

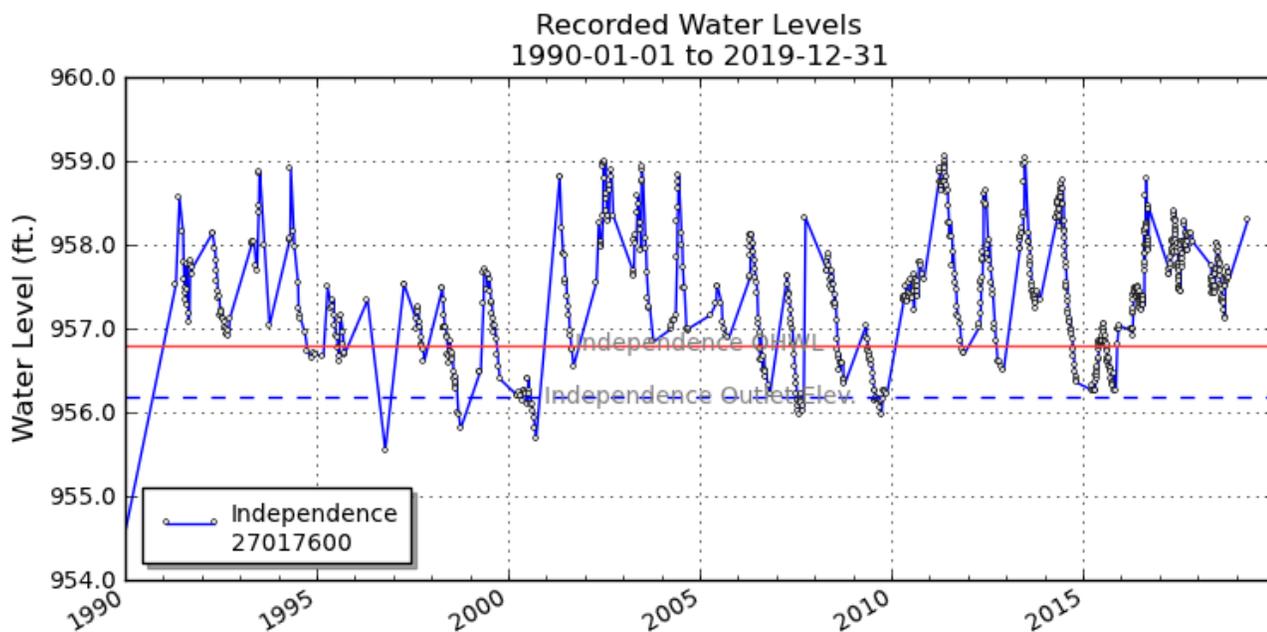
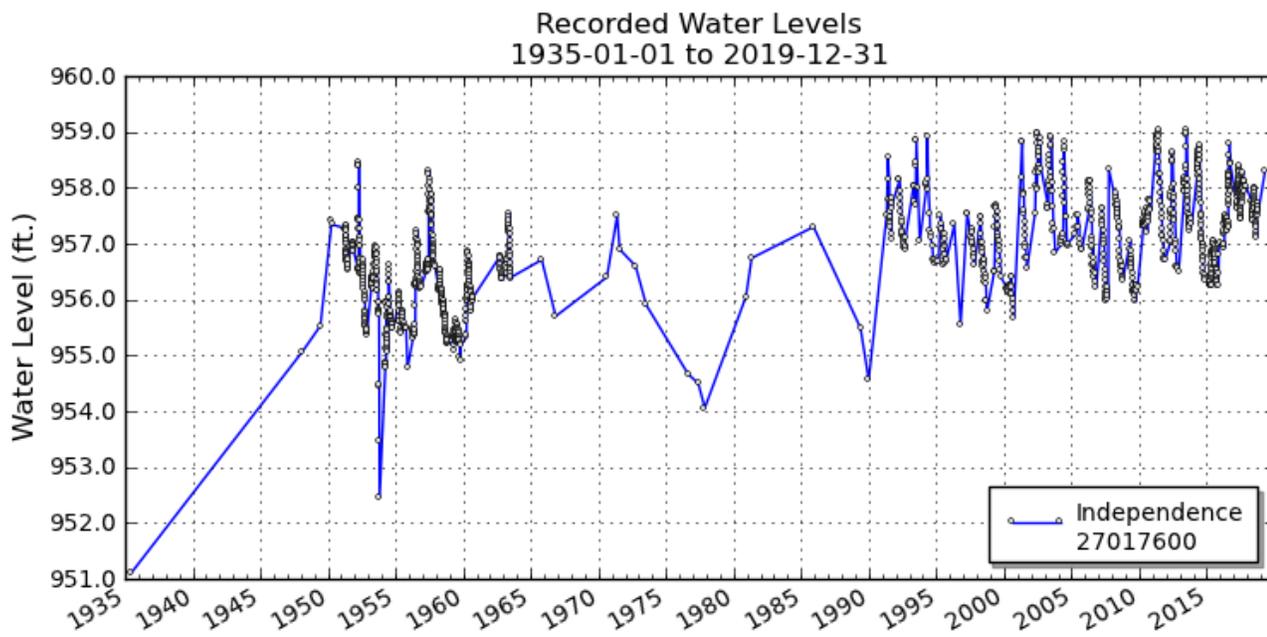
MN DNR Lake Level MN Monitoring Program

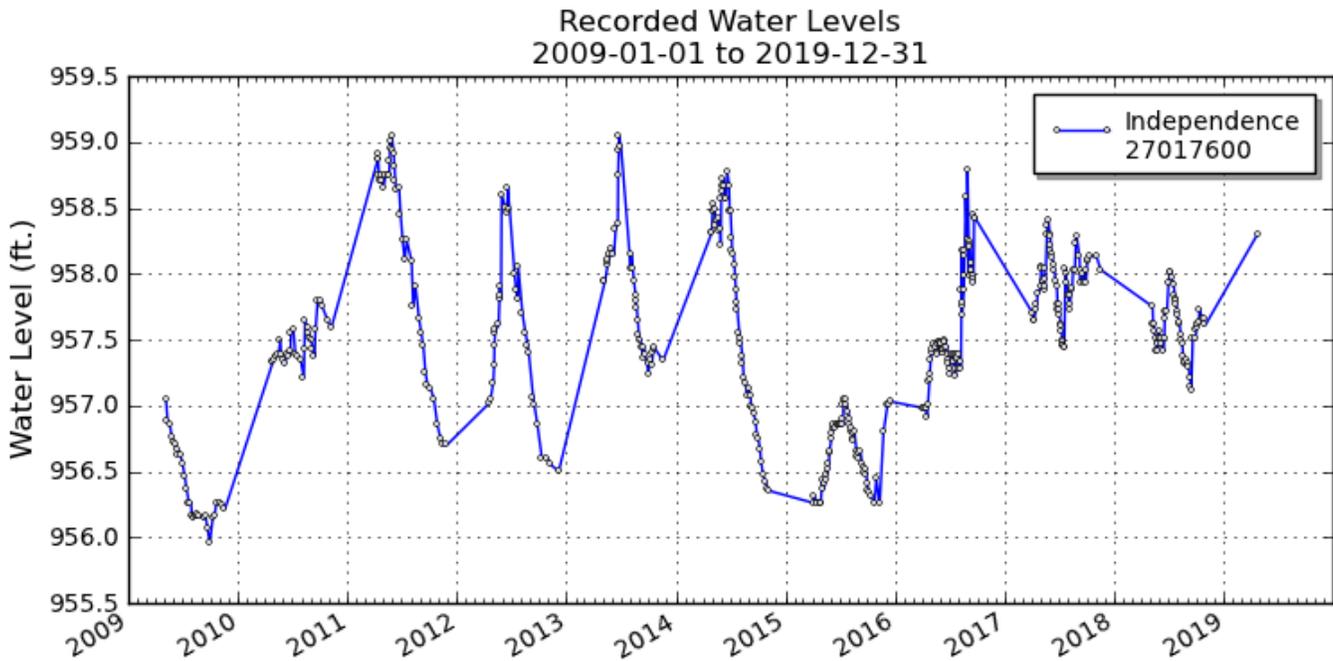
Celebrating 49 Years ~ 1970 - 2019

MN DNR main website: <https://www.dnr.state.mn.us/>

MN DNR Information Center Toll-free: 888-MINN-DNR or 888-646-6367

- 1) **Lake hydrographs** (shown in different time periods) of all the Lake Independence (27-0176) lake level information we have received as of 7/15/19 - last elevation we have received was for 4/24/19





2) Water Level Data Summary – Lake Independence 27-0176

Beginning Elevation:	951.10' (1935-06-13)
Ending Elevation:	958.30' (2019-04-24)
Highest Recorded:	959.05' (2011-05-30)
Lowest Recorded:	951.10' (1935-06-13)
Average Recorded:	956.9'
Number of Readings:	1468
Recorded Range:	7.95'

Datum: NGVD 1929

3) Lake level fluctuations:

The water levels of all lakes fluctuate dependent on their unique water budget -- some more than others. The primary factor that affects water level changes is the quantity and distribution of precipitation. Other factors that contribute to water level changes are outlet conditions, beaver dams, human-made dams, ground water movement and watershed characteristics and size. Historical water level data are useful in calibrating hydrologic and hydraulic computer models and the water budget. **Each lake is unique.** Knowing, understanding, and accepting the history of water level fluctuations and precipitation can help lake users deal with expectations and issues associated with the **ever-changing levels**. Lake landowners may never experience the same conditions or elevation on the lake as the day they bought their property. Because of the unique water budget factors, lakes go up and lakes go down; they are not static bathtubs. Lake landowners may get used to above normal or high precipitation years and characterize those high rain and higher lake level months or years as what they expect – or vice versa for being used to lower lake level years. Owners may be faced with different lengths of docking needed, different amounts of shoreline, different abilities to use the lake, different water quality, etc. over the days and years of ownership and the natural vertical fluctuations of the lake.

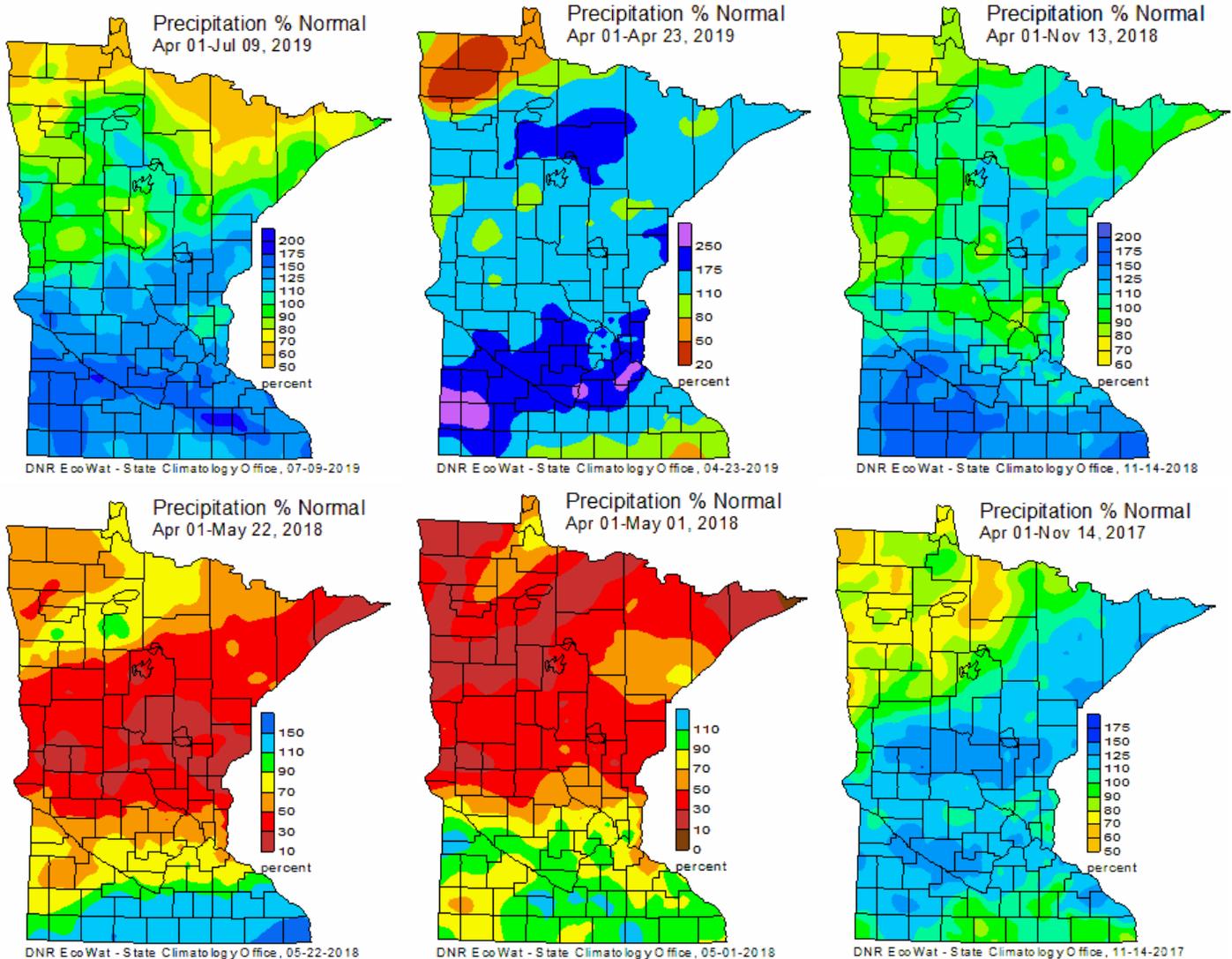
The hydrology of a lake can be described in terms of components of its water budget. Think of it like a money budget. A water budget is the sum of "incoming" resources minus "outgoing" resources. It is an estimation of the water resources available to "spend" or "save" and must take into account all available ground and surface water. This includes climate (precipitation, evaporation), surface water (runoff,

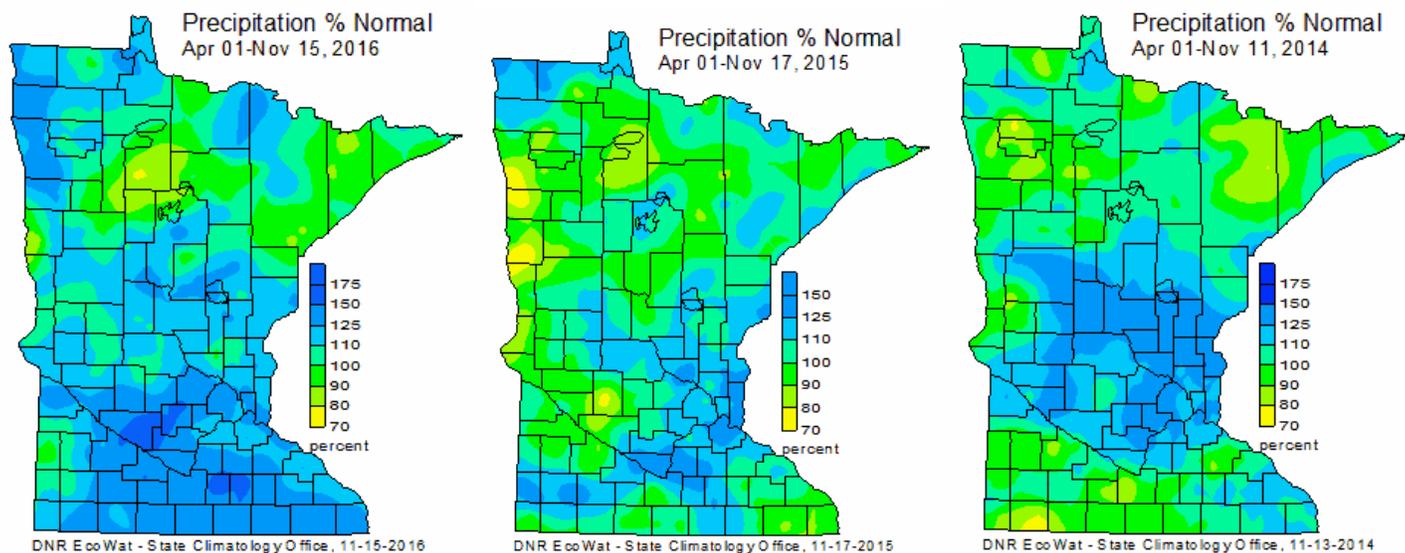
streamflow, and storage), and ground water (flow, storage). The water budget for a specific lake for a specific period of time may be represented by the equation:

$$DS = (\text{Precip} + SW_{in} + GW_{in}) \text{ MINUS } (\text{Evap} + SW_{out} + GW_{out})$$

where DS is the change in the volume of water stored in the lake during a period of interest. This is equal to the sum of the volumes of water entering the lake minus the sum of the volumes of water leaving the lake. Water enters the lake as precipitation (Precip), surface-water inflow (SW_{in}), and ground-water inflow (GW_{in}). Water leaves the lake as evaporation (Evap), surface-water outflow (SW_{out}), and ground-water outflow (GW_{out}).

- 4) **Climatology:** Lake levels and fluctuations are typically affected by **precipitation**. Here are maps that illustrate percentage of normal precipitation to compare to your monthly lake levels. See below for the website link for all of the historic weekly maps of precipitation.





In addition to these quick maps, see the following MN climatology website information on a regular basis:

<http://climateapps.dnr.state.mn.us/index.htm> - main page - click on the many sites

<https://www.dnr.state.mn.us/climate/weekmap/weekmap.html> - weekly precipitation maps

<https://www.dnr.state.mn.us/climate/historical/introduction.html> - click on various sites in left-hand column to get to the best records for past years

<https://www.drought.gov/drought/states/minnesota> - current drought status map

<http://droughtmonitor.unl.edu/Maps/MapArchive.aspx> - archive of drought conditions weekly map under State – Minnesota – date

5) DNR Hydrologic Conditions Report

Keep up with our monthly analysis during the ice-free season on the status of water resources at selected example locations in many of Minnesota's watersheds. Along with a general state analysis of lake levels, the **Hydrologic Conditions Report** places current measurements of precipitation, lake levels, stream flow, and ground water levels in historical context for that particular month against all previous lake level records for that month for two dozen lakes.

https://www.dnr.state.mn.us/current_conditions/hydro_conditions.html

Fifty-three percent of the statewide lakes with reported June 2019 lake levels are High or Above Normal, when comparing June 2019 lake levels to their entire historic record. Seventy-three percent of gaged lakes showed June lake elevations above their average lake level of the entire historic record. Over 62% of these "above average" lakes reported lake elevations more than ½ foot higher than their average. For the 30 gaged lakes in Hennepin County, 60% are in the High or Above Normal percentile for their most recent lake level and 40% are in the Normal percentile.

6) How can residents and users find lake level information?

a) Finding and using lake level records of lakes that have gages historically owned and maintained by the State of Minnesota Department of Natural Resources

The DNR LakeFinder web site is the best means for the public to access available data on more than 4,500 Minnesota lakes relating to fisheries information, lake area and maximum depth, depth maps, lake water levels, air photos, and topographic maps. About 1,450 of the lakes have a historical record of more than 100 water level elevations. After searching by county, lake name, or 8-digit identification

number for your lake, click on the lake in the Search Results. On the next page, click on Water Levels report in the left hand column. <https://www.dnr.state.mn.us/lakefind/index.html>

The Lake Water Level report page contains information from reported data, including:

- reported historical and current lake levels
- period of record and number of readings
- highest recorded lake level
- highest known lake level
- lowest recorded lake level
- recorded range
- ordinary high water level [also shown as the red line on the 10-year graph]
- datum
- benchmarks
- most recent 10-year graph [X-axis Year tick mark references mid-year]

Besides looking at the 10-yr graph, a **LakeFinder website user can retrieve and view all the reported historic and current lake elevations for a specific lake** where we have received lake level elevations. Over 900 volunteers take gage readings and submit them to us on a regular basis. For this retrieval action, you must use the main DNR LakeFinder website from your favorite browser on your phone, tablet, or computer <https://www.dnr.state.mn.us/lakefind/index.html> , NOT the **excerpted mobile website** <https://maps1.dnr.state.mn.us/lakefinder/mobile/> . Like many mobile versions, the mobile website's excerpts do not include all of the millions of items of LakeFinder information.

Go to the center of the Lake Water Level report page to the paragraph, Download lake level data as: [dBase] [ASCII]. Clicking on [dBase] may allow opening or saving the entire list to a computer spreadsheet. Clicking on [ASCII] is the most common method used to view all of the historical reported data, or copy it to a spreadsheet. Additions of more recent data is based on timing of receipt from our 800 lake level gage volunteer citizen monitors - there is no hidden cache of lake levels.

http://webapps5.dnr.state.mn.us/cgi-bin/lk_levels_dump.pl?format=csv&id=27017600

Check out how your lake's levels compare to other historic drought or wet years or other lakes. If the data are copied, we ask that a user not change the raw data numbers/dates, and that DNR EWR Lake Level Minnesota Monitoring Program is credited as the data source for any publications or reports.

The chronological water surface elevation data can then be viewed, or saved, or highlighted and copied [use Edit/Copy in your browser toolbar] into a computer software spreadsheet for sorting and graphing and comparing to summary information. For example with the ASCII download you've copied: If you're using Microsoft Office 2010 or 2013 Excel©, go to the Home menu and click on Paste for the previously copied selection. Then highlight the first column of pasted data, go to the Data menu and click on Text to Columns for the wizard. Highlight the first column of your pasted data; choose Delimited; choose Comma. Correct formats as you wish, and choose Finish.

With either the dBase or ASCII spreadsheet, you are now able to use the Excel© Home menu and Editing/Sort for rearranging the data, the Excel© Data menu for Subtotals, the Excel© Insert menu and Excel© Chart for a standard line graph or other graph of your choice, or the Excel© Formulas menu and Function for calculations. See the Excel© Help menu for more detailed directions.

b) What do those numbers tell you about vertical change or the ups and downs in the lake level?

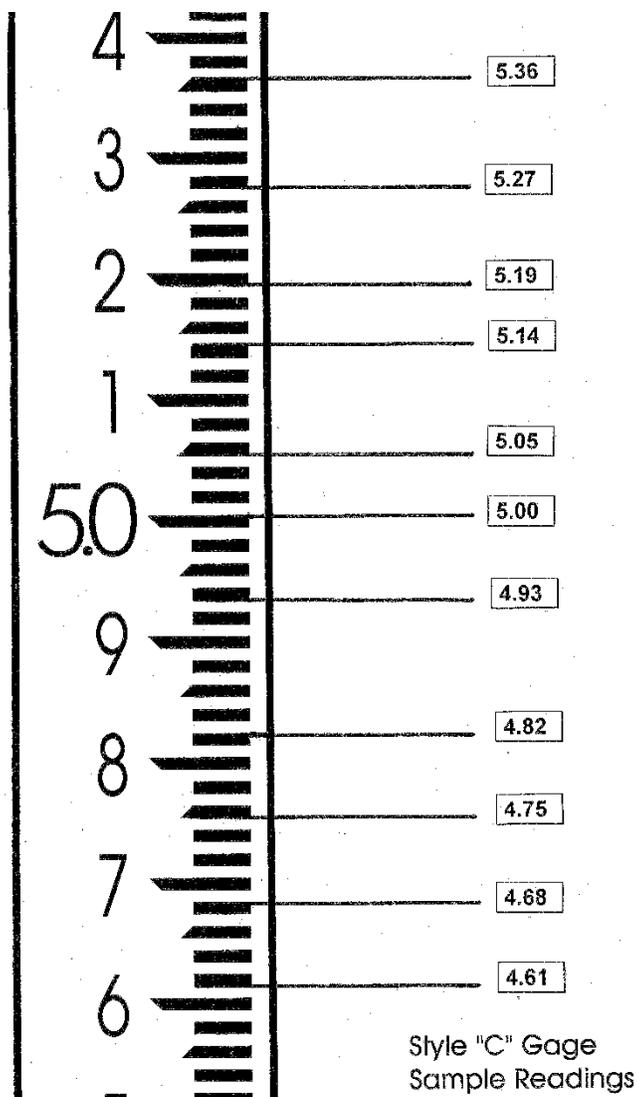
Want to check out the change in lake levels from one date to another from the LakeFinder download list or the graph? The elevation numbers are in feet. Subtract one lake level from another. This gives you the difference or change in vertical feet -- generally feet above sea level in accordance with the datum. Multiply that difference by 12 to get the vertical difference in lake levels in inches, instead of in the original feet. {Dividing by 12 would be used in converting inches into feet.} Lake landowners must be careful to distinguish between the vertical fluctuation of lake levels versus the horizontal change of

where the lake level touches the shoreline from one day to the next. There is a difference between say a drop of 6 inches vertically from one date to another as measured by our gages versus a horizontal change of water 6 inches further away from the shore on a different date which may be a very small vertical change.

7) Lake Independence Permanent Lake Level Gage – This is a Style C lake level gage of 2 sections attached on right downstream wingwall of Independence Rd. bridge at outlet, north of 2335 Independence Rd, Independence, on SW side of lake. Resurveyed by DNR on 7/19/17. Zero elevation = 954.17' (NGVD 1929). Gage owned and maintained by local unit of government.

For anyone physically and SAFELY able to read the gage on site, you are then able to calculate the Lake Independence lake level on that date by taking a gage reading where the top of the water is hitting the gage plate on a calm day.

How to read Style "C" lake level gages - sample gage readings – This is just a portion of a gage plate section sample, but the method of determining the hundredths of a foot remains the same between the larger "foot" numbers/lines.



FORMULA: Gage reading PLUS Zero Elevation = Lake Level Elevation (feet) (NGVD 1929 datum)

Lake Independence Permanent Gage Example:

Gage reading 3.27 PLUS 954.17' zero elevation = 957.44' (NGVD 1929) lake level elevation on 7/19/17