Ground-Water Aspects Of the Lower Henrys Fork Region, Eastern Idaho

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1879-C

Prepared in cooperation with the U.S. Bureau of Reclamation and Idaho Department of Reclamation

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By E. G. CROSTHWAITE, M. J. MUNDORFF, *and* E. H. WALKER

CONTRIBUTIONS TO THE HYDROLOGY OF THE UNITED STATES

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UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1970

UNITED STATES DEPARTMENT OF THE INTERIOR

WALTER J. HICKEL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

Library of Congress catalog-card No. 78-607066

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price 70 cents (paper cover)

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GROUND-WATER ASPECTS OF THE LOWER HENRYS FORK REGION, EASTERN IDAHO

By E. G. Crosthwaite, M. J. Mundorff, and E. H. Walker

ABSTRACT

The lower Henrys Fork region in eastern Idaho includes the plains and low benches between Ashton and the junction of Henrys Fork and Snake River. The northwestern and western parts of the area are part of the Snake River basalt plain. The central part of the area is occupied by alluvial plains of the Snake, Teton, and Falls Rivers and of Henrys Fork. The alluvial deposits are underlain by basalt. The southeastern part of the area is a bench (Rexburg Bench), chiefly on silicic and basaltic volcanic rocks, which rises gradually to mountain peaks (Big Hole Mountains) southeast of the area.

Irrigation wells open to the basalt under the Snake River Plain and the basalt and sands and gravels under the alluvial plains yield large amounts of water with small drawdowns. Irrigation wells in the silicic volcanic rocks and the interbedded ash, pyroclastics, and sedimentary deposits beneath the Rexburg Bench generally yield much less water.

The regional water table slopes southwestward beneath the basalt and alluvial plains. It is recharged by precipitation that infiltrates into the ground in the headwaters of Henrys Fork and Falls, and Teton Rivers and by water that moves downward from an extensive perched water body caused by seepage from stream channels and surface-water irrigation. The perched water in part moves vertically down to the regional water table and in part laterally to the streams. Ground water beneath the Rexburg Bench moves generally northwestward to join the regional ground-water body beneath the alluvial and basalt plain, but this area contributes very little recharge to the main aquifer body. Recharge to the regional water table is estimated to average 725,000 acre-feet annually.

The regional water table is below the level of the streams in the area, and ground water in the main aquifer, therefore, is not tributary to the streams. Pumping from the regional ground-water reservoir for irrigation or other uses would have no effect on streamflow or surface-water rights within the study area. However, depletion of the underflow would eventually reduce the inflow to American Falls Reservoir, unless the depletion was offset by additional recharge.

Total withdrawals of ground water for irrigation in 1962, principally in the Rexburg Bench, were estimated to be 25,000 acre-feet. About 10,000 acre-feet was withdrawn for domestic, municipal, and stock supplies. These withdrawals caused no significant decline in the water table.

In the Ashton area, surface-water irrigation has caused water to be perched in basalt above the silicic volcanic rocks, and much of this perched water contributes to streamflow. Some ground water can be pumped from the basalt for irrigation and other uses. If ground water were pumped for irrigation, the flow of Henrys Fork would be decreased by the amount of pumped water consumed by crops. Water pumped for nonconsumptive use would have little effect on streamflow.

Ground-water prospects for irrigation in the Falls River area are not encouraging.

INTRODUCTION

This report describes the geologic and hydrologic setting of the lower Henrys Fork region. It provides a base of knowledge for use by administrators or others who must make decisions concerning future development and management of the region's water resources. The study was made in cooperation with the U.S. Bureau of Reclamation to provide preliminary data for planning their Lower Teton Division of the Teton Basin Project and also in cooperation with the Idaho Department of Reclamation to provide information to aid this Department in administering the water resources.

The study area is largely in southern Fremont and western Madison Counties, eastern Idaho (fig. 1). It includes the lowlands and benchlands north of the Snake River in the lower drainages of Henrys Fork, Teton, and Falls Rivers. The Bureau of Reclamation designates the report area as the lower Teton basin, although the study area is better known as a part of the lower Henrys Fork basin.

In the lower Henrys Fork region, the lowlands are irrigated with water diverted from Henrys Fork and Teton and Falls Rivers. The lowlands and the irrigated area around Ashton are in the Fremont-Madison Irrigation District (fig. 2) and encompass about 112,400 acres. More irrigation water could be used in about 13 of 30 years in the St. Anthony-Rexburg part of the irrigation district and in about 26 of 30 years in the Ashton part. An upland area southeast of the Fremont-Madison Irrigation District is partly irrigated with ground water and partly dry farmed. Ground-water irrigation is concentrated largely east of Rexburg and Newdale. When constructed, Fremont Reservoir would provide a full water supply for about 39,000 acres on the upland east and northeast of Rexburg (fig. 2).

PREVIOUS INVESTIGATIONS

Bradley (1873) and St. John (1879) briefly studied the geology of parts of the area during the survey of the territories. Stone (Lee and others, 1915) described some of the geologic features along the rail-

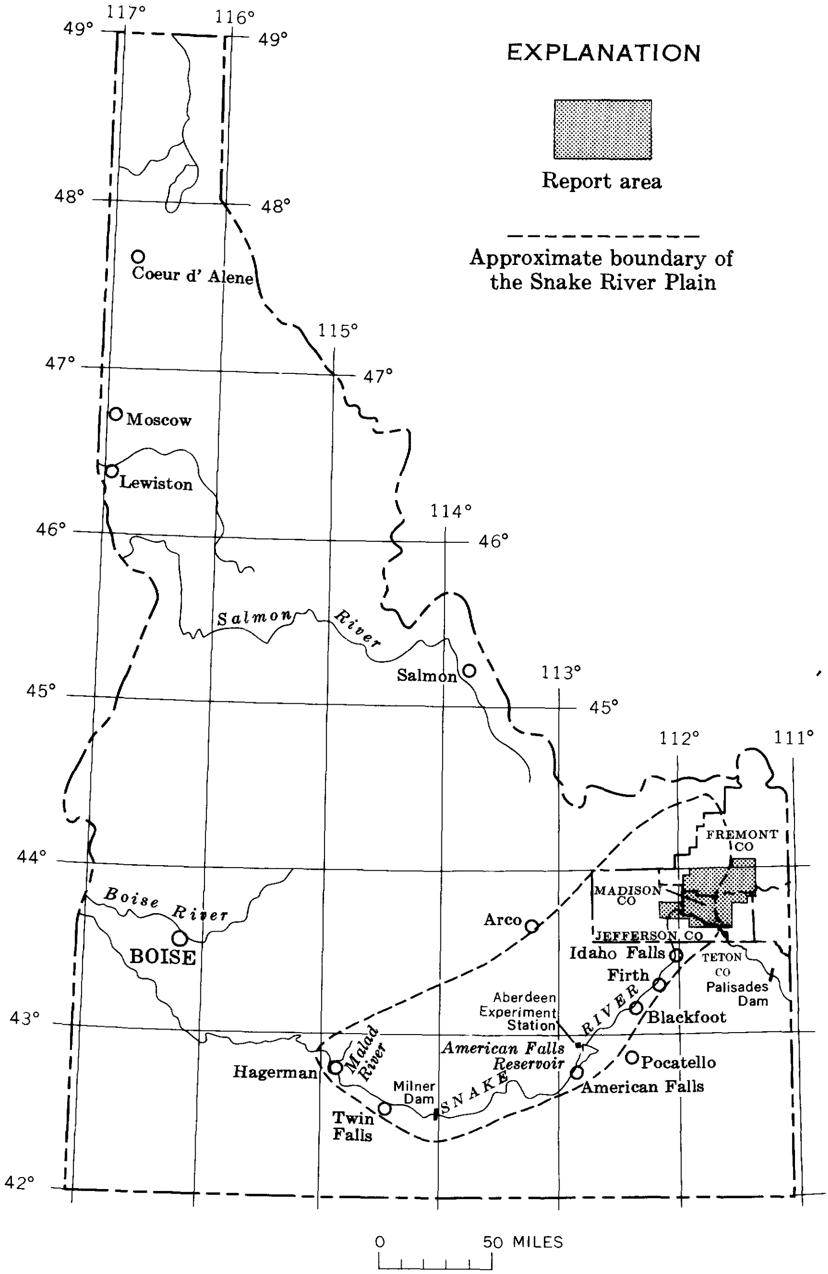

FIGURE 1.—Location of report area.

road from Thornton to beyond Ashton. Mansfield (1920) compiled a reconnaissance geologic map of the area. Kirkham (1927) mentioned

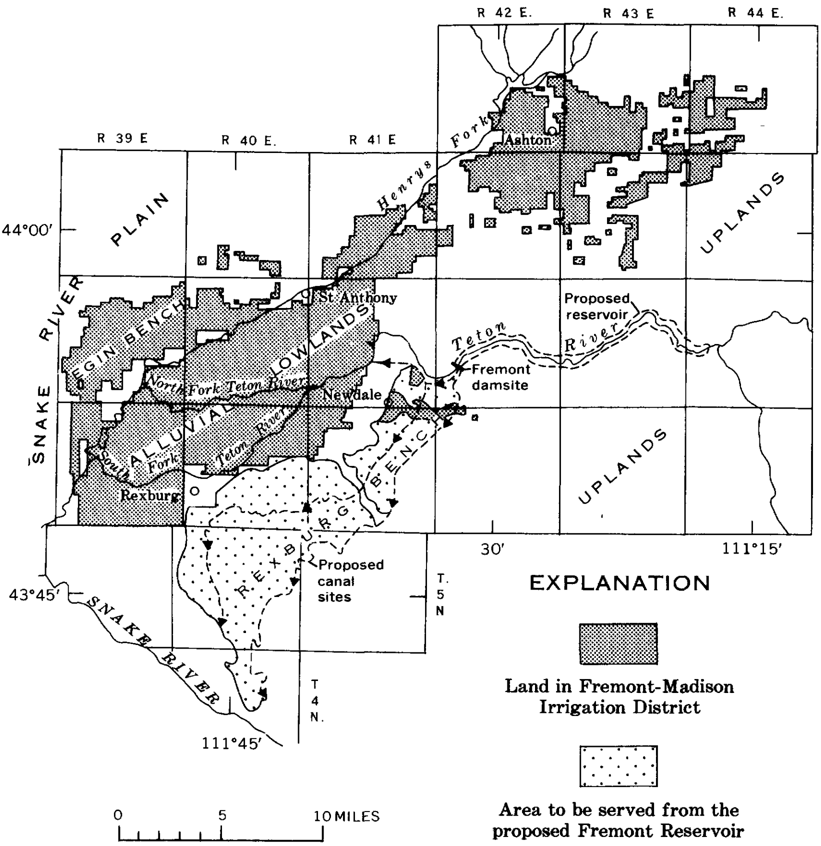

FIGURE 2.—Land in Fremont-Madison Irrigation District and area to be served by the proposed Fremont Reservoir.

the volcanic rocks southeast of Rexburg; and Stearns, Crandall, and Steward (1938) and Stearns, Bryan, and Crandall (1939) mapped the volcanic rocks west of Henrys Fork. Most of these studies were used in compiling the part of the geologic map of Idaho that covers the area of this report (Ross and Forrester, 1947, 1958).

In a report describing a special study of the Lower Teton Division of the Teton Basin Project by the U.S. Bureau of Reclamation (1962), a plan was outlined for a reservoir to supply irrigation water for new land on the Rexburg Bench. The report also suggested that ground water from within the area might be used as a supplemental supply for lands presently developed in the St. Anthony-Rexburg part of the Fremont-Madison Irrigation District. A report by Mundorff, Crosthwaite, and Kilburn (1964) briefly described the geology and ground water in the lower Henrys Fork basin and provided a map showing water-table contours and flow lines in the lowland part of the project area. Mundorff (1962) also studied the feasibility of artificially recharging the Snake Plain aquifer adjacent to and west of the Egin Bench, which is adjacent to the western border of this project. He concluded that the use of surplus flood water from Henrys Fork and Snake River for artificial recharge was feasible.

Measurements of streamflow were begun in 1890 on the Henrys Fork near Ashton, Falls River at Canyon, and Teton River near St. Anthony (Wells, 1956). Since 1890, 33 other gaging stations and reservoir-stage gages have been operated for varying intervals in the Henrys Fork basin. The streamflow data are available in the annual reports of surface-water records of the U.S. Geological Survey.

GEOGRAPHIC SETTING

The lower Henrys Fork region may be divided into three parts, each having a distinctive physiographic character. The northwestern and western parts of the area are a gently rolling plain, veneered in places with windblown sediments and underlain by basalt (pl. 1). The central part is an area of low relief, slightly lower in altitude than the basalt plain. It consists of alluvial fans and flood plains of the Snake, Teton, and Falls Rivers and of Henrys Fork. The alluvial deposits are underlain by basalt similar to that beneath the plain. The southeastern part of the area is a bench (Rexburg Bench) or upland that rises gradually to the Big Hole Mountains southeast of the project area. It is underlain by silicic volcanic rocks and intermixed and overlying basalt.

The basalt plain in the northwestern part of the area rises gradually from the alluvial lowland toward centers of lava extrusion a few miles to the northwest. Although it does not have great topographic relief, the surface of the plain is generally very rough and irregular in detail and has many closed depressions. Two prominent cinder cones, the Menan Buttes, rise 500–600 feet above the plain just west of the confluence of Henrys Fork with the Snake River.

The central alluvial lowland slopes southwestward about 12 feet per mile from an altitude of about 5,000 feet near St. Anthony to about 4,800 feet near the junction of Henrys Fork and Snake River, a distance of 17 miles. The lowland averages about 8 miles in width. The central alluvial lowland and the western basaltic lava plain are hydrologically and topographically part of the Snake River Plain, which extends southwestward from near Ashton in eastern Idaho to south-central Idaho.

The southeastern part of the area is a segment of a regional upland that forms the southeastern border of the Snake River Plain. This upland, which is steepest near the mountains, slopes northwestward

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from the mountain ranges toward the plain and reaches its greatest width in the Newdale-Rexburg area, where it extends about 15 miles from the Big Hole Mountains to the margin of the Snake River Plain. The segment southwest of Moody Creek is called the Rexburg Bench. Its altitude at the base of the mountains is about 6,500 feet and at its lower outer margin about 5,000 feet. South of Rexburg the bench is separated from the plain by a fault scarp as much as 300 feet high. The bench is dissected by the deep canyons of the Teton River and Moody and Canyon Creeks.

Almost all the drainage in the area is tributary to Henrys Fork, which, in turn, discharges into the Snake River in the southwestern part of the area. Henrys Fork rises near the Wyoming-Montana-Idaho border, flows southward to a point near Ashton, then southwestward to the Snake River. It emerges from a canyon near Ashton and at St. Anthony its channel is incised only a few feet below the general land surface. Below St. Anthony the river flows in a valley as much as a mile wide and cuts as much as 10–15 feet into the flood-plain deposits.

Falls River rises in Wyoming and flows westward to join the Henrys Fork between Ashton and St. Anthony. The river flows in a deep narrow valley through most of its course, but about 6 miles from the river's mouth the river leaves the valley to flow in a shallow channel cut in the lava plain.

The Teton River is similar to the Falls River in that it also flows in a deep valley, then emerges onto a broad flood plain before emptying into Henrys Fork. The canyon of Teton River averages about three-fourths of a mile wide, and extends upstream from a point near Newdale to above the river's junction with the East Fork outside the report area.

CLIMATE

The area is characterized by cold winters and hot summers. Precipitation in the area ranges from a maximum of about 25 inches on the Rexburg Bench to about 8 inches at the west end of the lowland plain; however, precipitation in the headwaters of the streams is as

Average annual precipitation, snowfall, and mean annual temperature at Weather Bureau stations in the lower Henrys Fork basin for period of record through 1961

[From the records of the U.S. Weather Bureau]

Station	Altitude (ft)	Precipitation (in.)	Years of record	Snowfall (in.)	Years of record	Temperature (°F)	Years of record
Ashton	5, 220	17. 04	54	74. 7	54	41. 5	54
St. Anthony	4, 968	[1] 13. 96	48	49. 5	48	42. 4	17
Sugar City	4, 890	11. 05	55			42. 5	32

[1] Partly estimated.

much as 60 inches a year. The precipitation is greater and the temperatures are lower on the benchlands than on the alluvial and basaltic plains. The areal distribution of precipitation in the drainage basin is shown on the isohyetal map (fig. 3). Precipitation and temperature data recorded in the area are shown in the following table. The lowest and highest temperatures in the area, −44° and +104°F, have been recorded at the town of Sugar City.

Annual precipitation has ranged from 8.97 to 24.18 inches at Ashton for the period 1897–1961 and from 6.52 to 19.24 inches at Sugar City for the period of 1908–61. Precipitation is chiefly snow during December, January, and February.

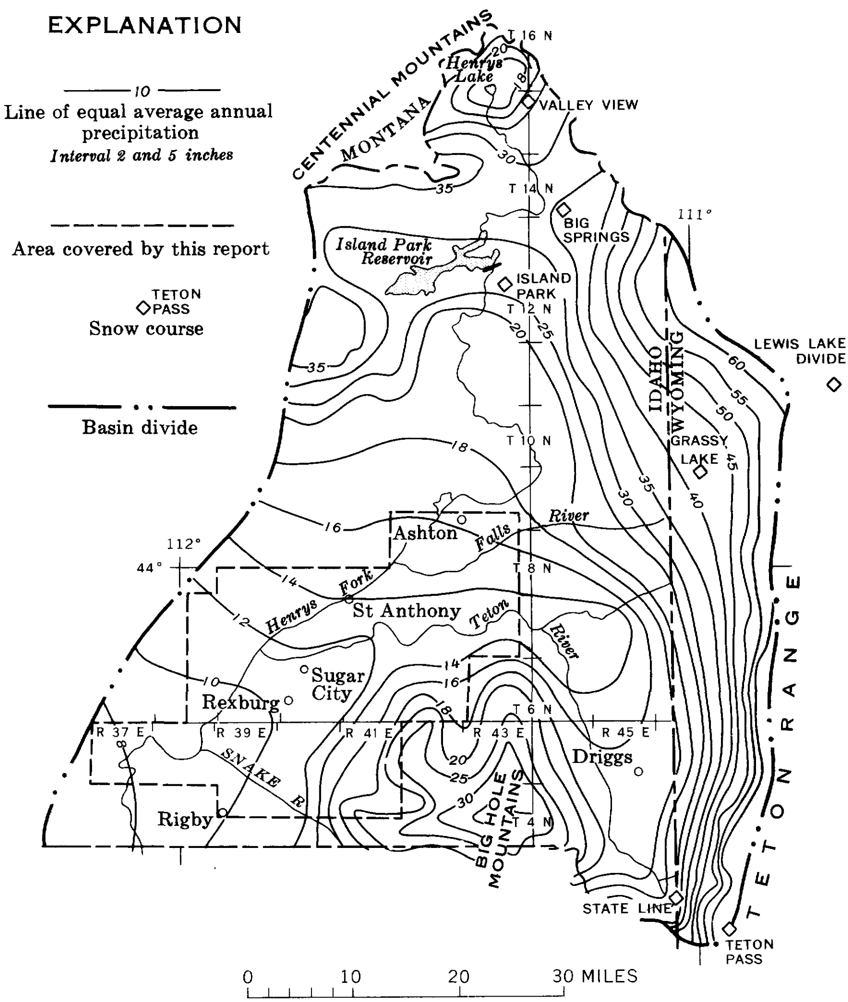

FIGURE 3.—Precipitation in Henrys Fork basin. After Thomas, Broom, and Cummans (1963).

Much of the precipitation in the mountains and at the higher altitudes, where the headwaters areas of the perennial streams are found, is in the form of snow. The largest average annual snowfall recorded within the area is 203.1 inches at Island Park Dam on Henrys Fork. Data collected by the Soil Conservation Service, U.S. Department of Agriculture, at snow measuring stations in the upper Snake River drainage basin are as follows:

Snow course	Drainage	Altitude (ft)	Average water content [1] (in.)
Big Springs	Henrys Fork	6, 500	23. 6
Grassy Lake	Falls River	7, 230	36. 7
Island Park	Henrys Fork	6, 315	17. 8
Lewis Lake Divide	Falls-Snake Rivers	7, 900	48. 4
State Line	Teton River	6, 400	16. 4
Teton Pass	do	8, 500	40. 6
Valley View	Henrys Fork	6, 500	16. 4

[1] Generally measured near end of March, occasionally at beginning of April. Average water content for the period 1943–57.

Monthly precipitation at Ashton and Sugar City is shown in figure 4. The months of December, January, February, and June have above average precipitation; the month of April and the months of July through October have below average precipitation; the other months are near average.

The frost-free growing season ranges from about 105 days on the alluvial lowlands to about 95 days on the benchlands.

The nearest U.S. Weather Bureau stations at which evaporation has been measured by Class-A land pans are at Aberdeen Experiment Station, 80 miles southwest of Rexburg, and at Palisades Dam, 30 miles southeast of Rexburg. Evaporation averaged 41.64 inches at Aberdeen Experiment Station for the 6-month period May to October for the years 1937–60, and 35.32 inches at Palisades Dam for the 5-month period May to September for the years 1948–60. Average annual lake and reservoir evaporation in the lower Henrys Fork region is shown on maps prepared by Kohler, Nordenson, and Baker (1959, pl. 2) to be about 32 inches.

The amount of water consumed by native and cultivated vegetation is variable. Native vegetation is sparse. The method devised by Blaney and Criddle (1949) shows that consumptive use (evapotranspiration) by sparse native vegetation in the area where the annual precipitation varies from 11 to 17 inches ranges from 6 to 9 inches per year. The higher value probably applies to the lower Teton basin where there is a scattered growth of juniper trees on the benchlands that have not been cleared for cultivation. Juniper trees require more moisture than that which will support a growth of sagebrush and native grasses.

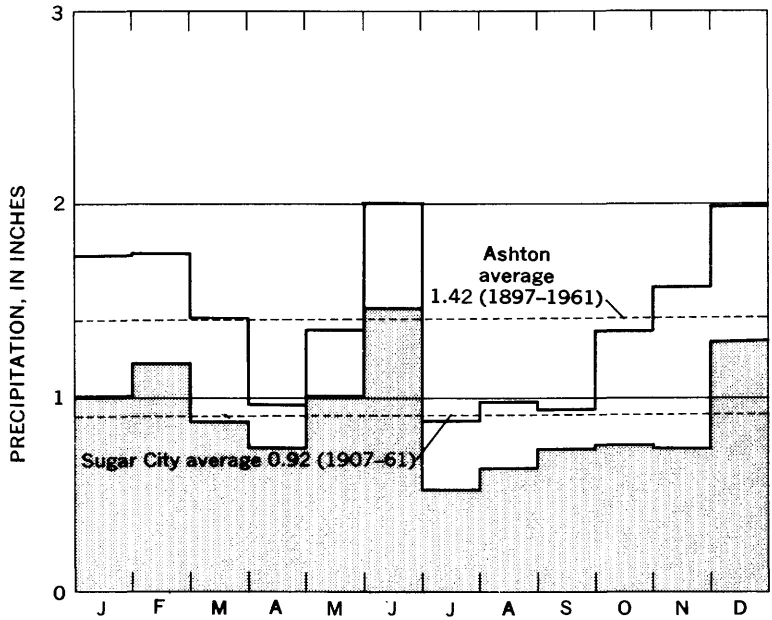

FIGURE 4.—Average monthly precipitation at Ashton and Sugar City.

Net consumptive use by vegetation on irrigated land, including precipitation during the growing season, has been estimated to range from about 20 inches for alfalfa to about 11 inches for truck crops (Jensen and Criddle, 1952, p. 12). Simons (1953, p. 62) estimated net consumptive use, not including growing-season precipitation, to average about 17 inches for all crops. The actual net consumptive use of irrigation water by crops is not known, so a value of 18 inches was selected for use in this report because it lies between the estimate of Jensen and Criddle and the estimate of Simons.

The prevailing wind is from the southwest with sustained velocities of 15–20 miles per hour. Gusts of much higher rate are common; however, winds of destructive force are rare. Some wind erosion occurs on newly plowed and seeded land, especially on the benchlands where loessial soils are easily transported by the wind.

AGRICULTURAL DEVELOPMENT

The local economy is based on agriculture sustained by irrigation and on industry related to agriculture. Potatoes, sugar beets, alfalfa, and small grains are the principal crops. Beef and dairy cattle are the chief livestock. About 115,000 acres of land is irrigated with water diverted from Henrys Fork, Falls, and lower Teton Rivers. Irrigation-water use is high because much of the area is subirrigated. Diversion of as much as 15 acre-feet per acre per year is not uncommon in parts of the area.

The benchlands are partly dry farmed, wheat being the most common crop. The first irrigation well was drilled on the benchlands in about 1953, and, in 1962, about 9,000 acres was irrigated from 50 wells. The principal irrigated crop on the benchlands is potatoes.

Rexburg is the largest city in the area with a population (1960) of 4,767. St. Anthony and Ashton also are important towns. Newdale, Teton, Sugar City, Chester, and Parker are small villages.

WELL-NUMBERING SYSTEM

The well-numbering system used by the U.S. Geological Survey indicates the locations of wells within the official rectangular subdivisions of the public lands, with reference to the Boise base line and meridian. The first two segments of a number designate the township and range. The third segment gives the section number, and it is followed by two letters and a numeral, which indicate the quarter section, the 40-acre tract, and the serial number of the well within the tract, respectively. Quarter sections are lettered a, b, c, and d in counterclockwise order, from the northeast quarter of each section (fig. 5). Within the quarter sections 40-acre tracts are lettered in the same manner. Well 5N–40E–12cd1 is in the SE¼SW¼ sec. 12, T. 5 N., R. 40 E., and is the well first visited in that tract.

THE GEOHYDROLOGIC FRAMEWORK

The rolling plain and lowland are underlain by stream alluvium and basaltic lava flows of the Snake River Group. The benchland, which forms a broad transition zone from the lowland to the broad plateaus and mountains to the north and east, is underlain by silicic volcanic rocks and, at some places, by basalt flows. The mountains and plateaus, which are outside the area of study, are composed of many types of volcanic and consolidated sedimentary rock. The mountains and plateaus are water-yielding areas and supply surface runoff and ground-water recharge to the plain, lowland, and benchland, which are water-using areas.

The alluvial deposits and basaltic lavas lie in a broad structural depression. The silicic volcanic rocks rise above the depression to form an apron on the northwest and north flanks of the mountains to the east and southeast. The areal distribution of the geologic formations is shown on plate 1.

SILICIC VOLCANIC ROCKS

The oldest rocks in the area are silicic volcanic rocks of late Tertiary(?) age. They consist of massive rocks of light gray, pink, or lavender color, and they vary from lightly compacted tuff to well in-

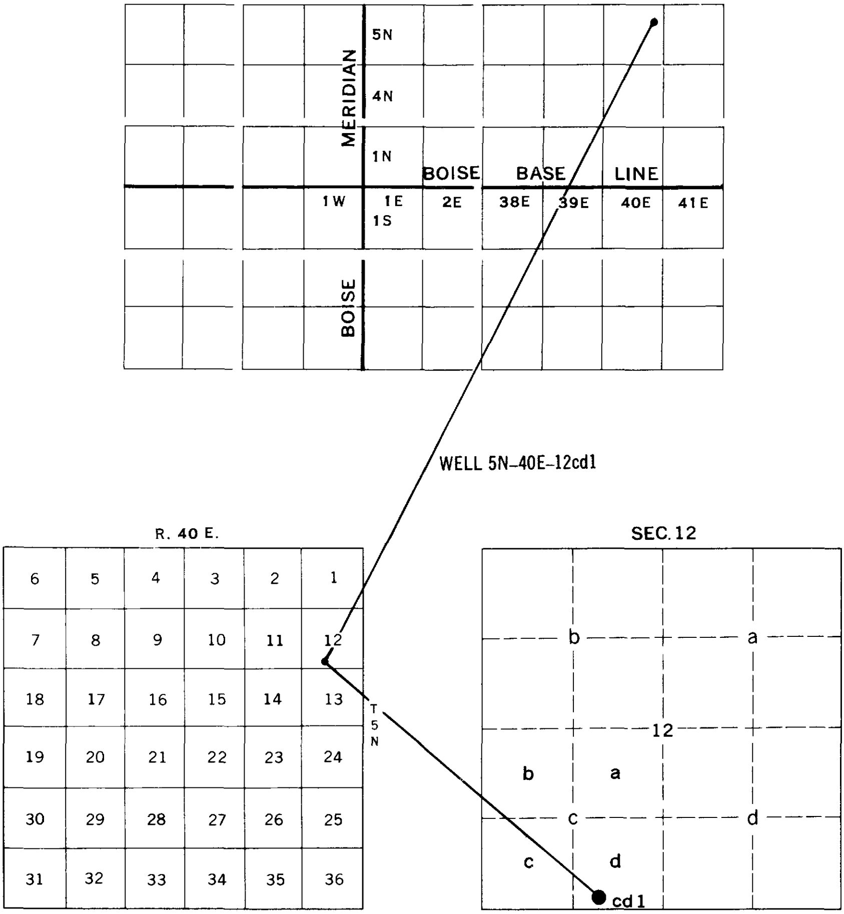

FIGURE 5.—Well-numbering system.

durated rock that appears to be welded tuff or welded ash flows. Logs of wells and core holes show that ash, gravel, sand, conglomerate, and basalt flows are interbedded with the silicic volcanic rocks at depth, but none of these interbedded rocks are known to crop out at the surface.

The silicic volcanic rocks are exposed in the eastern part of the area (pl. 1), underlying much of the Rexburg Bench and the upland south of Ashton. The regional geology indicates that these rocks underlie the remainder of the report area at depth, but wells in the basalt and alluvium in the central and western part of the area are not deep enough to penetrate them.

Water is contained in and obtained from sand, gravel, conglomerate, ash, cinders, and similar granular materials interbedded in the silicic volcanic rocks and from joints and other fractures in silicic volcanic flow rocks and welded ash flows.

Generally, irrigation well yields range from a few hundred to several thousand gallons per minute with drawdowns of several tens of feet. Specific capacities usually range from about 10 to 300 gpm (gallons per minute) per foot of drawdown. Several wells in a small area a few miles east of Rexburg have large yields and large specific capacities; that is, they have yields of 2,000–3,000 gpm with drawdowns of about 1 foot. There are beds of volcanic ash and layers of basalt of very high permeability interbedded with the massive silicic volcanic rocks in this part of the area. These highly permeable zones have not been found in wells in the remainder of the report area.

In the Ashton area, the few wells drilled into the silicic volcanic rock have not obtained supplies adequate for irrigation. Thus, it appears that the permeability of the rocks is very low and exploration for irrigation supplies in the silicic rocks northeast from the vicinity of St. Anthony has not been encouraging.

BASALT

Gray to dark-gray vesicular basalt flows of the Snake River Group overlie much of the silicic volcanic rocks in the benchlands and also occur at or near the surface in the western part of the area, west of Henrys Fork (pl. 1). Basalt also underlies the alluvial deposits in the central lowland part of the area.

Most of the basalt underlying the Rexburg Bench originated from the buttes shown on the geologic map (pl. 1). Individual flows appear to have an areal extent of only a few square miles. Outcrops and well logs show that much of the basalt underlying the benchlands is only one flow thick, except in a topographic low near Newdale and in the southwestern part of the Rexburg Bench. In those two places the aggregate thickness of the flows is several tens to several hundreds of feet. At the buttes the basalt is a few hundred feet thick, but it thins rapidly away from the vents and is only a few feet thick at the edges of the flows. Much of the basalt on the Rexburg Bench is above the water table.

Basalt of the Snake River Group, of unknown but great thickness, underlies the lowland and is a part of the series of flows which, with associated alluvium, constitutes the Snake Plain aquifer (Mundorff and others, 1964, p. 142). This basalt underlies much of the alluvium in the St. Anthony-Rexburg area at depths of as much as 300 feet (pl. 1).

In the basalt plain west of the irrigated district, the basalt is only thinly mantled by windblown deposits and, in many places, is exposed at the surface. In the thinly mantled area, the uppermost flow, which is younger than the basalt of the Snake Plain aquifer, overlies alluvial deposits that are as much as 140 feet thick. Also, much of the basalt between Ashton and St. Anthony is veneered with silt, sand, and gravel that probably does not exceed 25 feet in thickness.

In general, the basalt underlying the Snake River Plain is an excellent aquifer, but not all parts of it are equally permeable. The major water-bearing zones in the basalt occur at the contacts between flows, where open spaces and rubbly zones at the top of one flow were not filled completely by the succeeding flow. Scoriaceous materials, cinders, and gravel also add to the permeability of the interflow zones. Water-bearing interflow zones occur primarily where two or more lava flows occur in succession. Where individual basalt flows interfinger with fine-grained sediments, the basalt is not a good aquifer. However, where 100 feet or more of basalt is penetrated below the water table, wells generally yield 2,000–3,000 gpm with drawdowns of 1–10 feet.

ALLUVIAL DEPOSITS

Alluvial deposits composed of clay, silt, sand, and gravel occupy almost all the central lowland from near St. Anthony southwestward to beyond the Snake River (pl. 1). Also, much of the basalt between Ashton and St. Anthony is veneered with alluvial deposits. The alluvial deposits become progressively thicker southwestward from St. Anthony. Near the confluence of the South Fork Teton River with Henrys Fork, they are about 250 feet thick, and they may be as much as 350 feet thick near the mouth of Henrys Fork. The log of well 7N–38E–23db1, in the rolling plain, indicates that as much as 140 feet of alluvial deposits underlie basalt that is younger than the basalt of the Snake Plain aquifer.

Logs of several wells suggest that the alluvial deposits west of Henrys Fork are predominantly sand; whereas logs of wells from the remainder of the area show that the rest of the alluvial deposits contain a large amount of gravel. The coarse sand and gravel, which predominate in the alluvium, form an excellent aquifer. Clay and silt strata, interbedded with the sand and gravel, are individually thin and collectively form only a small percentage of the total thickness. The sand and gravel ordinarily do not have as high a coefficient of transmissibility as the basalt, but yields of several thousand gallons per minute with little drawdown probably can be obtained from properly constructed wells.

THE PERCHED WATER TABLE

Surface-water irrigation has resulted in a perched water table in the alluvial deposits in the Fremont-Madison Irrigation District downstream from St. Anthony (pl. 1). The perched water extends as far west as Menan Buttes. The perched table is only a few feet below land surface and in parts of the area, particularly on the Egin Bench, subirrigation of crops is practiced. The perched water table fluctuates 2–40 feet annually depending on the amount of irrigation water applied and the local nature of the alluvial deposits.

Part of the perched water on the south side of Henrys Fork moves downward to the regional water table, and part moves to Henrys Fork, either directly or after entering Teton River and other drainage channels. Perched water north of Henrys Fork forms a ground-water ridge from which there are two components of flow. One component is downward to the regional water table and the other is laterally to the north, west, and south away from the ridge. Henrys Fork receives water from the southward lateral component of flow, but the remaining components eventually descend to the regional water table.

In the Ashton part of the Fremont-Madison Irrigation District, 20–100 feet of basalt overlies the silicic volcanic rocks. Irrigation with water from Falls River has built up a water table in the basalt that is perched above the regional water table. The perched water lies at shallow depth beneath the land surface and has formed many swampy areas. Although some of the perched water may percolate downward through the silicic volcanic rocks to the main water table, much of the discharge is to Henrys Fork.

An average (for the period 1928–57) of about 865,000 acre-feet of water was diverted each season (May to September inclusive) to irrigate 112,400 acres in the Fremont-Madison Irrigation District. Forty canals, which head in Henrys Fork and Falls and lower Teton Rivers, carry the water. As much as 15 acre-feet per acre is diverted in some of the canal-system areas, but the average diversion per acre for all irrigated land is about 7.7 acre-feet. Falls and Teton Rivers and Henrys Fork gain, from discharge of perched water and irrigation return flows, an average of about 190,000 acre-feet per irrigation season in the reaches adjacent to the irrigated area. Loss of water to evapotranspiration (crop use) is estimated to be about 170,000 acre-feet annually (112,400 acres × 1.5 acre-feet per acre). Thus about 500,000 acre-feet of the water entering the perched water table percolates downward to the regional water table.

Data on winter diversions to the canal system are available for only 1942–43 winter, when they totaled about 235,000 acre-feet. The gain in streamflow from the perched water body during the same winter period was 135,000 acre-feet. For estimation purposes the foregoing values are assumed to be representative of the average annual winter diversions for this area. Because evapotranspiration rates are low during the winter months, a figure of 0.5 acre-foot per acre was used to compute a total evapotranspiration loss of about 56,000 acre-feet from October to April inclusive. Calculations using these data and the irrigation season data suggest that the perched water table contributes a total of about 550,000 acre-feet annually to the Snake Plain aquifer.

THE REGIONAL WATER TABLE

Contours drawn on the regional water table are shown on plate 1. In general, the water table beneath the Rexburg Bench slopes northwestward toward the alluvial plain. The water table beneath the central alluvial plain and beneath the Snake River Plain slopes westward and southwestward. In the western part of the report area the water-table gradient is mostly less than 1.5 feet per mile. The gradient is greater in the eastern part and is as much as 5 feet per mile east of Newdale and St. Anthony.

In the proposed reservoir area on the Teton River and in the adjacent uplands, the position of the water table cannot be determined satisfactorily from the available data. Diamond-drill holes on the upland at the Fremont damsite (pl. 1) indicate that ground water occurs at about 5,030 feet above mean sea level on the south side of the Teton River and at about 4,995 feet on the north side of the river. The altitude of the river surface at the damsite is about 5,030 feet. The water level in drill hole 7 (pl. 1), about 10 miles upstream from the damsite and on the south side of the river stands at about 5,000 feet; and the water level in drill hole 8, on the north side of the river, opposite drill hole 7, stands at about 4,970 feet. Water levels in irrigation wells 2–3.5 miles north the damsite stand at about 5,000 feet in the wells farthest from the river, and at 4,865 (in well 7N–41E–24dc1) to 4,900 feet in the wells nearest the river. These wells were drilled from 235 to 640 feet below the water level (altitude at bottom of deepest well, 7N–42E–6dd1, is 4,355 feet). Water levels in stock and domestic wells north of the reservoir site range from about 5,140 feet near the river to about 5,380 feet several miles northeast of the reservoir site.

The altitude of water levels in four wells south of the reservoir site ranges from 4,865 to 5,370 feet. Water-level altitudes, rounded to the nearest 5 feet, are shown on the water-table contour map (pl. 1).

The data suggest that the water levels in wells 7N–41E–24dc1, 6N–42E–5bd1, 7N–43E–32bc1, and drill hole 8 coincide with the altitude of the regional water table, but that the water in most wells and drill holes is perched above the regional water table; the data also suggests that the river is perched above the regional water table. If these indications are correct, then the river is perched an average of about 150 feet above the regional water table at the damsite and at least as far upstream as drill hole 8. The foregoing suggests that interconnection between the perched water table and the regional water table must be very poor.

The regional water table is below the water surfaces of all canals and streams in the Fremont-Madison Irrigation District and in the Rexburg Bench and other upland areas. Near the mouth of Henrys Fork the water table is only a few feet below river level, and in early autumn, when the water table is the highest and the river level is low the water table may be at or very near river level. The geologic and hydrologic sections along Henrys Fork and North and South Forks Teton River (pl. 1) show that the water table becomes progressively farther below river level in the upstream direction. Henrys Fork at St. Anthony and the Teton River near Teton are perched about 100 feet above the regional water table. As mentioned above, the Teton River is about 150 feet above the regional water table at the Fremont damsite.

The annual range in fluctuation of the regional water table is about 5 feet in the western part of the Fremont-Madison Irrigation District and 8–10 feet in the St. Anthony-Teton area. Water levels are lowest in April and highest in the latter part of September or the early part of October (fig. 6).

The annual cycle of fluctuation in the Rexburg Bench and other upland areas is not as great as in the Fremont-Madison Irrigation District, and the dates of the high and low water levels are slightly different. The annual range in fluctuation is 3–6 feet, the low being in May and the high being in late October or early November.

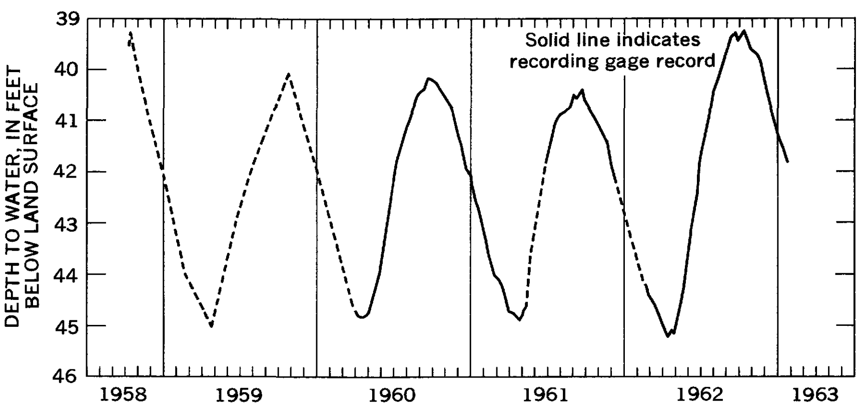

FIGURE 6.—Hydrograph of well 7N–38E–23db1.

The regional water table in the St. Anthony-Rexburg part of the Fremont-Madison Irrigation District is strongly influenced by surface-water irrigation, whereas this same regional water table in the silicic volcanic rocks is little influenced by irrigation and only slightly influenced by local precipitation.

Mundorff (1962, p. 24) estimated that the average annual amount of ground water leaving the lower Henrys Fork region is on the order of 725,000 acre-feet a year. About 550,000 acre-feet of this amount originates in the Fremont-Madison Irrigation District, as explained in the preceding section. The lesser part (175,000 acre-feet) is precipitation that infiltrates into the ground in the headwaters of Henrys Fork, Falls, and Teton Rivers and moves southwestward beneath the lower Henrys Fork region.

REGIONAL AVAILABILITY OF GROUND WATER

PLAINS AND LOWLANDS

The basalt aquifers beneath the basalt plain probably will yield large quantities of water to wells. Mundorff, Crosthwaite, and Kilburn (1964, pl. 6) show that the coefficient of transmissibility is more than 20 million gpd (gallons per day) per foot.[1] Data from the few large wells in the lowland suggest coefficients which approach those in the basalt plain if they produce from the basalt below the alluvium. Although no large capacity wells produce from the alluvial deposits, abundant supplies for domestic and stock use are obtained from small wells. The alluvial deposits could probably yield several hundred to a few thousand gallons per minute to properly constructed wells. As mentioned previously, an estimated 725,000 acre-feet, of which about 500,000 acre-feet originates in the Madison-Fremont Irrigation District, moves westward out of the lower Henrys Fork as ground-water flow. At the present time, only a very small amount is withdrawn annually by wells—probably less than 10,000 acre-feet for stock, domestic, municipal, and irrigation use.

The water-level data indicate that the regional water-table is below stream level. If this is true, then pumping from the regional ground-water body for supplemental irrigation would not adversely affect streamflow. In fact, pumping would augment streamflow because the pumped water not used by crops or evaporated would mingle with the existing irrigation supply, part of which recharges the perched water body and part of which runs off into the streams.

[1] The coefficient of transmissibility, *T*, is defined as the rate of flow of water, at the prevailing temperature, in gallons per day, through a vertical strip of the aquifer 1 foot wide extending the full saturated height of the aquifer under a hydraulic gradient of 100 percent.

REXBURG BENCH AND OTHER UPLAND AREAS

The silicic volcanic rock aquifers beneath the Rexburg Bench and beneath the area extending to the northeast a few miles past Moody Creek toward Newdale generally yield large quantities of water to wells. Calculations using specific-capacity data from irrigation wells suggest that coefficients of transmissibility range from about 15,000 to 4 million gpd per foot. These coefficients must be used with caution because most of the specific-capacity information is from wells that were pumped at several rates for a total time of only 2–4 hours. Nevertheless, general conclusions can be made from the data.

In general, wells in the southeast quarter of T. 6 N., R. 40 E., have the highest yields with least drawdown; that is, wells in this part of the Rexburg Bench have the largest specific capacities, and therefore indicate that the coefficient of transmissibility of the silicic volcanic rocks must be much higher here—up to 4 million gpd per foot—than it is in other places where exploration for ground water has occurred. Specific capacities of more than 2,000 gpd per foot of drawdown have been measured in wells 6N–40E–23bb1 and 6N–40E–26aa1.

Northeast and southwest of the southeast quarter of T. 6 N., R. 40 E., specific capacities are much smaller, and the coefficient of transmissibility of the silicic volcanic rocks probably ranges between 15,000 and 250,000 gpd per foot. However, tests on some of the wells just east of Rexburg indicate coefficients of transmissibility in the range from 100,000 to 400,000 gpd per foot.

In the uplands northeast of Newdale and extending toward Ashton, wells drilled for irrigation have not been very successful. North of Falls River and in the Ashton area, irrigation and public-supply wells obtain relatively small amounts of water from silicic volcanic rocks because the rocks have a very low permeability.

Just south of Rexburg, yields of a few thousand gallons per minute are obtained from wells in basalt of the Snake River Group. In the vicinity of Ashton, where the basalt is above the regional water-table, wells open to a perched water body in the basalt yield several hundred gallons per minute. Elsewhere in the Rexburg bench and other parts of the uplands, the basalt is above the regional water table and contains little if any perched water.

Pumping of ground water from silicic volcanic rocks and basalt of the Snake River Group beneath the Rexburg Bench has caused no significant decline in water levels. Total pumpage in 1962 is estimated to be 25,000 acre-feet.

Most of the recharge to the silicic volcanic rocks of the Rexburg Bench is by precipitation on the area of outcrop occurring at high altitudes and by seepage from streams along the northwest flank of the Big Hole Mountains. The area contributing recharge to this unit is roughly 300 square miles or about 200,000 acres. According to the relationship between water yield (all water leaving a basin by surface or underground flow) and average annual precipitation given in the report by Mundorff, Crosthwaite, and Kilburn (1964, fig. 7), the average annual water yield based on an estimated average annual precipitation of 16 inches is about 4½ inches over the area. Total water yield for the area of the Rexburg Bench would be about 75,000 acre-feet annually. Available streamflow records suggest that about 40,000–50,000 acre-feet run off annually in Canyon and Moody Creeks, leaving about 25,000–35,000 acre-feet for annual recharge to the Rexburg Bench. Thus, estimated annual withdrawals are approaching the estimated annual recharge.

Ground-water flow in the Rexburg Bench is estimated to be small, and withdrawal of significant amounts of ground water in those parts of the bench where the coefficient of transmissibility is low eventually will cause the water table to decline considerably. At places where the coefficient of transmissibility, as inferred from the hydraulic gradient and specific capacities, is high, the decline in the water table will be correspondingly small. The present (1962) withdrawal rate should cause a measurable decline in the water table within the next few years. However, if surface water is used to irrigate an extensive part of the Rexburg Bench, seepage losses from irrigation will more than offset ground-water depletion and cause a rise in the water table.

If the regional water table is below the streams as postulated, pumping from the regional water body generally will not deplete streamflow within the report area. However, part of the water in the aquifer discharges into the reach of the Snake River from Blackfoot to American Falls. Depletion of ground water by pumping will be reflected by a reduction of inflow in that reach unless seepage from applied surface water increases sufficiently to offset the depletion. Additional seepage could be obtained either by artificial recharge or by irrigating additional land with surface water, or by both methods.

ASHTON AREA

Some ground water can be pumped from the basalt aquifer in the area around Ashton and Marysville and in an area extending a few miles southwestward from Ashton. Sparse data about water levels and geology suggest that the water in the basalt is perched upon the underlying silicic volcanic rocks. Many swampy areas, seeps, and springs discharge into natural channels which drain to Henrys Fork. Some of the land is waterlogged. Pumping could alleviate some drainage problems and, at the same time, provide supplemental water.

Well data indicate that a satisfactory ground-water supply is not available for irrigation in the remainder of the Ashton area of the Fremont-Madison Irrigation District.

The quantities of ground water that can be pumped for supplemental irrigation cannot be estimated satisfactorily until further work is done in the area. Pumping of supplemental ground water from the perched water, which is tributary to Henrys Fork, will deplete the flow of Henrys Fork to the extent that the supplemental water is consumed by evapotranspiration.

FALLS RIVER

A brief examination was made of the Falls River drainage from east of Chester to the Idaho State line. Nothing was found to suggest that a significant amount of ground water could be developed for irrigation.

SUMMARY

Wells on the Rexburg Bench and other upland areas produce mostly from silicic volcanic rocks. Yields range from a few hundred to several thousand gallons per minute with drawdowns of 1 foot to several tens of feet, but the large yields are restricted to the southeastern part of T. 6 N., R. 40 E. In a small part of the Rexburg Bench and in the central lowlands, wells produce from the basalt of the Snake River Group; these wells generally yield several thousand gallons per minute with only 1–10 feet of drawdown. Some wells in the lowland produce from the sand and gravel in the alluvial deposits; generally these deposits do not have as high a coefficient of transmissibility as the basalt, but yields of several thousand gallons per minute with little drawdown can probably be obtained from properly constructed wells.

Surface-water irrigation has resulted in a perched water table in the alluvial deposits in the Fremont-Madison Irrigation District. It is estimated that downward leakage of the perched water contributes 550,000 acre-feet annually to the regional water table, and the perched water and irrigation return flows contribute an estimated 325,000 acre-feet annually to streamflow. In the Ashton part of the irrigation district, perched water lies at shallow depth in basalt. Some of the perched water may percolate downward to the regional water table, but much of it discharges to Henrys Fork.

In general, the regional water table beneath the central alluvial lowland slopes southwestward and westward, but beneath the Rexburg Bench it slopes northwestward. Near the mouth of Henrys Fork, the regional water table is only a few feet below river level, but becomes progressively farther below river level in an upstream direction. At St. Anthony, it is about 100 feet below the Henrys Fork. At the Fremont damsite on the Teton River, the regional water table is about 150 feet below stream level.

It is estimated that about 725,000 acre-feet of ground water leaves the lower Henrys Fork region annually. About 550,000 acre-feet of this amount originates in the Fremont-Madison Irrigation District and 175,000 acre-feet infiltrates into the ground in the headwaters of the Henrys Fork, Falls, and Teton Rivers and moves southwestward beneath the lower Henrys Fork region.

Aquifers beneath the Rexburg Bench generally yield large quantities of water to wells, but northeast of Newdale in the area extending to Ashton only small amounts of water can be developed from the regional ground-water body. Withdrawals from the Rexburg Bench were about 25,000 acre-feet in 1962. This withdrawal caused no significant lowering of the regional water table. Ground-water pumping generally will not deplete streamflow within the report area. However, depletion by ground-water pumping will be reflected by a reduction in discharge of the regional ground-water body many miles downstream from the lower Henrys Fork region.

In the Ashton area, some water can be pumped from the basalt aquifer. Pumping from this aquifer would deplete the flow of Henrys Fork to the extent that the water pumped is consumed by evapotranspiration.

The evidence does not indicate that a significant amount of ground water can be developed in the Falls River area for irrigation.

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U.S. GOVERNMENT PRINTING OFFICE: 1970 O 378-972