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UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BRIEF DESCRIPTION AS OF APRIL, 1968, OF THE GEOLOGY AND HYDROLOGY OF THE LAKE MINNEQUA AREA, PUEBLO, COLORADO, AND SUGGESTED SOLUTIONS FOR TROUBLE CAUSED BY A HIGH WATER TABLE

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This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards and nomenclature.

Brief description as of April, 1968, of the geology and hydrology of the Lake Minnequa area, Pueblo, Colorado, and suggested solutions for trouble caused by a high water table

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Lake Minnequa lies in a poorly drained broad upland buried valley west of the valley of Salt Creek. Immediately north of Lake Minnequa the buried valley is sharply constricted in secs. 11 and 12, T. 21 S., R. 65 W., where it is entrenched in a buried ridge of bedrock (see geologic map). The bedrock throughout the buried valley is composed of calcareous shale, limestone, and chalk of the Smoky Hill Shale Member of the Niobrara Formation. These beds are relatively impermeable to the flow of ground water, but contribute large quantities of sodium sulfate to both the surface and ground water.

The bedrock is overlain by surficial deposits ranging in thickness from 8 to 43 feet and in grain size from clay to pebbles. The surficial material apparently is thickest near St. Charles Reservoir No. 2 and thinnest near Lake Minnequa; however no holes have been drilled in the buried valley between Lake Minnequa and one-fourth mile downstream from St. Charles Reservoir No. 2 (see profile E1-E4). Near St. Charles Reservoir No. 2, profile E1-E4 shows that the fill of the buried valley is composed, in ascending order, of 12-17 feet of limestone gravel and 11-26 feet of stony silt, stony clay, silt, and clay. Near Lake Minnequa the clay is humic, and probably more compressible.

The surficial material is called alluvium and is thought to have been deposited by an ephemeral stream that flowed through the buried valley about 10,000 years ago. The alluvium also is partly composed of colluvium carried downslope by a process called slopewash, from the Columbia Heights anticline, which lies 4 miles west of the buried valley. The colluvium forms a mantle about 15 feet thick over bedrock on the slope between the buried valley and Columbia Heights anticline. The alluvium on the east side of the buried valley is overlain by a pile of slag nearly 1/2 mile wide and nearly 2 miles long.

Permeability undoubtedly is high through the limestone gravel in the lower part of the alluvium, but would be low through the overlying silt and clay. Evapo-transpiration at the surface of the surficial material produces a concentrate or efflorescence of sodium sulfate. Alternate wetting and drying of the clayey soil probably will produce swelling clay problems like those that trouble the northern part of Pueblo where clayey foundation materials lie at the ground surface.

Small ridges lie north and east of Lake Minnequa. Drill holes (see profile F-F') show that the Niobrara Formation lies only 8-10 feet, or possibly a little deeper, beneath the crests of the ridges. Thus, the buried valley narrows where it cuts through these ridges of bedrock and apparently has only one outlet, which is near the junction of Lake and Minnequa Avenues. This outlet is closed by the dam that forms Lake Minnequa.

North of the ridges is a broad high terrace cut by the Arkansas River and covered by as much as 26 feet of gravel deposited by the Arkansas River. This gravel is overlain by wind-blown sand that is locally more than 20 feet thick.

Hydrology of the Lake Minnequa area

Water apparently flows slowly but perennially northeastward along the buried valley in which Lake Minnequa is located. The source of the water is the Minnequa Canal which brings water from the Arkansas River, and the St. Charles Flood Ditch which brings water from the St. Charles River (south and east of map area). The water flows through two large reservoirs (St. Charles Reservoirs Nos. 2 and 3), which dam the valley of Salt Creek. The two reservoirs raise the water table to near ground surface over a width of nearly 2 miles as shown by a dark pattern interpreted as marsh grass and sedge on aerial photographs. Northward from St. Charles Reservoir No. 2, the width of intermittently wet ground supporting marsh grass remains 1 1/2 mileswide or more all the way to Lake Minnequa. The water table apparently is sufficiently high to permit the water to migrate westward out of the channel of Salt Creek and northward into the previously described buried valley (location and depth should be tested by drilling) that contains Lake Minnequa at its north end. The flow of water in this buried valley apparently is constricted at its north end by the bedrock ridge described in the section on geology, and the water table consequently is held at or near the ground surface over a large area adjacent to Lake Minnequa. The destination of the water that flows out of Lake Minnequa is unknown; however, if it is not channeled into pipes, it most likely spreads out in the gravel on the high terrace cut by the Arkansas River.

Another cause of the high water table near Lake Minnequa is a diversion ditch which carries water directly from St. Charles Reservoir No. 2 to Lake Minnequa. Seepage from this ditch and spreading of water from Lake Minnequa would contribute to a high water table whether or not subsurface flow emanated from St. Charles Reservoir No. 2.

Problem of high water table near Lake Minnequa
and its possible solution

A high water table in the low area near Lake Minnequa is causing trouble to home owners. Two alternatives seem to be available that would prevent further hazard from the use of the marshy ground near Lake Minnequa as the site for buildings. One alternative involves the permanent lowering of the water table so that water (the chief cause of most foundation problems) is no longer in contact with any part of a foundation. Some hazard is inherent in the withdrawal of water, for the clayey soil almost certainly will shrink differentially as it dries and some damage to foundations may result from the shrinkage.

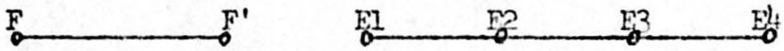
Correction of the marshy condition could be accomplished by several means. The cost probably would be the lowest if Lake Minnequa were drained. A quick lowering of the water table would result from the draining of Lake Minnequa, deepening of its outlet so that the buried valley upstream from it would drain more readily, discontinuance of use of the diversion ditch leading into Lake Minnequa, and establishment of a cutoff trench or of tile drains backfilled with pervious material and laid on bedrock (probably in sec. 26, T. 21 S., R. 65 W.) so that water from St. Charles Reservoir No. 2 could not enter the buried valley that leads northward to Lake Minnequa. A noncorrodible drain is recommended because of the corrosive nature of the sodium sulfate in the soil and ground water.

If Lake Minnequa is to be retained, then corrective measures are expected to be more expensive, and possibly less effective. Spreading of water from Lake Minnequa and seepage from the diversion ditch would produce enough water to cause a high water table unless a well field or a cutoff trench or tile drain system was established adjacent to the south end of Lake Minnequa. The disposal of the water thus withdrawn probably would be a difficult problem, for, in this area, Salt Creek lies to the east of many formidable obstacles, including Interstate Highway 25, two railroads, and the Colorado Fuel and Iron Corp. plant and its slag dump and rail lines. Although a well field or cutoff trench immediately to the south of Lake Minnequa probably would lower the water table in sec. 14, T. 21 S., R. 65 W., it would not lower it in the south end of the valley in secs. 23 and 26, T. 21 S., R. 65 W., and another cutoff trench or tile drain laid on bedrock would also be required there to prevent underflow water from entering the south end of the buried valley. Lining with bentonite of the diversion ditch from St. Charles Reservoir No. 2 to Lake Minnequa would reduce seepage from the ditch to the ground water.

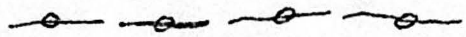
The second alternative involves restrictive zoning so that no further building will be permitted on any land classified as marshy and hazardous by Pueblo County. This solution would permit retention of the marshy valley and the lake as a park, and, in addition, preserve the status of the lake as a flood retention structure and allow unchecked local flood flow (also spillover from Salt Creek) to follow the valley into the lake.

EXPLANATION

For explanation of most geologic symbols on map see U.S. Geological Survey Map I-597--Geologic Map of the Southwest and Southeast Pueblo Quadrangles, Colorado.

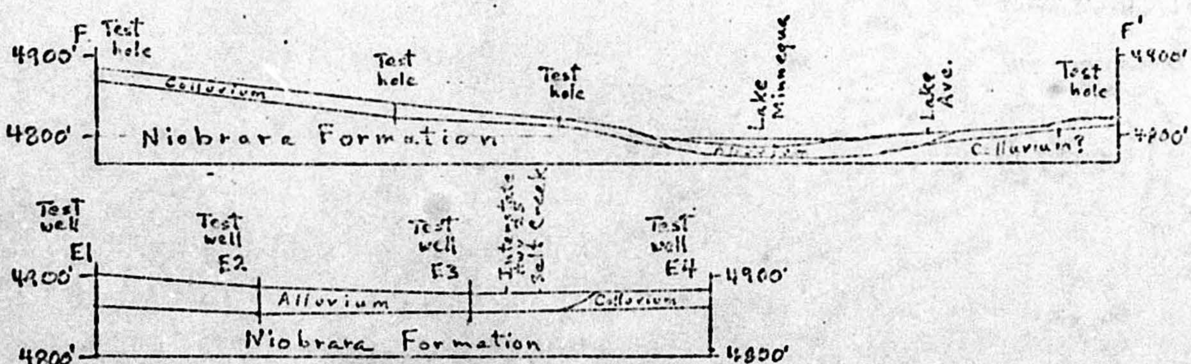


Line of cross section



Inferred boundary of water-logged area

The water-logged area has a water table potentially within about 6 feet of surface. Altitude of water table fluctuates both seasonally and annually as a result of fluctuations in precipitation and owing to seepage or underflow from irrigation canals and reservoirs. Some areas are perennially marshy. Alkali (sodium sulfate?) locally is concentrated at surface. In alkali-rich areas, type 2 or type 5 cement should be used in all concrete exposed to soil or water. Map scale 1:24,000 or 1 inch=2,000 feet.



Cross sections across Lake Minnequa and valley of Salt Creek. Lines of sections shown on geologic map. Test well information from McGovern and others (1964). Vertical exaggeration X8.