Ground Water in the Vicinity of American Falls Reservoir, Idaho

By M. J. MUNDORFF

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By M. J. Mundorff

ABSTRACT

Analysis of ground- and surface-water relationships suggests that increasing the capacity of the American Falls Reservoir by raising the height of the dam 15 feet would increase leakage from the reservoir by less than 0.2 percent of the average inflow to the reservoir, or less than 10,000 acre-feet per year. This amount is less than one-tenth of the evaporation rate from the reservoir.

The American Falls Reservoir lies near the south margin of the Snake River Plain in southeastern Idaho. The Snake River Plain is about 200 miles long and averages nearly 60 miles in width. It is underlain by a thick sequence of basaltic lava flows, interbedded pyroclastics, and sedimentary deposits. The uppermost few thousand feet of this sequence is the Snake Plain aquifer, one of the great aquifers of the United States.

Recharge to the aquifer is chiefly by water percolating from the Snake River, its tributaries, and irrigated tracts, and by underflow from surrounding areas. Ground water moves generally southwestward and discharges to the Snake River through springs in the American Falls Reservoir reach and in the Hagerman Valley reach (between Twin Falls and Bliss). Total discharge from the aquifer is about 9,000 cfs (cubic feet per second).

The occurrence and movement of ground water in the vicinity of American Falls Reservoir are controlled by the local geology. Silt and tuff in the Neeley Formation and the Walcott Tuff and silt and fine sand in the Raft Formation and American Falls Lake Beds have a low permeability. These rocks transmit little ground water compared with the basalt and intercalated pyroclastics and gravels of the Snake Plain aquifer. The less permeable deposits underlie the reservoir area and act as a barrier to the movement of ground water.

Under present conditions the water table on the periphery of the reservoir slopes toward the reservoir, except within 3 or 4 miles of the dam, where the water table slopes away from the reservoir. Most of the springs discharge at altitudes above 4,370 feet, some 15 feet above the maximum reservoir stage. Thus, reservoir stage has little effect on ground-water inflow to the reservoir.

A fairly close relationship exists between the annual amount of surface water diverted for irrigation of lands up the Snake River from the reservoir and the annual ground-water discharge through springs for the period 1911–60. After about 1952, greatly increased ground-water withdrawals from wells, which increased consumptive use, virtually balanced increased diversions from the surface-water system for irrigation, so that ground-water inflow to the reservoir remained about constant.

All or nearly all the seepage loss from the reservoir reappears at the surface as seeps or springs along the reach between American Falls Dam and Minidoka Dam. Rough estimates of seepage loss were made from water-budget calculations below the reservoir and by extrapolating spring-flow data below the reservoir. Although both estimates are in close agreement, neither is probably reliable except as an order of magnitude. The best estimates are as follows:

Existing seepage loss: average, 60 cfs; maximum, 80 cfs.

Seepage loss if dam is raised 15 feet: average, 70 cfs; maximum, <100 cfs.

The net effect of raising the maximum reservoir stage by 15 feet would be twofold: seepage loss would be increased by about 10 cfs, and some areas in the vicinity of Sterling and Springfield would become waterlogged. The decrease in annual inflow to the reservoir would probably be negligible.

INTRODUCTION

American Falls Reservoir (fig. 1) is on the Snake River in southeastern Idaho. It is the largest reservoir for storage of irrigation water in Idaho (1.7 million acre-ft. capacity at an altitude of 4,354.50 ft. above sea level). American Falls Dam is not only downstream

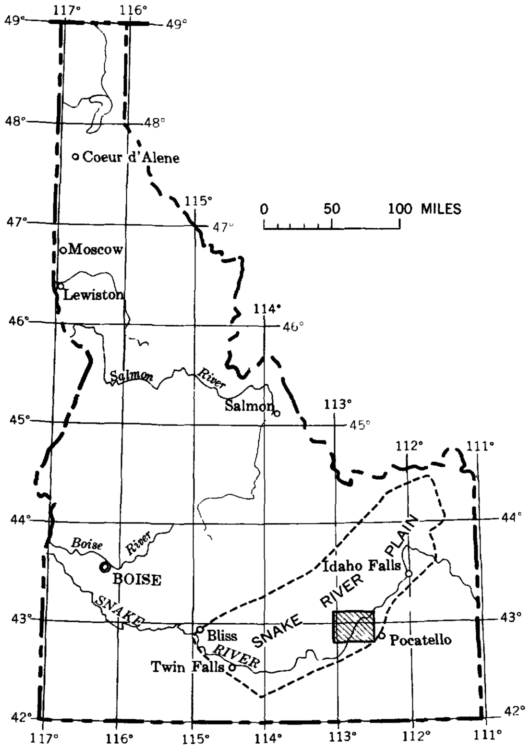

FIGURE 1.—Location of area described in this report (shaded).

from all major tributaries in eastern Idaho (except Big Wood River), it also receives ground-water inflow averaging about 2,500 cfs (cubic feet per second) in the reservoir reach and in the river reach several miles upstream from the reservoir. Irrigation agriculture is the dominant factor in the economy of southern Idaho, and American Falls Reservoir is an integral part of the Bureau of Reclamation's plans for the development of the water resources of the area for irrigation.

PURPOSE AND SCOPE OF INVESTIGATION

The investigation was undertaken in cooperation with the U.S. Bureau of Reclamation. The Bureau was investigating the practicality of substantially increasing the capacity of the American Falls Reservoir by raising the height of the dam. Raising the dam 10 feet would provide an additional capacity of 600,000 acre-feet; a dam 15 feet higher would increase the capacity by about 900,000 acre-feet. The Bureau asked the Geological Survey to supply information concerning the effects on the hydrologic regimen that would be caused by raising the dam.

This report presents a semiquantitative appraisal of the effects of the proposed changes on the hydrologic regimen and gives estimates of the quantities of water involved. Water budgets are prepared for the reservoir reach and for the reach of the Snake River immediately downstream between Neeley and Minidoka, using all available data.

The report discusses the extent of the ground-water inflow to the reservoir and the effect of change in reservoir stage on amount and location of ground-water inflow. The amount and location of the present seepage losses from the reservoir are also discussed. The report includes information on the relationship between reservoir stage and the amount of seepage loss and comments upon the amount of seepage losses to be expected with an increase in stage. Finally, the report discusses what effect the raising of the reservoir stage will have on drainage of adjacent irrigated lands and ground-water inflow to the reservoir.

The following methods of investigation were used in carrying out the investigation: The surficial geology was compiled in part from a manuscript geologic map prepared by Trimble and Carr of the Geological Survey, supplemented by geologic mapping on aerial photographs and by the use of miscellaneous geologic data in the files of the Geological Survey. All available well logs were collected, studied, and correlated. Graphic sections were prepared to show the geologic controls on the movement of ground water. Water levels were measured periodically in about 45 wells; several continuous water-level recorders were maintained to provide information on the relation of irrigation to water level and the relation of reservoir stage to water level. Periodic discharge measurements were made at several places to find the seasonal variations of inflow and outflow.

Fieldwork included geologic mapping, well canvassing, measuring of water levels in a large number of wells (once in the autumn and again in the spring), periodic measuring of water levels in selected observation wells, and measuring discharge at selected spring outlets. The U.S. Bureau of Reclamation determined the altitudes of the measuring points of about 190 wells in the area.

PREVIOUS STUDIES

The investigation was greatly facilitated by information contained in reports of previous investigations. These reports are listed in "References."

The earliest known geologic map of any part of the area was made by Mansfield (1920), who mapped the northeast end of the reservoir area. Piper (1924) mapped the surficial geology of the southwestern part of the area in connection with a two-county study of petroleum possibilities, and his geologic findings have been drawn upon in this report. Hydrologic and geologic studies to evaluate reservoir-site conditions were made by personnel of the U.S. Bureau of Reclamation prior to construction of the American Falls Dam from 1922–26 (written commun., D. L. Crandall, January 18, 1961). In 1927 and 1928, T. R. Newell (1928, 1929) made a detailed hydrologic study of the reservoir area and compiled a water budget for the area. He developed a formula for computing ungaged ground-water inflow to the reservoir basin that is still being used. During the period 1928–30, Stearns, Crandall, and Steward (1938) studied the ground-water resources of the entire eastern Snake River Plain and mapped the geology of the plain, including the American Falls Reservoir area.

In September 1934, C. P. Berkey (1934) made a brief reconnaissance of the geology of the reservoir area to appraise potential reservoir leakage if the dam were raised. A report by Debler and Riter (1935) evaluated inflow, outflow, bank storage, and seepage losses. Both of these appraisals are of interest because they are based on procedures that are similar to the ones used in the present analysis. In 1950–51, the U.S. Bureau of Reclamation drilled a number of core holes immediately downstream from American Falls Dam to determine the subsurface geologic conditions, and the geology of the reach below the dam was mapped in detail (Jarrard and Mead, 1951, 1952). The logs of these test holes were used in this report to prepare the fence diagram showing the subsurface geology near the southwest end of American Falls Reservoir.

In 1952 the U.S. Geological Survey, in cooperation with Water District 36 and the Idaho Department of Reclamation, began a continuing program for measuring water levels in observation wells near the reservoir (Shuter, 1953; Sisco and Luscombe, 1961). During 1956–59 the Geological Survey, in cooperation with the U.S. Bureau of Reclamation, made a quantitative appraisal of the ground-water resources of the Snake River Plain (Mundorff and others, 1960). That report was regional in scope and covered all the area covered by this report as well as contiguous areas.

In 1957, members of the Geological Survey began mapping the geology of several quadrangles in the area, including the American Falls, Rockland, Yale, and Michaud 15-minute quadrangles. Mapping in some of the quadrangles was in progress in 1962. Carr and Trimble's (1963) geologic map of the American Falls quadrangle helped in delineating the geology both in the vicinity of the dam and in the strip along the west side of the reservoir.

ACKNOWLEDGMENTS

The study was financed by the U.S. Bureau of Reclamation. The friendly cooperation of well drillers and well owners in this area is gratefully acknowledged. The Falls Irrigation District, the Aberdeen-Springfield Canal Co., the Idaho Department of Reclamation, and the U.S. Bureau of Reclamation furnished information from their files and cooperated in other ways.

WELL-NUMBERING SYSTEM

The well-numbering system used in Idaho by the Geological Survey indicates the location of wells within the official rectangular subdivisions of the public lands with reference to the Boise base line and meridian. The first two segments of a number designate the township and range. The third segment gives the section number followed by two letters and a numeral which indicate the quarter section, the quarter-quarter section or 40-acre tract, and the serial number of the well within the tract. Quarter sections are lettered a, b, c, and d in counterclockwise order from the northeast quarter of each section (fig. 2). Within the quarter sections, 40-acre tracts are lettered in the same manner. Well 7S–30E–12ca1 is in the NE¼SW¼ sec. 12, T. 7 S., R. 30 E. and is the first visited well in that tract.

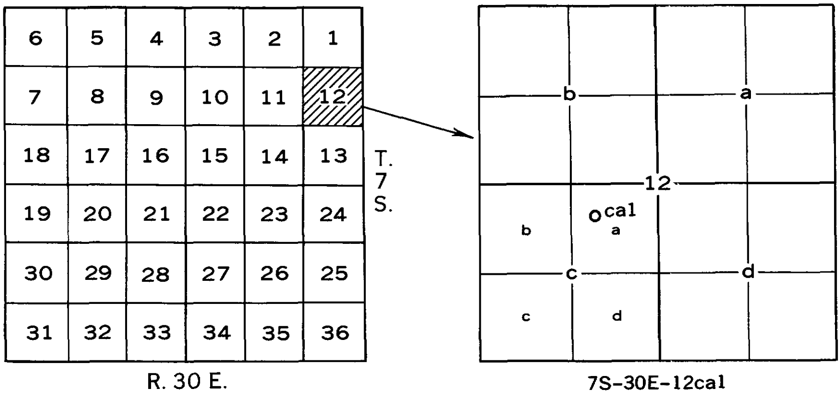

FIGURE 2.—Well-numbering system.

GEOLOGIC SETTING AS RELATED TO THE WATER REGIMEN

The occurence and movement of water in and on the earth are controlled largely by geologic factors. Hydraulic characteristics of the surficial materials are a major factor in ground-water recharge because they control percolation from surface-water bodies. The porosity and permeability of formations are essential to the storage and movement of ground water. Geologic boundaries and spatial relations of geologic units control direction of movement of ground water and determine the places of ground-water discharge.

GENERAL PHYSICAL SETTING

American Falls Reservoir is in the Snake River Plain of eastern Idaho adjacent to the southeast margin of the plain. The hydrologic regimen of the reservoir is closely related to the geology and hydrology of the entire Snake River Plain east of Bliss; so the general features of the plain are described to provide a background for a more detailed description of the reservoir area.

The Snake River Plain (pl. 1) extends northeastward from Bliss nearly to the eastern boundary of the State, a distance of about 200 miles. Its width ranges from about 40 to 65 miles and averages nearly 60 miles. At the northeastern end the altitude of the surface is about 6,000 feet above sea level, and at the western end it is about 3,200 feet. The altitude in the American Falls Reservoir area ranges generally from 4,300 to 4,600 feet. The area is semiarid; the annual precipitation averages about 13 inches at American Falls and 8 inches at Aberdeen.

The Snake River Plain is underlain by a thick sequence of basaltic lava flows, interbedded pyroclastics, and sedimentary deposits. The sequence accumulated in a structural trough between much older rocks of the mountain ranges that flank the trough along the northwest and southeast. The total thickness of the fill in the trough is not known, but it is believed, on the basis of geophysical evidence, to exceed 10,000 feet at some places (LeFehr, 1961, p. 25–28).

The central part of the plain is generally higher than the margins and contains many lava domes and cones, indicating that at least in late stages of volcanism, the basalt spread from the central part of the plain towards the northwest and southeast flanks. In the process, the Snake River was crowded against the southeast flank of the plain. Sedimentary interbeds, deposited in stream channels, flood plains, and lakes, are thick and extensive along and adjacent to the present course of the Snake River, whereas they are thin or absent toward the central part of the plain.

The uppermost few thousand feet of basalt flows, pyroclastics, and sedimentary interbeds compose the Snake River Group. These rocks form a great aquifer system—the Snake Plain aquifer—that stores and transmits large amounts of water. Precipitation on the plain is generally less than 8 inches annually, so recharge from that source is small. Chief sources of recharge to the aquifer are percolation from the channels of the Snake River, Henrys Fork, and other streams; percolation from canals and irrigated tracts; and underflow from peripheral valleys and highlands. Although perched aquifers have developed at several places, particularly beneath irrigated tracts that are underlain by surficial or near-surface fine-grained sedimentary deposits, the regional water table is well defined at most places. Contours and flow lines indicating the shape of the water table and the direction and quantity of underflow in the Snake Plain aquifer are shown on plate 1.

The consolidated rocks bordering the Snake River Plain and the fine-grained sedimentary deposits that occur at some places on the edges of the plain have low permeabilities. The margin of the Snake Plain aquifer is the contact between the basalt and the consolidated rocks or the sedimentary deposits of low permeability. Alluvial valleys between the mountain ranges on the margin of the plain contribute considerable underflow to the plain. Some valleys along the northwest flank contain water tables that are several hundred feet higher than the one in the Snake Plain aquifer nearby. In other valleys, the water tables merge with the water table beneath the plain.

The aquifer discharges to the Snake River chiefly in two reaches: between the mouth of the Blackfoot River and American Falls (American Falls Reservoir reach), and between Milner Dam and Bliss (Hagerman Valley reach). Discharge in these two reaches is caused by the specific spatial relationships of the aquifer to aquitards (geologic units of low permeability) in the reach. In the Hagerman Valley reach, the contact between the aquifer and underlying aquitard intersects the canyon of the Snake River at an altitude generally 100–200 feet above river level, and springs issue at or above that contact. In the American Falls Reservoir reach the contact is generally 20–45 feet above maximum reservoir level.

Discharge from the aquifer during the past decade has averaged about 6,500 cfs in the Hagerman Valley reach and about 2,500 cfs in the American Falls reach.

GEOLOGIC UNITS AND THEIR WATER-BEARING CHARACTER

Areal distribution of geologic units is shown on two maps (fig. 3; pl. 2). The subsurface geology in the vicinity of American Falls Dam and at the southwest end of the reservoir is shown by a fence diagram (pl. 3) and a geologic section (pl. 4).

The limited time available for the investigation did not permit detailed geologic mapping of extensive areas. The map by Stearns, Crandall, and Steward (1938, pl. 6) and the maps by Jarrard and Mead (1951, pls. 1 and 2; 1952, pl. 1) were modified by the author to make the map of the geology in the vicinity of the American Falls Dam (fig. 3). The geologic map of the American Falls quadrangle (Carr and Trimble, 1963) helped in delineating the geology in the reservoir. The geology northeast of the American Falls quadrangle shown in figure 3 is based entirely on the author's observations.

A brief reconnaissance of the shoreline was made by the author at low reservoir stages. Large-scale aerial photographs of the west shoreline and the north end of the reservoir were supplied by the Bureau of Reclamation. The aerial photographs were taken at a low reservoir stage on October 1, 1959, when the water surface was at an altitude of 4,307.5 feeet, about 47 feet below the maximum level. Mapping at a low reservoir stage permitted delineation of geologic units not visible when the reservoir is full.

The geology of the strip along the west shore and the north end of the reservoir (pl. 2) was mapped because of its influence on the ground water of the area. Three thick units crop out along the shore: the Raft Formation, the Big Hole Basalt of the Snake River Group, and the American Falls Lake Beds. Surficial deposits, including terrace sand and gravel, and windblown deposits, blanket much of the area. Generally, these deposits are less than 10 feet thick and were omitted from the map so that the distribution of the thicker, underly-

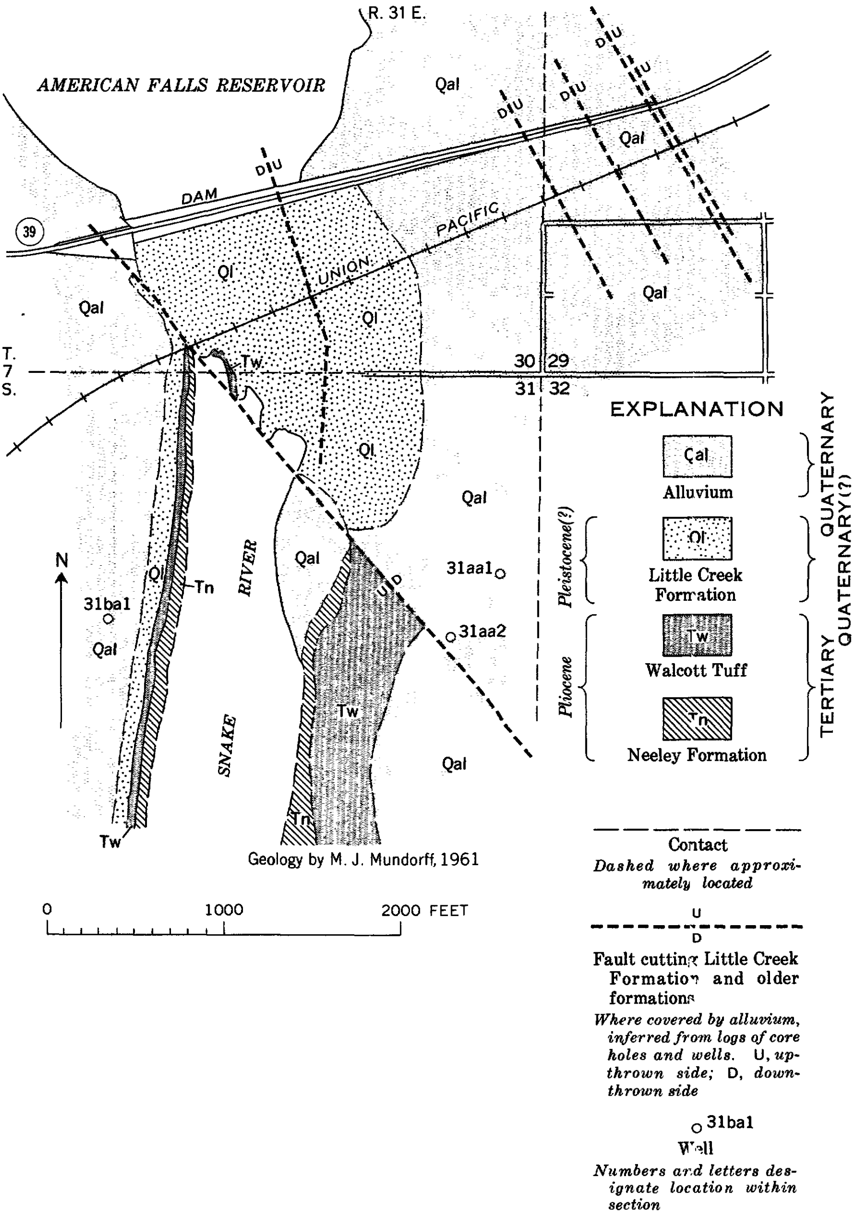

FIGURE 3.—Geology in the vicinity of American Falls Dam.

ing units could be shown. Along the west shore of the reservoir are one or more terraces, which range in altitude from about 4,390 feet at the southwest end to about 4,370 feet at the north end of the reservoir. Wave action has cut back along the reservoir shoreline so that a nearly vertical bluff extends from the terrace down to maximum pool altitude at about 4,355 feet.

The Snake River Plain is underlain by a thick sequence of basalt lava flows and interbedded pyroclastics and sedimentary deposits. According to Kirkham (1931), the basin in which they accumulated was formed by downwarping. More recently, geologists have suggested that faulting has been a major process in forming the structural trough (LeFehr, 1961). The geologic units and their water-bearing characteristics are shown in table 1.

STRUCTURAL CONTROL OF GROUND WATER

Most of the sedimentary units were deposited in nearly horizontal layers. Some of the older formations, including the Neeley Formation, the Walcott Tuff, and the Little Creek Formation, have subsequently been faulted, tilted, and locally, slightly folded. The Walcott Tuff dips about 3 degrees northwestward down Ferry Hollow. Well logs from the vicinity of American Falls Dam also suggest a northwesterly dip of this formation. The Neeley Formation and Walcott Tuff crop out in the low rolling hills southeast of American Falls at altitudes as high as 4,600 feet, which is more than 300 feet higher than their outcrop along the Snake River 2 miles to the northwest. It is not known how much of this difference in altitude is due to tilting and how much is due to displacement by faulting.

A series of high-angle normal faults trending northwestward has offset the geologic units older than the Raft Formation. The faults are clearly visible in the canyon of the Snake River below American Falls Dam, but they are covered elsewhere by younger formations (Raft Formation, Big Hole Basalt of the Snake River Group, American Falls Lake Beds, and alluvial and windblown deposits) which were not faulted. Away from the canyon and upstream from the dam, the fault traces can be inferred only from well logs and water-level data.

Stearns, Crandall, and Steward (1938, pl. 6) showed eight faults crossing the Snake River Canyon in a 3.5 mile reach below the dam. The trend of all the faults ranges from slightly north of west to northwest. Several faults are shown cutting the section beneath the dam in the fence diagram (pl. 3). Displacement ranges from a few feet to about 50 feet, and the strike is northwest. These faults are inferred from core holes drilled by the Bureau of Reclamation in 1926. The approximate location and trend of the faults are also shown in figure 3.

TABLE 1.—*Character and water-bearing properties of geologic units in the American Falls Reservoir area*

[Geologic units after Carr and Trimble (1963)]

System	Series	Stratigraphic unit	Thickness (feet)	Character and distribution	Water supply
Quaternary	Recent and upper Pleistocene	Dune sand, alluvium, terrace deposits, and thin loessial deposits	0–50	Unconsolidated wind-blown sand and silt, and fluviatile clay, silt, sand, and gravel discontinuously overlying older formations around the reservoir. Not shown in fig. 4.	Upstream from the reservoir the coarse deposits yield moderate to large supplies to wells where they occur below the water table. Along the west and southeast sides of the reservoir the deposits are above the water table.
	Upper Pleistocene	-Unconformity- American Falls Lake Beds	0–80	Partly consolidated medium- to thin-bedded clay, silt, and fine sand with a persistent but discontinuous thin layer of gravel at the base. Crops out on both sides of the reservoir for many miles above American Falls and along the river below American Falls.	Yields small supplies to domestic and stock wells. Discharges a significant amount of water to reservoir from gravel at base of formation.
	Upper or middle Pleistocene	-Unconformity- Basalt of the Snake River Group (includes Big Hole Basalt)	1,000+	Medium- to dark-gray, fine- to medium-grained, commonly vesicular basalt flows, locally separated by basaltic pyroclastic rocks. Lake, playa, and stream deposits interbedded with the flows at some places. Intertongue with and overlie the Raft Formation on the west side of the reservoir.	Basalt flows and pyroclastic rocks (Snake Plain aquifer) yield large quantities of water to wells. The principal source of ground water for irrigation west, north, and northeast of the reservoir.
		-Unconformity- Raft Formation	75–200+	Light-colored poorly bedded silt and fine sand with a few clay beds, a few local beds of basaltic and rhyolitic tuffs, and some gravel in the lower part. Underlies most of the American Falls Reservoir and extends an undetermined distance west and southwest of the reservoir.	Sandy and gravelly beds yield small amounts of water to wells. Not a principal aquifer in the American Falls area.
Quaternary(?)	Pleistocene(?)	-Unconformity- Little Creek Formation	15–100	Medium- to dark-gray dense to fine-grained, somewhat vesicular basalt, and white, buff, red, and brown basaltic and rhyolitic tuff with some conglomerate lenses. Underlies the southwestern part of the area.	Appears to be moderately permeable. Probably a major source of irrigation water in the Michaud Flats Project and west of American Falls.
Tertiary	Middle Pliocene	-Unconformity- Walcott Tuff	15-50	White bedded rhyolitic tuff, black obsidian welded tuff, and red welded tnff. Central part perlitic and spherulitic. Exposed in the canyon of the river below American Falls and south of American Falls.	Yields moderate amounts of water to wells and is the chief aquifer for some wells in the Michaud Flats Project.
		Neeley Formation	30–150	Tan to brown fine- to coarse-grained rhyolitic tuff with lenses of gravel and a few beds of white marl. Exposed in the canyon of the river, but subsurface extent not known.	Sandy and gravelly beds probably yield some water to wells in the Michaud Flats Project.

The hills southeast of American Falls receive more precipitation than the plain, and outcrops of the tuff units in these hills are conducive to recharge. The transmissibility of most aquifers is much greater parallel to the bedding than across the bedding, so that the dip of the aquifers from the area of recharge toward the area of discharge (American Falls Reservoir and the Snake River) materially aids the movement of ground water. Under this condition one might expect the water table to be near river level at the edge of the upland bench near the Snake River. However, it is generally considerably above river level. The considerable differences in altitude of the water table in some wells that are close together could be due to the fact that the wells are on opposite sides of a fault.

WATER REGIMEN IN THE AMERICAN FALLS RESERVOIR AREA

Undoubtedly there was a large spring inflow to the American Falls Reservoir reach when the first settlers arrived in the area; certainly irrigation has greatly increased the inflow volume. An understanding of the effects of irrigation and of ground-water withdrawals on spring inflow in the reach is essential to an appraisal of the current water regimen.

A large tract of land (the Aberdeen-Springfield tract) adjacent to the American Falls Reservoir at the north end and along the west and northwest sides of the Snake River is irrigated with surface water diverted from the Snake River upstream from Blackfoot. The tract includes about 63,000 acres extending in a strip about 2–6 miles wide adjacent to the entire length of the reservoir and for about 20 miles upstream from the northeast end of the reservoir. The higher lands west and northwest of the Aberdeen-Springfield tract have been irrigated with ground water since the late forties. Large amounts of ground water were withdrawn in the fifties, and in 1961 the pumpage was about 400,000 acre-feet for the irrigation of about 125,000 acres.

The Fort Hall tract includes about 35,000 acres on the east side of the Snake River upstream from the head of the reservoir, between Blackfoot and Pocatello, and is irrigated with the surface water diverted from the Blackfoot and Snake Rivers. The Michaud Flats Project of the U.S. Bureau of Reclamation (which contains the Falls Irrigation District) includes a strip of land 1–3 miles wide extending about 8 miles northeast and an equal distance southwest of American Falls. Part of the area is irrigated with surface water from the reservoir, and part is irrigated with water from wells.

The Raft Formation and American Falls Lake Beds intertongue with the Snake Plain aquifer upstream from American Falls and have only a small fraction of the transmissibility of the Snake Plain aquifer. Consequently, the large amount of underflow moving southwestward in the Snake Plain aquifer in the vicinity of Blackfoot and Moreland discharges into the American Falls Reservoir reach because the Snake Plain aquifer pinches out between the Raft Formation and American Falls Lake Beds near the reservoir. Part of the ground water bypasses to the north of the reservoir. The altitude of the reservoir area is low compared with the altitude of the water table to the north and east, and a large part of the underflow comes to the surface in the reservoir area.

Some of the largest springs discharge from stream gravels at the base of a terrace adjacent to the southwest side of Ferry Butte, 9 miles northeast of American Falls Reservoir (pl. 2), at an altitude of about 4,410 feet. Because well logs for the area are lacking, details of the relation of the gravels to basalt are not known.

Many other springs discharge from gravel, particularly in the river reach between Ferry Butte and the head of the reservoir. Spring outlets in this reach are at altitudes of 4,365–4,410 feet. At the north end and along the west side of the reservoir, most of the discharge is from basalt above the contact with underlying clayey or silty deposits. Most spring outlets in that area are at altitudes of 4,370–4,390 feet.

In the vicinity of Springfield and Sterling, aquifers of sand and gravel, chiefly at depths of 225–250 feet, pinch out into fine-grained deposits. The water in the sand and gravel aquifers is under sufficient pressure to cause it to rise a few feet above the land surface in many cased wells. Wherever overlying confining beds are thin or absent, water from these aquifers leaks upward to add to the discharge from the springs. The location of selected wells and of most large springs is shown on plate 5.

DEVELOPMENT OF DIVERSIONS FOR IRRIGATION

Irrigation diversions to the Snake River Plain upstream from the American Falls Reservoir reach began about 1880. According to Simons (1953, p. 60–65) and to Ross (1901, p. 13, 61), the sudden increase in the use of irrigation in eastern Idaho occurred between 1895 and 1900. The data from Simons (1953, p. 65) show that the area irrigated in Idaho upstream from the American Falls Reservoir reach (by diversions upstream from Blackfoot), exclusive of headwaters areas, was about 1,000 acres in 1880, 47,000 acres in 1890, 225,000 acres in 1900, 310,000 acres in 1905, and 530,000 acres in 1945. According to the report by Ross, 41,000 acres was irrigated in the area (Bingham County) in 1889, 65,000 acres (upstream from American Falls but excluding Ross Fork and Portneuf River drainages) in

1896, and 211,000 acres in 1900. Thus, it appears that prior to 1896, diversion of water for irrigation was not a major factor in recharge of the aquifer, but that by 1900 it had become important. The irrigated area and the diversions to the area from 1910 to 1960 are given in table 2.

FLUCTUATIONS OF THE WATER TABLE

Information regarding the depth to water or the shape of the water table prior to irrigation of the Aberdeen-Springfield tract in 1910 is practically nonexistent. Stearns, Crandall, and Steward (1938, p. 117) reported one observation of the water level made at an early date as follows: "During the construction of the Aberdeen-Springfield canal, in 1907, a well was dug by Mr. Shaw in sec. 7, T. 4 S., R. 32 E., in which water was first encountered at 20 feet and a permanent supply was found at 25 feet." The exact location and topographic situation of the well are not known, although during recent years water levels ranging from about 20 to 50 feet below the land surface have been measured in wells in the general area. This range is due in part to seasonal changes in water level and in part to topographic location. Thus, the meager available information suggests that there has not been a great change in the water table since construction of the canal and the beginning of irrigation on the tract at the location of the described well.

Since about 1919, the U.S. Bureau of Reclamation, the Aberdeen-Springfield Canal Company, Water District 36, and the U.S. Geological Survey have made periodic measurements of water levels in observation wells. The Geological Survey has maintained a network of 20–25 observation wells in the report area since 1952 and has measured water levels one or more times in several hundred additional wells. A few of these wells were ones in which the water level had been measured from 20 to 40 years earlier. Comparison of current (1961) water levels with water-level measurements published by Stearns, Crandall, and Steward (1936, p. 103–4, 108–9, 114–15, 118–20) for several periods between 1919 and 1928, before and during the construction of the dam, indicates that the change in water levels has not been more than a few feet since the first measurements were made.

The position of the water table in the spring of 1919 is shown on plate 5 from a map made by the U.S. Reclamation Service (now U.S. Bureau of Reclamation), Burley, Idaho, May 1919. The contours were modified in and adjacent to section 12, T. 7 S., R. 30 E., where the original map showed a very pronounced mound on the water table on the basis of water-level measurements in two wells. Current information indicates that the two wells were completed in a perched aquifer; consequently, the measurements were disregarded in reconstructing the position of the water table as of 1919. The position of the water table in October 1961 is also shown on plate 5. Most of the measurements on the west side of the reservoir were made during the period October 15–19, 1961, when the altitude of the water surface in the reservoir ranged from 4,314 to 4,317 feet. Measurements made in some wells on the west side of the reservoir and in most of the wells on the east side at various times prior to October 1961 were also used in drawing the water-level contours. However, the measurements made at other times were adjusted by comparison with the records from nearby observation wells to reflect the position of the water table during the period of October 15–19, 1961. Caution must be used in comparing the two sets of contours because the 1919 measurements were made in the spring, when water levels are low, and the 1961 measurements were made in the autumn, when water levels are high. The map shows that ground-water movement on the west side of the reservoir is generally southwestward, but that within a few miles of the reservoir, ground water moves toward and discharges into the reservoir.

A ground-water ridge is shown approximately paralleling the Aberdeen-Springfield High Line Canal. Water to the east of the ridge moves toward the reservoir; water to the west moves westward with the main underflow in the aquifer. The contours show that the water table beneath lands near the west margin of the reservoir, except near the dam, ranged from altitudes of 4,340 to 4,370 feet when the water surface in the reservoir was at a level of about 4,316 feet (pl. 5). This indicates a steep slope in the water table near the reservoir. As most of the sediments of the reservoir bed and in the area adjacent to the reservoir are fine grained (Raft Formation and American Falls Lake Beds), a steep gradient would be expected. Almost all the large springs issue from basalt at altitudes of 4,370 feet or above and at some distance from the reservoir. Thus, fluctuations of the reservoir between 4,296 feet (minimum) and 4,355 feet (maximum) has no effect on discharge of major springs and only a minor effect on the ground water in the sediments.

Seasonal fluctuations of the water table, and longer term trends in some wells, are shown by hydrographs of eight selected observation wells in figures 4, 5, and 6. Seven of the wells are at the north end and along the west side of the reservoir within the Aberdeen-Springfield Project; well 4S–34E–5cc1 is east of the river, adjacent to the Fort Hall Project.

Although most of the ground water discharging in the American Falls Reservoir reach is derived from recharge above Blackfoot, the annual cycle of fluctuations of the water table on the west side of the

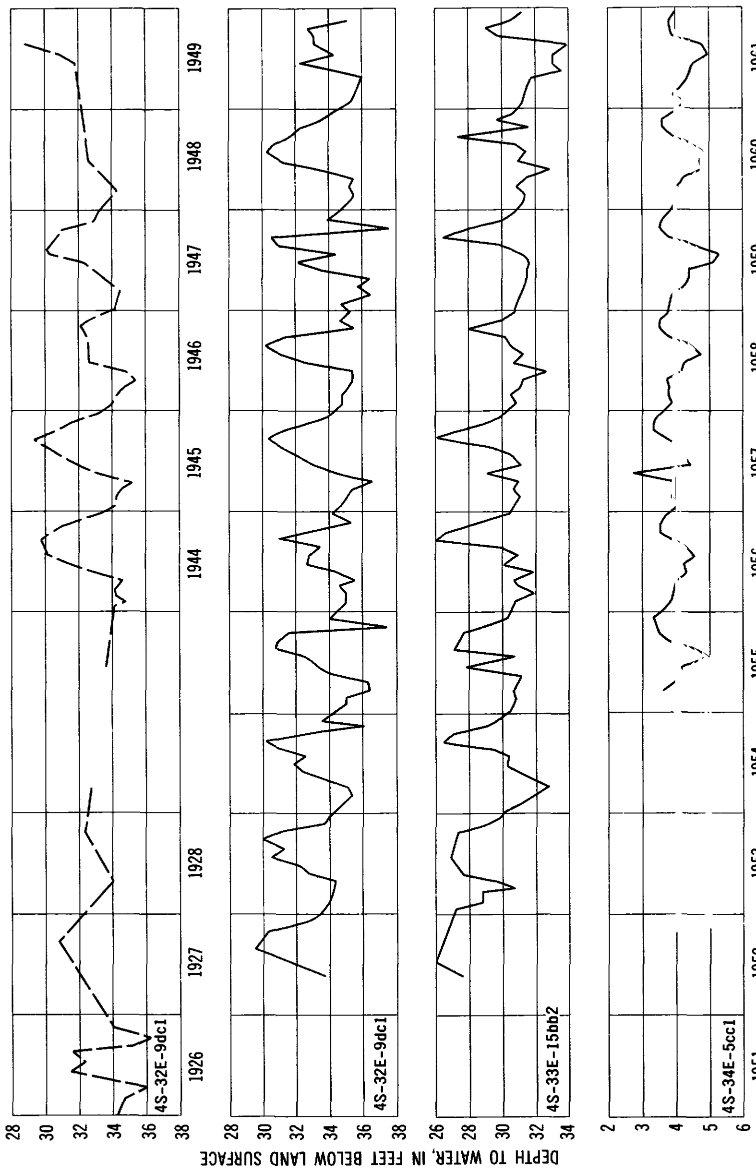

FIGURE 4.—Hydrographs of wells 4S–32E–9dc1, 4S–33E–15bb2, and 4S–34E–5cc1.

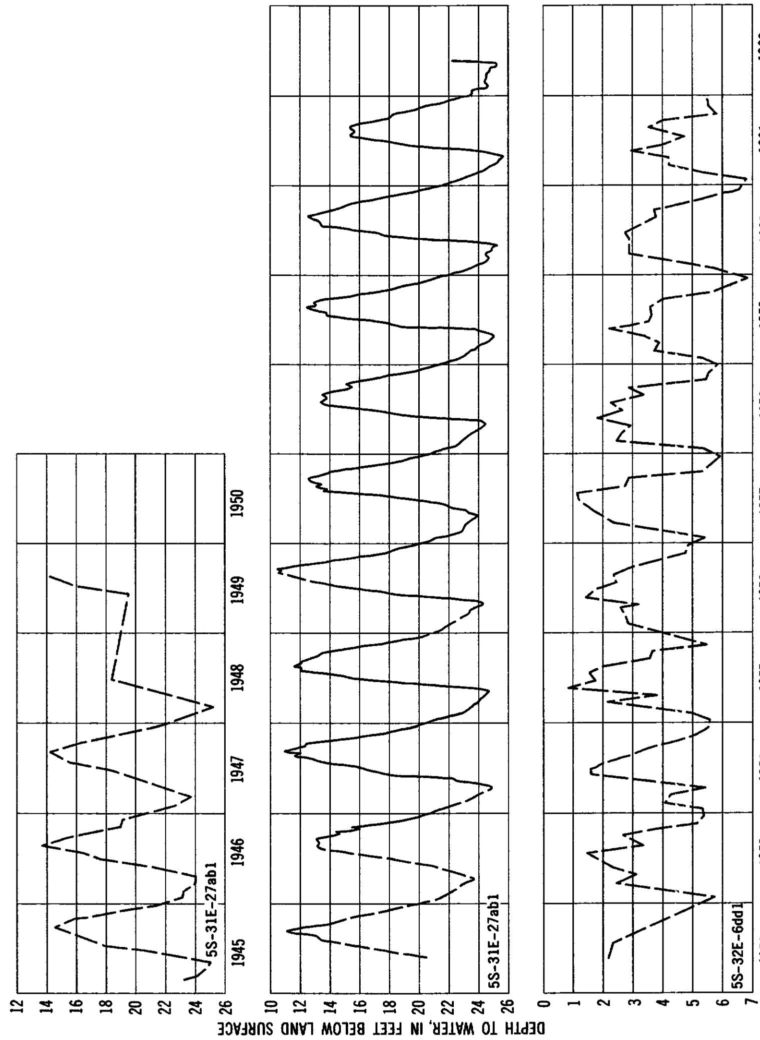

FIGURE 5.—Hydrographs of wells 5S-31E-27ab1 and 5S-32E-6dd1.

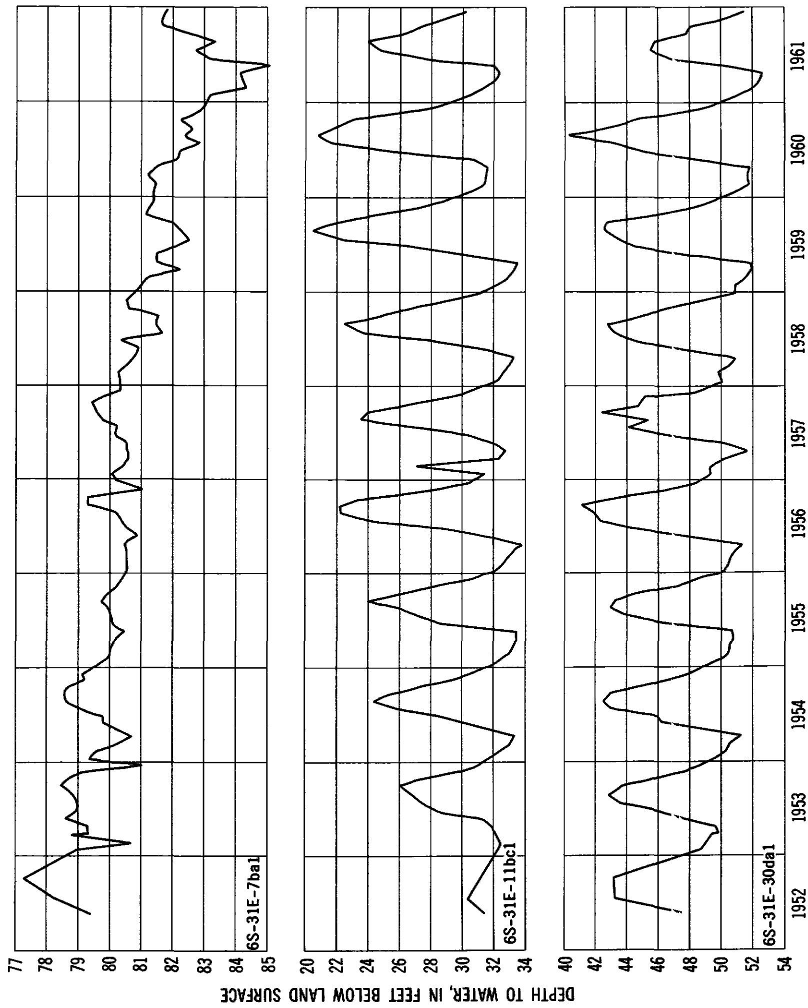

FIGURE 6.—Hydrographs of wells 6S-31E-7ba1, 6S-31E-11bc1, and 6S-31E-30da1.

reservoir is obviously related to irrigation on the Aberdeen-Springfield tract west of the reservoir. Water levels begin rising in April or May shortly after irrigation starts, rise rapidly during the first part of the irrigation season, hold fairly steady during the latter part of the irrigation season, and decline steadily after irrigation ceases.

Water-level fluctuations in wells near the southwest end of the reservoir show the effects of different influences (fig. 7). Water levels in all these wells rise and fall with the stage of the reservoir. At high reservoir stages the water in the reservoir is higher than the water level in the wells, but at low stages the water level in the wells is higher than that in the reservoir. The water levels in wells near the reservoir, and particularly in those very near the south end (wells 7S–30E–24dd1 and 7S–31E–30cb1), show the greatest fluctuations and are lower than the reservoir for longer periods than wells farther north. Wells farther west show less fluctuation.

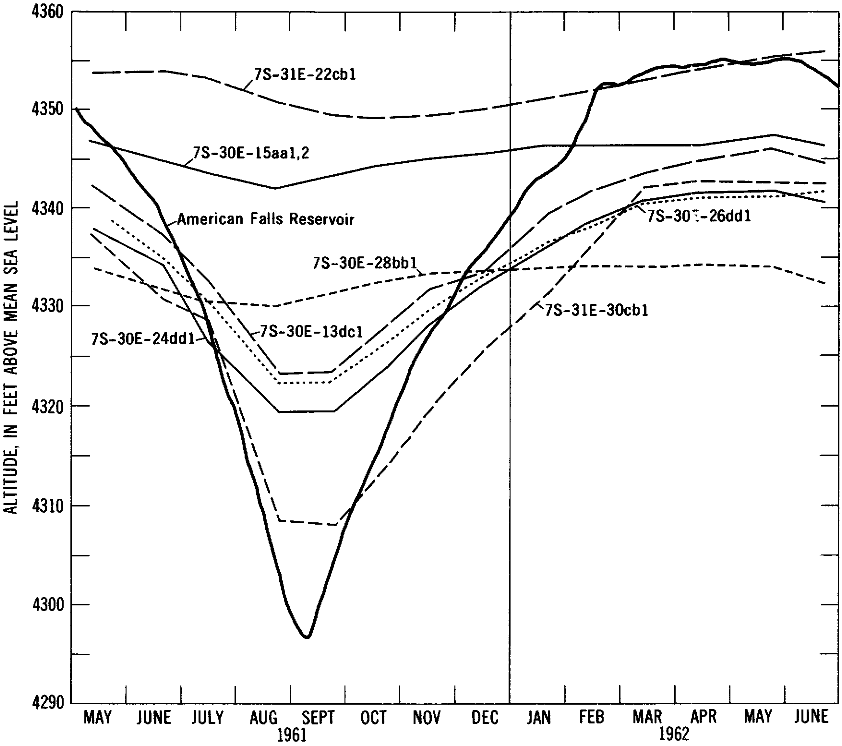

Figure 7.—Hydrographs of wells 7S–30E–13dc1, 7S–30E–15aa1, 7S–30E–15aa2, 7S–30E–24dd1, 7S–30E–26dd1, 7S–30E–28bb1, 7S–31E–22cb1, 7S–31E–30cb1 and American Falls Reservoir.

Profiles of the relative position of the water table, the land surface, and the water level in the reservoir area are shown on plate 4. The profiles for October show the position of the water table beneath the Aberdeen-Springfield tract a month or two after the table had started to decline. All five profiles show the water table sloping toward the reservoir, which had been drawn down to supply water for irrigation downstream. However, profiles *D–D′* and *E–E′*, which are farthest southwest (pl. 2), show a ground-water divide; the water table beyond a certain point on the profile slopes away from the reservoir.

The profiles for April 1962 show the position of the water table at a time when the water table in much of the area, raised by percolation of irrigation water during the preceding season, had receded to a low position immediately prior to the beginning of the 1962 irrigation season. The reservoir was full at the time. Profiles *A–A′*, *B–B′*, and *C–C′* show the water table sloping toward the reservoir at about the same slope as it did the previous October. Profile *D–D′* shows a shift in the ground-water divide to a point farther from the reservoir. This shift is undoubtedly due to cessation of local recharge from irrigation in the vicinity of well 6S–31E–30da1. Profile *E–E′* shows a westward component of slope on the water table, away from the reservoir, and indicates that there is some seepage loss from the reservoir at high stage.

The water-table map for the southeast side of the reservoir is based on measurements made over a period of several years. All these measurements were corrected to reflect the water level in the aquifer at a low reservoir stage to correspond to the water level during the period October 15–19, 1961. The water table slopes northwestward toward the reservoir from the hills and mountains flanking the Snake River Plain. The slope of the water table is fairly uniform with an average gradient of about 25 feet per mile. The only large springs discharging into American Falls Reservoir along the southeast side are near the Portneuf River. However, many small seeps are seen along extensive reaches of the shore at low reservoir stages.

Hydrographs of wells 5S–33E–35cc1, 6S–32E–27ad1, and 7S–31E–33ab1 (fig. 8) show both seasonal and long-term trends. The seasonal cycle in well 5S–33E–35cc1, at the northeast end of the reservoir, is closely related to recharge from runoff in the spring of the year and to irrigation. The water level begins rising in April or May, reaches a peak in September or October, and declines the rest of the year. This cycle is similar to the seasonal cycle shown by most wells along the north end and the west side of the reservoir. A longer term trend—a decline of about 1.5 feet in the past 4 years—is also shown by this hydrograph.

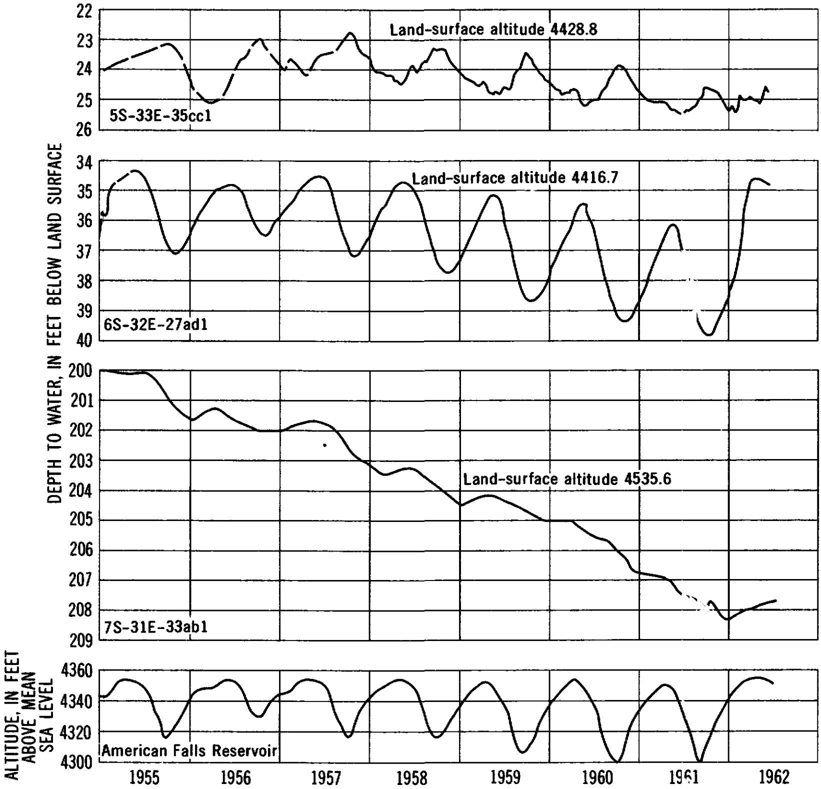

FIGURE 8.—Hydrographs of wells 5S–33E–35cc1, 6S–32E–27ad1, and 7S–31E–33ab1, and the stage of American Falls Reservoir.

The hydrograph of well 6S–32E–27 ad1 is typical for wells along most of the southeast side of the reservoir. The seasonal cycle is influenced by the stage in American Falls Reservoir, which is the discharge boundary of the aquifer. The water level in the well declined about 1.5 feet in the years 1957–61, probably owing to decreased recharge because of below-average precipitation. The unusual rise in the water level after February 1962 is probably related to heavy flood runoff in February and subsequent above-normal precipitation in the spring of 1962.

Water-level measurements in well 7S–31E–33ab1 are not frequent enough to show the precise seasonal cycle in the well, but they are sufficient to show that the water level is related, at least in part, to the stage of American Falls Reservoir. The seasonal cycle is probably influenced by recharge from precipitation in the hills a few miles to the south. Also, since 1957 when pumping on the Michaud Flats Project began, the seasonal cycle apparently has been modified by pumping. The longer term trend shown by the well—a decline of more than 5 feet in 4 years (1957–61)—may be related in part to withdrawals for irrigation on the project.

In summary, the seasonal fluctuations of the water table at the north end and along most of the west side of the reservoir are related to diversion of water to the adjacent irrigated tracts. Fluctuations along most of the east side of the reservoir south of the Portneuf River are related to recharge in the hills to the south. Fluctuations at the southwest end of the reservoir are related to the stage of water in the reservoir.

WATER BUDGET, AMERICAN FALLS RESERVOIR REACH

Ground-water inflow to the American Falls Reservoir reach can be estimated as a residual of the water budget for the reach. About half of the ground-water inflow can be accounted for by measurement of spring discharge in the reach during the irrigation season. The combined surface and ground water inflow in the reach consists of the following items:

1. Flow in the Snake River (measured at the Blackfoot gage).
2. Portneuf River discharge (measured at the Pocatello gage).
3. Discharge of Bannock Creek, Ross Fork, and other small surface streams.
4. Precipitation on the reservoir and sheet runoff from peripheral area.
5. Surface waste from irrigated tracts.
6. Bank storage (returned during declining reservoir stages).
7. Ground-water inflow.

Outflow includes:

1. Flow in the Snake River (measured at the Neeley gage).
2. Evaporation from the reservoir.
3. Evapotranspiration from the exposed parts of the reservoir.
4. Canal diversions (Michaud Canal).
5. Seepage losses.
6. Bank storage (during rising reservoir stages).

The budget must also be corrected for change in storage in the reservoir.

Snake River inflow to the reach is measured at the gaging station about one-quarter mile downstream from the mouth of the Blackfoot River. Not all ground-water inflow occurs below this station. According to Stearns, Crandall, and Steward (1938, p. 187), spring inflow begins in the Snake River a short distance upstream from the mouth of the Blackfoot River and spring inflow above the gaging station totals about 120–150 cfs. Above this reach, for many miles, the Snake River is an influent stream.

In the water budget, spring inflow in the short reach upstream from the gaging station is disregarded. To obtain total spring inflow for the entire American Falls Reservoir reach, 120–150 cfs would have to be added to the amounts given. Discharge of the Portneuf River is measured at the gaging station a few miles upstream from the mouth at the west edge of Pocatello. Snake River outflow is measured at the gaging station at Neeley, 0.9 mile downstream from American Falls Dam. Surface water is diverted for the Michaud Project at American Falls Dam. Discharges of Bannock Creek and Ross Fork have been measured for short periods only; the estimate of the inflow from these sources was derived from the scanty records available and was adjusted on the basis of variations in flow of the Portneuf River.

Precipitation on the reservoir is a variable component of inflow that must be accounted for in the budget. The annual precipitation was averaged for Weather Bureau stations at American Falls, Aberdeen Experiment Station, and Blackfoot. Records at Pocatello airport were used to help complete the record. The average annual precipitation was multiplied by the maximum reservoir area (56,000 acres) to obtain the total contribution from precipitation. This was done to equate the precipitation gain in the prereservoir period to that of the postreservoir period.

The total precipitation is not a net gain; evaporation from the reservoir surface and evapotranspiration from the uninundated part of the reservoir area deduct from the total precipitation. Before the reservoir was constructed, there was considerable water loss from the bottom lands, large parts of which were covered by lush grasses and phreatophytes, in addition to the normal loss from dry-land vegetation on somewhat higher lands. In computing the total evapotranspiration losses for the prereservoir period, it was assumed that evapotranspiration from the higher land consumed 9–10 inches of precipitation (about 45,000 acre-ft annually), and that grasses and phreatophytes on the bottom lands (25 percent of the area) consumed an additional 2.5 feet (35,000 acre-ft annually). These computations do not include the years of far below average precipitation.

In computing annual evaporation from the reservoir, the monthly loss, based on pan evaporation, was multiplied by the average reservoir area for each month. Pan evaporation at the Aberdeen Experiment Station was used for the period of record 1935–60. Evaporation at Milner Dam was used for the period 1927–34. Pan evaporation was corrected to lake evaporation by using a coefficient of 72 percent (Kohler and others, 1959, pl. 3).

When the reservoir surface is lowered, large flat areas at the head of the reservoir are uncovered. These areas support a lush grassland which is dotted with ponds and sloughs, and evaporation and transpiration losses from these areas are large. It was assumed that total losses from the uncovered area of the reservoir were one-half the losses that would have occurred from the same part had the reservoir remained full; that is, evapotranspiration from 1 acre of uncovered area would be one-half the evaporation from 1 acre of water area.

The computations for the water budget are given in table 2, in the columns under "Annual runoff" and "American Falls Reservoir." Continuous records of flow in the Snake River at the two gaging stations used in the analysis are available only since 1911. Spring inflow at earlier dates can be obtained only by analysis of earlier miscellaneous records. Discharge measurements were made at different places along the Snake River in the vicinity of the American Falls Reservoir reach between 1902 and 1910. By estimating inflow from some tributaries, gains and losses in several reaches, and evapotranspiration losses from the reservoir reach, rough estimates of spring discharge were made for a period in August in three different years. These estimates are 2,000 cfs (1,450,000 acre-ft per year) in 1902; 1,840 cfs (1,330,000 acre-ft per year) in 1905, and 1,830 cfs (1,325,000 acre-ft per year) in 1908. Although the records are incomplete and the quantities determined may be considerably in error, the records do indicate that spring inflow in the reach was considerably less before 1908 than in the years since 1911. Data from table 2, under "irrigated area," "total," "5-year progressive average," and "ground-water inflow" are plotted for the period 1900–60 in figure 9.

Irrigation diversions range greatly in length. The distance from where the water is first diverted to the places where it is discharged to the inflow reach ranges from a few miles to 100 miles. For this reason and because the storage capacity of the aquifer is large, it seemed advisable to use some kind of averaging method that takes into account the diversions in previous years as well as the diversions during the current year. A 5-year progressive average was used which, considering the limitations of the data, showed a good correlation with ground-water inflow. The trends of the two curves in figure 9 show a good correlation until about 1952, after which time ground-water inflow was significantly less, although the average amount of water diverted increased. The break in the trends, in about 1952, coincides with the time that ground-water pumpage began to be large. This suggests that if it were not for large ground-water withdrawals on the Snake River Plain, the inflow to the American Falls Reservoir reach would continue to increase as long as average surface-water diversions upstream from the reservoir continue to increase.

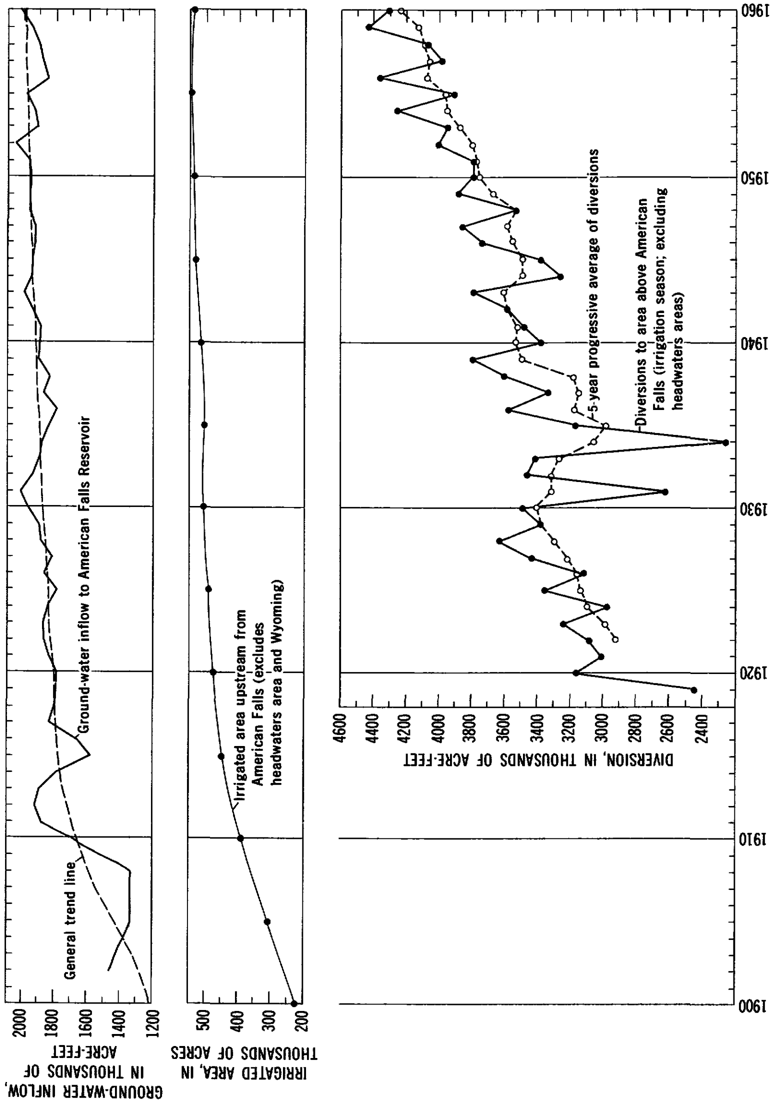

FIGURE 9.—Irrigated area and irrigation diversions to Snake River Plain upstream from American Falls Dam and ground-water inflow in American Falls Reservoir reach, 1900–60.

TABLE 2.—*American Falls Reservoir inflow analysis*

[Water quantities in thousands of acre-ft. (+) indicates surface-water outflow, or the amount of water that leaves the reservoir area, or an increase in the contents of the reservoir during the water year. (−) indicates the amount of water that must be subtracted from the surface-water outflow to obtain the ground-water increment.]

Water year	Irrigated area [1] (acres)	Irrigation season diversions				Annual runoff				American Falls Reservoir				
		Heise to Blackfoot [2]	Henrys Fork and tributaries [3]	Total	5-year progressive average	Snake River at Neeley (+)	Portneuf River at Pocatello (−)	Snake River at Blackfoot (−)	Other small drainages [4] (−)	Change in storage (+ or −)	Precipitation on reservoir (−)	Evaporation (+)	Evapotranspiration [5] (+)	Ground-water inflow [6]
1910	390,000													
1911						7,077	[7] 270	4,906	30		66		75	1,880
1912						8,042	259	5,839	30		82		75	1,907
1913						8,601	208	6,495	25		61		75	1,887
1914						7,549	278	5,467	30		62		75	1,787
1915	450,000					4,953	172	3,211	20		50		75	1,575
1916						6,824	192	4,966	25		62		75	1,654
1917						8,119	221	6,068	25		52		75	1,828
1918						7,590	211	5,584	20		52		75	1,798
1919		1,791	657	2,448		4,606	189	2,635	20		38		73	1,797
1920	475,000	2,326	848	3,174		5,326	201	3,342	20		50		75	1,788
1921		2,188	819	3,007		6,773	299	4,637	35		48		75	1,829
1922		2,275	820	3,095		6,017	267	3,882	30		49		75	1,864
1923		2,397	847	3,244	2,990	5,628	224	3,534	25		53		75	1,867
1924		2,233	737	2,970	3,100	3,902	177	1,902	20		29		64	1,838
1925	490,000	2,532	826	3,358	3,130	6,287	199	4,298	25		58		75	1,782
1926		2,336	776	3,112	3,160	4,785	165	2,772	20	+4	39	0	74	1,867
1927		2,570	863	3,433	3,220	5,077	200	4,537	25	+1,385	58	163	10	1,815
1928		2,742	896	3,638	3,300	7,170	196	4,769	25	−421	43	165	8	1,889
1929		2,514	859	3,373	3,380	4,986	173	2,792	20	−222	45	140	12	1,886
1930	505,000	2,671	820	3,491	3,410	4,442	138	2,220	15	−194	60	130	18	1,963
1931		2,033	589	2,622	3,310	3,811	122	1,263	15	−513	40	120	35	2,013
1932		2,592	869	3,461	3,320	3,874	154	2,059	20	+193	46	115	27	1,930
1933		2,570	839	3,409	3,270	4,006	153	2,066	20	+12	39	131	22	1,893
1934		1,792	458	2,250	3,050	2,777	85	712	10	−212	39	110	45	1,874
1935	505,000	2,393	775	3,168	2,980	3,277	110	1,449	15	+13	36	119	40	1,838
1936		2,725	857	3,582	3,170	4,163	158	2,881	20	+561	47	156	15	1,788
1937		2,531	796	3,327	3,150	3,877	150	1,748	20	−194	52	152	15	1,880
1938		2,721	883	3,604	3,190	4,819	172	3,174	20	+273	66	155	9	1,824
1939		2,853	950	3,803	3,500	4,650	156	2,269	20	−433	30	145	16	1,903
1940	515,000	2,523	862	3,385	3,540	3,540	118	1,609	15	+12	69	137	22	1,900
1941		2,636	850	3,486	3,520	3,504	142	1,588	20	+56	65	126	15	1,886
1942		2,697	892	3,589	3,570	4,161	171	2,218	20	+90	58	150	13	1,947
1943		2,888	900	3,788	3,610	6,194	215	4,563	25	+487	45	158	9	2,000
1944		2,437	812	3,249	3,500	5,134	182	2,718	25	−363	51	144	10	1,949

1945	530,000	2,574	805	3,379	3,500	4,515	223	2,820	25	+391	48	151	7	1,948
1946		2,833	907	3,740	3,550	6,131	246	3,829	30	−206	54	152	10	1,928
1947		2,962	892	3,854	3,600	5,358	181	3,315	25	−32	40	150	8	1,923
1948		2,664	879	3,543	3,550	5,736	200	3,618	25	−22	54	142	8	1,967
1949		2,959	933	3,892	3,680	5,277	182	3,089	25	−130	41	136	12	1,958
1950	535,000	2,838	955	3,793	3,760	6,181	277	4,415	35	+391	45	141	8	1,949
1951		2,921	871	3,792	3,780	6,891	203	4,918	25	+95	35	150	5	1,960
1952		3,051	960	4,011	3,810	7,385	231	4,776	25	−438	35	165	10	2,055
1953		2,974	976	3,950	3,890	4,919	189	2,831	25	−95	39	160	10	1,910
1954		3,252	1,018	4,270	3,960	4,714	143	2,916	20	+139	32	180	10	1,932
1955	545,000	2,866	946	3,812	3,970	4,595	118	2,258	15	−363	36	160	16	1,981
1956		3,356	1,028	4,384	4,090	6,098	156	4,601	20	+359	31	170	11	1,830
1957		2,969	1,017	3,986	4,080	5,574	187	3,266	25	−330	42	150	15	1,889
1958		3,085	1,008	4,093	4,110	4,540	188	2,529	25	−37	36	155	20	[8] 1,909
1959		3,390	1,086	4,476	4,150	4,101	146	1,978	20	−166	31	140	35	[8] 1,951
1960	540,000	3,310	1,059	4,369	4,260	4,108	139	2,018	20	−76	31	135	35	[8] 2,013

[1] Area irrigated by surface-water diversions upstream from American Falls, exclusive of headwaters areas that are outside the Snake River Plain.
[2] Does not include diversions from Blackfoot River to Fort Hall canals.
[3] Exclusive of headwaters areas.
[4] Ross Fork, Bannock Creek; estimated from partial record by comparison with Portneuf River.
[5] Evapotranspiration from uncovered part of reservoir area. Prior to 1927, from area now occupied by reservoir.
[6] Inflow to American Falls Reservoir reach, exclusive of 120-150 cfs (87,000-110,000 acre-ft per year) inflow above gaging station ¼ mile below mouth of Blackfoot River. Figure includes bank storage (+ or −) and seepage loss (−).
[7] Estimated.
[8] Diversions from American Falls Reservoir to Michaud Canal—1958, 9; 1959, 16; 1960, 19—represent gains and are added to ground-water inflow.

Since 1957, however, when water in Palisades Reservoir, about 110 miles upstream from American Falls Reservoir, became available, many canals have tended to divert more water at the head and spill a larger part back to the river than formerly. The magnitude of the spills is not known. Because the area irrigated by surface-water diversion has not increased significantly since 1957, it might reasonably be assumed that the actual amount of water applied to the land has become somewhat stabilized.

The average ground-water inflow to the reservoir was about 1.96 million acre-feet for the period 1943–52—before ground-water pumping became significant. The average for the last 5 years, as shown in table 1, was about 1.92 million acre-feet. The apparent decline is so small that the only significant conclusion to be made is that ground-water inflow is not increasing.

By using a one-year lag between the 5-year progressive average of diversions and ground-water inflow, points from the two curves were plotted in figure 10. Although widely scattered, the points show a definite relationship. If the points for the period 1953–60 are disregarded, a line through the remaining points indicates that the average increase of inflow is about 2.5 acre-feet for every 10-acre-feet increase in water diverted. The points for 1953–60 may show the influence of ground-water pumping in the vicinity of and upstream from the reservoir reach. In 1961 the pumpage was about 400,000 acre-feet for irrigation of an estimated 125,000 acres; depletion of ground water by evapotranspiration exceeded 250,000 acre-feet.

Although the data in table 2 and figure 9 show long-term trends of inflow and cyclic trends caused by periods of drought, they give no indication of seasonal trends. To obtain some indication of seasonal trends, a water budget was computed on a monthly basis for the period beginning with water year 1951 (beginning October 1950) and continuing through calendar year 1960. (See "Basic Data," p. 56–58.) The same elements of inflow, outflow, change in storage, evaporation, evapotranspiration, and precipitation were considered, as they were in developing the annual water budget. The figures for ground-water inflow include bank storage (+ or −) and seepage loss (−).

The surface inflow of small streams tributary to the American Falls Reservoir and surface waste from irrigated tracts are a small part of the water budget. The annual reports of Water District 36 give the discharges of Ross Fork and Bannock Creek for the period May-September of each year. Study of the data indicates that the flow of Ross Fork, as given in the reports, includes 50–90 percent ground-water discharge from adjacent irrigated lands. Surface waste is also given in Water District 36 reports for the period May–September. How-

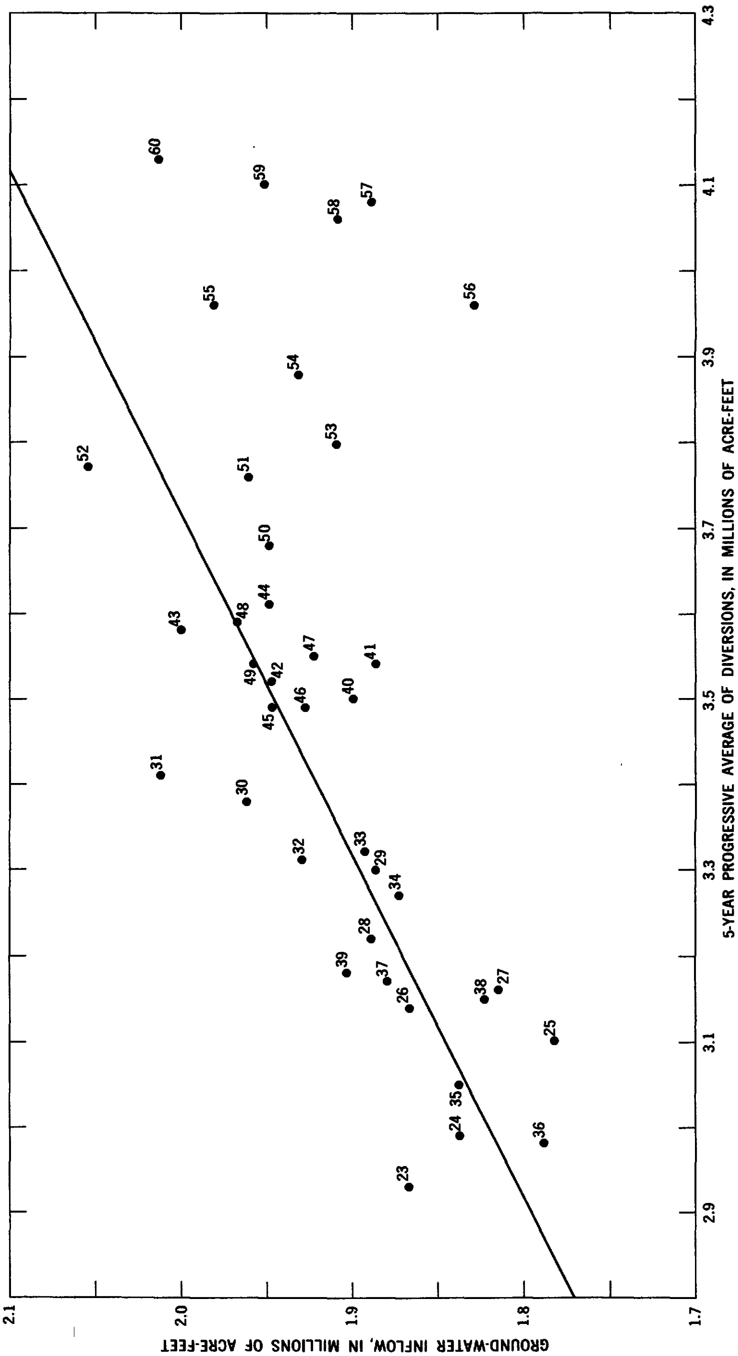

FIGURE 10.—Relation between 5-year progressive average of irrigation diversions to the area above American Falls Dam and inflow to the American Falls Reservoir reach.

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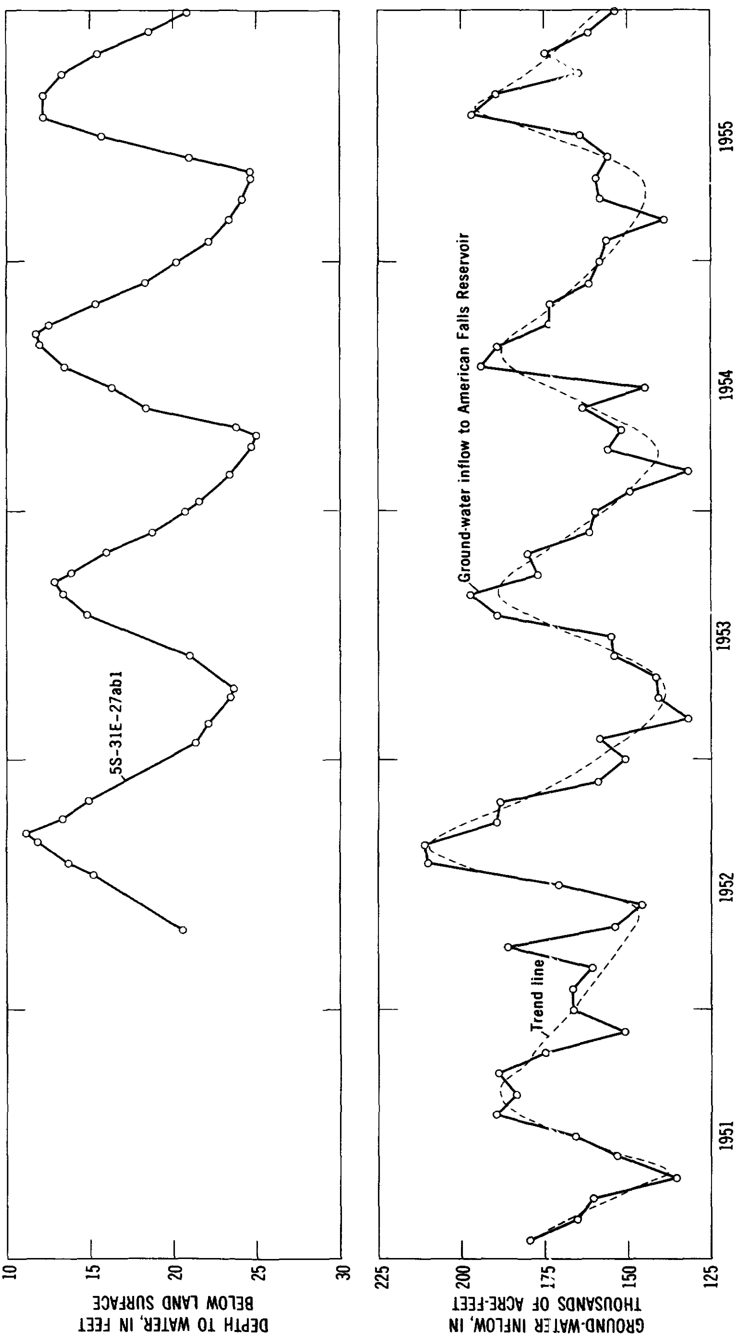
ever, study of these data also suggests that a significant part of the water measured in the wasteways was ground-water inflow. No data are available for wasteway inflow during the period October–April of each year, and few data are available on the flow of Ross Fork and Bannock Creek for the same period. Therefore, these two items of surface inflow are disregarded in the table, and the figure for ground-water inflow is too large by the amount of such surface inflow. The amount of this surface inflow is small, generally not more than a few thousand acre-feet a month. Stream inflow is greatest during winter and early spring, whereas inflow from surface waste is greatest during the summer; thus, there would be a tendency toward a uniform gain from these unmeasured sources of inflow. Because the unmeasured surface inflow is small and it tends to be uniformly distributed throughout the year, the unmeasured inflow in most months probably does not appreciably affect the cyclic pattern shown by monthly figures for ground-water inflow.

The monthly ground-water inflows to the reservoir are plotted in figure 11 along with the water level of well 5S–31E–27ab1 for comparison. This well was selected because it is fairly centrally located, about 1 mile northeast of Aberdeen, and because the available record is relatively complete. Obviously, it would be extremely fortuitous if any one well were to show an exact quantitative relation to the ground-water inflow to the reservoir that occurs over a wide area. However, it is apparent that the variations in ground-water inflow are closely related to the water level in the aquifer. This, of course, is what should be expected.

The plot of the inflow data is somewhat erratic, but this is an inevitable result of inaccuracies in discharge measurements and an inability to account for all the variations in precipitation, snowmelt, waste water, and evapotranspiration, as mentioned previously. If a smooth line is drawn through the plotted points, the deviations of points from the line are generally small and represent only a few percent of the total quantity of water involved in each monthly budget. Comparison of the curves of water level and of ground-water inflow shows that at times the ground-water inflow cycle apparently leads the water-level cycle. On the hypothesis that changes in water level cause the changes in inflow, this is an impossible situation. A partial explanation may be that the water level in well 5S–31E–27ab1 fails to accurately reflect the gross effect of the water-table rise in the entire area. In part the situation may also be caused by unmeasured surface waste at the beginning of the irrigation season, or by unmeasured run-off from snowmelt in Ross Fork, Bannock Creek, and other tributaries.

The possibility that the discrepancies are due to variations in seepage loss from the reservoir or in loss or gain from bank storage must also be considered.

To facilitate comparison of the two graphs shown in figure 11, mid-month water levels and end-of-month inflows are tabulated and plotted in figure 12. Except for a few points, correlation between the two is fairly good. In 1959 and 1960, inflow apparently was slightly out of phase with the water level in well 5S–31E–27ab1. A better correlation would have been obtained for 1959 and 1960 by plotting end-of-month water levels against inflow for the month.


5S-31E-27ab1
Ground-water inflow to American Falls Reservoir
Trend line
1951
1952
1953
1954
1955
DEPTH TO WATER, IN FEET BELOW LAND SURFACE
10
15
20
25
30
GROUND-WATER INFLOW, IN THOUSANDS OF ACRE-FEET
225
200
175
150
125

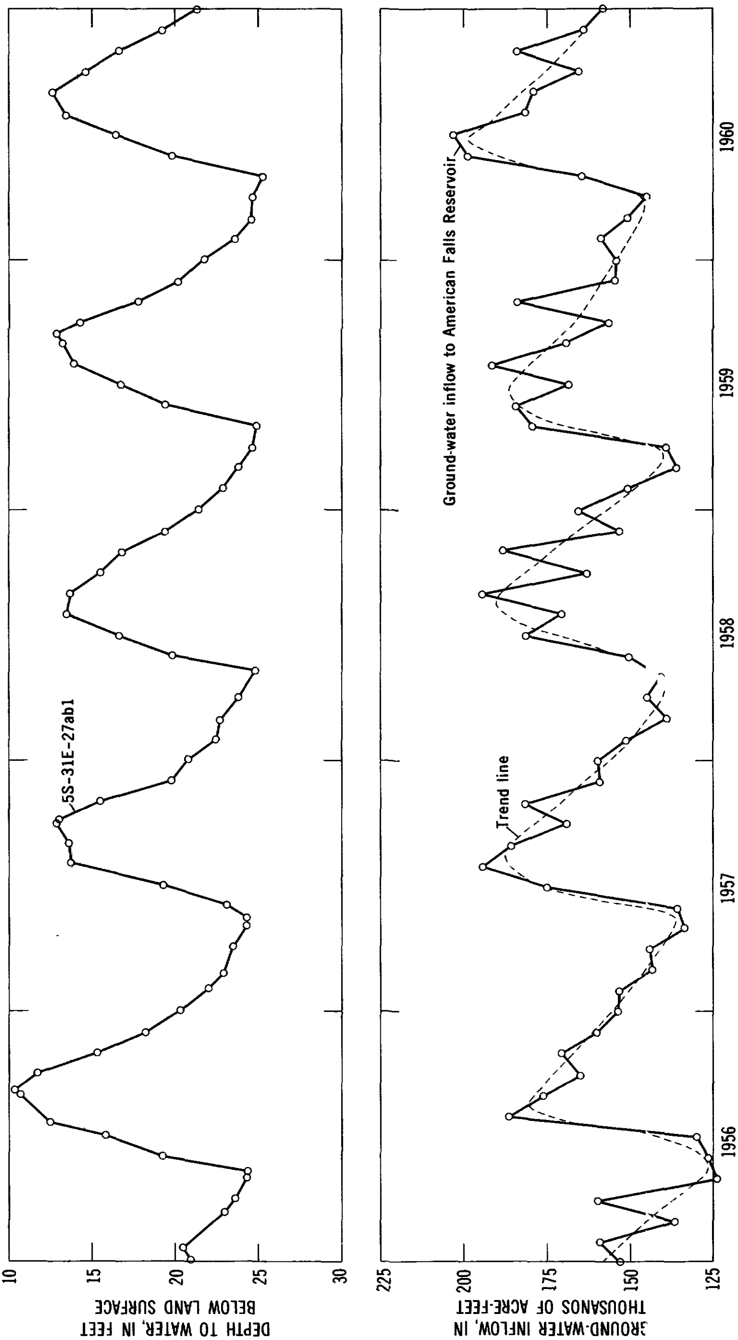


FIGURE 11.—Ground-water inflow to American Falls Reservoir and the hydrograph of well 5S–31E–27ab1.

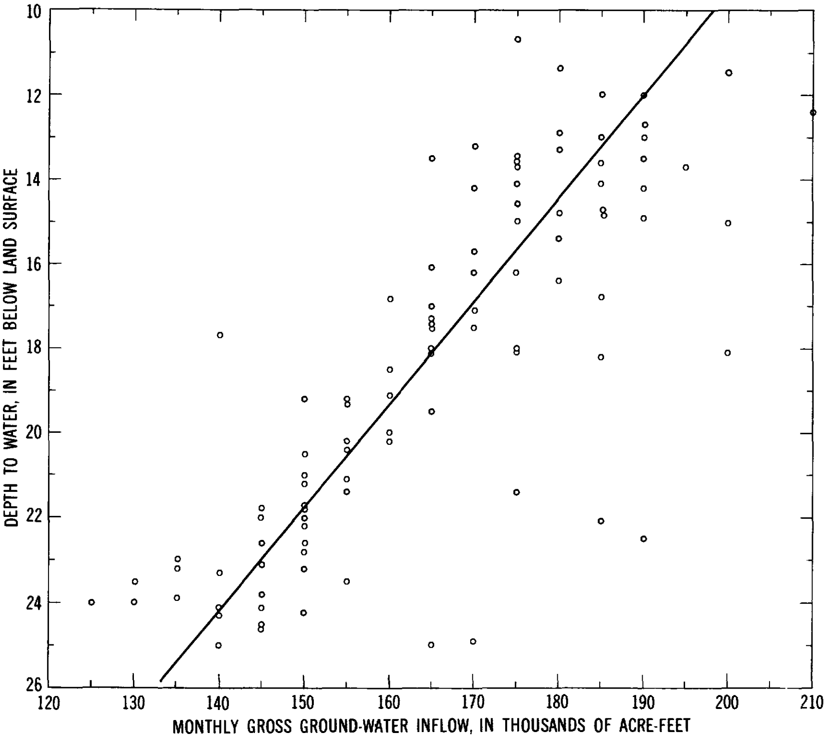


Figure 12.—Ground-water inflow to American Falls Reservoir plotted against midmonth water levels in well 5S–31E–27ab1.

A straight line is drawn through the points, and deviations from the line are tabulated (table 3) in terms of an excess or a deficiency of inflow with reference to the inflow that would have occurred according to the straightline plot. Several noteworthy items are shown by the tabulation:

1. Inflow was deficient during all 1956 (the graphs of water-table fluctuation and inflow (fig. 11) suggest that the water level in the well was abnormally high, perhaps because of local application of water or leakage from a canal).
2. September, October, and November generally show a deficiency of inflow.
3. May, June, July, and August generally show an excess of inflow.

Possible explanations for the deviations, other than inaccuracies in the budget, and the postulated relation between water level and inflow are considered next.

TABLE 3.—*Deviation of inflow from straightline relations of inflow and water level, and the stage in American Falls Reservoir*

	1952		1953		1954		1955		1956	
	Deviation of inflow [1]	Stage in American Falls Reservoir [2]	Deviation of inflow	Stage in American Falls Reservoir	Deviation of inflow	Stage in American Falls Reservoir	Deviation of inflow	Stage in American Falls Reservoir	Deviation of inflow	Stage in American Falls Reservoir
Jan	--------	--------	−3	51.76	0	48.93	+4	47.57	−5	47.75
Feb	--------	--------	−4	53.49	+1	52.11	+4	51.59	−5	48.67
Mar	--------	48.72	−10	53.75	0	54.42	+3	54.60	−9	49.99
Apr	−3	51.00	−13	54.51	+3	54.49	+6	54.65	−11	52.88
May	−10	54.68	+1	52.03	−3	54.43	+12	52.24	−16	54.84
June	+1	54.84	+6	54.59	−3	53.77	+10	49.65	−26	54.36
July	+23	46.93	+8	45.87	+1	48.27	+12	40.55	−9	46.97
Aug	+22	36.48	+9	34.45	+3	37.63	0	28.00	−12	37.08
Sept	+8	28.95	+4	25.68	−5	30.33	−6	16.61	−20	30.20
Oct	+4	32.55	−2	30.47	−6	35.25	−4	22.63	−19	34.57
Nov	−2	39.75	+3	39.60	−4	40.03	−3	33.04	−8	40.51
Dec	−3	46.07	+3	44.83	−5	44.06	+3	42.82	−5	45.32

	1957		1958		1959		1960	
	Deviation of inflow [1]	Stage in American Falls Reservoir [2]	Deviation of inflow	Stage in American Falls Reservoir	Deviation of inflow	Stage in American Falls Reservoir	Deviation of inflow	Stage in American Falls Reservoir
Jan	−2	47.04	0	47.13	+2	43.82	+4	43.18
Feb	−2	51.17	−2	51.50	−3	48.82	+5	48.05
Mar	−3	53.98	−3	54.35	+1	52.78	+7	53.01
Apr	−6	54.70	+1	54.80	+33	52.82	+28	54.00
May	+10	54.79	+6	54.32	+36	47.07	+43	46.85
June	+24	51.88	+10	49.53	+21	38.65	+35	38.56
July	+15	41.08	+6	37.28	+4	25.62	+12	22.06
Aug	+2	27.88	+6	22.46	−8	08.35	−1	08.74
Sept	−5	17.94	+6	16.27	−15	07.01	−8	99.20
Oct	−11	26.15	+2	20.37	−8	19.08	−5	09.64
Nov	−2	36.21	0	28.60	−1	29.36	0	22.52
Dec	−1	43.11	0	37.29	+3	37.69	+4	32.12

[1] Deviation of inflow for all years in thousands of acre-ft.
[2] Stage in American Falls Reservoir minus 4,300 ft for all months except September 1960, minus 4,200 ft.

Seepage loss from the reservoir might explain deficiencies of inflow. Seepage loss is greatest when the reservoir is full. Maximum pool altitude is about 4,355 feet; in most years the reservoir is nearly full for several months. For the period 1952–60 shown in table 3, there were 22 months in which the reservoir stage at the end of month was 4,353 feet or higher. The average monthly deficiency of inflow for the 22 months was about 2,000 acre-feet. This suggests some seepage loss occurs at high reservoir stages.

The effect of bank storage is to add to the inflow during declining reservoir stages, and to decrease inflow during rising stages. Table 3 shows 39 months, of a total 105 months, in which the reservoir stage declined. The average monthly excess of inflow for these months was 5,500 acre-feet.

The total decline of reservoir stage in the 39 months was about 320 feet, or an average of 8 feet per month. The average return to the reservoir, per foot of decline, was about 700 acre-feet. Newell (1929, p. 120) stated that "The mean rate of return for 1928 is more than 1,500 acre-feet per foot of drawdown." However, as he pointed out, the reservoir was drawn down in 1928, from 4,354.5 to 4,338.2 feet. Study of the data in table 3 indicates that the return from bank storage, per foot of decline in reservoir level, is considerably greater during declines at a high reservoir stage than it is at a low reservoir stage. If only the data in table 3 are used for declines between 4,355 and about 4,338 feet, an average gain of 1,800 acre-feet per foot of decline is given, which is close to the figure given by Newell.

Table 3 shows 60 months in which the water level in the reservoir rose (excluding those months in which the rise was slight). Average monthly deficiency of inflow for those months was 1,500 acre-feet.

Average loss, per foot of reservoir rise, was 300 acre-feet. Newell (1929, p. 123) stated that "The average rate of seepage per foot of fill experienced in 1927 and 1928 is 2,000 to 2,400 acre-feet or about 50% greater than the corresponding rate of bank return * * *. This is a small loss for the initial years of reservoir operation when some percolation is expected to go into dead storage." Here again it should be mentioned that the reservoir-stage fluctuation for the water budget presented in this report was from less than 4,300 feet to 4,355 feet; whereas in 1927 and 1928 the stage was entirely above 4,338 feet, a level where losses, whether to seepage or to bank storage, undoubtedly are greater than at low stages. Neither the excess of 5,500 acre-feet mentioned previously nor the deficiency of 1,500 acre-feet is large enough to be significant to the analysis. Errors and discrepancies in the data, and in the correlation, probably are too great to give much credence to these figures. However, it is noteworthy that falling stages consistently showed an excess of inflow, and rising stages showed a deficiency of inflow. It is also noteworthy that the average monthly quantities indicated are on the order of 1,000–5,000 acre-feet.

WATER BUDGET, NEELEY TO MINIDOKA REACH

The water-table maps (pls. 1 and 5) show that ground water percolating from the American Falls Reservoir returns to the Snake River in the reach between American Falls Dam and Minidoka Dam.

An accurate water budget would define the gain in the reach and permit compuations of the seepage loss from the reservoir. Because of several unknown factors, an accurate budget cannot be made; however, comparison of partial water budgets before and after operation of American Falls Reservoir gives an indication of the change in the budget due to construction of the reservoir, and of the magnitude of seepage losses.

Inflow in the reach consists of the discharge of the Snake River, Rock Creek, the Raft River, and small tributaries, and ground-water inflow. The Snake River discharge is measured at the gaging station at Neeley, 0.9 mile downstream from American Falls Dam. Discharge measurements of the Raft River and Rock Creek are not available near the mouths of these streams. No measurements are available for other tributaries.

Outflow from the reach occurs in the Snake River and in the North and South Side Minidoka Canals. All three of these are measured. Another item of outflow is seepage loss from Lake Walcott, behind Minidoka Dam.

The major unknown items of inflow are discharge of the Raft River, Rock Creek, and other tributaries, and ground-water inflow. Assumedly these items of inflow averaged about the same over a period of several years, both before and after the operation of American Falls Reservoir began, except for a gain from seepage loss from the reservoir. The major unknown item of outflow, seepage loss from Lake Walcott, was minimized by selecting periods when the lake level was relatively constant, both before and after operation of American Falls Reservoir began.

The interval 1916–26 (water years) was used for the period prior to operation of American Falls Reservoir, and the intervals 1928–32 and 1944–49 were used for the period after operation of American Falls Reservoir began. The interval 1933–43 was not used because it included a number of unusually dry years, and because operation of Lake Walcott was more erratic. Only December, January, February, and March were used in the analysis because the river discharge and the level in Lake Walcott are more stable and evaporation from the lake surface is small during that interval of each year. Even if variations occur from year to year, they would be small.

The following table compares the measured gain or loss in the reach between the gaging station at Neeley and the gaging station below the Minidoka Dam:

Average measured gain or loss in the reach between the gaging stations at Neeley and near Minidoka (in cubic feet per second)

Period	Dec.	Jan.	Feb.	Mar.	Average of 4 months
1916–26 (pre-reservoir)	125	175	235	−30	125
1928–32 and 1944–49 (post-reservoir)	165	205	200	140	175
Difference	+40	+30	−35	+170	+50

If the above analysis is valid, seepage loss from American Falls Reservoir contributes an inflow of about 50 cubic feet per second (36,000 acre-ft annually) within the reach. This quantity of water is small and rather insignificant when compared with the total amount of streamflow passing the gages at Neeley and Minidoka. The data suggest, however, that ground-water inflow has increased since the construction of American Falls Dam and Reservoir.

SPRING DISCHARGE BELOW AMERICAN FALLS DAM

Several springs of moderate size discharge water into the Snake River between American Falls Dam and Minidoka Dam. Many small seeps discharge additional water. The observed springs and seeps are shown on the maps on plates 1 and 5. Named springs include Rueger, Davis, Mary Franklin Mine, Mower, and Gifford Springs. A good description of the springs was given by Stearns, Crandall, and Steward (1938, p. 151–154). Rueger Spring, about 0.75 mile downstream from American Falls Reservoir is the nearest spring to the reservoir dam. Discharge measurements of Rueger Spring between 1925 and 1928 were listed by Stearns, Crandall, and Steward (1938, p. 151), and additional measurements were listed by Newell (1928, 1929). Measurements have been made regularly in summer months since 1927 and are given in reports of the Watermaster, Water District 36. As a part of this investigation, monthly measurements were made during the winter of 1961–62; these are the only measurements available for the winter season. Selected discharge measurements are shown graphically in figure 13. The only measurements available for years prior to filling of the reservoir are the four made during the summer months both in 1925 and 1926. Average prereservoir discharge was about 16 cfs. Average summertime discharge increased to about 24 cfs, a 50 percent increase, in 1927, the first year the reservoir was filled.

The discharge of the springs has not increased since 1927. In fact, the discharge during the summer of 1961 was less than that in the

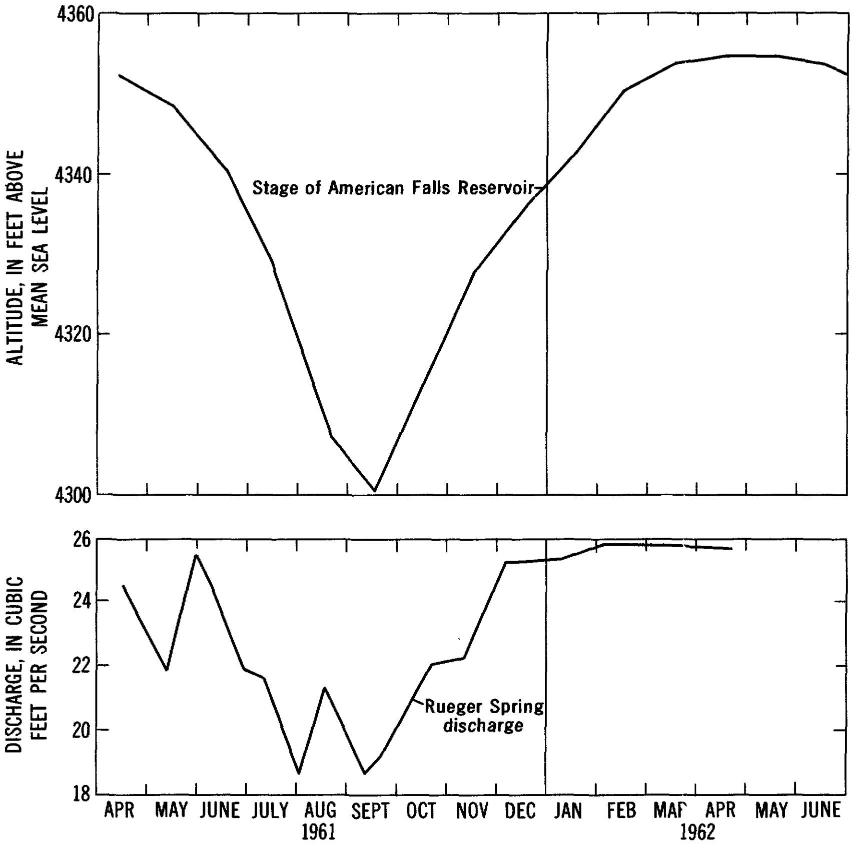


FIGURE 13.—Discharge from Rueger Spring and stage in American Falls Reservoir.

summer of either 1927 or 1928, because the reservoir was drawn down to such a low level in 1961. In contrast, the reservoir was maintained at a high level during the summers of 1927 and 1928. The spring discharge for April 1961–April 1962 is compared with the stage in American Falls Reservoir for the same period in figure 13. It is obvious that fluctuations in discharge of the springs are related to stages of the reservoir. Discharge at full reservoir stage (about 4,355 ft) is about 25–26 cfs; when the reservoir is empty (about 4,296 ft) the discharge is 18–19 cfs, or little more than it was before the reservoir was constructed.

Stearns, Crandall, and Steward (1938, p. 152) gave several discharge measurements of Davis Springs, but only two of the measurements were made before the reservoir was constructed. These measurements suggest that the average discharge increased from about 2 to 3.5 cfs because of the reservoir. The same report (p. 153) lists many measurements of Mary Franklin Mine Springs, including 25 measurements made in 1925 and 1926, prior to filling the reservoir. Average prereservoir discharge, including that from nearby seeps, was about 8 cfs. Average postreservoir discharge (1927–28) was about 10.5 cfs, or an increase of slightly more than 30 percent. As would be expected, the percentage of increase is less at Mary Franklin Mine Springs than at Rueger Springs because the former are 2 miles downstream from the dam as compared with 0.75 mile downstream for Rueger Springs. Thus, the change in gradient caused by the filling of the reservoir is much less for Mary Franklin Mine Springs than for Rueger Springs.

The report by Stearns, Crandall, and Steward (1938, p. 152–153) gives considerable information on Gifford Springs and concludes that the discharge of the spring group now known as Gifford Springs probably was 25–35 cfs prior to irrigation of the Aberdeen-Springfield tract. Presumably, the discharge of these springs increased after irrigation on the tract began. No information could be obtained to substantiate this because construction of Minidoka Dam in 1907 and impoundment of water in Lake Walcott behind the dam resulted in drowning of some spring outlets.

The data cited on previous pages show that prior to filling American Falls Reservoir, total spring inflow into the Snake River between American Falls Dam and Minidoka Dam was probably at least 60 cfs; because many seeps are unmeasured, the total inflow may have been 80–100 cfs. If an inflow of 100 cfs prior to construction of the reservoir is assumed, the total spring inflow because of reservoir losses after construction of American Falls Reservoir has probably increased as much as 25 percent, or about 25 cfs, because of reservoir losses after construction of the reservoir. This maximum increase would be at high reservoir stages; the average inflow probably increased only 15–20 cfs.

Some water discharges from the basalt beneath the dam. According to Glen Simmons, U.S. Bureau of Reclamation, Burley, Idaho (oral commun., May 1962), 10–15 cfs discharges into the Idaho Power Co. forebay in the left penstock section. This discharge is visible when the forebay is emptied at low reservoir stages. Presumably the discharge would be more, perhaps two or three times as much, at high reservoir stages. The average discharge may be about 25–30 cfs, and thus the total gain between American Falls Dam and Minidoka Dam that originates as seepage from American Falls Reservoir would be about 50 cfs. Maximum discharge at high reservoir stages probably would be about 70 cfs.

SEEPAGE LOSS FROM AMERICAN FALLS RESERVOIR

The water budget in the Neeley to Minidoka reach suggests an average seepage loss of 50 cfs. If the seepage loss through the basalt beneath the dam is added, then the total seepage loss determined by the water-budget method is about 60–80 cfs. Analysis of spring discharge indicates a seepage loss of 40–50 cfs. Because the data are inaccurate, the estimates have been averaged, and a value of 60 cfs is assumed to be the average seepage loss from the reservoir. Seepage loss at maximum stage is assumed to be 80 cfs. These estimates are probably reliable only as an order of magnitude.

Most of this seepage loss is through the fine-grained sediments in an area extending from the American Falls Dam to about 6 miles north of the dam. In this area and from there northward at least 8 more miles the materials from land surface, or from near the surface, to depths of 50–100 feet below the bottom of the reservoir are fine grained (pl. 4) and transmit little water. Accordingly, the Snake Plain aquifer is considerably below the bottom of the reservoir.

The water-table maps (pls. 2, 5) show that from about 6 miles north of the dam northward the water table is above high stages of the reservoir. What effect filling of the reservoir has on the segment extending from 6 to 14 miles north of the dam is not known, but water-level measurements and a comparison of the water-level contours shown on plate 2 with those shown on plate 5 suggest that in April 1962 the water table stood at an altitude about 2 feet higher than it would if the reservoir had not been filled. It is not known if rise in water level is caused by leakage from the fine-grained deposits into the basalt aquifers beneath or if the rise is a pressure effect from loading. However, the result is to increase the ground-water gradient west of the south end of the reservoir and, thus, to increase underflow in the aquifer.

EFFECT ON THE WATER REGIMEN OF RAISING THE RESERVOIR LEVEL

Raising the reservoir level might cause several changes in the hydrologic regimen of the area. The changes probably include:

1. Increased seepage loss.
2. Diversion of, or reduction of, ground-water inflow.
3. Increased drainage problems.

A quantitative evaluation of these effects is helpful in considering the feasibility of raising the maximum stage of the reservoir.

INCREASED SEEPAGE LOSS

Present seepage loss from the reservoir averages about 60 cfs; the maximum rate is probably not more than 80 cfs (5,000 acre-ft a month), and this occurs when the reservoir is full.

Spring outlets to the Snake River below American Falls Dam are between altitudes of 4,196 and 4,280 feet. Thus, at present maximum pool stage in American Falls Reservoir there is a head difference of 75–160 feet between the reservoir level and the spring outlets. Raising the maximum pool stage in the reservoir 15 feet would increase the hydraulic head by an average of perhaps 15 percent and would increase the maximum seepage.

The increase in seepage loss can not be estimated on any sound basis, but one might speculate whether the amount is likely to be significant to the water regimen. The following assumptions were made:

1. Seepage loss from the American Falls Reservoir is proportional to the head in the reservoir.
2. The maximum head in the reservoir is about 100 feet above the average altitude of the springs.
3. The seepage loss at maximum head is about 80 cfs, and the average loss is about 60 cfs.

Under these assumptions, seepage loss increases about 0.8 cfs per foot of head in the reservoir. Thus, increasing the head in the reservoir 15 feet would increase seepage loss about 12 cfs. If one assumes the loss is double this amount, or 24 cfs, it would seem to be a more than ample allowance. As a reasonable guess, raising the dam 15 feet might increase the maximum seepage rate by about 20 cfs to a total of 100 cfs, and the average rate by 10 cfs to a total of 70 cfs.

The calculated rates of increased seepage loss seem small when compared with either the capacity of the reservoir or the average inflow to it. An increase of 10 cfs amounts to about 7,000 acre-feet per year, and one of 20 cfs, about 14,000 acre-feet per year. Both amounts are small when compared with the present reservoir capacity of 1.7 million acre-feet or the proposed increase in capacity of 0.9 million acre-feet. The same seepage rates contrast with inflow to the reservoir of 4–6 million acre-feet per year. An estimate greater by an order of magnitude would be only about 3 percent of the inflow.

An area of concern with respect to a possible increased seepage loss with an increased maximum reservoir stage begins 3 miles north of the west end of American Falls Dam. From the north edge of section 13, T. 7 S., R. 30 E., basalt crops out intermittently in the reservoir bank for about 2 miles (pl. 2). The actual length of outcrop along the shore line is about 1.5 miles. The basalt overlies the Raft Formation, and the contact between the two units is at an altitude of 4,335–4,340 feet. Thus, at present maximum reservoir stages the basalt is submerged 15–20 feet, and with an increased stage it would be submerged 30–35 feet. The basalt is porous and permeable and can transmit large quantities of water. The water-table map showing the water table at a full-reservoir stage in April 1962 (pl. 2) shows the water table sloping westward from this area. However, this is the water table in the Snake Plain aquifer, tapped by wells ending below the Raft Formation. The water table in the basalt overlying the Raft Formation is perched and slopes toward the reservoir. Figure 14 shows the relative position of the perched water table in wells 7S–30E–12ca1 and –14dc1 and the stage of the reservoir for the period May 1961–July 1962. A small, probably insignificant amount of water percolates downward to the Snake Plain aquifer through the fine-grained sediments of the Raft Formation. An increased head caused by higher reservoir stages

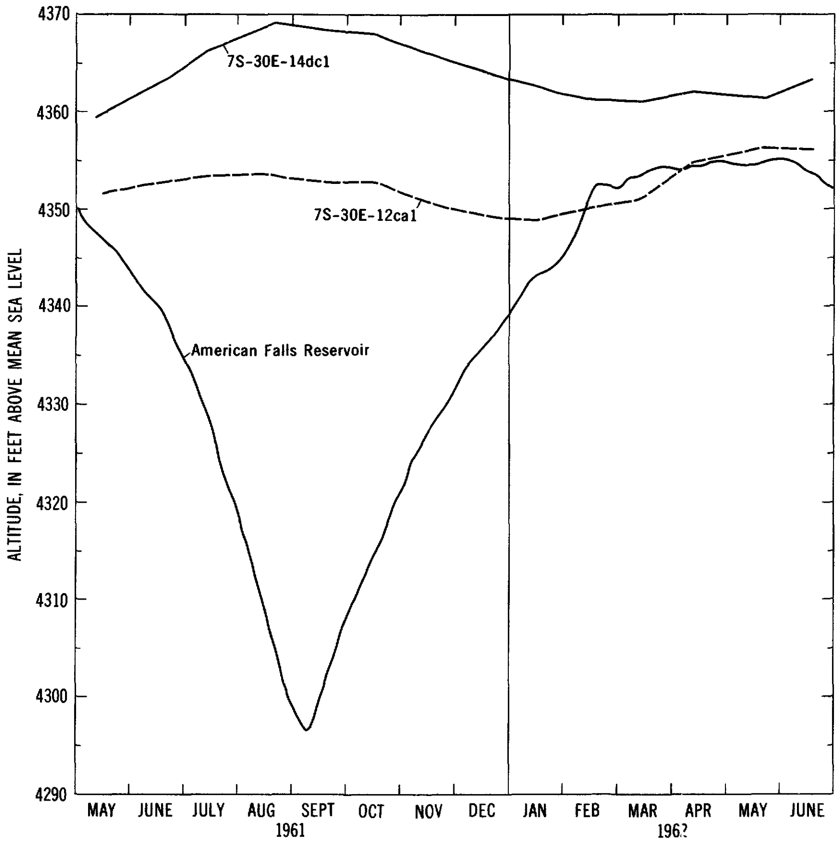


FIGURE 14.—Hydrographs of wells 7S–30E–12ca1, 7S–30E–14dc1 (perched water table) and of American Falls Reservoir.

probably would not greatly increase percolation through the Raft Formation from the perched water table.

An increased reservoir stage would raise the perched water table and might slightly reduce inflow from the perched aquifer to the reservoirs but it probably would not result in any direct seepage loss along this segment of shoreline.

The water-table map (pl. 5) also suggests that there is some seepage loss from a short segment of the reservoir at the east end of American Falls Dam. However, the materials exposed along the shoreline and those penetrated by wells are generally fine grained and have low permeabilities. Supply wells in the area are drilled far below reservoir level to obtain an adequate water supply. The seepage loss from that segment of the reservoir is undoubtedly small.

DECREASED GROUND-WATER INFLOW

Field examination and the topographic quadrangle maps show that nearly all major spring-outlet areas are at altitudes above 4,370 feet, and most are above 4,375 feet. The profiles and water-table map (pls. 4, 5) show that the water table drops steeply near the reservoir; thus, raising the reservoir level will affect the water table for only a short distance away from the reservoir.

Most of the springs whose outlets are below 4,375 feet are along the Snake River at the northwest end of the reservoir. Temporary submergence of these outlets would delay inflow to some extent, but the ground-water divide is sufficiently distant that it would not shift greatly in the few months during which the reservoir was at the higher level. Later, as the reservoir is drawn down, the inflow to the reservoir would increase, roughly by an amount equivalent to the decrease in inflow at high stages.

DRAINAGE PROBLEMS

A number of areas in the vicinity of American Falls Reservoir were waterlogged in 1961. The largest area extended from about 3 miles northeast of Aberdeen, through Sterling, to near Springfield. Study of aerial photographs and topographic maps shows that most of these areas are at altitudes that preclude waterlogging as a result of high reservoir stage; heavy applications of irrigation water are probably the cause. Waterlogged areas are shown on the Springfield 7½-minute quadrangle map. One group of ground-water ponds and swamps is on the lowest terrace, about 0.75–1 mile from the reservoir edge, at the foot of the next higher terrace—20–30 feet higher than maximum pool stage. Another band of waterlogged land is on the second terrace near the foot of the third terrace; this area is 40–60 feet above present maximum pool stage. Examination of the hydrographs in figures 4 and 5, shows that the water table in this area is highest in the late summer, when the reservoir is low, and lowest in the spring, when the reservoir is full. Obviously, most of the waterlogged areas were not caused by the reservoir.

Raising the maximum reservoir level to 4,370 feet would affect an area near Sterling and one between Sterling and Strang. An area of 7 or 8 square miles near Sterling is below an altitude of 4,380 feet; raising the maximum reservoir level to 4,370 feet would probably cause waterlogging in some parts that are not already waterlogged. One or two square miles of land between Springfield and Sterling would be similarly affected.

East of Aberdeen, between Big Hole and Little Hole, the land-surface altitude is irregular. Some areas would be inundated at a reservoir stage of 4,370 feet, and additional areas would be only a few feet above maximum reservoir stage and would probably be waterlogged at times.

Southwest of Little Hole most of the lowest terrace is above 4,390 feet, and little or no land would be waterlogged at an increased reservoir stage.

Along the southeast side of American Falls Reservoir the lowest terrace is mostly above 4,400 feet, and the area below 4,390 feet is only a few hundred acres. It is unlikely that any extensive areas on the southeast side of the reservoir will become waterlogged at an increased maximum stage of 4,370 feet.

CONCLUSIONS

Ground-water inflow in the American Falls Reservoir reach was probably about 1.2–1.4 million acre-feet a year (1,700–1,900 cfs) before irrigation began in eastern Idaho. Inflow increased with the increasing diversions of surface water to lands adjoining the Snake River and in the late forties and early fifties averaged about 1.95 million acre-feet annually (2,600 cfs). About 1952 increased withdrawals of ground water apparently became large enough to prevent further increases of ground-water inflow. Between 1922 and 1952 the ground-water inflow increased roughly 2.5 acre-feet for every 10 acre-feet of surface water diverted to lands on the Snake River Plain upstream from American Falls Dam.

The water budget for the period 1950–60 shows that a reasonably good correlation exists between fluctuations of the water table and cyclic fluctuations in ground-water inflow. No correlation can be made between the water table in the area of spring inflow and the stage of the reservoir. However, near the dam the water-table fluc-

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tuations coincide with the reservoir stage, and at high stages the water level in the reservoir is higher than the water table; thus, there is some seepage loss from the reservoir. The fine-grained deposits cropping out along the shore extend to depths of 50–100 feet below the bottom of the reservoir. Because they have a low transmissibility and because of northwest trending impermeable faults that cut the underlying permeable units, seepage loss from the reservoir is relatively small. Water-table contours and flow lines indicate that this seepage returns to the Snake River between American Falls Dam and Minidoka Dam.

Extrapolation of spring-flow data and computations of a partial water budget for the reach of river between American Falls Dam and Minidoka Dam provide a rough estimate of seepage loss from American Falls reservoir. Under existing conditions the average loss is estimated to be 60 cfs, and at maximum stage, 80 cfs. The increase in loss, if the dam were raised 15 feet, might be 10 cfs on the average and 20 cfs at maximum. Even if the values are low by an order of magnitude, the increased loss at maximum stage would be less than 3 percent of the average rate of inflow to the reservoir.

Raising the maximum reservoir level 15 feet, to an altitude of 4,370 feet, probably will not decrease ground-water inflow greatly because most spring outlets are above 4,370 feet.

Areas currently waterlogged are well above maximum reservoir stage and are not related to reservoir stage. However, several square miles of terrace is at altitudes only slightly above 4,370 feet, and some parts of this terrace are already waterlogged. Raising the maximum reservoir stage to 4,370 feet will undoubtedly waterlog additional acreage. To determine the extent of this acreage will require detailed mapping of the areas.

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BASIC DATA

Records of selected wells near American Falls Reservoir

[Locations of wells shown on plate 2]

Altitude: land-surface datum at well.
t, altitude estimated from topographic map.

Depth to water: in feet below land surface datum.
e, estimated from measurements made at other times.

Well	Owner	Depth (feet)	Diameter (inches)	Character of aquifer	Altitude	Depth to water			
						Depth	Date	Depth	Date
3S-31E-35cd1	Herbert Hall	148	16	Basalt and cinders	4,510.9	95 e	10- -61	98.7	4-14-62
33E-31dc1	W. T. Hansen				4,462.2	45.8	7-15-53	52.1	4-16-62
36dd1	Dee Winmill	60	14	Basalt and cinders	4,438 t				
4S-30E-34ca1	Clifford Wride	240	16		4,595.7	197.5 e	10- -61	199.57	4-14-62
31E-2bc1	Herbert Hall	113	8	Cinders	4,508.0	95.0	7- 9-53	95.3	4-14-62
9db1					4,517.6			111.0	4-14-62
11cb1	Irvin Satterfield	160	16		4,471.9	67.7 e	10- -61	68.7	4-14-62
14dc1	Bruce Parmlee Estate	133	16	Basalt	4,456.5	47.7	10-16-61	48.7	4-16-62
15dc1	E. P. Heaney	85		do	4,464.8	56.7	10-16-61	57.6	4-16-62
20bb1	Joe Hinkle	201	16		4,523.3	115.1	10- 2-53	119.2	4-14-62
24bc1	Jack Norman	150	12		4,452.5	45.0	10-16-61	46.7	4-16-62
28bc1					4,462.6	60 e	10- -61	61.3	4-12-62
29aa1					4,467.8	65 e	10- -61	66.5	4-12-62
29da1					4,453.4	50 e	10- -61	52.7	4-12-62
31cc1	Arthur Huether	162	16		4,536.2	134.5	8-25-53	138.2	4-12-62
33dd1	R. T. Nelson		6	Basalt	4,433.5	27.8	8-27-49	29.9	3- 5-48
36ab1	U.S. Geol. Survey	17	1¼	Sand and gravel	4,401.8	2.3	10-15-61	5.8	4-15-62
32E-1da1	Alden Judge	74	16	Cinders	4,443.1	43.4	10-17-61	46.4	4-16-62
6dc1	Shaw Leich	60	6		4,437.3	19.7	11- 7-46	21.4	3- 6-47
8aa1					4,463.1			51.8	4-16-62
8cd1	Milton Line	207	12-36	Basalt and cinders	4,457.3	35.0	10-16-61	52.4	4-15-62
9dc1	Bob Chandler	105	6	Basalt	4,438.9	32.7	10-16-61	37.0	4-15-62
9dd1	Harvey Claunch	111	7	Basalt and cinders	4,440 t				
11ab1	Norel Thurston	112	6	Basalt	4,141 t				
13cb1	Raymond A. Ruff	60	6		4,410.9	15.6	10-17-61	17.5	4-15-62
13cd1	Lee B. Lofgreen	55	10		4,413.0	20.2	10-17-61	21.9	4-15-62
13da3	Clarence L. Annen	79	10		4,423.2	27.0	10-17-61	29.0	4-15-62
13dc1	Lee B. Lofgreen	37	6		4,393.6	1.1	10-17-61	3.2	4-15-62
14ad1	Floyd Shipley		10		4,408.0	12.9	10-17-61	14.8	4-15-62
14da2	Mark Palmer	226	8	Sand and gravel	4,410.6	1.1	10-17-61		
15cd1	Phillip Chandler	220	6		4,390.9	+18.4	10-17-61	+18.0	4-12-62
16dd1	Les Bradley	255	8	Sand	4,415 t	Flows			
17da1	Dorris L. Thomas	171	8		4,414.1	5.8	10-16-61	10.4	4-15-62
17dd1	Santo DeGuilio		5		4,411.9	6.2	10-16-61	10.0	4-15-62
21bb1	Richard D. Michaelson	47	6		4,406.8	6.0	10-16-61	8.0	4-15-62

21db1	D. C. Wadsworth	238	6	Quicksand and gravel	4,377.6	Flows			
22ad1	Sam A. Chandler	152	6		4,375.8	+7.6	10-17-61	+9.5	4-12-62
23cc1	Lamar Whyte	29	6		4,371.6	2.4	10-17-61	2.1	4-15-62
24cb1	Crystal Springs Trout Farm	9	6		4,383.5	5.3	10-17-61	5.7	4-15-62
28ba1	Agnes Driscoll	236	8	Gravel	4,380 t	Flows			
28bc1	Agnes Driscoll	103	4		4,370.8	3.0	10-16-61	2.7	4-15-62
28cc2	O. E. Nelson	9	6	Basalt	4,370.3	3.9	9-22-61		
29ab1	Clara Driscoll	70	6		4,388.2	6.7	10-16-61	7.3	4-15-62
29dd1	Brookbush	192	8	Sand and gravel	4,368.9	Flows			
31ab1	Everett Claunch, Jr.	65	12	Cinders	4,401.1	10.0	10-17-61	11.3	4-15-62
31ba1	Don P. Michaelson	218	8	Basalt	4,401 t	Flows			
31da1	Frank C. Herbert	71	8		4,386.7	6.0	10-17-61	6.1	4-15-62
33bc1	Bill Webb	248	6	Gravel	4,374 t	Flows			
33E-1bc1	Herbert Crumley	48	6	Basalt	4,434.3	26.8	6-13-61	29.0	4-16-62
3cb2	R. F. Cammack	53	6	do	4,447.9	36.3	10-18-61	39.0	4-18-62
5bb1	Robert Houghland	76	16	do	4,444.9	41.9	7-15-61	45.9	4-16-62
8bb1	Arthur J. Jones	100	16		4,459.8	48 e	10- -61	53.6	4-16-62
10da1	Paul Butts	40	12	Cinders	4,405 t				
15bb2	Gerald C. Kinney	48	16	Basalt	4,413.0	29.0	10-17-61	31.3	4-15-62
17cb1					4,426.6	21 e	10- -61	29.3	4-16-62
18cb1	Clarence L. Annen		8		4,422.6	26.9	10-17-61	28.9	4-15-62
20bb1	Elmer Stecklein	85	16-18	Gravel and cinders	4,411.8	17 e	10- -61	23.1	4-12-62
20cd1		77	16		4,420.1	38 e	10- -61	42.2	4-16-62
20db1		56	22		4,414.3	30 e	10- -61	35.6	4-16-62
22ba1	T. P. Fackrel		16	Basalt	4,405.0	29.5	12-11-57	30.6	4-15-62
22cb1	Josephine Shelman	34	14	Basalt (crevice)	4,386.5	24.8	10-17-61	25.4	4-15-62
29ac1	Eugene Shelman	133	16	Gravel	4,417.3	45 e	10- -61	46.3	4-16-62
29bc1	Mildred Reid	38	20		4,391.3	19 e	10- -61	20.2	4-16-62
29bd1	Eugene Shelman	18	10		4,395 t	15 e	10- -61	15.6	4-16-62
34E-5cc1	U.S. Govt	37	6	Gravel	4,405.2	3.8	10-18-61	4.5	4-13-62
5S-30E-2ac1	Clifford Wride	169	18	Cinders	4,553.6	157	1953		
10cb1	T. S. Vanderford	240	24	Basalt and cinders	4,582.1	192 e	10- -61	193.5	4-11-62
10db1	do	200	24	do	4,554.8	165 e	10- -61	166.0	4-11-62
12bb1	George Inskeep	200	12		4,501.5	109.0	10-15-61	109.2	4-12-62
12cd1	Walt Inskeep	126	12		4,481.5	88.2	8-29-51	92.2	4-12-62
13bc1	Frank Klempel	120	18		4,467.4	78 e	10- -61	79.7	4-11-62
13cc1	do	195.5	16	Basalt	4,458.9	71.8 e	10- -56	72.6	4-11-62
14ca1	Alex Schelske	194	16	Cinders	4,515.7	130.3	7-21-53	129.2	4-11-62
16ad1	T. S. Vanderford	278	24	Basalt and cinders	4,609.3	223 e	10- -61	223.2	4-11-62
24ab1	Lowell Thornley	74	8	Basalt	4,446.9	59.3 e	10- -61	60.7	4-11-62
36db1	Alex Schelske				4,464.3			85.7	4-11-62
31E-2cd1	Aberdeen-Springfield Canal Co	100	18	Basalt	4,410 t				
4da1	Ernest Underwood	81.3	8	do	4,448.8	49.4	10-15-61	53.4	4-14-62
6dc1	Leslie Pratt	178.5			4,518.3	123 e	10- -61	123.3	4-12-62
7aa1	do	165	18		4,503.9	109 e	10- -61	109.9	4-12-62
5S-31E-8ad1	Gus Klempel	86	4		4,462.2	65.4	10-15-61	66.0	4-12-62
11ca1	Aberdeen-Springfield Canal Co	111			4,410.0	14.5	10-16-61	17.4	4-15-62
12bc1	W. D. Thompson	73	8		4,398.9	12.4	10-15-61	14.0	4-15-62
14ba1	Kramer Estate	35	4		4,407.5	15.4	10-15-61	19.1	4-15-62
14cd1	Mrs. Lucile Comer	60	4		4,404.2	19.2	10-15-61	26.9	4-15-62

Records of selected wells near American Falls Reservoir—Continued

Well	Owner	Depth (feet)	Diameter (inches)	Character of aquifer	Altitude	Depth to water			
						Depth	Date	Depth	Date
5S-31E-15ab1	Chris Maisch	325	10-18	Gravel and basalt	4,428.7	37.3	10-15-61	38.8	4-15-62
19dd1	Don Dancliff	61.3	6		4,427.0	43.3	10-15-61	44.4	4-11-62
22ad1	George P. Brewington	70∓	6		4,401.0	16.8	10-15-61	24.4	4-15-62
23ab1	Ben C. Johnson	58.4	8		4,396.5	11.4	10-15-61	20.0	4-15-62
23ad1	do	273	6		4,396.3	8.0	10-15-61	7.6	4-15-62
25bb1	Kendall Thornley	108	16		4,395.0	24.5	10-15-61	26.7	4-11-62
25bc1	Florncio Omachevarria	33	6		4,394.0	24.9	10-15-61	26.5	4-11-62
27ab1	Woodrow Yonngstrom	46	12-16	Basalt	4,399.8	18.4	10-15-61	24.8	4-11-62
27da1	Aberdeen-Springfield Canal Co	106	12	Basalt aud cinders	4,403.1	25.1	10-16-61	31.0	4-11-62
27dc1	Grant Beck	70	4		4,402.6	21.1	8- 1-52	26.6 e	4- -62
29ad1	Aberdeen-Springfield Canal Co	116	18		4,406.3	18.6	10-16-61	20.5	4-11-62
29cc1	Bank R. Westfall	85	4		4,432.0	45.1	10-24-45		
33ad2	Idaho Potato Growers, Inc	327		Basalt and cinders	4,404 t				
33bd1	H. L. Lowe	35.8	6	Basalt	4,399.4	16.0	10-15-61	19.2 e	4- -62
33cc1	City of Aberdeen	85	16	Cinders	4,403.0	19.9	10-16-61	21.7	4-11-62
34aa2	Bruce Beck	36.9	8		4,396.5	20.5	10-15-61	24.8	4-11-62
35aa1	Maril Beck	61.2	6	Basalt	4,391.7	22.0	10-15-61	23.8	4-11-62
36aa1	State of Idaho	200	8	Gravel	4,355 t	Flows			
32E-6dd1	Dayton Martin	21	6	Sand and clay	4,370.8	5.8	10-15-61	2.5	4-15-62
7cc2	U.S. Geol. Survey	15.4	1¼	Gravel	4,374.7	2.7	10-15-61	2.9	4-15-62
18cd1	Charles F. Cornforth	240	8	do	4,373.8	+9.9	10-15-61	+15.7	4-12-62
18dc1	A. L. Cornforth	220		Sand	4,375 t				
33E-25bb1	T. A. Swanson	165			4,457.4	58.5	10-14-27	61.2	6- 6-28
34ad1	Fort Hall Indian Res	153.5	16	Sand and gravel	4,418 t	13 e	10- -61	12.8	4-26-59
34cb1	do	123	6	do	4,431 t	30.9	8-29-52	33.6	4-26-59
35cc1	U.S. Geol Survey	60	6	Gravel	4,428.8	24.6	10-16-61	25.0	4-11-62
36aa1	Ida Watson	90	6		4,460 t	54 e	10- -61	54.1	4-27-55
34E-30aa1	C. F. Bullock	70	6		4,460 t	35	1955		
30da1		89.6	6	Gravel	4,470 t	61.6	8-15-52		
6S-30E-13ac1	Elmer Funk	120	14-16	Cinders	4,471.9	96.6	10-19-61	93.7	4-13-62
13bc1	do	236	16	do	4,480 t	107	1953		
13ca1	Earl Moser	170	14-16	do	4,468.2	98.0	10-19-61	97.0	4-13-62
22aa1	Enra Ruff	270±	10		4,546.2			186.0	4-13-62
24ac1	Jensen Bros	145±	12	Cinders	4,454.3	85.4	10-19-61	82.5	4-13-62
24bb1	do	165±	14	do	4,458.0	89.4	10-19-61	88.4	4-12-62
24ca1	William Funk	165	16	do	4,467.6	100.5	10-19-61	99.1	4-12-62
25bb1	Armin Schroeder	175	16	do	4,468.8	102.9	10-19-61	101.5	4-13-62
26aa1	Travis Michaelson	205	20	Basalt and cinders	4,480 t				
34aa1	Kenneth Marshall	235	16	Cinders	4,514.8	170.2	10-16-61	169.8	4-13-62
34ca1	R. O. and A. L. Josman	206.8	16-21	Basalt	4,523.8	177.3	10-19-61	174.7	4-12-62
35cc2	William Funk	218	16	Basalt and cinders	4,518.2	173.0	10-19-61	170.2	4-13-62
36ac1	Armin Schroeder	154	16	Cinders	4,427.1	62.2	10-19-61	60.4	4-13-62

31E-1da1	Gordon Toeves	200	14		4,384.9	13.8	10-18-61	Flows	4-13-62
1db1	do	200	14		4,406.8	52.3	10-18-61	35.9	4-13-62
6cd1	Wilson Nowels	111	19	Cinders	4,455 t	84	1953		
7ba1	Aberdeen Airport	97	8		4,457.2	82.7	10-19-61	83.0	4-11-62
9cd1	Aberdeen-Springfield Canal Co.	70		Sand	4,388 t	Flows	3- -45		
10cc1	Clyde Henderson	60	6		4,401.6	21.8	10-18-61	25.1	4-13-62
10dd1	W. C. Dirks		6		4,398.3	43.0	10-18-61		
11ab1	Callaby		4		4,399.1	49.6	10-18-61	45.5	4-13-62
11bc1	Eddie J. Phillips	54	6	Sand and clay	4,390 t	27.3	10-18-61	31.5	4-11-62
16ba1	John W. Palmer	134	12		4,392.2	14.6	10-18-61	16.1	4-11-62
16dd1	Aberdeen-Springfield Canal Co.	180	12-18	Sand	4,403.9	26.3	10-17-47	27.2	3- 5-48
18db1	do	110	18	Basalt	4,435 t	23	9- -34		
21dc1	Travis Michaelson	500	10-16		4,390 t				
30bb1	F. M. Gamble	150	6	Basalt	4,430 t				
30da1	Bartholoma Bros.	78	7	do	4,415.0	48.0	10-18-61	51.9	4-11-62
31dd1	Jim Brown	103	12	Sand and gravel	4,395 t	23.8	8-21-52		
32cd1	Bill Vollmer	105	6	Cinders	4,400 t	54.6	7-24-61		
33bc1	Fenstermaker	225		Gravel	4,400.2	64.1	10-18-61	48.4	4-13-62
36ac1	Ira Neibaur	176	16	Sand and gravel	4,388 t				
32E-2ba1	Broncho				4,397.8	71.9	8- 7-59		
2bb1	Fort Hall Indian Res.	86	4		4,390 t	66.9	8- 7-59		
11aa1	do	100	6	Sand and gravel	4,405 t	49.9	8- 7-59		
27ad1	U.S. Geol. Survey	62.7	6	Sand	4,416.7	38.9	10-16-61	34.6	4-11-62
29cc1	Vern Eames	67.5	6		4,414.6	60.5	10-26-53	60.6	4- 4-54
29dc1	Eames and Clothiel	319	12-14		4,403.3	77.4	8-18-58		
31ac1	Vern Eames	232	16		4,400 t	77.0	9-20-61	40.0	4-10-60
31da1	Satterfield Farms	442	12-14	Sand and gravel	4,407.5	64.0	9-20-61	41.6	3-14-61
32ba1	Horace and Grace Caldwell	245	12-14	do	4,403.1	40 e	10- -61	36.5	4- 7-61
33E-1cd1	Rowland Bros.	265	14-16	Cinders	4,452 t	46.0	7- 9-56		
2ca1	George R. Wainscott	149	8		4,438 t	37.7	9-27-58		
10da1	City of Pocatello	214	12	Basalt; sand and gravel	4,443 t				
11db1	Bistline and Evans	130	16	Gravel	4,452 t			50.3	4-27-59
12dd1	Westvaco Chem. Co	120	6	do	4,487 t	91.7	8-14-58		
13bb1	do	206	16	Rhyolite	4,449.0				
15cd1	Bistline and Evans	160	18		4,495t	99.9	8-28-52	97.3	4-25-59
17bc1	Lyman and Welch				4,428 t			26.3	4-25-59
20ab1	Anton Smith	153	5	Gravel	4,436.9	35.5	10-16-61	35.0	4-11-61
21cb1	do	215	18	Sand and gravel	4,430 t	35 e	10- -61	33.0	4-25-59
28ca1	Fort Hall Indian Res.	220	6		4,560 t	157 e	10- -61	155.3	4-27-59
31dc1	Jim Brown	193	14	Sand and gravel	4,432 t	29 e	10- -61	28.1	4-27-59
7S-29E-10ac1	Ferdinand Gehring	262	22	Cinders	4,549.1	233.0	10-17-61	231.3	4-12-62
15aa1	do	248	18	do	4,518.2	210.8	10-17-61	209.0	4-12-62
16ac1	Gottfried Hofmeister	300	14	Basalt	4,544.9	245.8	10-17-61	243.8	4-12-62
13bd1	do	[illegible]	16	do	4,559.3	261.0	10-17-61	[illegible]	4-12-62
21bb1	Cecil Weigenburger	222	18	Cinders	4,591.8	196.0	10-17-61	193.8	4-12-62
24ca1	Albert Burgemeister	475	18-20	do	4,557.0	254.6	10-17-61	252.6	4-11-62
28ca1	M. E. Fenstermaker	244	17	do	4,514.8	217.6	10-16-61	215.8	4-11-62
32cb1	Edward Walter		6		4,468.2	179.5	10-17-61	177.0	4-11-62
30E-1bc1	Robert Schroeder	167	10	Sand	4,427.7	78.0	10-19-61	75.8	4-13-62
2bc1	George Funk	155	18	Basalt and cinders	4,471.4	127.1	10-18-61	125.2	4-13-62
3ac1	do	171	18	Basalt	4,480 t				

Records of selected wells near American Falls Reservoir—Continued

Well	Owner	Depth (feet)	Diameter (inches)	Character of aquifer	Altitude	Depth to water			
						Depth	Date	Depth	Date
7S-30E-5ba1	Joe Allen	251	16-18	Basalt	4,529.3	185.0	10-18-61		
6ab1	do	266	16-18	do	4,541.8	199.8	10-18-61	197.6	4-12-62
6ad1	do	232	16	Cinders	4,520 t	181.4	7-25-61		
10ab1	George Funk	136	18	Basalt	4,455.2	110.6	10-18-61	108.2	4-12-62
11aa1	W. A. Rowe	301	12-16	Cinders; sand and gravel	4,462 t				
11ba1	Chris Funk	160	16	Cinders	4,462.3	118.3	10-18-61	115.5	4-12-62
11bc1	Ben Mayer Estate	144	18	Basalt	4,465 t				
12ca1	Jess Meadows	63	6	Basalt	4,399.2	46.4	10-20-61	44.3	4-12-62
13dc1	U.S. Govt	210	8	Gravel	4,386.1	58.8	10-18-61	41.2	4-12-62
14bb1	J. Heulett	200	16	Sandstone	4,466.5	122.2	10-18-61	119.4	4-12-62
14dc1	David Bethke	67	5		4,415.1	46.9	10-18-61	53.2	4-12-62
15aa1	Joe Mayer	152	6-8	Basalt and cinders	4,468.4	126.0	8-23-61	121.1	5-2-61
15aa2	do	136.7	6		4,468.4	123.9	10-18-61	121.9	4-12-62
16cc1	Ed Rast	326	14-16		4,415.2	171.8	10-18-61	169.1	4-12-62
18ca1	Otto Tiede	500±	24		4,644.0			295.5	5-11-61
20ab1	Emil Bauer	277	18	Cinders	4,470 t				
20da1	Emil Bauer	350	18		4,578 t				
21dc1	John Rast	255	21	Basalt	4,535.6	201.4	10-17-61	200.7	4-11-62
23cc1	Teles Mastigui	400	12	do	4,426.0	85.8	10-18-61	85.2	4-11-62
24ab1	Adolph Bethke		6		4,386.6	59.6	10-17-61	42.1	4-12-62
24dd1	C. H. Vollmer	215	16	Cinders	4,394.3	70.9	10-16-61	52.7	4-11-62
25ba1	Mack Bowler	240	16	Basalt	4,390 t				
25da1	do	200	20	do	4,393 t				
26ab1	Paul McMillan	242	12	Cinders	4,413.4			76.2	3-22-61
26dd1	Dan France	243	6	Basalt	4,395.4	70.7	10-18-61	55.4	4-11-62
27dd1	Charles Simms		6	Perched	4,397.2	34.3	10-17-61	42.8	4-11-62
28bb1	John Rast	288	12-18	Basalt	4,533.6	200.9	10-18-61	199.3	4-11-62
29aa1	do	335	18	Cinders	4,565 t				
30aa1	Fred Tiede	392	20	do	4,583.2			246.8	5-11-61
30da1	do	295	18	do	4,561.0	243.6	10-17-61	241.7	4-12-62
34ab2	Ray W. Polzin	234	6	Gravel and basalt	4,400.1	66.3	10-17-61	52.0	4-11-62
35aa1	Walter Siebel	216	6	Basalt	4,395 t				
35dc1	Lamb and Weston	220	16	Basalt	4,400 t				
35dd1	Lloyd Whitnah	198	6		4,390.8	68.3	10-17-61	52.9	4-11-62
36ab1	Don B. Moss		6		4,395.8	69.3	10-17-61	55.0	4-11-62
36ad1	L. A. Williams	200	6	Sandstone	4,388 t	67.0	9-20-61		
31E-1ab2	Vern Eames	210	16	Sand and gravel	4,410 t				
1bc1	T. S. Vanderford	275	12		4,413.5	77.6	10-16-61		
2da1	Vern Eames	340	14		4,402 t				
5cd1	Oren Geesey	255	6	Basalt	4,395 t				
6bc1	Arnold Paulson	53	16	do	4,400 t	35.8	7-23-61	37.7	5-26-52
6cc1	George Geesey	129	6	do	4,392 t				

11bd1	Ira Neibaur	300	14	Gravel	4,422.9	68.3	10-25-57	61.7	4-23-58
12ba1	Della M. Currier	375	14	Sand	4,411.3	59.5	10- 1-57	50.5	4-22-58
13dc1	Paul Evans	79.7	6		4,430 t	61.7	10-23-57	61.5	4-23-58
14ad1	Grace McLaughlin	74	6		4,419.0	55.5	9-20-50	55.1	6-22-50
15dc1	Kucera		6		4,415.2	56.1	8-16-50		
19cc1	Mack Bowler	135	4		4,390 t			51.4	5-10-61
21cc1	Paul Spaulding	86	4		4,400 t	62.4	10-22-59	59.9	4-22-59
22cb1	American Falls Airport	90	6		4,413.7	64.5	10-16-61	59.6	4-11-62
23cb1	George Kopp	156	8	Sandstone	4,423.8	71.5	8-10-59		
25db1	Dave Kosanke	280	10		4,515.4			122.7	4-27-51
27cb1	do	240	6-14		4,560 t	236.9	8-10-59		
29aa1	Paul Spaulding	135	13	Sand and gravel	4,405 t			58.6	6-17-52
29db1	City of Am. Falls	352	20		4,390 t	85.0	9-20-61		
30cb1	Alvin Kranzler	165	8	Sand	4,395.3	81.4	10-18-61	52.5	4-11-62
31aa1	Idaho Power Co	600	20	do	4,350.1	73.1	10-18-61	[1] 94.7	4-11-62
31aa2	do	200	20	do	4,350.6	75.0	12-14-61	69.6	4-11-62
32bd2	E. G. Lish	103	14		4,418.7	93.3	9- 2-58	93.6	3-31-59
32bd3	United Oil Co	340	6	Sand	4,420 t				
32dc1	J. P. Mehlhaff	412	20		4,525 t			135.0	3-29-57
33ab1	Woody Meadows	232	10		4,535.6	207.7	10-16-61	208.0	4-10-62
33bb1	Alex Scherer	234			4,524.1	186.9	9-20-50		
32E-6bb1	Della M. Currier	320	12-14		4,407.5	56.7	10- 1-57	42.6	3- 1-57
6cc1	Hughes		6		4,414.0	46.2	10-21-51	44.1	2-27-52
7da2	Bill Smith	298	16	Sand and gravel	4,405 t	31.2	9-29-58	28.0	3-30-59
8bd1	Ray Barnard	250	14		4,406.4	23.3	8-10-49		
18da1	do	68	6		4,467.9	68.8	8-10-59		
22ab1	Fort Hall Indian Res	234	6	Basalt	4,575 t	157.9	8- 8-59		
24db1	do	215	6	do	4,600 t	168.0	8- 8-59		
29bb1		132	6		4,514.0	118.5	9-19-50		
33E-20bb1	H. H. Zimmerli	445+	8-20	Sand and gravel	4,540 t				
32ad1	Fort Hall Indian Res. School	165	8		4,580 t	13.9	8-16-52		
8S-29E-9ca1	William Nachtigal	209	6		4,454.4	201.3	10-17-61	199.5	4-11-62
13cc1	Mack Bowler	500	16	Sand	4,430 t				
15ab1	do	154	6	Cinders	4,407.5	138.2	10- 3-56		
23ba1	do	210	6		4,446 t	186.2	10-18-61	185.7	4-11-62
30E-2db1	George Ringe	230	6		4,388.4	110 e	10- -61	99.3	5-10-61
15db1	A. R. Kramer	42	8		4,266.0	32.7	9-18-50		
18cc1	Mack Bowler	350	16		4,397.3	129.2	10-16-61	129.0	4-11-62
21cd1	U.S. Bur. Reclamation	126		Volcanic tuffs and breccias	4,239.4	43.3	10-12-51		
22aa1	A. R. Kramer	248	16	Sand	4,352.1	114.5	8- 1-58	114.1	4- 2-58
24ab1	Emil Mayer				4,513.6	147.4	9-22-50		
31E-4cb1	Hornbacher	277	6		4,568.4	243.2	10-16-61	243.0	4-10-62
5bc1	do	217	10	Sandstone	4,466.7	172.4	10-27-51		
6cd1	E. C. Winter	297	18	Sand	4,447 t	145.0	11- 4-60	141.0	5- 1-61
7ac2	Elbron Thornton	315	12	Sand and gravel	4,470 t			206.6	4-26-51
9da1	Fred Mayer	250	4		4,800 t	230.6	9-21-50		

[1] Pumping.

Analysis of ground-water inflow to American Falls Reservoir

[Water quantities in thousands of acre-feet. (+) indicates surface-water outflow, or the amount of water that leaves the reservoir area, or an increase in the contents of the reservoir during each month. (−) indicates the amount of water that must be subtracted from the surface-water outflow to obtain the ground-water increment]

Water year and month	Surface-water increments			American Falls Reservoir						Gross ground-water inflow (rounded)
	Outflow from reservoir	Inflow to reservoir		Stage at end of month (altitude, in ft)	Change in contents (+ or −)	Water surface area (acres)	Evaporation (acre-ft) (+)	Evapotranspiration (+)	Precipitation (−)	
	Snake River at Neeley (+)	Portneuf River at Pocatello (−)	Snake River near Blackfoot (−)							
				[1] 4,338.60						
1951										
October	259	18.7	275	43.13	+196	45,500	8.2	1	2.8	168
November	208	21.0	296	48.58	+263	50,700	4.2	0	4.1	154
December	285	20.2	286	52.01	+179	53,600	3.6	0	3.3	158
January	508	17.9	246	50.72	−68	52,500	3.5	0	2.1	178
February	571	23.0	311	49.39	−69	51,400	4.2	0	5.9	166
March	623	25.2	408	48.68	−36	50,700	8.1	0	1.3	161
April	547	31.0	635	53.25	+241	54,700	15.8	1	3.8	135
May	1,107	21.7	969	53.54	+16	55,000	23.1	0	1.9	154
June	810	5.8	736	54.89	+75	56,200	24.5	0	1.2	166
July	761	3.6	266	48.84	−325	50,800	25.0	0	2.1	189
August	676	7.8	325	45.33	−173	47,600	16.9	1	5.2	183
September	538	7.3	155	40.88	−203	43,100	14.1	1	.0	188
1952										
October	364	13.9	280	43.04	+96	45,300	8.3	1	2.4	173
November	277	19.0	315	47.34	+205	48,500	4.3	0	1.7	151
December	270	18.7	258	50.78	+176	52,500	3.6	0	5.9	167
January	381	17.7	254	51.86	+57	53,500	3.7	0	2.7	167
February	554	15.5	299	50.36	−79	52,200	4.2	0	4.0	161
March	654	19.9	368	48.72	−85	50,700	8.2	0	3.6	186
April	766	41.6	703	51.00	+118	52,800	15.6	1	3.3	153
May	1,103	49.0	1,130	54.68	+201	56,000	22.9	0	1.7	146
June	976	13.9	828	54.84	+9	56,200	28.4	0	.6	171
July	783	6.4	180	46.93	−417	49,200	27.9	1	.0	208
August	745	7.5	91	36.48	−460	38,300	24.6	3	1.7	212
September	511	8.0	70	28.95	−259	30,700	11.7	4	.4	189
1953										
October	166	9.2	94	32.55	+117	34,200	6.2	2	.0	188
November	96	17.4	196	39.75	+273	41,800	3.3	1	1.9	158
December	105	20.0	218	46.07	+287	48,300	3.2	0	6.1	151
January	160	23.9	266	51.76	+290	53,500	3.6	0	5.5	158
February	260	19.4	205	53.49	+94	54,900	4.3	0	2.0	132
March	352	23.1	209	53.75	+14	55,200	8.8	0	2.1	141
April	343	24.7	231	54.51	+43	55,800	16.6	0	4.8	142
May	584	17.3	284	52.03	−137	58,000	17.0	0	8.4	154
June	847	20.3	836	54.59	+141	56,000	27.3	0	4.2	155
July	771	3.9	158	45.87	−455	48,200	34.3	1	.8	189
August	727	4.9	71	34.45	−483	36,200	23.6	3	1.1	194
September	508	4.9	65	25.68	−279	28,000	14.0	4	.3	177
1954										
October	157	9.4	117	30.47	+143	32,200	7.0	3	3.8	180
November	47	15.7	208	39.60	+336	41,700	3.3	1	1.7	162
December	143	18.0	200	44.83	+234	42,100	3.1	0	1.9	160
January	157	17.1	193	48.93	+201	51,000	3.4	0	2.6	149
February	156	17.4	175	52.11	+166	53,700	4.2	0	1.9	132
March	239	22.6	192	54.42	+128	55,800	8.7	0	4.4	157
April	446	22.7	285	54.49	+3	55,800	15.2	0	3.9	153

See footnotes at end of table, p. 58.

Analysis of ground-water inflow to American Falls Reservoir—Continued

Water year and month	Surface-water increments			American Falls Reservoir						Gross ground-water inflow (rounded)
	Outflow from reservoir	Inflow to reservoir								
	Snake River at Neeley (+)	Portneuf River at Pocatello (−)	Snake River near Blackfoot (−)	Stage at end of month (altitude, in ft)	Change in contents (+ or −)	Water surface area (acres)	Evaporation (acre-ft) (+)	Evapotranspiration (+)	Precipitation (−)	
1954—Con.										
May	813	7.3	666	4,354.43	−3	55,800	28.4	0	2.7	162
June	584	3.8	419	53.77	−37	55,200	27.2	0	6.9	144
July	743	2.8	294	48.27	−290	50,300	37.2	0	.4	193
August	726	2.8	81	37.63	−482	39,500	27.1	3	1.2	189
September	503	3.6	86	30.33	−260	32,000	18.0	3	.7	174
1955										
October	165	6.0	162	35.25	+169	37,000	7.6	2	2.6	173
November	192	10.2	212	40.03	+189	42,200	3.6	1	1.4	162
December	166	14.3	176	44.06	+179	46,400	3.1	0	1.5	156
January	150	13.8	152	47.57	+170	49,700	3.4	0	1.7	156
February	74	12.8	132	51.59	+207	53,300	4.1	0	1.8	138
March	188	16.5	180	54.60	+165	55,900	8.8	0	2.7	163
April	409	18.4	240	54.65	+2	55,900	16.8	0	6.3	163
May	636	10.3	339	52.24	−133	53,900	26.4	0	3.5	177
June	683	5.6	400	49.65	−136	51,600	28.4	0	5.8	164
July	735	2.4	132	40.55	−432	42,700	27.5	2	1.4	197
August	696	3.7	75	28.00	−452	29,900	20.2	5	.9	190
September	501	4.1	57	16.61	−291	21,700	9.2	6	.4	164
1956										
October	136	6.1	105	22.63	+143	25,700	4.5	3	.4	175
November	64	13.8	202	33.04	+310	34,700	2.7	1	.7	161
December	54	16.5	273	42.82	+390	45,100	2.8	--------	4.9	152
January	205	19.0	257	47.75	+236	49,900	3.3	0	9.1	159
February	256	15.0	153	48.67	+46	50,700	4.0	0	1.0	137
March	415	23.4	306	49.99	+67	51,900	8.2	0	.8	160
April	737	31.7	749	52.88	+154	54,500	15.9	0	1.7	124
May	1,061	17.8	1,044	54.84	+109	56,200	24.3	0	5.3	127
June	1,257	4.3	1,130	54.36	−27	55,800	34.2	0	.3	130
July	752	1.7	208	46.97	−388	48,200	32.0	1	.4	187
August	685	3.0	93	37.08	−439	39,000	23.1	3	.1	176
September	476	3.7	83	30.20	−242	32,000	16.1	3	.7	166
1957										
October	199	6.3	172	34.57	+148	36,200	6.5	2	6.5	171
November	156	13.7	220	40.51	+234	42,600	3.6	1	.9	160
December	144	15.5	196	45.32	+219	47,500	3.1	0	1.8	153
January	221	14.0	138	47.04	+83	49,200	3.4	0	2.2	153
February	138	22.8	184	51.17	+211	52,700	4.1	0	2.9	143
March	329	24.0	318	53.98	+153	55,400	8.7	0	4.4	144
April	478	20.2	375	54.70	+40	56,000	16.7	0	6.5	133
May	1,168	40.2	998	54.79	+5	56,200	15.7	0	14.9	136
June	722	17.9	400	51.88	−160	54,000	27.4	0	1.4	170
July	783	3.1	89	41.08	−526	43,200	28.2	2	1.2	194
August	731	3.9	86	27.88	−479	29,800	20.6	5	1.6	186
September	507	5.3	89	17.94	−258	22,600	9.5	5	.0	169
1958										
October	119	8.8	143	26.15	+208	28,200	4.6	3	1.1	182
November	60	15.6	219	36.21	+331	38,000	3.0	1	1.6	159
December	118	17.9	230	43.11	+289	45,300	2.9	0	2.2	160
January	182	17.2	203	47.13	+191	49,300	3.3	0	3.9	152
February	142	23.6	204	51.50	+224	53,200	4.1	0	3.4	139
March	218	26.6	208	54.35	+156	55,700	8.9	0	3.0	145

See footnotes at end of table, p. 58.

Analysis of ground-water inflow to American Falls Reservoir—Continued

Water year and month	Surface-water increments: Outflow from reservoir: Snake River at Neeley (+)	Surface-water increments: Inflow to reservoir: Portneuf River at Pocatello (−)	Surface-water increments: Inflow to reservoir: Snake River near Blackfoot (−)	American Falls Reservoir: Stage at end of month (altitude, in ft)	American Falls Reservoir: Change in contents (+ or −)	American Falls Reservoir: Water surface area (acres)	American Falls Reservoir: Evaporation (acre-ft) (+)	American Falls Reservoir: Evapotranspiration (+)	American Falls Reservoir: Precipitation (−)	Gross ground-water inflow (rounded)
1958—Con.										
April	396	33.0	260	4,354.80	+25	56,100	16.8	0	4.0	141
May	748	28.5	567	54.32	−27	55,700	26.9	0	2.0	[2] 151
June	671	5.1	253	49.53	−257	51,500	28.4	0	3.8	[2] 182
July	772	2.5	68	37.28	−560	39,200	26.9	3	2.3	[2] 171
August	722	4.3	81	22.46	−471	25,500	19.5	7	.1	[2] 194
September	392	5.1	94	16.27	−146	21,500	9.4	6	.6	[2] 163
1959										
October	158	7.4	69	20.37	+94	24,100	7.4	5	.0	188
November	136	15.1	191	28.60	+223	30,400	2.4	1	3.1	153
December	81	18.4	198	37.29	+301	39,200	2.4	1	3.1	166
January	75	18.6	184	43.82	+279	46,200	3.0	0	3.8	151
February	88	17.7	179	48.82	+243	50,800	3.8	0	2.2	136
March	140	22.4	194	52.78	+209	54,300	8.4	0	1.6	139
April	341	22.4	164	52.82	+2	54,400	22.8	0	1.0	[2] 179
May	578	9.2	108	47.07	−298	49,100	23.7	1	5.3	[2] 184
June	661	4.1	139	38.65	−381	40,700	24.9	3	1.2	[2] 168
July	751	2.4	149	25.62	−442	27,900	22.3	7	.0	[2] 192
August	684	2.4	164	08.35	−376	15,200	14.5	11	.7	[2] 169
September	408	5.7	238	07.01	−20	14,000	5.3	7	1.5	[2] 157
1960										
October	136	10.0	180	19.08	+229	23,300	4.8	4	0.6	183
November	92	13.4	204	29.36	+277	31,200	2.4	1	.0	155
December	64	14.4	191	37.69	+293	39,500	2.5	1	1.3	154
January	78	13.8	149	43.18	+235	45,400	3.0	0	3.0	159
February	61	14.4	128	48.05	+233	50,100	3.8	0	4.2	151
March	87	28.1	180	53.01	+260	54,500	8.4	0	2.8	144
April	318	27.4	195	54.00	+55	55,500	16.5	0	2.3	[2] 165
May	670	7.0	118	46.85	−374	49,000	26.6	1	1.7	[2] 199
June	682	2.4	138	38.56	−374	40,600	28.8	3	1.4	[2] 203
July	796	1.2	115	22.06	−532	25,200	21.1	8	.5	[2] 182
August	698	3.4	262	08.74	−276	15,600	12.5	7	1.5	[2] 179
September	425	3.6	169	4,299.20	−102	4,200	4.7	9	.1	[2] 166
1961										
October	156	5.5	90	4,309.64	+116	16,300	2.8	5	.5	[2] 184
November	30	7.3	133	22.52	+274	25,600	1.9	1	2.4	164
December	13	12.9	126	32.12	+282	33,800	2.0	1	.8	158

[1] Water-surface altitude of reservoir at the end of September 1951.
[2] Includes Michaud Canal diversions for May-September 1958: 1.0, 1.8, 2.3, 2.1, 1.6; for April-September 1959:0.5, 1.7, 3.9, 4.8, 2.9, 1.9; for April-October 1960: 0.4, 2.2, 4.6, 5.8, 4.0, 1.9, 0.5.