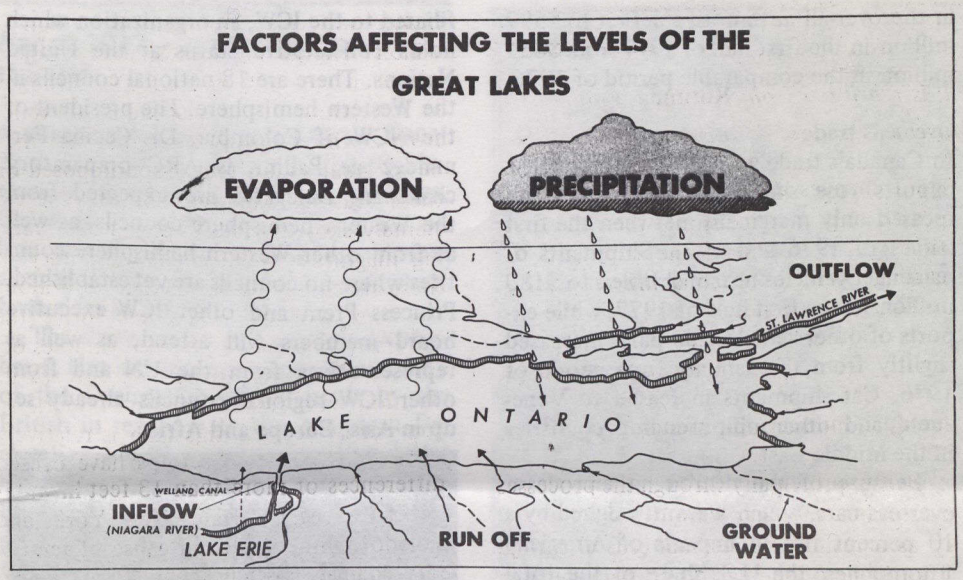

cause the property damage during high water. The search for the cause of these fluctuations has involved studies of the climate of the Great Lakes Basin and the hydrology of the lakes.

Volume of water

The total area of the Great Lakes drainage basin is 295,800 square miles, of which 94,680 square miles or 32 per cent is occupied by water. All lakes except for Lake St. Clair and Lake Erie have depths that extend below sea level. It is important to realize that because of the very large water surface of the lakes, even small changes in levels account for enormous quantities of water. The seasonal and long-term changes recorded by measuring gauges on any lake indicate an enormous increase or decrease in the volume of water in that lake.

In each of the lakes, the volume of water is dependent upon the amount of precipitation (snow and rain) over the lake, the amount of water delivered by rivers and streams flowing into the lake, the inflow from the lake above, the flow of groundwater into the lake, and any artificial diversion into the lake from outside the basin.

The gain in water is lost by counteracting processes. These processes are evaporation, outflow, either natural or through artificial diversion of water to other drainage basins, and withdrawal for municipal and industrial use. Compared with the total volume of water in the lakes these latter two uses at present are very minor, though they may increase. In the Great Lakes system, Lake Superior has no large inflow, since it is the uppermost lake of the system. It does receive waters from two small diversions from the Hudson Bay drainage, but about 88 per cent of Lake Superior's supply of water comes from precipitation.

Although we can measure the outflow of a lake we can only estimate how much water is lost through evaporation, because of the many factors that influence this process. It has been estimated that twice as much water evaporates from the Great Lakes as flows down the St. Lawrence River. Calculations suggest that for Lake Superior, about 55 per cent of the new waters return to the atmosphere, while for Lake Ontario, the evaporation is thought to be almost equal to the precipitation. By way of further contrast, about 86 per cent of the waters stored in Lakes Erie and Ontario come from inflow from the upper lakes.

The "water budget"

The principal factor that determines inflow, outflow, and evaporation – what is known as the "water budget" of the lakes – is climate. The rate of precipitation and evaporation is determined by long-term climatic trends over the whole watershed. A single dry spell or rainy season has little effect on lake levels. It is only when precipitation is persistently above average or persistently below average for a number of years that lake levels are significantly raised or lowered.

The Great Lakes, in fact, are naturally well-regulated bodies of water, because the lakes have relatively small restricted outlets through which their waters are discharged. The outflow from Lakes Michigan-Huron through the St. Clair River, Lake St. Clair, and the Detroit River, into Lake Erie, depends on the levels of the upstream and downstream lakes. Similarly, the outflow of Lake Erie to a great extent governs the level of Lake Ontario. The efficiency of the system is reflected in the relatively small variations between winter and summer flows through the connecting channels. In fact, maximum flows of the outlet rivers are only two or three times their minimum – in comparison, for example, with the Mississippi River, whose maximum flow can be 35 times greater than its minimum. This natural regulation of outflows is the reason for the relative stability of the lake levels.

* * * *

The waters of Lake Ontario are controlled by dams along the St. Lawrence Seaway at Cornwall, Ontario and Massena, New York. The regulation of the discharge must take into account not just the levels of Lake Ontario, but also the levels of the St. Lawrence River at Montreal Harbour. It is interesting to note that during the high waters of 1973, for all of the months of June and July the outflow of Lake Ontario was allowed to exceed by a considerable amount the maximum flow ever recorded in the St. Lawrence River before the Seaway was built. This increased outflow diminished the water level in Lake Ontario by just over one foot.

IJC study

It is evident, then, that our existing methods of control can alter lake levels only minimally. In response to the problem of fluctuating lake levels, the International Joint Commission, through the International Great Lakes Level Board, carried out a thorough study from 1964-1974 in order to ascertain the feasibility of further regulating any or all of the unregulated Great Lakes. The general conclusion was that the cost of the structures that would be required to regulate water levels on all the lakes would be far in excess of the benefits that would be gained, although modifications in the regulations that govern the discharge through the control structures at Sault Ste. Marie and on the St. Lawrence Seaway can be made to reduce extreme water levels. The conclusions are clear. Our financial resources and technical ability to control the levels of the lakes are strictly limited. Instead of seeking to control, we must develop new policies in order to live with the lakes more comfortably.

(Continued on P. 8)