The Todd Valley is a former channel of the Platte River that was probably abandoned at least 27,000 years ago and is filled with fluvial sediments overlain by Peoria Loess and modern soil. The saturated thickness of Quaternary material in these alluvial aquifers ranges from approximately 40 to 120 feet.

Although the alluvial aquifers are widespread in the eastern Saunders County, the thickest saturated Quaternary materials occur in the western part of the county in paleovalleys eroded into bedrock. The two deepest paleovalley aquifers in Saunders County are collectively referred to here as the Dwight-Valparaiso Ground Water Reservoir, with saturated thicknesses ranging from approximately 100 to 230 feet.

In addition to the primary Quaternary aquifers, the Dakota aquifer (formally the Maha aquifer) serves as a secondary aquifer in places. The Dakota Group (~100 million years old) is the uppermost bedrock unit beneath most of the county. The lithology of the Dakota Group includes both aquifer and aquitard material in highly variable proportions. Given this variability, transmissivity is perhaps a more useful parameter than saturated thickness to describe potential aquifer yield. Estimates of transmissivity for the Dakota suggest minimum values of at least 5,000 to 10,000 gallons per day per foot (gpd/ft) across most of Saunders County.

Groundwater in both the Quaternary and Dakota aquifers generally flows from west to east. The flow directions in the Quaternary aquifers are more variable than in the Dakota due to the effects of surface and bedrock topography and hydrologic connections to surface water. Groundwater under the Platte River valley generally follows the river valley, while groundwater in the Todd Valley appears to flow fairly consistently to the southeast at an estimated velocity of about 2.5 feet per day. Two localized groundwater divides occur in the Quaternary aquifers, one located in
the Todd Valley near Morse Bluff, which probably causes some north-south flow, and the other in the Dwight-Valparaiso Ground Water Reservoir near Valparaiso, which causes localized east-west flow.

Quaternary aquifers in Saunders County probably receive about 2.3 inches of recharge annually. The locations and mechanisms of this recharge are not well understood and are the subject of continuing investigation by scientists and government agencies. Water quality in the Quaternary aquifers is generally good, with nitrate being the most widespread contaminant. The water quality in the Dakota aquifer is also generally good, although it may have naturally high concentrations of salt or other dissolved ions. The distribution of salty or mineralized water in the Dakota aquifer is not well known, although chloride concentrations appear to be highest in the vicinity of Ceresco and Ithaca. Saline water in the Dakota aquifer is probably sourced from salts that dissolve out of the underlying Pennsylvanian rocks and move into the Dakota aquifer by either natural or pumping-induced upward gradients.