US Army Corps
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GREAT LAKES LEVELS

INTERNATIONAL GREAT LAKES DATUM

Each publication of the Monthly Bulletin of Lake Levels for the Great Lakes presents both graphical and tabular displays of past, present, and probable lake levels. Each lake has been assigned a "chart datum" or "low water datum," which is referenced to an internationally coordinated vertical datum plane. This article previews the introduction, commencing in January 1992, of a revised datum to be known as the International Great Lakes Datum, 1985 (IGLD 1985).

What is IGLD 1985?

Because of movement of the earth's crust, the "datum" or elevation reference system used to define water levels within the Great Lakes-St. Lawrence River system must be adjusted every 25 to 35 years. The current datum is known as the International Great Lakes Datum, 1955 (IGLD 1955). The date of the new datum, 1985, is the central year of the period 1982-1988 during which water level information was collected for preparing the datum revision.

Why is a revised datum required?

Water level gaging responsibility for the Great Lakes-St. Lawrence River system is shared by the United States and Canada (Figure 1). The harmonious use of these waters

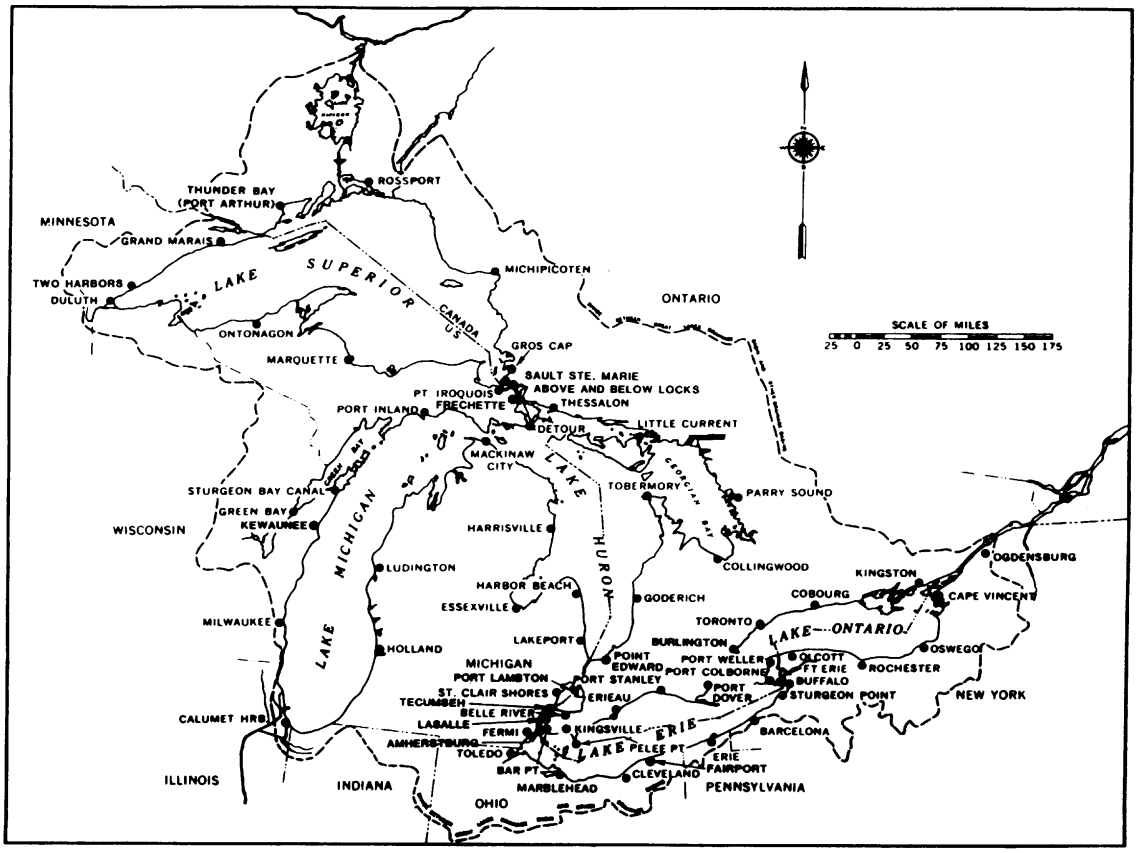


Figure 1. Water Level Gauging Stations on the Great Lakes- St. Lawrence River System.

requires international coordination of many aspects of their management. The most basic requirement for coordinated management is a common elevation reference or "datum" by which water levels can be measured.

The first common datum used by United States and Canada was IGLD 1955. This datum was established by geodetic levelling (a precise form of surveying) which is performed from the Atlantic Ocean, inland up the St. Lawrence River, and thereafter, into each lake through the connecting channels (the Niagara, Detroit, St. Clair, and St. Mary's Rivers). The geodetic levelling process established numerous bench marks (fixed land points or monuments) with very accurate elevations. These elevations are then transferred via levelling to water level gages strategically located along shorelines and waterways.

The Datums of 1903, 1909, and 1935, previously in use, were abandoned during the late 1950s and early 1960s in favor of IGLD 1955. This occurred with implementation and use of IGLD 1955 as the single vertical reference for both countries. It provided for considerably more correct hydraulic determinations of Great Lakes-St. Lawrence River water levels and flows.

When IGLD 1955 was established, it was realized that this common datum would have to be periodically revised due to isostatic rebound, sometimes referred to as crustal movement. Isostatic rebound is the gradual rising or "bouncing back" of the earth's crust from the weight of the glaciers that once covered the Great Lakes-St. Lawrence River region during the last ice age. This movement is very gradual and has been occurring since the retreat of the glaciers. Figure 2 shows the estimated rate of vertical movement for the Great Lakes-St. Lawrence River basin. From this figure, it can be seen that the rate of rebound is not uniform across the Great Lakes-St. Lawrence basin. For example, the isostatic rebound line running near Duluth and extending near to Toronto shows 0.50 foot increase at a point 150 miles from the zero isostatic rebound line in the lowest part of the basin. This movement causes bench marks to shift, not only with respect to the initial reference point at the Atlantic Ocean, but also relative to each other as well. Some bench marks may also have shifted due to local effects, such as ground subsidence, caused by mining or the weight of associated structures or through accidental damage.

The new datum is also a more desirable solution, due to addition of more geodetic connecting points (networking) than were used in IGLD 1955. Thus, the geometric figure for adjustment is strengthened, thereby resulting in a more statistically significant solution for the bench mark elevations. The added statistical precision is inherent in the water level measurements provided to the Great Lakes water resource managers. New surveying technology and adjustment techniques made it desirable to revise the datum.

As part of the datum revision, a new reference zero point (the point to which all other elevations are referenced) was established. The new reference zero point of IGLD 1985 is located at Rimouski, Quebec, on the Gulf of St. Lawrence, which is considered as sea level on the Atlantic Ocean. The old reference point of IGLD 1955 is located at Pointe-au-Pere, Quebec, which is in the vicinity of the new reference point. The concept of the reference zero point is illustrated in Figure 3. From the zero reference point at Rimouski, the elevations increase as you progress up through the Great Lakes-St. Lawrence River system. The IGLD 1985 also increases the number and accuracy of bench marks located throughout the Great Lakes region.

The new datum establishes a set of elevations consistent with one another for surveys taken within the time span 1982-1988. The key word, consistent, defined as being within geodetic levelling tolerances (a specified degree of accuracy), allows the Canadian and United States Governments to authorize the continued use of a common datum by their respective agencies.

Who is revising the datum?

The establishment and revision of this common datum is being performed under the auspices of the Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data. This committee was formed in 1953 to establish a basis for development and acceptance of common Great Lakes-St. Lawrence River system data. Representatives from various U.S. and Canadian federal government agencies constitute the committee and its sub-committees, with their agencies providing the resources to perform the required work. A total of about one and a half million dollars in resources has been expended by the National Oceanic and Atmospheric Administration, the U.S. Army Corps of Engineers, the Canadian Hydrographic Service, and the Geodetic Survey of Canada for the development of IGLD 1985.

The method for establishing IGLD 1985, selected by the committee, paved the way for a more precise datum and created a time-saving and state-of-the-art method for future datum evaluations. In addition, the work on IGLD 1985 was integrated with the effort for a common international datum in Canada, the United States, and Mexico. This common datum will be referred to as the North American Vertical Datum, 1988 (NAVD 1988). This unification of efforts reduced the cost and work required in establishing IGLD 1985, provided a check on the accuracy of the work, and established a conversion between the two datums.

What will IGLD change?

The most significant change between IGLD 1955 and IGLD 1985 will be in the elevations assigned to water levels. This is a result of bench mark elevation changes due to adjustments for crustal movement, more accurate measurement of elevation differences, a new reference zero point, and an expanded geodetic network. The agencies responsible for the collection of water levels (the Canadian Hydrographic Service and the National Ocean Service) will begin reporting water levels referenced to IGLD 1985 upon its implementation. As noted in the introduction of this article, this change will also be reflected in future copies of the monthly water level bulletins published by the U.S. Army Corps of Engineers and the Canadian Hydrographic

Table 1
Great Lakes Hydrology[1]

PRECIPITATION								
BASIN	OCTOBER				YEAR-TO-DATE			
	1991*	AVERAGE**	DIFF.	% OF AVERAGE	1991*	AVERAGE**	DIFF.	% OF AVERAGE
Superior	3.6	2.7	0.9	133	28.9	25.7	3.2	112
Michigan-Huron	5.7	2.8	2.9	204	30.3	26.8	3.5	113
Erie	4.2	2.7	1.5	156	27.2	29.4	-2.2	93
Ontario	2.8	3.0	-0.2	93	28.7	29.0	-0.3	99
Great Lakes	4.6	2.8	1.8	164	29.3	27.1	2.2	108

LAKE	OCTOBER WATER SUPPLIES***		OCTOBER OUTFLOW[3]	
	CFS[2]	AVERAGE[4]	CFS[2]	AVERAGE[4]
Superior	83,000	38,000	68,000	82,000
Michigan-Huron	145,000	1,000	186,000[5]	192,000
Erie	-12,000***	-23,000***	195,000[5]	199,000
Ontario	6,000	7,000	239,000	240,000

* Estimated (inches) ** 1900-89 Average (inches)
*** Negative water supply denotes evaporation from lake exceeded runoff from local basin.

1 Values (excluding averages) are based on preliminary computations.
2 Cubic Feet Per Second 3 Does not include diversions 4 1900-89 Average (cfs)
5 Reflects effects of ice/weed retardation in the connecting channels.

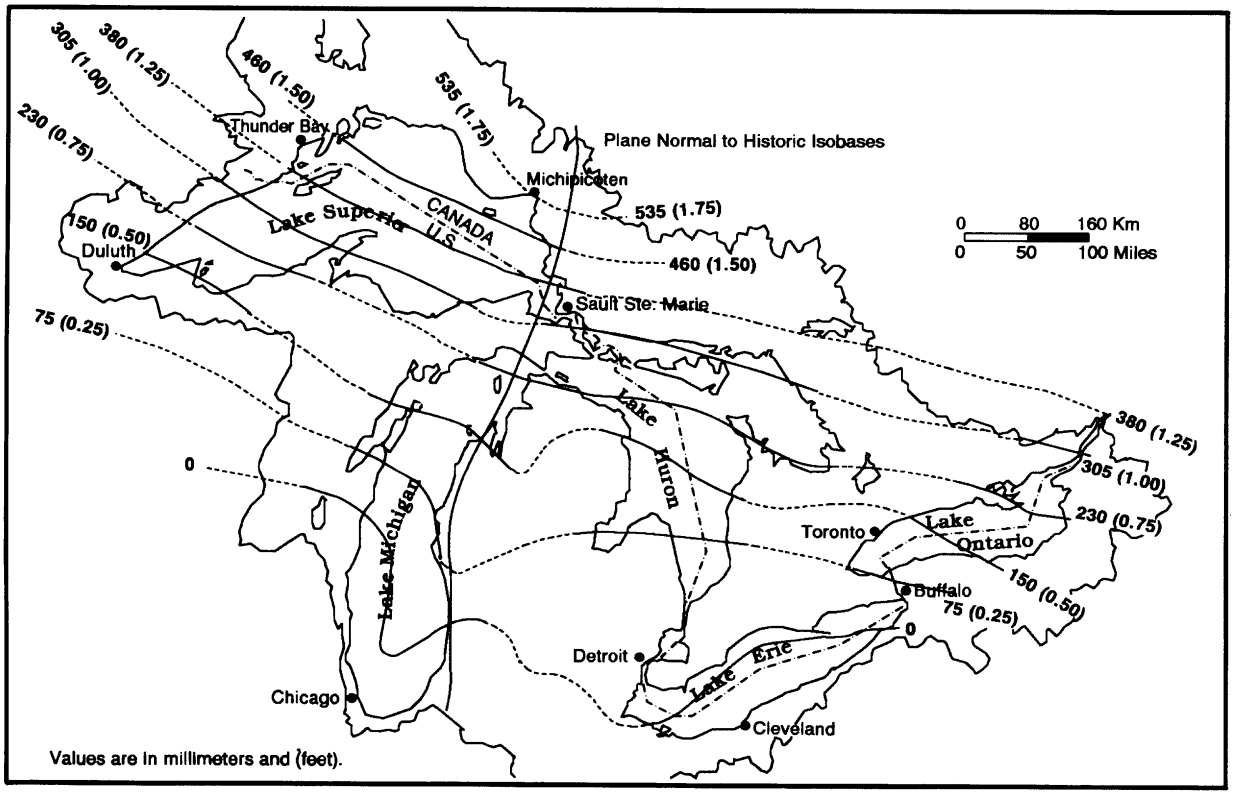


Figure 2. Vertical Movement of the Great Lakes-St. Lawrence River System.

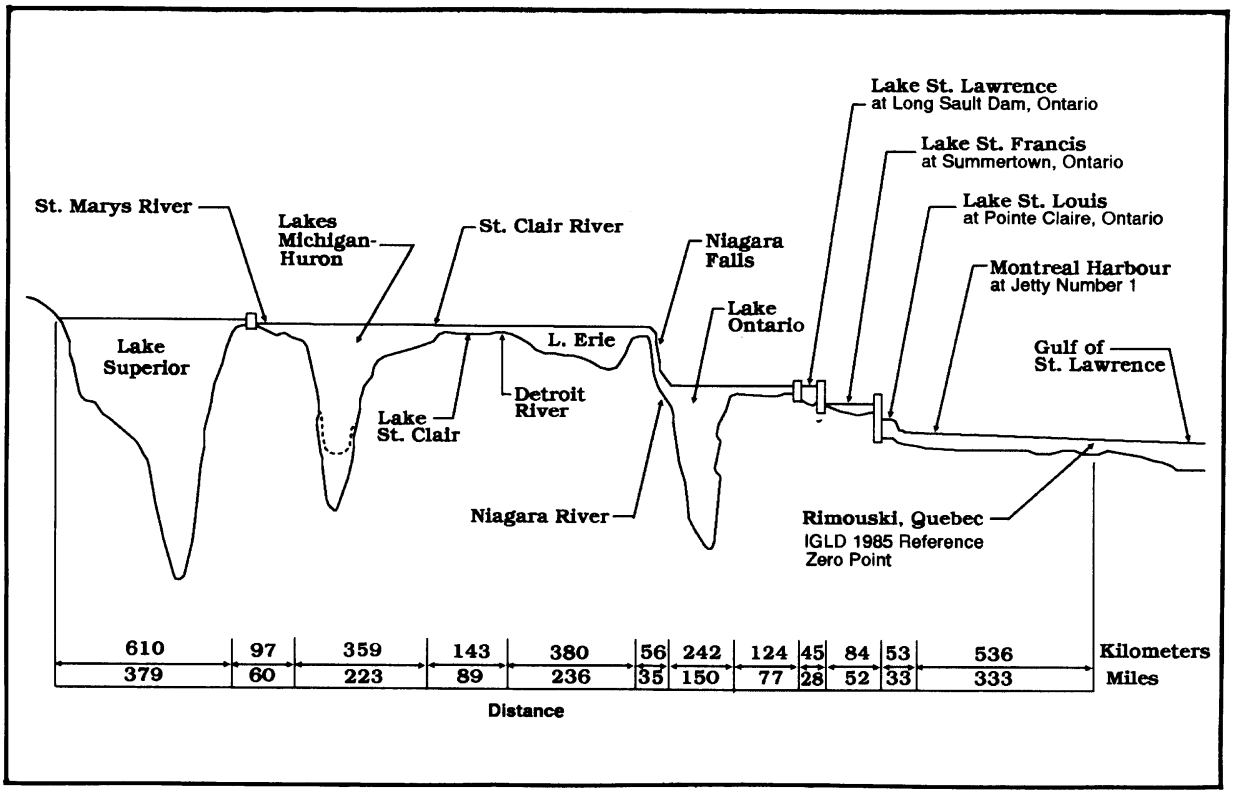


Figure 3. Illustration of Zero Reference Point.

Service. For a period of time, conversion factors will be provided for the water level data, so that the public can relate to the two datums. The IGLD 1985 will not change water levels established for Canadian zoning restrictions or water levels established for federal flood insurance purposes in the United States. These levels are referenced to the Geodetic Survey Canadian Datum, and the National Geodetic Vertical Datum 1929 (NGVD 1929). However, elevations referenced to these datums will be reassigned when NAVD 1988 is implemented. Elevations at common bench marks between NAVD 1988 and IGLD 1985 will be made available in future by the responsible agencies.

The limits of jurisdiction under Section 10 of the Rivers and Harbors Act for projects in the United States will not physically change in extent but will be reassigned elevations referenced to IGLD 1985. The limits of Section 10 jurisdiction on the Great Lakes are defined by the Corps of Engineers' Ordinary High Water Mark (OHWM). New applications for permits submitted to the U.S. Army Corps of Engineers under Section 10 should reference water levels on any drawings to IGLD 1985.

The low water datum (or chart datum) on Great Lakes-St. Lawrence River system navigation charts will be changed from IGLD 1955 to IGLD 1985. The soundings (or water depths) shown on navigation charts will not require modification. Navigators need not buy new charts immediately but should note the new low water datum on their existing charts. New charts, reflecting the revised low water datum, will be printed over the next several years according to the existing printing schedule of the responsible agencies.

The methods of regulating Lake Superior and Lake Ontario outflows will not be affected by the implementation of IGLD 1985. The range of levels within which the lakes are regulated will be assigned new elevations, but the ranges will remain the same with respect to their position with the shoreline and navigation depths.

When will IGLD 1985 be implemented?

The implementation and publication of IGLD 1985 will occur in January 1992. This revised datum should be acceptable for general use in the Great Lakes-St. Lawrence River system for at least the next 25 years.

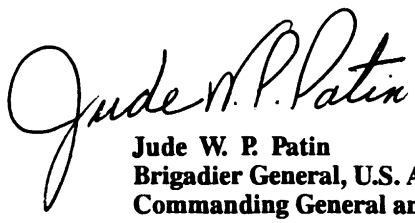
Where can more information be obtained?

A workshop to introduce IGLD 1985 will be conducted on Wednesday, November 20, 1991, at the Great Lakes Environmental Research Laboratory, 2205 Commonwealth Boulevard, Ann Arbor, Michigan 48105. The workshop will open with presentations by technical experts of the committee, to be followed by a question and answer session. The workshop is scheduled to begin at 1:00 p.m. and is expected to last until 5:00 p.m. Since workshop spaces are limited, please R.S.V.P. to Ms. Deborah Lee, (313) 668-2148, to reserve a space or to obtain more information.

Great Lakes Basin Hydrology

The level conditions on the lakes are shown in graphical and tabular form in the bulletin. This includes the actual levels for the past 1-2 years, as compared to the recorded (1900-1990) maximum, minimum, and average levels; a forecast plot for the next 6 months; and a table of the past month's mean levels as compared to a year earlier and the recorded (1900-1990 average, maximum and minimum levels.

The precipitation, water supplies, and outflows for the lakes are provided in Table 1. For the precipitation, this includes the actual for the past month, the year-to-date and the long-term average. Both the actual and long-term average water supplies and outflows are also shown.



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