ATTACHMENT C

Statewide Groundwater Monitoring Program
MASTER PLAN

Version 1.0

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September, 1993

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1.0 INTRODUCTION

In October of 1989, the State of Oregon passed the Groundwater Protection Act (Act). The goal of this Act is to "...prevent contamination of Oregon's groundwater resource while striving to conserve and restore this resource and to maintain the high quality of Oregon's groundwater resource for present and future uses." (State of Oregon, 1989).

Pursuant to Section 29 of the Act, the Department of Environmental Quality (DEQ), the Oregon Water Resources Department (WRD), and Oregon State University (OSU) are required to cooperate in an "...ongoing statewide monitoring and assessment program of the quality of the groundwater resource of this state." (State of Oregon, 1989). The Act further requires that a program be set up that identifies:

1. Areas of the State that are especially vulnerable to groundwater contamination;

2. Long term trends in groundwater quality;

3. The ambient quality of the groundwater resource of Oregon; and,

4. Any emerging groundwater quality problems.

This document focuses on the evaluation of groundwater quality in areas that may have been impacted by nonpoint source contamination or that may be vulnerable to groundwater contamination. As part of this program, work plans will be developed for different areas across the State which have been identified as priorities for assessment.

The work plans will describe the hydrogeologic features and land uses of each area and contain all of the information necessary to locate and sample the wells.

Once an area specific work plan is prepared, the DEQ Laboratory will sample the wells and the DEQ and Oregon Department of Agriculture (ODA) laboratories will analyze the groundwater samples following DEQ's quality assurance and quality control procedures. Once the samples are analyzed and the results distributed, a report on the study will be prepared.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The Statewide Groundwater Monitoring Program is an interagency project with participants from the DEQ, the ODA, the Oregon Health Division (OHD), WRD, and OSU. Table 1 lists the participating agencies and their roles. A list of key individuals involved with each project is included with the site specific work plans.

3.0 AREA IDENTIFICATION AND PRIORITIZATION

Before groundwater sampling work plans could be prepared and before sampling could be conducted, the areas that were at risk needed to be identified. The area identification and prioritization process is outlined below.

3.1 AREA SELECTION CRITERIA

Areas in Oregon with known or suspected contamination or that may be susceptible to contamination were identified utilizing a

TABLE 1
List of Participating Agencies

AGENCY NAME	AGENCY PHONE NO.	DESCRIPTION OF ROLE IN PROJECT
Department of Environmental Quality Water Quality Division, Groundwater Section	229-5279	Responsible for project management including developing sampling plans and preparing reports.
Department of Environmental Quality Laboratory Division Groundwater Monitoring Section	229-5983	Responsible for conducting the groundwater sampling and performing inorganic chemical analyses.
Department of Human Resources Health Division Drinking Water Section	731-4010	Responsible for providing health risk assessments and for notifying well owners of sample results and health risks.
Oregon Department of Agriculture	378-3797	Responsible for performing pesticide

Laboratory Division		analyses and reporting the test results to the DEQ an OHD.
Oregon Water Resources Department	378-3741	Provides access to water well reports, water right records, and technical support.
Oregon State University Agricultural Extension Agents	Call Local Office	Provide updates on pesticide use and agricultural practices.
Oregon State University Agricultural Chemistry Department	737-1789	Responsible for assisting the Oregon Department of Agriculture Laboratory with pesticide analyses, data interpretation, and quality control and quality assurance.

number of resources. DEQ and OHD personnel involved with statewide groundwater monitoring in the past were instrumental in identifying areas that needed further assessment. Table 2 is a list of prioritized areas which need further assessment. This list was generated in January, 1993. The criteria used in selecting study areas are outlined below. Figure 1 shows the location of the study areas.

[FIGURE 1 is not available]

Areas may be added or subtracted from the list, and priorities modified, as additional information is available. The DEQ is currently working on a groundwater vulnerability mapping project that be used in the future to prioritize and list areas of the state for groundwater sampling.

3.1.1 Areas Identified by the Oregon Health Division

The OHD (Leland, 1992) (see Appendix A) identified four areas which the OHD felt qualified as "Areas of Concern" based upon data from property transfer private well testing. The DEQ has subdivided these four areas into the Prineville, Redmond, Madras, Klamath Falls-Merrill, Medford, Junction City, Albany-Lebanon, Woodburn, and Canby areas for detailed groundwater assessment to confirm the OHD findings.

3.1.2 Areas Identified During Past Assessments

A number of areas within the state have been assessed in the past. This sampling was conducted as part of past DEQ studies, or as part of the DEQ's Volunteer Nitrate Testing Program (DEQ, 1992b).

"Oregon's 1992 Water Quality Status Assessment Report" (305b report) (DEQ, 1992a) summarizes past sampling events conducted by the DEQ. If Table 4.3-3 of the 305B report indicated that additional data was needed for a given area, the area was included on the priority list. A copy of Table 4.3-3 and a list of the areas tested by the Volunteer Nitrate Testing Program are include in Appendix B.

Areas identified by the 305b report include Clatsop Plains, Harbor Beach, Jackson County, Mission Bottom, Mid-Multnomah County, Farmington/Hillsboro, Dever-Connor, Lake Labish, Sauvie Island, Jefferson, Coburg, Milwaukie, La Pine, Lower Umatilla

Basin, Milton-Freewater, City of Imbler, Ontario, Klamath Falls, and Santa Clara-River Road.

Mid-Multnomah County, Milwaukie, Lower Umatilla Basin, and Northern Malheur County (Ontario) are part of ongoing DEQ investigations and are not include on the priority list of areas needing further assessment.

TABLE 2

Areas of Potential, Suspected, or Known Nonpoint Source Groundwater Contamination

Ranking	Area	County	SIPA[1] Score	IR[2] Score	SA[3] Score	LU[4] Score	Population/Multiplier	total score
1	Woodburn	Marion	50	25	25	15	13,600/1.3	150
2	Junction City	Lane	50	25	25	20	7,400/1.2	144
3	Prineville	Crook	50	25	25	15	5,600/1.2	138
4	Canby	Clackamas	50	25	25	10	9,400/1.2	132
5	Albany-Lebanon	Linn	25	25	25	15	44,900/1.4	126
6	Medford	Jackson	20	25	25	15	49,100/1.4	119
7	Upper Grande Ronde Valley	Union	25	25	25	15	17,100/1.3	117
8	Redmond	Deschutes	50	25	0	20	7,900/1.2	114
9	Washington/Yamhill Co.	Washington/ Yamhill	20	25	25	10	39,500/1.4	112
10	Clatsop Plains	Clatsop	50	0	25	10	19,200/1.3	111
11	Hood River-Parkdale	Hood River	30	25	25	20	4,800/1.1	110
12	Burns-Hines	Harney	30	25	25	15	4,300/1.1	105
13	Milton-Freewater	Umatilla	20	25	25	15	5,600/1.2	102

Ranking	Area	County	SIPA[1] Score	IR[2] Score	SA[3] Score	LU[4] Score	Population/Multiplier	total score
14	Lake Labish-Mission Bottom	Marion	45	25	25	5	100/1.0	100
15	Klamath Falls-Merrill	Klamath	20	25	25	5	17,800/1.3	98
16	John Day-Canyon City	Grant	25	25	25	10	2,500/1.1	94
17	The Dalles	Wasco	30	25	0	15	11,200/1.3	91
18	Harbor Beach	Curry	20	25	25	10	4,700/1.1	88
19	Sauvie Island	Multnomah/ Columbia	20	25	25	10	4,100/1.1	88
20	Jefferson	Marion	20	25	25	5	1,900/1.1	83
21	Tillamook	Tillamook	0	25	25	25	4,200/1.1	83
22	La Pine	Deschutes	50	0	25	5	200/1.0	80
23	Grants Pass	Josephine	20	0	25	15	17,800/1.3	78
24	Madras	Jefferson	30	25	0225	15	3,600/1.1	77
25	Dever-Conner	Linn	20	25	25	5	200/1.0	75
26	Haines	Baker	20	25	25	5	400/1.0	75
27	Coburg	Lane	15	25	25	10	800/1.0	75
28	Lakeview	Lake	0	25	25	15	2,600/1.1	72

Ranking	Area	County	SIPA[1] Score	IR[2] Score	SA[3] Score	LU[4] Score	Population/Multiplier	total score
29	Paisley	Lake	10	25	25	10	300/1.0	70
30	Enterprise	Wallowa	0	25	25	10	2,100/1.1	66
31	Myrtle Point	Coos	0	0	25	10	2,700/1.1	39
32	Coquille	Coos	0	0	25	10	4,100/1.1	39

Notes:

1. SIPA = State Identified Priority Area
2. IR = Irrigation
3. SA = Shallow Aquifer
4. LU = Land Use

The Jackson County area has been narrowed down to the Medford Area.

Mission Bottom and Lake Labish are adjacent to each other and have been combined into one area.

Farmington/Hillsboro has been included in a broader Washington/ Yamhill County area. This was done to emphasize the need to sample wells in different areas of Washington and Yamhill Counties.

The City of Imbler has been included in a larger Upper Grande Ronde River Valley area.

Santa Clara-River Road was not included on the list at this time because sewer installation has not been completed. Once the homes in the area are hooked up to the sewer, the area will be re-sampled.

3.1.3 Other Area Selection Criteria

Additional areas were identified based upon the percent of land under irrigation (WRD, 1992), the detection of arsenic in the

groundwater (Leland, 1992), and the presence of shallow sensitive aquifers (Sweet, 1980). Figure 2 is a reproduction of Sweet-Edwards' "Ground Water Aquifers" map.

Areas identified by this criteria are Hood River-Parkdale, Burns-Hines, John Day-Canyon City, The Dalles, Tillamook, Grants Pass, Lakeview, Paisley, Enterprise, Myrtle Point, and Coquille.

[FIGURE 2 is not available]

3.2 AREA PRIORITIZATION

The areas listed on Table 2 were prioritized according to the criteria listed below. The priorities of the areas on this list are subject to change as additional information becomes available.

3.2.1 State Identified Problem Areas

The DEQ and other state agencies have identified areas of the state with known or suspected nonpoint source contamination. The scoring criteria for this category are listed below. No more than 50 points were assigned to any area. If more than one criteria was met, only the highest score was assigned.

Scoring Criteria

Fifty (50) points were assigned if an area has a known or suspected groundwater problem based upon one or more of the following: OHD testing of public water supply systems, the OHD data base on property transfer well testing, and DEQ Volunteer Nitrate Testing.

Thirty (30) points were assigned if the OHD (Leland, 1992) indicated that arsenic was detected in the groundwater in the area. Although arsenic naturally occurs in some areas, it can also be an indicator of arsenic-based pesticide contamination.

Twenty (20) points were assigned if an area was sampled during past DEQ and OHD groundwater sampling events and contamination has been identified. Additional sampling needs to be conducted to confirm the presence of contamination and/or to determine the extent of the problem.

Zero (0) points were assigned if there has not been any State conducted groundwater sampling.

3.2.2 Percent of Irrigated Land/Precipitation

The percent of land under irrigation and precipitation reflects the intensity of agriculture and the potential for leaching of pesticides and other contamination into the groundwater. The scoring criteria for this category are listed below.

Scoring Criteria

Twenty-five (25) points were assigned if 80 to 100 % of the area is irrigated or if 60 to 80 % of the area is irrigated and the area receives 80 or more inches of precipitation annually. Zero (0) points were assigned if the above criteria was not met.

3.2.3 Sensitive Aquifers

Areas with shallow unconfined aquifers are more susceptible to contamination. The scoring criteria for these sensitive aquifers is listed below.

Scoring Criteria

Twenty-five (25) points were assigned if the area has a shallow groundwater aquifer as identified by Sweet-Edwards and Associates (Sweet, 1980).

Zero (0) points were assigned if the area does not have a shallow groundwater aquifer.

3.2.4 Land Uses

The presence of land uses of concern in an area reflects potential groundwater pollution as a result of these land uses. The land use score is the sum of the scoring criteria listed below.

Scoring Criteria

Five (5) points were assigned if agriculture was practiced in the area.

Five (5) points were assigned if food processing is one of the industries in the area.

Five (5) points were assigned if wood products (logging, saw and

planing mills, plywood, boxes, mobile homes, paper, furniture, and fixtures) are one of the industries in the area.

Five (5) points were assigned if manufacturing (textile and apparel, printing and publishing, chemical, petroleum, plastics, leather, stone, clay, glass, concrete, metals, machinery and transportation equipment, electrical and control instruments) is conducted in the area.

Five (5) points were assigned if more than 25 confined animal feeding operations (CAFOs) were present in the area.

3.2.5 Population Scoring

The total scores for each area were multiplied by a population factor. The estimated populations of the areas are listed on Table 2 along with the population factors for each area.

This criteria emphasizes both the potential impacts from septic systems and the population at risk from utilizing the groundwater in an area. The multipliers and corresponding population ranges are listed below.

MULTIPLIER	POPULATION
1	<1,000
1.1	1,000 to 4,999
1.2	5,000 to 9,999
1.3	10,000 to 19,999
1.4	>20,000

3.2.6 Adjustments To Scores

In order to factor in information not included in the above scoring, the scores for some areas were adjusted. Listed below are the areas for which the scoring has been changed and the reasons for the change. These adjustments were made in the state identified problem area scoring.

Albany-Lebanon This area was assigned 25 points. This was done because the Albany-Lebanon aquifer covers a greater area than other areas with similar scores.

Upper Grande Ronde Valley Originally this area was split into two areas, Grande Ronde and Imbler. Although Imbler has been sampled in the past, the Upper Grande Ronde Valley area was assigned 25 points to emphasize the fact that most of the valley has not been sampled.

Clatsop Plains Although this area has been sampled in the past, it was assigned 50 rather than 20 points to emphasize the need to re-sample in order to determine if adoption of a groundwater management plan in 1982 has had a beneficial effect on the groundwater. In addition, the area has not been sampled since 1984.

Lake Labish-Mission Bottom This area was assigned 45 points because groundwater sampling conducted prior to 1986 indicated that nitrate may be present in the groundwater in the Lake Labish area and because nitrate and EDB contamination have been confirmed in the Mission Bottom area.

Klamath Falls-Merrill Although the OHD has identified this area as an area of concern, the DEQ has sampled the groundwater on

several occasions and as recently as 1990. Since data on the groundwater quality in the area is available, the area was given a score of 20 instead of 50 points.

John Day-Canyon City The OHD indicates that arsenic may be present in the groundwater in this area. Normally 30 points would be assigned for this criteria. However, since the arsenic may be naturally occurring, the John Day-Canyon City area was assigned 25 points.

La Pine This area has been sampled 6 times in the past. However, no sampling has occurred since 1982. This area was assigned 50 points to emphasize the need to conduct follow-up sampling. The sampling will be used to determine if there have been any beneficial effects from the sewer installation in the La Pine core area and to determine if there have been any impacts to groundwater quality in areas outside the core area due to population growth.

Paisley The OHD has indicated that arsenic is present in the groundwater in this area. However, the arsenic may be naturally occurring, therefore the area was assigned 10 instead of 30 points.

4.0 AREA SPECIFIC WORK PLANS

Work plans will be developed for each area on the priority list. The plans serve to document well location, summarize area information, and to outline groundwater sampling requirements.

4.1 PROJECT DESCRIPTIONS

Appendix C contains a sample outline for the work plans. The work plans must describe the objectives and scope of the project. Although this document outlines many of the criteria for preparing work plans, individual work plans may include additional requirements. These requirements may be based upon new knowledge or may be necessary in order to coordinate efforts with other DEQ divisions or sections or with other state agencies.

4.2 WELL SELECTION

While the criteria for selecting wells may vary from area to area, the following is a summary of the usual process for selecting wells.

Prior to selecting wells, the area to be sampled must be defined. This may include: determining the limits of shallow sensitive aquifers (from maps or water well reports);

determining the limits of apparent contamination based upon OHD property transfer

data and/or DEQ voluntary testing data; identifying areas of high irrigation (or moderate irrigation and high rainfall); or evaluating any other data that may be available for a specific area.

The local sanitarian, the water master, the Soil Conservation Service, the local agricultural extension agent, and the DEQ regional office are all possible sources for information that may be useful in locating wells or areas with potential problems.

Once the area is defined, well selection begins by reviewing water well reports at WRD. The number of water well reports selected for further evaluation can vary depending on specific needs, however selecting 3 to 5 wells per square mile usually provides enough water well reports so that the number and distribution of wells field-verified meet the criteria outlined herein.

Although specific criteria can change depending on the characteristics of each area, water well reports are typically selected based upon the following criteria.

1. If possible, water well reports for wells which tap shallow, unconfined aquifers should be selected. Ideally, wells with depths less than 100 feet below ground surface should be chosen. This is necessary because shallow aquifers have the greatest chance of being impacted by nonpoint source contamination (Follett, 1989).

2. Water well reports with street addresses should be selected whenever possible since this can reduce the amount of field time required to locate the wells.

3. Some of the water well reports should be picked near potential nonpoint sources and near areas identified as having high nitrate concentrations by OHD's property transaction data base or DEQ's voluntary nitrate testing. This may include selecting wells which were sampled previously. The data from testing conducted following this program will be used to confirm the prior data. In addition, it is important to have wells situated in areas where there may not be any data available to better evaluate area wide groundwater quality.

4. Since the sampling data will be used to help determine if an area wide problem exists as well as confirming existing

sample results, the well locations should be selected so that a fairly even distribution of the wells is achieved across the area. If a section of the study area has been identified as one needing additional sampling, and a water well report is not available for that area from WRD, a well will have to be located by visiting

the area and making door to door contacts. The well owner should be asked for a copy of the water well report, if available, or any other known information concerning the well.

4.2.1 Field Verification of Well Locations

Once well logs are selected, specific wells need to be identified for sampling. This requires re-reviewing the water well reports to ensure that they meet the above criteria and indicating the preferred well locations on a map. The actual wells selected for the study will vary from this preliminary map due to difficulties in locating the selected wells and difficulties in obtaining permission to sample wells during field visits. Any adjustments to wells selected should be made using the above well selection criteria.

Once the preferred well locations are identified, well owners must be identified, contacted, and permission to sample the wells obtained. The names on the water well reports may not be the current well owners names.

Local telephone books are a useful resource in identifying well owners. Often water well reports list only an owners name and no address. Addresses can often be verified by comparing addresses in the telephone book to the location of the well. The telephone books are also useful since the well owners can be contacted for permission and directions prior to field verification of the well and sampling point locations. For most areas, the best times for calling are between 12 and 1 p.m. and 5 and 9 p.m.

In metropolitan areas, an additional aid for locating well owners is the Cole Reverse Directory. This directory lists street and route/box addresses and the current residents name and telephone number.

In areas where mailing addresses have changed from the old route/box addresses to street addresses, it may be possible to locate some of the older wells by contacting the county planner, or the local post office. The county planners and post offices may have a list of the old addresses correlated to the new addresses or old maps.

Where the current well owner's name and telephone number are not available, permission to sample the well has to be obtained by a visit to the well address.

Once the well owner is contacted and permission to sample the well obtained, the locations of the wells need to be field verified. The purpose of this visit is two-fold. During the visit, the location of the property, the well, and the sampling point can be determined and described in a manner to facilitate location of the well by the sampling crew.

The visit also provides an opportunity to gather additional information about the area around the well. This information is used to complete the "Well and Site Identification Record". A copy of this form is in Appendix D.

Information that should be noted in the field includes: locations of septic systems, pastures, corrals, agricultural fields, industries, and any other information that may be useful in evaluating the sample results. Photographs are also useful in aiding future location of the wells and sampling points.

If it appears that the well construction/maintenance is poor or local sources might overwhelm area-wide sources in effects on the well water, these factors should be noted and the well rejected as a sampling point.

The field visits are a good time to distribute informational brochures regarding nonpoint source pollution, health effects, and DEQ's program and to answer any questions the well owner might have regarding the purpose for the sampling.

Approximately 20 wells (or in multiples of twenty wells if more than a week of sampling is needed to adequately characterize an area) should be selected. This is the optimum number of wells that can be efficiently located, and sampled, in a week due to scheduling and staff limitations.

4.2.2 Well Selection Limitations

Some shallow irrigation and domestic farm wells were drilled, or dug, prior to records being kept. Un-logged wells are not typically located and selected while preparing sampling plans for several reasons. Improper well seals, and other problems which can't be identified without a water well report, can limit the use of the data from un-logged wells.

In addition, locating unlogged wells requires additional staff time to identify the wells, to obtain permission to sample the

wells and to interview the owner regarding well construction.

However, if a properly installed well can't be located within a specific part of the study area, un-logged wells may be selected to provide data for the sub-area.

4.3 ANALYTE SELECTION

Two separate sets of analyses will be conducted on the groundwater samples. The first set analyses tests for analytes which are tested for in all areas. These analytes are listed on Table 3.

The second set of analyses are for pesticides. Pesticide analyte selection is based upon pesticide use. This information is obtained from "Oregon State Pesticide Use Estimates for 1987" (Rinehold and Witt, 1989) and through contact with the local OSU agricultural extension agent or OSU in Corvallis.

Any pesticide with a use greater than 1000 pounds per year, in the county where the area is located, is considered for analysis. Pesticides that fit this criteria are selected if they are on the list of pesticides selected for analysis during the National Pesticide Survey (NPS), were detected during the NPS (EPA, 1990), or are on the California list of pesticide groundwater contaminants (Johnson, 1989). These lists are in Appendix E.

4.3.1 Limitations to Pesticide Selection

Groundwater samples are not tested for all of the pesticides used in a specific area. Only those pesticides with high use and a high potential for reaching groundwater are tested.

In addition, the ODA Laboratory resources are limited. Adequate staff and/or equipment are not available to test for every pesticide separately. Therefore, careful decisions must be made with the assistance of the ODA Laboratory and OSU chemistry staff regarding which multiple analyte screens and detection limits are appropriate for pesticides used in a particular sampling area.

Single analyte analyses might be desired to evaluate the presence of a widely used pesticide in an area where multiple analyte screens are used to detect less common pesticides. OSU can also provide QA/QC for multiple analyte analyses in the form of single analyte analyses on limited number of samples for some pesticides.

The purpose of the pesticide sampling is to identify areas where current or past agricultural practices and pesticide use may have impacted the groundwater. If groundwater contamination

from pesticides is encountered in a given area, additional pesticides should be included in future sampling events.

TABLE 3
Standard Analyte List

Field Parameters

Alkalinity as $CaCO_3$	Conductivity
Temperature	pH

Indicator Parameters

Ammonia (NH_3 as N)	Chemical Oxygen Demand (COD)
Chloride (Cl^-)	Total Kjeldahl Nitrogen (TKN)
Nitrate/Nitrite-Nitrogen (NO_3/NO_2 as N)	
Total Organic Carbon (TOC)	
Total Phosphate (PO_4)	Sulfate (SO_4)

Metals

Aluminum (Al)	Arsenic (As)
Boron (B), dissolved only	Calcium (Ca)
Copper (Cu)	Iron (Fe)
Magnesium (Mg)	Manganese (Mn)
Mercury (Hg)	Potassium (K)
Silicon as SiO_2, dissolved only	Sodium (Na)
Zinc (Zn)	

Volatile Organic Compounds (VOCs)

Acrolein (2-Popenal)	Benzene
Bromodichloromethane	Bromoform
Bromomethane	Carbon Tetrachloride
Chlorobenzene	Chloroethane
2-Chloroethyl Vinyl Ether	Chloroform
Chloromethane	Cis-1,3-Dichloropropene
Dibromochloromethane	1,2-Dibromoethane (EDB)
1,2-Dichlorobenzene	1,3-Dichlorobenzene
1,4-Dichlorobenzene	1,1-Dichloroethane
1,2-Dichloroethane	1,1-Dichloroethylene
1,2-Dichloropropane	1,2-Dimethylbenzene
1,3-Dimethylbenzene	1,4-Dimethylbenzene
Ethylbenzene	Methylene Chloride
1,1,2,2-Tetrachloroethane	1,1,2,2-Tetrachloroethylene
Toluene	trans-1,3-Dichloropropane
trans-Dichloroethylene	1,1,1-Trichloroethane

Trichloroethylene

Vinyl Chloride

5.0 FIELD SAMPLING/SAMPLING LOGISTICS

The DEQ Laboratory Water Quality Monitoring Section will conduct the field sampling. The ODA Laboratory will be notified of the sampling schedule prior to the DEQ Laboratory conducting the sampling so they can plan to receive the samples. In addition, the DEQ Laboratory will notify the well owners of the sampling schedule. The notification should be in writing several weeks before the scheduled event. In addition, as indicated in the work plans, some individual well owners will need to be contacted by telephone to arrange the sampling visit.

The sampling will be conducted according to standard procedures as outlined below.

5.1 SAMPLING PROCEDURES

Samples will be collected from a tap, hose bib, or gate valve as close to the well as possible. Samples will be collected before pressure tanks, other holding vessels, and treatment systems whenever possible. To assure that a representative water sample is obtained at least one well casing volume of water should be purged from the well prior to sampling. For domestic and irrigation wells that are in current use, the well shall be pumped until a stable water temperature is achieved or for five minutes, whichever is sooner. Wells that have not been in recent use will be purged until stable water temperatures are achieved.

The samples will be collected in accordance with the procedures established in the "DEQ Laboratory Field Sampling Reference Guide" (DEQ, 1993b). Table 4 lists the sample containers and sample preservation necessary for the samples.

In addition to well sampling, the sampling crew will use a global positioning system (GPS) to identify the latitude and longitude of each well. The DEQ Laboratory uses a Magellan NAV 5000 GPS with an accuracy of +/- 15 meters in two dimensions.

5.2 SAMPLE DOCUMENTATION AND CUSTODY

Routine chain of custody procedures shall be observed. The Field Data Sheets will:

1. Indicate the date and time each well is sampled.

2. Identify each sample site by well owner name,

3. Identify each container by number,

4. Indicate each well's assigned STORET data base number,

TABLE 4
Sample Containers and Preservation*

LABORATORY	CONTAINER	PRESERVATION	HOLDING TIME	ANALYSIS
DEQ	(1) 250 ml DP Poly	Ice Chest (≤ 4°C)	28 days	Ions
DEQ	(4) 40 ml glass vials	Ice Chest (≤ 4°C)	14 days	Volatile Organic Compounds (VOCs)
DEQ	(1) 250 ml DM Poly (1) 250 ml TM Poly	HNO_3 (pH ≤2), Ice Chest HNO_3 (pH ≤2), Ice Chest	14 days to 6 months	Metals, Dissolved Metals (Field Filtration)
DEQ	(1) 500 ml R Poly	H_2SO_4 (pH ≤2), Ice Chest	28 days	Nutrients, Organic Compounds
DEQ	(1) 500 ml TH Poly	HNO_3 (pH ≤2), Ice Chest	14 days	Mercury
DEQ	(1) 1000 ml P Poly	Ice Chest		Physical
OSU	(1) variable**	variable**	variable**	variable**
ODA	(1) 2000 ml Glass	Ice Chest	14 to 28 days	Pesticides

* Per Sample.
** The OSU laboratory will be used in a support role to perform analyses as needed, such as to confirm constituent values above background levels, to perform QA/QC testing, and to test samples when the other laboratories are backlogged.

5. Indicate what analyses are to be performed, and

6. Indicate which laboratories are to perform the different analyses.

5.3 SAMPLE TRANSPORT

Each day, the sampling crew will ship the pesticide samples to the Oregon Department of Agriculture Laboratory in Salem and the

rest of the samples to the DEQ Laboratory in Portland via a designated carrier.

The work plans should include a section that identifies the transporter of the samples (typically Greyhound) and should include the address and telephone number of the transporter.

5.4 HEALTH AND SAFETY

All personnel who participate in this project will conform to the Occupational Safety and Health Administration (OSHA) regulations that govern personal protection in the work place. The sampling stations in this project are domestic water wells. Samples

obtained from these sources are not considered hazardous. However, unknown constituents or concentrations may be present in the media to be collected.

It is the responsibility of the participating personnel to initiate and follow all necessary safety measures related to the project in accordance with the "Mode of Operations Manual For The Water Quality Monitoring Section" (DEQ, 1986) and to be aware of the potential hazards that are associated with the collection, handling, analysis, and disposal of the samples.

Field conditions which may require additional precautions include the following:

1. Severe temperature extremes;

2. Unavailable potable water;

3. Exposure to dogs, insects, reptiles, and rodents;

4. Hazards that are associated with extended travel in very primitive and remote terrain during severe weather conditions;

5. Lifting and carrying of heavy equipment including coolers of samples and ice; and

6. Possible exposure to hazardous materials.

6.0 LABORATORY ANALYSES

Once the DEQ Laboratory receives the samples, and the DEQ Sample Tracker has accepted them and assigned case numbers, the monitoring personnel will forward the case numbers on to the ODA (and OSU lab personnel if they are participating in a particular sampling event) to be referred to when reporting the data.

6.1 ANALYTICAL METHODS

All analyses will be performed using Environmental Protection Agency (EPA) or other approved methods. Table 5 lists constituents, test methods, and minimum reporting values to be utilized for this project.

7.0 DATA QUALITY CONTROL/QUALITY ASSURANCE

Table 4 lists the data quality objectives for this project. Data analyses for constituents with drinking water standards will be used for health risk assessments.

TABLE 5
Laboratory Analyses

PARAMETER	REFERENCE	ANALYTICAL TECHNIQUE	MIN. REPORT VALUE (mg/l)
Chemical Oxygen Demand (COD)	R2-410.4	Dichro. Spectro.	5.0
Total Organic Carbon (TOC)	R2-415.2	UV/Sulfate Oxidation	1.0
Volatile Organic Compounds (VOC)	EPA 8260	Purge & Trap, GC/MS	0.0005
Calcium (Ca)	R2-200.7	Inductively Coupled Plasma (ICP)	0.1
Manganese (Mn)	R2-200.7	ICP	0.02
Sodium (Na)	R2-200.7	ICP	0.5
Potassium (K)	R2-200.7	ICP	0.5
Chloride (Cl^-)	R2-325.1	Auto Ferricyanide	0.5
Sulfate (SO_4)	R2-375.2	Auto Methyl Thymol	0.5
Arsenic (As)	R2-206.3	Gaseous Hydride	0.005
Mercury (Hg)	R2-245.1	Cold Vapor	0.0005
Iron (Fe)	R2-200.7	ICP	0.04

Magnesium (Mg)	R2-200.7	ICP	0.5
Silicon as SiO_2, dissolved only	R2-200.7	ICP	0.3
Boron (B), dissolved only	R2-200.7	ICP	0.03
Aluminum (Al)	R2-200.7	ICP	0.1
Copper (Cu)	R2-200.7	ICP	0.02
Zinc (Zn)	R2-200.7	ICP	0.02
Total Kjeldahl Nitrogen (TKN)	R2-351.1	Block Digestion	0.2
Ammonia (NH_3 - N)	R2-350.1	Auto Phenate	0.02
Nitrate/Nitrite-Nitrogen (NO_3+NO_2-N)	R2-353.2	Auto Cd Reduction	0.02
Total Phosphate (PO_4)	R1-424F	Ascorbic Acid Reduction	0.01
Pesticide Screens	NPS	Methods 1, 2, 3, 4, & 5	0.0002 to 0.002
Alkalinity	R2-310.1	Titration	1.0
Conductivity	R2-150.1	Wheatstone Bridge	1 µ_/cm
pH	R2-150.1	Electrode	0 - 14 SU

Referenced methodologies are detailed in the following publications:

R1 - Standard Methods for the Examination of Water and Wastewater, 16th Edition, APHA, AGWA, WPCF, 1985.

R2 - Methods for Chemical Analysis of Water and Wastes, EPA/4-79-020 (revised, 1983).

EPA - SW-846 Test Methods for Evaluating Solid and Hazardous Wastes, 3rd Edition, 1986. Conforms with EPA Drinking Water Method 524.2.

NPS - National Pesticide Survey Methodology, EPA Technical Support Division, Office of Drinking Water.

The DEQ Laboratory's Quality Assurance Section will prepare a quality assurance plan for each site. The quality assurance plan will outline the number of spike, duplicate, blank, and split samples that are necessary for the sampling event based upon the total number of samples to be collected.

7.1 EQUIPMENT CALIBRATION AND MAINTENANCE

The established DEQ Laboratory procedures will be followed, along with the manufacturers' recommendations for calibrating, maintaining, and operating equipment.

7.2 DATA REDUCTION, VALIDATION, AND REPORTING

Each participating laboratory will review the data that they generate to evaluate and report whether the data meets the quality assurance (QA) objectives. The reports, along with the data, will be sent to the DEQ project manager and the laboratory groundwater monitoring coordinator. Monitoring personnel will transfer the data from the Laboratory Information Management System (LIMS) to the STORET system for data storage and manipulation. Latitude and longitude coordinates, which STORET requires, will be determined during sampling (see 5.1 SAMPLING PROCEDURES).

If data objectives are not met, the laboratory QA personnel will schedule a meeting to determine why the objectives were not met and to recommend subsequent action.

7.3 QUALITY CONTROL PROCEDURES

Routine quality control (QC) procedures will be employed as listed in the DEQ Laboratory Quality Assurance Manual (DEQ, 1993). Acceptable limits for the laboratory quality assurance objectives are listed in Table 5. In addition to the QA manual requirements, the following QC procedures will be performed:

1. Duplicate samples will be analyzed to measure the analytical precision on a minimum of 10% of the samples that are collected.
2. A transport and a transfer blank will be analyzed to detect interferences introduced during sampling or transport.
3. Reagent blanks will be analyzed to detect interferences during analysis, and to verify method detection limits.

TABLE 6
Quality Assurance Objectives

CONSTITUENT	CONCENTRATION RANGE	PRECISION RANGE	RPD	100% + ACCURACY
Conductivity	≥ 25 µ_/cm^3	-	± 5%	± 5%
pH	0 - 14 SU	± 0.2 SU	-	± 0.1 SU
Alkalinity	≥ 10 mg/l	-	± 5%	Not Applicable
Total Kjeldahl Nitrogen	0.2 - 1.0 mg/l ≥ 1.0 mg/l	± 0.2 mg/l -	- ± 20%	- ± 20%
Ammonia NH_3 - N	0.02 - 0.2 mg/l ≥ 0.2 mg/l	± 0.05 mg/l -	- ± 20%	- ± 20%
Nitrate/Nitrite-Nitrogen $NO_3 + NO_2$ - N	0.02 - 0.2 mg/l ≥ 0.2 mg/l	± 0.05 mg/l -	- ± 10%	- ± 15%
Total Phosphate	0.01 - 0.1 mg/l ≥ 0.1 mg/l	± 0.05 mg/l -	- ± 20%	- ± 20%
Chemical Oxygen Demand (COD)	5.0 - 10.0 mg/l ≥ 10.0 mg/l	± 0.5 mg/l -	- ± 20%	- ± 20%
Total Organic Carbon (TOC)	1.0 - 5.0 mg/l ≥ 5.0 mg/l	± 0.5 mg/l -	- ± 20%	- ± 20%
Volatile Organic Compounds (VOC)	0.0005 - 0.010 mg/l ≥ 0.01 mg/l	± 0.001 mg/l -	- ± 15%	- ± 15%
Manganese (Mn)	0.02 - 0.10 mg/l ≥ 0.10 mg/l	± 0.01 mg/l -	- ± 15%	- ± 15%
Calcium (Ca), Sodium (Na), Potassium (K), Magnesium (Mg), Silica (SiO_2)	0.5 - 10.0 mg/l ≥ 10.0 mg/l	± 1.0 mg/l -	- ± 15%	- ± 15%
Aluminum (Al)	0.1 - 5.0 mg/l ≥ 5.0 mg/l	± 1.0 mg/l -	- ± 15%	- ± 15%
Sulphate (SO_4), Chloride (Cl^-)	0.5 - 5.0 mg/l ≥ 5.0 mg/l	± 1.0 mg/l -	- ± 15%	- ± 15%
Iron (Fe), Copper (Cu), Zinc (Zn), Boron (B)	0.05 - 0.5 mg/l	± 0.05 mg/l	- ± 15%	- ± 15%

	≥ 0.5 mg/l	-		
Mercury (Hg)	0.0005 - 0.005 mg/l > 0.005 mg/l	± 0.0003 mg/l	- ± 15%	- ± 15%
Arsenic (As)	0.005 - 0.1 mg/l ≥ 0.1 mg/l	± 0.001 mg/l -	- ± 15%	- ± 15%

7.4 PERFORMANCE AND SYSTEM AUDITS

The DEQ Laboratory participates in the EPA Water Pollution Performance Evaluation Studies and is a certified drinking water laboratory. The DEQ will perform inorganic and volatile organic compound (VOC) analyses.

The ODA coordinates the Pesticide Analytical Response Center and is authorized under the Federal Insecticide, Fungicide, Rodenticide Act (FIFRA) program to perform pesticide analyses.

The OSU laboratory is recognized to perform analyses for the registration of pesticides under the U.S. Department of Agriculture (USDA) minor crop program.

7.5 DATA ASSESSMENT

Each laboratory is responsible for maintaining the quality of the data generated. The DEQ and ODA laboratories will evaluate their generated data for accuracy and precision, prior to reporting the results to the DEQ project manager. Table 5 lists the general acceptance criteria for accuracy and precision. The numerical difference between duplicate analyses, divided by the mean, determines the precision. Complete procedures for assessing accuracy and precision are detailed in the DEQ "Quality Assurance Manual" (DEQ, 1993a).

7.6 VALIDATION ANALYSES

For analytical results which are at or near the drinking water standard for the constituent being assessed, additional analyses may be requested. The project manager and the laboratory QA officer will perform a complete review of the data and

analytical methodology available to determine the applicable methodology to be used in the confirmatory analysis.

7.7 DATA DISTRIBUTION

All participating laboratories (DEQ, ODA, and OSU) shall send their data reports to the DEQ Laboratory sample tracker. When the sample tracker has assembled all of the data, he will forward copies to the DEQ project manager, the DEQ laboratory groundwater monitoring coordinator, and to OHD.

The DEQ Laboratory groundwater monitoring coordinator will be responsible for assuring that all of the data is entered into the STORET water quality data base, and verified within 60 days after the sample tracker releases the data.

The DEQ Laboratory will forward a copy of the data, along with well owner information, to the OHD. The OHD will be responsible for assuring that each individual well owner receives a letter describing the results from their well.

The project manager will maintain a mailing list of persons interested in receiving data from the project and will ensure that reports are sent to each individual when they are finalized.

7.8 CORRECTIVE ACTION

Corrective action will be initiated at the first indication of non-conformance with the project QA objectives. Prior to initiating corrective action, the personnel initiating the corrective action will flag the data in question, and inform the laboratory QA officer, the groundwater monitoring coordinator, and the project manager. If warranted, a meeting will be held to determine the causative factors, and to recommend subsequent action.

7.9 QUALITY ASSURANCE REPORTS

Annually, each laboratory will generate a report that summarizes the integrity of the analytical data generated, as well as any significant aspects of the program which has affected, or may affect, the quality of the data that this project has generated.

8.0 CONFIRMATORY SAMPLING

If a problem is indicated by the groundwater sampling, the area will be revisited and confirmatory samples collected. Water samples will be collected only from wells which had detections of pesticides or volatile organic compounds, or which had nitrate concentrations greater than 5 mg/L.

9.0 REPORTS

A final report will be prepared by the DEQ's Water Quality Division, Groundwater Section that summarized the initial and confirmatory groundwater sampling. If an extended period of time lapses between the initial sampling and confirmatory sampling, a preliminary final report will be prepared using only the data from the initial sampling.

The report will describe the area; why the area was chosen; how the wells and pesticide analytes were chosen; groundwater use; agriculture; the geology and hydrogeology; the results of the study, comparisons of the data to OHD Property Transfer and Volunteer Nitrate Testing Data; and recommendations for further work.

Copies of the historic sampling data should be included in the appendices of the report if the data is not readily available elsewhere.

The reports will include a table of the data, copies of the analyses, the water well reports and the well identification records, and maps of the area. Appendix F is a sample outline for the final reports.

10.0 STUDY AREA BINDERS

A binder must be prepared for each study area. The binders are used to store all of the information pertinent to the study and should include the following:

The study area work plan;
A preliminary and/or final report;
Field reports;
Laboratory Analyses;
A computer disk with all pertinent documents;
Film negatives;
Copies of historic sampling reports/data;
Maps; and
Any other information pertinent to the study area that is

not readily available elsewhere.

Section one of the binder is reserved for the work plans, preliminary and final reports. The last document prepared should be the first in the binder.

The computer disk should contain work plans, preliminary and final reports, and any other pertinent documents. This allows for easy incorporation of portions of the work plans into preliminary and final reports, etc.

The binders have clear plastic windows for labels. The binder labels are prepared using Harvard Graphics.

REFERENCES

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Rinehold, J.W. and Witt, J.M., 1989. Oregon Pesticide Use Estimates for 1987. Oregon State University, April 1, 1989.

State of Oregon, 1989. Groundwater Protection Act of 1989. House Bill 3515, Sections 17 Through 66. (Oregon Revised Statutes 468B.150 through 468B.185)

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June 3, 2003

APPENDIX C
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2. List of Participants
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1.0 INTRODUCTION

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3.0 HISTORIC GROUNDWATER SAMPLING

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3.2 Health Division Property Transaction Testing
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