UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

GROUND WATER OF THE COLUMBIA BASIN

By

R. C. Newcomb

Not reviewed for conformance with the editorial standards
of the Geological Survey

Open File Report 57-81
January 1958

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INTRODUCTION

Part of the water that infiltrates from the surface reaches a zone of saturation whence it percolates toward the outlet and thereby is delayed in its course to the sea. This ground water is one form of natural storage which has different degrees of effect on stream flow in different segments of the Columbia River basin. As a whole the Columbia River receives a substantial part of its base flow from the discharge of ground water. The inflow from ground water differs materially in each of the six general terrain areas, which are described briefly below.

GROUND-WATER AREAS OF THE BASIN

(1) The Interior Plateaus of Canada and the Rocky Mountain area of Montana, Washington, and Idaho, are composed predominantly of crystalline metamorphic and igneous rocks of relatively low permeability. These bedrocks are overlain in the valley areas by widespread deposits of unconsolidated and semiconsolidated sedimentary materials of relatively high permeability. North of the Clark Fork and Spokane Rivers the permeable valley-fill deposits are largely Pleistocene glacial deposits. South of those rivers the valley-fill deposits are largely sedimentary deposits of Tertiary and Quaternary age and Recent alluvium with some glacial outwash. The permeable valley deposits store ground water received from the infiltration of precipitation and from the percolation and overflow of the streams. The gradual discharge of this ground water to the streams forms a significant part of the stream flow, especially so during the autumn and winter months.

(2) The Snake River plains and adjacent plateaus of southern Idaho, Utah, and Nevada are largely underlain by permeable and moderately permeable rocks, mostly lavas, and by semipermeable lake beds, although there are present other types of rocks as well as much Recent alluvium. Infiltration from the surface recharges the ground water, which percolates through the volcanic and other rocks to discharge in the streams. The most prominent is in the Thousand Springs area, where 5,000 to 6,000 cubic feet of water per second discharges to the Snake River after percolating as much as 100 miles southwest from the sinks of the Lost Rivers and from other sources.

(3) The large plateau area, which comprises much of central, southeastern, and south-central Washington and north-central Oregon, is underlain by a thick accumulation of basaltic lavas that are only moderately permeable. Although in general, these lava rocks discharge only small or moderate amounts of ground water to the streams (to the Palouse, Umatilla, and John Day Rivers), the downwarped areas of the plateau contain large amounts of ground water in the basalt and the overlying sedimentary deposits. Thus, the 60,000 acre-feet of water that percolates annually from the Walla Walla River into the upper part of the alluvial fans and returns to the river from the lower part of the fans, contributes significantly to the stability of the water supply. Likewise, the intermittent sinking and emergence of Crab Creek in the Quincy Basin and the percolation and underground return of large quantities of water to the Yakima River are features of ground water that contribute to stream stabilization and furnish domestic, irrigation, and public water supplies.

(4) The central Oregon mountains and the Coast Range of Oregon and Washington are similar in that they are composed of rocks of relatively low permeability, do not contain sizable bodies of permeable alluvium, and have steep topography with quick runoff. In both of these mountain areas, ground water contributes little to the stream flow and the water supply in general.

(5) The Cascade Range in Oregon, and to lesser extent in southern Washington, is capped by an extensive deposit of highly permeable volcanic materials. The most permeable deposits occur on the eastern slopes of the range, receive a large aggregate infiltration, and drain to numerous large springs. The Deschutes River owes the stability of its flow to this ground-water increment. In Washington the northern part of the Cascade Range is composed largely of impermeable rocks; there, land slopes are steep and ground water does not contribute greatly to the streams.

(6) The part of the Puget-Willamette Trough drained by the Columbia River possesses somewhat different ground-water features north and south of the main stem. To the north, the Lewis and Cowlits Rivers gather runoff mainly from the Tertiary rocks, which form the west side of the Cascade Range, and flow across hilly lowlands cut mostly in Tertiary sedimentary rocks of low permeability; consequently, ground water contributes little to their flow. To the south, in the Willamette Valley, the strong rivers from the western slope of the Cascade Range have built fans and terraces of relatively coarse-grained alluvium along the eastern side of the valley. These coarser materials accept and transmit moderate volumes of ground water which supplies much of the local irrigation, industrial, and public-supply water and also assists in maintaining the base flow of streams in periods of little rainfall.

QUALITY OF THE GROUND WATER

The chemical and physical quality of the ground water is, in general, good or excellent; however, locally the water has detrimental amounts of one or more dissolved substances. East of the Cascade Range the ground water commonly carries only slightly more dissolved solids than the surface water and is mainly a calcium-bicarbonate type of neutral or slightly basic reaction; to the west of that range the ground water is commonly neutral or slightly acid and the bicarbonate waters contain somewhat less calcium. In the small areas of inferior quality waters, the chemical constituents present in more than commonly allowable concentrations include chloride, fluoride, iron, sodium and magnesium.

PRINCIPAL EFFECTS OF THE GROUND WATER

In total quantity, the natural storage of water underground commonly exceeds the water on the land surface at any one time. It is a great equalizer in the discharge of many streams and it affords additional opportunities for the withdrawal and use of a region's water supply.

The regional water table is the upper surface of the main body of ground water. It stands generally at about the level of the principal local drainage. When the streams rise, some water from the streams commonly infiltrates to the ground water where it is held temporarily in so-called "bank storage" until it returns to the streams during periods of declining or low stream levels. For example, in 50 miles of stream channel above McNary Reservoir the annual bank-storage cycle of the Columbia River stores, and later discharges, about 100,000 acre-feet of the river's flood flow. In the aggregate the bank storage is a significant diversion from the channels of the river system during its annual flood stages.

At some places where streams have been diverted in glacial derangements, as have many of the branches of the Columbia River, the diversionary deposits continue to transmit ground water in the old direction and interstream transfers of ground water occur. Prominent among these is the transfer of many hundreds of cubic feet of water per second southwest from Pend Oreille Lake through the glacial outwash gravels to the Spokane River near Spokane. Diversions of stream waters underground through permeable volcanic deposits are illustrated by the percolation of the discharge of numerous streams bordering the Snake River plain through lava rocks to the Snake River in the Thousand Springs area.

The ground water provides readily available sources for domestic, stock and public supplies, as well as for irrigation and industrial purposes over broad areas where other sources are lacking or economically unavailable.

USE OF GROUND WATER

Present estimates on the amount of ground water withdrawn and used within the part of the Columbia River basin in the United States includes the following (in acre-feet per year):

Use / State	Irrigation	Public supply	Industrial	Domestic	Total
Idaho	1,300,000	60,000	140,000	16,000	1,516,000
Montana	10,000	500	200	300	11,000
Nevada	1,500	0	0	100	1,600
Oregon	125,000	40,000	20,000	25,000	210,000
Utah					Negligible
Washington	70,000	180,000	30,000	40,000	320,000
Wyoming					Negligible
Totals	1,506,500	280,500	190,200	81,400	2,058,600

The amounts shown are only a small part of the ground water available. The ground-water resources are intensively developed in but a few localities. At many places they have capacities for much greater exploitation and by artificial recharge and wise management could supply larger amounts of water. There are only a very few areas where the withdrawal of ground water has exceeded the rate at which it is being recharged. Among these areas are the small Cow Creek valley in northern Malheur County, Oregon, the vicinities of Pullman Washington and Moscow Idaho, and small parts of the Snake River plain in Idaho. Artificial recharging has been practiced extensively only at the well fields of the city of Richland, Washington.

The States of Idaho, Nevada, Oregon, Utah, Washington, and Wyoming have laws governing the withdrawal and use of ground water.

GROUND-WATER INFORMATION

The ground-water resources of many of the main inhabited parts of the Columbia Basin in the United States are described in publications. These publications include State and Federal bulletins, water-supply papers, and open-file reports. Many of these papers treat the ground-water resources of sub-basins or of political units; none concern the entire Columbia Basin area or any large part of it. In addition to the published information, miscellaneous data can be obtained from the State water authorities, the Federal water-investigational agencies, and other sources. The Water Resources Division of the U. S. Geological Survey maintains investigative programs in cooperation with each State of the basin and makes periodic water-level measurements at about 600 wells and springs. These records indicate the local and regional fluctuations of the ground-water levels, their short- and long-term trends, and the time of recharge and discharge of the ground water. Many of these measurements are published in Water Supply Papers numbered between 777 (for 1935) and 1408 (for 1955, the last published). Other records are published in reports on particular areas or are available from unpublished records of State and Federal agencies.

The longest records of periodic measurements of the ground-water levels go back no more than 40 years, but fragmental data extend the information back into the nineteenth century at some places. In general, these longest records show a relatively high water level during the 1890's and the first 10 or 15 years of this century, a decline through the 1920's to a low during the 1930's, and a rising water level beginning about 1940. At many places the ground-water level now is comparable to the levels sparsely recorded during the period from 1890 to 1910.

Records on the ground-water levels in major valleys, such as the Willamette Valley where the ground water is controlled by the base level of the river, show that there has been no substantial change in the last 30 years.