Prepared in cooperation with the
UTAH DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS, AND MINING

Freethey, G.W., 1994, Geohydrologic information in an area of salt-water disposal, eastern Altamont-Bluebell Petroleum Field, Uinta basin, Utah

The potentiometric surface of the aquifer within the Duchesne River and Uinta Formations (fig. 11) indicates that the direction of horizontal ground-water movement is from northwest to southeast. The water-table configuration for the alluvial and glacial-outwash aquifer shows a similar direction of ground-water flow (Hood and Fields, 1978, fig. 15). Although no data are available, the locations of the probable recharge and discharge areas would indicate that the most likely direction of flow in the uppermost disposal zone would be the same as in the overlying aquifers; however, salt water injected into this zone at pressures of 1,300 to 1,500 pounds per square inch may locally change the direction and rate of movement near the disposal wells.

Vertical movement of ground water within 1,000 feet of land surface generally is upward in the valley of Cottonwood Creek as evidenced by deeper water wells having higher heads than those of shallow water wells. The number of wells having hydraulic heads above land surface is largest at the southeast end of the valley near the town of Roosevelt, Utah. This predominance of upward ground-water movement, if it exists at depths greater than 1,000 feet below land surface, would facilitate the migration of deeper, more saline water into more shallow zones where it could be withdrawn through water wells.

Aquifer properties

Hood (1976, tables 2, 3, 4, and 5; pls. 2 and 3) estimated the hydrologic properties of the aquifers in the study area from specific-capacity data, aquifer tests, and core analyses, and summarized values reported from previous investigations. The data indicate that hydraulic conductivity generally decreases with depth and degree of consolidation. Unconsolidated deposits in the study area have the largest hydraulic conductivity (median was 60 feet per day from 33 values). Hydraulic conductivity from 46 values for the Duchesne River Formation ranged from 0.03 to 50 feet per day (median was 0.65 foot per day). Only three values of hydraulic conductivity for the Uinta Formation were available for the study area. The values are 0.2, 0.3, and 21 feet per day.

Transmissivity values for the unconsolidated deposits in the study area ranged from 100 to 12,000 feet squared per day; for the Duchesne River Formation from 0.1 to 1,800 feet squared per day; and for the Uinta Formation two values, 40 and 3,500 feet squared per day, were reported. Specific yield for the unconsolidated deposits was estimated to be 0.10. The storage coefficient for the Duchesne River Formation, from one aquifer test, was 0.0002 to 0.0007. Porosity derived from core analyses of the Duchesne River Formation ranged from about 17 to 41 percent, and generally increases from north to south (Hood, 1976, fig. 18).

It cannot be determined if the hydrologic properties that Hood (1976) estimated for the Duchesne River and Uinta Formations are in the same range as the hydrologic properties for the uppermost disposal zone. Even though the uppermost disposal zone is located primarily within the Duchesne River Formation, the depth of burial and the character of the fluids in this zone might result in different hydrologic and hydraulic properties than those near land surface.

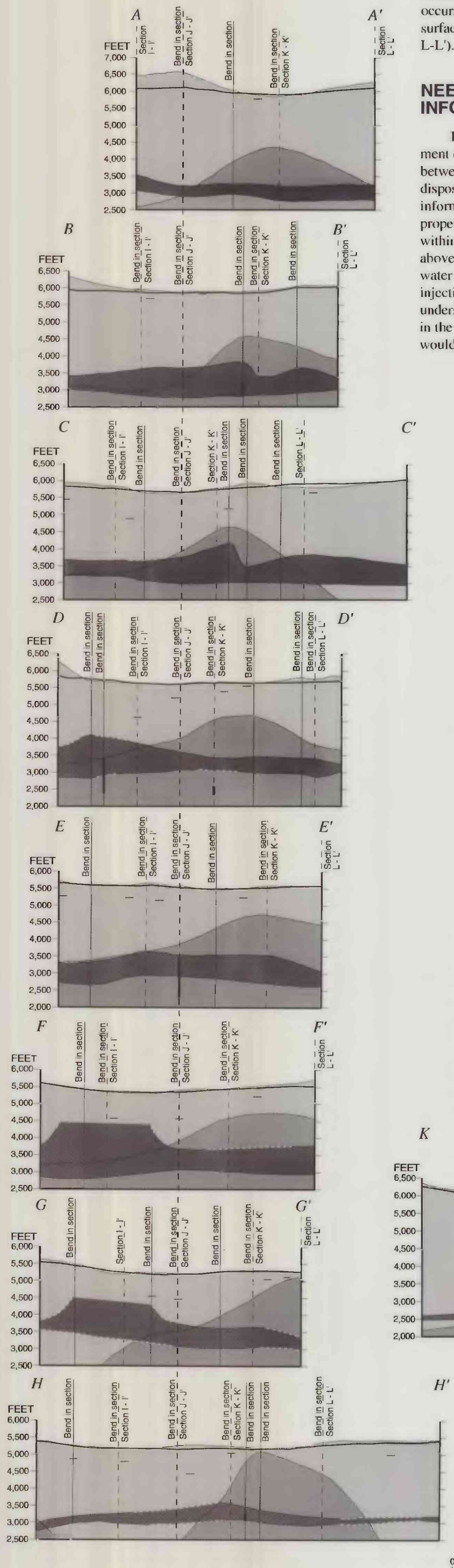
Concentration of dissolved solids in potable ground water

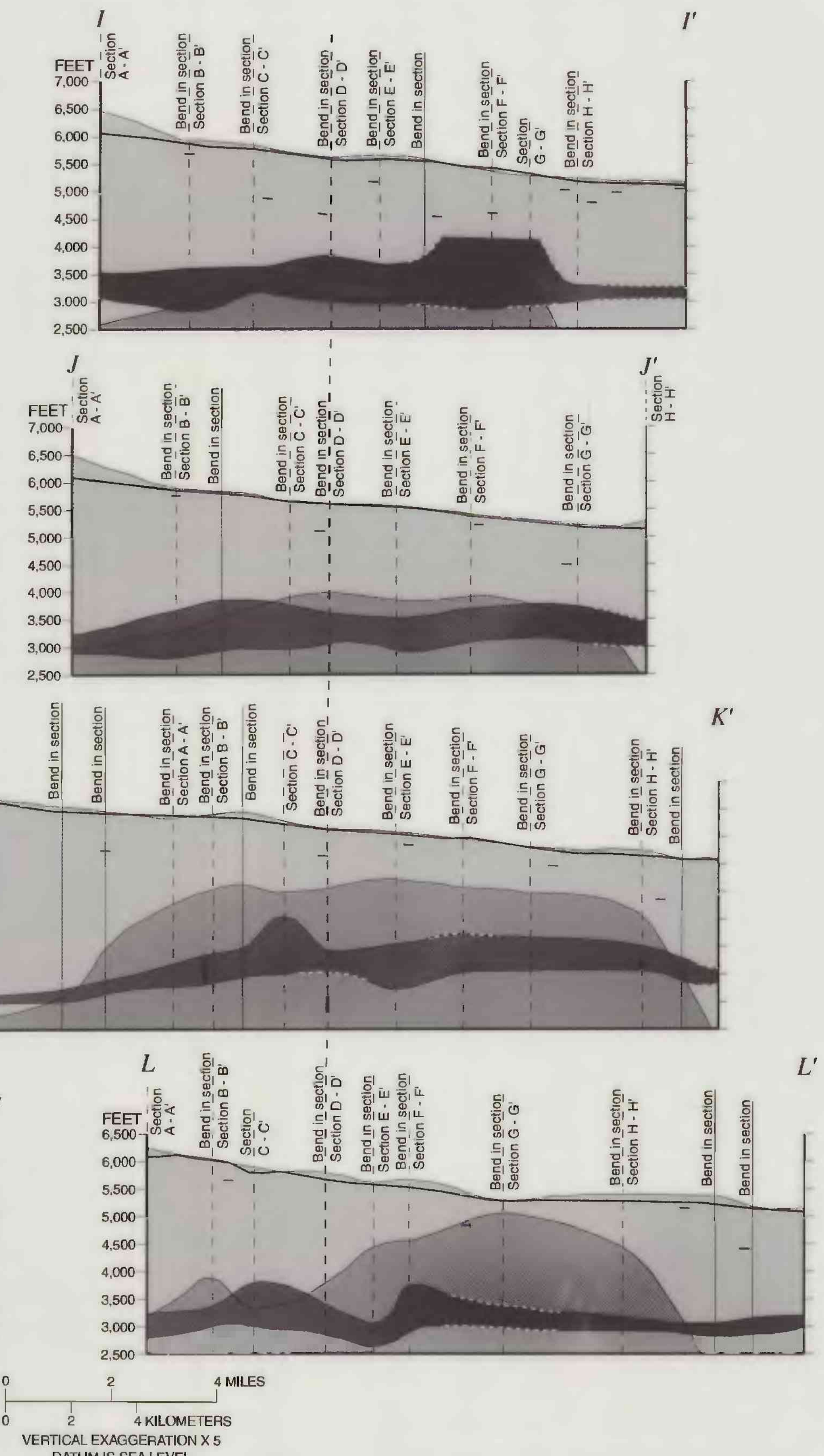
The concentration of dissolved solids in ground water used for private and public supply in the study area ranges from about 200 to 2,500 milligrams per liter (Hood, Mundorff, and Price, 1976, table 10). Hood and Fields (1978) indicated that concentration generally increases in the direction of movement, from northwest to southeast (fig. 12), but there are several local variations to this suggested pattern because of the differences in the depth of sampled wells and the lithologic character of the rock where each well is completed. The concentration of dissolved solids in water from sampled wells that are near one another is usually smaller in the deepest well, suggesting an upward direction of ground-water movement with additional minerals being dissolved along the flow path or a different recharge area and flow path for each depth. A larger concentration (greater than 1,000 milligrams per liter) of dissolved solids in ground water exists in the vicinity of and to the northeast of the town of Roosevelt. This larger concentration might be related to the naturally occurring saline water that is within 500 feet of land surface in this area (fig. 8, sections G-G', H-H', and L-L').

NEED FOR ADDITIONAL INFORMATION AND INVESTIGATION

In order to make a more comprehensive assessment of whether a vertical hydraulic connection exists between the fresh-water aquifers and the uppermost disposal zone, additional information is needed. This information might include measured hydrologic properties in both horizontal and vertical direction within the uppermost disposal zone and in the aquifer above the disposal zone, but below the depth that water wells now penetrate. Information related to the injection of produced water would be useful for understanding variations in hydraulic-head gradients in the aquifers. The information described above would be useful in developing cross-sectional or areal variable-density flow models that would help in understanding the possible mechanisms that influence the migration of salt water, naturally occurring and injected.

Geochemical indicators might be used to determine if produced salt water has migrated upward and mixed with fresh water in the overlying aquifer (B.A. Kimball, U.S. Geological Survey, written commun., 1991). By comparing the expected changes in the geochemical evolution of ground water that would theoretically take place along a ground-water flow path with actual changes, as determined from chemical analyses of samples collected along the flow path, the degree of mixing with saline water from deeper in the formation can be estimated. In order to obtain geochemical information, a monitoring network of wells could be established along a typical ground-water flow path in the study area.





EXPLANATION

Profile of the uppermost disposal zone—Contacts dashed where approximate. Contacts omitted where uncertain

Profile of zone where dissolved solids in ground water are greater than 10,000 milligrams per liter

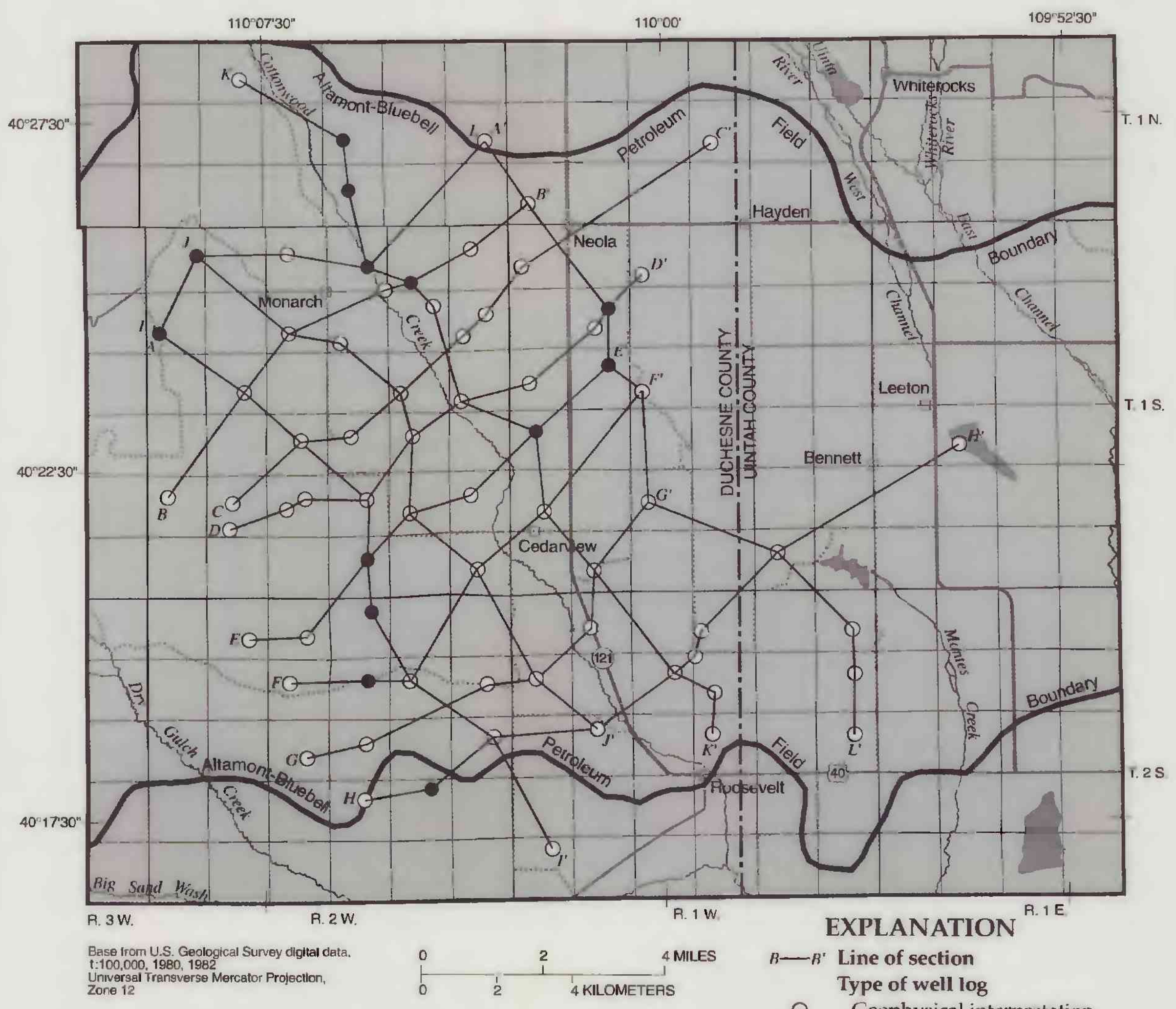
Profile of potentiometric surface of aquifer less than 1,000 feet below land surface

Line indicating depth of deepest nearby water well

Openings depth interval of nearby salt-water disposal well

VERTICAL EXAGGERATION X 5
DATUM IS SEA LEVEL

Figure 8. Vertical and lateral relation of the uppermost disposal zone, the zone of dissolved solids greater than 10,000 milligrams per liter, and the deepest water wells.



Base from U.S. Geological Survey digital data, 1:100,000, 1980, 1982
Universal Transverse Mercator Projection, Zone 12

EXPLANATION

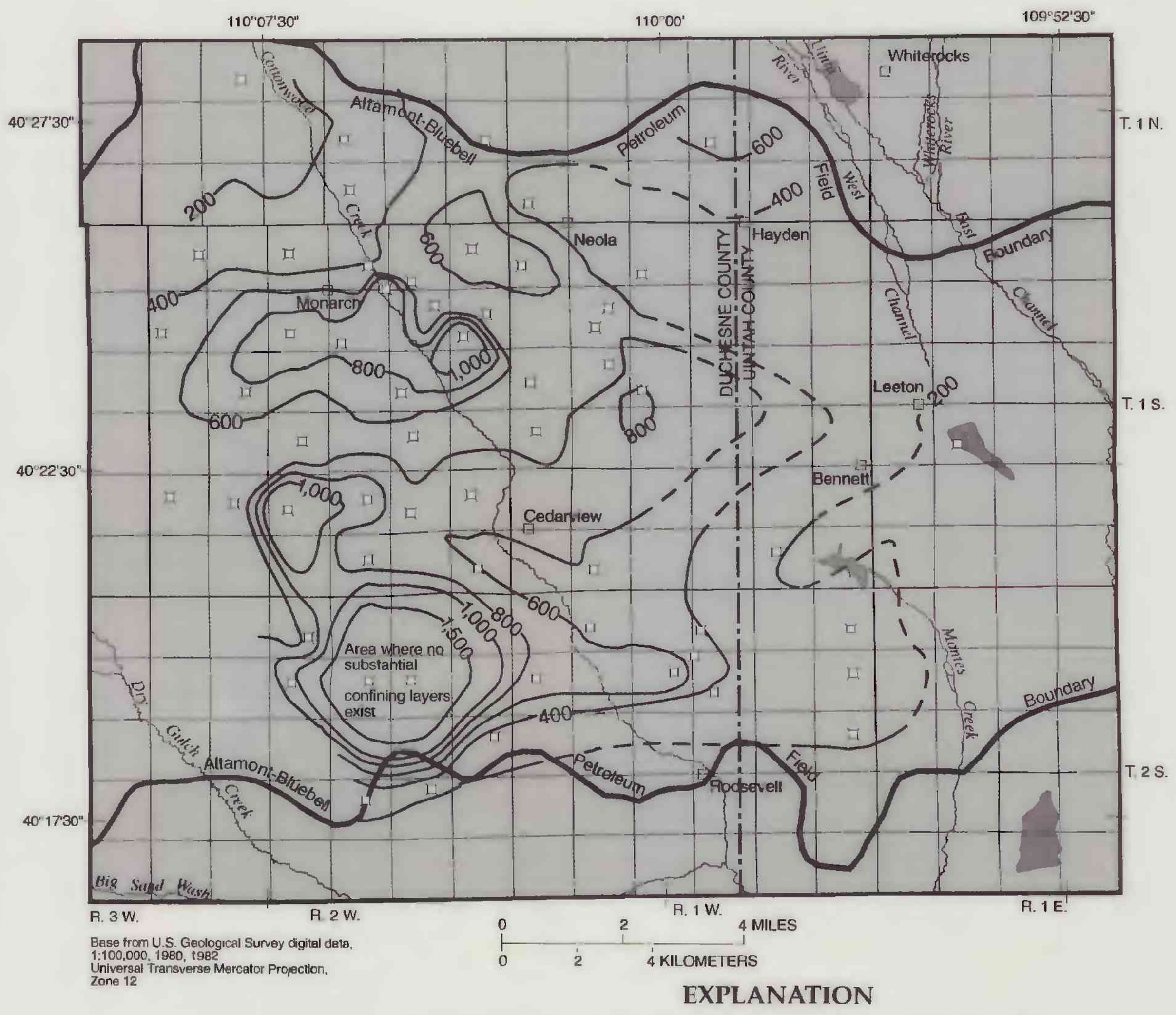
B—B' Line of section

Type of well log

Geophysical interpretation

Lithologic interpretation

Figure 9. Location of sections and control points.



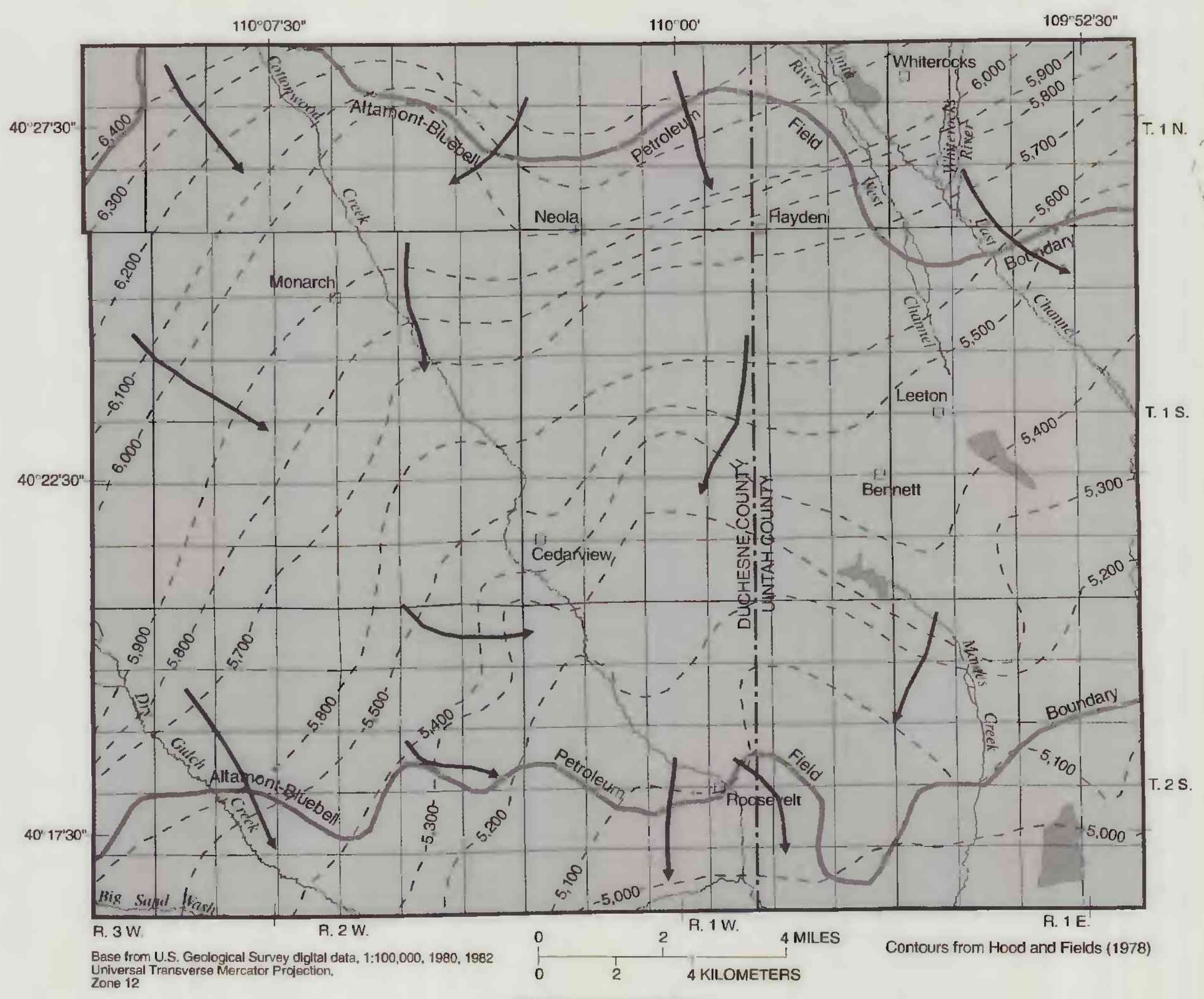
Base from U.S. Geological Survey digital data, 1:100,000, 1980, 1982
Universal Transverse Mercator Projection, Zone 12

EXPLANATION

—400— — Line of equal thickness of uppermost disposal zone—Dashed where uncertain. Intervals 200 and 500 feet

Control point

Figure 10. Thickness of the uppermost disposal zone.



Base from U.S. Geological Survey digital data, 1:100,000, 1980, 1982
Universal Transverse Mercator Projection, Zone 12

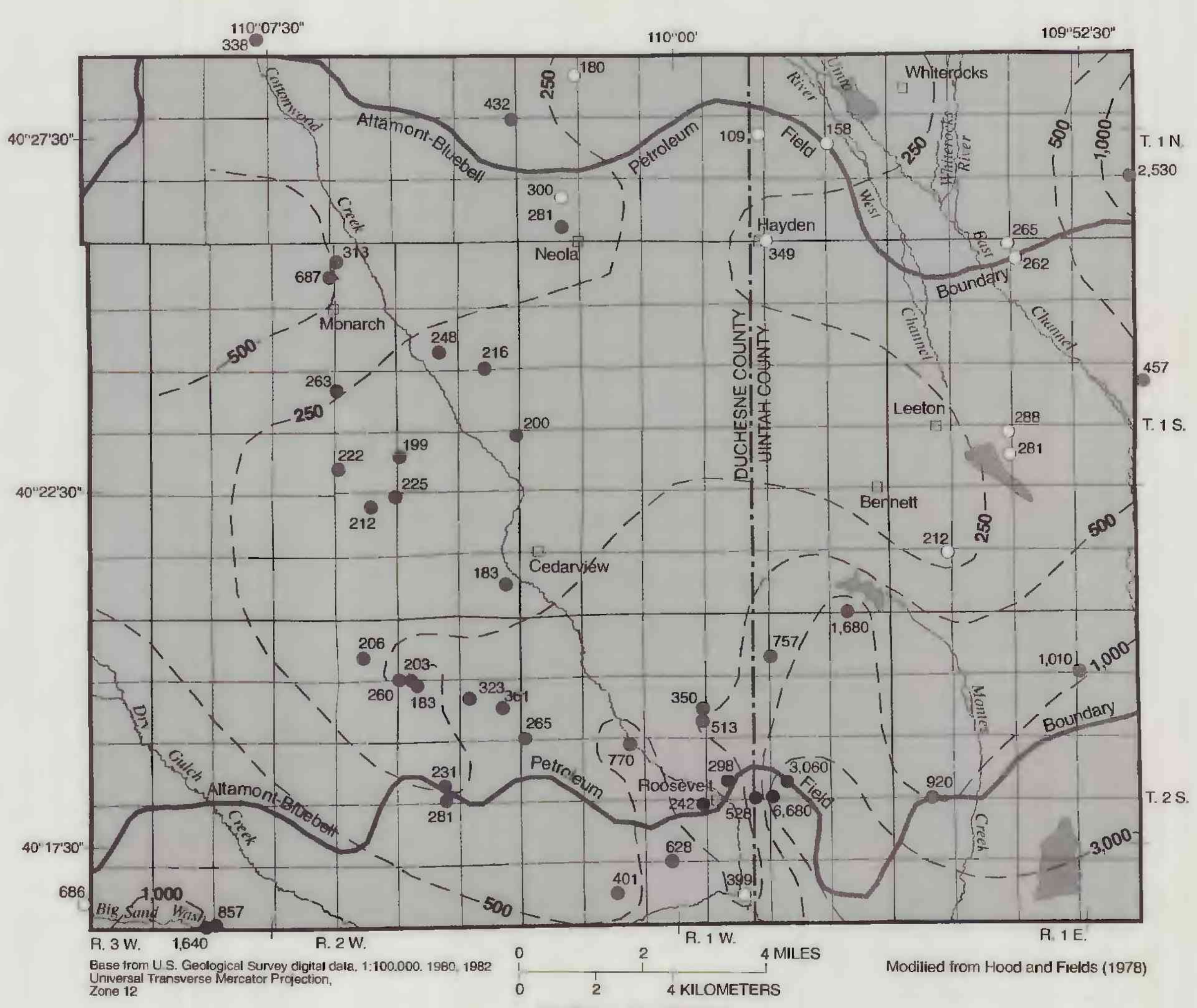
Contours from Hood and Fields (1978)

EXPLANATION

- - 5900- - Approximate potentiometric contour—Shows altitude at which water levels would have stood in tightly cased wells or altitudes of springs. Contour interval 100 feet. Datum is sea level

Arrow—Indicates direction of horizontal ground-water movement

Figure 11. Generalized potentiometric surface, less than 1,000 feet below land surface, for the aquifer in Duchesne River and Uinta formations.



Base from U.S. Geological Survey digital data, 1:100,000, 1980, 1982
Universal Transverse Mercator Projection, Zone 12

Modified from Hood and Fields (1978)

EXPLANATION

- -500- - Line of equal dissolved-solids concentration—Interval variable. Units are milligrams per liter

Control point—part of aquifer sampled. Number is concentration of dissolved solids, in milligrams per liter

399 Alluvium or outwash

628 Duchesne River Formation

528 Uinta Formation

Figure 12. Generalized concentration of dissolved solids in the ground water less than 1,000 feet below land surface.

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CONVERSION FACTORS, VERTICAL DATUM, ABBREVIATED WATER-QUALITY UNITS, AND DATA-SITE NUMBERING SYSTEM

Multiply	By	To obtain
acre	0.4047	hectare
	4,047	square meter
acre-foot	0.001233	cubic hectometer
	1,233	cubic meter
foot	0.3048	meter
foot per day	0.3048	meter per day
foot squared per day	0.0929	meter squared per day
mile	1.609	kilometer
pound per square inch	0.070307	kilogram per square centimeter
square mile	2.59	square kilometer

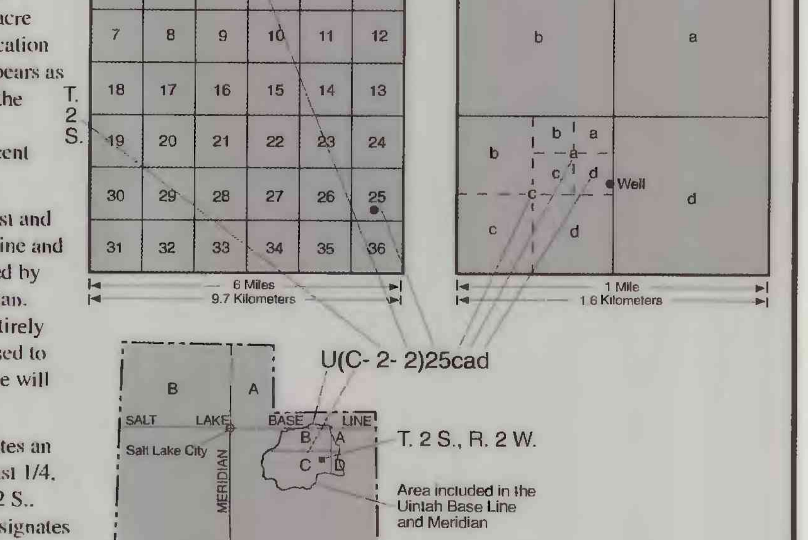
Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Chemical concentration is given in milligrams per liter. Milligrams per liter is a unit expressing the solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to 1 milligram per liter. For concentrations less than 7,000 milligrams per liter, the numerical value is about the same as for concentrations in parts per million.

The data-site numbering system used by the U.S. Geological Survey, Water Resources Division, for numbering hydrologic-data sites in Utah is based on the cadastral land-survey system of the U.S. Government. The number, in addition to designating the well, describes its position in the land net. By the land-survey system, the State is divided into four quadrants by the Salt Lake Base Line and the Salt Lake Meridian. These quadrants are designated by the uppercase letters A, B, C, and D, indicating the northeast, northwest, southwest, and southeast quadrants, respectively. Numbers designating the township and range follow the quadrant letter and the three are enclosed in parentheses. The number after the parentheses indicates the section, and is followed by three letters indicating the quarter section, the quarter-quarter section, and the quarter-quarter-quarter section—generally 10 acres for regular sections[1]; the letters a, b, c, and d indicate, respectively, the northeast, northwest, southwest, and southeast quarters of each subdivision. The number after the letters is the serial number of the well and designates the sequence in which it was inventoried by the U.S. Geological Survey. Few, if any, petroleum wells have been inventoried; thus, site numbers representing petroleum wells will have no serial number. In the case of some petroleum wells, locations described in logs were not detailed enough to place a site location within a 10-acre plot. If only 2 letters are shown, then the location is within that 40-acre plot. If the letter x appears as the last letter, then the location is placed at the center of the last quadrant designated. The numbering system is illustrated on the adjacent figure.

In the Uinta Basin, part of the southeast and northeast quadrants of the Salt Lake Base Line and the Salt Lake Meridian have been subdivided by the Uintah Base Line and the Uintah Meridian. The study area described in this report is entirely within this land parcel; thus, the numbers used to denote hydrologic-data sites described above will be preceded by the letter U.

For examples, U(C-2-2)25cad designates an uninventoried petroleum well in the southeast 1/4, northeast 1/4, southwest 1/4, section 25, T. 2 S., R. 2 W., Uintah Meridian; U(B-1-2)5bcx designates an uninventoried petroleum well in the center of southwest 1/4, northwest 1/4, section 5, T. 1 N., R. 2 W., Uintah Meridian; and U(D-1-1)6abc-1 designates the first inventoried well in the southwest 1/4, northwest 1/4, northeast 1/4, section 6, T. 1 S., R. 1 E., Uintah Meridian.



[1] Although the basic land unit, the section, is theoretically 1 square mile, many sections are irregular. Such sections are subdivided into 10-acre tracts, generally beginning at the southeast corner, and the surplus or shortage is taken up in the tracts along the north and west sides of the section.

MAPS SUMMARIZING GEOHYDROLOGIC INFORMATION IN AN AREA OF SALT-WATER DISPOSAL, EASTERN ALTAMONT-BLUEBELL PETROLEUM FIELD, UINTA BASIN, UTAH

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