DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
U.S. AIR FORCE

WATER-RESOURCES INVESTIGATIONS REPORT 85-4154

INTRODUCTION

Many private residences near the southwest corner of Francis E. Warren Air Force Base, adjacent to the western city limits of Cheyenne, Wyo., depend on wells for water supply. The source of ground water is the Ogallala Formation of late Miocene age; water levels generally are less than 20 feet below land surface west and south of the base, and generally less than 10 feet below land surface on the base. Landowners have installed their own septic systems. Although most of the wells are drilled to depths of more than 100 feet, there is evidence that pumping can affect the shallow water levels. Additional residences are being constructed in a new subdivision consisting of small-acreage lots near the west boundary of the base. A refuse landfill along with military facilities where liquid materials have been stored and used on the Air Force base are located across the road from many of the residences.

There are concerns of possible ground-water contamination. Therefore, it is necessary to estimate the direction of ground-water movement in the area so that a sampling program to monitor the movement of potential contaminants can be designed if needed. Boundaries of the study area are approximately 1 mile to each side of Diamond Creek extending about 2 miles upstream from the confluence with Crow Creek.

The objective of this study was to determine the direction of ground-water movement in sufficient detail to aid in selecting the location of monitoring wells should they ever be needed for monitoring the movement of contaminants in the ground-water system. Data for a water-table contour map was obtained from 22 test holes, ranging in depth from 10 to 28 feet, that were augered on the Air Force base to examine the lithology of the Ogallala Formation and to enable measuring the depth to water. Water levels were also measured in two existing wells in the vicinity of the landfill. Beyond the boundary of the Air Force base, water levels in 14 private wells, measured by personnel of the Wyoming State Engineer's Office and the U.S. Geological Survey, were used with data from the test holes to map the water table. Altitude of the land surface at all measurement sites was determined by instrument level to enable accurate contouring of the water levels using an interval of 2 feet.

LITHOLOGY

Examination of the cuttings from the augered test holes showed that lenses of sand and gravel generally predominate to a depth of about 7 feet. From about 7 to 10 feet below land surface, the formation usually grades to finer material. Below about 10 feet, the formation principally is sandy silt and silty clay. Cuttings from test holes 17, 18, and 21 indicated that the formation near the landfill consists of mostly silty clay. No gravel was found in these test holes.

Cuttings from a domestic well just northeast of the landfill, drilled to similar depth of other nearby domestic wells, are assumed to be representative of the deeper Ogallala Formation in the area. The log of this well, drilled in the SW1/4,NW1/4, NW1/4, sec. 27, T. 14 N., R. 67 W., indicated unconsolidated sand and gravel to a depth of about 18 feet with less permeable clayey siltstone containing a few thin lenses of fine- to medium-grained sandstone to a depth of about 150 feet. From 150 to 170 feet, the formation is permeable coarse-grained sand and fine to medium gravel. A hard, cemented layer was found at 170 feet where drilling was stopped.

Lithology of the formation has an effect on the position of the water table. The less-permeable silt and clay layers below about 10 feet restrict downward movement of the water and are the probable reason for the water levels to remain relatively shallow. The silty clay material found in the formation near the landfill could be one reason for the ridge in the water table in that vicinity.

GROUND-WATER MOVEMENT

Ground water moves from high altitude to lower altitude and generally in a direction that is perpendicular to the water-table contours. The contour map shows that the ground water moves toward Diamond and Crow Creeks and that the creek valleys are ground-water discharge areas.

The rate of ground-water discharge to the creeks was estimated by seepage measurements. Stream discharge in Diamond Creek May 24, 1984, increased about 0.1 cubic foot per second in the reach between the west boundary of the base and just upstream from the confluence with Crow Creek. Discharge measurements on Crow Creek May 30, 1984, at sites near the west boundary of the base and just downstream from the bridge on Plant Road, showed a gain of 5.4 cubic feet per second in this reach.

A small, unnamed creek that originates near the southwest boundary of the base derives its flow from ground-water discharge. Surface flow disappears where the stream channel is buried under fill near the location of barracks (between test holes 12 and 13). A spring located just east of the barracks probably discharges some of the flow observed in the creek upstream from the fill.

Ground-water discharge also was observed in other springs. A spring near the southern boundary of the Air Force base forms a pond where some of the water is removed by evapotranspiration. Ground water also is discharged in a spring along the south escarpment of Crow Creek east of test hole 22 and near the picnic area in the creek valley. The discharge rate from this latter spring could not be measured because seepage occurs throughout a large area along the steep embankment and disappears into the permeable alluvium along Crow Creek.

SELECTED REFERENCES

Crist, M. A., 1980, Effect of pumpage on ground-water levels as modeled in Laramie County, Wyoming: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-1104, 26 p.

Lowry, M. E., and Crist, M. A., 1967, Geology and ground-water resources of Laramie County, Wyoming, with a section on Chemical quality of ground water and of surface water by J. H. Tilstra: U.S. Geological Survey Water-Supply Paper 1834, 71 p.

CONVERSION FACTORS AND VERTICAL DATUM

For use of readers who prefer to use metric units, conversion factors for terms used in this report are listed below:

Multiply	By	To obtain
foot	0.3048	meter
mile	1.609	kilometer
cubic foot per second	0.02832	cubic meter per second

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level. NGVD of 1929 is referred to as sea level for water-table altitudes.

For additional information write to:

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Copies of this map can be purchased from:

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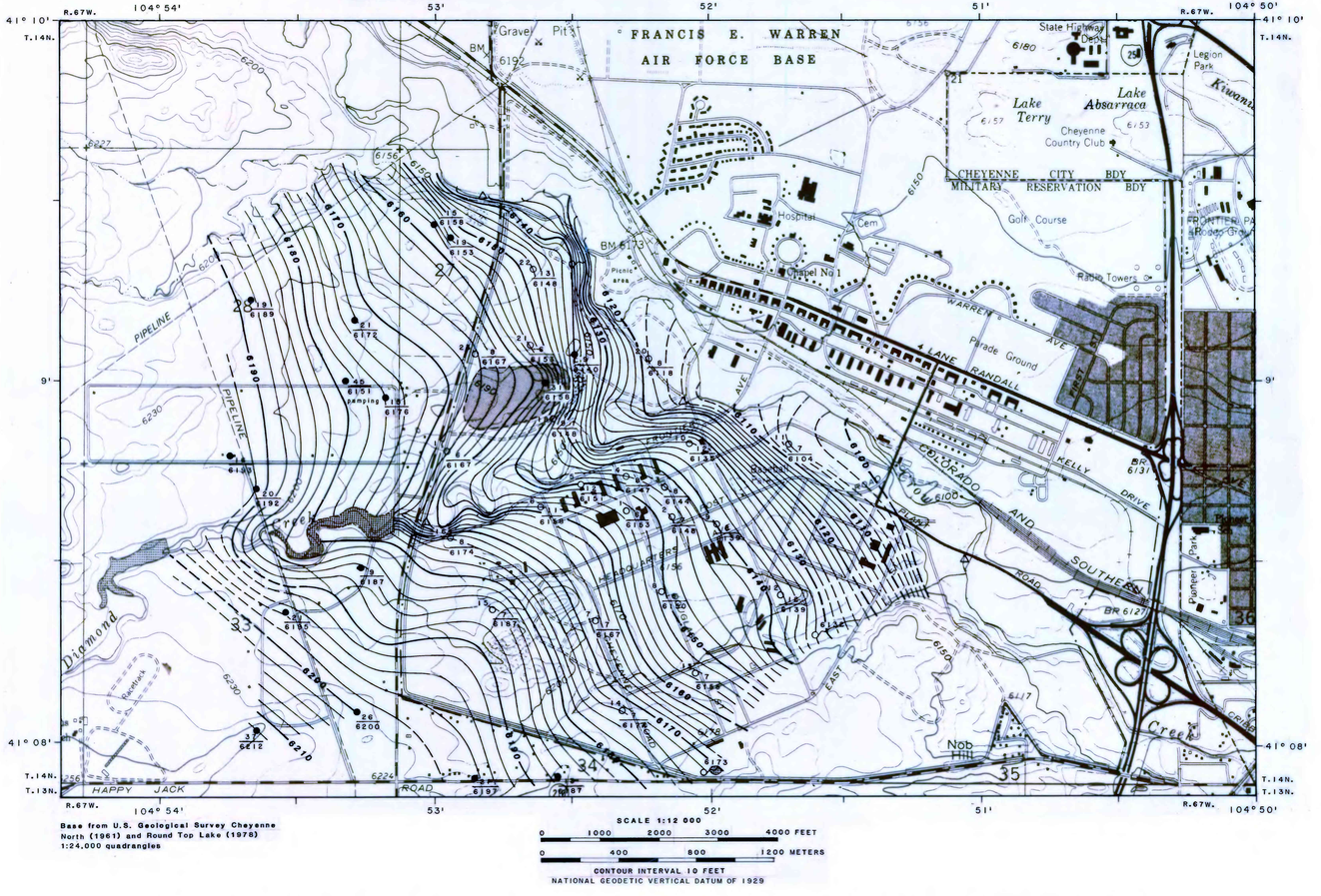
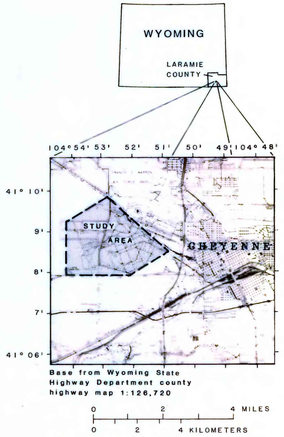


Base from U.S. Geological Survey Cheyenne North (1961) and Round Top Lake (1978) 1:24,000 quadrangles

SCALE 1:12 000
0 1000 2000 3000 4000 FEET
0 400 800 1200 METERS
CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

EXPLANATION

- 6110 — WATER-TABLE CONTOUR--Shows altitude of water table, May 1984. Dashed where approximately located. Contour interval, 2 feet. Datum is sea level
- 9 / 6140 — WELL--Number above bar is depth to water, in feet below land surface. Number below bar is altitude of water table, in feet above sea level
- 11 / 7 / 6104 — TEST HOLE--Top number is hole number (test hole 19 was not drilled). Number above bar is depth to water, in feet below land surface. Number below bar is altitude of water table, in feet above sea level
- 6132 — SPRING--Number is altitude of land surface, in feet above sea level
- △ — STREAM-DISCHARGE MEASUREMENT SITE
- APPROXIMATE AREA OF LANDFILL



Base from Wyoming State Highway Department county highway map 1:126,720

LOCATION OF STUDY AREA

ALTITUDE AND CONFIGURATION OF THE WATER TABLE AND DEPTH TO WATER NEAR CHEYENNE, WYOMING, MAY 1984

By

Marvin A. Crist

1985