Ambient Ground-Water Monitoring in the Dungeness Watershed, Clallam County, Washington

Quality Assurance Project Plan

By
Kirk Sinclair

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Washington State Department of Ecology
Environmental Assessment Program
Olympia, WA 98504-7710

Approvals

Melanie Kimsey_____ _____
SWRO WQ, Client Date

Ann Soule_____ _____
Clallam County, Client Date

Tania Busch-Weak_____
Clallam County Environmental Health Date

Kahle Jennings_____ _____
Acting Section Head, SWRO WQ Date

Will Kendra_____ _____
Section Head, Watershed Ecology Date

Dale Norton_____ _____
Unit Supervisor, Contaminant Studies Date

Stuart Magoon_____ _____
Director, Manchester Laboratory Date

Cliff Kirchmer_____ _____
Ecology Quality Assurance Officer Date

Kirk Sinclair_____ _____
Project Lead, Contaminant Studies Date

Project Description

The Environmental Assessment Program (EAP) was asked, by Melanie Kimsey of Ecology's Water Quality Program, to establish an ambient groundwater monitoring network for the communities of Agnew and Carlsborg, which are located on the Sequim/Dungeness Peninsula in northeastern Clallam County. Agnew and Carlsborg lie west of the City of Sequim and loosely encompass that portion of the Dungeness peninsula lying north of State Hwy 101, west of the Dungeness River, and east of Siebert Creek (Figure 1).

Groundwater is the primary source of potable water for most residents of the Sequim/Dungeness peninsula. The peninsula's human population has nearly tripled, since 1970, as land use progressively shifted from irrigated agriculture to mix agriculture and residential/municipal development. Much of the growth occurred within the City of Sequim and the outlying communities of Agnew, Carlsborg, and Jamestown.

The incorporated city of Sequim and Sunland are the only communities on the Dungeness peninsula currently served by sanitary sewers. All other development depends on individual septic systems to dispose of domestic wastewater. Past sampling of Clallam County wells in 1980 and 1990-91 yielded mean dissolved nitrate + nitrite (N) levels of 1.3 and 2.4 mg/L respectively (Drost, 1983, Soule, 1991). Concentrations in individual wells varied from <0.01 to 2.5 mg/L in 1980 and from <0.05 to 10.8 mg/L in 1990. County staff coordinated a mass sampling of 340 Clallam county wells in 1992 and undertook smaller follow-up samplings in the Carlsborg area (1993, 1999-2000), northeast Sequim (1994), and the west end of Woodcock Road (1994). Viewed together, these sample results suggest that nitrate + nitrite (N) concentrations may be increasing over time in some areas of the county (Drost, 1983, Soule, 1991, Sequim, 1994, and Thomas, 1999, Clallam Co, 2000).

Project Objectives

The objective of this study is to establish an ambient groundwater monitoring network in the Agnew/Carlsborg area of Clallam County. The network will be used to update past monitoring results, to expand upon past ground-water quality monitoring in the area, and to determine if area groundwater nitrate concentrations vary seasonally.

The results of this study will be used by Ecology and County staff to develop mitigation measures to alleviate groundwater contamination problems in the Agnew-Carlsborg area.

Previous Investigations

Wells within the Agnew-Carlsborg area have been sampled during numerous statewide or county-wide studies. Van Denburgh and Santos (1965) sampled wells in Clallam County

during their statewide characterization of groundwater quality. Walters (1971) and Dion and Sumioka (1984) sampled area wells during seawater intrusion investigations of Washington's coastal aquifers. Drost (1986) summarized much of the pre-1980 groundwater quality data that was available for the area while investigating the water resources of Clallam County. Turney (1986) summarized water quality data for the area as part of a groundwater quality investigation of the Puget Sound region. Drost (1983), Soule (1991), Sequim (1994), and Thomas (1999) sampled 138, 36, 340, and 74 Clallam County wells respectively during studies of the Sequim Dungeness area. In 1999-2000 Clallam County staff sampled 28 wells for several months in the Agnew area (Clallam Co., 2000).

The work of Drost (1983), Soule (1991), Sequim (1994), Thomas (1999) and Clallam Co. (2000) provides both a baseline and subsequent points of comparison for evaluating the results of this study.

Project Organization and Responsibility

Clients: *Melanie Kimsey*, Project client, Ecology SWRO WQ program (360) 407-6368: Responsible for coordinating with other agency staff and reviewing drafts of the project QAPP and final data report.

Ann Soule, Clallam County (360) 417-2424: Responsible for coordinating county activities related to this project and reviewing drafts of the project QAPP and final data report.

Project Lead: *Kirk Sinclair*, Ecology (360) 407-6557: Responsible for managing the project, preparing the project Quality Assurance Project Plan (QAPP), coordinating and completing sampling activities, analyzing project data, and preparing the draft and final data reports. Serves at the principal public contact for the technical aspects of the study.

Project Assistants: Present and future EAP interns: Responsible for assisting with sampling activities.

Laboratory Services: *Karin Feddersen*, MEL (360) 871-8829: Responsible for coordinating requests for analysis, scheduling sample processing, and providing access to project data.

Study Approach

The objectives of this study will be met through a combination of fieldwork and in-office evaluations of historic water quality and groundwater level data. The following criteria will be used to select the 8 to 12 domestic wells that will comprise the monitoring network for this study.

1) A well drillers report (well log) must be available for the well
2) The well must be completed in the "upper aquifer" as defined by Thomas (1999)
3) The well must be easily accessed for water level and water quality sampling
4) The current well owner must grant access to the well
5) The well was preferably monitored during at least one previous investigation (Drost, 1983, Soule, 1991, Sequim, 1994, Thomas, 1999, or Clallam County 2000).
6) The well must be located in the Agnew/Carlsborg area
7) The well can not have a water treatment device, such as a water softener or iron treatment system, or a large storage tank that can not be bypassed during well purging and sampling
8) The wells, in total, should be distributed to provide a reasonable coverage of the Agnew/Carlsborg area

Shallow ("upper aquifer") wells are preferred for this study since they are the most likely wells to be impacted by increased septic discharges, changing agricultural practices, or other land use activities that may adversely effect groundwater quality.

The well network will be monitored quarterly for two years. Network wells will be sampled for field parameters (temperature, conductivity, pH, dissolved oxygen, and water level) and the following laboratory parameters: total persulfate nitrogen (TPN), nitrate + nitrite as N, total coliform, fecal coliform, chloride, total dissolved solids, total iron, and total manganese. These parameters were chosen because they provide a good indication of overall water quality and are typically present in a number of contaminant sources.

Data Quality Objectives

EAP Watershed Assessment Section (WAS) protocols will be followed when measuring water quality field parameters (Ecology, 1992). The expected detection or precision limits for field parameters and laboratory analyses are listed in Table 1 along with the anticipated analysis method. The data quality objectives for this project are presented in Table 2. To enable the data to be used for water quality trend analysis, an overall accuracy of 20-30 percent is warranted for all parameters except coliform bacteria, for which an accuracy of 100 percent is acceptable. The total accuracy is reflective of the precision and bias limitation of the respective analytical methods. Data quality objectives and quality control procedures for the indicated laboratory analyses are documented in the Manchester Environmental Laboratory User Manual (MEL, 1994).

Analytical and Sampling Procedures

Standard MEL laboratory methods are appropriate for this study and should enable us to meet the project data quality objectives. "Clean" techniques or low-detection limit methods are not warranted for this study.

Ground-water levels will be measured in each of the study wells prior to sampling. Water level measurements will be made using a calibrated electric well probe or steel tape in accordance with standard USGS methodology (Stallman, 1983).

To ensure consistent purging and sampling techniques we will use a flow through cell and only properly functioning and calibrated field meters. All field meters will be calibrated in accordance with the manufacturers instructions at the start of each sampling day. Wells will be purged at a rate of approximately 3 gallons per minute (the maximum rate for the flow through cell). Ground-water temperature, electrical conductivity, pH, and dissolved oxygen concentration will be measured at three minute intervals during well purging. Samples for laboratory analysis will be collected only after all field parameters have stabilized. Stabilization has occurred when there is less than a five percent difference, between successive three-minute measurements, for all parameters. All samples will be collected in pre-cleaned bottles supplied by MEL and stored on ice pending their arrival at the laboratory. Sampling will be completed in a single day in order to meet established parameter holding times.

Quality Control Procedures

The equipment used to measure ground-water levels (electric tape or steel tape) will be inspected prior to use to verify that it is working properly. Steel tapes will be checked for bends or twists that might result in inaccurate readings. Electric tapes will be checked to confirm they have fresh batteries and will be calibrated prior to initial use.

At least two water level measurements will be made at each well to evaluate measurement precision and to assure that the well is not recovering from recent pumping. Individual measurements will be made to the nearest 0.01 foot. The difference between successive measurements should not exceed 0.01 feet.

All meters used to monitor water-quality-field parameters (water temperature, conductivity, pH and dissolved oxygen concentration) will be checked and calibrated as appropriate against known standards at the start of each sampling day. Calibration will be done in accordance with the manufacturer directions. Blind field duplicate samples, comprising approximately 10 percent of total samples, will be submitted to the laboratory during each sampling event to assess total variability.

Representativeness

The sampling design is intended to ensure the data are representative. Duplicate groundwater level measurements will be made at each well site to assure that the

measured water level represents static conditions and is not recovering from recent pumping.

Completeness

To maximize the amount of usable data collected during this study, we will follow accepted USGS and WAS protocols for ground-water level and water-quality data acquisition. Only appropriately calibrated and maintained field equipment will be used.

Comparability

Data comparability between this study and others will be assured by following standard USGS protocols for ground-water level data acquisition, (Stallman, 1983) and WAS protocols for water quality field parameters (Ecology, 1992).

Data Assessment and Reporting

At the completion of each sampling event all field and laboratory analytical data will be compiled and evaluated against the project data quality objectives. Data reduction, review, and reporting will follow the procedures outlined in MEL's lab users manual (MEL, 1999). Lab results will be checked for improbable or missing data. Analytical precision will be evaluated using standard statistical techniques (relative percent difference (RPD), standard deviation (s), pooled standard deviation (sp) or percent relative standard deviation (%RSD)) as appropriate. The %RSD for field and laboratory duplicates will be used to assess data quality relative to that listed in Table 2.

Once verified project results will be transitioned to the EIM data repository. The project lead will forward all ground-water level and quarterly sampling results to the project clients upon completing the first year of sampling (following sample event four). A draft data report summarizing monitoring results for years 1 and 2 of the project will be forwarded to the clients within four months of receiving the final round of sample results from MEL. Water quality trends, if any, will be evaluated by comparing this sample population against the data sets previously compiled by Drost (1983), Soule (1991), Sequim (1994), Thomas (1999), and Clallam Co. (2000), for the Agnew/Carlsborg area. The final data report should be ready for publication within three months of receiving review comments on the draft data report.

Project Budget

Laboratory analytical costs: Project total: $15,184 (see Table 3 for details)
Estimated Infrastructure Costs: None Anticipated.

Project Schedule

July 2000 through May 2003 (see Table 4 for details)

Table 1 - Summary of field and laboratory measurements, methods, target detection limits and expected ranges

Parameter	Method	Reporting Limit	Expected Range*
Field Measurements			
pH	Field Meter	+/- 0.1 SU	5.5-8.5 standard units
Specific Conductivity	Field Meter	+/- 5%	150-700 umhos/cm @ 25 C
Temperature	Field Meter	+/- 0.2 C	9-14 C
Dissolved Oxygen	Field Meter	+/- 0.2 mg/L	< 1-10 mg/L
Laboratory Parameters			
Total persulfate nitrogen	SM 4500 NO3-F (Modified)	0.10 mg/L	Unknown
Nitrate + nitrite as N	SM 4500 N03I	0.01 mg/l	< 0.1-15 mg/L
Coliform, total (MF)	SM 9222B	1 CFU	0-TNTC
Coliform, fecal (MF)	SM 9222D	1 CFU	Unknown
Chloride	EPA 300.0	0.1 mg/L	3-10 mg/L
TDS	EPA 160.1	1 mg/L	50-1000 mg/L
Iron (total)	SW 6010	20 ug/L	< 20-2000 ug/L
Manganese (total)	EPA 600/4-79-020	1 ug/L	< 1-5000 ug/L

***Expected range defined from prior investigations by Drost, 1983, Soule, 1991, and Thomas, 1999**

Table 2 - Data Quality Objectives

Parameter	Accuracy (2*precision + bias)	Precision (%RSD)	Bias	Lowest level of interest
pH (field)	30%	10	10	NA
Specific conductivity (field)	30%	10	10	25 umhos/cm @ 25 C
Temperature (field)	NA	NA	NA	NA
Dissolve Oxygen (field)	30%	10	10	0.5 mg/L
TPN	30%	10	10	0.1 mg/L
Nitrate + Nitrite as N	20%	5	10	0.1 mg/L
Coliform, total (MF)	100%	40	20	1 CFU
Coliform, fecal (MF)	100%	40	20	1 CFU
Chloride	25%	5	15	1 mg/L
TDS	30%	10	10	1 mg/L
Iron (total)	30%	10	10	5 ug/L
Manganese (total)	30%	10	10	1 ug/L

Table 3 - Estimated Laboratory Cost by Parameter (8 samplings of 12 wells)

Parameter	Number of Samples*	Cost per sample	Cost per Parameter
TPN	104	$16	$1664
Nitrate + Nitrite as N	104	$21	$2184
Coliform, total (mf)	104	$25	$2600
Coliform, fecal (mf)	104	$20	$2080
Chloride	104	$12	$1248
TDS	104	$10	$1040
Iron (total)	104	$21	$2184
Manganese (total)	104	$21	$2184
TOTAL LAB COST			**$15,184**

*** Includes one set of field duplicate samples for each of the 8 sampling events**

Table 4 - Project Timeline (by Task)

TASK	2000 JASOND	2001 JFMAMJJASOND	2002 JFMAMJJASOND	2003 JFMAM
Project Planning	J			
QAPP preparation	JA			
Well selection	SO			
Project setup in EIM	ON			
Quarterly sampling		D M J S	D M J S	
Quarterly LIMS upload to EIM		F M A N	F M A N	
Annual data submittal to Client			D	
Compile project data				OND
Prepare draft data report				D J
Incorporate Review Comments and Finalize Report				FMAM

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