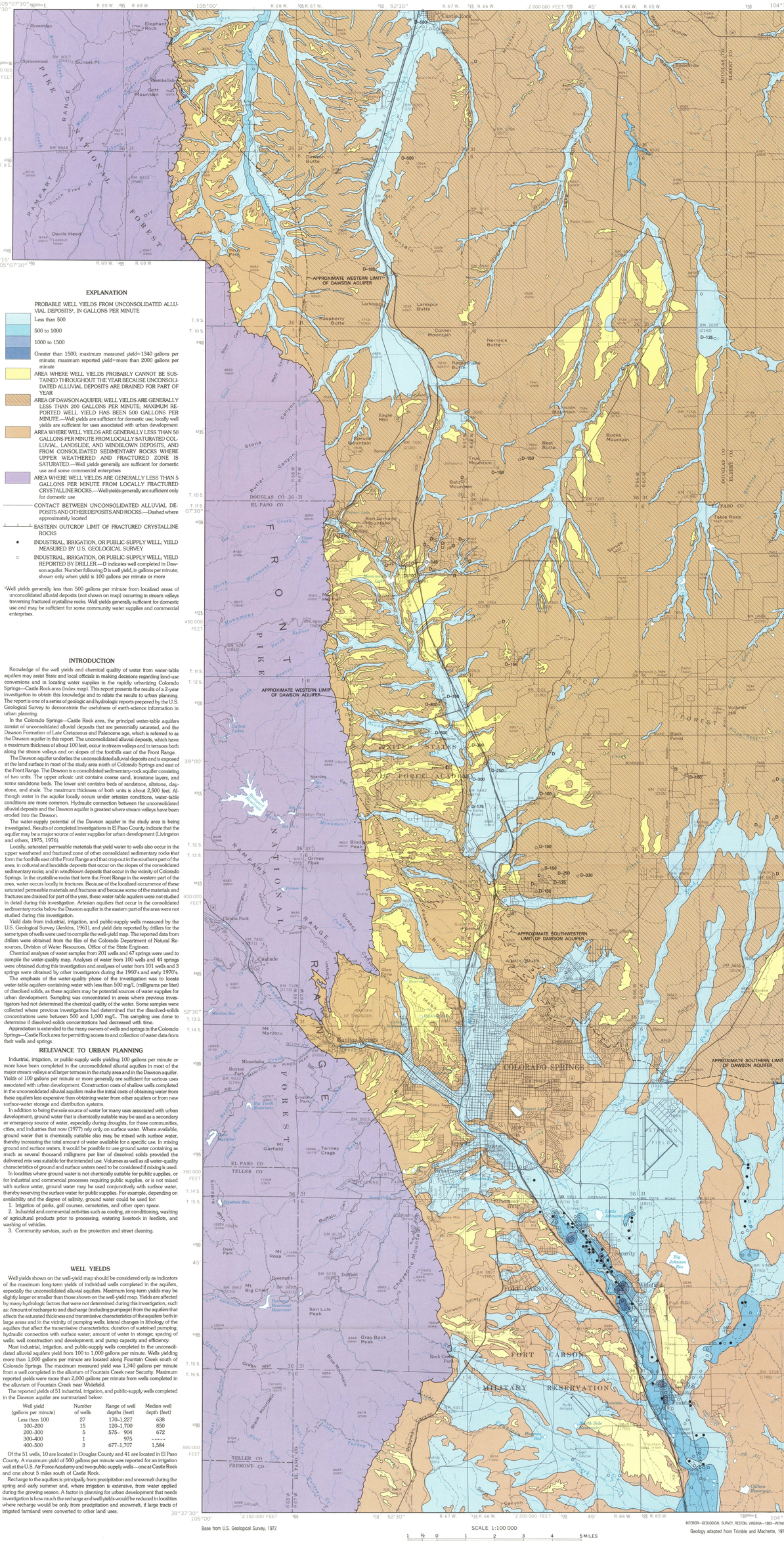

Base from U.S. Geological Survey, 1972

SCALE 1:100 000

1 ½ 0 1 2 3 4 5 MILES

1 .5 0 1 2 3 4 5 KILOMETERS

Geology adapted from Trimble and Machette, 1979

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980—W79495

EXPLANATION

PROBABLE WELL YIELDS FROM UNCONSOLIDATED ALLUVIAL DEPOSITS[1], IN GALLONS PER MINUTE

- Less than 500
- 500 to 1000
- 1000 to 1500
- Greater than 1500; maximum measured yield=1340 gallons per minute; maximum reported yield=more than 2000 gallons per minute
- AREA WHERE WELL YIELDS PROBABLY CANNOT BE SUSTAINED THROUGHOUT THE YEAR BECAUSE UNCONSOLIDATED ALLUVIAL DEPOSITS ARE DRAINED FOR PART OF YEAR
- AREA OF DAWSON AQUIFER; WELL YIELDS ARE GENERALLY LESS THAN 200 GALLONS PER MINUTE. MAXIMUM REPORTED WELL YIELD HAS BEEN 500 GALLONS PER MINUTE.—Well yields are sufficient for domestic use; locally well yields are sufficient for uses associated with urban development
- AREA WHERE WELL YIELDS ARE GENERALLY LESS THAN 50 GALLONS PER MINUTE FROM LOCALLY SATURATED COLLUVIAL, LANDSLIDE, AND WINDBLOWN DEPOSITS, AND FROM CONSOLIDATED SEDIMENTARY ROCKS WHERE UPPER WEATHERED AND FRACTURED ZONE IS SATURATED.—Well yields generally are sufficient for domestic use and some commercial enterprises
- AREA WHERE WELL YIELDS ARE GENERALLY LESS THAN 5 GALLONS PER MINUTE FROM LOCALLY FRACTURED CRYSTALLINE ROCKS.—Well yields generally are sufficient only for domestic use
- CONTACT BETWEEN UNCONSOLIDATED ALLUVIAL DEPOSITS AND OTHER DEPOSITS AND ROCKS.—Dashed where approximately located
- EASTERN OUTCROP LIMIT OF FRACTURED CRYSTALLINE ROCKS
- ● INDUSTRIAL, IRRIGATION, OR PUBLIC-SUPPLY WELL; YIELD MEASURED BY U.S. GEOLOGICAL SURVEY
- ○ INDUSTRIAL, IRRIGATION, OR PUBLIC-SUPPLY WELL; YIELD REPORTED BY DRILLER.—D indicates well completed in Dawson aquifer. Number following D is well yield, in gallons per minute; shown only when yield is 100 gallons per minute or more

[1]Well yields generally less than 500 gallons per minute from localized areas of unconsolidated alluvial deposits (not shown on map) occurring in stream valleys traversing fractured crystalline rocks. Well yields generally sufficient for domestic use and may be sufficient for some community water supplies and commercial enterprises.

INTRODUCTION

Knowledge of the well yields and chemical quality of water from water-table aquifers may assist State and local officials in making decisions regarding land-use conversions and in locating water supplies in the rapidly urbanizing Colorado Springs—Castle Rock area (index map). This report presents the results of a 2-year investigation to obtain this knowledge and to relate the results to urban planning. The report is one of a series of geologic and hydrologic reports prepared by the U.S. Geological Survey to demonstrate the usefulness of earth-science information in urban planning.

In the Colorado Springs—Castle Rock area, the principal water-table aquifers consist of unconsolidated alluvial deposits that are perennially saturated, and the Dawson Formation of Late Cretaceous and Paleocene age, which is referred to as the Dawson aquifer in this report. The unconsolidated alluvial deposits, which have a maximum thickness of about 100 feet, occur in stream valleys and in terraces both along the stream valleys and on slopes of the foothills east of the Front Range.

The Dawson aquifer underlies the unconsolidated alluvial deposits and is exposed at the land surface in most of the study area north of Colorado Springs and east of the Front Range. The Dawson is a consolidated sedimentary-rock aquifer consisting of two units. The upper arkosic unit contains coarse sand, ironstone layers, and some sandstone beds. The lower unit contains beds of sandstone, siltstone, claystone, and shale. The maximum thickness of both units is about 2,500 feet. Although water in the aquifer locally occurs under artesian conditions, water-table conditions are more common. Hydraulic connection between the unconsolidated alluvial deposits and the Dawson aquifer is greatest where stream valleys have been eroded into the Dawson.

The water-supply potential of the Dawson aquifer in the study area is being investigated. Results of completed investigations in El Paso County indicate that the aquifer may be a major source of water supplies for urban development (Livingston and others, 1975, 1976).

Locally, saturated permeable materials that yield water to wells also occur in the upper weathered and fractured zone of other consolidated sedimentary rocks that form the foothills east of the Front Range and that crop out in the southern part of the area; in colluvial and landslide deposits that occur on the slopes of the consolidated sedimentary rocks; and in windblown deposits that occur in the vicinity of Colorado Springs. In the crystalline rocks that form the Front Range in the western part of the area, water occurs locally in fractures. Because of the localized occurrence of these saturated permeable materials and fractures and because some of the materials and fractures are drained for part of the year, these water-table aquifers were not studied in detail during this investigation. Artesian aquifers that occur in the consolidated sedimentary rocks below the Dawson aquifer in the eastern part of the area were not studied during this investigation.

Yield data from industrial, irrigation, and public-supply wells measured by the U.S. Geological Survey (Jenkins, 1961), and yield data reported by drillers for the same types of wells were used to compile the well-yield map. The reported data from drillers were obtained from the files of the Colorado Department of Natural Resources, Division of Water Resources, Office of the State Engineer.

Chemical analyses of water samples from 201 wells and 47 springs were used to compile the water-quality map. Analyses of water from 100 wells and 44 springs were obtained during this investigation and analyses of water from 101 wells and 3 springs were obtained by other investigators during the 1960's and early 1970's.

The emphasis of the water-quality phase of the investigation was to locate water-table aquifers containing water with less than 500 mg/L (milligrams per liter) of dissolved solids, as these aquifers may be potential sources of water supplies for urban development. Sampling was concentrated in areas where previous investigators had not determined the chemical quality of the water. Some samples were collected where previous investigations had determined that the dissolved-solids concentrations were between 500 and 1,000 mg/L. This sampling was done to determine if dissolved-solids concentrations had decreased with time.

Appreciation is extended to the many owners of wells and springs in the Colorado Springs—Castle Rock area for permitting access to and collection of water data from their wells and springs.

RELEVANCE TO URBAN PLANNING

Industrial, irrigation, or public-supply wells yielding 100 gallons per minute or more have been completed in the unconsolidated alluvial aquifers in most of the major stream valleys and larger terraces in the study area and in the Dawson aquifer. Yields of 100 gallons per minute or more generally are sufficient for various uses associated with urban development. Construction costs of shallow wells completed in the unconsolidated alluvial aquifers make the initial costs of obtaining water from these aquifers less expensive than obtaining water from other aquifers or from new surface-water storage and distribution systems.

In addition to being the sole source of water for many uses associated with urban development, ground water that is chemically suitable may be used as a secondary or emergency source of water, especially during droughts, for those communities, cities, and industries that now (1977) rely only on surface water. Where available, ground water that is chemically suitable also may be mixed with surface water, thereby increasing the total amount of water available for a specific use. In mixing ground and surface waters, it would be possible to use ground water containing as much as several thousand milligrams per liter of dissolved solids provided the delivered mix was suitable for the intended use. Volumes as well as all water-quality characteristics of ground and surface waters need to be considered if mixing is used.

In localities where ground water is not chemically suitable for public supplies, or for industrial and commercial processes requiring public supplies, or is not mixed with surface water, ground water may be used conjunctively with surface water, thereby reserving the surface water for public supplies. For example, depending on availability and the degree of salinity, ground water could be used for:

1. Irrigation of parks, golf courses, cemeteries, and other open space.
2. Industrial and commercial activities such as cooling, air conditioning, washing of agricultural products prior to processing, watering livestock in feedlots, and washing of vehicles.
3. Community services, such as fire protection and street cleaning.

WELL YIELDS

Well yields shown on the well-yield map should be considered only as indicators of the maximum long-term yields of individual wells completed in the aquifers, especially the unconsolidated alluvial aquifers. Maximum long-term yields may be slightly larger or smaller than those shown on the well-yield map. Yields are affected by many hydrologic factors that were not determined during this investigation, such as: Amount of recharge to and discharge (including pumpage) from the aquifers that affects the saturated thickness and transmissive characteristics of the aquifers both in large areas and in the vicinity of pumping wells; lateral changes in lithology of the aquifers that affect the transmissive characteristics; duration of sustained pumping; hydraulic connection with surface water; amount of water in storage; spacing of wells; well construction and development; and pump capacity and efficiency.

Most industrial, irrigation, and public-supply wells completed in the unconsolidated alluvial aquifers yield from 100 to 1,000 gallons per minute. Wells yielding more than 1,000 gallons per minute are located along Fountain Creek south of Colorado Springs. The maximum measured yield was 1,340 gallons per minute from a well completed in the alluvium of Fountain Creek near Security. Maximum reported yields were more than 2,000 gallons per minute from wells completed in the alluvium of Fountain Creek near Widefield.

The reported yields of 51 industrial, irrigation, and public-supply wells completed in the Dawson aquifer are summarized below:

Well yield (gallons per minute)	Number of wells	Range of well depths (feet)	Median well depth (feet)
Less than 100	27	170–1,227	638
100–200	15	120–1,700	850
200–300	5	575– 904	672
300–400	1	975	--------
400–500	3	677–1,707	1,584

Of the 51 wells, 10 are located in Douglas County and 41 are located in El Paso County. A maximum yield of 500 gallons per minute was reported for an irrigation well at the U.S. Air Force Academy and two public-supply wells—one at Castle Rock and one about 5 miles south of Castle Rock.

Recharge to the aquifers is principally from precipitation and snowmelt during the spring and early summer and, where irrigation is extensive, from water applied during the growing season. A factor in planning for urban development that needs investigation is how much the recharge and well yields would be reduced in localities where recharge would be only from precipitation and snowmelt, if large tracts of irrigated farmland were converted to other land uses.

MAP SHOWING WELL YIELDS

WELL YIELDS AND CHEMICAL QUALITY OF WATER FROM WATER-TABLE AQUIFERS IN THE COLORADO SPRINGS—CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO

By
Donald E. Hillier and E. Carter Hutchinson

1980

For sale by Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225