

REPORT ON CEDAR LAKE
WATER LEVEL PROBLEM
1970

Donohue & Associates, Inc.

REPORT ON CEDAR LAKE WATER LEVEL PROBLEM
CEDAR LAKE
MANITOWOC COUNTY, WISCONSIN

October, 1970

Donohue & Associates, Inc.
Consulting Engineers
Sheboygan, Wisconsin

DONOHUE & ASSOCIATES, INC.



SUCCESSORS TO THE
JERRY DONOHUE ENGINEERING CO.

CONSULTING & DESIGNING ENGINEERS

SEWERS • SEWAGE DISPOSAL • WATER SUPPLY • PAVING • DRAINAGE • SURVEYS • REPORTS

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SHEBOYGAN
WISCONSIN 53081

October 8, 1970

Board of Directors
Cedar Lake Advancement Association
Manitowoc County, Wisconsin

Re: Cedar Lake Water Level Problem
Project No. 4064

Gentlemen:

We are pleased to submit herewith our report on the lake level problem in Cedar Lake, Manitowoc County, Wisconsin.

The report includes a discussion of the fluctuation in lake level in Cedar Lake, the results of investigations into the feasibility of raising the lake level by pumping ground water into the lake, a description of the facilities that would be needed to pump ground water, and an estimate of the costs of these facilities.

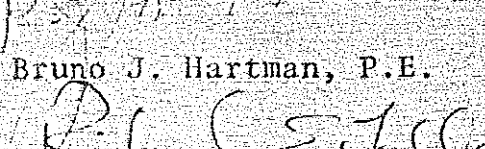
Should you have any questions on this matter, please feel free to contact us.

Very truly yours,

DONOHUE & ASSOCIATES, INC.

By:

Bruno J. Hartman, P.E.


Richard E. Fedler, P.E.

BJH:REF:ku

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INTRODUCTION

Cedar Lake is located approximately six (6) miles east of Kiel, Wisconsin, in the Town of Schleswig in Manitowoc County. There are approximately 100 cottages and homes along the shoreline of the lake. Camp Rokilio, operated by the Boy Scouts of America, Kettle Moraine Council, is located on the east side of Cedar Lake.

The surface area of Cedar Lake is approximately 140 acres. The lake has no defined surface inlet or outlet, and has only a small drainage area. The water level in the lake is maintained mainly by precipitation and ground water inflow.

During the past several years, the level of Cedar Lake has decreased considerably. This declining lake level has resulted in the exposure of large areas of mud and muck along the shoreline and has caused concern among the residents around the lake.

PURPOSE AND SCOPE

In September, 1970, residents of the Cedar Lake area requested Donohue & Associates, Inc. to study the problem of declining lake levels in Cedar Lake and to investigate the feasibility and costs of constructing a well to pump water into the lake in an attempt to raise the level of the lake. This report presents the results of the investigations conducted concerning this problem.

The report includes discussions of the fluctuations in levels of Cedar Lake, the feasibility of raising the lake level by pumping ground water into the lake, the facilities that would be needed to pump ground water and the results that may be anticipated, and the costs of the required facilities.

LAKE LEVELS

The water levels of land-locked lakes, such as Cedar Lake, normally reflect changes in ground water levels in the vicinity of the lake. Many such lakes vary in level by as much as 5 to 10 feet over long periods of time. The ground water level of the shallow aquifer, which supplies water to Cedar Lake, is the most important factor regulating lake level. Ground water is replenished by rainfall or snowmelt. Thus in years when there is only a small amount of rainfall or snowmelt, the ground water level of the shallow aquifer will decline and water will seep out of Cedar Lake, thereby lowering the water level of the lake. In years when rainfall or snowmelt is above average, ground water levels rise and more water is supplied to the lake, thereby raising the water level of the lake.

The fluctuation of the water level in Cedar Lake during the past 34 years is shown by the graph in Figure 1. The highest and lowest water levels observed for the lake in each year since 1937 are plotted on this graph.

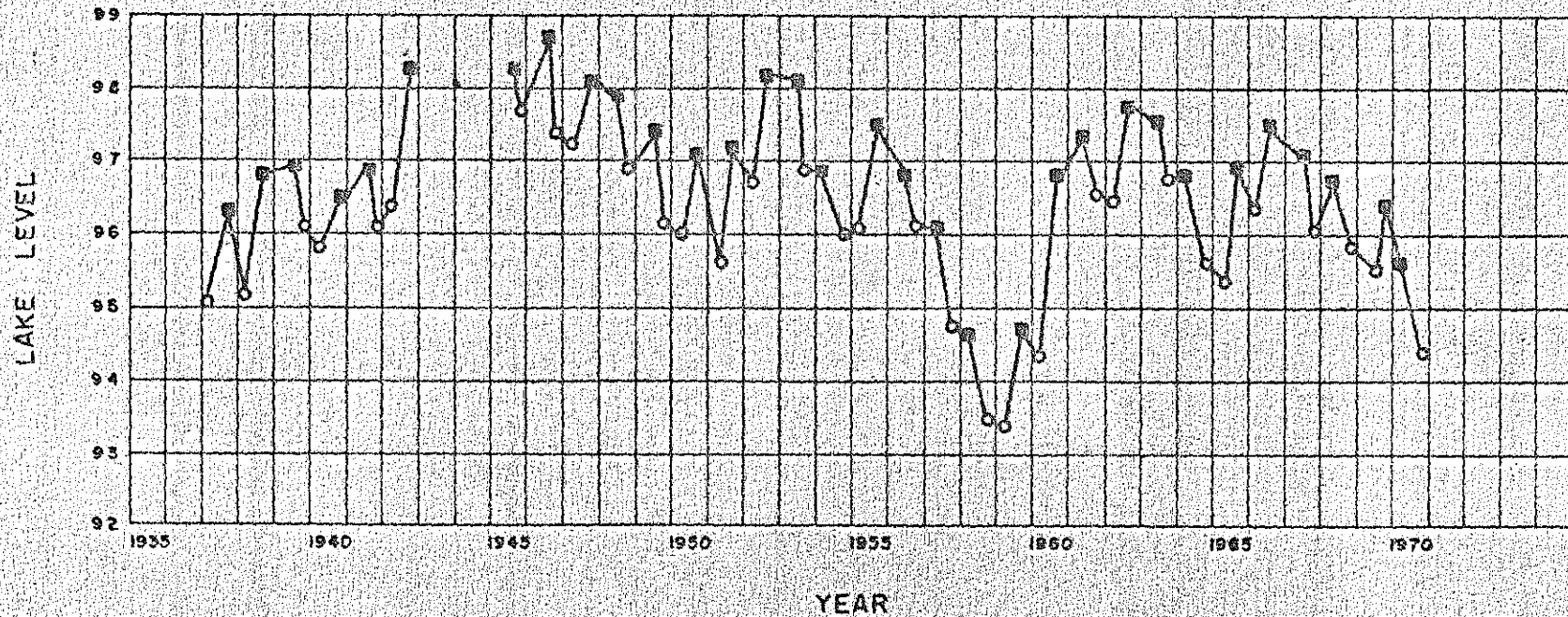
As indicated in Figure 1, the level of Cedar Lake has fluctuated from a high of approximately 98.7 feet in 1946 to a low of approximately 93.3 feet in 1959. The average lake level during the past 34 years has been in the range of 96 to 97 feet. The upward and downward trends in lake levels in Cedar Lake are similar to those exhibited in many other similar lakes around the State.

During the past 20 years, there was a high lake stage in 1952-1953, a very low lake stage in 1958-1959, another high stage in 1961-1963, a low stage in 1965, and a high stage in 1966. From 1967 through 1969, lake levels fluctuated near or slightly below the long term average of 96 to 97 feet.

The level of Cedar Lake has been declining since July, 1969. The water level has dropped from 96.4 in July, 1969, to 94.3 in August, 1970, a drop of slightly greater than 2 feet. The level of 94.3 observed in August, 1970, is approximately 2 feet below the long term average lake level.

The ground water level of the shallow aquifer surrounding Cedar Lake, which supplies water to the lake, is the most important factor regulating the lake level. Ground water is replenished by rainfall or snowmelt. Snowfall during the winter of 1969-1970 and rainfall during the spring of 1970 were below normal and did not recharge ground water to its normal early summer level. This lack of recharge to the ground water caused the level of Cedar Lake to decline during the

LAKE LEVEL
CEDAR LAKE, MANITOWOC COUNTY



○ MINIMUM LEVEL OBSERVED
■ MAXIMUM LEVEL OBSERVED

FIGURE 1

winter and spring of 1970. Very little rainfall was received during the months of June, July and August of 1970 and this resulted in the further decline of the level of Cedar Lake.

It is reported that the level of the lake rose slightly during the latter part of September, 1970, following the moderately heavy rains received during the month of September. It may be expected that if precipitation remains at or above normal levels, the level of Cedar Lake will rise to near its long term average level, as happened in 1960 following the extremely low levels during 1958 and 1959.

RAISING LAKE LEVEL

The recent decline in lake level, particularly during this past summer, has exposed large areas of shoreline which were previously below the water level and has created generally unfavorable conditions around and in the lake. The feasibility and costs involved in drilling a well to be used to pump ground water into Cedar Lake to raise the lake level have been investigated and will be discussed in this section of the report.

The total volume of water that would be required to raise the level of Cedar Lake 1.0 feet would be approximately 45,600,000 gallons. If a well were drilled and water pumped from the well into the lake at a rate of 500 gallons per minute, it would take approximately 2 months of continuous pumping to discharge 45,600,000 gallons of water into the lake. The actual

time that would be required to raise the level of Cedar Lake 1.0 feet would be somewhat longer than 2 months since some of the water that would be pumped into the lake would be lost through evaporation, seepage, and raising the ground water level.

We have investigated the geology around the Cedar Lake area to determine the feasibility of drilling a well that would be used to pump water into the lake. It would be possible to obtain an adequate quantity of water with a well approximately 300 to 400 feet deep. However, a well of this depth would be drawing water from the same ground water reservoir as the private wells located around the lake. Since the well may be pumped continuously for long periods of time, it could substantially lower water levels in the vicinity of the well. The lowering of the water level in the water-bearing strata could extend as much as one-half mile from the well when the well was being pumped continuously.

It is possible, therefore, that a well 300 to 400 feet deep near the lake could lower water levels enough to dry up the private wells around the lake. It would certainly not be desirable to drill a well and pump water from it to raise the lake level at the expense of drying up many of the private wells around the lake.

The geology of the area around Cedar Lake is such that water could be obtained from deeper than 400 feet without

affecting water levels in the water-bearing strata being used by the private wells around the lake. It would be necessary to construct a well approximately 1,000 feet deep to obtain this water.

There is a layer of shale approximately 200 to 250 feet thick and at a depth of approximately 500 feet in the Cedar Lake area. This shale acts as an impervious barrier to the downward movement of water. Thus if a well were drilled through this shale and into the water-bearing strata beneath the shale, water could be pumped from the lower area without causing any interference with the private wells around the lake.

It is estimated that the well would be approximately 1,000 feet deep. It is anticipated that the well should produce at least 500 gallons per minute. It would be necessary to case the well from the ground surface to the top of the shale in order to prevent interference with the shallower wells around the lake. Casing would also be required through the shale because shale is generally unstable and must be cased to prevent caving.

It is estimated that the cost for drilling the well, installing the pump and motor, and constructing a pump building, installing the required discharge piping, etc., is approximately \$50,000. A breakdown of this cost is as follows:

Construct well 1,000 feet deep	\$35,000
Deep well pump and motor installed	10,000
Pump building, discharge piping, etc.	<u>5,000</u>
TOTAL	\$50,000

It would be possible to drill the well only to the top of the shale, at an estimated depth of approximately 400 feet, and to test the well at that depth to determine the interference with nearby private wells. If there were no substantial interference between the proposed new well and the private wells it would not be necessary to go any deeper with the well and a savings of approximately \$10,000 to \$15,000 would be realized in the cost of the project. However, we feel that there will most likely be substantial interference with the private wells and that it will be necessary to finish the well to a depth of approximately 1,000 feet, as described previously.

The costs of operating the pump continuously are estimated to be approximately \$500 to \$600 per month, mainly for the power required for running the pump motor.

As discussed previously, if a well is constructed that will yield 500 gallons per minute it would require approximately 2 months of continuous pumping at that rate to discharge a sufficient volume of water to the lake to raise the lake level 1 foot. However the actual time of pumping that would be required to raise the lake level 1 foot would be somewhat longer than 2 months since some of the water pumped into the

lake would most certainly be lost from the lake through seepage. The quantity of seepage and the exact time of pumping that would be needed cannot be determined from information available at this time.

We have investigated the soil conditions around the lake and found that there is clay in most of the areas surrounding the lake. The presence of the clay would tend to hold the water in the lake and reduce the amount of seepage from the lake. However, there is one area on the west side of the lake which is composed mainly of organic soils which are relatively porous and through which water could seep at a fairly rapid rate. It is anticipated that a substantial quantity of water could be lost from the lake by seepage through this area of porous soils.

Although there is clay present along the shoreline of the lake to retard losses through seepage, there may be gravel in various areas along the bottom of the lake where water could also seep out of the lake. If the water level in Cedar Lake were to be raised above that of the surrounding area, as would be done by pumping water into the lake from a well, it is possible that substantial quantities of water could be lost by seepage through such gravel veins.

An additional factor that should be taken into consideration when deciding whether or not a well should be drilled to raise the lake level is the frequency that the well

and summer has resulted in a general lowering of ground water levels in the area and consequently a lowering of the lake level. A similar situation occurred during the period 1958-1959, when the lake level dropped even lower than during the past summer, but above average precipitation in 1960 brought the lake level back up to normal. It is anticipated that if precipitation is normal or above normal during the coming months, the level of Cedar Lake will return to near its long term average of 96 to 97 feet.

At the request of the residents around Cedar Lake, we have investigated the feasibility of drilling a well to be used to pump water into the lake in an attempt to raise the lake level. There are two layers of water-bearing strata in the vicinity of Cedar Lake from which water could be obtained. If the shallower strata were to be utilized, it would be necessary to construct a well approximately 400 feet deep. However, if a well were constructed in the shallower strata and pumped continuously for long periods of time, it is likely that there would be substantial interference between the well and nearby private wells. It is possible that many of the private wells around the lake would be dried up when the proposed well is being used. Thus we do not anticipate that a well 400 feet deep would be suitable.

The deeper water-bearing strata in the area is located under a thick layer of shale which would prevent the downward

movement of water. Water could be obtained from this strata without causing interference with private wells around the lake. To obtain water from the strata would require a well approximately 1,000 feet deep. The estimated cost of a well 1,000 feet deep, including the deep well pump and motor and a pump building, is approximately \$50,000.

If a well is to be constructed, it would be desirable to test the well when it is approximately 400 feet deep to determine the exact extent of interference with the nearby private wells. If it were found that there is no interference with the private wells, there would be no need to go any deeper with the well and a savings of approximately \$10,000 to \$15,000 would be realized in the project.

There are two additional important points that should be considered when deciding whether or not to construct a well to be used to raise the water level of Cedar Lake. If the water level in the lake is raised several feet, it is likely that there will be a substantial amount of water lost from the lake through seepage. Although the soils around most of the lake are clay soils which will prevent seepage, there is one area on the west side of the lake where the soil is mostly porous organic material. It is likely that a substantial quantity of water will seep out of the lake in this area. There may also be gravel on some areas of the bottom of the lake through which a substantial quantity of water will seep

out of the lake. Thus, while theoretically it would take approximately 2 months of continuous pumping at a rate of 500 gallons per minute to discharge a sufficient volume of water to raise the lake level 1 foot, the actual time required to increase the lake level 1 foot may be substantially greater than 2 months because of the water lost through seepage from the lake.

A second point that should be considered is the frequency that the well would be needed. If it were desired to keep the lake level no lower than 1 foot below the normal level by using the well to pump water into the lake whenever the lake level dropped 1 foot below normal, the well would have been needed only 3 years during the past 34 years, or an average frequency of 1 year in every 10 years. Thus the well may be idle on an average of as much as 90 percent of the time.

In summary, we feel that it is technically feasible to drill a well in the vicinity of Cedar Lake that could be used to pump water into the lake in an attempt to raise lake level. However, since construction of the well is estimated to cost approximately \$50,000, we feel that consideration should be given to the points discussed above before a decision is made as to whether or not to proceed with construction of the well.

Before a well can be constructed, it is necessary to prepare plans and specifications for the project and submit

them to the State of Wisconsin Department of Natural Resources for approval. The Department of Natural Resources has indicated that they are not too favorable to a project such as this because it depletes the ground water supply. However, if the residents of the Cedar Lake area decide that they want to proceed with this project, we are reasonably certain that an approval can be obtained.