

REPORT ON COMPARISON OF SHIELDED AND NON-SHIELDED
PRECIPITATION GAGE STUDY

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being conducted by the Weather Bureau in cooperation with the Corps of Engineers, U.S. Lake Survey

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Throughout the fall, winter and spring months of 1951-52 the levels of all the Great Lakes were abnormally high. In May and June of 1952 Lakes Erie and Ontario reached seasonal levels higher than at any time during the 92 years of record. Also, Lakes Michigan and Huron in August 1952 rose to within a foot of the all-time high monthly mean reached in June 1886.

During this period of abnormally high stages there occurred a considerable number of storms which generated waves causing widespread damage to beaches, harbors, industry and residential property along the shores of the lakes. Over the past 20 years there has been a marked increase in the development of shore property which resulted in total damages greater than any experienced since the last occurrence of high lake levels in 1929.

On March 26, 1951, the Committee on Public Works of the House of Representatives adopted a Resolution directing the Board of Engineers for Rivers and Harbors to report on the damages resulting from the high lake stages and present feasible measures to prevent the recurrence of such damages. This report and others were prepared by the Department of the Army, Corps of Engineers, Division Engineer, Great Lakes Division, and their contents are undoubtedly familiar to those of you concerned with operations affected by the Great Lakes.

These reports also served as the impetus for investigations of the basic hydrologic data for the Great Lakes to establish what additional data on precipitation, runoff, groundwater, and evaporation were desirable to strengthen methods for forecasting lake levels. In this regard the U.S. Weather Bureau was asked to assist the U.S. Lake Survey in the establishment of additional precipitation stations in Northern Lake Michigan on various islands and on the shore to study the relationship between precipitation on land and over the lake surface. The present practice for estimating lake precipitation is based entirely upon precipitation observations from land stations. Since the combined lake surfaces comprise only about $\frac{1}{3}$ of the total Great Lakes drainage area, one might assume that errors from estimating lake precipitation from nearby land station data would be insignificant. However, precipitation over the lakes makes a direct and 100% contribution to runoff, which is an important factor to consider when attempting to establish a water budget. Therefore, it seemed that it would be necessary to determine if precipitation occurring over the lake area was materially different from that occurring over the land area.

During November, 1952 precipitation gauges were installed on six islands in the northeastern section of Lake Michigan. Storage precipitation gauges (Sacramento type) were established at Gull, Ile Aux Galets, Beaver, South Fox, North Manitou and South Manitou Islands. (See Figure 1.) The storage gauges were equipped with Alter type windshields since the proposed gauge sites were expected to experience the full force of the prevailing winds blowing across the lake.

In order to make accurate comparisons of precipitation measurements from the island stations with the shore stations, it was decided that the shore check stations should be similarly equipped with gauges and Alter shields in addition to the standard unshielded 8-in. non-recording gauge. Figure 1 also shows the check stations which are: Manistique, Mackinaw City, St. James Beaver Island, Charlevoix, Suttons Bay and Elberta.

Over the years many studies have been made comparing gauge catches of shielded and unshielded gauges. The most notable of these studies conducted in recent years was the work of C. C. Warnick, the results of which were summarized in Bulletin No. 10, April 1956, of the University of Idaho Engineering Experiment Station. Most of the past experiments have been carried on under what might be considered ideal conditions regarding site selection and exposure. The Great Lakes study currently under way is to make certain the precipitation measured at the island stations can be accurately compared with observations collected at a typical Weather Bureau cooperative climatological station.

Tests conducted at the Central Sierra Snow Laboratory demonstrated that selection of the proper site could provide a natural shield for precipitation gauges. Under these conditions the installation of a mechanical shield made little or no improvement in the gauge catch.

In the operation of the Bureau's precipitation observation stations, which number over 10,000, neither the manpower or potential observers are available to select initially the ideal gauge exposure, nor has it been possible to keep the desirable check on the changes of the gauge environment over the years. Frequently the selection of a gauge site is entirely dependent upon the availability of an observer.

Therefore, recognizing that many factors exert a considerable effect upon precipitation gauge exposure, it appeared that no arbitrary decisions could be made regarding the possible adjustment of observations from unshielded gauges. It was necessary to make a detailed study of the gauge exposure at each check station. To demonstrate the study currently under way the following data were selected from that collected thus far at three check stations:

- Describe Graph I - Charlevoix.
- Describe Graph II - Elberta.
- Show pictures of gauge exposure.
- Describe Graph III - Mackinaw City.
- Show pictures of gauge exposure.

In January, 1956 totalizing anemometers were installed at each of the land check stations to record the total daily wind movement passing the gauge orifices. The second season of these data is currently being collected. It is expected that the degree of windiness at each station, correlated with other site factors, will be studied as the project progresses.

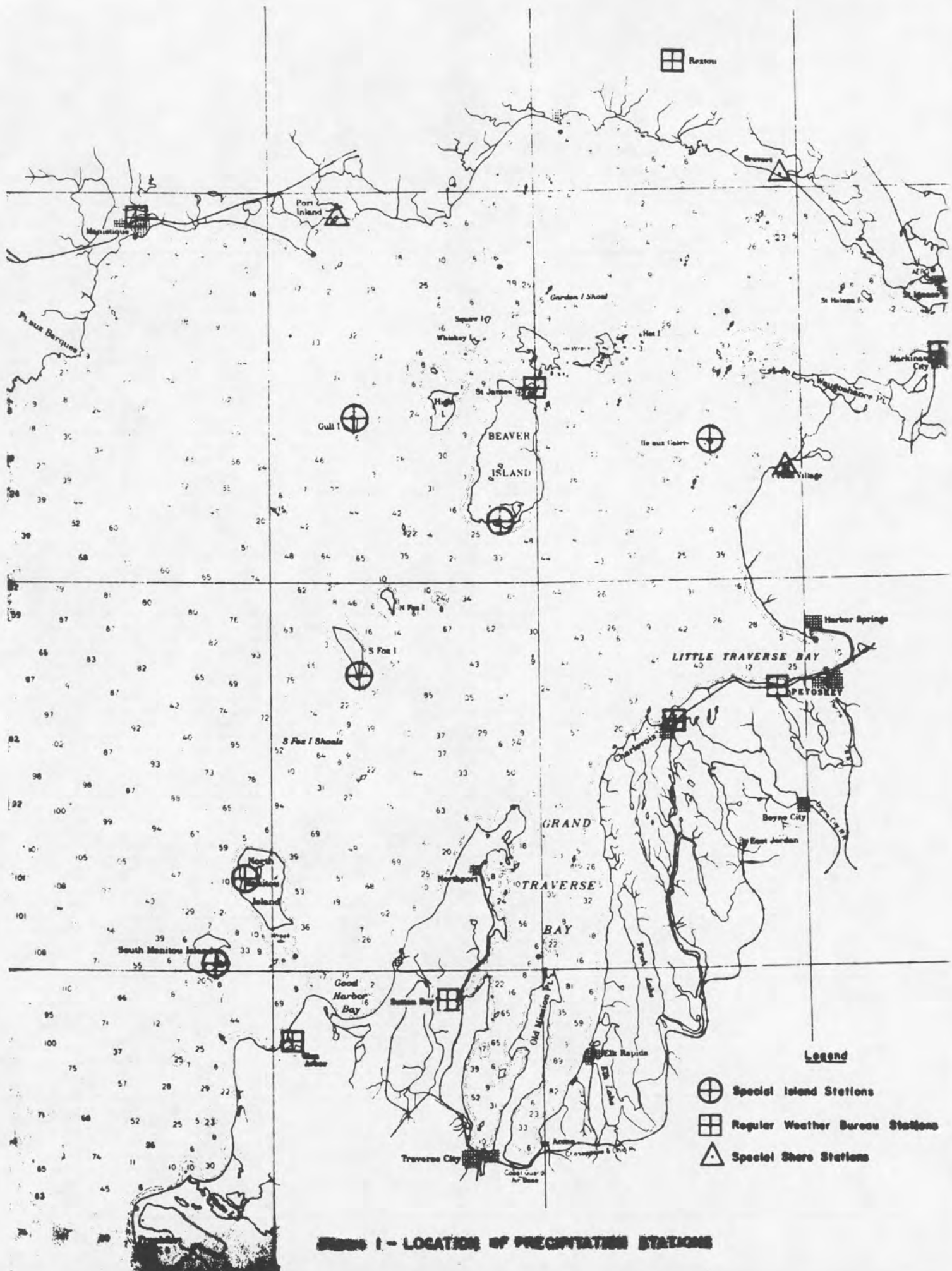
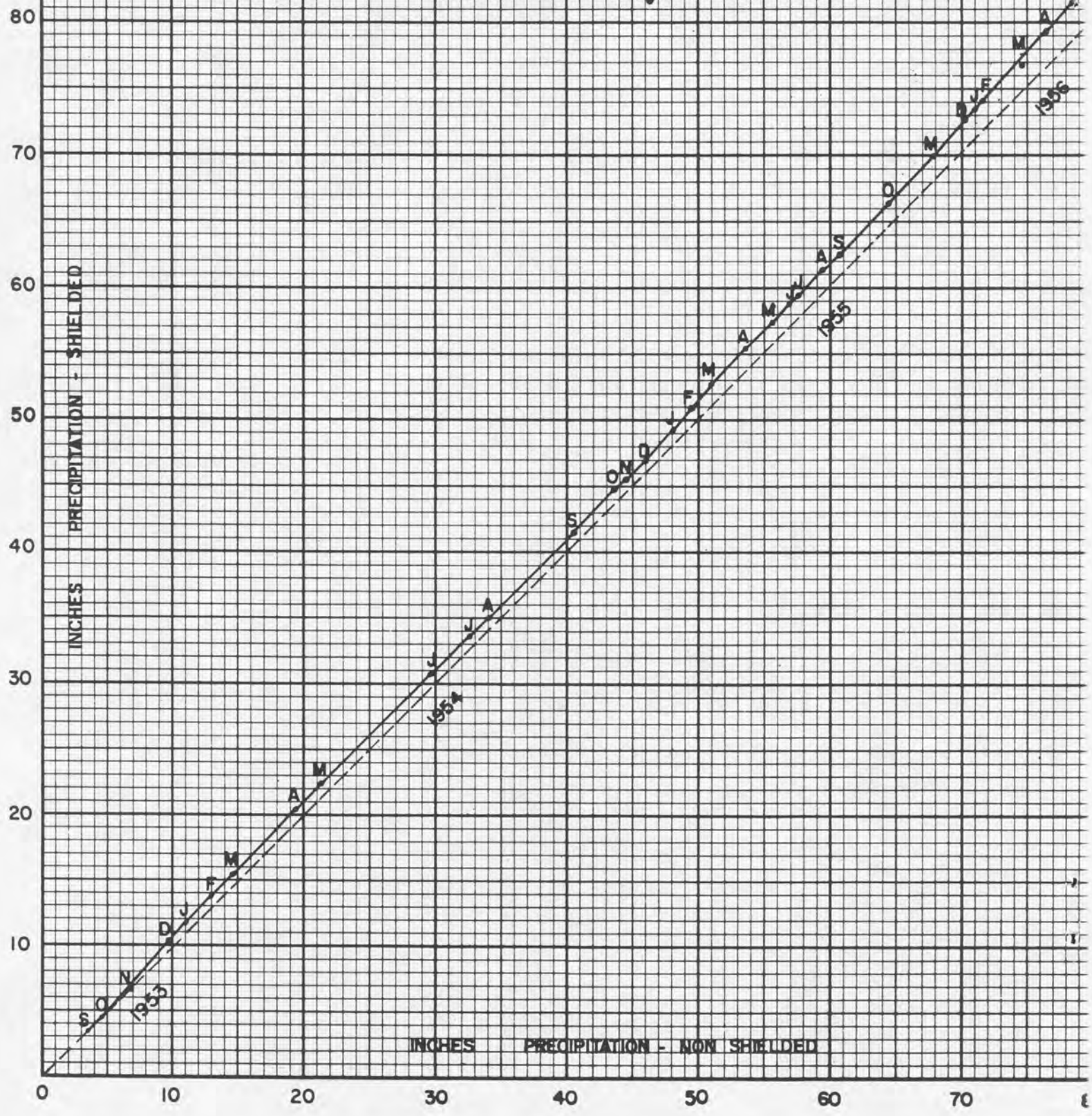
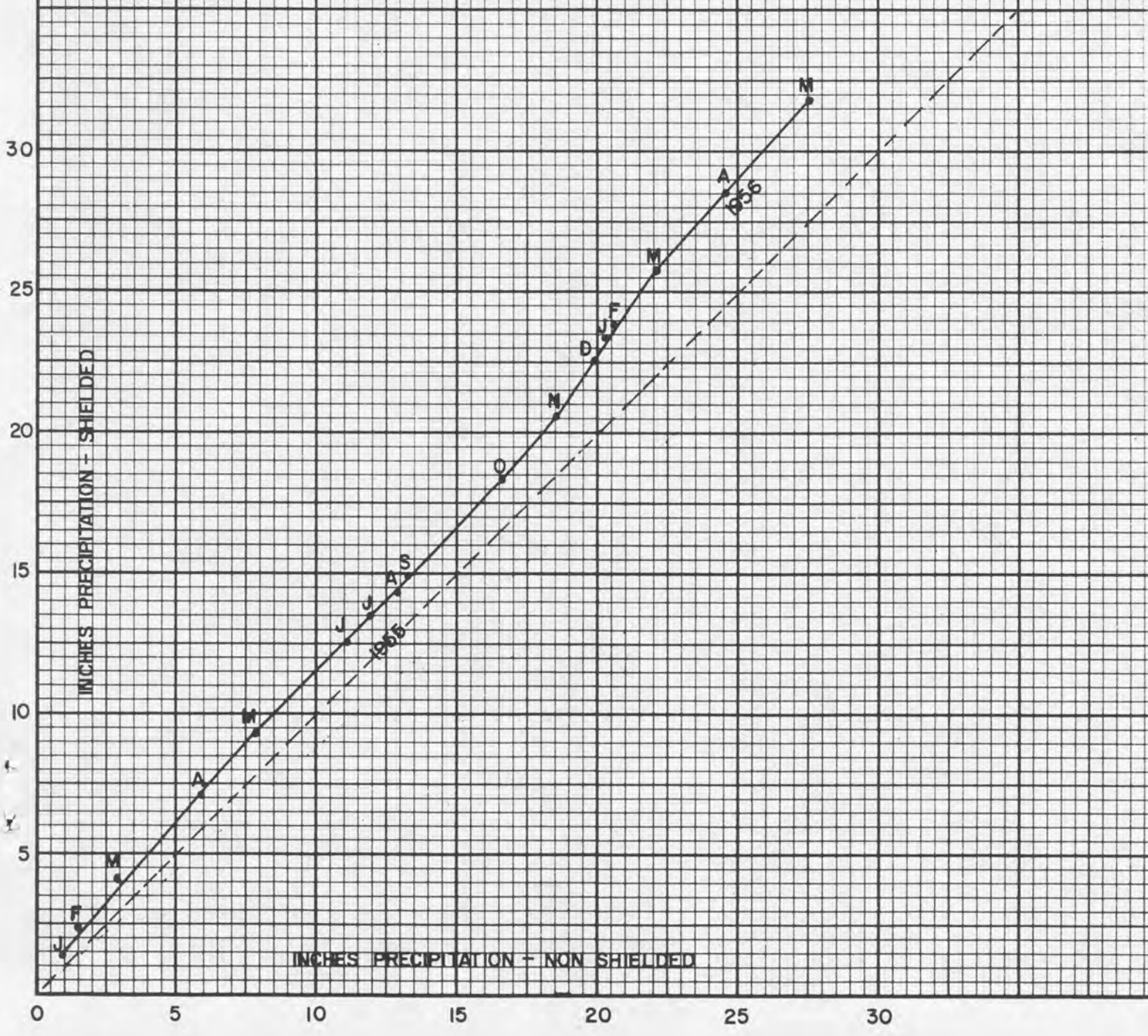


FIGURE 1 - LOCATION OF PRECIPITATION STATIONS

COMPARISON OF SHIELDED AND NON SHIELDED PRECIPITATION GAGES CHARLEVOIX, MICH.



COMPARISON OF SHIELDED AND NON SHIELDED PRECIPITATION GAGES ELBERTA, MICH.



COMPARISON OF SHIELDED AND NON SHIELDED PRECIPITATION GAGES MACKINAW CITY, MICH.

