

records do not exist preliminary design values are estimated from empirical relationships. These empirical relationships are a valuable guide but they do not replace actual gauge data.

Since the Conservation Branch was established in 1944 the number of gauges has been increased from 9 to over 120. During the past 6 years, with the co-operation of the Conservation Authorities and the Water Resources Branch, Ottawa, some 28 of the existing manually read gauges have been replaced with recording gauges which provide reliable continuous records. This program is continuing and eventually most of the gauges will be of the recording type. In addition accurate records of precipitation on the various watersheds are required. The tabulation of precipitation data is administered by the Federal Department of Transport but as in the case of the stream gauges the network of rain gauges was inadequate for accurate water control studies on the watershed with which the Conservation Branch is concerned. A program is underway in co-operation with the Federal Department to expand the precipitation gauge network.

Many advocate that flood control can be obtained through the preservation of swamps and the establishment and maintenance of forests and proper land use practices in the headwater regions. While these measures are of significant benefit to the overall water problem they are insufficient to control major floods. La Salle's difficult journey in the time when Ontario was still largely covered with forest, is evidence that floods are not due entirely to settlement activities. Land use changes, accompanying settlement and development, may create problems and increase run-off rates and cause higher flood peaks than would have otherwise occurred, but measures in addition to good forest and agricultural practices are required to give protection from floods. These include:

- (1) reduction of peak stage by channel improvements,
- (2) diversion of flood water through by-pass channels,
- (3) confinement of the flood within dikes or flood walls,
- (4) reduction of peak flow by reservoirs,
- (5) zoning or acquiring flood plains so that only low-hazard uses are permitted, and,
- (6) flood forecasting coupled with a system to warn of impending danger in sufficient time for protection or evacuation of the people and valuable property.

Channel improvements, consisting of widening, deepening, and straightening the existing channel, may be an expedient solution to the local flood situation but they tend to increase flood stages on downstream locations. Channel improvement works have been carried out by several Conservation Authorities and examples may be seen on the Humber River at Weston; the Don River at Hogg's Hollow; or the Thames River at Mitchell and Ingersoll.

Channel diversions capable of carrying the entire flood flow of a river or a flow in excess of the natural channel capacity may be constructed around a hazard area. Such a diversion has been made at Brampton where the Etobicoke Creek formerly passed under the main street in a covered channel. The original channel, with its limited capacity, was unable to handle the heavy spring flows and the business section of the town was severely flooded on many occasions. Now a diversion channel carries the flood waters safely around the low-lying centre of the town. This is a concrete-lined channel 3,100 feet in length with a 30-foot bottom width and is designed to carry 3,500 cubic feet per second, although it safely discharged as much as 5,000 c.f.s. at the time of Hurricane "Hazel" in 1954.