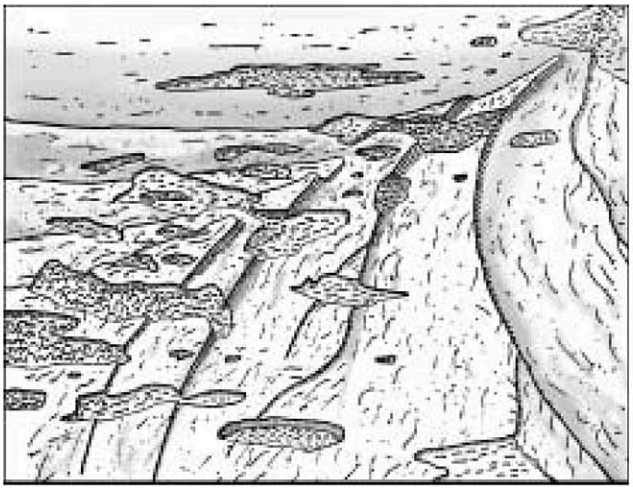
C.



LAKE SEDIMENT AND LANDFORMS

Pleistocene lakes

On plate 1, map unit **on** indicates the location of several nearly flat, low-lying plains interpreted to be the sites of nonglacial lakes that existed near the close of the Wisconsin Glaciation. They are typically 0.5 to 1 km across; most are in the southern half of the county and are in or near the Kettle Moraine. The offshore sediment, especially of the smaller ones, is largely sand.

These lake plains occupy basins that resulted from the melting of masses of glacial ice that had been buried in meltwater-stream sediment. The plains lack the hummocky topography of the surrounding collapsed supraglacial stream sediment (map unit **sc**), indicating either that the topography has been flattened by wave action and by deposition of offshore sediment or that knobs were lacking from the start because the ice masses had too little stream sediment on them to produce hummocky topography.

Most of the areas mapped as unit **on** in and near the Kettle Moraine have basins that lack obvious outlet channels. This indicates that lake level fell because the water table was lowered rather than because an outlet was cut down to the level of the lake bottom. If the water table was lowered as a result of the melting of permafrost in the region, these lakes disappeared roughly 13,000 BP (fig. 7).

Lake Scuppernong

Glacial Lake Scuppernong is here so named because it occupied the valley of Scuppernong River in southwestern Waukesha County and adjacent areas. Evidence for the lake includes large areas of laminated silt and clay deposited offshore in the deeper basins of the lake (shown by map unit **ou,** plate 1). Offshore sediment is exposed in drainage ditches across the area. Clay is commonly mentioned in well constructor's reports; a report for a Wisconsin Department of Transportation bridge boring where Highway 135 crosses Mud Creek, 4 km northwest of Palmyra, identified more than 25 m of clay and silty clay.

The extent of Lake Scuppernong, however, is obscure because its beaches are poorly preserved. Those that were identified are shown by a dotted line symbol on plate 1. The most conspicuous series of Scuppernong beaches is at the east edge of an outwash delta east of Beaver Dam Lake, in the southwestern Waukesha County. Several probable beaches can be seen on aerial photographs at an elevation of approximately 265 m (870 ft) in secs. 5 and 7, T5N, R17E.

Beaches have been identified through only a short north–south distance, and they probably can be found at more than one elevation in any area. As a result, it is unclear if the beaches are horizontal or have been tilted by rebound of the Earth's crust when the weight of the ice sheet was removed. If, however, a reasonable rate of rebound is extrapolated from the area of glacial Lake Wisconsin (Clayton and Attig, 1989, p. 27–35), and if the glacier had melted from the area, and if the rock sill at the Janesville outlet had not yet been deeply en-

trenched, the lake would have covered approximately the area shown in figure 19.

Segments of such a lake, covering most of Jefferson County and parts of adjacent counties, have been previously recognized. Alden (1904, p. 64, 1918, p. 289 and plate 1) noted evidence for glacial lakes in this area, but he apparently visualized a lower-level lake or a series of several smaller lakes. Hypothetical Lake Scuppernong, as reconstructed in figure 19, was at about the same level as glacial Lake Yahara in central Dane County (Mickelson, 1983, p. 18–21); Lake Yahara may have flowed into Lake Scuppernong, or it may have been part of the same lake. Several paleontological sites in the middle of the area shown in figure 19, with bones of mastodon, giant beaver, and other mammals, are in clay interpreted to be offshore sediment; this sediment was probably deposited in Lake Scuppernong (West and Dallman, 1980, p. 27–32).

As the Green Bay Lobe began to waste back from the Kettle Moraine, early versions of Lake Scuppernong must have formed between the ice and the Kettle Moraine. They may have overflowed to the southwest through unknown outlets in southern Jefferson County and northern Rock County.

Once the ice had wasted back to what is now Fort Atkinson, in southwestern Jefferson County, Lake Scuppernong had to drain through the Rock River. The narrowest part of the Rock River trench is in central Rock County (fig. 19). The level of Lake Scuppernong was probably maintained by a sill of Ordovician dolomite in Riverside Park on the northwestern edge of Janesville (north part of sec. 23, T3N, R12E).

Lake Scuppernong persisted at lower and lower levels as the sill was eroded. At first it was a glacial lake, with ice along its northern shore and later with glacial meltwater rivers flowing into its north end. Once the glacier had wasted back into the Lake Winnebago basin for the last time, around 12,000 BP, no more meltwater entered the lake. According to West and Dallman (1980, p. 27–32), radiocarbon dates indicate that the lake at the paleontological sites mentioned above persisted until the early Holocene, at least until 9,000 BP. On the other hand, ice-wedge polygons are evident on a part of the bed of Lake Scuppernong that had been left dry when the lake receded to the extent shown in figure 19; this indicates that the lake had drained from at least this area by about 13,000 BP, when the last permafrost melted from the region (Attig and Clayton, 1992). In figure 7, the eastern extent of Lake Scuppernong is shown to recede through time as the Janesville outlet eroded down through the dolomite sill.

Pewaukee Lake

Pewaukee Lake, which is 7 km long, is the largest lake existing today in Waukesha County. It now drains eastward out the Pewaukee River (**p,** fig. 20). Earlier, when the Lake Michigan Lobe blocked its eastern end, Pewaukee Lake drained out higher outlets to the west (fig. 7). Few beaches remain, but the lake-level history can be reconstructed from outlet elevations and ice-margin positions.

Just after the Lake Michigan Lobe melted back from the Kettle Moraine, a small early version of Pewaukee Lake drained westward down the Naga–Waukee channel, through outlet **a** in figure 20, which cut through the moraine across the head of the channel. The shoreline, if still preserved, should be at an elevation of about 297 m (975 ft); its hypothetical location is shown with short dashes in figure 20. The lake persisted at this level until the glacier melted back to ice-margin **w** in figure 20.

With further ice-marginal recession, the lake could begin to drain through outlet **b** (fig. 20); a small alluvial fan was built on the outwash terrace at the mouth of this outlet (just east of the middle of sec. 10, T7N, R18E). The corresponding hypothetical shoreline should

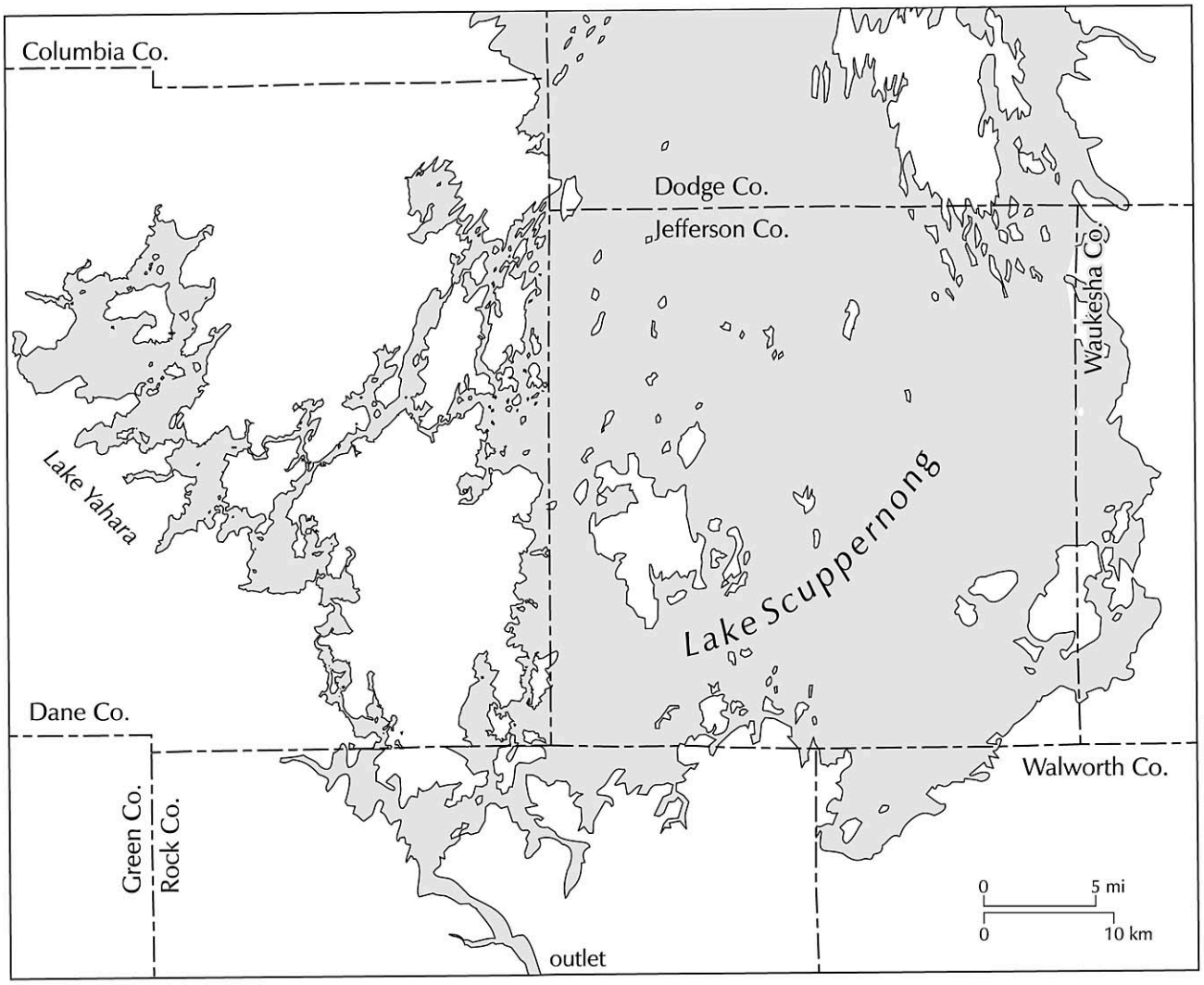


Figure 19. Hypothetical extent of glacial Lake Scuppernong, assuming crustal rebound of 0.13 m/km to the north–northeast, and assuming the glacier had receded northward from the area before the rock sill in the outlet in central Rock County had been substantially entrenched.

be at an elevation of about 290 m (951 ft), shown with a dash-and-dot line in figure 20. The beach shown on plate 1 near the southwest corner of sec. 17, T7N, R18E, is near this level.

The lake persisted at this level until a lower outlet was uncovered as the glacier receded. A low spot in the present drainage divide (at **c**, fig. 20) is at an elevation of about 285 m (935 ft). This could have been an outlet for Pewaukee Lake after the glacier wasted back from ice margin **x** in figure 20. However, there is no evidence that water ever flowed across this divide; apparently there was enough buried stagnant glacial ice here to prevent water draining this way. The lake had to stay at level **b** until the glacier wasted back to ice-margin **y** (fig. 20).

At that time, the lake dropped to the level of outlet **d** (into Pebble Creek), at an elevation of about 270 m (886 ft). The lake must have stayed at this level, shown with long dashes in figure 20, until the glacier wasted back to ice-margin **z**. Soon after, the lake dropped to near its present level, when it began to drain down the Pewaukee River (**p,** fig. 20).

Lake Vernon

Another glacial lake, here called Lake Vernon

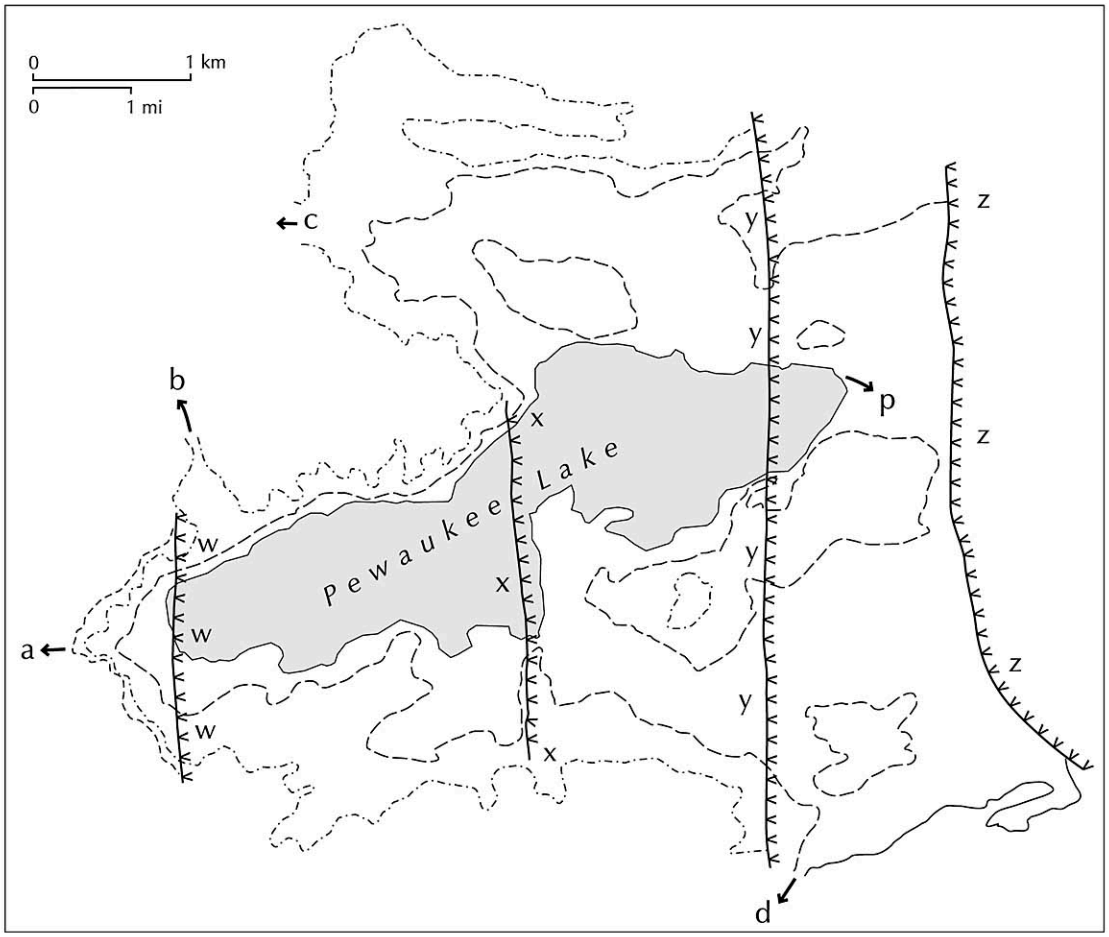


Figure 20. Glacial Pewaukee Lake. Letters on figure are explained in text.

after Vernon Marsh and Vernon Township, occupied the Fox River lowland in the south-central part of the county (fig. 21). The lake came into existence as the Lake Michigan Lobe wasted eastward across the county. During much of its existence, the lake apparently drained southward from its southwestern arm (**a,** fig. 21). The outlet was southeastward of the northeastern end of Lake Beulah, in Walworth County, at an elevation of about 250 m. It drained to the Honey Creek valley, and then to the lower Fox River valley in Racine County. Evidence for this lake includes delta foreset faces southwest of Waukesha (plate 1). The first phase of Lake Vernon persisted until the glacier melted back to expose the Fox River trench at the south edge of the village of Big Bend, allowing the lake to drain (**b,** fig. 21).

The second phase of Lake Vernon occurred when the glacier briefly readvanced into the county and deposited the till of the Oak Creek Formation (fig. 7). The glacier blocked the Fox River trench near Waterford in Racine County (D.M. Mickelson, University of Wisconsin–Madison, Department of Geology and Geophysics, verbal communication, 1992), causing Lake Vernon to refill. Its outlet was in the SW¼ sec. 17, T4N, R19E, northwest of Waterford (**c,** fig. 21); it was a few meters lower than the first-phase outlet southeast of Lake Beulah. The delta at the village of Big Bend may have formed at this time.

Other glacial lakes

Other smaller areas of proglacial lake sediment are scattered around the county (map units **ou** and **oc**), and several areas of offshore sediment deposited in ice-walled lakes are found in the southeastern part of the county (map unit **oi**).

The ice-walled-lake plains typically are 0.5 to 1 km wide, are a few meters above the surrounding till plain, and are composed of offshore silt and clay.

Holocene lakes

The lakes of Waukesha County have changed little since they formed at the end of the Wisconsin Glaciation. Most were originally floored with glacial-lake sediment, meltwater-stream sediment, or till. Since their inception, they have gradually infilled with sand near shore and around stream mouths and with silt, clay, and marl farther off shore. Some lakes and ponds have been completely filled with sediment, or the water level dropped and exposed the lake floor; the resulting lake plains are generally covered with a thin layer of peat (map unit **op**).

During agricultural-lime investigations in the mid-1930s, several dozen holes were augered in exposed bottoms of former lakes in Waukesha County (unpublished reports in WGNHS files). Typically, 1 to 3 m of peat overlies silt, clay, marl, or sand. In some places, more than 4 m of marl is present, much of it reported to be approximately 80 percent calcium carbonate equivalent.

Early in this century, marl was mined from a former lake bed 6 km north of Eagle, in the SW¼ SE¼ sec. 34, T6N, R17E and the NW¼ NE¼ sec. 3, T5N, R17N (Steidtmann, 1924, p. 145–146). The abandoned main pit is 0.5 km long and about 20 m wide. The lake bed is 1 km wide and is shown covered with peat and surrounded by a beach ridge on plate 1 (map unit **op** and symbol).

Muskego Lake, in the southeast part of the county, is shown on plate 1 surrounded by peat-covered lake sediment, which is bordered by a shoreline. This was shown as the shoreline of the existing lake on the public land survey map of the area dated 1836. A ditch was later dug to lower the outlet.

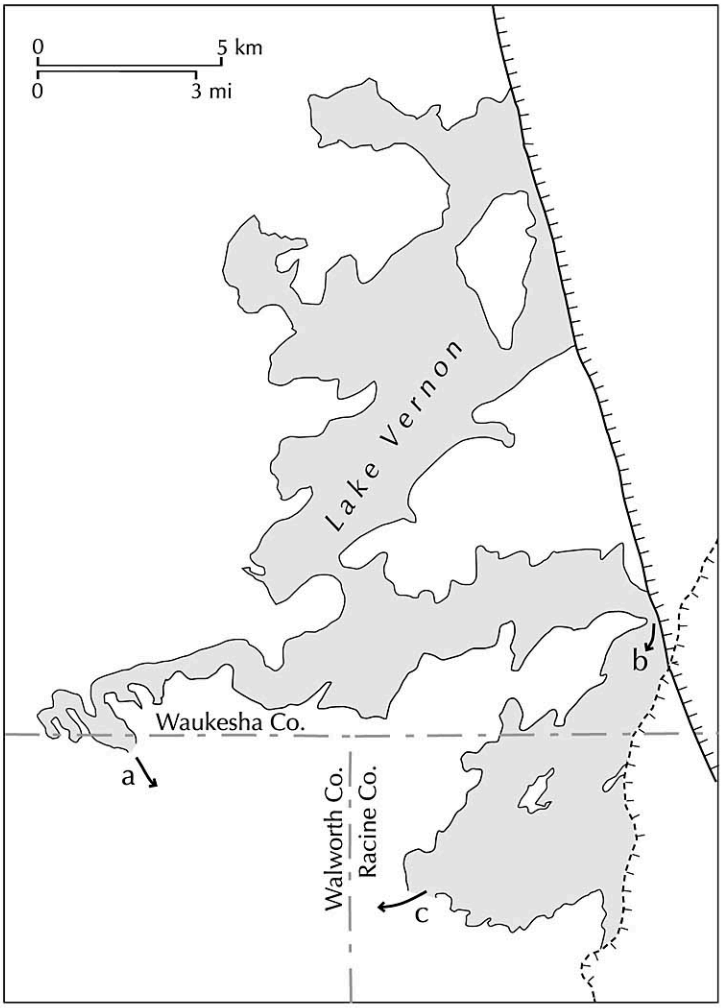


Figure 21. Glacial Lake Vernon. When ice terminated west of the solid line with hachures (shown in detail in fig. 23E), the outlet was at **a.** When the ice terminated at the solid line, the outlet was at **b.** When the ice terminated at the dashed line with hachures (shown in detail in fig. 23G), an extra bay was added in Racine County, and the outlet was at **c.**

WINDBLOWN SEDIMENT

No windblown sediment is shown on plate 1 because it is too sparse to map. Some windblown sand is on the sand plains in places in the western half of the county, but it is generally less than 1 m thick.

Windblown silt is more widespread. According to Steingraeber and Reynolds (1971), the less-eroded areas of till of the Oak Creek Formation are overlain by about 0.3 m of silty material; the till of the Holy Hill Formation is