Hydrology of Stock-Water Development in Southeastern Idaho

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1475-P

Prepared as part of the soil and moisture conservation program of the Department of the Interior

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By RICHARD F. HADLEY

HYDROLOGY OF THE PUBLIC DOMAIN

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By Richard F. Hadley

ABSTRACT

The public domain lands in southeastern Idaho administered by the Bureau of Land Management include altogether about 6 million acres, which are used almost exclusively for grazing. These lands are divided into four grazing districts for range management and grazing administration. Because most of the area still in the public domain is not irrigable and is sparsely populated, little information is available on water resources. This report incorporates the results of several reconnaissances of small areas that were concerned with development of water resources on grazing lands throughout southeastern Idaho. The area considered in the report includes scattered tracts of public land south of the Snake River between Salmon Falls Creek on the west and Portneuf and Blackfoot Rivers on the east. Also, the occurence of ground water is described at some localities on the lava plain and mountain valleys north of the Snake River between Idaho Falls and Bliss.

The principal aquifers in the area of public domain are the basaltic flow rocks and associated ash and cinder beds which generally yield ample supplies of water for stock use. Rhyolitic rocks and tuff may yield moderate amounts of water where fracturing has increased transmissibility. Alluvium and lake beds in the stream valleys and in the broad intermontane basins generally yield small amounts of water. Ground water in the basalt and in the alluvium is generally unconfined, but artesian conditions may prevail where interflow sedimentary rocks are relatively impermeable.

INTRODUCTION

The southern part of Idaho, as shown in figure 70, may be classed in three general categories with respect to land use. These are (a) irrigated farmland located principally along the Snake River Plain and tributary valleys, (b) forest land at higher altitudes, and (c) unappropriated public domain used principally for grazing, located generally at intermediate altitudes between the valley floors and the forest land. Also, thousands of acres of irrigable lands in the public domain are used for grazing (Crosthwaite, 1957, p. 100).

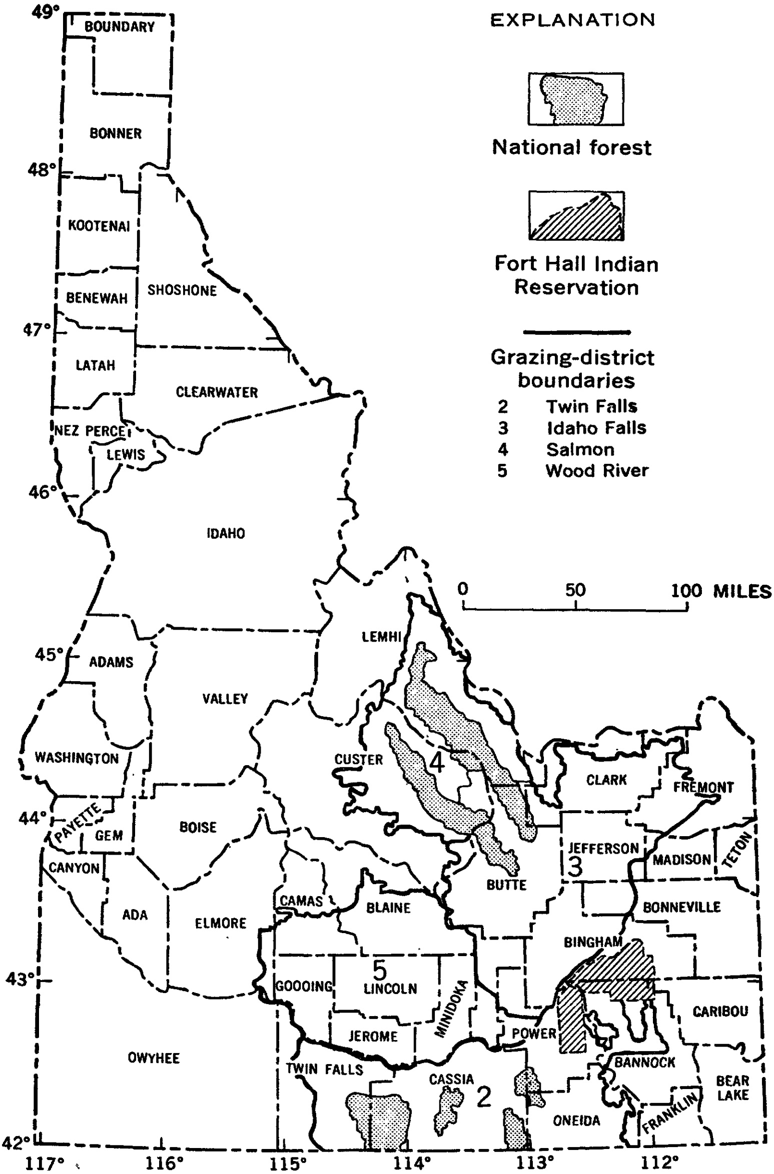

FIGURE 70.—Index map of southern Idaho showing location of grazing districts.

PURPOSE AND SCOPE OF REPORT

This report is concerned with the development of both surface-water and ground-water resources for livestock on the public domain, which is administered by the Bureau of Land Management, and on some of the land within the Fort Hall Indian Reservation. One of the most important items in the efficient use of rangelands is water supply. By having watering places spaced properly, the grazing load is more evenly distributed, and the likelihood of local overgrazing is reduced. Most of the grazing land has no dependable surface-water supply and wells have been drilled only at scattered locations. Data on water supply are therefore, scant for large tracts of grazing lands.

The ground-water possibilities south of Snake River, including the Snake River Plain and tributary valleys, have been discussed in some detail in a report by Crosthwaite (1957). That report is concerned primarily with the lowlands or the stream valleys where irrigation is most feasible. The areas considered in this report are generally remote from those areas, but the water resources are just as necessary to maintain the stock-raising industry.

This report is based on several investigations by the Geological Survey for the Bureaus of Land Management and Indian Affairs. Brief geologic reconnaissances were made for the purpose of selecting specific locations for drilling water wells. The individual investigations generally were restricted to a small area designated by the administering agency as being in urgent need of water. Therefore only small parts of the total area of public domain lands were considered. At sites where prospects of obtaining a well seemed poor, drilling was not recommended or a change in location was suggested that was compatible with land-management practices. The results of drilling at the recommended sites are included in this report.

The investigations on which this report is based were part of the Geological Survey's contribution to the soil and moisture program of the Department of the Interior.

LOCATION AND EXTENT OF AREA

The study area includes the public domain land in southern Idaho, which is divided into four grazing districts by the Bureau of Land Management under the provisions of the Taylor Grazing Act. Parts of the Fort Hall Indian Reservation are also included. (See fig. 70.) The public domain lands are on the north and south sides of the Snake River. The area of these lands is 6,006,872 acres (table 1), which is about 4 percent of the public domain being administered by the Bureau of Land Management. The lava plains between Idaho Falls and King Hill that extend northward from the Snake River to the Sawtooth and Lemhi Ranges include about 2.5 million acres of grazing land. Also, the intermontane valleys in the Birch Creek and Lemhi and Pahsimeroi River basins include an additional 1.3 million acres of public domain lands. South of the Snake River between Salmon Falls Creek and Pocatello, about 1.2 million acres of public domain lands is interspersed with irrigated farmland and national forests. This area south of the Snake River nearly coincides with the area studied by Crosthwaite (1957). Although many of the tracts of public domain in southern Idaho are on rocky deserts and are unsuitable for irrigation farming, they support sufficient vegetation for controlled grazing of cattle, sheep, and horses. Judicious use of these lands by ranchers has made livestock growing one of the most commercially important industries of the area. Table 1 shows some statistics for the grazing districts for 1959.

TABLE 1.—*Statistics for Bureau of Land Management grazing districts in Idaho, 1959*

[Bureau of Land Management State Office, Boise, Idaho]

District	Public domain (acres)	Number of permittees	Numbers of livestock		
			Cattle	Sheep	Horses
2 Twin Falls	1, 217, 391	576	44, 862	121, 102	420
3 Idaho Falls	1, 885, 224	386	34, 288	275, 074	519
4 Salmon	1, 300, 463	313	38, 828	39, 815	979
5 Wood River	1, 603, 794	496	37, 452	305, 359	294
Total	6, 006, 872	1, 771	155, 430	741, 350	2, 213

PREVIOUS INVESTIGATIONS

Several studies have been made of ground-water geology in the Snake River Plain and adjacent areas described in this report. Some were of a reconnaissance type, and others were detailed investigations of small areas. The first study of ground-water occurrence in the Snake River Plain was a reconnaissance made by I. C. Russell (1902). Mansfield (1920) mapped the geology in the Fort Hall Indian Reservation and Heroy (in Mansfield, 1920) prepared a chapter on the water resources. Piper (1923) made a reconnaissance of the geology and ground water in the Goose Creek basin. The part of the Snake River Plain above King Hill, Idaho, was the subject of a detailed ground-water report by Stearns and others (1938). In the most recent investigation in the area, Crosthwaite (1957) described ground-water occurrence south of the Snake River between Twin Falls and Pocatello. The information given in these reports on the geology and water-bearing properties of the rocks has been of great assistance in the preparation of this report.

GEOGRAPHY

The part of southern Idaho considered in this report lies within three distinct physiographic provinces: the Columbia Plateaus, the Basin and Range province, and the Northern Rocky Mountains (Fenneman, 1931). The Snake River Plain section of the Columbia Plateaus extends across southern Idaho in a broad arc and separates the Northern Rocky Mountains from the Basin and Range province.

SURFACE FEATURES

The Snake River Plain is a gently rolling lava plain across southern Idaho that is nearly featureless except for scattered buttes and cones of volcanic origin. The plain ranges in width from about 1 mile, at its eastern edge, to more than 50 miles, north of American Falls. The thin soil developed on the relatively young basalt flows and on the wind-blown material that occupies shallow depressions is generally productive where irrigated. Even the rocky uplands, which constitute much of the grazing land on the public domain, support a dense cover of sagebrush and some grass despite the scant precipitation.

The Snake River flows below the plain in a canyon that ranges in depth from 25 feet to about 500 feet and is cut in the basalt, lake beds, and alluvium. The land along the Snake River and the larger tributaries joining it from the south are irrigated by diversion of surface flow and by wells, but grazing land is generally too far from the perennial streams to benefit from this water. In the northern part of the plain there are no tributaries between Henrys Fork, northeast of Idaho Falls, and Big Wood River, near Bliss, a distance of about 250 miles (Stearns and others, 1938). This unusual condition is caused by the high permeability of the porous and fractured basaltic rocks, which absorb the surface flow before it reaches the master stream. Therefore, the central part of the Snake River Plain is a desert, and the only water to be found is in scattered ice caves in lava flows or at a few stock wells, where the water is several hundred feet below the surface (Stearns and others, 1938).

The part of the study area south of the Snake River Plain is in the Basin and Range province and consists of north-trending ranges of fault-block mountains separated by wide, flat intermontane basins partly filled with lake beds and alluvium. The mountains rise to an altitude of 8,000 to 10,000 feet, and the basin floors have an average altitude of about 4,800 feet. For the most part the public domain grazing lands occupy the rocky uplands between the irrigated farms on the basin floors and the forests of the mountain slopes but include also some land on the basin floors.

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In the Northern Rocky Mountains north of the Snake River Plain, the mountain ranges consist of folded and faulted sedimentary and igneous rocks. The mountain ranges trend generally northwestward rising to an average altitude of about 9,000 feet. As on the south side of the Snake River Plain, alluvial valleys separate the mountain ranges. The public domain lands north of the Snake River Plain considered in this report are in the valleys of Birch Creek and the Pahsimeroi and Big Lost Rivers, which drain the Lemhi and Lost River Ranges.

SOILS AND VEGETATION

The soils of the Snake River Plain and of the part of the area in the Basin and Range province are mainly members of the various desert soils. The soils developed on the basalt flows support a dense growth of sagebrush on the grazing lands and are highly productive on the irrigated farmland. Around the eastern border of the area and in the mountains, however, the rainfall is higher and grass growth has developed a belt of darker soils than those in the desert.

In general, the surface in the grazing lands is covered by a soil composed of wind-blown dust and alluvium; however, there are large tracts where the basalt flows are exposed having no soil cover and supporting no vegetation.

Most of the Snake River basin considered here is occupied by shrubs of the northern desert shrub type. Scattered small areas of grasslands are at lower elevations, and forests, mostly yellow pine, are in the mountainous areas.

The perennial vegetation on the grazing lands is principally sagebrush. The most abundant grasses are bluebunch wheatgrass and cheatgrass. Although only a small part of the area is natural grassland, many large tracts have been cleared of sagebrush by means of chemicals and then have been planted to crested wheatgrass or some other hardy grass species.

Juniper occupies the rough, broken country or the shallow, rocky soils principally on ridges at altitudes generally between 4,000 and 6,000 feet.

CLIMATE

The climate of southern Idaho ranges from semiarid on the Snake River Plain and southern valleys to subhumid in the mountainous areas north and south of the Plain. Winters are generally cold and wet, and summers are hot and dry. Most of the public domain grazing lands are in parts of the area having semiarid climate. Distribution of precipitation throughout the year plays an important part in the water problems of the grazing lands. January is generally the wettest month, and in most years about 60 percent of the anual precipitation occurs during the period December to May. June, July, and August are generally hot and dry, consequently, summer grazing operations are made difficult because of the lack of surface water for stock use. It is impractical, and even impossible, in most areas to store runoff from winter precipitation in surface reservoirs. Also, vegetation is harmed from lack of moisture during the months when much of the grazing land might otherwise be used for extensive grazing.

PRECIPITATION

The average annual precipitation in the study area ranges from about 8 inches on the Snake River Plain west of Idaho Falls to about 20 inches in the upland areas north of Hailey in the Wood River Grazing District. Very few precipitation measurements were made on the grazing lands, but records for some long-term stations in the area are listed in table 2.

TABLE 2.—*Average annual and monthly precipitation for selected stations in southern Idaho*

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

Station	Years of record	Precipitation (inches)												
		Annual	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Gooding	18	9.27	1.24	1.02	0.75	0.94	0.76	0.61	0.30	0.20	0.39	0.78	1.26	1.02
Hailey	51	15.33	2.23	1.98	1.29	1.15	1.33	1.04	.53	.50	.70	1.11	1.39	2.08
Hollister	44	9.35	.87	.85	.70	1.18	1.13	.91	.37	.38	.46	.88	.83	.79
Idaho Falls	29	11.61	1.31	.97	1.08	.94	1.24	1.21	.62	.59	.82	.98	.79	1.06
Idaho Falls 46W	7	7.69	.66	.57	.45	.75	1.02	.81	.44	.64	.36	.68	.56	.75
Malad	43	15.01	1.42	1.32	1.26	1.55	1.30	1.16	.99	.95	1.13	1.25	1.29	1.39
Oakley	56	10.20	.76	.76	.81	1.14	1.30	1.10	.62	.60	.76	.92	.77	.65

The north-central part of the Snake River Plain, which lies west of Idaho Falls and north of the Snake River, is the driest part of the area, as it receives less than 10 inches of precipitation in most years. The Twin Falls Grazing District, which lies south of the Snake River, has a range in annual precipitation from 10 to 16 inches, and much of the district has an average annual precipitation in excess of 13 inches. The Wood River Grazing District, which extends from the Snake River Plain northward to the foothills of the mountains near Fairfield and Hailey, has a wide range in annual precipitation, from less than 10 inches to about 18 inches. The Salmon Grazing District, which occupies the intermontane valleys north of the Snake River Plain, is mostly in the rain shadow of high mountain ranges and receives less than 10 inches of precipitation annually. However, the valley floors in this district receive runoff from the mountains, where precipitation exceeds 30 inches in some localities.

EVAPORATION

Annual evaporation rates from class–A evaporation pans at stations on the Snake River Plain range from less than 3 to about 6 feet (Stearns and others, 1938). More recent studies of average annual lake evaporation (Kohler and others, 1959) show that the annual rate of evaporation in southern Idaho ranges from 26 inches in the mountains to 40 inches in the valleys near the Utah boundary. Evaporation rates from open-water surfaces on the Snake River Plain range from 32 to 36 inches annually. Although these rates are for open-water surfaces rather than from soil and vegetation, they serve to emphasize the need for moisture conservation in this area of scant precipitation.

GEOLOGY

Field study of the geology was confined mainly to a few small areas where examinations were made for proposed wells. The data gathered at these widely scattered locations are discussed later in the report. Most of the material concerning the general geology and stratigraphy was compiled from the available geologic literature. The rocks exposed in the southern part of Idaho (pl. 29) range in age from Precambrian(?) to Recent. The older rocks are exposed in the mountains, and the younger rocks, mainly of late Tertiary and Quaternary age, crop out on the Snake River Plain and in the valleys of tributary streams.

GENERAL FEATURES

Regional subsidence of the Snake River Plain, accompanied by faulting at the margins, formed the Snake River downwarp (Kirkham, 1931). This structural depression was filled with post-Miocene volcanic rocks and interbedded sediments. Subsidence continued intermittently until Pleistocene time, so that the rocks filling the depression are downwarped in varying degree and are locally broken by faults. The basalt flows that cover the Plain are nearly all Pleistocene and Recent in age and except for minor faulting are relatively undisturbed.

The mountains that border the Snake River Plain on the south and extend into Nevada were formed by block faulting in late Tertiary time. The fault-block mountains, which are uplifted and deeply dissected, consist principally of metamorphosed Precambrian(?) and Paleozoic sedimentary rocks and Cretaceous(?) granite. The intermontane valleys are partly filled with late Tertiary and Recent volcanic rocks, alluvium, and lacustrine deposits. In the areas discussed in this report, the rocks exposed in the mountains are chiefly limestone and quartzite. These rocks yield only small quantities of water at the depths feasible for stock and domestic wells. However, they are important in the hydrology of the area because much of the precipitation on them travels through solution openings and fractures to replenish the ground-water reservoirs of the valleys (Crosthwaite, 1957).

North of the Snake River Plain are the folded and overthrust mountain ranges of the Northern Rocky Mountains. The rocks in this area include Precambrian(?) and Paleozoic sedimentary rocks, Cretaceous(?) granitic rocks, and Tertiary basalt flows interbedded with small amounts of tuff and gravel. Some glacial and alluvial deposits of Pleistocene and Recent age and a small amount of Quaternary basalt are also in the area. Small masses of granite, which were intruded into the sedimentary rocks in late Mesozoic time, are outlying parts of the Idaho batholith. During and after the batholithic intrusions, orogenic forces produced a series of overturned folds in the sedimentary rocks which in places pass into overthrust faults. During the Tertiary period volcanic rocks accumulated to a depth of several thousand feet.

The distribution of the rocks and their stratigraphic relation are shown on the geologic map (pl. 29).

STRATIGRAPHIC UNITS AND THEIR WATER-BEARING CHARACTERISTICS

The principal aquifers in the area are the basaltic flow rocks and the associated ash and cinder beds, which generally yield ample supplies of water for stock use. Rhyolitic rocks and tuffs may yield moderate amounts of water to stock wells where fracturing has increased transmissibility. Alluvial deposits in the larger tributary valleys may also yield small amounts of water where drainage areas are sufficiently large to recharge the alluvium.

Tertiary volcanic rocks and associated sedimentary rocks overlie the Cretaceous(?) granitic rocks in most places in southern Idaho. The rhyolitic rocks of late Miocene age (H. Malde, oral communication, 1960) are the oldest rocks in this sequence. They consist of flows of rhyolite and basalt interbedded with lake beds and a terrestrial series. The volcanic rocks are generally fine grained and massive. The lake beds and terrestrial series consist of sequences of sandstone, shale, and water-laid pyroclastic rocks. The total thickness of the rhyolitic rocks is several thousand feet. These rocks are found in the mountains both north and south of the Snake River Plain and they are not important as aquifers.

The silicic volcanic rocks are probably early Pliocene and may be equivalent to volcanic rocks in the Salt Lake formation of Pliocene age farther east (Mapel and Hail, 1960). These rocks border the Snake River Plain on the north and the south. North of the plain, the rocks are erosional remnants found on the southward-facing slopes of the mountains. On the southern side of the Snake River Plain, the silicic volcanic rocks appear on the ridges of the mountains extending into the Snake River downwarp, on the crests of the mountains, and in the valleys between the ranges. Where the silicic volcanic rocks are highly fractured, they are permeable and yield large amounts of water to wells (Littleton and Crosthwaite, 1957).

The Idaho group (Cope, 1884) of Pliocene and Pleistocene age overlies the silicic volcanic rocks and the rhyolitic rocks and is confined to the part of the Snake River Plain generally west of Hagerman Valley.

The Idaho group is mainly a poorly to well-stratified terrestrial and lake deposit. The formation consists of lenses, tongues, and sheets of clay, silt, sand, and sandstone. A few beds of relatively pure ash and diatomite are scattered throughout the section.

Water can be obtained from permeable beds of sand and sandstone, thick lenses of sand or ash, and channel deposits and from the contact zones between the basalt and tuff beds (Littleton and Crosthwaite, 1957). Most of the outcrop area of the Idaho group is west of the area discussed in this report.

The Snake River group is Pleistocene and Recent and is a succession of flows that cover the surface of much of the Snake River Plain. It consists mainly of fine-grained dense dark-gray to black olivine basalt. Columnar jointing, vesicles, and a pahoehoe surface are common features. The basalt of the Snake River group is as much as 1,000 feet thick but is generally less than 400 feet. Intercalated with the basalt flows are layers of tuff, loess, and pediment gravel.

The Snake River group is highly permeable in most localities because of fracturing and permeable interflow cinder beds. It yields large quantities of unconfined ground water to wells and is the most productive aquifer on the Snake River Plain.

The alluvial deposits of late Pleistocene and Recent age consist of pediment gravel, alluvial fans, valley alluvium, and slope wash.

The terrace gravel, which is at various heights above the streams, consist mainly of cobbles, coarse gravel, and some sand. These deposits are generally less than 50 feet thick and are poor aquifers except for those at scattered localities that contain bodies of perched water.

The alluvial-fan deposits lie along the mountain fronts, especially north of the Snake River Plain. These deposits consist of cobbles, sand, and silt derived from sedimentary and igneous rocks. These deposits are good aquifers, especially for stock wells where high yields are not required.

The stream deposits, or valley alluvium, are generally coarse material deposited along the principal stream valleys. The material is derived from many sources and consists generally of sand, silt, and well-worn gravel. Fine-grained slope wash interfingers with the stream deposits along the valley margins. The thickness of the alluvium seldom exceeds 50 feet (Littleton and Crosthwaite, 1957). In localities where the recharge area is sufficiently large, the alluvium contains unconfined ground water and is a productive aquifer, especially for stock water.

OCCURRENCE AND DEVELOPMENT OF GROUND WATER

The possibilities of developing ground water on the public domain lands vary from excellent to very poor. At most places in the Snake River Plain where the jointed basalt and interflow scoriaceous zones are aquifers, the depth to water is moderate. Also, in the wells that are drilled in sand and gravel aquifers, yields are generally ample for stock use. Prediction of ground-water occurrence in the rhyolitic and silicic volcanic rocks is commonly difficult because the presence of water is dependent on fracturing not visible at the surface. The limestone and quartzite exposed in the mountains is generally not water bearing.

TWIN FALLS GRAZING DISTRICT

The Twin Falls Grazing District includes the public domain lands, except national forests, south of the Snake River in the south-central part of Idaho between Salmon Falls Creek on the west and an irregular boundary on the east that approximately follows long 112°15′ W. (See fig. 70.) Much of the grazing land administered by the Bureau of Land Management is interspersed with privately owned irrigated farmland and with national forests, which are in areas of low precipitation and with undeveloped water resources.

At the request of the Bureau of Land Management a reconnaissance of geology and of hydrologic conditions was made in five areas considered to be in need of an adequate water supply to improve management practices. These areas are (a) Castleford, (b) Shoshone basin, (c) South Walcott, (d) Blue Spring Hills, and (e) Juniper-Black Pine. (See pl. 30.) In addition, five scattered sites were examined. Because of the diverse geology and hydrology among these areas, each will be considered separately.

CASTLEFORD AREA

The Castleford area is about 10 miles southwest of Twin Falls, Idaho, and occupies parts of T. 10–12 S., R. 13–16 E. It is bounded on the east by U.S. Highway 93 and on the west by the canyon of Salmon Falls Creek; it extends from Castleford on the north to Hollister, Idaho, on the south. (See pl. 30.) Within this area is a tract of public domain from which the brush will be cleared and which will then be seeded to wheatgrass to increase the grazing capacity. To utilize the seeded area efficiently, wells or other sources of stock water must be developed.

The area proposed for the seeding program is on a gently rolling plain underlain by Snake River group. The basalt is irregularly exposed between large areas mantled by wind-blown sand and silt. At the western edge of the area, detrital deposits may interfinger with the basalt flows. Scoriaceous zones and intercalated tuff beds within the basalt flows are generally permeable. Fractures in the basalt also permit free movement of ground water. Although there are no wells in the area proposed for seeding, many wells in the farming areas to the north and south obtain water from the basalt and so provide an index to the ground-water possibilities. (See table 3.)

The data in table 3 indicate that the water table in the Snake River group in the northern part of the area slopes generally to the south. The probable reason for this condition is that recharge from seepage into the basalt from irrigation canals and lateral ditches has raised the water level in most wells north of the Highline Canal (pl. 29). A local resident reports that the water level in his well (well 3) has risen more than 100 feet since it was drilled in 1919. In the seeding area, which is not irrigated, water levels will probably be lower.

Hollister 2 well along Deep Creek (table 3) near the southern edge of the area taps a body of perched water in the valley alluvium. The water level in this well is not typical of the water level in the greater part of the area.

No specific locations were selected for drilling wells in the seeding area. However, because the data gathered from nearby wells indicate a water table in the area, ground water should lie at moderate depths at any location deemed most suitable for land-management practices. In the valley of Deep Creek in the southern part of the area, the water table in the valley alluvium possibly may be 100 feet or less below the land surface. Elsewhere in this area, in the Snake River group or Hagerman lake beds (of former usage), the water table probably is 350 to 500 feet below the land surface. Holes drilled at lower altitudes will probably reach water at shallower depths.

SHOSHONE BASIN AREA

Shoshone Basin is the name applied to an administrative unit of the Bureau of Land Management occupying the upper part of Shoshone Creek basin just north of the Nevada boundary and about 5 miles east of Idavada, Idaho. (See pl. 30.) The area is within the Basin and Range province and includes several wide, relatively flat valleys separated by north-trending fault-block ridges. Two of these valleys in the Shoshone Basin have been cleared of sagebrush cover One valley, White Rock seeding area (pl. 30), has been planted to crested wheatgrass, and another, the Barton area, is proposed for seeding. The soils on the valley alluvium and the colluvium derived from the ridges support a good growth of vegetation. The White Rock seeding area has been successful, and the Barton area appears to be equally favorable, but the lack of an adequate supply of water for livestock has restricted the utilization of the improved range.

Shoshone Creek, which flows through the southern part of the area, is a perennial stream fed largely by Magic Hot Springs. The channel is not accessible to the seeding areas and cannot be readily used as a water supply. There are three permanent springs in the area, but only one, Rock Cabin Spring in the SE¼ sec. 21, T. 16 S., R. 16 E., is close enough to serve part of the Barton seeding area. Therefore, it was necessary to explore the possibility of ground-water development in both areas.

WHITE ROCK SEEDING AREA

The White Rock seeding area includes about 3½ square miles in T. 16 S., R. 16 and 17 E. (See pl. 30.) The proposed well site is near the center of the area, about 1¼ miles north of Shoshone Creek and about two-thirds of a mile east of a ridge that appears to be a low fault scarp in the SW¼ sec. 7, T. 16 S., R. 17 E. To the east and west, the seeding area is bounded by ridges composed of Tertiary rhyolitic flows. These flows are thinly bedded and permeable, at least in part, as indicated by the springs along the edges of the valley. The valley floor is underlain by alluvium, which is probably too thin to retain a perennial supply of ground water. Beneath the alluvium the rhyolitic rocks of probable early Pliocene age extend to undetermined depths.

At the time of the reconnaissance little was known of the permeability of the rhyolitic rocks. However, because of the urgent need for water an exploratory hole was drilled. The land surface at the site is about 220 feet higher than the channel of the perennial Shoshone Creek; therefore, drilling to a depth of 300 feet should have been an adequate test of the rocks.

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A successful well was completed at the site of the exploratory hole in October 1958 (well 7, table 4). The total depth of the hole is 160 feet, and the static water level was 136 feet below the land surface at the time of drilling. The driller's log is in table 5. After penetrating 5 feet of broken rock and alluvium, 138 feet of tan to gray volcanic ash or tuff was penetrated. At a depth of 143 feet below the land surface solid rock was struck; the driller lists it as black rhyolite. This rock is probably a dark vitrophyre that commonly caps the Tertiary silicic volcanic rocks in Owyhee County, Idaho. The volcanic ash and tuff beds are generally relatively impermeable, and water entered the well at the contact between them and the vitrophyre. The yield of this well, as shown by a bailing test, is about 13 gpm.

BARTON SEEDING AREA

The Barton seeding area is in secs. 22 and 23, T. 16 S., R. 16 E., and consists of about 500 acres on the valley floor that has been stripped of sagebrush cover and planned for seeding to crested wheatgrass. The Barton area is about half a mile southwest of the White Rock seeding area. To utilize the expected improved forage resulting from the seeding, a stock-water supply must be developed. The Bureau of Land Managament preferred a well, and a reconnaissance of the area was made to evaluate the possibility of ground-water development.

A well site was located in the NW¼ sec. 23, T. 16 S., R. 16 E. (pl. 30), near the center of a valley that is about 2 miles wide and is bounded on the east and west by ridges composed of rhyolitic rocks. Examination of the area showed that these ridges are defined by normal faults. The valley fill, of unknown depth, consists of alluvial-fan deposits and minor amounts of wind-blown material.

An ephemeral stream, Lost Creek, flows southward at the eastern edge of the valley. There are two springs in the vicinity of the well site; Rock Cabin Spring is about 1 mile west-southwest of the site at an altitude of about 5,800 feet, and State Line Spring is about 2 miles southwest of the site at an altitude of about 5,430 feet. (See pl. 29.) The altitude of the land surface at the well site is about 5,670 feet; thus, the Rock Cabin Spring is higher than the site and the State Line Spring is lower. Therefore, the water table should be 200 to 250 feet below the land surface at the well site in the valley fill. Geologic structure and stratigraphy in the Barton seeding area, in general, are similar to the White Rock seeding area, where a successful well has already been drilled. The major difference between the two areas is the probably greater thickness of unconsolidated valley fill in the Barton area.

HUB BUTTE SEEDING AREA

The Hub Butte area is about 8 miles south of Twin Falls, Idaho, in sec. 5, T. 12 S., R. 17 E. Hub Butte is a broad, cone-shaped hill that stands about 200 feet above the surrounding lava plain. It is one of many similar features that dot the Snake River Plain and is a shield-type volcanic cone. A small area on the gently sloping south and west margins of the butte has been cleared of sagebrush cover and seeded to crested wheatgrass. Development of a stock-water supply is necessary for utilization and management of the area now that the forage is improved.

The depth to ground water in the surrounding area varies greatly. (See table 3.) South of the recommended well site, which is in the NW¼ sec. 5, T. 12 S., R. 17 E., the depth to water ranges from 90 to 130 feet, whereas north of Hub Butte at the Bellville well (no. 8, table 3 and pl. 29) water is pumped from 480 feet, and the total depth of the well is 655 feet. The wide range in water levels may be attributed to variations in permeability in the basalt flows or in the sediments underlying the area; irregularities in the buried erosional surface on the Tertiary silicic volcanic rocks or faulting that is not exposed may produce barriers to ground-water movement.

Data from wells (table 3) indicate that the Snake River group contains an adequate supply of ground water for livestock. Permeability may vary from place to place in the flows because of differences in jointing and vesicularity. Also, ash beds overlying and interbedded with the Tertiary silicic volcanic rocks are thicker in the Hub Butte area than in areas farther west in Owyhee County (H. T. Powers, oral communication, 1960) and probably are tapped by many wells for which logs are not available.

In the opinion of the author, the only uncertainty involved in drilling an exploration well in the Hub Butte seeding area is an accurate forecast of depth to water. This is caused by an erratic distribution of aquifers in the underlying rocks. However, an adequate supply of water for livestock probably is less than 500 feet below the land surface.

OAKLEY SEEDING AREA

The Oakley seeding area is about 5 miles south of Oakley, Idaho, on an upland area overlooking lower Goose Creek valley. The altitude of the area is about 5,000 feet, about 500 feet higher than the flood plain of Goose Creek near Oakley. Ground-water conditions in the Oakley district, which occupies part of the lower Goose Creek valley, are described by Crosthwaite (1957, p. 124–126). The water levels in the irrigated area along Goose Creek, however, are probably not related to those in the upland seeding area.

The upland area south of Oakley slopes to the north toward Goose Creek valley and is mantled by alluvium and colluvium of undetermined thickness. Underlying this detrital mantle is the Salt Lake formation of Pliocene age, which is composed of fine-grained lake beds, volcanic ash, and interbedded welded tuff (Mapel and Hail, 1960). The water-bearing characteristics of these beds in this area are not well known, but the volcanic-ash beds yield generally large amounts of water to wells in other parts of southeastern Idaho. Most of the ground water that is pumped for irrigation in the Oakley district is obtained from alluvium (Crosthwaite, 1957).

About 1 mile downstream from the Oakley dam in the SW¼ sec. 17, T. 14 S., R. 22 E., on the Kelly Poulson ranch, a well has been drilled for domestic use. (See table 3.) The altitude of the water level in this well, about 4,540 feet, is considered to be an indication of the altitude of the water table in Goose Creek canyon. The water level in Goose Creek Reservoir, which was at an altitude of 4,750 feet on May 5, 1958, is probably indicative of the water table in the area above the dam. The water level in the vicinity of the proposed site, which is in the NE¼SE¼ sec. 29, T. 14 S., R. 22 E., probably lies below the level of the reservoir and not much higher than the water level in the Poulson well.

A well was drilled at the proposed site in May 1958 to a total depth of 565 feet, and the rocks penetrated were composed chiefly of volcanic ash and intercalated layers of welded tuff of the Salt Lake formation. The static water level in the well is 540 feet below the land surface, which is at an altitude of about 4,470 feet. The volcanic-ash beds and welded tuff must be more impermeable than supposed because the water level in the well in the Oakley seeding area is much lower than that in the Goose Creek Reservoir or in the Poulson well.

SOUTH WALCOTT AREA

The South Walcott area is a basalt plain of low relief south of Lake Walcott. (See pl. 30.) The Snake River group is irregularly exposed between large areas mantled by wind-blown material and alluvium. Well logs indicate that basalt underlies the entire area to a depth of at least 400 feet (Crosthwaite, 1957). On the east side of the area, lake sediments and alluvium of the Raft River are interfingered with the Snake River group. The geology and ground-water hydrology of the South Walcott area have been described in a general way by Crosthwaite (1957, p. 128–129). The present report describes two small tracts of public domain within the South Walcott area that have been seeded to crested wheatgrass by the Bureau of Land Management and are in need of a ground-water supply in order to utilize the improved forage.

Unconfined ground water occurs in fractured basalt, cinder beds, and alluvium south of Lake Walcott (Crosthwaite, 1957). Water levels in 7 wells visited in the area ranged from 127 to 267 feet below the land surface (table 3). As indicated by wells in the northern part of the area (Nos. 14–18), the altitude of the water level ranges from 4,170 to 4,197 feet. The water levels are at higher altitudes in the Anderson and Werner wells (Nos. 19 and 20), which are on higher ground. This might indicate a general northward movement of ground water in the area, but Crosthwaite found (1957, p. 129) that ground water moves from the northeast, east, and south toward the central part of the South Walcott area. In the western part of the area, ground water moves toward the Snake River and Burley, Idaho. Crosthwaite also states that the surface of Lake Walcott is above the regional water table, and leakage from the lake may provide a substantial amount of recharge to the ground-water reservoir. Although most of the wells have been drilled along the margins of the area, well data indicate that the water table probably lies at moderate depths throughout the area.

The two tracts of land that have been seeded to crested wheatgrass are here called the Highway and Basalt seeding areas. The Highway area includes about 5,000 acres in the southern part of T. 9 S., R. 26 E., and the Basalt area includes about 3,200 acres in the southwest part of T. 10 S., R. 27 E. (See pl. 30.) Two wells were drilled at recommended sites (Nos. 21 and 22) in 1959 and 1960, one in each of the seeding areas, and both yield sufficient quantities of ground water for stock use. (See table 4.) The rocks penetrated at both sites were alternating beds of basalt and cinders. Further development of ground-water resources for livestock in the South Walcott area probably will meet with no unusual drilling problems; the depth to water should not exceed 300 feet and at most locations should be less than 250 feet.

JUNIPER-BLACK PINE AREA

The Juniper-Black Pine area lies along the Utah border in southwestern Oneida County, Idaho. (See pl. 30.) The entire area is within the Basin and Range province (Fenneman, 1931) and is composed of ranges of faulted limestone hills that separate broad, flat valleys. The fault-block hills are composed of undifferentiated Carboniferous sedimentary rocks, mostly limestone and some quartzite. Underlying the valleys to an undetermined depth are lake beds of Tertiary and Quaternary age and Recent alluvium. The lake beds, some of which may be part of the Salt Lake formation of Pliocene age, are composed chiefly of clay and fine gravel.

Unconfined ground water occurs in the alluvial deposits and lake beds in the valley between Juniper and Black Pine. Little is known, however, of the occurrence of ground water in the canyons or mountain areas underlain by limestone and quartzite. Faulting, fracturing, and solution openings, however, probably drain any precipitation on the upland areas.

The Bureau of Land Management requested an investigation of the area to determine the possibility of ground-water development. Three specific areas were examined, two on the lake beds and one in a canyon in the limestone terrane. The three areas proposed for ground-water development are included in the seeding program of the Bureau of Land Management, which is designed to improve grazing by increasing forage on the public domain.

WIGHT SEEDING AREA

The Wight seeding area is in the northeastern part of T. 15 S., R. 30 E., on a broad flat valley floor underlain by unconsolidated lake sediments. The valley is bordered by fault-block limestone hills along which are alined well-defined shoreline terraces remnant from the pluvial lake that occupied the valley in Pleistocene time.

No perennial streams cross the valley floor. Any runoff from the mountains that reaches the edges of the valley floor moves through the alluvium and lake sediments to recharge the ground-water reservoir in the valley.

There are six wells in the vicinity of the Wight seeding area (Nos. 23–28, table 3), four of which are currently in use. The abandoned wells, drilled by early homesteaders, are still potential sources of ground water if properly rehabilitated.

The depth to ground water in the six wells ranges from 60 to 341 feet. The average depth to water is about 320 feet, if the Bouwhuis well, in which the depth to water is 60 feet, is excluded. The Bouwhuis well is near the west edge of the basin near the faulted limestone hills, and a spring 1½ miles west of the well, flowing 3 gpm, is probably a fault-line spring. Therefore, the water table in the vicinity of the Bouwhuis well may be perched and is not representative of the water level in the central part of the basin.

A site for exploratory drilling was selected by the author and personnel of the Bureau of Land Management in the SW¼ sec. 11, T. 15 S., R. 30 E., in the central part of the seeding area (well No. 31, pl. 29). A well was drilled to a total depth of 428 feet at this location in 1959. The log of the well indicates that all the beds penetrated consisted of clay and fine gravel of Quaternary lake beds and associated alluvium. Ground water, reached at a depth of 397 feet, rose to a static level 387 feet below the land surface.

Data from all the wells in the basin indicate that ground water in the lake beds is moving southward from the north and west margins. However, there are not enough wells to determine accurately the origin or destination of the ground water.

GLEN CANYON AREA

The Glen Canyon area is about 4½ miles north of Juniper, Idaho. The Bureau of Land Management plans to strip the sagebrush cover from a tract of public land on the canyon floor and to seed it to crested wheatgrass. This area is in sec. 15, T. 14 S., R. 30 E. (See pl. 30.) In order to utilize this grazing land, a permanent source of water for livestock will have to be developed.

Little is known of the occurrence of ground water in the canyon, but the meager data available indicate that possibilities of obtaining a well are poor. Quaternary alluvium 10 to 40 feet thick and undifferentiated Carboniferous sedimentary rocks, chiefly limestone, of unknown thickness underlie the canyon floor. The moderately to steeply sloping canyon walls are composed of highly fractured and faulted, westward-dipping, limestone beds. Glen Canyon appears to be formed along a northeastward-trending fault. The combination of these factors greatly diminishes the possibility of a water table in the canyon or of underflow in the stream channels. In 1951 an oil test well was drilled in Glen Canyon in sec. 11, T. 14 S., R. 30 E., by the Phillips Petroleum Company. Several attempts were made by the oil company to obtain water for drilling by shallow exploration in the vicinity of the proposed seeding area. None of these attempts were successful.

No perennial streams are in the canyon or its tributaries, and the ephemeral flow is too sporadic to justify construction of a surface reservoir. The best prospect in the canyon for developing a water supply for livestock is a small spring in the SW¼ sec. 11, T. 14 S., R. 30 E., that issues on the canyon floor about 1 mile northeast of the proposed seeding area. The flow of the spring averages about 1 gpm, varying with the amount of precipitation in the area. Reports indicate that the spring does not flow in the late summer. The source of the spring water is probably a small block of alluvial material in the canyon wall that has been isolated by faulting. A covered storage tank of large capacity could provide sufficient water for use in late summer when the spring flow decreases or stops. The spring is estimated to yield in excess of 100,000 gallons in an average season.

Glen Canyon is typical of many tributaries that drain the limestone hills along the periphery of the Juniper-Black Pine basin. Thousands of acres of public domain grazing lands in the limestone hills cannot be properly utilized because of the lack of a suitable water supply. Although not all the canyons were examined during this investigation, small, undeveloped springs probably exist in many places because of the intense faulting in the area. The recharge areas for these springs may be small, but by providing some type of storage facilities, such as those recommended for the Glen Canyon area, the critical problem of a shortage of water for livestock might be alleviated to some extent.

STONE SEEDING AREA

The Stone seeding area is about 9 miles southeast of the Wight seeding area on the west edge of Deep Creek valley. The topography and geology in the Stone area are about the same as that in the Wight and Glen Canyon areas. The tract of land proposed for seeding by the Bureau of Land Management is in a small valley underlain by highly faulted limestone beds of Carboniferous age that dip to the southwest at a low angle. A fault scarp on the eastern edge of the limestone hills follows a north-south line that approximately coincides with the range line between R. 31 E. and R. 32 E. East of the fault the valley of Deep Creek, known locally as Curlew Valley, is underlain by Quarternary lake beds of undetermined thickness. The valley is about 4 miles wide, and the water table in the lake beds is relatively uniform in altitude, 150 to 170 feet below the land surface.

A well site was selected in sec. 7, T. 16 S., R. 32 E. The records of two wells (Nos. 29 and 30) drilled in the lake beds near this site are given in table 3. The Stocker well was drilled as an irrigation well on a desert-entry permit and was drilled probably deeper than would have been necessary for a stock-water supply. Both the Stocker and Gap wells are about 100 feet lower in altitude than the land surface at the proposed site in the Stone seeding area. Prospects are good for obtaining water for stock use at this site at a depth of about 250 feet in the lake beds. Most of the seeding area is west of the fault in the limestone hills, but drilling in the limestone does not seem advisable because the faulting, jointing, and solution openings probably transmit ground water out of the area.

BLUE SPRING HILLS AREA

The Blue Spring Hills are a northward-trending range of mountains about 10 miles west of Malad City, Idaho. (See pl. 30.) The mountains are composed chiefly of limestone beds of Carboniferous age that have been folded and faulted. The entire range is a series of fault blocks that have been tilted to the southwest. The east slope of the range is dissected by several canyons that are tributary to the Little Malad River and are generally without water except for snowmelt seepage from localized pockets of alluvium that have been isolated by faulting. The small flow and seepage provided by snowmelt generally lasts only until June. Water is most urgently needed in the canyons and on the mountain slopes during middle and late summer, when the area is used for grazing.

Little is known of the occurrence of ground water in the undifferentiated Carboniferous limestone and quartzite but a reconnaissance of the rocks in the Blue Spring Hills indicates that conditions are unfavorable for storage or recovery of water. The limestone is fractured, jointed, and faulted and yields water to some small springs in the area, but most of the precipitation on the uplands is probably transmitted to the intermontane valleys.

The Bureau of Land Management requested an examination of four specific areas and an evaluation of the possibility of stock-water development. All the areas are along the eastern slope of the Blue Spring Hills in the canyons that drain the mountains. The geology and the possibility of ground-water development are similar in each of the four areas. Their locations are: (a) Daniels Canyon in the SW¼ sec. 21, T. 13 S., R. 34 E.; (b) Morgan Jones Canyon in the SW¼ sec. 21, T. 13 S., R. 34 E.; (c) John Evans Canyon in the NE¼ sec. 5, T. 14 S., R. 35 E.; and (d) Ireland Canyon in the NE¼ sec. 35, T. 14 S., R. 33 E. (See pl. 30.)

The Daniels Canyon site is in one of a group of canyons that drain the Blue Spring Hills along the western edge of the Little Malad River valley. Thin-bedded limestone, which dips steeply to the southwest, is exposed on both walls of the canyon. The canyon floor is about 200 feet wide and is underlain by alluvium less than 40 feet thick. A well drilled on the canyon floor near the proposed site was abandoned at a depth of about 40 feet when limestone was reached. Any underflow in the thin alluvial mantle is probably drained through the fractured and jointed limestone.

The reconnaissance of the Daniels Canyon area indicates that the possibility of developing ground water is unfavorable.

The Morgan Jones Canyon site is about 6 miles south of the Daniels Canyon site, and geologic conditions at the two sites are similar. The canyon floor is about 300 feet wide, and the alluvial mantle is 45 to 50 feet thick, based on measurements in a dug well near the site. The recharge area is approximately 6 square miles of mountainous terrain that receives abundant snowfall during the winter. Although much of the snowmelt probably drains through the limestone of the canyon floor, quantities sufficient for livestock probably reach the site. Water stood in the dug well in May 1958, and local residents report that water is available in the well until June or July each year. Because water is urgently needed in this canyon for late summer use, development of this supply for storage is recommended. Deeper drilling in the limestone beds probably will not yield additional quantities of ground water.

At the site in John Evans Canyon, the canyon floor is underlain by about 350 feet of Recent alluvium and Pleistocene lake beds, and the canyon walls are composed of southeastward-dipping limestone beds. The thickness of the unconsolidated deposits at this location, coupled with a recharge area that is much larger than those at the two sites just discussed, makes the possibility of ground-water development more favorable.

A well here called the Henry Jones well (No. 32, table 3), is about one-quarter of a mile north of the site in the SE¼ sec. 32, T. 13 S., R. 35 E. This well, no longer in use, is on a lake terrace on the north side of the canyon. The altitude of the land surface at this well is about 25 feet higher than the land surface at the proposed site. The depth to water in the Henry Jones well is 306 feet, and, if the altitude of the water table in the canyon fill is fairly uniform, a drill hole at the proposed site should reach water at a depth of about 330 feet.

The location proposed for development of ground water in Ireland Canyon is on the canyon floor on the west flank of the Blue Spring Hills. (See pl. 30.) Alluvium in the canyon is probably less than 300 feet thick, and the canyon walls are composed of limestone that is fractured and faulted. A fault crosses the canyon about 700 feet west of and slightly downstream from the proposed site. If the fault acts as a barrier to the movement of ground water, a perched water body that could provide sufficient water for stock use may be present east of the fault. In order to take advantage of this ground-water source, the hole must be drilled east of the fault and not more than a few hundred feet west of a line between secs. 35 and 36, T. 14 S., R. 33 E. If water-bearing beds are not penetrated within 400 feet of the land surface, deeper drilling probably would not be successful.

WOOD RIVER GRAZING DISTRICT

The part of the Snake River Plain between Bliss and Dietrich, Idaho, on the north side of the Snake River is a nearly featureless lava plain sloping gently westward. The public domain lands in this area include 1,603,794 acres and are in the Wood River Grazing District. (See fig. 70.) The Big Wood and Little Wood Rivers are the major drainage courses on the highly permeable basalt surface.

Early and late Pleistocene basalt flows are exposed in most of the area. In small areas the volcanic rocks are covered by a thin mantle of wind-blown sand and dust. The younger flows show little evidence of weathering, and the older rocks have only thin soils. The Idaho Group, which is composed of poorly to well stratified terrestrial and lake deposits, underlies the basalt of the Snake River Group near Bliss, Idaho, and is exposed on the flanks of an isolated mesa in sec. 13, T. 5 S., R. 12 E.

HYDROLOGY

Ground water occurs in fractured basalt, scoriaceous zones, cinder beds, and intercalated sedimentary deposits and may be either unconfined or under slight artesian pressure. According to Stearns and others (1938), the water table in this area ranges from 140 to 400 feet below the land surface. However, five wells that were drilled at scattered locations in the area (table 4, Nos. 35–39) obtained water under slight artesian pressure at depths ranging from 222 to 606 feet. The sites are described below.

MONUMENT BUTTE AREA

Monument Butte is about 12 miles south of Carey, Idaho, in T. 3 S., R. 21 E. (pl. 29), in the northeast corner of Lincoln County. Monument Butte is a volcanic cone that rises about 200 feet above the lava plain, which extends several miles in all directions.

The lava flows exposed near Monument Butte are composed of basalt of Pleistocene age. In most places the flows are covered with wind-blown sand and silt, which support vegetation composed predominantly of sagebrush and other shrubs of the northern-desert type. Also, large tracts of bare rock have been swept clean by wind action. The high permeability of the surficial mantle and jointed basalt allow little runoff from the area.

Although little information is available concerning the depth to ground-water in the Monument Butte area, estimates may be made.

Small springs discharge from the basalt on the eastern flank of Monument Butte in sec. 6, T. 3 S., R. 22 E. These springs, known locally as Old Indian Wells, are the result of the melting of ice in caverns within the basalt flows and, therefore, represent a perched water body. Perched water is common in this area. Water from these springs is generally of insufficient quantity to be recovered in a well.

A dry hole in sec. 16, T. 2 S., R. 21 E., was drilled reportedly to a depth of 400 feet. The hole is badly caved and could not be measured. A well at Tikura, Idaho, in the SW¼ sec. 25, T. 2 S., R 20 E., reached water at a depth of 161 feet below the land surface at an altitude of about 4,540 feet. A map prepared by Stearns and others (1938) showing water-table contours indicates that the altitude of the water table at the southern part of T. 3 S., R. 21 E. may be about 4,300 feet.

The Bureau of Land Management requested that a geologic examination be made of the area in the SW¼ sec. 15, T. 3 S., R. 21 E., west of Monument Butte, for the purpose of drilling a stock-water well. After a brief reconnaissance the author estimated that a well drilled in this area might obtain water in sufficient quantities for livestock at a depth of less than 400 feet below the land surface. A well was drilled in August 1957, but it was necessary to drill to a depth of 606 feet before reaching water. The rock penetrated consisted of basalt flows and interflow zones of scoria and cinders.

BRAILSFORD ALLOTMENT

The Brailsford allotment is in sec. 30, T. 2 S., R. 17 E., Camas County, Idaho, and is part of the public domain administered by the Bureau of Land Management. A request was made by the Bureau of Land Management to have an examination made of the area for the purpose of developing a stock-water well.

The allotment is on a flat valley floor that is bounded on the east and west by escarpments about 100 feet high. These escarpments, which are formed by normal faulting, are composed of flows of Snake River group overlying silicic volcanic rocks of Tertiary age. Many faults in the area trend generally northwest; and, along the west edge of sec. 30, T. 2 S., R. 17 E., the silicic volcanic rocks have been brought to the surface, and the overlying Snake River group has been removed by erosion. The eroded surface of the silicic volcanic rocks evidently had high relief, and small isolated outcrops that were not buried by the basalt flows are exposed in sec. 25, T. 2 S., R. 16 E. The silicic volcanic rocks are not considered to be good aquifers, but the basalt of the Snake River group is generally water bearing if it is not drained by fractures and faults.

A well on the valley floor in the NW¼ sec. 6, T. 3 S., R. 17 E. was drilled reportedly to a depth of 475 feet and yields an adequate supply of ground water for livestock. The altitude of the land surface at this well is about 5,550 feet, and the water level stands at an altitude of about 5,075 feet.

A site was selected for a stock-water well in the SW¼ sec. 30, T. 2 S., R. 17 E., on the assumption that the water level would be at a uniform depth beneath the valley floor in places where the silicic volcanic rocks did not lie close to the surface. The altitude of the land surface at this location is about 5,500 feet. Therefore, it was estimated that water would be reached at a depth of about 475 feet. The well was drilled in August 1957 to a depth of 500 feet and yields an adequate supply of water for livestock. The water level in the well stands at 415 feet or an altitude of 5,085 feet. A driller's log is not available for this well, but it is assumed that no silicic volcanic rocks were penetrated.

DIETRICH BUTTE AREA

The Dietrich Butte area is about 8 miles directly east of Shoshone and about 4 miles northeast of Dietrich, Idaho. The area is underlain by basalt flows of Pleistocene age. Dietrich Butte, which rises about 350 feet above the lava plains, is a broad volcanic cone with gently sloping sides. Rich but shallow soils support a luxuriant growth of grass that was seeded by the Bureau of Land Management after eradication of the sagebrush.

Data on depth to ground water are very scant in the Dietrich Butte area. Data for two wells are listed in table 3. The altitude of the water level in these wells is 3,865 and 3,825 feet. In addition to these data, the report of Stearns and others (1938) shows that the 3,900-foot water-table contour crosses the Dietrich Butte area.

The Bureau of Land Management selected a site in the NE¼ sec. 31, T. 5 S., R. 19 E., as the most desirable site for a well. This site is on the east slope of Dietrich Butte at an altitude of about 4,315 feet. The basalt flows underlying the area were assumed to have nearly uniform water-bearing characteristics, and a reconnaissance revealed no visible faults that might alter the flow of ground water. The depth to ground water below the land surface was estimated to be between 415 and 490 feet.

The well was drilled in June 1958 to a depth of 420 feet. Water was first struck at 387 feet, and after completion of the well the static water level was 376 feet below the land surface at an altitude of about 3,940 feet. The driller's log shows that the entire hole was drilled in basalt and interflow cinder beds. The water level in this well stands higher than the water level in wells 40 and 41 listed in table 3. The water level is also higher than indicated by the water-table contour map of Stearns and others (1938). This may indicate that the aquifer is perched as well as under slight artesian pressure. The artesian rise in this well is 11 feet.

WENDELL ALLOTMENT

The Wendell allotment is a community cattle pasture about 4 miles north of Wendell, Idaho, on a rocky upland area that is 120 to 150 feet higher than the irrigated valley to the south. The upland area is underlain by basaltic flows and has a gently rolling surface with a maximum relief of about 60 feet. The Wendell Grade basalt (Stearns, 1936) of Pleistocene age forms the surface and is less than 25 feet thick in most places. Underlying the Wendell Grade basalt are the older basalt flows of the Snake River. The volcanic rock outcrops are separated by shallow depressions that are partly filled with wind-blown sand and silt on which skeletal soils have formed. These areas support enough vegetation for limited grazing, but the area lacks a water supply for livestock.

Unconfined ground water occurs in the basalt at moderate depths in the area north of Wendell. Many wells in the area surrounding the pasture yield adequate supplies of ground water for domestic use and for livestock at depths of 150 to 265 feet. Wells for which data were obtained during this investigation are listed in table 3. In addition, the map of Stearns and others (1938) shows that the 3,300- and 3,350-foot water-table contours cross the area.

The Bureau of Land Management indicated that one well in the SW¼ sec. 12, T. 7 S., R. 15 E., could serve the needs of livestock in the Wendell cattle allotment. The altitude at the selected site is about 3,590 feet. From data on wells in the area and from the water-table contour map of Stearns and others (1938), the depth to ground water was estimated to be between 250 and 300 feet below the land surface. Also, the possibility was considered of obtaining, at lesser depths, ground water that has its source as seepage from irrigation canals in the area.

The well was drilled at the selected site to a depth of 250 in November 1958. The driller's log, which is included in table 5, shows that after penetrating 3 feet of soil at the surface the entire hole was drilled in basalt, interflow scoriaceous zones, and clay. The log does not indicate at what depth water was reached, but the static water level is at an altitude of 3,368 feet, or 222 feet below the land surface. Data from other wells indicate that ground water in this area is probably unconfined.

BLISS POINT AREA

The Bliss Point area is 5 miles north of Bliss, Idaho, and occupies the eastern part of a mesa that has an area of about 6 square miles. The mesa is capped by a basalt flow about 50 feet thick which is underlain by buff to brown fine-grained sedimentary rocks of the Idaho formation. The southern side of the mesa slopes gently to the edge of the Snake River canyon near Bliss, and the northern edge breaks steeply to the valley of Clover Creek. The erosion of Clover Creek valley through the basalt flow and sedimentary rocks has left the mesa as an isolated remnant of a surface that can be traced north of the valley. The eastern and western escarpments of the mesa are less steep but are well defined. The mesa surface has been stripped of sagebrush and seeded with crested wheatgrass. In order to utilize the improved pasture that has been established, a stock-water supply is needed.

No wells were in the Bliss Point area at the time of the investigation, and estimates of depths to ground water were based on a reconnaissance of the geology and on data from wells in the valley south of the mesa. Also, about 4 miles north of the area at the foot of the mesa, Clover Creek flows during most months. Three ranches at the foot of the mesa on the south side have domestic wells. (See table 3.) The water level in these wells ranges from 83 to 250 feet below the land surface, or from altitudes of 3,370 to 3,130 feet. The relatively large range in altitude of water level at these three wells is probably due to erratic distribution of permeable zones or to differences in permeability in the sediments of the Idaho group.

The Bureau of Land Management indicated that one well could supply stock water for the seeded area on Bliss Point if it were located in such a place as to allow for distribution through pipes by gravity flow. The area is divided into two parts by the north-south Hill City-Bliss road. The site selected is in the SE¼ sec. 13, T. 5 S., R. 12 E. (See pl. 29.) The altitude at this site is 3,600 feet. The minimum difference in altitude between the land surface at the selected site and a known aquifer is 313 feet, and the maximum difference is 470 feet. The difference in altitude between the land surface at the site and the water level in well 46 (table 3) is 383 feet. The difference between the site and Clover Creek on the north side of the mesa is 331 feet. The author estimated that a hole drilled at the selected site would probably reach ground water at depths of 350 to 400 feet below the land surface.

The hole was drilled in December 1959 to a depth of 418 feet; water was reached at 380 feet. The aquifer is a brown sandstone lens 58 feet thick. The static water level was 355 feet below the land surface at an altitude of 3,245 feet.

IDAHO FALLS GRAZING DISTRICT

Most of the public-domain lands in the Idaho Falls Grazing District are in the nearly featureless sagebrush-covered Snake River Plain west of Idaho Falls. (See fig. 70.) There is no surface flow over much of the area, and in the few wells that have been drilled water is pumped from depths of several hundred feet. The possibilities of ground-water development are generally good because recharge from the mountainous areas to the north to the basalt underlying the plain far exceeds withdrawal. However, the highly fractured and jointed rocks permit drainage of ground water to great depths, thus necessitating large pumping lifts. The Bureau of Land Management has not constructed many stock wells in this area because of the high cost of drilling and pumping the water. However, the author did examine two sites in the Big Southern Butte area in 1958 at the request of the bureau for evaluating the possibilities of developing ground water for stock use.

The Big Southern Butte area is on the north edge of the Snake River Plain about 20 miles southeast of Arco, Idaho. The Snake River Plain in this area is a nearly featureless lava plain of low relief. Isolated high buttes of volcanic origin, such as Big Southern Butte, serve as prominent landmarks. Shield-type volcanic cones of relatively low height and broad bases that merge into the surrounding plain are common.

The basalt flows that underlie the plain are of Pleistocene and Recent age. The volcanic sequence is composed of many flows, most of which are vesicular, having scoriaceous zones along the contacts between flows. In addition to these primary zones of permeability, a network of joints and fractures greatly expedites the movement of ground water. Although large tracts are rocky wasteland, thin soils developed on wind-blown deposits in some parts of the area support enough vegetation for limited grazing. The ranchers who use this area for grazing, however, have had to haul water for their livestock because of the paucity of wells or springs. Also, the permeable lava plain has few stream channels; thus little opportunity exists for storing runoff.

Little was known of the occurrence of ground water in the area until recent years when the Geological Survey drilled several test holes to determine water levels in the area for the National Reactor Testing Station. This station is just north of the Big Southern Butte area. As a result of the test holes, water levels in this area were determined to be generally 660 to 790 feet below the land surface, depending on the altitude of the surface and the permeability of the aquifer.

The Bureau of Land Management selected two sites where wells would be desirable to improve the management of the grazing lands. These are in the SW¼ sec. 2, T. 1 S., R. 28 E., and the SW¼ sec. 10, T. 1 N., R. 28 E. (See pl. 29.) A reconnaissance of the area was made and drilling was recommended at both locations. On the basis of data gathered at the three wells in the area (table 3, Nos. 49–51), the depth to water was estimated to be 700 to 750 feet below the land surface in the SW¼ sec. 2, T. 1 S., R. 28 E. At the other site, the depth to water was estimated to be about 800 to 850 feet.

Drilling was begun at the site in sec. 2 in August 1958 (well 48, pl. 29 and table 4). The hole was drilled to a depth of 796 feet. The rocks penetrated consisted of basalt, scoria, fine-grained sediments, and gravel. The principal aquifer is basalt, which was reached at a depth of 769 feet. The water level in the well was 710 feet below the land surface, which indicates that the ground water is under slight artesian pressure. The site in sec. 10 has not been tested.

With the meager data available for the Big Southern Butte area only generalized conclusions may be presented on the occurrence of ground water. The area is typical of several hundred square miles of the Snake River Plain, and the water-bearing characteristics of the basalt flows and associated rocks that underlie the plain probably are similar throughout the area. These volcanic rocks are highly permeable, and surface flow is insignificant; thus, most of the precipitation percolates to ground-water storage. In addition, the Big Lost and Little Lost Rivers, which drain the mountains north of the Snake River Plain, lose their flow in the permeable basalt of the plain. The large quantity of ground water discharged from the basalt along the northern rim of the Snake River canyon is indicative of the large quantity of water being transmitted under the plain. Therefore, the possibility is good of recovering sufficient quantities of water for livestock at most localities on the public domain between Arco, Idaho, and the Snake River. At some places, however, drilling may have to be as deep as 800 feet.

SALMON GRAZING DISTRICT

The Salmon Grazing District (No. 4, fig. 70) is on the northern edge of the Snake River Plain near the Idaho-Montana boundary. The district is principally composed of the intermontane valleys in the Lemhi and Pahsimeroi River basins, which are tributary to the Salmon River, and in the Birch Creek and Big Lost River basins, which drain to the Snake River Plain. The public domain administered by the Bureau of Land Management includes 1,300,463 acres in an area that is about equally divided administratively between the Bureau of Land Management and the Forest Service. Most of the Forest Service land is in the Lemhi and Lost River Ranges, and the Bureau of Land Management land is in the wide alluvial valleys.

The valleys of Birch Creek and the Lemhi, Pahsimeroi, and Big Lost Rivers are underlain by thick deposits of unconsolidated alluvial material derived from erosion in the adjacent mountain areas. At many places along the mountain fronts coalescing alluvial fans that have been built at the mouths of canyons reach far out into the central parts of the valleys, where they interfinger with stream deposits.

Springs and perennial streams supply water to a large part of the Salmon Grazing District, but in some valleys surface water is not available in sufficient amounts for stock. The average annual precipitation recorded in the valleys at Salmon and Lemhi, Idaho, is less than 9 inches, whereas in the mountainous areas the annual precipitation exceeds 16 inches at many locations. Therefore, although many of the valleys have a generally arid climate and no surface flow, much of the runoff from the mountains enters the valley fills where it is available to wells.

All the areas in need of water-resources development for livestock are in the alluvial valleys scattered throughout the Salmon Grazing District. Wells drilled in these valleys should penetrate only alluvium from the land surface to the water table. The interfingering alluvial-fan and stream deposits may have a wide range in texture both horizontally and vertically in any section, thus markedly affecting permeability and transmissibility. In most places, however, permeable zones at moderate depths yield sufficient water for stock wells. The depth to ground water depends on the topographic location of the well and the textural characteristics of the alluvium. In most places, however, the maximum depth to ground water should not exceed 500 feet.

FORT HALL INDIAN RESERVATION

In addition to the stock-water investigations made by the Geological Survey on public domain administered by the Bureau of Land Management, a reconnaissance was made at several locations on grazing lands in the Fort Hall Indian Reservation (fig. 70) and represents an appraisal of ground-water conditions at scattered localities. The reservation has a total area of about 512,000 acres, but only a small part is considered in this report.

GEOGRAPHY AND DRAINAGE

The reservation is bordered by two mountain ranges, the Deep Creek Mountains on the west and the Bannock Range on the east. In the central part of the reservation is a plain of low relief that extends from the Snake River on the north to the southern boundary of the reservation. Bannock Creek and its tributaries drain the western part of the reservation, and the Portneuf and Blackfoot Rivers drain the northern and eastern parts.

GEOLOGY AND OCCURRENCE OF GROUND WATER

The geology of the Fort Hall Indian Reservation was mapped and was described in considerable detail by Mansfield (1920). His investigations were concerned mainly with the appraisal of mineral resources and, therefore, contain little detail on the occurrence of ground water. Mansfield's report, however, includes a chapter by Heroy on water resources, both surface and ground water, which is directed primarily to an appraisal of possible water supplies for irrigation. Little is known of the occurrence of ground water in the remote parts of the reservation that are used for grazing.

The eastern part of the reservation, extending eastward from about the central part of R. 36 E., is mountainous, and, except in isolated places, the supply of stock water from permanent streams and numerous springs is adequate.

An area of moderate relief underlain chiefly by Tertiary and Quarternary alluvium, volcanic ash and hill wash extends westward from the base of the higher mountains to the irrigated tracts around Fort Hall (Mansfield, 1920). In some places hills are capped by volcanic rocks, but generally the surface is mantled with fine-textured soil and fine volcanic sand. Driller's logs of several wells in the area show irregular layers of sand, clay, gravel, cinders, and dense and broken lava. This sequence is derived in part from erosion of surrounding hills and mountains and in part from volcanic sources.

The clay penetrated by the wells, sometimes shown as shale on the logs, is relatively impervious and cannot be considered as a possible source of ground water. The fine sand, which is mixed with clay in most sections, also yields only small quantities of ground water. Most of the logs indicate that ground water is obtained from gravel, broken lava rock, or volcanic cinder and ash beds. These rock types are generally permeable and serve as aquifers in many localities on the Snake River Plain. Unfortunately, because of the irregular depositional pattern of these rocks, the depth or location of aquifers cannot be predicted with accuracy.

The depths to which stock-water wells may be drilled depends on the condition of the range to be serviced by the well and on other economic considerations. On most of the grazing lands of the Fort Hall Indian Reservation, the value of the forage and the urgent need for better stock distribution to prevent overgrazing justify drilling to depths of 500 to 600 feet. Data gathered during the investigation indicate that ground water should be found at most locations at a depth of less than 600 feet below the land surface. Data from wells indicate that a regional water table extends westward from the base of the Bannock Range to the Snake River and lowlands near Fort Hall. The general slope of the water table is about 8 feet per mile to the south and southwest from the front of the Bannock Range.

The possibility is good in the area of obtaining a supply of ground water at depths of 60 to 330 feet, depending on the location of the well, which is adequate for stock. Ground water may not always be reached at the altitude of the water table because of the unpredictable distribution of impermeable beds at any specific location. However, if deeper drilling is required in order to find an aquifer, the water level will generally rise under artesian pressure to the altitude of the regional water table.

TABLE 3.—*Records of wells and dry holes visited during the reconnaissance in southeastern Idaho*

[Aquifer: Qs, Snake River group; Qal, alluvium; Tsl, Salt Lake formation; Ql, Lake sediments; QTi, Idaho group]

Well (pl. 29)	Location: Section quarter	Location: Township	Location: Range	Name	Altitude of land surface (feet)	Depth of well (feet below land surface)	Depth to water below land surface (feet)	Altitude of water level (feet)	Aquifer	Remarks
Twin Falls grazing district										
1	SE 6	11 S.	15 E.	Kaster 1	4,070	240	190	3,880	Qs	
2	SW 6	11 S.	15 E.	Kaster 2	4,050	210	180	3,870	Qs	
3	NW 35	10 S.	15 E.	Roesler	4,090	500	176	3,914	Qs	Water level has risen more than 100 feet since 1919.
4	NE 26	12 S.	15 E.	Hollister 1	4,500	600	315	4,185	Qs	
5	SE 23	12 S.	15 E.	Hollister 2	4,500	65	65	4,435	Qal	Perched water table at bedrock-alluvium contact.
6	SW 7	11 S.	15 E.		4,160	420	dry			
8	NW 20	11 S.	17 E.	Bellville	4,335	655	480	3,855	Qs	
9	SE 18	12 S.	17 E.	McMaster 1	4,370	230	130	4,240	Qs	
10	SE 24	12 S.	16 E.	McMaster 2	4,430	235	90	4,340	Qs	
11	SW 8	12 S.	17 E.		4,350		130	4,220	Qs	
12	SW 17	14 S.	22 E.	Poulson	4,660		120	4,540	Tsl(?)	
14	SE 23	9 S.	25 E.	Eby	4,320		128	4,192	Qs	
15	SW 13	9 S.	26 E.	East	4,350		153	4,197	Qs	
16	SW 15	9 S.	26 E.	Middle	4,315		127	4,188	Qs	
17	SW 17	9 S.	26 E.	West	4,320		135	4,185	Qs	
18	NE 33	9 S.	26 E.	Toey	4,420		250	4,170	Qs	
19	SE 28	10 S.	26 E.	Anderson	4,535	427	267	4,268	Qs	Irrigation well.
20	NE 35	10 S.	26 E.	Werner	4,530	334	140	4,390	Qs	
23	NW 15	15 S.	30 E.	Pump Station	5,360	541	267	5,093	Ql	
24	SE 14	15 S.	30 E.	Rentmaster	5,345	341	332	5,013	Ql	Abandoned.
25	SW 1	16 S.	30 E.	Higley	5,060		341	4,719	Ql	
26	SW 5	16 S.	31 E.	Holliday	5,090		333	4,757	Ql	Abandoned.
27	NW 9	16 S.	30 E.	Bouwhuis	5,050		60	4,990	Ql	
28	NW 3	15 S.	30 E.	Wight	5,440	548	320	5,120	Ql	
29	SW 20	16 S.	32 E.	Stocker	5,020		265	4,755	Qal	
30	NE 16	16 S.	32 E.	Gap	5,010		150	4,860	Qal	
32	SE 32	13 S.	35 E.	Henry Jones	5,050	311	306	4,744	Qal(?)	
33	SW 26	14 S.	33 E.	Ireland Canyon	5,065	329	308	4,757	Qal	
34	NW 23	14 S.	33 E.	Wood Canyon	5,130		235	4,895	Qal	

Wood River grazing district										
40	NW 7	5 S.	19 E.	Ruiz	4,130		265	3,865	Qs	
41	SE 6	6 S.	20 E.		4,150		325	3,825	Qs	
42	SE 28	7 S.	16 E.	Thompson	3,645		265	3,380	Qs	
43	NW 27	7 S.	15 E.	Connors	3,490		185	3,305	Qs	
44	NW 34	7 S.	15 E.	Anderson	3,470		150	3,320	Qs	
45	SE 30	5 S.	13 E.		3,380		250	3,130	QTi	
46	SW 30	5 S.	13 E.		3,380		163	3,217	QTi	
47	SW 30	5 S.	13 E.		3,370		83	3,287	QTi	
Idaho Falls grazing district										
49	NW 30	1 N.	29 E.	Geological Survey 11	5,080	704	649	4,431	Qs	
50	NE 16	2 S.	28 E.	Cox	5,090		745	4,375	Qs	
51	SW 18	2 S.	29 E.	Houghland	5,150		733	4,417	Qs	
Fort Hall Indian Reservation										
52	17	5 S.	35 E.		4,800	150	140	4,660	Tsl	
53	31	3 S.	36 E.	Sandmill	4,990	250	140	4,850	Ql	
54	SW 24	3 S.	35 E.	Stevens Peak	5,000	356	331	4,669	Ql	
55	NE 34	3 S.	36 E.	Chicken Flat	5,400	337	200	5,200	Tsl	

TABLE 4.—*Records of wells drilled at sites recommended in this report*

[Aquifer: Qs, Snake River Group; Tsv, silicic volcanic rocks; QTi, Idaho Group, Ql, lake sediments; Tsl, Salt Lake formation]

Well (pl. 29)	Location			Name	Year drilled	Depth of well (feet below land surface)	Casing		Character of aquifer	Altitude of land surface (feet above mean sea level)	Water level		Yield of well (gpm)
	Section (quarter)	Town-ship (S)	Range (E)				Diameter (inches)	Depth (feet)			Depth to water (feet)	Altitude of water surface (feet above mean sea level)	
Twin Falls grazing district													
7	SW 7	16	17	White Rock	1958	160	6	143	Tsv	5, 500	136	5, 357	13
13	SE 29	14	22	Oakley	1958	565	6	315	Tsl	5, 000	315	4, 685	2
21	SE 19	10	27	Basalt seeding	1959	145	8	2	Qs	4, 400	118	4, 282	5
22	NW 35	9	26	Highway seeding	1960	250	6	6	Qs	4, 400	235	4, 165	3
31	SW 11	15	30	Wight Well	1959	428	8	428	Ql	5, 000	387	4, 613	------
Wood River grazing district													
35	SW 15	3	21	Monument Butte	1957	652	6	8	Qs	4, 580	606	--------	------
36	SW 30	2	17	Brailsford	1957	500	--------	------	Tsc(?)	5, 475	415	--------	------
37	SE 13	5	12	Bliss Point	1959	418	6	380	QTi	3, 600	355	3, 245	10
38	SW 12	7	15	Wendell Allotment	1958	250	8	4.5	Qs	3, 610	222	--------	------
39	NE 31	5	19	Dietrich Butte	1958	420	6	7	Qs	4, 315	376	--------	------
Idaho Falls grazing district													
48	SW 2	1	28	Big Southern Butte	1958	796	8–6	46	Qs	5, 140	710	4, 430	17

TABLE 5.—*Drillers' records of wells in grazing districts of southeastern Idaho*

[The number preceding the well name is the number of the well shown on pl. 29]

Type of material	Thickness (feet)	Depth (feet)	Type of material	Thickness (feet)	Depth (feet)
22. Hiway well 4, NW¼NW¼ sec. 35, T. 9 S., R. 26 E., Cassia County, Idaho [Altitude at top of well, 4,440 feet above mean sea level; drilled by Clarence Barney, Burley, Idaho, in 1960]					
Soil	4	4	Alternate layers of basalt and cinders. (Water in cinders at 235 feet.)	246	250
21. Basalt well, NE¼SE¼ sec. 19, T. 10 S., R. 27 E., Cassia County, Idaho [Altitude at top of well, 4,400 feet above mean sea level; drilled by Clarence Barney, Burley, Idaho, in 1959]					
Slay	2	2	Gray broken rock and cinders	12	95
Gray basalt	46	48	Gray basalt	50	145
Tan, light-colored clay	35	83			
13. Oakley well, NE¼SE¼ sec. 29, T. 14 S., R. 22 E., Cassia County, Idaho [Altitude at top of well, 5,000 feet above mean sea level; drilled by Clarence Barney, Burley, Idaho, in 1958]					
Clay and arkosic sand	50	50	Fine sand	30	345
Arkosic sand	40	90	Rhyolite	50	395
Clay	105	195	Clay, with sand	140	535
Sand	40	235	Brown sand	30	565
Basalt	80	315			
31. Wight well, SW¼SW¼ sec. 11, T. 15 S., R. 30 E., Oneida County, Idaho [Altitude at top of well, 5,000 feet above mean sea level; drilled by Clarence Barney in 1959]					
Clay	45	45	Clay and fine gravel	383	428
7. White Rock well, SW¼SW¼ sec. 7, T. 16 S., R. 17 E., Twin Falls County, Idaho [Altitude at top of well, 5,500 feet]					
Broken rock	5	5	Gray, sandy clay	78	143
Tan, sandy clay	60	65	Black lava (vitrophyre)	17	160
48. Big Southern Butte 1, NE¼SW¼ sec. 2, T. 1 S., R. 28 E., Butte County, Idaho [Altitude at top of well, 5,140 feet above mean sea level; drilled by Chesley Drilling Co., Burley, Idaho, in 1958]					
Topsoil	8	8	Gray lava	36	448
Broken gray lava	10	18	Brown lava, creviced	20	468
Gray lava, hard	40	58	Reddish-brown lava	30	498
Gray lava, clay crevices	10	68	Hard gray lava	68	566
Brown lava and clay	10	78	Reddish-brown lava	10	576
Gray lava and loose rock	55	133	Brown lava and clay	20	596
Brown clay	10	143	Solid gray lava	38	634
Gray lava	40	183	Solid brown lava	40	674
Brown lava	18	201	Brownish-gray lava	20	694
Gray lava	20	221	Reddish-brown lava	35	729
Brown lava	16	237	Gray lava	5	744
Brown clay	3	240	Red lava	10	754
Brown lava	10	250	Brown clay with gravel	15	769
Gray lava	28	278	Reddish-black lava	27	796
Brown lava, creviced	134	412			

TABLE 5.—*Drillers' records of wells in grazing districts of southeastern Idaho*—Continued

[The number preceding the well name is the number of the well shown on pl. 29]

35. Monument Butte well, SW¼ sec. 15, T. 3 S., R. 21 E., Lincoln County, Idaho

[Altitude at top of well, 4,700 feet above mean sea level; drilled by Jack Alexander, Rupert, Idaho, in 1957]

Type of material	Thickness (feet)	Depth (feet)	Type of material	Thickness (feet)	Depth (feet)
Topsoil	2	2	Red lava	40	360
Gray lava	13	15	Gray lava	10	370
Red lava	30	45	Broken red lava	10	380
Gray lava	25	70	Brown lava	30	410
Gray and red lava	30	100	Gray lava	35	445
Red lava	20	120	Red lava	18	463
Gray and red lava	5	125	Gray lava	34	497
Red lava	5	130	Brown lava	3	500
Red lava cinders	10	140	Gray lava	10	510
Gray lava	45	185	Broken gray and red lava	30	540
Broken gray lava	20	205	Gray lava	20	560
Gray lava	45	250	Gray and red lava	13	573
Brown lava	20	270	Gray lava	29	602
Red lava	10	280	Gray lava and red cinders	25	627
Gray lava	40	320	Gray lava	25	652

39. Dietrich Butte well, NE¼ sec. 31, T. 5 S., R. 19 E., Lincoln County, Idaho

[Altitude at top of well, 4,300 feet above mean sea level; drilled by Gailey Bros., Paul, Idaho, in 1958]

Type of material	Thickness (feet)	Depth (feet)	Type of material	Thickness (feet)	Depth (feet)
Sandy soil	4	4	Pink lava	49	264
Hard gray lava	15	19	Hard gray lava	17	281
Pink lava boulders	26	45	Cinders and boulders	31	312
Firm gray lava	32	77	Firm brown lava	42	354
Pink lava	43	120	Cinders and boulders	14	368
Pink lava boulders	17	137	Firm brown lava	19	387
Firm gray lava	47	184	Red cinders	25	412
Brown lava	31	215	Black cinders	8	420

37. Bliss Point well, NE¼SE¼ sec. 13, T. 5 S., R. 12 E., Gooding County, Idaho

[Altitude at top of well, 3,600 feet above mean sea level; drilled by George Gailey, Shoshone, Idaho, in 1959]

Type of material	Thickness (feet)	Depth (feet)	Type of material	Thickness (feet)	Depth (feet)
Soil	2	2	Hard black lava	15	80
Hardpan	13	15	Gray sand	250	330
Gray sandy clay	10	25	Red sand	30	360
Firm black lava	40	65	Brown sand	58	418

38. Wendell allotment well, SW¼ sec. 12, T. 7 S., R. 15 E., Gooding County, Idaho

[Altitude at top of well, 3,600 feet above mean sea level; drilled by C. B. Eaton and Sons, Wendell, Idaho, in 1958]

Type of material	Thickness (feet)	Depth (feet)	Type of material	Thickness (feet)	Depth (feet)
Topsoil	3	3	Gray lava	19	147
Gray lava	57	60	Clay	4	151
Red lava	7	67	Gray lava	12	163
Red sand	3	70	Red lava, creviced	23	186
Gray lava, creviced	15	85	Gray lava, creviced	34	220
Red lava	40	125	Red lava	15	235
Clay	3	128	Gray lava	15	250

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