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Geology and Ground Water

R.F. Diffendal, Jr., research geologist, Conservation and Survey Division, University of Nebraska-Lincoln, helped prepare this section.

All of Garden County is underlain by the Brule Formation. This formation is tightly cemented and yields sufficient water to wells only in areas where the siltstone has been fractured. In most places the Brule Formation forms an impermeable seal that prevents water from moving downward from the overlying aquifers.

The Arikaree Group is unimportant as an aquifer in the county, but the younger Ash Hollow Formation is important, particularly beneath the Cheyenne Tableland. Most, if not all, of the domestic and livestock wells on the tableland tap this aquifer. The thickness of the Ash Hollow Formation is 100 feet or less beneath much of the tableland except in the southeastern part of the county in the Ash Hollow Creek area, where it is more than 200 feet thick, and in the southwestern part of the county in the Rush Creek area, where it is more than 300 feet thick. In most of the area of the Cheyenne Tableland, the supply of ground water is adequate for domestic and livestock watering needs but not for irrigation. The Ash Hollow Formation is more than 700 feet thick in the northeastern part of the county beneath the Sandhills and contains an abundant supply of water. It has not been used extensively as a source of water because the overlying younger deposits also contain an abundant supply of water.

The Broadwater Formation and the younger

Quaternary alluvium are probably hydraulically connected directly to the Ash Hollow Formation beneath most of the Sandhills. These units contain abundant ground water and have been used for domestic and livestock watering needs. Some development of irrigation has occurred in this area, particularly in the flatter upland areas adjacent to the North Platte River valley. The unit equivalent in age to the Broadwater Formation in the southeastern part of the county does not contain abundant water and is not an important aquifer.

Quaternary alluvial sands and gravels are important sources of water for domestic, livestock, irrigated agricultural, and business needs in the North Platte River valley. The thickness of these deposits is as much as 100 feet or more. In 1991 Garden County had 313 registered irrigation wells, 2 registered municipal wells, 1 registered commercial well, and 8 other registered but unclassified wells. A larger number of wells used for domestic needs and livestock watering were unrecorded. A fish farming operation south of Lisco uses ground water from Quaternary alluvium.

The quality of the water in the county is good. It is hard or very hard for the most part. The water in the Sandhills varies from soft to hard. Contamination of water supplies is not a major problem in the county, but levels of nitrates above 10 ppm have been recorded in wells near Oshkosh. The potential for other forms of contamination is present.

Ground water issuing from springs produces surface flows near Ash Hollow and along Rush Creek south of the North Platte River. Springs feed Blue Creek and Mutton Creek north of the North Platte River. Ground water also is responsible for the lakes in the Sandhills.

Garden County includes parts of three physiographic regions of the State. From north to south they are the Sandhills, the North Platte River Valley, and the Cheyenne Tableland. The rocks and sediments exposed across these regions were first described in some detail by H. Stansbury in 1849 and were mapped and named by N.H. Darton in 1899. Numerous investigations have been carried out in the county since then.

The oldest rocks in the county belong to the Whitney and the younger Brown Siltstone members of the Brule Formation (White River Group) of the Oligocene epoch. These pink to brown siltstones are generally thick bedded to massive rocks made up of airfall volcanic debris carried into the county by high altitude winds after eruptions of volcanoes probably to the west in the Great Basin about 30 million years ago. The siltstones are made up of silt- and fine sand-sized grains of volcanic ash, or glass, shards and mineral

crystals cemented together by clays. Most of the siltstones are impure, but some almost pure volcanic ash beds occur in the sequence. The Brown Siltstone beds contain abundant concretions of cemented calcium carbonate that are not common in the older Whitney member.

The Brule Formation crops out more or less continuously westward along the south side of the North Platte River valley from the county line on the east to Coumbe Bluff, a distance of about 24 miles. The formation also crops out discontinuously along the north side of the valley from near Lewellen to about 3 miles east of Lisco and along the valley sides of the lower reaches of Blue Creek, a northern tributary of the North Platte River. Most of the rugged tributary valleys on the south side of the North Platte River are formed in the Brule Formation (fig. 2).

In other parts of the Nebraska Panhandle the Brule Formation is overlain by grayish brown, silty sandstones of the Arikaree Group. The group is largely made up of volcanic debris and carbonate concretions. The Arikaree Group is not exposed in Garden County but has been encountered in test holes beneath parts of the Sandhills. The rocks of the group were deposited unconformably above the Brule Formation in valleys carved into the formation by rivers. The age of the Arikaree Group ranges from the late Oligocene epoch to the early Miocene epoch.

The Ash Hollow Formation of the Ogallala Group is unconformably above the Brule Formation beneath all of the Cheyenne Tableland and beneath the floor of the North Platte River valley from about 3 miles east of Lisco west to the county line (fig. 3). It is unconformably above the Brule Formation and, where present, the Arikaree Group beneath the Sandhills. In contrast to the Brule Formation and the Arikaree Group the Ash Hollow Formation is dominantly made up of river-deposited sediments eroded from the Rocky Mountains of southern Wyoming and north-central Colorado. The formation consists of siltstones, sandstones, conglomerates, and pebbly sandstones and their uncemented equivalent sediments that have been deposited in valleys that were carved by rivers into the underlying older beds. Diatomites mark the positions of ponds in the area during the deposition of the Ash Hollow beds. At least five volcanic ash beds were deposited in the Ash Hollow Formation during its accumulation in the area that is now Garden County during the late Miocene epoch. Caliche horizons that mark the positions of stable land surfaces and soil formation are common throughout the Ash Hollow Formation. Ground water calcretes that resemble caliches in appearance and general chemistry occur in some conglomerates.

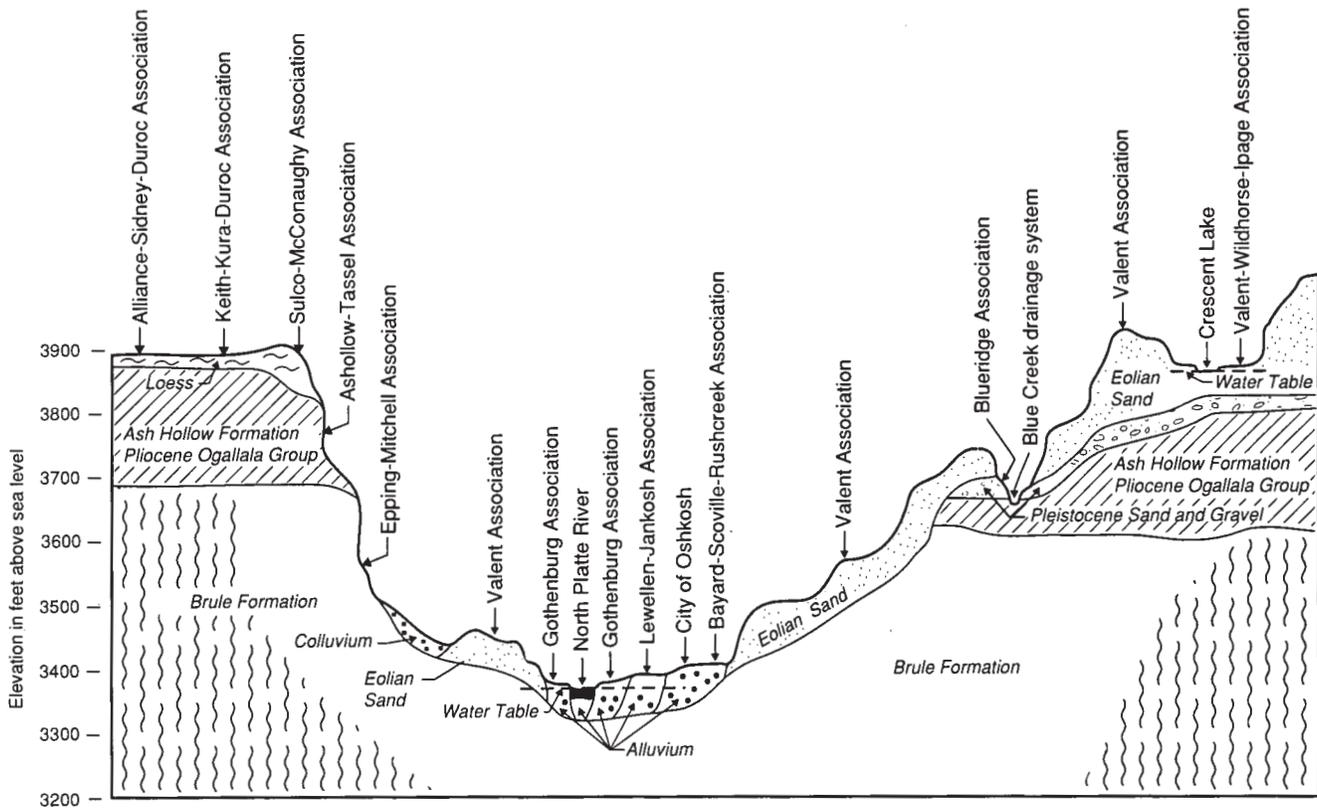


Figure 2.—A schematic cross section of Garden County, showing the general relationship of parent materials, soil associations, and elevations.

Deformation of the Ash Hollow and Brule Formations in the form of folding has affected the distribution and inclination of the strata of both units in western Garden County. Dips of 8 to 9 degrees have been observed in the Rush Creek drainage basin and near Lisco. This folding formed a structural basin with a long axis that roughly follows Rush Creek.

Overlying the older rocks are unconsolidated Pliocene and Quaternary alluvial sediments and Quaternary windblown silts and sands. The oldest alluvium belongs to the Broadwater Formation and equivalents of Pliocene age. The Broadwater Formation is exposed high on the north side of the North Platte River valley discontinuously across the county and underlies the southern part of the Sandhills. It consists primarily of sand and gravel beds that are generally coarser grained than the older Ash Hollow sands and gravels. Lesser quantities of diatomite and wind-deposited silts are interbedded with the alluvium. The formation was deposited in a valley eroded by a major river into the underlying Ash Hollow and Brule Formations. Sands and gravels that are closely equivalent in age were also deposited in a river valley carved into the Ash Hollow Formation in

the extreme southeastern part of the county. These deposits crop out along Ash Hollow Creek and its tributaries and on parts of the Cheyenne Tableland. Terraces and flood plains of the North Platte River and its tributaries, drainageways crossing the Cheyenne Tableland, and some parts of the Sandhills are underlain by Quaternary alluvium. Wind-deposited silt (loess) mantles the older beds beneath the surface of the Cheyenne Tableland in the southern part of the county and at a few sites north of the North Platte River. Some of the land that is farmed on the uplands just south of the well developed Sandhills may also be loessic. The Sandhills are underlain by wind-deposited sand of Quaternary age. They extend down the north side of the valley onto the flood plain of the North Platte River east of Oshkosh. Wind-deposited sands also mantle the lower slopes on the south side of the North Platte River and extend in a few places onto the Cheyenne Tableland.

Physiography, Relief, and Drainage

Garden County is in the Central High Plains, Central High Tableland, and Nebraska Sandhills major