ground water quality is likely to change both seasonally and over the long-term.

STUDY AREA CHARACTERISTICS

Whatcom County Study Area

The Whatcom County study area is located in the western part of the county about 12 miles north of Bellingham and three miles west of Lynden. It is 6.5 square miles in size.

Farms in Whatcom County average about 90 acres. Major crops grown in the study area include raspberries, strawberries, certified seed potatoes, blueberries, beans, corn, carrots, potatoes, peas, and cauliflower. Most of these crops are irrigated using rills or sprinklers.

The study area is underlain by an unconfined, sandy outwash aquifer with an average thickness of about 30 to 40 feet (Easterbrook 1971, 1976; Creahan and Kelsey, 1988). The water table is shallow and usually occurs at a depth of less than 10 feet. Regionally, ground water flows toward the Nooksack River to the south, but because the aquifer is shallow and unconfined,

the ground water flow pattern is locally affected by surface water and seasonal variations due to pumping and irrigation practices. Bertrand Creek, an ungauged stream that discharges to the Nooksack River about 1 mile south of the study area, is the primary drainage in the area. There are numerous other small creeks and irrigation trenches in the area. The main drainages and ground water are hydraulically interconnected. Surficial soils are generally sandy and permeable (Poulson and Flannery, 1953), providing moderate to low attenuation for potential organic contaminants.

About 200 water supply wells have been identified in the study area (Black and Veatch, 1986; Creahan and Kelsey, 1988). All of these wells are completed in the shallow outwash aquifer and most serve either to supply water for domestic uses or for irrigation.

The Whatcom County study area boundaries coincide with those of "Area B" previously defined based on the detection of ethylene dibromide (EDB) contamination in ground water (Black and Veatch, 1986).

Franklin County Study Area

The Franklin County study area is located in the southern portion of the county about 10 miles north of Pasco. It occupies an area of about 34 square miles and is the largest of the three study areas.

Major crops grown in the vicinity are wheat, alfalfa, potatoes, corn, asparagus, beans, and peas (U.S. EPA, 1986). Other crops include grass, clover, barley, apples, carrots, grapes, onions, and miscellaneous stone fruit. All cultivated land in the study area is irrigated. Most crops are irrigated using sprinklers, commonly center-pivot systems.

The geology of the area consists of 200-400 feet of unconsolidated and semi-consolidated gravel, sand, silt, and clay deposits overlying basalt flows (Walters and Grolier, 1960, and Drost and Whiteman, 1986). The saturated upper portions of the sedimentary deposits were the focus for the pilot study. Depth to ground water ranges from about seven to 100 feet and is usually less than 50 feet. Hydraulic properties of the shallow aquifer are highly variable due to variations in grain size, texture, and packing of the materials comprising the aquifer system. Regional ground water flow in the sedimentary deposits is to the southeast and south toward the Columbia River located about ten miles south of the study area (Bauer, et al, 1985). Because the ground water is shallow and unconfined, flow patterns vary seasonally due to pumping and irrigation. Locally, since the 1950's, the water table has risen tens of feet due to irrigation. Soils consist of permeable sand that provides only moderate to low attenuation of potential organic contaminants.

A well inventory compiled from U.S. Geological Survey (USGS) and Ecology Eastern Regional Office files identified about 100 wells in and near the study area. Virtually all of these wells serve either domestic supplies or are used for irrigation. Five wells serve public water supplies. About 30 wells, none of which are public wells, are completed in the shallow, unconfined water-bearing portions of the sedimentary units. Eleven of these shallow wells are observation wells installed by the Bureau of Reclamation in the 1950's to monitor water table responses to irrigation.

Elevated nitrate concentrations have been reported in the study area and vicinity (Turney, 1986; Department of Solid and Health Services, 1988; and Ebbert, 1988). USGS is conducting a ground water quality assessment of affected portions of Benton-Franklin Counties. The Franklin County study area occurs in the north-central portion of the USGS study area. Recent sampling by the USGS has identified low concentrations of aldicarb sulfone, atrazine, dicamba, picloram, and 2,4,5-T (Ebbert, 1989).

Yakima County Study Area

The Yakima County study area is located in the southeastern portion of the county about three miles southwest of Sunnyside and occupies an area of about 10 square miles.

Major crops consist of hops, grapes, alfalfa, wheat, and some corn. Stone fruit orchards occur at the northern margin. All agriculture in the study area is irrigated commonly using sprinklers or rills.

Beneath the study area about 200 feet of unconsolidated gravel, sand, silt, and clay deposits overlie basalt (Campbell, 1979; Drost and Whiteman, 1986). The upper saturated portions of these sedimentary deposits represent the target aquifer for the pilot study. Depth to ground water ranges from about six to 30 feet. Hydraulic properties of the target aquifer vary widely because of the heterogeneity of the units that comprise it. The regional ground water flow direction in the sedimentary deposits is south and southeast toward the Yakima River which forms the south boundary of the study area (Bauer, et al, 1985, and Kinnison and Sceva, 1963). Because the target aquifer is shallow and unconfined, flow patterns vary seasonally due to pumping and irrigation. Surficial soils are generally sandy and permeable (Lenfesty and Reedy, 1985) and provide moderate to low attenuation of organic contaminants.

About 80 wells have been identified in the study area and vicinity from well logs on file at the Ecology Central Regional Office files and a reconnaissance well survey conducted July 1988 as a part of the pilot study. Of these wells, about 50 are completed in the target aquifer. Because all drinking water in the area is supplied by individual wells, it is certain that there are additional wells in the area which were not identified during the study. Most of the wells supply water for domestic use or irrigation.

Turney (1986) reported nitrate-N concentrations in the Lower Yakima River Basin ground water ranged from one to five mg/L. No previous occurrences of pesticides in ground water have been reported.

RESULTS

Pesticides

Eighty-one wells were sampled during initial sampling. In 23 of the 81 wells (27 percent) sampled, at least one pesticide was detected. A summary of the pesticide results is shown in Table 4.

Table 4. Summary of Pesticides Detected in Agricultural Chemicals Pilot Study

Study Area	Number of Detections	Detection Frequency (Percentage)	Concentration Mean (ug/L)	Concentration Range (ug/L)
WhatcomCounty:				
1,2-Dichloropropane	9	33.0	6.9	0.3-24
Dibromochloropropane	1	3.7	0.36	NA
Ethylene Dibromide	2	7.4	I.5	0.02-2.95
Carbofuran	1	3.7	2.4	NA
Prometon	2	7.4	0.55	0.5-0.6
Franklin County:				
Dacthal (DCPA)	7	26.0	0.7	0.26-1.08
1,2-Dichloropropane	2	7.4	0.6	0.4-0.8
Bromacil	1	3.7	11	NA
Yakima County:				
Atrazine	1	3.7	0.4	NA

Eight different pesticides were identified. The classification, uses, and regulatory status of the eight pesticides are listed in Table 5.

Table 5. Classification, Use, and Status of Detected Pesticides

Pesticide Name	Classification	Use	Status
1,2-Dichloropropane	Halogenated Hydrocarbon	Fumigant	Cancelled*
Atrazine	Triazine	Herbicide	Restricted**
Bromacil	Uracil	Herbicide	Restricted**
Carbofuran	Carbamate	Insecticide	Restricted**
Dacthal (DCPA)	Benzoic Acid	Herbicide	
Dibromochloropropane	Halogenated Hydrocarbon	Fumigant	Cancelled*
Ethylene Dibromide	Halogenated Hydrocarbon	Fumigant	Cancelled*
Prometon	Triazine	Herbicide	Restricted**

**Use of these pesticides has been cancelled in the United States.*
***Declared state restricted use due to ground water concerns - can only be applied by a certified applicator or by someone under their supervision.*

The frequency of pesticide detection varied between the study areas. In the Whatcom County study area fifteen pesticide occurrences were observed in twelve wells. Ten occurrences of pesticides were observed in the Franklin County study area in ten wells. In contrast, only one pesticide occurrence was observed in the Yakima study area. 1,2-dichloropropane which was detected in eight wells was the primary pesticide observed in the samples from the Whatcom County study area. The concentrations detected ranged from 0.3 to 24 ug/L, and the mean of detected concentrations was 6.9 ug/L. Dacthal (DCPA), the primary pesticide detected in the Franklin County study area, and was detected in seven wells. These concentrations ranged

from 0.26 to 1.08 ug/L with a mean of 0.7 ug/L. Atrazine was the only pesticide observed in the Yakima study area samples. It was measured at a concentration of 0.4 ug/L. No pesticides were detected in the two public wells sampled.

Maximum Contaminant Levels (MCLs) have not yet been established by EPA for any of the pesticides found during this study. However, health advisories and/or proposed MCLs have been calculated by EPA. These are listed in Table 6. MCLs are enforceable public drinking water standards. They are the maximum permissible concentration of a contaminant in water which is delivered to any user of a public water system. MCL's are established by considering health effects, treatment technology, national costs, and limitations of laboratory methods.

Table 6. Proposed Drinking Water Standards and Health Advisories for Pesticides Detected in the Pilot Study.

Pesticide	Proposed MCL (ug/L)	Lifetime Health Advisory (ug/L)	10^{-6} Cancer Risk* (ug/L)
Atrazine	3	3	--
Bromacil	--	90	--
Carbofuran	40	40	--
Dacthal (DCPA)	--	3500	--
Dibromochloropropane	0.2(1)**	--	0.03(1)**
1,2-Dichloropropane	5(5)**	--	0.6(6)**
Ethylene Dibromide	0.05(1)**	--	0.0004(2)**
Prometon	--	100	

**EPA estimates that if an individual drinks water containing this pesticide at the indicated concentration over his or her entire lifetime, that individual would theoretically have no more than a one-in-a-million additional chance of developing cancer as a result of drinking this water.*
***Number of occurrences exceeding the listed concentration are in parenthesis.*

Source: U.S. EPA (1989)

None of the observed concentrations exceeded those that would cause non-carcinogenic adverse health affects. However, concentrations exceeded the proposed Maximum Contaminant Level in five wells for 1,2-dichloropropane, one well for dibromochloropropane, and one well for ethylene dibromide. All wells that exceeded proposed MCLs were located in the Whatcom County study area.

Nitrate

Nitrate in ground water can result from multiple sources including natural processes. The presence of nitrate in ground water does not necessarily mean that ground water is being contaminated from agricultural practices.

Nitrate/nitrite was detected in about three-quarters of the wells tested. Of the 81 wells sampled, 61 wells showed detectable concentrations of nitrate/nitrite as nitrogen (N) which ranged from 0.10 to 24.4 mg/L with a mean of 5.5 mg/L. The results are summarized in Table 7.

Table 7. Summary of Nitrate/Nitrite (as N) Results for the Agricultural Chemicals Pilot Study.

Study Area	Number of Detections	Detection Frequency (Percentage)	Concentration Mean (Range) (mg/L)	Number of Wells With 10 mg/L
Whatcom County	26	96	6.8 (0.28-24.4)	7
Franklin County	27	100	8.6 (0.5-18.8)	11
Yakima County	8	30	1.0 (0.10-6.2)	0
Totals	61	75	5.5 (0.10-24.4)	18

Eighteen wells had levels of nitrate/nitrite that exceeded the Primary Drinking Water Standard of 10 mg/L. The number of occurrences of nitrate/nitrite in each study area was variable. Detectable concentrations of nitrate/nitrite were observed in nearly all wells in the Whatcom and Franklin County study areas, whereas eight wells in the Yakima County study area showed detectable concentrations of nitrate/nitrite. In the Whatcom County study area seven wells exceeded the 10 mg/L standard. In the Franklin County study area eleven wells exceeded the standard, and in the Yakima County study area all concentrations were below 10 mg/L.

Concluding Remarks

The purpose of this interim report is to present the pesticide and nitrate/nitrite results of the first round of sampling for the Agricultural Chemical Pilot Study. The pesticide data is considered preliminary until a second sampling round (verification sampling) is completed. Therefore, an evaluation of the water quality results is not presented in this report.

A final report will be prepared that describes and evaluates all water quality results including a second round of verification sampling and quality assurance samples, land use of each study area and correlation with pesticide and nitrate/nitrite occurrence, analysis of indicator parameters and pesticide occurrence, and findings and recommendations. The final report is scheduled for completion December 1989.

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