Washington State
Cooperative Observation Well Network

Department of Ecology - U.S. Geological Survey

April 1984

WDOE 84-5

State of Washington
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Governor

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Washington State Cooperative Observation Well Network, Department of Ecology - U.S. Geological Survey

WDOE Report #84-5

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5-30-84

This report describes the current Washington State observation well network program and documents changes made in the program over the last five years as described in the project request (Appendix A). The report includes observation well locations, frequency of measurement, date of first measurement, well observer, and changes in individual well status since 1978. The material has been compiled from U.S. Geological Survey Water Data Reports, Department of Ecology - U.S. Geological Survey Cooperative Agreement ground water data files, unpublished office reports, and personal communication. Principal sections of the report are an introduction, program description, program changes 1978-1982, test observation wells, well hydrographs, and recommendations. A copy of the U.S. Geological Survey report review is attached (Appendix B).

Key words: aquifer, ground water, observation well, water level

Introduction

Hydrologists, geologists, engineers, and other water resource professionals use observation wells for measuring changes in water table elevations and changes in the piezometric surface for artesian systems. These changes reflect changes in ground water storage and may be either rapid fluctuation caused by pumpage for short-term uses or long-term declines caused by cumulative pumpage and variations in climate. Observation well measurements are also used for drawing ground water contour maps, cross-section diagrams, and calculating ground water flow.

The frequency of observation well measurement depends on the variability of the water level in the well. More frequent measurements are required for monitoring water levels that vary significantly with rainfall or seasonal ground water recharge. The most common frequencies of measurement are monthly, bi-monthly, semi-annually, and annually. The minimum frequency for reliable interpretation of water level trends for a well with a short period of record is semi-annually, immediately following the period of maximum recharge and following the period of greatest pumpage.

An observation well may either be a single casing open to one or more aquifers or multiple, smaller pipes called piezometers installed in the same casing but isolated to individual aquifers by screening and grouting. The casing often serves as the uppermost piezometer as shown in Figure 1. Single wells open to several aquifers will have a "composite" water level reflecting some combination of the potentiometric heads in the various aquifers. Water level changes in the individual aquifers cannot be accurately measured in this type of well.

Program Description

Observation wells have been measured in Washington State over a period of at least 75 years. The earliest records are for several wells near Spokane which were first measured in 1907. Other wells have been measured near Walla Walla since 1932 and near Pullman since 1934. The U.S. Geological Survey (USGS) has measured wells in the state as part of a nationwide network since about 1950. Figure 2 diagrams the five types of observation well measurements collected in Washington State. The areas in bold outline are those elements discussed in this report.

The USGS cooperative observation well network program began about 1948 and included 113 observation wells by 1954. Figure 3 shows the locations of observation wells in the network in 1958. They include 76 wells of which 31 were in the western part of the state (west of the Cascade Mountains). The program included 186 observation wells in 1978 of which 17 were in Western Washington as shown in Figure 4 and 169 were in Eastern Washington as shown in Figure 5. These wells were measured by arrangement with several cooperators (the Bureau of Reclamation, City of Tacoma, and City of Fircrest) as well as the Department of Ecology.

Figure 1. DRAWING OF A MULTIPLE–PIEZOMETER INSTALLATION

(NOT TO SCALE)

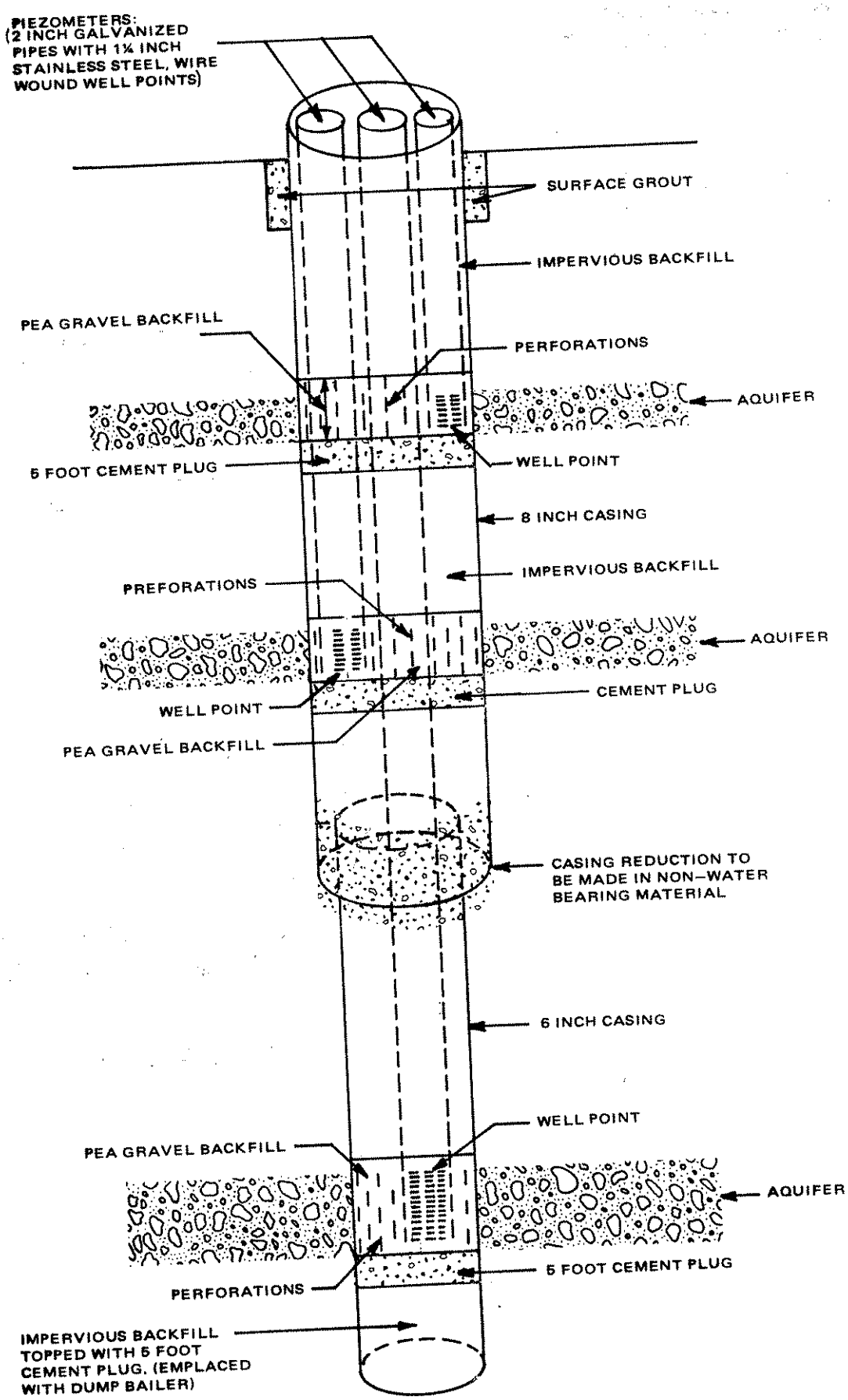
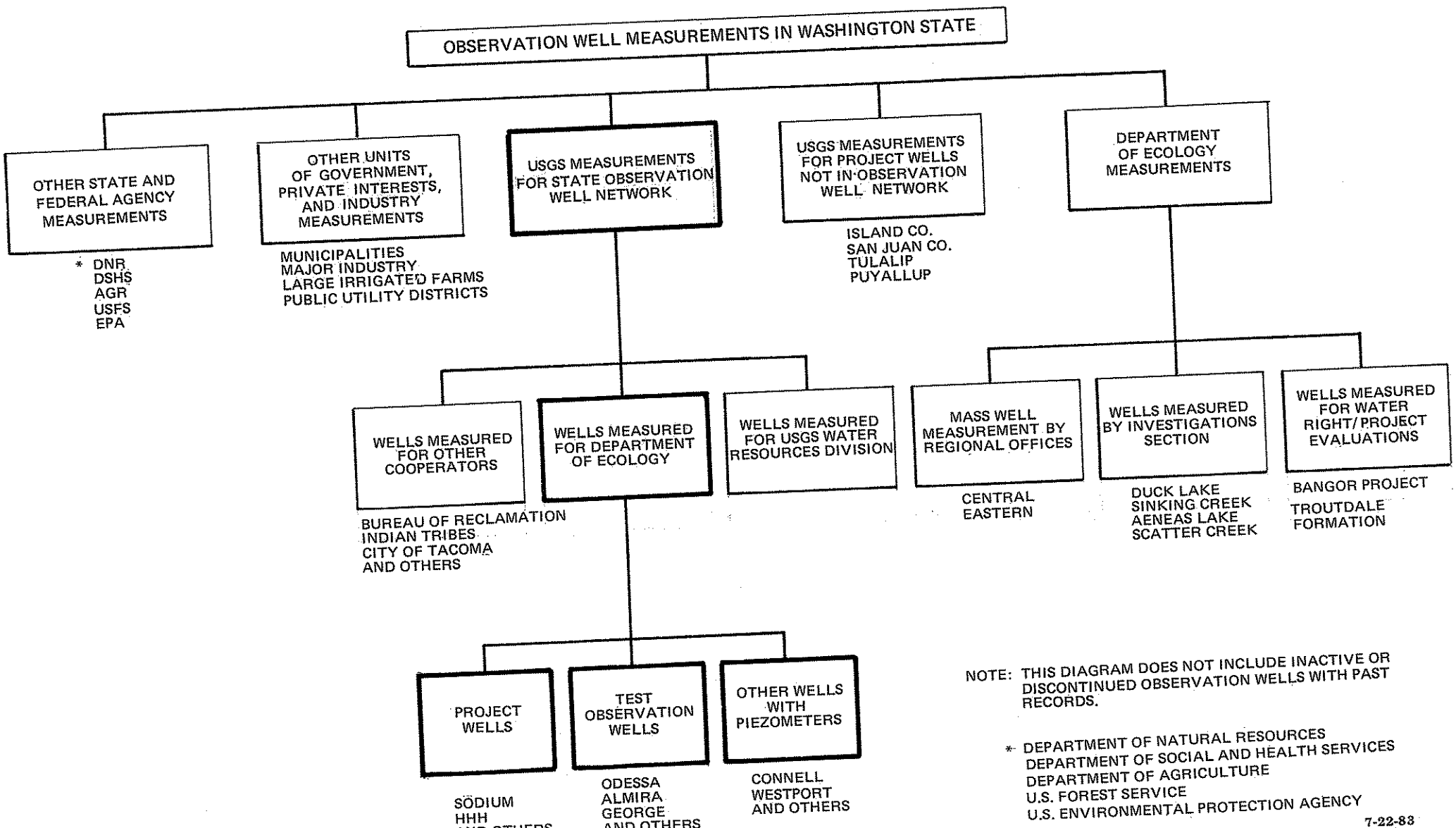


Figure 2. DIAGRAM OF OBSERVATION WELL MEASUREMENTS IN WASHINGTON STATE



NOTE: THIS DIAGRAM DOES NOT INCLUDE INACTIVE OR DISCONTINUED OBSERVATION WELLS WITH PAST RECORDS.

* DEPARTMENT OF NATURAL RESOURCES
DEPARTMENT OF SOCIAL AND HEALTH SERVICES
DEPARTMENT OF AGRICULTURE
U.S. FOREST SERVICE
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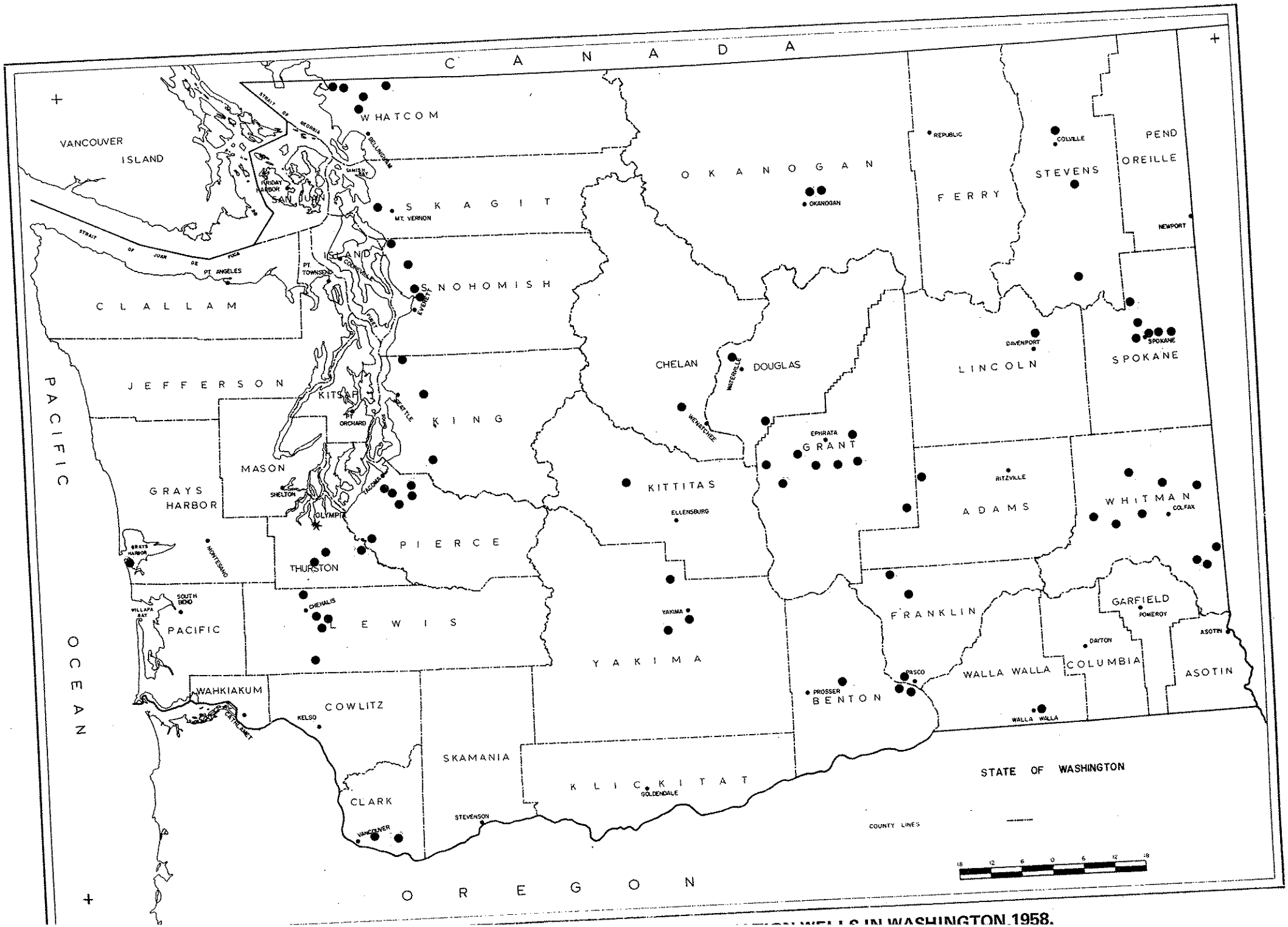
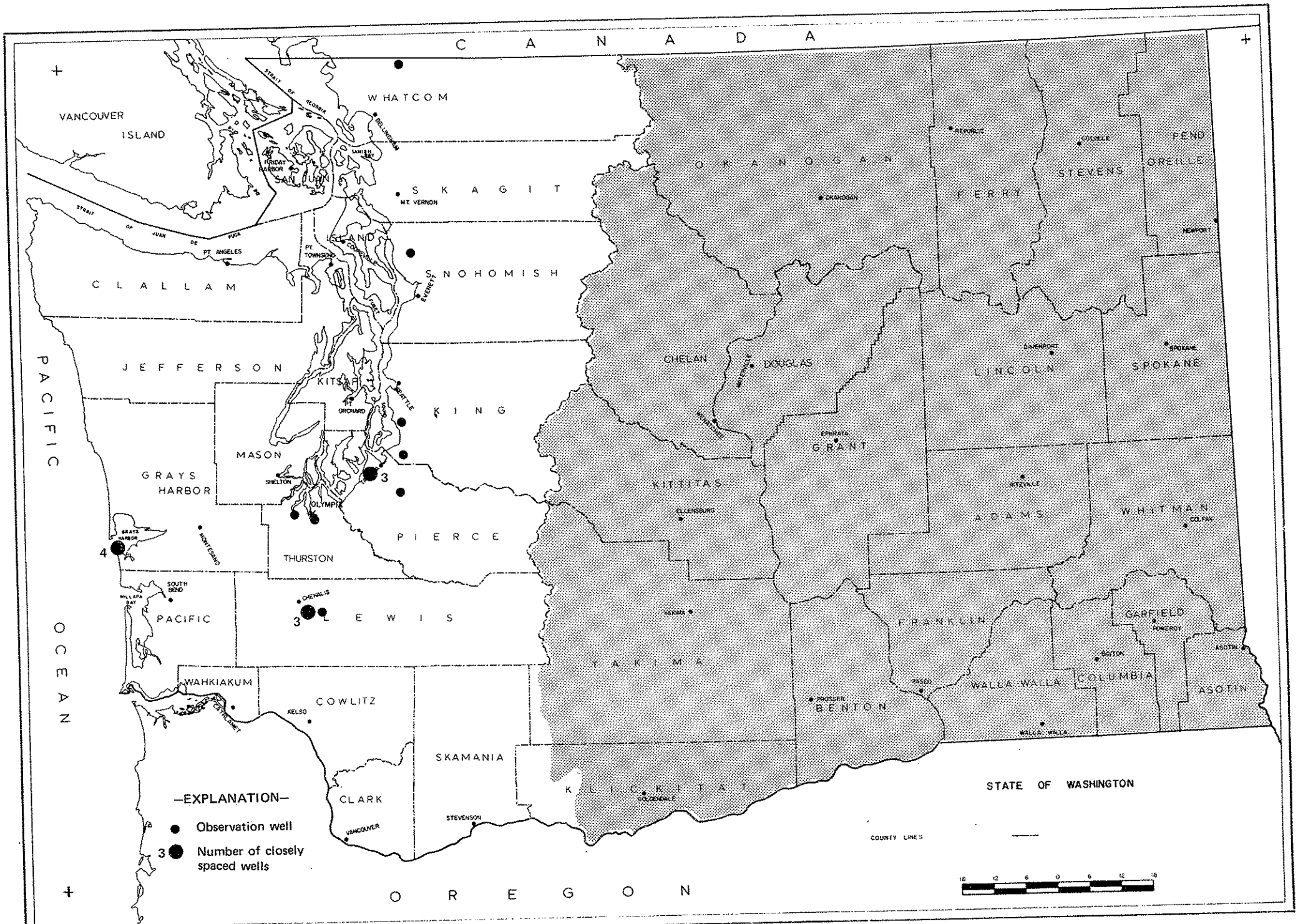
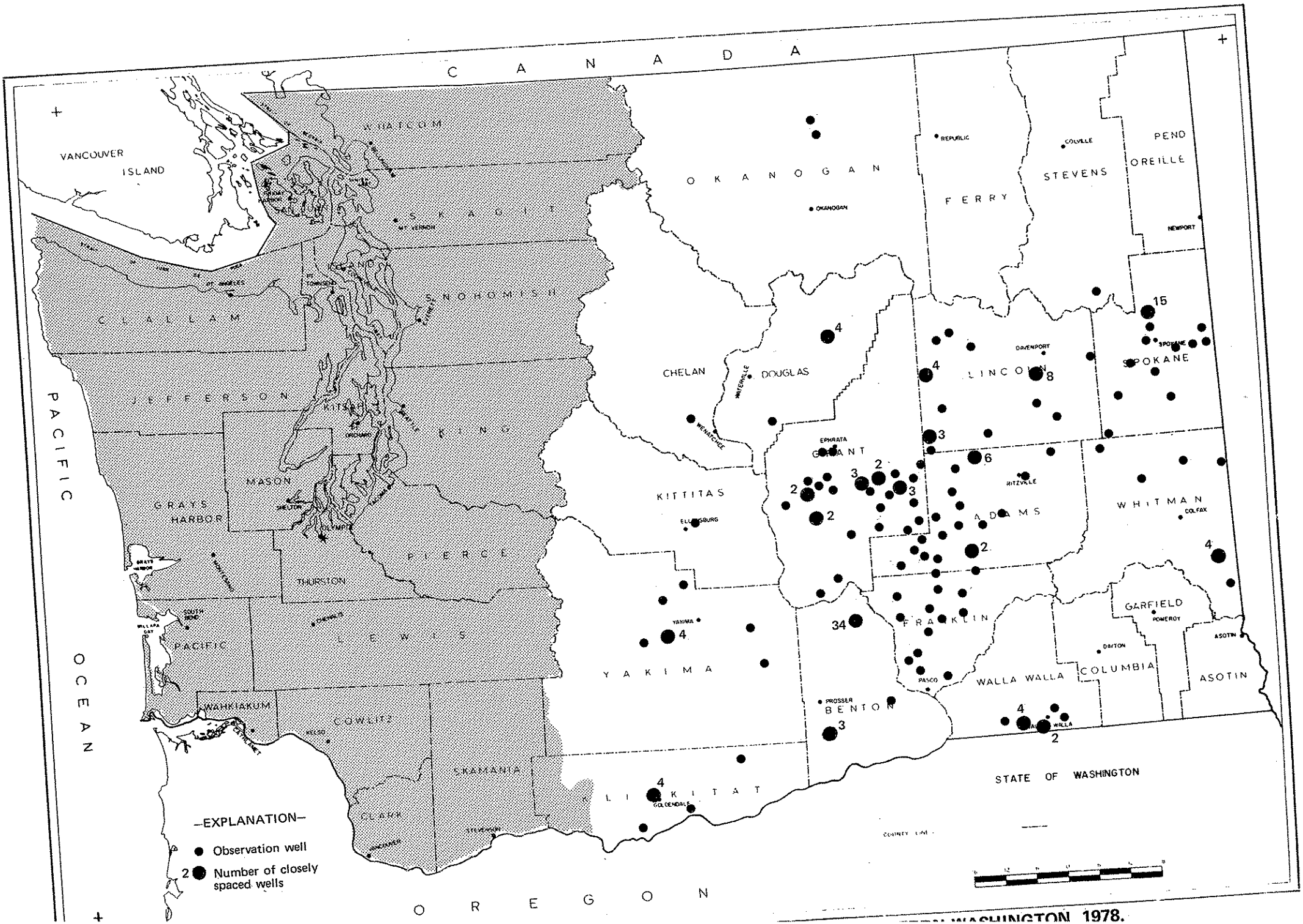


WELLS IN WASHINGTON 1958.



WELLS IN WESTERN WASHINGTON 1978.



WASHINGTON 1978.

Program Changes 1978-1982

In 1978, 127 wells statewide were measured by the USGS specifically for the department's cooperative agreement. Twelve of these were in Western Washington and 115 were in Eastern Washington. Table 1 lists the location of these wells by county, township, range, and section, their observer, frequency of measurement, and dates of first measurement.

The 1978 program was not changed in 1979. In 1980, two wells in Western Washington (those in Thurston and Snohomish counties) were discontinued. In 1981, six wells in Western Washington (those in Lewis and King counties) were discontinued. The 1982 program included only four wells in Western Washington (four piezometers in the single Grays Harbor County well). During the period 1978-1982, the number of wells measured in Eastern Washington was not changed although some specific locations may have changed. When a well in Eastern Washington was discontinued, another nearby well was added to the network.

The state observation well network program for Eastern Washington includes wells that are also used in specific research projects by the USGS. Some of these research projects are the Horse Heaven Hills Study, Columbia Basin Pumpage Study, Sodium Study, and the Regional Aquifer Systems Analysis (RASA). Since 1982, all the wells (except those with piezometers) in Eastern Washington previously in the state observation well network have been reassigned as project wells or discontinued. It is not known at this time whether water level measurements on these project wells, which were previously published as part of the observation well network, will be published in the annual Water Data Reports in the future.

Table 1. Location of wells in the U.S. Geological Survey Department of Ecology Cooperative Agreement for 1978, observer, frequency of measurements, and date of first measurement.

County	Location (Township/Range/Section)	USGS Observer (Office)	*Frequency of Measurements	Date of first measurement
Adams	16/35-21M1	Pasco	SA	1968
	18/31-6F1	Spokane	SA	1967
	19/35-14Q2	Spokane	SA	1962
	20/32-25C2	Spokane	SA	1964
	20/37-9J1	Spokane	SA	1965
	20/33-16E1 (E2 through E6)	Spokane	MO	1971
Benton	7/25-36N1 (N3 and N4)	Pasco	BI	1972
	8/28-6M1	Pasco	SA	1972
	9/25-17R2	Pasco	SA	1978
Chelan	23/19-4E2	Spokane	BI	1945
Douglas	27/26-25D1 (D2, D4, and D5)	Spokane	BI	1974
	23/23-36G1	Spokane	SA	1943
Franklin	14/32-33Q1	Pasco	BI	1952
	13/34-6B1	Pasco	SA	1966
	14/35-21L1	Pasco	SA	1966
Grant	18/25-15E1	Spokane	B1	1979
Grays Harbor	16/12W-24J4 (J5, J6, and J7)	Tacoma	SA	1970
King	21/4-20Q1	Tacoma	SA	1967
	22/4-8A1	Tacoma	SA	1960
Kittitas	18/19-32B1	Pasco	SA	1968
Klickitat	3/15-28A1	Pasco	SA	1957
	4/15-16F1 (F2, F3, and F4)	Pasco	SA	1973
	4/17-31L1	Pasco	SA	1957
	6/20-22D1	Pasco	SA	1968
Lewis	13/1W-22R2	Tacoma	SA	1954
	13/1W-20E1	Tacoma	SA	1955
	13/1W-28P1	Tacoma	SA	1976
	13/1W-29D1	Tacoma	SA	1967

Lincoln	21/31-10M2 (M3 and M4)	Spokane	BI	1972
	24/31-16E1 (E2, E3, and E4)	Spokane	BI	1971
	24/36-16A1 (A2 through A8)	Spokane	BI	1971
	21/31-32D1	Spokane	SA	1964
	21/33-12P1	Spokane	SA	1966
	22/36-20A1	Spokane	SA	1968
	22/37-12C1	Spokane	SA	1966
	23/32-20A1	Spokane	SA	1965
	23/36-21P1	Spokane	SA	1962
	24/39-1R1	Spokane	SA	1966
	25/34-2G1	Spokane	SA	1967
	26/32-21J1	Spokane	SA	1966
	26/33-18G1	Spokane	SA	1968
	25/36-27Q1	Spokane	AN	1966
Okanogan	37/26-10H1	Spokane	BI	1964
	37/26-26J1	Spokane	BI	1964
Pierce	19/4-4L1	Tacoma	BI	1964
	20/3-18C1	Tacoma	BI	1953
Snohomish	31/5-10J3	Tacoma	BI	1940
Spokane	26/43-19A1	Spokane	BI	1938
	26/45-32J2	Spokane	BI	1958
	25/42-14L1	Spokane	MO	1941
	21/41-31R1	Spokane	SA	1967
	22/43-4F1	Spokane	SA	1967
	23/41-19R1	Spokane	SA	1967
	24/42-6J1	Spokane	SA	1963
	24/42-25G1	Spokane	SA	1964
	25/44-23D1	Spokane	SA	1931
	25/45-16C1	Spokane	SA	1938
Stevens	28/40-17J1	Spokane	BI	1954
Thurston	18/2W-7R1	Tacoma	BI	1958
Walla Walla	6/35-18A1 (A2, A3, and A4)	Pasco	BI	1973
	6/35-1P2	Pasco	SA	1968
	6/35-12N1	Pasco	SA	1913
	7/34-29C1	Pasco	SA	1956
	7/35-36F1	Pasco	SA	1948
	7/36-17L1	Pasco	SA	1946
	7/36-27G1	Pasco	SA	1948
	6/36-7M1	Pasco	AN	1958
	6/36-7M2	Pasco	AN	1958
	6/36-9L1	Pasco	AN	1945
	7/34-26R1	Pasco	AN	1957
	7/35-7Q1	Pasco	AN	1955
	7/35-33H2	Pasco	AN	1946

Multiple Piezometer and Test Observation Wells

The department completed the first well (Odessa #1) of its test observation well program in July 1970. A total of 14 wells in this program have been drilled in various parts of the state since then. These wells penetrate aquifers of more then one water-bearing zone and piezometers have been installed in most of them to measure the different water levels. The department has also assisted the USGS in placing piezometers in three other wells in eastern Washington for additional water level measurements.

Table 2 lists the locations of the 14 test observation wells and 5 additional, multiple piezometer installations included in the state observation well network.

Well Hydrographs

The department has well hydrographs for 192 wells in the state observation well program that include water level measurements up to 1980. These hydrographs were plotted manually and updated each year with measurements reported by the USGS.

State observation well network data is now stored in a computer data base by the USGS. This data storage system includes a print routine for illustrating hydrographs for wells in the network. Although the department can retrieve data from the USGS data system through its own computer facilities, it does not have the computer printing capability for reproducing hydrographs. Figure 6 shows a sample hydrograph, plotted on USGS equipment, for a well in the state observation well network.

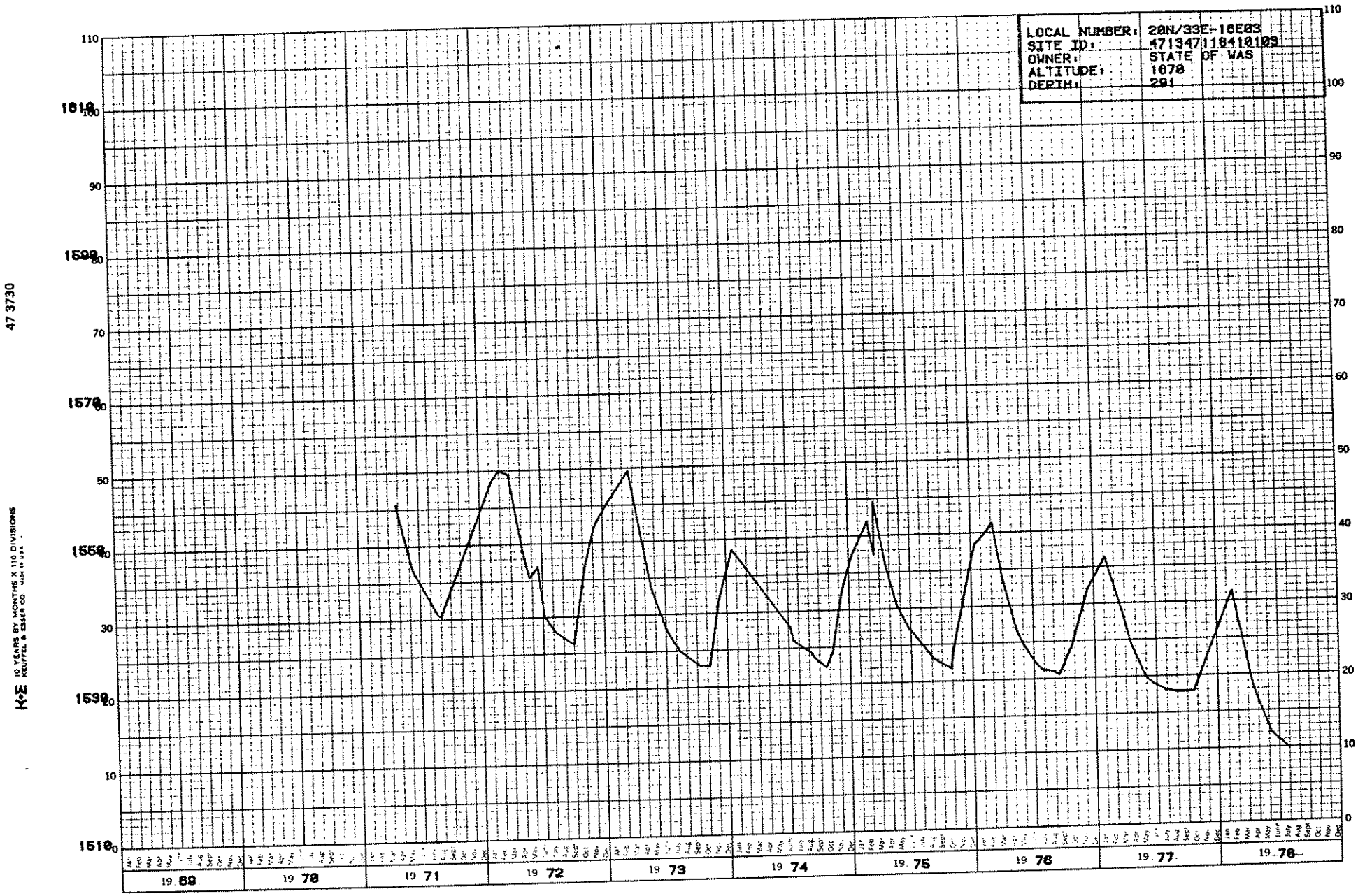


Figure 6. HYDROGRAPH FOR A WELL, STATE OBSERVATION WELL NETWORK.

Recommendations

1. As shown in Figure 2, there are additional wells in the state being monitored by the department and others that could be included in a statewide observation well data bank. For example, the department's eastern regional office each year measures about 400 private wells (over 300 of which are in the Odessa groundwater area) and several of the small-diameter drought wells drilled in 1977.

   As a follow-up to this report, an inventory of wells independently measured by the department, other state and federal agencies, municipalities, private industry, and others should be compiled.

2. There are no longer any wells in Western Washington being read for the state observation well network except for the piezometers at the Gray's Harbor well and two wells measured for the cities of Tacoma and Fircrest. Although ground water conditions are highly variable in the glacial drift and alluvial aquifers of the Pacific Coast and Puget Sound basins, there is still much interest in ground water supplies in these areas.

   The reservation of ground water for future water supply, increasing demand for municipal and industrial use of ground water in urban growth areas, decreased availability of additional surface water supplies because of instream flow needs, and an increasing need for ground water measurements in water right decisions are four reasons for maintaining an observation well network in Western Washington. As the years of nonmeasurement accumulate, the department will be increasingly unable to answer inquiries on trends or recent changes in ground water levels in most aquifers of this part of the state.

   An inventory of principal aquifers and a program for observation well measurements should be part of the ground water management program for Western Washington.

Appendix A

Project Request

JOHN SPELLMAN
Governor

DONALD W. MOOS
Director

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Mail Stop PV-11 • Olympia, Washington 98504 • (206) 459-6000

MEMORANDUM

February 7, 1983

TO: Al Wald

FROM: George Kill

SUBJECT: USGS Co-op Program, Test Observation Wells

One of the ongoing USGS Co-op activities is the ground water level network which includes reading the observation wells and repair according to Bill Miller, Contract Officer.

I believe it is important that we have a handle on this activity. We can probably go to the USGS anytime for specific information if needed; however, I feel that we need to track and have sufficient data in the Department from which we could call upon to answer general questions regarding ground water trends if it were applicable. Since we are also furnishing a little money to help collect and maintain the data, its all the more reason we should track a little closer. I'm not thinking of anything extravagant but something that we can put our fingers on immediately for broad information. Bill Miller informs me that Betty Martin was doing something in this area. The 1981 - 82 Sixth Biennial Report to the Legislature has a good brief overview of the activity.

I would like for you to follow-up and obtain the following at a minimum:

1. Location of state observation wells being read by USGS. This would be the wells not transferred to project areas. Legal description and plotted on map(s).

2. Determine if they are being observed and the frequency of such readings.

3. Determine if hydrographs or other data are available. Should we plot hydrographs or assemble data in some format if USGS has not?

4. Location of observation wells in network five years ago that have been transferred to project areas.

Appendix B

Report Review

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Water Resources Division
1201 Pacific Avenue - Suite 600
Tacoma, Washington 98402

January 9, 1984

Mr. George E. Krill
Project Assistance and Investigations Section
State of Washington
Department of Ecology
Mail Stop PV-11
Olympia, Washington 98504

Dear Mr. Krill:

Thank you for the opportunity to review and comment on the draft report, "Washington State Cooperative Observation Well Network," by Alan Wald.

I made minor changes (in red) on page 8 of the report, and Denny Cline supplied information to update Table 2.

Your concern about the lack of ground-water-level data in western Washington is understandable. Our published estimates in 1975 indicated that pumpage in western Washington was about 240,000 acre feet, compared to 230,000 acre feet in eastern Washington. Our current estimate for eastern Washington is approximately 580,000 acre feet in 1982, but western Washington would still account for 30% of the total ground-water pumpage in the State, even assuming no increase over here in the last seven years.

Our problem with maintaining an observation-well network in western Washington has been the limited extent of the aquifers penetrated by the observation wells and, indeed, by most wells in western Washington. However, the same factor (discontinuous aquifers) that precludes observation wells also tends to limit significant ground-water development.

If, in fact, significant ground-water supplies cannot be developed, this augurs poorly for the Seattle-Tacoma metropolitan area, because that area is rapidly reaching the limits of surface-water supply available to it under present legal constraints.

I certainly concur with your perceived need for some ground-water-level monitoring in western Washington. The monitoring probably should concentrate on the pumpage in five counties: Clark, King, Pierce, Whatcom, and Thurston. These five counties accounted for about 90% (200,000 AFY) of western Washington pumpage in our 1975 estimate.