## Ground Water

An overview of the ground-water framework is presented in this section of the report. Additional information is presented in a subsequent section of the report describing the ground-water resources.

The hydrologic setting of the Black Hills area is schematically illustrated in figure 30, and the distribution of the hydrogeologic units was presented previously in figure 19. The major bedrock aquifers in the Black Hills area are the Deadwood, Madison, Minnelusa, Minnekahta, and Inyan Kara aquifers. Minor bedrock aquifers occur in other units, including confining units, due to fracturing and interbedded permeable layers. Infiltration of precipitation on outcrops is the primary source of recharge to most bedrock aquifers. The unconsolidated units, which includes alluvium and **colluvium**, are considered aquifers where saturated.

***The major bedrock aquifers in the Black Hills area are the Deadwood, Madison, Minnelusa, Minnekahta, and Inyan Kara aquifers.***

Many of the sedimentary units contain aquifers, both within and beyond the study area. Within the Paleozoic rock interval, aquifers in the Deadwood Formation, Madison Limestone, Minnelusa Formation, and Minnekahta Limestone are used extensively. These aquifers are collectively confined by the underlying Precambrian rocks and the overlying Spearfish Formation. Individually, these aquifers are separated by minor confining layers or by low-permeability layers within the individual units. Extremely variable leakage can occur between these aquifers (Peter, 1985; Greene, 1993).

Confined (artesian) conditions generally exist within the aquifers, where an upper confining layer is present. Under confined conditions, water in a well will rise above the top of the aquifer in which it is completed. Flowing wells will result when drilled in areas where the potentiometric surface (level to which water will rise) is above the land surface. Flowing wells and artesian springs that originate from confined aquifer**s** are common around the periphery of the Black Hills.

The Precambrian basement rocks generally have low permeability and form the lower confining unit for the series of sedimentary aquifers (fig. 30). However, localized aquifers occur in many locations in the crystalline core of the Black Hills where **secondary permeability** (developed after the rock was formed) has resulted from weathering and fracturing. Water-table (unconfined) conditions generally occur in these localized aquifers, and topography can strongly control ground-water flow directions.

Overlying the Precambrian rocks is the Deadwood aquifer, which is contained within the Deadwood Formation and is used primarily near outcrop areas. Regionally, the Precambrian rocks act as an underlying confining unit to the Deadwood aquifer, and the Whitewood and Winnipeg Formations, where present, act as overlying semiconfining units (Strobel and others, 1999). Where the Whitewood and Winnipeg Formations are absent, the Deadwood aquifer is in contact with the overlying Englewood Formation, which was included as part of the Madison aquifer for this study.

The Madison aquifer generally occurs within the karstic upper part of the Madison Limestone, where numerous fractures and solution openings (fig. 31) have created

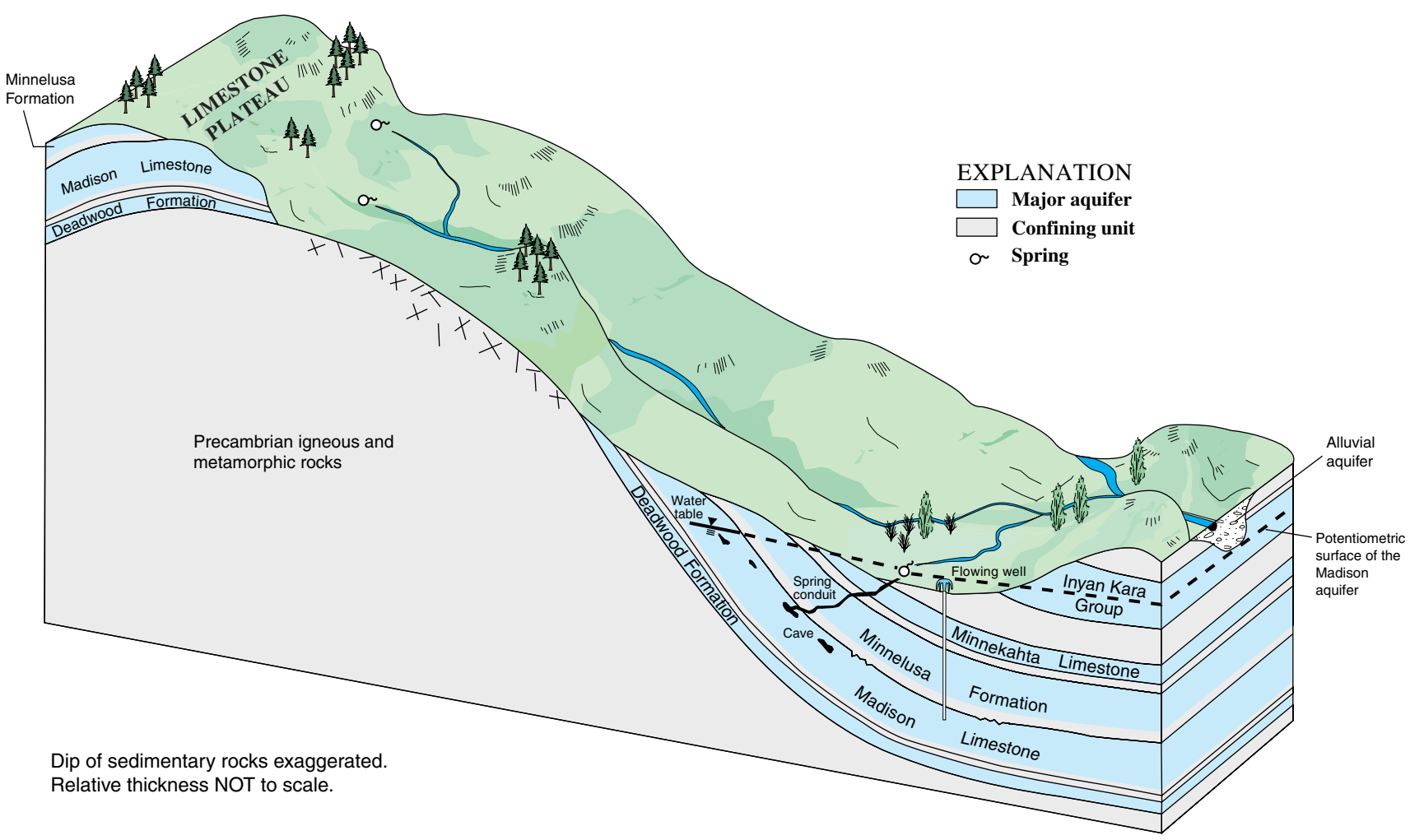
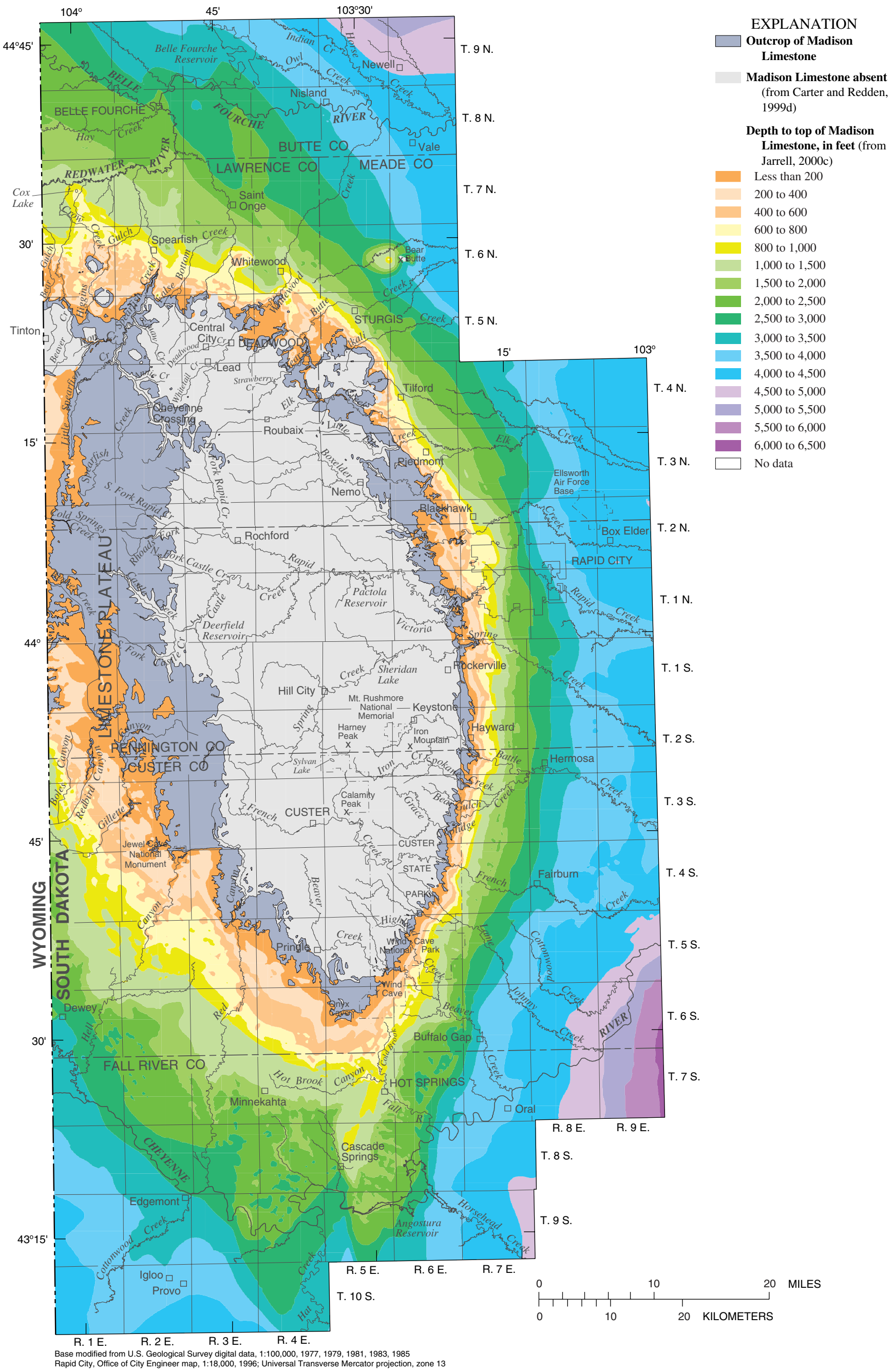
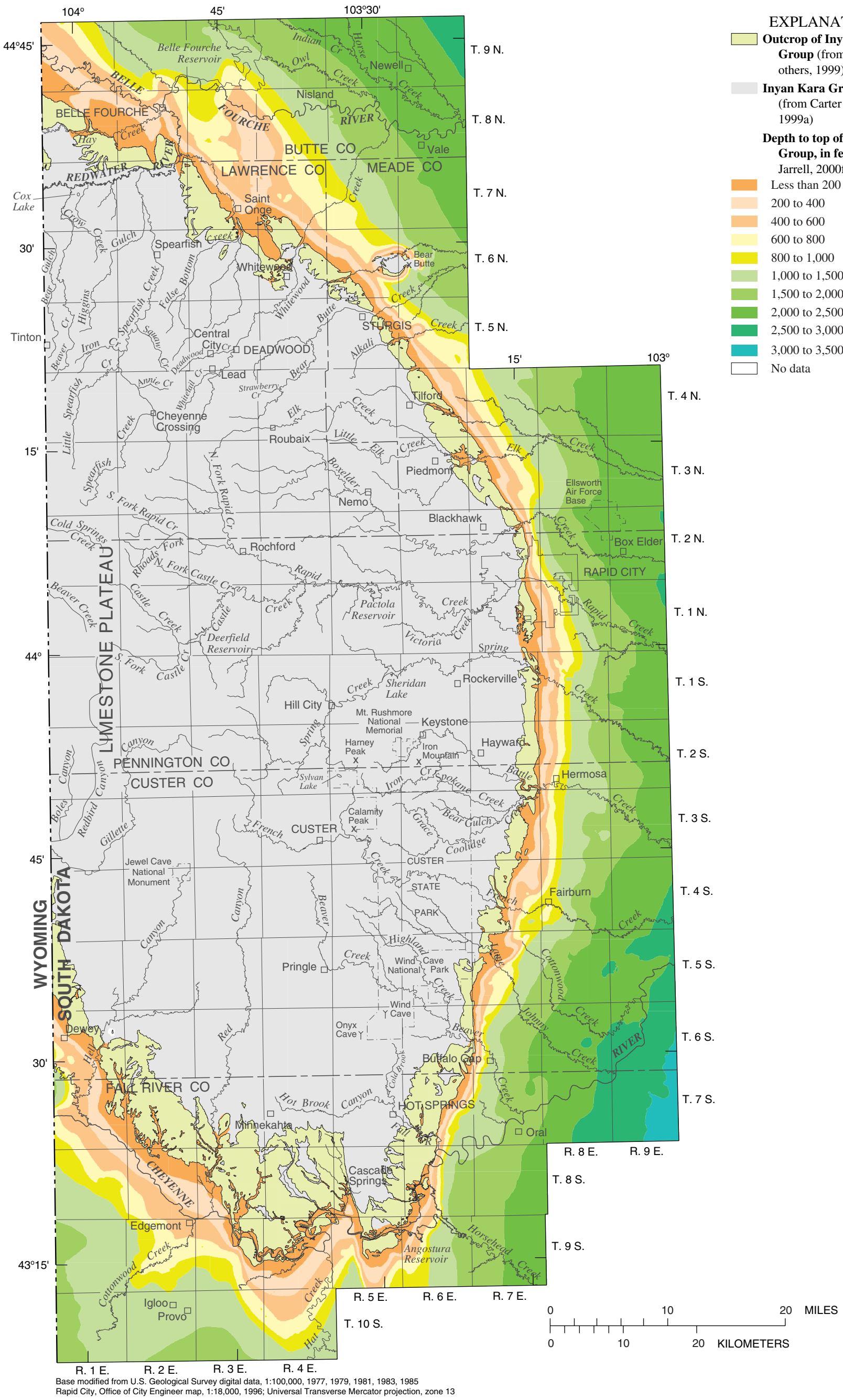



**Figure 30.** Schematic diagram showing simplified hydrologic setting of the Black Hills area. Schematic diagram generally corresponds with geologic cross section shown in figure 20.




Base modified from U.S. Geological Survey digital data, 1:100,000, 1977, 1979, 1981, 1983, 1985
Rapid City, Office of City Engineer map, 1:18,000, 1996; Universal Transverse Mercator projection, zone 13

**Figure 49**. Depth to top of Madison Limestone.




Base modified from U.S. Geological Survey digital data, 1:100,000, 1977, 1979, 1981, 1983, 1985
Rapid City, Office of City Engineer map, 1:18,000, 1996; Universal Transverse Mercator projection, zone 13

**Figure 52**. Depth to top of Inyan Kara Group.