REGIONAL FLOOD LIMITS OF LOWER YAHARA RIVER, LAKE WAUBESA AND SOUTH IN DANE COUNTY, WISCONSIN

by C. L. Lawrence

Purpose and Scope

The purpose of this report is to provide information on the extent, depth, and frequency of flooding of the lower Yahara River in Dane County, Wis.

The report contains discharge-frequency data for flood peaks, flood-frequency profiles, and the regional flood- (100-year flood) inundation limits for the lower Yahara River. The study reach is in southern Dane County extending from part of the shoreline of Lake Waubesa downstream through Lake Kegonsa to the Dane-Rock County line. Specifically the parts of the shoreline of Lake Waubesa included are those in and south of section 8, T. 6 N., R. 10 E. on the west shore and the south half of section 34, T. 7 N., R. 10 E. on the east shore. (See figure 2.) The reach is 21 river miles (34 km) long.

The Wisconsin Legislature has enacted flood-plain-zoning legislation (1965) to encourage economic use of flood plains and to minimize flood losses. This act gave counties, cities, and villages the responsibility of enacting, administering, and enforcing reasonable and effective flood-plain regulations.

This report is a sequel to earlier reports by Lawrence and Holmstrom (1971) and Holmstrom and Lawrence (1971). The earlier reports provided much of the same information, but the scale of the maps defining limits of flooding was much smaller. This report, using orthophotographs at a scale of 1 in = 400 ft, provides greater detail.

The report is based on conditions existing in 1971. All elevations are referenced to mean sea level, datum of 1929.

Figure 1 shows the location and extent of the Yahara in Dane County. It also shows the orientation of the 13 orthophotographs within the lower Yahara River basin.

Table 1 gives factors for converting English units, as used in the report, to International System (SI) units.

Table 1.--Factors for converting English units to International System (SI) units

Multiply English units	By	To obtain SI units
feet (ft)	0.3048	meters (m)
miles (mi)	1.609	kilometers (km)
square miles (mi^2)	2.590	square kilometers (km^2)
cubic feet per second (ft^3/s)	.02832	cubic meters per second (m^3/s)

Cooperation and Acknowledgments

This report was prepared by the U.S. Geological Survey in cooperation with the Dane County Regional Planning Commission. The 10-, 50-, and 500-year flood profiles were developed for a flood-insurance study that was prepared for the Federal Insurance Administration, U.S. Department of Housing and Urban Development. Some information contained in this report came from the following other sources: the Wisconsin Department of Natural Resources, the Dane County Parks Department, the Stoughton Electric Utility, and local residents. Their helpfulness is appreciated. The orthophotographs were prepared by Hansa Engineering Corporation, San Francisco, Calif., under a contract with the U.S. Geological Survey.

Peak Flood Discharges

The flood-frequency profiles in this report represent the water-surface elevations expected to be caused by flood discharges having average recurrence intervals of once in 10, 50, 100, and 500 years. For example, a 100-year flood discharge will occur on the average once every 100 years. Also, there is one chance in 100 that the 100-year flood discharge will occur in any given year.

Discharge-frequency estimates were determined in part from a statistical analysis of the streamflow records observed at the Yahara River at McFarland gaging station. The gaging station, which has been in operation since 1930, is located just downstream from the low lock and dam at the outlet of Lake Waubesa. Using the log-Pearson Type III distribution and station skew, the statistical analysis of the observed annual peak discharge values provided estimates of 2-, 5-, 10-, 25-, 50-, and 100-year peak flood discharges. Discharges defined by this method were plotted on log-normal probability paper and the curve defined by these points extended to give the 500-year peak flood discharge. Discharge-frequency estimates for other locations in the study reach were made on a drainage area ratio basis considering the effects of storage.

The computed flood discharges were reviewed by the Wisconsin Department of Natural Resources, Bureau of Water and Shoreland Management. Flood discharges used in this study are presented in table 2.

Table 2.--Discharge-frequency data for selected sites in lower Yahara River

Location	Drainage area (mi^2)	Frequency (years)	Discharge (ft^3/s)
U.S. Highway 51 at outlet of Lake Waubesa (gaging station no. 05429500)	327	10	615
		50	790
		100	860
		500	1,020
Fourth Street bridge at Stoughton	410	10	690
		50	880
		100	960
		500	1,140

Flood-Frequency Profiles

The 10-, 50-, 100-, and 500-year flood-frequency profiles (fig. 3) for the reach downstream from Lake Kegonsa were computed by the standard step method (Chow, 1959, p. 265) using a digital-computer model. Input to the computer model was stream valley and bridge geometry, surface roughness, and peak discharge data. Effects of dams on flood elevations in the study reach also were evaluated.

Profiles for the reach upstream from Lake Kegonsa were determined using statistical analysis of long records of stage on Lake Monona, adjusted to Lake Waubesa, and at the gaging station on the Yahara River at McFarland. Flood profiles between the McFarland gage and Lake Kegonsa, where the elevation change is small, were estimated on the basis of topographic characteristics and field observations.

The normal low-water profile, as shown in figure 3, is based on "normal" elevations at the major lakes, as legally set by the Wisconsin Department of Natural Resources. Downstream from Lake Kegonsa this profile is based on normal operation level of the pools above the three small power installations at Stebbinsville, Dunkirk, and Stoughton Dams. These dams have not been used for power production since 1974 and the pool above Dunkirk has been drained most of the time since, pending repairs.

The channel thalweg is the line joining points of greatest depth in successive cross sections.

Geometry of the stream valley is represented by cross sections in figure 4. The full extent of the surveyed cross sections shown were not necessarily used in the model, and in a few cases additional points not shown were estimated from available maps and used in the model. Interpretations were made to consider probable flow pattern or conveyance at each cross section. Roughness characteristics were expressed in terms of Manning's "n" values (Chow, 1959, p. 99), estimated during field inspection.

Flood-Inundation Limits

The flood-plain limits for the regional (100-year) flood are shown in figure 2, which consists of orthophotographs at a scale of 1 in = 400 ft (1:4800). Two-foot (0.6-m) contours are shown in a range that overlaps the elevation of the regional flood along with other relevant information.

In all cases the flood limits shown are based on flood elevations of the Yahara River. Tributary streams may produce more extensive flooding in their own valleys than that shown in the photographs in this report. No attempt was made to account for this in drawing the inundation limits.

The flood-plain limits and flood profiles in this report do not represent the most severe flooding that could occur in the study reach; both the regional-flood discharge and the 500-year flood discharge could be exceeded. Also bridges or dams plugged with ice or debris can cause flood stages higher than for unobstructed flow conditions.

Vertical Control

Descriptions of bench marks and other points of known elevation used in this study are presented in table 3. Locations of these points are shown on the orthophotographs.

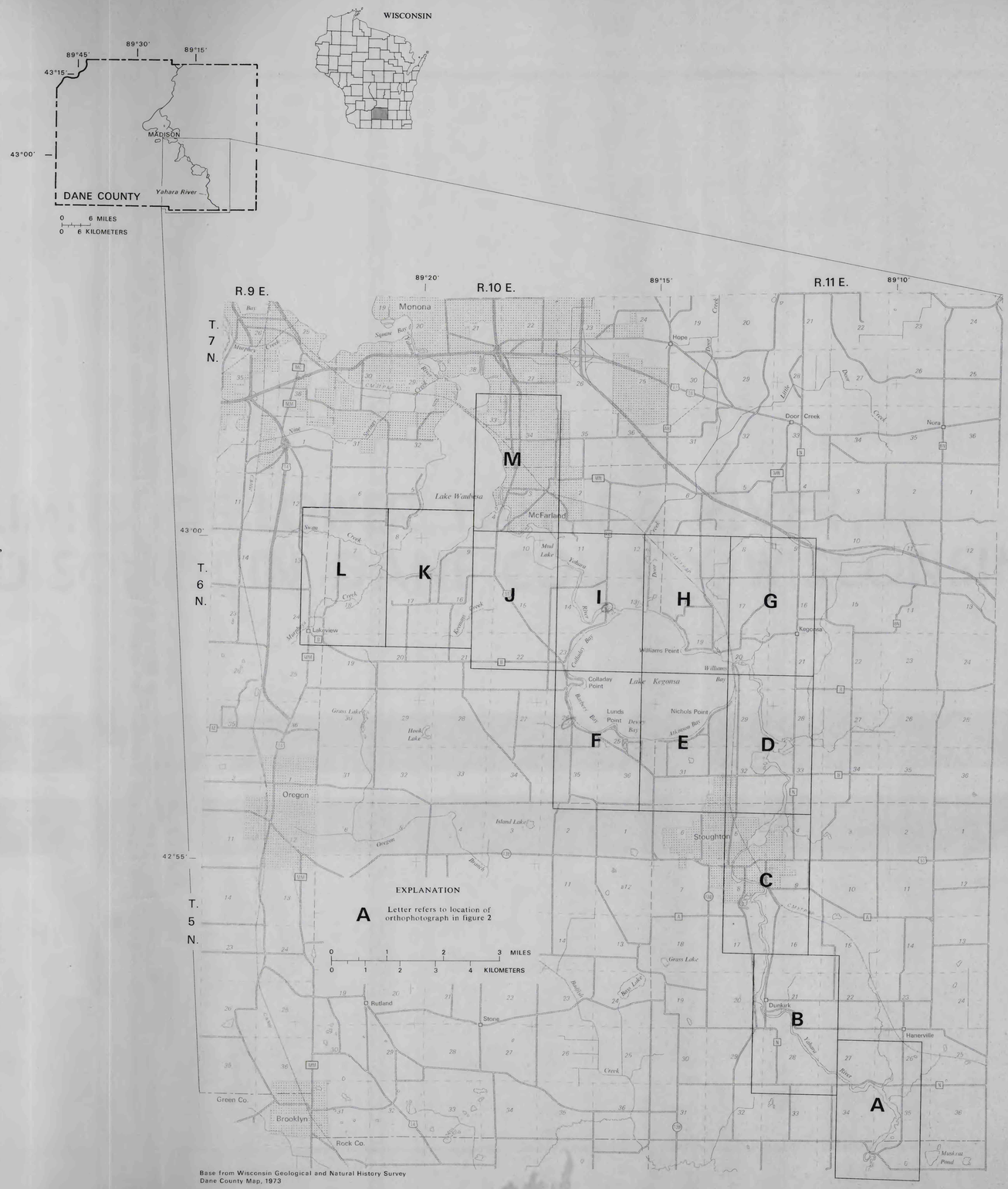
References Cited

Chow, V. T., 1959, Open channel hydraulics: New York, McGraw-Hill, 621 p.

Holmstrom, B. K., and Lawrence, C. L., 1971, Floods on Yahara River, Lake Mendota to Lake Kegonsa, Dane County, Wisconsin: U.S. Geol. Survey open-file rept., 12 p.

Lawrence, C. L., and Holmstrom, B. K., 1971, Floods on Yahara River, Lake Kegonsa Dam to county line, Dane County, Wisconsin: U.S. Geol. Survey open-file rept., 10 p.

Wisconsin Legislature, 1965, Senate Bill 620 in Water Resources Act, Chapter 614, Laws of 1965: Madison, Wis., Dept. of Resource Development, 26 p.



Base from Wisconsin Geological and Natural History Survey Dane County Map, 1973

FIGURE 1. LOCATION AND EXTENT OF STUDY AREA