Stage Fluctuations

of Wisconsin Lakes

By Leo B. House
U.S. Geological Survey

PREPARED BY
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

IN COOPERATION WITH
UNIVERSITY OF WISCONSIN-EXTENSION
WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

Stage Fluctuations of Wisconsin Lakes

By Leo B. House
U.S. Geological Survey

This report is a product of the Geological and Natural History Survey Water Resources Program which includes: systematic collection, analysis, and cataloguing of basic water data; impartial research and investigation of Wisconsin's water resources and water problems; publication of technical and popular reports and maps; and public service and information.

CONTENTS

ILLUSTRATIONS

TABLES

CONVERSION TABLE

Multiply inch-pound unit	By	To obtain SI (metric) unit
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi²)	2.59	square kilometer (km²)

Stage Fluctuations of Wisconsin Lakes

By Leo B. House
U.S. Geological Survey

ABSTRACT

This report describes lake-stage fluctuations of
83 gaged lakes in Wisconsin and presents techniques
for estimating stage fluctuation at ungaged lakes.
Included are stage information at 83 lakes and
stage-frequency data for 32 of these lakes that had
sufficient record for analysis.

Lakes are classified by a hydrologic-topographic lake classification scheme as ground-water flow-through (GWF) lakes, surface-water drainage (SWD) lakes, and surface-water flow-through (SWF) lakes. Lakes within the same class were found to have similar water-level fluctuations. The lake-stage records indicate that most annual maximums occur during the months of May and June for all three classes. Annual minimum lake levels generally occur in September for surface-water drainage lakes, in March for surface-water flow-through lakes, and in November for ground-water flow-through lakes.

Data for each lake include location, period of water-level record, hydrologic classification, drainage area, surface area, lake volume, maximum depth, long-term mean stage and its standard deviation, maximum and minimum observed lake stage, and the average annual lake-stage fluctuation.

Stage-frequency analysis was performed for 32 lakes that have long-term records. Analysis includes maximum and minimum stage estimates for the 2-, 5-, 10-, 20-, 50-, and 100-year recurrence intervals. Estimates of the annual stage fluctuation for the same recurrence intervals also are provided. An analysis of stage fluctuation-probability curves for each lake class show that there is a 50 percent probability that a SWF lake's average annual stage fluctuation will exceed 1.5 feet, GWF lakes will exceed 1.1 feet, and SWD lakes will exceed 0.8 feet.

Equations were developed to estimate the average annual stage fluctuations for ungaged lakes. Due to the variability in lake-level characteristics, equations were determined for each of four geographic zones within the State. The equations were determined from multiple-regression analyses that relate stage-fluctuation data at lake gaging stations to their lake and drainage basin characteristics. Drainage area, lake surface area, maximum depth, relative depth, and drainage area to surface area ratio were the most significant characteristics in explaining the stage fluctuation for ungaged lakes. The average error of estimate equations were: 25.6 percent for the southern zone; 27.9 percent for the northeastern zone; 31.8 percent for the northwestern zone; and 40.5 percent for the central zone.

INTRODUCTION

Background

Lake-level fluctuations are important to lake-district managers, lakeshore property owners, developers, and recreational users. During drought, a lake's shoreline may retreat lakewards beyond the reach of piers and boat launching ramps. During periods of above-normal precipitation, lakes may extend their shorelines and flood lakeside dwellings. The range of lake stage that can be expected is needed to make proper management decisions. There are no stage records available for most lakes in Wisconsin, and methods are needed to estimate stage fluctuations that do not rely on observed stage records.

A hydrologic-topographic lake classification scheme is outlined in this report. Wisconsin lakes can be differentiated into three classes with this scheme. This classification scheme grouping is the basis for the stage-fluctuation analysis presented in the report.

The study was conducted in cooperation with the Wisconsin Geological and Natural History Survey. The first year of the 5-year project was conducted in cooperation with the Wisconsin Department of Natural Resources.

Purpose and Scope

This report presents lake-stage fluctuation data for 83 gaged Wisconsin lakes and describes methods for estimating stage fluctuations at ungaged lakes. Generalized stage fluctuation-probability curves are presented in Appendix I. Appendix II presents two techniques to estimate stage fluctuations for un-gaged lakes: One is comparison with observed fluctuation values on nearby gaged lakes and the other is regression equations to predict average annual fluctuations at ungaged lakes. Both methods can be used to obtain an average estimate.

Lake levels were measured in 97 Wisconsin lakes (fig. 1) that have periods of record ranging from 1 to 98 years. Of the 97 lakes, 83 have sufficient records for use in analysis for this report. Fourteen lakes were measured for 1 year, 32 lakes had records of more than 8 years, and 23 lakes had records of more than 20 years. Lake Winnebago

had the longest period of record, 98 years, from July 1882 through December 1979.

Methods of Study

The 83 lakes were grouped for statistical analysis according to a scheme derived from the classification system developed by Born, Smith, and Stephenson (1974) as either: (1) Ground-water flow-through (GWF); (2) surface-water drainage (SWD); or (3) surface-water flow-through (SWF). Statistical analysis of long-term records provided estimates of stage duration and fluctuation probability.

The stage fluctuation-probability curves were developed to estimate the magnitude and likelihood of annual water-level fluctuations for lakes where no long-term water-level records exist. These curves are presented in Appendix I.

Regression analysis of data from 32 study lakes was used to define a method for predicting the average annual fluctuation of lakes lacking sufficient stage data for statistical analysis. The equations developed from the analysis relate physical characteristics of a lake to its average annual water-level fluctuation. The equations are presented in Appendix II.

Acknowledgments

The author wishes to acknowledge the work of Richard P. Novitzki (U.S. Geological Survey) who began this project and Dennis A. Wentz (U.S. Geological Survey) who contributed greatly to the statistical analyses.

HYDROLOGIC-TOPOGRAPHIC CLASSIFICATION OF LAKES

Each of the 83 lakes presented in this report was classified into one of three general hydrologic groups: (1) Ground-water flow-through lakes (GWF); (2) surface-water drainage lakes (SWD); and (3) surface-water flow-through lakes (SWF). These general classes were derived from a classification scheme proposed by Born, Smith, and Stephenson (1974), and provide a ready means of defining the hydrologic class of a lake from inspection of a U.S. Geological Survey 15- or 7½-minute topographic map.
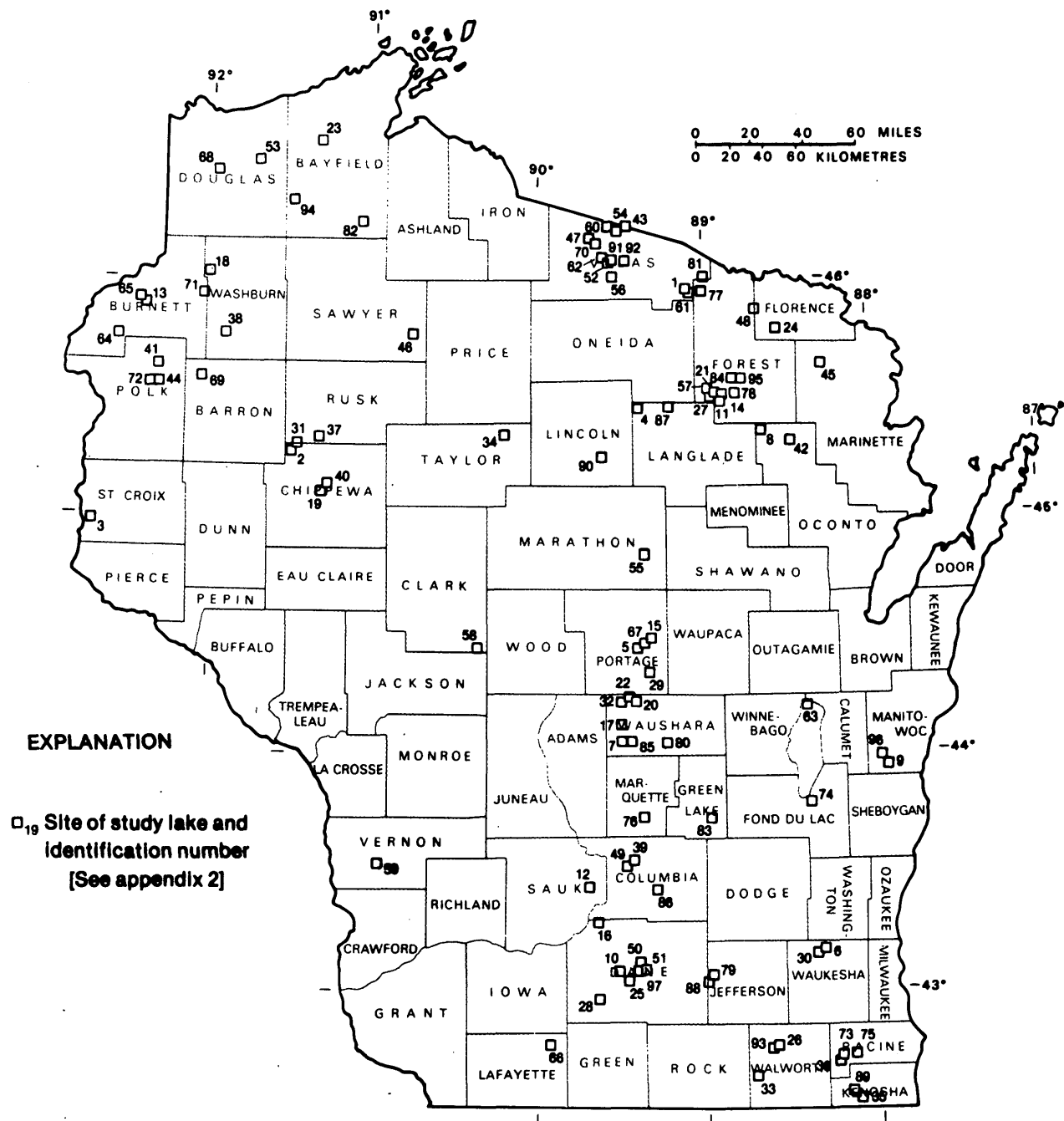
Figure 1. Location of Wisconsin lakes included in study.

Figure 2 shows examples of the three lake classes as they appear on a U.S. Geological Survey topographic map. Ground-water flow-through lakes have no continuous outlet stream, although they may have an inflow stream. Surface-water drainage lakes have a continuously flowing outlet stream, and have small or no inflow streams. Streams draining a marsh adjacent to the lake are not considered significant to classification. Surface-water flow-through lakes have perennial inflow and outflow streams.

Ground-Water Flow-Through (GWF) Lakes

The class "ground-water flow-through (GWF) lakes" consists of lakes fed by direct precipitation and ground water. Some subgrouping of these lakes should be recognized, however. Figure 3 shows the three major subgroups of GWF lakes, based on their relationship to the local water table and related ground-water flow paths.

Lakes of the discharge lake subgroup depicted in figure 3a commonly have the smallest range in water-level fluctuations of the GWF lake class. These lakes tend to be located in lowland areas and have a relatively constant source of ground-water inflow.

The recharge lakes, fig. 3b, are also known as "mounded" lakes because they create a mound in the local water table. Recharge lakes have the greatest range in water-level fluctuations because their primary sources of inflow are direct precipitation and runoff from the adjacent land surfaces. During severe drought conditions, a recharge lake may dry up. Recharge lakes are typically located at higher elevations and receive little ground-water inflow.

Lakes of the flow-through subgroup (fig. 3c) are fed primarily from ground-water inflow and from direct precipitation. Water leaves the lake by evapotranspiration and as ground-water outflow. There is no continuously flowing surface-water outlet. Fluctuations in lake levels have a small range, reflecting the influence of stable ground-water inflow; however, spring snowmelt or intense rainstorms can quickly raise the level of a GWF lake because there is no surface outlet. At high lake stages, surface-water outflow may occur, but will cease when the stage drops below the outlet level.

Surface-Water Drainage (SWD) Lakes

Surface-water drainage lakes (SWD) are fed primarily by ground-water inflow and direct precipitation. These lakes have small or no inflow stream. However, by definition, they have a continuously flowing outlet stream. The ground-water flow paths depicted in figure 3 for GWF lakes are the same as those for SWD lakes. Influences of local geology and topography determine the hydrologic situation of a lake.

Because these lakes have a surface-water outlet, the lake level cannot rise much above the outlet level. These lakes also typically have bottom elevations below the local water table. Therefore, lake-level fluctuations are generally not as large as those of GWF lakes.

Many surface-water drainage lakes in Wisconsin have been modified by constructing a dam or water-level control structure at their outlet. Lake-level fluctuations of such modified SWD lakes would more closely approximate those of GWF lakes with no surface outlet. However, these outlet-controlled lakes are still considered to be SWD class lakes due to their significant surface-water outflow.

At some SWD lakes, the outlet channel has been deepened to drain surrounding wetlands or to convey flood flows. This results in lower lake stages than would otherwise occur. Such lakes will have a smaller rise in level due to spring snowmelt or storm runoff because the excess water quickly leaves the lake through the deepened outlet channel.

Surface-Water Flow-Through (SWF) Lakes

Surface-water flow-through (SWF) lakes have perennial inflow, and outflow streams and are fed primarily by surface-water inflow, although ground-water flow and direct precipitation also contribute. SWF lakes tend to have larger water-surface areas and drainage basins than do GWF and SWD lakes. Surface-water flow-through lakes are typified by the many "chain-of-lakes" systems in northeastern Wisconsin.

Because surface-water flow-through lakes have a continuous source of inflow, they do not dry up as GWF lakes occasionally do. Because they have a

Ground-water flow-through lake
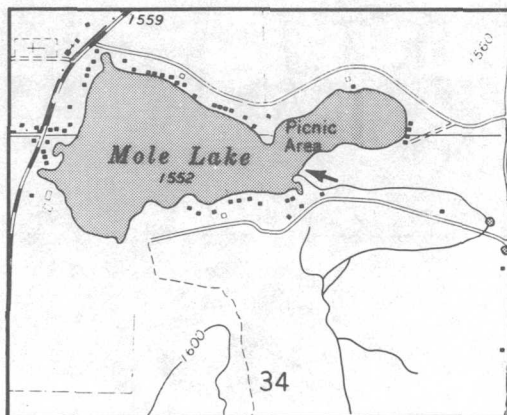
[No surface-water outlet]

Surface-water drainage lake
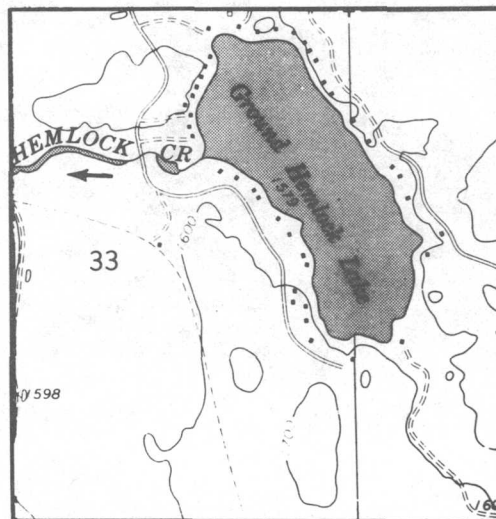
[Surface-water outlet]

Surface-water flow-through lake
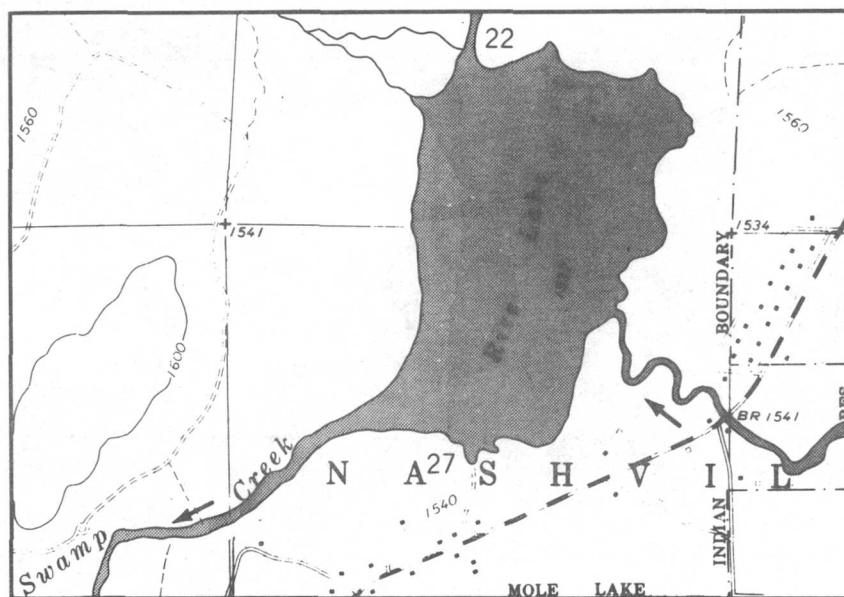
[Surface-water inflow and outflow stream]

Figure 2. Determination of lake class from topographic maps.
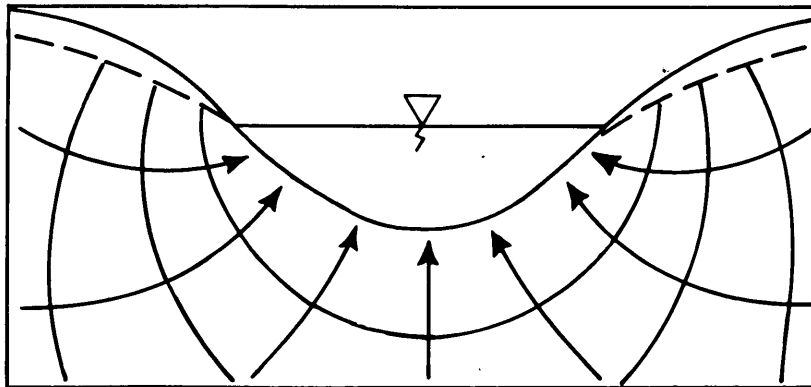
DISCHARGE LAKE
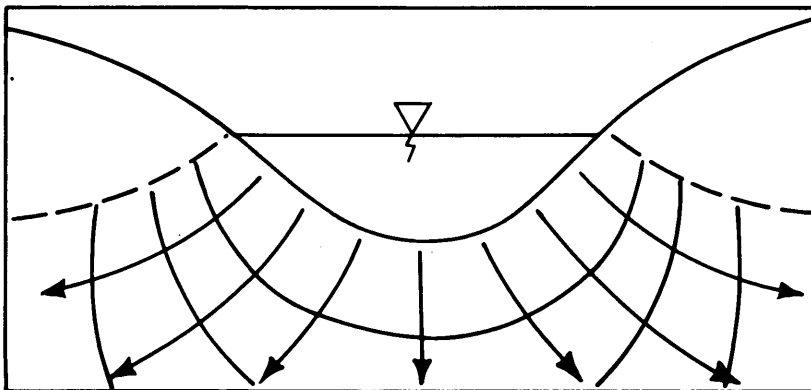
RECHARGE LAKE
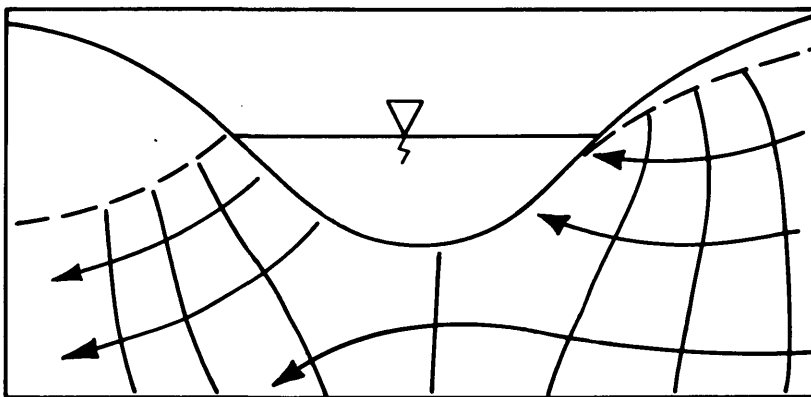
FLOW-THROUGH LAKE

EXPLANATION

Pond water surface

Ground-water flow path with
equipotential head line

Water table
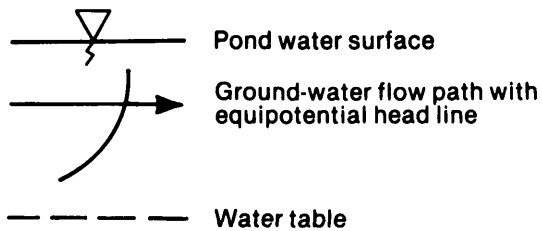
Figure 3. Ground-water flow-through lake subgroups and related ground-water
flow paths. [Adapted from Born, Smith, and Stevens, 1974].

surface-water outlet, lake levels above the outlet elevation quickly lower as do SWD lakes. However, SWF lakes can experience large short-term water-level fluctuations following snowmelt or intense prolonged storms that produce large inflow volumes relative to lake volume. This is because SWF lakes tend to have large drainage areas relative to SWD and GWF lakes.

Many SWF lakes have been created in Wisconsin since the late 1800's by damming major rivers. These impoundments are typically used to produce power or to provide a reliable water supply for the pulp industry. Such dams are managed under complex operating rules and the resulting lake-level fluctuations are difficult to characterize.

Other SWF lakes have been modified by construction of dams at their outlets to raise the normal lake level. These lakes may have less long-term stage fluctuation than otherwise would occur, but may have greater short-term lake-level rises from snowmelt and storm inflow.

STATISTICAL ANALYSIS OF LAKE STAGE DATA

Data Base

The data base used in the statistical analysis consisted of water-level records for 83 lakes. Only 15 ground-water flow-through lakes, 10 surface-water drainage, and 7 surface-water flow-through lakes had record lengths of 8 or more years. For the purposes of the statistical analysis, these 32 lakes with 8 or more years of record are referred to as the long-term record lakes (table 1).

The average record length differed considerably among the lake-class groups used in this study. The SWF-lake class has the longest average record length with 44.6 years; the GWF-lake class has an average record length of 35.4 years; and the SWD-lake class has an average record length of 25.3 years.

Two of the seven SWF lakes had only 8 years of record, but one, Lake Winnebago, had 98 years of record. Lake Winnebago is the largest lake in Wisconsin and is not typical of the average SWF lake, in that the lake is relatively shallow and has a

dam-regulated outlet. Therefore, caution is necessary when comparing statistics derived from the SWF-lake data.

Definition of Long-Term Mean Stage

The long-term mean stage is the arithmetic average of all stage observations during the period of record. Long-term mean stage is given in table 2 for all lakes analyzed in this study. This method of computation gives greater weighting to water-level conditions that prevailed in a month or year that had numerous stage observations. However, most lakes used in this study had regular observations at daily, weekly, or monthly frequency. Lakes with a weekly or monthly stage-observation frequency were not monitored during periods of ice cover.

It should be noted that lake levels have both annual and long-term stage fluctuations, as shown in figure 4, and that average stage levels determined using only a few years of data can be considerably above or below the true long-term mean stage for a lake.

Stage-Departure Duration Analysis

Stage departure is defined as the difference between an observed lake stage and the lake's long-term mean stage. Duration analysis was applied to each long-term record to determine the percentage of time that observed lake stage was above or below the long-term mean stage by an indicated departure in feet. A composite stage-departure duration curve was constructed for each lake class (GWF, SWD, and SWF) with data from the long-term record lakes. These curves are shown in figure 5.

Figure 5 indicates that the water level of a typical GWF lake can be expected to be 1.4 ft or more above or below the lake's long-term mean stage 10 percent of the time. Similarly, 90 percent of the time the water level of a GWF lake would be within 1.4 ft of its long-term mean stage. The water level of a typical SWF lake would be 0.8 ft or more above or below the long-term mean stage 10 percent of the time, and of a SWD lake the departure would exceed 0.65 ft 10 percent of the time.

Monthly Distribution of Annual Maximum and Minimum Lake Stages by Lake Class

The long-term records available for 32 lakes (15 GWF, 10 SWD, 7 SWF) were analyzed to determine in which month the maximum and minimum lake level occurred each calendar year. The number of maximum or minimum stage levels in a month was tabulated for each lake class. When two nearly identical maximum or minimum stages occured in different months of the same year, both months were considered months of maximum or minimum stage. These data were used to determine the percentage distributions of the monthly maximum and minimum stage. The results are shown for each lake class in figure 6.

Lakes in the GWF class experienced maximum lake levels most commonly in June and minimum levels most commonly in November. Lakes of this class retain storm runoff longer than the SWD and SWF lakes whose surface outlets allow rapid drainage. As a result, in GWF lakes, more peak levels occurred at the end of the spring rainfall seasons.

Recharge lakes (fig. 2), a subgroup of the GWF lake class, receive little ground-water inflow after the spring snowmelt and consequently as a result of limited recharge, they commonly drop to lower levels in the fall than do other lakes. Therefore, the recharge lakes in the GWF lake class may bias the monthly distributions sufficiently to indicate that minimum lake levels occur a month or two later in the GWF class than those in the SWD class.

Surface-water drainage lakes had their maximum lake levels most often in May and minimum levels most often in August and September. Spring snowmelt and ground-water inflow account for the high levels observed in April and May. Low lake levels occur in late summer and early fall when evaporation is still high and rainfall is relatively low.

Surface-water flow-through class lakes reach their maximum levels most commonly in May, and minimum levels most commonly in March. The high lake levels in the spring result from storm runoff and increased ground-water discharge carried by the inflowing surface streams. Most annual low levels occur in late winter when the upland areas are still frozen and inflow is reduced, or when the dam-controlled lakes are drawn down in preparation for storage of spring runoff.

FACTORS THAT AFFECT WATER-LEVEL FLUCTUATIONS

Factors that affect lake water-level fluctuations include the natural variations of precipitation and evaporation, and the physical characteristics of the lake such as drainage area, volume, and morphology. These factors are discussed in the following section. Man-made factors that affect water levels are not considered.

Meteorologic Variables

The water level of a lake in any given month is strongly influenced by previous and current precipitation and evaporation conditions. Each of the 32 long-term lake records was analyzed by stepwise linear regression to determine which meteorologic
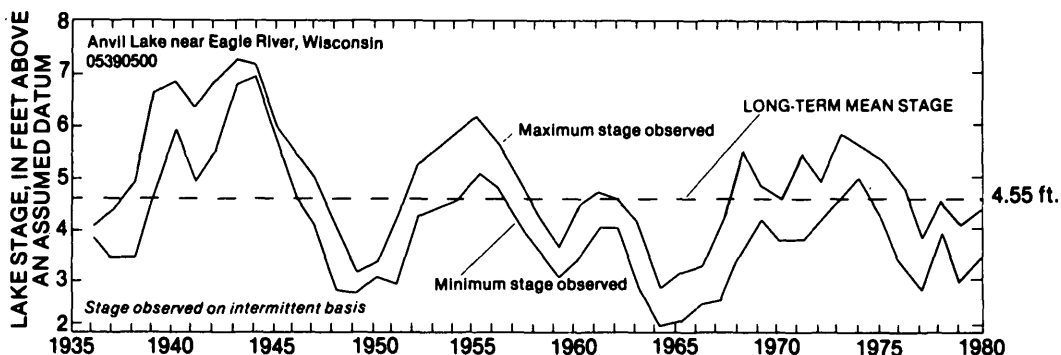

Figure 4. Relation of long-term mean stage to annual lake-stage fluctuations.
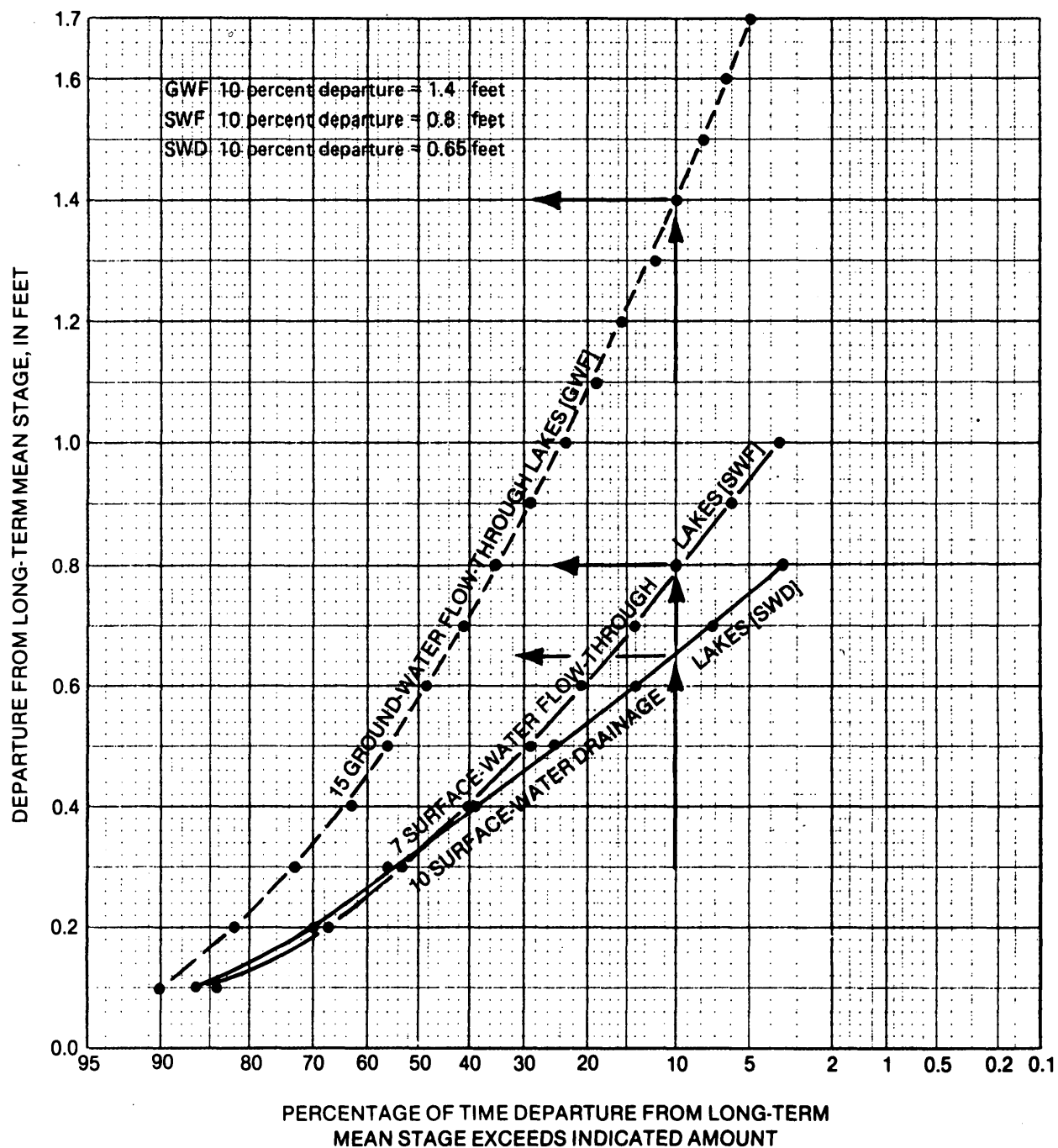
8

Figure 5. Composite stage-departure duration curves.

9

variables were most closely related to the observed lake stages.

The meteorologic variables used in the analysis include the cumulative monthly departure from long-term mean precipitation, monthly precipitation, monthly maximum storm intensity and duration, monthly evaporation, monthly maximum degrees above freezing, and the monthly precipitation that occurred 1, 2, and 3 months before the observed month.

The cumulative monthly departure from long-term mean precipitation was determined to be the most significant meterological variable. This variable is defined as the cumulative algebraic sum of the differences between .actual monthly precipitation and the long-term average. Other significant variables were found to be monthly precipitation and monthly evaporation. However, the meterological regression analysis was not very useful in predicting observed lake stages. The low average correlation coefficient of 0.37 indicates that the meteorologic variables examined are not the only factors that influence lake levels. Furthermore, although this regression analysis was useful in identifying significant meteorologic variables, the equations themselves are not useful for predicting what magnitude of annual stage fluctuation is likely to occur on a lake.

An additional regression analysis with physical characteristics as input variables was done to estimate the average annual fluctuation in lake stage. This analysis, described in the following section, was more successful and is presented in Appendix II.

Physical Characteristics of Lake Basins

The shape and area of a lake's drainage basin, and the shape, surface area, and volume of a lake and other physical factors affect the extent to which a lake's water level will respond to a given change in precipitation, inflow, or evaporation rates.

Drainage-area size and characteristics are important factors in determining the amount of inflow to SWF class and GWF class lakes. The amount of inflow in relation to lake volume is an important factor in determining the rise in water level following a storm. Lakes with a small storage volume in relation to volume of inflow commonly have a large

and rapid rise in water level following heavy rainfall. Typically, the greater a lake's drainage area, the greater the inflow volume resulting from a given rainfall. The type of terrain and land use within the drainage area also affect the volume of inflow produced from rainfall. The quantity and rate of runoff from precipitation differs between steep-sided rocky terrain and gently rolling forest, and between row-crop farmland and grasslands.

Lake morphology (depth and surface area) affects the magnitude of water-level fluctuations in response to a change in inflow or evaporation rate. A shallow lake with a large surface area will generally have greater water loss from evaporation than a deep lake with the same volume and a smaller surface area. For a given increase in inflow volume, a shallow lake with a large surface area will not have as great a rise in water level as a deeper lake of the same volume but with a smaller surface area. Lakes with gently sloping sides and banks usually have less water-level fluctuation from an increase in inflow than do lakes with steep sides and banks; however sloping banks allow the greatest change in water-surface area with accompanying horizontal fluctuation of the water's edge.

Stepwise regression analysis was applied to records from 71 Wisconsin Lakes in four geographic zones (Appendix II) to determine the best-fit equations to estimate average annual water-level fluctuations. These equations use physical characteristics as input variables. The characteristics identified as most significant were the lake's drainage-basin area, lake-surface area, maximum depth, ratio of drainage-basin area to water-surface area, and the lake's dimensionless relative depth (defined as the square foot of the lake's surface area divided by the lake's maximum depth). The regression correlation coefficients ranged from 0.78 to 0.92, and the average errore of estimate for the observed annual average fluctuation ranged from 40 to 26 percent.

DATA SUMMARY FOR STUDY LAKES

Table 2 presents a summary of the hydrologic data for the lakes used in this study report. These data are presented in the format explained below.

Lake Name -- As determined from U.S. Geological Survey topographic maps and stored in U.S. Geological Survey computer files.
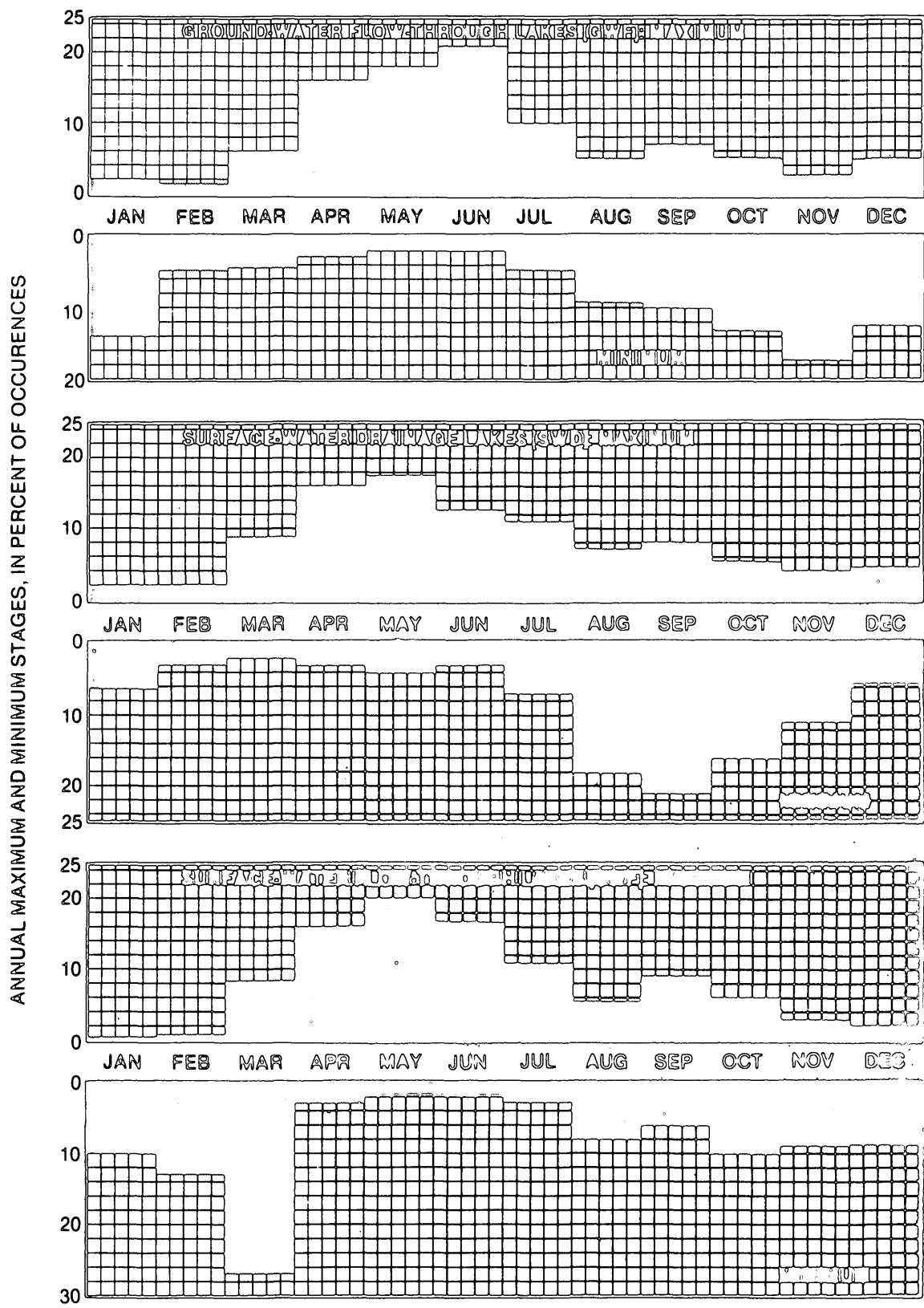
10

Figure 6. Monthly distribution of annual maximum and minimum lake stages.

Station Number -- The U.S. Geological Survey downstream order number or latitude-longitude code used to retrieve data from the computer file.

Report ID Number -- The lake location number as shown on figure 1 of this report.

Location -- Indicates the county where lake is located and a nearby city or town.

Period of Record -- Indicates the water years (period October 1 to September 30) for which stage records were collected. (1 record = 1 stage observation.)

Hydrologic Classification -- Indicates if the lake is a ground-water flow-through (GWF), surface-water drainage (SWD), or surface-water flow-through (SWF) lake as defined in this report.

Drainage Area -- The drainage area, in square miles, contributing to the lake. Determined from U.S. Geological Survey topographic maps. Includes lake surface area.

Surface Area -- The surface area of the lake, in square miles, determined from U.S. Geological Survey topographic maps.

Lake Volume -- The volume of the lake, in acre-feet, determined at mean stage for lakes where storage-elevation curves were available.

Maximum Depth -- The maximum depth of the lake, in feet, obtained from Wisconsin Department of Natural Resources publication 7-3600(81) "Wisconsin Lakes".

Long-Term Mean Stage -- The arithmetic average of all stage measurements, in feet, made during the period of record.

STD -- The standard deviation of the long-term mean stage, in feet. This is one measure of the water-level fluctuation of the lake.

Minimum and Maximum Stages and Years of Occurrence -- The extreme low and high stages, in feet, observed during the period of record and the year in which they occurred.

Average Annual Stage Fluctuation -- The average difference, in feet, between high and low stages obseved during a water year. Determined by averaging the annual ranges in stage for the period of record.

Stage Datum Information -- The value, in feet, needed to add to stage readings to obtain National Geodetic Vertical Datum elevation or Wisconsin Department of Natural Resources elevation. Also provides bench mark description if known.

Comments -- As indicated.

Note ND = Not determined for lake in question.

Additional Data For Long-Term Record Lakes
The results of a Pearson type III frequency analysis is shown, along with a plot of the annual maximum and minimum lake stage. Estimated maximum and minimum stages and the extreme annual stages fluctuation of water levels for the 2-, 5-, 10-, 20-, 50-, and 100-year occurence intervals are given. This information is presented below the standard items listed previously.

Hydrologic data summaries are provided for each study lake in alphabetical order on the pages indicated.

SUMMARY AND CONCLUSIONS

This report presents stage-fluctuation data for 83 Wisconsin lakes. Of these, 32 lakes had sufficient record length for stage-frequency analysis. Record lengths varied from 1 to 98 years. A minimum of 7 years of record was required for the frequency analysis.

Wisconsin lakes can be grouped into three classes based on features determined by inspection of topographic maps. These three classes are: (1) Ground-water flow-through; (2) surface-water drainage; and (3) surface-water flow-through lakes. Lakes within each class have similar water-level fluctuation characteristics.

Wisconsin lakes have long-term water-level fluctuations over a period of years and short-term and seasonal fluctuations over shorter periods. The ground-water flow-through lakes have the greatest fluctuations in long-term, water levels; the surface-water drainage lakes have the smallest fluctuations in long-term water levels.

Surface-water flow-through lakes experience maximum water levels most often in May and lowest levels most often in March. Ground-water flow-through lakes experience maximum levels most often in June and minimum levels most often in November. Surface-water drainage lakes experience maximum levels most often in May and minimum levels most often in September.

Meteorologic conditions, physical lake-basin factors, and man-induced controls affect mean lake stages and stage fluctuations of Wisconsin lakes.

Long-term precipitation trends and current precipitation and evaporation rates influence the observed lake-stage levels. Lake-drainage basin area, lake volume, lake-surface area, lake depth, and relation to the ground-water flow system influence the response of lake levels to changes in precipitation, inflow, or evaporation.

Regression equations were developed to estimate the average annual lake-stage fluctuation at an ungaged lake. A lake's geographic location within the State determines which of the four equations should be used. Equation input variables consist of physical parameters such as drainage area, surface area, and maximum depth. Details of the regression equations are presented in Appendix II.

REFERENCES

Born, S. M., Smith, S. A., and Stephenson, D. A., 1974, The hydrogeological regime of glacial-terrain lakes, with management and planning applications: Madison, University of Wisconsin Extension.

Wisconsin Department of Natural Resources, 1981, Wisconsin lakes: Publication 7-3600(81), 90 p.

APPENDIX I

PROBABILITY ANALYSIS OF ANNUAL STAGE FLUCTUATIONS

Stage-fluctuation frequency data for lakes with adequate record length for frequency analysis are presented in table 2. Few lakes in Wisconsin have adequate records for analysis. For lakes with short-term records and for ungaged lakes general-

ized stage-fluctuation probability curves provide a means to estimate the magnitude and frequency of water-level fluctuations. These curves are presented in the following appendix.

The annual stage fluctuation of a lake is defined as the difference between the highest and lowest observed water level for the year. The average-annual and maximum-annual stage fluctuation was determined for each lake with a long-term record. These data were then grouped together by lake class (GWF, SWD, SWF), and analyzed separately using a Pearson Type III probability distribution. Probability curves for the maximum and average annual stage-fluctuations were plotted for each lake class with the probability analysis results. These two curves are shown in figures 7 and 8.

Figure 7 indicates that SWF lakes have the greatest average annual fluctuations in stage, and SWD lakes the least. There is a 50 percent probability that the average annual fluctuation in stage for a SWF lake will exceed 1.5 ft. For the same probability (50 percent), the GWF lake class has an average annual fluctuation in stage of 1.1 ft, and the SWD lake class, 0.8 ft. The SWF lakes have the greatest average annual fluctuation in stage owing to the seasonal nature of their primary inflow source (streamflow). The SWD lake class has a more stable inflow source (ground water) and their surface outlets limit the maximum stage. Consequently, the SWD lakes have the smallest average annual fluctuation in stage as shown in figure 7.

Figure 8 indicates that, in general, the SWF lakes also have the greatest maximum annual stage fluctuations. There is a 50 percent probability that a SWF lake will have a maximum annual fluctuation in stage of 2.8 ft or more. For the same probability (50 percent), the GWF lakes have an annual maximum fluctuation in stage of 2.2 ft, and the SWD lakes, 1.5 ft. However, at 5 percent probability, the GWF lakes have a greater maximum fluctuation than the SWF lakes. This may indicate a bias in the analysis caused by the inclusion of the subgroup of GWF recharge lakes that may dry up during extended periods of drought.

The range in fluctuations of water levels in lakes in the SWD class is limited by relatively stable ground-water inflow and an efficient surface outflow. Therefore, the SWD lakes can be expected to have the smallest maximum fluctuations, as shown in figure 8.

APPENDIX II

ESTIMATION OF STAGE FLUCTUATIONS AT UNGAGED LAKES

Statistical analysis of long-term records of lake stage can be used to determine average annual stage fluctuations as presented in table 2 and defined in this appendix. Other methods must be used to determine the fluctuations in lakes for which inadequate or no stage records are available. Such other methods include comparative techniques and regression equations to estimate fluctuations in water levels.

Comparative techniques can be used when the lake in question is near a lake of similar hydrologic characteristics and for which a long-term record of water levels exists. The lake data in table 2 are useful in this respect. If there exists similar physical and hydrologic characteristics, which can be determined by inspection of a topographic map, it can be assumed that the ungaged lake may have similar average annual stage fluctuations.

For example, if Palmer Lake near Land O'Lakes in Vilas County were an ungaged lake, comparison with nearby Big Lake would be valid because both lakes have the same SWF hydrologic class and similar physical characteristics. Big Lake has an average annual stage fluctuation of 1.02, which is close to the 0.96 ft actually determined for Palmer Lake.

Multiple regression analysis of 71 of the 83 lake records studied provided equations for estimating the average annual stage fluctuation for lakes in Wisconsin. The analysis related physical characteristics for a lake to its average annual stage fluctuation.

The 71 records used in the analysis were grouped according to hydrologic class, geographic zone within the State, and by type of outlet. The best correlation coefficients were obtained when the lakes were grouped according to the geographic zones shown in figure 9. Lakes within a geographical zone tend to have the same precipitation and evaporation characteristics. The physical setting tends to be the same for lakes within the same zone as well.

The regression equations took the form of $Y = ax_1 + bx_2 + cx_3$, where Y was the average annual stage fluctuations (dependent variable) and x_1, x_2,

x_3 were physical characteristics determined for each lake. The coefficients a, b, c were determined by the regression analysis to provide the best-fit equation to estimate the stage fluctuation.

The dependent variable used in the regression analysis was:

Average Annual Fluctuation (AAF) -- The difference in feet between the highest and lowest recorded stages during the water year, averaged over the period of record.

Independent variables used in the regression analysis were:

Drainage Area (DA) -- The drainage area, in square miles, that contributes to the lake, determined from U.S. Geological Survey topographic maps.

Surface Area (SA) -- The surface area of the lake, in square miles, determined from U.S. Geological Survey topographic maps or from DNR Publication 7-3600(81) titled "Wisconsin Lakes".

Maximum Depth (MD) -- The maximum depth, in feet, of the lake, obtained from DNR Publication 7-3600(81).

Drainage Area/Surface Area Ratio (DASA) -- The dimensionless ratio of the lake's drainage area to surface area.

Relative Depth (RD) -- This is the dimensionless ratio of the square foot of the lake's surface area to its maximum depth in miles, defined as: (SA)/(MD/5280).

· Other characteristics were used in the regression analysis but were eliminated from the final equations because they were not significant in estimating the average annual stage fluctuation. The final regression equations were determined as the best three-characteristic model for each geographic zone in the State. Use of models with four or more

characteristics did not significantly improve the correlation coefficients obtained by the regression.

The best-fit regression equations determined for each zone are presented below, along with their correlation coefficient (R^2) [1] and average percentage errors of estimate.

CENTRAL ZONE: 15 lakes with a DA of 12.0 mi^2 or less.
$$AAF = 0.00164\,(RD) + 0.0875\,(DA) + 0.0211\,(MD)$$
$$R^2 = 0.78 \quad Average\ error = 40.5\ percent$$

NORTHEASTERN ZONE: 19 lakes with a DA of 33.0 mi^2 or less.
$$AAF = 0.0036\,(RD) - 0.52\,(SA) + 0.0195\,(MD)$$
$$R^2 = 0.92 \quad Average\ error = 27.9\ percent$$

NORTHWESTERN ZONE: 19 lakes with an SA of 4.0 mi^2 or less.
$$AAF = 0.00658\,(DASA) + 0.0031\,(RD) + 0.00979\,(MD)$$
$$R^2 = 0.81 \quad Average\ error = 31.8\ percent$$

SOUTHERN ZONE: 17 lakes with a DA of 11.0 mi^2 or less.
$$AAF = 0.087\,(DASA) - 0.167\,(DA) + 1.89\,(SA)$$
$$R^2 = 0.88 \quad Average\ error = 25.6\ percent$$

The average error of estimate was determined as the average percentage difference between the actual average fluctuation and that estimated using the regression equation. The regression equations and errors of estimate were developed using lakes with the drainage or surface area limitations indicated for each zone. The equation for the central zone has the highest error and lowest correlation coefficient, probably due to fewer long-term records available for the regression analysis.

Example Application of Regression Equation: Assume that Palmer Lake in Vilas County near Land O'Lakes is an ungaged lake. It lies in the Northeastern Zone of figure 9. The lake's maximum depth (MD) is 13 ft and surface area (SA) is 0.99 mi, (obtained from table 2). The lake's dimensionless relative depth (RD) is calculated to be 404.1. Subtraction of this data in the Northeastern Zone regression equation results in an estimated average annual stage fluctuation of 1.19 ft, compared to the actual value of 0.96 ft. The estimate is within 24 percent of the actual value, and within the 27.9 percent average error of estimate for the equation.

[1] A correlation coefficient of 1.00 would indicate the regression equation provided a correct estimate of the annual average fluctuation value, 100 percent of the time. A coefficient of 0.00 would indicate a random, erroneous estimate 100 percent of the time.
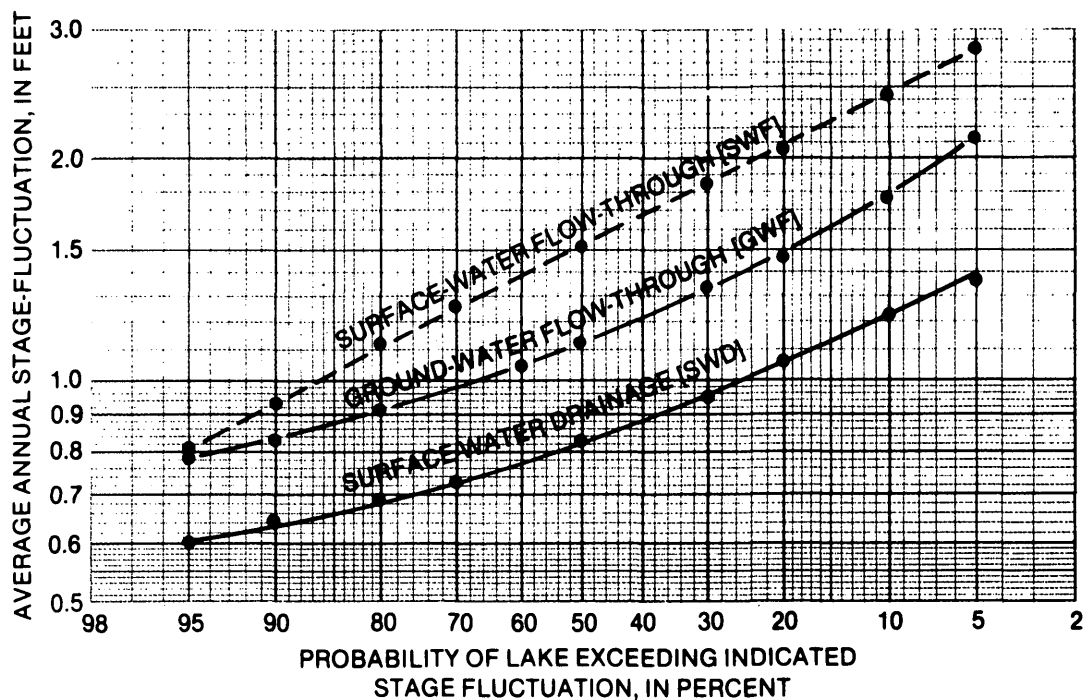
Figure 7. Probability curves for average annual stage fluctuation.
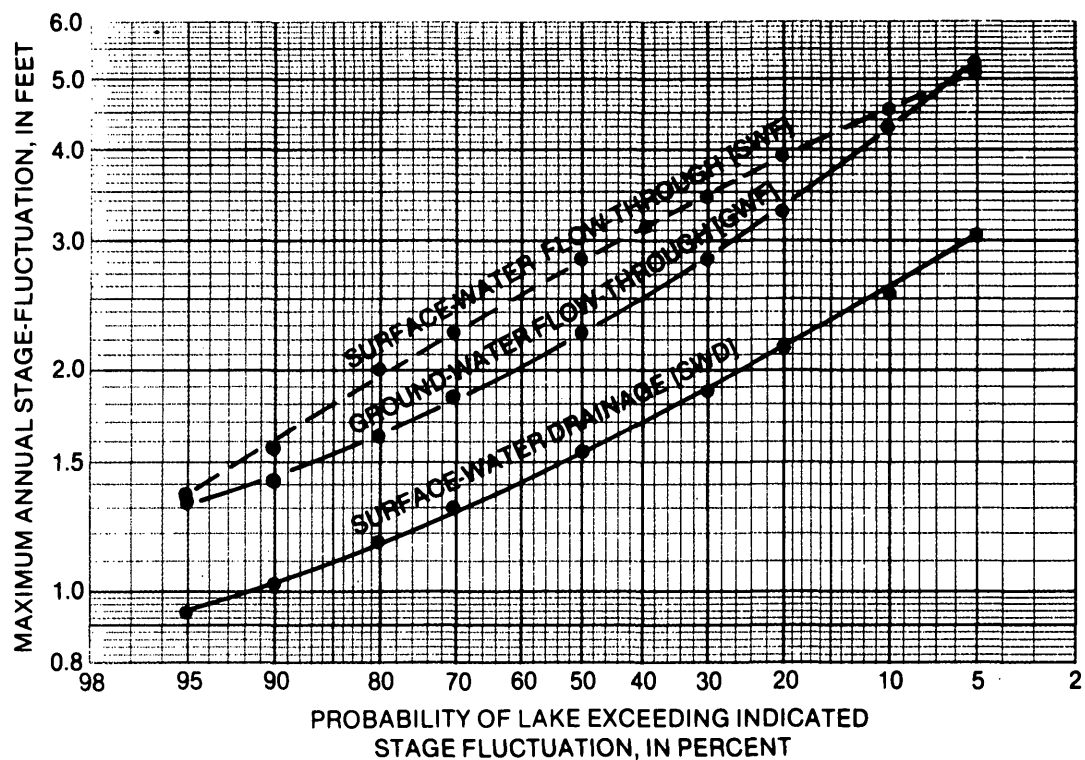
Figure 8. Probability curves for maximum annual stage fluctuation.

17
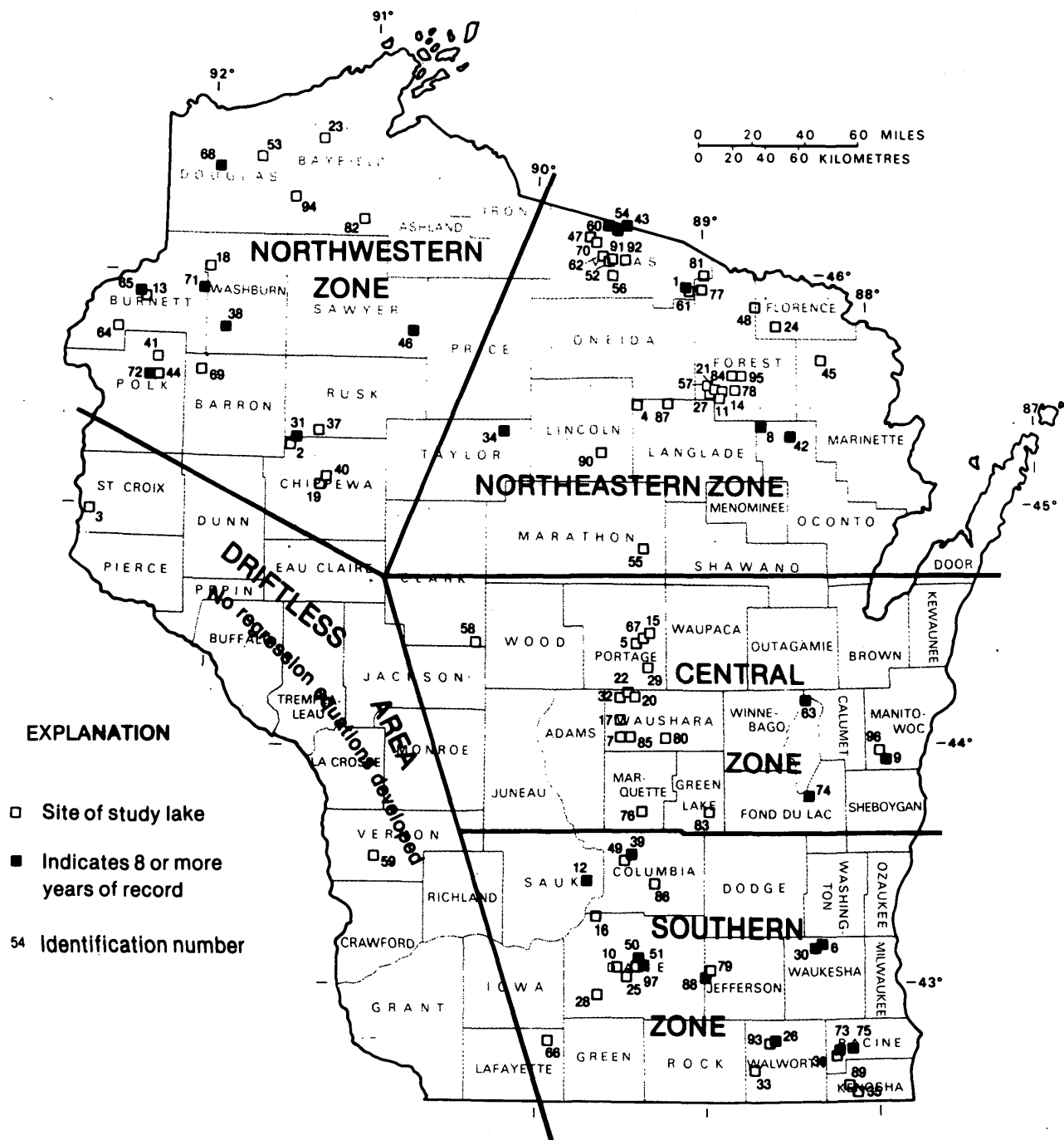
Figure 9. Map showing geographic zones used in regression analysis.

Table 1. Long-term record lakes used in statistical analysis.

Lake name	Record length (years)	Indentification number[1]
Ground-water flow-through (GWF) lakes (average record length = 36.4 years)		
Anvil Lake near Eagle River	44	1
Beaver Lake near Hartland	40	6
Boot Lake near Townsend	33	8
Cedar Lake near Kiel	42	9
Devils Lake near Baraboo	56	12
Fish Lake near Sauk City	13	16
Long Lake near Iron River	15	23
North Lake near Elkhorn	43	26
Pine Lake near Chetek	30	31
Pine Lake near Hartland	48	30
Rib Lake at Rib Lake	32	34
Rockland Lake near Burlington	13	36
Shell Lake at Shell Lake	44	38
Silver Lake at Portage	34	39
Wheeler Lake near Lakewood	44	42
Surface-water drainage (SWD) lakes (average record length = 25.3 years)		
Amnicon Lake near South Range	29	68
Bone Lake near Luck	28	72
Browns Lake near Burlington	27	73
Lake DeNeveu near Fond du Lac	29	74
Eagle Lake near Kansasville	32	75
Fish Lake near Wautoma	13	80
McKenzie Lake near Spooner	42	71
Lake Ripley near Cambridge	31	88
Turtle Lake near Delavan	14	93
Lake Wingra at Madison	8	97
Surface-water flow-through (SWF) lakes (average record length = 44.6 years)		
Big Lake near Land O'Lakes	8	43
Connors Lake near Phillips	30	46
Lake Mendota at Madison	64	50
Lake Monona at Madison	65	51
Palmer Lake near Land O'Lakes	8	54
Lake Winnebago at Oshkosh	98	63
Yellow Lake near Webster	39	65

[1] See figure 1 for locations of lakes.

Name: Adams Lake   Station No.: 04080903   Report ID No.: 67

Location: Portage County near Amherst

Period of record: 1978-79 (9 stage records)

Hydrologic class: SWD

Drainage area: 1.40 mi^2 Surface area: 0.05 mi^2

Lake volume: 44 acre-ft   Maximum depth: 51 ft

Long-term mean stage: 95.16 ft   STD: 0.12 ft

Minimum stage and year of occurrence: 94.90 ft, 1963

Maximum stage and year of occurrence: 95.32 ft, 1978

Average annual water-level fluctuation: 0.20 ft

Maximum annual water-level fluctuation and occurrence: 0.23 ft, 1978

Stage datum information: Not determined. Benchmark is two spikes in orange
painted blaze on east side of birch tree at public landing access. Assumed
elevation = 100.00 ft.

Comments: One stage measurement made in 1963, 94.90 ft. Lake shown on USGS
7 1/2-minute Arnott quadrangle map.

Name: Amnicon Lake   Station No.: 04024500   Report ID No.. 68

Location: Douglas County near South Range

Period of record: 1936-64 (2,032 stage records)

Hydrologic class: SWD

Drainage area: 5 mi^2 (approx.)   Surface area: 0.67 mi^2

Lake volume: 4,210 acre-ft   Maximum depth: 31 ft

Long-term mean stage: 1,196.93 ft   STD: 0.43 ft

Minimum stage and year of occurrence: 1,195.82 ft, 1949

Maximum stage and year of occurrence: 1,199.32 ft, 1950

Average annual water-level fluctuation: 1.11 ft

Maximum annual water-level fluctuation and occurrence: 3.03 ft, 1950

Stage datum information: Benchmark 611-C is a bronze disc marked "Railroad
Commission of Wisconsin" set in the top of a 6-ft concrete post located 29 ft
from centerline of County Highway A on E. R. Lindblad property at lake outlet on
southwest side of the lake. Elevation = 1,208.02 ft above mean sea level.

Comments: 1977-79 record data not used in statistical analysis, only two
measurements made each year. One stage measurement also was made in 1970 =
7.20 ft, 1973 = 7.09 ft, 1974 = 7.73 ft, and in 1976 = 6.71 ft.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	1196.39	1196.18	1196.06	1195.97	1195.86	1195.78
Maximum stage (ft)	1197.67	1198.21	1198.53	1198.81	1199.14	1199.38
Annual fluctuation (ft)	1.27	1.79	2.12	2.41	2.77	3.03

Comments: 29 years of record used in analysis.

WATER YEAR MAX-MIN

21
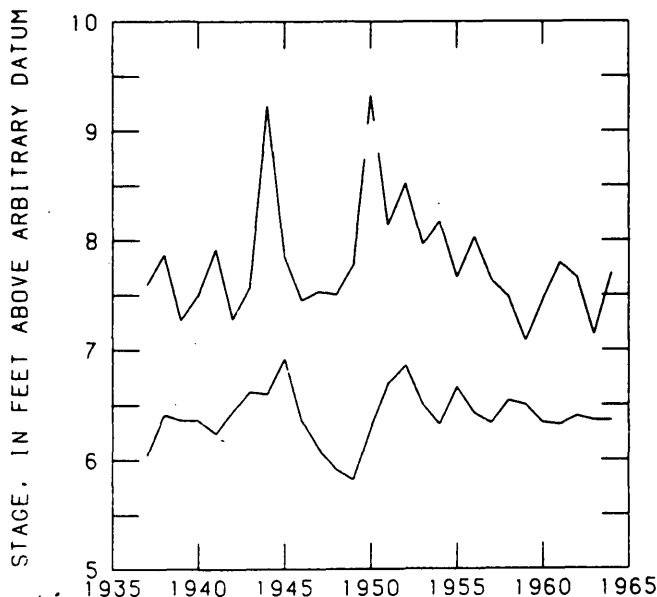
Name: Anvil Lake   Station No.: 05390500   Report ID No.: 1

Location: Vilas County near Eagle River

Period of record: 1936-79 (1,648 stage records)

Hydrologic class: GWF

Drainage area: 4.11 mi^2 Surface area: 0.59 mi^2

Lake volume: Not determined   Maximum depth: 40 ft

Long-term mean stage: 4.55 ft   STD: 1.10 ft

Minimum stage and year of occurrence: 2.10 ft, 1964

Maximum stage and year of occurrence: 7.20 ft, 1943

Average annual water-level fluctuation: 0.96 ft

Maximum annual water-level fluctuation and occurrence: 2.08 ft, 1968

Stage datum information: Add 90.00 ft to lake stage to get WDNR assumed datum.
Benchmark No. 8 assumed elevation = 100.67 ft, location unknown.

Comments: Lake shown on USGS 7 1/2-minute Anvil Lake quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	3.82	2.99	2.63	2.36	2.10	1.95
Maximum stage (ft)	4.87	5.84	6.37	6.82	7.34	7.70
Annual fluctuation (ft)	0.93	1.32	1.54	1.72	1.94	2.09

Comments: 44 years of record used in analysis.

WATER YEAR MAX-MIN

22
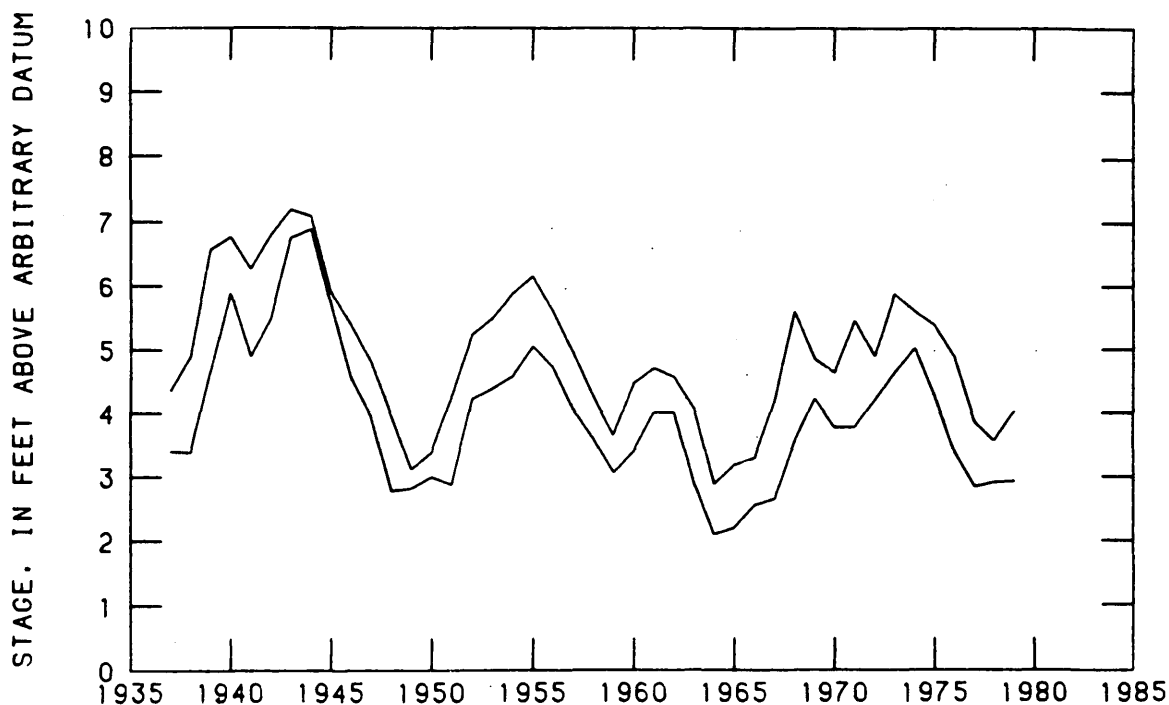
Name: Axehandle Lake   Station No.: 053674638   Report ID No.:   2

Location: Chippewa County near Chetek

Period of record: 1979 (6 stage records)

Hydrologic class: GWF

Drainage area: 074 mi²   Surface area: 0.13 mi²

Lake volume: Not determined   Maximum depth: 70 ft

Long-term mean stage: 0.99 ft   STD: 0.22 ft

Minimum stage and year of occurrence: 0.76 ft, 1979

Maximum stage and year of occurrence: 1.72 ft, 1979

1979 water-level fluctuation: 0.96 ft

Stage datum information: Not determined. Reference Mark No. 1 at base of
16-in diameter oak in center of access road, 25 ft from edge of water at public
landing at southeast end of lake. Assumed elevation = 10.0 ft.

Comments: Lake shown on USGS 7 1/2-minute Chain Lake quadrangle map.

Name: Bass Lake   Station No.: 05341748   Report ID No.:   3

Location: St. Croix County near Hudson

Period of record: 1975-79 (246 stage records)

Hydrologic class: GWF

Drainage area: 7.11 mi²   Surface area: 0.47 mi²

Lake volume: Not determined   Maximum depth: 33 ft

Long-term mean stage: 1.33 ft   STD: 0.61 ft

Minimum stage and year of occurrence: 0.40 ft, 1977

Maximum stage and year of occurrence: 2.81 ft, 1976

Average annual water-level fluctuation: 0.65 ft

Maximum annual water-level fluctuation and occurrence: 1.26 ft, 1976

Stage datum information: Add 881.00 ft to lake stage to get mean sea level

Comments: Only 5 stage measurements made in 1979. Location of benchmarks is
unknown. Lake shown on USGS 15-minute New Richmond, Wis.-Minn., quadrangle map.

Name: Bass-Long Lakes   Station No.: 05392024   Report ID No.:   4

Location: Langlade County near Parrish

Period of record: 1978 (43 stage records)

Hydrologic class: GWF

Drainage area: 1.28 mi^2 Surface area: 0.36 mi^2

Lake volume: Not determined   Maximum depth: 25 ft

Long-term mean stage: 10.44 ft   STD: 0.19 ft

Minimum stage and year of occurrence: 10.19 ft, 1978

Maximum stage and year of occurrence: 10.88 ft, 1978

1978 water-level fluctuation: 0.69 ft

Stage datum information: Not determined. Reference point No. 1 is a 1-in. pipe
driven into lake bed 10 ft from shore and 1 ft north of pier at the Edwin Beyer
residence. Assumed elevation = 10.10 ft.

Comments: One stage measurement made in 1979, 10.41 ft. Lakes shown on USGS
7 1/2-minute Parrish quadrangle map.

Name: Bear Lake   Station No.: 442602089234101   Report ID No.:   5

Location: Portage County near Amherst

Period of record: 1965, 1970, 1974, 1978, 1979

Hydrologic class: GWF

Drainage area: 0.52 mi^2 Surface area: 0.04 mi^2

Lake volume: 237.4 acre-ft   Maximum depth: 28 ft

Long-term mean stage: 87.62 ft   STD: 1.91 ft

Minimum stage and year of occurrence: 86.24 ft, 1978

Maximum stage and year of occurrence: 93.14 ft, 1974

1979 water-level fluctuation: 1.42 ft

Stage datum information: Not determined. Benchmark is orange-painted iron pipe
at high water line on west boundary of public access. Assumed elevation =
100.00 ft.

Comments: Only one stage measurement made during 1965, 1970, 1974, and 1978.
Seven stage records for 1979. Fluctuation values based on 1979 data. Lake
shown on USGS 7 1/2-minute Arnott quadrangle map.

Name: Beaver Dam Lake   Station No.: 05367630   Report ID No.: 6⊆

Location: Barron County at Cumberland

Period of record: 1975-79 (30 stage records)

Hydrologic class: SWD

Drainage area: 12.0 mi^2 Surface area: 1.74 mi^2

Lake volume: 34,700 acre-ft   Maximum depth: 106 ft

Long-term mean stage: 9.60 ft   STD: 0.54 ft

Minimum stage and year of occurrence: 8.27 ft, 1978

Maximum stage and year of occurrence: 10.67 ft, 1977

Average annual water-level fluctuation: 1.13 ft

Maximum annual water-level fluctuation and occurrence: 1.50 ft, 1976

Stage datum information: Not determined. Benchmark 918-A is a square cut in top center of north end of culvert between narrows of lake on U.S. Highway 63. Elevation = 1,236.86 ft mean sea level.

Comments: Only two stage measurements made in 1975, so data not used to determine fluctuation data. Dam at outlet. Lake shown on USGS 15-minute Cumberland quadrangle map.

Name: Beaver Lake   Station No.: 05424500   Report ID No.: 6

Location: Waukesha County near Hartland

Period of record: 1933-68, 1970-73 (3,780 stage records)

Hydrologic class: GWF

Drainage area: 3 mi^2 (approx.)   Surface area: 0.48 mi^2

Lake volume: Not determined   Maximum depth: 46 ft

Long-term mean stage: 9.80 ft   STD: 0.39 ft

Minimum stage and year of occurrence: 8.44 ft, 1965

Maximum stage and year of occurrence: 10.94 ft, 1940

Average annual water-level fluctuation: 0.90 ft

Maximum annual water-level fluctuation and occurrence: 1.75 ft, 1971

Stage datum information: Add 900.00 ft to lake stage to get mean sea level.
Benchmark 637-B is a bronze tablet marked "Railroad Commission, State of
Wisconsin", set in top of upstream end of culvert wall at lake outlet.
Elevation = 912.88 ft.

Comments: Lake is shown on USGS 7 1/2-minute Merton and Hartland quadrangle maps.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	9.33	9.02	8.84	8.69	8.52	8.40
Maximum stage (ft)	10.18	10.43	10.58	10.71	10.87	10.98
Annual fluctuation (ft)	0.85	1.17	1.35	1.51	1.69	1.82

Comments: 40 years of record used in analysis.   WATER YEAR MAX-MIN
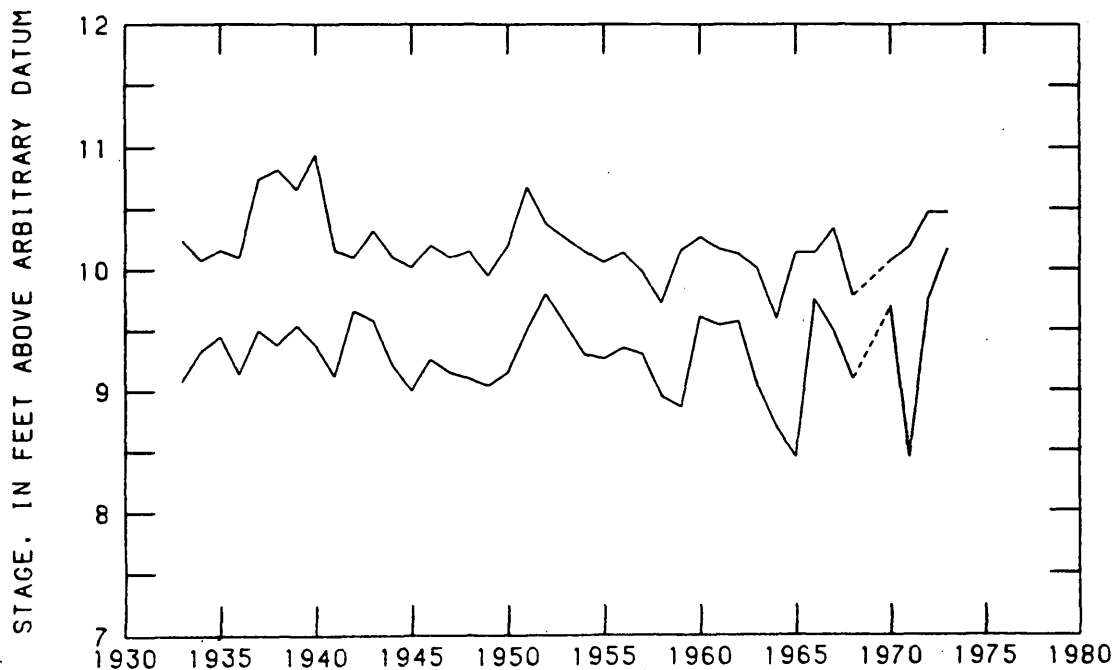
Name: Big Crooked Lake   Station No.: 05357154   Report ID No.: 70

Location: Vilas County near Boulder Junction

Period of record: 1979 (7 stage records)

Hydrologic class: SWD

Drainage area: 3.32 mi^2 Surface area: 0.98 mi^2

Lake volume: Not determined   Maximum depth: 35 ft

Long-term mean stage: 5.96 ft   STD: 0.09 ft

Minimum stage and year of occurrence: 5.83 ft, 1979

Maximum stage and year of occurrence: 6.09 ft, 1979

Annual water-level fluctuation: 0.26 ft

Stage datum information: Not determined. Benchmark is a lag screw set in base
of pine tree located 80 ft east of the boat ramp adjacent to the Dairyman's
County Club, approximately 25 ft from the shoreline. Assumed elevation =
10.00 ft.

Comments: Lake shown on USGS 15-minute Boulder Junction quadrangle map.

Name: Big Lake   Station No.: 04037002   Report ID No.: 43

Location: Vilas County near Land O'Lakes

Period of record: 1938-45 (970 stage records)

Hydrologic class: SWF

Drainage area: 32 mi^2 (approx.)   Surface area: 1.20 mi^2

Lake volume: 10,200 acre-ft   Maximum depth: 30 ft

Long-term mean stage: 5.85 ft   STD: 0.21 ft

Minimum stage and year of occurrence: 4.40 ft, 1940

Maximum stage and year of occurrence: 6.54 ft, 1943

Average annual water-level fluctuation: 0.96 ft

Maximum annual water-level fluctuation and occurrence: 2.12 ft, 1941

Stage datum information: Not determined. Benchmark No. 1 is a bronze tablet marked "Public Service Commission of Wisconsin" set in top of 6-ft concrete post about 0.3 ft above ground, located 29 ft south of southwest corner of boathouse on R. J. Hook resort property. Gage datum = 14.42 ft.

Comments: Lake shown on USGS 15-minute Starlake, Wis.-Mich. quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	5.48	4.92	4.55	4.20	3.75	3.43
Maximum stage (ft)	6.30	6.46	6.55	6.63	6.73	6.80
Annual fluctuation (ft)	0.84	1.45	1.85	2.22	2.68	3.02

Comments: 8 years of record used in analysis.

28
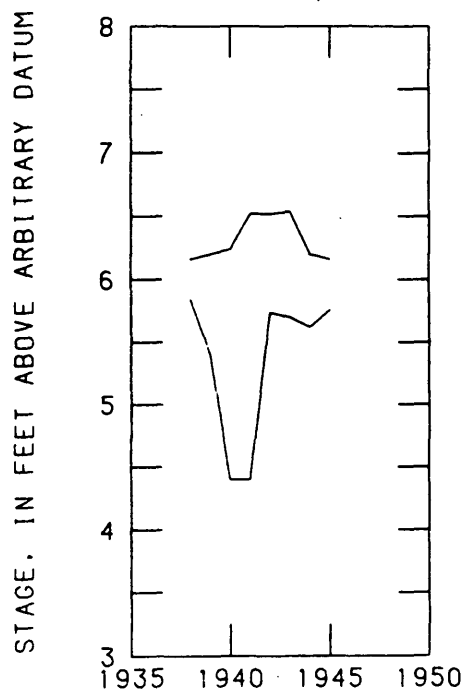
Name: Big Round Lake   Station No.: 05341031   Report ID No.: 44

Location: Polk County near Luck

Period of record: 1979 (21 stage records)

Hydrologic class: SWF

Drainage area: 28.3 mi^2 Surface area: 1.65 mi^2

Lake volume: Not determined   Maximum depth: 15 ft

Long-term mean stage: 7.16 ft   STD: 0.11 ft

Minimum stage and year of occurrence: 7.02 ft, 1979

Maximum stage and year of occurrence: 7.32 ft, 1979

1979 water-level fluctuation: 0.30 ft

Stage datum information: Not determined. Reference point No. 1 is a lag screw
set 1 ft up from base of 2-ft diameter ash tree, 12 ft from shore and about
50 ft east of pier on B. Viviano property at northeast end of lake. Gage
datum = 22.40 ft.

Comments: Lake shown on USGS 15-minute Frederic quadrangle map.

Name: Bing Lake   Station No.: 04073178   Report ID No.: 7

Location: Waushara County near Coloma

Period of record: 1978-79 (40 stage records)

Hydrologic class: GWF

Drainage area: 1 mi^2 (approx.)   Surface area: 0.01 mi^2

Lake volume: Not determined   Maximum depth: 31 ft

Long-term mean stage: 1.82 ft   STD: 0.43 ft

Minimum stage and year of occurrence: 1.24 ft, 1978

Maximum stage and year of occurrence: 2.56 ft, 1979

Average annual water-level fluctuation: 0.76 ft

Maximum annual water-level fluctuation and occurrence: 1.12 ft, 1979

Stage datum information: Not determined.

Comments: Lake shown on USGS 7 1/2-minute Richford quadrangle map.

29

Name: Bone Lake   Station No.: 05341000   Report ID No.: 72

Location: Polk County near Luck

Period of record: 1936-64, 1975-79 (1,330 stage records)

Hydrologic class: SWD

Drainage area: 15 mi^2 (approx.)   Surface area: 3.20 mi^2

Lake volume: 38,499 acre-ft   Maximum depth: 43 ft

Long-term mean stage: 6.54 ft   STD: 0.74 ft

Minimum stage and year of occurrence: 3.93 ft, 1976

Maximum stage and year of occurrence: 7.97 ft, 1942

Average annual water-level fluctuation: 0.69 ft

Maximum annual water-level fluctuation and occurrence: 1.48 ft, 1941

Stage datum information: Add 84.68 ft to lake stage to get Wisconsin Department
of Natural Resources benchmark datum. Benchmark 2032-A is a 6-ft long, 6-in.
diameter concrete post set on the north end of the lake at a public landing,
80 ft from the shore, 103 ft southeast of shelter house, and 38 ft south of
centerline of cul-de-sac road. Assumed elevation = 100.00 ft.

Comments: Lake shown on USGS 15-minute Frederic quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	6.45	6.25	6.15	6.08	6.00	5.94
Maximum stage (ft)	7.15	7.50	7.70	7.86	8.06	8.19
Annual fluctuation (ft)	0.69	1.00	1.17	1.31	1.48	1.60

Comments: 28 years of record used in analysis.   WATER YEAR MAX-MIN

30

Name: Boot Lake   Station No.: 04070500   Report ID No.: 8

Location: Oconto County near Townsend

Period of record: 1936-65, 1977-79 (1,262 stage records)

Hydrologic class: GWF

Drainage area: 1.5 mi^2 Surface area: 0.55 mi^2

Lake volume: Not determined   Maximum depth: 40 ft

Long-term mean stage: 5.60 ft   STD: 0.97 ft

Minimum stage and year of occurrence: 3.82 ft, 1950

Maximum stage and year of occurrence: 8.25 ft, 1943

Average annual water-level fluctuation: 0.80 ft

Maximum annual water-level fluctuation and occurrence: 1.58 ft, 1960

Stage datum information: Add 83.59 ft to lake stage to get benchmark 2014-A
datum. Benchmark 2014-A is a cast aluminum tablet set in a 6-ft concrete post
flush with ground located 28 ft south of access road centerline, 112 ft west of
lake on south side. Assumed elevation = 100.00 ft.

Comments: Lake shown on USGS 15-minute Wabeno quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	5.19	4.55	4.26	4.03	3.79	3.65
Maximum stage (ft)	5.98	6.79	7.26	7.68	8.17	8.51
Annual fluctuation (ft)	0.79	1.08	1.23	1.36	1.50	1.60

Comments: 33 years of record used in analysis.

WATER YEAR MAX-MIN

31

Name: Browns Lake   Station No.: 05545500   Report ID No.: 73

Location: Racine County near Burlington

Period of record: 1936-64, 1975-79 (1,971 stage records)

Hydrologic class: SWD

Drainage area: 2.5 mi^2 Surface area: 0.62 mi^2

Lake volume: 3,135 acre-ft   Maximum depth: 44 ft

Long-term mean stage: 5.86 ft   STD: 0.46 ft

Minimum stage and year of occurrence: 4.02 ft, 1956

Maximum stage and year of occurrence: 6.65 ft, 1960

Average annual water-level fluctuation: 0.93 ft

Maximum annual water-level fluctuation and occurrence: 2.28 ft, 1956

Stage datum information: Add 93.0 ft to lake stage to get benchmark datum.
Benchmark 599-A is a bronze tablet, marked "Railroad Commission of Wisconsin",
set in top of left wing wall of outlet dam, 1 ft from left end. Assumed
elevation = 100.00 ft.

Comments: Only one stage measurement in 1976 and 1979. 1976 = 5.46 ft, 1979 =
5.71 ft. Dam at outlet. Lake shown on USGS 7 1/2-minute Rochester quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	5.30	4.81	4.52	4.27	3.96	3.74
Maximum stage (ft)	6.37	6.51	6.55	6.57	6.58	6.58
Annual fluctuation (ft)	0.94	1.36	1.65	1.92	2.27	2.52

Comments: 27 years of record used in analysis.   WATER YEAR MAX-MIN

Name: Cedar Lake   Station No.: 04085500   Report ID No.:   9

Location: Manitowoc County near Kiel

Period of record: 1936-79 (3,648 stage records)

Hydrologic class: GWF

Drainage area: 1.33 mi^2 Surface area: 0.22 mi^2

Lake volume: 1,300 acre-ft   Maximum depth: 21 ft

Long-term mean stage: 7.42 ft   STD: 1.32 ft

Minimum stage and year of occurrence: 3.34 ft, 1959

Maximum stage and year of occurrence: 10.13 ft, 1979

Average annual water-level fluctuation: 1.23 ft

Maximum annual water-level fluctuation and occurrence: 2.57 ft, 1960

Stage datum information: Add 90.00 ft to lake stage to get Wisconsin Department
of Natural Resources assumed datum.

Comments: Lake shown on USGS 7 1/2-minute School Hill quadrangle map. Benchmark
not determined.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	6.12	5.06	4.47	3.97	3.39	2.99
Maximum stage (ft)	7.30	8.33	8.87	9.32	9.82	10.15
Annual fluctuation (ft)	1.19	1.57	1.80	2.00	2.25	2.42

Comments: 42 years of record used in analysis.

33
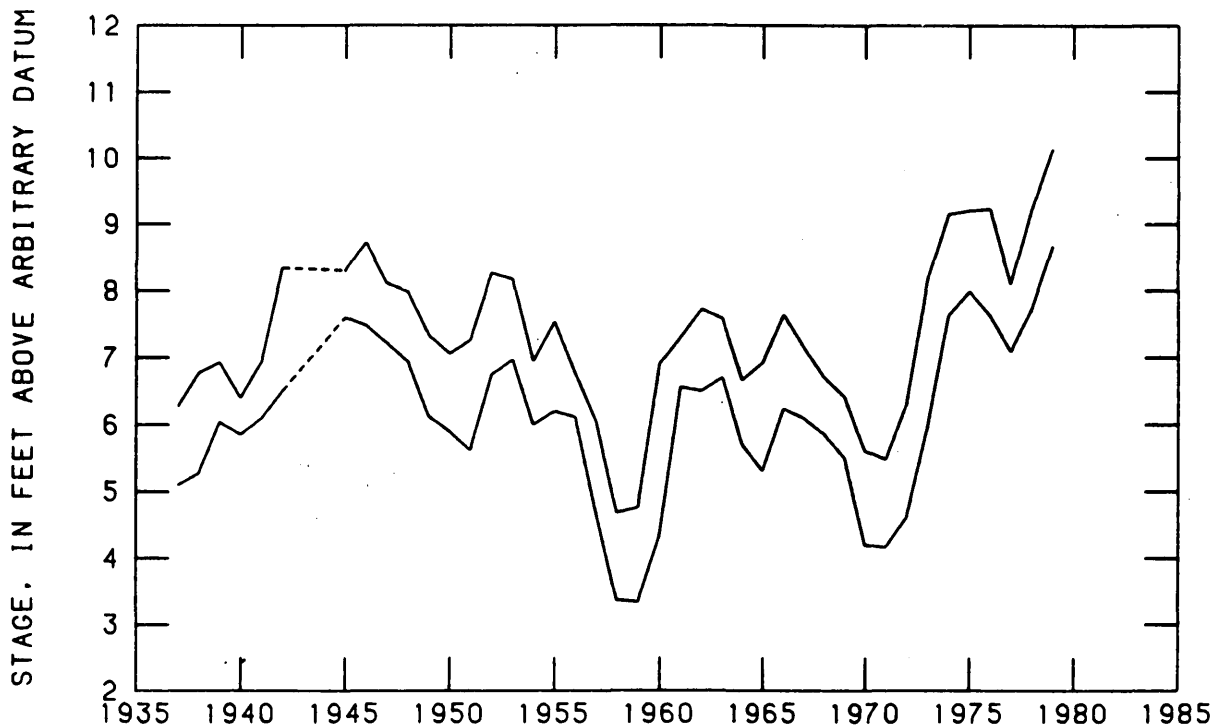
Name: Connors Lake   Station No.: 05359000   Report ID No.: 46

Location: Sawyer County near Phillips

Period of record: 1936-65, 1976-79 (1,673 stage records)

Hydrologic class: SWF

Drainage area: 20 mi^2 (approx.)   Surface area: 429 mi^2

Lake volume: 16,000 acre-ft   Maximum depth: 82 ft

Long-term mean stage: 1.01 ft   STD: 0.40 ft

Minimum stage and year of occurrence: -0.14 ft, 1937

Maximum stage and year of occurrence: 2.76 ft, 1941

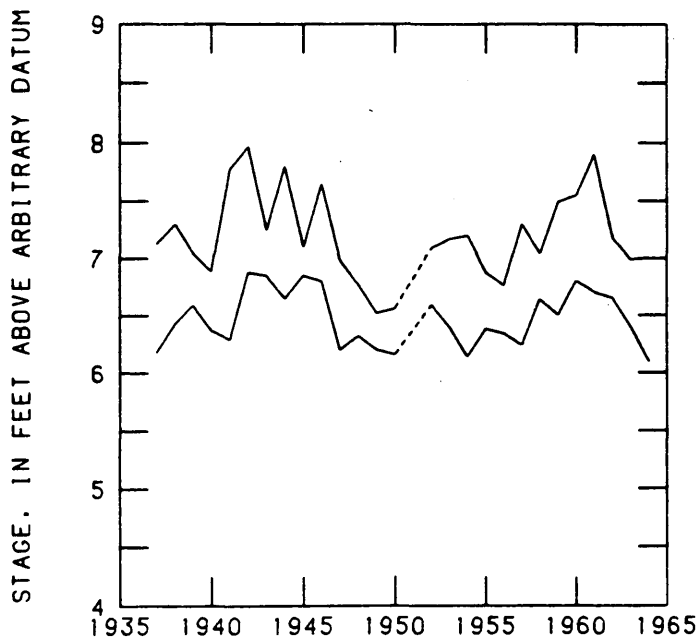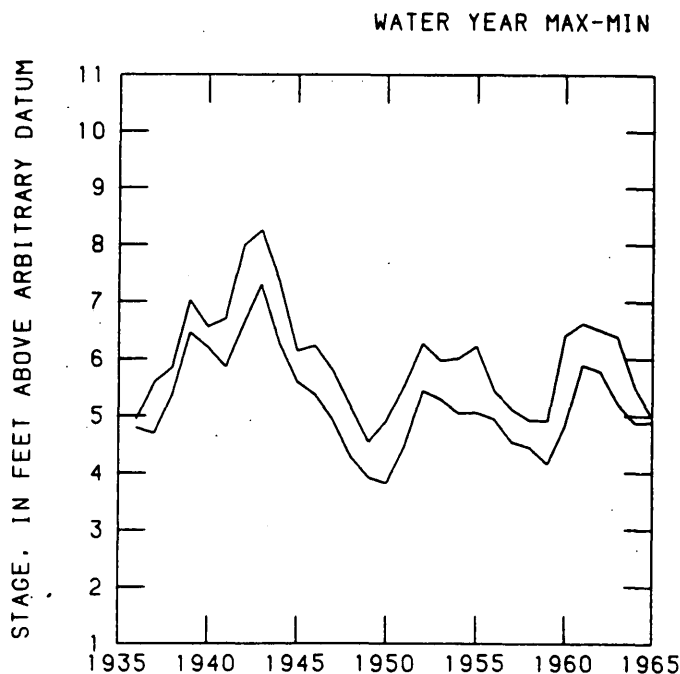Average annual water-level fluctuation: 1.01 ft

Maximum annual water-level fluctuation and occurrence: 2.28 ft, 1941

Stage datum information: Add 69.00 ft to lake stage to get benchmark datum.
Benchmark 708-A is a bronze tablet marked "Railroad Commission of Wisconsin" set
in concrete post on the property of the Connors Lake Resort on the southeast shore
of the lake. Located 94 ft south of main resort building. Assumed elevation =
100.00 ft. Later determined to be 1,419.07 ft mean sea level by USGS.

Comments: Only one stage measurement made in 1976 and 1977. 1976 = 0.63 ft,
1977 = 0.92 ft. Lake shown on USGS 7 1/2-minute Oxbo and Kennan NW quadrangle
maps.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	0.63	0.39	0.25	0.12	-0.03	-0.14
Maximum stage (ft)	1.69	2.13	2.35	2.53	2.72	2.84
Annual fluctuation (ft)	1.03	1.52	1.80	2.05	2.34	2.54

Comments: 30 years of record used in analysis.   WATER YEAR MAX-MIN
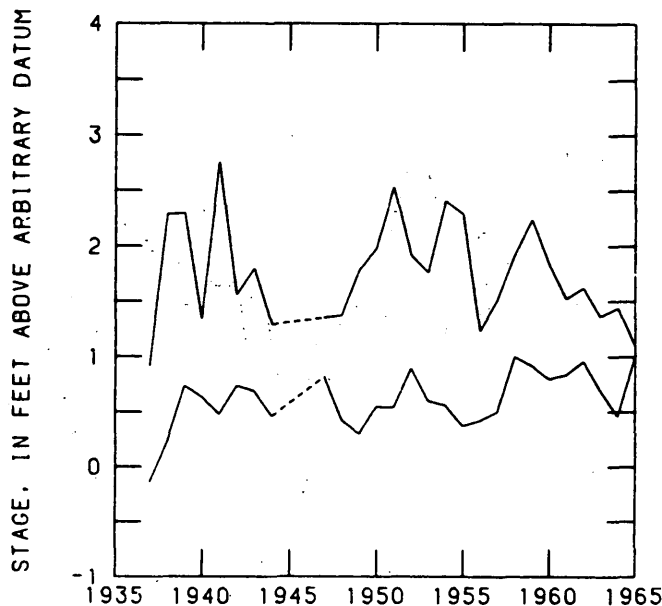
Name: Coyle Pond   Station No.: 430325089361601   Report ID No.: 10

Location: Dane County near Cross Plains

Period of record: 1975-79 (594 stage records)

Hydrologic class: GWF

Drainage area: 0.71 mi^2 Surface area: 0.03 mi^2

Lake volume: Not determined   Maximum depth: 6.0 ft

Long-term mean stage: 3.60 ft   STD: 0.91 ft

Minimum stage and year of occurrence: 2.03 ft, 1977

Maximum stage and year of occurrence: 5.90 ft, 1976

Average annual water-level fluctuation: 1.92 ft

Maximum annual water-level fluctuation and occurrence: 3.51 ft, 1976

Stage datum information: Not determined.

Comments: No USGS map reference. Stage records based on staff gage readings.

Name: Lake De Neveu   Station No.: 04084000   Report ID No.: 74

Location: Fond du Lac County near Fond du Lac

Period of record: 1936-64 (2,426 stage records)

Hydrologic class: SWD

Drainage area: 2 mi^2 (approx.)   Surface area: 0.12 mi^2

Lake volume: Not determined   Maximum depth: 67 ft

Long-term mean stage: 7.46 ft   STD: 0.14 ft

Minimum stage and year of occurrence: 6.90 ft, 1936

Maximum stage and year of occurrence: 8.32 ft, 1950

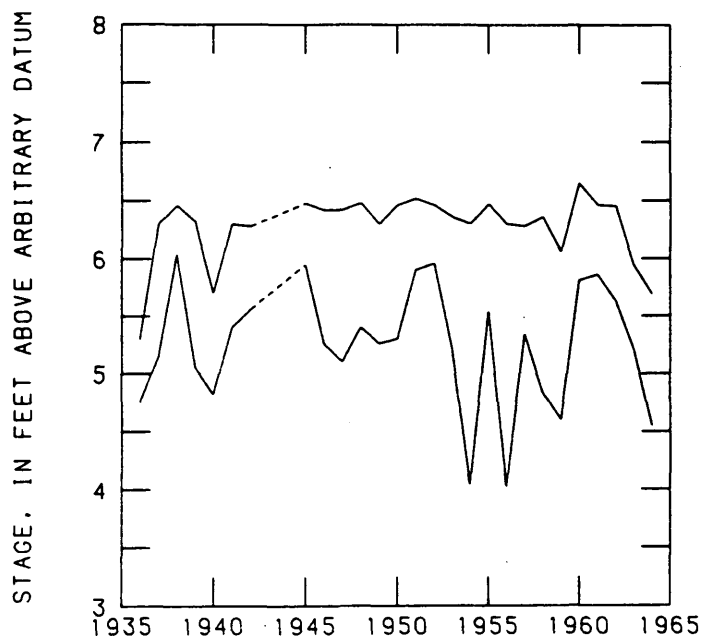Average annual water-level fluctuation: 0.66 ft

Maximum annual water-level fluctuation and occurrence: 1.14 ft, 1956

Stage datum information: Add 87.32 ft to lake stage to get benchmark datum.
Benchmark 811-B is a square cut in top of right wall of outlet dam, 3 ft north
of gate. Assumed elevation = 98.46 ft.

Comments: Dam at outlet. Lake shown on USGS 15-minute Campbellsport quadrangle
map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	7.23	7.13	7.07	7.00	6.93	6.87
Maximum stage (ft)	7.86	8.05	8.15	8.24	8.34	8.41
Annual fluctuation (ft)	0.64	0.84	0.96	1.06	1.19	1.28

Comments: 29 years of record used in analysis.

WATER YEAR MAX-MIN

36
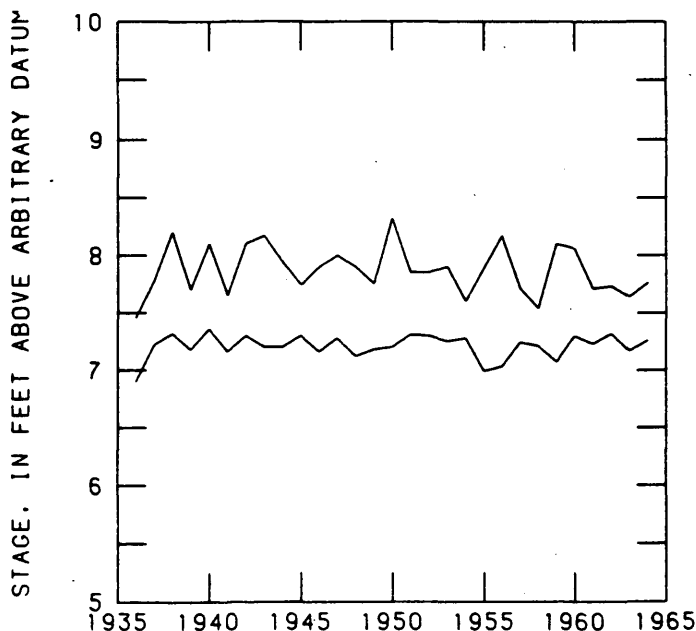
Name: Devil's Lake   Station No.: 05334495   Report ID No.: 13

Location: Burnett County near Webster

Period of record: 1979 (17 stage records)

Hydrologic class: GWF

Drainage area: 14.0 mi^2 Surface area: 1.66 mi^2

Lake volume: Not determined   Maximum depth: 21 ft

Long-term mean stage: 4.60 ft   STD: 0.23 ft

Minimum stage and year of occurrence: 3.96 ft, 1979

Maximum stage and year of occurrence: 4.80 ft, 1979

1979 water-level fluctuation: 0.84 ft

Comments: Stage record based on staff gage readings. Lake shown on USGS
15-minute Webster, Wis.-Minn., quadrangle map.

Name: Devil's Lake   Station No.: 05404500   Report ID No.: 12

Location: Sauk County near Baraboo

Period of record: 1922-79 (4,381 stage records)

Hydrologic class: GWF

Drainage area: 5.64 mi^2 Surface area: 0.59 mi^2

Lake volume: Not determined   Maximum depth: 40 ft

Long-term mean stage: 6.22 ft   STD: 1.90 ft

Minimum stage and year of occurrence: 1.49 ft, 1965

Maximum stage and year of occurrence: 12.40 ft, 1973

Average annual water-level fluctuation: 2.64 ft

Maximum annual water-level fluctuation and occurrence: 5.81 ft, 1960

Stage datum information: Add 956.39 ft to lake stage to get mean sea level

Comments: Daily stage records for 1937-40 water years.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	5.26	3.84	3.11	2.50	1.82	1.37
Maximum stage (ft)	8.05	9.44	10.09	10.59	11.11	11.43
Annual fluctuation (ft)	2.58	3.72	4.37	4.92	5.56	6.01

Comments: 56 years of record used in analysis.   WATER YEAR MAX-MIN

38
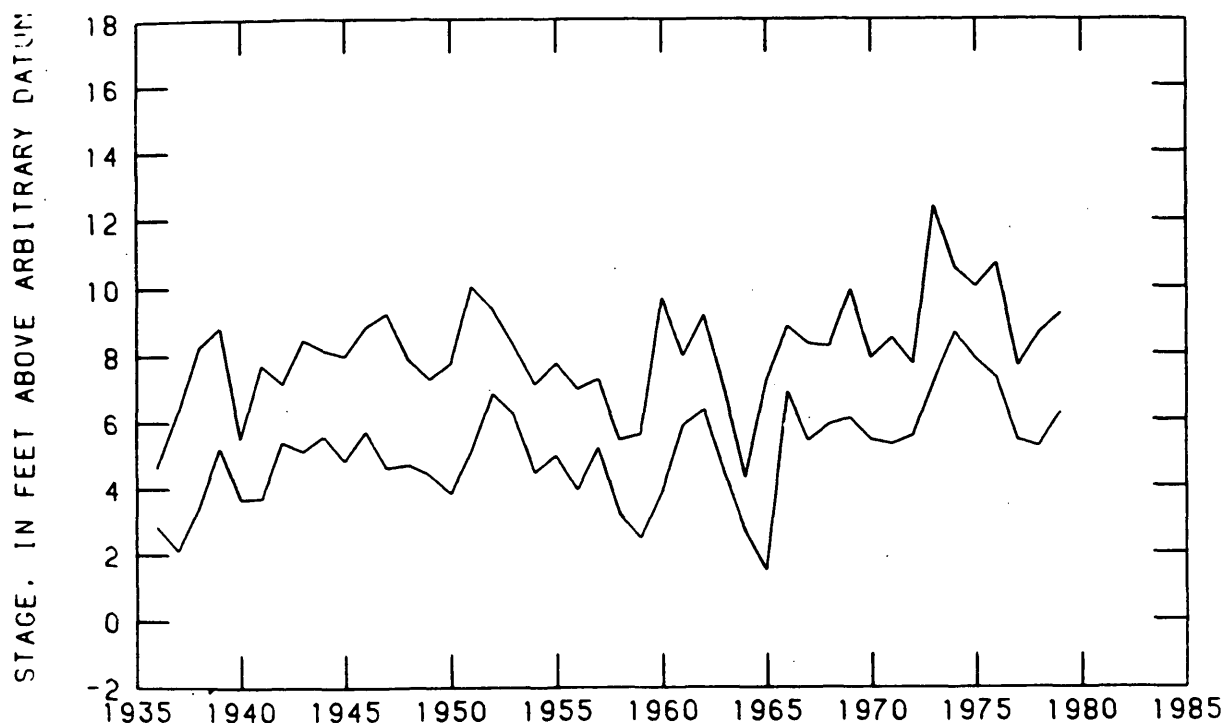
Name: Eagle Lake   Station No.: 05544500   Report ID No.: 75

Location: Racine County near Kansasville

Period of record: 1936-64, 1975-77 (1,858 stage records)

Hydrologic class: SWD

Drainage area: 6.1 mi^2 Surface area: 0.81 mi^2

Lake volume: 3,670 acre-ft   Maximum depth: 15 ft

Long-term mean stage: 6.30 ft   STD: 0.56 ft

Minimum stage and year of occurrence: 4.31 ft, 1964

Maximum stage and year of occurrence: 7.80 ft, 1942

Average annual water-level fluctuation: 1.14 ft

Maximum annual water-level fluctuation and occurrence: 2.00 ft, 1944

Stage datum information: Not determined

Comments: One stage measurement made in 1979, 5.89 ft. Dam at outlet. Lake shown on USGS 7 1/2-minute Rochester and Union Grove quadrangle maps. Original benchmarks destroyed.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	5.50	4.99	4.71	4.47	4.19	4.00
Maximum stage (ft)	6.83	7.24	7.38	7.46	7.53	7.56
Annual fluctuation (ft)	1.21	1.59	1.78	1.95	2.13	2.26

Comments: 32 years of record used in analysis.

WATER YEAR MAX-MIN

39
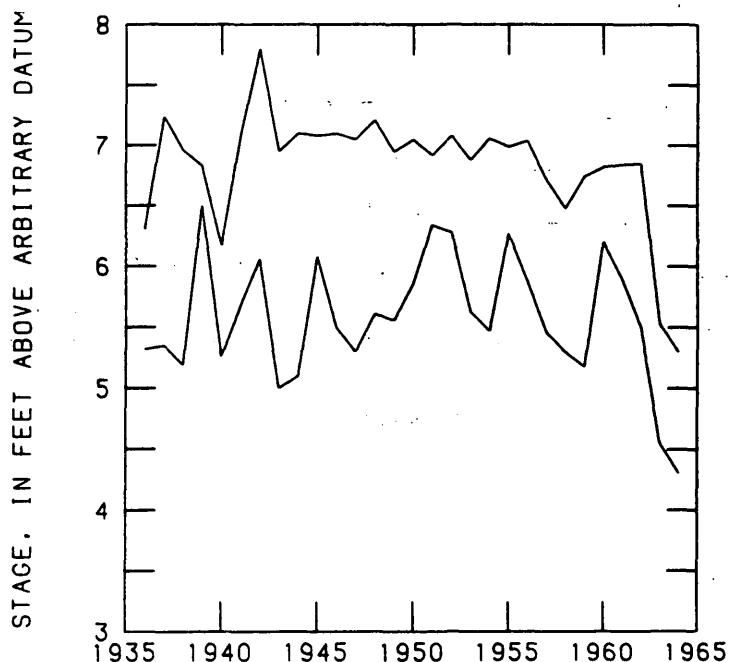
Name: Ennis Lake   Station No.: 04072734   Report ID No.: 76

Location: Marquette County near Endeavor

Period of record: 1978-79 (15 stage records)

Hydrologic class: SWD

Drainage area: 1.0 mi^2 Surface area: 0.05 mi^2

Lake volume: Not determined   Maximum depth: 30 ft

Long-term mean stage: 5.15 ft   STD: 0.09 ft

Minimum stage and year of occurrence: 4.90 ft, 1967

Maximum stage and year of occurrence: 5.25 ft, 1979

1979 water-level fluctuation: 0.24 ft

Stage datum information: Add 91.90 ft to lake stage to get benchmark datum.
Benchmark No. 1 is a white painted pipe in ground near tree to the south of the
boat launching ramp. Assumed elevation = 100.00 ft.

Comments: One stage measurement made in 1967 = 4.90 ft. Water-level fluctuation
based on 1979 water year data, 13 records. Lake shown on USGS 15-minute
Portage quadrangle map.

Name: Lake Emily   Station No.: 04080865   Report ID No.: 15

Location: Portage County near Amherst Junction

Period of record: 1977-79 (89 stage records)

Hydrologic class: GWF

Drainage area: 1.04 mi^2 Surface area: 0.16 mi^2

Lake volume: Not determined   Maximum depth: 36 ft

Long-term mean stage: 4.88 ft   STD: 0.51 ft

Minimum stage and year of occurrence: 4.32 ft, 1978

Maximum stage and year of occurrence: 6.03 ft, 1977

Average annual water-level fluctuation: 1.08 ft

Maximum annual water-level fluctuation and occurrence: 1.69 ft, 1977

Stage datum information: Not determined. Reference Point No. 1 is file marks
on top of large culvert between lake and pond at northeast end of lake. Assumed
elevation = 10.00 ft.

Comments: Lake shown on USGS 7 1/2-minute Amherst quadrangle map.

Name: Fish Lake   Station No.: 05406050   Report ID No.: 16

Location: Dane County near Sauk City

Period of record: 1967-79 (451 stage records)

Hydrologic class: GWF

Drainage area: 8.97 mi^2 Surface area: 0.39 mi^2

Lake volume: Not determined   Maximum depth: 62 ft

Long-term mean stage: 5.54 ft   STD: 1.50 ft

Minimum stage and year of occurrence: 3.02 ft, 1970

Maximum stage and year of occurrence: 8.20 ft, 1976

Average annual water-level fluctuation: 1.21 ft

Maximum annual water-level fluctuation and occurrence: 2.05 ft, 1973

Stage datum information: Add 848.07 ft to lake stage to get mean sea level.
Benchmark 2026-A is a 6-ft concrete post, 6-in. diameter, set 33 ft west of
centerline of Town Road, and 36 ft south of shelter house drive-in, 2 ft north of
fenceline, near public landing on west side of lake. Elevation = 863.36 ft mean
sea level.

Comments: Lake shown on USGS 15-minute Baraboo quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	4.64	3.44	2.84	2.37	1.86	1.53
Maximum stage (ft)	5.89	7.26	7.99	8.60	9.29	9.76
Annual fluctuation (ft)	1.20	1.56	1.75	1.91	2.10	2.23

Comments: 13 years of record used in analysis.   MAX-MIN

41

Name: Fish Lake   Station No.: 05401537   Report ID No.: 17

Location: Waushara County near Hancock

Period of record: 1971-72, 1978-79 (97 stage records)

Hydrologic class: GWF

Drainage area: 2.0 mi^2 Surface area: 0.28 mi^2

Lake volume: Not determined   Maximum depth: 42 ft

Long-term mean stage: 93.22 ft   STD: 1.46 ft

Minimum stage and year of occurrence: 91.73 ft, 1971

Maximum stage and year of occurrence: 96.16 ft, 1979

Average annual water-level fluctuation: 0.88 ft

Maximum annual water-level fluctuation and occurrence: 2.20 ft, 1979

Stage datum information: Add 971.00 ft to lake stage to get mean sea level.
Reference mark is top of observation well Ws-661 at old lakeside lodge site at
east end of lake (lodge burned down). Assumed elevation = 100.00 ft.

Comments: One stage measurement in 1973, 92.91 ft. Lake shown on USGS
7 1/2-minute Richford, Plainfield, and Hancock quadrangle maps.

Name: Fish Lake

Name: Fish Lake   Station No.: 04073410   Report ID No.: 80

Location: Waushara County near Wautoma

Period of record: 1966-77, 1979 (324 stage records)

Hydrologic class: SWD

Drainage area: 2.0 mi^2 Surface area: 0.45 mi^2

Lake volume: Not determined   Maximum depth: 5 ft

Long-term mean stage: 1.24 ft   STD: 0.54 ft

Minimum stage and year of occurrence:: 0.03 ft, 1967

Maximum stage and year of occurrence:: 2.04 ft, 1975

Average annual water-level fluctuation: 0.68 ft

Maximum annual water-level fluctuation and occurrence:: 1.14 ft, 1976

Stage datum information: Not determined. Reference mark is bronze disk marked "Railroad Commission of Wisconsin" set in concrete wall of culvert at State Highway 21. Gage elevation = 5.48 ft.

Comments: Stage fluctuation-frequency curves developed from stage records and presented in Appendix II. Lake shown on USGS 7 1/2-minute Spring Lake quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	0.58	0.22	0.05	-0.08	-0.21	-0.28
Maximum stage (ft)	1.27	1.72	1.97	2.18	2.44	2.61
Annual fluctuation (ft)	0.68	0.88	0.99	1.08	1.18	1.24

Comments: 13 years of record used in analysis.   MAX-MIN

43
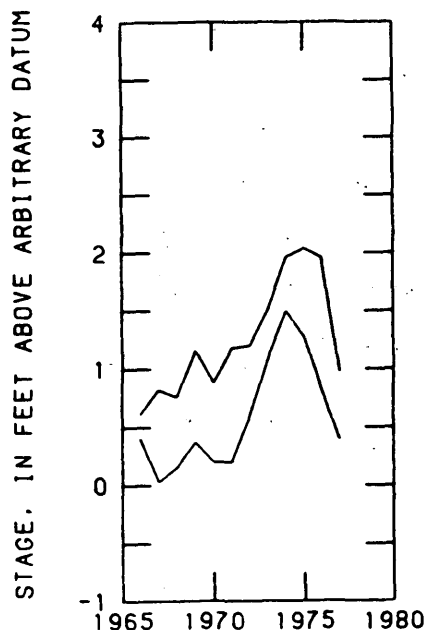
Name: Franklin Lake   Station No.: 04063032   Report ID No.: 77

Location: Forest County near Eagle River

Period of record: 1977-79 (22 stage records)

Hydrologic class: SWD

Drainage area: 5.22 mi^2 Surface area: 2.35 mi^2

Lake volume: Not determined   Maximum depth: 53 ft

Long-term mean stage: 98.01 ft   STD: 0.44 ft

Minimum stage and year of occurrence: 97.01 ft, 1977

Maximum stage and year of occurrence: 98.72 ft, 1979

Average annual water-level fluctuation: 0.67 ft

Maximum annual water-level fluctuation and occurrence: 0.77 ft, 1977

Stage datum information: Not determined. Reference Point No. 1 is a lag screw in white pine overhanging lake 175 ft south of boat landing at east end of lake. Assumed elevation = 99.76 ft.

Comments: One stage measurement made in 1976 = 97.38 ft. Lake shown on USGS 7 1/2-minute Anvil Lake and Alvin NW quadrangle maps.

Name: Hoinville Lake   Station No.: 05332715   Report ID No: 18

Location: Washburn County near Minong

Period of record: 1975-79 (40 stage records)

Hydrologic class: GWF

Drainage area: 0.43 mi^2 Surface area: 0.10 mi^2

Lake volume: 581 acre-ft   Maximum depth: 23 ft

Long-term mean stage: 8.23 ft   STD: 0.69 ft

Minimum stage and year of occurrence: 6.86 ft, 1977

Maximum stage and year of occurrence: 9.24 ft, 1979

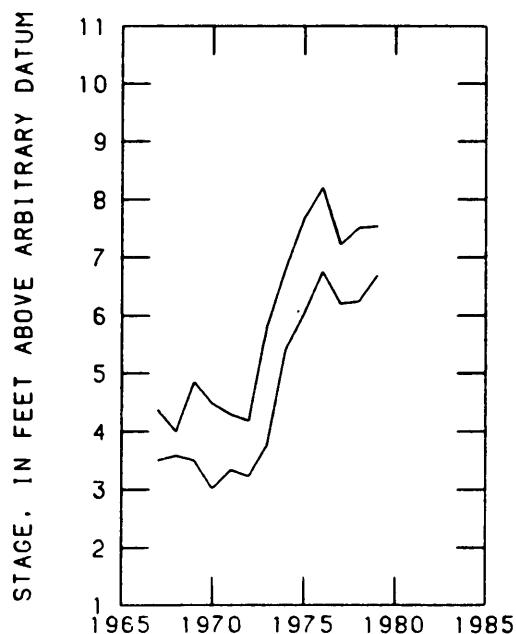Average annual water-level fluctuation: 0.62 ft

Maximum annual water-level fluctuation and occurrence: 1.29 ft, 1976

Stage datum information: Add 81.44 ft to lake stage to get benchmark datum. Benchmark 1318-A is a bronze disk set in a concrete post 2 in. above ground, located 29 ft east of shoreline, about 20 ft south of the Boy Scout camp beach area at the east end of the lake. Assumed elevation = 100.00 ft.

Comments: Only one stage measurement made in 1978, 7.70 ft. Lake shown on USGS 15-minute Minong and Webb Lake quadrangle maps.

Name: Hope Lake   Station No.: 05427503   Report ID No: 79

Location: Jefferson County near Cambridge

Period of record: 1976-79 (19 stage records)

Hydrologic class: SWD

Drainage area: 1.77 mi^2 Surface area: 0.17 mi^2

Lake volume: Not determined   Maximum depth: 24 ft

Long-term mean stage: 89.11 ft   STD: 0.86 ft

Minimum stage and year of occurrence: 88.23 ft, 1977

Maximum stage and year of occurrence: 91.37 ft, 1979

Average annual water-level fluctuation: 1.42 ft

Maximum annual water-level fluctuation and occurrence: 1.66 ft, 1979

Stage datum information: Not determined

Comments: Lake shown on USGS 7 1/2-minute Lake Mills quadrangle map.

Name: Howe Lake   Station No.: 05363099   Report ID No.: 19

Location: Chippewa County near Jim Falls

Period of record: 1977-79 (83 stage records)

Hydrologic class: GWF

Drainage area: 1.00 mi^2 Surface area: 0.10 mi^2

Lake volume: Not determined   Maximum depth: 28 ft

Long-term mean stage: 9.40 ft   STD: 0.24 ft

Minimum stage and year of occurrence: 8.01 ft, 1977

Maximum stage and year of occurrence: 9.84 ft, 1978

Average annual water-level fluctuation: 0.89 ft

Maximum annual water-level fluctuation and occurrence: 1.63 ft, 1977

Stage datum information: Add 82.48 ft to lake stage to get Wisconsin Department
of Natural Resources benchmark datum.

Comments: Lake shown on USGS 7 1/2-minute Jim Falls quadrangle map.

Name: Huron Lake   Station No.: 05410063   Report ID No.: 20

Location: Waushara County near Plainfield

Period of record: 1978-79 (7 stage records)

Hydrologic class: GWF

Drainage area: Less than 1.0 mi²   Surface area: 0.08 mi²

Lake volume: Not determined   Maximum depth: 37 ft

Long-term mean stage: 89.02 ft   STD: 1.24 ft

Minimum stage and year of occurrence: 88.03 ft, 1978

Maximum stage and year of occurrence: 90.99 ft, 1979

Average annual water-level fluctuation: 1.55 ft

Maximum annual water-level fluctuation and occurrence: 2.73 ft, 1979

Stage datum information: Not determined. Benchmark 1828-A is a bronze disk
marked "DNR" set in a concrete post 20 ft southeast of a 12-in. oak, 29 ft south
of centerline of public boat access and 42 ft west of shore on northwest side of
lake. Assumed elevation = 100.00 ft.

Name: Kentuck Lake   Station No.: 04059784   Report ID No.: 81

Location: Vilas County near Eagle River

Period of record: 1979 (27 stage records)

Hydrologic class: SWD

Drainage area: 11.5 mi²   Surface area: 1.56 mi²

Lake volume: Not determined   Maximum depth: 40 ft

Long-term mean stage: 11.92 ft   STD: 0.16 ft

Minimum stage and year of occurrence: 11.68 ft

Maximum stage and year of occurrence: 12.20 ft

1979 water-level fluctuation: 0.52 ft

Stage datum information: Not determined. Reference point is a 2-in. diameter
pipe in lakebed (usually submerged). Assumed elevation = 10.00 ft, location
near staff gage at public access on west side of lake.

Comments: One stage measurement made in 1978 = 11.87 ft. Lake shown on USGS
7 1/2-minute Anvil Lake and Alvin NW quadrangle maps

Name: Knotting Lake   Station No.: 04027145   Report ID No.: 82

Location: Bayfield County near Cable

Period of record: 1975-76, 1978-79 (75 stage records)

Hydrologic class: SWD

Drainage area: 0.33 mi^2 Surface area: 0.12 mi^2

Lake volume: Not determined   Maximum depth: 15 ft

Long-term mean stage: 90.56 ft   STD: 0.32 ft

Minimum stage and year of occurrence: 89.36 ft, 1977

Maximum stage and year of occurrence: 91.02 ft, 1979

Average annual water-level fluctuation: 0.82 ft

Maximum annual water-level fluctuation and occurrence: 1.40 ft, 1976

Stage datum information: Not determined. Benchmark 2138 is a 1-in. square cut
in concrete at northeast corner of cottage, located 18 ft west of centerline of
drive, 125 ft south of lake edge, on the Palmer residence property at the
southeast side of the lake. Assumed elevation = 100.00 ft.

Comments: One stage measurements made in 1974 and 1977. 1974 = 90.62 ft,
1977 = 89.36 ft. Lake shown on the USGS 7 1/2-minute Grand View quadrangle map.

Name: Little Crooked Lake   Station No.: 05357168   Report ID No.: 47

Location: Vilas County near Boulder Junction

Period of record: 1979 (24 stage records)

Hydrologic class: SWF

Drainage area: 9.78 mi^2 Surface area: 0.22 mi^2

Lake volume: Not determined   Maximum depth: 20 ft

Long-term mean stage: 11.80 ft   STD: 0.17 ft

Minimum stage and year of occurrence: 11.43 ft, 1979

Maximum stage and year of occurrence: 12.19 ft, 1979

1979 water-level fluctuation: 0.76 ft

Stage datum information: Not determined. Reference Mark No. 1 is a lag screw
in base of 10-in. diameter balsam tree located 8 ft from shore next to pier at
"Timber-Lost" Resort on west side of lake. Assumed elevation = 14.53 ft.

Name: Little Green Lake   Station No.: 04073000   Report ID No.: 83

Location: Green Lake County near Markesan

Period of record: 1961 (307 stage records), 1979 (o stage records)

Hydrologic class: SWD

Drainage area: 5.0 mi^2 Surface area: 0.73 mi^2

Lake volume: 4,820 acre-ft   Maximum depth: 28 ft

Long-term mean stage: 5.80 ft   STD: 0.07 ft

Minimum stage and year of occurrence: 5.22 ft, 1961

Maximum stage and year of occurrence: 6.50 ft, 1961

1961 water-level fluctuation: 1.28 ft

Stage datum information: Add 90.00 ft to lake stage to get benchmark datum.
Benchmark 605-G is a 2-in. square cut in south end of concrete walk leading to
gas pump on south side of the tavern adjacent to State Highway 44 near the lake
outlet on east side of the lake. Assumed elevation = 100.41 ft.

Comments: Fluctuation data based on 1961 water year. Dam at outlet. Lake
shown on USGS 15-minute Fox Lake quadrangle map.

Name: Long Lake   Station No.: U4026100   Report ID No.: 23

Location: Bayfield County near Iron River

Period of record: 1965-79 (589 stage records)

Hydrologic class: GWF

Drainage area: 1.21 mi^2 Surface area: 0.29 mi^2

Lake volume: Not determined   Maximum depth: 22 ft

Long-term mean stage: 2.58 ft   STD: 0.87 ft

Minimum stage and year of occurrence: 1.39 ft, 1968

Maximum stage and year of occurrence: 4.60 ft, 1974

Average annual water-level fluctuation: 0.78 ft

Maximum annual water-level fluctuation and occurrence: 1.53 ft, 1976

Stage datum information: Local gage readings only.

Comments: Lake shown on USGS 15-minute Iron Lake quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	2.20	1.60	1.35	1.17	1.01	0.91
Maximum stage (ft)	3.04	3.91	4.41	4.84	5.35	5.70
Annual fluctuation (ft)	0.72	1.00	1.17	1.34	1.54	1.70

Comments: 15 years of record used in analysis.

WATER YEAR MAX-MIN

49

Name: Long Lake   Station No.: 432943089262201   Report ID No.: 49

Location: Columbia County near Portage

Period of record: 1978-79 (4 stage records)

Hydrologic class: SWF

Drainage area: 3.74 mi^2 Surface area: 0.10 mi^2

Lake volume: 341 acre-ft   Maximum depth: 8 ft

Long-term mean stage: 5.63 ft   STD: 1.91 ft

Minimum stage and year of occurrence: 4.10 ft, 1979

Maximum stage and year of occurrence: 8.32 ft, 1978

Average annual water-level fluctuation: 1.50 ft

Maximum annual water-level fluctuation and occurrence: 2.66 ft, 1978

Stage datum information: Not determined. Reference Mark No. 1 is a lag bolt in a powerpole at east end of public landing parking lot adjacent to Lake Road at east end of lake. Assumed elevation = 10.00 ft.

Comments: Lake is an old oxbow cutoff of Wisconsin River and is subject to overbank flooding. Lake shown on USGS 15-minute Portage quadrangle map.

Name: Long Lake   Station No.: 04063658   Report ID No.: 48

Location: Florence County at Long Lake

Period of record: 1977-79 (25 stage records)

Hydrologic class: SWF

Drainage area: 10.1 mi^2 Surface area: 0.49 mi^2

Lake volume: Not determined   Maximum depth: 23 ft

Long-term mean stage: 7.56 ft   STD: 0.23 ft

Minimum stage and year of occurrence: 7.24 ft, 1979

Maximum stage and year of occurrence: 8.41 ft, 1979

Average annual water-level fluctuation: 0.57 ft

Maximum annual water-level fluctuation and occurrence: 1.17 ft, 1979

Stage datum information: Not determined. Reference Point No. 1 is a 3/8-in. lag screw in 24-in. diameter white pine leaning over water approximately 100 ft south of boat landing on northeast side of lake adjacent to State Highway 139. Elevation = 9.18 ft

Comments: One stage measurement made in 1976 = 7.48 ft. Lake shown on USGS 7 1/2-minute Long Lake quadrangle map.

Name: Long Lake   Station No.: 05401065   Report ID No.: 22

Location: Waushara County near Plainfield

Period of record: 1977-79 (48 stage records)

Hydrologic class: GWF

Drainage area: 1 mi^2(approx.)   Surface area: 0.07 mi^2

Lake volume: Not determined   Maximum depth: 6 ft

Long-term mean stage: 8.45 ft   STD: 0.73 ft

Minimum stage and year of occurrence: 7.02 ft, 1978

Maximum stage and year of occurrence: 9.52 ft, 1979

Average annual water-level fluctuation: 1.26 ft

Maximum annual water-level fluctuation and occurrence: 1.52 ft, 1979

Stage datum information: Reference marks not determined.

Comments: Lake shown on USGS 7 1/2-minute Plainfield quadrangle map.

Name: Lake Lucerne   Station No.: 04074501   Report ID No.: 84

Location: Forest County near Crandon

Period of record: 1977-79 (25 stage records)

Hydrologic class: SWD

Drainage area: 11.53 mi^2 Surface area: 1.57 mi^2

Lake volume: 31,270 acre-ft   Maximum depth: 73 ft

Long-term mean stage: 7.08 ft   STD: 0.42 ft

Minimum stage and year of occurrence: 6.27 ft, 1977

Maximum stage and year of occurrence: 8.08 ft, 1979

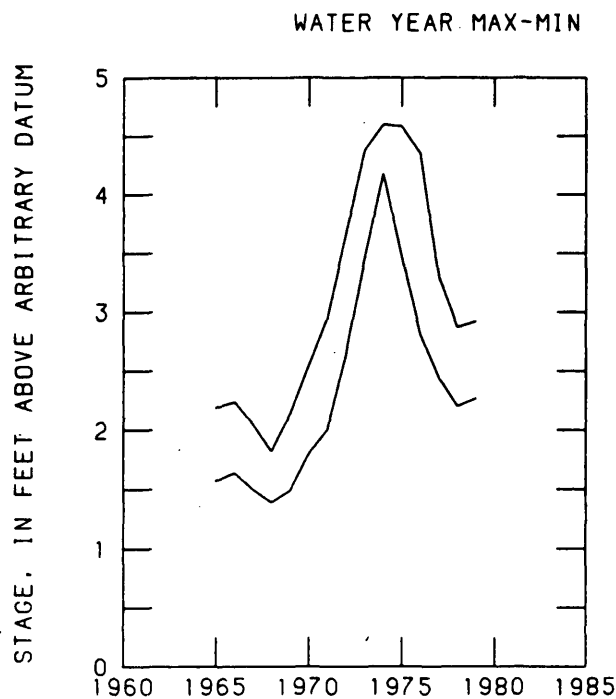Average annual water-level fluctuation: 0.79 ft

Maximum annual water-level fluctuation and occurrence: 1.08 ft, 1979

Stage datum information: Not determined. Reference Mark No. 2 is top of an
iron post in outlet channel, second from outlet culvert on west side of lake.
Assumed elevation = 8.61 ft.

Comments: Water-level control culvert outlet. Lake shown on USGS 7 1/2-minute
Lake Lucerene quadrangle map.

Location: Burnett County near Spooner

Period of record: 1936-78 (1,598 stage records)

Hydrologic class: SWD

Drainage area: 25 mi^2 Surface area: 1.85 mi^2

Lake volume: 22,100 acre-ft   Maximum depth: 71 ft

Long-term mean stage: 0.10 ft   STD: 0.40 ft

Minimum stage and year of occurrence: -0.52 ft, 1950

Maximum stage and year of occurrence: 1.36 ft, 1937

Average annual water-level fluctuation: 0.68 ft

Maximum annual water-level fluctuation and occurrence: 1.06 ft, 1951

Stage datum information: Not determined. Benchmark No. 5 is a 3/8-in. lag screw in powerpole, located approximately 2.5 ft above ground facing road. Pole is approximately 21 ft southeast of County Highway E bridge. Elevation = 4.50 ft.

Comments: Lake shown on USGS 15-minute Hertel quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	-0.29	-0.57	-0.70	-0.79	-0.89	-0.95
Maximum stage (ft)	0.41	0.76	0.96	1.13	1.34	1.49
Annual fluctuation (ft)	0.69	0.54	0.47	0.41	0.35	0.31

Comments: 42 years of record used in analysis.

WATER YEAR MAX-MIN

52
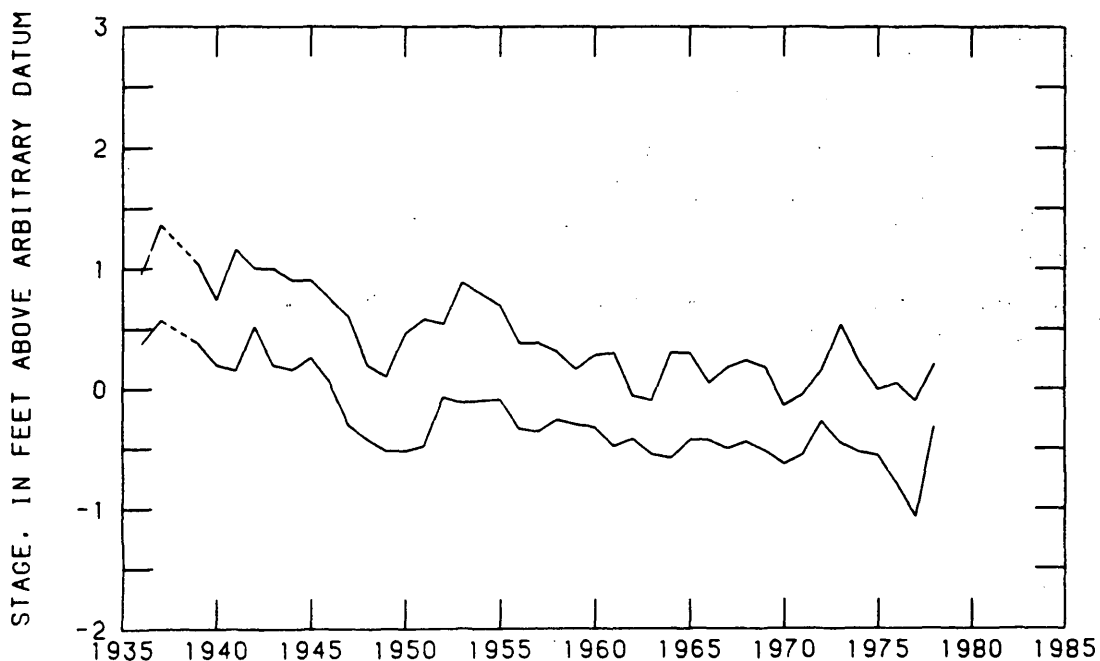
Name: Mecan Springs   Station No.: 04073179   Report ID No.: 85

Location: Waushara County near Hancock

Period of record: 1978-79 (118 stage records)

Hydrologic class: SWD

Drainage area: 1.0 mi^2 Surface area: 0.06 mi^2

Lake volume: Not determined   .   Maximum depth: 21 ft

Long-term mean stage: 5.97 ft   STD: 0.21 ft

Minimum stage and year of occurrence: 5.69 ft, 1978

Maximum stage and year of occurrence: 6.74 ft, 1978

Average annual water-level fluctuation: 0.75 ft

Maximum annual water-level fluctuation and occurrence: 1.05 ft, 1978

Stage datum information: Not determined. Reference Mark No. 1 is top of upstream
end of culvert on County Highway GG at lake outlet. Assumed elevation = 10.13 ft.

Comments: Water-level control dam at outlet. Lake shown on USGS 7 1/2-minute
Richford quadrangle map.

Name: Lake Mendota   Station No.: 0542600   Report ID No.: 50

Location: Dane County at Madison

Period of record: 1916-79 (19,083 stage records)

Hydrologic class: SWF

Drainage area: 254 mi^2 Surface area: 15.2 mi^2

Lake volume: Not determined   Maximum depth: 82 ft

Long-term mean stage: 1.73 ft   STD: 0.51 ft

Minimum stage and year of occurrence: 0.20 ft, 1920

Maximum stage and year of occurrence: 4.19 ft, 1959

Average annual water-level fluctuation: 1.61 ft

Maximum annual water-level fluctuation and occurrence: 3.35 ft, 1959

Stage datum information: Add 847.65 ft to lake stage to get mean sea level.
Water-level gage located in stilling well at police boathouse at lock and dam at
outlet.

Comments: Daily stage records for entire record period. Lake level regulated
by dam at outlet. Lake shown on USGS 15-minute Madison quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	1.05	0.72	0.54	0.39	0.21	0.09
Maximum stage (ft)	2.59	3.02	3.28	3.50	3.77	3.96
Annual fluctuation (ft)	1.55	2.10	2.42	2.71	3.05	3.30

Comments: 64 years of record used in analysis.   WATER YEAR MAX-MIN

54
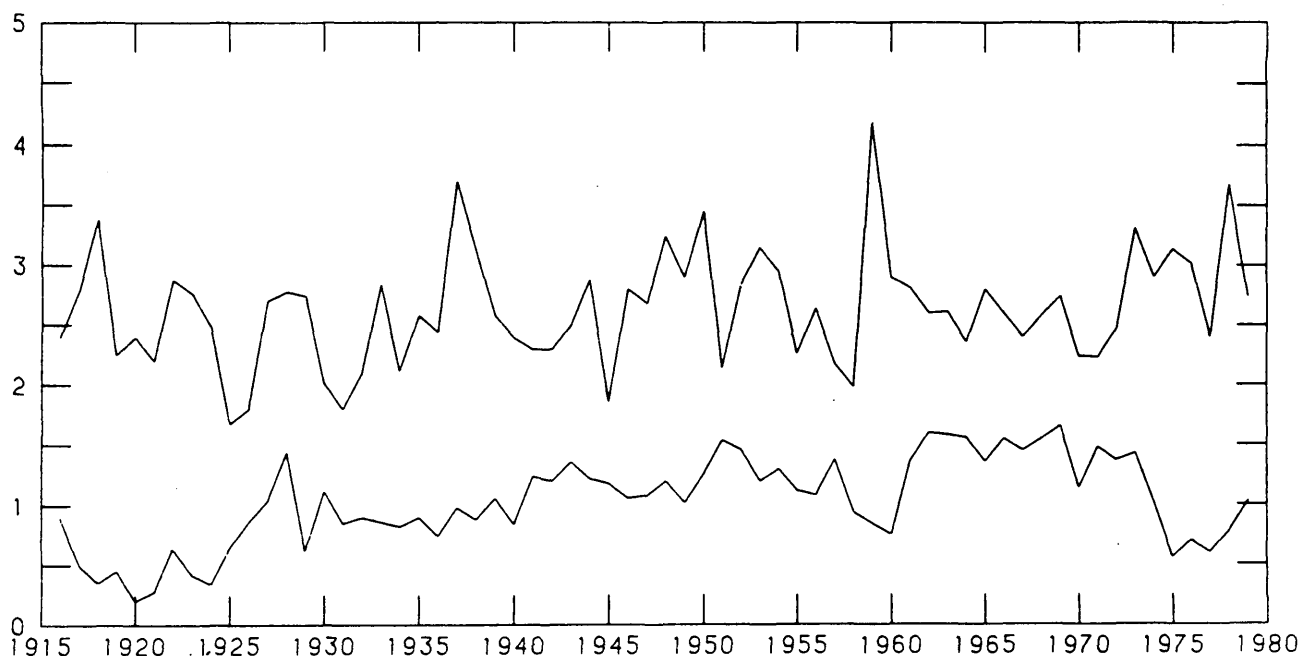
Name: Lake Monona   Station No.: 0542900   Report ID No.: 51

Location: Dane County at Madison

Period of record: 1915-79 (17,004 stage records)

Hydrologic class: SWF

Drainage area: 279 mi^2 Surface area: 5.21 mi^2

Lake volume: Not determined   Maximum depth: 64 ft

Long-term mean stage: 1.34 ft   STD: 0.62 ft

Minimum stage and year of occurrence: -0.39 ft, 1965

Maximum stage and year of occurrence: 3.66 ft, 1929

Average annual water-level fluctuation: 1.95 ft

Maximum annual water-level fluctuation and occurrence: 3.31 ft, 1937

Stage datum information: Add 843.61 ft to lake stage to get mean sea level.

Comments: Only 8 stage records for 1915. Daily stage records for 1918-36, 1945, 1954-55, and 1972-79. Lake Waubesa outlet dam controls water level. Lake shown on USGS 15-minute Madison quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	0.34	0.09	0.01	-0.03	-0.05	-0.06
Maximum stage (ft)	2.42	2.95	3.23	3.47	3.74	3.92
Annual fluctuation (ft)	1.93	2.49	2.79	3.05	3.35	3.55

Comments: 65 years of record used in analysis.

WATER YEAR MAX-MIN
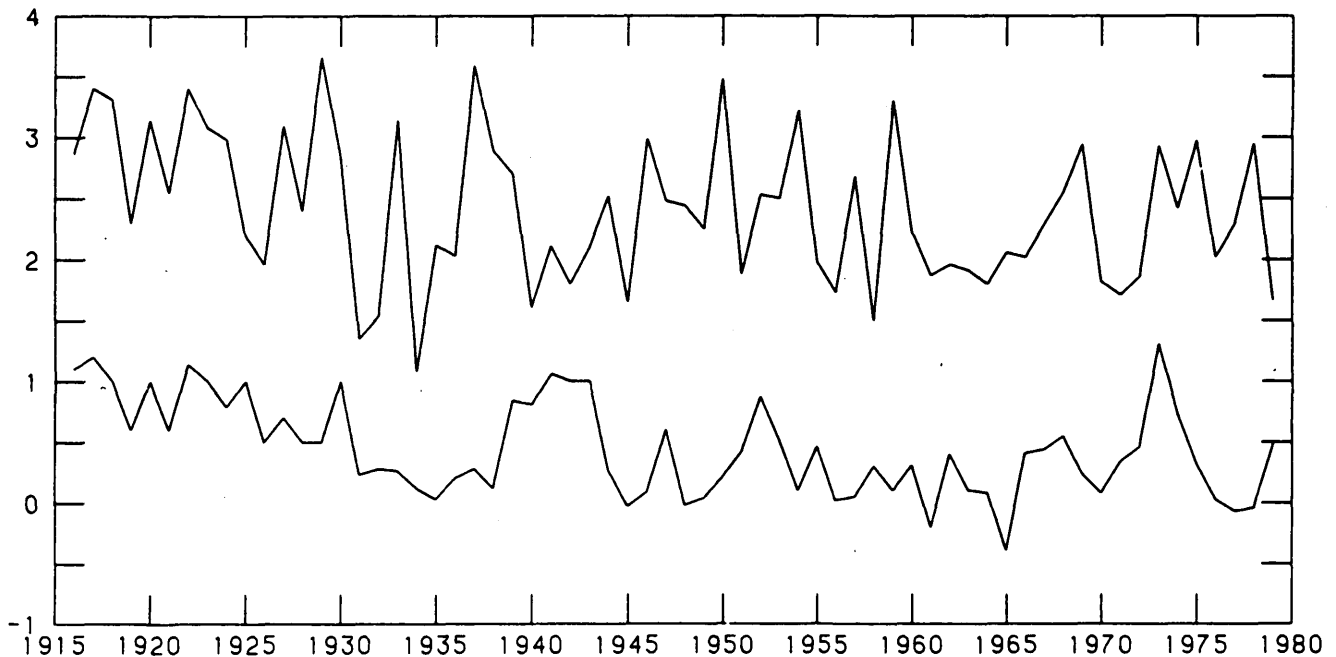
Name: Morgan Lake   Station No.: 04063678   Report ID No.: 24

Location: Florence County near Fence

Period of record: 1971-79 (29 stage records)

Hydrologic class: GWF

Drainage area: 0.14 mi^2 Surface area: 1.07 mi^2

Lake volume: Not determined   Maximum depth: 10 ft

Long-term mean stage: 5.11 ft   STD: 0.43 ft

Minimum stage and year of occurrence: 4.35 ft, 1977

Maximum stage and year of occurrence: 5.86 ft, 1977

Average annual water-level fluctuation: 0.93 ft

Maximum annual water-level fluctuation and occurrence: 1.51 ft, 1977

Stage datum information: Add 90.00 ft to lake stage to get benchmark datum.
Benchmark No. 1 is a galvanized lag bolt 1 ft above ground in north side of 8 in.
birch tree, 36 ft east of circle at boat landing access road. Assumed elevation =
100.00 ft.

Name: Morse Pond   Station No.: 05435929   Report ID No.: 25

Location: Dane County near Verona

Period of record: 1975-79 (591 stage records)

Hydrologic class: GWF

Drainage area: 0.70 mi^2 Surface area: 0.02 mi^2

Lake volume: Not determined   Maximum depth: 10 ft

Long-term mean stage: 13.73 ft   STD: 0.60 ft

Minimum stage and year of occurrence: 11.89 ft, 1977

Maximum stage and year of occurrence: 17.52 ft, 1978

Average annual water-level fluctuation: 3.49 ft

Maximum annual water-level fluctuation and occurrence: 4.16 ft, 1978

Stage datum information: Add 80.17 ft to lake stage to get reference mark datum.
Reference Mark No. 1 is a lag screw in west side of a large oak tree on east side
of pond near south end, between pond on County Highway M, about 4 ft above ground.
Elevation of top edge of lag screw assumed = 100.00 ft.

Comments: Lake shown on USGS 7 1/2-minute Middleton quadrangle map.

56

Name: Mud Lake   Station No.: 05405499   Report ID No.: 86

Location: Columbia County near Poynette

Period of record: 1976-79 (26 stage records)

Hydrologic class: SWD

Drainage area: 10.64 mi^2 Surface area: 1.10 mi^2

Lake volume: Not determined   Maximum depth: 1 ft

Long-term mean stage: 8.41 ft   STD: 0.48 ft

Minimum stage and year of occurrence: 7.70 ft, 1976

Maximum stage and year of occurrence: 9.65 ft, 1979

Average annual water-level fluctuation: 0.88 ft

Maximum annual water-level fluctuation and occurrence: 1.58 ft, 1976

Stage datum information: Not determined

Comments: Only two stage measurements made in 1976 and 1979. Lake shown on
USGS 15-minute Poynette quadrangle map.

Name: Mystery Lake   Station No.: 05357219   Report ID No.: 52

Location: Vilas County near Boulder Junction

Period of record 1976-79 (27 stage records)

Hydrologic class: SWF

Drainage area: 0.70 mi^2 Surface area 0.03 mi^2

Lake volume: Not determined   Maximum depth: 7 ft

Long-term mean stage: 5.68 ft   STD: 0.39 ft

Minimum stage and year of occurrence: 5.03 ft, 1978

Maximum stage and year of occurrence: 6.50 ft, 1979

Average annual water-level fluctuation: 0.87 ft

Maximum annual water-level fluctuation and occurrence: 1.11 ft, 1979

Stage datum information: Not determined. Reference Point No. 1 is a 1 1/4-in.
pipe driven into lakebed at the intersection of the boat landing channel and
the lake. Top of pipe has assumed elevation = 10.00 ft.

Comments: Only one stage measurement made in 1976, 5.70 ft.

Name: Lake Nebagamon   Station No.: 04025436   Report ID No.: 53

Location: Douglas County near Lake Nebagamon

Period of record 1978-79 (19 stage records)

Hydrologic class: SWF

Drainage area: 40.9 mi^2 Surface area 1.50 mi^2

Lake volume: Not determined   Maximum depth 56 ft

Long-term mean stage: 3.24 ft   STD: 0.81 ft

Minimum stage and year of occurrence: 2.18 ft, 1976

Maximum stage and year of occurrence: 6.00 ft, 1978

Average annual water-level fluctuation: 2.29 ft

Maximum annual water-level fluctuation and occurrence: 3.35 ft, 1978

Stage datum information: Add 86.88 ft to lake stage to get benchmark datum.
Benchmark 1479-A is a 2-in. square cut in the southwest corner of the concrete
wall of the schoolyard of village of Lake Nebagamon. Located 110 ft north of
lake and 33 ft east of centerline of boat landing road, at the corner of 1st
Street and 5 ft northeast of lightpole at corner. Assumed elevation =
100.00 ft.

Comments: One stage measurement made in 1976 and 1977. 1976 = 28.1 ft and 1977 =
2.88 ft. Lake shown on USGS 15-minute Brule and Ellison Lake quadrangle maps.

Name: North Lake   Station No.: 05545000   Report ID No.: 26

Location: Walworth County near Elkhorn
Period of record 1937-79 (3,652 stage records)

Hydrologic class: GWF

Drainage area: 1 mi^2 Surface area 0.55 mi^2

Lake volume: Not determined   · Maximum depth 11 ft

Long-term mean stage: 9.86 ft   STD: 1.60 ft

Minimum stage and year of occurrence: 5.81 ft, 1959

Maximum stage and year of occurrence: 15.62 ft, 1974

Average annual water-level fluctuation: 1.56 ft

Maximum annual water-level fluctuation and occurrence: 3.70 ft, 1946

Stage datum information: Not determined. Benchmark No. 1 is top of lag screw
in 42-in. diameter burr oak tree, 2 ft above ground. Tree is 60 ft northeast of
boathouse and 120 ft northeast of gage at public access on south side of lake.
Elevation is 18.76 ft when referred to zero of the staff gage.

Comments: Lake shown on USGS 7 1/2-minute Delavan and Elkhorn quadrangle maps.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	8.67	7.45	6.91	6.51	6.10	5.86
Maximum stage (ft)	10.16	11.79	12.77	13.69	14.81	15.60
Annual fluctuation (ft)	1.42	2.07	2.50	2.90	3.40	3.77

Comments: 43 years of record used in analysis.

WATER YEAR MAX-MIN

59

Location: Vilas County near Land O'Lakes
Period of record 1938-41, 1976-79 (210 stage records)

Hydrologic class: SWF

Drainage area: 15 mi^2 (approx.)   Surface area 0.99 mi^2

Lake volume: 5,013 acre-ft   Maximum depth 13 ft

Long-term mean stage: 2.02 ft   STD: 0.36 ft

Minimum stage and year of occurrence: 1.48 ft, 1979

Maximum stage and year of occurrence: 3.00 ft, 1939

Average annual water-level fluctuation: 1.02 ft

Maximum annual water-level fluctuation and occurrence: 1.39 ft, 1979

Stage datum information: Not determined. Benchmark 1671-A is a bronze disk set in top of a 6-ft concrete post, 0.3 ft above ground and about 16 ft from shore at the old Deer Path Camp landing on the east side of the lake. Elevation = 6.10 ft gage datum.

Comments: Single stage measurements made in 1960 = 2.30 ft and 1975 = 2.10 ft. Two stage measurements made in 1973, 1.84 and 2.76 ft. Lake shown on USGS 15-minute Boulder Junction and Starlake quadrangle maps.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	1.60	1.52	1.49	1.47	1.45	1.44
Maximum stage (ft)	2.71	2.97	3.08	3.14	3.20	3.23
Annual fluctuation (ft)	1.07	1.33	1.44	1.51	1.58	1.62

Comments: 8 years of record used in analysis.

MAX-MIN
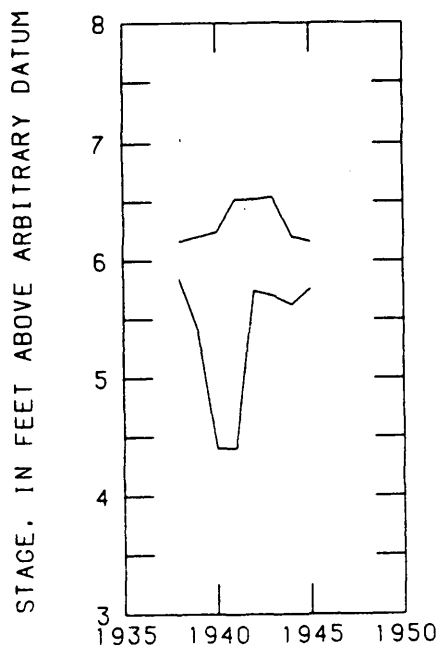
Name: Pat's Pond   Station No.: 05435987   Report ID No.: 28

Location: Dane County near Mt. Vernon
Period of record 1977-79 (98 stage records)

Hydrologic class: GWF

Drainage area: Less than 1 acre   Surface area 0.36 acre

Lake volume: Not determined   . Maximum depth

Long-term mean stage: 4.30 ft   STD: 1.68 ft

Minimum stage and year of occurrence: 1.00 ft, 1978

Maximum stage and year of occurrence: 6.62 ft, 1979
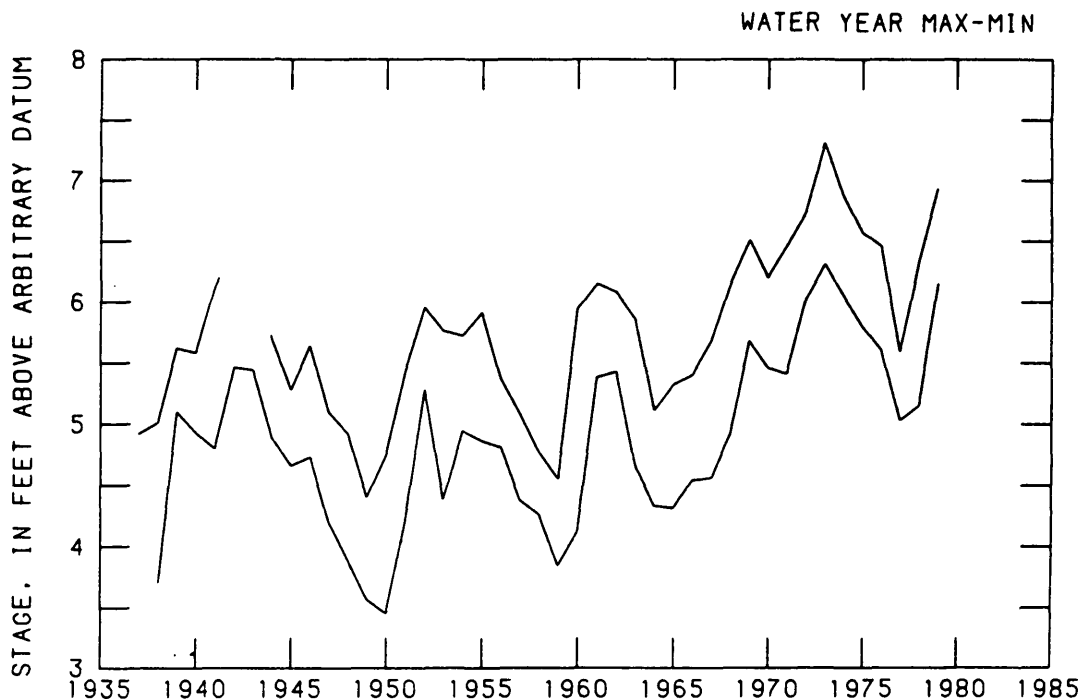
Average annual water-level fluctuation: 2.28 ft

Maximum annual water-level fluctuation and occurrence: 4.50 ft, 1978

Stage datum information: Add 83.57 ft to lake stage to get reference mark datum.
Reference Mark No. 1 is a 1 1/4-in. pipe driven into ground at south end of pond.
Assumed elevation = 100.00 ft.

Comments: Only three stage measurements for 1977. This is an artificial stock
pond excavation. Pond not shown on any USGS quadrangle map, located on USGS
7 1/2-minute Mt. Vernon quadrangle map, section 33, Springdale Township.

Name: Pickeral Lake   Station No.: 04080945   Report ID No.: 29

Location: Portage County at Blaine
Period of record 1976-79 (51 stage records)

Hydrologic class: GWF

Drainage area: 0.56 mi^2 Surface area 0.06 mi^2

Lake volume: Not determined   Maximum depth 16 ft

Long-term mean stage: 8.64 ft   STD: 0.65 ft

Minimum stage and year of occurrence: 7.88 ft, 1978

Maximum stage and year of occurrence: 10.46 ft, 1976

Average annual water-level fluctuation: 0.88 ft

Maximum annual water-level fluctuation and occurrence: 1.50 ft, 1977

Stage datum information: Not determined. Reference Mark No. 1 is a 3/8 in. lag
bolt in 24-in. diameter poplar tree on south side of boat landing road on east
side of lake. Gage elevation = 15.91 ft.

Comments: Only two stage records for 1976. Lake shown on USGS 7 1/2-minute Blaine
quadrangle map.

Name: Pike Lake   Station No.: 05400422   Report ID No.: 55

Location: Marathon County near Hatley
Period of record 1977-78 (41 stage records)

Hydrologic class: SWF

Drainage area: 3.2 mi^2 Surface area: 0.32 mi^2

Lake volume: Not determined   Maximum depth: 34 ft

Long-term mean stage: 6.64 ft   STD: 0.23 ft

Minimum stage and year of occurrence: 6.26 ft, 1977

Maximum stage and year of occurrence: 7.21 ft, 1978

Average annual water-level fluctuation: 0.76 ft

Maximum annual water-level fluctuation and occurrence: 0.80 ft, 1978

Stage datum information: Not determined. Reference Mark No. 1 is a chiseled square in the left lakeward abutment of the Lakeshore Drive bridge over the lake outlet on the north side of the lake. Assumed elevation = 10.00 ft.

Comments: Lake shown on USGS 15-minute Hatley quadrangle map. Water-level control dam at outlet.

Name: Pine Lake   Station No.: 451714091282701   Report ID No.: 31

Location: Chippewa County near Chetek
Period of record 1936-65, 1975-79 (1,639 stage records)

Hydrologic class: GWF

Drainage area: 1.64 mi^2 Surface area 0.41 mi^2

Lake volume: Not determined   Maximum depth: 106 ft

Long-term mean stage: 6.04 ft   STD: 0.72 ft

Minimum stage and year of occurrence: 4.10 ft, 1950

Maximum stage and year of occurrence: 7.58 ft, 1954

Average annual water-level fluctuation: 0.91 ft

Maximum annual water-level fluctuation and occurrence: 2.16 ft, 1951

Stage datum information: Add 87.42 ft to lake stage to get benchmark datum.
Benchmark No. 3 is a lag bolt in a red oak tree leaning over water about 10 ft
from the staff gage at north side of the lake. Assumed elevation = 100.00 ft.

Comments: Lake on USGS 7 1/2-minute Chain Lake quadrangle map. Only one stage
measurement per year made from 1975-79. Fluctuation values based on 1936-65
record period data.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	5.46	4.89	4.54	4.25	3.90	3.65
Maximum stage (ft)	6.52	7.17	7.46	7.69	7.92	8.06
Annual fluctuation (ft)	1.00	1.44	1.69	1.91	2.18	2.36

Comments: 30 years of record used in analysis.

WATER YEAR MAX-MIN

63
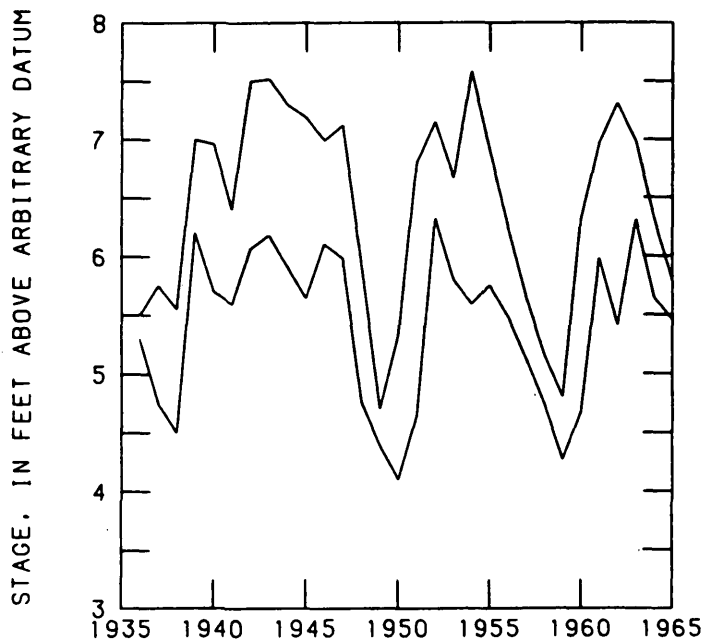
Name: Pine Lake   Station No.: 05425000   Report ID No.: 30

Location: Waukesha County near Hartland

Period of record: 1931-79

Hydrologic class: GWF

Drainage area: 6 mi^2 (approx.)   Surface area: 1.19 mi^2

Lake volume: Not determined   Maximum depth: 85 ft

Long-term mean stage: 11.56 ft   STD: 0.91 ft

Minimum stage and year of occurrence: 8.86 ft, 1935

Maximum stage and year of occurrence: 13.60 ft, 1978

Average annual water-level fluctuation: 1.23 ft

Maximum annual water-level fluctuation and occurrence: 2.80 ft, 1938

Stage datum information: Add 890.00 ft to lake stage to get mean sea level.

Comments: Only one stage measurement made in 1979, 12.48 ft. Lake shown on USGS 15-minute Hartland quadrangle map. Benchmark location uncertain.

| | Recurrence interval, in years | | | | | |
	2	5	10	20	50	100
Minimum stage (ft)	11.00	10.13	9.59	9.11	8.53	8.11
Maximum stage (ft)	12.29	12.91	13.16	13.34	13.51	13.61
Annual fluctuation (ft)	1.18	1.59	1.85	2.09	2.39	2.61

Comments: 48 years of record used in analysis.

WATER YEAR MAX-MIN

64
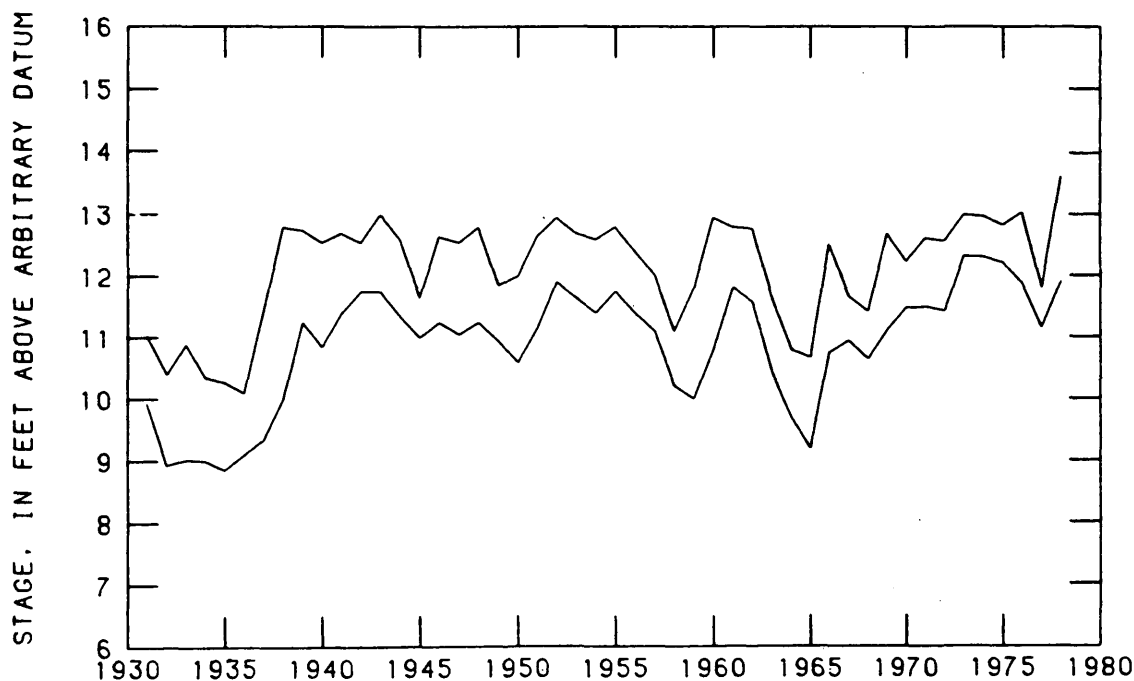
Name: Plainfield Lake   Station No.: 05401067   Report ID No.: 32

Location: Waushara County near Plainfield

Period of record: 1978-79 (10 stage records)

Hydrologic class: GWF

Drainage area: 1.74 mi^2 Surface area: 0.05 mi^2

Lake volume: Not determined   Maximum depth: 5 ft

Long-term mean stage: 87.04 ft   STD: 1.51 ft

Minimum stage and year of occurrence: 84.68 ft, 1978

Maximum stage and year of occurrence: 88.68 ft, 1979

Average annual water-level fluctuation: 1.78 ft

Maximum annual water-level fluctuation and occurrence: 2.63 ft, 1979

Stage datum information: Not determined. Reference Mark No. 1 is a lag bolt in a
tree about 100 ft from shore and 140 ft west of USGS observation well no. Ws-672
on northeast side of lake adjacent to public access road. Elevation = 90.93 ft.
Top of Ws-672 is assumed elevation of 100.00 ft.

Comments: Lake shown on USGS 7 1/2-minute Plainfield quadrangle map.

Name: Rib Lake   Station No.: 05395500   Report ID No.: 34

Location: Taylor County at Rib Lake

Period of record: 1936-79 (2,060 stage records)

Hydrologic class: SWD

Drainage area: 33 mi^2 (approx.)   Surface area: 0.50 mi^2

Lake volume: 1,980 acre-ft   Maximum depth: 9 ft

Long-term mean stage: 0.97 ft   STD: 0.36 ft

Minimum stage and year of occurrence: -0.25 ft, 1947

Maximum stage and year of occurrence: 4.52 ft, 1942

Average annual water-level fluctuation: 1.66 ft

Maximum annual water-level fluctuation and occurrence: 4.09 ft, 1941

Stage datum information: Add 93.55 ft to lake stage to get benchmark 17.2*B datum. Reference Point No. 1 is a lag bolt in an elm tree adjacent to lake 25 yards south of inlet on east side of lake. Assumed elevation = 10.00 ft.

Comments: Lake may be classified as SWF during high precipitation. Only one stage measurement made in 1979, 1.34 ft. Dam control at outlet. Lake shown on USGS 15-minute Rib Lake quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	0.58	0.20	-0.02	-0.20	-0.40	-0.55
Maximum stage (ft)	2.02	2.68	3.18	3.67	4.31	4.80
Annual fluctuation (ft)	1.51	2.27	2.76	3.21	3.78	4.19

Comments: 32 years of record used in analysis.

WATER YEAR MAX-MIN

Name: Lake Ripley   Station No.: 05427500   Report ID No.: 8t

Location: Jefferson County near Cambridge

Period of record: 1936-61, 1975-79 (1,747 stage records)

Hydrologic class: SWD

Drainage area: 2.54 mi^2 Surface area: 0.65 mi^2

Lake volume: Not determined   Maximum depth: 50 ft

Long-term mean stage: 6.15 ft   STD: 0.29 ft

Minimum stage and year of occurrence: 5.40 ft, 1936

Maximum stage and year of occurrence: 8.18 ft, 1977
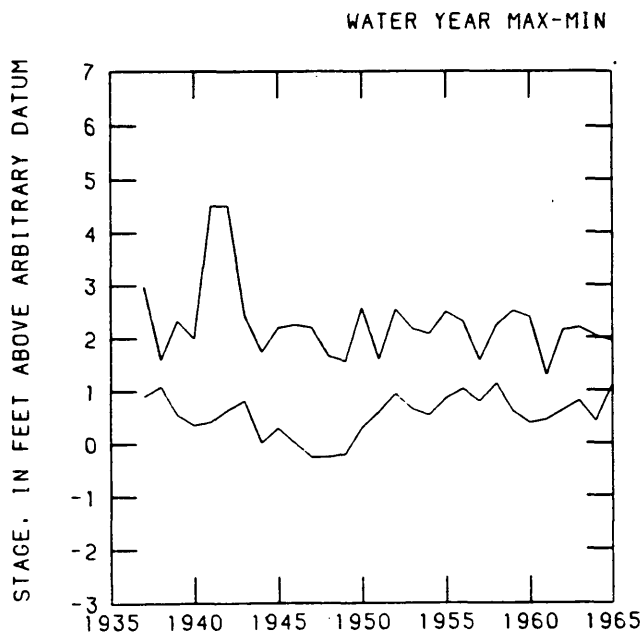
Average annual water-level fluctuation: 0.72 ft

Maximum annual water-level fluctuation and occurrence: 1.77 ft, 1976

Stage datum information: Add 90.00 ft to lake stage to get benchmark datum. Benchmark No. 812-A is a 1-in. square cut in top of center of upstream wall of bridge over outlet about 300 ft downstream from dam on northwest side of lake. Assumed elevation = 100.00 ft.

Comments: Only two stage measurements made in 1975. Lake shown on USGS 7 1/2-minute Lake Mills, Deerfield, and Busseyville quadrangle maps.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	6.06	5.53	4.92	4.20	3.16	2.31
Maximum stage (ft)	6.53	6.92	7.20	7.48	7.85	8.13
Annual fluctuation (ft)	0.68	0.98	1.16	1.31	1.50	1.64

Comments: 31 years of record used in analysis.

WATER YEAR MAX-MIN

67

Name: Rockland Lake   Station No.: 05545550   Report ID No.: 36

Location: Racine County near Burlington

Period of record: 1967-79 (670 stage records)

Hydrologic class: GWF

Drainage area: 0.99 mi^2 Surface area: 0.07 mi^2

Lake volume: 416 acre-ft   Maximum depth: 25 ft

Long-term mean stage: 4.91 ft   STD: 0.32 ft

Minimum stage and year of occurrence: 4.11 ft, 1977

Maximum stage and year of occurrence: 5.73 ft, 1979

Average annual water-level fluctuation: 0.87 ft

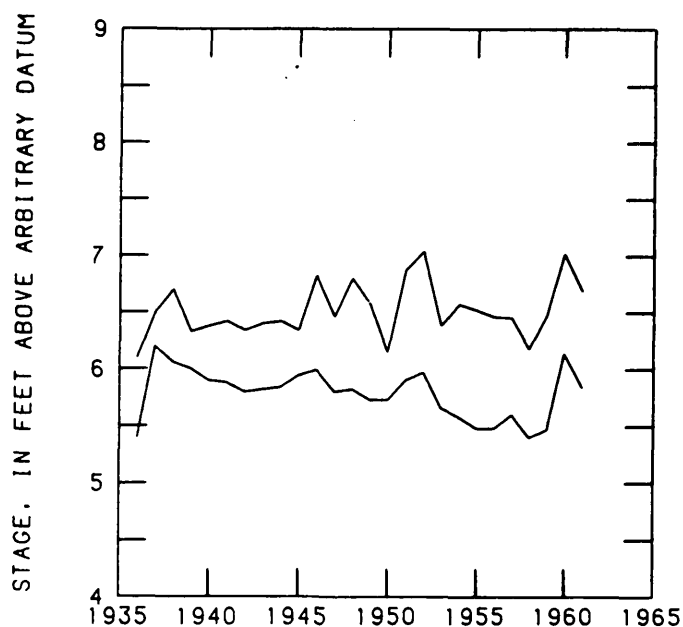Maximum annual water-level fluctuation and occurrence: 1.30 ft, 1978

Stage datum information: Not determined. Benchmark No. 1 is a chiseled square at north end of upper concrete beachwall on the southeast side of the lake at Camp Maclean. Elevation = 8.97 ft gage datum.

Comments: Lake shown on USGS 7 1/2-minute Burlington and Rochester quadrangle maps.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	4.48	4.31	4.21	4.13	4.04	3.97
Maximum stage (ft)	5.37	5.57	5.66	5.72	5.78	5.81
Annual fluctuation (ft)	0.88	1.08	1.18	1.26	1.35	1.40

Comments: 13 years of record used in analysis.

MAX-MIN

68
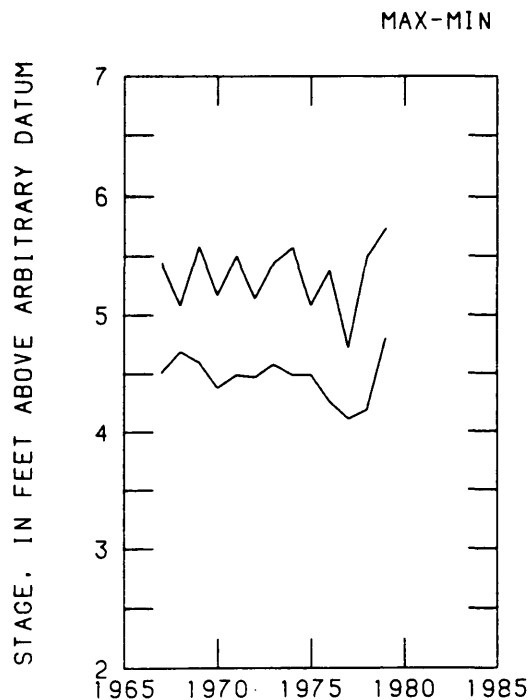
Name: Sand Lake   Station No.: 05357000   Report ID No.: 37

Location: Rusk County near Chetek

Period of record: 1979 (38 stage records)

Hydrologic class: GWF

Drainage area: 2.53 mi^2 Surface area: 0.43 mi^2

Lake volume: Not determined   Maximum depth: 91 ft

Long-term mean stage: 5.68 ft   STD: 0.15 ft

Minimum stage and year of occurrence: 5.32 ft, 1979

Maximum stage and year of occurrence: 6.02 ft, 1975

1979 water-level fluctuation: 0.70 ft

Stage datum information: Not determined. Reference Point is chiseled square
atop a 6-in. by 6-in. log on south side of the old County Highway bridge
spanning the channel between Goose Lake and Sand Lake. Assumed elevation =
10.00 ft.

Comments: Lake shown on USGS 7 1/2-minute Fireside Lakes quadrangle map.

Name: Shell Lake   Station No.: 05334000   Report ID No.: 38

Location: Washburn County at Shell Lake

Period of record: 1936-79 (1,928 stage records)

Hydrologic class: GWF

Drainage area: 14 mi^2 (approx.)   Surface area: 4.03 mi^2

Lake volume: 60,400 acre-ft   Maximum depth: 36 ft

Long-term mean stage: 1.89 ft   STD: 1.25 ft

Minimum stage and year of occurrence: -0.92 ft, 1949

Maximum stage and year of occurrence: 5.12 ft, 1954

Average annual water-level fluctuation: 1.40 ft

Maximum annual water-level fluctuation and occurrence: 2.94 ft, 1951

Stage datum information: Add 1,215.88 ft to lake stage to get mean sea level.

Comments: Lake shown on USGS 15-minute Shell Lake quadrangle map. Benchmarks not determined.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	1.43	0.46	-0.06	-0.51	-1.02	-1.36
Maximum stage (ft)	2.86	3.81	4.27	4.63	5.01	5.26
Annual fluctuation (ft)	1.34	1.82	2.10	2.34	2.64	2.85

Comments: 44 years of record used in analysis.

WATER YEAR MAX-MIN

70
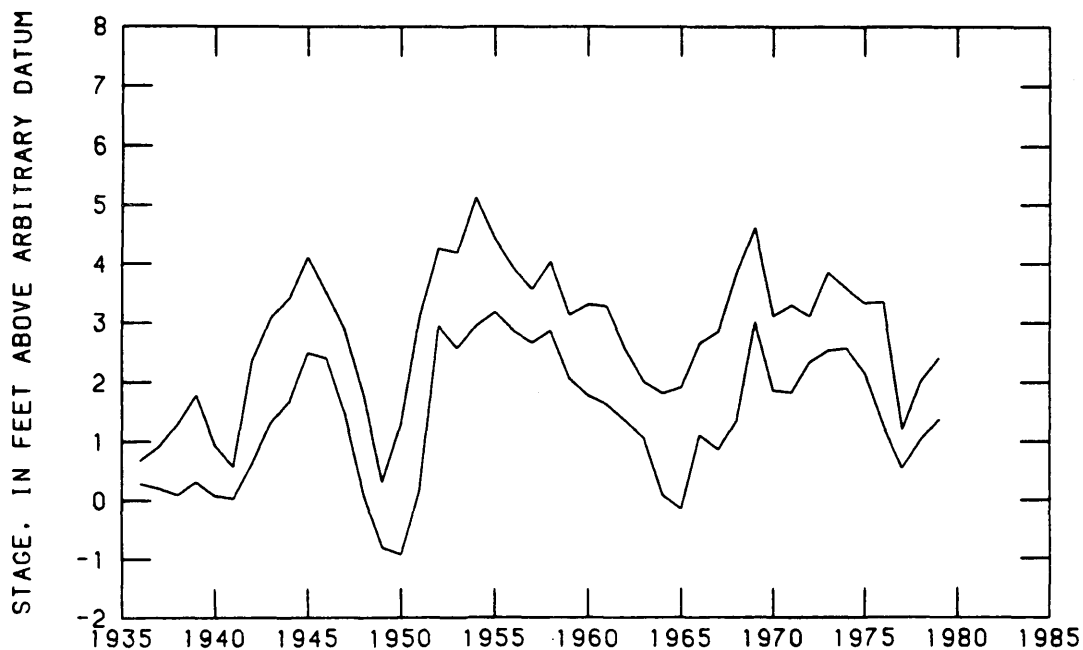
Name: Sherwood Lake   Station No.: 05381160   Report ID No.: 58

Location: Clark County near Sherwood
Period of record: 1977-79 (27 stage records)

Hydrologic class: SWF

Drainage area: 11.73 mi^2 Surface area: 0.18 mi^2

Lake volume: Not determined   Maximum depth: 8 ft

Long-term mean stage: 95.36 ft   STD: 0.88 ft

Minimum stage and year of occurrence: 93.18 ft, 1977

Maximum stage and year of occurrence: 96.40 ft, 1977

Average annual water-level fluctuation: 1.58 ft

Maximum annual water-level fluctuation and occurrence: 3.22 ft, 1977

Stage datum information: Not determined. Benchmark No. 1 is top of bronze disk
marked "Public Service Commission of Wisconsin", set in top of concrete spillway
at lake outlet on east side of lake. Assumed elevation = 100.00 ft.

Comments: Dam controlled outlet. Lake shown on USGS 7 1/2-minute City Point NW
and City Point NE quadrangle maps.

Name: Silver Lake   Station No.: 04072500   Report ID No.: 39

Location: Columbia County at Portage

Period of record: 1936-65, 1975-79 (1,200 stage records)

Hydrologic class: GWF

Drainage area: 1 mi^2 (approx.)   Surface area: 0.12 mi^2

Lake volume: 1,195 acre-ft   Maximum depth: 42 ft

Long-term mean stage: 7.31 ft   STD: 0.80 ft

Minimum stage and year of occurrence: 4.80 ft, 1965

Maximum stage and year of occurrence: 8.81 ft, 1962

Average annual water-level fluctuation: 1.03 ft

Maximum annual water-level fluctuation and occurrence: 2.26 ft, 1951

Stage datum information: Add 90.00 ft to lake stage to get benchmark local datum.
Benchmark No. 738-E is the top of a lag screw with an "X" cut in the head on the
northwest wingwall of the Silver Lake Drive bridge, 1.5 ft west of edge of the
sidewalk, on west side of bridge. Elevation = 99.67 ft local datum and 796.35 ft
mean sea level.

Comments: Only one stage measurement made in 1975 = 8.03 ft. Lake shown on
USGS 15-minute Portage quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	6.67	5.89	5.45	5.07	4.67	4.32
Maximum stage (ft)	7.84	8.44	8.68	8.84	8.98	9.06
Annual fluctuation (ft)	1.00	1.46	1.73	1.97	2.26	2.47

Comments: 34 years of record used in analysis.

WATER YEAR MAX-MIN

72
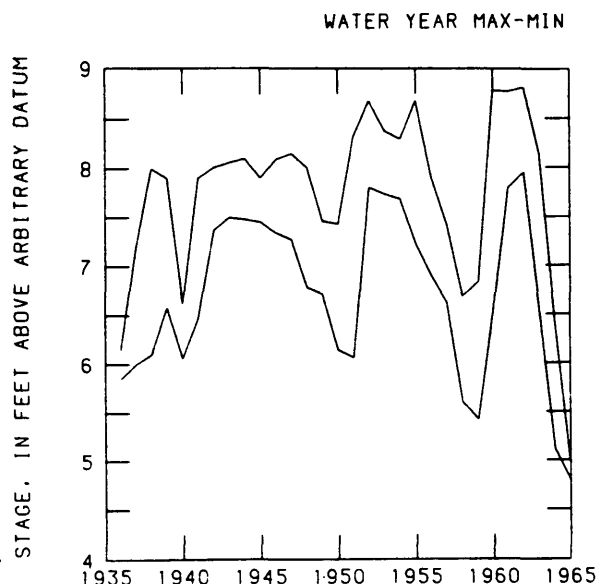
Name: Silver Lake   Station No.: 05546000   Report ID No.: 89

Location: Kenosha County at Silver Lake

Period of record: 1975-79 (30 stage records)

Hydrologic class: SWD

Drainage area: 5 mi^2 (approx.)   Surface area: 0.72 mi^2

Lake volume: 4,900 acre-ft   Maximum depth: 44 ft

Long-term mean stage: 7.58 ft   STD: Not determined

Minimum stage and year of occurrence: 6.89 ft, 1977

Maximum stage and year of occurrence: 8.30 ft, 1977

1977 water-level fluctuation: 1.41 ft

Stage datum information: Add 90.00 ft to lake stage to get benchmark datum.
Benchmark 700-A is bronze disk marked "Railroad Commission of Wisconsin" set in
a 6-ft concrete post flush with ground. Located 47.6 ft southwest of southwest
rail of double railroad tracks running over outlet, 16.9 ft west of corner
fencepost across track from outlet, 14 ft south of roadway centerline (County
Highway F) on south side of the lake. Elevation = 100.00 ft.

Comments: Only one stage measurement in 1979, 7.79 ft. Water-level fluctuation
estimate based on 1977 water year data. Lake shown on USGS 7 1/2-minute Silver
Lake quadrangle map.

Name: Spruce Lake   Station No.: 05357217   Report ID No.: 91

Location: Vilas County near Boulder Junction

Period of record: 1977-79 (26 stage records)

Hydrologic class: SWD

Drainage area: 0.15 mi^2 Surface area: 0.02 mi^2

Lake volume: Not determined   Maximum depth: 16 ft

Long-term mean stage: 3.44 ft   STD: 0.47 ft

Minimum stage and year of occurrence: 2.39 ft, 1977

Maximum stage and year of occurrence: 4.03 ft, 1979

Average annual water-level fluctuation: 0.69 ft

Maximum annual water-level fluctuation and occurrence: 0.99 ft, 1977

Stage datum information: Not determined. Reference Mark No. 1 is a lag bolt in
an oak tree painted red on east side of public landing at north end of lake.
Elevation = 10.00 ft.

Comments: Lake shown on USGS 15-minute Boulder Junction quadrangle map.

Name: Star Lake   Station No.: 460105089282301   Report ID No.: 92

Location: Vilas County at Star Lake

Period of record: 1979 (29 stage records)

Hydrologic class: SWD

Drainage area: 4.48 mi^2 Surface area: 1.89 mi^2

Lake volume: Not determined   Maximum depth: 67 ft

Long-term mean stage: 11.87 ft   STD: 0.16 ft

Minimum stage and year of occurrence: 11.65 ft, 1979

Maximum stage and year of occurrence: 12.21 ft, 1979

1979 water-level fluctuation: 0.56 ft

Stage datum information: Not determined. Reference Mark No. 1 is corner of concrete minnow tank pointed orange on property of L. G. Pattinger residence adjacent to County Highway K. Tank is located about 40 ft from staff gage in lake. Elevation = 14.28 ft.

Comments: Lake shown on USGS 15-minute Star Lake quadrangle map.

Name: Tenderfoot Lake   Station No.: 04039010   Report ID No.: 60

Location: Vilas County near Land O'Lakes

Period of record: 1938-39 (87 stage records)

Hydrologic class: SWF

Drainage area: 21.3 mi^2 Surface area: 0.67 mi^2

Lake volume: Not determined   Maximum depth: 36 ft

Long-term mean stage: 2.17 ft   STD: 0.29 ft

Minimum stage and year of occurrence: 1.54 ft, 1940

Maximum stage and year of occurrence: 2.72 ft, 1939

Average annual water-level fluctuation: 0.97 ft

Maximum annual water-level fluctuation and occurrence: 1.14 ft, 1940

Comments: Lake shown on USGS 15-minute Boulder Junction quadrangle map. Stage datum not referenced.

Name: Turtle Lake   Station No.: 05431000   Report ID No.: 93

Location: Walworth County near elavan

Period of record: 1952-65, 1975-79 (486 stage records)

Hydrologic class: SWD

Drainage area: 1.3 mi^2 Surface area: 0.25 mi^2

Lake volume: Not determined   Maximum depth: 30 ft

Long-term mean stage: 8.88 ft   STD: 0.43 ft

Minimum stage and year of occurrence: 7.61 ft, 1977

Maximum stage and year of occurrence: 9.78 ft, 1962

Average annual water-level fluctuation: 0.68 ft

Maximum annual water-level fluctuation and occurrence: 1.55 ft, 1959

Stage datum information: Add 80.00 ft to lake stage to get benchmark datum.
Benchmark 885-A is a square cut in the top of the old spillway concrete wall at
downstream end and 9.6 ft left of culvert at outlet. Elevation = 88.95 ft.

Comments: Only one stage measurement made in 1976 and 1979. 1976 = 7.84 ft,
1979 = 8.37 ft. Dam controlled outlet. Lake shown on USGS 7 1/2-minute Delavan
quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	8.48	8.07	7.83	7.62	7.37	7.17
Maximum stage (ft)	9.40	9.65	9.71	9.74	9.77	9.77
Annual fluctuation (ft)	0.81	1.10	1.26	1.39	1.55	1.66

Comments: 14 years of record used in analysis.

MAX-MIN

75
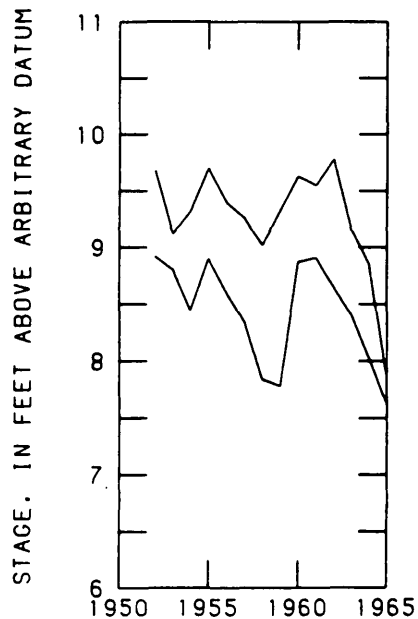
Name: Upper Eau Claire Lake   Station No.: 053315925   Report ID No.: 94

Location: Bayfield County near Brule

Period of record: 1979 (6 stage records)

Hydrologic class: SWD

Drainage area: Not determined   Surface area: 1.62 mi^2

Lake volume: Not determined   Maximum depth: 84 ft

Long-term mean stage: 4.10 ft   STD: 0.09 ft

Minimum stage and year of occurrence: 3.98 ft, 1979

Maximum stage and year of occurrence: 4.20 ft, 1979

1979 water-level fluctuation: 0.22 ft

Stage datum information: Not determined. Reference point is the top of a bolt in outlet dam wingwall at end of the wall about 12 ft from the right edge of dam. Bolt is the highest of three and painted red. Assumed elevation = 5.0 ft.

Comments: Lake shown on USGS 7 1/2-minute Upper Eau Claire Lake quadrangle map. Dam controlled outlet.

Name: Upper Nine Mile Lake   Station No.: 455430089031201   Report ID No.: 61

Location: Vilas County near Eagle River

Period of record: 1978, 1979 (6 stage measurements)

Hydrologic class: SWF

Drainage area: 1.03 mi^2 Surface area: 0.174 mi^2

Lake volume: Not determined   Maximum depth: 5 ft

Long-term mean stage: 11.24 ft   STD: 0.12 ft

Minimum stage and year of occurrence: 11.01 ft, 1979

Maximum stage and year of occurrence: 11.39 ft, 1979

1979 water-level fluctuation: 0.38 ft

Stage datum information: Not determined. Reference Point is a 2-in. pipe driven into lakebed next to staff gage on south side of lake adjacent to Butternut Lake Road. Assumed elevation = 10.00 ft.

Comments: Only one stage measurement made in 1978, 11.23 ft. Fluctuation values based on 1979 water year record. Lake shown on USGS 7 1/2-minute Anvil Lake quadrangle map.

Name: Upper Twin Lake   Station No.: 05363100   Report ID No.: 40

Location: Chippewa County near Jim Falls

Period of record: 1977-79 (50 stage records)

Hydrologic class: GWF

Drainage area: 1.12 mi^2 Surface area: 0.06 mi^2

Lake volume: Not determined   Maximum depth: 25 ft

Long-term mean stage: 8.37 ft   STD: 0.15 ft

Minimum stage and year of occurrence: 7.92 ft, 1977

Maximum stage and year of occurrence: 8.72 ft, 1978

Average annual water-level fluctuation: 0.46 ft

Maximum annual water-level fluctuation and occurrence: 0.62 ft, 1977

Stage datum information: Not determined. Reference mark is a lag bolt in white oak tree at end of logging road access to lake. Assumed elevation = 10.00 ft.

Comments: Lake shown on USGS 7 1/2-minute Jim Falls quadrangle map.

Name: Wabikon Lake   Station No.: 453327088460101   Report ID No.: 95

Location: Forest County near Crandon

Period of record: 1978, 1979 (9 stage records)

Hydrologic class: SWD

Drainage area: 4.56 mi^2 Surface area: 0.82 mi^2

Lake volume: Not determined   Maximum depth: 15 ft

Long-term mean stage: 5.88 ft   STD: 0.15 ft

Minimum stage and year of occurrence: 5.67 ft, 1979

Maximum stage and year of occurrence: 6.12 ft, 1979

1979 water-level fluctuation: 0.45 ft

Stage datum information: Not determined. Reference point is a lag bolt in cedar tree hanging over water near wayside on north end of lake adjacent to U.S. Highway 8, about 120 ft east of wayside along lakeshore footpath. Assumed elevation = 10.00 ft.

Comments: Only one stage measurement made in 1978, 5.98 ft. Lake shown on USGS 7 1/2-minute Lake Lucerne quadrangle map.

Name: Ward Lake   Station No.: 05335315   Report ID No.: 41

Location: Polk County near Fredric

Period of record: 1979 (24 stage records)

Hydrologic class: GWF

Drainage area: 1.10 mi^2 Surface area: 0.13 mi^2

Lake volume: Not determined   Maximum depth: 35 ft

Long-term mean stage: 1.82 ft   STD: 0.51 ft

Minimum stage and year of occurrence: 1.18 ft, 1979

Maximum stage and year of occurrence: 3.20 ft, 1979

1979 water-level fluctuation: 2.02 ft

Stage datum information: Reference Point No. 1 is a lag bolt 1 ft up from base of
3-ft diameter cottonwood tree, 40 ft southwest of observer's trailer and 40 ft
from shore. Located on Carl Wright property at north end of lake. Assigned
elevation = 10.00 ft.

Comments: Lake shown on USGS 15-minute Frederic quadrangle map.

Name: Wheeler Lake   Station No.: 04070000   Report ID No.: 42

Location: Oconto County near Lakewood

Period of record: 1936-79 (2,498 stage records)

Hydrologic class: GWF

Drainage area: 2.23 mi^2 Surface area: 10.43 mi^2

Lake volume: Not determined   Maximum depth: 35 ft

Long-term mean stage: 5.22 ft   STD: 0.71 ft

Minimum stage and year of occurrence: 3.45 ft, 1950

Maximum stage and year of occurrence: 7.31 ft, 1973

Average annual water-level fluctuation: 0.91 ft

Maximum annual water-level fluctuation and occurrence: 1.82 ft, 1960

Stage datum information: Add 90.00 ft to lake stage to get benchmark datum.
Benchmark 1741-C, elevation = 100.00 ft, location unknown.

Comments: Lake shown on USGS 7 1/2-minute Wheeler Lake quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	4.82	4.20	3.89	3.63	3.34	3.15
Maximum stage (ft)	5.74	6.35	6.66	6.91	7.19	7.37
Annual fluctuation (ft)	0.89	1.16	1.31	1.44	1.59	1.70

Comments: 44 years of record used in analysis.

WATER YEAR MAX-MIN
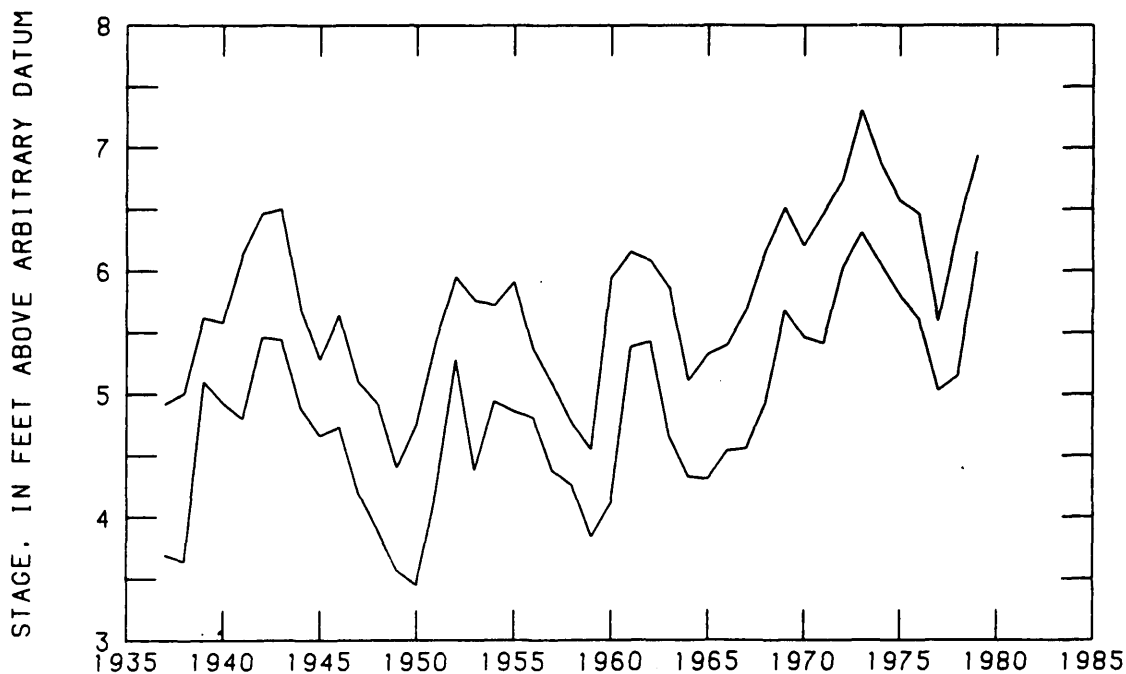
Name: White Sand Lake   Station No.: 05357147   Report ID No.: 62

Location: Vilas County near Boulder Junction

Period of record: 1979 (25 stage records)

Hydrologic class: SWF

Drainage area: 12.8 mi^2 Surface area: 1.17 mi^2

Lake volume: Not determined   Maximum depth: 68 ft

Long-term mean stage: 11.70 ft   STD: 0.26 ft

Minimum stage and year of occurrence: 11.31 ft, 1979

Maximum stage and year of occurrence: 12.16 ft, 1976

1979 water-level fluctuation: 0.85 ft

Stage datum information: Not determined. Reference mark is a painted point on retaining wall next to lake about 1 ft from east end, located on J. C. Steiro property on south side of lake. Elevation = 13.56 ft.

Comments: Lake shown on USGS 15-minute Boulder Junction quadrangle map.

Name: Lake Wingra   Station No.: 05429118   Report ID No.: 97

Location: Dane County at Madison

Period of record: 1970-77 (2,513 stage records)

Hydrologic class: SWD

Drainage area: 6.0 mi^2 Surface area: 0.54 mi^2

Lake volume: 2,715 acre-ft   Maximum depth: 21 ft

Long-term mean stage: 1.47 ft   STD: 0.21 ft

Minimum stage and year of occurrence: 0.47 ft, 1970

Maximum stage and year of occurrence: 2.28 ft, 1973

Average annual water-level fluctuation: 0.88 ft

Maximum annual water-level fluctuation and occurrence: 1.09 ft, 1972

Stage datum information: Add 846.8 ft to lake stage to get mean sea level.

Comments: Daily stage records for period of record. Dam controlled outlet.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	1.16	0.88	0.69	0.51	0.28	0.11
Maximum stage (ft)	2.00	2.16	2.22	2.27	2.31	2.33
Annual fluctuation (ft)	0.88	1.01	1.08	1.13	1.20	1.25

Comments: 8 years of record used in analysis.

MAX-MIN

Name: Lake Winnebago   Station No.: 04082500   Report ID No.: 63

Location: Winnebago County at Oshkosh

Period of record: 1882-1979 (33,593 stage records)

Hydrologic class: SWF

Drainage area: 5,610 mi^2 Surface area: 215 mi^2

Lake volume: Not determined   Maximum depth: 21 ft

Long-term mean stage: 2.16 ft   STD: 0.77 ft

Minimum stage and year of occurrence: -2.00 ft, 1891

Maximum stage and year of occurrence: 5.33 ft, 1881

Average annual water-level fluctuation: 2.47 ft

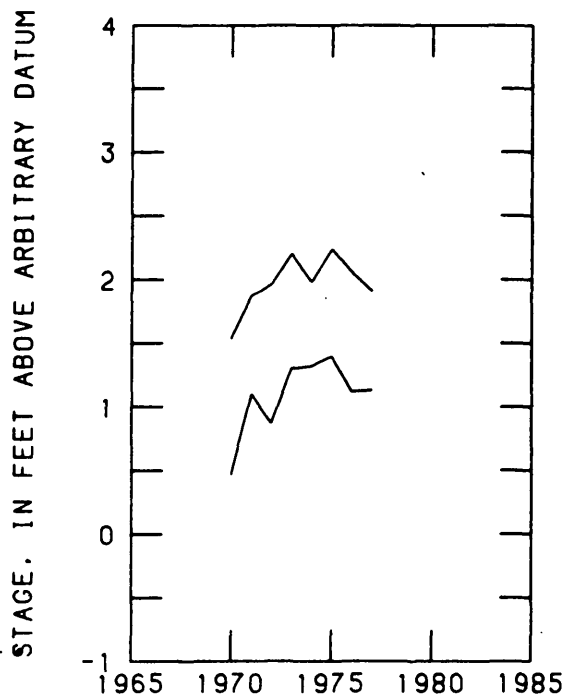Maximum annual water-level fluctuation and occurrence: 4.84 ft, 1892

Stage datum information: Add 745.05 ft to lake stage to get mean sea level.

Comments: Daily stage records for entire period. Dam controlled outlet. Lake shown on USGS 15-minute Oshkosh, Neenah, Rosendale, and Fond du Lac quadrangle maps.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	0.93	0.38	0.04	-0.28	-0.68	-0.96
Maximum stage (ft)	3.39	3.73	3.86	3.95	4.03	4.08
Annual fluctuation (ft)	2.34	3.01	3.43	3.82	4.29	4.64

Comments: 98 years of record used in analysis.

04082500   WATER YEAR MAX-MIN
LAKE WINNEBAGO AT OSHKOSH. WI
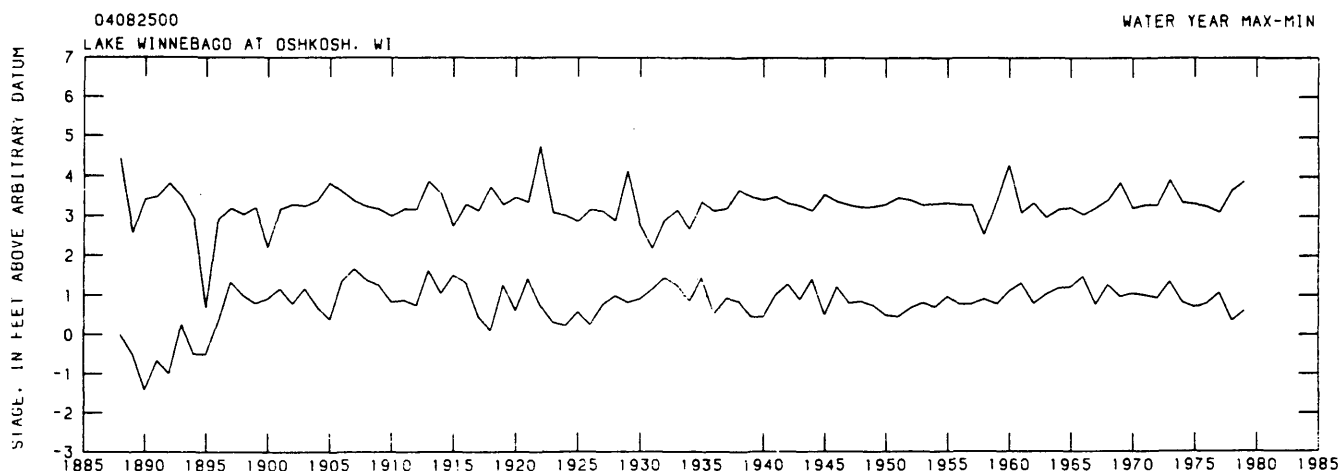
Name: Wood Lake   Station No.: 05338920   Report ID No.: 64

Location: Burnett County near Grantsburg

Period of record: 1979 (6 stage records)

Hydrologic class: SWF

Drainage area: 72 mi^2 (approx.)   Surface area: 0.78 mi^2

Lake volume: Not determined   Maximum depth: 35 ft

Long-term mean stage: 11.22 ft   STD: 0.39 ft

Minimum stage and year of occurrence: 10.85 ft, 1979

Maximum stage and year of occurrence: 11.84 ft, 1979

1979 water-level fluctuation: 0.99 ft

Stage datum information: Reference point is three file marks on rail post on downstream side of County Highway Y bridge over lake outlet on west side of lake. Elevation = 20.00 ft.

Comments: Lake shown on USGS 15-minute Grantsburg and Milltown quadrangle maps.

Name: Yellowstone Lake   Station No.: 05433520   Report ID No.: 66

Location: Lafayette County near Blanchardville

Period of record: 1975-76, 1979 (10 stage records)

Hydrologic class: SWF

Drainage area: 7.18 mi^2 Surface area: 0.72 mi^2

Lake volume: Not determined   Maximum depth: 21 ft

Long-term mean stage: 67.58 ft   STD: 0.09 ft

Minimum stage and year of occurrence: 67.39 ft, 1976

Maximum stage and year of occurrence: 67.72 ft, 1979

1976 water-level fluctuation: 0.19 ft

Stage datum information: Add 60.01 ft to lake stage to get benchmark datum. Benchmark 1012-A is a bronze disk marked "Public Service Commission of Wisconsin", set in top of west end of dam wingwall at outlet on east end of lake. Elevation = 75.99 ft.

Comments: Water-level fluctuation based on five stage measurements in the 1976 water year. Dam controlled outlet.

Name: Yellow Lake   Station No.: 05334999   Report ID No.: 65

Location: Burnett County near Webster

Period of record: 1941-79 (9,438 stage records)

Hydrologic class: SWF

Drainage area: 255 mi^2 Surface area: 3.58 mi^2

Lake volume: 43,330 acre-ft   Maximum depth: 31 ft

Long-term mean stage: 2.43 ft   STD: 0.61 ft

Minimum stage and year of occurrence: 1.05 ft, 1963

Maximum stage and year of occurrence: 4.46 ft, 1941

Average annual water-level fluctuation: 1.83 ft

Maximum annual water-level fluctuation and occurrence: 3.02 ft, 1953

Stage datum information: Add 926.90 ft to lake stage to get mean sea level.
Benchmark 437-E is a bronze tablet marked "Public Service Commission" set in the
top of the southwest abutment of bridge at outlet known as Ulrich Bridge on west
side of lake. Assigned elevation = 102.75 ft, mean sea level elevation =
935.65 ft.

Comments: Lake shown on USGS 15-minute Webster, Wis.-Minn. quadrangle map.

	Recurrence interval, in years					
	2	5	10	20	50	100
Minimum stage (ft)	1.47	1.26	1.17	1.10	1.04	1.00
Maximum stage (ft)	3.29	3.68	3.91	4.13	4.39	4.58
Annual fluctuation (ft)	1.78	2.13	2.34	2.54	2.77	2.94

Comments: 39 years of record used in analysis.

WATER YEAR MAX-MIN

84