GROUND-WATER RESOURCES IN THE HOOD BASIN, OREGON

UNITED STATES DEPARTMENT OF THE INTERIOR
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GROUND - WATER RESOURCES IN THE HOOD BASIN, OREGON

By Stephen J. Grady

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REPORT 81-1108

Prepared in cooperation with

WASCO AND HOOD RIVER COUNTIES

Portland, Oregon 1983

U.S. DEPARTMENT OF THE INTERIOR

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[Plates are in pocket]

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CONVERSION FACTORS

[For use of those readers who may prefer to use metric (SI) units rather than inch-pound units, the conversion factors for the terms used in this report are listed below]

To convert from	To	Multiply by
Length		
inch (in.)	millimeter (mm)	25.40
foot (ft)	meter (m)	0.3048
mile (mi)	kilometer (km)	1.609
Area		
acre	square meter (m^2)	4,047
square mile (mi^2)	square kilometer (km^2)	2.590
Volume		
gallon (gal)	liter (L)	3.785
acre-foot (acre-ft)	cubic meter (m^3)	1,233
Specific combinations		
foot squared per day (ft^2/d)	meter squared per day (m^2/d)	0.0929
gallon per minute (gal/min)	liter per second (L/s)	0.06309
gallon per minute per foot [(gal/min)/ft]	liter per second per meter [(L/s)/m]	0.2070
Temperature		
degree Fahrenheit (°F)	degree Celsius (°C)	5/9 after subtracting 32 from °F value

GLOSSARY OF SELECTED TERMS

Aquifer.--A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells or springs.

Confined ground water.--Ground water that is under pressure greater than atmospheric. In a well that taps a confined ground-water body, the static water level is above the top of the aquifer.

Drawdown.--The lowering of head caused by pumping. It is the difference, generally, in feet, between the static water level and the pumping water level in a well.

Evapotranspiration.--Water withdrawn from a land area by evaporation from water surfaces and moist soil and by plant transpiration.

Hydraulic conductivity.--A property of the porous water-bearing media and is defined as the volume of water at the existing kinematic viscosity that will move in unit time under unit hydraulic gradient through a unit area of the media measured at right angles to the direction of flow.

Hydraulic gradient.--The change in hydraulic head per unit of distance in a given direction. The direction generally is understood to be that of the maximum rate of decrease in head.

Intermittent stream.--A stream that flows only during those parts of the year when it receives water from springs or from some seasonal surface source such as melting snow in mountainous areas.

National Geodetic Vertical Datum of 1929 (NGVD of 1929).--A geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called "Mean Sea Level." NGVD of 1929 is referred to as sea level in this report.

Perched ground water.--Unconfined ground water separated from an underlying body of ground water by an unsaturated zone.

Perennial stream.--A stream that flows continuously.

Permeability.--A general term that defines the relative ease with which a porous medium, such as a geologic formation, can transmit water or other liquid.

Potentiometric surface.--A surface that represents the head. In an aquifer, it is defined by the levels at which water stands in tightly cased wells.

Specific capacity.--The rate of discharge of water from a well divided by the drawdown of water level within the well, expressed in gallons per minute per foot of drawdown. It is an approximate index of the capability of an aquifer to transmit water.

Specific conductance.--The ability of water or other substance to conduct an electric current. Conductance of water increases with increasing concentration of dissolved-mineral matter; it is, therefore, an approximate index to the concentration of dissolved solids. Specific conductance may be measured with simple instruments either in the field or in a laboratory.

Static water level (static head).--The level at which water stands in a well, when the well has not been recently pumped. In a shut-in flowing well, it is the pressure, converted to feet of water, above the pressure-gage datum. The static water level in a well represents the average head of the water-bearing materials open to the well bore and is expressed in feet above or below a datum. That datum may be land surface or sea level.

Storage coefficient.--A property of the porous water-bearing media and is defined as the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head.

Transmissivity.--The rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of the aquifer under a unit hydraulic gradient. It is a property of the aquifer, and it embodies the saturated thickness of the aquifer and the properties of the contained liquid.

Unconfined ground water.--Ground water in an aquifer that has a free water surface.

Water table.--The free surface water in a ground-water body at which the water pressure is equal to atmospheric pressure. It is defined by the levels at which water stands in wells that penetrate the water body just far enough to hold standing water. In wells that penetrate to greater depths, the water level will stand above or below the water table if an upward or downward component of ground-water flow exists.

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ABSTRACT

The Hood Basin, an area of 1,035 square miles in north-central Oregon, includes the drainage basins of all tributaries of the Columbia River between Eagle Creek and Fifteenmile Creek. The physical characteristics and climate of the basin are diverse. The Wasco subarea, in the eastern half of the basin, has moderate relief, mostly intermittent streams, and semiarid climate. The Hood subarea, in the western half, has rugged topography, numerous perennial streams, and a humid climate.

Water-bearing geologic units that underlie the basin include volcanic, volcaniclastic, and sedimentary rocks of Miocene to Holocene age, and unconsolidated surficial deposits of Pleistocene and Holocene age. The most important water-bearing unit, the Columbia River Basalt Group, underlies almost the entire basin. Total thickness probably exceeds 2,000 feet, but by 1980 only the upper 1,000 feet or less had been developed by wells. Wells in this unit generally yield from 15 to 1,000 gallons per minute and a few yield as much as 3,300 gallons per minute.

The most productive aquifer in the Columbia River Basalt Group is The Dalles Ground Water Reservoir, a permeable zone of fractured basalt about 25 to 30 square miles in extent that underlies the city of The Dalles. During the late 1950's and mid-1960's, withdrawals of 15,000 acre-feet per year or more caused water levels in the aquifer to decline sharply. Pumpage had diminished to about 5,000 acre-feet per year in 1979 and water levels have stabilized, indicating that ground water recharge and discharge, including the pumping, are in balance.

The other principal geologic units in the basin have more limited areal distribution and less saturated thickness than the Columbia River Basalt Group. Generally, these units are capable of yielding from a few to a hundred gallons per minute to wells.

Most of the ground water in the basin is chemically suitable for domestic, irrigation, or other uses. Some ground water has objectionable concentrations of iron (0.3 to 6.4 milligrams per liter) and manganese (0.05 to 1.2 milligrams per liter) or is moderately hard to very hard (60 to 260 milligrams per liter as $CaCO_3$).

The principal use of ground water in the Hood Basin is for irrigation of crops, with an estimated withdrawal of 7,700 acre-feet in 1979. Additional ground-water withdrawals in 1979 were estimated as: Industrial, 2,600 acre-feet; public supply, 2,100 acre-feet; and domestic and stock supply, 200 acre-feet.

INTRODUCTION

Ground water has long been recognized as a valuable resource in the Hood Basin. In the Wasco subarea, concentrated development of the resource for irrigation, public-supply, and industrial uses caused a rapid decline in water levels, culminating in 1959 in the declaration by the State of Oregon of a critical ground-water area at The Dalles. Presently (1980), increased pumping for domestic use in residential areas near The Dalles and Mosier causes concern for potential overdevelopment of ground water in those areas.

Location and Extent of the Area

The Hood Basin includes an area of 1,035 mi^2 in north-central Oregon (fig. 1). It is bounded on the north by the Columbia River, on the west by Mount Hood and the Cascade Range, and on the east and south by the drainage divide to the Deschutes River basin. Streams draining the basin are tributaries to the Columbia River and include, from west to east, Eagle Creek, Hood River, and Mosier, Chenoweth, Mill, Threemile, and Fifteenmile Creeks.

The Hood Basin includes parts of three counties: 482 mi^2, or 90 percent of Hood River County; 553 mi^2, or 23 percent of Wasco County; and a very small part, about 400 acres, of Multnomah County. In this report the basin has been divided into the Hood subarea and the Wasco subarea (see fig. 1 and pls. 1, 2) because of the very different physical and hydrological characteristics of each subarea.

Purpose

This study was made in cooperation with the planning departments of Wasco and Hood River Counties. The purposes of this report are (1) to describe the occurrence, movement, availablity, and quality of ground water in the basin; and (2) to assess, where possible, the extent, thickness, hydrologic boundaries, and hyraulic properties of the principal aquifers.

Previous Investigations

The geology and ground water of The Dalles area were first described by Piper (1932). A basinwide evaluation of surface- and ground-water supplies and their use and control was made by the Oregon Water Resources Board (1965). Sceva (1966) prepared a reconnaissance report on the ground-water resources in the Hood River area. Foxworthy and Bryant (1967) tested the potential for artificial recharge of the basalt aquifer at The Dalles. Newcomb (1969) investigated the effect of geologic structure in controlling ground-water movement in the Columbia River Basalt Group aquifers in The Dalles area.

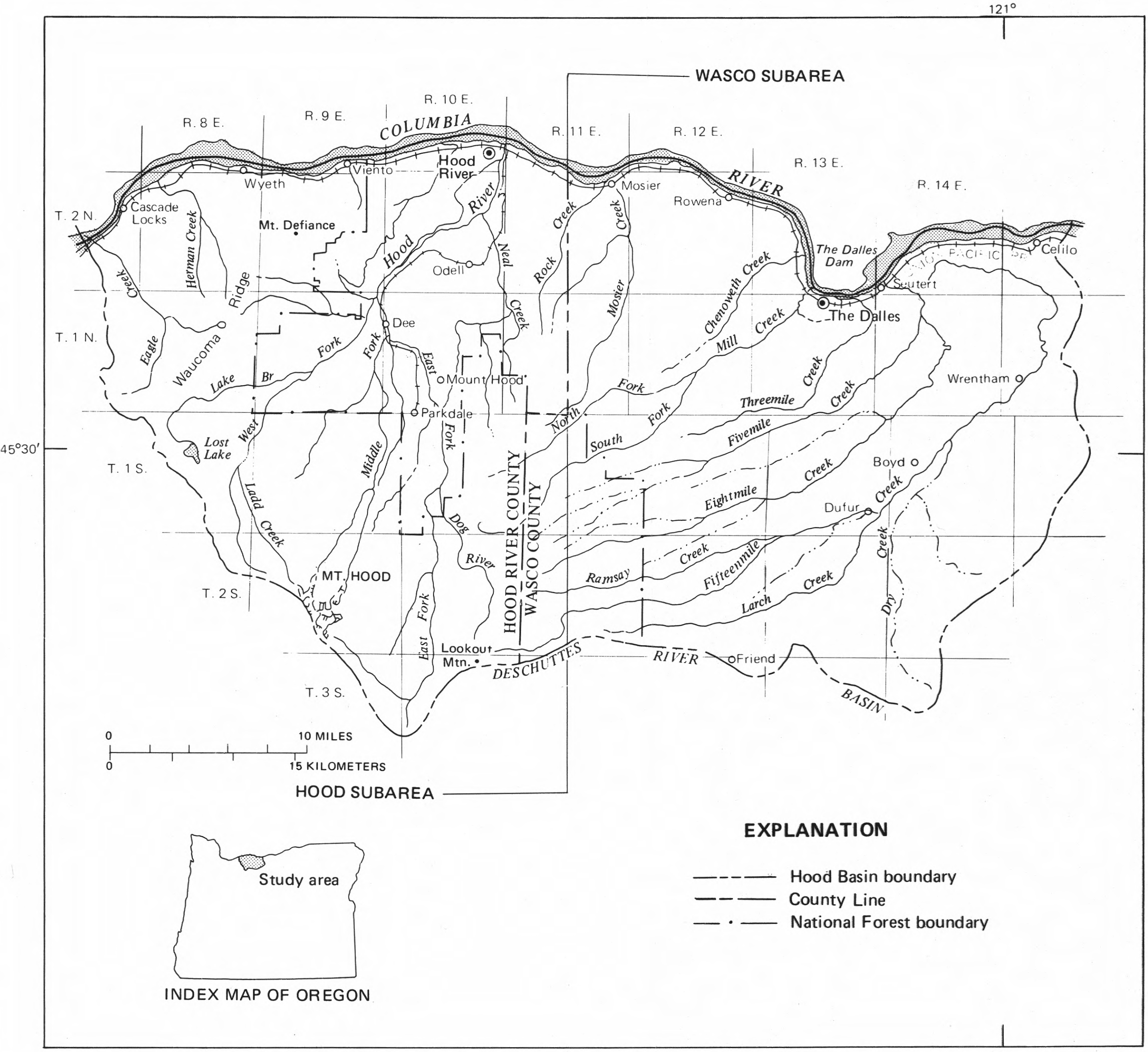


FIGURE 1. – Location and general physiographic features of the Hood Basin and subareas.

Geologic maps of parts of the Hood Basin are included in the above-mentioned reports of Piper (1932), Sceva (1966), and Newcomb (1969), and in publications by Waters (1968), Wise (1969), and Beaulieu (1977). Reports by Blackwell and others (1978) and Blackwell and Steele (1979) include evaluation of geothermal resources near Mount Hood.

Methods of Investigation

During the summer and fall of 1979, 436 wells and nine springs were field located and inventoried. Topographic maps, scale 1:24,000, were used to determine altitude. Water level, temperature, pH, and specific conductance were measured on site. Table 4 (in "Ground-Water Data" section) includes data for all wells and springs that were field located, and table 5 (in "Ground-Water Data" section) includes drillers' logs for selected wells. Drillers' logs for 373 wells not inventoried were reviewed, and hydraulic characteristics of major aquifers were estimated from these records.

To supplement previous chemical data, samples of ground water from 33 wells and one spring were analyzed. Borehole geophysical logs were made for five wells (see table 4 in "Ground-Water" section). Although not presented in this report, these data are available at the U.S. Geological Survey, Portland, Oreg., office.

Acknowledgements

Cooperation and assistance of local officials, well drillers, and well owners and operators greatly facilitated this study. The author is especially grateful to Thomas Paul, Wasco and Hood River Counties Watermaster; George Allen, manager of Lower Chenoweth Water District; and Joseph Hasbrouck and Clifford Wilds of The Dalles Department of Public Works for providing data and assistance.

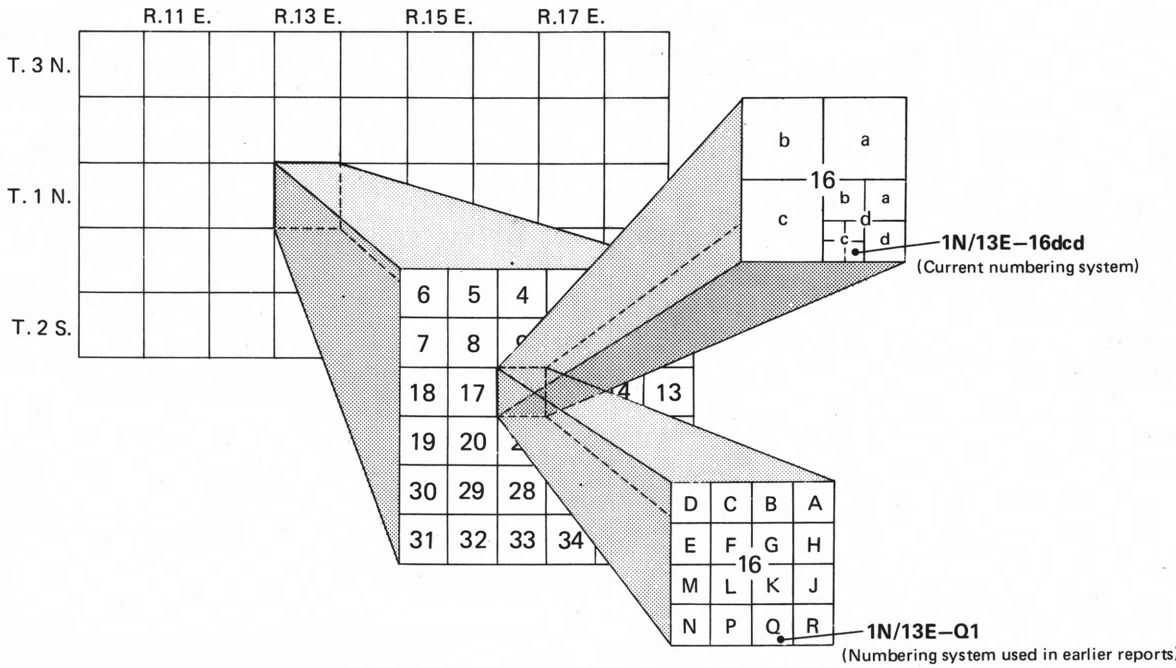


FIGURE 2. – Well- and spring-numbering systems.

Well - and Spring - Numbering System

The Well- and spring-numbering system presently used in Oregon is based on the rectangular system for subdivision of public land. Each number indicates the location of the well with respect to township, range, and section (fig. 2); thus, well 1N/13E-16dcd is in township 1 north, range 13 east, section 16. The letters following the section number show the location within the section, the first letter designating the quarter section (160 acres), the second letter the quarter-quarter section (40 acres), and the third letter the quarter-quarter-quarter section (10 acres). For springs, a suffix, the letter (s), is added to the number. Where two or more wells are in the same 10-acre subdivision, serial numbers are added after the third letter.

Earlier reports, which include data for some wells also included in this study, used a numbering system differing somewhat from the above. The well location within the section was designated by a single letter, representing the 40-acre subdivision of that section, and a serial number.

PHYSICAL SETTING

Geographic Features

The Hood Basin straddles two major Oregon physiographic provinces (Baldwin, 1976): the High Cascade Range, which includes the crest of the Cascades from Mount Hood north to the Columbia River, the western Columbia River Gorge, and Hood River Valley; and the Deschutes-Umatilla Plateau, which includes the eastern Columbia River Gorge and the deeply dissected plateaus and ridges, south and east of The Dalles. As previously stated, for this report, the basin has been divided into two subareas. The dividing line coincides with the northern segment of the Hood River County-Wasco County line and extends southward to the basin boundary. This division follows, approximately, both the natural drainage divide between the Hood River and the Mosier Creek-Fifteenmile Creek watersheds and the extensive Hood River Fault Zone. The Hood subarea contains 507 mi^2 and the Wasco subarea contains 528 mi^2.

Wasco Subarea

The dominant topographic features of this subarea are the eastern Columbia River Gorge and the broad, undulating plateaus deeply incised by streams. The land surface rises from 72 ft at the Columbia River to more than 3,200 ft at the crest of Tygh Ridge about 18 mi south of The Dalles, and to more than 4,000 ft on ridge tops along the western edge of the subarea.

The major streams originate in the timbered uplands in the western part of the Wasco subarea and flow generally northeastward to the Columbia River. Mosier, Mill, Eightmile, and Chenoweth Creeks are perennial; however, summer streamflow in some is nearly depleted by diversions for irrigation and municipal supply. All other streams are intermittent.

Estimated 1978 population of Wasco County was 21,100 (Oregon Secretary of State, 1979, p. 255). About 58 percent of the population lived in the incorporated cities of The Dalles (11,400), Dufur (600), and Mosier (270). Although only 23 percent of Wasco County, by area, is included in the Hood Basin, that area has more than 90 percent of the county's population. Major land uses are for agriculture, including orchards, grazing, and forestry. In 1965, the Wasco subarea contained 223 mi^2 of forested land (Oregon Water Resources Board, 1965), mostly in the western part of the subarea.

Hood Subarea

Extreme topographic relief characterizes this subarea; altitudes range from 72 ft on the Columbia River to 11,235 ft on the summit of Mount Hood, Oregon's highest mountain. In the Columbia River Gorge, vertical cliffs rise as much as 2,000 ft above the river. Most streams are perennial and originate in the timbered, mountainous terrain; some are fed by meltwater from glaciers on Mount Hood. The Hood River, with its tributaries, is the major stream.

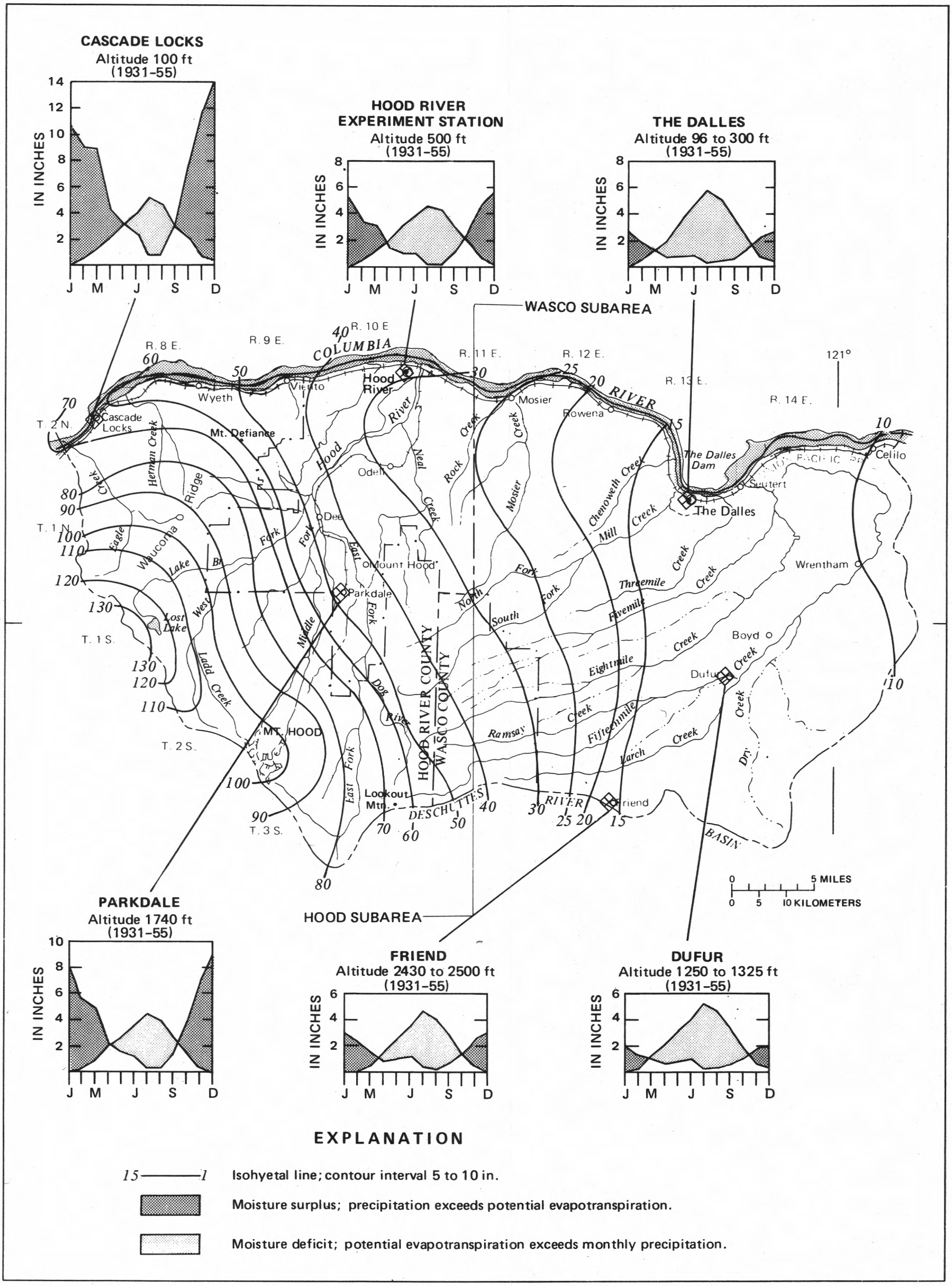


FIGURE 3. – Isohyetal map showing mean annual precipitation in the Hood Basin, with graphs of average monthly precipitation and potential evapotranspiration at selected stations (Johnsgard, 1963).

Hood River Valley extends about 16 mi south from the city of Hood River. The valley floor slopes northward, from an altitude of about 2,200 ft at the south to 200 ft at Hood River, and is underlain by glaciofluvial and alluvial deposits. The valley is separated into Upper Hood River Valley and Lower Hood River Valley by Middle Mountain, an asymmetrical basalt hill.

Estimated 1978 population of Hood River County was 15,100 (Oregon Secretary of State, 1979, p. 255); 38 percent lived within the incorporated cities of Hood River (4,860) and Cascade Locks (860).

The principal land use in the valley is for agriculture, mainly orchards and grazing. Forestry is the principal land use in the surrounding uplands. In 1965, the Hood subarea contained 354 mi^2 of forested land, including 248 mi^2 in the Mount Hood National Forest (Oregon Water Resources Board, 1965).

Climate

The Hood Basin lies in a transitional zone between the humid maritime climate characteristic of western Oregon and the arid continental climate of eastern Oregon. Consequently, climatic conditions differ greatly between the Hood and Wasco subareas.

Figure 3 shows mean annual precipitation in the Hood Basin (data from National Weather Service). Annual precipitation is as much as 130 in. along the crest of the Cascade Range, much of it occurring as snow at higher elevations. Precipitation diminishes rapidly eastward in the rain shadow of the Cascade Range, so that nearly all the Wasco subarea receives less that 30 in. per year. The eastern half of the Wasco subarea, the principal grain-production land, receives only 10 to 15 in. annually.

Figure 3 also shows graphs of average monthly precipitation and estimated potential evapotranspiration for six stations in the Hood Basin (Johnsgard, 1963). Months in which precipitation exceeds potential evapotranspiration are moisture-surplus months. Months in which evaporation exceeds precipitation are moisture-deficient months. Totaling the monthly values provides an average annual moisture balance at each station. Stations in the Hood subarea have cumulative moisture surpluses: Cascade Locks, +49.7 in./yr; Parkdale, +23.3 in./yr; and Hood River Experiment Station, +3.7 in./yr. Stations in the Wasco subarea have cumulative moisture deficits: Friend, -5.1 in./yr; Dufur, -13.6 in./yr; and The Dalles, -15.2 in./yr. These values indicate a much greater potential for ground-water recharge in the Hood subarea than in the Wasco subarea.

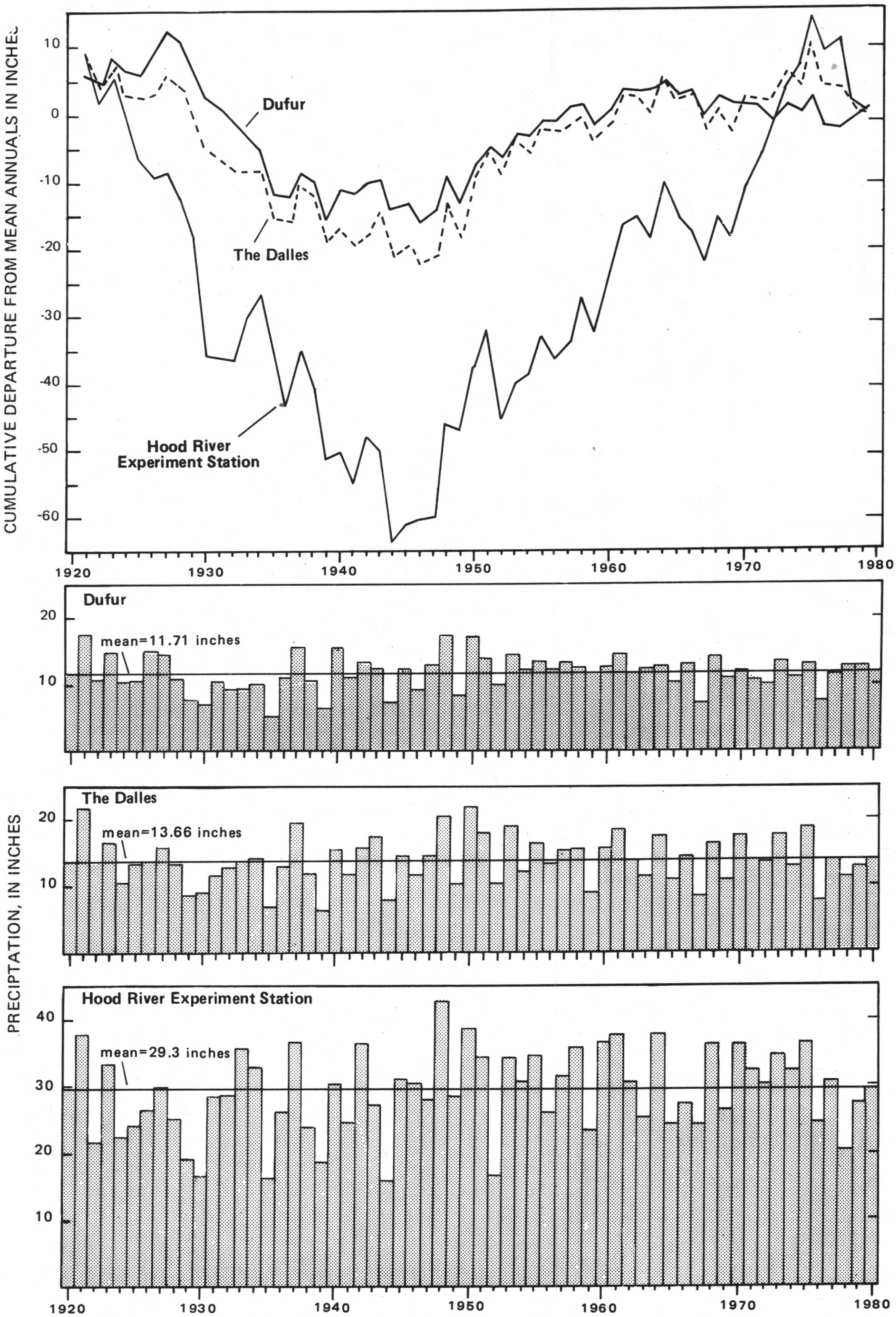


FIGURE 4. – Annual precipitation, 1921–79, and cumulative departure from annual mean at three stations in the Hood Basin (Data from National Weather Service).

Figure 4 shows the total annual precipitation at three stations in the Hood Basin for 1921 through 1979. During this period, large variations in annual precipitation have occurred. At the Hood River Experiment Station, annual precipitation ranged from a high of 42.9 in. in 1948 to a low of 15.8 in. in 1944. Mean annual precipitation at this station is 29.3 in. The highest annual precipitation at The Dalles and Dufur was 21.8 in. in 1950 and 17.5 in. in 1921, respectively; the lowest was 6.4 in. in 1939 and 5.1 in. in 1935, respectively. Mean annual precipitation at The Dalles is 13.7 in. and at Dufur 11.7 in.

Figure 4 also shows the cumulative departure from mean annual precipitation; that is, the accumulative excesses and deficiencies of precipitation for the year 1921-79. On the departure graph, a falling line indicates a period of below-mean precipitation and a rising line a period of above-mean precipitation. The graph shows that precipitation during the period 1921-45 was generally below mean, whereas from 1945 to 1975 most years were above mean.

GEOLOGIC UNITS AND THEIR WATER - BEARING CHARACTERISTICS

Consolidated rock units of Miocene to Holocene age and unconsolidated deposits of Pleistocene and Holocene age underlie the Hood Basin. The consolidated rocks include basalt, andesite, and diorite; tuff, tuff breccia, agglomerate, and volcanic ash; and conglomerate, sandstone, siltstone, and shale. The unconsolidated deposits include alluvial sand and gravel; glaciofluvial and glaciolacustrine gravel, sand, silt, and clay; glacial till consisting of boulders, gravel, sand, silt, and clay; and eolian sand and silt.

The geology, compiled from Piper (1932), Waters (1968), Newcomb (1969), Wise (1969), and Beaulieu (1977), is included on plates 1 and 2. Thin deposits of windblown silt and ash mapped by Waters (1968) as the Palouse Formation are not shown.

Eagle Creek Formation

The Eagle Creek Formation (Te), of early Miocene age, is the oldest geologic unit exposed at the surface or penetrated by water wells in the Hood Basin. It crops out in a narrow section along the Columbia River near Cascade Locks. The formation consists mainly of volcanic debris and mudflow materials and minor water-laid sediments. Rock types include agglomerate, tuff breccia, conglomerate, sandstone, siltstone, and shale. Total thickness of the Eagle Creek Formation in the study area is unknown, but it is probably less than 500 ft. A 200-foot well (2N/8E-5dab) at the U.S. Forest Service Columbia Gorge Ranger Station penetrated 178 ft of Eagle Creek Formation. This well was test pumped at 4 gal/min with 169 ft of drawdown. Data are insufficient to evaluate the hydrologic properties of this unit, because this is the only well that penetrates the formation. Considering its lithology, however, the unit is unlikely to yield more than small quantities of water.

Columbia River Basalt Group

A thick sequence of well-layered basalt flows of Miocene age underlies the entire Hood Basin, except for the outcrop area of Eagle Creek Formation described above. These rocks are part of the Columbia River Basalt Group (Tcr), that underlies 50,000 mi^2 of the Columbia Plateau in Idaho, eastern Washington, and northern Oregon. Total exposed thickness of the basalt exceeds 2,000 ft near Rowena (Newcomb, 1969, p. 3), and the unit probably exceeds this thickness throughout much of the basin.

Thickness of individual lava flows ranges from a few tens of feet to more than 100 ft. A typical flow has a thin lower zone of highly fractured, finely crystalline basalt. The middle of most flows is massive and finely crystalline and generally contains vertical cooling joints. These joints are generally widely and irregularly spaced, but in places they form closely spaced columns. The upper zone of the flow is commonly broken and irregular, and may consist of scoriaceous, rubbly, vesicular, brecciated, or weathered basalt. Pillow basalts with ellipsoidal pillow structures in a matrix of palagonite and tuff occur where lava flows entered water. Locally, thin beds of volcanic ash, tuff, sediment, or coal occur between lava flows. The thickness and texture of individual flows may vary considerably over a short lateral distance.

The Columbia River Basalt Group is the most important water-bearing unit in the basin. The zones of broken, scoriaceous basalt are highly permeable and, where saturated, yield a few hundred to a few thousand gallons per minute to wells. The most productive wells penetrate several of these water-bearing zones. The dense, unfractured basalt in the middle of most lava flows probably restricts vertical movement of water and may confine ground water under pressure.

The Columbia River Basalt Group in the Hood Basin has been deformed into several broad, gentle folds. The axes of these folds generally trend northeasterly, and the strata within them are inclined at shallow dips of about 2° to 10°. In some places, the basalt layers have been deformed into smaller and tighter folds, with local dips exceeding 30°. Several faults with large displacement, and numerous smaller faults disrupt the strata.

Troutdale Formation

The Troutdale Formation (Tt), in the study area, consists of early Pliocene conglomerate, sandstone, and quartzite-pebble beds. Thickness of this unit in the study area is not well known, but probably is less than 300 ft. The formation is exposed in cliffs of the Columbia River Gorge in the Hood subarea between the Columbia River Basalt Group and Pliocene and Pleistocene lavas. Sceva (1966, p. 10) considered gravels of similar stratigraphic position, penetrated by wells near Odell, as Troutdale Formation. One well (2N/10E-26dbd) was drilled to a depth of 262 ft, of which the bottom 102 ft were in gravel and clay. This well was tested at 125 gal/min with 150 ft of drawdown.

Dalles Formation

The Dalles Formation (Td), of early and middle Pliocene age, consists primarily of volcaniclastic rocks interfingered with sedimentary deposits. Rock types include agglomerate, tuff, tuff breccia, ash, at least one thin basalt flow, and conglomerate, sandstone, and siltstone. In the Wasco subarea, total thickness is about 1,800 ft in upper Mill Creek Valley (Newcomb, 1966, p. 59), but thins to the east and north. In the Hood subarea, it is not exposed west of Hood River Valley, but may underlie younger volcanic rocks.

The Dalles Formation yields generally small to moderate quantities of water (0.5 to 55 gal/min) to wells, but a few large-yield wells (150 to 250 gal/min) produce from this unit. Much of the formation is poorly sorted, consists largely of fine-grained material, and has low permeability. However, more permeable beds or lenses of well-sorted sandstone are present, especially in the lower part of the unit.

Quaternary and Tertiary Volcanic Rocks

The rocks designated as Quaternary and Tertiary volcanic rocks (QTv) in this report originated during the late Pliocene, Pleistocene, and Holocene time as a result of volcanic activity in the Cascades. These rocks consist primarily of andesite and basalt, agglomerate, tuff breccia, and volcanic debris flows, but also include minor intrusive rocks, primarily diorite, at Shellrock Mountain and Government Cove. The unit contains rocks previously designated as "volcanic rocks of the High Cascades" (Callaghan and Buddington, 1938; Newcomb, 1969), "Cascades Formation" (Beaulieu, 1977), and "Cascade andesite" (Sceva, 1966).

Wells penetrating this unit have yields of 0.5 to 88 gal/min. Water occurs primarily in the irregualr, broken scoriaceous zones in or between lava flows. Wells completed in the poorly consolidated volcaniclastic rocks generally yield only small quantities of water.

Quaternary Undifferentiated Deposits

In this report, all unconsolidated surficial sediments of Pleistocene and Holocene age are designated as Quaternary undifferentiated deposits (Qu). The most important water-bearing deposits are (1) alluvial sand and gravel in terraces and flood plains along the Columbia and Hood River and tributary streams, and (2) glaciofluvial and glaciolacustrine sand, silt, and clay, primarily in Upper and Lower Hood River Valley and Mosier Creek Valley. Most of these deposits have fairly high permeability, range from 30 to 250 ft or more in saturated thickness, and are in hydraulic continuity with rivers or streams. They are capable of yielding from a few to a few hundred gallons per minute to wells.

Other sediments included in this unit are glacial till, consisting of unsorted boulders, gravel, sand, silt, and clay in moraines deposited by active or extinct glaciers on Mount Hood; and eolian sand and silt, mainly along the Columbia River, where it is derived from terrace alluvium. Many of these deposits are thin, discontinuous, and unsaturated.

GROUND WATER

Occurrence

Ground water occurs beneath the land surface in the voids and fractures of consolidated rocks and in the openings between grains in unconsolidated materials.

Ground water in the Hood Basin occurs under both unconfined and confined conditions. Unconfined ground water probably occurs in most of the unconsolidated Quaternary deposits in the principal valleys. Unconfined conditions also occur at shallow depths in the consolidated rocks and in zones of perched ground water in upland areas. Numerous small, mostly intermittent, springs that occur on hillsides may represent discharge areas of small, perched ground-water bodies.

Confined, or artesian, ground water occurs where an aquifer is overlain by beds of low permeability, or confining beds. A flowing well can be developed in areas where the pressure head in the confined aquifer is sufficient to raise the ground water above the land surface. In the Hood Basin, aquifers in the Columbia River Basalt Group contain confined ground water. Dense, unfractured basalt confines water in fractured, rubbly zones or in interflow zones, causing the water to be under artesian pressure in the downdip areas of the inclined aquifers. Some ground water in the Dalles Formation and in the younger volcanic rocks probably occurs under semiconfined conditions because permeable zones in these units are lenticular and discontinuous and interfinger with fine-grained, less permeable material.

Recharge, Movement, and Discharge

Precipitation is the principal source of ground-water recharge. Only a small part of the total precipitation infiltrates through the soil and unsaturated zone to recharge the aquifers. The remainder is lost to evaporation, plant transpiration, or surface runoff. Some recharge also occurs by infiltration through streambeds and unlined irrigation canals and from irrigation return flow. The small quantity of recharge to the deeper aquifers occurs primarily by leakage from overlying and underlying aquifers.

In the Wasco subarea, recharge is limited by low annual precipitation and high potential evapotranspiration. Precipitation ranges from about 40 in./yr in the southwestern corner of the subarea to less than 10 in./yr along its eastern edge (see fig. 2), and runoff from most watersheds is only 3 to 6 in./yr. The Oregon Water Resources Board (1965, p. 110) estimated about 1 in./yr of ground-water recharge in the Fifteenmile Creek watershed, which includes the more arid eastern part of the Wasco subarea. Newcomb (1969, p. 24) suggested that recharge in the more humid Mosier Creek watershed is about 1 to 3 in./yr. In the Hood subarea, where annual precipitation exceeds potential evapotranspiration, runoff from most watersheds ranges from 30 to 90 in./yr, and ground-water recharge is probably several inches per year.

In the Hood Basin, the general direction of ground-water movement is from south to north. The hydraulic gradient roughly conforms to the regional slope of the land surface. In the Wasco subarea, both the slope of the land and the hydraulic gradient may reflect the regional dip of the Columbia River Basalt Group, which is about 2° to the north.

Discharge of ground water occurs naturally by (1) springs, where an aquifer intersects the land surface, (2) seepage to streams, where the water table is above the stream level, and (3) evapotranspiration, where the water table is shallow. Ground water is discharged artificially by wells. Water in unconfined aquifers discharges directly to the major rivers and some secondary streams, whereas water in the confined aquifers tends to move upward and discharge to the overlying aquifers in most of the principal valleys.

The movement of ground water from recharge area to discharge area constitutes a ground-water flow system. Figure 5 shows a generalized profile through the Hood Basin from the Columbia River at The Dalles through Tygh Ridge to the Deschutes River near Tygh Valley. The figure shows the author's concept of the ground-water flow systems in that area. Similar flow systems occur in the Hood subarea. The arrows indicate the dominant directions of ground-water flow within three interrelated systems. A brief discussion of the characteristics of local, intermediate, and regional ground-water flow systems follows. The reader is referred to Freeze and Cherry (1979) for a more comprehensive discussion of principles.

Local flow systems have the shortest and shallowest flow paths between recharge and discharge areas. They occur primarily in hilly topography where recharge from precipitation on hilltops and slopes enters the system and flows toward the nearest topographic low. In the Hood Basin, local flow systems are present in the unconfined and shallow semiconfined aquifers.

Intermediate flow systems are recharged directly from precipitation and by leakage from local and regional flow systems. The ground water in intermediate flow systems travels along longer, deeper flow paths between recharge and discharge areas. In the Hood Basin, the deeper semiconfined aquifers, and probably all confined aquifers penetrated by wells to date, are parts of intermediate flow systems.

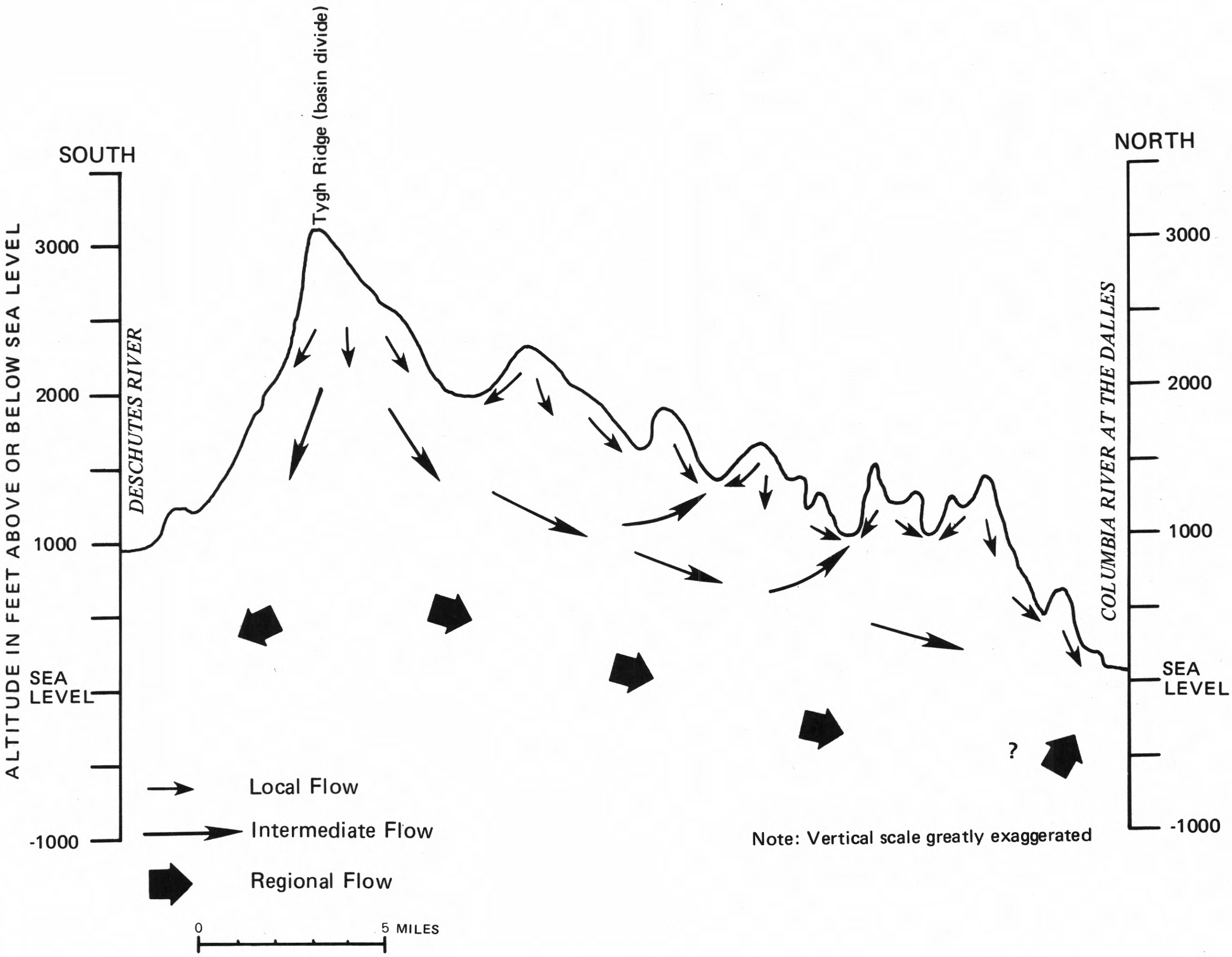


FIGURE 5. – Generalized profile showing author's concept of local, intermediate, and regional flow systems in the eastern part of the Hood Basin.

Regional flow systems have the deepest and longest flow paths from recharge areas to discharge areas. Recharge to the regional flow system occurs mainly by leakage from overlying systems. Local topography has little or no influence on regional flow. In the Hood Basin, regional flow in the Columbia River Basalt Group may occur below depths of several hundred to a thousand feet or more.

Plate 1 includes water-level contours for a generalized potentiometric surface in the Wasco subarea for the period September to November 1979. It is a composite surface compiled chiefly from water levels in selected deep wells penetrating the intermediate flow system in the Columbia River Basalt Group. In the author's judgment, no wells, as of 1979, have been drilled in the area south of The Dalles sufficiently deep to penetrate the regional flow system.

Plate 2 includes water-level contours for part of the Hood subarea. Water-level data for the Upper Hood River Valley are mainly from wells completed in unconsolidated glaciofluvial deposits, and the surface here is a water table. Northward in Lower Hood River Valley, the unconsolidated materials probably are unsaturated; the contours represent the potentiometric surface of the shallow consolidated rocks beneath the valley.

The effect of geologic structures on the movement of water in basalt aquifers has been documented by Newcomb (1961, 1969, 1970). Folds and faults may, in effect, compartmentalize aquifers by disrupting their hydraulic continuity and restricting ground-water flow. Figure 6 shows the locations of the major faults and axes of folds in the Hood Basin. Water moves down the regional dip of basalt aquifers. Where the lateral continuity of these aquifers is disturbed by a fault or a tight fold, oriented transverse to the direction of dip, a structural barrier to ground-water flow may occur. Ground water may become dammed upgradient from structural barrier and be under considerable greater pressure than is present on the downgradient side of the barrier. Newcomb (1969, p. 23-28) reported that the flowing wells developed near Mosier and south of The Dalles on Mill Creek and Threemile Creek are the result of such barriers. However, flowing wells occur in other areas where structural barriers are not apparent.

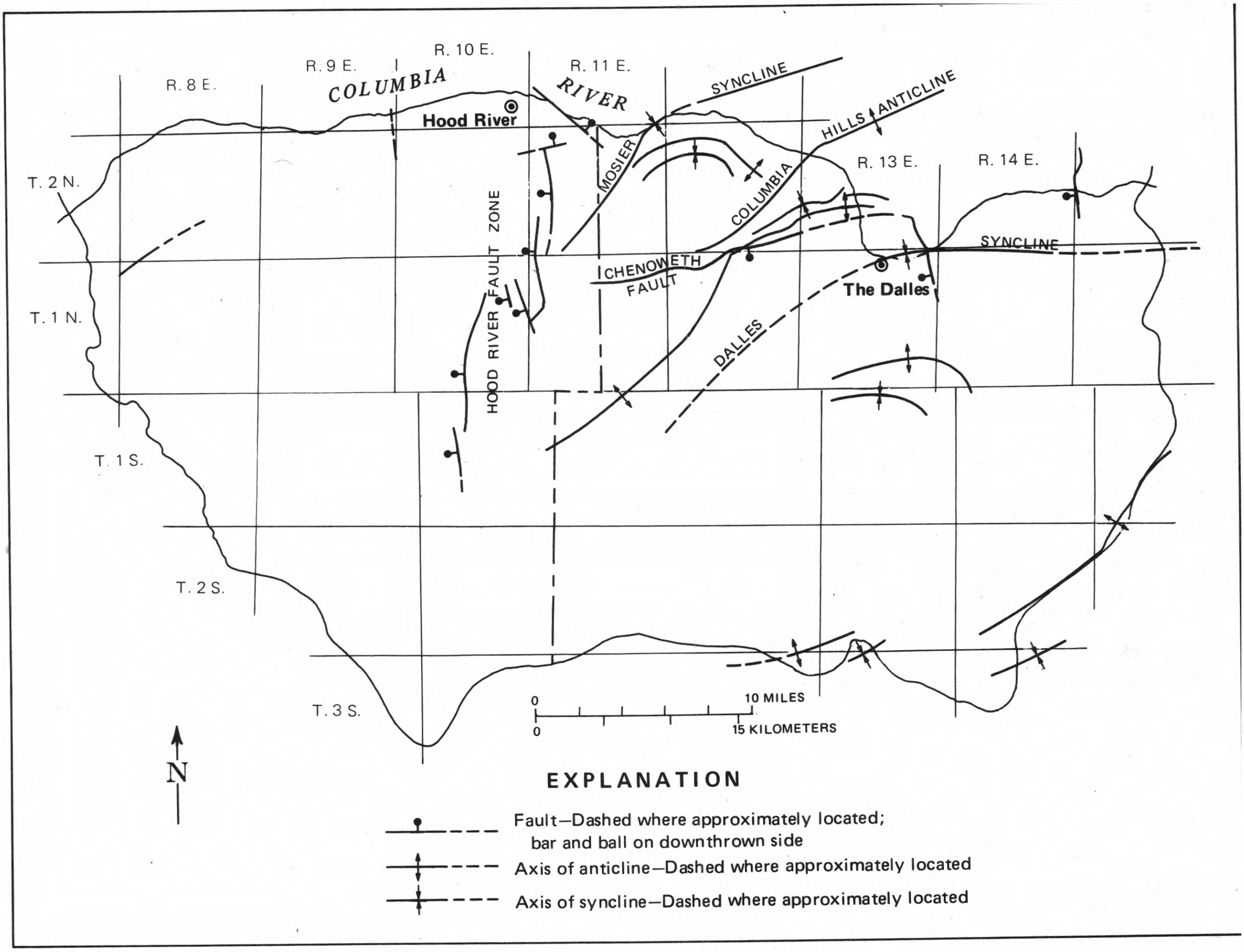


FIGURE 6. – Major geologic structures in the Hood Basin (Modified from Newcomb, 1970).

Water - Level Fluctuations

An observation-well network, maintained by the Oregon Water Resources Department in cooperation with the U.S. Geological Survey, presently includes 31 wells in the Hood Basin. Periodic measurements have been made in some wells since 1953. Hydrographs of selected representative wells are shown in figures 7, 8, and 9.

Water levels in most wells show seasonal fluctuations. Levels generally are highest in spring following aquifer recharge from winter precipitation, and lowest in late summer following the season of least precipitation and greatest pumping.

Withdrawal of water from an quifer by well pumping disturbs the flow pattern and the natural equilibrium between recharge to and discharge from an aquifer. Pumping causes water-level declines as water is removed from storage in the aquifer. Water levels decline until the volume of water pumped is balanced by an increase in aquifer recharge or a decrease in natural aquifer discharge. Presently (1980), water levels in some wells in basalt aquifers are declining (2N/12E-7ada fig. 7; 1N/12E-13cbc and 1N/13E-32aca1, fig. 8), others that formerly were declining have stabilized (1N/13E-3bca, 1N/13E-4bdd, and 2N/13E-28cdb, fig. 7), and locally, some are rising (1N/13E-15acd, fig. 7).

Wells 1N/13E-3bca, 1N/13E-4bdd, and 2N/13E-28cdb (fig. 7) produce water from a highly permeable artesian aquifer in the Columbia River Basalt Group beneath The Dalles named "The Dalles Ground Water Reservoir" (Oregon State Engineer, 1959). Heavy pumping of the aquifer during the 1950's caused large water-level declines that prompted the Oregon State Engineer to declare the aquifer a critical ground-water area. Since the mid-1960's, water levels have ceased to decline and have remained at about the 1968 levels. This stabilization of water levels probably is the result of decreased pumping, as suggested by the decreased amplitude in the seasonal fluctuations of water levels. The history of the development of this aquifer is discussed later in this report.

The "Threemile Ground Water Reservoir" is another aquifer in the Columbia River Basalt Group in which water levels have declined because of large withdrawals. This aquifer consists of one or more permeable zones in the upper 100 ft of the Columbia River Basalt Group beneath the Threemile Creek Valley south of The Dalles. Heavy pumping for irrigation had lowered the potentiometric surface as much as 100 ft by 1959, when this aquifer was also declared a critical ground-water area (Oregon State Engineer, 1959). The hydrograph of well 1N/13E-15acd (fig. 7) shows that water levels rose more than 11 ft per year between 1965 and 1972, and have risen 3 to 4 ft per year since 1975. This rapid recovery rate probably results from the combination of decreased pumping and increased recharge from the infiltration of irrigation return flow. Very little water has been pumped from this aquifer since 1965, when water from the Columbia River began to serve the irrigation needs of the area.

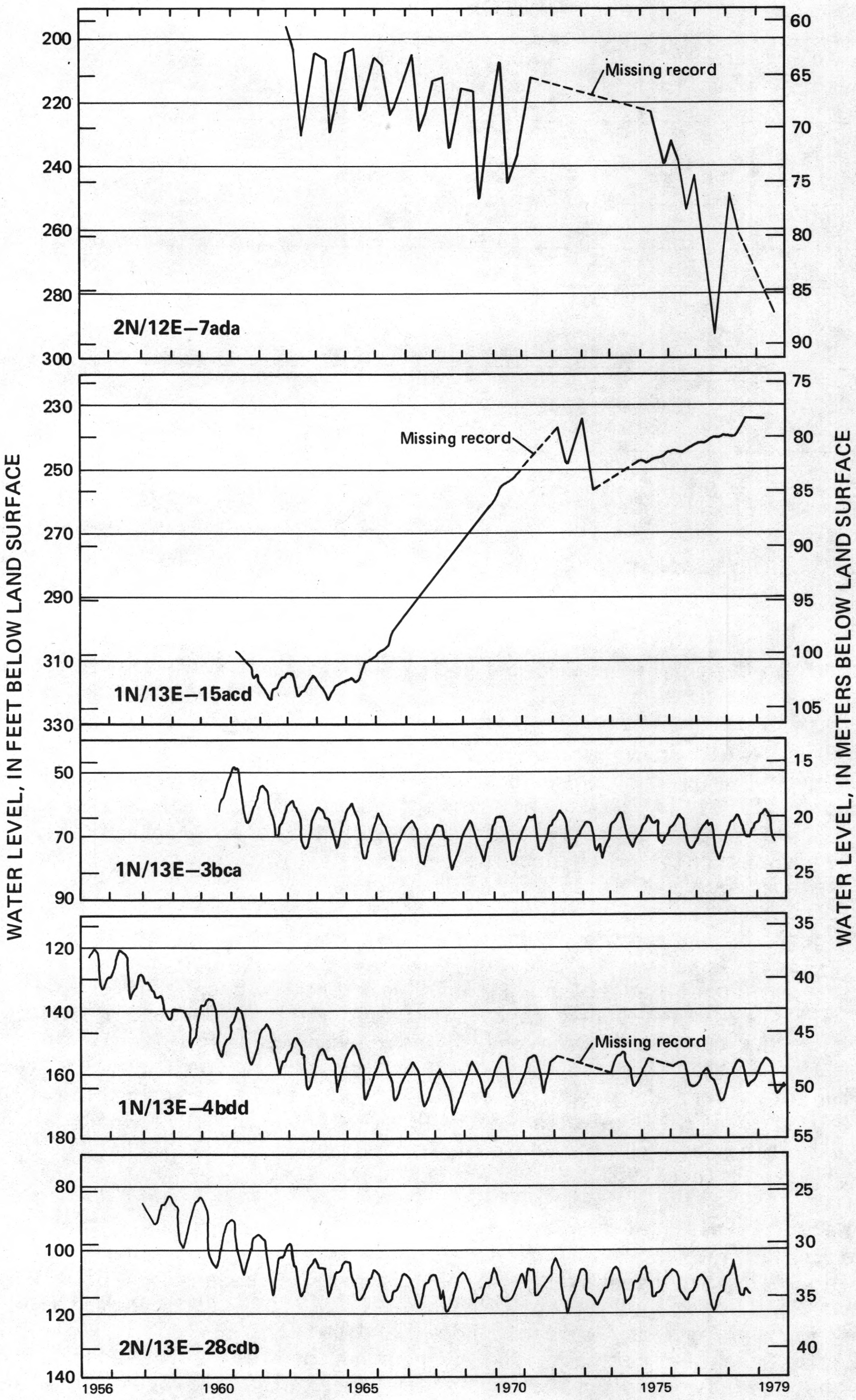


FIGURE 7. – Hydrographs of selected observation wells in the Columbia River Basalt Group.

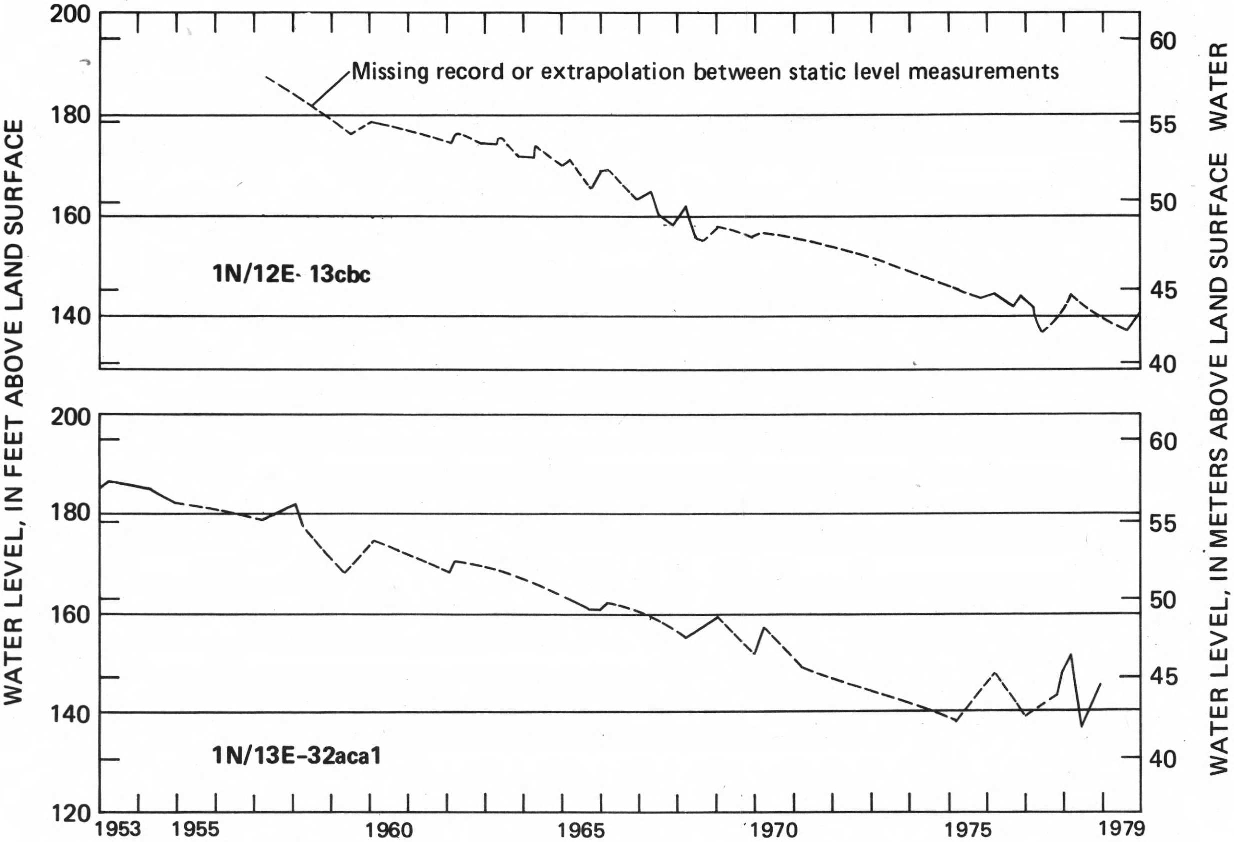


FIGURE 8. – Hydrographs of selected flowing observation wells in the Columbia River Basalt Group.

Water levels in Columbia River Basalt Group aquifers in other areas of the Hood Basin are declining. Well 2N/12E-7ada produces water from the upper 300 ft of the basalt in an area southeast of Mosier, where numerous wells have recently been drilled. The hydrograph of this well (fig. 7) shows only small declines prior to 1971; however, since 1975 water levels declined at an increasing rate.

Figure 8 shows the hydrographs of two flowing artesian wells (1N/12E-13cbc and 1N/13E-32aca1) that tap Columbia River Basalt Group aquifers with confined ground-water conditions. These aquifers, in the upper Mill Creek and upper Threemile Creek Valleys, occur in the upper 300 ft of the basalt. Discovery of a moderately large supply of water at shallow depths, with heads 100 ft or more above land surface, led to drilling of several irrigation wells in each aquifer during the 1940's and 1950's. Water levels in wells 1N/12E-13cbc and 1N/13E-32aca1 have been declining at average rates of about 1.5 and 2.1 ft per year, respectively, since 1957.

Water levels in two observation wells completed in the Dalles Formation (2N/12E-25ddc and 2N/12E-36cad) are shown in figure 9. Levels in both wells have been stable since observation began in 1961. Figure 9 also includes hydrographs for well 2N/10E-4dbb, completed in Quaternary and Tertiary volcanic rock, and well 2N/8E-5dab, completed in the Eagle Creek Formation. The hydrograph of well 2N/8E-5dab shows a small but steady rise in water level since 1971; however, the water level in well 2N/10E-4dbb has declined about 10 ft since 1976.

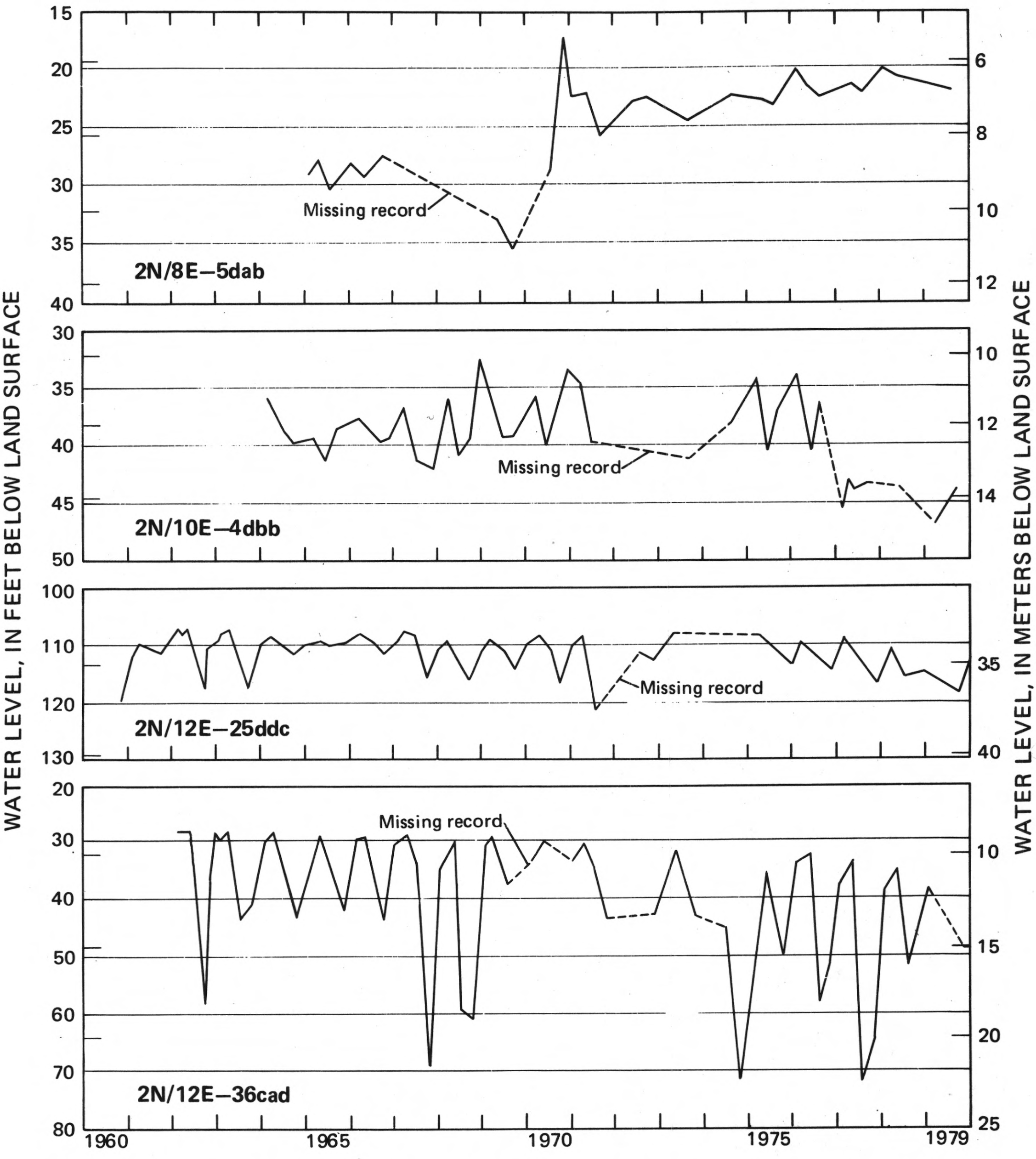


FIGURE 9. – Hydrographs of selected observation wells in Eagle Creek Formation, Dalles Formation, and Quaternary and Tertiary volcanic rocks.

Availability

All geologic units in the Hood Basin may yield at least small quantities of ground water adequate for most domestic needs. However, the depth of wells may range widely depending on the topographic setting, aquifer characteristics, geologic structure, and other factors.

Table 1 summarizes data for 809 wells in the Hood Basin for which drillers' logs or well reports were available. Fifty-five percent of all the wells were completed in the Columbia River Basalt Group. The basalt aquifers are the most productive and yield 1,000 gal/min or more to wells in several areas. Ninety-two percent of all irrigation, industrial, and public-supply wells produce from the basalt. The average depth of wells in the basalt is somewhat greater than for wells in other units because the basalt is thicker and underlies the other units. Basalt wells drilled for irrigation, industrial, or municipal supply average 100 ft deeper than wells drilled for domestic supply. The average specific capacity for these high-yield wells is 88 (gal/min)/ft of drawdown; however, this value is not representative of the basalt as a unit. High specific capacities, 100 to 550 (gal/min)/ft of drawdown for wells completed in The Dalles Ground Water Reservoir in Tps. 1 N. and 2 N., R. 13 E., substantially increase the average. Specific capacities of high-yield basalt wells outside these two townships average less than 17 (gal/min)/ft of drawdown and do not exceed 100 (gal/min)/ft. Yields of basalt wells are highly variable and depend, in part, on the extent of fracturing of the aquifer at the well site.

Thirty-one percent of the wells in the Hood Basin produce from the Dalles Formation; most were drilled to obtain a domestic supply, and most are in upland areas. The few wells in this unit producing sufficient quantities of water for irrigation or public supply occur mainly along Chenoweth Creek and Brown Creek. Domestic- and stock-supply wells that penetrate an equal saturated thickness of the Dalles Formation or the Columbia River Basalt Group have similar average yields and specific capacities. This similarity suggests that the principal differences between the two aquifers is the saturated thickness. The saturated thickness of the basalt probably exceeds 1,000 ft, whereas the saturated thickness of the Dalles Formation is generally 300 ft or less.

Only 58 wells have been drilled to date (1980) in the Quaternary and Tertiary volcanic rocks of the Hood subarea. Most of these are in the uplands west of the Hood River Valley. Their yields are generally small, a few to a few tens of gallons per minute, and the average specific capacity is 0.53 (gal/min)/ft of drawdown. Several large springs, that serve most of the population of Hood River Valley, discharge from highly factured zones in young andesite flows.

Table 1.—Summary of well characteristics

Use: D, domestic; I, irrigation; N, industrial; P, public supply; S, stock.
Depth to water: + indicates height above land surface calculated from shut-in pressure in flowing wells; no mean value determined if flowing wells in township.
Yield: Discharge in gallons per minute by pumping or natural flow; zero reported as minimum for dry holes, but they are not included in calculation of mean.

Specific capacity: Yield divided by drawdown, where yield is in gallons per minute and drawdown is in feet below static (nonpumping) water level. Calculated from values reported by driller.
Principal geologic units: Qu, Quaternary undifferentiated; QTv, Quaternary-Tertiary volcanic rocks; Td, Dalles Formation; Tt, Troutdale Formation; Tcr, Columbia River Basalt Group; Te, Eagle Creek Formation.

Township and range	Number of wells D,S	Number of wells I,N,P	Number of wells Total	Depth of wells (feet) D,S Range	Depth of wells (feet) D,S Mean	Depth of wells (feet) I,N,P Range	Depth of wells (feet) I,N,P Mean	Depth to water (feet) D,S Range	Depth to water (feet) D,S Mean	Depth to water (feet) I,N,P Range	Depth to water (feet) I,N,P Mean	Yield (gal/min) D,S Range	Yield (gal/min) D,S Mean	Yield (gal/min) I,N,P Range	Yield (gal/min) I,N,P Mean	Specific capacity [(gal/min)/ft] D,S Range	Specific capacity [(gal/min)/ft] D,S Mean	Specific capacity [(gal/min)/ft] I,N,P Range	Specific capacity [(gal/min)/ft] I,N,P Mean	Number of wells per principal geologic unit	Remarks
By Location																					
1N/9E	2	1	3	106-200	153	--	572	32-97	64	--	90	16-13	17	--	400	0.17-.48	.33	--	0.83	1,Qu; 1,QTv; 1,Tcr	
1N/10E	27	0	27	43-350	127	--	--	2-125	41	--	--	0-33	25	--	--	.15-1.3	.45	--	--	18,Qu; 1,QTv; 8,Tcr	2 dry holes.
1N/12E	79	8	87	80-790	240	410-1,000	606	3-735	149	+210-359	--	1.5-80	20	150-1,220	532	.06-25	1.9	1.3-6.3	3.0	76,Td; 11,Tcr	5 flowing wells.
1N/13E	124	36	160	41-880	297	114-970	420	10-690	131	+300-756	--	0-150	16	20-3,300	710	<.01-17	1.1	1.8-550	114	105,Td; 55,Tcr	1 dry hole; 11 flowing wells.
1N/14E	8	6	14	51-350	191	245-655	494	4-300	105	73-410	251	5-50	25	200-800	420	.19-2.0	.90	2.0-5.3	3.3	14,Tcr	
1N/15E	3	2	5	160-273	193	120-309	214	23-153	95	26-52	39	20-90	47	50-600	325	--	2.1	2.4-4.3	3.4	5,Tcr	
2N/7E	1	0	1	--	50	--	--	--	7.5	--	--	--	15	--	--	--	1.0	--	--	1,Qu	
2N/8E	7	2	9	40-200	90	104-150	127	15-64	39	32-64	43	4-80	32	30-390	210	.02-30	3.9	.36-390	--	7,Qu; 1,Tcr; 1,Te	
2N/9E	1	0	1	--	275	--	--	--	54	--	--	--	50	--	--	--	.54	--	--	1,Tcr	
2N/10E	52	4	56	40-680	237	160-275	237	+13-452	--	4-45	30	0-100	19	21-125	78	<.01-6.2	.52	.18-.83	.52	3,Qu; 46,QTv; 1,Tt; 6,Tcr	3 dry holes; 2 flowing wells.
2N/11E	23	8	31	71-645	316	120-553	301	20-470	204	+185-225	--	.5-50	17	20-400	179	<.01-.42	.18	1.0-9.1	3.2	6,Td; 25,Tcr	3 flowing wells.
2N/12E	202	16	218	50-1,070	298	95-620	403	+20-354	--	+27-271	--	0-100	22	50-400	201	<.01-25	1.10	.43-90	8.4	1,Qu; 37,Td; 180,Tcr	5 dry holes; 3 flowing wells.
2N/13E	26	14	40	50-770	322	32-605	296	18-607	206	19-343	129	0-115	24	34-2,160	674	.05-29	2.0	2.8-490	170	2,Qu; 15,Td; 23,Tcr	1 dry hole.
2N/14E	12	6	18	31-502	195	165-700	440	7-338	34	10-370	135	5-60	25	200-1,460	460	.04-14	2.4	.65-17	6.4	2,Qu; 16,Tcr	
2N/15E	1	3	4	--	550	97-250	186	--	403	3-28	15	--	20	230-400	302	--	.29	3.6-34	14	1,Qu; 3,Tcr	
3N/9E	2	0	2	--	80	--	--	42-43	42.5	--	--	32-50	41	--	--	--	--	--	--	2,Qu	
3N/10E	11	3	14	56-745	283	71-430	305	23-318	129	14-323	220	0-45	22	25-350	142	.15-4.8	1.4	.35-7.4	2.8	2,Qu; 8,QTv; 4,Tcr	3 dry holes.
3N/11E	1	0	1	--	200	--	--	--	16	--	--	--	50	--	--	--	.42	--	--	1,Tcr	
3N/12E	1	1	2	--	256	--	303	--	70	--	113	--	10	--	350	--	.06	--	50	2,Tcr	
1S/10E	3	0	3	50-225	112	--	--	14-165	90	--	--	0-25	16	--	--	.13-.54	.34	--	--	2,Qu; 1,Tcr	1 dry hole.
1S/12E	10	0	10	40-863	472	--	--	6-790	390	--	--	0-55	19	--	--	.05-2.2	.85	--	--	1,Qu; 7,Td; 2,Tcr	1 dry hole.
1S/13E	5	20	25	125-381	249	111-1,017	355	27-323	134	+243-520	--	15-70	33	50-2,900	465	.38-5	2.0	.25-15	3.9	25,Tcr	11 flowing wells.
1S/14E	16	7	23	70-445	242	170-440	271	+189-353	--	+277-270	--	1.5-210	47	50-700	299	.04-2.7	.72	5-12	8.8	1,Td; 22,Tcr	7 flowing wells.
1S/15E	4	0	4	100-300	190	--	--	+60-110	--	--	--	20-200	75	--	--	.79-3	4.4	--	--	4,Tcr	1 flowing well.
2S/10E	5	0	5	40-200	82	--	--	2.5-58	21	--	--	8-75	32	--	--	.26-2.9	1.3	--	--	4,Qu; 1,QTv	
2S/12E	22	2	24	70-1,010	401	290-728	509	30-660	298	216-480	348	0-50	20	--	100	.03-5.5	.60	--	1.4	1,QTv; 7,Td; 16,Tcr	4 dry holes.
2S/13E	10	3	13	145-675	382	316-755	466	45-460	224	38-455	185	2.5-60	22	113-400	256	.01-2.2	.45	1.4-47	17	13,Tcr	
2S/14E	3	0	3	289-377	344	--	--	57-242	163	--	--	6-50	24	--	--	.06-25	8.4	--	--	3,Tcr	
3S/10E	2	0	2	50-65	58	--	--	--	10	--	--	10-20	15	--	--	--	--	--	--	2,Qu	
3S/13E	3	0	3	494-869	636	--	--	425-635	495	--	--	3-10	6	--	--	.03-.08	.06	--	--	3,Tcr	
3S/14E	1	0	1	--	390	--	--	--	236	--	--	--	2.5	--	--	--	--	--	--	1,Tcr	
Totals	667	142	809	31-1,070		32-1,017		+189-854		+300-756		0-210		20-3,300		<.01-30		.18-550		49,Qu; 58,QTv; 254,Td; 1,Tt; 446, Tcr; 1,Te	21 dry holes; 43 flowing wells
By principal geologic unit																					
Qu	44	5	49	31-225	85	32-275	116	+18-165	--	13-64	30	9-100	25	82-390	239	.13-30	2.9	.43-390	--		2 flowing wells.
QTv	58	0	58	40-680	247	--	--	+3-452	--	--	--	0-38	20	--	--	<.01-4.6	.53	--	--		5 dry holes; 1 flowing well.
Td	249	5	254	41-880	295	95-410	242	3-790	190	20-272	106	0-150	17	55-250	171	<.01-25	1.5	1.4-3.8	--		3 dry holes.
Tt	0	1	1	--	--	--	262	--	--	--	35	--	--	--	125	--	--	--	.83		
Tcr	315	131	446	50-1,070	297	111-1,017	398	+189-854	--	+300-756	--	0-210	25	20-3,300	493	<.01-29	1.1	.18-550	38		13 dry holes; 40 flowing wells.
Te	1	0	1	--	200	--	--	--	22	--	--	--	4	--	--	--	.02	--	--		

The average depth of wells in the Quaternary undifferentiated deposits is about 90 ft, which is considerably less than in the other units. Most of the wells are for domestic supply and yield small to moderate quantities of water (less than 100 gal/min). The average specific capcity of the domestic-supply wells, 2.9 (gal/min)/ft of drawdown is about twice that of similar wells in the Dalles Formation and the Columbia River Basalt Group. In alluvium adjacent to the Columbia River, a few wells yield moderate to large quantities of water (100 to 350 gal/min) for irrigation, industrial, or municipal supply. As of 1980, only 49 wells are known to produce water from these surficial unconsolidated deposits. Aquifers in these deposits commonly are thin, have high permeability, and are hydraulically connected to nearby streams.

Presently (1980), ground water is developed in much of the southwestern Wasco subarea and most of the Hood subarea outside of Hood River Valley. Little or no data are available on the occurrence and availability of ground water in these areas. However, the same geologic units that are productive in the populated areas of the Hood Basin underlie the undeveloped areas, and the author believes that ground-water supplies adequate for at least domestic needs can be developed in these areas. Discussion of the availability of ground water in specific areas where the aquifers are being developed follows.

The Dalles Ground Water Resevoir

The occurrence of a highly permeable aquifer in the Columbia River Basalt Group beneath The Dalles was first documented by Piper (1932, p. 156). This confined aquifer underlies an area of about 25 to 30 mi^2 and consists of one to several hydraulically connected zones of fractured basalt or rubbly basalt breccia. The thickness of this aquifer ranges from less than 10 to more than 50 ft. Reported well yields range from 100 to 2,500 gal/min, with an average yield of about 1,000 gal/min. Specific capacities range from about 100 to 550 (gal/min)/ft of drawdown and average about 300 (gal/min)/ft of drawdown, which is more than 10 times the average specific capacity of high-yield basalt wells elsewhere in the basin. These high specific capacities suggest a transmissivity for the reservoir ranging from 30,000 to 150,000 ft^2/d. Foxworthy and Bryant (1967, p. 15) estimated a similar range based on an aquifer test of well 1N/13E-4bdd. The flat potentiometric surface is additional evidence for the unusually high transmissivity of the aquifer. In 1979, the potentiometric surface over the entire aquifer was 25 to 30 ft above sea level.

The hydrogeologic boundaries of the aquifer are poorly known. The altitude of the top of the aquifer, the zone of porous basalt, ranges from about 100 ft below sea level at well 1N/13E-3acd to about 9 ft below sea level at well 1N/13E-3bca, 2,300 ft to the west. At wells 2N/13E-28cab, cbc, ccd, and cdb, 10,000 ft to the northwest, this zone lies between 118 and 177 ft below sea level. The top of the aquifer is 100 to 300 ft beneath the land surface at most locations along the terrace of the Columbia River near The Dalles. At well 1N/13E-22abd, 3 mi south of the Columbia River, the aquifer is more than 600 ft below land surface and more than 1,000 ft beneath nearby hilltops.

The area contained within the 100-foot water-level contour on plate 1 is the approximate extent of The Dalles Ground Water Reservoir in the study area. Newcomb (1969, p. 28) suggested that the aquifer may extend about a mile north of the Columbia River beneath Dallesport, Wash. The east hydrogeologic boundary of The Dalles Ground Water Reservoir probably is a fault that crosses the Columbia River from sec. 35, T. 2 N., R. 13 E., in Washington on the north side of the river and trends southeastward into Oregon through sec. 1, T. 1 N., R. 13 E. Static water levels in wells east of this fault generally are 70 to 100 ft higher than the potentiometric surface of The Dalles Ground Water Reservoir. The west boundary seems to be the Chenoweth fault and a small anticlinal fold, that trend northeastward through sec. 19, 20, 21, T. 2 N., R. 13 E. Faulting and folding could have disrupted hydraulic continuity of the aquifer along this trend. Wells 1N/13E-18bdc and 1N/13E-22abd are the southernmost wells with water levels typical of The Dalles Ground Water Reservoir. However, flowing wells completed at a similar altitude farther south, along Mill Creek and upper Threemile Creek, produce from confined aquifers with heads 600 ft or more above the potentiometric surface of The Dalles Ground Water Reservoir. This great difference in head in a short lateral distance is unusual. One possible explanation is that the south boundary of the reservoir is a structural barrier to ground-water flow, as suggested by Newcomb (1969, p. 27). Another possibility is that the large drop in head reflects an abrupt increase in the hydraulic conductivity of the reservoir compared with the enclosing strata. Because the transmissivity of the reservoir is an order of magnitude greater than the other basalt aquifers, the hydraulic gradient required to transmit water through it is low.

By 1960, at least 23 high-yield wells had been completed in The Dalles Ground Water Reservoir. Heavy pumping of these wells in the late 1950's and early 1960's caused steep declines of the potentiometric surface. Water rights, permits, and applications for water from The Dalles Ground Water Reservoir totaled 26,500 acre-ft/yr in 1959. However, actual withdrawals from 1957 to about 1964, the period of steepest decline, were estimated to be about 15,000 acre-ft/yr (Foxworthy and Bryant, 1967, p. 9). During the 1970's, totalizing flowmeters were installed on some wells, and records for metered wells and estimates of pumpage from unmetered wells indicate that withdrawals have decreased to about 5,000 acre-ft in 1979. Hydrographs of wells producing from the reservoir (1N/13E-3bca, 1N/13E-4bdd, and 2N/13E-28cdb, fig. 8) show the effect of reduced pumpage. Since the mid-1960's, the amplitude of the seasonal fluctuations of water levels has decreased and water levels have remained at about the 1968 level.

The Dalles - Dufur Area

In the central part of the Wasco subarea, aquifers in the Columbia River Basalt Group sustain numerous high-yield wells. Most of these wells are in an area south and southeast of The Dalles, extending to within 5 mi of the basin divide. The potentiometric surface of the ?rbasalt in this area (shown on pl. 1) is derived from water-level data for wells open in the intermediate flow system, completed to depths of 100 to 700 ft below the bottoms of the principal valleys.

Potentiometric contours indicate that ground-water flow in the basalt aquifers is generally from south to north. In the principal valleys, the altitude of the potentiometric surface is above land surface; consequently, flowing wells can be developed in many of these valleys. It should be noted that many wells in the valleys are not flowing wells. This is probably because the wells are not tightly cased and water moves upward through the well bore and out into the shallow permeable zones of lower head. Other wells may penetrate an upper, unconfined or poorly confined basalt aquifer with a potentiometric surface below the surface shown on plate 1. Yields reported for irrigation, industrial, and public-supply wells in this area range from 50 to more than 2,900 gal/min and average about 400 gal/min. Most of the flowing wells have reported flow rates of 300 to 600 gal/min. Specific capacities for a few wells are as high as 100 (gal/min)/ft of drawdown; however, most are less than 20 (gal/min)/ft of drawdown and the average value is about 6 (gal/min)/ft of drawdown. This range in specific capacity suggests an approximate range in transmissivity of from 1,600 to 5,400 ft^2/d for these basalt aquifers.

Ground-water withdrawals will deplete aquifer storage, and water levels can be expected to decline. Interference (that is, the lowering of the water level in one well caused by pumping of a nearby well) has been reported in several wells near Dufur and on upper Threemile Creek. Efficient use of an aquifer is accomplished by spacing wells at sufficient distances to minimize interference between pumping wells, resulting in uniform lowering of aquifer water levels. In a confined aquifer having a transmissivity of 1,600 ft^2/d and a storage coefficient of 0.0005, the computed drawdown at a point 1 mi distant from a well pumping 300 gal/min for a period of 90 days is 9.1 ft; for a transmissivity of 5,400 ft^2/d, the drawdown is 3.8 ft (Theis, 1935).

As of 1980, aquifers in only the upper 1,000 ft or less of the basalt have been developed. Some additional water can be obtained from the upper basalt aquifers in The Dalles-Dufur area, and large additional quantities of water can be obtained from aquifers below a depth of 1,000 ft.

Undeveloped deep basalt aquifers are part of the regional flow system. In the southern two-thirds of The Dalles-Dufur area, water levels in the deep basalt aquifers probably are lower in altitude than those observed in wells completed in the intermediate flow system. Close to the Columbia River, water in the undeveloped deep basalt aquifers probably discharges upward to shallow basalt. Data to verify this flow pattern are sparse however. Water levels in well 1N/13-1baa completed in a basalt aquifer underlying The Dalles Ground Water Reservoir are shallower than those in wells completed in the reservoir. Initial water levels in tightly cased deep basalt wells near the Columbia should be shallower than in similar wells in shallow basalt.

Upland Areas

In recent years, residential development in areas near The Dalles, Mosier, and Hood River has increased. Most of this development has been in upland areas, including the hillsides and hilltops south of The Dalles the "Cherry Heights" divide between Chenoweth Creek and Mill Creek, the crest and northwest slope of Sevenmile Hill between The Dalles and Mosier, Rocky Prairie south of Mosier, and the York Hill area southwest of Hood River. Most of these areas are outside municipal water districts, and water supplies for domestic use are obtained mainly from individual wells.

Geology of the upland areas varies, but the hydrology of each tends to be similar. Most wells are drilled deep enough to obtain only the small yield required from domestic needs and generally tap ground water in local flow systems (see fig. 6).

Recharge to local flow systems in upland areas is small because it is derived from a small area. Ground-water movement beneath the uplands is both lateral and downward toward adjacent valleys and to underlying deeper flow systems. Because of this pattern of flow, static water levels in wells decrease in altitude with increased depth of well until the intermediate flow system is penetrated. The hydrogeologic sections (pls. 1, 2) show these conditions.

Some ground water in upland areas is probably perched above the local water table by beds of impermeable material. To identify perched ground water, extensive drilling may be needed.

Most domestic wells in the uplands have yields of less than 20 gal/min; however, yields are unpredictable, and some dry holes have been reported. Specific capacities of most wells are less than 2 (gal/min)/ft of drawdown. Eleven wells in the uplands in T. 2 N., R. 12 E., and three wells in T. 2 N., R. 10 E., have required deepening since they were initially drilled, suggesting that water levels are declining locally.

In general, upland areas are not favorable locations for developing more than several gallons per minute from wells less than 300 ft deep. Because ground-water flow beneath the uplands is downward and away from hilltops, each new well bore drilled into the shallow aquifers becomes a conduit for increased downward flow unless each well is tightly cased. Residential development of the uplands increases the number of wells per unit area and leads to increased competition for a limited supply of water. Dependable water supplies may be obtained in most upland areas by deepening or completing wells into the intermediate flow system where water may be derived from a more extensive area; however, well depths of 500 ft or more may be required in some upland areas. Because of the complex nature of the local flow systems beneath these uplands, it is practically impossible to predict how much water or how many wells can be developed at a given depth or altitude beneath a given upland site.

Hood River Valley

Relatively little ground water is being pumped from wells in Hood River Valley because of the abundance of springs and surface-water supplies. These supplies may be vulnerable to contamination from accidental spills of contaminants. Springs and surface-water supplies could also be endangered by natural disasters such as floods or future eruptions of Mount Hood similar to that of Mount St. Helens in May 1980. Crandell (1980) indicated that the channels and adjacent flood plains of the West, Middle, and East Forks of the Hood River, extending to the Columbia River, could be affected by mudflows and floods generated by an eruption of Mount Hood, and that ash-cloud deposits might accumulate over a much larger area. Ground water would be largely unaffected by such events, and sufficient quantities could be developed in the Hood River Valley to provide an alternative source of supply in the remote possibility that such a disaster occurred.

In some places along the Columbia River near Hood River, 100 ft or more of saturated, highly permeable alluvium is present and may be capable of yielding large quantities of water to wells. One well (3N/10E-25dbc) in these deposits is 70 ft deep and yields 350 gal/min. Another source capable of yielding large quantities of water is the Columbia River Basalt Group that crops out at Hood River and is at fairly shallow depth beneath much of Hood River Valley. Several wells in the valley that penetrate only about 100 ft of the basalt yield from 70 to 100 gal/min, but well 1N/9E-1abd which penetrates 572 ft of basalt yields 400 gal/min. Other geologic units in the valley probably lack either sufficient saturated thickness, permeability, or extent to yield any large quantities of water.

Chemical Quality

Ground water contains dissolved minerals derived from rock and soil materials through which it moves. Commonly, ground water contains higher proportions of dissolved mineral constituents than does surface water. Samples from 49 wells and one spring indicate that the ground water in the Hood Basin generally contains low concentrations of most dissolved minerals.

Table 2 lists 61 detailed or partial ground-water analyses; 46 of the analyses were made by the U.S. Geological Survey laboratory; the remainder were made by other laboratories as indicated. Chemical diagrams showing the proportions of major constituents of selected ground-water samples are included on plates 1 and 2. The size of the diagram is proportional to the dissolved minerals determined, and similarly shaped diagrams indicate similar types of water.

Table 2.--Chemical analyses of water from selected wells and springs in the Hood Basin

[Analyses by U.S. Geological Survey unless otherwise indicated]

No.	Well or spring no.	Principal geologic source[1]	Date of collection	Silica (SiO_2)	Iron (Fe) [2](0.3)	Manganese (Mn) [2](0.05)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F) [3](1.8)	Nitrite (NO_2) + nitrate (NO_3) as N [3](10)	Arsenic (As) [3](0.05)	Boron (B)	Dissolved solids, calculated from determined constituents	Hardness As $CaCO_3$	Hardness Noncarbonate	Specific conductance (micromhos/cm at 25°C)	pH	Temperature (°C)	Sodium-adsorption-ratio (SAR)
				Milligrams per liter (established or recommended levels for drinking water in parentheses)																					
1	1N/9E-1abd	Tcr	2-25-80	99	[4]<0.01	0.001	0.4	0.0	40	5.1	102	[5]--	1.4	1.8	1.2	0.09	0.000	0.05	200	1	0	185	--	27	17
2	1N/10E-31dca	QTv	11-13-79	64	<.01	.004	6.6	1.8	6.9	3.1	35	--	2.0	1.2	.1	2.2	.000	.000	113	24	0	87	6.3	8	.6
3	1N/12E-12acb	Td	11- 7-79	70	<.01	.002	14	10	8.7	3.1	115	--	1.7	4.3	.1	.37	.000	.008	170	76	0	194	6.8	13	.4
4	1N/12E-13cbc	Tcr	[6,7]7-31-58	95	.04	.00	16	4.6	62	11	234	0	1.5	7.5	1.6	--	--	--	314	59	0	378	7.9	28	3.5
5	do.	Tcr	11- 6-79	98	--	--	--	--	--	--	220	0	3.5	4.9	1.7	.01	.000	--	--	--	--	364	8.0	26	--
6	do.	Tcr	4-22-80	--	--	--	14	4.8	60	11	219	0	.4	5.2	1.6	--	--	--	--	55	0	373	8.1	27	3.5
7	1N/12E-13dca	Tcr	[7]8-18-59	73	.14	0	15	6.4	63	10	170	18	.5	12	1.5	--	--	--	283	63	0	--	8.2	--	4.4
8	1N/12E-15cda	Td	11- 7-79	72	--	--	--	--	--	--	158	0	6.9	4.8	.2	.00	.000	--	--	--	--	262	7.0	13	--
9	do.	Td	4-22-80	--	6.4	1.2	17	14	13	4.7	146	0	4.3	4.9	.2	--	--	--	--	.00	0	259	6.9	13	.6
10	1N/13E-1aaa	Tcr	[7]7-15-75	63	.12	.07	30	19	23	6	195	0	35	21	.6	.04	<.005	--	294	.53	0	--	7.5	--	.6
11	1N/13E-1baa	Tcr	[8]7-18-79	28	.60	--	52	28	--	--	112	0	6.6	5.7	.5	--	--	--	[9]249	92	153	--	7.8	15	--
12	1N/13E-1bdc	Tcr	[10]7-26-67	48	.65	.1	35	19	27	12	198	0	80	6.8	.7	<.01	<.005	--	328	.62	5	430	7.8	--	.7
13	1N/13E-3bca	Tcr	[11]7-26-30	70	.02	--	18	8.2	44	6.2	196	0	12	6.0	--	.01	--	--	261	79	0	--	--	--	2.4
14	do.	Tcr	[7]7-18-45	72	--	--	--	--	--	--	133	4	19	14	.1	--	--	--	[9]205	75	0	--	8.2	--	--
15	1N/13E-4bdd	Tcr	[12]10-27-60	62	.07	--	37	14	39	9.3	249	--	28	10	.7	.01	--	--	324	.52	0	470	7.7	17	1.1
16	1N/13E-4cdb	Tcr	[7,12]3-16-51	--	.09	--	--	--	--	--	158	--	23	--	.6	--	--	--	--	--	--	--	--	--	--
17	do.	Tcr	[6,8]6-25-54	80	0	0	17	12	[13]50	--	160	0	15	6.4	1.1	--	--	--	260	92	0	--	7.6	--	--
18	do.	Tcr	[10,12]7-30-58	74	.06	0	17	6.8	44	8.0	190	--	10	6.0	1.0	0	--	--	260	70	0	335	8.0	20	2.7
19	do.	Tcr	[12]6-22-61	66	.04	--	26	10	44	8.8	194	6	31	6.0	.9	.02	--	--	295	108	0	402	8.5	20	1.8
20	do.	Tcr	10-23-79	69	--	--	--	--	--	--	195	0	38	6.6	.8	.01	.000	.050	--	--	--	398	7.9	20	--
21	1N/13E-8cba	Tcr	[8]9- 2-75	--	.05	--	36	38	--	--	212	--	22	14	.5	--	--	--	[9]259	174	72	--	8.2	--	--
22	1N/13E-16aaa	Td	10-24-79	70	<.01	<.001	72	38	24	5.6	317	0	29	57	.4	9.5	.001	.010	494	260	76	778	7.5	16	.6
23	1N/13E-22dbb	Qu	do.	69	.01	.020	39	23	33	6.8	232	0	32	18	.3	6.0	.003	.020	362	190	2	525	6.9	13	1.0
24	1N/13E-28ddc	Tcr	11- 9-79	91	--	--	12	4.8	40	6.5	158	0	2.3	4.0	1.1	.04	.000	--	238	50	0	270	8.0	20	2.5
25	1N/13E-32aca1	Tcr	10-24-79	80	.03	.020	14	3.1	41	7.2	158	0	2.0	4.9	1.1	.02	.000	.120	232	48	0	267	7.9	30	2.6
26	1N/13E-32aca2	Tcr	[6]7-30-58	84	.03	.0	15	2.9	41	7.2	167	0	2.4	6.0	.9	.0	--	--	241	49	0	279	8.5	22	3.6
27	1N/14E-27cdd	Tcr	12-11-79	59	<.01	.009	29	15	18	4.8	195	0	6.3	9.0	.5	.98	.002	.009	242	130	0	344	7.8	16	.7
28	2N/8E-6dad	Qu	2-27-69	21	.03	.00	4.9	2.0	2.6	1.4	28	0	2.0	1.5	.1	.02	--	--	50	20	0	57	6.7	5	.5
29	2N/9E-4aad	Tcr	10-22-79	21	.02	<.001	6.9	3.1	5.4	.8	49	0	5.6	6.7	.1	.03	.000	.005	70	30	0	87	7.2	11	.4
30	2N/10E-13dca	Tcr	[14]3-25-65	--	.04	--	15	6.4	13	--	154	--	4.5	3.3	--	--	--	--	[9]185	64	0	223	8.6	--	.9
31	2N/10E-15cca	Qu	3-25-65	--	.01	--	10	14	5.4	--	110	--	.5	2.5	--	--	--	--	[9]166	83	0	158	6.6	--	.5
32	do.	Qu	11- 5-79	57	<.01	.001	14	9.6	7.9	2.6	100	0	6.2	3.8	.1	.29	.000	.020	152	74	0	183	6.3	11	.4
33	2N/10E-19aaa	QTv	11-13-79	20	.02	.004	4.2	3.3	3.1	.6	30	0	1.3	1.2	.1	.58	.000	.006	51	24	0	62	5.8	10	.3
34	2N/10E-26dbd	Tt	[14]3-25-65	--	.66	--	30	25	22	--	250	--	1.0	15	--	--	--	--	[9]290	178	0	355	7.0	--	.5
35	do.	Tt	11- 5-79	42	<.01	.120	17	11	17	2.6	158	0	3.5	4.0	.1	.09	.000	.000	176	80	0	250	7.1	11	.8
36	2N/11E-1cbc	Tcr	[6]7- 9-64	36	.91	.3	30	24	17	4.1	158	0	74	3.5	.6	.04	--	.00	269	130	42	397	8.0	13	.4
37	2N/11E-2dad	Tcr	do.	36	.67	.10	38	28	14	4.3	161	0	76	9.2	.2	4.1	--	.040	304	132	77	456	7.2	10	.3
38	2N/11E-2ddb	Tcr	11- 8-79	38	.02	.260	48	36	17	4.2	195	0	150	2.5	.3	.00	.000	.004	392	160	110	578	7.7	15	.5
39	2N/11E-12aad	Tcr	10-26-79	56	.54	--	20	14	19	--	158	0	12	2.8	.4	.10	.000	--	--	108	0	277	7.9	13	.8
40	2N/11E-14cbd	Td	11- 8-79	72	<.01	.080	10	5.4	7.9	3.3	76	0	2.0	2.5	.1	.38	.000	.006	142	47	0	132	6.6	10	.5

See footnotes at end of table.

Table 2.--Chemical analyses of water from selected wells and springs in the Hood Basin--Continued

No.	Well or spring no.	Principal geologic source 1/	Date of col-lection	Milligrams per liter: Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mn)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrite (NO_2) + nitrate (NO_3) as N	Arsenic (As)	Boron (B)	Dissolved solids, calculated from determined constituents	Hardness: As $CaCO_3$	Hardness: Noncarbonate	Specific conductance (micromhos/cm at 25°C)	pH	Temperature (°C)	Sodium-adsorption-ratio (SAR)
41	2N/12E-7bcd	Tcr	6/7- 9-64	49	0.19	0.10	20	14	19	3.7	164	0	9.6	3.8	0.4	0.02	--	0.020	201	108	0	281	7.9	16	0.8
42	2N/12E-8adc	Tcr	11- 8-79	75	<.01	.007	17	14	46	3.0	146	0	3.8	48	.1	.27	0.001	.020	280	100	0	403	7.2	9	2.0
43	2N/12E-11abd	Tcr	11- 7-79	54	.03	.005	27	11	6.7	3.8	116	0	16	7.6	.2	4.1	.000	.020	202	95	18	273	6.8	12	.3
44	2N/12E-18bbd	Tcr	10-26-79	57	.03	.080	23	17	11	2.8	171	0	3.6	3.6	.2	.08	.000	.002	203	130	0	290	7.7	15	.4
45	2N/12E-22dbc2	Tcr	11- 7-79	43	<.01	.030	17	14	7.5	2.5	134	0	7.5	2.3	.2	.03	.000	.000	160	100	0	228	7.8	10	.3
46	2N/13E-17dad	Tcr	11- 7-79	47	.20	.090	40	22	14	4.7	183	0	77	3.5	.4	.04	.000	.008	299	150	40	449	7.7	17	.4
47	2N/13E-32daa1	Tcr	6,8/1-10-62	75	<.01	<.05	21	13	38	10	187	--	47	6.6	1.0	.02	--	--	9/295	105	0	310	8.1	--	1.6
48	2N/14E-31cca	Tcr	11- 6-79	53	--	--	--	--	--	--	183	0	46	20	.6	.15	.000	--	--	--	--	438	7.8	19	--
49	do.	Tcr	4-22-80	--	--	.10	34	20	26	6.5	182	0	44	17	.6	--	--	--	--	150	17	445	7.6	19	.9
50	2N/14E-31dcc	Tcr	6,10/?-54	56	.10	--	24	14	27	4.0	157	--	31	4.9	--	.01	--	--	238	118	0	296	7.8	--	1.1
51	2N/15E-33cdc	Tcr	11- 6-79	48	<.01	<.001	28	16	19	3.8	183	0	9.5	7.6	.5	1.0	.001	.008	227	140	0	343	7.8	14	.7
52	1S/10E-29bbcs	QTv	11- 5-79	39	--	--	--	--	--	--	24	0	5.2	1.3	.1	.36	.000	--	--	--	--	84	6.9	5	--
53	1S/13E-12bab	Tcr	10-25-79	59	1.5	.040	12	4.7	39	6.1	158	0	3.6	4.7	1.1	.03	.000	.110	210	49	0	266	8.0	15	2.4
54	1S/13E-25dca	Tcr	do.	60	<.01	<.001	11	6.7	10	4.4	89	0	4.4	2.8	.3	.77	.001	.000	147	55	0	170	7.5	15	.6
55	1S/13E-26dac2	Tcr	do.	65	.11	.020	14	5.4	37	5.3	158	0	2.0	4.8	1.0	.01	.000	.110	213	57	0	271	7.9	18	2.1
56	1S/14E-3adc	Tcr	10-22-79	57	.28	--	17	11	40	--	195	0	11	4.7	1.1	.00	.001	--	--	88	0	331	7.9	16	2.0
57	1S/15E-5aaa	Tcr	11-14-79	48	<.01	<.001	20	12	19	5.2	146	0	11	7.6	.5	1.1	.001	.010	200	99	0	284	7.9	14	.8
58	2S/12E-1cdd	Tcr	10-25-79	50	<.01	.002	20	12	12	4.7	134	0	5.8	4.4	.3	.47	.001	.002	177	99	0	251	7.7	14	.5
59	2S/12E-15dab	Tcr	8/5-16-78	--	.10	--	45	27	--	--	211	--	0	8.5	1.1	--	--	--	9/233	173	50	--	8.1	23	--
60	2S/13E-28aba	Tcr	11-14-79	60	.03	<.001	24	14	16	4.0	122	0	12	1.3	.2	8.9	.000	.010	231	100	18	302	7.4	8	.6
61	2S/14E-16aba	Tcr	do.	56	<.01	<.001	18	13	13	3.3	107	0	11	9.0	.4	5.3	.000	.006	200	88	10	268	7.7	9	.6

1/ Qu, Quaternary, undifferentiated; QTv, Quaternary-Tertiary volcanics; Td, Tertiary Dalles Formation; Tt, Tertiary Troutdale Formation; Tcr, Tertiary Columbia River Basalt Group.
2/ Recommended by U.S. Environmental Protection Agency (1976).
3/ Established by U.S. Environmental Protection Agency (1975).
4/ Less than indicated value.
5/ Not analyzed.
6/ Newcomb (1972, p. 56-59).
7/ Analysis by Charlton Laboratories, Inc., Portland, Oreg.
8/ Analysis by Oregon Public Health Laboratory.
9/ Residue on evaporation at 180°C.
10/ Analyst unknown.
11/ Piper (1932, p. 162).
12/ Foxworthy and Bryant (1967, p. 50, 51).
13/ Sodium and potassium.
14/ Sceva (1966, p. 40).

Variations in Chemical Quality

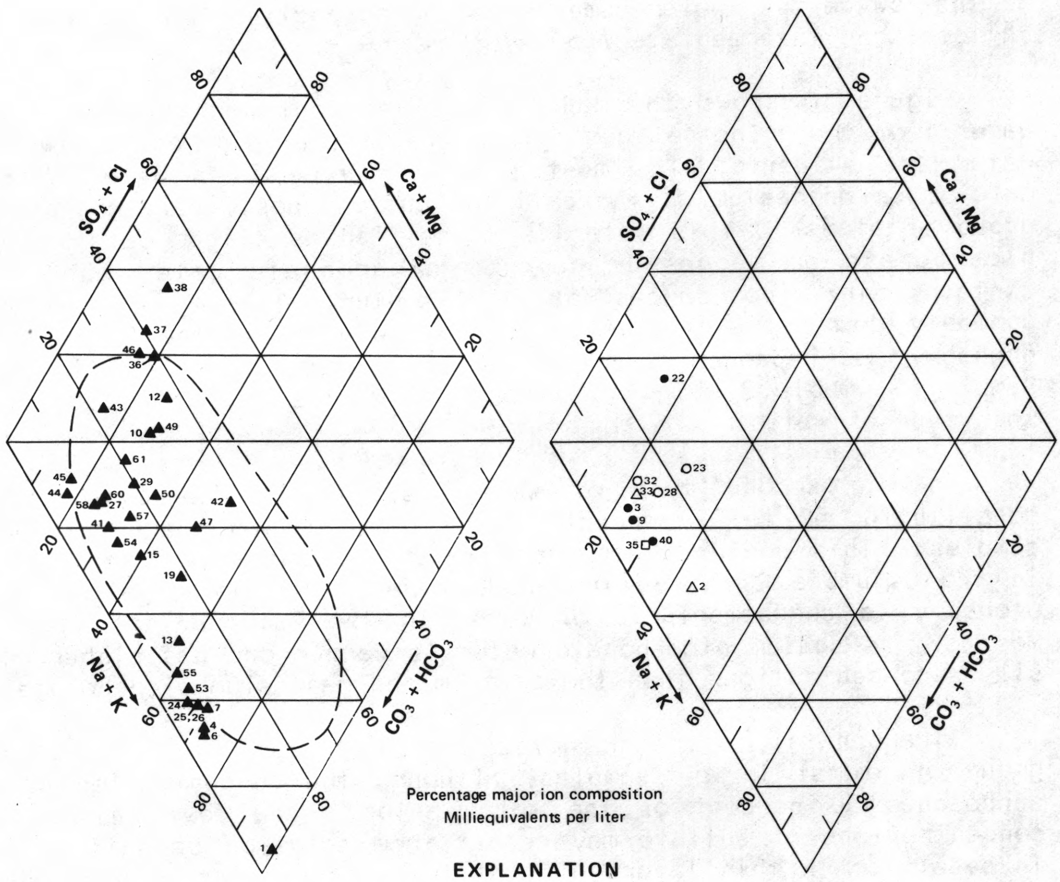
The chemical quality of ground water in the Hood Basin varies with location, depth, and time. In general, the concentration of dissolved minerals increases with the distance between recharge and discharge areas. However, numerous factors may influence or alter the chemical composition of ground water, including variation in geology, rate of ground-water movement, ground-water temperature, and contamination from human activities. Because most wells in the study area are cased only to shallow depths, water samples may be composites from several aquifers in local and intermediate flow systems.

Figure 10 shows the major dissolved ionic constituents of ground water from the principal geologic units in the Hood Basin. Two types of water are evident. The most prevalent type is a water with either calcium or magnesium as the dominant cation (positively charged atom or group of atoms). This water is classified as either calcium magnesium bicarbonate or magnesium calcium bicarbonate water and generally contains only minor concentration of sodium. This type of water occurs commonly, but not exclusively, in shallow wells in the upland areas and probably is representative of ground water in local flow systems. Sample 45 (table 2, fig. 10) from well 2N/12E-22dbc2 is an example of this type of water.

In the second type of water, sodium is the dominant cation, constituting 52 to 92 percent of the total cation concentrations in 10 samples. This sodium bicarbonate water is generally from deeper wells in the Columbia River Basalt Group beneath the principal valleys, and probably is characteristic of water in the intermediate flow system. Most of the sodium bicarbonate water is warmer and has higher dissolved silica concentrations than the calcium and magnesium bicarbonate water.

Bicarbonate is the principal anion (negatively charged atom or group of atoms) in all samples, although the concentration of sulfate approaches 50 percent of the total anions in a few samples. Higher concentrations of sulfate may result from solution of sulfide minerals in basalt or in thin layers of coal that occur in some interbeds in the basalt. Several samples containing from 74 to 150 mg/L of sulfate, were from wells near the Columbia River between The Dalles and Mosier, where a thin coal-bearing interbed was reported (Newcomb, 1969, p. 15).

Newcomb (1972) compiled 525 chemical analyses of water from Columbia River Basalt Group aquifers throughout the Columbia Plateau. Chemical composition of ground water from basalt aquifers in the Hood Basin falls within the range of Newcomb's "prevalent ground water of the basalt" (fig. 10).



EXPLANATION

Principal geologic source:

- ○ Quaternary undifferentiated deposits (Qu)
- △ Quaternary and Tertiary volcanic rocks (QTv)
- ● Dalles Formation (Td)
- □ Troutdale Formation (Tt)
- ▲ Columbia River Basalt Group (Tcr)

Number designates analysis in table 2.

Dashed line shows Newcomb's "prevalent ground water of the Columbia River Basalt Group" (1972, p. 12)

FIGURE 10. – Quadrilinear plot of analyses of ground-water samples from the principal geologic units in the Hood Basin.

Suitability for Use

The concentrations of certain chemical constituents of ground water affect its suitability for irrigation, industrial, public supply, domestic, and stock uses. In general, ground water in the Hood Basin does not contain objectionable concentrations of most constituents.

Water hardness which results largely from the presence of dissolved calcium and magnesium, is a property of water associated with soap-consuming capacity and encrustation in boilers and cooking utensils. Hardness is classified by the Geological Survey as follows:

Hardness range (mg/L as $CaCO_3$)	Description
0-60	Soft
61-120	Moderately hard
121-180	Hard
More than 180	Very hard

Hardness in ground water is the major chemical-quality problem in the Hood Basin; hardness in 55 samples ranged from 1 to 160 mg/L. Fourteen of the samples were classified as soft, 25 moderately hard, 14 hard, and two very hard. Water with more than 100 mg/L hardness may be objectionable for some uses and may require softening.

Maximum public drinking water limits (U.S. Environmental Protection Agency, 1976) for iron and manganese are 0.3 and 0.05 mg/L, respectively. High levels of iron and manganese may produce objectionable taste and cause staining of laundry and plumbing fixtures. Excessive iron was reported in eight samples; excessive manganese was reported in 12 samples. Well 1N/12E-15cda had the highest reported iron and manganese concentrations, 6.4 and 1.2 mg/L, respectively. This well is in upper Brown Creek Valley, where several other wells completed in the Dalles Formation are also reported to have high iron concentrations.

Fluoride is a beneficial constituent, up to the recommended limit, because it retards tooth decay. However, in concentrations greater than the recommended limit, it may cause mottling and darkening of teeth. The maximum recommended public drinking water limit for fluoride (U.S. Environmental Protection Agency, 1975, p. 59570) depends on the annual average of the mean daily maximum air temperature. In the Hood Basin, that temperature ranged from 14.8°C at Friend to 18.0°C at The Dalles. The recommended fluoride concentrations for those temperatures range from 2.0 to 1.8 mg/L. The fluoride concentration was less than 1.8 mg/L in all samples analyzed; however, several samples were in the 1.5 to 1.7 mg/L range.

Concentrations in excess of 10 mg/L of nitrite and nitrate reported as nitrogen may be an indication of man-caused contamination and may cause methemoglobinemia (blue-baby syndrome) in bottle-fed infants. Although no samples of ground water exceeded this level, several contained more than 4 mg/L, and one sample from well 1N/13E-16aaa contained 9.5 mg/L. Potential sources of nitrogen in ground-water samples are municipal and industrial waste water, septic-tank effluent, leachates from barnyards and feedlots, cropland and lawn fertilizers, animal wastes, leachates from garbage dumps and landfills, and some kinds of mine wastes. Natural sources are decaying organic matter and nitrogen compounds in soil and rocks. Nitrite and nitrate, the most common dissolved nitrogen species, are soluble and highly mobile. These species can readily enter the ground water and persist at high concentrations for long distances in coarse-grained, permeable materials with shallow water tables, as in some of the unconsolidated surficial deposits, or in fractured and jointed rocks, such as basalt or andesite.

Concentrations of dissolved arsenic in all samples were well below the maximum public drinking water limit of 0.05 mg/L (U.S. Environmental Protection Agency, 1975). The order of hydrogen sulfide gas was noticeable during sampling of several wells in the basalt; these waters may require aeration if used for domestic supply.

Dissolved-solids concentration and the sodium-adsorption-ratio (SAR) are important determinants of the suitability of water for irrigation. The range of dissolved solids in ground water in the Hood Basin was 50 to 494 mg/L; the mean value was 232 mg/L. Generally, the level of dissolved solids must exceed 1,000 to 2,000 mg/L to have an adverse effect on crops. The SAR indicates the relative proportion of sodium to other cations in the water. High SAR values signify a potential hazard of sodium replacing absorbed calcium and magnesium in soils through cation-exchange reations. This process is damaging to soil structure and tends to decrease soil permeability. Figure 11 shows that most ground water in the Hood Basin is classified as having a low sodium hazard and a low to medium salinity hazard. One sample, from well 1N/9E-1abd, had a high sodium hazard; however, the dissolved-solids concentration was low and water from this well is not used for irrigation.

Boron, in very small concentrations, is an essential element for growth of plants. However, toxic effects in sensitive crops occur at concentrations of 1.0 mg/L or less (U.S. Environmental Protection Agency, 1976, p. 25); therefore, a maximum level of 0.75 mg/L is recommended. All samples analyzed for boron contained less than 0.75 mg/L; the values ranged from 0.000 to 0.120 mg/L.

Temperature

Temperatures of shallow, unconfined ground water (at depths of less than 100 ft) range from about 9° to 15°C. This is approximately the range of mean annual air temperature for stations in the Hood Basin. Ground-water temperature generally increases with depth, indicating a flow of heat from deeper in the Earth toward the surface. The rate at which temperature increases with depth is the geothermal gradient.

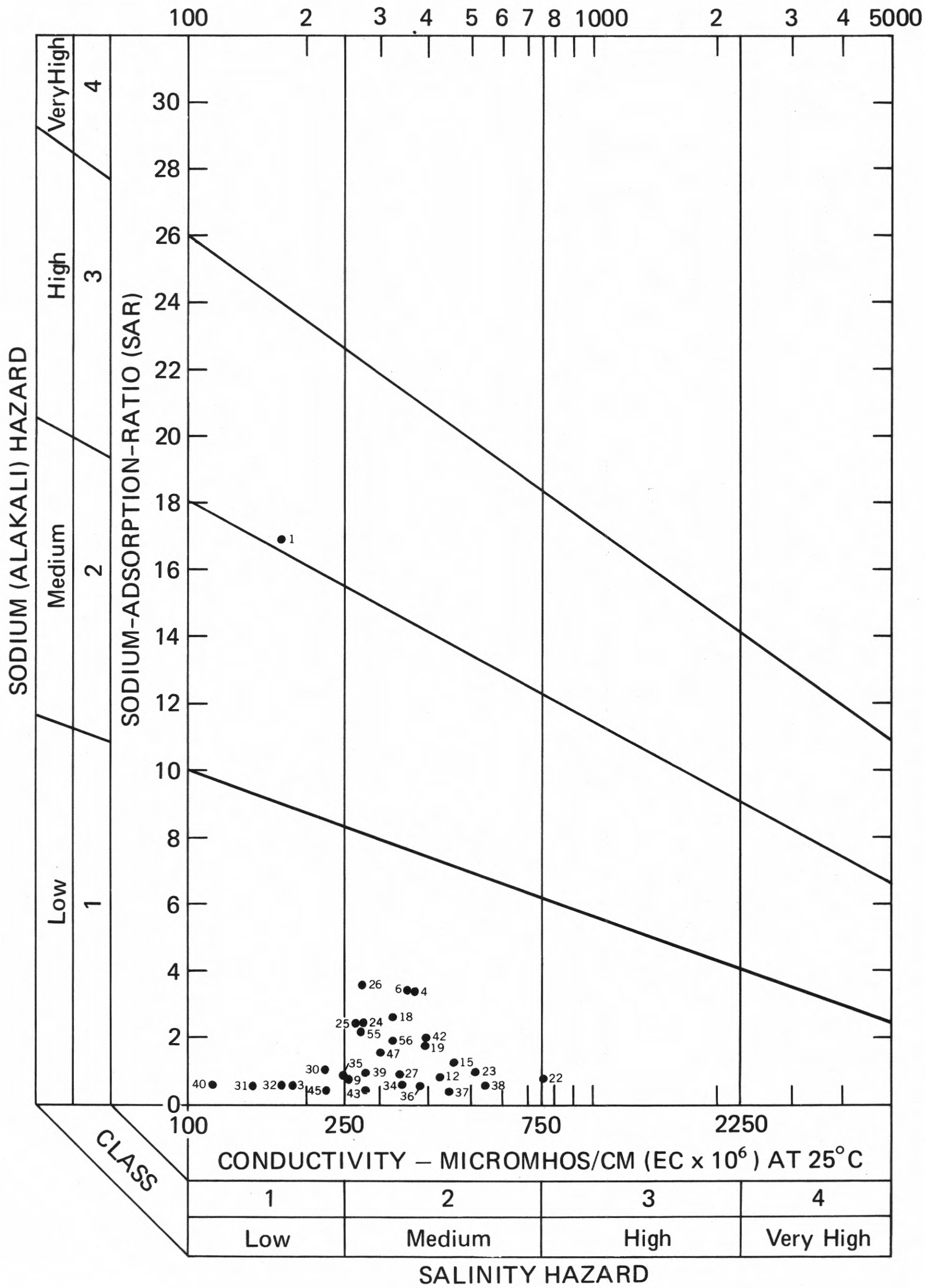


FIGURE 11. – Classification of irrigation water (after U.S. Salinity Laboratory Staff, 1954, p. 80). Numbers of plotted circles correspond to sample numbers in table 2.

Local geothermal gradients vary greatly from the worldwide average of about 0.76°C/100 ft. Higher gradients are generally associated with a shallow local or regional geothermal source. Blackwell and others (1978) determined an average geothermal gradient of 1.33°C/100 ft for the Deschutes-Umatilla Plateau. This geothermal gradient is compared with ground-water temperature data collected in the Hood Basin (fig. 12). Most of the temperature data fall within the normal range; however, a significant number are warmer than expected for the depth of the well. Most of these anomalously warm waters are from wells in the Columbia River Basalt Group.

The highest ground-water temperature was 34°C, reported for well 1N/13E-33cbc. Although this temperature is too low for geothermal-power generation, the water can be used efficiently by heat pumps. Heat can be removed with a heat pump from all ground water; however, water above about 25°C can be utilized for space heating or greenhouse operations.

Use of Ground Water

In 1979, the estimated ground-water withdrawals in the Hood Basin for all uses was 12,600 acre-ft (table 3). The principal source of ground water was aquifers of the Columbia River Basalt Group that supplied 96 percent of the total estimated withdrawals.

Estimates of the ground-water withdrawals by source and use were compiled from data supplied by municipal water departments and private water districts, Wasco County Watermaster's records of metered wells, drillers' reports, interviews with well owners and operators, and field observations during 1979. Estimates of irrigation use are based on an irrigation season of 90 to 120 days. Irrigation use varies annually depending upon climatic conditions, availability of surface water, type of crops, acreage under cultivation, and other factors. Domestic use was estimated using a per capita consumption rate of 75 gal/d for the cooler, humid Hood subarea and 100 gal/d for the warmer, arid Wasco subarea.

The largest use of ground water in 1979 was for irrigation of crops and pastures. Approximately 70 irrigation wells supplied an estimated 7,700 acre-ft during the 1979 irrigation season. Most of these wells are in the Wasco subarea, and most produce water from the Columbia River Basalt Group. Since 1965 water from the Columbia River has largely replaced ground water as the source of irrigation water in the area near The Dalles. Ground-water use for irrigation is increasing in the central part of the Wasco subarea, mainly in the Eightmile Creek and Fifteenmile Creek Valleys. The principal crops irrigated are grain, alfalfa, hay, pasture, and orchards, and application of water is commonly by sprinkler.

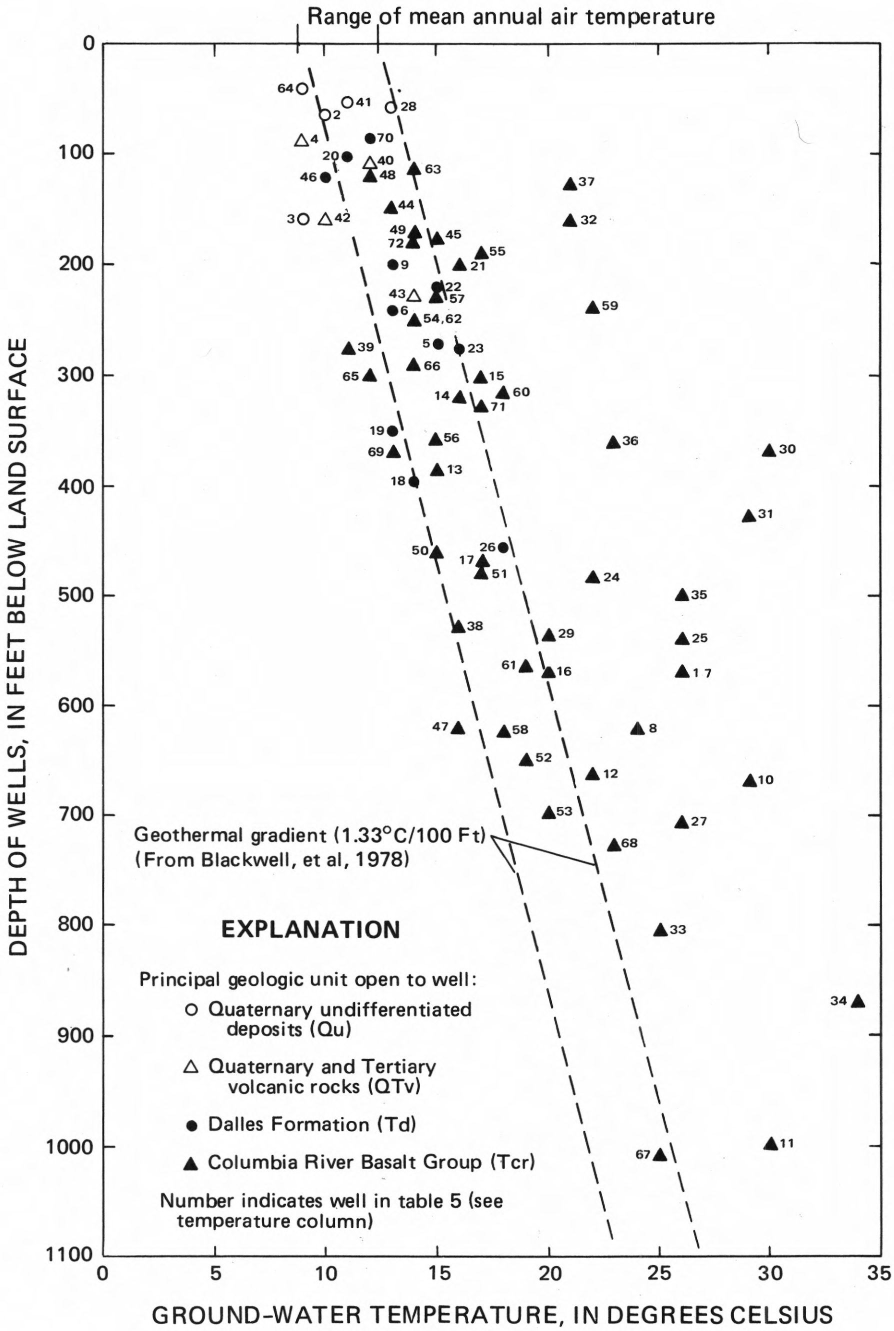


FIGURE 12. – The geothermal gradient and ground-water temperatures in the Hood Basin.

Table 3.--Summary of estimated ground-water withdrawals (acre-feet per year) and water use in the Hood Basin during 1979

Use	Hood subarea Source, principal geologic unit				Wasco subarea Source, principal geologic unit			Total (rounded)
	Qu	QTv	Tt	Tcr	Qu	Td	Tcr	
Irrigation	140	10	--	--	--	120	7,400	7,700
Public supply	44	--	--	16	11	120	1,920	2,100
Industrial and commercial	2	1	5	6	--	--	2,544	2,600
Domestic and stock	17	23	--	5	2	12	152	200
Total	203	34	5	27	13	252	12,016	12,600

The next largest use of ground water in 1979 was for industrial purposes. The Martin Marietta Aluminum, Inc., plant at The Dalles, the largest industrial user, reportedly pumped 2,513 acre-ft from four wells (2N/13E-28cab, cbc, ccd, and cdb) in The Dalles Ground Water Reservoir. Additional minor withdrawals were mainly for fruit packing and cold storage, washing sand and gravel, mixing concrete, and agricultural chemical preparation.

Wells in the Columbia River Basalt Group are either the principal or a significant supplemental source of municipal water supply for the cities of The Dalles, Dufur, and Mosier. Reported or estimated withdrawals in 1979 included a combined 1,668 acre-ft (from The Dalles Ground Water Reservoir) by the city of The Dalles and the Chenoweth Irrigation Cooperative; 88 acre-ft by the city of Dufur; and 54 acre-ft by the city of Mosier. In addition, private water districts in the Wasco subarea supplied about 110 acre-ft from the Columbia River Basalt Group, 120 acre-ft from the Dalles Formation, and 11 acre-ft from the unconsolidated surficial aquifers. In the Hood subarea, most of the population is served by public and private water systems using surface water and an undetermined quantity of ground water from several springs. The city of Cascade Locks supplements its surface-water supply with about 44 acre-ft of ground water from a well in alluvium near the Columbia River.

Ground water is used widely for domestic and stock supplies in the rural areas of the Hood Basin. Estimated pumpage in 1979 includes 155 acre-ft from the Columbia River Basalt Group, mostly in the Wasco subarea; 25 acre-ft from the Quaternary and Tertiary volcanic rocks of the Hood subarea; 20 acre-ft from Quaternary unconsolidated surficial aquifers, mainly in the Hood River Valley; and 10 acre-ft from the Dalles Formation in the Wasco subarea. Numerous small springs also supply an undetermined amount of water for domestic and stock use.

SUMMARY

In the Hood subarea, abundant precipitation, especially on the steep eastern slopes of the Cascade Range, feed perennial streams and recharges the aquifers. The Wasco subarea is in the rain shadow of the Cascades and receives little precipitation. Most streams in this subarea are intermittent; summer streamflow in perennial streams is mostly appropriated for irrigation or municipal supply. Ground-water recharge is small, probably an inch or less, over much of the Wasco subarea.

Volcanic, volcaniclastic, and sedimentary rocks of Miocene to Holocene age and unconsolidated surficial deposits of Pleistocene and Holocene age underlie the basin. Most of these geologic units have limited areal distribution or saturated thickness, generally low permeability, and yield from a few to a few hundred gallons per minute of water to wells.

The main water-bearing unit underlying the Hood Basin is the Columbia River Basalt Group. Total thickness of this unit is probably 2,000 ft or more throughout much of the basin; much of it is saturated. The most productive water-yielding zones are in porous, fractured basalt or rubbly basalt breccia that commonly occurs near the top of individual lava flows. The reported yields of wells in basalt vary widely, from a few to a few thousand gallons per minute. High-yield wells generally penetrate several of the fractured or brecciated zones.

The most productive basalt aquifer in The Dalles Ground Water Reservoir which underlies about 25 to 30 mi^2 at The Dalles. Specific-capacity data for wells in this aquifer suggest that its transmissivity is about 30,000 to 150,000 ft^2/d. Withdrawals of 15,000 acre-ft per year or more during the late 1950's and early 1960's caused water levels in the aquifer to decline sharply. Annual pumpage from this aquifer had declined to about 5,000 acre-ft in 1979, and water levels have stabilized indicating that ground-water withdrawals and recharge are in balance.

Presently (1980), only the upper 1,000 ft or less of the Columbia River Basalt Group has been tapped by water wells, and most of these wells are in or near The Dalles and Dufur in the Wasco subarea. Additional ground water can be obtained from the upper 1,000 ft of the basalt; however, large quantities of ground water may be available from the deeper basalt aquifers. Interference between pumping wells can be minimized by spacing high-capacity wells at sufficient distances apart so that the potentiometric surface will be lowered uniformly.

The yields and dependability of shallow wells (that is, generally less than 300 ft deep) in upland areas are erratic because recharge is small. More dependable supplies of ground water can be obtained in these upland areas by deepening or completing wells into intermediate flow systems; however, well depths of 500 ft or more may be required.

Generally, ground water in the basin is chemically suitable for domestic, irrigation, or other uses. Some ground water has objectionable concentrations of iron and manganese or is moderately to very hard. In several samples, the concentration of dissolved nitrogen was between 4 and 9.5 mg/L. These data suggest possible degradation of water by effluent from domestic waste-disposal systems or by application of excessive nitrate fertilizer or animal waste to agricultural land.

In 1979, an estimated 7,700 acre-ft of ground water was used for irrigation of crops, 2,600 acre-ft for industrial supply, 2,100 acre-ft for municipal supply, and 200 acre-ft for domestic and stock supply. Ninety-six percent of this total estimated withdrawal of ground water was from aquifers in the Columbia River Basalt Group.

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GROUND-WATER DATA

Table 4.--Records of selected wells and springs in the Hood Basin

Well or spring number: See page 4 for description of well- and spring-numbering system.
Type of well: Refers to method of drilling. C, cable tool; R, rotary.
Altitude: Altitude of land surface at well, in feet above mean sea level, estimated from topographic maps.
Diameter of well: Nominal inside diameter of the innermost casing at the surface.
Finish: F, gravel packed and perforated; O, open end; P, perforated; X, open hole.
Aquifer: Principal water-bearing geologic unit or unit open to well. Qu, Quaternary undifferentiated; QTv, Quaternary-Tertiary volcanic rocks; Td, Tertiary Dalles Formation; Tt, Tertiary Troutdale Formation, Tcr, Tertiary Columbia River Basalt Group; Te, Tertiary Eagle Creek Formation.
Water level: Depths to water below land surface given in feet and decimal fractions were measured by the Geological Survey, the Oregon State Water Resources Department, or the Wasco County watermaster; those given in whole feet were reported by well driller or owner. Flows, flowing well whose static level is not known; + indicates feet of head above land surface; dry, dry hole.

Specific conductance: Field measurement by Geological Survey; in micromhos per centimeter at 25°C.
Temperature: Field measurement by Geological Survey or reported value; number in parentheses refers to data plotted in figure 12.
Well performance: Yield, in gallons per minute, and drawdown, in feet, generally reported by driller, owner, or pump company for period indicated. Type of test: A, air lift; B, bailed; P, pumped.
Use: D, domestic; I, irrigation; N, industrial; P, public supply; S, stock; U, unused.
Remarks: C, chemical analysis reported in table 2; G, project observation well; H, water-level hydrograph in this report; L, driller's log in table 5; O, observation well whose water level is measured periodically; pH, field measurement by Geological Survey; PP 383-C refers to Newcomb (1969); WSP 659-B refers to Piper (1932); WSP 1594-E refers to Foxworthy and Bryant (1967); remarks on the adequacy and dependability of water supply and general quality of water were reported by owners, tenants, drillers, or others.

Well or Spring Number	Owner	Type of well	Year com-pleted	Alti-tude (feet)	Depth of well (feet)	Depth of casing (feet)	Dia-meter of well (inches)	Fin-ish	Aquifer	Water level: Feet below datum	Water level: Date meas-ured	Speci-fic conduc-tance of water	Tempe-rature of water (°C)	Well performance: Yield (gal/min)	Well performance: Draw-down (feet)	Well performance: Pumping period (hr)	Well performance: Type of test	Use	Remarks
T. 1 N., R. 9 E.																			
1abd	Trout Lodge, Inc.	R	1977	910	572	35	12	X	Tcr	84.2	9-19-79	185	27 (1)	400	482	--	A	N	C., L.
2cdd	T. Hans	C	1965	1,200	103	103	6	F	Qtv	32	11-22-65	111	--	16	33	1	B	D	pH = 7.4
24dda	M. Nichols	R	1976	1,421	200	160	6	X	Qu	97.6	9-19-79	--	--	18	--	--	A	U	L.
T. 1 N., R. 10 E.																			
15cca	•G. Bosley	R	1971	1,565	350	--	--	--	Tcr	dry	--	--	--	--	--	--	--	U	L., deepened in 1972 from 200 ft without obtaining adequate supply; filled and abandoned.
18dbb	J. Werst	R	1979	1,043	245	20	6	X	Tcr	31.8	9-13-79	--	--	30	195	--	A	D	
18dbc	W. Coldiron	C	1979	1,105	45	45	6	O	Qu	7.4	do.	93	--	20	0	1	B	D	
19aba	R. Alberty	R	1974	1,295	100	79	6	X	Qtv	40	6-14-74	102	--	30	--	1	A	D	
19ada	G. Meyers	R	1974	1,325	200	194	6	P,O	Qtv	66.8	9-13-79	133	--	50	--	1	A	D	Water reported to be high in iron content; well has water-conditioning unit.
19dab	B. Mitchell	R	1977	1,363	160	100	6	X	Qu	42	5- 3-77	123	--	20	118	--	A	D	L.
19dad	J. Weseman	R	1979	1,370	133	55	8	X	Qu	39.8	9-13-79	--	--	43	71	1	P	D	
19dba	L. Hawkins	R	1977	1,363	80	60	6	X	Qu	21	5- 4-77	57	--	20	59	--	A	D	
21baa	J. Losee	C	1962	1,335	90	80	8	X	Qu	1.7	9-14-79	--	--	22	30	2	P	D	L.
29bbb	R. Arthur	R	1976	1,418	64	59	6	X	Qu	10.0	9-13-79	85	10 (2)	12	--	--	A	D	
30aab	E. Chrisman	R	1978	1,403	158	133	6	O	Qu	87.6	9-19-79	137	9 (3)	18	--	3	A	D	Gravel placed from 133 to 158 ft water; reported to be high in iron content.
31dca	M. Smith	R	1978	1,658	90	88	6	X	Qtv	14.7	9- 6-79	87	8 (4)	88	--	--	A	D	C., L.
33aba	M. Harris	C	1964	1,520	120	120	8	F	Qu	47	5- 6-64	--	--	19	35	1	B	D	
T. 1 N., R. 12 E.																			
1aab	W. Goeckel	C	1972	870	500	115	8	X	Td	432	4-28-72	298	--	9	28	1	P	D	pH = 7.1.
1add	R. Goolsby	R	1975	1,005	160	140	6	P,O	Td	117.6	11- 2-79	--	--	15	16	1	B	D	
1bda	C. McCall	C	1959	655	177	50	6	X	Td	115.4	7-10-79	258	--	15	--	--	--	D	pH = 6.9.
1bdb	L. Gardipee	C	1974	545	80	41	6	X	Td	10.3	11- 2-79	--	--	--	--	--	--	D	
1dad	H. Lutz	C	1955	1,080	250	116	8	X	Td	172.8	do.	--	--	4.8	0	--	B	D	
1dcd1	L. Richman	C	1969	1,050	255	255	6	F	Td	178.9	7-11-79	243	--	15	20	1	B	D	pH = 6.8.
1dcd2	do.	C	1978	1,030	230	166	6	X	Td	146.4	do.	--	--	22	5	1	B	D	

Table 4.—Records of selected wells and springs in the Hood Basin--Continued

Well or Spring Number	Owner	Type of well	Year completed	Altitude (feet)	Depth of well (feet)	Depth of casing (feet)	Diameter of well (inches)	Finish	Aquifer	Water level: Feet below datum	Water level: Date measured	Specific conductance of water	Temperature of water (°C)	Well performance: Yield (gal/min)	Well performance: Drawdown (feet)	Well performance: Pumping period (hr)	Well performance: Type of test	Use	Remarks
									T. 1 N., R. 12 E.--Continued										
11acd	A. Wasson	R	1976	860	410	156	8	X	Td	272	4- 9-76	--	--	150	110	1	A	I	
11bcd	K. Sutton	R	1977	1,110	270	220	6	P,X	Td	132	10-24-77	167	15 (5)	60	--	--	A	D	pH = 7.0.
11cad	L. Richman	C	1978	865	350	90	6	X	Td	207.5	7-10-79	--	--	14	90	1	B	D	
11dcd	W. Benson	R	1978	1,040	345	97	6	X	Td	283.0	7-11-79	--	--	10	20	1	A	D	
12abb	L. Richman	C	1979	1,010	535	65	6	X	Td	450	2- 2-79	--	--	8	5	1	B	D	
12acb	do.	C	1978	1,060	240	214	6	X	Td	210.5	7-11-79	194	13 (6)	20	5	1	B	D	C., L., pH = 7.0.
12cab	N. Pointer	R	1976	1,120	330	28	6	X	Td	265	9-21-76	--	--	15	0	1	B	D	
12cac	O. Frouarp	C	1972	1,120	305	286	6	X	Td	254.4	7-11-79	--	--	15	3	1	B	D	
12dda	P. Maney	R	1978	1,080	265	245	6	P,X	Td	188.1	11- 2-79	--	--	6	40	1	A	D	
13cbc	C. Sandoz	C	1954	550	572	346	8	X	Tcr	+178	7-12-79	373	27 (7)	--	--	--	--	I	C., L., H., O; flowed 200 gal/min, 1954; deepened in 1963 from 546 ft. Flowed 1,221 gal/min; well 14R1 in PP 383-C.
13dca	K. Kortge	C	1955	515	521	270	8	X	Tcr	+175	do.	--	24 (8)	--	--	--	--	I	C., L., O; flowed 795 gal/min, 1955; deepened in 1963 from 580 ft, flowed 300 gal/min; well 13Q1 in PP 383-C.
14bbb	J. Joerling	C	1973	985	200	200	6	F	Td	104.6	7-10-79	148	--	25	17	1	P	D	pH = 6.7.
15ada	J. Carter	C	1978	945	400	90	6	X	Td	72.6	7-10-79	274	--	35	190	4	P	D	pH = 6.6; water reported to be high in iron content; well has water-conditioning unit.
15cda	T. Lepinski	C	1977	985	200	120	6	X	Td	79.6	11- 2-79	262	13 (9)	22	70	4	P	D	C., L.; water contains excessive iron and manganese.
15dba	R. Cherry	R	1977	980	155	20	8	X	Td	65	5-20-79	195	--	20	55	1	A	D	pH = 7.1.
22cca1	D. Felker	R	1976	785	110	18	6	X	Td	42	12-22-76	--	--	25	68	--	A	D	
22cca2	R. Lawson	C	1973	780	145	32	6	X	Td	35	12- 4-73	--	--	25	1	1	B	D	
23bcd	D. Elliott	C	1954	635	670	440	8	X	Tcr	+71	11-29-78	--	29 (10)	--	--	--	--	I	O.; flowed about 800 gal/min in 1954; well 23D1 in PP 383-C.
28dcd	City of The Dalles	C	1962	972	1,000	751	10	X	Tcr	359.0	12-30-77	--	30 (11)	340	54	10	P	P	C., L., O.; well 28Q1 in PP 383-C.
29dad	J. Wilds	C	1972	1,065	219	41	8	X	Td	185	3- 8-72	137	--	12	10	1	B	D	
									T. 1 N., R. 13 E.										
1aaa	Inn at The Dalles	C	1955	240	564	53	10	X	Tcr	165	2-10-59	--	22 (12)	340	60	8	P	N	C., L., well 1A1 in PP 383-C.
1baa	City of The Dalles	R	1979	108	385	385	16	P	Tcr	64.6	12-11-79	--	15 (13)	3,300	29.5	6.8	P	P	C., L., G.
1bdc	Lynch Equipment Company	C	1945	127	335	32	16	X	Tcr	28.6	9-17-79	--	--	1,500	--	--	--	U	C., L., O., G.; well 1F1 in PP 383-C.
1cal	R. Mosser	R	1974	365	160	42	6	X	Tcr	92.8	11-27-79	--	--	25	--	--	A	D	L.
1cbd	H. Sanderson	C	1966	340	110	29	8	X	Tcr	29	9-26-66	--	--	15	75	1	B	U	
1cca	W. Piehl	C	1959	473	133	133	6	P	Td	100.1	11-28-79	--	--	18	0	--	B	D	
1ccb1	H. Rueber	C	1963	485	143	143	6	F	Td	115	11-15-63	--	--	20	4	1	B	D	
1ccb2	L. Hughes	C	1967	480	158	158	6	F	Td	106	2-26-67	--	--	10	0	1	P	D	
1cda	D. Jones	C	1973	485	250	148	6	X	Tcr	112	10-16-73	--	--	20	112	1	B	D	L.
1dcd	T. Sipe	C	1978	445	268	120	6	X	Tcr	170.8	11-27-79	--	--	12	50	4	P	D	
1ddb	The Dalles Livestock Auction	R	1976	380	140	58	6	X	Tcr	72	11- 9-76	--	--	35	30	1	A	S	
3acd	The Dalles Cherry Growers	C	1954	100	114	77	8	X	Tcr	55.1	3-14-80	--	--	125	0	3	P	N	O.
3bca	City of The Dalles	C	1923	99	200	62	12	X	Tcr	73.0	8- 3-79	--	--	2,500	5.5	3	P	P	C., L., H., O.; well no. 43 in WSP 659-B, 3C1 in PP 383-C and WSP 1594-E.
4bad	Sisters of the Holy Name	C	1928	165	210	?	8	?	Tcr	134.3	11-29-78	--	--	--	--	--	--	U	O.; well 4C1 in PP 383-C and WSP 1594-E.
4bbc	R. Bennett	R	1975	285	320	284	7	X	Tcr	250	8-22-75	303	16 (14)	150	--	5	A	D	pH = 7.7.
4bcd	Columbia Lodges, I.O.O.F.	C	1946	242	303	52	18	X	Tcr	232.8	9- 4-79	--	--	840	0	3	P	I	O.; well 4E1 in PP 383-C and WSP 1594-E.
4bdd	City of The Dalles	C	1954	190	304	145	18	X	Tcr	165.0	10-22-79	--	17 (15)	2,500	30	--	P	P	C., L., H., O.; well 4F1 in PP 383-C and WSP 1594-E.

Table 4.--Records of selected wells and springs in the Hood Basin--Continued

Well or Spring Number	Owner	Type of well	Year completed	Altitude (feet)	Depth of well (feet)	Depth of casing (feet)	Diameter of well (inches)	Finish	Aquifer	Water level: Feet below datum	Water level: Date measured	Specific conductance of water	Temperature of water (°C)	Well performance: Yield (gal/min)	Well performance: Drawdown (feet)	Well performance: Pumping period (hr)	Well performance: Type of test	Use	Remarks
									T. 1 N., R. 13 E.--Continued										
4cdb	City of The Dalles	C	1931	273	570	116	12	X	Tcr	272.5	do.	398	20 (16)	1,200	4	50	P	P	C., L., H., O., G.; well 4P1 in PP 383-C and WSP 1594-E.
5acb	Cherry Heights Irrigation Coop.	C	1946	452	546	349	12	X	Tcr	442	11-27-79	--	--	950	4	--	P	I	O.
5adc	J. Fleck	C	1957	360	470	46	3	X	Tcr	157.5	10-19-79	330	17 (17)	25	0	1	B	P	Supplies about 25 homes; deepened in 1968 from 285 ft.
5bab	J. Miller	R	1968	763	395	34	8	X	Td	358	8- 1-68	368	14 (18)	11	2	1	B	D	pH = 7.1.
5bbd	Martin Marietta, Inc.	C	1963	905	537	56	6	X	Td	452.6	11-27-79	335	14	8.5	5	--	B	D	pH = 7.3.
5bcb	E. Hendricks	R	1975	870	530	51	6	X	Td	350	10-30-75	--	--	10	180	--	A	D	L.
5cba	Foley	C	1959	740	323	99	6	X	Td	234	12-14-59	--	--	8.5	19	--	B	D	L.
6aab1	C. Smith	R	1976	1,055	360	223	6	X	Td	162	8- 1-76	--	--	12	--	--	A	U	Deepened from 160 ft; inadequate supply.
6aab2	do.	R	1978	1,070	350	20	8	X	Td	141.6	11-28-79	311	13 (19)	6	20	1	A	D	pH = 6.7.
6aba	L. Shoemaker	C	1978	1,090	790	323	6	X	Td	633	5-27-78	--	--	10	20	1	B	D	L.
6ada	M. Malcolm	C	1977	1,002	103	19	6	X	Td	86.6	11-28-79	265	11 (20)	5	1	1	B	D	L.; pH = 6.6.
6baa	L. Shoemaker	R	1978	1,130	330	518	6	X	Td	690	12-27-78	--	--	20	120	1	A	D	
6bbc	R. Krueger	C	1954	965	700	193	8	X	Td	501	3-27-74	--	--	21	39	1	B	D	Deepened from 325 ft in 1974.
6bdc1	E. Ayres	R	1978	1,215	360	20	8	X	Td	290	11-27-78	--	--	20	20	1	A	D	
6bdc2	J. Ayres	R	1976	1,225	365	22	8	X	Td	265	12-18-76	--	--	30	40	1	A	D	
8cba	City of The Dalles	C	1945	320	371	130	12	X	Tcr	298.5	10-22-79	--	--	550	1	100	P	P	C., L., O; well 8M1 in PP 383-C and WSP 1594-E.
9cdb	K. Tucker	C	1961	660	724	430	6	X	Tcr	606	4- 5-61	340	--	105	0	3	P	D	L.
9ddc	M. Polehn	C	1972	775	390	20	8	X	Td	257.2	8-14-79	320	--	10	90	1	B	D	
10cca	do.	C	1967	605	272	266	6	F	Td	125	7- 9-69	--	--	7	75	1	P	D	Supply for orchard laborers camp.
10dac	A. Williams	R	1975	620	250	250	6	F	Td	94.4	7-19-79	640	--	14	80	1	P	D	pH = 7.5.
10dbd1	N. Phetteplace	C	1945	630	264	264	6	F	Td	121	12-15-70	450	--	5	90	1	B	D	pH = 7.7.
10dbd2	D. Radford	R	1972	595	200	60	6	X	Tcr	92.0	7-19-79	330	16 (21)	4	40	2	A	D	pH = 7.6.
11aba	K. Cole	C	1973	420	200	106	8	X	Tcr	84	11-10-73	--	--	10	75	1	B	D	
11abc	D. Larsen	C	1973	455	220	130	6	F,X	Td	90.8	12- 6-79	470	15 (22)	35	40	1	P	D	
11cba	T. Hendricks	R	1975	735	370	23	6	X	Td	227	9-27-75	--	--	8	143	--	A	D	
12acb	E. Jones	R	1975	545	250	·212	6	X	Tcr	175	5- 8-75	--	--	25	30	1	A	D	
12bbb1	A. Byrd	R	1978	540	215	23	8	X	Td	129.1	11-28-79	--	--	15	40	1	A	D	
12bbb2	W. Maley	R	1979	620	300	297	6	F	Td	230	7-27-79	--	--	20	30	1	A	D	
12bdd	G. Clayton	C	1960	565	249	249	6	F	Td	184	7-15-60	--	--	4	33	3	P	D	
13ccd	J. Blaser	C	1962	920	970	478	8	X	Tcr	756	3- 5-62	360	--	90	50	3	P	D	L., well 13N1 in PP383-C; pH = 8.0.
14aca	KMW Irrigation Coop.	C	1949	515	521	230	8	X	Tcr	250	10-49	--	--	300	140	--	P	I	
14acc	G. Rood	R	1977	620	245	57	6	X	Tcr	183	2-24-77	--	--	8	30	1	A	D	
14bab	J. Phetteplace	C	1967	670	315	58	6	X	Td	225	4-16-67	460	--	3	0	2	P	D	pH = 7.5.
14bbb	D. Rempel	C	1915	650	325	?	?	?	Td	109.0	8- 7-79	255	--	6	100	--	--	D	Well no. 58 in WSP 658-B; pH = 7.4.
14bcc	G. Stadelman	C	1954	580	231	40	8	X	Tcr	105.9	do.	460	--	250	--	--	P	D	pH = 7.0.
14cab	V. Martin	C	1931	530	230	120	10	X	Tcr	149	1949	--	--	360	37	7	P	I	Well 14L1 in PP 383-C.
14cad	J. Douthit	C	1975	660	250	53	6	X	Td	158.8	8- 8-79	--	--	5	--	--	P	D	Supply for orchard laborers camp.
15aaa	D. Cooper	C	1961	670	225	183	6	X	Td	134.8	12- 4-79	--	--	15	22	4	P	D	Supply for orchard laborers camp.
15acd	Parklawn Memorial Gardens	C	1956	705	433	362	8	X	Tcr	258.0	7-19-79	225	--	180	2.5	2	P	I	L., H., O.
15cac	R. Riggs	C	1967	800	250	60	6	X	Td	183.1	8- 9-79	690	--	8	4	3	P	D	
15dca	D. Haener	C	1978	660	225	30	6	X	Td	124.5	7-19-79	530	--	8	60	1	B	D	pH = 7.4.
16aaa	M. Polehn	C	1963	570	275	44	8	X	Td	215.8	8-14-79	730	16 (23)	5	34	1	B	D	C., L.
16aba	D. Bailey	C	1965	775	370	37	6	X	Td	251.9	do.	--	--	4	89	2	B	D	L.
16dcd	R. Bailey	C	1965	1,020	507	59	6	X	Td	443.2	8-13-79	--	--	7	46	1	B	D	
17ccd	L. Houda	C	1968	700	152	40	8	X	Td	64.6	8-16-79	300	--	9	23	2	P	D	pH = 7.1.
18bdc	V. Tenneson	C	1951	405	435	175	8	X	Tcr	345	5-17-61	--	22 (24)	--	--	--	--	U	L.; well 18F1 in PP 383-C; water reported to effervesce from high dissolved carbon dioxide content.
18cba	K. Melby	C	1953	421	540	?	8	?	Tcr	+134	11-29-78	--	26 (25)	--	--	--	--	I	L., O.; flowed 440 gal/min 1953; deepened in 1963 from 433 ft, flowed 360 gal/min; well 18M1 in PP 383-C.

Table 4.—Records of selected wells and springs in the Hood Basin—Continued

Well or Spring Number	Owner	Type of well	Year completed	Altitude (feet)	Depth of well (feet)	Depth of casing (feet)	Diameter of well (inches)	Finish	Aquifer	Water level: Feet below datum	Water level: Date measured	Specific conductance of water	Temperature of water (°C)	Well performance: Yield (gal/min)	Well performance: Drawdown (feet)	Well performance: Pumping period (hr)	Well performance: Type of test	Use	Remarks
T. 1. N., R. 13 E.—Continued																			
20bab	D. Webster	C	1972	720	225	65	8	X	Td	83	11-22-72	300	--	16	120	1	B	D	pH = 7.0.
20bba	J. Schmidt	C	1968	700	175	45	8	X	Td	63.0	8-17-79	--	--	12	53	1	B	U	
20bbd	N. Watts	R	1978	760	225	41	6	X	Td	144.3	8-16-79	270	--	21	36	2	A	D	pH = 7.3.
20bcb	W. Hammond	R	1978	840	204	22	6	X	Td	131.0	do.	--	--	9	--	--	A	D	
20bcd	G. Hayes	C	1976	860	350	25	6	X	Td	110	10- 2-76	260	--	20	210	1	B	D	pH = 7.8.
20cbas	Bessette	--	--	1,040	--	--	--	--	Td	--	--	170	--	--	--	--	--	D	pH = 7.5.
20ccbs	P. Moore	--	--	1,000	--	--	--	--	Td	--	--	160	--	--	--	--	--	D	pH = 7.3; discharging about 3 gal/min 8-16-79.
21abc1	Orchard View Farms	R	1975	1,040	460	177	6	X	Td	382	4- 4-75	260	--	6	10	1	P	D	
21abc2	do.	R	1979	1,040	555	197	6	X	Td	393	5- 6-79	235	--	5	100	1	A	D	
21ada	B. Smith	R	1977	920	436	40	6	X	Td	251	3-15-77	--	--	5	150	1	A	D	
21bcd	W. Meyer	R	1977	1,420	613	177	8	X	Td	313.5	8-14-79	190	--	6	70	--	A	D	pH = 7.3.
21bda	C. Omeg	C	1956	1,060	456	55	6	X	Td	403	3-28-79	260	13 (26)	7.4	18	--	B	D	pH = 7.9.
22aab	J. Chatterton	C	1930	590	159	13	8	X	Td	42	6-19-67	330	--	10	0	--	P	D	
22adb	R. Renken	C	1947	580	704	350	10	X	Tcr	552	2-20-63	280	26 (27)	160	9	2	P	I	L.; pH = 8.1; deepened from 348 ft in 1955; well 22B2 in PP 383-C.
22bbb	Huntley	C	1956	900	400	20	8	X	Td	213.3	8- 9-79	305	--	3	--	--	B	D	L.; pH = 7.7.
22bbc	E. Wilson	C	1977	930	415	415	5	P	Td	282.0	do.	290	--	5	100	1	B	D	pH = 7.3.
22bcd	E. Eddy	R	1978	800	272	19	8	X	Td	180	8- 2-78	310	--	7	20	1	P	D	pH = 7.2.
22dbb	R. Anderson	R	1975	630	55	55	6	F	Qu	20.5	7-13-79	525	13 (28)	25	7	1	P	D	C., L.
22dbc	G. Fortin	C	1978	640	58	58	6	F	Td	33	10-11-77	--	--	18	10	1	B	D	
22ddb	L. Polehn	C	1955	760	705	317	8	X	Tcr	90.4	7-11-79	390	16	75	420	--	P	D	L.; pH = 7.5.
26bca	W. Keys	R	1972	1,310	805	192	6	X	Tcr	dry	11-13-72	--	--	--	--	--	--	U	Deepening of old well from 189 ft, no water encountered.
26cca	E. Wilson	R	1976	1,330	445	72	8	X	Td	343	7-31-76	--	--	10	65	1	A	I	L.
27aab	T. Christian	C	1979	940	400	400	5	P	Td	297	3- 9-79	270	--	10	88	1	B	D	L.; pH = 7.3.
27baa	G. Fortin	R	1978	700	270	37	6	X	Td	63.0	7-12-79	--	--	6	--	--	A	D	
28ddc	N. Phetteplace	C	1948	841	536	51	8	X	Tcr	F	--	270	20 (29)	300	95	12	P	I	C., L.; flowed 50 gal/ min in 1948; well 28R1 in PP 383-C.
32aca1	M. Martin	C	1946	1,200	368	240	6	X	Tcr	+145	11-29-78	267	30 (30)	--	--	--	--	I	C., L., H., O., flowed 2,000 gal/min 1946; deepened in 1976 from 336 ft, flowed 600 gal/min; well 32G1 in PP 383-C.
32aca2	do.	C	1955	1,209	427	336	6	X	Tcr	+104	1-22-76	280	29 (31)	--	--	--	--	I	C., L., flowed 1,000 gal/min 1955; 300 gal/min 1976.
32adb1	D. Lash	R	1976	1,240	160	76	8	X	Tcr	32	11- 2-76	500	21 (32)	500	30	1	A	I	pH = 8.0.
32adb2	do.	C	1946	1,223	179	65	6	X	Tcr	+69	4-46	250	21	64	7	--	--	I	pH = 8.0; flowed 300 gal/min in 1946; well 32H1 in PP 383-C.
32bcc	S. Skirving	C	1956	1,167	805	263	8	X	Tcr	+291	3- 8-71	300	25 (33)	--	--	--	--	I	L., pH = 8.1; flowed 1,600 gal/min in 1956; well 32E1 in PP 383-C.
33abb	A. McClure	C	1913	1,050	214	20	6	X	Tcr	162	1979	490	16	30	--	--	--	D	pH = 7.3.
33cbc	Carter and Fortin Orchards	C	1960	1,050	870	775	8	X	Tcr	+134	10- 9-74	275	34 (34)	--	--	--	--	I	L., O.; pH = 8.0; flowed 800 gal/min in 1960; deepened in 1974 from 844 ft; well 33M1 in PP 383-C.
34cab	G. Bradley	C	1958	1,050	500	320	8	X	Tcr	133.4	11-29-78	--	26 (35)	375	54	2.5	P	I	O.; well 34L1 in PP 383-C.
34ccc	W. Greenwood	R	1974	960	360	161	8	X	Tcr	27.6	7-10-79	--	23 (36)	500	20	9	A	I	Flowed 50 gal/min in 1974.
35caa	W. Thomas	R	1974	850	128	109	8	X	Tcr	+35	7-27-74	275	21 (37)	--	--	--	--	I	Flowed 500 gal/min in 1974.
36bbb	H. Ketchum	C	1964	795	384	204	8	X	Tcr	140.0	6-29-79	--	--	537	9	1.5	P	I	L.
36dbd	Dick Brothers	C	1955	910	277	247	8	X	Tcr	--	--	--	--	820	65	2	P	I	Well 36K1 in PP 383-C.
T. 1 N., R. 14 E.																			
12abb	J. Fulton	R	1979	880	245	49	8	X	Tcr	72.8	11-14-79	--	--	300	110	3	P	I	
19dba	J. Benson	C	1965	550	100	37	5	P,X	Tcr	28.6	6-29-79	--	--	45	0	1	B	D	
24acb	K. Kortge	R	1979	1,042	300	159	6	P,X	Tcr	168	10- 1-79	--	--	23	121	4	P	D	
26cac	G. Harth	R	1977	1,117	525	172	10	X	Tcr	315	10-18-77	--	--	--	--	--	--	I	No pump test, reportedly will yield 500 gal/min.
25cca	do.	R	1974	1,110	656	300	7	X	Tcr	410	10-25-77	--	--	220	--	--	--	I	Deepened in 1975 from 360 ft and in 1977 from 417 ft.

Table 4.--Records of selected wells and springs in the Hood Basin--Continued

Well or Spring Number	Owner	Type of well	Year com- pleted	Alti- tude (feet)	Depth of well (feet)	Depth of casing (feet)	Dia- meter of well (inches)	Fin- ish	Aquifer	Water level: Feet below datum	Water level: Date meas- ured	Speci- fic conduc- tance of water	Tempe- rature of water (°C)	Well performance: Yield (gal/ min)	Well performance: Draw- down (feet)	Well performance: Pumping period (hr)	Well performance: Type of test	Use	Remarks
T. 1 N., R. 14 E.--Continued																			
27cdd1	V. Harth	R	1977	990	530	98	10	X	Tcr	206.8	12-11-79	345	16 (38)	500	150	1	A	U	C., L., G.
27cdd2	do.	R	1979	990	596	50	12	X	Tcr	230	7-12-79	--	--	800	150	1	A	I	
29ccd	R. Overman	R	1978	945	415	20	8	X	Tcr	225	9-19-78	--	--	200	100	1	A	I	
T. 1 N., R. 15 E.																			
8aac	D. Petroff	C	1959	625	162	?	6	X	Tcr	23	6-24-59	--	--	90	42	12	P	D	Deepened from 71 ft.
10baa	J. Petroff	C	1960	860	160	27	8	X	Tcr	109.1	6-15-79	--	--	30	0	--	B	D	
30cad	H. Eddins Ranch	R	1978	878	309	18	10	X	Tcr	65	11-15-78	--	--	600	140	1	A	I	
T. 2 N., R. 8 E.																			
1aba	G. Twidwell	C	1962	140	83	83	6	O	Qu	64	2- 2-62	--	--	30	3	1	B	D	
5cbb	Cascade Locks Lumber Co.	R	1974	90	150	30	8	X	Tcr	32.1	9-24-79	--	--	30	82	1	A	U	
5dab	Columbia Gorge Ranger Sta.	C	1963	150	200	177	6	F	Te	21.7	do.	--	--	4	159	2	B	D	L., H., O.
5dad	City of Cascade Locks	C	1969	120	104	104	8	P	Qu	64.0	do.	57	5	330	1	8	P	P	C., L.
6dbc	Hood River Sand and Gravel	R	1976	120	40	38	6	O	Qu	15	6- 6-76	--	--	50	--	--	A	N	
T. 2 N., R. 9 E.																			
4aad	Starvation Creek State Wayside	R	1973	140	275	275	5	P	Tcr	53.9	9-25-79	87	11 (39)	50	93	1	B	D	C., L.
T. 2 N., R. 10 E.																			
3bcb	F. Bellus	R	1979	680	88	78	6	X	QTv	Flows	3-19-79	108	--	30	--	--	A	D	Flowed 4 gal/min.
3cdb	F. Van Atta	R	1979	700	60	58	6	O	Qu	30	7-29-79	--	--	20	30	--	A	D	
4bda	R. Lee	R	1973	725	74	20	6	X	QTv	30.2	9- 5-79	78	--	15	0	1	B	D	
4caa	E. Schwartz	R	1977	790	87	18	6	X	QTv	29.4	9-11-79	210	--	20	57	--	A	D	
4cbb	R. Johnson	R	1978	1,040	680	119	6	X	QTv	344	6-30-78	--	--	10	297	2	A	D	
4dbb	D. Dexter	R	1964	782	111	60	6	P,X	QTv	44.8	9-21-79	175	12 (40)	18	63	--	A	D	L., H., O., pH = 6.8.
8aca	R. Winslow	C	1978	1,100	70	21	6	X	QTv	29	3-13-78	--	--	8	21	2	B	D	L.
8acd	K. Curtiss	C	1963	1,110	110	19	8	X	QTv	89	7-26-63	--	--	2	0	--	B	D	
8adc	F. Vittoria	C	1978	1,060	80	21	6	X	QTv	52	3-25-78	--	--	5	30	1	B	D	L., well lost water at 119 to 137 ft; plug set at 80 ft.
8bdc	L. Bausch	R	1977	1,340	185	18	6	X	QTv	123	7-13-77	--	--	13	62	--	A	D	
8cca	F. Dye	C	1977	1,440	195	21	6	X	QTv	180	11-19-77	--	--	4	7	2	B	D	
8ccb	do.	R	1977	1,500	465	20	6	X	QTv	333.8	11- 8-79	--	--	0.5	54	1	A	U	Inadequate supply.
8ccc	P. Rossiter	R	1979	1,550	603	79	6	X	QTv	dry	5- 1-79	--	--	--	--	--	--	U	
9dab	R. Sohler	R	1978	860	600	59	6	X	QTv	452	6-23-78	--	--	5	135	2	A	D	L.
13cac	M. Walton	R	1968	630	275	75	8	X	Tcr	45	8-15-68	300	--	75	180	1	B	N	L.
13dca	Diamond Fruit Growers	C	1955	650	160	160	8	P	Tcr	4	7-55	--	--	90	141	18	P	N	L.
15cca	Hood River Co. Road Dept.	C	1963	490	53	52	8	P	Qu	31.5	9-13-79	183	11 (41)	20	18	1	B	D	C., L.; Tucker Park well.
15ccc	V. Joslin	R	1977	520	198	62	6	X	Tcr	93	5- 1-77	--	--	10	105	--	A	D	
17aad	Luhr Jensen, Smoker Div.	R	1973	990	440	138	6	X	QTv	298	12-28-73	--	--	20	120	1	B	N	
17abb	M. Berry	R	1975	1,230	525	136	6	X	QTv	426	4-23-76	--	--	15	--	--	A	D	Deepened in 1976 from 340 ft.
17bcd1	J. Hasegawa	R	1977	1,380	307	100	8	X	QTv	264	10-24-77	--	--	35	43	1	A	U	
17bcd2	do.	R	1978	1,380	163	152	6	X	QTv	80.2	9-27-79	--	--	30	--	--	A	D	
17cba	M. Hasegawa	R	1977	1,380	320	93	8	X	QTv	278	7-15-77	--	--	26	42	--	A	D	
17cdd	R. Kobayashi	R	1978	1,220	408	74	6	X	QTv	355	11- 7-78	--	--	12	53	--	A	D	
18aaa	W. Ford	R	1971	1,530	610	157	6	X	QTv	191	6-24-71	--	--	15	110	1	B	D	
19aaa	R. Kobayashi	R	1976	1,480	150	140	6	X	QTv	115.9	9-12-79	52	10 (42)	25	--	--	A	D	C., L.
19baa	G. Akiyama	R	1977	1,680	195	50	6	X	QTv	56	5-24-77	--	--	15	139	--	A	D	
20abc	R. Meyer	R	1978	930	483	134	6	X	Tcr	388	12-15-78	--	--	20	95	--	A	D	
20adb	J. Woodcock	R	1976	620	227	37	6	X	Tcr	78	5- 3-76	210	14 (43)	60	149	--	A	D	

Well or Spring Number	Owner	Type of well	Year completed	Altitude (feet)	Depth of well (feet)	Depth of casing (feet)	Diameter of well (inches)	Finish	Aquifer	Water level: Feet below datum	Water level: Date measured	Specific conductance of water	Temperature of water (°C)	Well performance: Yield (gal/min)	Well performance: Drawdown (feet)	Well performance: Pumping period (hr)	Well performance: Type of test	Use	Remarks
T. 2 N., R. 10 E.--Continued																			
20dcc	J. Bailey	R	1978	770	257	120	6	X	QTv	190	9-18-78	--	--	10	--	--	A	U	
24bad	R. Hamann	C	1968	570	71	71	6	O	Qu	F	1- 9-68	--	--	100	16	12	P	D	Flowed 15 gal/min in 1968.
26dbd	Duckwall and Pooley, Inc.	C	1958	690	262	262	6	O	Tt	35	3-15-58	250	11	125	150	6	P	N	C., L.
27ada	Hood River Port Comm.	R	1974	710	128	100	6	P,X	QTv	+1.1	12-10-79	--	--	40	95	24	P	U	
28bbd	R. Shutes	R	1978	1,270	350	100	6	X	Tcr	242.2	9-13-79	--	--	9	--	--	A	D	
36acb	G. Cowles	R	1976	790	192	27	8	X	Tcr	1	8-16-76	--	--	10	--	--	A	D	
T. 2 N., R. 11 E.																			
1cbc	City of Mosier	C	1931	135	149	72	10	X	Tcr	65	9- 5-79	--	13 (44)	185	20	--	P	U	C., L.; well 1M1 in PP 383-C.
2dad	do.	C	1952	148	250	41	10	X	Tcr	57	10-22-64	--	--	400	49	--	P	P	C., L.; well 2J1 in PP 383-C.
2dca	McEwen Construction Co.	R	1975	145	120	35	8	X	Tcr	52.1	12-11-79	--	--	75	--	--	A	U	
2ddb	Mosier Mobil Manor	R	1975	175	180	95	8	X	Tcr	71.1	10-26-79	110	15 (45)	20	0	1	B	N	C., L.
10aab	B. Abercrombie	R	1976	705	420	18	8	X	Tcr	226.5	9-18-79	--	--	200	--	--	A	I	Deepened in 1978 from 284 ft.
10acc	J. Willis	R	1979	860	425	19	6	X	Tcr	279.0	9-18-79	--	--	15	147	--	A	D	
10adb	J. Ellett	R	1978	810	230	20	6	X	Tcr	125	10-23-78	--	--	25	--	--	A	D	
10adc	do.	R	1979	840	330	32	6	X	Tcr	232	4-13-79	--	--	25	--	--	A	D	
10bba	A. Miller	R	1977	990	262	65	6	X	Tcr	149	5-26-77	--	--	25	60	1	A	D	
10bbb	M. Troxel	R	1979	980	320	109	6	X	Tcr	141.2	9-18-79	--	--	25	147	--	A	D	
11caa	D. Yerges	R	1976	540	305	38	6	X	Tcr	187.8	9-20-79	--	--	10	153	--	A	D	
12aad	M. Troxel	R	1974	375	553	438	6	X	Tcr	+35	11- 8-79	277	13	--	--	--	--	I	C., L.; flowed 300 gal/min in 1974.
12abd	City of Mosier	R	1971	235	404	275	8	X	Tcr	+146	9- 5-79	--	--	--	--	--	--	P	L.; flowed 151 gal/min in 1971; deepened in 1973 from 340 ft, flowed 400 gal/min; main municipal supply.
12bab	S. Grimes	R	1973	680	645	18	6	X	Tcr	470	6-20-78	--	--	25	175	--	A	D	
14bcb	W. Huskey	R	1975	970	303	295	6	P,X	Td	162.4	9-19-79	--	--	40	--	--	A	U	
14cbd	D. Huskey	R	1978	1,050	140	120	5	P,X	Td	70	8- 4-78	132	10 (46)	50	0	3	A	D	C., L.
15ddc	J. Huskey	R	1978	1,130	180	160	6	X	Td	135	8- 1-78	--	--	11	33	4	A	D	
20acb	R. Shivers	C	1976	2,060	425	21	6	X	Tcr	382.4	9-25-79	--	--	4	18	1	B	D	
20acd	do.	C	1977	2,060	71	21	6	X	Td	21.0	do	--	--	5	35	1	B	D	
20bbb	E. Glaser	R	1979	1,140	585	340	6	X	Tcr	421	5-12-79	--	--	7.5	80	1	P	D	L.
24abc	V. VanOsdall	R	1978	520	170	40	6	X	Tcr	103.8	9- 6-79	--	--	7	75	1	A	D	
30dba	E. Heflin	R	1974	1,060	340	200	5	P,X	Tcr	260	7- 9-74	--	--	8	--	1	A	D	
T. 2 N., R. 12 E.																			
3bcc	K. Johnson	R	1978	670	350	20	6	X	Tcr	290	4-21-79	--	--	12	--	--	A	D	
3cca	do.	R	1975	805	650	20	8	X	Tcr	490	10- 7-76	--	--	30	0	48	P	P	Supply for about 10 homes; deepened in 1976 from 410 ft.
3ccc	do.	R	1976	660	515	58	8	X	Tcr	360.0	12-12-79	--	--	40	143	--	A	U	G.
3ccd	do.	R	1974	620	360	38	6	X	Tcr	260	12-25-74	--	--	25	--	--	A	D	
4ada	Heglin	R	1975	610	640	18	6	X	Tcr	342	10-10-76	--	--	6	--	--	A	D	
4adb	J. Goodwin	R	1975	605	390	18	5	X	Tcr	318	2-14-77	--	--	7	72	--	A	D	Deepened in 1977 from 165 ft.
5aba	C. Jenkinson	R	1978	580	290	19	5	X	Tcr	225	10- 5-78	--	--	9	65	--	A	D	
5baa	R. Farrar	R	1978	570	634	19	6	X	Tcr	383.3	5-18-79	234	--	14	--	--	A	D	pH = 7.8
5bad	K. Johnson	R	1978	610	390	20	6	X	Tcr	223	4-23-78	--	--	15	--	--	A	U	
5bba	R. Berthold	R	1976	580	630	18	6	X	Tcr	480	12-20-78	--	--	15	150	--	A	D	
5bbb	R. Melton	R	1975	500	195	20	6	X	Tcr	77.2	5-18-79	230	--	10	70	1	A	D	pH = 7.5
5cbc1	L. Putnam	R	1976	820	260	177	6	X	Tcr	213	5- 6-76	--	--	6	--	--	A	U	Well reported to have inadequate yield and declining water level.
5cbc2	do.	R	1978	830	548	160	6	X	Tcr	380	8- 2-78	--	--	40	--	--	A	D	
5ccb	M. Lutje	R	1967	705	325	50	6	X	Tcr	203	7-28-67	--	--	30	0	1	B	D	Owner reports water level declining.

Table 4.--Records of selected wells and springs in the Hood Basin--Continued

Well or Spring Number	Owner	Type of well	Year com- pleted	Alti- tude (feet)	Depth of well (feet)	Depth of casing (feet)	Dia- meter of well (inches)	Fin- ish	Aquifer	Water level: Feet below datum	Water level: Date meas- ured	Speci- fic conduc- tance of water	Tempe- rature of water (°C)	Well performance: Yield (gal/ min)	Well performance: Draw- down (feet)	Well performance: Pumping period (hr)	Well performance: Type of test	Use	Remarks
									T. 2 N., R. 12 E.--Continued										
5ccd	S. Smith	R	1979	725	412	200	6	X	Tcr	265	8- 1-79	--	--	50	147	--	A	D	
5dcb	A. Stevens	C	1979	670	95	95	5	P	Td	20	10- 3-79	--	--	55	30	120	P	I	
5dcc	do.	C	1977	685	255	80	6	X	Tcr	120	7-25-77	--	--	35	--	5	P	D	
6aca	D. Stevens	R	1974	485	160	73	6	X	Tcr	52	5- 8-74	--	--	10	102	1	B	D	
6acc	L. Bishop	R	1979	420	150	38	6	X	Tcr	83	5-24-79	--	--	20	67	--	A	D	
6bbc1	Wilson Brothers Farm	R	1959	270	300	17	8	X	Tcr	7.1	5-18-79	--	--	10	275	1	A	U	Deepened in 1975 from 94 ft.
6bbc2	do.	C	1963	270	125	39	6	X	Tcr	43	4- 2-63	--	--	18	20	6	P	D	
6bcd	P. Berthold	R	1975	460	200	21	6	X	Tcr	93	7-22-75	--	--	35	50	1	B	D	
6ccb	C. Byrd	R	1975	440	275	174	8	X	Tcr	144.1	11- 2-79	--	--	100	--	--	A	I	
6dda	L. Lutje	R	1971	680	292	292	6	P	Tcr	222	11-30-73	--	--	25	45	1	A	D	Deepened in 1973 from 250 ft.
7aac	V. Root	C	1944	680	427	237	8	X	Tcr	197	12-20-73	--	--	180	2	4	P	I	L.
7ada	A. Francois	C	1960	710	401	272	8	X	Tcr	284.9	9-24-79	--	--	200	0	1	P	I	L., H., O.; well 7H1 in PP 383-C.
7bbc1	E. Maine	C	1973	270	90	57	6	X	Tcr	8.4	9-18-79	--	--	50	12	1	B	D	
7bbc2	C. Reyes	C	1973	275	120	66	6	X	Tcr	15.7	do.	250	--	19	88	1	B	D	pH = 7.4.
7bcc	D. Evans	C	1947	440	620	160	8	X	Tcr	+29	3- 9-71	290	16 (47)	--	--	--	--	I	C., O.; flowed 100 gal/min in 1947; deepened in 1959 from 500 ft, flowed 250 gal/min; well not flowing since 1973, water level about 25 ft below land surface.
7bda	V. Root	R	1979	595	380	260	10	X	Tcr	180	9-24-79	--	--	400	200	1	A	I	L.
7ccb1	K. Smith	C	1979	385	235	25	6	X	Tcr	+21	9-20-79	--	--	50	118	--	A	D	
7ccb2	M. Anthony	R	1976	490	220	115	8	X	Tcr	102	3-11-75	--	--	40	23	1	B	D	Flowed 6 gal/min.
7dbd	B. Veatch	R	1976	430	81	29	6	X	Tcr	11.1	9-25-79	--	--	35	--	--	A	D	
7dcb	J. Kaufman	R	1974	420	80	29	6	X	Tcr	14.0	do.	--	--	60	--	1	A	D	
8aad	D. Bishop	C	1969	845	340	24	6	X	Tcr	198.3	5-22-79	258	--	5	120	2	B	D	Deepened in 1975 from 130 ft.
8adc	T. Sherrard	R	1976	930	405	18	6	X	Tcr	274.8	11- 8-79	403	9	5	--	--	A	D	C., L.
8cba	D. Harmon	R	1977	690	282	60	6	X	Tcr	65	6- 3-77	--	--	20	100	1	A	D	L.
8ccd	W. Leininger	C	1968	795	144	54	8	X	Td	104	2-26-68	--	--	20	10	1	B	D	
9aaa	E. Helman	R	1979	670	205	39	6	X	Tcr	93	5-19-79	--	--	15	50	1	A	D	
9bda	K. Johnson	R	1978	850	555	20	6	X	Tcr	230	12-10-78	--	--	0.5	--	--	A	U	
11abd	H. Brown	C	1968	158	120	38	6	X	Tcr	29.2	11- 7-79	273	12 (48)	27	25	1	B	D	C., L.
12bcb	C. Austin	R	1978	160	170	46	6	X	Tcr	53.2	5-24-79	305	14 (49)	40	--	--	A	D	
12dab	J. Todd	R	1978	180	220	36	6	X	Tcr	105	1-28-78	--	--	18	65	1	A	D	
12dbb	R. Melton	C	1965	175	150	51	6	X	Tcr	108.0	5-24-79	190	--	20	5	1	P	D	
15ccd	R. Murray	R	1979	1,430	365	78	6	X	Tcr	96.3	12-13-79	--	--	30	265	--	A	U	
16bba	A. Lane	R	1976	1,180	550	26	6	X	Tcr	450	10- 1-76	--	--	5	--	--	A	D	
16bbb	G. Calverly	R	1978	1,210	440	82	6	X	Tcr	335	7-10-78	265	--	28	30	2	P	D	
16bbc	G. Griffin	R	1979	1,250	762	19	6	X	Tcr	562	4-20-79	--	--	1.5	200	--	A	D	
16bcd	Thody	R	1976	1,250	642	18	6	X	Tcr	422	5-31-76	--	--	15	--	--	A	D	L.
16bdc	W. Robinson	R	1975	1,180	605	43	5	X	Tcr	490	6-18-75	--	--	12	100	1	B	D	
16cac	F. Johns	R	1979	1,325	363	139	6	X	Td	290	5-20-79	--	--	15	73	--	A	D	
16cbb	E. Davis	C	1970	1,315	145	146	6	P	Td	38.0	9-25-79	--	--	5	58	1.5	P	D	
16dcc	K. Johnson	R	1979	1,370	636	--	--	--	Tcr	dry	7- 7-79	--	--	--	--	--	--	U	Filled and abandoned.
16dcd	do.	R	1979	1,280	744	29	6	X	Tcr	308	7-16-79	--	--	22	131	1.5	P	U	L.
18bab	B. Molesworth	R	1968	665	553	32	8	X	Tcr	240	4-26-77	--	--	350	213	--	A	I	Deepened in 1977 from 340 ft.
18bbd	P. Brooks	R	1978	660	460	139	8	X	Tcr	229.5	11- 8-79	290	15 (50)	200	243	--	A	I	C., L.
18bda	H. Bordner	R	1977	680	505	40	8	X	Tcr	249.8	11- 2-79	--	--	400	--	--	A	I	
18bdb	J. Mortinson	R	1978	700	450	158	8	X	Tcr	271.2	9- 6-79	--	--	100	180	--	A	I	
18bdd	H. Bordner	R	1979	760	572	20	6	X	Tcr	332	4-12-79	--	--	25	--	--	A	D	
18caa	W. Nance	R	1979	795	560	20	6	X	Tcr	351	4- 9-79	--	--	25	--	--	A	D	
18dab	W. Catron	R	1966	705	335	30	6	X	Tcr	180	10-14-66	--	--	35	3	1	B	D	
19bbd	S. Kofahl	R	1972	430	90	86	5	O	Tcr	--	--	270	--	--	--	--	--	D	Flowed 100 gal/min in 1972; water level reportedly below land surface in 1979.
19ddd	J. Ward	C	1964	1,370	445	72	6	X	Tcr	390.4	9-27-79	--	--	11	15	2	P	D	
21abb	S. Szabo	R	1977	1,395	540	265	6	X	Tcr	344.3	4-18-79	330	11	5	65	1	A	D	pH = 8.1.
21acc	H. Jones	C	1972	1,430	151	34	6	X	Tcr	98.8	do.	260	--	17	80	1	P	D	

Table 4.—Records of selected wells and springs in the Hood Basin--Continued

Well or Spring Number	Owner	Type of well	Year completed	Altitude (feet)	Depth of well (feet)	Depth of casing (feet)	Diameter of well (inches)	Finish	Aquifer	Water level: Feet below datum	Water level: Date measured	Specific conductance of water	Temperature of water (°C)	Well performance: Yield (gal/min)	Well performance: Drawdown (feet)	Well performance: Pumping period (hr)	Well performance: Type of test	Use	Remarks
										T. 2 N., R. 12 E.--Continued									
22abo	M. Jackson	R	1976	1,570	230	19	6	X	Tcr	82.6	12-13-79	--	--	15	--	--	A	D	
22abc	R. Ward	R	1975	1,620	190	38	6	X	Tcr	129	9-19-75	--	--	40	61	--	A	D	
22aca1	L. Moore	R	1975	1,755	230	39	6	X	Tcr	158	9-15-75	--	--	20	72	--	A	D	
22aca2	D. Jones	R	1976	1,758	270	59	6	X	Tcr	173	5-25-76	--	--	15	--	--	A	D	
22acc	S. Nagel	R	1975	1,720	230	23	6	X	Tcr	141.8	11- 2-79	--	--	18	104	--	A	D	L.; deepened in 1976 from 205 ft.
22acd	D. Macnab	R	1975	1,765	245	37	5	X	Tcr	184.2	do.	--	--	32	55	1	B	D	
22adc	S. Fadness	R	1975	1,780	285	37	6	X	Tcr	204.7	do.	245	--	8	90	1	B	D	pH = 7.4.
22bbd	R. Murray	R	1979	1,490	345	78	6	X	Tcr	155	5-31-79	--	--	60	190	--	A	U	L.
22bca	Sevenmile Hill Estates	R	1975	1,475	398	28	8	X	Tcr	190	7-14-75	--	--	20	3	1	B	U	L.
22bcc	R. Murray	R	1978	1,600	700	85	6	X	Tcr	250	7-28-78	--	--	3.5	--	--	A	U	
22cba	L. Black	R	1979	1,580	125	19	5	X	Tcr	50	6- 2-79	--	--	18	75	--	A	U	
22cod	S. Decker	R	1974	1,590	320	110	5	X	Tcr	33	7-23-74	--	--	60	100	2	P	D	Also used to irrigate pasture.
22dbc1	L. Duarte	C	1974	1,725	211	130	6	X	Tcr	54.0	5-25-79	148	--	35	20	1	B	D	pH = 7.6.
22dbc2	M. McCall	R	1976	1,675	225	38	6	X	Tcr	172.0	11- 7-79	228	10	6	90	--	A	D	C., L.
22dca	R. Dettmann	R	1979	1,805	280	19	6	X	Tcr	221	7- 4-79	--	--	20	--	--	A	D	
22ddd	B. Ferguson	C	1979	1,760	195	195	5	P	Tcr	175	2-19-79	185	--	11	5	1	P	D	L.; pH = 7.4.
23bcd	M. Peters	C	1979	1,850	400	23	8	X	Tcr	363	6-13-79	--	--	6	4	1	B	D	
25bab	K. Sauter	R	1978	910	357	25	6	X	Tcr	185	9- 3-78	--	--	30	--	--	A	S	
25bbb	do.	R	1977	985	267	218	6	P,X	Tcr	130	8-30-78	--	--	15	--	--	A	U	Deepened in 1973 from 218 ft, water level dropped 143 ft and yield declined.
25ddc	E. Kuck	C	1939	520	443	30	8	X	Td	120.7	8-29-79	--	--	150	--	--	P	I	L., H., O.
26aab	G. Johnson	C	1973	1,075	100	28	6	X	Tcr	15	3-15-73	--	--	40	3	1	B	D	
27abc	G. Robbins	R	1975	1,900	323	85	6	X	Tcr	196.5	4-17-79	205	--	30	128	--	A	D	
30aaa	P. Joseph	R	1976	1,400	478	38	6	X	Tcr	431	9- 7-79	--	--	3	--	--	A	D	
32acc	L. Newby	R	1979	2,140	380	375	5	O	Tcr	315	9-27-79	--	--	2	--	--	A	D	
35cad	W. Ketchum	R	1979	640	286	64	5	X	Td	47	9-26-79	--	--	100	120	1	A	D	
35dbc	R. Edling	C	1973	593	330	29	8	X	Td	11.1	9-27-79	--	--	50	9	1	B	D	
36cad	H. Douthit	C	1955	525	302	--	--	X	Td	38.6	11-29-78	--	--	30	0	--	B	D	L., H., O.; old well deepened from 140 ft.
36cca	S. Cousins	C	1975	665	300	44	8	X	Td	184.7	7- 9-79	--	--	30	0	1	B	D	
36ccb	H. Douthit	C	1975	710	315	55	6	X	Td	174.7	9-27-79	--	--	10	0	2	B	D	Supply for several families.
36cdc	S. Cousins	C	1973	590	410	334	8	P,X	Td	97	11-17-78	--	--	27	3	1	B	D	Supply for orchard laborer's camp.
36ddb	C. Buster	C	1973	380	500	107	8	X	Td	425.1	11- 2-79	--	--	10	45	1	B	D	L.
										T. 2 N., R. 13 E.									
17abc	Tooley Water District	C	1955	175	306	20	8	X	Tcr	94.1	5-24-79	380	16	34	12	1	P	P	pH = 7.1; deepened in 1959 from 222 ft.
17baa1	do.	C	1963	100	32	32	8	F	Qu	20.1	do.	--	--	82	0	3	P	P	This well and 17abc supplies 33 homes.
17baa2	D. Hill	R	1976	105	78	77	6	O	Qu	21	11-18-76	--	--	60	57	--	A	D	
17dad	The Dalles Country Club	R	1972	220	480	45	12	X	Tcr	182.9	5-21-79	449	17 (51)	385	88	9	P	I	C., L.; also an older well, 350 ft deep which pumps 100+ gal/min.
19dcb	J. Huffman	R	1970	518	375	34	6	X	Tcr	265.3	11-29-79	308	--	116	4	1	P	D	pH = 7.7; deepened in 1971 from 152 ft and in 1975 from 235 ft.
21bbc1	Pine Wood Mobile Manor	R	1969	180	220	18	5	X	Tcr	120	10-11-69	--	--	85	5	34	P	P	Supplemental supply for 60 homes.
21bbc2	The Dalles Fruit and Produce League	C	1968	140	250	64	8	X	Tcr	93	6-10-68	--	--	50	0	1	B	U	
28cab	Martin Marietta, Inc.	C	1957	136	302	227	10	X	Tcr	113	11- 1-78	--	--	1,080	11	8	P	N	O.
28cbc	do.	C	1957	144	314	220	20	X	Tcr	114	do.	--	--	2,160	4.4	8	P	N	O.
28ccd	do.	C	1957	141	319	207	10	X	Tcr	113	do.	--	--	1,000	2.2	4	P	N	O.
28cdb	do.	C	1957	138	303	227	10	X	Tcr	113	do.	--	--	1,170	3	8	P	N	L., H., O.
30aacs	W. Pullen	--	--	390	--	--	--	--	Qu	--	--	146	11	--	--	--	--	P	Flow varies from about 400 to 2,000 gal/min.
30abc	R. Walters	R	1968	425	665	456	6	X	Tcr	405.7	11-30-79	--	--	35	140	3	P	U	Well 30B1 in PP 383-C.
30abd	W. Pullen	C	1962	410	605	480	10	X	Tcr	343	do.	360	12	220	3	10	P	P	pH = 7.9; well and spring (30aacs) supply for about 90 homes.

Table 4.—Records of selected wells and springs in the Hood Basin--Continued

Well or Spring Number	Owner	Type of well	Year com-pleted	Alti-tude (feet)	Depth of well (feet)	Depth of casing (feet)	Dia-meter of well (inches)	Fin-ish	Aquifer	Water level: Feet below datum	Water level: Date meas-ured	Speci-fic conduc-tance of water	Tempe-rature of water (°C)	Well performance: Yield (gal/min)	Well performance: Draw-down (feet)	Well performance: Pumping period (hr)	Well performance: Type of test	Use	Remarks
T. 2 N., R. 13 E.--Continued																			
30acc	Lower Chenoweth Water District	C	1954	380	248	37	8	X	Td	149	8-30-79	--	--	250	66	2	P	P	Supplemental supply.
30cad	do.	C	1939	330	222	17	8	X	Td	129	8-26-79	--	--	450	--	--	P	P	Supply for 150 homes.
32aab	Chenoweth Irrigation Coop.	C	1956	150	275	52	16	X	Tcr	131	11- 2-78	--	--	1,200	2	8	P	P	O.
32daa1	do.	C	1946	165	258	13	16	X	Tcr	133	5- 1-79	--	--	920	1	--	P	P	C., L.
32daa2	do.	C	1949	165	260	21	10	X	Tcr	141	11- 2-78	--	--	700	1	--	P	P	O.
T. 2 N., R. 14 E.																			
25abc	M. Markman	R	1977	670	80	25	8	X	Tcr	10.6	6- 5-79	--	--	6	--	1	A	S	Well drilled to 502 ft but plug set at 30 ft.
25cbc	K. Johnson	C	1962	470	65	59	8	P,X	Tcr	10.8	do.	--	--	13	0	1	B	D	
26acd	J. Kaser	R	1977	445	165	38	8	X	Tcr	15	12-23-77	500	--	300	85	2	A	I	pH = 7.4.
28acc	C. Kaser	C	1958	540	202	4	6	X	Tcr	77.1	6- 5-79	--	--	15	138	.75	B	D	
31adb	G. Fulton	R	1977	443	448	142	5	X	Tcr	336.8	6- 7-79	404	--	30	20	1	A	D	pH = 7.8.
31cca	C. Byers	R	1975	275	650	73	8	X	Tcr	110	5-11-75	445	19 (52)	201	310	6	A	P	C., L.; supply for about 60 homes.
31dac	J. Waters	R	1977	205	340	27	8	X	Tcr	90	6-24-77	--	--	250	100	1	A	I	
31dcc	Bonneville Power Administration	C	1954	495	700	700	8	P	Tcr	370	1954	--	20 (53)	350	20	--	P	N	C., L.
31ddb	M. Stewart	R	1978	325	410	105	8	X	Tcr	209.8	12-11-79	--	--	200	83	3.5	A	U	
32dca	Tenold	C	1973	270	250	30	8	X	Tcr	37.7	5- 8-79	--	--	50	10	1	B	D	
32ddd	G. Fulton	R	1971	260	119	28	6	X	Tcr	23	7-12-71	--	--	60	--	4	A	D	
T. 2 N., R. 15 E.																			
20dbc	L. Messinger	R	1979	756	560	162	5	X	Tcr	403	9- 7-79	--	--	20	70	1	A	D	
30ccc	C. Quirk	R	1977	510	210	200	8	X	Tcr	8	10-21-77	--	--	230	52	12	P	I	
33cdc	P. Kelly	R	1978	580	250	28	8	X	Tcr	33.6	11- 6-79	343	14 (54)	400	110	1	A	I	C., L.
T. 3 N., R. 9 E.																			
35cbb	Viento State Park	R	1973	120	80	80	6	O	Qu	43	3-28-73	--	--	50	5	1	B	D	
T. 3 N., R. 10 E.																			
25dbc	Port of Hood River	C	1967	100	71	70	12	P	Qu	18.2	9-20-79	--	--	350	47	4	P	I	Water reported to be highly mineralized.
27dcd1	L. Henderson	R	1971	400	415	117	6	X	Tcr	322.9	do.	194	--	50	100	1	B	P	pH = 8.3; supplies 23 homes and 14 camp sites.
27dcd2	do.	R	1973	400	430	118	6	X	Tcr	323	5- 9-73	--	--	25	70	1	B	P	Supplemental supply.
32bca	M. Harbert	R	1979	180	185	44	6	X	QTv	77	3-14-79	169	--	18	--	--	A	D	pH = 7.2.
32bcc	T. Aronson	R	1974	400	397	354	6	P,X	QTv	317.9	9-21-79	155	--	7.5	48	1	A	D	pH = 6.8.
33aabs	Unknown	--	--	400	--	--	--	--	QTv	--	--	196	11	--	--	--	--	U	Numerous seasonal springs in Highway cut (I80N).
33bbc	H. Beech	R	1978	740	745	20	6	X	Tcr	dry	6-28-78	--	--	--	--	--	--	U	
33bda	do.	R	1978	620	210	38	6	X	QTv	119.1	9-20-79	161	--	32	7	1	P	D	pH = 7.7.
33bdb	T. Manful	R	1978	685	470	20	6	X	QTv	dry	6-21-78	--	--	--	--	--	--	U	
33bdc	J. Emerson	R	1978	720	230	40	6	X	QTv	162.7	11- 8-79	--	--	20	70	1	A	U	
T. 3 N., R. 11 E.																			
30ccb	Northwest Natural Gas	R	1963	110	214	20	10	X	Tcr	--	--	--	--	--	--	--	--	U	An "anode bed," not a water well.
32bdb	Koberg Beach State Park	R	1973	90	200	58	6	X	Tcr	16	3-24-73	--	--	50	120	1	B	D	
T. 3 N., R. 12 E.																			
32cda	Memaloose State Park	C	1967	150	255	22	6	X	Tcr	77.1	11- 8-79	--	--	10	175	4	P	U	
32dca	do.	R	1971	190	303	60	10	X	Tcr	113	11-10-71	--	--	350	7	3	P	D	Water supply for campsites, rest area, and some lawn irrigation.

Table 4.—Records of selected wells and springs in the Hood Basin—Continued

Well or Spring Number	Owner	Type of well	Year com-pleted	Alti-tude (feet)	Depth of well (feet)	Depth of casing (feet)	Dia-meter of well (inches)	Fin-ish	Aquifer	Water level: Feet below datum	Water level: Date meas-ured	Speci-fic conduc-tance of water	Tempe-rature of water (°C)	Well performance: Yield (gal/min)	Well performance: Draw-down (feet)	Well performance: Pumping period (hr)	Well performance: Type of test	Use	Remarks
T. 1 S., R. 8 E.																			
10cdbs	U.S.F.S. - Lost Lake Campground	--	--	3,230	--	--	--	--	?	--	--	24	9	--	--	--	--	D	pH = 6.4; partial supply for campground.
15bda	do.	C	1963	3,196	185	--	8	--	QTv	135.1	9-17-79	--	--	--	--	--	--	U	
T. 1 S., R. 9 E.																			
1babs	R. Merten	--	--	1,718	--	--	--	--	QTv	--	--	66	6	--	--	--	--	P	Supply for several homes; estimated discharge at 600 gal/min.
T. 1 S., R. 10 E.																			
18cad	M. Jubitz	R	1976	2,242	60	58	6	P,O	Qu	14	8-24-76	52	12	25	--	--	A	D	
29bccs	Crystal Springs Water District	--	--	2,450	--	--	--	--	QTv	--	--	84	5	--	--	--	--	P	C.; supplies most of east side of Hood River Valley.
30bad	D. Smith	R	1976	2,780	225	225	6	O	QTv	165	4-30-76	--	--	8	60	--	A	D	
31acb	R. Slater	C	1963	3,154	50	24	6	X	QTv	dry	10-12-63	--	--	--	--	--	--	U	
T. 1 S., R. 12 E.																			
24dcd	C. Hause	C	1972	1,300	40	40	8	O	Qu	7.6	6-26-79	190	--	20	9	1	B	D	pH = 7.5.
26dcd	D. Carver	R	1979	2,053	863	19	8	X	Td	676.1	10-30-79	--	--	12	9	1.5	A	D	
36dcd	L. Eckert	R	1979	1,670	478	73	6	X	Tcr	190	8- 5-79	--	--	15	--	--	A	D	
T. 1 S., R. 13 E.																			
11aaa	B. Brogan	C	1973	915	190	107	8	X	Tcr	15	3-13-79	415	17 (55)	75	5	1	P	I	L.; pH = 8.2.
11ccb	K. Falk	R	1979	958	150	37	6	X	Tcr	27.3	12- 6-79	--	--	70	107	--	A	D	L.
12bab	T. May	C	1974	930	360	333	10	X	Tcr	5.8	6-26-79	266	15 (56)	1,280	15	24	P	I	C., L.; flowed 2,925 gal/min when drilled in 1974; well flowing in Oct. 1979.
13add	Miller Ranch	C	1959	1,270	366	238	6	X	Tcr	144	2-25-59	--	--	15	3	--	B	D	
15cbd	T. Davidson	R	1968	1,030	299	44	10	X	Tcr	50.8	12- 5-79	--	--	215	--	--	A	I	
20dab	Miller Ranch	C	1969	1,140	465	270	10	X	Tcr	170	4- 2-69	--	--	610	90	12	P	I	
21bcb	C. Ingram	R	1979	1,162	223	39	6	X	Tcr	42.7	12- 5-79	175	--	50	131	2	A	D	
25bbb	W. Hanna	R	1966	1,476	381	76	6	X	Tcr	323.7	12- 6-79	--	--	40	2	1	B	U	
25cca	City of Dufur	R	1968	1,310	417	72	10	P,X	Tcr	20.4	12-13-79	--	--	100	284	2	P	U	G.; deepened in 1971 from 264 ft.
25daa	W. Petersen	R	1971	1,255	200	97	8	X	Tcr	+164	11-25-78	--	--	600	0	1	A	I	Flowed 17.5 gal/min in 1971; deepened in 1978 from 125 ft, flowed 450 gal/min.
25dca	L. Wilson	R	1977	1,270	230	118	8	X	Tcr	+128	11- 8-79	170	15 (57)	--	--	--	--	N	C., L.; flowed 600 gal/min when drilled; pressure drops when 25daa flowing.
26dac1	City of Dufur	R	1973	1,340	400	144	8	X	Tcr	+51	7- 2-76	--	--	--	--	--	--	P	Supplemental supply.
26dac2	do.	R	1976	1,340	624	385	10	X	Tcr	+137	10-25-79	271	18 (58)	--	--	--	--	P	C., L.; flowed 1,000 gal/min when drilled; main supply for city.
26dca1	R. Barnett	R	1968	1,328	411	19	8	X	Tcr	7.9	12- 7-79	--	--	180	--	--	A	I	Flowed 80 gal/min in 1968.
26dca2	do.	R	1968	1,326	200	75	8	X	Tcr	+28	8-17-68	--	--	500	--	--	A	I	Flowed 180 gal/min in 1968; not flowing in 1979.
30aba	F. Carothers	R	1968	1,220	238	174	10	X	Tcr	+243	6-27-79	314	22 (59)	550	100	2	P	I	pH = 8.1; flowed 220 gal/min in 1968.
30bbb	Dawkins	R	1968	1,260	315	151	8	X	Tcr	+2	6-26-79	355	18 (60)	250	270	3	P	I	pH = 8.2; flowed 30 gal/min in 1968.
30dcb	Miller Ranch	R	1970	2,005	1,017	651	8	X	Tcr	514.6	6-25-79	--	--	50	200	2	A	I	
31dcd	R. Cantrell	C	1961	1,550	111	19	8	X	Tcr	50.0	11-28-78	--	--	618	50	5.5	P	I	O.
33cab	W. Moe	R	1971	1,441	322	55	6	X	Tcr	96	9- 4-71	345	--	86	62	1	B	D	
34abc	K. Purdom	R	1977	1,380	565	398	10	X	Tcr	+95	6-27-79	275	19 (61)	300	410	2	P	I	L.; pH = 8.1; flowed 150 gal/min in 1977.
34dbb	M. Fargher	R	1970	1,420	160	26	10	X	Tcr	68	4- 8-70	--	--	200	--	--	A	I	L.
35aba	R. Barnett	R	1968	1,368	250	68	8	X	Tcr	63.7	12- 7-79	--	--	230	--	--	A	U	

Table 4.—Records of selected wells and springs in the Hood Basin--Continued

Well or Spring Number	Owner	Type of well	Year com-pleted	Alti-tude (feet)	Depth of well (feet)	Depth of casing (feet)	Dia-meter of well (inches)	Fin-ish	Aquifer	Water level: Feet below datum	Water level: Date meas-ured	Speci-fic conduc-tance of water	Tempe-rature of water (°C)	Well performance: Yield (gal/min)	Well performance: Draw-down (feet)	Well performance: Pumping period (hr)	Well performance: Type of test	Use	Remarks
T. 1 S., R. 14 E.																			
2ddd	G. Kaufman	R	1975	1,155	250	169	6	X	Tcr	+128	8-29-79	325	14 (62)	--	--	--	--	I	pH = 7.7; flowed 410 gal/min in 1975.
3adc	Fax Brothers Ranch	R	1977	955	281	118	10	X	Tcr	+277	10- 5-77	331	16	--	--	--	--	I	C., L.; flowed 700 gal/min in 1977.
3ccc	J. Ward	R	1977	990	213	61	6	X	Tcr	17.0	6- 8-79	355	--	60	120	1	A	D	pH = 8.2.
17cad	W. Bolton	R	1977	1,160	440	168	8	X	Tcr	96.7	10-24-79	--	--	300	50	1	A	I	
17cdd	G. Marvel	C	1963	1,128	218	175	6	X	Tcr	+171	2-26-63	310	14	--	--	--	--	D	pH = 7.5; flowed 210 gal/min in 1963.
17dac	N. Wiidanen	R	1978	1,120	259	103	6	X	Tcr	100	4-24-78	--	--	70	--	--	A	D	
19cdc	W. Petersen	R	1979	1,200	225	104	6	X	Tcr	+189	6-22-79	--	--	--	--	--	--	D	Flowed 100 gal/min in 1979.
22ddc	H. Bolton	R	1965	1,635	225	18	6	X	Tcr	164.1	6-14-79	--	--	20	15	1	B	D	
23cdc	L. Marvel	C	1956	1,715	385	52	8	X	Tcr	217	10-12-56	--	--	20	0	3	P	D	
25cbc	R. Hastings	R	1977	1,870	445	20	6	X	Tcr	354.5	6-14-79	233	--	8	40	1	P	D	pH = 7.6.
29bca	J. Underhill	R	1970	1,280	170	21	8	X	Tcr	+60	6-13-79	--	--	120	--	--	A	I	Flowed 46 gal/min in 1970; owner has 2nd well, 170 ft deep; flowed 30 gal/min.
30bcb	W. Petersen	R	1976	1,240	298	162	10	X	Tcr	+173	8-27-77	--	--	300	25	1	A	I	Deepened in 1977 from 210 ft; flowed 200 gal/min.
32acd	A. Limmeroth	R	1977	1,695	410	410	6	P,X	Tcr	225.0	12- 7-79	--	--	33	--	--	A	D	Well is open hole from 18 to 190 ft. perforated liner 190 to 410 ft.
T. 1 S., R. 15 E.																			
3bcb	R. Johnson	C	1960	1,635	248	40	6	X	Tcr	110	10-27-60	--	--	20	0	1	B	D	
5aaa	G. Fulton	C	1961	1,270	114	24	6	X	Tcr	+60	1-31-61	284	14 (63)	--	--	--	--	D	C., L.; flowed 40 gal/min in 1961.
T. 2 S., R. 10 E.																			
8aba	U.S.F.S.-Pollalie Campground	R	1978	2,870	63	58	6	X	Qu	5.6	9- 4-79	--	--	40	57	2	A	D	
17dba	U.S.F.S-Sherwood Campground	C	1963	3,079	40	40	6	O	Qu	24.0	9- 5-79	111	9 (64)	20	0	5	P	D	
T. 2 S., R. 12 E.																			
1aaa	M. Fenimore	R	1976	1,620	404	136	6	X	Tcr	117	11- 3-76	217	--	40	--	--	A	D	pH = 7.2.
1baa	J. Olson	R	1976	1,682	300	--	8	X	Tcr	135.2	10-30-79	184	12 (65)	35	164	--	A	D	pH = 7.3; deepening of older well from 185 ft.
1cdd	P. Lindhorst	R	1978	1,703	290	39	8	X	Tcr	216	1- 3-78	251	14 (66)	100	74	1	A	I	C., L.
2ada	J. Olson	R	1977	1,730	310	130	6	X	Tcr	105.8	12-11-79	--	--	20	--	--	A	U	
3bac	A. Stelzer	R	1977	2,324	1,010	30	6	X	Tcr	660	6-23-77	193	25 (67)	10	38	1	P	D	pH = 8.0.
4bba	M. Osborn	C	1969	2,442	635	90	10	X	Td	601	7- 7-79	230	--	15	15	1	B	D	
4bdb	T. Osborn	R	1971	2,390	708	43	6	X	Td	556	11-15-76	--	--	15	--	--	A	D	Deepened in 1976 from 470 ft.
10ddb	W. Lamb	R	1979	2,395	608	100	6	X	Tcr	540	9-17-79	--	--	9	68	--	A	D	
15baa	J. Ellett	C	1978	2,490	418	416	6	P	Tcr	344.8	10-31-79	--	--	7	40	1	B	U	
15dab	City of Dufur	R	1978	1,945	728	26	8	X	Tcr	480	4- 6-78	--	23 (58)	100	--	--	A	P	C., L., supplemental supply.
21dcd	S. Kreitzberg	R	1977	2,518	370	18	6	X	Tcr	249.1	10-31-79	--	--	12	104	--	A	D	
21ddd	J. Layman	R	1977	2,539	370	31	6	X	Tcr	262.3	do.	228	13 (69)	3.5	116	--	A	D	pH = 7.2.
22bdd	D. Brosseau	C	1965	2,495	280	14	8	X	Td	244	8-28-65	340	--	20	--	--	B	D	pH = 7.4.
22cca	J. McVey and J. Stuart	R	1977	2,406	270	38	6	X	Tcr	146.1	11- 2-79	160	11	21	156	--	A	D	pH = 6.8.
35ddd	D. Clarke	C	1966	2,418	85	21	8	X	Td	30.2	10-13-79	266	12 (70)	44	8	1	B	S	
T. 2 S., R. 13 E.																			
4dbc	G. Chase	C	1963	1,594	316	--	10	X	Tcr	52	10- 1-63	185	18	235	5	5	P	I	pH = 7.6; deepening of old well from 173 ft.
6aba	R. Cantrel	R	1976	1,550	328	98	8	X	Tcr	38	11-11-76	250	16 (71)	400	--	--	A	I	pH = 7.7.
14ccds	J. Clausen	--	--	1,955	--	--	--	--	--	--	--	209	--	--	--	--	--	D	pH = 7.5; discharge about 4.5 gal/min 10/18/79.

Table 4.--Records of selected wells and springs in the Hood Basin--Continued

Well or Spring Number	Owner	Type of well	Year completed	Altitude (feet)	Depth of well (feet)	Depth of casing (feet)	Diameter of well (inches)	Finish	Aquifer	Water level: Feet below datum	Water level: Date measured	Specific conductance of water	Temperature of water (°C)	Well performance: Yield (gal/min)	Well performance: Drawdown (feet)	Well performance: Pumping period (hr)	Well performance: Type of test	Use	Remarks
											T. 2 S., R. 13 E.--Continued								
15cda	T. Hix	R	1968	1,918	342	21	8	X	Tcr	171.4	11- 2-79	194	12	45	--	--	A	D	L.; pH = 7.4.
18bda	L. Lyda	R	1977	1,922	605	--	6	X	Tcr	321	10- 2-77	312	--	25	--	--	A	I	pH = 7.5; deepening of older well from 223 ft.
18dda	D. Hurd	R	1979	2,150	215	85	6	X	Tcr	108.2	11- 1-79	420	13	5	30	1	A	D	pH = 7.4.
20cda	W. DeMoss	R	1975	2,180	675	18	6	X	Tcr	460	10-24-75	298	--	2.5	--	--	A	D	pH = 7.3.
24bdb	W. Neal	R	1968	2,015	228	30	6	X	Tcr	123	6-28-68	--	--	12	--	--	A	D	
26ccb	C. Filbin	R	1978	2,392	430	20	8	X	Tcr	368	10-18-79	385	--	8	30	1	A	S	
27ccb	W. Stanley	C	1959	2,082	181	9	6	X	Tcr	45	10- 9-59	192	14 (72)	21	10	--	B	D	L.; pH = 7.4.
28aba	DePriest Ranch	R	1977	2,235	497	20	6	X	Tcr	241	10-17-79	302	8	40	180	1	A	D	C., L.
35aca	W. Cody	R	1970	2,483	755	32	8	X	Tcr	455	9-29-70	--	--	113	72	4	P	U	
											T. 2 S., R. 14 E.								
16aba	W. Hanna	R	1968	2,055	365	19	6	X	Tcr	241.9	6-14-79	263	9	15	--	--	A	D	C., L.
											T. 3 S., R. 13 E.								
10bdc	L. Hendricks	C	1968	2,726	869	23	8	X	Tcr	635	11- 1-68	215	--	3	105	3	B	D	pH = 7.6; deepening of old well from 500 ft.
11aaa	W. Hulse	C	1961	2,602	494	45	6	X	Tcr	425	5-11-61	--	--	6	0	7	B	U	
12adbS	M. Hulse	--	--	2,517	--	--	--	--	--	--	--	260	13	--	--	--	--	S	Discharge about 3 gal/min 10/16/79.
12dddS	do.	--	--	2,660	--	--	--	--	--	--	--	190	14	--	--	--	--	D	pH = 6.9.
											T. 3 S., R. 14 E.								
4ddb	F. Hillgen	C	1959	2,675	390	13	8	X	Tcr	236.5	6-12-79	--	--	2.5	0	1	B	U	Inadequate for stock supply.

Table 5.--Drillers' logs of representative wells

[Lithologic descriptions in drillers' terms]

1N/9E-1abd. Trout Lodge, Inc. Altitude 910 ft. Drilled by Murray Well Drilling Co., 1977. Casing: 12-in. diam to 35 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	2	2
Boulders and cobbles	32	34
Basalt, gray, hard	18	52
Basalt, black	9	61
Basalt, gray, vesicular, water-bearing	64	125
Basalt, black	41	166
Lignite, water-bearing	2	168
Basalt, black and green, water-bearing	12	180
Basalt, gray, hard	176	356
Basalt, black, vesicular, water-bearing	11	367
Basalt, gray, hard	173	540
Basalt, black	32	572

1N/9E-24dda. M. Nichols. Altitude 1,421 ft. Drilled by Murray Well Drilling Co., 1976. Casing: 6-in. diam to 160 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	6	6
Gravel and boulders, water-bearing	10	16
Clay, brown, and cobbles	14	30
Clay, yellow	24	54
Conglomerate, medium-gray	66	120
Clay, tan, and boulders	40	160
Boulders	24	184
Gravel, cobbles, and sand, water-bearing	16	200

1N/10E-15cca. G. Bosley. Altitude 1,565 ft. Drilled to 200 ft by O'Leary Well Drilling, Inc., in 1971; deepened to 350 ft in 1972. Casing: 6-in. diam to 74 ft

Materials	Thickness (feet)	Depth (feet)
Clay, brown, soft	25	25
Clay, with shale, brown	13	38
Shale, with clay, brown	22	60
Shale, brown	14	74
Basalt, gray	9	83
Basalt, gray, fractured	17	100
Shale, brown, hard	4	104
Basalt, gray, fractured	49	153
Basalt, gray, fractured, and brown shale	47	200
Basalt, fractured, and brown shale	44	244
Basalt, gray, vesicular	106	350

1N/10E-19dab. B. Mitchell. Altitude 1,363 ft. Drilled by Murray Well Drilling Co., 1977. Casing: 6-in. diam to 100 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	6	6
Gravel, medium-sized	32	38
Clay, brown	40	78
Boulders and gravel, water-bearing	82	160

1N/10E-21baa. J. Losee. Altitude 1,335 ft. Drilled by Bert Clayton & Son, 1962. Casing: 8-in. diam to 80 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil and boulders	4	4
Silt	1	5
Boulders and brown clay	9	14
Clay, gray, rocky	11	25
Clay, blue-gray	13	38
Rock, gray, round	5	43
Rock, round, and gray and red sand	23	66
Clay, blue, rocky	7	73
Rock, round, and gray sand and gravel	17	90

1N/10E-31dca. M. Smith. Altitude 1,658 ft. Drilled by M-K Drilling Co., 1978. Casing: 6-in. diam to 79 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	10	10
Rhyolite, gray, creviced	8	18
Rhyolite, gray and red, medium-hard	19	37
Rhyolite, gray, creviced, porous		75
Rhyolite, gray and brown, vesicular, water-bearing	15	90

1N/12E-12acb. L. Richman. Altitude 1,060 ft. Drilled by Murray Well Drilling Co., 1978. Casing: 6-in. diam to 214 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil, brown	3	3
Clay and sandstone, brown	37	40
Clay and sandstone, gray	100	140
Clay and sand, gray	55	195
Sandstone, gray	40	235
Clay, yellow	5	240

1N/12E-13cbc. J. Sandoz. Altitude 550 ft. Drilled to 546 ft 1953-54 (driller unknown); deepened to 572 ft in 1963 by Bert Clayton & Son. Casing: 8-in. diam to 346 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	6	6
Clay and boulders	43	49
Sandstone	183	232
Clay	108	340
Basalt, gray	116	456
Basalt, black, seamed	90	546
Basalt and clay	2	548
Clay, blue	5	553
Wood, lignite, blue rock, porous rock, and pyrite	19	572

1N/12E-13dca. K. Kortge. Altitude 515 ft. Drilled to 580 ft by Dorin Wilburn in 1955; deepened to 621 ft by Bert Clayton & Son in 1963. Casing: 8-in. diam to 270 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	6	6
Gravel and boulders	21	27
Sandstone, dense	97	124
Sand and clay	52	176
Clay and sandstone	31	207
Clay, light and dark	61	268
Basalt, gray	111	379
Clay, blue	21	400
Basalt, blue, hard	43	443
Basalt and clay, black	24	467
Basalt, black, water-bearing	50	517
Basalt	24	541
Basalt, water-bearing	37	578
Basalt, gray, hard	2	580
Basalt, black, hard	4	584
Basalt, black, broken	5	589
Basalt, black, hard	12	601
Basalt, black, medium-hard	20	621

1N/12E-15cda. T. Lepinski. Altitude 875 ft. Drilled by Harry F. Douthit, 1977. Casing: 6-in. diam to 120 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	5	5
Sandstone	10	15
Clay, brown, soft	10	25
Sandstone, brown, firm	15	40
Sandstone, gray, firm	20	60
Sandstone, dark-gray, hard	25	85
Sandstone, brown, soft	30	115
Sandstone, gray, firm	45	160
Sandstone, brown, soft	5	165
Sandstone, gray, firm	20	185
Clay, light-brown, soft	10	195
Sandstone, gray, soft	5	200

Materials	Thickness (feet)	Depth (feet)
1N/12E-28dcd. City of The Dalles. Altitude 972 ft. Drilled by R. J. Strasser Drilling Co., 1962. Casing: 10-in. diam to 751 ft; open hole		
Boulders, sand, gravel, and some clay	23	23
Rock, brown and gray, soft	4	27
Gravel, cemented	54	81
Sand and clay	12	93
Clay, brown	8	101
Pea gravel and clay	25	126
Sand and clay	13	139
Gravel, cemented, water-bearing	29	168
Sandstone, very coarse	72	240
Sandstone, very coarse, and porous rock	40	280
Rock, black and brown, porous	32	312
Clay, brown, with sand and small-sized gravel and porous black rock	44	356
Sandstone, dark-gray, water-bearing	16	372
Clay, brown, with sand and gravel, water-bearing	12	384
Basalt, black, mostly porous	18	402
Basalt, black, water-bearing	26	428
Basalt, red and black	26	454
Basalt, black, and layers of silt and sandstone	8	462
Rock, black and tan, very porous, and porous black basalt	17	479
Rock, black, brown, and red, with clay and sandstone	138	617
Basalt, black	6	623
Clay, tan, sticky, with layers of rock; caving badly at 630 ft	25	648
Rock, light-blue, and sticky gray clay	23	671
Sandstone, gray	36	707
Rock, black, with clay streaks; caving at 730 ft	36	743
Basalt, black and gray	78	821
Basalt, gray, with clay	46	867
Basalt, black, red, and gray, water-bearing	72	939
Basalt, black and red, very porous, water-bearing	13	952
Basalt, dark-gray and black, water-bearing	48	1,000
1N/13E-1aaa. Inn at The Dalles. Altitude 240 ft. Drilled by R. J. Strasser Drilling Co., 1955. Casing: 10-in. diam to 53 ft; open hole		
Rock and clay, soft	48	48
Basalt, gray, hard	16	64
Basalt, gray, soft	29	93
Shale, green and gray	11	104
Basalt, gray, soft	43	147
Basalt, gray, hard	24	171
Rock, gray and brown, porous, water-bearing	9	180
Basalt, gray, soft	58	238
Basalt, blue-gray, hard	35	273
Basalt, gray, broken	14	287
Basalt, gray, hard	124	411
Basalt, black, broken	13	424
Basalt, black, medium-hard	24	448
Basalt, gray, hard	53	501
Rock, gray, porous	12	513
Basalt, gray, hard	43	556
Basalt, gray, broken	31	587
Basalt, gray, hard	8	595
Basalt, gray, hard, broken	31	626
Basalt, gray, very hard	3	629
Basalt, black, porous, with crevices	8	637
Basalt, blue-gray, broken	4	641
Shale, green and black, rounded and sandy, water-bearing	23	664
1N/13E-1baa. City of The Dalles. Altitude 108 ft. Drilled by West Coast Drilling Co., Inc., 1979. Casing: 20-in. diam to 24 ft, 16-in. diam to 385 ft; perforated 309-385 ft; gravel packed		
Soil and fill material	8	8
Basalt, gray and brown, fractured	4	12
Basalt, gray, hard	47	59
Basalt, brown and gray, porous	18	77
Basalt, gray, hard	62	139
Basalt, gray with green streaks, porous	6	145
Basalt, gray, hard	53	198
1N/13E-1baa.--Continued		
Basalt, gray and green, porous	6	204
Basalt, gray, hard	85	289
Basalt, gray, porous	6	295
Basalt, gray, hard	16	311
Basalt, gray and green, very porous	26	337
Basalt, gray, fractured	5	342
Basalt, gray, hard	21	363
Basalt, gray, broken	11	374
Basalt, gray, hard	3	377
Basalt, gray, broken	6	383
Basalt, gray, very hard	2	385
1N/13E-1bdc. Lynch Equipment Co. Altitude 127 ft. Drilled in 1945 (driller unknown). Casing: 16-in. diam to 32 ft; open hole		
Soil and boulders	4	4
Clay, yellow and brown	23	27
Clay, green	2	29
Sand, gray	3	32
Rock, black, porous	11	43
Rock, gray, hard	55	98
Rock, black, porous	97	195
Rock, gray, hard	38	233
Rock, black, porous	102	335
1N/13E-1cad. R. Mosser. Altitude 365 ft. Drilled by Gilbert Clayton Well Drilling, 1974. Casing: 6-in. diam to 42 ft; open hole		
Soil, black	6	6
Soil, light, sandy	1	7
Sandstone, light-brown	5	12
Sandstone, gray	6	18
Sandstone and yellow clay	5	23
Clay, light-gray	2	25
Sandstone, brown	5	30
Sandstone, brown, broken	5	35
Rock, gray basalt	45	80
Rock, gray, with clay seams	45	125
Rock, porous, with blue clay	10	135
Rock and quartz	6	141
Rock, porous, with clay	9	150
Rock, porous, water-bearing	10	160
1N/13E-1cda. D. Jones. Altitude 485 ft. Drilled by owner, 1973. Casing: 6-in. diam to 148 ft; open hole		
Soil	1	1
Sandstone, gray	4	5
Sandstone, brown	39	44
Clay and broken rock	16	60
Sandstone, light-gray	48	108
Clay, light-gray	4	112
Sandstone, light-brown	31	143
Clay, blue	7	150
Basalt, broken, and yellow clay	25	175
Basalt, blue, hard	11	186
Sandstone, gray	4	190
Claystone, dark-gray	10	200
Basalt, gray	50	250
1N/13E-3bca. City of The Dalles. Altitude 99½ ft. Drilled by G. E. Scott, 1923. Casing: 12-in. diam to 62 ft; open hole		
Clay	12	12
Rock, platy	7	19
Basalt, black	11	30
Clay, blue	31	61
Basalt, black	1	62
Basalt, gray, dense	4	66
Basalt, black, dense	26	92
Basalt, gray, very dense	43	135
Basalt, soft, water-bearing	13	148
Basalt, black, dense	32	180
Basalt, black, soft, water-bearing	20½	200½

IN/13E-4bdd. City of The Dalles. Altitude 190 ft. Drilled by R.J. Strasser Drilling Co., 1954. Casing: 18-in. diam to 145 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil and sand	8	8
Boulders, basalt, and sand	8	16
Basalt, gray, hard, broken	11	27
Rock, black, porous, with brown clay seams	9	36
Basalt, black, with blue clay seams	7	43
Basalt, gray, hard	5	48
Basalt, gray, medium-hard	16	64
Basalt, gray, hard	9	73
Basalt, gray, medium-hard; water in porous zone at 78 ft	10	83
Basalt, gray, hard	4	87
Rock, gray, porous, water-bearing	6	93
Basalt, gray, very hard	9	102
Basalt, gray, medium-hard	2	104
Basalt, gray, porous; some blue clay in seams	37	141
Basalt, gray	25	166
Rock, brown	5	171
Rock, gray, hard	63	234
Rock, black, porous; some water	2	236
Basalt, black, water-bearing	36	272
Basalt, gray, medium-hard	11	283
Basalt, gray, broken, caving	8	291

IN/13E-4cdb. City of The Dalles. Altitude 278 ft. Deepened from 116 ft to 570 ft by W. Wilburn, 1931. Casing: 12-in. diam to 116 ft; open hole

Materials	Thickness (feet)	Depth (feet)
No record	116	116
Basalt, black	8	124
Basalt, gray, hard	11	135
Clay, blue, water-bearing	3	138
Shale, blue, water-bearing	23	161
Clay, blue, water-bearing	4	165
Shale and clay, blue	11	176
Shale, blue, with streaks of basalt	14	190
Basalt, blue and gray	36	226
Basalt, black	11	237
Shale, blue and brown	29	266
Basalt, black	26	292
Basalt, black, porous, water-bearing	4	296
Basalt, gray, blue, and black	168	464
Cavity, water-bearing	2	466
Basalt, blue and gray	30	496
Sandstone, gray, hard	60	556
Basalt, black, porous	14	570

IN/13E-5bcb. E. Hendricks. Altitude 870 ft. Drilled by Murray Well Drilling Co., 1975. Casing: 6-in. diam to 51 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	1	1
Sandstone, brown	4	5
Sandstone, tan	5	10
Sandstone, brown	70	80
Sandstone, tan	22	102
Sandstone, brown, water-bearing	428	530

IN/13E-5cba. Foley. Altitude 740 ft. Drilled by Dorin Wilburn, 1959. Casing: 6-in. diam to 99 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Sandstone, brown, soft areas	35	35
Clay, brown, with streaks of sandstone	31	66
Sandstone, brown	46	112
Sandstone, gray	12	124
Sandstone, brown	108	232
Sandstone, black, with some clay	38	270
Sandstone, brown	15	285
Sandstone, black, water-bearing	43	328

IN/13E-6aba. L. Shoemaker. Altitude 1,090 ft. Drilled by Murray Well Drilling, Inc., 1978. Casing: 6-in. diam to 323 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	3	3
Clay, brown	77	80
Clay, gray	60	140
Clay, yellow	40	180
Claystone, gray	60	240
Sandstone, brown	170	410
Sandstone, gray	110	520
Sandstone, brown, water-bearing	230	750
Conglomerate, gray	40	790

IN/13E-6adb. M. Malcolm. Altitude 1,002 ft. Drilled by owner, 1977. Casing: 6-in. diam to 19½ ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	5	5
Rock, large-sized, and sandstone	5	10
Sandstone, coarse	10	20
Sandstone and clay	20	40
Sandstone and hard black rock	10	50
Sandstone, fine, and clay	15	65
Gravel	5	70
Sandstone, coarse	13	83
Sandstone, fine	10	93
Sandstone and hard black rock	10	103

IN/13E-8cba. City of The Dalles. Altitude 320 ft. Drilled by Bert Clayton, 1945. Casing: 12-in. diam to 130 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil, gravel and boulders	18	18
Sandstone and boulders	12	30
Clay and sand	70	100
Talc and chalk	29	129
Shale, brittle, some water	1	130
Basalt	133	263
Clay, gray, and "rosin" rock	26	289
Basalt	60	349
Open, water-bearing	1	350
Basalt	21	371

IN/13E-9cdb. K. Tucker. Altitude 660 ft. Drilled to 648 ft. by Bert Clayton & Son, 1960; deepened to 724 ft. in 1961. Casing: 8-in. diam to 36 ft., 6-in. diam to 430 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil and hardpan	6	6
Sand, eolian	24	30
Sandstone, gray, hard	8	38
Sandstone, soft	31	69
Sandstone, hard	11	80
Clay, sandy	40	120
Rock, black, and boulders	20	140
Clay, brown	60	200
Clay, brown, and rocks	110	310
Clay and gray rocks	90	400
Talc	25	425
Rock, gray, hard	110	535
Clay, green	3	538
Lignite, brown	3½	541½
Clay, green, and black rock	2½	544
Rock, black	9	553
Rock, gray	50	603
Rock, black, pyrites	2	605
Rock, black	7	612
Rock, black, vesicular	2	614
Rock, gray	20	634
Rock, gray, vesicular	4	638
Rock, light-gray	4	642
Rock, gray, hard	6	648
Rock, gray	29	677
Rock, black, porous	47	724

Materials	Thickness (feet)	Depth (feet)
1N/13E-13ccd. J. Blaser. Altitude 920 ft. Drilled by Bert Clayton & Son, 1962. Casing: 8-in. diam to 478½ ft; open hole		
Soil, light-brown	2	2
Sandstone, light-brown and gray	354	356
Clay, yellow	1	357
Sandstone, gray	28	385
Clay, gray	12	397
Sand and gravel, water-bearing	33	430
Sand, gray	6	436
Rock, black, broken	4	440
Clay, brown, yellow, and white, with rocks	32	472
Rock, black, hard	23	495
Rock, black, coarse cutting	10	505
Rock, black	10	515
Clay, gray and green	45	560
Rock, gray	4	564
Clay, green, gray, and yellow	14	578
Rock, black	7	585
Rock, red and black, porous	6	591
Rock, black	6	597
Rock, black, porous	4	601
Rock, black	7	608
Rock, black, porous	27	635
Rock, gray	10	645
Rock, gray, porous	5	650
Rock, gray	28	678
Rock, red and black, porous, with pyrites	11	689
Rock, black, porous, with white crystals	5	694
Rock, black, porous, filled with blue clay	17	711
Rock, red and black	27	738
Rock, black, with blue clay, crevice	13	751
Rock, greenish-gray, crevice	177	928
Rock, gray, crevice	13	941
Rock, black	3	944
Rock, black, porous	13	957
Rock, black, porous, with pyrites	4	961
Rock, black	9	970
1N/13E-15acd. Parklawn Memorial Gardens. Altitude 705 ft. Drilled by Dorin Wilburn, 1956. Casing: 8-in. diam to 362 ft; open hole		
Soil	4	4
Clay, light-colored	34	38
Sandstone, light-brown, fine-textured	25	63
Sandstone, brown, medium	29	92
Sandstone, gray, fine	9	101
Sandstone, brown, hard	17	118
Sandstone and clay, brown, soft	32	150
Sandstone, light-gray	16	166
Sandstone, brown	5	171
Gravel and boulders, seep water	5	176
Sandstone, gray, and some clay	69	245
Clay, gray	74	319
Shale, white, caving	2	321
Clay, green, and rock	6	327
Lava rock, gray	5	332
Clay, green, and rock	3	335
Shale, blue, and rock, caving	6	341
Shale, cream-colored, caving	19	360
Sandstone, brown, hard	44	404
Basalt, black, porous, fractured, water-bearing	29	433
1N/13E-16aaa. M. Polehn. Altitude 670 ft. Drilled by Bert Clayton & Son, 1963. Casing: 8-in. diam to 44 ft; open hole		
Soil, brown	6	6
Sandstone, light-brown	12	18
Clay, sandy, light-brown	25	43
Sandstone, light-brown, rocky	7	50
Sandstone, light-brown, sandy	14	64
Sandstone, gray-brown, rocky	7	71
Clay, white, rocky	9	80
Clay, white	4	84
Clay, brown	6	90
Sandstone, brown	21	111
Sandstone, reddish-brown	4	115
Sandstone, brown, rocky	11	126
Sandstone, brown, sandy	8	134
Sandstone, brown, rocky	32	166
Clay, yellow, rocky	8	174
1N/13E-16aaa.--Continued		
Sandstone, light-brown, sandy	30	204
Clay, white and yellow, rocky	10	214
Sandstone, light-brown, sandy	40	254
Clay, gray-blue	21	275
1N/13E-16aba. D. Bailey. Altitude 775 ft. Drilled by Dorin Wilburn, 1965. Casing: 6-in. diam to 37 ft; open hole		
Soil and clay	2	2
Sandstone, brown, hard	74	76
Sandstone, gray, hard	49	125
Sandstone, brown, with some medium-to-large sized boulders	105	230
Sandstone, brown, with streaks of claystone; some boulders to 285 ft; seep water at 285 ft	60	290
Sandstone, gray, with streaks of clay; water bearing 340 - 355 ft	74	364
Sandstone, brown, hard	6	370
1N/13-18bdc. V. Tenneson. Altitude 405 ft. Drilled by Dorin Wilburn, 1961. Casing: 8-in. diam to 176½ ft; open hole		
Soil, with small boulders	5	5
Boulders and sandstone	59	64
Sandstone, with embedded large boulders; water-bearing areas	37	101
Clay, yellow, white, and brown, cavey	58	159
Clay, with blue and black rock, cavey	16	175
Basalt, gray, hard	118	293
Rock, black and blue clay, conglomerate	14	307
Basalt, blue, hard	54	361
Rock, black, porous, water-bearing	25	386
Rock, black, dense	25	411
Rock, black, seamy; water-bearing 421-423 ft	12	423
Rock, dark-red, medium-hard to soft	11	434
Rock, black, soft; water-bearing 431-479 ft	45	479
Rock, black, dense	6	485
1N/13E-18cba. K. Melby. Altitude 421 ft. Drilled to 433 ft by Dorin Wilburn, 1952-53; deepened by Bert Clayton & Son, 1963. Casing: 8-in. diam to 67 ft; open hole		
Gravel and boulders	36	36
Sandstone and blue clay	162	198
Basalt, blue	37	235
Basalt, black and clay	31	266
Basalt, gray	21	287
Basalt, black, water-bearing	24	311
Basalt, gray	11	322
Basalt, black, water-bearing	108	430
Basalt, gray	3	433
Basalt, black, hard	44	477
Basalt, black, porous	20	497
Basalt, black, very hard	21	518
Basalt, black, broken	5	523
Basalt, black, hard	4	527
Basalt, black, porous, and pyrites	5	532
Basalt, black, hard	8	540

Table 5.--Drillers' logs of representative wells--Continued

1N/13E-22abd. R. Renken. Altitude 580 ft. Drilled to 350 ft by R. J. Strasser Drilling Co., 1946; deepened in 1955. Casing: 10-in. diam to 350 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	17	17
Boulders	10	27
Conglomerate, with brown binder	45	72
Sandstone, yellow	41	113
Clay, yellow	14	127
Sandstone, brown	11	138
Conglomerate, yellow	6	144
Rock, fairly soft	5	149
Basalt, gray, very hard	55	204
Rock, gray, softer	8	212
Rock, gray, hard	4	216
Rock, very hard	3	219
Clay, yellow	5	224
Rock, black, soft	4	228
Conglomerate, yellow	11	239
Hard streak	2	241
Conglomerate, black, soft	5	246
Hard streak	2	248
Conglomerate, brown, soft	9	257
Hard streak	2	259
Conglomerate, black, soft	19	278
Rock, black, soft	12	290
Rock, black, harder	25	315
Rock, black, very hard	33	348
Basalt, black, hard	33	381
Basalt, black and brown	12	393
Rock, black	27	420
Basalt, black, soft	9	429
Basalt, black and gray, hard	14	443
Rock, gray, medium-hard	11	454
Basalt, gray, medium-hard to very hard	99	553
Basalt, black and gray	84	637
Basalt, gray, hard	19	656
Rock, black, porous	4	660
Rock, black, medium-hard	44	704

1N/13E-22bbb. Huntley. Altitude 900 ft. Drilled by Bert Clayton, 1956. Casing: 8-in. diam to 20 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil and clay	10	10
Sandstone, brown and white	55	65
Gravel, cemented	5	70
Sandstone, brown and white	8	78
Gravel, cemented	17	95
Sandstone, white, brown, black, and gray	124	219
Clay, yellow	4	223
Sandstone, brown and gray	18	241
Clay, gray	4	245
Sandstone, brown and white	46	291
Gravel, cemented	42	333
Clay, gray	12	345
Sandstone, gray	17	362
Clay, yellow	16	378
Clay, brown	7	385
Clay, yellow	5	390
Basalt	10	400

1N/13E-22dbb. R. Anderson. Altitude 630 ft. Drilled by Gilbert Clayton Well Drilling, 1976. Casing: 6-in. diam to 55 ft; perforated 35-54 ft

Materials	Thickness (feet)	Depth (feet)
Soil, black	3	3
Silt, brown	12	15
Sandstone, brown	10	25
Gravel, large	4	29
Gravel, medium	6	35
Sand and gravel	20	55

1N/13E-22ddb. L. Polehn. Altitude 760 ft. Drilled by Dorin Wilburn, 1955. Casing: 8-in. diam to 317 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Sandstone and clay	316	316
Basalt, gray, hard	32	348
Clay, blue, dense	2	350
Basalt, black, and blue clay	6	356
Basalt, gray, hard	24	380
Basalt, black, with porous streaks; water-bearing	36	416

1N/13E-22ddb.--Continued

Materials	Thickness (feet)	Depth (feet)
Basalt, gray, hard	48	464
Basalt, black	39	503
Basalt, blue, hard	38	541
Basalt, brown, honeycombed; some water	5	546
Basalt, black	50	596
Basalt, blue, hard	52	648
Basalt, gray, hard, water-bearing	71	719

1N/13E-26cca. E. Wilson. Altitude 1,330 ft. Drilled by Gilbert Clayton Well Drilling, 1976. Casing: 8-in. diam to 72 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil, brown	3	3
Clay, brown	3	6
Clay, yellow	59	65
Sandstone, gray	10	75
Sandstone, gray, rocky	15	90
Gravel, cemented	5	95
Sandstone, gray	10	105
Sandstone, brown	10	115
Sandstone, gray	75	190
Sandstone, brown, rocky	95	285
Sandstone, light-gray	45	330
Sandstone, gray, rocky	12	342
Sandstone, gray-brown	23	365
Sandstone, brown	35	400
Sandstone, gray	5	405
Sandstone, brown	7	412
Rock and white clay	3	415
Clay, yellow	30	445

1N/13E-32aca1. M. Martin. Altitude 1,200 ft. Drilled to 336 ft by Dorin Wilburn in 1946; deepened to 368 ft by Gilbert Clayton Well Drilling in 1976. Casing: 8-in. diam to 44 ft; 6-in. diam to 244 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Sandstone, hard	21	21
Sandstone, soft	5	26
Sandstone, hard	55	81
Rock, broken; some water	21	102
Soapstone and clay	16	118
Rock, broken	8	126
Soapstone	9	135
Basalt, hard, black	9	144
Clay, sticky	3	147
Rock, hard	9	156
Rock, broken	22	178
Clay, sticky	18	196
Rock, broken	16	212
Soapstone and rock, caving	3	215
Soapstone	7	222
Shale, black and green	23	245
Basalt, black	7	252
Basalt, green	40	292
Basalt, broken	5	297
Shale, green	4	301
Rock, black, water-bearing	21	322
Rock, black, and sand	9	331
Basalt, black, broken, water-bearing	5	336
Rock, black, hard	4	340
Rock, black, porous	26	366
Clay, green, sticky	2	368

1N/13E-32aca2. M. Martin. Altitude 1,209 ft. Drilled by Dorin Wilburn, 1955. Casing: 6-in. diam to 336½ ft, 8-in. diam to 255 ft, and 10-in. diam to 20 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	2	2
Sandstone, dense; water at 36 ft	34	36
Basalt, gray, coarse	66	102
Basalt, blue, coarse	36	138
Basalt, gray, coarse	30	168
Clay and rock	11	179
Rock, black, and green shale, water-bearing	19	198
Shale, green and black	40	238
Basalt, black, hard	6	244
Basalt, green, and clay	38	282
Clay, gravel, and rock, dense	36	318
Conglomerate, soapstone, black rock, and shale, water-bearing	20	338
Basalt, black, porous, and soapstone, water-bearing	85	423
Soapstone and conglomerate; no water	4	427

1N/13E-32bcc. S. Skirving. Altitude 1,167 ft. Drilled by Dorin Wilburn, 1956. Casing: 8-in. diam to 263 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Gravel and boulders	28	28
Sandstone, brown	130	158
Clay, brown, and sand	19	177
Sandstone, brown	83	260
Lava, brown, hard	9	269
Lava, gray, coarse	9	278
Lava, brown, fine	20	298
Sandstone, brown, with streaks of clay	20	318
Lava, gray, coarse	5	323
Lava, blue	45	368
Lava, black, with blue clay seams	22	390
Lava, brown, with green clay seams	10	400
Clay, brown, and rock	12	412
Basalt, blue, hard	56	468
Basalt, black, water-bearing; artesian flow at 471 ft	126	594
Basalt, gray, hard	208	802
Basalt, black, fractured; large flow of water	3	805

1N/13E-33cbc. Carter & Fortin Orchards. Altitude 1,050 ft. Drilled by Dorin Wilburn, 1960. Casing: 8-in. diam to 185 ft, 6-in. diam to 775 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil and boulders	3	3
Sandstone	48	51
Clay, blue	21	72
Rock, gray, and blue clay	18	90
Rock, gray, coarse	19	109
Rock, black, and blue clay	5	114
Clay, blue	26	140
Rock, black, and clay	10	150
Rock and shale	11	161
Rock, black	17	178
Basalt, green, dense	5	183
Basalt, gray and blue, hard	37	220
Rock, black and clay; trickle of water over top at 268 ft	48	268
Basalt, blue, hard	8	276
Basalt, black, coarse, water-bearing	42	318
Basalt, blue, hard	24	342
Basalt, black, broken, soft, water-bearing	12	354
Basalt, black	67	421
Basalt, blue, hard	15	436
Basalt, black, and some clay, water-bearing	38	474
Basalt, blue, hard	20	494
Basalt, gray, hard	95	589
Basalt, black, varying textures, water-bearing	56	645
Basalt, blue, hard	23	668
Basalt, black, varying textures	87	755
Boulders, clay, soapstone, and shale, water-bearing	20	775
Basalt, blue, hard	18	793
Basalt, gray, hard; fractured 793-795 ft; increased water flow	31	824
Basalt, gray, hard; fractured 848-853 ft; increased water flow	29	853

1N/13E-36bbb. H. Ketchum. Altitude 795 ft. Drilled by Bert Clayton & Son, 1964. Casing: 8-in. diam to 81½ ft (or to 204 ft?)

Materials	Thickness (feet)	Depth (feet)
Soil, black, and rocks	6	6
Gravel	10	16
Rock, black, broken	29	45
Rock, broken and decomposed	9	54
Rock, red and black, with clay	8	62
Rock, red, and porous	6	68
Rock, red and black	4	72
Rock, black	10	82
Rock, black, broken, porous, decomposed	12	94
Rock, gray-green, broken, porous	22	116
Rock, decomposed, with yellow clay	3	119
Rock, black, gray, and brown	17	136
Rock, black, porous	18	154
Rock, black, with whitish crystals	60	214
Rock, greenish-gray	150	364
Rock, dark-gray	6	370
Rock, gray, porous, with white quartz crystals	6	376
Rock, with pyrites of iron; water-bearing	8	384

1N/14E-27cdd1. V. Harth. Altitude 990 ft. Drilled by Gilbert Clayton Well Drilling, 1977. Casing: 10-in. diam to 98 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil and clay, light-brown	10	10
Clay, brown	30	40
Sandstone, gray	15	55
Gravel, large-sized, bonded	10	65
Rock, gray, broken	25	90
Rock, gray	35	125
Rock, red and black, porous	5	130
Rock, red, porous	25	155
Rock, brown	10	165
Rock, gray, hard	25	190
Rock, with yellow and white clay	20	210
Rock, decomposed	17	227
Rock, gray, with yellow clay	8	235
Rock, gray, porous	25	260
Rock, black	45	305
Rock, gray, hard	127	432
Rock, porous, and green clay	45	477
Rock, porous, red	5	482
Rock, porous, gray	48	530

2N/8E-5dab. U.S. Forest Service Columbia Gorge Ranger Station. Drilled by Steinman Bros., 1963. Casing: 6-in. diam to 177 ft; perforated at 75 ft and from 158 to 173 ft

Materials	Thickness (feet)	Depth (feet)
Clay, white, soft	4	4
Boulders	5	9
Conglomerate, yellow	13	22
Tuff, blue, hard and soft	13	35
Tuff	13	48
Shale, gray, sandy, hard	10	58
Sandstone, bluish-gray	22	80
Tuff, bluish-gray, with quartz crystals	10	90
Tuff, gray, hard and soft	60	150
Shale, bluish-gray, soft	5	155
Tuff, blue, with brown specks	12	167
Tuff, white and gray	33	200

2N/8E-6dad. City of Cascade Locks. Altitude 120 ft. Drilled by R. J. Strasser Drilling Co., 1969. Casing: 8-in. diam to 104 ft; perforated 75-100 ft

Materials	Thickness (feet)	Depth (feet)
Silt, sandy	2	2
Gravel and boulders	5	7
Sand, gravel, boulders, and some clay	19	26
Sand and gravel	14	40
Sand, loose, and gravel	64	104

Materials	Thickness (feet)	Depth (feet)
2N/9E-4aad. State of Oregon Parks Division. Drilled by Crawford Well Drilling, 1973. Casing: 6-in. diam to 78½ ft, 5-in. diam to 275 ft; perforated 117-275 ft		
Fill	1	1
Clay, conglomerate, brown	29	30
Rock, black, medium-hard	30	60
Rock, green, hard	47	107
Rock, gray, medium-hard	2	109
Rock, green and black, medium-hard	4	113
Rock, black, with brown rock seams	27	140
Rock, gray, medium-hard	9	149
Rock, black, with strips of hard crystal	46	195
Rock, gray, medium-hard, with strips of crystal	13	208
Rock, black, hard	10	218
Sand, gray, coarse, hard	12	230
Rock, black, hard	11	241
Sand, gray, coarse, hard	11	252
Rock, gray, hard	6	258
Sand, gray, coarse, hard	13	271
Rock, black, hard	4	275
2N/10E-4dbb. D. Dexter. Altitude 782 ft. Drilled to 60 ft by R. J. Strasser Drilling Co. in 1964; deepened to 111 ft by Richard J. Murray in 1979. Casing: 6-in. diam to 60 ft; perforated 47-60 ft		
Soil	1½	1½
Clay and boulders	9½	11
Lava, gray and brown	10	21
Cinders, red	7	28
Lava, gray and brown	4	32
Lava, gray, porous	4	36
Rock, gray, hard	11	47
Rock, red and black, porous, water-bearing	5	52
Rock, gray, hard	8	60
Basalt, vesicular, water-bearing	51	111
2N/10E-8aca. R. Winslow. Altitude 1,100 ft. Drilled by Gilbert Clayton Well Drilling, 1978. Casing: 6-in. diam to 21 ft; open hole		
Clay, red	46	46
Clay and silt, brown	11	57
Basalt, dark-brown, hard	5	62
Basalt, fractured	5	67
Clay, red	3	70
2N/10E-8adc. F. Vittoria. Altitude 1,060 ft. Drilled by Gilbert Clayton Well Drilling, 1978. Casing: 6-in. diam to 21 ft; open hole		
Clay, red	37	37
Basalt, fractured	5	42
Clay, brown, and silt	16	58
Basalt, hard	2	60
Basalt, fractured	10	70
Clay, red	7	77
Clay, brown, and silt	25	102
Basalt, hard	17	119
Basalt, fractured, and volcanic ash	18	137
Basalt	40	177
Basalt, fractured	23	200
2N/10E-9dab. R. Sohler. Altitude 860 ft. Drilled by Marinelli Drilling Co., 1978. Casing: 6-in. diam to 59 ft; open hole		
Clay and boulders, brown	7	7
Clay, brown	36	43
Sandstone	58	101
Clay and boulders, brown	61	162
Basalt, brown, hard	43	205
Basalt, gray; some fractures	129	334
Cinders, red	7	341
Basalt, brown, hard	119	460
Sandstone, brown, water-bearing	40	500
Sandstone, gray	87	587
Basalt, brown, hard	13	600
2N/10E-13cac. M. Walton. Altitude 630 ft. Drilled by Ralph Turner Drilling Co., 1968. Casing: 8-in. diam to 75 ft; open hole		
Soil	3	3
Clay, dark-brown	12	15
Clay, light-brown	25	40
Clay, blue, and sand	20	60
Gravel, cemented	10	70
Basalt, blue, hard	20	90
Basalt, gray, hard	30	120
Rock, light-red, hard	4	124
Rock, gray, hard	21	145
Rock, red and gray, hard	25	170
Rock, gray, hard	14	184
Rock, gray, with dirt seams	9	193
Rock, medium-gray	42	235
Lava rock	15	250
Rock, medium-gray	25	275
2N/10E-13dca. Diamond Fruit Growers. Altitude 650 ft. Drilled by Haakon Bottner Drilling Co., 1955. Casing: 10-in. diam to 115 ft, 8-in. diam 110-160 ft; perforated 115-155 ft		
Soil	3	3
Clay, gray	6	9
Sand, yellow	13	22
Sand, gray	23	45
Sand and clay, gray and brown	5	50
Clay, blue	14	64
Gravel	6	70
Clay, gray	31	101
Gravel	14	115
Rock, broken, water-bearing	8	123
Basalt, gray, soft	13	136
Basalt, black, with crevices; water-bearing	24	160
2N/10E-15cca. Hood River County Road Department. Altitude 490 ft. Drilled by Haakon Bottner Drilling Co., 1963. Casing: 8-in. diam to 39 ft, 6-in. diam 33-52 ft		
Soil	4	4
Boulders, large, and fine sand	35	39
Gravel, water-bearing	14	53
2N/10E-19aaa. R. Kobayashi. Altitude 1,480 ft. Drilled by Richard J. Murray, 1976. Casing: 6-in. diam to 140 ft; open hole		
Soil	5	5
Clay, reddish-brown	47	52
Sandstone, lavender	6	58
Clay, reddish-brown	52	110
Sandstone, brown, water-bearing	50	160
2N/10E-26dbd. Duckwall & Pooley, Inc. Drilled by Strayer Drilling, 1958. Casing: 8-in. diam to 41 ft, 6-in. diam to 262 ft; open end		
Soil and gravel	30	30
Rock, fractured	10	40
Rock, hard	5	45
Rock, mixed with clay	10	55
Rock, fractured	22	77
Rock, gray	43	120
Rock, gray, hard	15	135
Rock, gray, softer	25	160
Clay, brown	21	181
Gravel	29	210
Clay, brown	20	230
Gravel, with brown clay	15	245
Gravel	17	262

2N/11E-1cbc. City of Mosier. Altitude 135 ft. Drilled in 1931; driller unknown. Casing: 10-in. diam to 72 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil and alluvium; water in lower part	35	35
Basalt, fairly hard	15	50
Basalt, crumbly, water-bearing	8	58
Basalt, fairly hard	11	69
Basalt, black, very hard	70	139
Basalt, porous, water-bearing	8	147
Basalt, hard	2	149

2N/11E-2dad. City of Mosier. Altitude 148 ft. Drilled by R. J. Strasser Drilling Co., 1952. Casing: 10-in. diam to 41 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	2	2
Rock, fractured, and soil	13	15
Gravel, cemented, and boulders	21	36
Basalt, black, medium-hard	19	55
Basalt, gray, hard	11	66
Shale	11	77
Basalt, black; some water	21	98
Basalt, gray, hard	118	216
Basalt, black, fractured, water-bearing	5	221
Basalt, gray, hard	5	226
Basalt, black, porous, water-bearing	15	241
Clay, blue	9	250

2N/11E-2ddb. Mosier Mobile Manor. Altitude 180 ft. Drilled by Richard J. Murray, 1975. Casing: 8-in. diam to 95 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Rock, fractured	75	75
Clay, tan	15	90
Clay, green	3	93
Basalt, gray, water-bearing	67	160
Claystone, water-bearing	3	163
Basalt, gray, water-bearing	12	175

2N/11E-12aad. M. Troxel. Altitude 375 ft. Drilled by owner, 1974. Casing: 8-in. diam to 174 ft, 6-in. diam to 438 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	3	3
Sand, light-brown	55	58
Clay, light-brown	12	70
Conglomerate	17	87
Clay, gray	19	106
Basalt, gray, hard	25	131
Clay, brown	19	150
Basalt, gray, hard	7	157
Sand, yellow, fine, water-bearing	4	161
Clay, light-gray	8	169
Basalt, blue and gray, hard	153	322
Basalt, gray	35	357
Claystone, green, water-bearing	114	471
Basalt, gray, soft, water-bearing	7	478
Claystone, green and gray	9	487
Rock, black and green, soft	7	494
Basalt, gray, hard	19	513
Basalt, gray, water-bearing	1	514
Basalt, gray, hard	10	524
Claystone, dark-green, water-bearing	1	525
Basalt, gray, hard	2	527
Scoria, black, water-bearing	2	529
Basalt, gray, water-bearing	24	553

2N/11E-12abd. City of Mosier. Altitude 235 ft. Drilled to 340 ft by R. J. Strasser Drilling Co. in 1971, deepened to 404 ft in 1973; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	1	1
Clay, brown	4	5
Clay, sandy, and boulders	5	10
Basalt, brown, fractured	14	24
Basalt, gray, medium-hard	6	30
Basalt, gray, hard	56	86
Basalt, gray, fractured	1	87
Basalt, light-gray, hard	89	176
Basalt, brown and gray, medium-hard	17	193
Cinders, brown	31	224
Sand, gray, packed	31	255

2N/11E-12abd.--Continued

Materials	Thickness (feet)	Depth (feet)
Clay, blue	11	266
Basalt, dark-gray	19	285
Basalt, gray, fractured	1	286
Basalt, gray, hard	18	304
Basalt, gray, fractured	11	315
Basalt, gray, hard	5	320
Basalt, gray, porous	18	338
Basalt, gray, medium-hard	18	356
Basalt, gray, hard	12	368
Basalt, gray, cracked	1	369
Basalt, gray, gray, hard	19	388
Basalt, gray, fractured	5	393
Basalt, gray, hard	4	397
Basalt, gray, cracked	3	400
Basalt, gray, hard	4	404

2N/11E-14cbd. D. Huskey. Altitude 1,050 ft. Drilled by Marinelli Drilling Co., 1978. Casing: 6-in. diam to 90 ft, 5-in. diam to 120 ft; perforated 90-120 ft

Materials	Thickness (feet)	Depth (feet)
Clay and sand	21	21
Clay	11	32
Clay, sand, gravel, and boulders	36	68
Sandstone, gray	3	71
Sandstone, brown, water-bearing	44	115
Gravel, consolidated, water-bearing	8	123
Clay, sand, and gravel, water-bearing	17	140

2N/11E-20bbb. E. Glaser. Altitude 1,140 ft. Drilled by Murray Well Drilling, Inc., 1979. Casing: 6-in. diam to 340 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil and fractured basalt	90	90
Basalt, brown, fractured	240	330
Basalt, gray, water-bearing	255	585

2N/12E-7aac. V. Root. Altitude 680 ft. Drilled by owner in 1944. Reconditioned in 1973 from 240-427 ft by Ron Edgell Pump & Well Drilling. Casing: 8-in. diam to 237 ft, 6-in. diam 237-431 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Sandstone, soft	54	54
Clay	70	124
Sandstone, soft, water-bearing	10	134
Clay, gray	41	175
Clay, reddish	13	188
Clay, soft	49	237
Clay, blue	3	240
Clay, yellow, sandy	42	282
Basalt, dark-gray, hard	142	424
Basalt, black, vesicular, water-bearing	3	427

2N/12E-7ada. A. Francois. Altitude 710 ft. Drilled by Bert Clayton, 1960. Casing: 8-in. diam to 272 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil, brown	3	3
Sandstone, gray	22	25
Boulders, red and blue	32	57
Clay, yellow, jointed	9	66
Sandstone, gray, with red and blue boulders	24	90
Clay, blue, jointed	25	115
Sandstone, brown; trickle of water at 130 ft	50	165
Clay, yellow, sandy	20	185
Sandstone, brown	30	215
Clay, bluish-gray, sandy	6	221
Rock, brown, black, and red	8	229
Clay, green, and porous black rock	15	244
Rock, black	16	260
Rock, gray, hard	69	329
Rock, gray, soft	1	330
Rock, bluish-gray	31	361
Rock, gray	12	373
Rock, black, porous, and pyrite iron	21	394
Rock, dark-gray, hard	7	401

Materials	Thickness (feet)	Depth (feet)
2N/12E-7bda. V. Root. Altitude 595 ft. Drilled by Grant C. Robbins, 1979. Casing: 12-in. diam to 38 ft, 10-in. diam to 260 ft; open hole		
Sandstone, light-brown	40	40
Sandstone, light-gray	10	50
Sandstone, light-brown	10	60
Sand, light-gray	30	90
Clay, light-brown	30	120
Sandstone, light-brown	10	130
Clay, light-gray	40	170
Sandstone, light-gray	10	180
Gravel, ½-in. diam	20	200
Clay, with fine gravel	10	210
Sandstone, gray	50	260
Basalt, black, hard	120	380
Basalt, porous, fractured, water-bearing	--	380
2N/12E-8adc. T. Sherrard. Altitude 930 ft. Drilled by Murray Well Drilling Co., 1976. Casing: 6-in. diam to 18 ft; open hole		
Soil	2	2
Sandstone	31	33
Sandstone, salmon color	6	39
Sandstone, gray	5	44
Sandstone, yellow	6	50
Sandstone, tan	35	85
Clay, white	19	104
Sandstone, gray	99	203
Basalt, black	32	235
Basalt, gray, hard	19	254
Basalt, black, water-bearing	30	284
Basalt, fractured	31	315
Sandstone, brown	8	323
Basalt, gray	17	340
Basalt, brown, water-bearing	8	348
Basalt, gray, hard	57	405
2N/12E-8cba. D. Harmon. Altitude 690 ft. Drilled by Gilbert Clayton Well Drilling, 1977. Casing: 8-in. diam to 60 ft; open hole		
Clay, gray	12	12
Sandstone, gray	5	17
Clay, yellow, sandy	5	22
Clay, green, sandy	37	59
Sandstone, gray	66	125
Rock, gray	80	205
Rock, porous, with brown spots	25	230
Rock, gray	15	245
Rock, brown	20	265
Rock, porous	17	282
2N/12E-11abd. Mrs. H. Brown. Altitude 158 ft. Drilled by Bert Clayton & Son, 1968. Casing: 6-in. diam to 38 ft; open hole		
Sand and rocks	14	14
Rock, gray, fractured	18	32
Rock, gray	15	47
Rock, black	58	105
Rock, gray, with pyrites	11	116
Rock, gray, fractured, water-bearing	4	120
2N/12E-16bcd. Thody. Altitude 1,250 ft. Drilled by Murray Well Drilling Co., 1976. Casing: 6-in. diam to 18 ft; open hole		
Soil	2	2
Clay, brown	35	37
Clay, white	15	52
Sandstone, tan	13	65
Clay, white	20	85
Sandstone, gray	273	358
Basalt, gray	195	553
Basalt, brown, water-bearing	18	571
Basalt, gray	66	637
Basalt, brown, water-bearing	5	642
2N/12E-16dcd. K. Johnson. Altitude 1,280 ft. Drilled by Marinelli Drilling Co., 1979. Casing: 10-in. diam to 29 ft; open hole.		
Clay, brown, with cobbles	16	16
Clay, white and black	8	24
Basalt, gray, hard	93	117
Sandstone, brown	11	128
Basalt, gray, hard	13	141
Sandstone, gray	32	173
Basalt, gray, hard	94	267
Lava, hard, fractured, water-bearing	21	288
Basalt, gray, hard	5	293
Sandstone, brown, water-bearing	7	300
Lava, fractured, water-bearing	9	309
Basalt, gray, hard	199	508
Sandstone, brown, hard, water-bearing	3	511
Conglomerate, water-bearing	26	537
Basalt, gray, hard	119	656
Basalt, gray, fractured	14	670
Basalt, gray, hard	74	744
2N/12E-18bbd. P. Brooks. Altitude 660 ft. Drilled by Murray Well Drilling Co., 1978. Casing: 8-in. diam to 139 ft; open hole		
Soil	7	7
Sand	29	36
Sandstone, tan	36	72
Cobbles	6	78
Clay, gray	24	102
Sandstone, gray	21	123
Basalt, gray, water-bearing	152	275
Rock, gray and green, water-bearing	115	390
Basalt, gray, vesicular, water-bearing	70	460
2N/12E-22acc. S. Nagel. Altitude 1,720 ft. Drilled to 205 ft by Murray Well Drilling Co. in 1975; deepened to 230 ft in 1976. Casing: 6-in. diam to 23 ft; open hole		
Soil	3	3
Basalt, gray	30	33
Basalt, brown	25	58
Basalt, black; some seepage	20	78
Basalt, brown	7	85
Basalt, black	20	105
Basalt, gray	10	115
Basalt, black and gray	90	205
Basalt, gray, with green clay seams	10	215
Basalt, brown and maroon, water-bearing	15	230
2N/12E-22bbd. R. Murray. Altitude 1,490 ft. Drilled by Murray Well Drilling, Inc., 1979. Casing: 6-in. diam to 78 ft; open hole		
Soil	6	6
Rock, brown, fractured	43	49
Sand, yellow	24	73
Basalt, gray, hard, water-bearing	257	330
Void, water-bearing	7	337
Basalt, gray	8	345
2N/12E-22bca. Seven Mile Hill Estates. Altitude 1,475 ft. Drilled by Murray Well Drilling Co., 1975. Casing: 8-in. diam to 28 ft; open hole		
Soil	7	7
Basalt, brown, water-bearing	17	24
Basalt, gray	36	60
Basalt, black	15	75
Basalt, gray	40	115
Basalt, black	13	128
Basalt, gray, hard	62	190
Basalt, black, water-bearing	80	270
Basalt, gray	50	320
Claystone, green, water-bearing	5	325
Basalt, gray, water-bearing	73	398

Materials	Thickness (feet)	Depth (feet)
2N/12E-22dbc2. M. McCall. Altitude 1,675 ft. Drilled by Murray Well Drilling Co., 1976. Casing: 6-in. diam to 38 ft; open hole		
Soil and cobbles	6	6
Basalt, brown, fractured	14	20
Basalt, brown	45	65
Basalt, gray	103	168
Basalt, black, water-bearing	12	180
Basalt, gray	30	210
Basalt, black	15	225
2N/12E-22ddd. B. Ferguson. Altitude 1,760 ft. Drilled by Harry Douthit Well Drilling, 1979. Casing: 8-in. diam to 19 ft, 5-in. diam to 195 ft; perforated 175-195 ft		
Soil	6	6
Sandstone, brown, firm	6	12
Clay, light-brown, soft	10	22
Basalt, black, hard	91	113
Basalt, greenish, soft, with clay	32	145
Basalt, dark-gray, hard	35	180
Basalt, black and red, fractured	8	188
Basalt, black, hard	7	195
2N/12E-25ddc. E. Kuck. Altitude 520 ft. Drilled by Dorin Wilburn, 1939. Casing: 8-in. diam to 30 ft; open hole		
Soil	14	14
Sandstone, varying textures and colors, water seep at 138 ft	151	165
Basalt, dense	3	168
Basalt and blue shale, in streaks	35	203
Sandstone, fine	35	238
Sandstone, coarse, water-bearing	7	245
Sandstone, water-bearing	52	297
Sandstone, hard	21	318
Shale, blue	32	350
Shale, brown	60	410
Shale, brown, with streaks of soapstone	10	420
Shale, black, with streaks of sand	19	439
Shale, blue, with streaks of sand	4	443
2N/12E-36cad. H. Douthit. Altitude 525 ft. Date and driller of old well unknown; deepened to 302 ft by Dorin Wilburn in 1965. No casing		
Old well; no record	140	140
Sandstone, dense	78	218
Clay, brown	13	231
Clay, brown, and streaks of sandstone	42	273
Sandstone, with streaks of water-bearing gravel	28	301
Sandstone, dense	1	302
2N/12E-36ddb. C. Buster. Altitude 880 ft. Drilled by Gilbert Clayton Well Drilling, 1973. Casing: 8-in. diam to 107 ft; open hole		
Soil, black	1	1
Clay, rocky	3	4
Boulders and clay, bonded	15	19
Clay, brown, rocky	40	59
Clay, yellow; some seepage	10	69
Clay, green	20	89
Clay, brown	5	94
Sand and gravel, loose	11	105
Sandstone, gray	10	115
Sandstone, brown	15	130
Sandstone, rusty-brown, rocky	50	180
Sandstone, black, rocky	15	195
Sandstone, brown	10	205
Sandstone, gray	5	210
Sandstone, brown, silty	35	245
Sandstone, gray, rocky	30	275
Sandstone, brown	55	330
Sandstone, gray, rocky	10	340
Sandstone, gray, sandy	10	350
Sandstone, gray	5	355
Sandstone, light-brown, silty	15	370
Sandstone, rusty-brown, silty	25	395
Sandstone, brown	5	400
2N/12E-36ddb.--Continued		
Sandstone, brown, silty	15	415
Sandstone, brown	5	420
Sandstone, gray	14	434
Clay, light-brown	1	435
Sandstone, gray, coarse	10	445
Sandstone, gray, medium	10	455
Sandstone, brown	10	465
Sandstone, light-gray	10	475
Sandstone, brown	25	500
2N/13E-17baa1. Tooley Water District. Altitude 100 ft. Drilled by Bert Clayton & Son, 1963. Casing: 8-in. diam to 32 ft; perforated 27-32 ft		
Sand	4	4
Boulders, small	6	10
Gravel, cemented	19	29
Gravel, water-bearing	3	32
2N/13E-17dad. The Dalles Country Club. Altitude 220 ft. Drilled by R. J. Strasser Drilling Co., 1972. Casing: 12-in. diam to 45 ft; open end		
Soil	4	4
Sand, gray, dry	30	34
Basalt, gray, hard	33	67
Basalt, gray, fractured	3	70
Basalt, gray, hard	175	245
Basalt, fractured	11	256
Basalt, gray, hard	106	362
Basalt, gray, fractured	13	375
Basalt, gray, hard	6	381
Basalt, gray, porous	3	384
Basalt, gray, hard	34	418
Sandstone	8	426
Clay, blue	11	437
Basalt, gray, hard	11	448
Basalt, gray, porous	7	455
Basalt, gray, hard	25	480
2N/13E-28cbc. Martin Marietta Aluminum, Inc. Altitude 144 ft. Drilled by R. J. Strasser Drilling Co., 1957. Casing: 20-in. diam to 220 ft; open hole		
Soil	4	4
Rock ledge, sloping, hard	7	11
Rock, gray, hard	8	19
Rock, broken	2	21
Rock, gray, hard	6	27
Rock, grayish-black and white, hard	9	36
Rock, decomposed	3	39
Rock, gray, very hard	56	95
Rock, gray, hard, coarse-textured	9	104
Rock, gray, very hard	42	146
Rock, black, rough, medium-hard	6	152
Rock, gray, hard	3	155
Rock, black, rough, medium-hard	26	181
Rock, gray, hard	8	189
Shale, blue	16	205
Conglomerate	7	212
Rock, brown, medium-hard	17	229
Rock, gray, hard	57	286
Rock, black, porous, water-bearing	8	294
Rock, brown, harder, water-bearing	2	296
Rock, black, porous, water-bearing	10	306
Rock, black, rough	8	314

Table 5.--Drillers' logs of representative wells--Continued

2N/13E-28cdb. Martin Marietta Aluminum, Inc. Altitude 138 ft. Drilled by A. M. Jannsen Drilling Co., 1957. Casing: 10-in. diam to 223 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Fill	10	10
Basalt, fractured	18	28
Basalt, hard	2	30
Rock and clay, soft	11	41
Basalt, black	17	58
Basalt, hard	31	89
Basalt, weathered	9	98
Basalt, gray, hard	12	110
Basalt, gray, with clear quartz	5	115
Basalt, gray, hard	17	132
Basalt, gray, porous	8	140
Basalt, gray, hard	3	143
Basalt, gray, porous	19	162
Coal or peat	28	190
Clay, gray	5	195
Clay, with small-sized gravel	17	212
Clay, brown, and rock	5	217
Rock	6	223
Basalt, gray, hard	39	262
Basalt, porous, with hard and soft layers	28	290
Basalt, gray, slightly porous	10	300
Rock, firm, but turning brown with bits of clay	3	303

2N/13E-32daa1. Chenoweth Irrigation Cooperative. Altitude 165 ft. Drilled by Dorin Wilburn, 1946. Casing: 16-in. diam to 13 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil, sandy	10	10
Rock, gray, very hard	35	45
Rock, porous; some water	15	60
Rock, gray, solid	3	63
Rock, black, porous	6	69
Rock, gray, hard	2	71
Rock, black, porous	4	75
Rock, gray, hard	3	78
Rock, black, porous	4	82
Rock, gray, hard	3	85
Clay, yellow and blue, with black rock and trace of gravel	5	90
Rock, black	6	96
Clay, blue, with black and white rock; some water	9	105
Rock, gray, black, and white, with traces of blue clay; some water	57	162
Rock, black, porous, with traces of blue clay, and pyrite	7	169
Rock, red, porous, and some iron pyrite	12	181
Rock, gray, porous, and some iron pyrite	7	188
Rock, red and black, with trace of iron pyrite	2	190
Rock, gray, hard	2	192
Rock, red and gray, very hard	11	203
Rock, gray, very hard	34	237
Rock, red and black, porous, with pyrite	11	248
Rock, red and black	3	251
Rock, gray, hard	7	258

2N/14E-31cca. C. Byers. Altitude 275 ft. Drilled by Great Western Drilling, Inc., 1975. Casing: 8-in. diam to 73 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Clay, brown	10	10
Clay, yellow, with rock	20	30
Rock, brown	15	45
Basalt, black	10	55
Rock, brown	55	110
Rock, black, soft	15	125
Rock, black	50	175
Basalt, black	65	240
Rock, brown, water-bearing	20	260
Basalt, black	140	400
Basalt, black, water-bearing	13	413
Basalt, black	137	550
Rock, gray	40	590
Rock, black, fractured	35	625
Basalt, black	10	635
Sand	5	640
Shale, blue, with sand	10	650

2N/14E-31dcc. Bonneville Power Administration. Altitude 495 ft. Drilled by Gus Jannsen, 1954. Casing: 10-in. diam to 308½ ft, 8-in. diam 304-700 ft; perforated 560-700 ft

Materials	Thickness (feet)	Depth (feet)
Fill	10	10
Clay and sand	10	20
Silt	10	30
Sand, pebbly, cemented	45	75
Basalt, black	25	100
Basalt, porphyritic	14	114
Basalt, dark-gray	20	134
Tuff, pinkish-white	2	136
Basalt, dark-gray, soft	24	160
Basalt, gray, hard, porphyritic	44	204
Basalt, black and brown, soft	56	260
Basalt, blue, very soft	54	314
Basalt, dark-gray, very hard	61	375
Basalt, gray	98	473
Basalt, gray, porphyritic	58	531
Basalt, gray	14	545
Basalt, fractured	5	550
Basalt, gray	12	562
Basalt, gray, porphyritic	38	600
Basalt, light-gray	15	615
Breccia, black, basaltic, water-bearing	30	645
Basalt, gray	10	655
Breccia, black, basaltic, water-bearing	35	690
Basalt, black, vesicular, water-bearing	10	700

2N/15E-33cdc. P. Kelly. Altitude 580 ft. Drilled by Gilbert Clayton Well Drilling, 1978. Casing: 8-in. diam to 28 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil, sandy	6	6
Gravel	4	10
Boulders, with gravel	13	23
Rock, gray	132	155
Rock, with gray seams	50	205
Rock, black	15	220
Rock, with pyrite, seams	3	223
Rock, black, porous	7	230
Rock, gray, hard	20	250

1S/13E-11aaa. B. Brogan. Altitude 915 ft. Drilled by Gilbert Clayton Well Drilling, 1973. Casing: 8-in. diam to 107 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil, brown	4	4
Clay, brown, rocky	8	12
Boulders and clay	8	20
Rock, decomposed	10	30
Rock, black	10	40
Rock, decomposed	19	59
Rock, hard	7	66
Rock, fractured	7	73
Rock, black, with blue and green clay seams	27	100
Rock, black, porous, with green clay	25	125
Rock, gray, with clay seams	48	173
Clay, green	1	174
Rock, black, porous	16	190

1S/13E-11ccb. K. Falk. Altitude 958 ft. Drilled by Murray Well Drilling, Inc., 1979. Casing: 6-in. diam to 37 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	3	3
Boulders	8	11
Rock, brown	21	32
Basalt, gray, water-bearing	33	65
Basalt, brown, vesicular	13	78
Basalt, black, vesicular, with green and blue clay seams; water-bearing	72	150

1S/13E-12bab. T. May. Altitude 930 ft. Drilled by R. J. Strasser Drilling Co., 1974. Casing: 16-in. diam to 60 ft, 12-in. diam to 85 ft, 10-in. diam to 333 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Clay, brown, sandy	45	45
Clay, sand, and rock	25	70
Basalt, black, medium-hard	15	85
Basalt, black, hard	9	94
Pea gravel, cemented	6	100
Rock, brown, broken	24	124
Basalt, gray, medium-hard	32	156
Basalt, black, hard	36	192
Basalt, brown, fractured	8	200
Basalt, gray, medium-hard	20	220
Basalt, black, hard	23	243
Basalt, gray, medium-hard	27	270
Basalt, black, hard	60	330
Basalt, gray, hard	13	343
Basalt, black, fractured	7	350
Basalt, gray, hard	2	352
Basalt, black, fractured	6	358
Basalt, gray, hard	2	360

1S/13E-25dca. Farm Chemicals. Altitude 1,270 ft. Drilled by Gilbert Clayton Well Drilling, 1977. Casing: 8-in. diam to 118½ ft; open hole

Materials	Thickness (feet)	Depth (feet)
Fill	10	10
Rock, decomposed	8	18
Rock, gray, hard	25	43
Rock, fractured	5	48
Rock, gray, hard	20	68
Rock, brown, fractured	5	73
Rock, gray, hard	90	163
Rock, brown, porous	6	169
Rock, gray, porous	16	185
Rock, brown, porous	10	195
Rock, gray, porous	20	215
Rock, red-brown, porous	10	225
Rock, with yellow clay	5	230

1S/13E-26dac2. City of Dufur. Altitude 1,340 ft. Drilled by R. J. Strasser Drilling Co., 1976. Casing: 12-in. diam to 35 ft, 10-in. diam to 385 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	3	3
Clay and gravel	6	9
Basalt, brown, fractured	8	17
Basalt, gray	27	44
Basalt, dark-gray	21	65
Basalt, brown and gray	7	72
Basalt, dark-gray	19	91
Basalt, gray	56	147
Basalt, brown and gray	36	183
Basalt, black	7	190
Basalt, gray	7	197
Basalt, brown and black, fractured	14	211
Basalt, red and black	14	225
Basalt, dark-gray	41	266
Basalt, gray, fractured	30	296
Basalt, gray	58	354
Basalt, gray, fractured	31	385
Basalt, black	15	400
Basalt, gray, with mud seams	5	405
Basalt, gray, medium-hard	15	420
Basalt, gray, with mud seams	33	453
Basalt, gray, hard	4	457
Basalt, gray, with mud seams	26	483
Basalt, gray, hard	7	490
Shale, green	2	492
Basalt, gray, porous, with sediment seams	14	506
Basalt, gray, soft	2	508
Basalt, gray, medium-hard	94	602
Basalt, gray, with clay seams	17	619
Basalt, gray, fractured	2	621
Basalt, black, porous	3	624

1S/13E-34abc. K. Purdom. Altitude 1,380 ft. Drilled by Murray Well Drilling Co., 1977. Casing: 10-in. diam to 398 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	13	13
Sandstone	59	72
Gravel, medium-sized, water-bearing	10	82
Basalt, gray, hard	12	94
Basalt, gray-green	62	156
Basalt, soft, fractured, water-bearing	7	163
Basalt, gray, hard	20	183
Basalt and clay, brown	11	194
Basalt, gray, water-bearing	83	277
Basalt, brown, fractured	4	281
Basalt, gray, hard	141	422
Basalt, gray, fractured, water-bearing	6	428
Basalt, gray and black	45	473
Basalt, black, soft	2	475
Basalt, brown	40	515
Basalt and cobbles	19	534

1S/13E-34dbb. M. Fargher. Altitude 1,420 ft. Drilled by PROJECT: Corporation, 1970. Casing: 10-in. diam to 10 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil, brown, and loam	8	8
Basalt, brown, fractured	12	20
Basalt, black	80	100
Basalt, black, porous, fractured	5	105
Basalt, gray, hard	33	138
Basalt, black and brown, fractured	20	158
Basalt, gray, hard	2	160

1S/14E-3adc. Fox Brothers Ranch. Altitude 955 ft. Drilled by Gilbert Clayton Well Drilling, 1977. Casing: 10-in. diam to 118 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil, brown	6	6
Gravel	14	20
Rock, fractured	10	30
Rock, gray, water-bearing	115	145
Shale, green, water-bearing	5	150
Rock, gray, porous, water-bearing	32	182
Rock, gray, porous, with white flakes, water-bearing	25	207
Rock, gray, water-bearing	23	230
Rock, black, porous, with quartz, water-bearing	35	265
Rock, brown, with yellow seams, water-bearing	10	275
Rock, black, with yellow seams, water-bearing	6	281

1S/15E-5aaa. G. Fulton. Altitude 1,270 ft. Drilled by Dorin Wilburn, 1961. Casing: 6-in. diam to 24 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	5	5
Boulders and gravel	13	18
Basalt, blue, hard	23	41
Basalt, gray, hard	58	99
Rock, black, fractured, with streaks of soapstone; artesian water	15	114

2S/12E-1cdd. P. Lindhorst. Altitude 1,703 ft. Drilled by Murray Well Drilling Co., 1978. Casing: 8-in. diam to 39 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	4	4
Clay, tan	8	12
Rock, black	8	20
Sandstone	14	34
Basalt, gray, hard, water-bearing	176	210
Basalt, gray, brown, and green, vesicular, with some small seams of yellow clay; water-bearing	75	285
Claystone, blue, caving	5	290

2S/12E-15dab. City of Dufur. Altitude 1,945 ft. Drilled by Wallace Well Drilling Co., 1978. Casing: 10-in. diam to 26 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Cobbles	10	10
Basalt, gray	5	15
Basalt, gray, hard	145	160
Basalt, red	13	173
Basalt, gray, hard, water-bearing	362	535
Basalt, fractured	57	592
Basalt, gray, hard, water-bearing	103	695
Basalt, gray, fractured	29	724
Basalt, gray, hard	4	728

2S/13E-15cda. T. Hix. Altitude 1,918 ft. Drilled by Bert Clayton & Son, 1968. Casing: 8-in. diam to 21 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	2	2
Clay, brown	10	12
Basalt, decomposed	4	16
Basalt, gray	105	121
Conglomerate	5	126
Basalt, gray	43	169
Basalt, black, porous; trickle of water	1	170
Basalt, gray	33	203
Basalt, red, porous	14	217
Basalt, seamy, with white crystals	49	266
Rock, black, porous, water-bearing	6	272
Basalt, gray	6	278
Rock, yellow, porous	4	282
Basalt, gray	49	331
Clay, cream-colored	1	332
Basalt, gray	10	342

2S/13E-27ccb. W. Stanley. Altitude 2,082 ft. Drilled by Dorin Wilburn, 1959. Casing: 6-in. diam to 9½ ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil	2	2
Gravel and boulders	6	8
Basalt, blue, hard	38	46
Rock, brown, soft	37	83
Basalt, blue, hard	36	119
Basalt, gray, hard	24	143
Rock, brown, soft, porous, fractured; water-bearing areas	38½	181½

2S/13E-28aba. DePriest Ranch. Altitude 2,235 ft. Drilled by Gilbert Clayton Well Drilling, 1977. Casing: 6-in. diam to 20 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Soil, with brown clay	5	5
Clay, brown and reddish-brown	10	15
Rock, decomposed	20	35
Rock, fractured	30	65
Rock, gray, porous	15	80
Rock, gray	10	90
Rock, decomposed	15	105
Rock, gray	5	110
Rock, red, porous	12	122
Clay, brown	8	130
Rock, decomposed	15	145
Rock, gray	40	185
Rock, fractured	15	200
Rock, gray	30	230
Rock, fractured	5	235
Rock, brown, porous	10	245
Rock, gray	30	275
Rock, porous	5	280
Rock, gray and black	75	355
Rock, red, porous	2	357
Rock, gray and black	33	390
Rock, decomposed	3	393
Rock, black and gray	57	450
Rock, porous, with yellow clay	47	497

2S/14E-16aba. W. Hanna. Altitude 2,055 ft. Drilled by Dick Akins Well Drilling, 1968. Casing: 6-in. diam to 19 ft; open hole

Materials	Thickness (feet)	Depth (feet)
Sand and clay	5	5
Shale, brown, fractured	11	16
Basalt, gray	79	95
Shale, brown, fractured	9	104
Basalt, gray	19	123
Sand, gravel, and yellow clay	12	135
Shale, brown, fractured	17	152
Basalt, gray, medium to hard	25	177
Shale, brown, fractured	20	197
Basalt, gray, hard	10	207
Shale, brown, medium-hard	7	214
Basalt, gray, hard	5	219
Shale, brown, medium-hard	13	232
Basalt, gray, hard	19	251
Shale, brown, fractured	38	289
Basalt, gray, hard	27	316
Shale, brown, fractured	16	332
Clay, blue, and sand	32	364
Basalt, gray, hard	1	365

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