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GREAT LAKES ICE COVER, WINTER 1975-76

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GREAT LAKES ICE COVER, WINTER 1975-76*

George A. Leshkevich

From ice-cover data received at the Great Lakes Environmental Research Laboratory during the past winter, 19 composite ice charts were produced to illustrate estimated ice distributions and concentrations on the Great Lakes at weekly intervals from mid-December 1975 through mid-April 1976.

According to the definitions of mild, normal, and severe winters set forth by Rondy (1971), freezing degree-day accumulations indicate that the 1975-76 winter was normal for all lakes. Accumulations were at their seasonal maximum on 21 March in the northern portion of the Great Lakes and on 8 February in the southern portion.

Skim ice was reported during late November and early December at various sites around the Great Lakes. Freeze-over was reported in late November on some bays and protected areas of Lake Superior and the lower St. Marys River and near mid-December at other sites on the Great Lakes, including portions of Green Bay, Saginaw Bay, and Lake St. Clair. Responding to lower average weekly temperatures, ice growth continued on these and other protected shore areas during the week ending 21 December. During the next 2 weeks slightly warmer temperatures retarded ice growth, especially on the northern lakes. Ice growth in&eased substantially during the week ending 11 January, reflecting colder air temperatures. On the average, ice covers increased during late January, reaching their maximum extents during early February on all lakes except Lake Superior, where it reached maximum near mid-March. Maximum ice extent was estimated to be approximately 40 percent on Lake Superior, 20 percent on Lake Michigan, 50 percent on Lake Huron, 95 percent on Lake Erie, and 20 percent on Lake Ontario. Warmer temperatures during the week ending 15 February caused substantial loss of ice cover on most of the Great Lakes and, except for short periods of relatively stable conditions, started the period of ice deterioration on the southern portion of the Great Lakes. On the northern portion of the Lakes ice covers continued to grow or remain relatively stable until the week ending 21 March, when warmer temperatures started a period of ice deterioration that continued to the end of the season. Last reports of significant ice on the northern lakes came near mid-April.

*GLERL Contribution No. 104.

1. INTRODUCTION

As part of the Great Lakes Environmental Research Laboratory's ongoing Lake Ice Project, each annual ice cycle on the Great Lakes is documented. This report describes the 1975-76 Great Lakes ice cycle. Reports describing the progression of ice cover on the Great Lakes for past winters, beginning with the 1962-63 winter season, are available from the Great Lakes Environmental Research Laboratory, Ann Arbor, Mich. As in more recent reports in this series, this report contains information on ice-cover formation, growth, and decay on the Great Lakes on a weekly basis. A summary of freezing degree-day (FDD) accumulations is also included as an indicator of winter severity.

2. DATA COLLECTION AND ANALYSIS

2.1 Data Sources

Ice-cover data collected and used in preparing this report include aerial ice charts, satellite imagery, side-looking airborn radar (SLAR), and surface ice reports. Ice charts depicting ice distribution and ice concentration, as well as size and age of floes, were received throughout the winter from the Ice Navigation Center, Cleveland, Ohio, and Ice Forecasting Central, Ottawa, Ont., Canada. NOAA-4 VHRR and LANDSAT-1 and -2 satellite imagery was received from the National Environmental Satellite Service in Washington, D.C. SLAR imagery was received from the Ice Navigation Center, Cleveland. Weekly and daily surface reports of ice conditions and thickness were received from observers for the Great Lakes Environmental Research Laboratory and the United States Coast Guard.

2.2 Data Analysis

United States Coast Guard and Canadian ice charts are graphic representations of visual observations made by ice observers periodically throughout the winter season. Sixty-six Coast Guard ice charts, covering Lake Superior, Whitefish Bay, the St. Marys River, the Straits of Mackinac, Lake Michigan, Green Bay, Lake Huron, Saginaw Bay, Lake St. Clair, and Lakes Erie and Ontario (see map, Fig. 1) and forty-seven Canadian visual ice charts, covering Canadian portions of the Great Lakes, were received. Little, if any, interpretation of these charts is necessary as they depict actual observed ice conditions through the use of symbols and codes.

Weekly and daily surface reports of ice thickness and ice conditions received from GLERL and Coast Guard observers were in written form and similarly needed little or no interpretation.

SLAR imagery and ice charts were received for 51 days of the winter season. The frequency and extent of coverage, in addition to the imaging capabilities of the radar system, made it a valuable source of ice-cover data.

NOAA-4 VHRR visible and thermal infrared imagery and LANDSAT (ERTS) -1 and -2 bands 4, 5, 6, and 7 (visible and near infrared) satellite imagery was

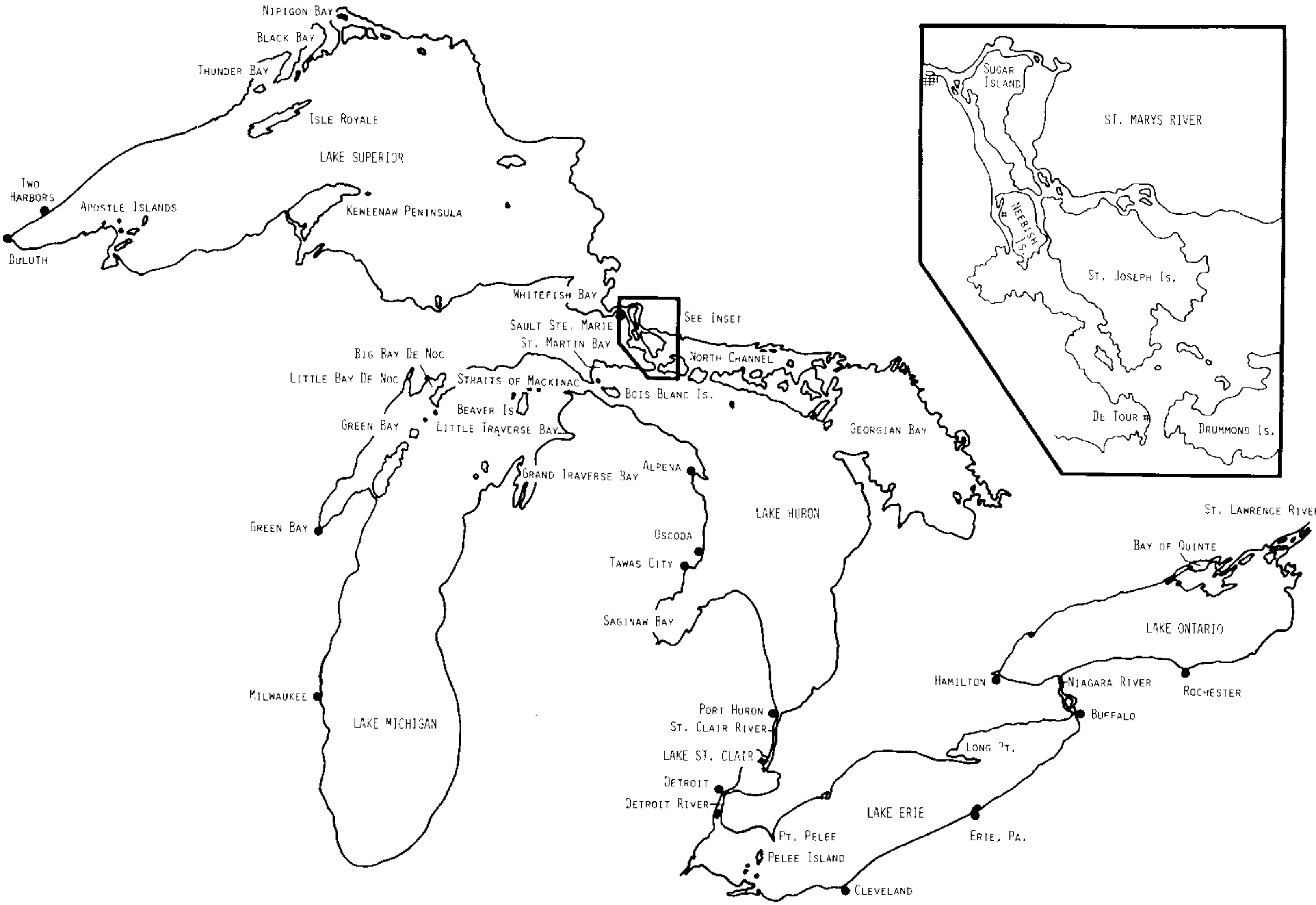


Figure 1. The Great Lakes

received for the ice season in the form of positive transparencies. The satellites' spectral scanners recorded reflected and emitted radiation in the visible and infrared wavelengths. SLAR imagery was received in the form of paper prints. Flown at approximately 11,000 ft (3400 m), SLAR recorded its own reflected radar pulse. By using density, tone, and texture, supplemented by visual ice charts and reinforced by other imagery, if available at or near the time in question, the imagery was visually interpreted and information about ice cover and concentration abstracted and transferred to the composite ice charts.

3. DATA PRESENTATION

3.1 Freezing Degree-Days

Based on average weekly temperatures given in the *Weekly Weather and Crop Bulletin*, a joint publication of the U.S. Departments of Agriculture and Commerce, FDD accumulations were compiled for selected National Weather Service meteorological stations on the perimeter of the Great Lakes. These stations include: Duluth, Minn.; Sault Ste. Marie, Mich.; Alpena, Mich.; Green Bay, Wis.; Milwaukee, Wis.; Detroit, Mich.; Cleveland, Ohio; and Rochester, N.Y. FDD's measure the cumulative temperature departure from 32°F. Based on the mean of the daily maximum and minimum air temperatures (defined as the mean daily air temperature), 1 FDD is accumulated for each degree of negative departure from 32°F. Thus, for a mean daily air temperature of 28°F, 4 FDD's are accumulated. Graphs depicting the 1975-76 FDD accumulations compared to a 10-year mean are given for each of the Great Lakes (Figs. A.1 through A.5).

3.2 Composite Ice Charts

The seasonal pattern of ice formation, growth, and decay on the Great Lakes from 14 December 1975 to 18 April 1976 is illustrated on 19 composite ice charts (Figs. A.6 through A.24). Based on a subjective evaluation of available ice-cover information, these charts portray estimated ice conditions at weekly intervals as abstracted from data discussed in Section 2 of this report.

FDD accumulations at the eight representative stations noted above are also given on each composite ice chart. Weekly, seasonal, and normal seasonal accumulations are presented as an indication of the weekly variation in winter severity and the seasonal variation in severity relative to a lo-year mean (1961-70).

4. DISCUSSION

4.1 Winter Characteristics

One method of characterizing winter seasons and comparing winter severity involves the use of maximum FDD accumulations as an indicator. Applying the FDD winter classification set forth by Rondy (1971), the 1975-76 winter season can be characterized as near normal for all of the Great Lakes. The date of maximum accumulation separates a period of potential ice formation from a period of potential ice decay. FDD accumulations were near their seasonal maximum on 21 March on northern portions of the Great Lakes and on 8 February on southern portions of the Lakes.

Compared to the average dates of maximum FDD accumulations given by Rondy (1971), the 1975-76 maximum accumulations occurred earlier at all representative stations and total accumulations were less at all but two stations (Cleveland, Detroit). Compared to the 1974-75 season, 1975-76 maximum FDD accumulations were greater at all of the representative stations except Milwaukee and were the same at Green Bay. Maximum accumulations occurred approximately 1 to 3 weeks earlier than in the 1974-75 season.

Although somewhat superficial, another indicator of the relative severity of a winter season during the past few years has been the dates of the closing of the locks at Sault Ste. Marie to navigation. Under the Extension to the Navigation Season Demonstration Program, navigation on the Great Lakes has progressively been extended further into the winter season with the 1974-75 sea,-son becoming the first year-round shipping season in history. The 1975-76 winter season became the second consecutive year-round shipping season.

It should also be noted that the St. Lawrence Seaway was closed to shipping on 21 December 1975 and reopened on 3 April 1976.

4.2 General Seasonal Trends in Ice-Cover Distribution

Skim ice was reported during late November and early December at various sites around the Great Lakes. Freeze-over was reported in late November on some bays and protected areas of Lake Superior and the lower St. Marys River and near mid-December at other sites on the Great Lakes (Fig. A.6). Responding to lower average weekly temperatures, ice growth continued on these and other protected shore areas during the week ending 21 December (Fig. A.7). During the next 2 weeks, slightly warmer temperatures retarded ice growth, especially on the northern portions of the Lakes (Figs. A.8 and A.9). Ice growth increased substantially during the week ending 11 January (Fig. A.lO). On the average, ice covers increased during late January and early February, reflecting the low average temperatures and increased FDD's prevalent at that time (Figs. A.11 through A.14). Ice covers reached their maximum extents during early February on all of the Great Lakes except Lake Superior (Figs. A.13 and A.14). A break in the weather starting about 10 February and continuing during late February caused significant deterioration of the ice covers on most of the Great Lakes during the week ending 15 February (Fig. A.15) and started the period of ice deterioration on the southern portions of the Lakes (Figs. A.16 through A.24). Resumption of cold temperatures on the northern portions of the Lakes caused stable conditions and some new ice formation during the first 2 weeks of March (Figs. A.18 and A.19). The period of ice decay and deterioration on the northern portion of the Lakes began during the week ending 28 March and continued to the end of the season. Last reports of significant ice on the Great Lakes came during the week ending 18 April.

4.3 Lake Superior and the St. Marys River

Skim ice was reported at shore sites on western Lake Superior as early as 23 November and along the St. Marys River on 22 November. Freeze-over was reported in these areas during late November and early to mid-December. By 14 December, Thunder Bay, Black Bay, and Nipigon Bay, along the north-central shore of Lake Superior, as well as portions of the lower St. Marys River, were partially ice covered. Fluctuating temperatures prevented any substantial ice formation until late December when the upper St. Marys River, the southern portion of Whitefish Bay, and the area around the Apostle Islands had partial ice cover (Figs. A.6 through A.8). No significant change took place until the week ending 11 January, when markedly lower temperatures caused ice formation on most of the St. Marys River and Whitefish Bay, around the Apostle Islands and the Keweenaw Peninsula, and along the south shore and the north shore from Thunder Bay to Isle Royale (Figs. A.9 through A.10). Although some deterioration of the ice cover occurred in the central and eastern portions of the lake, ice continued to form in the western portion during the week ending 18 January (Fig. A.11). Ice gradually continued to form until the week ending 15 February (Figs. A.12 through A.15). Starting that week, a period of relatively warm weather caused some melting, especially in the northern portion of the lake (Fig. A.16). Unlike conditions to the south, colder than normal temperatures during early March caused new ice formation on Lake Superior. Except for some deterioration along the southern shoreline, this trend continued until the week ending 21 March (Figs. A.17 through A.20). It was during this period that the ice cover on Lake Superior reached its maximum extent, covering approximately 40 percent of the lake's surface area near mid-March. Once formed, ice cover on the St. Marys River remained relatively stable until late March. At that time the upper St. Marys River became ice-free. Warmer temperatures beginning the week ending 28 March started the period of ice deterioration on Lake Superior that continued to the end of the season (Figs. A.21 through A.24). Much of the ice cover had deteriorated by early April, with virtually ice-free conditions occurring on the lake by the week ending 11 April. Last reports of significant ice on Whitefish Bay came near mid-April, while Black Bay and Nipigon Bay, on the north shore of the lake, retained ice cover as late as 24 April.

4.4 Lake Michigan

First reports of skim ice on Lake Michigan came from Green Bay on 2 December with freeze-up date ranging from near mid-December to late January, depending on location. Lower temperatures just past mid-month caused an increase in ice formation on the southern part of Green Bay, the Bays de Noc, and along the northern shore of the lake (Fig. A.7). Ice continued to grow in thickness and concentration in southern Green Bay although warmer temperatures during late December and early January caused some melting in northern Green Bay during the week ending 4 January (Figs. A.8 and A.9). However, the cold weather that returned to the Great Lakes area during early January had a marked effect on ice formation in Lake Michigan. By the week ending 11 January, Green Bay had a ten-tenths ice cover as did much of the Straits of Mackinac (Fig. A.10). The period of low temperatures that was to continue until early February caused a fluctuating but general increase in ice cover and concentration on the lake. The week ending 18 January saw some ice deterioration in the northern part of Green Bay, the Straits of Mackinac, and northern Lake Michigan, while substantial ice formation occurred for the first time in the southern part of the lake (Fig. A.ll). During the following week, southern Lake Michigan became mostly ice-free, while Green Bay and the Straits of Mackinac once again gained a ten-tenths ice cover (Fig. A.12). Ice nearly encompassed the entire perimeter of the lake during the week ending 1 February, while an area of open water developed in the northern part of Green Bay and some deterioration occurred in the northern part of the lake (Fig. A.13). Conditions remained fairly stable during the next week, when ice concentrations reached ten-tenths coverage over the Straits of Mackinac and most of the northern part of the lake (Fig. A.14). It was during this week, on 6 February, that Lake Michigan reached its estimated maximum ice cover of 20 percent. The week ending 15 February brought warmer temperatures and a subsequent decrease in FDD's to the southern portion of the Great Lakes, causing substantial deterioration of the ice cover on southern Lake Michigan. The extent of ice cover remained about the same in the northern sector of the lake (Fig. A.15). Some new ice formation occurred in the vicinity of Beaver Island during the following week. In the northern part of Green Bay, there reappeared an area of open water that changed shape and position, but remained and increased in size until the end of the season (Fig. A.16). Some redistribution of ice occurred in the northern portion of the lake during the week ending 29 February, while the Straits of Mackinac remained ten-tenths ice covered and Green Bay primarily ice covered. It was during this week that the southern portion of the lake lost its ice cover, not to regain it for the remainder of the season (Fig. A.17). Although some new thin ice formed along the northwest shore of the lake during the following week, conditions remained fairly stable until the week ending 21 March (Figs. A.18 through A.20). Warmer temperatures starting the following week prevailed throughout the Great Lakes system for the remainder of the season. This started the period of ice deterioration on Lake Michigan that continued to the end of the season (Figs. A.21 through A.24). Northeast winds during the week ending 4 April caused some lakeward redistribution of the ice cover (Fig. A.22), subsequently making it easier to melt. The Straits of Mackinac and Green Bay were essentially ice free by 15 April, with last reports of ice coming from Little Traverse Bay on 16 April.

4.5 Lake Huron

Skim ice formed on portions of Saginaw Bay as early as 5 December, with reports of freeze-over on Lake Huron ranging from near mid-December to early in January. Significant ice formation started during the second half of December. Cold temperatures over the lake during the week ending 21 December increased FDD accumulation and caused ice formation in Saginaw Bay, St. Martin Bay, the North Channel, and the northeast shore of Georgian Bay as well as along the southeastern shore of the lake (Fig. A.7). Ice continued to form in Saginaw Bay, the North Channel, and Georgian Bay the following week, but succumbed to warmer temperatures during the week ending 4 January, with the exception of the southern part of Saginaw Bay, which developed a ten-tenths ice cover (Figs. A.8 and A.9). As on others of the Great Lakes, the sharp increase in FDD's due to the marked drop in temperatures during the week ending 11 January caused rapid ice growth in most areas of the lake (Fig. A.10) and started a period of ice formation that continued for the following 4 weeks (Figs. A.11 through A.14). During this period the North Channel became ten-tenths ice covered, ice encompassed nearly the total perimeter of the lake, and a maximum ice cover of approximately 50 percent was reached on 6 February. Relatively warmer temperatures starting the following week caused significant ice deterioration over most of the lake (Fig. A.15). Conditions remained relatively stable with only minor fluctuations until 29 February, after which renewed ice formation took place along the western shoreline and in Georgian Bay for the next 2 weeks (Figs. A.16 through A.19). Slightly warmer average temperatures during the week ending 21 March caused some ice deterioration in Saginaw Bay and along the western shoreline (Fig. A.20) and ushered in a warming trend and period of ice deterioration that continued to the end of the season (Figs. A.21 through A.24). Breakup in the Straits of Mackinac was reported on 25 March, with last reports of ice on 12 April. Saginaw Bay became ice free during the week ending 4 April and by 18 April the only significant ice was to be found in Georgian Bay and the North Channel.

4.6 Lakes St. Clair and Erie

First reports of skim ice from Lakes St. Clair and Erie came early in December with freeze-over taking place during late December and early January at various sites. Colder temperatures during the week ending 21 December were reflected in the formation of a substantial ice cover on Lake St. Clair during that week (Fig. A.7). Some ice decay and redistribution occurred on Lake St. Clair during the following week, while ice formed in western Lake Erie, extending to beyond Point Pelee, as well as along the northern shore near Point aux Pins and Long Point (Fig. A.8). Conditions remained fairly stable during the next week (Fig. A.9). However, as on others of the Great Lakes, the onset of cold temperatures during the week ending 11 January caused rapid and extensive ice formation. The St. Clair River became seven- to nine-tenths ice covered. Lake St. Clair became nearly ten-tenths ice covered, while ice grew eastward in Lake Erie (Fig. A.10). Ice cover and concentration on Lake St. Clair remained relatively unchanged during the week ending 18 January, although an ice jam in the lower St. Clair River near Algonac caused difficult navigation. The Coast Guard icebreaker *Mackinaw* was required to break up the ice jam. Concurrently, ice of various concentrations nearly covered Lake Erie (Fig. A.11). During the following week, ice jamming was again reported on the St. Clair River from Port Lampton to the St. Clair cutoff. Lake St. Clair became ten-tenths ice covered, while some melting occurred in Lake Erie along the southern shore (Fig. A.12). Lake St. Clair remained ten-tenths ice covered during the week ending 1 February, while new ice growth on Lake Erie contributed to a nearly complete ice cover (Fig. A.13). A maximum ice cover of approximately 95 percent was estimated to have occurred during the following week on 6 February as did maximum FDD accumulation at Detroit and Cleveland. Some melting later that week caused an area of open water to appear on Lake Erie extending nearly the full length of the northern shore (Fig. A.14).

Warmer temperatures starting about 10 February caused a significant break in the weather on the southern portion of the Great Lakes and marked the end of any major ice formation in that area (Figs. A.15 through A.24). Lake St. Clair became ice free during the week ending 14 March (Fig. A.19), while westerly winds caused ridging and rafting of the ice in eastern Lake Erie, where ice prevailed until late April (Fig. A.24).

4.7 Lake Ontario

Due to its more southward location and its heat storage, ice usually forms later in the season in Lake Ontario, at least in open water areas (Figs. A.6 through A.9). Although skim ice was reported as early as 28 November in protected shore areas, most reports of first ice formation weren't made until late December and early January with freeze-over of bays and harbors occurring from early to late January in many areas. Cold temperatures prevalent over the Great Lakes system starting the week ending 11 January caused freeze-over in the Bay of Quinte (Fig. A.lO). By the end of the following week, ice covered most of the northeastern portion of the lake as well as the area near Hamilton and the mouth of the Niagara River (Fig. A.ll). Ice continued to grow on Lake Ontario, covering most of the northeastern portion of the lake by the week ending 25 January, and encompassed much of the northern shore during the following week (Figs. A.12 and A.13). During this week, ice was estimated to cover a maximum of approximately 20 percent of the lake and FDD's at Rochester reached their maximum accumulation for the season. The lake-wide warming trend that started about 10 February caused retreat of the leading edge of the ice boundary and decay of the ice cover in the northeastern portion of the lake (Fig. A.15). Except for the week ending 14 March, when average temperatures dipped below freezing in the northeast, the warm temperatures caused steady, deterioration of the remaining ice cover (Figs. A.16 through A.24). Last reports of significant ice came 19 March, and the lake became ice free during the week ending 4 April.

5. ACKNOWLEDGMENTS

This report presents information in the form of composite ice charts abstracted from United States Coast Guard and Canadian visual ice reconnaissance charts, NOAA-4, LANDSAT-1 and -2 satellite imagery, and side-looking airborne radar (SLAR) imagery. Canadian visual ice reconnaissance charts were provided by the Atmospheric Environment Service, Department of the Environment, Canada. Climatological data used in this report were taken from the *Weekly Weather and Crop Bulletin*, published jointly by the U.S. Departments of Agriculture and Commerce.

The research and chart compilation was carried out as a part of the Lake Ice Project of the Lake Hydrology Group, Great Lakes Environmental Research Laboratory, under the general direction of Dr. F. H. Quinn, Head of the Lake Hydrology Group, and under the supervision of R. A. Assel.

6. REFERENCES

Randy, D. R. (1971): Great Lakes ice atlas, NOAA Tech. Memo. NOS LSCR 1, National Tech. Information Service, Springfield, Va.

U.S. Departments of Agriculture and Commerce (1975-76): *Wkly. Weather and Crop Bull.*, Vol. 62, No. 46 - Vol. 63, No. 17.

APPENDIX: ICE-COVER CHARTS

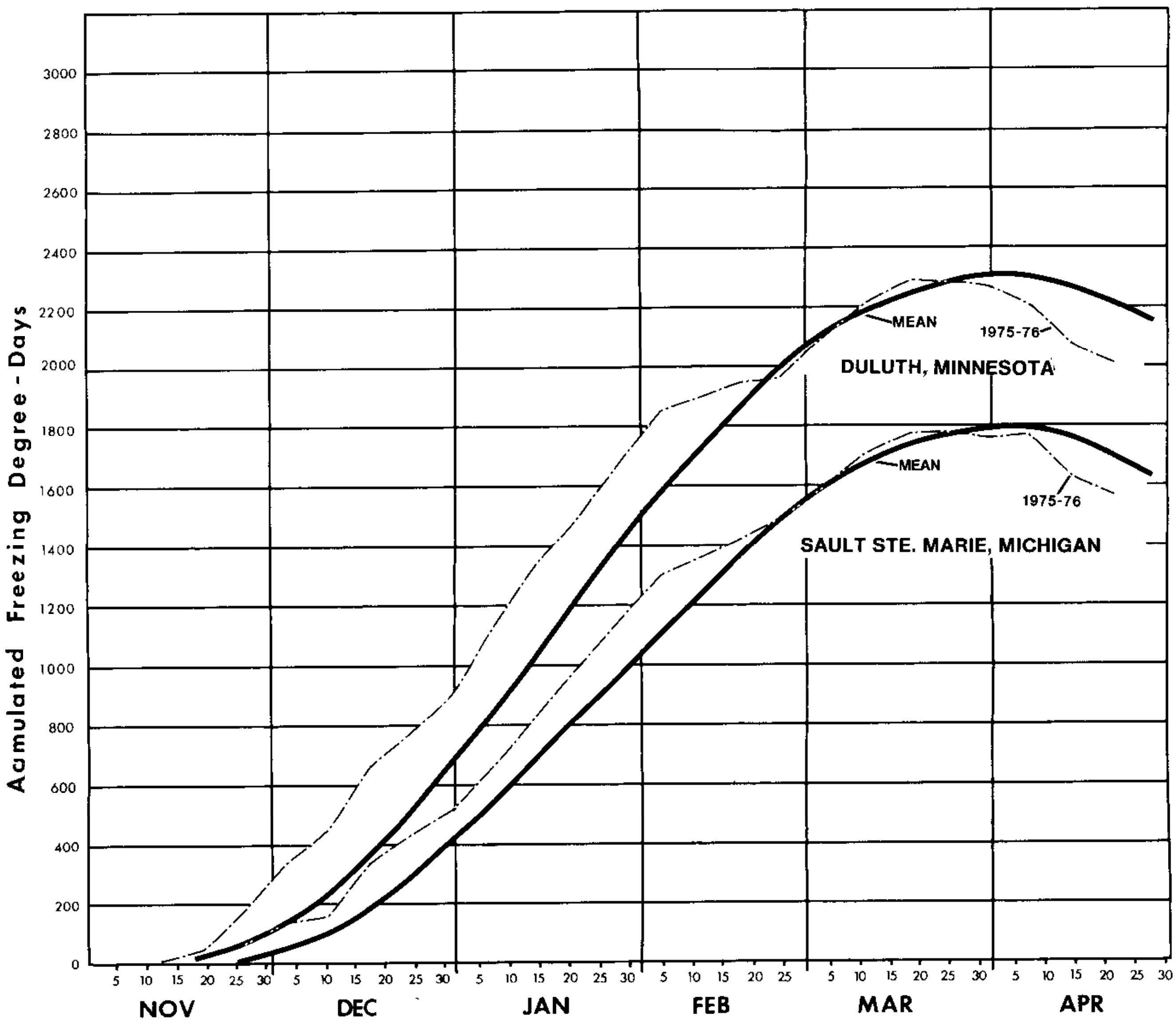


Figure A.1. Accumulated freezing degree-days - Lake Superior at Sault Ste. Marie, Mich., and Duluth, Minn.

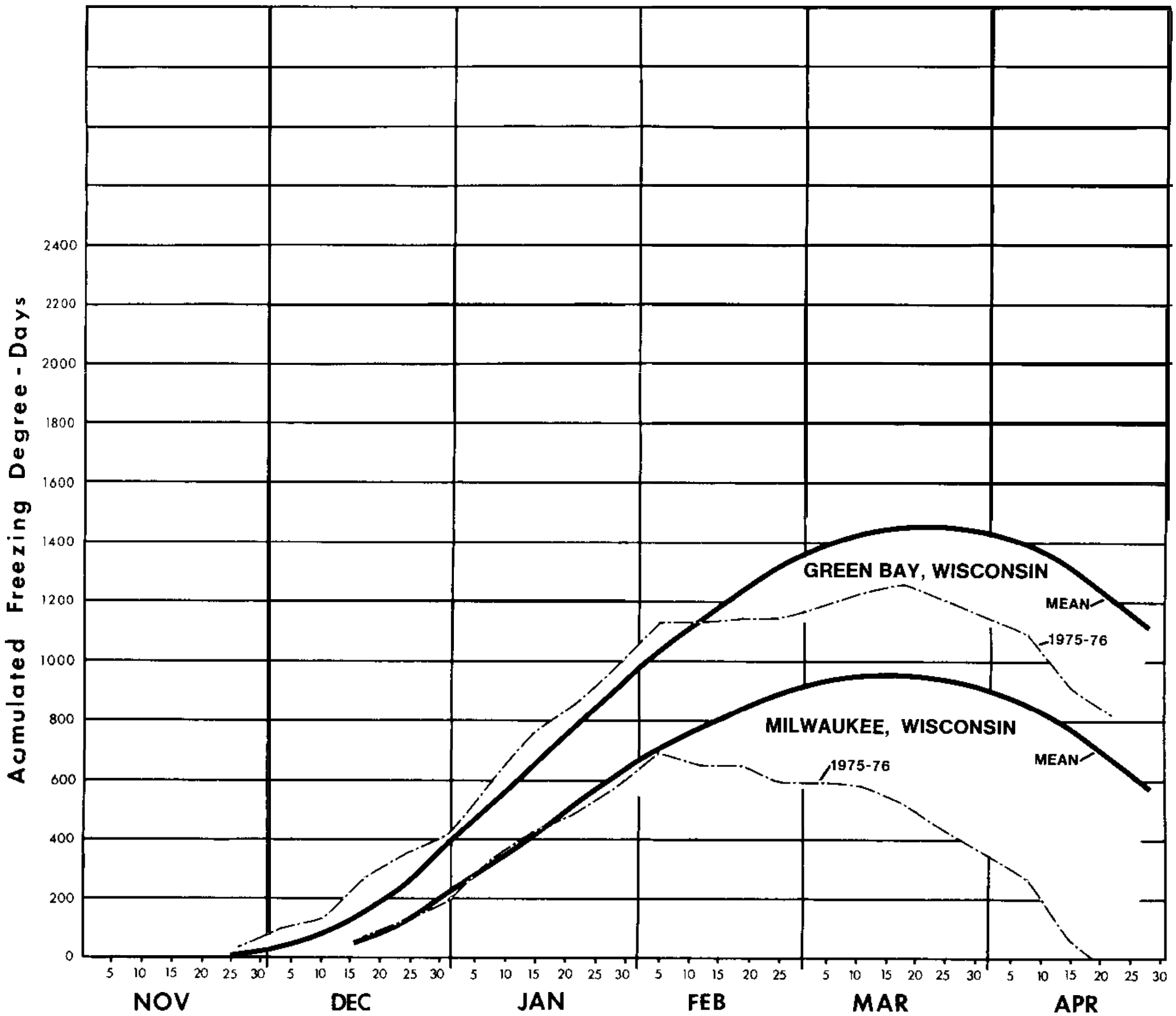


Figure A.2. Accumulated freezing degree-days - Lake Michigan at Green Bay and Milwaukee, Wis.

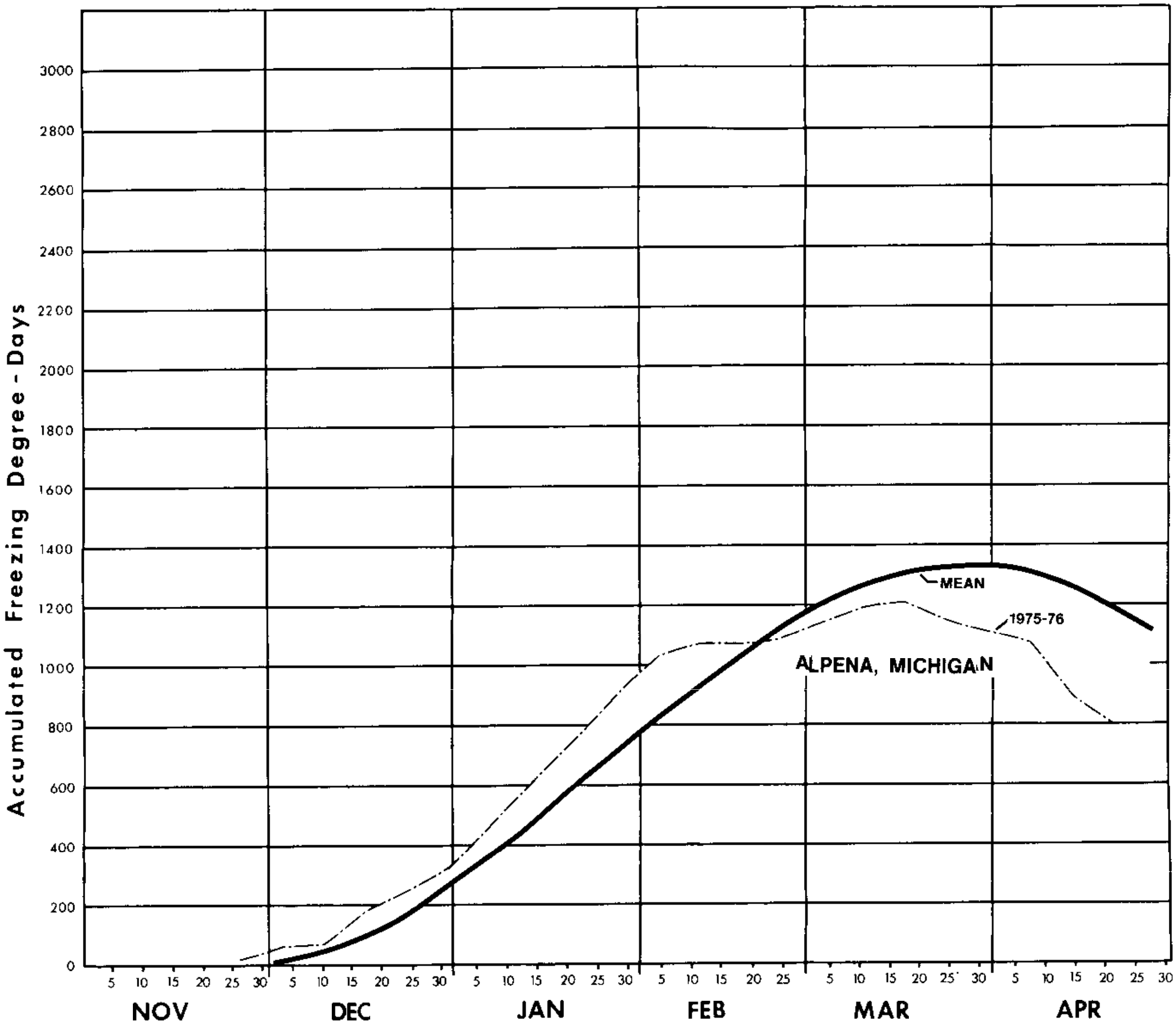


Figure A.3. Accumulated freezing degree-days - Lake Huron at Alpena, Mich.

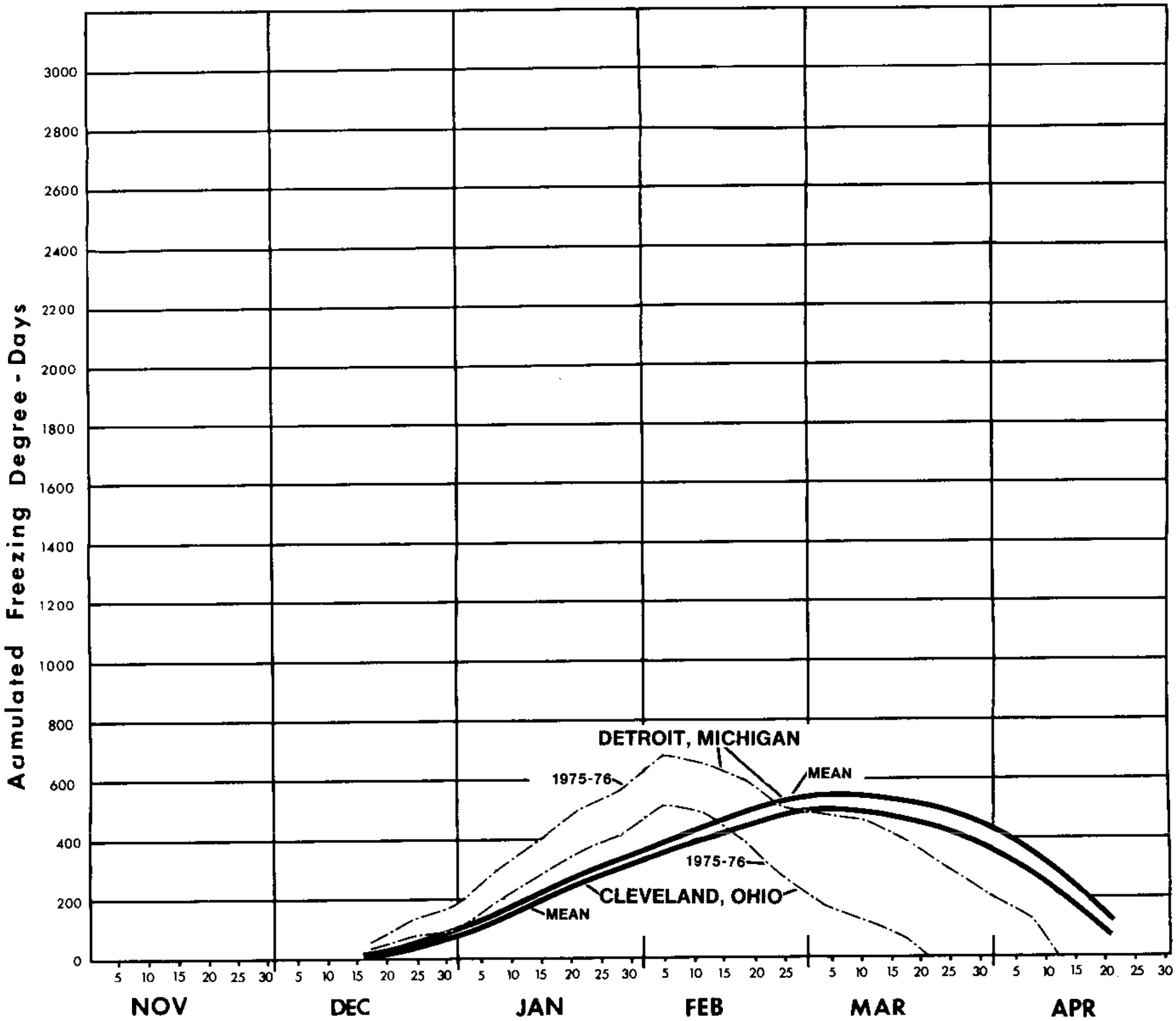


Figure A.4. Accumulated freezing degree-days - Lakes St. Clair and Erie at Detroit, Mich., and Cleveland, Ohio.

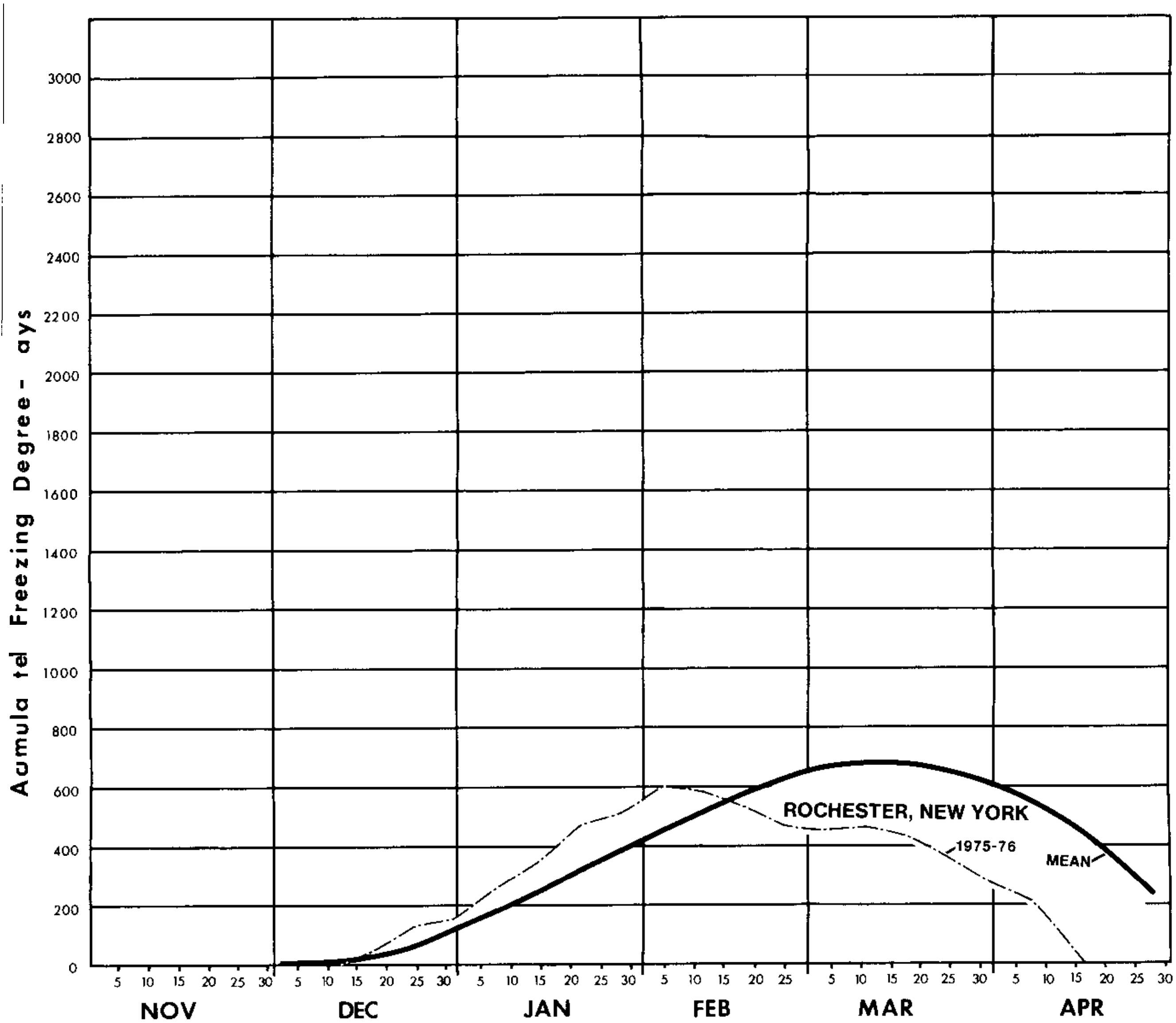


Figure A.5. Accumulated freezing degree-days - Lake Ontario at Rochester, N. Y.

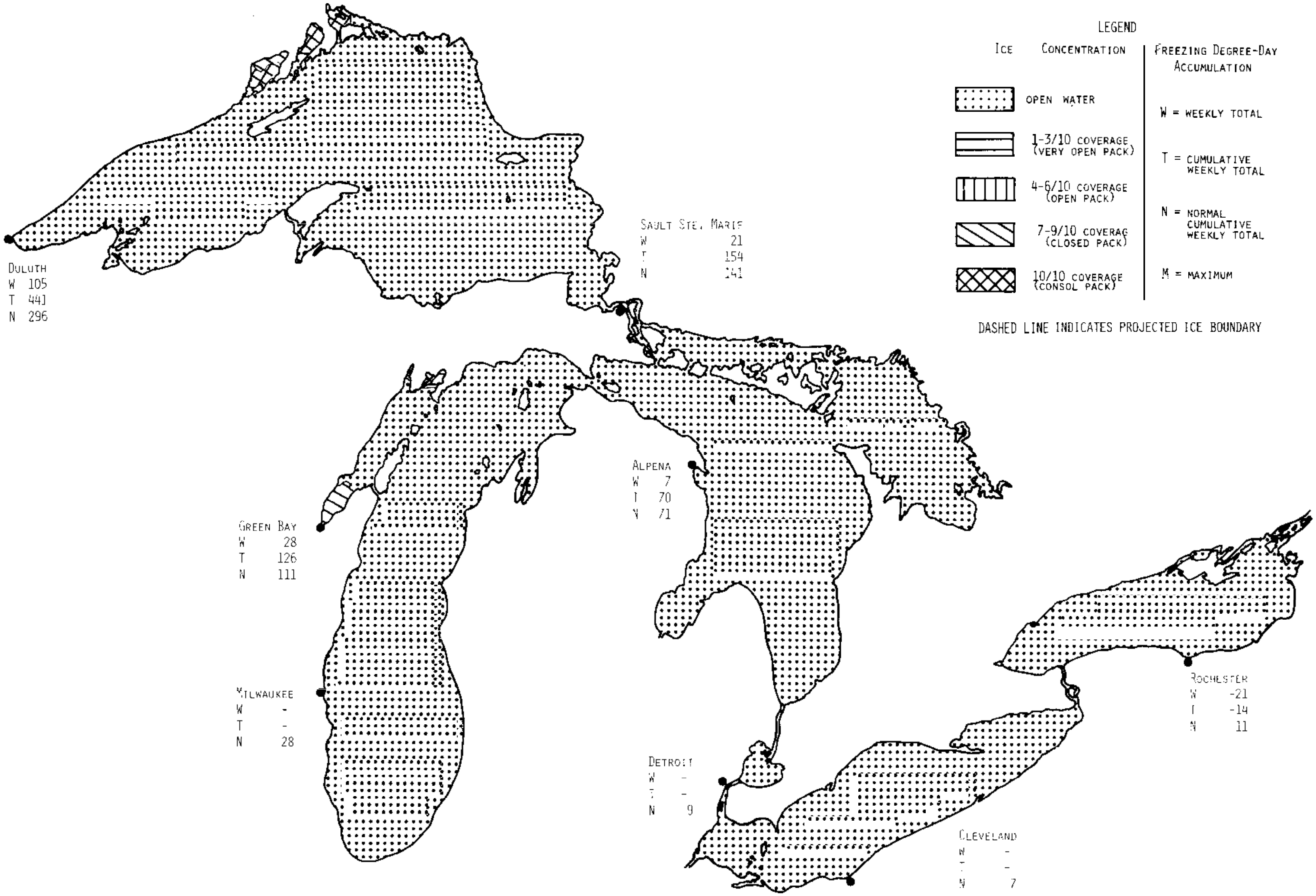


Figure A.6. Composite ice chart - week ending 14 December 1975.

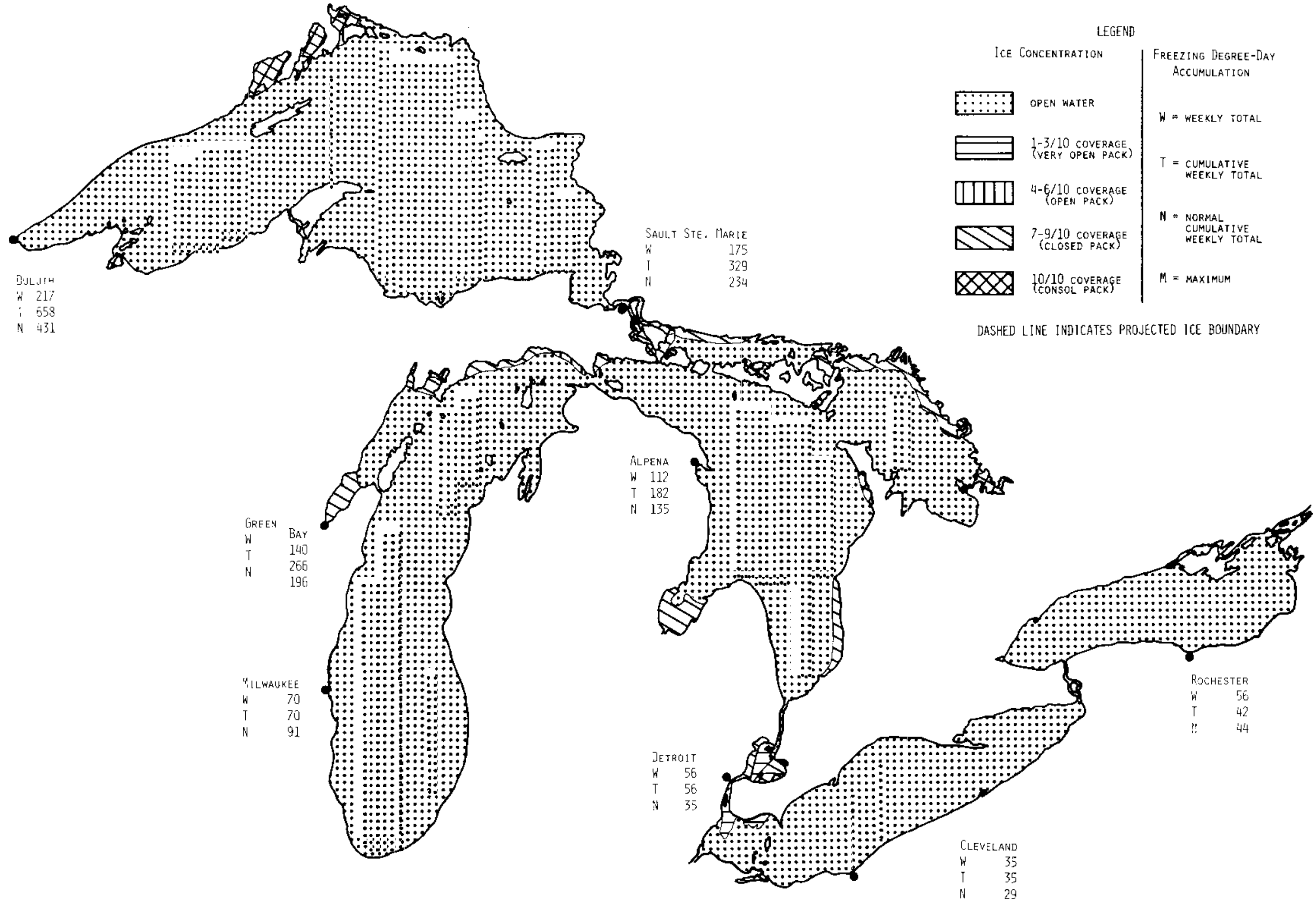


Figure A.7. Composite ice chart - week ending 21 December 1975.

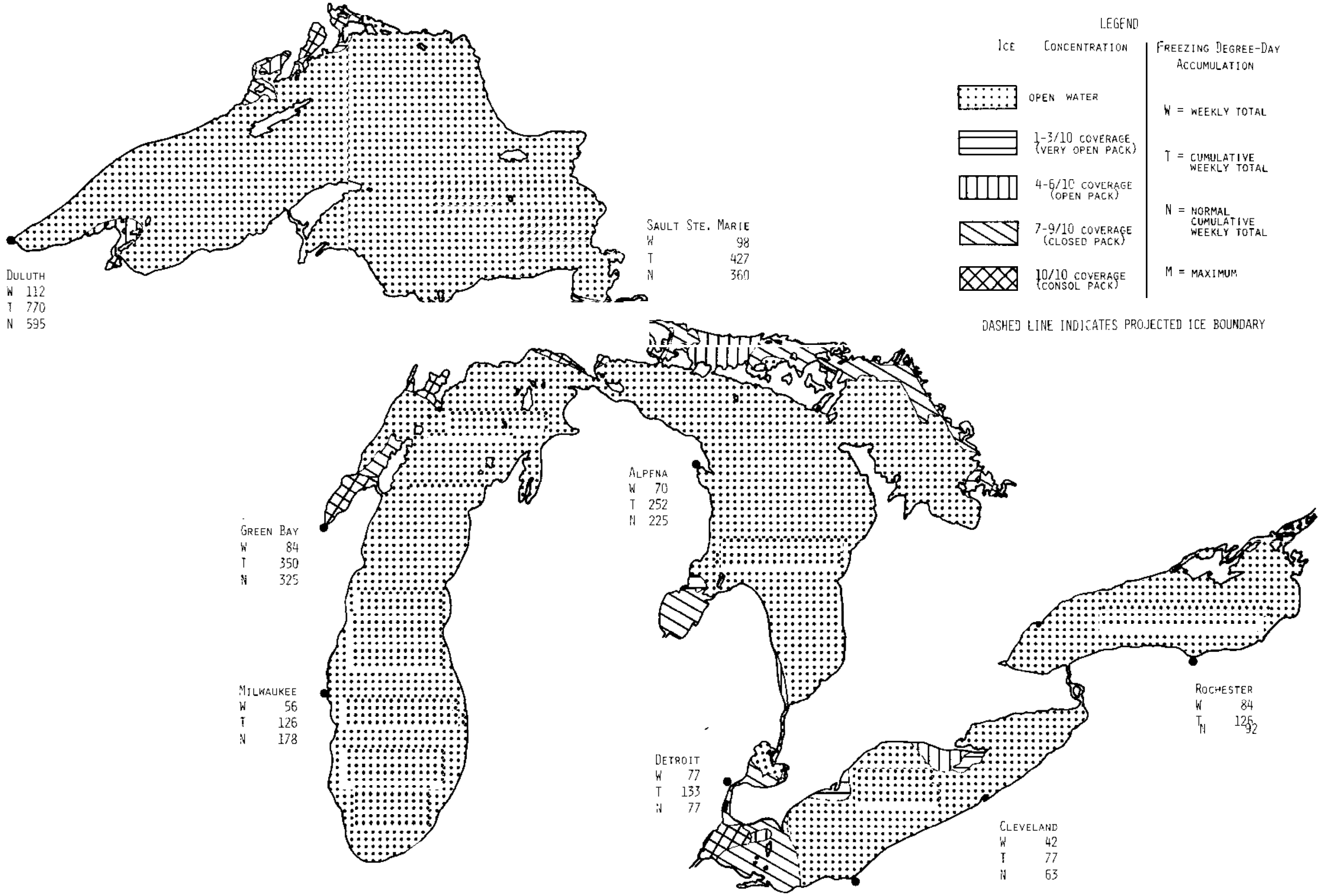


Figure A.8. Composite ice chart - week ending 28 December 1975.

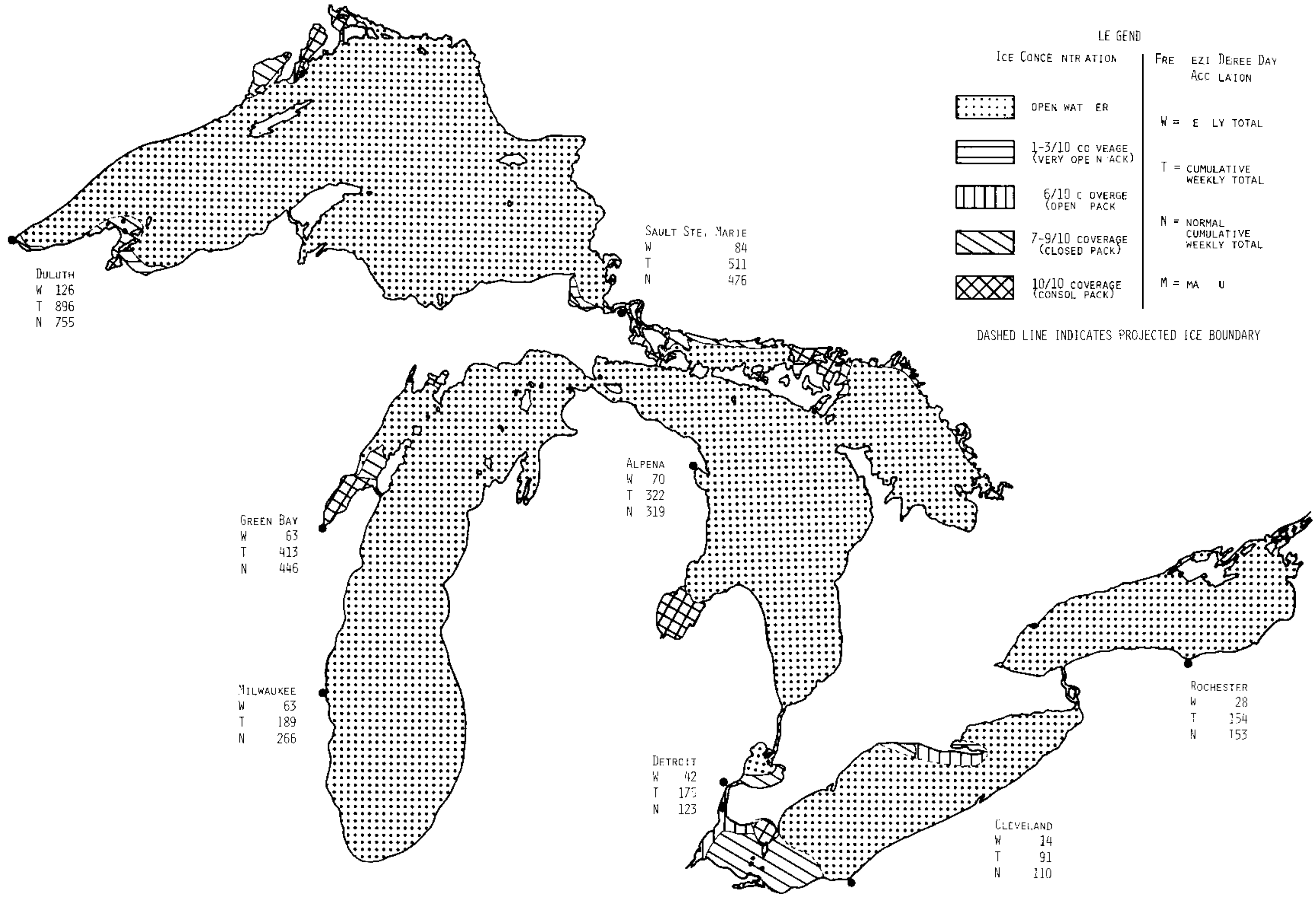


Figure A.9. Composite ice chart - week ending 4 January 1976

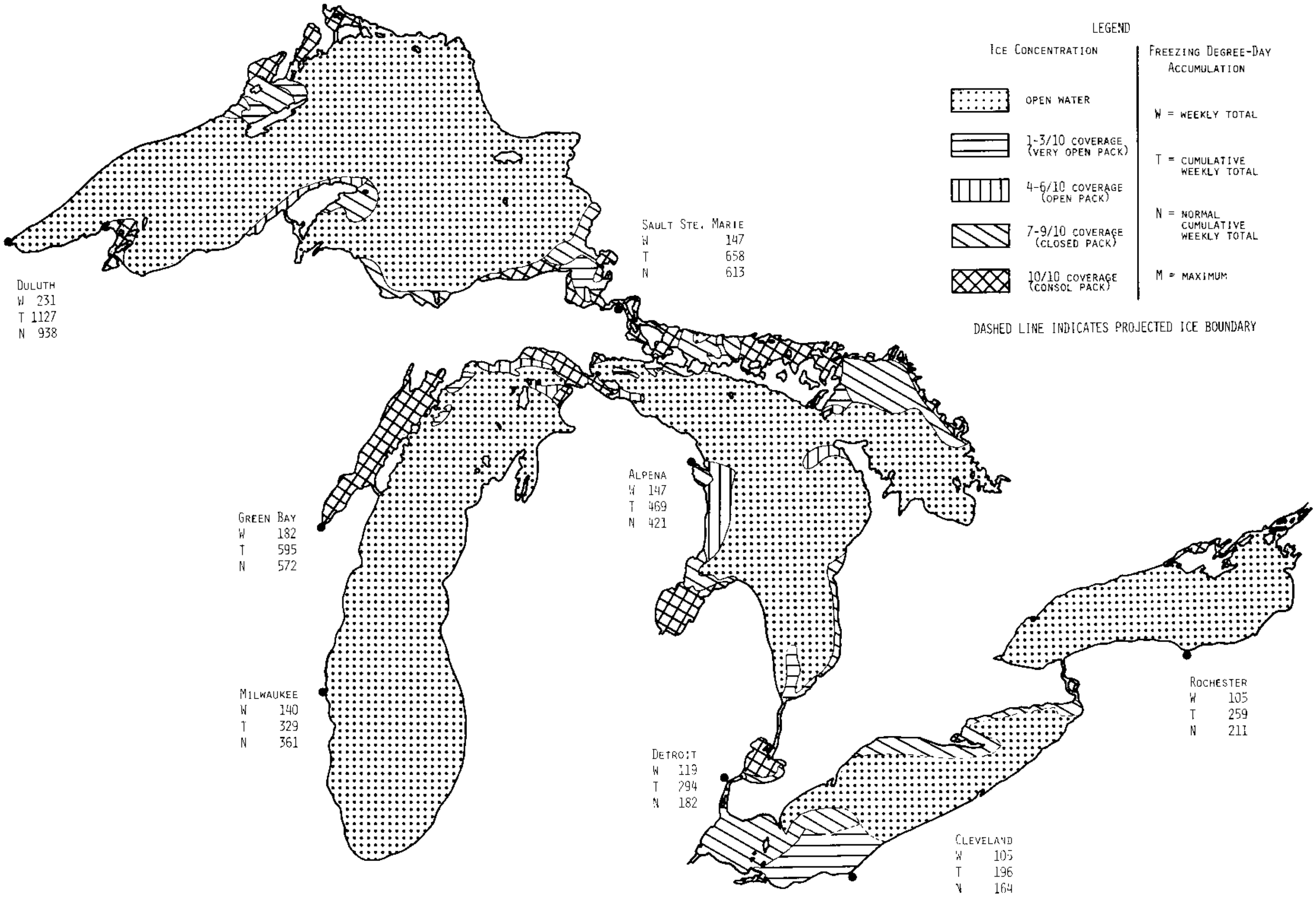
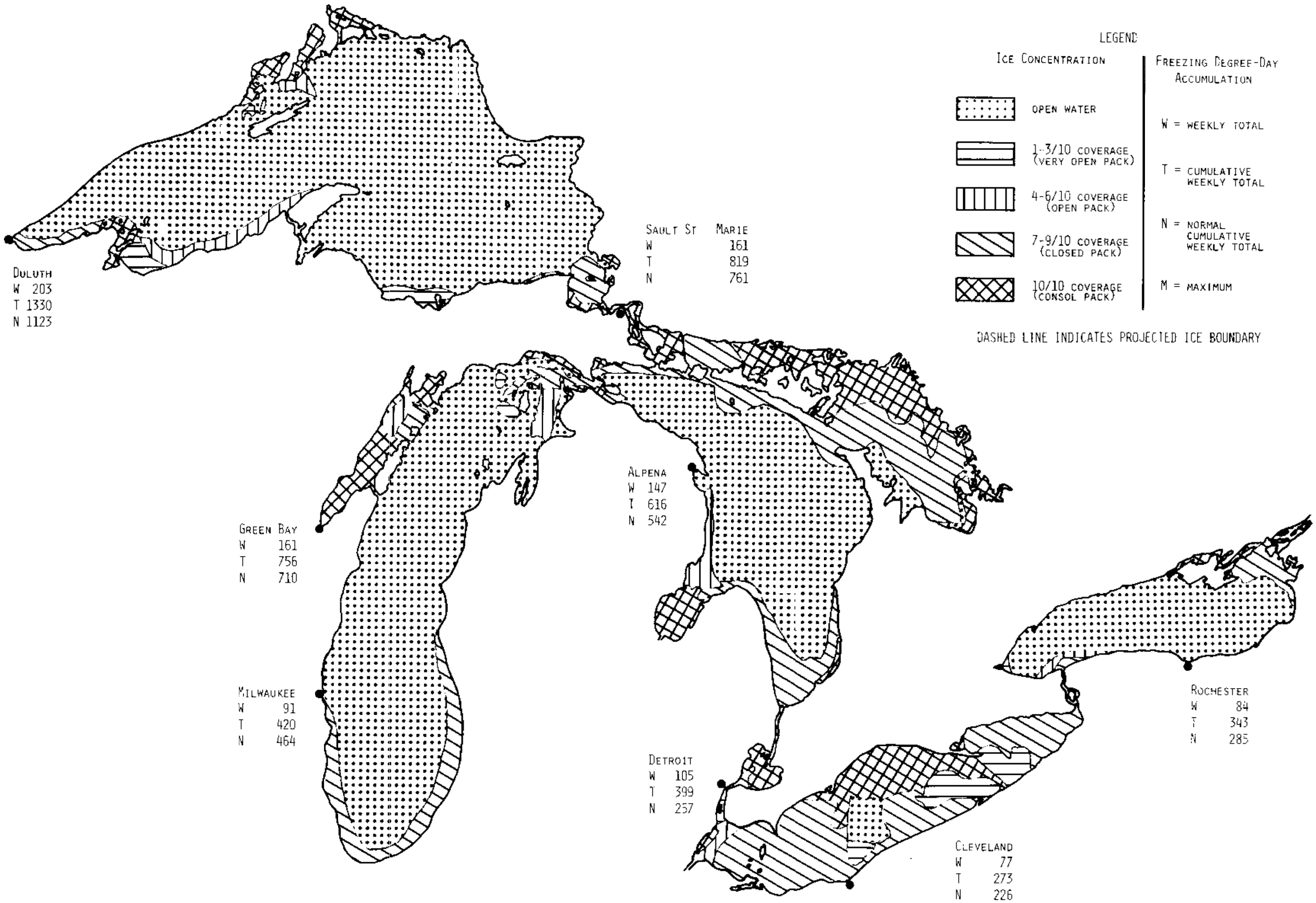


Figure A.10 Composite ice chart - week ending 11 January 1976.



A.11. Composite ice - 18

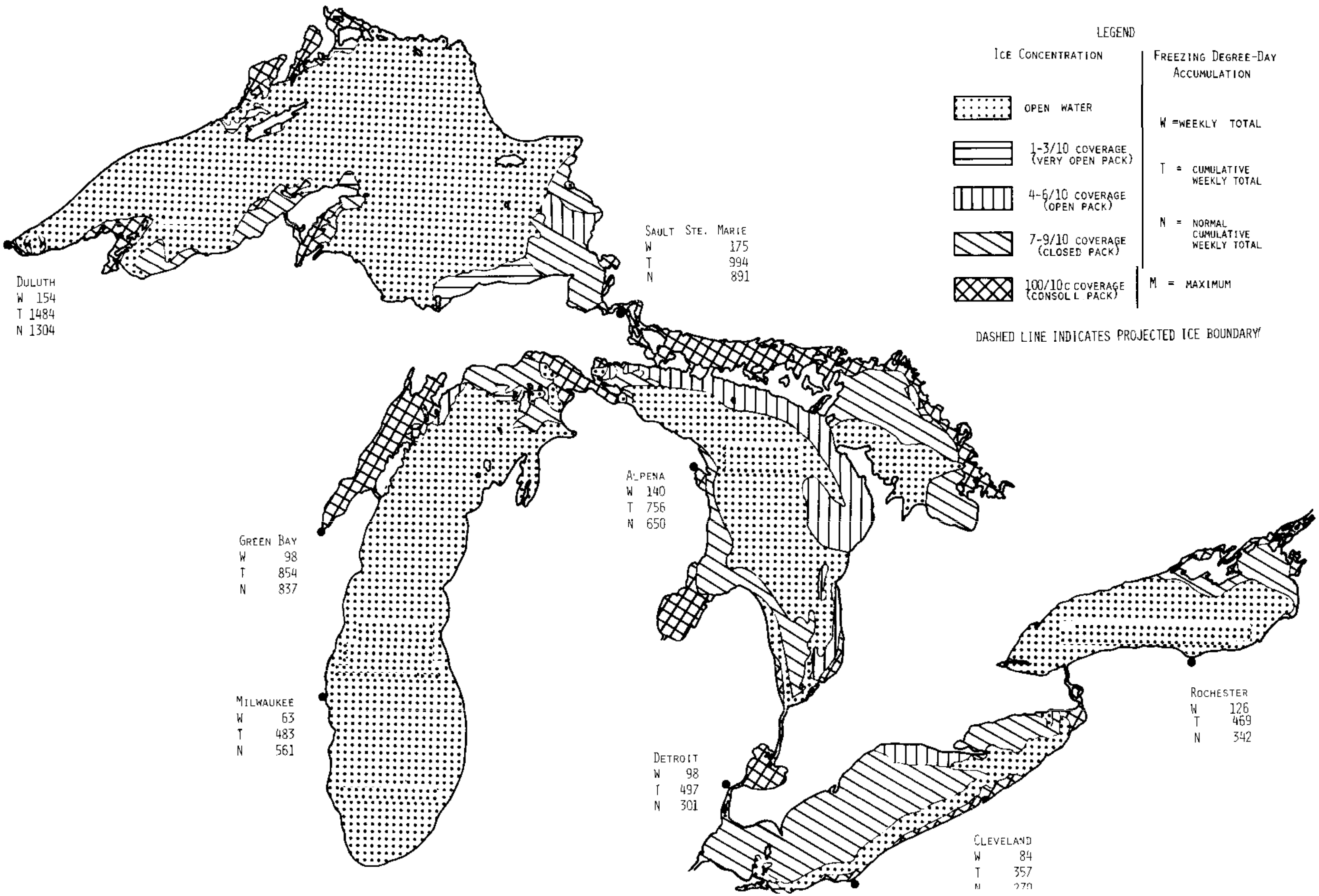


Figure A.12. Composite ice chart - week ending 25 January 1976.

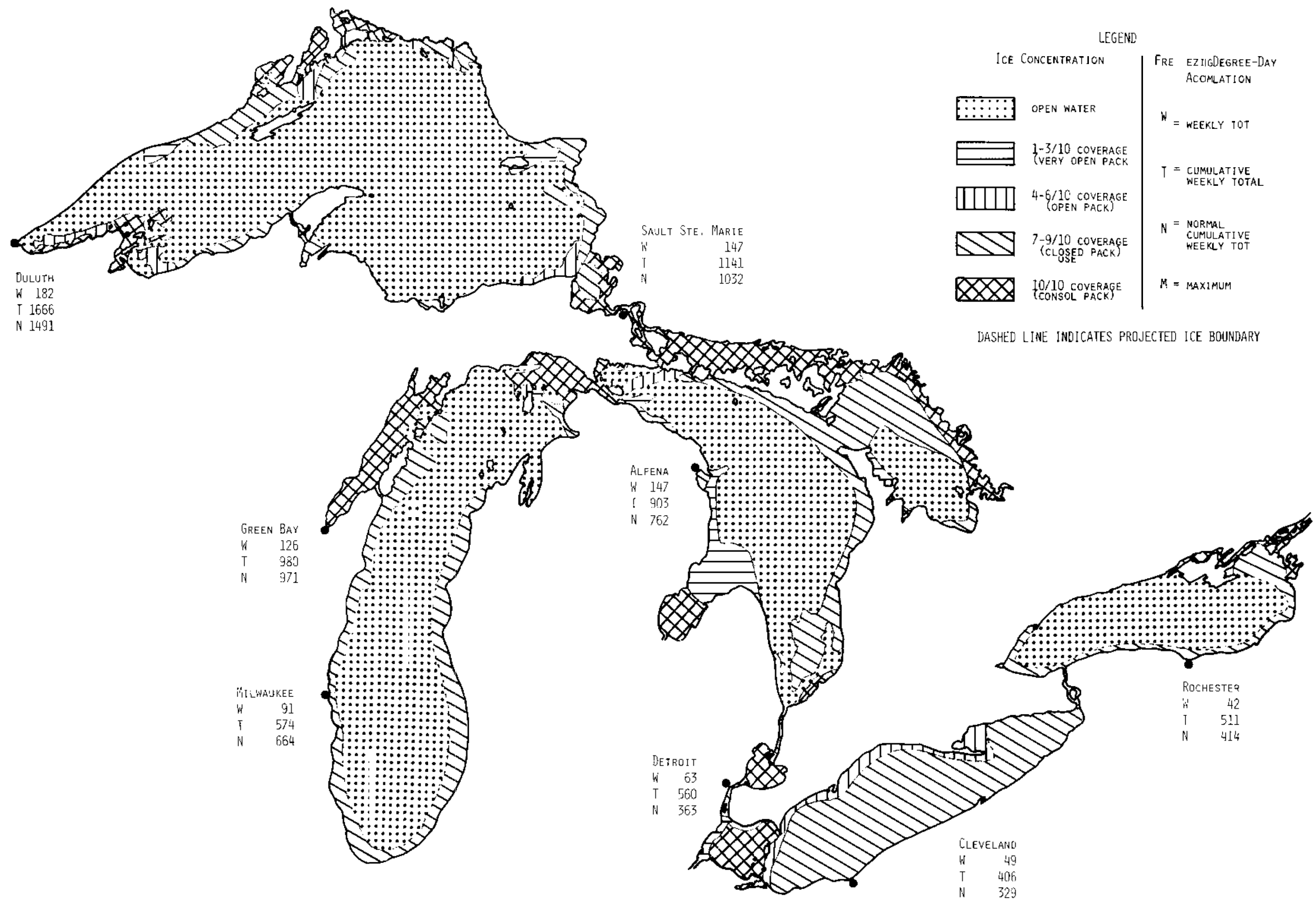


Figure A.13. ice - week 1 1976.

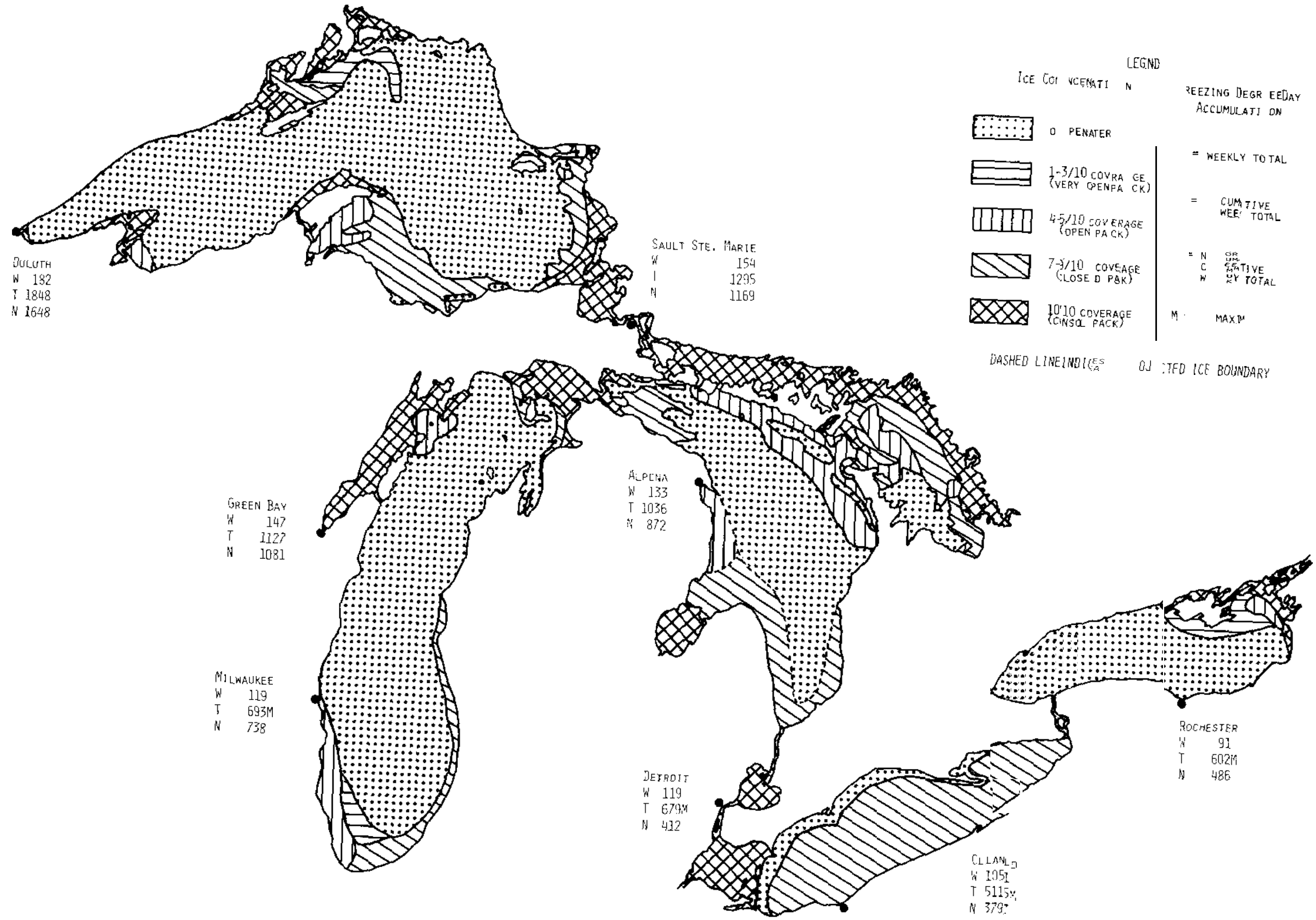


Figure A.14 Composite ice chart - week ending 8 February 1976

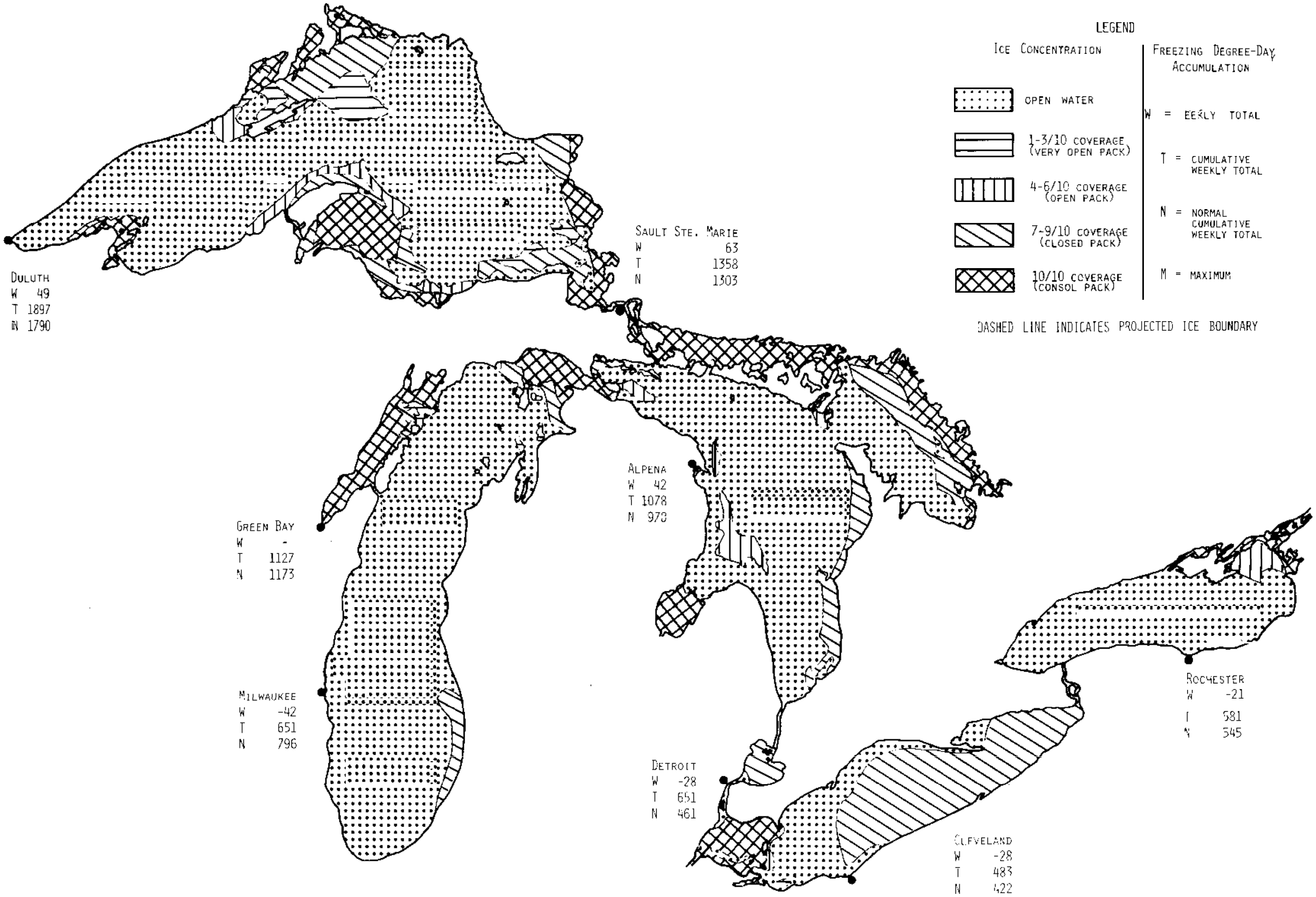
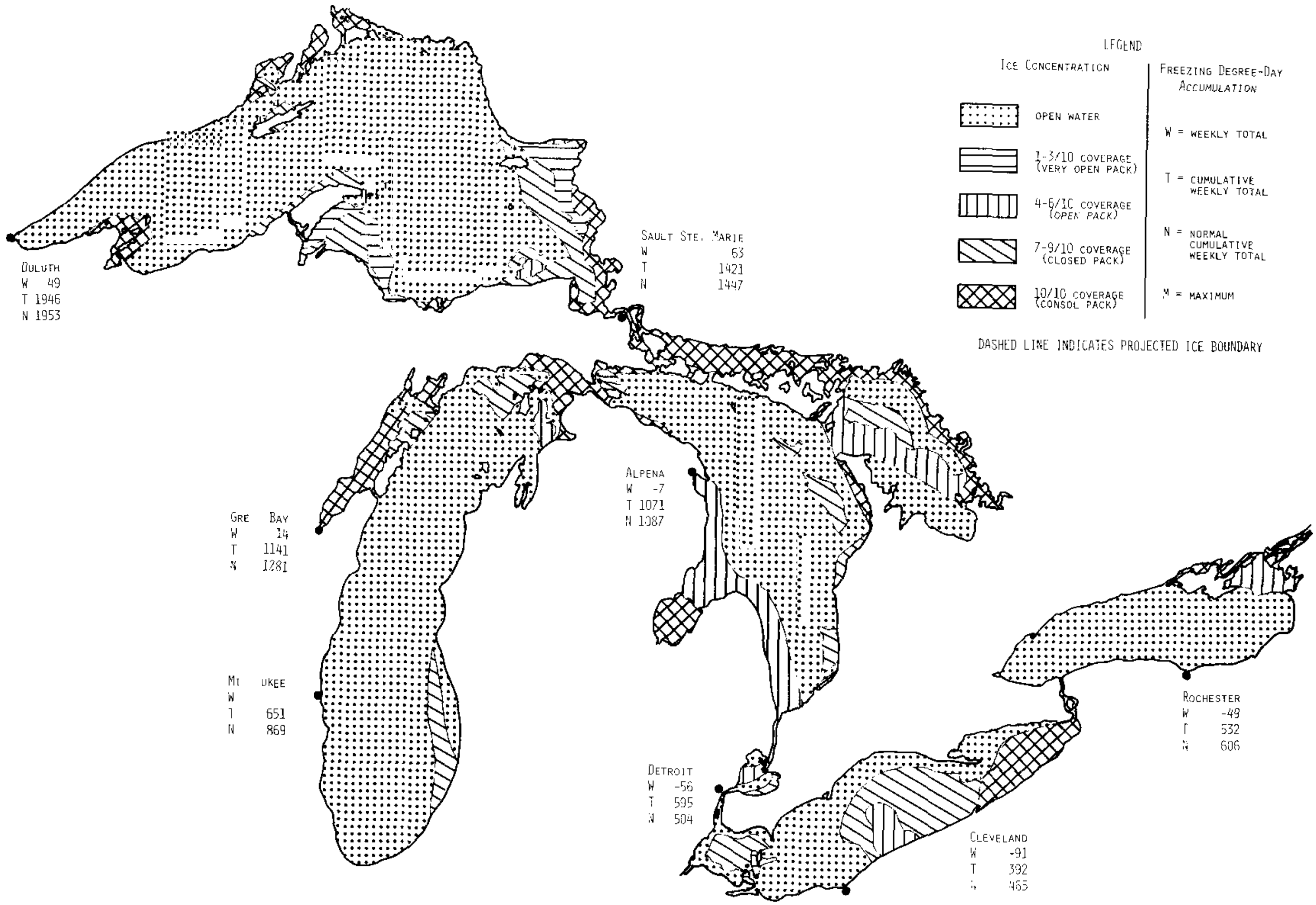


Figure A.15. Composite ice chart - week ending 15 February 1976.



LEGEND
Ice Concentration
Open water
1-3/10 coverage (very open pack)
4-6/10 coverage (open pack)
7-9/10 coverage (closed pack)
10/10 coverage (consol pack)
Freezing Degree-Day Accumulation
W = weekly total
T = cumulative weekly total
N = normal cumulative weekly total
M = maximum
DASHED LINE INDICATES PROJECTED ICE BOUNDARY
Duluth
W 49
T 1946
N 1953
Sault Ste. Marie
W 63
T 1421
N 1447
Gre Bay
W 14
T 1141
N 1281
Alpena
W -7
T 1071
N 1087
Mi ukee
W
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Rochester
W -49
T 532
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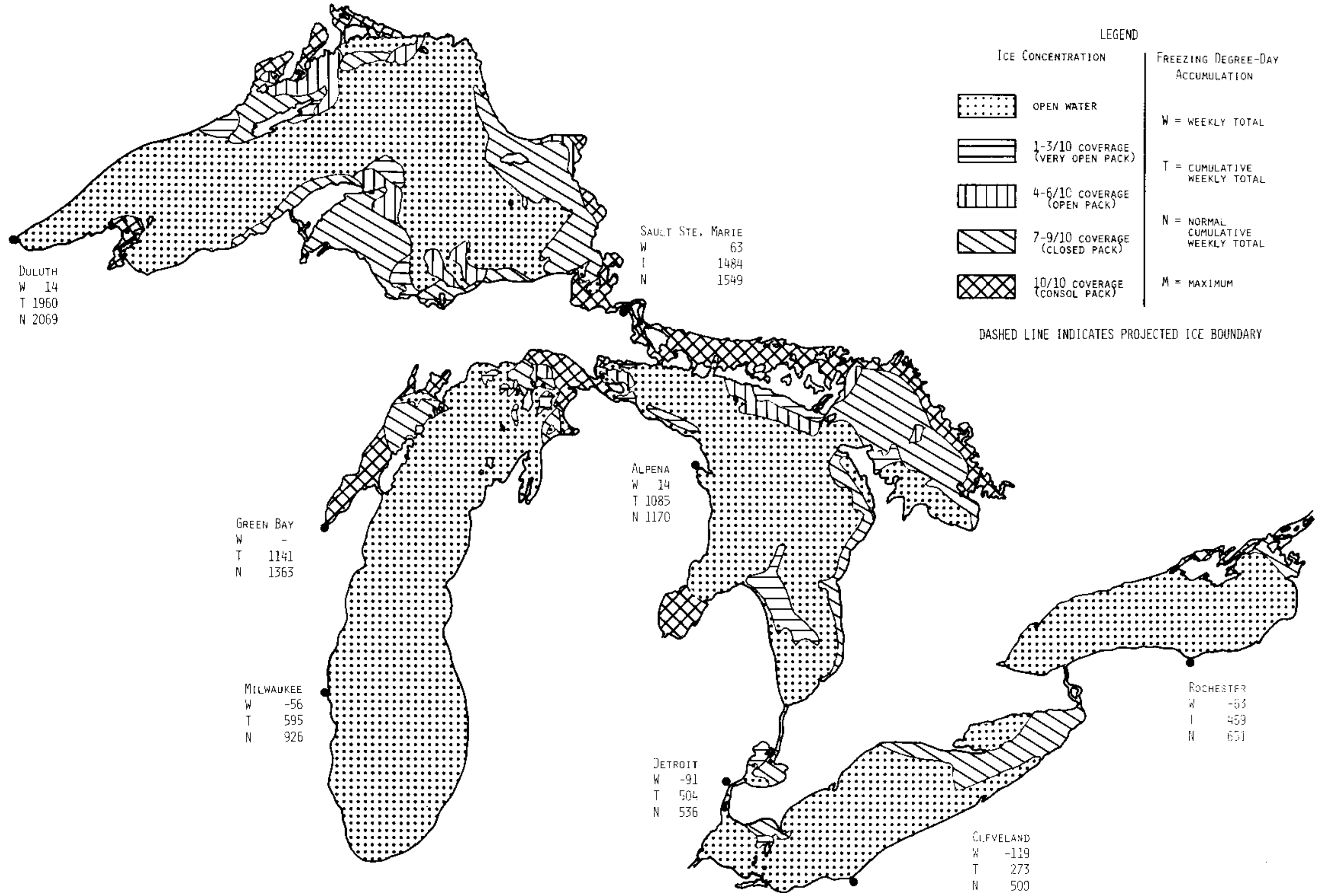


Figure A.17. Composite ice - 29 February 1976.

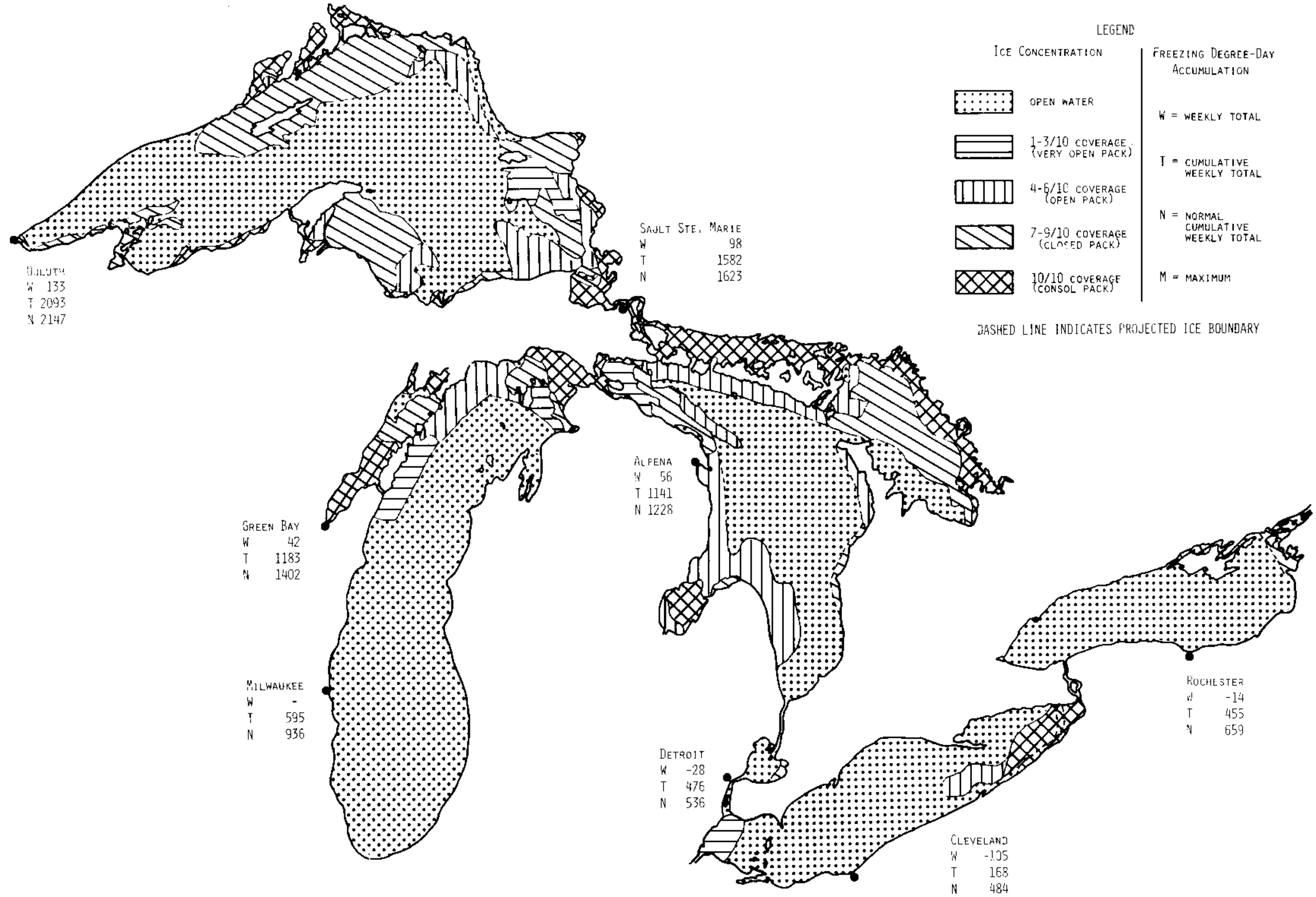
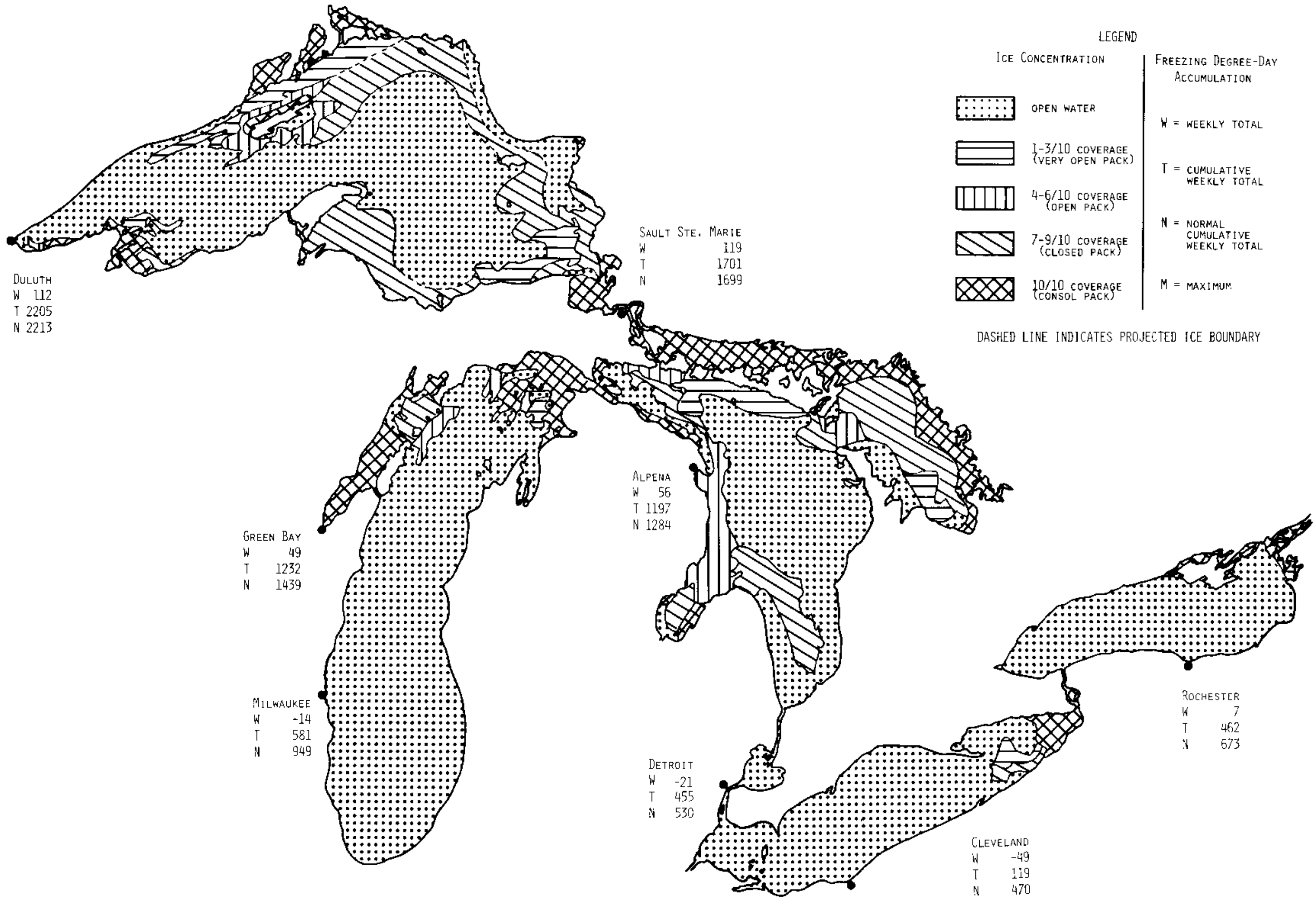


Figure A.18 Composite ice chart - week ending 7 March 1976


LEGEND
ICE CONCENTRATION
OPEN WATER
1-3/10 COVERAGE (VERY OPEN PACK)
4-6/10 COVERAGE (OPEN PACK)
7-9/10 COVERAGE (CLOSED PACK)
10/10 COVERAGE (CONSOL PACK)
FREEZING DEGREE-DAY ACCUMULATION
W = WEEKLY TOTAL
T = CUMULATIVE WEEKLY TOTAL
N = NORMAL CUMULATIVE WEEKLY TOTAL
M = MAXIMUM
DASHED LINE INDICATES PROJECTED ICE BOUNDARY
DULUTH W 112 T 2205 N 2213
SAULT STE. MARIE W 119 T 1701 N 1699
GREEN BAY W 49 T 1232 N 1439
ALPENA W 56 T 1197 N 1284
MILWAUKEE W -14 T 581 N 949
DETROIT W -21 T 455 N 530
CLEVELAND W -49 T 119 N 470
ROCHESTER W 7 T 462 N 673

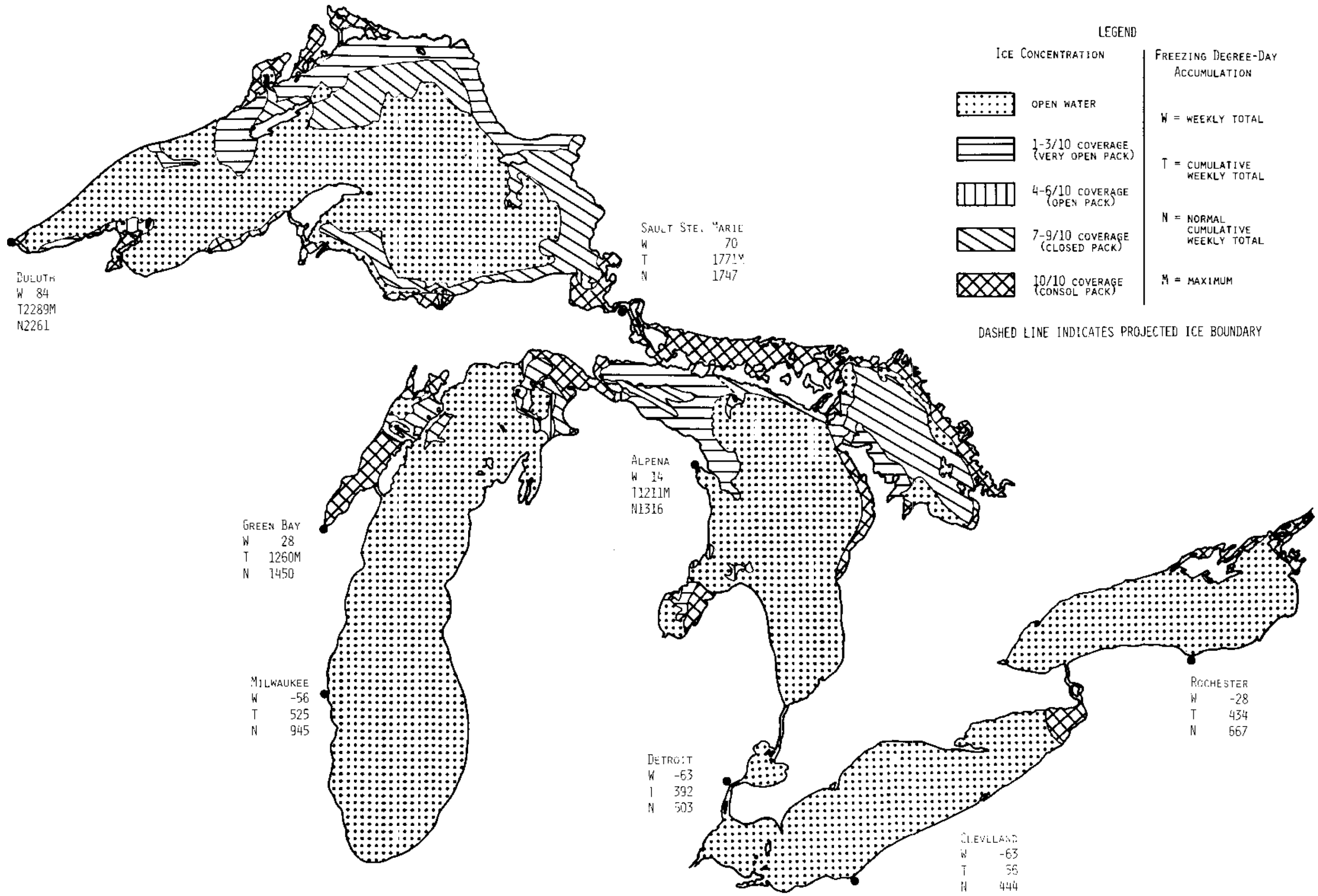


Figure A.20 Composite ice chart - week ending 21 March 1976

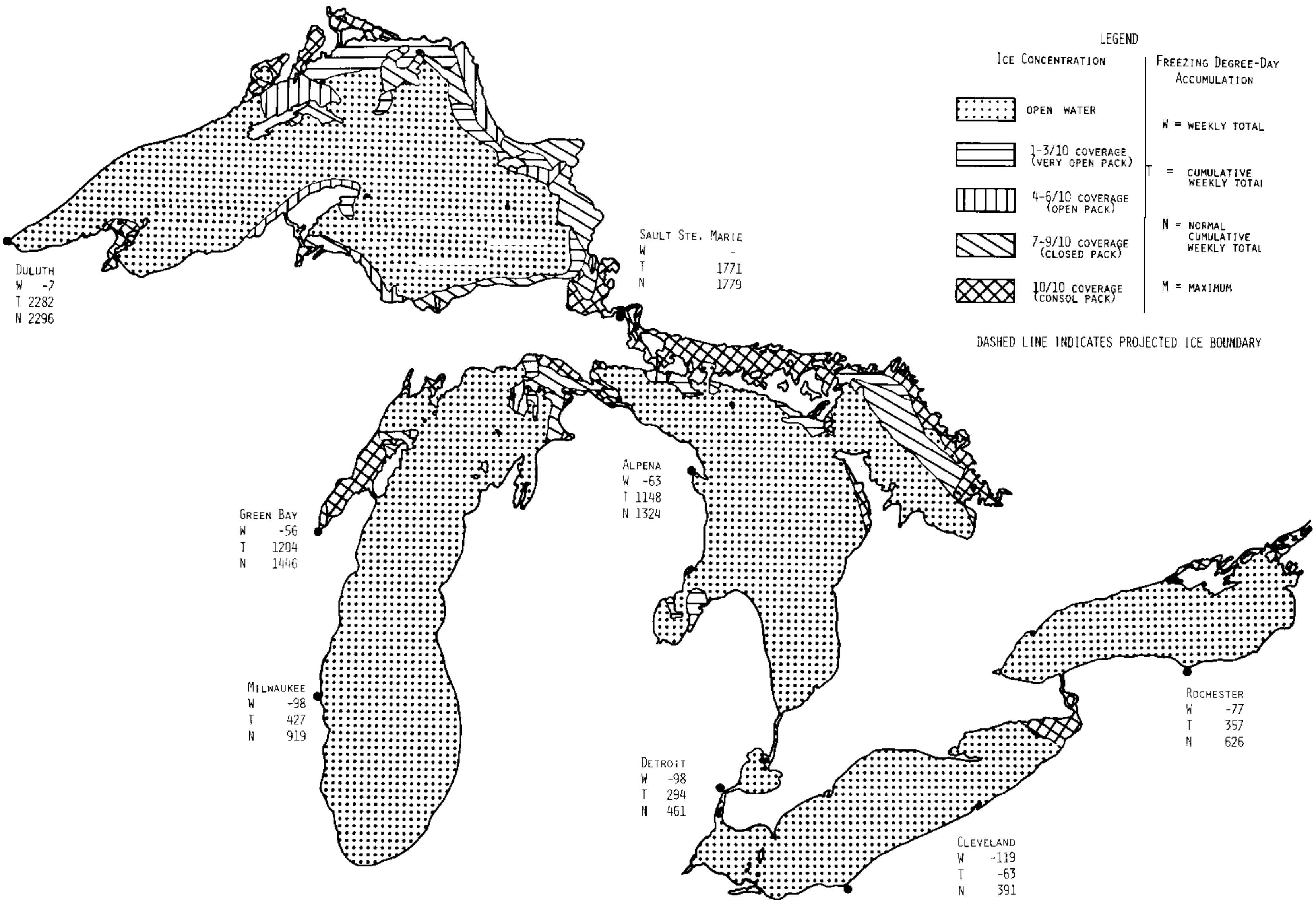


Figure A.21. Composite ice chart - week ending 28 March 1976.

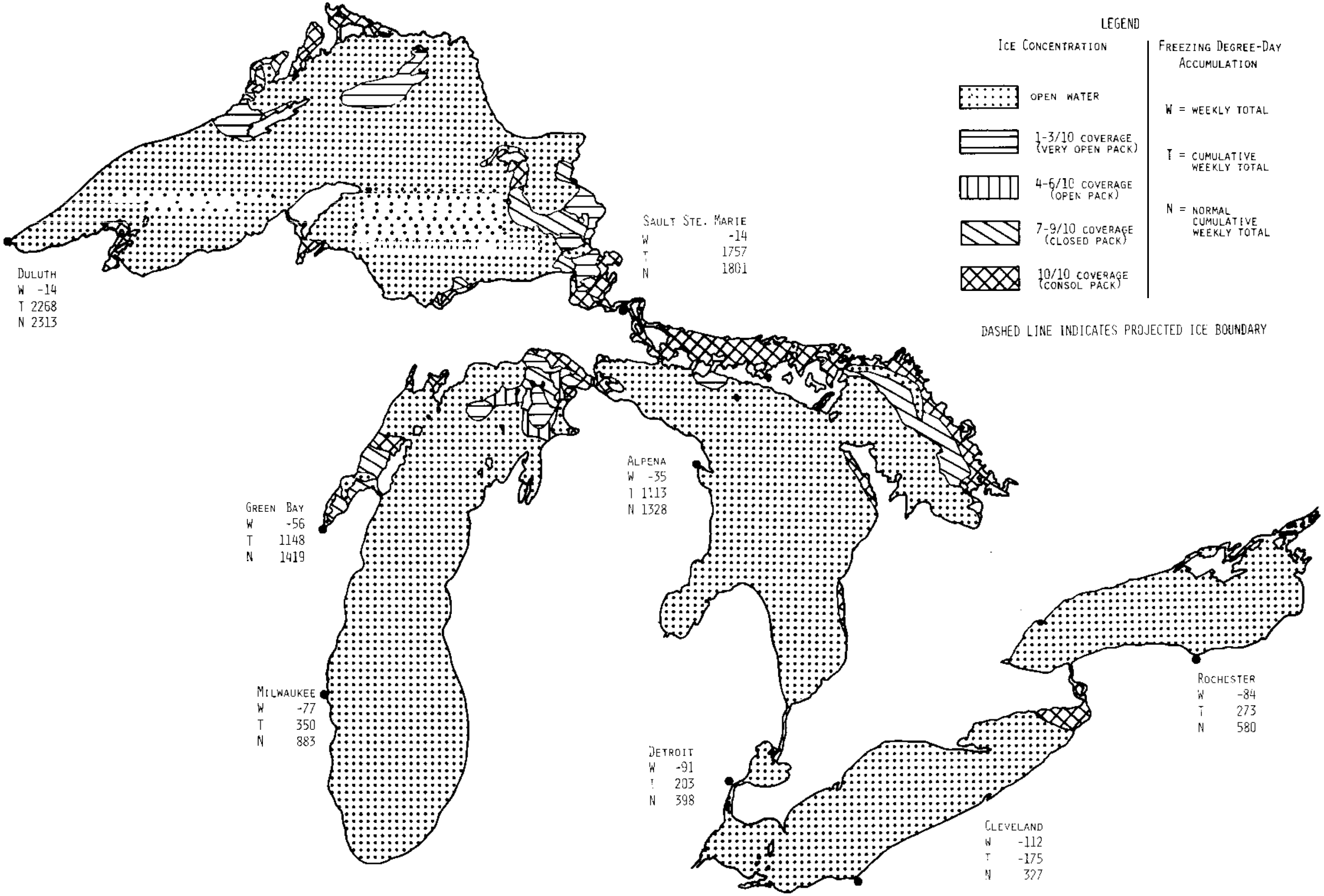


Figure A.22. Composite ice chart - week ending 4 April 1976.

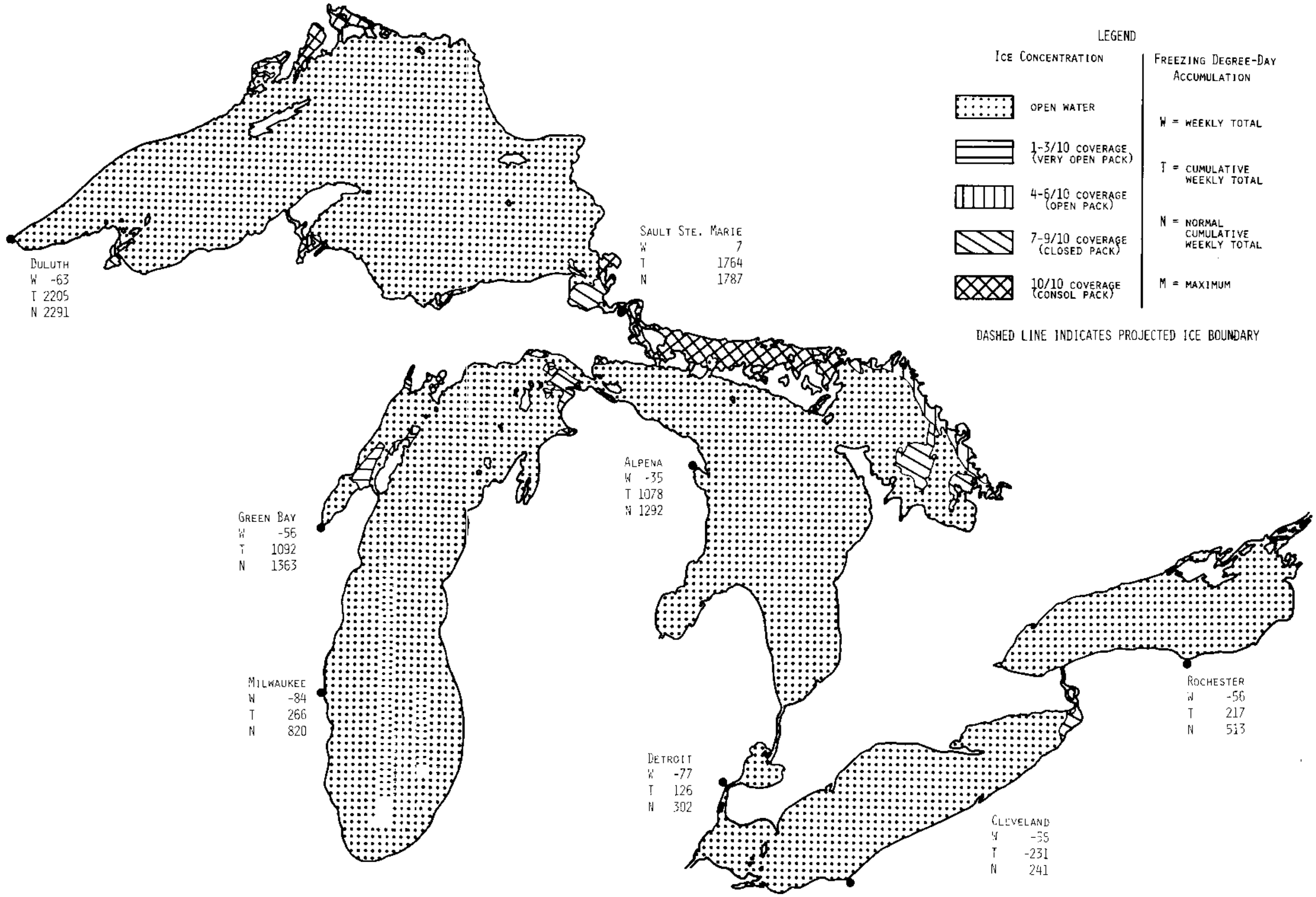


Figure A.23. ice chart - week ending 11 April 1976

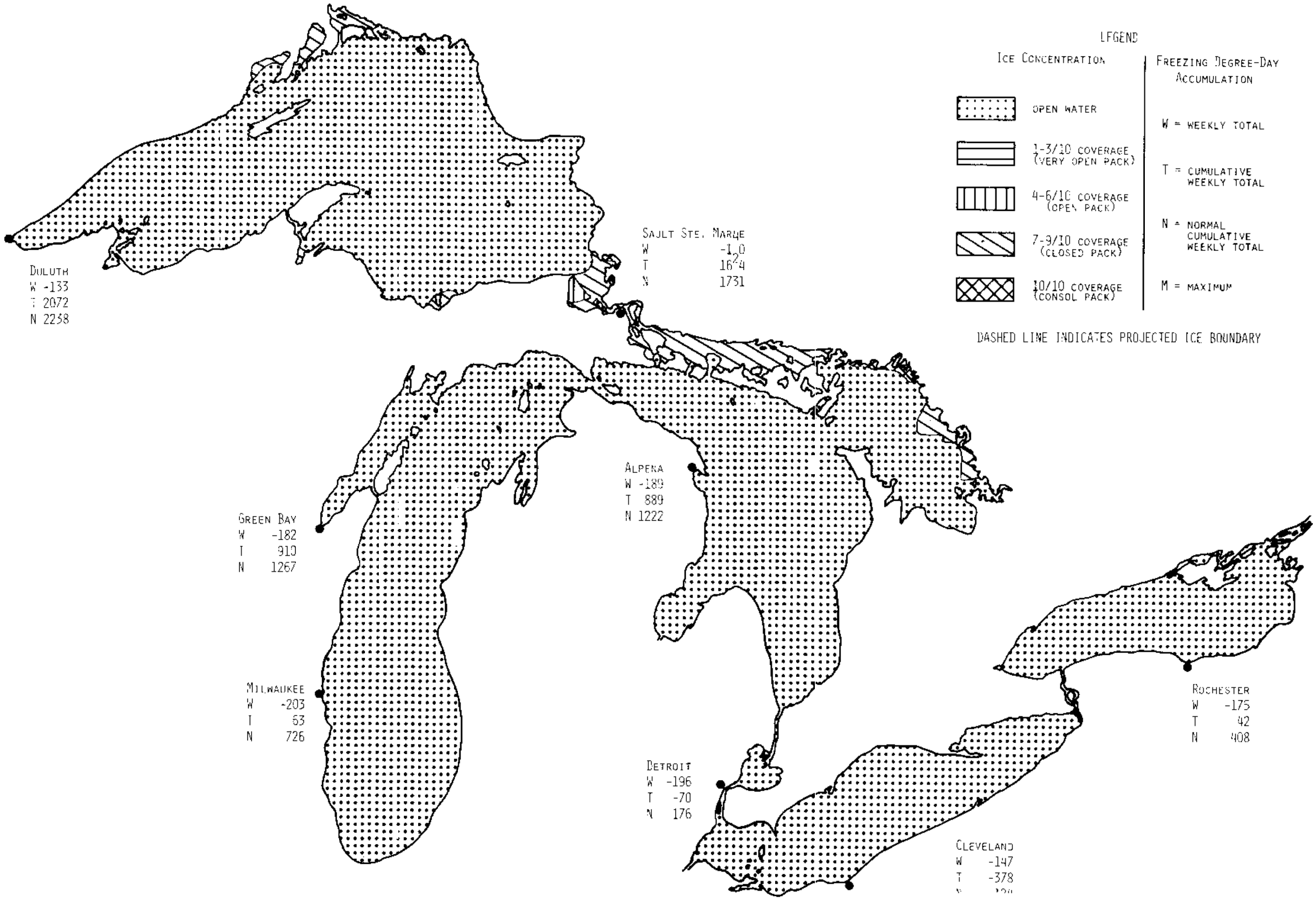


Figure A.24. Composite ice chart - week ending 18 April 1976.