Status of Shallow-Aquifer Mapping in the Northern Front Range Area, Colorado

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INTRODUCTION

Mapping of shallow aquifers in the northern Front Range area of Colorado has been completed as part of the U.S. Geological Survey Front Range Infrastructure Resources Project. The aquifer mapping was undertaken as part of a comprehensive effort to better define the mineral, energy, cartographic, biological, and water resources that are critical to the support and development of the area's infrastructure, such as streets, highways, airports, and buildings. The aquifer mapping was undertaken in cooperation with the Colorado Division of Water Resources and the Colorado Water Conservation Board.

The shallow aquifers have been mapped in a 2,450-square-mile area extending as an approximately 30-mile-wide band from north of Fort Collins to the Arapahoe-Douglas County line south of Denver (fig. 1). The shallow aquifer mapping in the Denver metropolitan area was published in 1996 as Hydrologic Investigations Atlas HA–736 (Robson, 1996). Shallow aquifer mapping in the Greeley-Nunn area was published as HA–746A (Robson, Arnold, and Heiny, 2000a); mapping in the Fort Collins-Loveland area was published as HA–746B (Robson, Arnold, and Heiny, 2000b); mapping in the Fort Lupton–Gilcrest area was published as HA–746C (Robson, Heiny, and Arnold, 2000c); and mapping in the Boulder-Longmont area was published as HA–746D (Robson, Heiny, and Arnold, 2000d).

Each of the five atlases contains five map sheets at 1:50,000 scale showing:

1. The thickness and extent of the unconsolidated sediments (loose gravel, sand, silt, and clay) that overlie the bedrock formations in the area (fig. 2).
2. The altitude and configuration of the bedrock surface.
3. The altitude of the water table and direction of groundwater movement.
4. The saturated thickness of the shallow aquifers.
5. The depth to the water table in the shallow aquifers.

THICKNESS AND EXTENT OF THE UNCONSOLIDATED SEDIMENTS

Unconsolidated sediments consist of alluvium (loose sediments transported primarily by flowing water), colluvium (loose sediments on hillsides transported primarily by gravity), and eolian materials (loose sediments transported primarily by wind). The maps of the thickness of the unconsolidated sediments are contoured at 20-foot intervals and provide information about the potential thickness of the shallow aquifers in the area, the thickness of sediments that might be mined as a source of sand and gravel, and the depth to bedrock needed for construction of highway and building foundations or for hazardous waste cleanup activities.

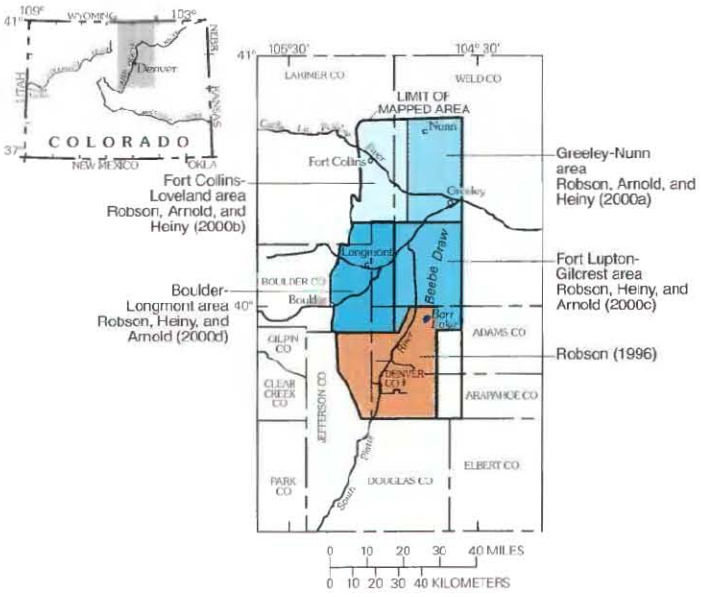

Figure 1. *Extent of shallow-aquifer mapping.*

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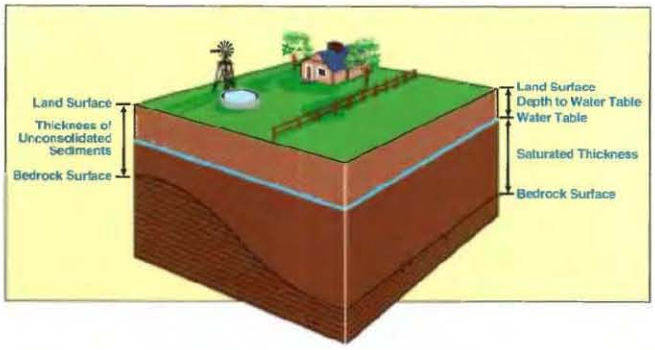

Figure 2. *Terms used to describe a shallow aquifer.*

ALTITUDE AND CONFIGURATION OF THE BEDROCK SURFACE

The maps of the altitude of the bedrock surface are contoured at 20-foot intervals and have the appearance of a topographic map of the land surface. In fact, these maps also are known as paleotopographic maps—that is, maps of an ancient land surface. The maps indicate what the land surface would look like if all the unconsolidated sediments were removed. This ancient land surface has valleys aligned with present-day streams and valleys in areas with no present-day streams or with present-day streams too small to have eroded the valleys. These paleovalleys generally were cut into the bedrock surface by ancient streams that no longer flow through the area. For example, Beebe Draw contains a large paleovalley that likely was cut by the ancestral South Platte River. Today, the South Platte River is located about 10 miles west of Beebe Draw, and the paleovalley in the draw is largely filled with more recent sediments deposited by the wind. The paleotopographic maps provide information about the locations of buried stream valleys that could contain important sources of ground water and aggregate.

ALTITUDE OF THE WATER TABLE AND DIRECTION OF GROUND-WATER MOVEMENT

The maps of the altitude of the water table represent the average standing-water level in wells. The maps are contoured at 20-foot intervals where data points (water-level measurements in wells) are numerous and are contoured at 100-foot intervals where data points are sparse. Most 100-foot contours and some 20-foot contours are shown as dashed lines, indicating that ground water may not be present in the area or may be present only during some times of the year.

Ground water flows through the unconsolidated sediments from areas of higher water-table altitude toward areas of lower water-table altitude, as is indicated by arrows on the maps. The maps indicate that ground water flows from upland areas toward adjacent valleys, then down the valleys and toward the larger streams. Water flows from the aquifers to the streams and, thus, maintains perennial flow in the streams. The water-table maps provide information on the source areas for water in the shallow aquifer, the potential direction of movement of any contaminated water in the aquifer, and the potential for ground-water flow to or from construction excavations or aggregate pits.

SATURATED THICKNESS OF THE SHALLOW AQUIFERS

Saturated thickness is the distance from the water table to the top of the bedrock. These maps define the thickness of the shallow aquifers and are contoured at 20-foot intervals. Areas of large saturated thickness typically will yield more water to wells than areas of small thickness. The maps indicate that the areas of greatest saturated thickness are in the more downstream parts of the larger stream valleys, such as the South Platte River and Cache La Poudre River. Other thick areas are in the larger paleovalleys, such as Beebe Draw and an unnamed paleovalley near Wellington. The maps also can be used to estimate how much water level could decline in a shallow well before the well runs dry, or to estimate the volume of ground water in storage in the aquifer.

DEPTH TO THE WATER TABLE IN THE SHALLOW AQUIFERS

The depth to water-table maps are contoured at 20-foot intervals and show the distance from the land surface to the water table. The maps provide information on the depth to water that might be expected in shallow wells in the area and can help define areas where a shallow water table might preclude urban development and favor wetland land use.

SOURCES OF DIGITAL DATA

Each of the five map sheets for the five reports are available as ArcINFO coverages; metadata and the text for each report also are available. This digital data can be examined and downloaded from the project Web site at http://rockyweb.cr.usgs.gov/frontrange/index.html/.

REFERENCES CITED

Robson, S.G., 1996, Geohydrology of the shallow aquifers in the Denver metropolitan area, Colorado: U.S. Geological Survey Hydrologic Investigations Atlas HA–736, 5 sheets, scale 1:50,000.

Robson, S.G., Arnold, L.R., and Heiny, J.S., 2000a, Geohydrology of the shallow aquifers in the Greeley-Nunn area, Colorado: U.S. Geological Survey Hydrologic Investigations Atlas HA–746A, 5 sheets, scale 1:50,000.

Robson, S.G., Arnold, L.R., and Heiny, J.S., 2000b, Geohydrology of the shallow aquifers in the Fort Collins-Loveland area, Colorado: U.S. Geological Survey Hydrologic Investigations Atlas HA–746B, 5 sheets, scale 1:50,000.

Robson, S.G., Heiny, J.S., and Arnold, L.R., 2000c, Geohydrology of the shallow aquifers in the Fort Lupton-Gilcrest area, Colorado: U.S. Geological Survey Hydrologic Investigations Atlas HA 746C, 5 sheets, scale 1:50,000.

Robson, S.G., Heiny, J.S., and Arnold, L.R., 2000d, Geohydrology of the shallow aquifers in the Boulder-Longmont area, Colorado: U.S. Geological Survey Hydrologic Investigations Atlas HA–746D, 5 sheets, scale 1:50,000.

Information on technical reports and hydrologic data may be obtained from:

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