U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
CITY OF BOISE, PUBLIC WORKS DEPARTMENT, AND
IDAHO DEPARTMENT OF HEALTH AND WELFARE, DIVISION OF ENVIRONMENTAL QUALITY

WATER-RESOURCES INVESTIGATIONS REPORT 94–4116
Tungate, A.M., and Berenbrock, Charles, 1995, Configuration of the water table, 1970 and 1992, and water-table change, between 1970 and 1992, in the Boise area, Idaho

INTRODUCTION

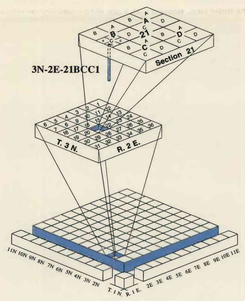
The 80-mi² study area, herein referred to as the Boise area, is located in north-central Ada County and includes the cities of Boise and Garden City. A shallow, unconfined ground-water system (less than about 150 ft deep) underlies the Boise area and consists of unconsolidated alluvial deposits and terrace gravels (Dion, 1972, p. 23). The alluvial deposits are composed of silt, sand, and coarse, well-sorted gravel (Dion, 1972, p. 22). Private, domestic, and some commercial and industrial supplies rely on water from the shallow system. Water for irrigating crops and pastures is provided primarily by an extensive network of canals and laterals. However, since about 1950, ground water has been used for irrigation when surface-water supplies have been inadequate.

Ground water in the shallow system is recharged mainly by irrigation water, precipitation, leakage from canals and laterals, and wastewater from septic-tank drain systems. Most recharge is probably from irrigation from April through October (Dion, 1972, p. 24). Rapid population growth and expanding urbanization during the past 20 years have resulted in widespread changes in land and water uses in the Boise area that potentially have affected the quantity and quality of recharge to the shallow ground-water system.

The purpose of this report, prepared in cooperation with the City of Boise, Public Works Department, and the Idaho Department of Health and Welfare, Division of Environmental Quality, is to document the configuration of the water table during August 1992 and to evaluate changes in ground-water levels since October 1970. This comparative study is the first step in reassessing shallow ground-water conditions in the Boise area in more than 20 years. The last comprehensive report on the shallow ground-water system was by Dion (1972).

WELL-NUMBERING SYSTEM

The U.S. Geological Survey in Idaho numbers well locations within the official rectangular subdivisions of the public lands, with reference to the Boise base line and Meridian. For example, the first segment (3N) of well number 3N-2E-21BCC1 designates the township north or south, the second (2E), the range east or west, and the third (21), the section in which the well is located. Letters (BCC) following the section number indicate the well's location within the section and are assigned in counterclockwise order beginning with the northeast quarter. The first letter (B) denotes the 1/4 section (160-acre tract), the second (C) denotes the 1/4-1/4 section (40-acre tract), and the third (C) denotes the 1/4-1/4-1/4 section (10-acre tract). The last number (1) is a serial number assigned when the well was inventoried.



EXPLANATION

- 2,700 — **Water-table contour**—Shows altitude of water table, August 1992. Hachures indicate depression. Contour interval 20 feet. Datum is sea level
- **Direction of ground-water movement**
- 20DBD1 — **Well and number**
- **Garden City**

Base from U.S. Geological Survey, Boise North, 1972; Boise South, 1972; Cloverdale, 1978; Eagle, 1978; 1:24,000 quadrangles. Universal Transverse Mercator (UTM) projection, Zone 11

CONFIGURATION OF THE WATER TABLE AND DIRECTION OF GROUND-WATER MOVEMENT, AUGUST 1992

WATER TABLE

Static water levels were measured during August 1992 (map at bottom left) in about 170 wells (well depths less than about 150 ft) completed in the shallow ground-water system of the Boise area. All measurements were made with a steel tape. The altitude of the water table was calculated by subtracting the depth to water (below land surface) from the land-surface altitude. Land-surface altitude generally was estimated from 1:24,000-scale topographic maps of the Boise area; altitude at some wells was surveyed from benchmarks.

Ground-water movement in the shallow system in August 1992 generally was from southeast to northwest and toward the Boise River. In the southern part of the Boise area, ground water moved southwestward toward the Snake River. Altitudes of the water table ranged from about 2,740 ft above sea level in well 3N-2E-25DAA1 to about 2,565 ft in well 4N-1E-15BAC1 (map at bottom left). The average water-table gradient ranged from about 15 to 20 ft/mi.

A cone of depression (an area where water-table altitude is lower than the surrounding areas because of pumping) was mapped near the Boise River between Vista Avenue and Broadway Avenue in 1992 (map at bottom left). A water-table mound was mapped around well 3N-2E-20DBD1. This mound probably can be attributed to leakage of water from the New York Canal into the shallow ground-water system. The mound also was present in October 1970 (Dion, 1972, fig. 13) at about the same water-table altitude. On the basis of seepage tests, Dion (1972, p. 24) showed that the amounts of leakage from the New York Canal were greatest in this area. A second but smaller water-table mound was mapped 3 mi west of well 3N-2E-20DBD1 in 1992. The origin of this mound is unknown.

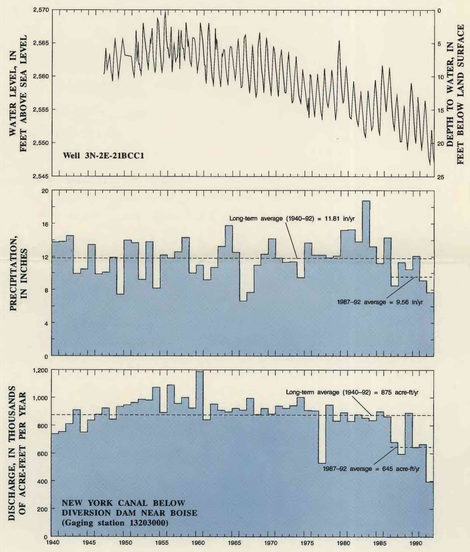
CHANGES IN THE WATER TABLE

Dion (1972) measured water levels in about 50 wells in the Boise area in October 1970 (map at upper right). He noted that ground water moved generally northwestward, parallel to the Boise River, except in the southern part of the study area where movement was southwestward toward the Snake River. The water-table surface sloped northwestward at an average gradient of about 19 ft/mi (Dion, 1972, p. 24). The average gradient toward the Snake River in the southern part of the Boise area was about 16 ft/mi (Dion, 1972, p. 24). A water-table mound was centered around wells 3N-2E-20DBD1 and 3N-2E-21BCC1. Water levels in these wells were the highest measured in 1970.

An attempt was made in 1992 to remeasure water levels in all wells that were measured in 1970 by Dion (1972) to determine water-table changes. However, repeated measurements could be made in only 18 wells because some wells had been destroyed or were no longer measurable. At both times, few data were available for the southeastern part of the Boise area. Because only a few wells could be remeasured, maps of water-table contours for the two periods were compared to define the changes in water levels over the 22-year period. This was done by digitizing both maps (at bottom left and upper right) into a geographic information system and creating a lattice—a regularly spaced set of points representing a surface (the water table) with common points. The points were spaced about 33 ft apart to represent the water table, and the lattices were subtracted from one another. The resultant lattice indicated the changes in the water table between 1970 and 1992, which are depicted in the map at the bottom right. The water table in October 1970 was compared with that in August 1992 because at both times, water-level measurements were made in wells after irrigation water was drained from the canals after the irrigation season ended.

The water-table change map (bottom right) indicates that the water table declined in about 90 percent of the Boise area between October 1970 and August 1992. Declines exceeded 10 ft in about 50 percent of the area, 20 ft in about 10 percent of the area, and 30 ft in about 5 percent of the area. In about 10 percent of the area, the water table rose. Overall, the average change between 1970 and 1992 was a decline of about 10 ft, or about 0.5 ft/yr. Locally, the water table rose or declined at different rates. The largest rise was in the southeastern part of the Boise area; five smaller rises were apparent along the Boise River. The largest declines were south of the Boise River between the Ridenbaugh and the New York Canals. These declines may be caused in part by the decrease in discharge through irrigation canals during the drought of 1987–92.

Water levels in the 18 wells measured in 1970 and 1992 ranged from a rise of 1 ft (in well 3N-2E-20DBD1) to a decline of 22 ft (in well 3N-2E-15BDB1) (map at bottom right). Water levels declined in all but 2 of the 18 wells (4N-1E-15BAD1 and 3N-2E-20DBD1); the average decline was about 10 ft.



The hydrograph for well 3N-2E-21BCC1 (above), which is 58 feet deep, shows seasonal effects of recharge and discharge on the shallow ground-water system. Water levels fluctuate seasonally from 5 to 10 ft and are usually highest during August or September, near the end of the irrigation season, and lowest during March or April, prior to diversion of streamflow for irrigation.

The hydrograph for well 3N-2E-21BCC1 also shows long-term water-level changes. Water levels were fairly stable during 1945–65, but the rate of decline during 1966–92 was about 0.6 ft/yr. The largest rate of decline (1 ft/yr) was during the drought of 1987–92 when precipitation and water diverted from canals for irrigation were lower than average (map at top right). Discharge in 1992 from the New York Canal below Diversion Dam near Boise (gaging station 13203000), which probably represents most of the water that is available for irrigation, was the lowest (395,700 acre-ft/yr) since 1940, and precipitation in 1992 was the second lowest (7.67 in/yr) since 1940. Ground-water levels in 1992 were much lower than in previous years, probably because of the drought-related effects.

SELECTED REFERENCES

Dion, N.P., 1972, Some effects of land-use changes on the shallow ground-water system in the Boise-Nampa area, Idaho: Idaho Department of Water Administration, Water Information Bulletin 26, 46 p.

National Oceanic and Atmospheric Administration, 1976–93, Climatological data—Idaho, annual summaries: National Oceanic and Atmospheric Administration, v. 80 to v. 92 (published annually).

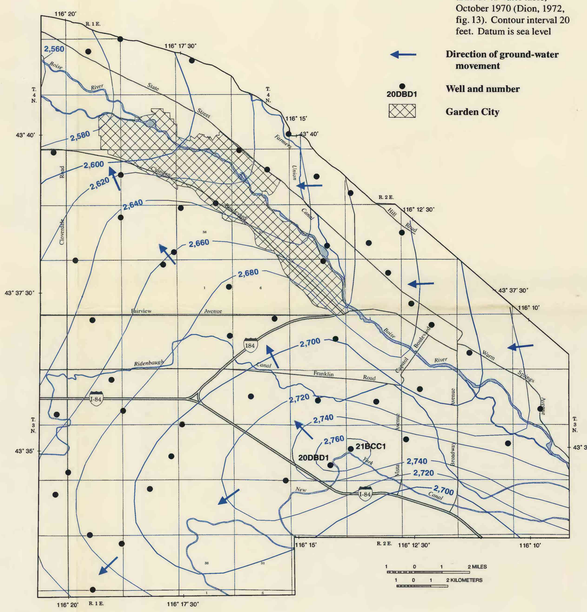
U.S. Department of Commerce, Weather Bureau, 1940–76, Climatological data—Idaho, annual summaries 1953–75: U.S. Department of Commerce, v. 57 to v. 79 (published annually).

——1958, Climatic summary of the United States—supplement for 1931 through 1952, climatography of the United States: U.S. Department of Commerce, no. 11–4, 156 p.

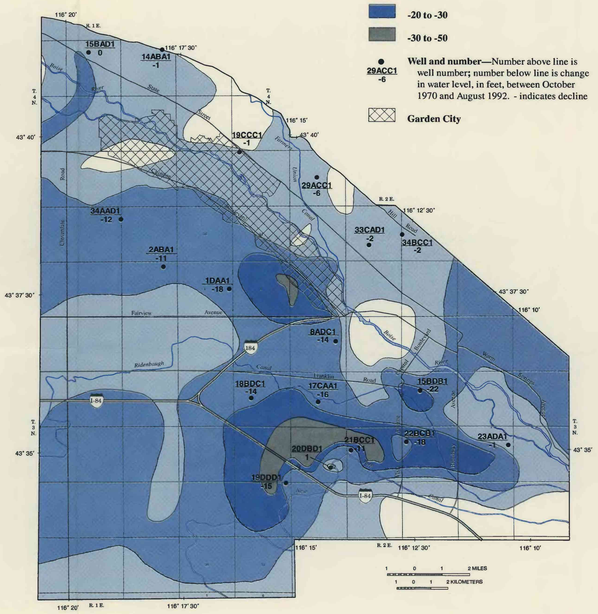
CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
acre	4,047	square meter
acre-foot (acre-ft)	1,233	cubic meter
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
square mile (mi²)	2.590	square kilometer

Sea Level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.



CONFIGURATION OF THE WATER TABLE AND DIRECTION OF GROUND-WATER MOVEMENT, OCTOBER 1970



CHANGES IN THE WATER TABLE BETWEEN OCTOBER 1970 AND AUGUST 1992

CONFIGURATION OF THE WATER TABLE, 1970 AND 1992, AND WATER-TABLE CHANGE BETWEEN 1970 AND 1992 IN THE BOISE AREA, IDAHO

By
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1995

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