

WATER AND SEWERAGE—GROUND WATER, UPPER WEISER RIVER BASIN, IDAHO—Geological Survey Water-Supply Paper 1779-Q

Ground Water in the Midvale and Council Areas Upper Weiser River Basin Idaho

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1779-Q

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



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By EUGENE H. WALKER and H. G. SISCO

CONTRIBUTIONS TO THE HYDROLOGY OF THE UNITED STATES

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UNITED STATES DEPARTMENT OF THE INTERIOR

STEWART L. UDALL, *Secretary*

GEOLOGICAL SURVEY

Thomas B. Nolan, *Director*

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By EUGENE H. WALKER and H. G. SISCO

ABSTRACT

The Midvale and Council areas are two broad parts of the Weiser River valley in Washington and Adams Counties, near the western border of Idaho. Stock-raising and hay production are the principal types of farming, though some diversified farming is done in the Midvale area. There is a deficiency of surface water for irrigation, and very little rain falls in summer.

The lowlands are underlain by sedimentary deposits, mostly silt and clay, of late Tertiary age, that accumulated in basins on a terrain of warped and faulted basalt flows having sedimentary interbeds. The Columbia River Basalt, of Miocene age, forms the uplands that surround the lowland areas. Some sand and gravel, deposited in stream channels and alluvial fans, and fine-grained lake beds, all of Quaternary age, are in the lowlands.

The basalt is the best aquifer. It occurs beneath the lowlands at depths ranging from a few feet to many hundreds of feet. Known yields from the basalt are as much as a few hundred gallons a minute; yield increases with greater penetration of the basalt below water level. Most wells in basalt in the Midvale area flow at the surface.

Thin beds of sand in the deposits of Tertiary age beneath the Midvale area yield an ample supply for farm use, and at places might yield enough for supplemental irrigation of small acreages. In the Council area the sedimentary deposits of Tertiary age contain little sand and are not adequate as a source of water.

Thin sheets of sand and gravel of Quaternary age are a water source for a number of domestic wells in both the Midvale and Council areas.

The quality of ground water in both areas is satisfactory for all common uses. Hardness averages about 70 parts per million. The shallow waters are mainly the calcium magnesium bicarbonate type; the deeper waters tend to be the sodium bicarbonate type, owing at least partly to base exchange with clayey materials.

INTRODUCTION

This report describes the ground-water resources of the Midvale and Council areas, which are two of the broader basins in the drainage of the Weiser River, near the western margin of Idaho (fig. 1). The Midvale area is in Washington County and the Council area in Adams County. The economy of these areas is based almost entirely on

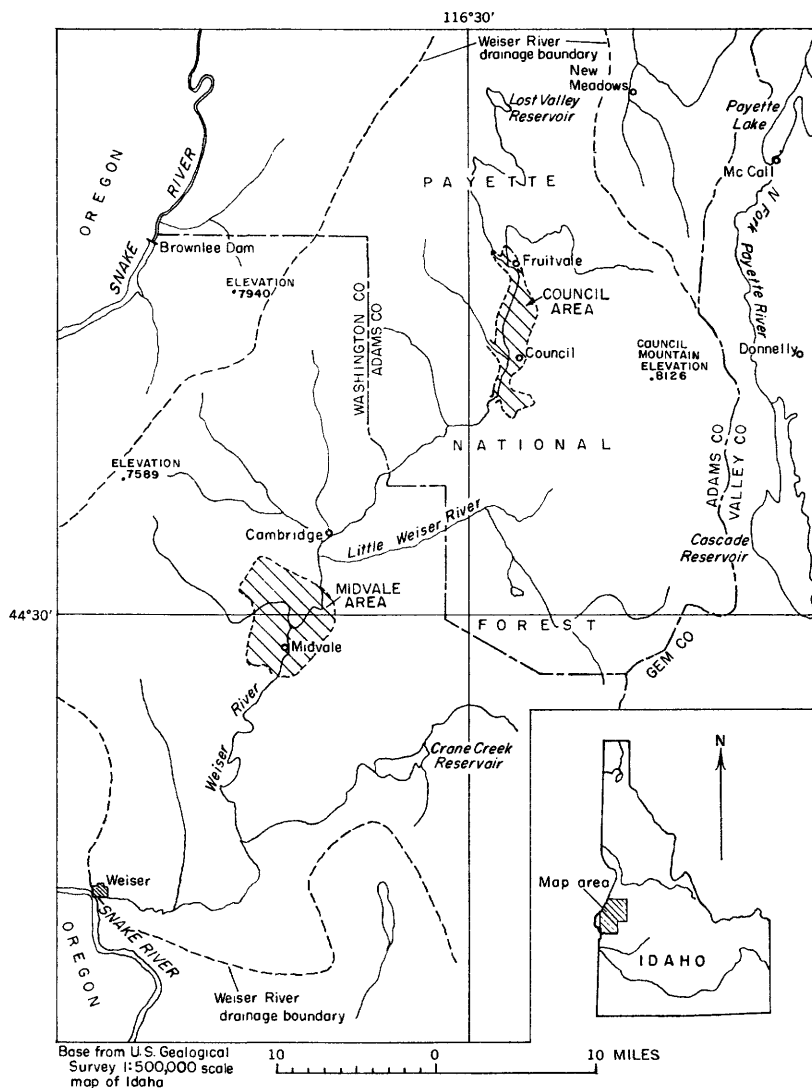


FIGURE 1.—Index map of the Weiser River basin, Idaho, showing the Midvale and Council areas.

agriculture. Additional supplies of water for irrigation would be of great value to parts of the areas where productivity is limited by inadequate supplies of surface water and the typically small amount of summer rainfall.

This study was made by the U.S. Geological Survey in cooperation with the U.S. Bureau of Reclamation. The inventory of wells was made by H. G. Sisco, and E. H. Walker studied the geology and prepared the report.

The data on the occurrence of ground water in the areas were derived mostly from the records of wells, obtained through interviews with landowners and well drillers. Drillers' logs of typical wells were obtained from well drillers and from the files of the Idaho Department of Reclamation. Water samples were collected for analysis to show the chemical character of the ground waters.

The well-numbering system used in Idaho by the Geological Survey indicates the location of wells in the official rectangular subdivisions of the public lands. The first two segments of a number designate the township and range. The third segment gives the section number and is followed by two letters and a numeral, which indicate, respectively, the quarter section, the 40-acre tract, and the serial number of the well within the tract. Quarter sections are lettered a, b, c, and d in counterclockwise order from the northeast quarter of each section (fig. 2). In the quarter sections, 40-acre tracts are lettered in the same manner. Thus well 13N-4W-13db1 is in the NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 13, T. 13 N., R. 4 W., and it is the first well visited in that tract.

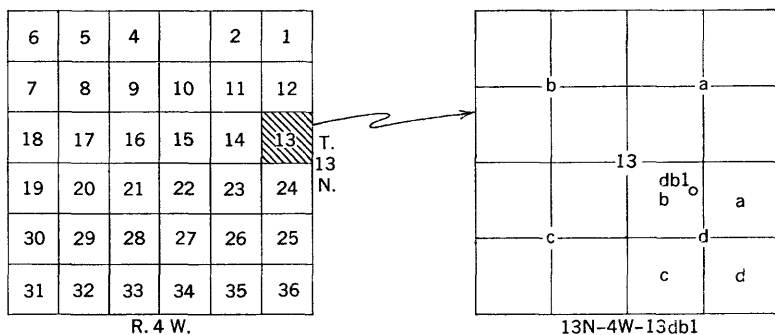


FIGURE 2.—Sketch showing well-numbering system.

GEOGRAPHIC FEATURES

The segment of the Weiser River basin that includes the Midvale and Council areas consists largely of uplands that are underlain by flows of the Columbia River Basalt. The Weiser River crosses the resistant basalt in narrow valleys. The broader lowlands, such as the Midvale and the Council areas, have developed where relatively soft sedimentary materials filled structural basins in the basalt terrane. The Council area lies near the headwaters of the Weiser River, in Adams County, and the Midvale area is about 25 airline miles to the southwest, in Washington county.

The floor of the elongate valley of the Council area covers about 16 square miles. The Weiser River flows southward along the west side of the valley, and drops from an elevation of about 3,040 feet at the

head of the valley to about 2,900 feet at the lower end, 9 miles to the south. The west side of the valley is bordered by gentle slopes that rise to an upland a few hundred feet above the valley floor. The east side of the valley is enclosed by the steep slopes of the mountains of the Payette National Forest, which reach an elevation of 8,126 feet in Council Mountain.

The Midvale area is a rudely circular lowland of about 30 square miles. The lowland is enclosed by gentle slopes that rise a few hundred feet to a dissected upland. A border of the lowland can be drawn only approximately, for a gradual transition occurs through alluvial fans on the lowland to slopes cut on basalt or sedimentary deposits.

Two topographic divisions of the Midvale area are readily recognized. The Middle Valley is an extensive lowland on the east side of the Weiser River. It is a terrace separated from the fairly narrow flood plain by a bluff 30-50 feet high. A slightly higher surface, sometimes called the Shoe Peg Valley, occupies most of the lowland area west of the Weiser River.

The elements of the climate of the two areas are shown by tables of average monthly precipitation and temperature at Council and at Cambridge, which is 8 miles north of Midvale in another wide part of the Weiser River valley (table 1). Very little precipitation falls in summer. The sum of the precipitation in July and August averages only 0.70 inch at Council and 0.39 inch at Cambridge. Annual precipitation averages 27.14 inches at Council and 19.39 inches at Cambridge.

TABLE 1.—Average monthly temperature and precipitation at Cambridge and Council, Idaho, 1931-55

[From records of U.S. Weather Bureau]

| Month | Temperature, in degrees Fahrenheit | | Precipitation, in inches | |
|---------------------|------------------------------------|---------|--------------------------|---------|
| | Cambridge | Council | Cambridge | Council |
| January..... | 22. 6 | 24. 9 | 2. 83 | 3. 86 |
| February..... | 27. 5 | 29. 2 | 2. 55 | 3. 31 |
| March..... | 37. 8 | 37. 3 | 1. 95 | 2. 75 |
| April..... | 49. 4 | 48. 3 | 1. 47 | 2. 16 |
| May..... | 57. 5 | 56. 5 | 1. 23 | 1. 92 |
| June..... | 63. 9 | 62. 6 | 1. 41 | 1. 87 |
| July..... | 74. 6 | 72. 6 | . 23 | . 39 |
| August..... | 71. 7 | 70. 4 | . 16 | . 31 |
| September..... | 61. 3 | 61. 6 | . 58 | . 84 |
| October..... | 50. 2 | 50. 8 | 1. 34 | 2. 10 |
| November..... | 36. 4 | 37. 2 | 2. 59 | 3. 33 |
| December..... | 28. 1 | 29. 0 | 3. 05 | 4. 30 |
| Average annual..... | 48. 4 | 48. 4 | 19. 39 | 27. 14 |

The average monthly temperature at Council and at Cambridge is much the same. Both areas have a milder climate, less extremes of heat and cold, than do many other intermontane valleys of southern Idaho.

The soil of the Midvale and Council areas consists mostly of loess, at least to the depth of the plough furrow. Loess forms a pervasive cover, except on slopes and knolls that are being actively eroded or on recently formed flood plains and alluvial fans. In most of the lowland areas the loessial soil is underlain by alluvial gravel or sand; in a few places, however, it is underlain by the basalt lavas or by lake beds of clay, silt, or fine-grained sand.

Loessial soil is thickest on those older surfaces that are little eroded. The loess on the high bench land of the Midvale area is at least 3 feet thick, but it is not more than a foot thick on the low terrace above the flood plain of the Weiser River.

In the Council area, loessial soil more than a foot thick is confined to small areas on the gentler parts of the older alluvial fans. The soil through the steeper parts of the extensive alluvial fans of the Council area becomes gravelly at a depth of a few inches. The prevailing reddish color of the soil reveals the presence of much fine-grained slope wash derived by decomposition of basalt.

Both the Midvale and the Council areas have been settled for several generations, and almost all the lowlands are used for farming. There is only one village in each area: Midvale, having a population of 211, and Council, having a population of 827.

The Midvale area, due to its greater size and superior soil, is better for farming than the Council area. The land is used chiefly for the production of small grains and hay, although some sweet corn, potatoes, and clover seed are grown. In addition, beef cattle and sheep are raised; these are pastured in the uplands and mountains during the summer.

The low Middle Valley part of the Midvale area has an adequate supply of surface water for irrigation from the Weiser River. The higher land of the Shoe Peg Valley has a meager supply from the several small drainages that empty onto the bench. Some water is stored in small reservoirs. Most of the area is necessarily dry-farmed. Dryfarming is being extended onto the gentler slopes surrounding the Midvale lowland wherever there is a thick mantle of water-retentive loessial soil.

In the Council area the principal farming activity is stock raising and the attendant production of hay and management of pasture land. Only a small portion of the land is used for small grains, and row crops are raised primarily for local use. Some fruit, mainly apples, is grown

in a number of small orchards, which are concentrated on the upper parts of the alluvial fans on the east side of the valley.

Much timber is cut in the forests of the mountains surrounding the Council area, and there is a large lumber mill at Council.

GEOLOGY AND GROUND WATER

ELEMENTS OF THE AREAL GEOLOGY

The oldest formations exposed in the area are the lava flows of the Columbia River Basalt and the associated sedimentary materials. The sedimentary beds were assigned to the Payette Formation by Kirkham (1930). The Columbia River Basalt is generally considered to be of Miocene age (Ross, 1956, p. 85). In this area, however, there is evidence that basalt flows not readily distinguishable from those of the Columbia River Basalt continued to erupt in Pliocene time. Therefore, all the basalt lavas and associated sedimentary beds are referred to as being of Tertiary age.

The basalt crops out in the hills and mountains and is well exposed in canyons such as the one immediately north of the Midvale area. Individual sheets of lava range in thickness from a few to about 50 feet. Most of the lava is dense but intricately broken by many joints and irregular cracks. There are also zones of fragmental lava, and these are probably the main water-bearing zones.

The sedimentary materials interbedded with the lava flows apparently were deposited chiefly in lakes. They consist mostly of clay and silt and sporadic beds of sand; gravel is uncommon.

The basalt lavas and associated lake beds were warped and faulted at some time late in the Tertiary Period. Apparently a landscape of considerable relief was created. Erosion then proceeded to reduce much of the highlands to a surface of low relief. Some deposits of clay and silt and stray thin beds of sand accumulated in lowlands at this time. These deposits may be equivalent to the Idaho Formation of Savage (1961, p. 13), of late Pliocene and early Pleistocene age. In this report these deposits are grouped with the late Tertiary sedimentary deposits interbedded with the basalt lavas, and both are referred to as deposits of Tertiary age; they are similar, and no boundary is designated in well logs.

During the Pleistocene Epoch, the area was uplifted and the major topographic features are the result of differential erosion. The Weiser River has cut only narrow valleys across areas of resistant basalt, but during the same time has opened out wide lowlands on areas underlain by the soft lake beds.

The details of topography on the lowland areas show that the valley deepening was accomplished in several stages. For example, the Shoe Peg Valley section of the Midvale area represents a valley

floor that was widened when the Weiser River was flowing at a level 70 or more feet higher than at present. This surface was mantled with alluvial-fan and stream gravels. The river next cut downward several tens of feet and then cut laterally to form the flats of the Middle Valley. The river, now entrenched below the Middle Valley surface, is forming a new flood plain. A generally similar sequence occurred in the Council area, though the indications are less obvious. The successive steps in downcutting, valley widening, and spreading of gravel sheets are probably related to late substages of glaciation, which affected the regimen of streams in the region.

MIDVALE AREA

The topographic features and approximate limits of the Midvale area and the location of the wells inventoried are shown in figure 3.

Ground water in the Midvale area is obtained from the basalt and the lake beds of Tertiary age that underlie the entire area and from the sand and gravel of Pleistocene age that mantle the basalt and lake beds at low altitudes. Most of the wells bottom in the lake beds of Tertiary age and produce from thin beds of sand. However, the basalt is the best aquifer. A small percentage of the shallow wells derive water from the sand and gravel of Pleistocene age.

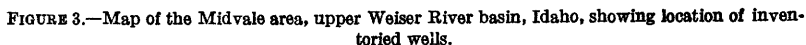
The ground water in the area originates from local precipitation on the lowland and the surrounding higher land. Some water moves for many miles through pervious zones in the basalt lavas, especially at depth, but it is unlikely that much water moves into or out of the area through the rocks.

BASALT OF TERTIARY AGE

The basalt lavas no doubt underlie all of the Midvale area at depth. Basalt is exposed on the slopes of the northern, western, and southern margins of the lowland area. The gentler slopes on the east side of the lowland are underlain by lake beds of Tertiary age, but even here the basalt occurs not far below the surface; for example, well 13N-3W-10cd1 at the Midvale Cemetery entered basalt at a depth of 205 feet (fig. 4).

Information from scattered wells shows that the depth to basalt increases inward from the margins of the lowland. Well 13N-4W-11cd1, close to the edge of the lowland, entered basalt at a depth of only 59 feet. Well 13N-4W-13ba1, a mile farther east, was still in lake beds at a depth of 185 feet. Well 14N-4W-36dd1, a mile away from the hills, was in lake beds through its total depth of 178 feet.

At Midvale, $1\frac{1}{2}$ miles from the east side of the valley, the first basalt was penetrated at a depth of 510 feet in well 13N-3W-8cc3.



Water in the basalt is commonly under enough pressure to rise in wells and flow at the surface. Water rises to the land surface in well 13N-3W-10cd1, at an elevation of about 2,650 feet in the Midvale Cemetery, which is on a low bench on the eastern margin of the valley.

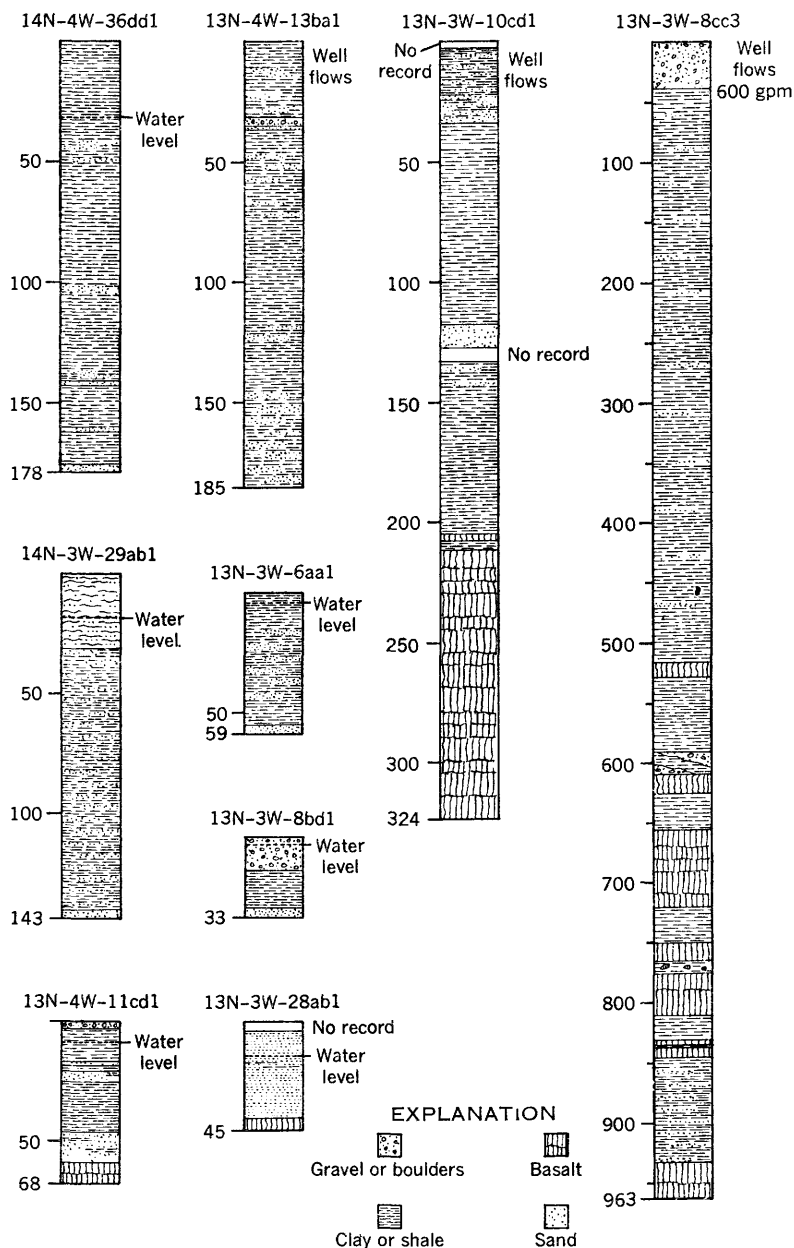


FIGURE 4.—Geologic logs of representative wells in the Midvale area, Idaho.

The artesian pressure increases with depth in the basalt. The Midvale town well 3 (13N-3W-8cc3) flowed about 10 gpm (gallons a minute) when the well was about 800 feet deep; the driller reported

that the head was low, although no exact measurement was made. When deepened to 963 feet, the well penetrated a water-bearing zone that produced a flow of 600 gpm under a pressure of 155 pounds at the surface. This pressure is equivalent to a head of about 360 feet. The elevation of the land surface at the well is about 2,550 feet, and static water level therefore is at an elevation of about 2,910 feet. This is only a few hundred feet below the broad uplands around the Midvale area, where water enters the basalt lavas.

The reported yields of wells known to penetrate the basalt, which presumably derive most of their water from basalt, are given below.

| Well | Depth (ft) | Yield (gpm) | Drawdown (ft) | Specific capacity (gpm per foot of drawdown) |
|-------------------|------------|-------------|---------------|--|
| 13N-4W-11cd1..... | 68 | 360 | | |
| 13N-3W- 8cc2..... | 521 | 318 | 47 | 6. 8 |
| 8cc3..... | 963 | 600 (flow) | | |
| 10cd1..... | 320 | 25 | 110 | . 2 |
| 28bb1..... | 45 | 6 | | |

The available information shows that properly constructed wells penetrating the basalt a sufficient distance will yield several hundred gallons of water a minute, but the information does not permit an estimate of the potentialities of the basalt as an aquifer in terms of yield to wells per foot of drawdown. The yield may approximate that which Newcomb (1959, p. 14) found for many wells in basalt in the State of Washington. There the yield in wells 10-12 inches in diameter having drawdowns of 50-100 feet averaged a little more than 1 gpm for each foot of penetration of water-saturated basalt.

SEDIMENTARY DEPOSITS OF TERTIARY AGE

Sedimentary deposits of Tertiary age occur everywhere beneath the lowlands of the Midvale area and also underlie some of the slopes on the east side of the Middle Valley. The thickness of sedimentary deposits above the basalt ranges from zero where the basalt crops out in the lower slopes to at least 510 feet in the Midvale village well. The total thickness of the sedimentary deposits is greater than the thickness above the first basalt met in a well, because more sedimentary strata are between lava flows.

Exposures and well logs (fig. 4) show that clay, silt, and fine-grained sand predominate in the sedimentary deposits. Beds of coarser grained sand occur sporadically.

In exposures, the fine-grained beds consist of alternate layers of silty clay and fine-grained sand, each a fraction of an inch to several inches thick. Some well records report heavy clay of various colors, such as black, blue, or red. A bed of this heavy clay is reported at

depths of 60–80 feet at a number of places beneath the surface of the Middle Valley. The clay is said to have a strong smell and to contain fragments of wood and other organic material.

The layers of coarser sand and silty sand are rusty colored in outcrops and are partially cemented by iron oxide. Such beds of sand are usually no thicker than 5 feet. However, about 40 feet of sand was reported between depths of 35 and 75 feet in well 13N–3W–10cd2 at the Midvale Cemetery, which is on a bench on the eastern side of the valley.

Groundwater in these deposits comes wholly from the beds of sand, which are frequent enough that practically all wells yield at least enough water for domestic purposes.

The water is confined in the beds of sand and rises in wells. Water flows from many wells that are within about half a mile of the edge of the lowland. Farther toward the center of the lowland the pressure declines below land surface, but in few wells is water level more than 10 feet below the surface. Greater depths to water are due to local topography: well 14N–4W–36dd1 is on a low hill and the water level is reported to be about 30 feet below land surface; well 13N–3W–6dd1 is near the east edge of the Shoe Peg Valley and the water level is reported to be 50 feet below land surface.

Most wells in the sedimentary deposits of Tertiary age provide supplies adequate for domestic use, for watering of lawns and gardens, and for watering of stock in winter. The measured or estimated yields of a number of wells, and the drawdown during pumping for some wells, reported by well owners or drillers, are given below.

| Well | Yield (gpm) | Drawdown (ft) | Specific capacity (gpm per foot of drawdown) |
|--------------|----------------|------------------|--|
| 14N–4W–36dd1 | 27 | 14 | 1.9 |
| 14N–3W–19dd1 | 10 | 8 | 1.3 |
| 13N–4W–11cd2 | 30 | | |
| 13ba1 | 70 | 18 | 3.9 |
| 14da1 | 72 | 62 | 1.2 |
| 13N–3W–3bb2 | 13 | 4 | 3.3 |
| 3bc1 | 13 | 5 | 2.6 |
| 3dc1 | 8 | 11 | .7 |
| 6aa1 | 20 | | |
| 6bb1 | 50 | | |
| 10cd1 | 25 | 110 | .2 |
| 10cd2 | 50 | | |

The average of the eight values for specific capacity is 1.9 gpm per foot of drawdown.

These values for specific capacity show that the sedimentary deposits of Tertiary Age can yield enough water for irrigation of small

acres. The two cemeteries in the area, the larger of which covers about 4 acres, are currently being irrigated with ground water from the sedimentary deposits.

The common domestic wells have 6-inch casing. Casing may extend to the bottom of the hole and be perforated. However, a number of wells are uncased at depth, indicating that the lake beds tend to stand without caving into holes. Well 14N-4W-36dd1, used to irrigate the Keithley Creek Cemetery, is cased to 55 feet and is an open 8-inch hole below that depth. The principal irrigation well (13N-3W-10cd2) at the Midvale Cemetery, a 12-inch gravel-packed well, also contains 6-inch casing.

Wells designed specifically to produce irrigation supplies would be more efficient than any of the foregoing except the 12-inch gravel-packed well (13N-3W-10cd2) and would have higher specific capacities. The lifts of ground water should not be too great at moderate rates of pumping. The development of ground water for irrigation will depend on economic factors such as the cost of wells and irrigation equipment and the value to the farmer of increased crop yields.

SEDIMENTARY DEPOSITS OF QUATERNARY AGE

Sheets of sand and gravel of Quaternary age occur at fairly shallow depth in the lowland terraces. Where these deposits are in the zone of saturation, they can supply small to fairly large amounts of water.

Sand and gravel is widespread on the Shoe Peg Valley. The deposits are mantled by loess and are exposed in streams, roadcuts, and steep bluffs. The gravels represent several episodes of deposition on alluvial fans and in stream channels.

The oldest gravel forms low ridges and knolls above the general level of the Shoe Peg Valley. It represents the remnants of once extensive alluvial fans, now almost wholly removed during erosion of the bench to its present level. These deposits are of no consequence for water supply because they occupy small areas and are above water level.

A younger sheet of alluvial material underlies large parts of the Shoe Peg Valley. It lies upon silty or clayey lake beds that are probably of Tertiary age, and it is usually covered by a few feet of loess. This sheet consists of alternate beds of rounded pebble gravel and poorly sorted sand. Apparently, it was deposited by small tributaries that flowed across the bench to join the Weiser River.

The thickness of the main sheet of sand and gravel on the Shoe Peg Valley ranges from zero against higher ground to some unknown maximum that probably does not exceed 30 feet. The gravel is reported to be 16 feet thick in well 13N-4W-1aa1, which is about 2 miles northwest of Midvale.

Some ground water is perched in the gravel upon the underlying silty and clayey lake beds. This perched condition is demonstrated by the small seeps at the base of the alluvial deposits exposed in stream cuts and in the bluff that terminates the bench on the west side of the Weiser River.

The gravel sheet supplies water to a few shallow wells where topography favors the accumulation of a perched body of water at least a few feet thick. Well 13N-4W-1aa1, which is 18 feet deep, has furnished a reliable domestic supply for decades. The owner reports that water level fluctuates from a depth of about 15 feet in autumn and winter to ground surface in spring.

The youngest gravel upon the Shoe Peg Valley forms small and thin alluvial fans near the base of the hill slopes. These alluvial fans are of no consequence as a source of water because they are generally above water level, and any water entering them rapidly drains out downslope.

A sheet of water-bearing gravel is found at shallow depth under the Middle Valley, the broad terrace on the east side of the Weiser River. The gravel is exposed in the bluffs that separate the Middle Valley from the flood plain of the Weiser River. Excellent exposures on the east side of the river about half a mile south of Midvale show a sheet of sand and gravel about 10-15 feet thick. Silt and fine sand, probably of late Tertiary age, underlie the sheet of gravel. The sand and gravel is about 14 feet thick in well 13N-3W-8bd1 (fig. 4), which is a short distance east of the Weiser River and half a mile north of Midvale. Only about 10 feet of gravel is in the cut made by Beaver Creek in the Middle Valley terrace in the center of section 17.

Ground water occurs everywhere in the gravel of Middle Valley. The water table is high enough in the gravels that subirrigation can be practiced in some places, and drainage ditches are necessary to lower the water level beneath part of the valley.

—The source of the water is precipitation, water that seeps from the main canal on the east side of the valley and from tributary canals, and percolation from irrigated fields. The water probably moves westward to southwestward on a gradient of somewhat less than 25 feet per mile, which is about the gradient of the land surface due west. It is discharged as seeps along the bluffs above the flood plain of the river.

The gravels can yield fairly large amounts of water where they are saturated through most of their thickness. Well 13N-3W-3bd2, 15 feet deep and 4 feet in diameter, reportedly is pumped by a tractor motor for irrigation. This well is a short distance from the main canal on the east side of the Middle Valley and may receive most of its water by infiltration from the canal.

COUNCIL AREA

The topographic features of the Council area and the location of wells inventoried in this study are shown in figure 5. A principal topographic feature of this area is the broad slope on alluvial fans that occupies about two-thirds of the lowland. Bottom land along the Weiser River occupies a belt less than a mile wide on the west side of the lowland.

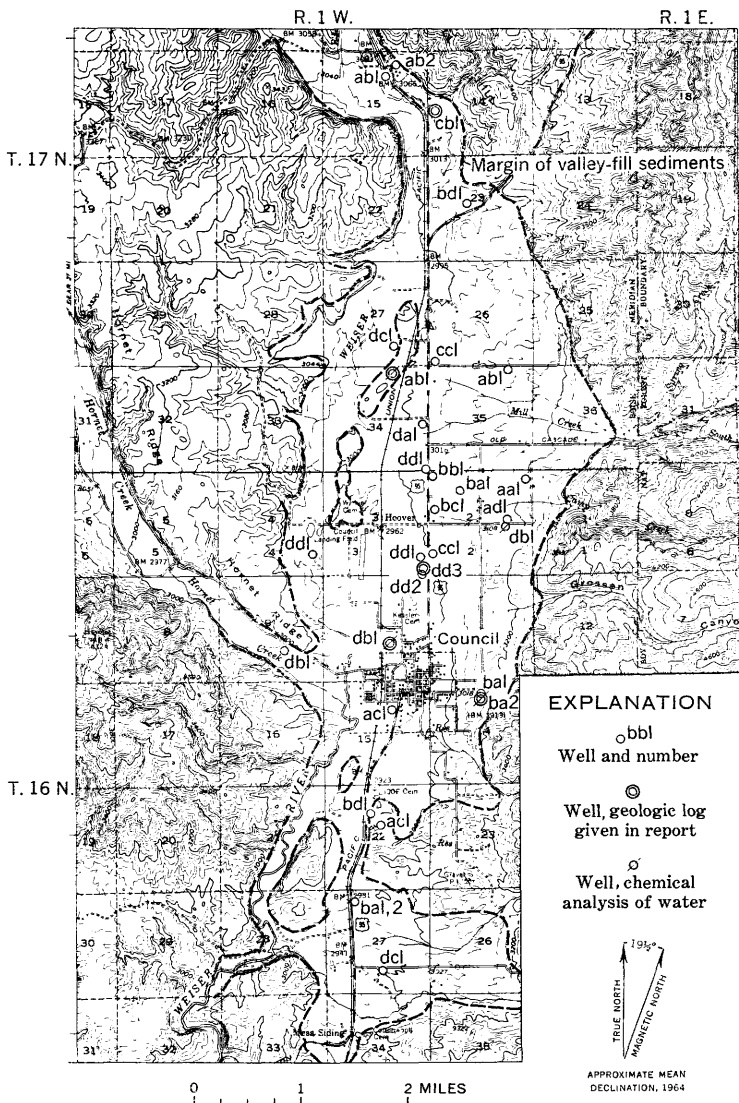


FIGURE 5.—Map of the Council area, upper Welser River basin, Idaho, showing location of inventoried wells.

Ground water is developed in the Council area from the basalt, the sedimentary deposits of Tertiary age, and the gravel of Pleistocene age. Although the gravel of Pleistocene age is the most used aquifer in the area, the basalt is the most prolific aquifer, as it also is in the Midvale area. Only a few wells derive water from the sedimentary deposits of Tertiary age.

BASALT OF TERTIARY AGE

Basalt forms the hill and mountain slopes that enclose the valley and also crops out as low hills in the lowland. The boundary between the basalt and valley-filling alluvial deposits is indicated by a dashed line (fig. 5).

A flow of basalt probably occurs at shallow depth beneath the lower part of the Council area. Well 16N-1W-10db1, half a mile north of Council, penetrated about 55 feet of basalt between depths of 45 and 100 feet (fig. 6), and low hills of basalt rise above the alluvial deposits farther north.

Basalt was first entered at a depth of 220 feet in the Council municipal well (16N-1W-14ba2), which is high on the alluvial fans close to the eastern mountain front. Ground surface is about 200 feet higher here than at well 16N-1W-10db1. The old valley floor, carved on the basalt and the sedimentary deposits of Tertiary age, may have a surface of fairly low relief under the cover of alluvial deposits.

Depth to water in the basalt depends on topographic situation. Water stands within a few tens of feet of the surface in wells that penetrate the basalt in the lower parts of the area. The depth to water increases eastward beneath the alluvial fans and is reported to be 200 feet below the surface in the Council municipal well 2 (16N-1W-14ba2). No wells tapping basalt yielded a flow of water at the surface.

The basalt is the best aquifer in the area. All the domestic and stock wells that penetrate the basalt provide satisfactory supplies. Well 16N-1W-10db1 provides enough water for a large sawmill; the water probably comes mostly from basalt rather than from the fine-grained sediments which also were penetrated.

The yields of five wells that produce from the basalt are given below.

| Well | Yield (gpm) | Drawdown (ft) | Specific capacity (gpm per foot of drawdown) |
|---------------------------------|-------------|---------------|--|
| 17N-1W-14cb1..... | 25 | | |
| 15ab2..... | 10 | | |
| 27dc1..... | 6 | | |
| 16N-1W-14ba1 ¹ | 135 | | |
| 14ba2 ² | 150 | 48 | 3 |

¹ Council municipal well 1.

² Council municipal well 2.

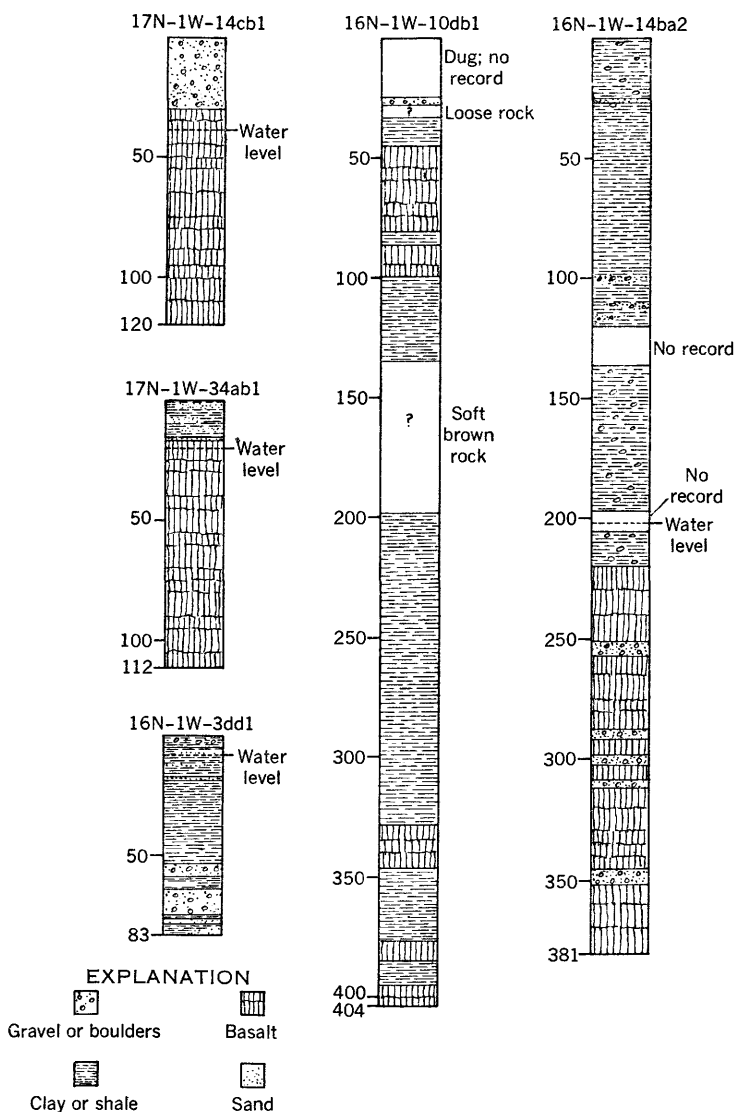


FIGURE 6.—Geologic logs of representative wells in the Council area, Idaho.

The Council municipal well 2, which has a specific capacity of 3 gpm per foot of drawdown, penetrates about 160 feet of basalt below the water level. The yield of 150 gpm is therefore close to the 1 gpm per foot of penetration of basalt that Newcomb (1959, p. 14) found as an average for wells in the Columbia River Basalt in parts of Oregon.

SEDIMENTARY DEPOSITS OF TERTIARY AGE

Thick sedimentary deposits of Tertiary age occur beneath the area, interbedded with the basalt lava, as shown by the log of well 16N-

1W-10db1 (fig. 6) at the Boise-Cascade lumber mill, about half a mile north of Council. Outcrops of these deposits were not found during the short time spent in the area. The well log shows the deposits to be mainly blue, brown, and red clay. No distinct beds of sand were reported by the driller. The nature of the "soft brown rock" the driller reported between depths of 135 and 200 feet is unknown.

No wells were found which produce water from the sedimentary deposits of Tertiary age. If the log of well 16N-1W-10db1 is representative in showing no beds of sand, very little water can be obtained from these deposits.

SEDIMENTARY DEPOSITS OF QUATERNARY AGE

Sedimentary deposits of Quaternary age underlie all of the Council lowland except the low hills where basalt crops out. These deposits are the principal source of water for domestic wells.

The entire 220 feet of sedimentary material shown above the basalt in the log of well 16N-1W-14ba2 (fig. 6) is probably of Pleistocene age. This log shows what are almost certainly alluvial gravels mixed with fine-grained slope wash extending from the surface to a depth of about 30 feet and from about 100 to 130 feet. Interpretation of the rest of the material shown by the log presents some uncertainties. The 85 feet of boulder clay the driller reported between 135 feet and the top of the basalt is a deposit of either glacial till or poorly sorted alluvial-fan material. The clay reported between depths of about 30 and 100 feet below the surface may indicate the existence of a lake at some time when the Weiser River was dammed to the south, or it may be just an unusual thickness of fine-grained slope wash on the surface of an alluvial fan. Unfortunately, no other logs were obtained that might reveal the nature of the sedimentary materials at depth.

Well 16N-1W-3dd1, which is on the lower slopes of the alluvial fans a mile north of Council, shows in a total depth of 83 feet two bodies of alluvial sand and gravel, having 70 feet of clay between them.

Because of a lack of well logs, the precise nature and thickness of the alluvial deposits beneath the bottom-land strip on the west side of the lowland could not be determined. Well 17N-1W-14cb1 (fig. 6) is reported to have penetrated 30 feet of cemented sand and gravel above basalt. Probably the alluvial deposits are no thicker beneath the bottom-lands farther south, and they may contain less gravel and more, finer grained material.

All the owners of wells deriving water from the alluvial deposits reported the supplies were adequate for domestic and stock use and

the watering of lawns and gardens. Reports of actual yields were obtained for only four wells, three of them fairly close to each other.

| Well | Yield (gpm) | Drawdown (ft) | Specific capacity (gpm per foot of drawdown) |
|-------------------|-------------|---------------|--|
| 17N-1W-34da1----- | 40 | 15 | 2.7 |
| 16N-1W- 3dd1----- | 10 | 44 | .2 |
| 3dd2----- | 10 | 55 | .2 |
| 3dd3----- | 40 | 8 | 5.0 |

These figures for specific capacity indicate that the yield from the sporadic beds of gravel in the alluvial fans will vary considerably, depending on local conditions and doubtless on method of well construction. The wells can be expected to yield more than enough water for normal domestic and farm needs. Zones of water-yielding sand and gravel seem to be few and thin amid much greater thicknesses of clay-rich material. The alluvial materials probably will not yield enough water for large-scale irrigation.

CHEMICAL QUALITY OF GROUND WATER

Chemical analyses of water from four wells in the Council area and from six wells and a thermal spring in the Midvale area are given in Table 2. The analyses are also plotted in figure 7 as a means of showing the character of the water.

The amounts of certain substances—specifically, silica, iron, and fluoride—commonly present in ground water were not determined. However, these and other less common substances normally amount to a small fraction of the total dissolved solids in waters of this region. The sum of the determined constituents probably is 80–90 percent of the total dissolved solids.

The sum of the determined constituents in the four samples of water from the Council area ranges from 66 to 130 ppm (parts per million), and hardness as calcium carbonate ranges from 43 to 75 ppm. Such hardness is relatively low compared to that of ground water in general.

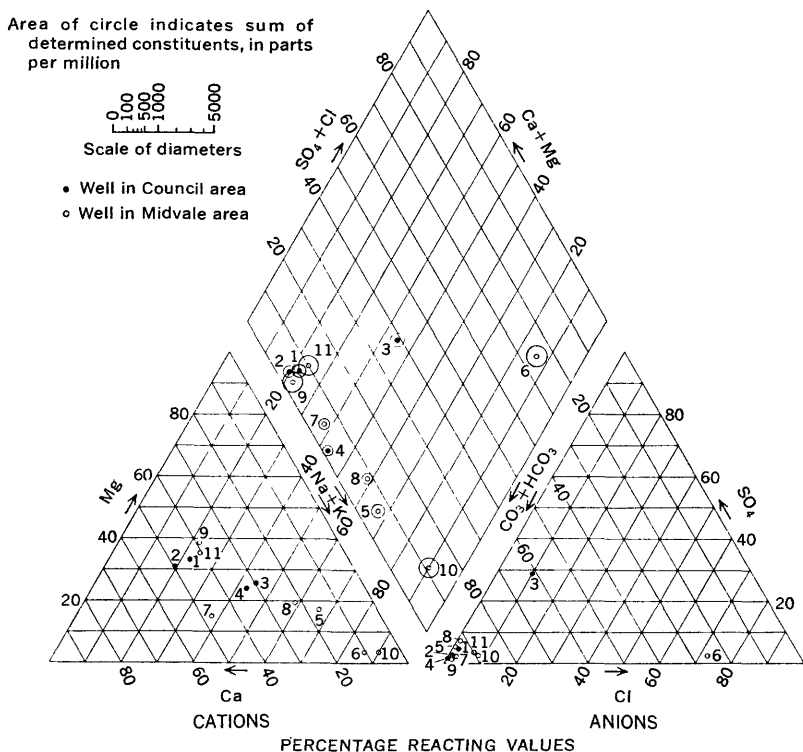
Three of the four sampled waters (points 1, 2, 4, fig. 7) are more or less similar chemically, and they may be considered the normal type of water in the Council area. Bicarbonate amounts to more than 90 percent of the anions determined. With respect to the cations, in the water from the two shallower wells, 17N-1W-34ab1 (120 ft deep) and 16N-1W-2db1 (135 ft deep), calcium and magnesium dominate, and sodium makes up only about 20 percent. The water from the Council municipal well, 16N-1W-14ba2, 381 feet deep, differs by having higher proportions of sodium.

TABLE 2.—*Chemical analyses of representative samples of ground water from the Midvale and Council areas, Idaho*

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

| Well | Depth of well (feet) | Date of collection | Temperature (°F) | Calcium (Ca) | Magnesium (Mg) | Sodium (Na) | Potassium (K) | Bicarbonate (HCO ₃) | Carbonate (CO ₃) | Sulfate (SO ₄) | Chloride (Cl) | Nitrate (NO ₃) | Boron (B) | Dissolved solids, sum of determined constituents | Residual sodium carbonate (meq per l) | Sodium-adsorption ratio (SAR) | Hardness as CaCO ₃ | Specific conductance (micromhos at 25°C) | pH | Class ² |
|--------------|----------------------|--------------------|------------------|--------------|----------------|-------------|---------------|---------------------------------|------------------------------|----------------------------|---------------|----------------------------|-----------|--|---------------------------------------|-------------------------------|-------------------------------|--|------|--------------------|
| 17N-1W-34ab1 | 120 | 5-24-62 | 151 | 17 | 7.8 | 8.7 | 2.7 | 109 | 0.0 | 4.3 | 1.4 | Trace | 0.00 | 96 | 0.29 | 0.44 | 75 | 176 | 7.98 | C1-S1 |
| 16N-1W-24b1 | 135 | do | 154 | 13.6 | 5.1 | 5.3 | 1.6 | 79 | .0 | 1.4 | 0 | 0.0 | .00 | 66 | .20 | .31 | 55 | 126 | 7.28 | C1-S1 |
| 10db1 | 404 | 5-23-62 | 154 | 14.2 | 7.4 | 21.6 | 4.7 | 85 | .0 | 31.7 | 8.5 | 0 | .05 | 130 | .08 | 1.16 | 66 | 235 | 7.48 | C1-S1 |
| 14be2 | 381 | do | 60 | 10 | 4.4 | 12.4 | 3.9 | 83 | .0 | 1.4 | .0 | 0 | .00 | 73 | .50 | .82 | 43 | 138 | 7.48 | C1-S1 |
| 14N-4W-36dd1 | 178 | 5-22-62 | 56 | 6.6 | 4.3 | 24.4 | 11.7 | 115 | .0 | 5.3 | .7 | 0 | .04 | 110 | 1.20 | 1.83 | 34 | 186 | 7.70 | C1-S1 |
| 14N-3W-19cb2 | Spring | do | 120 | 7.8 | 1.5 | 74 | 3.1 | 56 | 2.4 | 105 | 16 | Trace | .52 | 238 | .48 | 6.27 | 26 | 371 | 8.46 | C2-S1 |
| 19dd1 | 35 | do | 157 | 16.8 | 3.3 | 13.3 | 3.9 | 95 | .0 | 1.4 | 1.1 | 1.2 | .00 | 88 | .45 | .78 | 56 | 157 | 7.60 | C1-S1 |
| 13N-3W-6bb1 | 357 | do | 56 | 6.6 | 3.6 | 14.3 | 10.9 | 85 | .0 | 4.8 | 1.7 | 0 | .01 | 83 | .67 | 1.11 | 31 | 139 | 7.62 | C1-S1 |
| 8bd1 | 32 | do | 56 | 41 | 24 | 24 | 4.7 | 299 | .0 | 3.8 | 2.5 | Trace | .04 | 247 | .84 | .73 | 203 | 426 | 7.40 | C2-S1 |
| 8ec3 | 963 | 5-24-62 | 68 | 5.0 | 1.6 | 71 | 13.3 | 200 | 2.4 | 10.1 | 3.9 | 0 | .09 | 206 | 2.98 | 7.00 | 19 | 333 | 8.36 | C2-S1 |
| 10cd2 | 93 | 5-22-62 | 54.5 | 37 | 19.5 | 22.1 | 3.9 | 237 | .0 | 7.2 | 4.6 | 9.3 | .01 | 220 | .46 | .73 | 172 | 380 | 7.32 | C2-S1 |

¹ Not true ground-water temperature.² According to classification for suitability for irrigation, of U. S. Salinity Laboratory Staff, 1954.³ Depth was 802 feet when sampled 5-24-62.



| Number in figure 7 | Well | Depth | Sum of determined constituents (ppm) | Aquifer |
|--------------------|--------------|--------|--------------------------------------|------------------|
| 1. | 17N-1W-34ab1 | 120 | 96 | Basalt. |
| 2. | 16N-1W-2db1 | 135 | 66 | Gravel. |
| 3. | 10db1 | 404 | 130 | Basalt. |
| 4. | 14ba2 | 381 | 73 | Do. |
| 5. | 14N-4W-36dd1 | 178 | 110 | Sand. |
| 6. | 19cb2 | Spring | 238 | |
| 7. | 19bd1 | 35 | 88 | Sand(?). |
| 8. | 13N-3W-6bb1 | 357 | 83 | Do. |
| 9. | 8bd1 | 32 | 247 | Sand and gravel. |
| 10. | 8cc3 | 1802 | 206 | Basalt. |
| 11. | 10cd2 | 93 | 220 | Sand. |

¹ At time of sampling (May 24, 1962).

FIGURE 7.—Chemical character of typical ground waters of the Midvale and Council areas, Idaho.

Water from the well of the Boise-Cascade lumber mill, 16N-1W-10db1 (point 3, fig. 7), plots at a distance from the other waters of the Council area because sulfate makes up 30 percent of the anions. The water also contains a slightly higher proportion of chloride than do the other waters. The water shows about the same proportions of cations as the water from the Council municipal well.

The sum of the determined constituents in the waters sampled in the Midvale area ranges from 83 to 247 ppm, and hardness as calcium carbonate ranges from 19 to 203 ppm.

The waters of the Midvale area—excluding that from a hot spring, 14N-3W-19cb2—are related to each other though they plot through an elongated zone in figure 7. The anions consist mostly of bicarbonate. The cations show a wide range, from water with dominant calcium and magnesium and only 20 percent sodium to water in which sodium is 90 percent of the cations. The latter is found in the Midvale municipal well, 13N-3W-8cc3.

The water at shallow depth, such as that from gravel beneath the Middle Valley (well 13N-3W-8bd1), is the calcium magnesium bicarbonate type containing low proportions of sodium, and it has high hardness and concentration of dissolved solids. The water at greater depth tends toward the sodium bicarbonate type and has unusually low hardness; both of these features are probably due to contact with the clayey lake beds and to the resulting base exchange, in which the water exchanges calcium and magnesium for sodium contained in the clay.

The water sampled at the hot spring, 14N-3W-19cb2, in the northern part of the Shoe Peg Valley is the sodium sulfate type. The character of the water doubtless reflects the hot gas and water rising from depth, reactions with the formations at a higher level, and admixture of normal shallow ground water.

In summary, the normal waters of both the Council and Midvale areas are much the same type and character, and such differences as exist reflect differences in environment. Water from the Council area has fairly low hardness and concentration of dissolved solids, because the minerals in the basalt and alluvial deposits are not very soluble. The water of the Midvale area contains more dissolved solids, probably because of slower circulation and hence more time for solution of minerals from the lake deposits; however, the water is softer because of base exchange reactions with the clay of the lake deposits.

The character of water in both areas varies between the calcium magnesium bicarbonate type and the sodium bicarbonate type.

The waters are of good to excellent quality for all common uses and for irrigation. The analyses show no significant quantities of objectionable substances. However, no determination of fluoride content was made, and some of the water from the deeper zones may have a higher fluoride content than is desirable for domestic use.

SUMMARY

Ground water ample for domestic and stock needs can be obtained almost everywhere in the Midvale and Council areas from wells not more than a hundred feet deep. In a few places deeper wells are

required, but the water level in most of these wells is rarely as much as 50 feet below the surface.

Wells which penetrate the basalt beneath the lowland areas, at depths of 100 to more than 500 feet, can provide up to a few hundred gallons of water a minute.

In the Midvale area, water for irrigation of small acreages probably can be obtained from beds of sand amid the fine-grained lake deposits that underlie the lowland. The cost of drilling wells to the more productive but deeper-lying basalt probably would exclude this aquifer as a source of irrigation water.

In the Council area the basalt is the only formation that could be relied upon for water for supplemental irrigation. Beneath the upper parts of the alluvial fans on the east side of the lowland, the depth to water level may make pumping from the basalt uneconomical. However, beneath the lower parts of the alluvial fans the lift would not be great.

The quality of the ground water in both the Midvale and Council areas is suitable for irrigation and all other common uses.

RECORDS OF WELLS

The following tables (tables 3 and 4) present data on wells inventoried in the Midvale and the Council areas in the course of this investigation. Only a small percentage of all the wells in the two areas were visited. However, an effort was made to obtain a good geographic distribution, and it is believed that the inventoried wells show representative conditions.

The data were obtained through interviews with well owners and drillers and from records that drillers have submitted to the Idaho Department of Reclamation.

Reports of drawdown in wells during pumping are mostly from tests made by drillers upon completion of wells.

TABLE 3.—Records of wells in the Middle area, Upper Weiser River basin, Idaho

Type of well: D, dug; Dr, drilled.
 Depth of wells are reported depths.
 Character of aquifer: S, sand; C, gravel; Bas, basalt.
 Depth of well in feet below land surface datum.
 Water level: Depth in feet below surface datum. Measured depths to water are given to the nearest tenth of a foot. Reported depths to water are given to the nearest foot.

| Well | Owner | Year drilled | Type of well | Depth of well | Casing | | Char-acter of aquifer | Water level | | Pump | | Yield of well (gpm) | Use of water | Remarks |
|---|--|---|--|---|----------------------------------|-----------------------------------|--------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|--|--------------------------|---|--|
| | | | | | Diam-eter (in.) | Depth (ft) | | Depth | Date | Type | H.P. | | | |
| 14N-4W-25bd1 36bd1 36bd1 | Mayme Potter C. F. Kathley Kathley Creek Cemetery. | 1958 1930 1956 | Dr Dr Dr | 40 76 178 | 6 5 8 | — — 55 | S S S | Flows 8.9 31 | 11-29-61 10--56 | J C T | 1 1/2 3 | — 27 | Dom, St Dom, St Irr | Flows 2-3 gpm. Drawdown 14 ft while pump- ing 27 gpm. Log. Anal- ysis. Temp 61°. Analysis. |
| 14N-3W-19cb1 19cb2 | Joe Wiggins do. | 1942 | Dr | 42 | 6 | — | S | 12 | — | P | 0 | — | Dom | Flows 2 gpm. Drawdown 8 ft while pump- ing 10 gpm. Analysis. Log. |
| 19da1 19da1 | Carpenter & Son Co do. | — — | Dr Dr | 45 35 | 4 6 | — | S S | Flows Flows | 11-29-61 do. | C J | 1 1/2 3/4 | 10 | St Dom, St | Flows 2 gpm. Drawdown 14 ft while pump- ing 10 gpm. Analysis. |
| 28bd1 28bd1 30ad1 | Lawrence Boyd do. D. B. William | 1947 1947 1948 | Dr Dr Dr | 173 143 90 | 6 6 6 | — | S — S | 12 18 | — | J J C | 1 1 | 7 | Dom, St Dom, St Dom, St | Flows 2 gpm. Drawdown 8 ft while pump- ing 10 gpm. Analysis. Log. |
| 30bd1 31ad1 32bd1 32bd1 32bd1 33bd1 33bd1 | Clifford Hopper Gerald Johns L. H. Hopper Emerson Wiggins Bill Wiggins Hicks Jewell J. L. Baker do. | 1922 1951 1925 1950 — 1910 1958 1960 | Dr Dr Dr Dr Dr Dr Dr Dr | 48 100 60 93 58 18 68 40 | 6 6 6 6 6 14 6 | — 96 — — — 3 33 | S — — — G S, Bas S | 10 6 13 0-15 8 Flows | 11--61 — — 1958 11-28-61 | J J J J N N N N | 1/4 — — — 1 — — 0 | — — — 360 30 | Dom, St Dom, St Dom, St Dom, St Dom, St St N N N N | Soil 2 ft; gravel 16 ft. Pumps dry at 640 gpm. Log. Flows 10 gpm; pumps 30 gpm. |
| 11cd1 12cd1 | Ben Fairchild Arthur Fairchild | — — | Dr Dr | 169.6 | 6 6 | — | — | 16.0 | 11-27-61 | P N | — — | — — | N N | Drawdown 18 ft, while pump- ing 70 gpm. Log. |
| 13ba1 | do. | 1958 | Dr | 185 | 12 | 40 | S | Flows | — | T | 3 | 70 | Irr | Drawdown 62 ft, while pumping 72 gpm. |
| 13bb1 13bd1 14ad1 14ad1 14da1 | do. Midvale Airport Ben Fairchild Phyllis W. Fair- child. | — — — 1955 | Dr Dr Dr Dr | 160 — — 170 | 6 6 6 12 | 160 — — 70 | S — — — | 30.6 4.1 8 | 11-27-61 11-28-61 do. 1961 | J J N N | 3/4 1/4 — — | — — 72 | Dom, St Dom N N | Drawdown 22 ft, while pumping 10 gpm. |
| 23da1 24ad1 | Milton Branch Elvin Evans | 1920 1951 | Dr Dr | 50 102 | 6 6 | 66 | S | Flows 13 | 1951 | N J | — 1 | — 10 | Dom, St Dom, St | Drawdown 22 ft, while pumping 10 gpm. |
| 24ba1 | do. | 1910 | Dr | 65 | 6 | — | — | — | — | P | 0 | — | St | — |

TABLE 3.—Records of wells in the Midvale area, Upper Weiser River basin, Idaho—Continued

| Well | Owner | Year drilled | Type of well | Depth of well | Casing | | Char-acter of aquifer | Water level | | Pump | | Yield of well (gpm) | Use of water | Remarks |
|------------------|------------------|--------------|--------------|---------------|-----------------|------------|-----------------------|-------------|----------|------|------|---------------------|--------------|---|
| | | | | | Diam-eter (in.) | Depth (ft) | | Depth | Date | Type | H.P. | | | |
| 13N-3W-36b1-36b2 | Virgil Fairchild | 1964 | Dr | 90 | 4 | 60 | | 12 | 1961 | J | 1 | 13 | St | Drawdown 4 ft, while pump- ing 13 gpm. |
| | do. | | Dr | | 6 | | | 10 | 1961 | J | | | Dom | |
| 36c1 | B. R. Fairchild | 1940 | Dr | 60 | 6 | | | 10 | 1961 | J | ½ | 13 | Dom, St | Drawdown 5 ft, while pump- ing 13 gpm. |
| 36d1 | do. | 1962 | Dr | 55.1 | 12 | 60 | | 10 | 1961 | N | | 180 | N | |
| 36d2 | do. | 1967 | D | 15 | 48 | | G | 1 | 1961 | C | | | Irr | |
| 36d3 | W. C. Sutton | 1966 | Dr | 166 | 6 | 105 | | Flows | 11-29-61 | J | 2 | 8 | Dom, St | Drawdown 11 ft, while pump- ing 8 gpm. |
| 66a1 | Raymond Widner | 1965 | Dr | 59 | 6 | 45 | S | 4 | 1965 | J | ¾ | 20 | Dom, St | Log. |
| 66b1 | Ray Weite | 1963 | Dr | 357 | 8 | | S? | | | T | 1 | 50 | St, Irr | Temp 56°. Analysis. |
| 66d1 | D. D. Pickett | 1965 | Dr | 420 | 6 | 180 | S, G | 50 | 5- -55 | J | 1 | | Dom, St | Drawdown 10 ft, while pump- ing 20 gpm. Log. Analy- sis. |
| 86d1 | Earl Craig | 1960 | Dr | 32 | 6 | 29 | | 3 | 6- -60 | | | 20 | Dom, St | Well 1. |
| 86c1 | Town of Midvale | 1939 | Dr | 290 | 8 | 150 | S | 0 | 11-23-61 | T | 10 | | PS | Well 2. Drawdown 47 ft, while pumping 318 gpm. |
| 86c2 | do. | 1963 | Dr | 521 | 12 | 295 | | 0 | do. | T | 35 | 318 | PS | Well 3. Flows 600 gpm. Log. Analysis. |
| 86c3 | do. | | Dr | 963 | 12 | | Bas | Flows | | N | | | PS | |
| 96d1 | J. R. Fox | 1910 | Dr | 100 | 6 | | | 20 | 1961 | J | ½ | | Dom, St | |
| 96b1 | V. R. Fairchild | 1920 | Dr | 196 | 4 | | | 8 | do. | N | | | N | |
| 96b2 | do. | 1960 | Dr | 65 | 4 | 63 | S | | | J | ¾ | | Dom, St | |
| 96c1 | P. E. Jacks | 1964 | Dr | 40 | 6 | 40 | | 10 | 1964 | J | 1 | | Dom, St | |
| 10a1 | W. C. Sutton | 1966 | Dr | 200 | 6 | 166 | | Flows | 11-23-61 | J | 2 | 8 | Dom, St | Flows 6 gpm. Drawdown 11 ft, while pumping 8 gpm. |
| 10c1 | Midvale Cemetery | 1964 | Dr | 320.4 | 8 | 149 | Bas | .7 | 11-23-61 | N | | 25 | Irr | Well 1. 110 ft drawdown. Log. |
| 10c2 | do. | 1969 | Dr | 93 | 12 | 73 | S | 36 | | T | 5 | 50 | Irr | 12 in. bore, gravel packed. Well 2. Log. Analysis. |
| 10c3 | do. | 1915 | Dr | 112 | 3 | 112 | S | 75 | 1930 | P | 0 | | Dom | "Middle well," Flows 3 gpm. Drawdown 20 ft, while pumping 10 gpm. |
| 11b1 | M. W. Lewis | 1920 | Dr | 27 | 6 | 25 | | Flows | 11-23-61 | J | | 10 | Dom, St | |
| 16b1 | Othniel Evans | 1950 | D | 17 | 1 ¼ | | G | | | C | ¾ | | Dom, St | Flows 6 gpm. Log. |
| 17a1 | R. A. Hooper | 1960 | Dr | 73 | 6 | 73 | | 11 | 9- -61 | J | ¾ | | Dom, St | |
| 21c1 | do. | 1963 | Dr | 125 | 6 | 125 | S, Bas | Flows | 11-23-61 | N | | | Dom | |
| 28a1 | James Parks | 1960 | Dr | 45 | 6 | | | 14 | 6- -60 | | | 6 | Dom | |

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Ground Water in the Midvale and Council Areas Upper Weiser River Basin Idaho

By EUGENE H. WALKER and H. G. SISCO

CONTRIBUTIONS TO THE HYDROLOGY OF THE UNITED STATES

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1779-Q

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



UNITED STATES DEPARTMENT OF THE INTERIOR

STEWART L. UDALL, *Secretary*

GEOLOGICAL SURVEY

Thomas B. Nolan, *Director*

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CONTRIBUTIONS TO THE HYDROLOGY OF THE UNITED STATES

GROUND WATER IN THE MIDVALE AND COUNCIL AREAS, UPPER WEISER RIVER BASIN, IDAHO

By EUGENE H. WALKER and H. G. SISCO

ABSTRACT

The Midvale and Council areas are two broad parts of the Weiser River valley in Washington and Adams Counties, near the western border of Idaho. Stock-raising and hay production are the principal types of farming, though some diversified farming is done in the Midvale area. There is a deficiency of surface water for irrigation, and very little rain falls in summer.

The lowlands are underlain by sedimentary deposits, mostly silt and clay, of late Tertiary age, that accumulated in basins on a terrain of warped and faulted basalt flows having sedimentary interbeds. The Columbia River Basalt, of Miocene age, forms the uplands that surround the lowland areas. Some sand and gravel, deposited in stream channels and alluvial fans, and fine-grained lake beds, all of Quaternary age, are in the lowlands.

The basalt is the best aquifer. It occurs beneath the lowlands at depths ranging from a few feet to many hundreds of feet. Known yields from the basalt are as much as a few hundred gallons a minute; yield increases with greater penetration of the basalt below water level. Most wells in basalt in the Midvale area flow at the surface.

Thin beds of sand in the deposits of Tertiary age beneath the Midvale area yield an ample supply for farm use, and at places might yield enough for supplemental irrigation of small acreages. In the Council area the sedimentary deposits of Tertiary age contain little sand and are not adequate as a source of water.

Thin sheets of sand and gravel of Quaternary age are a water source for a number of domestic wells in both the Midvale and Council areas.

The quality of ground water in both areas is satisfactory for all common uses. Hardness averages about 70 parts per million. The shallow waters are mainly the calcium magnesium bicarbonate type; the deeper waters tend to be the sodium bicarbonate type, owing at least partly to base exchange with clayey materials.

INTRODUCTION

This report describes the ground-water resources of the Midvale and Council areas, which are two of the broader basins in the drainage of the Weiser River, near the western margin of Idaho (fig. 1). The Midvale area is in Washington County and the Council area in Adams County. The economy of these areas is based almost entirely on

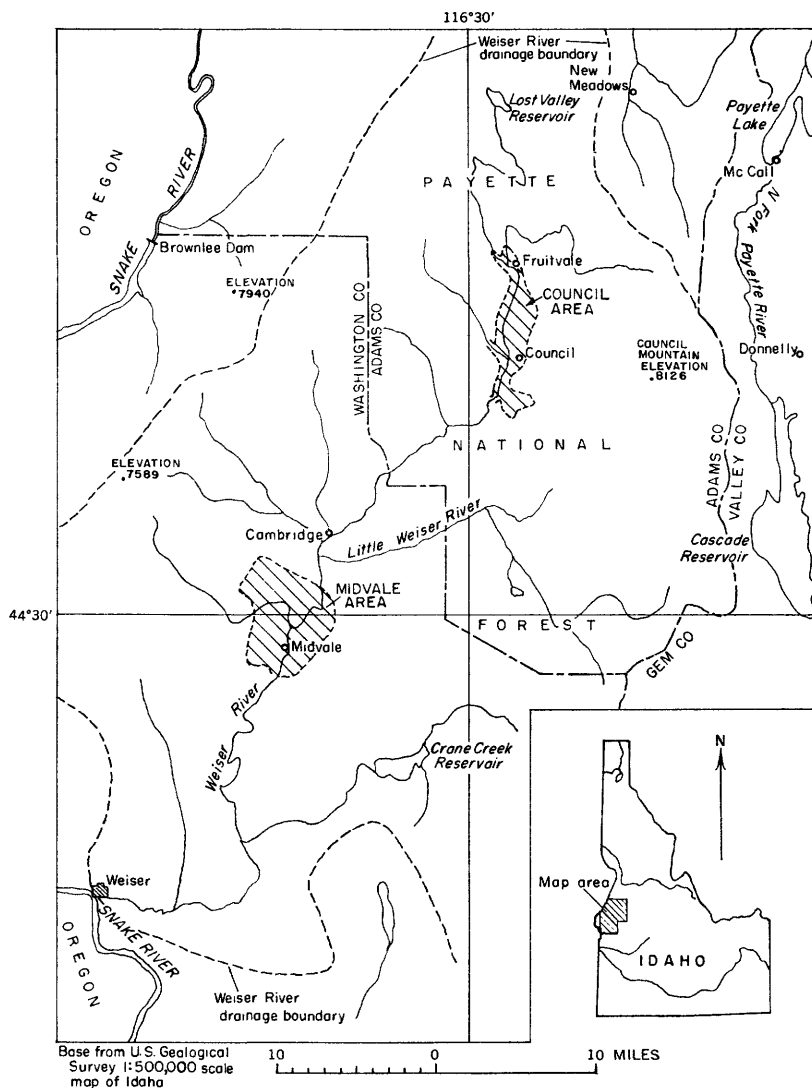


FIGURE 1.—Index map of the Weiser River basin, Idaho, showing the Midvale and Council areas.

agriculture. Additional supplies of water for irrigation would be of great value to parts of the areas where productivity is limited by inadequate supplies of surface water and the typically small amount of summer rainfall.

This study was made by the U.S. Geological Survey in cooperation with the U.S. Bureau of Reclamation. The inventory of wells was made by H. G. Sisco, and E. H. Walker studied the geology and prepared the report.

The data on the occurrence of ground water in the areas were derived mostly from the records of wells, obtained through interviews with landowners and well drillers. Drillers' logs of typical wells were obtained from well drillers and from the files of the Idaho Department of Reclamation. Water samples were collected for analysis to show the chemical character of the ground waters.

The well-numbering system used in Idaho by the Geological Survey indicates the location of wells in the official rectangular subdivisions of the public lands. The first two segments of a number designate the township and range. The third segment gives the section number and is followed by two letters and a numeral, which indicate, respectively, the quarter section, the 40-acre tract, and the serial number of the well within the tract. Quarter sections are lettered a, b, c, and d in counterclockwise order from the northeast quarter of each section (fig. 2). In the quarter sections, 40-acre tracts are lettered in the same manner. Thus well 13N-4W-13db1 is in the NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 13, T. 13 N., R. 4 W., and it is the first well visited in that tract.

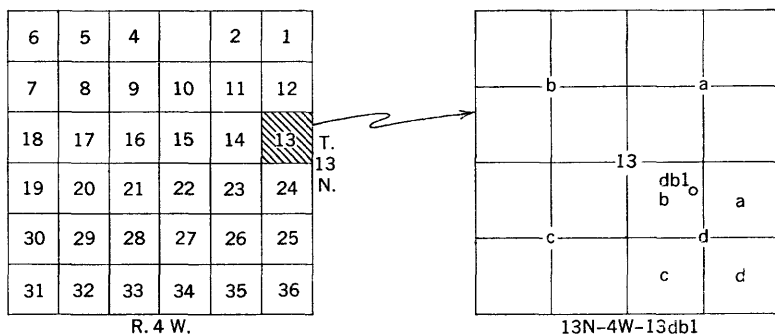


FIGURE 2.—Sketch showing well-numbering system.

GEOGRAPHIC FEATURES

The segment of the Weiser River basin that includes the Midvale and Council areas consists largely of uplands that are underlain by flows of the Columbia River Basalt. The Weiser River crosses the resistant basalt in narrow valleys. The broader lowlands, such as the Midvale and the Council areas, have developed where relatively soft sedimentary materials filled structural basins in the basalt terrane. The Council area lies near the headwaters of the Weiser River, in Adams County, and the Midvale area is about 25 airline miles to the southwest, in Washington county.

The floor of the elongate valley of the Council area covers about 16 square miles. The Weiser River flows southward along the west side of the valley, and drops from an elevation of about 3,040 feet at the

head of the valley to about 2,900 feet at the lower end, 9 miles to the south. The west side of the valley is bordered by gentle slopes that rise to an upland a few hundred feet above the valley floor. The east side of the valley is enclosed by the steep slopes of the mountains of the Payette National Forest, which reach an elevation of 8,126 feet in Council Mountain.

The Midvale area is a rudely circular lowland of about 30 square miles. The lowland is enclosed by gentle slopes that rise a few hundred feet to a dissected upland. A border of the lowland can be drawn only approximately, for a gradual transition occurs through alluvial fans on the lowland to slopes cut on basalt or sedimentary deposits.

Two topographic divisions of the Midvale area are readily recognized. The Middle Valley is an extensive lowland on the east side of the Weiser River. It is a terrace separated from the fairly narrow flood plain by a bluff 30-50 feet high. A slightly higher surface, sometimes called the Shoe Peg Valley, occupies most of the lowland area west of the Weiser River.

The elements of the climate of the two areas are shown by tables of average monthly precipitation and temperature at Council and at Cambridge, which is 8 miles north of Midvale in another wide part of the Weiser River valley (table 1). Very little precipitation falls in summer. The sum of the precipitation in July and August averages only 0.70 inch at Council and 0.39 inch at Cambridge. Annual precipitation averages 27.14 inches at Council and 19.39 inches at Cambridge.

TABLE 1.—Average monthly temperature and precipitation at Cambridge and Council, Idaho, 1931-55

[From records of U.S. Weather Bureau]

| Month | Temperature, in degrees Fahrenheit | | Precipitation, in inches | |
|---------------------|------------------------------------|---------|--------------------------|---------|
| | Cambridge | Council | Cambridge | Council |
| January..... | 22. 6 | 24. 9 | 2. 83 | 3. 86 |
| February..... | 27. 5 | 29. 2 | 2. 55 | 3. 31 |
| March..... | 37. 8 | 37. 3 | 1. 95 | 2. 75 |
| April..... | 49. 4 | 48. 3 | 1. 47 | 2. 16 |
| May..... | 57. 5 | 56. 5 | 1. 23 | 1. 92 |
| June..... | 63. 9 | 62. 6 | 1. 41 | 1. 87 |
| July..... | 74. 6 | 72. 6 | . 23 | . 39 |
| August..... | 71. 7 | 70. 4 | . 16 | . 31 |
| September..... | 61. 3 | 61. 6 | . 58 | . 84 |
| October..... | 50. 2 | 50. 8 | 1. 34 | 2. 10 |
| November..... | 36. 4 | 37. 2 | 2. 59 | 3. 33 |
| December..... | 28. 1 | 29. 0 | 3. 05 | 4. 30 |
| Average annual..... | 48. 4 | 48. 4 | 19. 39 | 27. 14 |

The average monthly temperature at Council and at Cambridge is much the same. Both areas have a milder climate, less extremes of heat and cold, than do many other intermontane valleys of southern Idaho.

The soil of the Midvale and Council areas consists mostly of loess, at least to the depth of the plough furrow. Loess forms a pervasive cover, except on slopes and knolls that are being actively eroded or on recently formed flood plains and alluvial fans. In most of the lowland areas the loessial soil is underlain by alluvial gravel or sand; in a few places, however, it is underlain by the basalt lavas or by lake beds of clay, silt, or fine-grained sand.

Loessial soil is thickest on those older surfaces that are little eroded. The loess on the high bench land of the Midvale area is at least 3 feet thick, but it is not more than a foot thick on the low terrace above the flood plain of the Weiser River.

In the Council area, loessial soil more than a foot thick is confined to small areas on the gentler parts of the older alluvial fans. The soil through the steeper parts of the extensive alluvial fans of the Council area becomes gravelly at a depth of a few inches. The prevailing reddish color of the soil reveals the presence of much fine-grained slope wash derived by decomposition of basalt.

Both the Midvale and the Council areas have been settled for several generations, and almost all the lowlands are used for farming. There is only one village in each area: Midvale, having a population of 211, and Council, having a population of 827.

The Midvale area, due to its greater size and superior soil, is better for farming than the Council area. The land is used chiefly for the production of small grains and hay, although some sweet corn, potatoes, and clover seed are grown. In addition, beef cattle and sheep are raised; these are pastured in the uplands and mountains during the summer.

The low Middle Valley part of the Midvale area has an adequate supply of surface water for irrigation from the Weiser River. The higher land of the Shoe Peg Valley has a meager supply from the several small drainages that empty onto the bench. Some water is stored in small reservoirs. Most of the area is necessarily dry-farmed. Dryfarming is being extended onto the gentler slopes surrounding the Midvale lowland wherever there is a thick mantle of water-retentive loessial soil.

In the Council area the principal farming activity is stock raising and the attendant production of hay and management of pasture land. Only a small portion of the land is used for small grains, and row crops are raised primarily for local use. Some fruit, mainly apples, is grown

in a number of small orchards, which are concentrated on the upper parts of the alluvial fans on the east side of the valley.

Much timber is cut in the forests of the mountains surrounding the Council area, and there is a large lumber mill at Council.

GEOLOGY AND GROUND WATER

ELEMENTS OF THE AREAL GEOLOGY

The oldest formations exposed in the area are the lava flows of the Columbia River Basalt and the associated sedimentary materials. The sedimentary beds were assigned to the Payette Formation by Kirkham (1930). The Columbia River Basalt is generally considered to be of Miocene age (Ross, 1956, p. 85). In this area, however, there is evidence that basalt flows not readily distinguishable from those of the Columbia River Basalt continued to erupt in Pliocene time. Therefore, all the basalt lavas and associated sedimentary beds are referred to as being of Tertiary age.

The basalt crops out in the hills and mountains and is well exposed in canyons such as the one immediately north of the Midvale area. Individual sheets of lava range in thickness from a few to about 50 feet. Most of the lava is dense but intricately broken by many joints and irregular cracks. There are also zones of fragmental lava, and these are probably the main water-bearing zones.

The sedimentary materials interbedded with the lava flows apparently were deposited chiefly in lakes. They consist mostly of clay and silt and sporadic beds of sand; gravel is uncommon.

The basalt lavas and associated lake beds were warped and faulted at some time late in the Tertiary Period. Apparently a landscape of considerable relief was created. Erosion then proceeded to reduce much of the highlands to a surface of low relief. Some deposits of clay and silt and stray thin beds of sand accumulated in lowlands at this time. These deposits may be equivalent to the Idaho Formation of Savage (1961, p. 13), of late Pliocene and early Pleistocene age. In this report these deposits are grouped with the late Tertiary sedimentary deposits interbedded with the basalt lavas, and both are referred to as deposits of Tertiary age; they are similar, and no boundary is designated in well logs.

During the Pleistocene Epoch, the area was uplifted and the major topographic features are the result of differential erosion. The Weiser River has cut only narrow valleys across areas of resistant basalt, but during the same time has opened out wide lowlands on areas underlain by the soft lake beds.

The details of topography on the lowland areas show that the valley deepening was accomplished in several stages. For example, the Shoe Peg Valley section of the Midvale area represents a valley

floor that was widened when the Weiser River was flowing at a level 70 or more feet higher than at present. This surface was mantled with alluvial-fan and stream gravels. The river next cut downward several tens of feet and then cut laterally to form the flats of the Middle Valley. The river, now entrenched below the Middle Valley surface, is forming a new flood plain. A generally similar sequence occurred in the Council area, though the indications are less obvious. The successive steps in downcutting, valley widening, and spreading of gravel sheets are probably related to late substages of glaciation, which affected the regimen of streams in the region.

MIDVALE AREA

The topographic features and approximate limits of the Midvale area and the location of the wells inventoried are shown in figure 3.

Ground water in the Midvale area is obtained from the basalt and the lake beds of Tertiary age that underlie the entire area and from the sand and gravel of Pleistocene age that mantle the basalt and lake beds at low altitudes. Most of the wells bottom in the lake beds of Tertiary age and produce from thin beds of sand. However, the basalt is the best aquifer. A small percentage of the shallow wells derive water from the sand and gravel of Pleistocene age.

The ground water in the area originates from local precipitation on the lowland and the surrounding higher land. Some water moves for many miles through pervious zones in the basalt lavas, especially at depth, but it is unlikely that much water moves into or out of the area through the rocks.

BASALT OF TERTIARY AGE

The basalt lavas no doubt underlie all of the Midvale area at depth. Basalt is exposed on the slopes of the northern, western, and southern margins of the lowland area. The gentler slopes on the east side of the lowland are underlain by lake beds of Tertiary age, but even here the basalt occurs not far below the surface; for example, well 13N-3W-10cd1 at the Midvale Cemetery entered basalt at a depth of 205 feet (fig. 4).

Information from scattered wells shows that the depth to basalt increases inward from the margins of the lowland. Well 13N-4W-11cd1, close to the edge of the lowland, entered basalt at a depth of only 59 feet. Well 13N-4W-13ba1, a mile farther east, was still in lake beds at a depth of 185 feet. Well 14N-4W-36dd1, a mile away from the hills, was in lake beds through its total depth of 178 feet.

At Midvale, $1\frac{1}{2}$ miles from the east side of the valley, the first basalt was penetrated at a depth of 510 feet in well 13N-3W-8cc3.

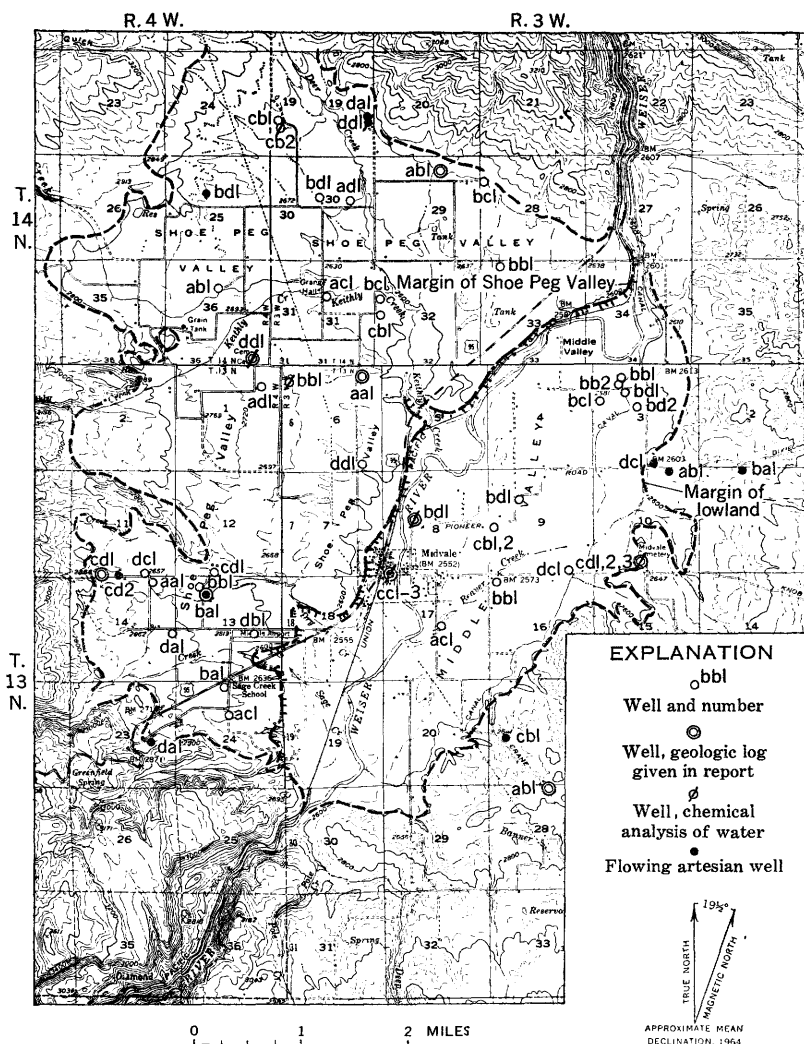


FIGURE 3.—Map of the Midvale area, upper Weiser River basin, Idaho, showing location of inventoried wells.

Well 13N-3W-6bb1, about 2 miles northwest of Midvale, is reported to be 357 feet deep. This well may have entered the basalt, but unfortunately all record of formations penetrated has been lost.

Water in the basalt is commonly under enough pressure to rise in wells and flow at the surface. Water rises to the land surface in well 13N-3W-10cd1, at an elevation of about 2,650 feet in the Midvale Cemetery, which is on a low bench on the eastern margin of the valley.

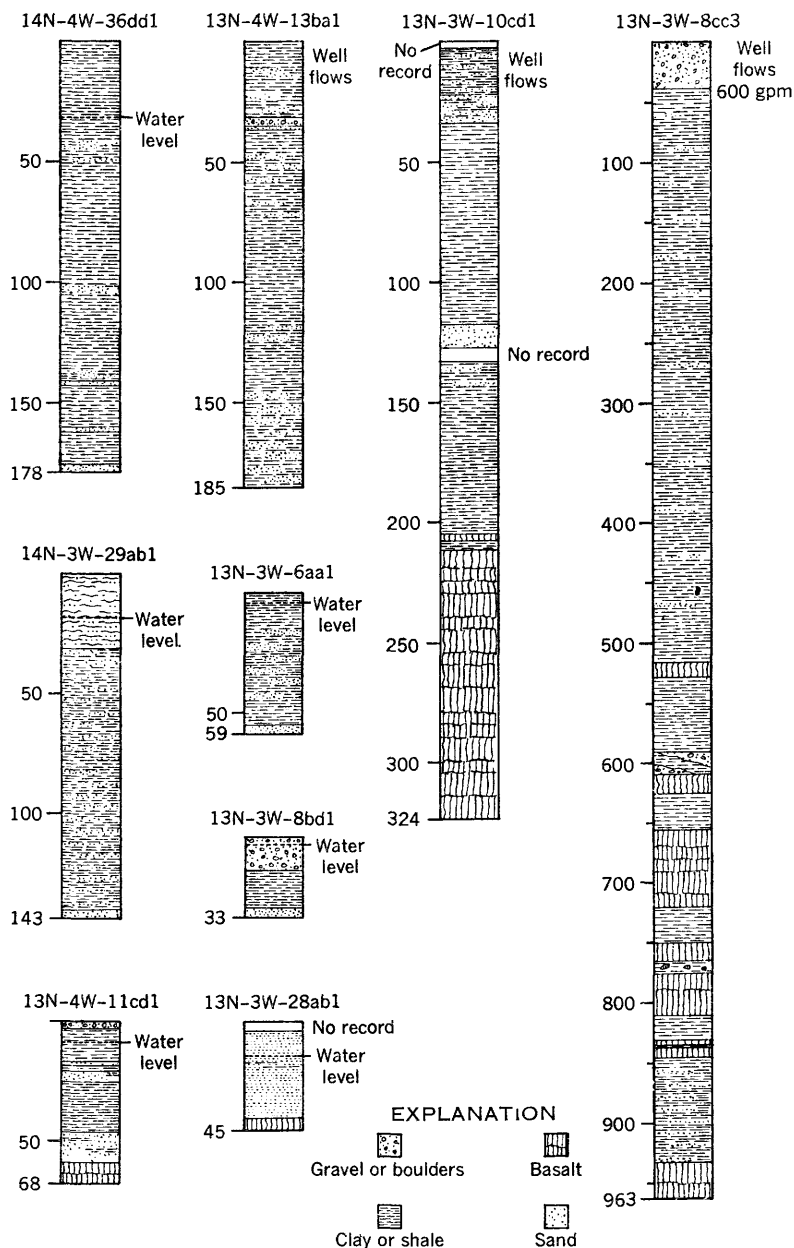


FIGURE 4.—Geologic logs of representative wells in the Midvale area, Idaho.

The artesian pressure increases with depth in the basalt. The Midvale town well 3 (13N-3W-8cc3) flowed about 10 gpm (gallons a minute) when the well was about 800 feet deep; the driller reported

that the head was low, although no exact measurement was made. When deepened to 963 feet, the well penetrated a water-bearing zone that produced a flow of 600 gpm under a pressure of 155 pounds at the surface. This pressure is equivalent to a head of about 360 feet. The elevation of the land surface at the well is about 2,550 feet, and static water level therefore is at an elevation of about 2,910 feet. This is only a few hundred feet below the broad uplands around the Midvale area, where water enters the basalt lavas.

The reported yields of wells known to penetrate the basalt, which presumably derive most of their water from basalt, are given below.

| Well | Depth (ft) | Yield (gpm) | Drawdown (ft) | Specific capacity (gpm per foot of drawdown) |
|-------------------|------------|-------------|---------------|--|
| 13N-4W-11cd1..... | 68 | 360 | | |
| 13N-3W- 8cc2..... | 521 | 318 | 47 | 6. 8 |
| 8cc3..... | 963 | 600 (flow) | | |
| 10cd1..... | 320 | 25 | 110 | . 2 |
| 28bb1..... | 45 | 6 | | |

The available information shows that properly constructed wells penetrating the basalt a sufficient distance will yield several hundred gallons of water a minute, but the information does not permit an estimate of the potentialities of the basalt as an aquifer in terms of yield to wells per foot of drawdown. The yield may approximate that which Newcomb (1959, p. 14) found for many wells in basalt in the State of Washington. There the yield in wells 10-12 inches in diameter having drawdowns of 50-100 feet averaged a little more than 1 gpm for each foot of penetration of water-saturated basalt.

SEDIMENTARY DEPOSITS OF TERTIARY AGE

Sedimentary deposits of Tertiary age occur everywhere beneath the lowlands of the Midvale area and also underlie some of the slopes on the east side of the Middle Valley. The thickness of sedimentary deposits above the basalt ranges from zero where the basalt crops out in the lower slopes to at least 510 feet in the Midvale village well. The total thickness of the sedimentary deposits is greater than the thickness above the first basalt met in a well, because more sedimentary strata are between lava flows.

Exposures and well logs (fig. 4) show that clay, silt, and fine-grained sand predominate in the sedimentary deposits. Beds of coarser grained sand occur sporadically.

In exposures, the fine-grained beds consist of alternate layers of silty clay and fine-grained sand, each a fraction of an inch to several inches thick. Some well records report heavy clay of various colors, such as black, blue, or red. A bed of this heavy clay is reported at

depths of 60-80 feet at a number of places beneath the surface of the Middle Valley. The clay is said to have a strong smell and to contain fragments of wood and other organic material.

The layers of coarser sand and silty sand are rusty colored in outcrops and are partially cemented by iron oxide. Such beds of sand are usually no thicker than 5 feet. However, about 40 feet of sand was reported between depths of 35 and 75 feet in well 13N-3W-10cd2 at the Midvale Cemetery, which is on a bench on the eastern side of the valley.

Groundwater in these deposits comes wholly from the beds of sand, which are frequent enough that practically all wells yield at least enough water for domestic purposes.

The water is confined in the beds of sand and rises in wells. Water flows from many wells that are within about half a mile of the edge of the lowland. Farther toward the center of the lowland the pressure declines below land surface, but in few wells is water level more than 10 feet below the surface. Greater depths to water are due to local topography: well 14N-4W-36dd1 is on a low hill and the water level is reported to be about 30 feet below land surface; well 13N-3W-6dd1 is near the east edge of the Shoe Peg Valley and the water level is reported to be 50 feet below land surface.

Most wells in the sedimentary deposits of Tertiary age provide supplies adequate for domestic use, for watering of lawns and gardens, and for watering of stock in winter. The measured or estimated yields of a number of wells, and the drawdown during pumping for some wells, reported by well owners or drillers, are given below.

| Well | Yield (gpm) | Drawdown (ft) | Specific capacity (gpm per foot of drawdown) |
|--------------------|----------------|------------------|--|
| 14N-4W-36dd1----- | 27 | 14 | 1.9 |
| 14N-3W-19dd1----- | 10 | 8 | 1.3 |
| 13N-4W-11cd2----- | 30 | | |
| 13ba1----- | 70 | 18 | 3.9 |
| 14da1----- | 72 | 62 | 1.2 |
| 13N-3W- 3bb2----- | 13 | 4 | 3.3 |
| 3bc1----- | 13 | 5 | 2.6 |
| 3dc1----- | 8 | 11 | .7 |
| 6aa1----- | 20 | | |
| 6bb1----- | 50 | | |
| 10cd1----- | 25 | 110 | .2 |
| 10cd2----- | 50 | | |

The average of the eight values for specific capacity is 1.9 gpm per foot of drawdown.

These values for specific capacity show that the sedimentary deposits of Tertiary Age can yield enough water for irrigation of small

acres. The two cemeteries in the area, the larger of which covers about 4 acres, are currently being irrigated with ground water from the sedimentary deposits.

The common domestic wells have 6-inch casing. Casing may extend to the bottom of the hole and be perforated. However, a number of wells are uncased at depth, indicating that the lake beds tend to stand without caving into holes. Well 14N-4W-36dd1, used to irrigate the Keithley Creek Cemetery, is cased to 55 feet and is an open 8-inch hole below that depth. The principal irrigation well (13N-3W-10cd2) at the Midvale Cemetery, a 12-inch gravel-packed well, also contains 6-inch casing.

Wells designed specifically to produce irrigation supplies would be more efficient than any of the foregoing except the 12-inch gravel-packed well (13N-3W-10cd2) and would have higher specific capacities. The lifts of ground water should not be too great at moderate rates of pumping. The development of ground water for irrigation will depend on economic factors such as the cost of wells and irrigation equipment and the value to the farmer of increased crop yields.

SEDIMENTARY DEPOSITS OF QUATERNARY AGE

Sheets of sand and gravel of Quaternary age occur at fairly shallow depth in the lowland terraces. Where these deposits are in the zone of saturation, they can supply small to fairly large amounts of water.

Sand and gravel is widespread on the Shoe Peg Valley. The deposits are mantled by loess and are exposed in streams, roadcuts, and steep bluffs. The gravels represent several episodes of deposition on alluvial fans and in stream channels.

The oldest gravel forms low ridges and knolls above the general level of the Shoe Peg Valley. It represents the remnants of once extensive alluvial fans, now almost wholly removed during erosion of the bench to its present level. These deposits are of no consequence for water supply because they occupy small areas and are above water level.

A younger sheet of alluvial material underlies large parts of the Shoe Peg Valley. It lies upon silty or clayey lake beds that are probably of Tertiary age, and it is usually covered by a few feet of loess. This sheet consists of alternate beds of rounded pebble gravel and poorly sorted sand. Apparently, it was deposited by small tributaries that flowed across the bench to join the Weiser River.

The thickness of the main sheet of sand and gravel on the Shoe Peg Valley ranges from zero against higher ground to some unknown maximum that probably does not exceed 30 feet. The gravel is reported to be 16 feet thick in well 13N-4W-1aa1, which is about 2 miles northwest of Midvale.

Some ground water is perched in the gravel upon the underlying silty and clayey lake beds. This perched condition is demonstrated by the small seeps at the base of the alluvial deposits exposed in stream cuts and in the bluff that terminates the bench on the west side of the Weiser River.

The gravel sheet supplies water to a few shallow wells where topography favors the accumulation of a perched body of water at least a few feet thick. Well 13N-4W-1aa1, which is 18 feet deep, has furnished a reliable domestic supply for decades. The owner reports that water level fluctuates from a depth of about 15 feet in autumn and winter to ground surface in spring.

The youngest gravel upon the Shoe Peg Valley forms small and thin alluvial fans near the base of the hill slopes. These alluvial fans are of no consequence as a source of water because they are generally above water level, and any water entering them rapidly drains out downslope.

A sheet of water-bearing gravel is found at shallow depth under the Middle Valley, the broad terrace on the east side of the Weiser River. The gravel is exposed in the bluffs that separate the Middle Valley from the flood plain of the Weiser River. Excellent exposures on the east side of the river about half a mile south of Midvale show a sheet of sand and gravel about 10-15 feet thick. Silt and fine sand, probably of late Tertiary age, underlie the sheet of gravel. The sand and gravel is about 14 feet thick in well 13N-3W-8bd1 (fig. 4), which is a short distance east of the Weiser River and half a mile north of Midvale. Only about 10 feet of gravel is in the cut made by Beaver Creek in the Middle Valley terrace in the center of section 17.

Ground water occurs everywhere in the gravel of Middle Valley. The water table is high enough in the gravels that subirrigation can be practiced in some places, and drainage ditches are necessary to lower the water level beneath part of the valley.

—The source of the water is precipitation, water that seeps from the main canal on the east side of the valley and from tributary canals, and percolation from irrigated fields. The water probably moves westward to southwestward on a gradient of somewhat less than 25 feet per mile, which is about the gradient of the land surface due west. It is discharged as seeps along the bluffs above the flood plain of the river.

The gravels can yield fairly large amounts of water where they are saturated through most of their thickness. Well 13N-3W-3bd2, 15 feet deep and 4 feet in diameter, reportedly is pumped by a tractor motor for irrigation. This well is a short distance from the main canal on the east side of the Middle Valley and may receive most of its water by infiltration from the canal.

COUNCIL AREA

The topographic features of the Council area and the location of wells inventoried in this study are shown in figure 5. A principal topographic feature of this area is the broad slope on alluvial fans that occupies about two-thirds of the lowland. Bottom land along the Weiser River occupies a belt less than a mile wide on the west side of the lowland.

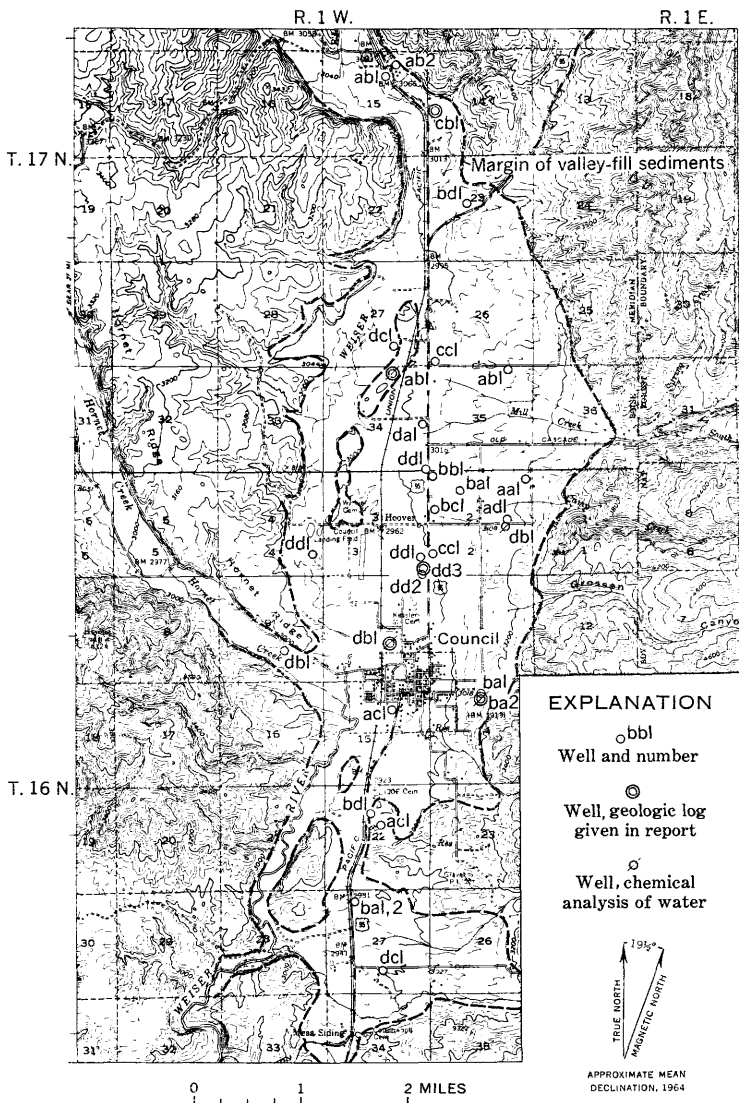


FIGURE 5.—Map of the Council area, upper Weiser River basin, Idaho, showing location of inventoried wells.

Ground water is developed in the Council area from the basalt, the sedimentary deposits of Tertiary age, and the gravel of Pleistocene age. Although the gravel of Pleistocene age is the most used aquifer in the area, the basalt is the most prolific aquifer, as it also is in the Midvale area. Only a few wells derive water from the sedimentary deposits of Tertiary age.

BASALT OF TERTIARY AGE

Basalt forms the hill and mountain slopes that enclose the valley and also crops out as low hills in the lowland. The boundary between the basalt and valley-filling alluvial deposits is indicated by a dashed line (fig. 5).

A flow of basalt probably occurs at shallow depth beneath the lower part of the Council area. Well 16N-1W-10db1, half a mile north of Council, penetrated about 55 feet of basalt between depths of 45 and 100 feet (fig. 6), and low hills of basalt rise above the alluvial deposits farther north.

Basalt was first entered at a depth of 220 feet in the Council municipal well (16N-1W-14ba2), which is high on the alluvial fans close to the eastern mountain front. Ground surface is about 200 feet higher here than at well 16N-1W-10db1. The old valley floor, carved on the basalt and the sedimentary deposits of Tertiary age, may have a surface of fairly low relief under the cover of alluvial deposits.

Depth to water in the basalt depends on topographic situation. Water stands within a few tens of feet of the surface in wells that penetrate the basalt in the lower parts of the area. The depth to water increases eastward beneath the alluvial fans and is reported to be 200 feet below the surface in the Council municipal well 2 (16N-1W-14ba2). No wells tapping basalt yielded a flow of water at the surface.

The basalt is the best aquifer in the area. All the domestic and stock wells that penetrate the basalt provide satisfactory supplies. Well 16N-1W-10db1 provides enough water for a large sawmill; the water probably comes mostly from basalt rather than from the fine-grained sediments which also were penetrated.

The yields of five wells that produce from the basalt are given below.

| Well | Yield (gpm) | Drawdown (ft) | Specific capacity (gpm per foot of drawdown) |
|---------------------------------|-------------|---------------|--|
| 17N-1W-14cb1..... | 25 | | |
| 15ab2..... | 10 | | |
| 27dc1..... | 6 | | |
| 16N-1W-14ba1 ¹ | 135 | | |
| 14ba2 ² | 150 | 48 | 3 |

¹ Council municipal well 1.

² Council municipal well 2.

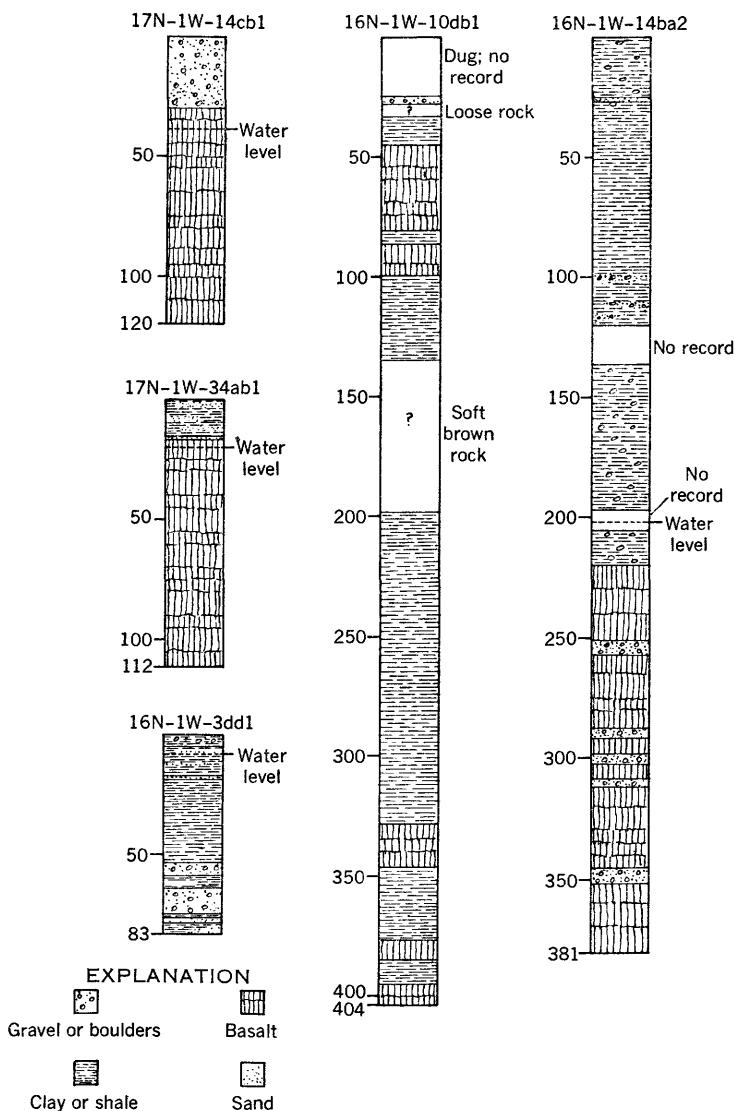


FIGURE 6.—Geologic logs of representative wells in the Council area, Idaho.

The Council municipal well 2, which has a specific capacity of 3 gpm per foot of drawdown, penetrates about 160 feet of basalt below the water level. The yield of 150 gpm is therefore close to the 1 gpm per foot of penetration of basalt that Newcomb (1959, p. 14) found as an average for wells in the Columbia River Basalt in parts of Oregon.

SEDIMENTARY DEPOSITS OF TERTIARY AGE

Thick sedimentary deposits of Tertiary age occur beneath the area, interbedded with the basalt lava, as shown by the log of well 16N-

1W-10db1 (fig. 6) at the Boise-Cascade lumber mill, about half a mile north of Council. Outcrops of these deposits were not found during the short time spent in the area. The well log shows the deposits to be mainly blue, brown, and red clay. No distinct beds of sand were reported by the driller. The nature of the "soft brown rock" the driller reported between depths of 135 and 200 feet is unknown.

No wells were found which produce water from the sedimentary deposits of Tertiary age. If the log of well 16N-1W-10db1 is representative in showing no beds of sand, very little water can be obtained from these deposits.

SEDIMENTARY DEPOSITS OF QUATERNARY AGE

Sedimentary deposits of Quaternary age underlie all of the Council lowland except the low hills where basalt crops out. These deposits are the principal source of water for domestic wells.

The entire 220 feet of sedimentary material shown above the basalt in the log of well 16N-1W-14ba2 (fig. 6) is probably of Pleistocene age. This log shows what are almost certainly alluvial gravels mixed with fine-grained slope wash extending from the surface to a depth of about 30 feet and from about 100 to 130 feet. Interpretation of the rest of the material shown by the log presents some uncertainties. The 85 feet of boulder clay the driller reported between 135 feet and the top of the basalt is a deposit of either glacial till or poorly sorted alluvial-fan material. The clay reported between depths of about 30 and 100 feet below the surface may indicate the existence of a lake at some time when the Weiser River was dammed to the south, or it may be just an unusual thickness of fine-grained slope wash on the surface of an alluvial fan. Unfortunately, no other logs were obtained that might reveal the nature of the sedimentary materials at depth.

Well 16N-1W-3dd1, which is on the lower slopes of the alluvial fans a mile north of Council, shows in a total depth of 83 feet two bodies of alluvial sand and gravel, having 70 feet of clay between them.

Because of a lack of well logs, the precise nature and thickness of the alluvial deposits beneath the bottom-land strip on the west side of the lowland could not be determined. Well 17N-1W-14cb1 (fig. 6) is reported to have penetrated 30 feet of cemented sand and gravel above basalt. Probably the alluvial deposits are no thicker beneath the bottom-lands farther south, and they may contain less gravel and more, finer grained material.

All the owners of wells deriving water from the alluvial deposits reported the supplies were adequate for domestic and stock use and

the watering of lawns and gardens. Reports of actual yields were obtained for only four wells, three of them fairly close to each other.

| Well | Yield (gpm) | Drawdown (ft) | Specific capacity (gpm per foot of drawdown) |
|-------------------|-------------|---------------|--|
| 17N-1W-34da1----- | 40 | 15 | 2.7 |
| 16N-1W-3dd1----- | 10 | 44 | .2 |
| 3dd2----- | 10 | 55 | .2 |
| 3dd3----- | 40 | 8 | 5.0 |

These figures for specific capacity indicate that the yield from the sporadic beds of gravel in the alluvial fans will vary considerably, depending on local conditions and doubtless on method of well construction. The wells can be expected to yield more than enough water for normal domestic and farm needs. Zones of water-yielding sand and gravel seem to be few and thin amid much greater thicknesses of clay-rich material. The alluvial materials probably will not yield enough water for large-scale irrigation.

CHEMICAL QUALITY OF GROUND WATER

Chemical analyses of water from four wells in the Council area and from six wells and a thermal spring in the Midvale area are given in Table 2. The analyses are also plotted in figure 7 as a means of showing the character of the water.

The amounts of certain substances—specifically, silica, iron, and fluoride—commonly present in ground water were not determined. However, these and other less common substances normally amount to a small fraction of the total dissolved solids in waters of this region. The sum of the determined constituents probably is 80–90 percent of the total dissolved solids.

The sum of the determined constituents in the four samples of water from the Council area ranges from 66 to 130 ppm (parts per million), and hardness as calcium carbonate ranges from 43 to 75 ppm. Such hardness is relatively low compared to that of ground water in general.

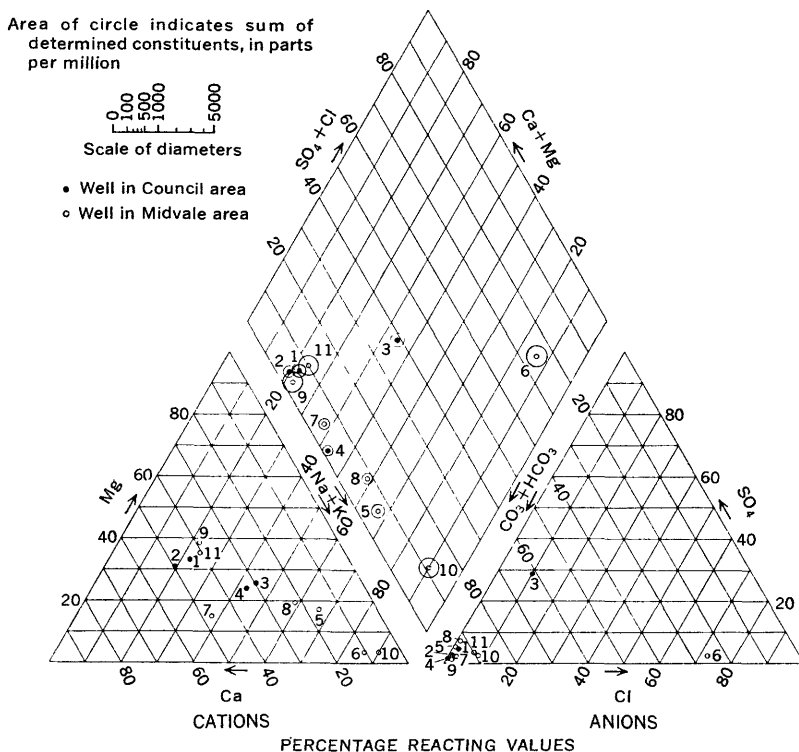
Three of the four sampled waters (points 1, 2, 4, fig. 7) are more or less similar chemically, and they may be considered the normal type of water in the Council area. Bicarbonate amounts to more than 90 percent of the anions determined. With respect to the cations, in the water from the two shallower wells, 17N-1W-34ab1 (120 ft deep) and 16N-1W-2db1 (135 ft deep), calcium and magnesium dominate, and sodium makes up only about 20 percent. The water from the Council municipal well, 16N-1W-14ba2, 381 feet deep, differs by having higher proportions of sodium.

TABLE 2.—*Chemical analyses of representative samples of ground water from the Midvale and Council areas, Idaho*

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

| Well | Depth of well (feet) | Date of collection | Temperature (°F) | Calcium (Ca) | Magnesium (Mg) | Sodium (Na) | Potassium (K) | Bicarbonate (HCO ₃) | Carbonate (CO ₃) | Sulfate (SO ₄) | Chloride (Cl) | Nitrate (NO ₃) | Boron (B) | Dissolved solids, sum of determined constituents | Residual sodium carbonate (meq per l) | Sodium-adsorption ratio (SAR) | Hardness as CaCO ₃ | Specific conductance (micromhos at 25°C) | pH | Class ² |
|--------------|----------------------|--------------------|------------------|--------------|----------------|-------------|---------------|---------------------------------|------------------------------|----------------------------|---------------|----------------------------|-----------|--|---------------------------------------|-------------------------------|-------------------------------|--|------|--------------------|
| 17N-1W-34ab1 | 120 | 5-24-62 | 151 | 17 | 7.8 | 8.7 | 2.7 | 109 | 0.0 | 4.3 | 1.4 | Trace | 0.00 | 96 | 0.29 | 0.44 | 75 | 176 | 7.98 | C1-S1 |
| 16N-1W-24b1 | 135 | do | 154 | 13.6 | 5.1 | 5.3 | 1.6 | 79 | .0 | 1.4 | 0 | 0.0 | .00 | 66 | .20 | .31 | 55 | 126 | 7.28 | C1-S1 |
| 10db1 | 404 | 5-23-62 | 154 | 14.2 | 7.4 | 21.6 | 4.7 | 85 | .0 | 31.7 | 8.5 | 0 | .05 | 130 | .08 | 1.16 | 66 | 235 | 7.48 | C1-S1 |
| 14be2 | 381 | do | 60 | 10 | 4.4 | 12.4 | 3.9 | 83 | .0 | 1.4 | .0 | 0 | .00 | 73 | .50 | .82 | 43 | 138 | 7.48 | C1-S1 |
| 14N-4W-36dd1 | 178 | 5-22-62 | 56 | 6.6 | 4.3 | 24.4 | 11.7 | 115 | .0 | 5.3 | .7 | 0 | .04 | 110 | 1.20 | 1.83 | 34 | 186 | 7.70 | C1-S1 |
| 14N-3W-19cb2 | Spring | do | 120 | 7.8 | 1.5 | 74 | 3.1 | 56 | 2.4 | 105 | 16 | Trace | .52 | 238 | .48 | 6.27 | 26 | 371 | 8.46 | C2-S1 |
| 19dd1 | 35 | do | 157 | 16.8 | 3.3 | 13.3 | 3.9 | 95 | .0 | 1.4 | 1.1 | 1.2 | .00 | 88 | .45 | .78 | 56 | 157 | 7.60 | C1-S1 |
| 13N-3W-6bb1 | 357 | do | 56 | 6.6 | 3.6 | 14.3 | 10.9 | 85 | .0 | 4.8 | 1.7 | 0 | .01 | 83 | .67 | 1.11 | 31 | 139 | 7.62 | C1-S1 |
| 8bd1 | 32 | do | 56 | 41 | 24 | 24 | 4.7 | 299 | .0 | 3.8 | 2.5 | Trace | .04 | 247 | .84 | .73 | 203 | 426 | 7.40 | C2-S1 |
| 8ec3 | 963 | 5-24-62 | 68 | 5.0 | 1.6 | 71 | 13.3 | 200 | 2.4 | 10.1 | 3.9 | 0 | .09 | 206 | 2.98 | 7.00 | 19 | 333 | 8.36 | C2-S1 |
| 10cd2 | 93 | 5-22-62 | 54.5 | 37 | 19.5 | 22.1 | 3.9 | 237 | .0 | 7.2 | 4.6 | 9.3 | .01 | 220 | .46 | .73 | 172 | 380 | 7.32 | C2-S1 |

¹ Not true ground-water temperature.² According to classification for suitability for irrigation, of U. S. Salinity Laboratory Staff, 1954.³ Depth was 802 feet when sampled 5-24-62.



| Number in figure 7 | Well | Depth | Sum of determined constituents (ppm) | Aquifer |
|--------------------|--------------|--------|--------------------------------------|------------------|
| 1. | 17N-1W-34ab1 | 120 | 96 | Basalt. |
| 2. | 16N-1W-2db1 | 135 | 66 | Gravel. |
| 3. | 10db1 | 404 | 130 | Basalt. |
| 4. | 14ba2 | 381 | 73 | Do. |
| 5. | 14N-4W-36dd1 | 178 | 110 | Sand. |
| 6. | 19cb2 | Spring | 238 | |
| 7. | 19bd1 | 35 | 88 | Sand(?). |
| 8. | 13N-3W-6bb1 | 357 | 83 | Do. |
| 9. | 8bd1 | 32 | 247 | Sand and gravel. |
| 10. | 8cc3 | 1802 | 206 | Basalt. |
| 11. | 10cd2 | 93 | 220 | Sand. |

¹ At time of sampling (May 24, 1962).

FIGURE 7.—Chemical character of typical ground waters of the Midvale and Council areas, Idaho.

Water from the well of the Boise-Cascade lumber mill, 16N-1W-10db1 (point 3, fig. 7), plots at a distance from the other waters of the Council area because sulfate makes up 30 percent of the anions. The water also contains a slightly higher proportion of chloride than do the other waters. The water shows about the same proportions of cations as the water from the Council municipal well.

The sum of the determined constituents in the waters sampled in the Midvale area ranges from 83 to 247 ppm, and hardness as calcium carbonate ranges from 19 to 203 ppm.

The waters of the Midvale area—excluding that from a hot spring, 14N-3W-19cb2—are related to each other though they plot through an elongated zone in figure 7. The anions consist mostly of bicarbonate. The cations show a wide range, from water with dominant calcium and magnesium and only 20 percent sodium to water in which sodium is 90 percent of the cations. The latter is found in the Midvale municipal well, 13N-3W-8cc3.

The water at shallow depth, such as that from gravel beneath the Middle Valley (well 13N-3W-8bd1), is the calcium magnesium bicarbonate type containing low proportions of sodium, and it has high hardness and concentration of dissolved solids. The water at greater depth tends toward the sodium bicarbonate type and has unusually low hardness; both of these features are probably due to contact with the clayey lake beds and to the resulting base exchange, in which the water exchanges calcium and magnesium for sodium contained in the clay.

The water sampled at the hot spring, 14N-3W-19cb2, in the northern part of the Shoe Peg Valley is the sodium sulfate type. The character of the water doubtless reflects the hot gas and water rising from depth, reactions with the formations at a higher level, and admixture of normal shallow ground water.

In summary, the normal waters of both the Council and Midvale areas are much the same type and character, and such differences as exist reflect differences in environment. Water from the Council area has fairly low hardness and concentration of dissolved solids, because the minerals in the basalt and alluvial deposits are not very soluble. The water of the Midvale area contains more dissolved solids, probably because of slower circulation and hence more time for solution of minerals from the lake deposits; however, the water is softer because of base exchange reactions with the clay of the lake deposits.

The character of water in both areas varies between the calcium magnesium bicarbonate type and the sodium bicarbonate type.

The waters are of good to excellent quality for all common uses and for irrigation. The analyses show no significant quantities of objectionable substances. However, no determination of fluoride content was made, and some of the water from the deeper zones may have a higher fluoride content than is desirable for domestic use.

SUMMARY

Ground water ample for domestic and stock needs can be obtained almost everywhere in the Midvale and Council areas from wells not more than a hundred feet deep. In a few places deeper wells are

required, but the water level in most of these wells is rarely as much as 50 feet below the surface.

Wells which penetrate the basalt beneath the lowland areas, at depths of 100 to more than 500 feet, can provide up to a few hundred gallons of water a minute.

In the Midvale area, water for irrigation of small acreages probably can be obtained from beds of sand amid the fine-grained lake deposits that underlie the lowland. The cost of drilling wells to the more productive but deeper-lying basalt probably would exclude this aquifer as a source of irrigation water.

In the Council area the basalt is the only formation that could be relied upon for water for supplemental irrigation. Beneath the upper parts of the alluvial fans on the east side of the lowland, the depth to water level may make pumping from the basalt uneconomical. However, beneath the lower parts of the alluvial fans the lift would not be great.

The quality of the ground water in both the Midvale and Council areas is suitable for irrigation and all other common uses.

RECORDS OF WELLS

The following tables (tables 3 and 4) present data on wells inventoried in the Midvale and the Council areas in the course of this investigation. Only a small percentage of all the wells in the two areas were visited. However, an effort was made to obtain a good geographic distribution, and it is believed that the inventoried wells show representative conditions.

The data were obtained through interviews with well owners and drillers and from records that drillers have submitted to the Idaho Department of Reclamation.

Reports of drawdown in wells during pumping are mostly from tests made by drillers upon completion of wells.

TABLE 3.—Records of wells in the Middle area, Upper Weiser River basin, Idaho

Type of well: D, dug; Dr, drilled.
 Depth of wells and reported depths.
 Character of aquifer: S, sand; C, gravel; Bas, basalt.
 Depth of well in feet below land surface datum.
 Water level: Depth in feet below surface datum. Measured depths to water are given to the nearest tenth of a foot. Reported depths to water are given to the nearest foot.

| Well | Owner | Year drilled | Type of well | Depth of well | Casing | | Char-acter of aquifer | Water level | | Pump | | Yield of well (gpm) | Use of water | Remarks |
|---|--|--|--|---|----------------------------------|-----------------------------------|--------------------------------------|-------------------------------------|--------------------------------------|---------------------------------|-----------------------------------|--------------------------|--|--|
| | | | | | Diam-eter (in.) | Depth (ft) | | Depth | Date | Type | H.P. | | | |
| 14N-4W-25bd1 36bd1 36bd1 | Mayme Potter C. F. Kathley Kathley Creek Cemetery. | 1958 1930 1956 | Dr Dr Dr | 40 76 178 | 6 5 8 | — — 55 | S S S | Flows 8.9 31 | 11-29-61 10--56 | J C T | 1 1/2 3 | — 27 | Dom, St Dom, St Irr | Flows 2-3 gpm. Drawdown 14 ft while pump- ing 27 gpm. Log. Anal- ysis. Temp 61°. Analysis. |
| 14N-3W-19cb1 19cb2 | Joe Wiggins do. | 1942 | Dr | 42 Spring | 6 | — | S | 12 | — | P | 0 | — | Dom | Flows 2 gpm. Drawdown 8 ft while pump- ing 10 gpm. Analysis. Log. |
| 19da1 19ad1 | Carpenter & Son Co do. | — — | Dr Dr | 45 35 | 4 6 | — — | S S | Flows Flows | 11-29-61 do. | C J | 1 1/2 3/4 | 10 | St Dom, St | Flows 2 gpm. Drawdown 14 ft while pump- ing 10 gpm. Analysis. |
| 28bd1 28cb1 30ad1 | Lawrence Boyd do. D. B. William | 1947 1947 1948 | Dr Dr Dr | 173 143 90 | 6 6 6 | — — — | S — S | 12 18 | — — — | J J C | 1 1 | 7 | Dom, St Dom, St Dom, St | Flows 2 gpm. Drawdown 8 ft while pump- ing 10 gpm. Analysis. Log. |
| 30bd1 31ad1 32bd1 32bd1 32bd1 33bd1 33bd1 | Clifford Hopper Gerald Johns L. H. Hopper Emerson Wiggins Bill Wiggins Hicks Jewell | 1922 1951 1925 1925 1950 1910 1958 | Dr Dr Dr Dr Dr Dr Dr | 48 100 60 93 58 18 68 | 6 6 6 6 6 14 6 | — 96 — — — 3 33 | S — — — G S, Bas S | 10 6 13 0-15 8 Flows | 11--61 — — 1958 11-28-61 | J J J J N N N | 1/4 — — — 1 — — | — — — 360 30 | Dom, St Dom, St Dom, St Dom, St Dom, St N N N | Soil 2 ft; gravel 16 ft. Pumps dry at 640 gpm. Log. Flows 10 gpm; pumps 30 gpm. |
| 11cd1 11cd1 12cd1 | J. L. Baker do. Ben Fairchild Arthur Fairchild | 1960 — — — | Dr Dr Dr Dr | 40 — 169.6 | 6 6 6 | — — — | — — — | 16.0 | 11-27-61 | P N N | 0 | — — — | N N N | Drawdown 18 ft, while pump- ing 70 gpm. Log. |
| 13ba1 13bd1 13bd1 14ad1 14ad1 14ad1 | do. do. Midvale Airport Ben Fairchild Phyllis W. Fair- child. | 1958 — — — 1955 | Dr Dr Dr Dr Dr Dr | 185 160 — — 170 | 12 6 6 6 12 | 40 160 — — 70 | S S — — — | Flows — 30.6 4.1 8 | 11-27-61 11-28-61 do. 1961 | T J J N N | 3 3/4 1/4 — — | 70 — — 72 | Irr Dom, St Dom N N | Drawdown 62 ft, while pumping 72 gpm. |
| 23da1 24ad1 24ad1 | Milton Branch Elvin Evans do. | 1920 1951 1910 | Dr Dr Dr | 50 102 65 | 6 6 6 | — 66 — | S — — | Flows 13 | 1951 | N J P | — 1 0 | — 10 0 | Dom, St Dom, St St | Drawdown 22 ft, while pumping 10 gpm. |

TABLE 3.—Records of wells in the Midvale area, Upper Weiser River basin, Idaho—Continued

| Well | Owner | Year drilled | Type of well | Depth of well | Casing | | Char-acter of aquifer | Water level | | Pump | | Yield of well (gpm) | Use of water | Remarks |
|------------------|-------------------------|--------------|--------------|---------------|-----------------|------------|-----------------------|-------------|--------------|--------|------|---------------------|--------------|---|
| | | | | | Diam-eter (in.) | Depth (ft) | | Depth | Date | Type | H.P. | | | |
| 13N-3W-36b1-36b2 | Virgil Fairchild do. | 1964 | Dr Dr | 90 | 4 6 | 60 | | 12 10 | 1961 1961 | J J | 1 | 13 | St Dom | Drawdown 4 ft, while pump- ing 13 gpm. |
| 36c1 | B. R. Fairchild | 1940 | Dr | 60 | 6 | | | 10 | 1961 | J | ½ | 13 | Dom, St | Drawdown 5 ft, while pump- ing 13 gpm. |
| 36d1 | do. | 1962 | Dr | 55.1 | 12 | 60 | | 10 | 1961 | N | | 180 | N | |
| 36d2 | do. | 1967 | D | 15 | 48 | | G | 1 | 1961 | C | | 8 | Irr | |
| 36d3 | W. C. Sutton | 1966 | Dr | 166 | 6 | 105 | | Flows | 11-29-61 | J | 2 | 20 | Dom, St | Drawdown 11 ft, while pump- ing 8 gpm. |
| 66a1 | Raymond Widner | 1965 | Dr | 59 | 6 | 45 | S | 4 | 1955 | J | ¾ | 20 | Dom, St | Log. |
| 66b1 | Ray Weite | 1963 | Dr | 357 | 8 | | S? | | | T | 1 | 50 | St, Irr | Temp 56°. Analysis. |
| 66d1 | D. D. Pickett | 1965 | Dr | 420 | 6 | 180 | S, G | 50 | 5- -55 | J | 1 | 20 | Dom, St | Drawdown 10 ft, while pump- ing 20 gpm. Log. Analy- sis. |
| 86d1 | Earl Craig | 1960 | Dr | 32 | 6 | 29 | | 3 | 6- -60 | | | | Dom, St | Well 1. |
| 86c1 | Town of Midvale | 1939 | Dr | 290 | 8 | 150 | S | 0 | 11-28-61 | T | 10 | | PS | Well 2. Drawdown 47 ft, while pumping 318 gpm. |
| 86c2 | do. | 1963 | Dr | 521 | 12 | 295 | | 0 | do. | T | 35 | 318 | PS | Well 3. Flows 600 gpm. Log. Analysis. |
| 86c3 | do. | | Dr | 963 | 12 | | Bas | Flows | | N | | | PS | |
| 96d1 | J. R. Fox | 1910 | Dr | 100 | 6 | | | 20 | 1961 | J | ½ | | Dom, St | |
| 96b1 | V. R. Fairchild | 1920 | Dr | 195 | 4 | | | 8 | do. | N | | | N | |
| 96b2 | do. | 1950 | Dr | 65 | 4 | 63 | S | | | J | ¾ | | Dom, St | |
| 96c1 | P. E. Jacks | 1954 | Dr | 40 | 6 | 40 | | 10 | 1954 | J | 1 | | Dom, St | |
| 10a1 | W. C. Sutton | 1956 | Dr | 200 | 6 | 166 | | Flows | 11-29-61 | J | 2 | 8 | Dom, St | Flows 6 gpm. Drawdown 11 ft, while pumping 8 gpm. |
| 10c1 | Midvale Cemetery | 1964 | Dr | 320.4 | 8 | 149 | Bas | .7 | 11-28-61 | N | | 25 | Irr | Well 1. 110 ft drawdown. Log. |
| 10c2 | do. | 1959 | Dr | 93 | 12 | 73 | S | 36 | | T | 5 | 50 | Irr | 12 in. bore, gravel packed. Well 2. Log. Analysis. |
| 10c3 | do. | 1915 | Dr | 112 | 3 | 112 | S | 75 | 1930 | P | 0 | | Dom | "Middle well," Flows 3 gpm. Drawdown 20 ft, while pumping 10 gpm. |
| 11b1 | M. W. Lewis | 1920 | Dr | 27 | 6 | 25 | | Flows | 11-29-61 | J | | 10 | Dom, St | |
| 16b1 | Othniel Evans | 1950 | D | 17 | 1 ¼ | | G | | | C | ¾ | | Dom, St | Flows 6 gpm. |
| 17a1 | R. A. Hooper | 1960 | Dr | 73 | 6 | 73 | | 11 | 9- -61 | J | ¾ | | Dom, St | Log. |
| 21c1 | do. | 1953 | Dr | 125 | 6 | 125 | S, Bas | Flows | 11-28-61 | N | | 6 | Dom | |
| 28a1 | James Parks | 1960 | Dr | 45 | 6 | | | 14 | 6- -60 | | | | | |

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