

Final Technical Report: Oregon Water Resources National Ground-Water Monitoring Network Cooperative Agreement G15AC00425 (10/01/2015 through 09/30/2016)

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Description of Oregon Water Resources Water-Level Monitoring Network

The Oregon Water Resources Department (OWRD) manages water supplies in the state of Oregon. The Department allocates water rights, evaluates water supplies, and regulates water use based on the doctrine of prior appropriation. Groundwater levels are monitored by the Department throughout the state to evaluate aquifer sustainability, the impacts of groundwater withdrawals on surface water sources, and the availability of groundwater for new proposed uses. Five principal USGS aquifers underlie extensive areas of Oregon: Willamette Lowland basin-fill aquifers, Pacific Northwest basin-fill aquifers, Pacific Northwest basaltic-rock aquifers, Columbia Plateau basin-fill aquifers, and Columbia Plateau basaltic-rock aquifers. Three additional principal aquifers underlie small areas of the state. Snake River Plain basin-fill aquifers and Snake River Plain basaltic-rock aquifers occur in a narrow strip in eastern Oregon, adjacent to Idaho, and Basin and Range basin-fill aquifers occur in southeastern Oregon adjacent to Nevada. A sizable fraction of Oregon is underlain by pre-Miocene rock that host low-yield bedrock aquifers. Although these are not defined as a USGS principal aquifer, they represent an important water supply in many areas of the state, especially west of the Cascade Mountains.

Most surface water supplies in Oregon are no longer available for new out-of-stream appropriations, especially in summer months. This has caused an increase in demand for groundwater supplies, particularly for irrigation. Groundwater has also seen more development in recent years as a buffer against drought. Increased reliance on groundwater has led OWRD to allocate significant resources to assess groundwater supplies. Groundwater-level monitoring is a major component of this work. A principal goal of the Department is to expand our monitoring networks to provide adequate spatial and vertical sampling of all of the principal aquifers of the state.

OWRD currently measures water levels in about 1200 wells across the state (Figure 1). A core set of about 380 wells are included in the State Observation Well Network which is designed to monitor seasonal and long-term water-level changes in the principal aquifers of the state. Wells in this network are usually measured quarterly and have periods of record that generally range from 20-90 years. Continuous recorders are currently installed in 43 of these wells, some with up to 20 years of record. The recorders are generally set at a 1- or 2-hour sampling interval.

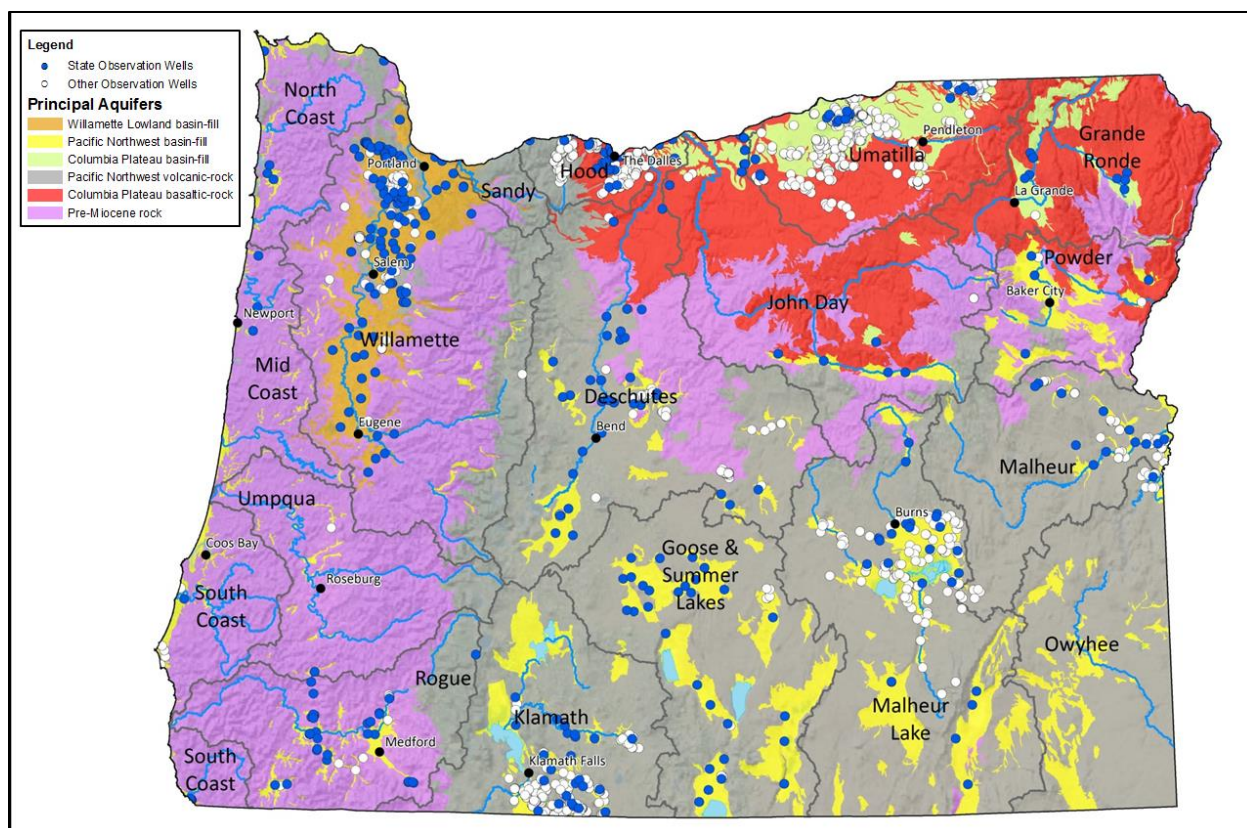


Figure 1. Current OWRD observation wells and major drainage basins (gray lines) in Oregon.

About 700 wells are maintained in other observation well networks throughout the state. Most of these support short- and medium-term water-supply investigations that are local or sub-regional in scale. Wells in these networks are generally measured quarterly or annually and have periods of records that range from 1-40 years. Continuous recorders are currently installed in 57 of these wells. Representative wells from these projects are periodically added to the State Observation Well Network as projects mature or are completed. State Observation Network Wells and a subset of other monitoring network wells, especially wells with continuous recorders, are the primary pool of candidates for Trend Wells in the NGWMN. Surveillance Wells for the NGWMN are largely selected from other project networks.

Description of the Process Used to Select Sites for the NGWMN

Prior to reviewing any potential OWRD sites existing NGWMN sites, established by the USGS Oregon Water Science Center, were evaluated to assess the current distribution of sites in the principal aquifers of the state. Information from these sites was downloaded from the NGWMN Portal and uploaded into a GIS layer for comparison with potential sites from the OWRD networks.

Selection of Oregon sites for the NGWMN was an iterative process that was completed independently for each of the 18 major drainage basins in the state. Where major structural features produce natural boundaries in the groundwater flow system, sub-basins were evaluated independently so that a set of representative sites could be selected in each of the major groundwater flow systems in the state.

In each basin, all current OWRD observation wells were reviewed to determine the frequency of water-level measurements, the period of record, and the completeness of the minimum data elements specified in the NGWMN Framework document and the Minimum Data Elements tip sheet. Each well was then associated with a Principal aquifer as defined by the USGS (U.S. Geological Survey, 2003; Whitehead, R.L., 1994). For each Principal aquifer, the spatial distribution of wells was reviewed using GIS software. A core set of Trend wells was selected from the State Observation Well Network using selection criteria in the NGWMN Framework document and the Well Selection Criteria for Water Levels tip sheet. In cases where the spatial distribution of Trend wells was inadequate, additional Trend wells were selected from other observation well networks. Preference was given to wells with continuous recorders installed, wells measured at least four times per year, wells with long periods of record, or dedicated observation wells recently drilled with state funds for the purpose of long-term monitoring. After a representative suite of Trend wells was selected, Surveillance wells were selected to complement the trend wells in each Principal aquifer. Some of the Surveillance wells have continuous recorders installed but many are generally measured quarterly or annually. Each well was then classified into the Background, Suspected Changes, or Documented Changes Subnetwork using the NGWMN tip sheet on Defining Monitoring Categories. The set of selected wells was then reviewed several times and adjustments were made to achieve the best possible spatial distribution for each Principal aquifer within each major groundwater flow system while ensuring good spatial and temporal patterns relative to human activity and climate variation.

Summary of Selected NGWMN Wells

A total of 279 water-level monitoring sites were added to the NGWMN during the performance period and web services were established for discrete water levels, mean daily recorder water levels, lithology, & well construction (Figure 2). The wells represent five USGS principal aquifers and several locally important pre-Miocene bedrock aquifers (Table 1). Sixty-two of the wells have continuous recorders installed. All of the required data elements have been entered into the site registry.

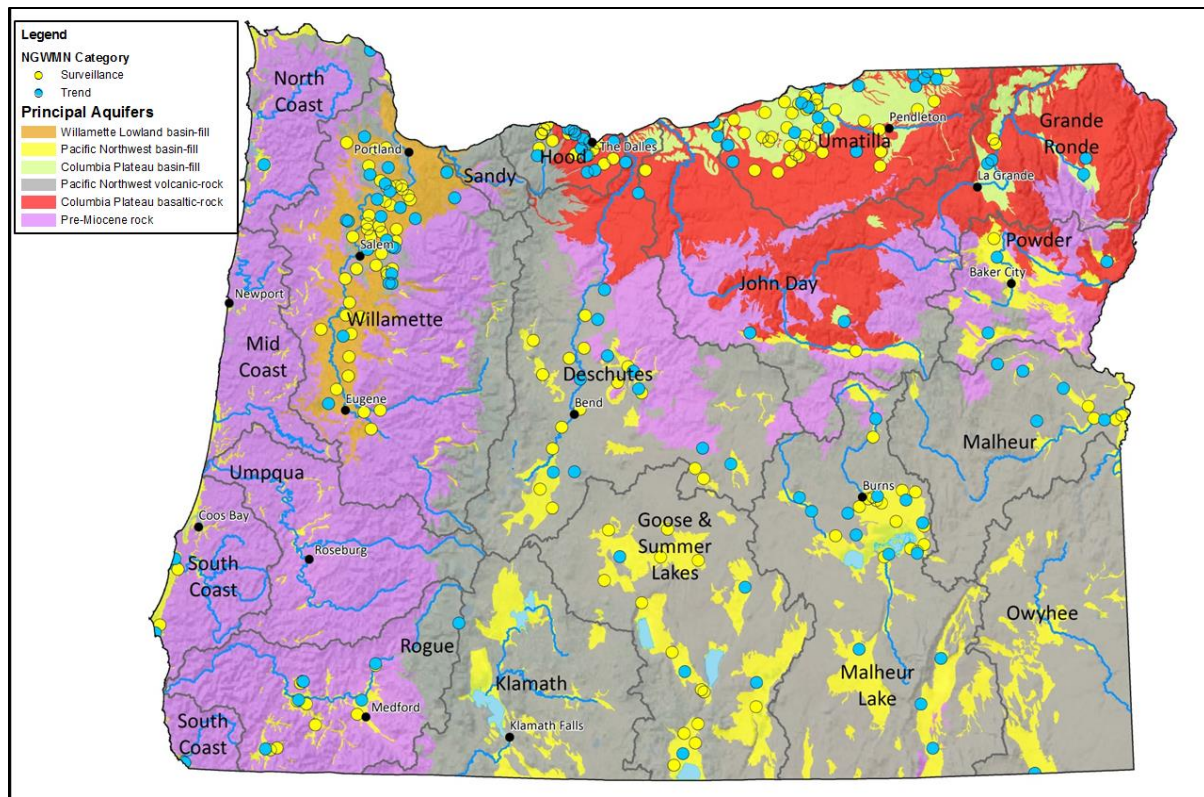


Figure 2. Current OWRD National Groundwater Monitoring Network wells.

USGS Principal Aquifer	Trend	Surveillance	Continuous Recorders	Total
Columbia Plateau basaltic-rock aquifers	33	44	13	77
Columbia Plateau basin-fill aquifers	5	9	6	14
Pacific northwest basin-fill aquifers	32	40	18	72
Pacific northwest volcanic-rock aquifers	24	49	15	73
Willamette Lowland basin-fill aquifers	10	23	6	33
Other aquifers (Pre-Miocene bedrock)	5	5	4	10
Totals	109	170	62	279

Table 1. Summary of current OWRD NGWMN wells.

Description of Web Services

OWRD has established web services for discrete water levels, mean daily recorder water levels, lithology, and well construction which adhere to guidelines in the NGWMN tip sheet on Developing Web Services for the Network. Each of the specific web services provides all of the minimum required data elements specified in the NGWMN Framework document and related tip sheet. All web service requests are submitted via an OWRD web page at:

http://apps.wrd.state.or.us/apps/gw/gw_data_usgs/. Documentation of the web services is available at: http://apps.wrd.state.or.us/apps/gw/gw_data_usgs/#hide1.

Description of Field Techniques

OWRD collects water-levels and well metadata using procedures and data collection standards that parallel those outlined in the NGWMN Framework document and in Groundwater Technical Procedures of the U.S. Geological Survey (Cunningham and Schalk, 2001). The Department uses steel tapes in a few wells but generally uses commercially available electric tapes from several vendors. Tapes are calibrated annually, or more frequently as needed, using a 500-foot dedicated steel tape that has been calibrated by the USGS Oregon Water Science Center. Calibrated flat tapes (electric tapes with a steel core) are used in all dedicated observation wells without pumps. Coaxial electric tapes are used in all wells with pumps. In flowing artesian wells, calibrated gages are used to measure shut-in pressure. A few of our NGWMN wells are measured using an airline and a calibrated gage. Whenever possible, independent calibrated electric tape measurements are made to verify airline lengths.

Water-level measurement errors are initially assigned to each measurement based on the tool used to obtain the measurement as follows:

- Calibrated steel tapes 0.01 feet
- Calibrated flat electric tapes 0.01 feet
- Calibrated coaxial electric tapes 0.02 feet
- Uncalibrated coaxial electric tapes 0.10 feet
- Calibrated gage measurements used for shut-in pressures 0.25 feet
- Calibrated gage measurements used for airlines with verified airline lengths 2 feet
- Calibrated gage measurements used for airlines with unverified airline lengths 4 feet

However, these initial error estimates are adjusted upward as needed based on conditions encountered in the field.

Measuring points are documented relative to land surface at each well as well as the horizontal and vertical errors associated with the well location and well-head elevation. All field measurements are recorded on dedicated paper forms and archived in a dedicated file for each observation well. Our current database has the ability to capture all metadata now documented on paper forms. Records for each well are reviewed annually to assess the overall quality of the data and to assign a reliability index to individual measurements based on the entire record for the year. When time permits, historical records are reviewed in the same manner.

All current recorder data is processed and reviewed using WISKI, a time-series water-information management system developed by the KISTERS Company. A customized processing file is established in WISKI for each monitoring site based on unique site attributes. Standard protocols are used to subtract barometric pressure (most of our transducers are non-vented models), correct for drift using independent measurements made with calibrated electrical or steel tapes during each site visit, and correct for miscellaneous baseline shifts. Some of these processes are automated by the WISKI software but each file is also reviewed at various times by a hydrogeologist to ensure that the final product meets our quality control standards. The data is also processed to provide a table of mean daily levels. The final, corrected unit measurements and the daily mean values are uploaded into SQL tables which are then available to the NGWMN Portal through our web services. Historic recorder data will be processed in the same manner as time permits.

OWRD does not currently have a formal groundwater field-collection manual. However, we are in the process of developing a manual that will outline our standard data collection, processing, and quality control procedures. We anticipate providing this manual to the NGWMN in conjunction with future projects.

Access to data and data sharing practices and policies

All data collected by the data provider (OWRD) is considered to be public information but policy dictates that personal identification information will not be made readily available on web pages. Other than personal identification information, all data collected for this project is made available on our web pages or in response to written requests. Database security and privacy protocols required by the State of Oregon will ensure data security and privacy.

Archiving of data

Groundwater and well data collected by OWRD is generated with the intention of providing long-term data records for groundwater studies. Field-collection notes are stored in paper files in a central filing system. Field measurements are also stored in digital tables in an enterprise-level SQL database. Copies of the paper files are available upon request. Digital records will be publicly available through an on-line interface on the agency's web page. All digital files are backed up on tape and external disks.

References

A National Framework for Ground-Water Monitoring in the United States, 2013, Prepared by The Subcommittee on Ground Water of The Advisory Committee on Water Information.

Cunningham, W.L., and Schalk, C.W., 2011, Groundwater technical procedures of the U.S. Geological Survey: U.S. Geological Survey Techniques and Methods 1–A1, 151 p.

U.S. Geological Survey, comp., 2003, Principal aquifers of the United States, prepared by the U.S. Geological Survey for the National Atlas, scale 1:5,000,000.

Whitehead, R.L., 1994, Ground water atlas of the United States, Segment 7, Idaho, Oregon, Washington: U.S. Geological Survey Hydrologic Investigations Atlas 730-H, 31 p.