UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GROUND WATER BRANCH

GROUND WATER IN BIRCH CREEK VALLEY, IDAHO

By M. J. Mundorff

Prepared in cooperation with the
U.S. Bureau of Reclamation

Open-file report 62-93

Boise, Idaho
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ABSTRACT

The broad alluvial valley of Birch Creek occupies the central two-fifths of Birch Creek basin. Strata in the flanking mountain ranges consist chiefly of limestone and shale. About midway between the head and mouth of the valley basaltic lava extends across and almost completely blocks the valley. Birch Creek has cut a canyon through the basalt and surface water drains out through this gap. However, the basalt and underlying conglomerate dip upvalley and form a barrier to ground-water flow.

Birch Creek is fed almost exclusively by springs rising in an area of a few square miles immediately upvalley from the barrier. Streamflow records indicate that ground-water storage upvalley from the barrier is large.

Large yields probably could be obtained from wells in the alluvium, upvalley from the barrier. Pumping during a 90-day irrigation season would reduce surface outflow, but if wells were several miles from the spring outlets, the decrease in surface flow would be fairly evenly distributed throughout the year. Assuming uniform time-distribution of the decrease in surface flow, the total amount of water available (surface and ground water) during a 90-day irrigation season, after a number of years during which equilibrium under the changed water regimen was being reestablished, would be equal to three-quarters of the amount pumped plus

the amount of spring discharge that would have occurred if there had been no pumping. This holds only to a maximum of about 320 cfs because the amount available annually could not exceed, except temporarily, the total outflow of the basin.

Ground water probably also could be obtained from the alluvium immediately downvalley from the barrier where the water table is within 30 feet of the land surface. Pumping in this reach would not affect streamflow, but because of the proximity of negative barriers, the water table might decline considerably. Farther downvalley the depth to water increases, probably to as much as 600 feet near the mouth of the valley.

Introduction and physical setting

This brief report was written in response to a request from the U.S. Bureau of Reclamation for a preliminary evaluation of the ground-water possibilities in the Birch Creek valley.

Birch Creek basin, in eastern Idaho (fig. 1), adjoins the Snake River Plain along its northern flank. The central two-fifths of the

Fig. 1.--Sketch map showing location and physical features of the Birch Creek basin.

basin is a broad alluvial filled valley in a southeast-trending down-dropped fault block. The flanking mountains rise to altitudes of 10,000 to 11,000 feet, some 4,000 feet above the valley floor. The strata in the mountains, and presumably the rocks underlying the alluvial and volcanic rocks of the valley, are chiefly limestone and shale of Paleozoic

Figure 1.--Sketch map showing locations and physical features of the Birch Creek basin.

age. The valley is about 40 miles long and 5 to 10 miles wide, and is as wide at the head of the valley as at the mouth. The alluvial fill was deposited chiefly as fans by streams from the flanking mountains. The role of Birch Creek in the deposition has been minor; along its course it has reworked and sorted the sand and gravel to a limited extent. The depth of the alluvium is not known, but considering the width of the valley and steep slope of the flanking mountains, it seems that it probably is at least several hundred, and perhaps one or two thousand feet thick.

About in the middle of the valley basaltic lava flows crop out (fig. 1) in an uplifted fault block on the upvalley side (north) of a normal fault which extends eastward across the valley. The basalt extends about 3 miles downvalley and probably extends entirely across the valley; however, younger alluvium overlies the basalt at places and obscures its extent. Near the center of the valley Birch Creek has cut a canyon in the basalt.

The U.S. Bureau of Reclamation (written communication, Jan. 1959) investigated a possible reservoir site at the upper end of the canyon in 1958. Core holes at the site of the proposed dam showed that basalt had been entirely removed from within the canyon at the site, and that alluvial sand and gravel, 40 to 50 feet thick, had been deposited upon conglomerate. Other core holes showed that the basalt was underlain by the conglomerate at approximately the same altitude at the margins of the canyon (20 to 50 feet below the canyon floor). The conglomerate is not exposed in the canyon, either at the site, or in the 3-mile canyon section downstream from the site. According to the Bureau of Reclamation the basalt dips to the northeast (diagonally upstream) at an angle of 10 degrees. The fact that only basalt is exposed in the canyon walls through its entire length, even though the upstream component of dip is several degrees, and the conglomerate underlies the basalt at an elevation of 20 to 50 feet below the floor at upstream end of the canyon may be explained by faulting. At some point downstream from the proposed dam site the basalt probably extends far below the canyon floor. Whatever the exact situation may be, the basalt, or basalt and conglomerate together, with their upstream dips, act as a barrier to downvalley flow of ground water.

Surface flow

Birch Creek rises from a large number of springs which discharge from alluvium in a basinal area covering a few square miles immediately upvalley from the barrier (fig. 1). The gaging station near Reno is in the canyoned gap in the basalt. Streamflow is almost entirely from ground-water inflow. In fact, a few miles upvalley from the spring area it proved difficult to find the stream channel. The channel is only about a foot deep, and 2 or 3 feet wide, and was dry on August 26, 1960. Surface water flows in this channel only rarely, and then only in small amounts.

The flow of Birch Creek is uniform (see table). The mean monthly discharge generally does not vary more than 10 to 15 percent during any one year. Discharge is greatest in April and May, when it averages 3 to 4 cfs (5 percent) more than in the winter months. This slight increase probably is due to snowmelt and precipitation in the immediate vicinity of the springs. Discharge in July and August is least, probably because of use of water by phreatophytes within the spring inflow area and adjacent to the creek above the gaging station, and because of minor diversions for irrigation. The average discharge for July, which has the lowest average discharge, is 76.8 cfs, only 6.8 cfs less than the average for May, 83.6 cfs, which has the highest average discharge.

For the 12 complete years of record given in the table, mean annual discharge has varied slightly less than 18 percent, from a low of 75.3 cfs in the 1957 water year to a high of 88.6 in the 1911 water year.

Mean monthly, and annual discharge, in cubic feet per second (cfs, of Birch Creek near Reno.

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Aver. Ann.
1911	94.0	88.0	88.0	93.0	90.0	92.2	88.5	87.1	88.9	83.2	83.3	86.7	88.6
1912	91.1	92.2	92.4	95.9	96.6	96.3	99.0	93.3	86.5				
1921							86.6	91.0	77.3	74.7	81.5	79.4	
1922	83.8	84.1	83.6	83.8	84.5	83.5	87.2	89.5	85.4	80.8	86.4	86.7	84.9
1951	74.3	75.8	77.9	76.3	80.0	79.0	79.0	79.2	74.8	74.9	77.2	77.5	77.1
1952	78.3	76.9	77.3	82.2	81.4	79.3	82.2	80.3	76.6	74.4	71.1	73.1	77.7
1953	75.1	74.0	76.3	79.2	80.1	75.3	79.1	80.3	80.0	73.0	70.5	72.0	76.2
1954	72.9	74.8	81.1	80.5	82.4	80.9	83.5	80.5	82.4	80.0	77.0	75.8	79.3
1955	72.7	76.6	76.3	76.6	74.9	74.6	75.2	82.5	76.9	74.4	76.7	74.2	76.0
1956	75.1	76.2	75.6	76.5	75.4	72.5	76.5	79.6	80.2	77.8	73.7	73.8	76.1
1957	75.7	76.9	75.1	73.4	76.0	76.4	76.7	77.7	74.0	72.1	72.7	76.8	75.3
1958	77.9	77.3	75.9	76.6	75.3	81.7	79.9	77.6	76.7	73.8	72.8	74.8	76.7
1959	76.5	78.2	79.7	79.3	77.2	73.4	79.2	82.0	80.1	79.6	82.1	86.4	79.5
1960	84.5	81.0	79.1	81.4	85.3	89.1	87.6	89.4	87.1	79.6	83.6	84.1	84.3
Ave.	79.4	79.4	79.9	81.1	81.5	81.1	82.9	83.6	80.5	76.8	77.6	78.6	79.3
Ave., 1951-60	76.3	76.8	77.4	78.2	78.8	78.2	79.9	80.9	78.9	76.0	75.7	76.8	77.8

Aquifer evaluation

Practically all the ground-water recharge to the Birch Creek basin is derived from snowmelt and rainfall on the flanking mountain ranges. Because these mountains have no precipitation stations and few snow stations, the best index to variations in recharge probably is the streamflow from a nearby basin where ground-water outflow is a minor component of the outflow. The basin above Wild Horse, on the Big Lost River about 50 miles to the west, is such a basin, and the records of discharge at the Wild Horse gage are a reasonably good index of the variations in recharge to the Birch Creek basin.

The flow of the Big Lost River at Wild Horse is believed to respond rather quickly to changes in precipitation, probably with a lag of not more than a few months. During the ten years from October 1950 through September 1960, mean annual streamflow at this station ranged from a low of 63.9 in 1959 to a high of 140 cfs in 1952, a range of more than 100 percent. Comparison of mean annual discharges of the two streams (fig. 2) shows that changes in the discharge of Birch Creek lags behind changes in discharge of the Big Lost River by about 2 years. This

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Fig. 2.—Mean annual discharge of Big Lost River at Wild Horse, Birch Creek near Reno and cumulative departure of mean discharge of Birch Creek near Reno.

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suggests that changes in discharge of Birch Creek may lag behind recharge to the aquifers feeding the creek by more than 2 years.

The uniform discharge of Birch Creek, and the probable long lag between recharge to and discharge from the aquifer, indicate a large storage volume in the aquifer. The alluvial aquifer upvalley from the springs is about 16 miles long and averages 8 miles wide. Whether the consolidated rocks in the adjoining mountains store and transmit any significant amounts of water is not known.

The large underground reservoir upvalley from the basalt barrier could be used for development of water supplies for irrigation. No well records are available, but it seems likely that wells of large yield could be developed at shallow depths in the alluvium. The extent that such wells would reduce streamflow during the irrigation season depends upon aquifer characteristics, and the distance of the wells from the spring outlets. To evaluate these factors quantitatively would require exploratory holes for determining the depth and character of the aquifer, and pumping tests for determining the coefficients of transmissibility and storage. However, analogy with similar alluvial deposits in other valleys bordering the Snake River Plain suggests that wells 2 or 3 miles from the spring outlets would cause little more diminution of spring outflow during the irrigation season than they would during other seasons of the year. That is, diminution of discharge would be fairly evenly distributed throughout the year. Assuming such uniform distribution, diminution of discharge by ground-water pumping during a 90-day ($\frac{1}{4}$-year) irrigation season, after a number of years under the changed water regimen during which equilibrium was being reestablished, would amount to 25 percent ($\frac{1}{4}$) of the total pumped during the 90-day period. Thus, the

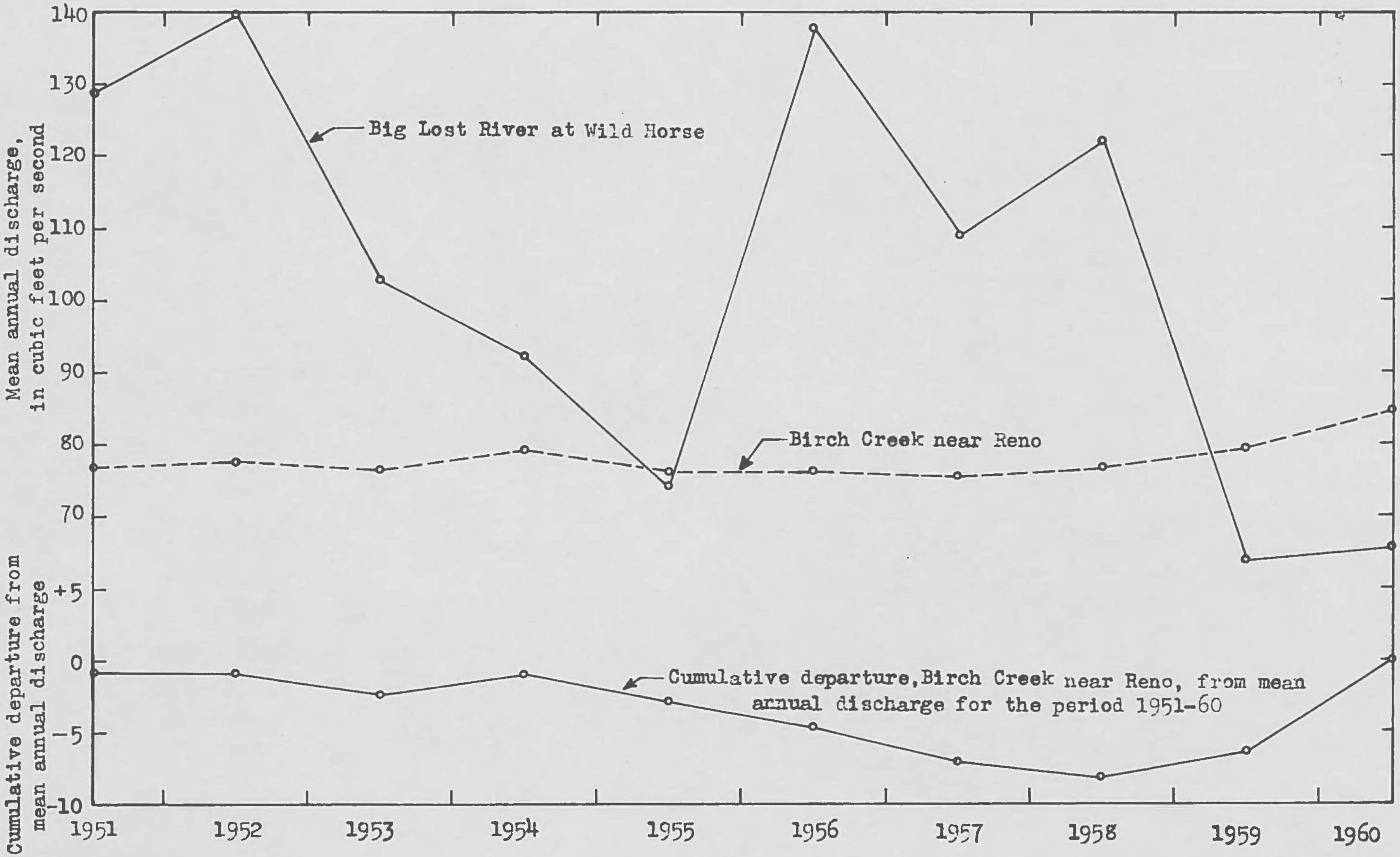

Figure 2.—Mean annual discharge of Big Lost River at Wild Horse, Birch Creek near Reno, and cumulative departure of mean discharge of Birch Creek near Reno.

total water available (Q) during the 90-day irrigation season would be equal to the amount pumped (P) plus the amount of spring discharge (streamflow)(S) that would have occurred if there had been no pumping minus $\frac{1}{4}$ the amount pumped ($\frac{1}{4}$P), or $Q = P+S - \frac{1}{4}P = \frac{3}{4}P+S$. This equation holds to a maximum of about 320 cfs, 4 times the average annual streamflow that would have occurred without pumping. For example, if 100 cfs were pumped each year during the 90-day irrigation season, the average spring discharge eventually would be reduced from about 80 to 55 cfs. However the water available during the irrigation season, after stabilization was established, would be 100 + 80 - 25 = 155 cfs instead of 80 cfs. During the many years before stabilization was reached, the total available during the irrigation season would exceed 155 cfs.

Ground water also might be obtained for irrigation from wells in the valley below the basalt barrier. Recharge to this reach of the valley is derived from leakage from Birch Creek and from the irrigation canal which diverts water from the creek, surface and underground inflow of tributary streams below the barrier, and leakage through the barrier and possibly through alluvium which may underlie the basalt barrier at depth.

The few wells in the 2-mile reach of the valley below the barrier, in the vicinity of Blue Dome, are as much as 100 feet deep and the depth to water is reported to be about 30 feet. The depth to water in a well at the Reno Ranch, on the Snake River Plain a few miles east of the mouth of Birch Creek valley, is reported to be about 535 feet. The water table on the Snake River Plain opposite the mouth of Birch Creek valley, in the south 2/3 of T. 7 N., R. 31 and 32 E. is at an altitude between 4,580 and 4,585. Because the altitude of the land surface at the mouth of the valley is generally more than 5,200 feet, the depth to water probably exceeds 600 feet. No information is available regarding the depth to water between the mouth of the valley and the vicinity of Blue Dome. The water table is possibly within a reasonable pumping lift for a distance of several miles downvalley from the barrier. Pumping in this area would not decrease streamflow as it would in the valley above the barrier. However, the water table might decline more rapidly because of the proximity of a negative barrier caused by the basalt (instead of the positive boundary represented by the spring discharge area). Test wells and aquifer tests would be needed for any quantitative analysis of the aquifer.