Ground-Water Resources of the Middle Big Wood River-Silver Creek Area Blaine County, Idaho

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1478

Prepared in cooperation with the United States Bureau of Reclamation

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By REX O. SMITH

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UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1959

UNITED STATES DEPARTMENT OF THE INTERIOR

FRED A. SEATON, *Secretary*

GEOLOGICAL SURVEY

Thomas B. Nolan, *Director*

The U. S. Geological Survey Library has cataloged this publication as follows:

Smith, Rex Onis, 1924–

Ground-water resources of the Middle Big Wood River-Silver Creek area, Blaine County, Idaho. Washington, U. S. Govt. Print. Off., 1959.

iv, 64 p. illus., maps, diagrs., tables. 25 cm. (U. S. Geological Survey. Water-supply paper 1478)

Prepared in cooperation with the United States Bureau of Reclamation.

Bibliography: p. 64.

1. Water-supply — Idaho — Blaine Co. 2. Water, Underground — Idaho—Blaine Co. (Series)

TC801.U2 no. 1478 551.4979632 G S 59–161

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For sale by the Superintendent of Documents, U. S. Government Printing Office
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GROUND-WATER RESOURCES OF THE MIDDLE BIG WOOD RIVER-SILVER CREEK AREA, BLAINE COUNTY, IDAHO

By Rex O. Smith

ABSTRACT

The middle Big Wood River-Silver Creek area, lying between the mountains of central Idaho and the Snake River Plain and drained in part by the Big Wood River and in part by Silver Creek—a tributary of Little Wood River, includes about 48,000 acres of lowland in Blaine County. About 20,000 acres of the lowland is irrigated, chiefly with surface water. Wells supply water to 575 acres and supplemental water to about 3,000 acres. About 7,500 additional acres of arable land could be irrigated if sufficient water were available. About 20,500 acres of the area is nonarable swamp, waterlogged land, and gravelly river bottom. Nearly all the surface water in the area has been appropriated for irrigation within, and downstream from, the area. The available natural flow is not adequate for late-season water demands within the area. Reservoir sites are available in the valley of the Big Wood River upstream from the middle Big Wood River-Silver Creek area, but the cost of large dams there probably would be too high to warrant their construction.

Water to supplement the supply for the presently irrigated land is wanted, and additional land might be irrigated if water could be obtained for it. The U. S. Bureau of Reclamation is considering proposals to install additional irrigation wells in the area, and to construct a small upstream storage reservoir. The river, the reservoir, and the wells then might be managed so that consequent reduction of the amount of water available for downstream storage in Magic Reservoir would be offset by delivery of pumped ground water to the reservoir.

This report is a general evaluation of the ground-water resources available for the irrigated area and of the relation of the ground-water supply to the discharge of streams and existing water wells.

Pre-Tertiary basement rocks form the relatively impermeable floor of a basin which is partially filled with fluvioglacial sediments, alluvium, and basalt, all of Quaternary age. The Quaternary materials yield both artesian and unconfined ground water copiously to wells and springs. The ground-water reservoir receives recharge by underflow from the north (upstream), by direct infiltration of precipitation and irrigation water, by seepage from certain reaches of the channel of the Big Wood River, and by mass percolation from surrounding highlands. Ground water is discharged by springs which give rise to Silver and Spring Creeks, by seepage into some reaches of the Big Wood River, by evapotranspiration, by wells, and by underflow through a southeastern outlet from the basin.

Among 28 representative irrigation wells the average yield of pumped wells is 1,875 gallons per minute (gpm) and of flowing artesian wells, 825 gpm. The depth to the water table ranges from 70 feet below the land surface in the northern part of the area to zero in the southern part. The average depth is about 18 feet. The piezometric surface of the artesian water in the small area where it was measured averages 27 feet above the land surface. Water-table wells range in depth from 23 to 81 feet and average 59 feet. Flowing artesian wells range in depth from 118 to 174 feet and average 139 feet. The estimated withdrawal of ground water for irrigation in 1954 was about 7,500 acre-feet. Ultimately, new development might increase the yearly withdrawal to about 60,000 acre-feet. Of the total of 60,000 acre-feet, probably about 21,000 acre-feet a year would be consumptively used—about 10 percent of the estimated total supply of ground water. That amount of depletion probably would not infringe materially on existing use of surface water from spring-fed streams, if pumping were restricted to strategic times and places. Some water that otherwise would escape by underflow southeastward out of the basin might be salvaged by pumping.

The ground-water reservoir is capable of yielding a large amount of water to wells. Increased pumping would cause general lowering of the water table and of the artesian pressure in the lowland, but the lowering probably would be small if pumping were properly managed. Nonartesian wells that yield 2,000 to 3,500 gpm with an average drawdown between 10 and 20 feet, and artesian wells that yield 500 to 1,500 gpm by free flow, could be developed in the central part of the area, where pumping lifts probably would range between 20 and 70 feet. The most suitable area for pumping supplemental irrigation water is in the central part of the area, but other areas are described in which such pumping would be feasible.

Construction and operation of a small storage reservoir upstream from the irrigated area might be desirable in a balanced program of water management.

One alternative plan of the Bureau of Reclamation proposes that the full additional water supply be obtained from wells. Water from well fields might be distributed through existing canals, but single wells or dispersed small groups of wells would be advantageous under some circumstances.

If increased pumping from wells in the central part of the area should deplete the surface-water supply to a greater extent than is desirable, the depletion might be offset by pumping water for replacement from the southeastern part of the basin, where estimated unused underflow out of the basin is about 30,500 acre-feet yearly. The pumped water would be discharged for downstream surface diversions. Additional exploration and study of the southeastern area is advisable.

By recognized standards the ground water and surface water in the basin are chemically suitable for irrigation.

INTRODUCTION

PURPOSE AND SCOPE OF THE INVESTIGATION

Irrigation in the middle Big Wood River-Silver Creek area depends largely on diversions of natural flow from the Big Wood River and Silver Creek. Supplemental water is needed for late-season irrigation in part of the area during years of low runoff. The United States Bureau of Reclamation (1953) reported on the possibility of meeting late-season water demands by providing upstream storage in the valley of the Big Wood River. The conclusion of the report was that the cost of a reservoir large enough to meet the water demand under existing water rights and diversion practices would exceed the repayment ability of water users. The Bureau of Reclamation therefore has considered two plans that do not involve large storage works. One plan calls for construction of a small upstream reservoir and installation of a well field within the irrigated area. The reservoir would supply supplemental water within the basin. The wells would be pumped when water users downstream from the middle Big Wood River-Silver Creek area were not receiving their share of surface water, owing to its storage in the reservoir. A second plan would provide for construction of wells where needed to supply all the additional water required.

Some supplemental water for irrigation is now obtained from wells. The demand for supplemental water and water to irrigate additional land is indicative of the need for an appraisal of the ground-water resources of the area. This report was prepared by the U. S. Geological Survey in cooperation with the Bureau of Reclamation at the request of the Director, Region 1, Bureau of Reclamation, Boise, Idaho, to aid in determining the feasibility of the plans for use of ground water. This ground-water investigation was under the supervision of R. L. Nace, district geologist of the Ground Water Branch of the Geological Survey, Boise, Idaho. E. G. Crosthwaite was project supervisor of the fieldwork and preparation of the report. J. W. Stewart, R. C. Scott, and A. W. Van't Hul provided technical assistance.

LOCATION OF THE AREA

The middle Big Wood River-Silver Creek area is in central Blaine County, Idaho (fig. 1). It is drained in part by the Big Wood River and in part by Silver Creek, a tributary of the Little Wood River. This report is concerned chiefly with the lowland area of about 48,000 acres, which is bounded by the contact between the unconsolidated alluvium of the valley floor and the ancient bedrock of the surrounding mountains. Part of the area surrounding the lowland is included on the map (pl. 1) to show the geologic and physiographic setting.

Hailey, the seat of Blaine County, is in the northern end of the area. Other towns and villages in the area are Bellevue, Gannett, and Picabo. The area is served by a branch line of the Union Pacific Railroad, by U. S. Highway 93, and by State Highway 23.

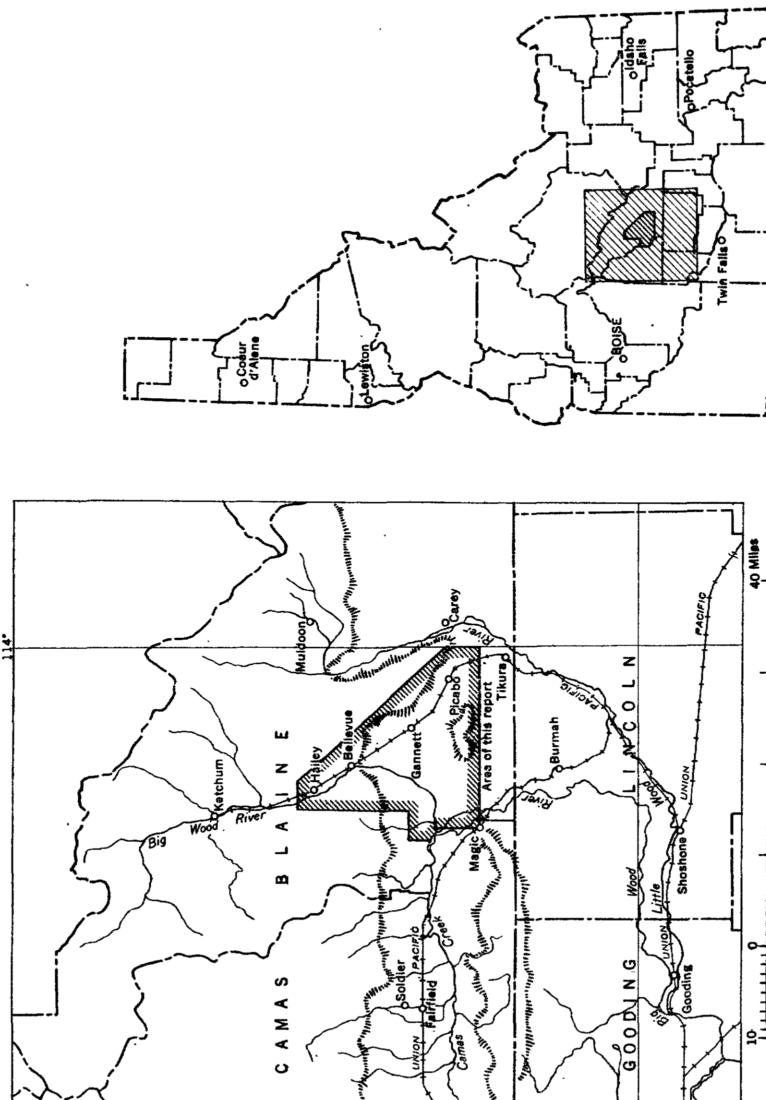

FIGURE 1.—Index map of southern Idaho showing the area covered by this report.

SYSTEM OF NUMBERING WELLS, SPRINGS, AND GAGING STATIONS

The well-numbering system used in Idaho by the U. S. Geological Survey indicates the locations of wells within 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 and is followed by two letters and a numeral, which indicate the quarter section, the 40-acre tract, and the serial number of the wells 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. The digit following the letters indicates the order in which the wells were first visited within the 40-acre tracts. Well 1S–18E–12ca1 is in the NE¼SW¼ sec. 12, T. 1 S., R. 18 E., and is the well first visited in that tract. Springs are numbered in the same manner as wells, but a capital letter "S" is inserted between the last 2 letters and the last numeral, 1S–19E–13bdS1.

Stream-gaging stations in Idaho are numbered in downstream order from the headwaters to the mouth. Stations on tributary streams are numbered in the order in which the tributaries enter the trunk stream. The locations of the stations are shown on plate 2.

PREVIOUS INVESTIGATIONS

General ground-water conditions in the middle Big Wood River-Silver Creek area were studied in 1920 and 1921 by S. H. Chapman (1921), then watermaster for the Big Wood River basin. The results of his study were included in annual reports to the State Reclamation Engineer for those years. The 1921 report contains a map showing the contours of the water table and a discussion of the direction of movement of the ground water. A report by Stearns and others (1938) on the geology and water resources of the Snake River Plain included data on the Big Wood River basin. Anderson, Kiilsgaard, and Fryklund (1950) reported on the geology and mineralization of the Hailey-Bellevue mining district, and their report included a detailed geologic map of the upper valley of the Big Wood River. Jones (1952) made an evaluation of streamflow records in the Big Wood River basin. D. L. Schmidt and Paul Williams of the U. S. Geological Survey mapped the geology of the area in 1954 as part of a regional survey of radioactive mineral deposits. Their geologic field maps were made available to the author for inspection.

FIELDWORK AND ACKNOWLEDGMENTS

An inventory was made in 1954 of all irrigation wells in the area; pumpage from each well was measured or estimated, and information

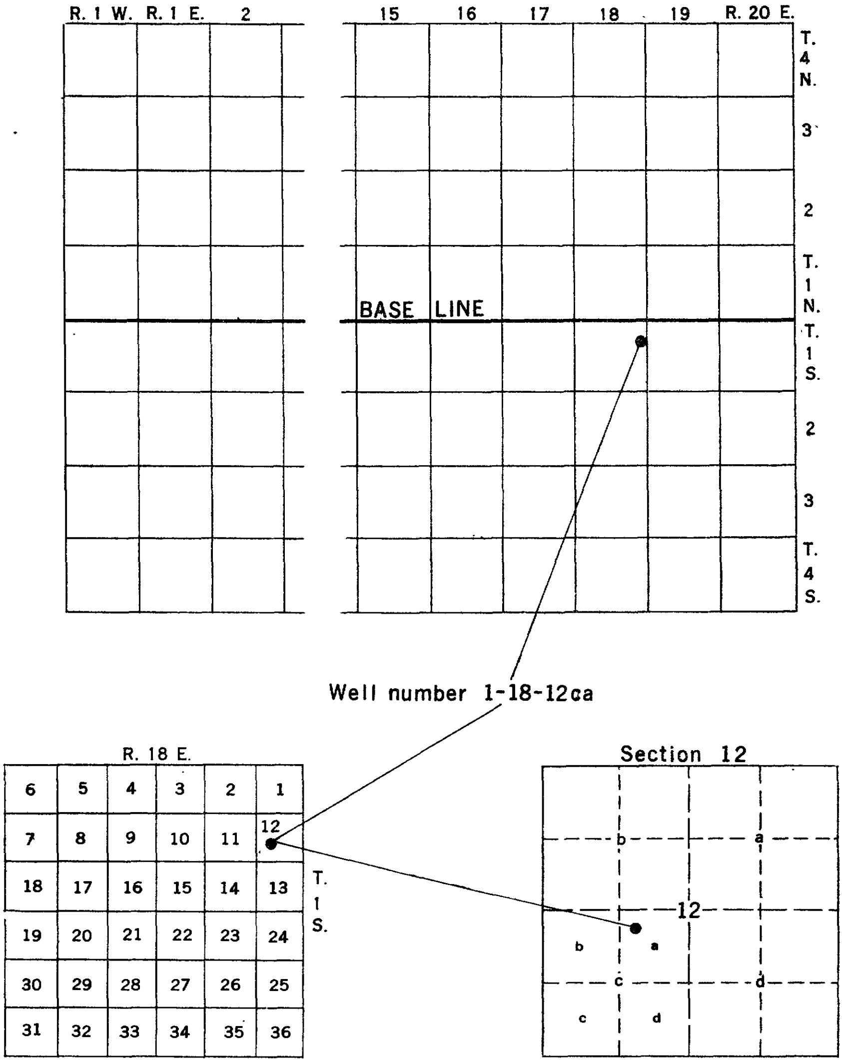

FIGURE 2.—System of numbering wells.

was obtained about the acreage irrigated. Twenty four of the irrigation wells are pumped with electrically powered units, and a few pumps are powered by tractors. Records of the power consumed at each electrically powered installation during the irrigation seasons of 1953 and 1954 were obtained; the records show the power demand in kilowatt hours (kwh) and the kilowatt-hour consumption. The hours of operation for each pump were computed by dividing the total number of kilowatt hours consumed during the season by the demand in kilowatts per hour.

The discharge rates of wells were measured wherever possible, but for some wells only reports of yields were available. The depth to water in each well was measured. In August 1954 essentially simultaneous measurements of the depths to water and the artesian pressure in 88 wells were made, to provide data for the map of the water table (pl. 2). The altitudes of well-measuring points, of the water surface in the Big Wood River between Hailey and Stanton crossing, and of the water surface in Silver Creek at gaging station 24 were determined by spirit leveling.

During the investigation 10 test wells were drilled to explore ground-water underflow and to disclose the physical and hydrologic properties of the aquifers in several parts of the area. Some of the test holes were used thereafter as project observation wells, five being equipped with recording gages. The coefficients of transmissibility and storage of the principal water-bearing beds tapped by the test wells were computed from pumping tests.

Samples of water were collected from 35 representative wells and springs and from 5 locations on surface streams. Chemical analyses of 7 samples were made by the U. S. Geological Survey, 28 samples by the U. S. Bureau of Reclamation, and 5 samples by the Idaho State Department of Public Health.

The geologic and hydrologic field data were recorded on aerial photographs and on county road maps. The base for maps published in this report was compiled from county maps of the Idaho State Highway Planning Commission and from existing geologic maps.

The U. S. Bureau of Reclamation collaborated in the investigation by contracting for drilling and pumping the test and observation wells, and by running spirit levels to wells and surface streams. Messrs. G. E. Smith and L. D. Bowlden, of the U. S. Department of Agriculture, made available aerial photographs of the area and supplied data on crops and the acreage under irrigation. Temporary storage space for equipment and samples was made available by the U. S. Forest Service at Hailey, through Mr. G. W. Carlson. Records of the electric-power consumption by pumping plants were furnished by Mr. Leon Jewett, manager of the Hailey office of the Idaho Power Company. The Idaho Power Company also kindly supplied electric power gratis for pumping tests. Mr. Mans H. Coffin, watermaster for the Big and Little Wood River districts; Mr. Woodrow Watts, deputy watermaster for the upper Big Wood River; and Mr. James Wheeler, of Gannett, assisted in locating wells and supplied much useful information. Messrs. J. Emmett Smith, E. W. Walker, and George Roessler, well drillers, furnished useful information and copies of logs for wells drilled by them in the area. Well owners

in the area cooperated fully by supplying information about their wells and permitting access for measurements. The assistance of all these individuals and organizations is gratefully acknowledged.

ECONOMIC AND WATER SITUATION

IRRIGATION AGRICULTURE

Irrigation in the middle Big Wood River-Silver Creek area was begun before 1885 when small private irrigation diversions were made to valley bottom lands. About 20,000 acres now are under irrigation, and there are about 7,500 additional acres of potentially irrigable land, some of which once was irrigated, according to Glenn Smith, Manager, Agricultural Stabilization and Conservation, U. S. Department of Agriculture (oral communication, January, 1955). The principal crops raised are alfalfa, clover, oats, barley, wheat, and potatoes. Most crops are irrigated, but some small areas are cultivated by dry-farming methods. Hay meadows and pasture are subirrigated areas where the water table is near the land surface. The hay, alfalfa, and small grains are used largely to feed sheep and cattle within the area. Wheat is the principal cash crop. About half the private income is from cattle and sheep raising.

About 20,500 acres of lowland is nonarable swamp, waterlogged land, and gravelly river bottom. Some of the wasteland is used for pasture, but in its present state it is unsuitable for cultivation.

WATER UTILIZATION

Surface water.—Nearly all surface water used in the upper Big Wood River-Silver Creek area is used for irrigation. A very small amount is consumed by livestock. Water is diverted by gravity from the Big Wood River in 23 canals between Hailey and Stanton crossing, from Silver Creek and its tributaries in 19 canals between the headwaters and gaging station 24, and in a few canals heading in Spring Creek and its tributaries. For most of the irrigated lands only short transmission distances are necessary. Although surface-water rights were established as late as 1947, most water rights in the basin were established before 1900. The average annual amount of water diverted for irrigation during the 15-year period 1940–54 was about 78,000 acre-feet, according to the Watermaster's records, Water District *7B*. About 17,000 acres is irrigated exclusively with surface water and 3,000 additional acres is irrigated jointly with ground water and surface water. The diversion records indicate a gross duty of water of about 4.25 acre-feet per acre. By "gross duty of water" is meant the average number of acre-feet per irrigated acre per year diverted from the river and measured at the canal headgates.

Creek drains the larger southeastern part of the basin, which it leaves near Picabo.

The average width of the valley floor between Hailey and Glendale bridge is about 1¾ miles. Immediately south of the bridge the width is increased abruptly to about 5 miles by a western reentrant, locally known as Poverty flat (pls. 1, 3). The broadened segment of the valley extends southward about 4½ miles to the point where a spur of the western bedrock extends eastward toward the axis of the valley. Between that point and the north base of the Picabo Hills the valley widens to more than 10 miles.

The valley floor slopes from an altitude of about 5,340 feet above mean sea level at Hailey to about 4,840 feet at the southwestern outlet of the basin near Stanton crossing, and to about 4,800 feet at the southeastern outlet near Picabo. South of Glendale bridge the alluvial floor of the valley is slightly convex, sloping gently southwestward toward Stanton crossing and southeastward beyond Picabo, where it meets the gently rolling surface of the Snake River Plain. Between Gannett and Picabo the floor is nearly flat, interrupted only by two inliers of bedrock and by a basaltic cone that rises about 200 feet above the floor and extends halfway across the valley. The Big Wood River follows a slightly incised course through the western part of the basin, and its narrow modern flood plain is bordered by a series of discontinuous stream terraces 5 to 40 feet above the river level.

The Pioneer Mountains extend parallel to the northeast side of the basin from Hailey to Priest, a distance of about 25 miles. The range reaches altitudes of about 8,200 feet near Hailey where it has high relief but the crest is lower and flatter northeast of Hay. The southern end of an unnamed mountain range extends along the upper west side of the basin and merges into low hills which extend southward to Magic Reservoir.

The Picabo Hills, which have moderately high relief, extend from the town of Picabo westward to Magic Reservoir. The hills in general have a steep northern slope and a more gentle southern slope and are lower and more rounded near the reservoir than they are farther east. These hills separate the basin from the Snake River Plain.

PHYSIOGRAPHIC HISTORY

Before eruption of the basalt on the Snake River Plain the ancestral Big Wood River probably flowed southeastward in a broad deep valley around the east end of the Picabo Hills. The depth of the valley is not known, but well 2S–20E–1ac1, near Priest, was drilled to a depth of 250 feet without reaching bedrock. A tributary of the ancestral Big Wood River seemingly rose west of Stanton crossing, flowing eastward to join the Big Wood in its ancestral valley.

Erosion by tributary streams, flowing eastward and graded to the bedrock, probably formed the large reentrants and pediment surfaces along the west side of the valley between Glendale bridge and Stanton crossing. Beyond the western limit of the map a fault, which may be composite, extends along the northern front of the Mount Bennett Hills and probably extends eastward along the northern front of the Picabo Hills. The age of the faulting is not known and no fault trace was identified in the area studied.

Basalt flows that originated near Hay and south of Picabo dammed the ancestral Big Wood River at least twice in Pleistocene time, impounding a lake south of the Boise baseline and causing the river to aggrade to a local base level. The Big Wood River began to build its alluvial fan at the north end of the basin. Each lake was a natural settling basin which became filled to the crest of the basalt dam with thick beds of clay, silt, and sand and a few intercalated beds of gravel (see log of well 2S–20E–1ac1, showing lake beds between basalt layers).

During the Wisconsin glacial stage, late in the period of accumulation of the sediments, valley glaciers in the headwaters area of the Big Wood River supplied a large volume of coarse fluvioglacial material (Schmidt, D. E., and Williams, Paul, oral communication, 1954). A sheet of that material was spread over the older valley sediments and formed what is now the floor of the basin. Extensive piedmont alluvial slopes along the southwest side of the valley probably were built by lateral streams that were caused to aggrade as the floor of the basin was built up.

The sediments in the basin have a convex surface profile when seen in cross section from east to west, like that of a large alluvial fan, suggesting that the Big Wood River repeatedly changed its course across the fan and built the central part higher than the lateral part. Toward the end of the cycle of deposition the river shifted to the west side of the fan and spilled over a low divide west of Stanton crossing near the present stream course. After a short period of downcutting the Big Wood River and Rock Creek were damned near Stanton crossing by another basalt flow. Some of the alluvium along the lower reach of Rock Creek was deposited upstream from that dam. The basalt dam, however, was low and did not impound a lake sufficiently high to overflow at the old river outlet east of the Picabo Hills. After a short period of aggradation the river spilled over the basalt and cut the outlet canyon through which it now flows. That canyon is about 80 feet lower than the northward-trending topographic divide on the alluvial fill within the basin. The series of terraces that borders the Big Wood River flood plain between Hailey and Stanton crossing was formed during the late downcutting. Bedrock spurs that project eastward toward the river protected the Poverty flat terrace from erosion by the Big Wood River.

Silver Creek and Spring Creek rise from springs and seeps where the water table in the alluvial fill intersects the land surface. They flow in opposite directions, away from the topographic divide on the valley fill. Spring Creek joins the Big Wood River near Stanton crossing. Silver Creek, after spilling over the ancient basalt dam near Picabo, discharges onto the Snake River Plain along the line of the ancestral valley of the Big Wood River.

CLIMATE

The middle Big Wood River-Silver Creek basin has moderately cold winters and relatively warm summers. The lowland is sheltered to some extent from severe cold waves and strong winds by the surrounding mountains. At Hailey the normal yearly precipitation is 15.33 inches (fig. 3), but less than 20 percent of the total falls during the period between killing frosts (see following table). Precipitation, chiefly snow, is greatest during the winter; the months of least precipitation are July, August, and September. Successful growth of many crops depends on irrigation.

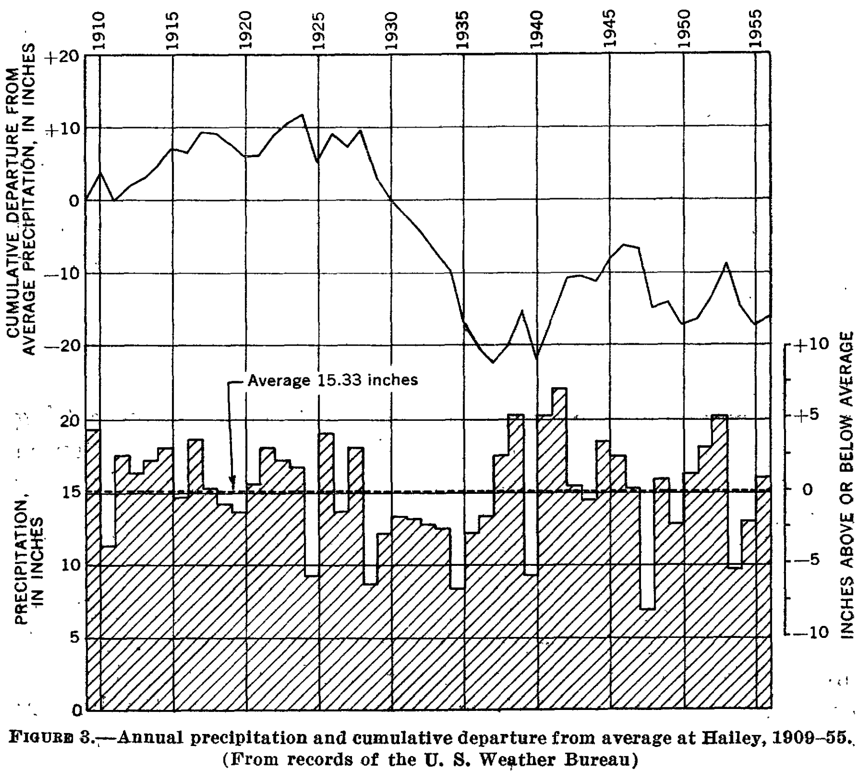

FIGURE 3.—Annual precipitation and cumulative departure from average at Hailey, 1909–55. (From records of the U. S. Weather Bureau)

The precipitation in the basin is sufficient to support sagebrush and native grasses on the lower mountain slopes and noncultivated areas of the valley floor. Forest growth in the mountains, which is largely firs and pines, is restricted to the higher elevations and the northern slopes of ridges. Silver and Spring Creeks are bordered by willows and marsh vegetation. Cottonwoods and willows border the Big Wood River and the older irrigation ditches.

The mean annual temperature at Hailey is 43.5° F. The highest recorded temperature was 109° F. and the lowest was −36° F. The frost-free growing season usually begins late in May and ends in mid-September—about 110 days at Hailey.

Normal monthly precipitation and percentage of normal yearly total at Hailey, 1909–55

[From publications of U. S. Weather Bureau. Average date of last killing frost, June 1; of first killing frost, Sept. 18]

Month	Normal precipitation (inches)	Percent of normal yearly total	Month	Normal precipitation (inches)	Percent of normal yearly total
January	2.23	14.54	August	0.50	3.26
February	1.98	12.92	September	.70	4.57
March	1.29	8.41	October	1.11	7.24
April	1.15	7.50	November	1.39	9.07
May	1.33	8.68	December	2.08	13.57
June	1.04	6.78			
July	0.53	3.46	Total	15.33	100.00

GEOLOGIC FORMATIONS AND THEIR WATER-BEARING PROPERTIES

The physical characteristics, the areal distribution, and the water-bearing properties of the geologic formations that underlie the middle Big Wood River-Silver Creek area are summarized in the following table, and their surface distribution is shown on the geologic map (pl. 1). For simplicity, the materials may be divided into three geohydrologic units on the basis of their geologic age, physical characteristics, distribution, and influence on the occurrence and movement of ground water: (a) consolidated rocks, here collectively called the bedrock, which crop out in the mountains around the lowland and form a basement at unknown depth beneath the lowland; (b) flows of the Snake River basalt, which crop out at the southwestern and southeastern outlets of the basin; (c) unconsolidated sediments of Quaternary age, which underlie the lowland floor of the basin. Included in the last group are flood-plain alluvium, fluvioglacial sediments, terrace gravel, lake beds, and undifferentiated slope wash and gravel that occur at higher altitudes in the foothills and mountains. The hydraulic permeability of the rocks of the area ranges from very high to very low. Units having the greatest significance in relation to ground-water problems are emphasized in this report.

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Geologic formations and their water-bearing properties

Period	Epoch	Formation and map symbol	Thickness (feet)	Physical character and areal distribution	Water-bearing properties
Quaternary	Recent	Alluvium Qual	0–10±	Silt, sand, and gravel underlying the channel and flood plain of the Big Wood River; chiefly of reworked flewioglacial sediments derived from the headwater area of the Big Wood River.	Permeability generally high; gravel yields water copiously to shallow dug wells, especially where pumping induces recharge from the river.
Quaternary	Pleistocene	Terrace gravel Qt	Undetermined	Sand, gravel, cobbles, and boulders in thin deposits on stream terraces. Consists chiefly of reworked older flewioglacial material; poorly sorted to moderately well sorted.	Contains unconfined water at shallow depth in south part of basin, but is unimportant as an aquifer because it is thin.
Quaternary	Pleistocene	Slope wash and gravel, undifferentiated Qsw	Undetermined	Silt, sand, and gravel, poorly sorted, with angular fragments; at some places interfingers with stream gravel; elsewhere overlies old pediment slopes; occurs around border of basin and along Rock Creek.	A minor aquifer, tapped locally by domestic and stock wells; occupies small recharge areas where precipitation and surface water percolate into the ground.
Quaternary	Pleistocene	Fluvioglacial sediments Qgf	300±	Clay, silt, sand, and pebble- to cobble-sized gravel deposited by streams and lakes; underlies most of the basin floor. Grades from poorly sorted coarse material on the north to interbedded clay and well-sorted sand and gravel south of the Boise baseline. Mantled at some places by topsoil.	The most productive aquifer and the immediate source of nearly all the ground water that is used in area; yields both unconfined and confined water abundantly to wells and springs; receives recharge readily north of the Boise baseline; the beds of clay beneath the southern part of the basin are confining layers over artesian aquifers.
Quaternary / Tertiary	Pleistocene / Pliocene	Snake River basalt QTsr	50–250±	Olivine basalt, light-gray to black, fine-grained, drusy to vesicular, jointed; contains zones of broken basalt, cinders, and interflow sediments; crops out between Gannett and Picabo and at the sontheastern and southwestern outlets from the basin.	Important aquifer and the conduit through which much ground water leaves the basin by underflow; sedimentary interflow beds, especially, transmit large quantities of ground water, yields water plentifully to wells between Gannet and Picabo.
Tertiary	Miocene(?)	Volcanic rocks Tv	Undetermined	Extrusive rocks ranging in composition from rhyolite to basalt; unconformably overlie older rocks; considerably jointed. In some places individual flows are separated by thin sedimentary beds; crop out in Picabo Hills and along northeastern border of basin.	The extrusive rocks, where jointed and overlying relatively impermeable sedimentary beds, yield small amounts of water to springs; have comparatively low porosity and permeability and store little ground water except locally.
Pre-Tertiary		Sedimentary and granitic rocks pre-T	Undetermined	Sedimentary rocks, well indurated, folded and faulted; intruded by stocks of granodiorite and quartz mon o-nite; crop out in mountains that border the basin and extend beneath it at unknown depth.	Tightly cemented and low in permeability and porosity; generally poor water-bearing rocks except where they contain joints and other fractures; under favorable conditions ground water is transmitted through the permeable zones and is discharged through springs; important chiefly as impermeable basement rocks.

THE BEDROCK

The bedrock consists of two principal rock units: pre-Tertiary indurated sediments intruded by igneous rocks, and younger Tertiary volcanic rocks.

Well-indurated sedimentary rocks, believed to be principally Carboniferous in age, crop out in the Picabo Hills and in the mountains forming the western, northern, and eastern borders of the basin. These rocks are intensely folded and faulted in much of their outcrop area. At some places they are overlain by volcanic rocks and locally are intruded by granitic rocks. The sedimentary rocks, locally intruded by granitic rocks, are low in permeability and porosity and generally are poor water-bearing materials except where they are broken. Where conditions are favorable, ground water is transmitted through the fractured zones and some of it is discharged by springs. Cold springs of substantial discharge issue from an inlier of Carboniferous rocks near Hay. In that vicinity the rocks probably form a subsurface ridge, buried for the most part at shallow depth beneath the alluvium. The ground water probably spills over the subsurface barrier formed by the ridge and some reaches the surface through joints or other openings where the rocks crop out on the valley floor (pl. 1).

Granitic rocks crop out along the western border of the basin and in the Picabo Hills. From their general character the rocks are inferred to be genetically related to the Idaho batholith. Locally, where they are jointed, they yield a small amount of water to springs.

Volcanic rocks of Miocene(?) age unconformably overlie the older igneous and sedimentary rocks in the Picabo Hills and along the eastern border of the basin. Commonly they consist of interbedded flow rock and tuff, and range in composition from rhyolite to basalt. The rocks are extensively jointed, and at some places individual flows are separated by thin sedimentary beds. Where they are jointed and interbedded with relatively impermeable sedimentary or tuffaceous beds, the volcanic rocks probably are better aquifers than the older intrusive rocks or the sedimentary rocks. Although numerous small springs issue from these rocks, they have comparatively low porosity and permeability and store relatively little ground water.

In summary, most of the older sedimentary and igneous rocks generally are poor water-bearing formations. Their chief geohydrologic function is to form a relatively impermeable floor beneath the valley lowland and to control the movement of ground water out of the lowland. They also transmit water to the lowland by mass percolation.

SNAKE RIVER BASALT

Snake River basalt of Pliocene and Pleistocene age, is exposed around the southeastern and southwestern outlets of the basin. The small basalt flow along the Big Wood River canyon between Stanton crossing and Magic Reservoir is about 50 feet thick and is believed to have originated about 1½ miles south of the crossing. The more extensive basalt flow over which Silver Creek crosses probably originated at a volcanic vent 2 miles south of Picabo. The small flow that extends nearly across the valley between Gannett and Picabo issued from a vent near the northeast side of the valley.

Most flows of the Snake River basalt are dense olivine basalt; some flow units have highly vesicular zones. The rock commonly is light gray to black, but pink to red colors are not rare. Most of the flows have gently rolling surfaces and characteristic interior columnar jointing.

Voids along broken interflow zones, open joints, and crevices make some flows highly permeable. Other flows are quite massive and impermeable. Fractures and other voids in some of the flows are filled with fine-grained sediments. The basalt drilled in well 2S–20E–1ac1, southeast of Picabo, is impermeable except along the brecciated zones adjacent to flow contacts. Below the water table in that well sediments are intercalated between basalt layers, and in the vicinity of Priest the interflow sediments transmit a considerable amount of water. Both upstream and downstream from gaging station 24 on Silver Creek, basalt underlies the Silver Creek flood plain at shallow depth. Irrigation canals in that vicinity lose substantial amounts of water by percolation. Much of the loss occurs during the natural high-water season of the creek, which coincides with the irrigation season. The stream scours the silt from its channel and flood plain, exposing large openings in the basalt into which surface water runs freely and percolates downward to join the regional ground-water body that underlies the Snake River Plain. Basalt is exposed between Gannett and Picabo, and the underlying cinder beds and broken interflow zones are quite permeable and yield water copiously to wells. The basalt flows and alluvial interflow beds in the vicinity of Picabo and Priest are important chiefly as conduits through which ground water escapes from the basin by underflow at the southeastern outlet.

UNCONSOLIDATED SEDIMENTS

The water-bearing properties of the Quaternary sediments vary with their physical characteristics. Two distinct groups of sediments are recognized: valley-fill deposits at low altitudes, and undifferentiated slope wash and gravel at higher altitudes in the mountains.

Most of the valley fill is stream and delta clay, sand, and gravel, deposited before the glacial stage of Wisconsin age. A relatively thin sheet of coarse fluvioglacial sediments was deposited during the Wisconsin stage and overlies the alluvium and lake beds (pl. 1). The fluvioglacial sediments grade in size from boulders, cobbles, and gravel at Hailey to fine gravel, sand, and clay at the south edge of the basin. The deposit is thickest around Hailey but is thin at the southern edge of the basin; in the vicinity of the Boise baseline the average thickness probably is about 50 feet. The fluvioglacial sediments form a symmetrical fan whose apex is just south of Bellevue. The maximum aggregate thickness of the unconsolidated sediments is not known. Well 1S–18E–1cd1, in the western part of the area, is 304 feet deep but does not reach the bedrock floor.

The alluvial gravel and sand yield artesian water plentifully to wells in the southwestern part of the basin. The coarse fluvioglacial deposits yield abundant unconfined ground water to wells throughout most of the basin. A veneer of reworked alluvial and fluvioglacial gravel covers the terraces that border the river flood plain, but the main mass of material beneath the terraces is the same as that in the valley fill elsewhere and has the same water-bearing characteristics.

The alluvium that underlies the river channel and flood plain is a mixture of reworked valley-fill sediments and material recently eroded from the headwaters area of the Big Wood River. The grain size of the alluvium ranges from cobble size to silt size and the percentage of fine material increases southward. Shallow dug wells yield large amounts of ground water from the alluvium; the pumping of wells near the river induces rapid infiltration of river water.

The slope-wash deposits that fringe the floor of the middle Big Wood River-Silver Creek basin are composed of angular poorly sorted gravel and sand. At some places the deposits lap onto and feather out against old pediment surfaces. At other places they interfinger with beds of rounded gravel deposited by intermittent tributary streams. The slope wash is not an important source of water for wells, except locally, but the sediments accept recharge readily and transmit water to the main ground-water reservoirs in the basin lowland.

WATER RESOURCES

Solution of the principal water problems in the middle Big Wood River-Silver Creek basin undoubtedly will require coordinated use of surface water and ground water. Less is known about the ground water than about the surface water, but further development in the basin may entail extensive use of additional ground water. At many places the surface streams lose water by percolation into the ground, and at other places ground water is discharged to surface streams. Owing to the continuous interchange of ground water and surface water, they cannot be considered successfully as separate entities.

The 15-year period 1940–54 was used as a base for computations and estimates of water resources—the same period used by T. R. Newell, District Engineer, U. S. Geological Survey, Boise, Idaho (written communication, February 28, 1955), to compute the average annual discharge of the Big Wood River and Silver Creek. No winter records are available for gaging station 9 prior to 1940.

SURFACE WATER

Surface inflow to the middle Big Wood River-Silver Creek basin in the Big Wood River is measured at gaging station 7 at Hailey. The average yearly discharge of the river past that station during the base period was 340,000 acre-feet. After the annual period of high runoff each spring, and until the end of the irrigation season, practically all water discharged by the river is diverted for irrigation. Thus, during much of the irrigation season the river bed is dry downstream from the diversion dam near Glendale bridge to a point near the Boise baseline. The natural flow is not sufficient for all late-season demands for irrigation water.

The average yearly discharge of Quigley, Slaughterhouse, and Seamans Creeks, plus that from intermittent streams that discharge into the basin, was estimated by Newell to be about 38,500 acre-feet (written communication, Feb. 28, 1955). His estimate was obtained by applying a rate per square mile equivalent to the average for the Camas Creek basin.

The average yearly discharge of Silver Creek at gaging station 24, near Picabo, is 116,500 acre-feet. The regimen of the creek is almost the reverse of that of the Big Wood River. Except during short periods of high runoff from local precipitation, the minimum flow of Silver Creek occurs during late winter and early spring, and the peak is late in the fall. Areas irrigated exclusively with water from Silver Creek usually have sufficient water late in the season.

GROUND WATER

SOURCE AND DISPOSAL

The original source of all ground water in the middle Big Wood River-Silver Creek basin is precipitation on the upper Big Wood River watershed and on the middle basin. Part of the rain and snowmelt is carried off by streams, some is evaporated, and the remainder percolates into the ground. Part of the water that enters the ground restores soil moisture and is used by plants or is returned to the atmosphere by evaporation. The water not held as soil moisture eventually reaches the zone of saturation and recharges the ground water. By underflow the water moves toward the stream valleys, where it either emerges from seeps and springs that maintain surface streams or joins the body of ground water in the valley aquifers. Most of the water discharged by small streams rising in the mountains around the middle basin sinks into the ground and recharges the ground water. The middle Big Wood River also loses water to the ground by percolation out of some reaches of the channel. There is some recharge also from local precipitation on the basin lowland.

The main body of ground water moves in the direction of the slope of the water table (pl. 2), and much of it is discharged through springs and seeps within the basin. Natural discharge occurs also by evapotranspiration where the water table is shallow or at the surface, and by underflow out of the basin. Ground water is discharged artificially from wells. In general, recharge in the area has equalled discharge; increased withdrawal owing to irrigation apparently has not appreciably reduced the quantity of water in storage.

OCCURRENCE AND MOVEMENT

Ground water in the middle Big Wood River-Silver Creek basin occurs under both unconfined and artesian conditions. Unconfined water is present throughout the basin lowland at depths ranging from 0 to 70 feet below the land surface. South of the Boise baseline unconfined water is present only in the upper part of the alluvium at shallow depth (see pls. 2, 4). At some places the unconfined water seems to be under slight artesian pressure, probably owing to the presence of discontinuous sloping beds of impermeable silt and clay beneath which pressure builds up. The percentage of fine-grained beds in the valley fill increases southward and creates conditions that favor local confinement of water, some at shallow depth. In general the water-table wells produce from the upper part of the valley-fill deposits.

Much of the ground water in the southern part of the basin lowlands is artesian, and deep wells in the area flow freely. Drillers' logs (see p. 48–55) reveal a southward gradation in the texture of the deep valley fill. North of the baseline the material is gravel, cobbles, and sand, with only traces of silt and clay. In the vicinity of the baseline the sand and gravel interfingers with layers of clay which thicken southward (pl. 5). The artesian aquifers consist of fine- to medium-grained gravel in a sand matrix and the confining beds are relatively impermeable clay and silt. They occur at depths ranging from 80 to 300 feet, but the most productive zones are 120 to 170 feet below the land surface. These zones yield water abundantly to most wells in the western part of the artesian area. Artesian wells in the eastern part of the artesian area yield only small quantities of water. Two wells (now destroyed) just outside the northwestern boundary of the main artesian area reportedly tapped water that rose nearly to the land surface (p. 56–59). Several wells have been drilled adjacent to the Picabo Hills in search of flowing artesian water; these reached depths as great as 325 feet but yielded very little water.

The confining beds in the artesian area are not wholly impermeable, and they allow upward leakage of some water which joins the unconfined water at shallow depth and helps to maintain the water table near the land surface. The shallow water feeds the springs and swamps in the southern part of the basin.

The configuration of the water table is shown by the water-table contours on plate 2. The ground water moves down the valley in a direction about perpendicular to the contour lines. A ground-water divide extends southward from a short distance north of the diversion dam near Glendale bridge to a northern spur of the Picabo Hills, separating the unconfined ground-water body into two unequal parts. The general direction of underflow in the basin is southward, but south of Glendale bridge the ground water on the west and east sides of the divide diverges, respectively, toward the southwest and the southeast, away from the divide. The larger share moves southeastward and much of it is discharged by wells and by the springs and seeps that feed Silver Creek. The component not pumped or discharged follows the general course of the Silver Creek drainage and leaves the basin by underflow through the southeastern basin outlet near Picabo. On the western side of the divide the ground water moves southwestward toward Stanton crossing. Some is discharged from wells and most of the remainder discharges naturally into the channels of the Big Wood River and of Spring Creek and its tributaries. Underflow at the southwestern outlet is negligible.

RECHARGE

Replenishment of the ground water in the basin occurs by direct infiltration of precipitation, by underflow from the upper Big Wood River valley and from tributary valleys, by percolation from the river channel and from irrigation canals, and by infiltration of unconsumed irrigation water.

Recharge from precipitation.—The yearly recharge to the ground-water reservoir from precipitation directly on the valley floor was estimated from weather records at Hailey (fig. 3 and p. 13), which are assumed to be representative for the whole lowland. The estimated yearly volume of precipitation on the lowland is 60,000 acre-feet. The proportion that becomes recharge is not known but is assumed arbitrarily to be 30 percent of the total, or 18,000 acre-feet.

Underflow from the upper Big Wood River valley.—A substantial amount of ground water is contributed to the lowland by underflow through the permeable valley fill from the drainage area above gaging station 7 at Hailey. Data from an aquifer test at well 1N–19E–6cb1 were used to estimate the yearly amount of underflow through the valley at station 7. The hydrogeologic conditions at the gaging station are presumed to be about the same as those around the test well, and it is believed that the test data are a reasonable basis for estimating underflow past the station. The estimate was made by applying the formula $Q=TIW$, in which Q is the volume of underflow in a unit period of time, T is the coefficient of transmissibility of the aquifer, I is the hydraulic gradient, and W is the average width of the aquifer. The value of T, computed from the test data, was 950,000 gallons per day per foot, but owing to a power failure and other disturbing factors during the test the computed value is only approximate and is rounded to 1 million. The hydraulic gradient between wells 2N–18E–9ab1 and 15bb1 is about 34 feet per mile. The estimated average width of the aquifer in the vicinity of the gaging station is about 5,250 feet. On that basis, the estimated underflow through the valley past the station is approximately 34,000 acre-feet a year.

The estimated combined average yearly runoff in Quigley, Slaughterhouse, and Seamans Creeks, plus that of all other local tributaries, is about 38,500 acre-feet (see p. 18). This water is an additional increment of recharge because the water from all these streams sinks into the lowland sediments along the edge of the valley.

Percolation from surface streams.—Percolation from the channel of the Big Wood River between Bellevue and a point about 5 miles south of Bellevue is an important source of replenishment. Percolation in the braided reach of the river below Glendale bridge is most rapid in the spring. After July, when the river is diverted into the bypass canal, that source of recharge is eliminated until after the end of the irrigation season. However, seepage from the canal and from the river channel upstream from the diversion dam recharge the ground water continuously. Irrigation canals and laterals also contribute water by percolation into the valley fill. The amount of recharge from percolation has not been estimated.

Infiltration of unconsumed irrigation water.—Unconsumed irrigation water that percolates downward to the zone of saturation also is an important source of recharge. The fluvioglacial material underlying most of the irrigated land, especially in the northern part of the basin, is quite coarse and highly permeable. The common methods of flood and furrow irrigation apply considerably more water than can be held as soil moisture and the excess is available for ground-water recharge. Recharge may range from zero to 12 acre-feet per acre yearly, according to the amount of water applied to the land and on the permeability of the soil.

DISCHARGE

Ground water is discharged within the basin by the springs that feed Silver and Spring Creeks, by seepage into certain reaches of the Big Wood River, by evapotranspiration, and by wells. Underground discharge from the basin is largely by underflow beneath the channel of Silver Creek at the southeastern outlet of the basin.

Silver Creek and Spring Creek are fed mainly by springs rising in the valley-fill sediments. The recorded average yearly discharge of Silver Creek is 116,500 acre-feet at gaging station 24 near Picabo. The combined surface discharge of Spring Creek and the Big Wood River averages 203,200 acre-feet yearly at gaging station 9. An appreciable part of the flow past station 9 is derived from the ground water that feeds Spring Creek and from ground water that discharges into the river between the baseline and the gaging station.

Ground water is discharged also by evapotranspiration and by evaporation from open water surfaces where discharging ground water is ponded. Transpiration is by native phreatophytes and hydrophytes (water-loving plants) and by cultivated plants. This investigation did not include a study of evapotranspiration (consumptive use) in the area. An estimated rate of evapotranspiration, based on data obtained from other studies, is used (Mower and Nace, 1957; U. S. Bureau of Reclamation, 1953; Criddle, 1947).

The irrigated area is about 20,000 acres. The assumed average yearly evapotranspiration by alfalfa, wheat, and meadow hay, the principal cultivated crops in the basin, is 1.8 acre-feet per acre. Evapotranspiration from 13,000 acres of nonirrigated land, which yields some crops but is occupied largely by grass, weeds, sagebrush, and other native vegetation, is assumed to be 1 acre-foot per acre per year. The principal water-loving plants in the area are swamp vegetation, willow, and cottonwood, all of which consume relatively large amounts of water. Generally, these plants grow where the water table is so shallow that evaporation from the soil and transpiration by the vegetation go on simultaneously. In most of the area covered by phreatophytes, which includes about 15,000 acres along the Big Wood River and south of the headwaters of Silver and Spring Creeks, the depth to the water table is less than 5 feet (pl. 4). The estimated annual rate of evapotranspiration in that area is 3.5 acre-feet per acre. The estimate includes allowances for evaporation from small ponds. The total yearly consumption of ground water by evapotranspiration in all areas is estimated to be 100,000 acre-feet. That amount necessarily is a very rough estimate, because the actual rates of consumptive use undoubtedly differ from those assumed, and because some of the acreages used are only rough approximations.

The estimated discharge of ground water from irrigation wells in the basin was about 7,500 acre-feet during the 1954 irrigation season. The estimated withdrawal from about 135 domestic and stock wells and a municipal well is 500 acre-feet yearly.

As indicated by the contours of the water table (pl. 2), ground water moves southeastward through the valley fill and thence into the Snake River Plain through the basalt and associated sedimentary formations that fill the southeastern outlet of the basin. To estimate the amount of ground-water underflow out of the basin, a pumping test was made on test well 2S–20E–1ac2 to determine the approximate coefficient of transmissibility of the water-bearing materials and to explore the geologic and hydrologic conditions at the southeastern outlet from the basin (also see p. 16 and 31). The computed coefficient of transmissibility is 800,000 gallons per day per foot. The estimated width of the more permeable section is about 9,000 feet (Fig. 4). The hydraulic gradient between well 1S–20E–35da1 and

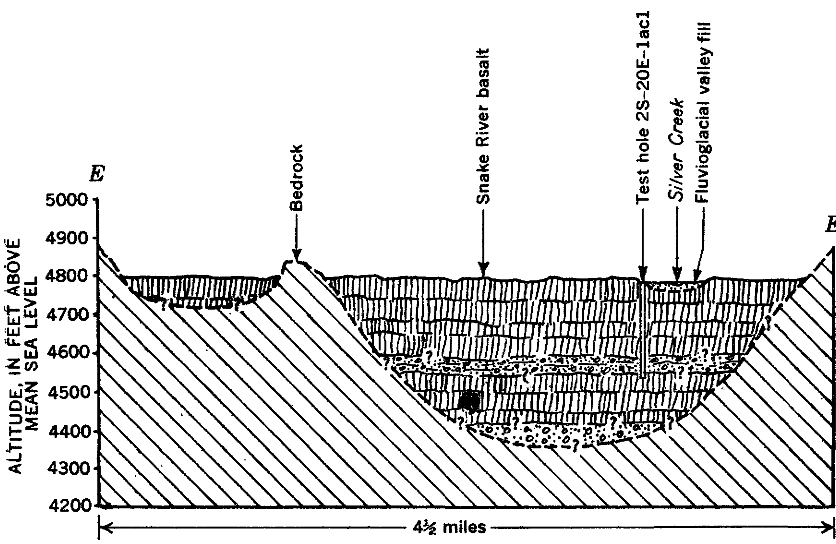

FIGURE 4.—Inferred geologic section along line *E–E'* of plate 1, three-eighths of a mile upstream from gaging station 24, Silver Creek near Picabo.

the test well was about 20 feet per mile. On the assumption that 800,000 gpd per foot is a reasonable figure for the transmissibility of the section as a whole, the underflow out of the basin through this outlet is computed as 27 million gallons per day or about 30,500 acre-feet per year.

The possibility of aquifers occurring at depths below that drilled in well 2S–20E–1ac1 cannot be ignored. To provide for that possibility an arbitrary amount of 25 percent of 30,500 acre-feet, or about 7,500 acre-feet, is added, making a total of 38,000 acre-feet.

At the former site of gaging station 9, in the southwestern outlet from the basin, granitic rocks form a nearly impermeable floor beneath the valley-fill sediments, and most of the water leaving the basin is surface flow in the river channel. Ground-water underflow is believed to be relatively small, owing to the small cross-sectional area of saturated permeable material (Fig. 5).

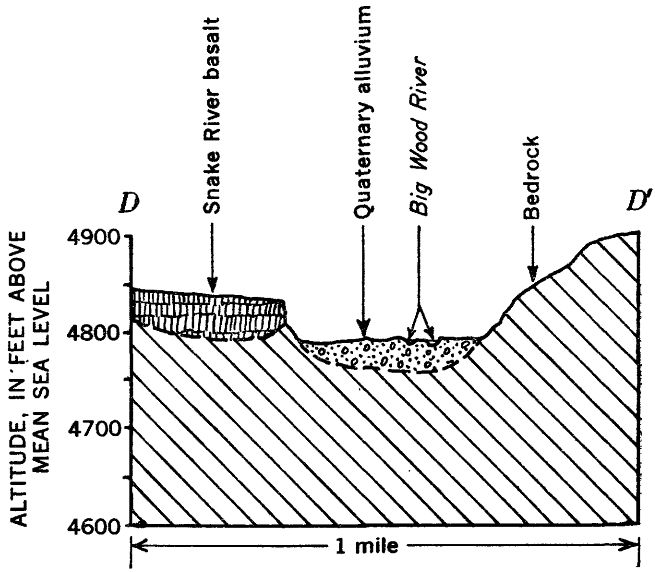

FIGURE 5.—Inferred geologic section along line D–D' of plate 1, near former site of gaging station 9, Big Wood River near Bellevue.

POSITION AND FORM OF WATER TABLE

The position and form of the water table are shown by water-table contours which join points of equal altitude on the water table (pl. 2). Between Hailey and Glendale bridge the slope of the water table is uniformly about 32 feet per mile, but in the vicinity of the bridge the slope steepens sharply. A slight ground-water divide extends southward from this vicinity toward the Picabo Hills. A short distance south of the bridge the slope flattens, and south of the baseline the water table intersects the land surface at many places, giving rise to an east-west line of springs which feed Silver and Spring Creeks. From that line to the Picabo Hills the water table steepens slightly, but it remains near the land surface. Between Hay and Picabo the main water table slopes more steeply than the land surface and the depth to water increases gradually toward Picabo. At Picabo the water table steepens abruptly, but at Priest the slope flattens. (Contours were not drawn on the shallow, perched water table between Hay and Picabo.)

The general form of the water table shows that from Hailey to near Bellevue ground water in the alluvium discharges into the Big Wood River (fig. 6). In the vicinity of Bellevue the conditions reverse and from there downstream the river recharges the ground water by seepage into the alluvium; the infiltration rate increases progressively southward to Glendale bridge (fig. 6). Records of stream discharge in 1920 and 1921 show that during the irrigation season the average flow of the river decreased about 21,500 acre-feet between Hailey and Glendale bridge (Chapman, 1921). Records have not been kept for that reach of the river since 1921. The abrupt local steepening of the water table in the vicinity of Glendale bridge probably is caused by a bedrock ridge at shallow depth beneath the valley floor. The bedrock which crops out in the river bed near the diversion dam tends to cause damming of the ground water because it lessens the cross-sectional area of gravel available to transmit the ground water. Hence, a steep hydraulic gradient is necessary to force the water through the constricted area of the aquifer. Downstream from the bedrock ridge the gradient is flattened because the cross-sectional area of alluvium through which the ground water passes is enlarged. Southward from the baseline the configuration of the water table probably does not vary much during the year, but between the baseline and Glendale bridge the form is more changeable in response to changes in the stage of the river and the volume of water diverted around the braided reach of the river. See plate 2 and also water-table contour map for 1921 by Chapman (1921). The position of the contours in August 1954, during the irrigation season, indicate that the ground water was being recharged by underflow from the alluvium above the bridge and by water from the upper reach of the bypass canal (pl. 2). The inflection of the contours southwest of the bridge suggests ground-water recharge from irrigation on Poverty flat.

The contours on Chapman's map for 1921 show that the river was recharging the ground-water reservoir from Glendale bridge to near the baseline. Chapman's map was based on data collected on June 2 and 3, 1921, before the effect of large-scale diversions bypassing the braided reach of the river were reflected by water-table fluctuations.

The local flattening of the water table in the vicinity of the baseline probably is due to widening or thickening of the water-bearing deposit, a change in permeability, or both. The finer grained valley-fill ma-

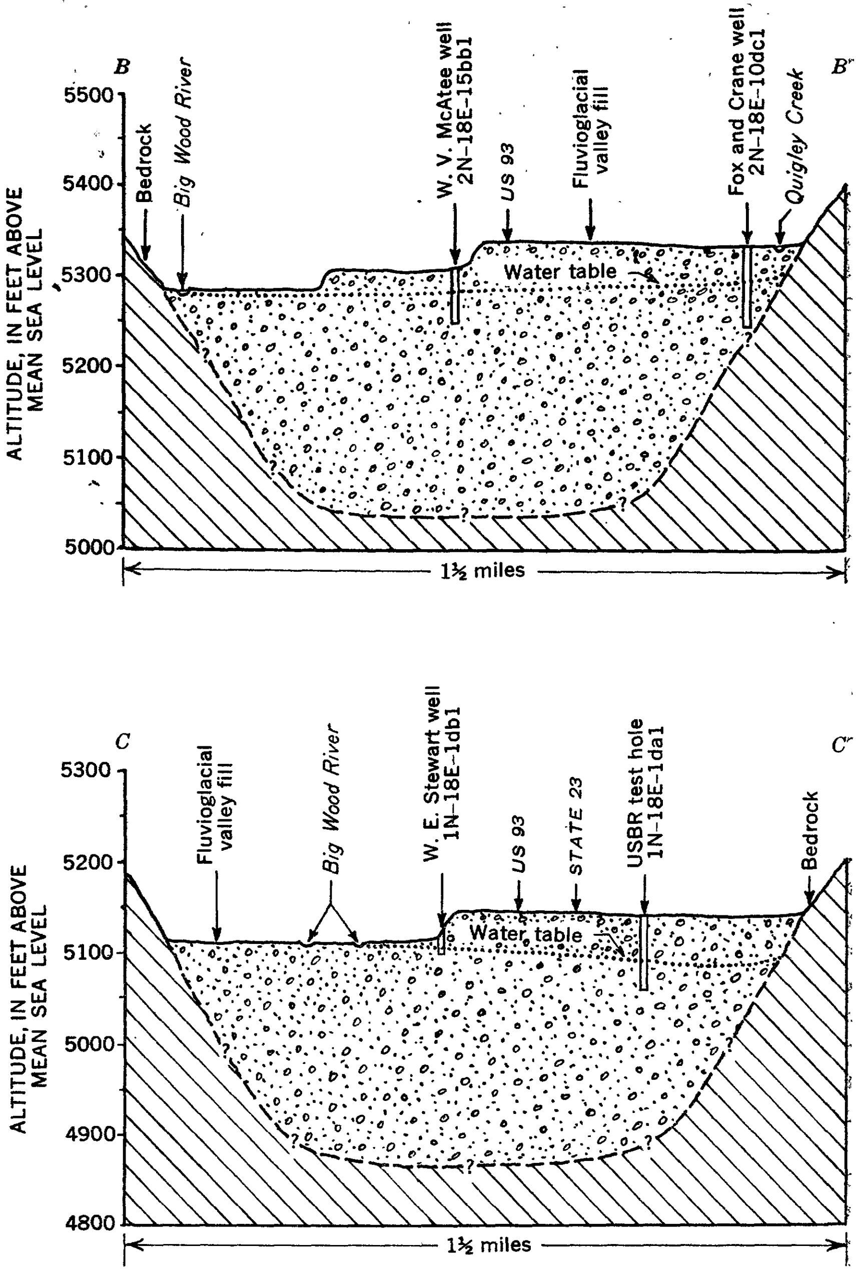

FIGURE 6.—Inferred geologic sections along line *B–B'* of plate 1, near gaging station 7 at Hailey, and line *C–C'*, 1⅝ miles northeast of gaging station 8 at Glendale bridge, showing position of water table.

terial at the downstream end of the valley, having a lower permeability than the coarser grained upstream part, may cause ponding of water in the ground-water reservoir in the vicinity of the baseline, and hence, the flattening of the water table.

Available data are not a sufficient basis for interpreting properly the form of the water table between Hay and Picabo. Ground-water behavior in that area is complicated by the basalt flow northeast of Hay and by local confining conditions in the vicinity of Picabo. South of Picabo, however, the ground water percolates into the more permeable zones and interbedded sediments in the Snake River basalt, and the slope of the water table steepens sharply. Where the water joins the regional body of ground water beneath the Snake River Plain the slope again becomes more gentle.

POSITION AND FORM OF THE PIEZOMETRIC SURFACE

Contours on the piezometric surface are shown on plate 2. The contours indicate the approximate altitude to which the confined water would rise in a well tapping the principal artesian aquifer. The piezometric surface is above the land surface at most of the arterian wells (pl. 5).

According to the contours, the shape of the piezometric surface resembles that of the water table, but the orientation is slightly different. In the southwestern part of the area mapped the piezometric surface slopes about 8 feet per mile between wells 1S–18E–1dd1 and 1S–18E–13ac1, then steepens toward the south boundary of the basin. In the southeast segment of the area mapped the piezometric surface also slopes gently, but it steepens slightly in the vicinity of test well 1S–19E–22aa1. The steepening near the southern boundary of the artesian basin represents a more rapid drop in pressure head. This loss of head is presumed to be due to friction in the aquifer, withdrawals of water from irrigation wells, and leakage of confined water through the confining beds.

FLUCTUATIONS OF GROUND-WATER LEVELS

Changes in water levels in wells reflect changes in the amount of ground water in storage. The annual cycle of ground-water recharge and discharge causes an annual rise and fall of the water table. The water table rises when the amount of recharge exceeds the amount of discharge and declines when discharge exceeds recharge.

During the period of this investigation, seven recording gages were operated on project observation wells in the basin, and periodic measurements of water levels were made in ten additional wells (pl. 2). Water-level fluctuations in four representative wells are compared with the runoff at stream gaging stations 7 and 24 in figures 7 and 8.

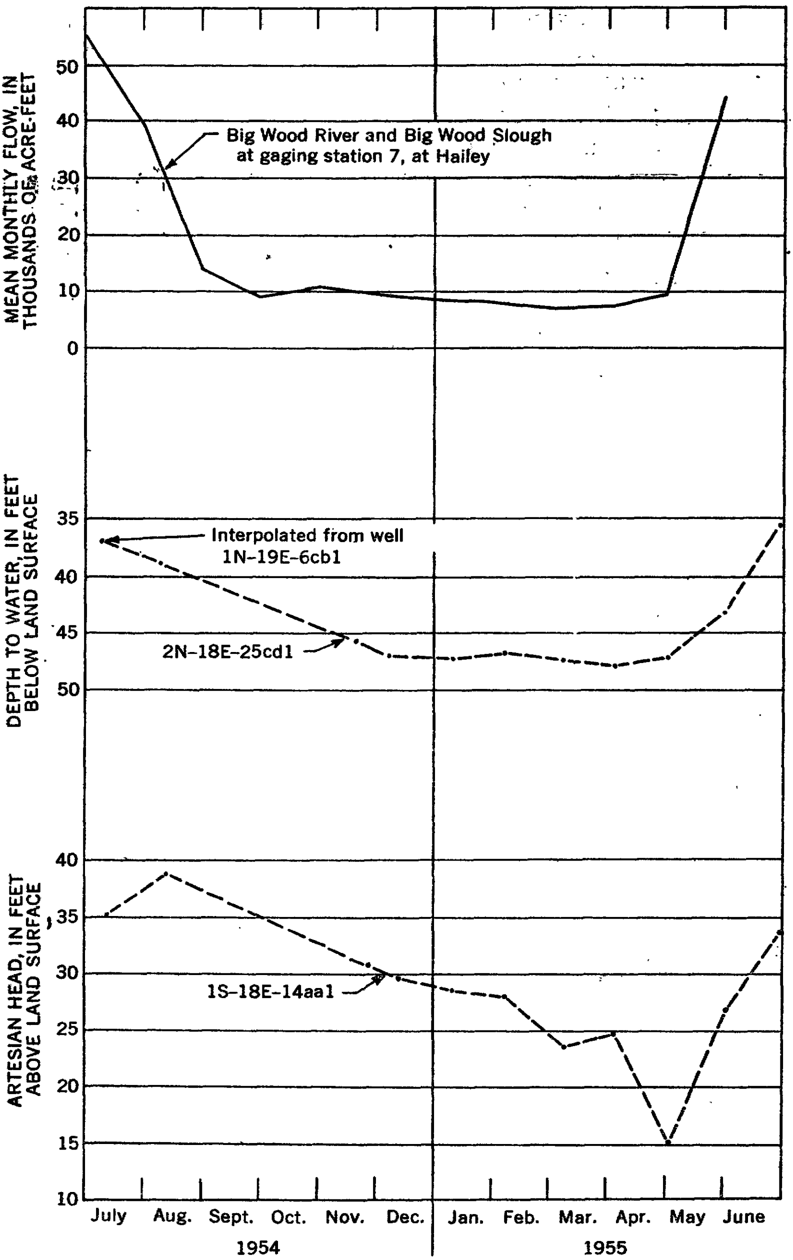

FIGURE 7.—Hydrographs of Big Wood River and of wells 2N–18E–25cd1 and 1S–18E–14aa1.

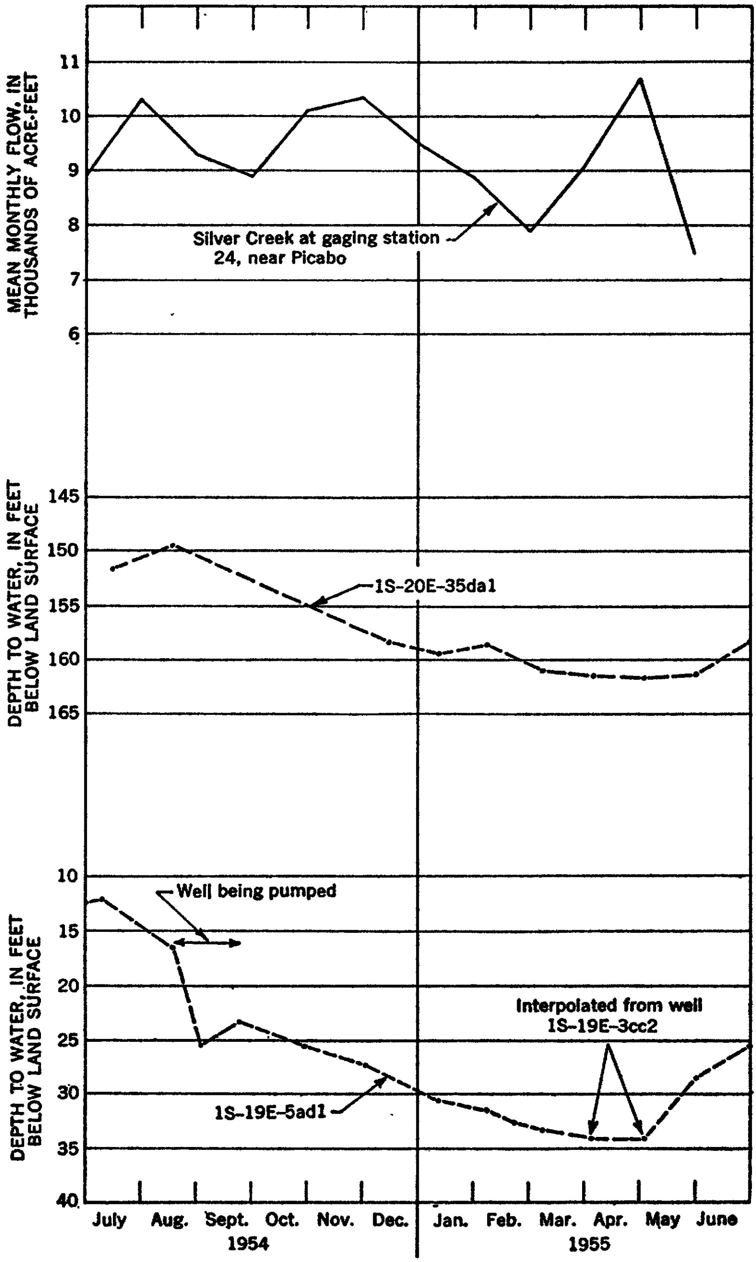

FIGURE 8.—Hydrographs of Silver Creek and of wells 1S-20E-35da1 and 1S-19E-5ad1.

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The period of observation was too short to warrant specific or detailed interpretation of the record, but the hydrographs clearly show the cyclic yearly rise and fall of the water table.

The water table begins to rise in April or May with the beginning of spring runoff, reaches its highest level in July, and then declines slowly until the next spring. The decline of the piezometric surface lags about a month behind the decline of the water table. After the spring recharge "wave" has passed, the pressure head tends to decline slowly.

The hydrographs indicate that the annual range of water-level fluctuations is about 10 feet in the northern part of the basin between Hailey and Glendale bridge, about 20 feet in the vicinity of the base-line, about 15 feet between Picabo and Priest, and about 25 feet in the artesian area.

WATER INVENTORY

The total quantity of water entering the middle Big Wood River-Silver Creek basin is the sum of the contributions from the various sources described previously. The amount varies from year to year, according to the amount of precipitation on the catchment area. The measured or estimated quantity from each source and the total from all sources, during the 15-year base period are summarized below.

	Acre-feet per year
Surface flow of Big Wood River and Big Wood Slough, gaging station 7, at Hailey (measured)	340,000
Underflow near Hailey from upper Big Wood River valley (estimated)	34,000
Surface flow from lateral tributary streams (estimated)	38,500
Precipitation directly on the lowland	60,000
Total	472,500

Estimated outflow from the area is summarized as follows:

Evapotranspiration from swamp areas and consumptive use by crops and native vegetation (estimated)	100,000
Surface flow of Big Wood River and Silver Creek at gaging stations 9 and 24 (measured)	320,000
Underflow through the southeastern outlet from the basin (estimated)	30,500
Total	450,500

The estimated amount of water entering the basin exceeds by 22,000 acre-feet a year the amount leaving the basin. The discrepancy is small, percentagewise, but that does not indicate that the estimates necessarily are accurate. A series of compensating errors may be responsible for the estimates checking as closely as they do. Assuming, however, that the estimated quantities are reasonable, the residual amount may be accounted for in several ways. Additional ungaged underflow may pass from the basin at the southeastern outlet through aquifers deeper than those penetrated in test hole 2S–20E–1ac1. The pumping test at that location presumably applied only to a 15-foot thickness of the most permeable alluvium below the depth of 185 feet; the test did not involve the basalt below the water table (see log of well 2S–20E–1ac1) because the basalt is relatively impermeable (see p. 16). Very likely, before the basalt flows dammed that outlet of the ancestral Big Wood River, the valley contained a partial fill of permeable alluvium and this possibility is indicated in figure 4. Additional sedimentary strata may be interbedded with basalt flows. Also, some of the deeper basalt flows may be water bearing. Such aquifers would transmit additional ground water. The transmission capacity of the rocks in the Picabo Hills along the south edge of the basin is not known, but some ground water may leave the basin through those rocks. There is a small amount of underflow through the southwestern outlet from the basin, but no estimate of that amount was included in the computation.

FEASIBILITY OF GROUND-WATER DEVELOPMENT

The feasibility of pumping supplemental water from the ground-water reservoir depends on the amount of water required, the availability of water from the aquifer, and the cost of properly constructed and spaced wells. Well depths, pumping lifts, the distribution of wells, and the chemical quality of the water also affect the potential development.

GROUND-WATER DEMAND

The estimated yearly canal-headgate diversion requirement on the Big Wood River water for irrigation in the middle Big Wood River-Silver Creek basin is 7.0 acre-feet per acre for 12,000 acres. (U. S. Bureau of Reclamation, 1953.) The Bureau of Reclamation study indicates an irrigated lowland area of 15,000 acres. The difference, 3,000 acres, is land upstream from Hailey that is not included in the area here given. The watermaster's records indicate that the yearly diversions from the Big Wood River between Hailey and Stanton crossing ranged from 42,000 acre-feet in 1939 to 123,000 acre-feet in 1938 and averaged 74,800 acre-feet for the period 1925 to 1954. The average deficiency was 9,200 acre-feet. However, the deficiency during July, August, and September for the past 15 years was 23,000 acre-feet (see following table). The last 15 years of record is used in this table because the yearly diversions averaged about 10,000 acre-feet less than the 30-year average, and thus indicate better the maximum amount of supplemental water needed.

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Surface-water diversions (in acre-feet) from the Big Wood River to irrigate land between Hailey and Stanton crossing, 1940–54

[From watermaster's records, Water District 7B]

Year	Month					Total [1]
	May	June	July	August	September	
1940	12,077	18,363	9,037	4,033	5,010	48,520
1941	15,430	19,794	14,834	10,065	6,101	66,224
1942	4,776	18,965	19,005	10,076	6,070	58,892
1943	12,336	20,623	19,963	15,599	10,093	78,614
1944	11,602	19,166	18,734	9,733	5,814	65,049
1945	12,373	19,452	18,878	9,060	5,438	65,201
1946	19,153	16,015	15,832	8,721	7,261	66,982
1947	23,066	21,101	16,031	8,036	5,197	73,431
1948	14,955	23,386	16,302	7,323	4,463	66,429
1949	19,528	19,955	12,274	4,804	3,340	59,901
1950	14,486	25,296	19,390	10,639	6,918	76,729
1951	15,246	25,451	20,460	15,205	8,767	85,129
1952	12,076	23,438	20,242	14,713	8,839	79,308
1953	16,524	23,933	23,326	12,734	7,191	83,708
1954	23,648	21,351	17,861	9,471	5,533	77,864
Average	15,152	21,086	17,478	10,014	6,402	70,132
Estimated requirement [2]	14,300	16,800	21,000	19,300	12,600	84,000
Average deficiency			3,522	9,286	6,198	[3] 19,000

[1] April diversions ranged from 0 to 3,625 acre-feet and averaged about 1,700 acre-feet.
[2] U. S. Bureau of Reclamation, (1953, p. 17):

	Month					Season
	May	June	July	August	September	
Percent	17	20	25	23	15	100
Demand (acre-feet per acre)	1.19	1.40	1.75	1.61	1.05	7.00

[3] Rounded.

From 1947 to 1954 ground-water withdrawals for irrigation increased from a negligible amount to about 7,500 acre-feet a year. Most pumping was done near where the water was used, and the ground water is subject to less transmission loss than is the surface water. Probably about 5 acre-feet of ground water per acre at the well head would be adequate for irrigated land. Thus, the average surface-water deficiency of 19,000 acre-feet (see above table) between Hailey and Stanton crossing could be made up by 13,600 acre-feet of ground water pumped on or near the farms (19,000 x 5/7). The 7,500 acres of nonirrigated arable land, if brought under irrigation, would have an additional well-head demand of 37,500 acre-feet. The aggregate need for supplemental water and water for new irrigation then would be 51,100 acre-feet if all of it were obtained from wells. That amount, plus ground water already being pumped, gives a potential total demand of about 60,000 acre-feet.

Seemingly, the principal area where there is a deficit in the surface-water supply is north and west of Silver Creek. Areas served with water from Silver Creek are not critically short of water. The low-flow period of Silver Creek is in late spring and early summer, but by July the streamflow usually is sufficient for average needs within the basin. Some downstream water rights, for land beyond the southeastern outlet of the Silver Creek drainage, are not fully satisfied in dry years. Within the middle Big Wood River-Silver Creek basin, therefore, much of the pumping demand would be to supply land not served by Silver Creek.

CONSUMPTIVE USE OF GROUND WATER

Pumped ground water not consumed by evapotranspiration within the basin would be available for return recharge to the ground. Rejected recharge would return at the surface to the streams and would be available for rediversion or for downstream storage. Assuming a consumptive-use requirement of 2.2 acre-feet per acre of cropland, 0.4 acre-foot of that demand being supplied directly by precipitation, consumptive use of pumped ground water would be 1.8 acre-feet per acre. Thus, only about 35 percent (21,000 acre-feet—rounded amount) of the pumped water would be consumed. Inasmuch as the nonartesian aquifers are at shallow depth and are readily recharged by percolation through overlying permeable gravel, return-recharging by pumped water would occur soon after the water was applied to irrigated fields and the unconsumed water would be available promptly for reuse.

AVAILABILITY OF GROUND WATER

Nearly all the unconsumed ground-water yield of the Middle Big Wood River-Silver Creek basin is discharged by underflow through the southeastern outlet, by seepage into the Big Wood River, or by the springs and seeps that feed Silver and Spring Creeks. Therefore, the aggregate of those discharge components is an approximate measure of the available supply of ground water. The components may be reasonably approximated by using records of surface discharge past station 24 and by estimating the ground-water component in surface flow past station 9. Streamflow records are not sufficient for computing directly the ground-water component at station 9, but an estimate was derived by assuming that the ground-water yield of the two parts of the basin, on either side of the ground-water divide, are proportional to their areas. The area of the western segment is 11,600 acres, and that of the eastern is 25,400 acres.

The average surface discharge of Silver Creek at station 24 is 116,500 acre-feet a year (see p. 22). The estimated volume of ground-water underflow at the southeastern outlet is 38,000 acre-feet a year (see p. 23–24). The total of the surface- and ground-water components is about 155,000 acre-feet. That, in effect, is the ground-water yield east of the ground-water divide because practically the entire flow of Silver Creek consists of discharged ground water. If the yield of the area west of the divide is proportional, then that yield is about 70,000 acre-feet (11,600/25,400=X/155,000). That estimate agrees well with an estimate for 1921 by Chapman, in a footnote to chart 41 in the report previously cited (Chapman, 1921), indicating that increments to the Big Wood River below Hailey from Spring Creek and directly from seepage are equivalent to a continuous flow of about 100 cfs (about 72,000 ac-ft/yr).

The above estimates indicate that the aggregate discharge of ground water from both parts of the basin is about 225,000 acre-feet a year. Consumptive use of ground water for irrigation in 1954 seemingly was less than 2 percent of the total. Consumptive use by full development would be about 10 percent of the total. That amount is easily available within the basin and probably would not infringe materially on the use of surface water within the basin, because the withdrawal would be late in the season, when the supply of surface water derived from spring-fed creeks ordinarily exceeds the demand. Downstream, beyond the limits of the basin, withdrawal of this water might be of more material concern.

Infringement on downstream water rights might occur even if a reduction of surface flow out of the basin occurs late in or after the irrigation season. Specifically, diminished flow of the Big Wood River would reduce the volume of water available for storage in Magic Reservoir. Thus, although the reduction of surface flow would be small in both districts during the irrigation season, that reduction undoubtedly would be viewed with concern by water users during years of low runoff.

Reduction of streamflow by pumping during the irrigation season could be held to a minimum by placing new wells at locations where their effects on streamflow would be indirect and delayed. Moreover, wells between Hay and Picabo would tap unappropriated water that is not effluent to Silver Creek either within or beyond the basin. Also, if a small new reservoir were constructed on the Big Wood River to supply supplemental late-season water to the area, ground-water recharge from irrigation would be increased and would compensate partly for the diminished supply of ground water. However, final net reduction of the total water supply would be the same in any case.

The conclusion is that the water supply in the Big Wood River-Silver Creek basin is adequate for the prospective increased demand, and that such increase would not greatly affect downstream use of water, provided that ground-water pumping is confined to favorable areas, and provided that other precautions are taken, as described herein.

AQUIFER CHARACTERISTICS

Five aquifer tests were made on wells in different parts of the valley to determine the coefficients of transmissibility and storage of the water-bearing beds. The coefficient of transmissibility may be defined as the rate of flow of water, in gallons per day, at the prevailing water temperature through each vertical strip of the aquifer 1 foot wide having a height equal to the thickness of the aquifer, under a unit hydraulic gradient. The coefficient of storage may be defined as the volume of water an aquifer releases or takes into storage per unit surface area of the aquifer per unit change in the component of head normal to that surface. Coefficients of transmissibility, as determined from the tests, ranged from about 800,000 to about 2.2 million gpd per foot, but because of partial penetration of the wells, incomplete knowledge of the thickness of water-bearing material, and stratification of the beds, this range indicates the order of magnitude only. For the same reasons, the determinations of coefficient of storage, which depend upon the determination of the coefficient of transmissibility, were not reliable and are not given. In order to determine the coefficients accurately, much more elaborate tests utilizing a number of observation wells plus test drilling to determine the thickness of the aquifer are needed, an undertaking beyond the scope of this investigation.

CHARACTERISTICS OF WELLS

The characteristics of 28 irrigation wells are summarized in the following table. Only those wells are included that are representative of the area in which ground-water withdrawals preferably would be made. Flowing artesian wells in the southeastern part of the main artesian area, where the yields are low, and dug wells that withdraw water from recent alluvium beneath the bottom land along the Big Wood River, are excluded. The yields of most of the wells included are moderately large, averaging about 1,875 gpm from pumped wells and 825 gpm from freely flowing wells. It is of interest that most pumped wells yield more water than well 1N–19E–31ca1 (Base Line Canal Co., 1,115 gpm), which supplies supplemental irrigation water to several farms.

The following table includes four wells that were pumped in aquifer tests. The average specific capacity (gpm per foot of drawdown) of those wells ranges from about 100 to 500 and substantiates the large values for coefficient of transmissibility determined from the aquifer tests. The depth to water in the water-table wells in August 1954 ranged from less than 5 feet to 40 feet, and south of the Boise baseline

Characteristics of representative irrigation wells

[From records of 28 wells, except as noted]

Characteristics	Maximum	Minimum	Average
Water-table wells (12 wells):			
Depth ft	81	23	59
Diameter in	42	10	17
Length of casing ft	81	23	59
Depth of water [1 2] ft	40	5	18
Penetration of water-bearing zone [2] ft	48	16	38
Pumping yield gpm	3,400	565	1,875
Horsepower of pump	50	10	31
Flowing artesian wells (16 wells):			
Depth ft	174	118	139
Diameter in	8	6	6.5
Length of casing ft	172	117	137
Artesian pressure head [3 4] ft	39	14	27
Depth to artesian aquifer ft	172	117	137
Yield by free flow gpm	1,525	355	825

[1] Depth below land surface, August 1954.
[2] From records for 9 wells.
[3] Above land surface, August 1954.
[4] From records for 14 wells.

the average depth to water was less than 5 feet (pl. 4). The well depths range from 23 feet (well 1S–19E–2cb1) to 81 feet (well 1N–19E–6cb1).

Properly constructed wells in the general vicinity of the test sites probably would have higher average yields than do the existing wells, many of which are substandard in design or were not fully developed. Discussion of well construction is beyond the scope of this report, but factors that are especially important in this area are the size of the slot openings in the casing or screen, the total open space (entrance area) in the casing or screen, and development of wells to assure maximum yield with minimum drawdown. Improved well construction and development would increase somewhat the unit construction cost of wells, but that increase would be compensated by greater efficiency and lower operating cost per unit volume of water pumped. Proper design and development are equally important in artesian and nonartesian wells.

EFFECTS OF PUMPING

EFFECT ON THE WATER LEVELS

Ground-water withdrawals in the area increased from about 2,500 acre-feet in 1946 to about 8,000 acre-feet in 1954. Although no long-term records of water-level fluctuations are available, the increase in pumping reportedly has not caused appreciable interference among wells or declines of water levels and artesian pressures.

Potential consumptive use of 21,000 acre-feet of ground water per year (see p. 33) is only a small part of the total ground-water yield of the basin. The high rate of transmission of water through the nonartesian aquifers would tend to minimize local lowering of the water table by heavy pumping. Unconsumed irrigation water also would recharge the unconfined ground-water reservoir within a short time after it was pumped, especially in areas where the water table is near the land surface, and would offset partly the local effects of pumping. Pumping from a well field would cause local lowering of the water table during the pumping season, but the net long-term effect of pumping either a group of wells or individual wells, in the number foreseen, would be small.

Although the artesian aquifers have relatively high coefficients of transmissibility, withdrawal of water from wells in the artesian basin quickly causes lowering of the artesian pressure head and, hence, lessening of the discharge from nearby wells. Also, little of the unconsumed irrigation water would return to the artesian aquifers as recharge, and recharge from the northern part of the basin might not offset the lowered artesian head during the same season. Large additional withdrawals of artesian water probably would reduce the flow from wells throughout the artesian basin, and it might become necessary to pump the wells to obtain the desired yield.

EFFECT ON THE BIG WOOD RIVER AND SPRING CREEK

Where streams are perched above the water table, pumping of ground water does not affect the streams. But the Big Wood River is not perched, and pumping from wells under water-table conditions near the river might induce infiltration wherever the river is continuous with the water table. This condition exists in the area between wells 1N–19E–6cb1 and 1N–19E–7cd1. Data obtained from the test on well 1N–19E–6cb1 indicate that the cone of depression around that well would extend to the river within about a day after the start of pumping. Presumably, similar aquifer characteristics prevail in valley fill along other reaches of the river. Where the water table slopes toward the river, pumping might lower or reverse the gradient. Reduction of surface flow in the river would reduce the benefits from pumping supplemental irrigation water from wells.

Withdrawal of ground water immediately north of the baseline and near the Big Wood River would reduce ground-water discharge to the river and to Spring Creek between the baseline and Stanton crossing, as would withdrawal from the western part of the artesian basin. Current withdrawal is negligible in the part of the ground-water reservoir that is tributary to the river and Spring Creek.

Under full irrigation development the ground-water discharge to Spring Creek and the lower reach of the Big Wood River probably would not be diminished by more than about 10 percent if the bulk of the proposed withdrawal is made from appropriately selected areas. That is, if withdrawal were proportional to the area on the east and west sides of the ground-water divide, the total withdrawal would be about 7,000 acre-feet (see p. 34).

EFFECT ON SILVER CREEK AND ON UNDERFLOW AT THE SOUTHEASTERN OUTLET

Water for irrigation from Silver Creek is obtained by diversions in the headwaters area, along the reach between Hay and Priest, and downstream from the basin on the Snake River Plain. Much of the land on which ground water is now used, and much that needs supplemental water, is east of the ground-water divide. Withdrawal of ground water east of the divide would affect the springs that feed Silver Creek as well as underflow through the southeastern outlet. In the eastern area, estimated to contain 25,400 acres, ground-water withdrawal for irrigation currently is 5,200 acre-feet yearly, but net consumptive use of the ground water is every small. The proposed pumping of additional ground water for supplemental supplies and for new irrigation would increase gross pumpage in the eastern area to about 45,200 acre-feet yearly. Consumptive use on irrigated land probably would not exceed 15,000 acre-feet a year, or about 10 percent of the aggregate water yield of the eastern area. Unconsumed irrigation water would reach Silver Creek as surface drainage or would recharge the ground water that feeds the creek through springs. The proportional distribution of the reduction between underflow and surface flow is not determinable at this time. Assuming a ratio near 1:4, which is not unreasonable though it cannot be verified at this time, the underflow might be diminished by about 3,000 acre-feet yearly and the flow of Silver Creek by about 12,000 acre-feet.

This proposed new consumptive usage would be only a small percentage of the total water supply entering the basin. That supply (partly estimated) is about 430,000 acre-feet—340,000 discharged by the Big Wood River at Hailey and 90,000 acre-feet of ground water derived from underflow to the basin and recharge from lowland precipitation (see p. 20–21). Moreover, a substantial part of the supply can be used and reused, one to several times, before it leaves the area.

WELL DEPTHS AND PUMPING LIFTS

The average depth of representative water-table irrigation wells in the basin is about 60 feet (table p. 36), but depths vary with location, quantity of water needed, well construction, and other factors. In the area between wells 1N–19E–7cd1 (112 feet deep) and 1N–19E–6cb1 (81 feet deep) the average depth of wells probably would be about 100 feet. Wells in the vicinity of the Boise baseline would be about 50 to 85 feet deep. Well 1S–19E–3da1, near Gannett, was deepened in July 1954 from 30 to 71 feet in order to increase its yield.

Wells in the western part of the main artesian basin would be 140 to 175 feet deep.

The pumping lift in wells also would differ from area to area. Assuming that the average drawdown would be between 10 and 20 feet pumping lifts probably would range between 20 and 70 feet. Probable pumping lifts in specific areas can be estimated from the depths to water shown on plate 4 by adding the probable drawdown to the depth to the water table.

WELL FIELDS AND SINGLE WELLS

Development plans calling either for well fields or for scattered single wells would have both advantages and disadvantages. The advantage of one or more well fields is threefold: existing canal systems might be utilized to deliver water to the farms; pumping in properly located fields might be done at any time of the year to deliver water to Magic Reservoir, thus replacing surface water that would be denied to the reservoir by other operations; pumping might be concentrated in areas where well yields are most plentiful, or where pumping would have the least adverse effect on other water uses. A small well group on Poverty flat and one or more well fields in the centrally located triangular area shown on plate 4 could use existing canals to deliver supplemental water to much of the area where water is needed.

In some localities near the Big Wood River, pumping of well fields (or single wells, for that matter) that tapped unconfined ground water would increase infiltration from the river. In the artesian area large withdrawals of artesian water would tend to reduce the yield of existing flowing wells and probably would reduce ground-water discharge to Spring Creek and the Big Wood River, because the unconfined ground water is derived partly from upward leakage out of the artesian aquifers. Although water from well fields might be distributed through existing canal systems, transmission of the water for long distances would entail high transit losses in the permeable valley-fill sediments, and a correspondingly larger amount of water would have to be pumped.

Water from dispersed wells, each in the immediate area where its water is to be used, would be subject to less transmission loss in canals and hence the gross pumping requirement would be smaller than that from groups of wells. Strategically located single wells might satisfy both the supplemental water needs of the Silver Creek area and the late-season needs in the central irrigated area. Some single wells would be capable of supplying the full amount of supplemental water for several farms.

Pumping, either from well fields or from scattered wells, would cause both local and regional lowering of water levels. The most pronounced effects would be around well fields, and might lead to increased cost of pumping and depletion of streamflow. In most instances single or paired wells would have less pronounced local effects and more evenly distributed regional effects.

With either type of development, well fields or single wells, construction could be by stages, with opportunity to observe the effects of pumping during development. Observation and study during a development by stages also would aid in determining the number of wells needed to satisfy the water demand and the most practical size, depth, and spacing of wells.

A reduction in the amount of water delivered to Magic Reservoir by the Big Wood River, caused by increased use of water in the middle Big Wood River-Silver Creek area, might be compensated by pumping from a well field in the general vicinity of Hay, and conveying the pumped water to the reservoir via pipeline and the Big Wood River. The wells preferably should tap the deeper ground water in order to have the smallest possible effect on surface discharge in Silver Creek. The wells probably could be pumped at any time of the year, but the preferred time would be during the nonirrigation season. Depletion of the discharge of Silver Creek by pumping of supplemental water in the northern part of the basin could be offset by pumping directly into the creek from a well field in the vicinity of Picabo. That well field also preferably should tap the deep ground water. During dry years, when Silver Creek water users below Picabo are short of water, additional water might be furnished from the wells.

CHEMICAL QUALITY OF THE WATER

Chemical analyses of 34 samples of ground water and 5 samples of surface water from the Big Wood River-Silver Creek area are shown in the table on pages 42–43. The chemical suitability of water for irrigation ordinarily is determined chiefly by (a) the ratio of sodium to total major cations, represented in chemical equivalents (so-called percent sodium); (b) the ratio of bicarbonate to calcium and magnesium; (c) the amount of dissolved solids; and (d) the concentration of boron. Various other chemical factors also affect the utility of water for domestic and general farm use.

Specific conductance, a measure of electrical conductivity, is related to the dissolved-solids content of water and thus is an approximate measure of the amount of dissolved solids. The specific conductance of a water sample also can be used as a general index of its suitability for irrigation. The range in specific conductance for the waters sampled was 247 to 605 micromhos and, according to that criterion, the water is suitable for irrigation (fig. 9).

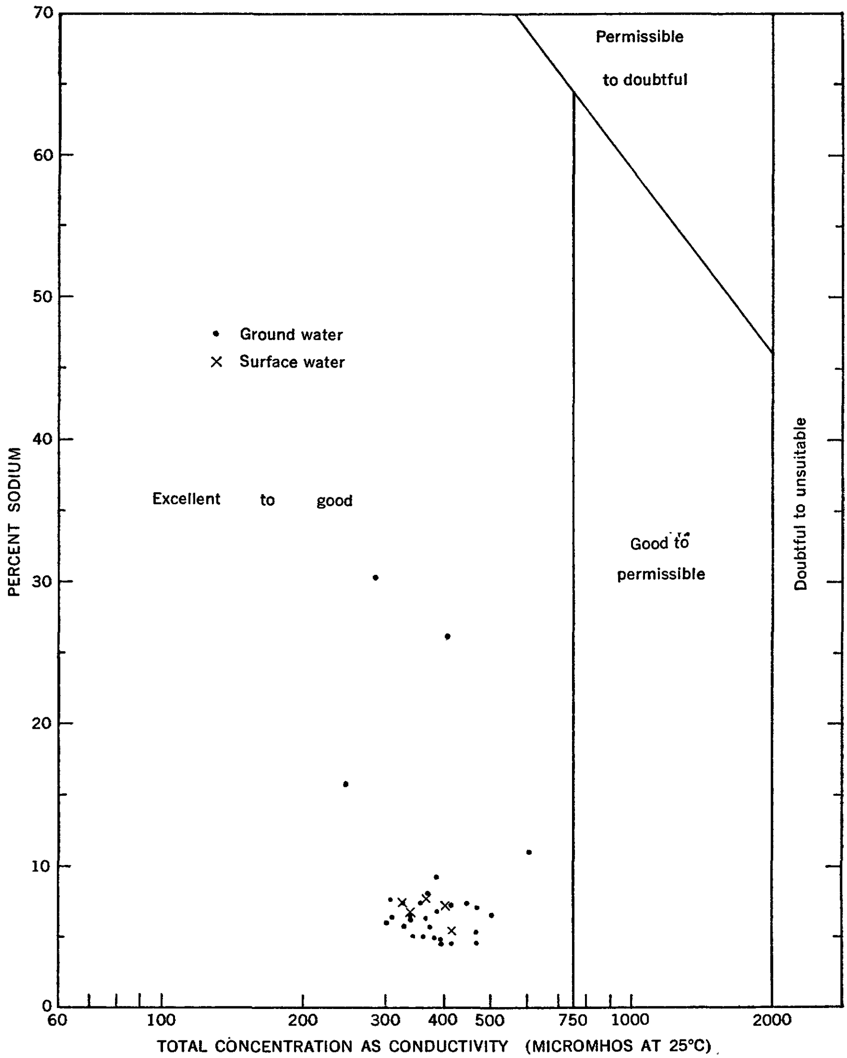

FIGURE 9.—Classification of waters from the middle Big Wood River-Silver Creek area.

Chemical analyses of waters from the middle Big Wood River-Silver Creek area

[Chemical constituents in parts per million. Analyses by U. S. Bureau of Reclamation, except as noted]

Location (well or spring No. or sampling point)	Date of collection	Temperature (° F)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$: Total	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio	Residual sodium carbonate (meq/l)	pH	Specific conductance (micromhos at 25° C)
Ground water																						
2N-18E-9bd1	8-19-54	46			51	15	5	0.8	201	12	1		3.1	0.04		189	24	5	0.2	0	7.5	383
-15bb1	8-19-54	50			55	16	5	.8	220	14	2		5	.02		203	23	5	.1	0	7.4	417
-25cd2	10-8-54	53.5			57	22	6	1.2	242	26	4		4.3	.00		233	34	5	.2	0	7.5	473
2N-19E-28dcS1 [1]	2-14-45	63		0	34	20			156	7	3	0			176	167					7.8	
1N-18E-1bc1	9-9-54	54			54	11	7	Tr	199	13	2		1.9	.00		180	17	8	.2	0	7.4	384
-13aa1	9-9-54	52			55	10	8	Tr	197	14	1		1.9	.00		178	17	9	.3	0	7.6	385
-14cb1	8-19-54	54			69	18	8	1.6	268	13	3		13	.00		246	27	6	.2	0	7.4	504
-25aa1	9-9-54	52			55	14	5	.4	206	13	2		5	.02		195	26	5	.1	0	7.9	392
-26cb1	9-9-54	54			27	7	19	Tr	112	18	6		2.5	.01		96	4	30	.8	0	8.1	285
1N-19E-6cb1	8-19-54	46			66	14	8	.8	239	14	3	0	6.2	.07		222	26	7	.2	0	7.5	446
-17ba1	10-8-54	52			58	18	5	.8	251	13	4		5	.00		219	13	5	.2	0	7.5	471
-26acS1	10-8-54	48			24	10	9	1.6	124	4	5		2.5	.00		101	0	16	.4	.02	7.3	247
-31ca1 [2]	11-7-54	52	16		52	9.7	4	1.1	197	12	2	.1	5.6	.04	206	170	8	5	.1	0	7.9	345
-32ab1 [2]	9-9-54	51.5	16		56	10	4	1.0	214	13	2	.2	3.2	.05	214	181	6	5	.1	0	7.4	362
1S-18E-1dd1	8-19-54	48			44	10	6	3.1	157	14	1		1.2	.06		151	22	8	.2	0	7.7	311
-2dd1	8-19-54	50.5			53	11	5	.8	190	13	1		5	.07		178	22	6	.2	0	7.5	368
-13dd1	8-19-54	49.5			48	11	5	.8	174	13	1		4.3	.00		165	22	6	.2	0	7.7	341
-14aa1	8-19-54	51			50	11	6	.8	181	13	1		5	.09		170	22	6	.2	0	7.7	340
-23ab1	8-19-54	54			49	12	6	.8	186	13	1	0	5.6	.07		172	19	6	.2	0	7.7	363
1S-19E-1cc1	10-8-54	52			36	12	23	1.6	171	10	15		12	.00		139	0	26	.8	.02	7.2	408
-3cc1 [2]	11-6-54	52	18		40	11	5	1.2	173	13	2	.1	4.0	.38	183	145	3	6	.1	0	8.4	302
-3dd2 [1]	7-30-54	60	40	.03	77	11	10		234	14	2	1.0	4.0		276	236					7.4	
-5ac1	10-8-54	52			57	12	4	.8	209	13	3		3.7	.00		192	20	4	.1	0	7.5	397
-8cd1	10-8-54	48			44	10	4	.8	162	16	2		3.1	.00		151	18	6	.2	0	7.6	330
-13aa1	10-8-54	51			41	21	7	1.6	219	17	3		3.1	.00		189	14	7	.2	0	7.8	417
-13bdS1 [1]	7-30-54	53	24	.07	54	18	10		200	18	3	1.0	1.8		230	209					7.6	
-20bc1	9-9-54	51.5			47	11	6	Tr	174	15	1		4.3	.00		162	20	7	.2	0	8.0	357
-22aa1 [1]	7-29-54	48	24	.04	46	12			140	14		.2	.8			164					7.9	
-22ca1	10-8-54	47			40	12	5	.8	160	15	1		1.9	.01		149	18	6	.2	0	7.8	311
1S-20E-17db1 [2]	9-9-54	58	16		43	16	7	2.2	206	23	3	.2	.3	.06	208	173	4	8	.2	0	7.7	370
-19ac1 [2]	9-9-54	51	32		65	34	17	1.8	355	23	5	.2	6.2	.02	368	302	1	11	.4	0	8.4	605
-33ddS1 [1]	2-15-45	36		.13	16	2.8			52	5	9	0			162	51	9				7.2	
2S-20E-1ac2 [2]	10-26-54	51	21	.24	67	16	8	1.9	281	17	2	.3	3.3	.11	274	233	3	7	.2	0	7.6	472
-1ac2 [2]	10-29-54	51	23		67	15	8	2.0	281	18	2	.2	3.3	.10	251	228	0	7	.2	.03	7.6	473

Location (well or spring No. or sampling point)	Date of collection	Temperature (° F)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$: Total	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium adsorption ratio	Residual sodium carbonate (meq/l)	pH	Specific conductance (micromhos at 25° C)
Surface water																						
Big Wood River at Hailey	9-9-54	53.5	------	------	42	11	6	0.4	160	14	1	------	1.9	0.00	------	150	19	7	0.2	0	8.2	324
Big Wood River at diversion dam above Glendale bridge	9-9-54	58	------	------	41	14	5	------	[3] 160	15	2	------	1.9	.00	------	160	29	7	.2	0	8.4	339
Big Wood River at Stanton Crossing	9-9-54	66	------	------	48	12	7	.4	188	12	1	------	1.9	.01	------	169	15	8	.2	0	8.2	365
Silver Creek in NW¼NW¼ sec. 20, T. 1 S., R. 19 E.	10-8-54	60	------	------	57	14	6	1.2	[4] 217	11	2	------	2.5	.00	------	200	22	6	.2	0	8.2	415
Silver Creek in SE¼SE¼ sec. 26, T. 1 S., R. 20 E.	9-9-54	60.5	------	------	48	16	6	.4	[5] 189	15	1	------	2.5	.05	------	186	31	7	.2	0	8.7	405

[1] Analysis by Idaho State Department of Public Health.
[2] Analysis by U. S. Geological Survey.
[3] Co_3=4.8 ppm.
[4] CO_3=6 ppm.
[5] CO_3=12.9 ppm.

An excessive proportion of sodium in relation to other cations in irrigation water alters the structure of some types of soils, especially clay soils, in such a way as to inhibit downward movement of water. Three methods of evaluating the sodium hazard of irrigation waters have gained wide use. One method (Wilcox, 1948) is to plot the percent sodium against total dissolved solids as measured by specific conductance in micromhos per centimeter (fig. 9). All the samples analyzed are excellent to good according to the sodium-percentage criterion, but that method does not express an exact ratio of sodium adsorption by the soil. The sodium-adsorption ratio (Richards and others, 1954) is expressed by the equation:

$$SAR=\frac{Na^{+}}{\sqrt{\frac{Ca^{++}+Mg^{++}}{2}}}$$

in which Na^{+}, Ca^{++}, and Mg^{++} represent respective concentrations, in millequivalents per liter (meq/liter), of sodium, calcium, and magnesium. The sodium-adsorption ratio of each of the waters sampled in the basin is very low, the range being from 0.1 to 0.8, and the sodium hazard is low according to that criterion.

Boron in small amounts is beneficial to plants, but contents as low as 1.0 ppm are toxic to boron-sensitive plants. If the boron content is too low—less than about 0.3 ppm—the water may leach boron from the soil and reduce its productivity (Eaton, 1944). The maximum concentration of boron in the samples analyzed was 0.38 ppm.

Excessive bicarbonate tends to aggravate the effects of a high percent sodium (Eaton, 1950). Bicarbonate in excess of the calcium and magnesium content is called the residual sodium carbonate and may be expressed in millequivalents per liter. (Residual sodium carbonate $=[CO_3^{--}+HCO_3^{-}]-[Ca^{++}+Mg^{++}]$). Water containing more than 2.5 meq/liter of residual sodium carbonate is not suitable for irrigation; water having a concentration of less than 1.25 meq/liter is probably safe. According to this method of classification, all the samples of water are probably safe.

The samples of water from the basin do not contain excessive amounts of calcium and magnesium, which cause hardness in water but are necessary in moderate amounts for plant growth and soil maintenance. The water is quite hard for domestic use, the hardness generally exceeding 160 ppm. Water from spring 1S–20E–33ddS1 had a hardness of 51 ppm, which was the lowest observed in the basin.

Other dissolved constituents in the water have minor importance in irrigation and other ordinary uses. None of the waters that were analyzed contained excessive amounts of fluoride, iron, silica, chloride, or nitrate.

In summary, all the ground water and surface water that was sampled in the basin is chemically suitable for irrigation according to accepted methods of determining water utility.

CONCLUSIONS

According to the estimates in this report the total water supply in the middle Big Wood River–Silver Creek area is adequate to meet the requirements of proposed plans for supplemental water and water to irrigate additional land. The principal problem would be to avoid material infringement on established uses of water. The prospects are good for achieving that end by proper management of surface storage and well pumping, and by balanced distribution and application of irrigation water.

The unconsolidated sediments that form the valley fill in the middle Big Wood River–Silver Creek basin contain a moderately large amount of unconfined and confined ground water. The aquifers are capable of yielding water plentifully to wells, with relatively small drawdown and small regional lowering of water levels. Water-table wells that yield 2,000 to 3,500 gpm with an average drawdown of no more than 10 feet, and flowing wells that yield 500 to 1,500 gpm, can be developed at suitable places in the basin. Pumping lifts probably would range between 20 and 70 feet in the water-table area if a large number of new wells were installed.

Additional pumping of unconfined ground water in the area would cause a net lowering of the regional water table. Pumping near the lower reach of the Big Wood River would lessen the normal discharge of ground water to Spring Creek and to the lower reach of the Big Wood River. That water is used currently for irrigation and for storage in Magic Reservoir. Pumping of unconfined water near the Big Wood River would induce increased infiltration from some reaches of the nearby river and would reduce usable surface flow in those reaches. Increased pumping of artesian water would lower the artesian pressure and diminish the discharge from flowing wells.

Much of the pumped water would not be consumptively used, and unconsumed water would be available for return recharge to the ground and for rediversion from surface drainageways.

If all needed supplemental water and water for new development were pumped from wells, the estimated maximum total pumpage would be about 60,000 acre-feet a year. Consumptive use of ground water during an average year would be about 21,000 acre-feet—about 10 percent of the average annual ground-water component in the discharge of Silver Creek and the Big Wood River at gaging stations 9 and 24. That depletion probably would not infringe seriously on existing surface-water use if proposed wells were properly located;

moreover, provision could be made for supplying replacement water.

Each of the plans considered by the Bureau of Reclamation to supply supplemental irrigation water (see p. 3) has certain advantages so far as ground-water hydrology is concerned. Plan 1 proposes a small storage reservoir above Hailey, to be operated in conjunction with a standby well field in the basin. Operation of the plan would increase the yearly recharge to the ground-water reservoir east of the ground-water divide because increased application of surface water for irrigation would increase ground-water recharge from that source. That increase would tend to cause a rise of the water table and an increase in the discharge of springs that feed Silver Creek. Those tendencies would persist each year that the supplemental surface water was used and the well field remained idle. During years of short water supply, pumping of the wells would reverse the tendencies. Pumping during a series of drought years might deplete the new ground-water storage and lead to a draft on the normal storage.

Under plan 1 continued increase in surface-water use without pumping of the standby wells inevitably would cause an increase of the area in which the water table is at or near the surface, and there would be additional waterlogging of land south of the Boise baseline. Seemingly, therefore, regular pumping of some ground water would be desirable under plan 1, and should be done at places where it would provide drainage benefits. The pumping might serve the additional purpose of furnishing replacement water to Magic Reservoir. Percolation loss of pumped water in transit in a canal to the reservoir would be a substantially smaller percentage than that of return recharge from water pumped for irrigation within the basin. Hence, net depletion of ground water by pumping of replacement water for transporting to Magic Reservoir would be proportionately greater than depletion by pumping for irrigation. Pumping of the replacement water, however, presumably would be largely during the nonirrigation season.

Plan 2 proposes that the entire supplemental water supply be obtained from wells. The plan provides flexibility in the location and spacing of wells. Well fields probably could use existing canals to deliver water but otherwise the well-field plan seems to be less desirable than the use of scattered single wells or widely distributed small groups of wells because of greater local drawdown of water levels. Drilling of the wells might be by stages, a few in each of successive years, accompanied by systematic study of the effects of pumping which would guide later stages. Plan 2 is more likely to lead to some infringement on existing water uses than plan 1. A compromise of the plans may be desirable.

The best area, all factors considered, for pumping supplemental irrigation water from wells is in a centrally located triangular area shown on plate 4. In that area, east of the ground-water divide, the ground water is tributary to Silver Creek and to the southeastern underflow outlet. Depletion of streamflow caused by pumping would tend to occur late in the season, when its effects would be least serious. Also, unconsumed pumped water would continue to reach Silver Creek. A few irrigation wells probably would be feasible on Poverty flat. Heavy withdrawals there, however, would not be feasible, owing to limited ground-water recharge in that area and to the probable reduction, by pumping, of ground-water discharge to Spring Creek and the Big Wood River.

Execution of either plan 1 or plan 2 might have a greater effect on the water supply than is anticipated because the amounts of water estimated in this report to be available are only rough approximations. Offsetting measures are possible, however, under either plan. The water that leaves the basin by underflow through the southeastern outlet is unappropriated and available. The estimated rate of underflow is 30,500 acre-feet a year. Pumped wells could intercept part of the underflow, thereby developing a new supply without affecting directly the existing uses of water in the basin. The main body of the underflow is not effluent to Silver Creek between Hay and Priest, and withdrawal from wells in that area would not affect directly the surface discharge of Silver Creek. A well field in the general vicinity of Hay, tapping deep ground water and excluding the shallow ground water, might supply replacement water to Magic Reservoir and to Silver Creek during times of water shortage.

The pumping lift in the wells probably would be less than 100 feet. With a pipeline no more than 6 miles long and a total pumping lift of less than 100 feet above the well head, the water could be conveyed from the Hay area to the low topographic divide along the central part of the basin. From the divide a canal could deliver water to the Big Wood River near Stanton crossing. A well field could be pumped at any time of the year. During times when water is short in Silver Creek below Picabo, owing either to depletion in the upper basin or to a dry year, a well field in the Picabo area might supply water directly to Silver Creek. Before construction of well fields near Hay or Picabo is undertaken, however, additional test wells should be drilled to explore the water-producing zones thoroughly. Pumping tests would be needed to determine accurately the hydraulic properties of the aquifers and the extent to which cones of depression would extend upgradient and intercept water that is tributary to Silver Creek.

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According to accepted methods of determining water utility, all the ground water and the surface water that was sampled is chemically suitable for irrigation.

Operation of observation wells should be continued in key areas in the vicinity of Bellevue, in the baseline area 3 or 4 miles west of Gannett, in the southeastern outlet area near gaging station 24, and near the center of the main artesian area.

Records of ground-water pumpage should be maintained. The water-table and depth-to-water maps of the basin should be revised periodically to show seasonal and long-term trends in the changing form and position of the water table and changes in ground-water storage. The maps would have permanent value and would be useful also during project construction to aid selection of well sites. Information on stream discharge, especially on local gains and losses, would be especially important.

RECORDS OF WELLS AND SPRINGS

The following well logs, records of wells and springs, and records of ground-water withdrawals were obtained from drillers, well owners, and the files of the Idaho State Reclamation Engineer. In the logs the drillers' terminology is largely unchanged. The logs are believed to be reasonably accurate and to give a reliable description of the materials drilled.

2N-18E-15bb1. W. V. McAtee, irrigation well

[Log obtained from George Roessler, driller, February 1955]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	4	4	Gravel and cobbles. Struck water at 15 feet	36	48
Gravel, coarse; with large boulders	8	12	Gravel, fine; and sand	12	60

1N-18E-1da1. Bureau of Reclamation, test hole 1

[Log obtained from J. Emmett Smith Drilling Co., July 15, 1954]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil, gravel, and cobbles	6	6	Gravel, fine, and sand; with traces of clay between 78 and 84 ft. Struck first water at 37 ft; plentiful water at 80 ft	54	84
Gravel and sand, with traces of clay	24	30	Sand and fine gravel	1	85

1N-18E-14aa1. Cloughton and Myers, domestic well

[Log obtained from E. W. Walker, driller, November 6, 1952]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Clay; contains angular pieces of rock. Struck water at 154 and 240 ft	360	360	Granite, gray	5	365

1N-18E-14cb1. John Brown, domestic well

[Log obtained from E. W. Walker, driller, November 6, 1952]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Gravel, boulders, and sand	24	24	Fine particles of granitic rock (gravel?) and sand. Water-bearing zone from 85 to 118 ft	33	118
Gravel, coarse	39	63	Clay and sand	99	217
Sand, fine. Water-bearing zone from 24 to 64 ft	1	64			
Clay, brown	21	85			

1N-18E-35dd1. George Allred, destroyed well

[Log obtained from J. Emmett Smith Drilling Co., October 8, 1951]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	4	4	Clay, cream colored	25	220
Gravel, coarse	6	10	Gravel and clay	6	226
Gravel and clay	20	30	Sand, loose; contains water under artesian pressure. Water struck at 226 ft reportedly rose to 2.5 ft below land surface	8	234
Clay, white	50	80			
Sand; contains water under artesian pressure. Water struck between 130 and 143 ft rose to 0.5 ft below land surface	115	195			

1N-19E-7cd1. Allen Hendrix, irrigation well

[Log obtained from E. W. Walker, driller, January 10, 1955]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	2	2	Clay and gravel	2.5	94
Gravel and sand. Struck water at 57 ft and between 64 and 78 ft	89.5	91.5	Gravel, coarse; and sand. Struck water between 94 and 112 ft	18	112

1N-19E-31ca2. Bureau of Reclamation, test hole 3

[Log obtained from J. Emmett Smith Drilling Co., July 28, 1954]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil and gravel	2	2	Gravel, sand, and cobbles	5	20
Sand, gravel, and cobbles	13	15	Sand and gravel. Struck water at 30 ft, which rose to 22 ft below land surface	56	76

1N-19E-31cc1. Base Line Canal Co., irrigation well

[Log obtained from E. W. Walker, driller, January 10, 1955]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	3	3	Gravel and sand	24	32
Gravel, coarse; and sand	5	8	Gravel, coarse; and sand. Struck water at 32 ft	40	72

1N-19E-32ab1. John Browning, domestic well

[Log obtained from E. W. Walker, driller, November 6, 1952]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	5	5	Clay	2	78
Sand and gravel, with traces of clay	54	59	Sand and gravel	5	83
Sand and gravel. Struck water at 59 feet	17	76	Sand, clean, fine. Struck water at 85 ft	3.5	86.5

1N-19E-33db1. Clarence Allred, irrigation well

[Log obtained from George Roessler, driller, September 30, 1952]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	4	4	Sand	14	42
Gravel, coarse	24	28	Gravel, coarse	30	72

1S-18E-1cd1. Wayne Clark, irrigation well

[Log obtained from J. Emmett Smith Drilling Co., October 15, 1951]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil and gravel	10	10	Sand, loose	22	192
Gravel	30	40	Clay and sand	18	210
Clay	20	60	Sand, loose	40	250
Sand, loose	40	100	Clay, blue	38	288
Clay	10	110	Clay and sand	12	300
Sand, loose	30	140	Sand	4	304
Sand and clay	30	170			

1S-18E-1dd1. Wayne Clark, stock well

[Log obtained from E. W. Walker, Driller, November 6, 1952]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	3	3	Clay, brown; sticky with some gravel (dry hole)	11	144
Gravel, sand, and clay. Water at 3 ft and 45 ft	42	45	Gravel, fine; and coarse sand; contains water under artesian pressure, first struck at 144 ft	1	145
Sand, brown, loose	71.5	116.5	Clay, brown, sticky	5	150
Clay, light-brown, sandy; doesn't cave	16.5	133			

1S-18E-2da1. George Allred, irrigation well

[Log obtained from J. Emmett Smith Drilling Co., September 1955]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil, gravel, and cobbles	5	5	Clay, brown, sticky	22	120
Sand and clay	93	98	Sand, brown; and gravel; contains water under artesian pressure	--------	--------

1S-18E-2dd1. L. J. Lawson, irrigation well

[Log obtained from J. Emmett Smith Drilling Co., September 1954]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	3	3	Sand, brown	39	102
Gravel, coarse	8	11	Clay, yellow, sticky	24	126
Sand and gravel, gray; struck water at 15 ft	44	55	Gravel. Struck water under artesian pressure below 126 ft	0.5	126.5
Clay, brownish-yellow	8	63			

1S-18E-2dd2. L. J. Lawson, irrigation well

[Log obtained from E. W. Walker, driller, November 6, 1952. Struck water under artesian pressure below 118 ft. Well flowed 1,602 gpm before being capped]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Gravel. Struck water at 8 ft	20	20	Sand, brown, loose. Struck water at 27 ft	77	104
Clay, brown	7	27	Clay, brown, sticky	14	118

1S-18E-10cb1. Crystal Farms Co., destroyed well

[Log obtained from E. W. Walker, driller, February 15, 1952. Struck water in all beds except clay]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Gravel	17	17	Sand and gravel, granitic; contains water under artesian pressure	21	127
Clay, blue	25	42			
Clay, brown; with brown gravel	43	85			
Gravel, quartzitic	21	106			

1S-18E-11ad1. Crystal Farms Co., irrigation well

[Log obtained from E. W. Walker, driller, November 6, 1952. Well flowed 936 gpm at completion of drilling, October 1948]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Gravel with some sand	42	42	Clay, blue, impervious	22	107
Clay, brown	1	43	Clay, brown, gummy	10	117
Clay and loose sand	21	64	Gravel; contains water under artesian pressure	1	118
Sand, loose	21	85			

1S-18E-12ba1. Wayne Clark, irrigation well

[Log obtained from J. Emmett Smith Drilling Co., October 15, 1951]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil, gravel, and clay	17	17	Clay, cream-colored, sticky	15	136
Sand and clay, light-brown	63	80	Sand and gravel; contains water under artesian pressure	4	140
Sand, brown, loose	26	106			
Sand and blue clay	15	121			

1S-18E-12bb1. Crystal Farms Co., irrigation well

[Log obtained from E. W. Walker, driller, February 15, 1952. Well flowed 459 gpm at completion of drilling]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Gravel with some sand	42	42	Clay, blue, dense	14	124
Clay, brown	1	43	Clay, brown, gummy	3.5	127.5
Clay and loose sand	21	64	Gravel; contains water under artesian pressure	2.5	130
Sand, loose	46	110			

1S-18E-13ac1. Winton Gray, irrigation well

[Log obtained from E. W. Walker, driller, November 6, 1952. Well flowed 1,323 gpm at completion of drilling]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Dug well	20	20	Gravel, coarse; and coarse sand; contains water under artesian pressure	--------	--------
Gravel	20	40			
Sand, brown, loose	30	70			
Clay, light blue	90	160			

1S-18E—13ba2. Frank Gomes, irrigation well

[Log obtained from George Roessler, driller, April 1955. Well flowed 360 gpm at completion of drilling but flow increased to 1,080 gpm within 2 weeks]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil, black	12	12	Gravel, yellow; and coarse sand; contains water under artesian pressure	2	134
Sand and clay with fine gravel	56	68			
Clay, blue	64	132			

1S-18E—13ca1. Henry Wurst, irrigation well

[Log obtained from E. W. Walker, driller, February 15, 1952]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Clay, dry	30	30	Particles of granitic rock (gravel?); contains water under artesian pressure	--------	--------
Sand, brown, loose	50	80			
Clay, blue, dry	74	154			
Clay, brown, sticky	9	163			

1S-18E—13dc1. Henry Wurst, irrigation well

[Log from files of Idaho State Reclamation Engineer, November 1954. Well flowed 396 gpm at completion of drilling]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	3	3	Clay, blue	78	138
Gravel	12	15	Clay, brown, sticky	3	141
Clay, brown	5	20	Gravel; contains water under artesian pressure	3	144
Sand, brown, loose	25	45	Clay, blue	--------	--------
Sand, blue, loose	15	60			

1S-18E-13dd1. Winton Gray, irrigation well

[Log from files of Idaho State Reclamation Engineer, November 1954]

Material	Thickness (feet)	Depth (feet)
Topsoil	5	5
Gravel	12	17
Clay, brown, sandy	12	29
Sand, brown, fine, loose	20	49
Sand, blue, fine, loose	11	60
Clay, blue	88	148
Clay, brown, sticky	2	150
Gravel; contains water under artesian pressure	2	152
Clay, blue	1	153

1S-18E-13dd2. Winton Gray, destroyed well

[Log from files of Idaho State Reclamation Engineer, November 1954]

Material	Thickness (feet)	Depth (feet)
Clay	10	10
Clay with trace of shaly gravel. Trace of water at 39 feet	60	70
Clay, muddy; and fine gravel	10	80
Clay and fine gravel	40	120
Mud	10	130
Clay and sand	32	162
Sand, coarse, cemented; and clay. Struck water between 162 and 171.5 ft	9.5	171.5
Clay and sand	73.5	245
Sand, fine; and clay	45	290
Sandstone (?), soft	8	298
Sand and clay	27	325

1S-18E-14cd1. Walter E. Nelson, domestic well

[Log obtained from George Roessler, driller, September 1952]

Material	Thickness (feet)	Depth (feet)
Gravel	--------	40
Clay, blue	--------	118
Gravel; contains water under artesian pressure	?	?

1S-18E-24bb1. J. E. Frederickson, irrigation well

[Log obtained from George Roessler, driller, September 1952. Well flowed 846 gpm at completion of drilling]

Material	Thickness (feet)	Depth (feet)
Gravel, fine	30	30
Clay, blue	94	124
Gravel, medium; contains water under artesian pressure	2	126

1S-19E-1cc1. C. W. Gardner, test well

[Log from files of Idaho State Reclamation Engineer, November 1954]

Material	Thickness (feet)	Depth (feet)
Topsoil	10	10
Clay, brown; and fine gravel	18	28
Clay, brown; and sand	17	45
Sand, fine; and clay	5	50
Clay, brown, sandy	35	85
Clay, light brown	15	100
Clay and sand	31	131
Gravel, fine, angular; and clay	14	145
Gravel, coarse; and clay	5	150
Clay and angular coarse sand	40	190

1S-19E-3cc2. Bureau of Reclamation, test hole 5

[Log obtained from J. Emmett Smith Drilling Co., July 28, 1954]

Material	Thickness (feet)	Depth (feet)
Topsoil and gravel	2	2
Gravel and sand	8	10
Gravel, fine; and sand	25	35
Sand, loose. Struck water at 35 ft. Water level rose to 10 ft below land surface	5	40
Gravel, fine; and sand	5	45
Gravel, fine, sand; and trace of clay	6.5	51.5

1S-19E-3da1. C. W. Gardner, irrigation well

[Log from files of Idaho State Reclamation Engineer, November 1954]

Material	Thickness (feet)	Depth (feet)
Old dug well	28	28
Gravel	2	30
Gravel and sand	5	35
Gravel, coarse; and sand	11	46
Sand, coarse	2	48
Gravel, coarse; and sand. Struck plentiful water between 30 and 69.5 ft	21.5	69.5
Rock, red, quartzitic	1.5	71

1S-19E-4bc1. Clarence Allred, irrigation well

[Log obtained from George Roessler, driller, September 1952]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	4	4	Sand	20	50
Sand and gravel	26	30	Coarse gravel	--------	50

1S-19E-8cd1. Otis Chaumell, irrigation well

[Log obtained from E. W. Walker, driller, November 6, 1952. Well flowed 270 gpm at completion of drilling

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil. Water-bearing from 5 to 12 ft	12	12	Clay, brown, sticky	9	159
Gravel	28	40	Clay, dry	2	161
Sand	10	50	Gravel. Water at 162 ft	1	162
Clay, brown	7	57	Clay, blue; and gravel	24	186
Sand, brown	25	82	Gravel	8	194
Clay, brown	19	101	Clay	24	218
Clay, blue, sandy	9	110	Sand and fine gravel; contains water under artesian pressure	1	219
Clay, blue	37	147	Clay, brown	25	244
Sand, brown, water-bearing	3	150			

1S-19E-18ca1. Henry Wurst, irrigation well

[Log obtained from E. W. Walker, driller, November 6, 1952. Well flowed 648 gpm at completion of drilling]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Clay	18	18	Clay, brown; gummy with some gravel	2	172
Clay and gravel	9	27	Sand and gravel; contains water under artesian pressure	1.5	173.5
Sand, brown, loose	48	75	Clay, blue	0.5	174
Sand, blue, loose	15	90			
Clay, blue	80	170			

1S-19E-20bc1. Earl Hutchinson, domestic well

[Log from files of Idaho State Reclamation Engineer, November 1954. Well flowed 25 gpm at completion of drilling]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	4	4	Clay, blue	81	152
Gravel, fine; and clay	6	10	Clay, brown; sticky with some gravel	8	160
Gravel and sand	22	32	Sand, fine, granitic; contains water under artesian pressure	1	161
Sand, brown, loose	12	44			
Clay, brown; with trace of sand	27	71			

1S-19E-22aa1. Bureau of Reclamation, test hole 7

[Log obtained from J. Emmett Smith Drilling Co., August 4, 1954]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	6	6	Gravel, basaltic; and clay	3	98
Soil, sandy; and gravel	4	10	Clay and loose basalt	12	110
Sand with some fine gravel. Water-bearing below 13 ft	10	20	Sand and clay	5	115
Sand and fine gravel with some clay; water-bearing	30	50	Sand, basaltic; and angular pieces of basalt	5	120
Clay	18	68	Basalt, blue-gray, hard	5	125
Clay and fine gravel	11	79	Clay and loose basalt	20	145
Sand; contains artesian water	6	85	Basalt, blue-gray, broken	5	150
Gravel, basaltic; contains artesian water	10	95			

1S-19E-24ac2. Verl Worthington, domestic well

[Log obtained from E. W. Walker, driller, November 6, 1952]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil with some gravel	22	22	Cinders, red; abundantly water-bearing	25	117
Basalt, gray, very hard	70	92			

1S-19E-24bb1. R. C. Mallon, domestic well

[Log obtained from E. W. Walker, driller, November 6, 1952]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	4	4	Basalt	--------	--------
Gravel	15	19			

1S-19E-24cb1. G. W. Grebe, domestic well

[Log from files of Idaho State Reclamation Engineer, November 1954]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	5	5	Gravel and sand, water-bearing	3	18
Sand and gravel, water-bearing	10	15			

1S-20E-17db1. Bill Castle, domestic and stock well

[Log obtained from owners copy of drillers log, July 16, 1954]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil and clay	31.5	31.5	Clay, red	13	80
Not recorded	3.5	35	Clay, white	8	88
Limestone(?) and clay	10.5	45.5	Clay, red, hard, water-bearing	7	95
Clay and sandstone(?)	12.5	58	Clay, hard	12	107
Sandstone(?); caves	9	67			

1S-20E-19ac1. Gary Castle, domestic well

[Log obtained from E. W. Walker, driller, November 6, 1952]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Old pit	5	5	Cinders. Contain artesian water	6	43
Topsoil	14.5	19.5	Basalt, black	8	51
Basalt, black, hard	17.5	37			

1S-20E-19cd1. Albrethson Hereford Ranch, irrigation well

[Log obtained from E. W. Walker, driller, November 6, 1952]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil and clay	12	12	Clay, blue	5	36
Gravel, medium; and sand	19	31			

1S-20E-27bd1. Bureau of Reclamation, test hole 8

[Log obtained from J. Emmett Smith Drilling Co., August 13, 1954]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil and clay	6	6	Clay, blue, very sticky	10	85
Gravel, coarse, water-bearing	3	9	Gravel, sand, and clay	6	91
Clay, fine gravel, and some medium gravel	16	25	Basalt, gray	4	95
Clay, blue; fine gravel; and some medium gravel	12	37	Basalt, gray with brownish tinge, vesicular; artesian water	5	100
Clay, blue; and sand; contains decayed vegetation between 45 and 50 ft	13	50	Basalt, gray, hard	27	127
Sand, dark gray; contains some clay between 65 and 75 ft	25	75	Basalt, broken	3	130
			Clay, green and yellow	3	133
			Basalt, gray, vesicular, with artesian water	7	140

2S-20E-1ac1. Bureau of Reclamation, test hole 9

[Log obtained from J. Emmett Smith Drilling Co., September 10, 1954]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	2	2	Basalt, gray; and clay	7	150
Clay, yellow	5	7	Basalt, gray	33	183
Basalt, gray, broken	23	30	Sand with fine to coarse gravel; plentiful water	9	192
Basalt, pinkish, broken	42	72	Clay, yellow; and sand	5	197
Basalt, gray, broken	20	92	Sand and gravel with plentiful water	5	202
Basalt, pinkish gray, broken; mixed with yellow clay	23	115	Clay, sand, and fine-grained to coarse gravel	16	218
Basalt, gray	10	125	Clay, cream-colored, sticky	7	225
Basalt, pinkish gray, broken	5	130	Basalt, dark-gray, vesicular	25	250
Basalt, gray. Struck water at 140 ft	13	143			

2S-20E-12cd1. H. W. Lehman, stock well

[Log obtained from George Roessler, driller, June 24, 1954]

Material	Thickness (feet)	Depth (feet)	Material	Thickness (feet)	Depth (feet)
Topsoil	1	1	Basalt, gray	11	137
Basalt, gray	30	31	Loose formation(?)	2	139
Crevice	1	32	Basalt, gray	3	142
Basalt	22	54	Crevice and loose rock, water-bearing	3	145
Crevice	1	55	Basalt	14	159
Basalt	29	84	Talc(?), white	5	164
Rock, red, loose; (cinders)	5	89	Gravel, fine	6	170
Basalt, gray	16	105			
Rock, brown, loose	21	126			

Records of wells and springs in the middle Big Wood River-Silver Creek area

Well or spring No.: Springs indicated by S.
Type of well: De, destroyed; Dn, driven; Dr, drilled or bored; Du, dug.
Depth of well and depth to water: R, reported, but not confirmed by measurement.
Type of casing: C, concrete; GI, galvanized iron; N, none; R, rock; W, wood; WIS, wrought iron or steel.
Type of pump and power: C, centrifugal; F, force; J, jet; L, lift; N, none; P, pitcher; T, turbine; E, electric; G, gasoline; H, hand.
Use of water: D, domestic; I, irrigation; Id, industrial; O, observation; PS, public supply; S, stock; U, unused.
Aquifer: B, basalt; C, cinders; Cl, clay; G, gravel; S, sand; Si, silt.

Well or spring No.	Owner	Year drilled	Type of well	Depth (feet)	Diameter of well (inches)	Type of casing	Type of pump and of power	Use of water	Aquifer	Water level: Above (+) or below land-surface datum (feet)	Water level: Altitude above mean sea level (feet)	Date of measurement	Temperature (°F)
2N-18E-9ab1	City of Hailey	1934	Du	90	18	WIS	N	O	G	14.2	5,320.3	8-10-54	
9bd1	do	1905	Du	11	84 x 144	R and W	T, E	PS	G	8.3	5,307.5	10-2-52	46
10dc1	Fox and Crone	1918	Dr	90R	4	WIS	J, E	D, S		36.9	5,294.3	8-10-54	
15bb1	W. V. McAtee	1954	Dr	60	10	WIS	T, E	I	G	20.0	5,287.1	8-10-54	50
15cc1	Beecher and others	1947	Du	10R	360 x 1,200	N	C, E	I	G	0.5	5,254.5	7-9-54	
22bd1	W. O. Watts		Dn	12	2	GI	C, E	D		6.9	5,240.7	8-11-54	
cd1	Sam Stitt		Du, Dr	60	5	WIS	N	O	G, S	38.9	5,156.4	8-10-54	
25cd2	Woodrow Watts		Dr	100R	6-5	WIS	J, E	D		45R		3-43	53.5
26dc1	W. E. Stewart	1933	Du	23	600	N	T, E	I	G	7.9	5,172.3	8-12-54	54.5
27ad1	Wallis Young		Du, Dn	16R	48-1	W and GI	C, E	D	G	4.2	5,196.4	8-11-54	
35ab1	J. W. Rooker	1940	Du	22R	72 x 84	W	N	U	G	4.8	5,162.6	8-12-54	
36cb1	George Todd	1948	Du	10	72 x 84	W	T, E	I	G, S	5.9	5,143.5	8-11-54	55
36cc1	do	1918	Du	16	48	W	T, E	I	S, G	4.4		10-5-54	
2N-19E-28dcS1	Village of Bellevue							PS					63
1N-18E-1bc1	Ed Seal	1922	Du	11	84 x 108	W	C, E	I	G	3.9	5,120.3	8-11-54	54
1da1	Upper Big Wood River Canal Co.	1954	Dr	85	6	WIS	N	O	G, S	40.2	5,096.5	8-6-54	
1da2	do	1954	Dr	81R	6	WIS	N	O	G	39.3	5,095.7	8-11-54	
1db1	W. E. Stewart	1930	Du	24R	24 x 36	W	J, E	D	G	23.3	5,102.9	8-12-54	
2ad1	Ray Williams	1947	Du	10	96	W	N	U	G	6.3	5,126.4	8-11-54	
12ab1	Otis Disbennett, Jr.	1951	Dn	20R	2	GI	C, E	D	G	13.0	4,978.2	8-12-54	
12ad1	A. T. Near	1929	Du, Dr	60R	6-4	WIS	J, E	D		40.0	5,075.0	8-12-54	
12dc1	Ted Devine	1929	Dr	55R	5	WIS	J, E	D, S		39.5	5,062.9	8-12-54	
13aa1	R. E. Carter	1929	Dr	65R	4	WIS	J, E	D, S		45.3	5,048.4	8-12-54	52
13dc2	Dick Johnson		Du, Dr	87	4	WIS	N	U		71.1	4,994.2	8-12-54	
14aa1	Cloughton and Myers	1948	Dr	321R	6	WIS	F, E	D	Cl	90R		2-7-54	
14cb1	John Brown	1949	Dr	217R	6	WIS	J,E	D,S	S	54.0	4,981.7	8-13-54	54
15dd1	do		Du	50	4	WIS	P,H	U		40.4	4,982.5	8-13-54	
22dc1	F. Shipp	1934	Du,Dr	62R	6	WIS	L,E	D,S		13.1	4,984.0	8-13-54	

	223cb1	J. J. Jennings	------	Dr	90R	6	WIS	L,H	D,O	------	24.6	4,979.9	8-13-54	------
	25aa1	Leon Friedman	------	Dr	96	6	WIS	L,E	D,S,O	------	68.3	4,958.3	9-14-54	52
	36cb1	Joe Lete	1948	Dr	87R	6	WIS	L,H	D	------	14.8	4,967.3	9-15-54	54
	35dc1	George Allred	1944	Du	12R	------	N	C,E	I	G	2.4	4,944.3	8-11-54	52
	35dd1	do	1948	De	234R	6	WIS	N	------	S	1 R	------	10- - 48	------
	36dd1	A. L. Montgomery	1943	Dr	44R	6	WIS	J,E	D,S,O	------	14.4	4,948.6	8-11-54	------
1N-19E-	6cb1	122 Ranch, Inc	1950	Dr	81R	18	WIS	T,E	I	G	36.7	5,100.6	7- 9-54	46
	6cc1	do	1948	Dr	102R	6	WIS	J,E	D,S	------	44.0	5,084.5	8-11-54	------
	7cd1	A. E. Hendrix	1954	Dr	112R	20	WIS	N	I	G,S	53.3	------	12- 1-54	51
	17ba1	William J. Buhler	1910	Du,Dr	140R	6	WIS	J,E	D	G,S	------	------	------	52
	20aa1	Cove Ranch, Inc	------	Du	89	30x36	W	L,H	U	------	49.2	4,987.6	8- 9-54	------
	26acS1	do	------	------	------	------	C	------	D,S	------	------	------	------	48
	28bc1	Cleo Baldwin	------	Du,Dr	90R	6	WIS	C,E	D	------	37.6	4,952.7	8-11-54	------
	31ba1	John Arkoosh	1926	Du,Dr	80R	4	GI	L,H	U	------	45.8	4,949.3	9-16-54	------
	31ca1	Base Line Canal Co	1947	Dr	72R	16	WIS	T,E	I	G	18.0	4,957.9	7- 9-54	52
	31ca2	Adolph and Theo. Bren	1954	Dr	75	6	WIS	N	O	S,G	24.8	4,950.1	8-11-54	------
	31ca3	do	1954	Dr	72	6	WIS	N	O	G,S	23.2	4,955.6	7-21-54	------
	31cc1	Base Line Canal Co	1954	Dr	72	20	WIS	N	I	G,S	30	------	12- -54	49
	31cd1	Adolph and Theo. Bren	------	Du,Dn	50R	4	WIS	J,E	D	------	18.3	4,944.5	8-28-54	------
	32ab1	John Browning	1948	Dr	87R	6	WIS	F,E	D	S	37.4	4,943.2	9-14-54	51.5
	33ca1	George Bruneel	1947	Dr	70R	14	WIS	T,E	I	------	25.3	------	9-30-52	51
	33cb1	Lyle Lower	1952	Dr	68R	16	WIS	T,E	I	G,S	21.6	4,941.8	8-11-54	51.5
	33cd1	George Bruneel	------	Dr	39	4	WIS	J,E	D	------	13.9	4,934.6	8-11-54	------
	33db1	Clarence Allred	1950	Dr	70R	16	WIS	T,E	I	G	22.3	4,937.3	8-11-54	52
1S-18E-	1cb2	Geo. Allred	1934	Du	17	60	W	P,H	U	G	0.9	4,935.8	8-11-54	------
	1cc2	do	------	Du	14R	48	W	L,H	U	G	0.6	4,930.0	8-11-54	------
	1cd1	Wayne Clark	1948	Dr	304R	6	WIS	N	I	S	+8.7	4,950.9	8-12-54	49
	1cd2	do	------	Du,Dr	25R	15	WIS	C,E	D	------	9.1	4,930.5	7-27-54	------
	1dd1	do	1949	Dr	150R	6	WIS	N	S	G,S	+7.1	4,950.0	8-12-54	48
	2da1	Geo. Allred	1949	Dr	125R	6	WIS	N	I	S	+18.6	4,950.6	8-12-54	51.5
	2dd1	L. J. Lawson	1948	Dr	126R	6	WIS	N	I	G	+18.5	4,948.6	8-12-54	50.5
	2dd2	do	1949	Dr	118R	8	WIS	N	I,D,S	------	+22.5	4,950.9	8-12-54	52
	3dd1	Joe Lete	------	Du	70	45	W	N	U	------	3.3	4,906.4	8-13-54	------
	9dd1	Willard Girard	------	Dn	------	2	WIS	P, H	S	------	8.2	4,869.3	9-15-54	------
	10bb1	L. J. Lawson	------	Dn	16	2	WIS	N	U	------	9.6	4,878.8	9-15-54	------
	10cb1	Crystal Farms Co	1948	De	127R	------	N	N	------	S, G	------	------	------	------
	11ad1	do	1948	Dr	118R	8	WIS	N	I	G	+34.5	4,946.5	8-12-54	52
	12ba1	Wayne Clark	1949	Dr	140R	6	WIS	N	I	G, S	+14.5	4,949.0	8-12-54	49
	12bb1	Crystal Farms Co	1948	Dr	130R	6	WIS	N	I	G	+23.5	4,948.6	8-12-54	50.5
	12ca1	G. P. McGonigal	1948	Dr	134R	6	WIS	N	I, S	------	+23.3	4,947.0	8-12-54	50
	12ca2	do	1948	Dr	156R	6	WIS	N	I, S	G	+21.8	4,946.6	8-12-54	49.5
	12cc1	do	1948	Dn	22R	6	WIS	C, E	D, O	G	5.7	4,905.6	8-11-54	------
	13ac1	Winton Gray	1949	Dr	160R	6	WIS	N	I	G	+32.4	4,943.7	8-12-54	50
	13ba2	Frank Gomes	1953	Dr	140R	6	WIS	N	I	G	+33.7	4,944.9	8-13-54	49
	13ca1	Henry Wurst	1948	Dr	163R	6	WIS	N	I	S	------	------	------	49
	13dc1	do	1953	Dr	144R	6	WIS	N	I	G	+37.2	4,929.6	8-11-54	49
	13dd1	Windton Gray	1953	Dr	153R	8	WIS	N	I, D	G	------	------	------	49.5
	13dd2	do	1953	De	325R	8	N	N	------	------	------	------	------	------
	14aa1	Frank Gomes	1948	Dr	120R	6	WIS	N	I, O	------	+38.5	4,942.9	8-12-54	51
	14cd1	Walter E. Nelson	1949	Dr	103R	5	WIS	N	D	G	+46.6	4,919.2	8-11-54	------

Records of wells and springs in the middle Big Wood River-Silver Creek area—Continued

Well or spring No.	Owner	Year drilled	Type of well	Depth (feet)	Diameter of well (inches)	Type of casing	Type of pump and of power	Use of water	Aquifer	Water level: Above (+) or below land-surface datum (feet)	Water level: Altitude above mean sea level (feet)	Date of measurement	Temperature (°F)
1S-18E-23ab1	Harry Snoderly	1948	Dr	126R	6-4	WIS	N	D, O	S, G	+14.1	4,915.7	8-11-54	54
23bb1	J. H. Hulett		Dn	16R	2	GI	P, H	D		3.5	4,865.5	8-25-54	
24ba2	H. L. Wurst	1936	Dr	22R	2	WIS	C, E	D	G	21.1	4,890.3	8-11-54	
24bb1	J. E. Fredrickson	1950	Dr	122R	6	WIS	N	I	G	+35.2	4,921.8	8-12-54	
24bc1	do		De	160R		N	N						
1S-19E-1cc1	C. W. Gardner	1954	Dr	45	8	N	N	U	G, S, Cl	25.3	4,911.6	8-18-54	52
2cb1	A. A. Rhodes	1938	Du	23	42	GI	T, E	I		8.2	4,916.7	9-14-54	54.5
2cc1	do		Dn		2	WIS	P, H	D		0.4	4,918.9	8-12-54	
3bd1	Mrs. Walter Brown	1946	Dr	49R	10	WIS	T, E	I		17.6	4,925.3	8-17-54	
3cc1	Jack Allred	1945	Dr	50R	14	WIS	T, E	I		8.7	4,927.0	8-12-54	52
3cc2	do	1954	Dr	51	6	WIS	N	O	G, S	7.1	4,926.6	8-13-54	
3cd1	do	1947	Du	19	54x60	W	C, E	I		9.0	4,922.2	8-12-54	54
3da1	C. W. Gardner	1954	Du, Dr	71R	72-20	W and WIS	T, E	I	G, S	19.2	4,914.2	5- 3-54	51.5
3da2	Joseph Ashton	1934	Du	18	42x60	W	C, G	U		12.6	4,916.3	9-29-54	
3dd2	Lawrence Lylia	1951	Du	16	36	W	C, G	I		8.1	4,917.7	8-11-54	60
4bc1	Clarence Allred	1946	Dr	60R	10	WIS	T, E	I	G, S	16.0		8-12-54	51
4cc1	R. G. Price	1939	Dr	20R	8	WIS	N	U		11.1	4,933.0	8-12-54	
4db1	Don Crone	1946	Du	15R	240	W	T, E	I	S, G	14.1	4,930.1	9-14-54	62
5ac1	B. R. Stocking		Dr	60R	6	WIS	J, E	D		25 R		7-23-54	52
5ad1	do		Du	34	60	W and C	T, E	I, O		16.6	4,941.9	8-17-54	
5bd1	George Sherbine	1948	Dr		14	WIS	T, E	I		16.0	4,944.1	8-17-54	50.5
7ba1	Carl Schoessler	1948	Dr	22R	36	W	C, E	D		2.3	4,939.6	8-12-54	
8cd1	Otis Chaumell	1949	Dr	244R	8	WIS	N	U	S, G	+16.4	4,936.9	8-12-54	48
9bc1	R. G. Price		Dr	20R	6	WIS	N	U	G	3.9	4,926.7	8-12-54	
9ca1	do		Du, Dn	20R	8	WIS	L, E	S	G	1.9	4,923.6	8-12-54	
10aa1	E. W. Byington	1938	Du	14R	48x72	W	T, G	I	G	6.4	4,915.7	8-12-54	
10bc1	Jack Allred	1920	Dr		6	WIS		U		0.1	4,920.8	8-18-54	
11ad1	Alva A. Rhodes		Dn	19	2	WIS	N	U		5.9	4,896.3	9-14-54	
11bb1	E. W. Byington	1938	Du	87	72-16	W and WIS	T, G	I, O	G	3.1	4,914.4	8-13-54	
13aa1	C. W. Gardner		Dr	100R	6	WIS	J, E	D		5 R		7-27-54	51
13bdS1	State of Idaho					C		Id					53
14cc1	Hans P. Johnson		Dr	30R	6	WIS	P, H	U	Si, G	4.5	4,882.1	8-12-54	
18ab1	S. J. Woodbury		Du, Dr	6	4	W	L, E	D		2.7	4,917.3	8-12-54	
18ca1	Henry Wurst	1948	Dr	172R	8	WIS	N	I	G, S	+28.1	4,941.5	8-11-54	58.5
20bc1	Earl Hutchison	1953	Dr	160R	8	WIS	C, E	D	S	+24.6	4,926.9	8-12-54	51.5
22aa1	Blaine County	1954	Dr	150	6	WIS	N	O	S, G	+8.0	4,993.2	8-11-54	48
22ca1	E. W. Byington	1946	Dr	170R	6	WIS	N	U	C	+20.6	4,902.5	8-12-54	47
23bb1	Clifton and Leroy May		Dn	11	6	WIS		U		6.0	4,881.1	8-12-54	

24ac1	Verl Worthington	1900	Du, Dn	20R	48	W	P, H	D	G, S	4.7	4,860.4	10- 1-54	
24ac2	do	1951	Dr	118R	6	WIS	J, E	D, S	C				
24bb1	R. C. Mallon	1951	Dr	18R	6	WIS	J, E	D	G	4 R		7-20-54	
24cb1	G. W. Grebe	1953	Dr	18R	6	WIS	J, E	D	G, S	5 R		7-20-54	
1S-20E-17db1	Bill Castle	1951	Dr	100	6	WIS	J, E	D, S	Cl	18.0	4,846.0	7-16-54	58
17db2	do	1914	Du	23	60	C	N	U		10.6	4,841.0	8-12-54	
19ac1	Gary Castle	1948	Dr	51R	6	WIS	J, E	D, O		10.3	4,839.5	8-11-54	51
19bb1	E. W. Featherston		Du	18	15	GI	L, E	D, S		11.2	4,852.1	8-11-54	
19cd1	Albrethson Ranch	1949	Dr	36R	14	WIS	T, E	I	G, S	4.7	4,848.7	8-11-54	53
27bd1	Blaine County	1954	Dr	140R	6	WIS	N	O	G, B	31.6	4,797.3	8-13-54	
27db1	Kilpatrick Bros	1914	Dr	130R	8	WIS	N	U		39.8	4,789.2	8-11-54	
33ddS1	Village of Picabo							PS					36
35da1	Lester Broadie		Dr	170	4	WIS	N	O		150.2	4,666.0	8-18-54	
1ac1	R. N. Leazenby	1954	Dr	250	6	WIS	N	O	S, G	142.0	4,647.5	9- 8-54	
2S-20E-1ac2	do	1954	Dr	209	10	WIS	N	O	S, G	143.8	4,646.4	10-18-54	51
1db1	do	1954	Dr	194	8	WIS	N	O	S, G	143.2	4,648.5	8-13-54	
12cd1	H. W. Lehman	1954	Dr	170R	6	WIS	L, G	S		142 R		5- -54	

Records of ground-water withdrawals in the middle Big Wood River-Silver Creek area in 1954

[Abbreviations: R, Reported by owners and drillers]

Well number	Owner	Discharge rate (gpm)	Date of measurement	Drawdown during pumping (feet)	Type of irrigation	Acres irrigated	Estimated withdrawal (acre-feet)
2N-18E- 9bd1	City of Hailey	R 1,500					164
15bb1	W. V. McAtee	397	8-24-54		Sprinkler	22	59
15cc1	K. Beecher and others.	R 3,060		R 6		100	208
26dc1	W. E. Stewart	2,204	8-10-54	R 2		80	257
36cb1	George Todd	905	8-24-54	R 2	Flood	18	218
36cc1	do	810	8-24-54	R 1.5	do	35	306
1N-18E- 1bc1	Ed Seal	1,590	8-24-54	R 1.5	do	50	80
35dc1	George Allred	1,635	9- 2-54	R 5	do	160	133
1N-19E- 6cb1	122 Ranch, Inc	1,390	8-10-54	4.3	do	100	366
31ca1	Base Line Canal Co.	1,530	8-10-54	6.1	do	300	304
33ca1	George Bruneel	1,455	8-11-54		do	80	288
33cb1	Lyle Lower	1,220	8-17-54		do	80	226
33db1	Clarence Allred	2,720	8-13-54		do	82	282
1S-18E- 1cd1	Wayne Clark	265	8-18-54	Flowing		25	19
1dd1	do	196	8-18-54	do			78
2da1	George Allred	685	8-19-54	do	Flood	14	90
2dd1	L. J. Lawson	R 700		do	do	15	46
2dd2	do	1,090	10-22-54	do	do	70	144
11ad1	Crystal Farms Co	1,525	8-20-54	do	do	15	121
12ba1	Wayne Clark	645	8-19-54	do		70	45
12bb1	Crystal Farms Co	525	8-20-54	do	Flood	15	23
12ca1	G. P. McGonigal	700	8-19-54	do		45	123
12ca2	do	630	8-19-54	do		45	111
13ac1	Winton Gray	R 1,350		do		70	356
13ba2	Frank Gomes	885	8-23-54	do	Flood	100	233
13ca1	Henry Wurst	R 675		do		15	45
13dd1	Winton Gray	355	8-23-54	do	Sprinkler	80	56
14aa1	Frank Gomes	1,440	8-23-54	do	Flood	140	379
24bb1	J. E. Frederickson	R 900		do	Sprinkler	160	436
1S-19E-2cb1	A. A. Rhodes	2,490	8-12-54	R 10	Flood		173
3bd1	Mrs. Walter Brown	R 1,260			do	103	156
3cc1	Jack Allred	2,165	11- 4-54	4.3	do	160	478
3cd1	do	1,140	9- 2-54	R 5	do	80	33
3da1	C. W. Gardner	3,405	8-11-54			275	579
4bc1	Clarence Allred	2,965	8-13-54		Flood	83	156
4db1	Don Crone	505	9- 2-54	R 2.5	do	160	29
5ad1	B. R. Stocking	1,610	8-12-54		do	275	335
5bd1	George Sherbine	1,360	8-12-54		do	197	347
10aa1	E. W. Byington	R 1,350		R 6	do	20	89
11bb1	do	R 900			do	18	178
18ca1	Henry Wurst	R 650		Flowing		100	200
1S-20E-19cd1	Albrethson Ranch	565	8-17-54	9.4		127	27

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