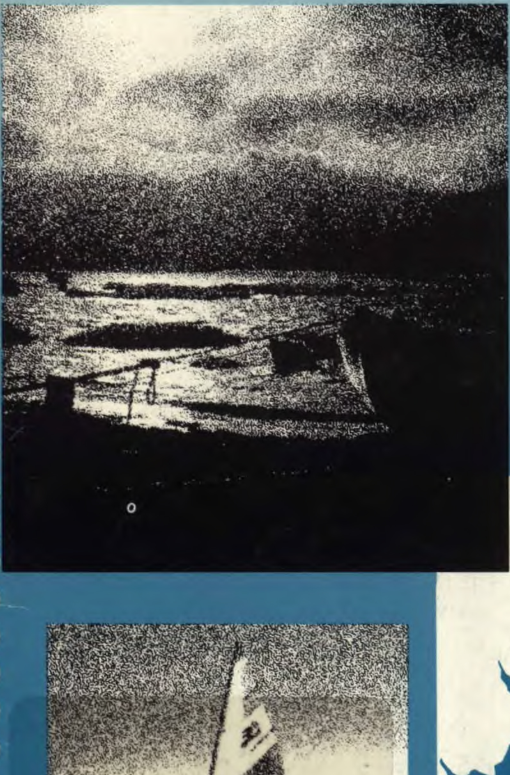
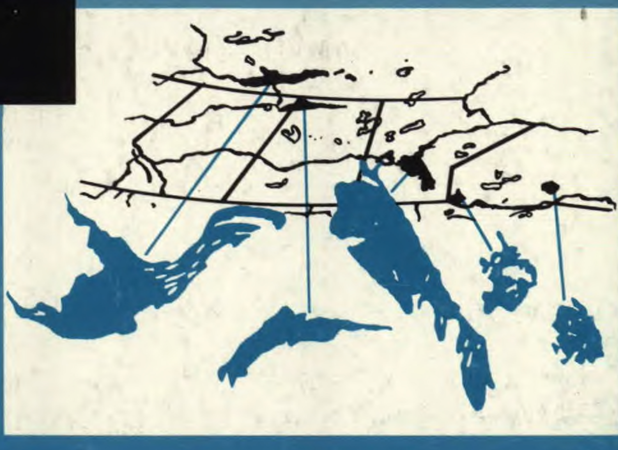
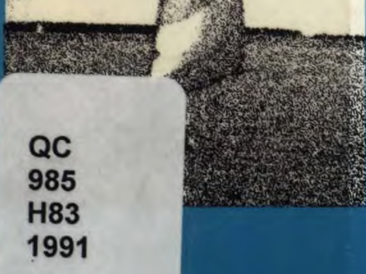
MARINE GUIDE
TO LOCAL CONDITIONS AND FORECASTS







GREAT SLAVE LAKE
LAKE ATHABASCA
LAKE WINNIPEG
LAKE OF THE WOODS
LAKE NIPIGON

Environment Canada   Environnement Canada

Production of this manual was funded by the National Search and Rescue Secretariat, Government of Canada.

This manual was designed, illustrated and page-set on computer by Embassy Graphics, Winnipeg.

Published by the authority of the federal Minister of the Environment

Catalogue no. En 56-86/1990E
ISBN 0-662-18391-6

Également disponible en français sous le titre:
Guide marin pour les conditions et provisions locales pour Lac Great Slave, Lac Athabasca, Lac Winnipeg, Lac des Bois, et Lac Nipigon

Printed on recycled paper.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the contributions to this manual by their fellow workers, scientific services personnel and management at the Arctic and Prairie Weather Centres. The existence of marine manuals for the east and west coasts made production of this manual much simpler and we are indebted to the authors of those manuals at the Maritimes and Pacific Weather Centres. Staff at the Pacific Weather Centre and the Atlantic Weather Centre have been helpful in providing resource material for this handbook while staff at the Ontario Weather Centre have provided information on freezing spray in the Great Lakes. If you also boat on the east or west coasts, the manuals for those areas are highly recommended.

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Photographs courtesy of:

Environment Canada, Parks Service: Cover, pages 67, 73 and 89.

Dr. Scott Norquay: Page 78

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INTRODUCTION

Weather plays a vital role in the day-to-day activities of commercial fishing vessels on Great Slave Lake, Lake Athabasca, and Lake Winnipeg. Weather also affects the pleasure boater. Mariners about to launch on the water face many uncertainties: are winds going to increase or diminish, are thunderstorms or squall lines going to develop? This manual is designed to help you find the answers to make your marine experience as safe and as pleasurable as possible.

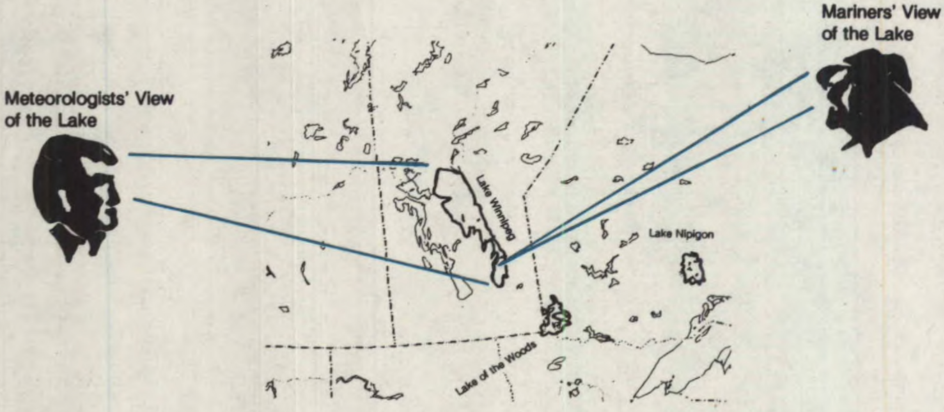
In this manual, we will explain:
- the information available to you from weather forecasts;
- how to access the forecasts;
- how to do a little 'forecasting' yourself; and
- some of the wind and wave conditions you can expect to find on Great Slave Lake, Lake Athabasca, Lake Winnipeg, Lake of the Woods, and Lake Nipigon.

A MATTER OF SCALE - THE METEOROLOGIST'S VIEW VERSUS YOUR VIEW

Meteorologists study weather systems spanning hundreds to thousands of miles. The mariner operates in an environment where the winds, wave and weather can change over very short distances. Meteorologists reduce the big view down to lake-size "windows" when they issue marine forecasts, but this scale still may not accurately predict the wind, waves, and weather for the even smaller area on the lake where you are operating.

In a forecast, the meteorologist describes the large-scale atmospheric systems, and the winds, waves and other conditions present and/or expected through a certain period of time. The meteorologist may even include some of the known larger-scale local effects. However, you, the mariner, can use your special knowledge of your local area to apply the larger-scale forecast to your particular needs.

The big picture forecast allows the meteorologist to concentrate on significant events. It also keeps the forecast brief enough to be transmitted, understood, and even copied down when heard on Transport Canada marine broadcasts and Environment Canada Weatheradio.



TIMING AND ACCURACY

The forecast that meteorologists provide at a given time is based on the most accurate information available at that time - but weather systems do not stand still. Fronts pick up speed or slow down. Lows deepen or weaken. Highs build or collapse. Thunderstorms and squall lines develop. The meteorologist gets new information.

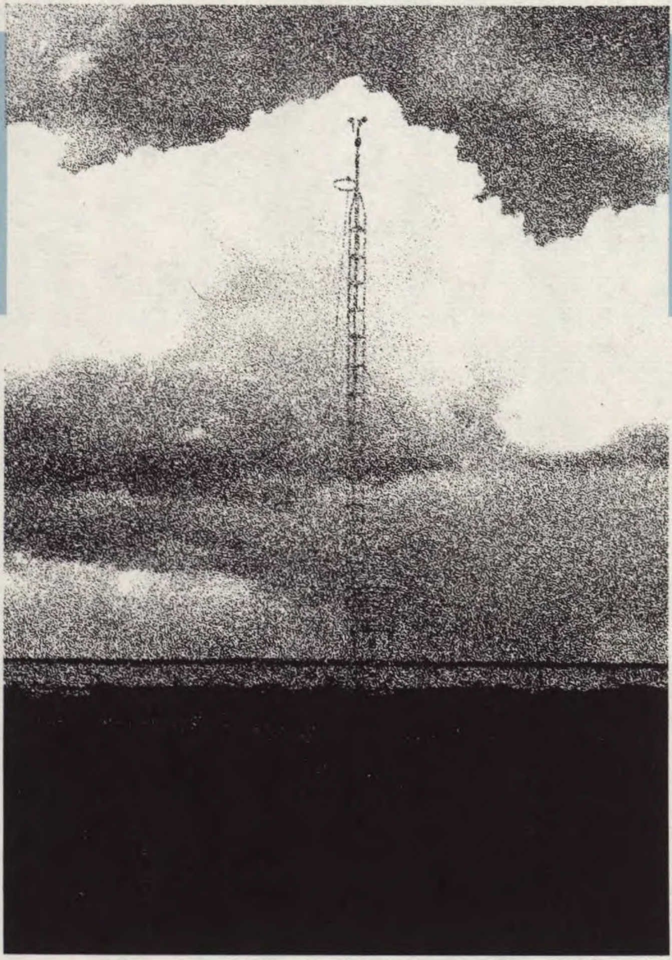
Thus, a 6 AM morning forecast intended to cover the entire day and into the next day may be totally rewritten before the next scheduled issue time, which can be 5 to 12 hours later. Indeed, mariners themselves may need to revise their own estimate of local conditions when, for example, they notice that wind has shifted earlier than was forecast or they see a line of dark clouds approaching.

YOUR ROLE

In preparing this manual, the authors found themselves pondering over local effects on the individual lakes. Here's where you can help. Return the response card which can be found at the back of this manual with a description of the local effects in the areas where you fish, boat, or sail. The information you provide may be used in future editions of this manual.

NOTES

MARINE WEATHER SERVICES



MARINE WEATHER SERVICES

Professional meteorologists employed by Environment Canada provide round-the-clock forecasting services, including marine forecasts. The weather centres providing the forecasts are:

for Great Slave Lake

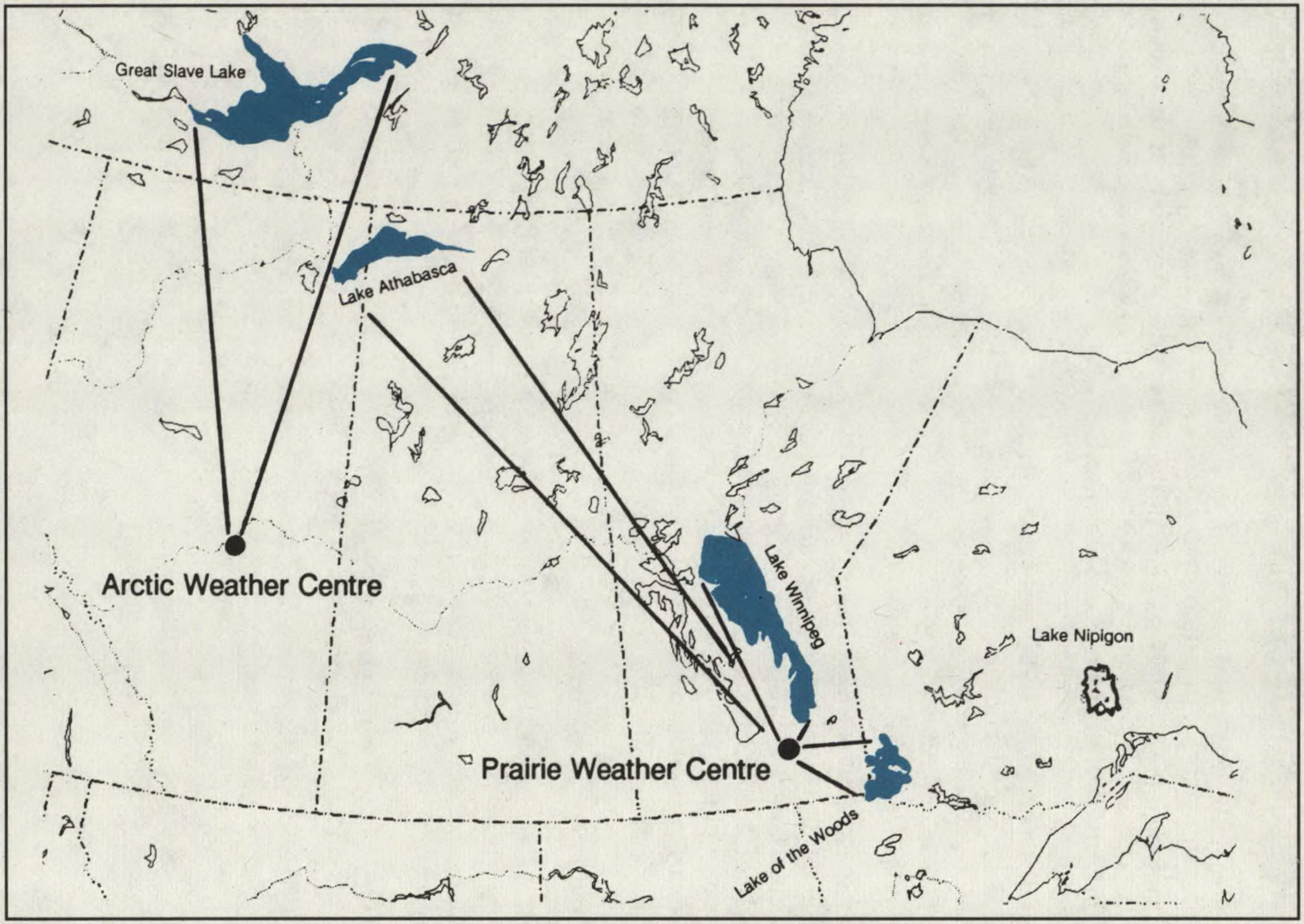
Arctic Weather Centre
Environment Canada
2nd Floor Twin Atria Bldg
4999 98th Avenue
Edmonton, Alberta
T6B 2X3

FAX (403) 468-~~7021~~ 7916
phone (403) ~~467922~~ 468-7922

for Lake Athabasca, Lake Winnipeg, and Lake of the Woods

Prairie Weather Centre
Environment Canada
10th Floor, Room 1000
266 Graham Ave
Winnipeg, Manitoba
R3C 3V4

FAX (204) 983-0109
phone (204) 983-2070


Great Slave Lake
Lake Athabasca
Arctic Weather Centre
Lake Winnipeg
Lake Nipigon
Prairie Weather Centre
Lake of the Woods

HOW CAN YOU GET MARINE FORECASTS AND WARNINGS?

Mariners require a means of not only getting the forecast but also having access to any new warnings or updates because weather conditions can change so rapidly. The meteorologists at the Arctic and Prairie Weather Centres need to be able to inform you about these potentially hazardous developments.

For Great Slave Lake and Lake Athabasca, you need a radio capable of receiving the single sideband broadcasts on 5803 kHz, the frequency used by Transport Canada at Hay River. The Hay River station broadcasts not only Marine Area Weather Forecasts on a regular basis but also warnings and updates when they are issued.

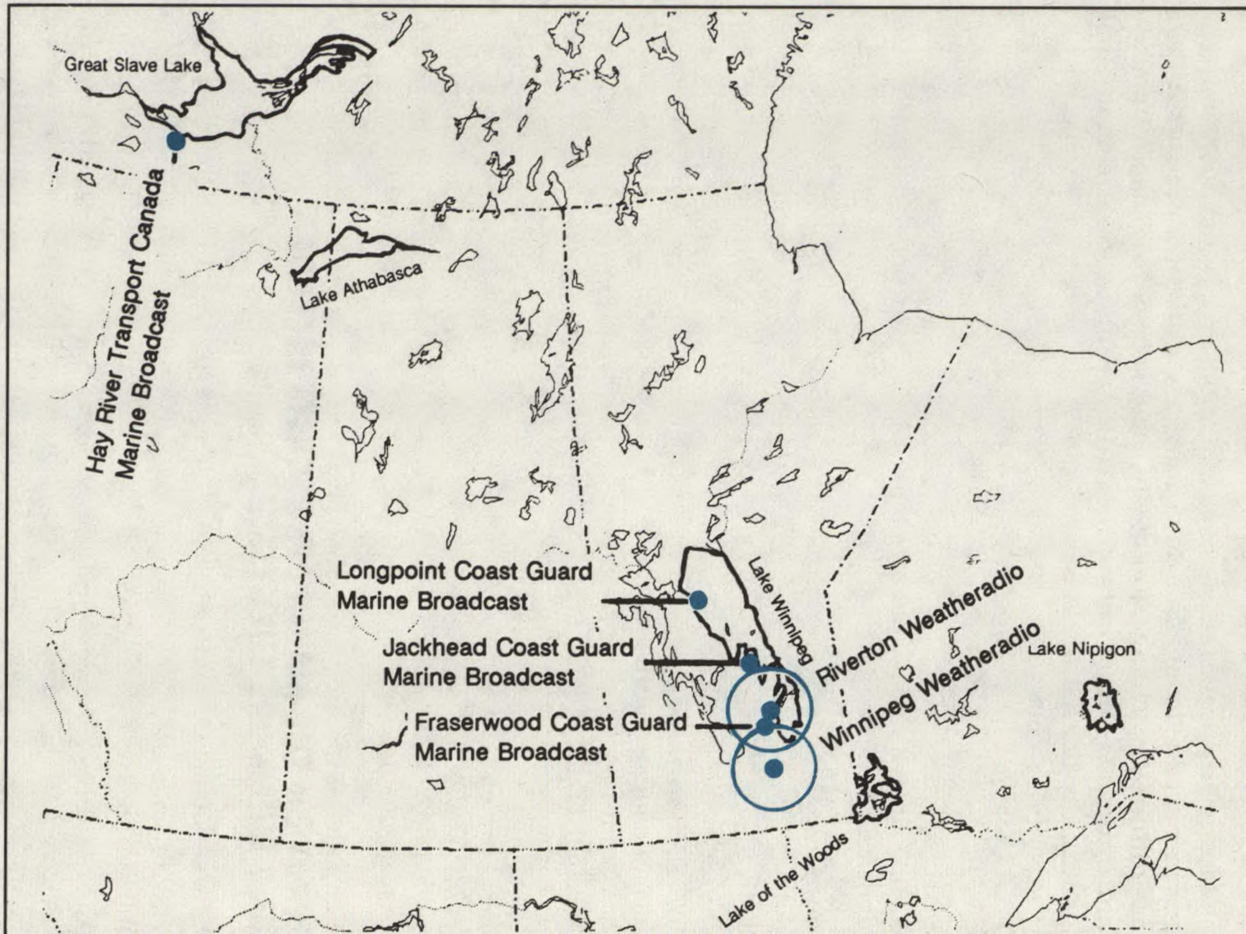
For Lake Winnipeg - South Basin, there are two possibilities. You need either a special VHF-FM weather radio or a radio capable of receiving marine VHF. The Winnipeg Weather Office Weatheradio and a repeater at Riverton broadcasts forecasts, updates, and warnings, and selected observations on a continuous and cyclic basis 24 hours a day, 7 days a week. Weather radio has an effective range of about 60 kilometres. The Canadian Coast Guard has a transmitter at Fraserwood (just west of Gimli) which provides Marine Weather Forecasts on a scheduled basis and updates and warnings when they are issued.

Please note - Weather radio has a special WEATHER WARNINGS feature. If your weather radio is equipped with a warning device, a loud continuous tone and/or flashing light will be activated automatically when meteorologists issue a warning.

For Lake Winnipeg - North Basin, the Coast Guard transmits regular forecasts on VHF from their Jackhead and Longpoint sites.

For Lake of the Woods and Lake Nipigon, monitoring public radio and/ or periodically checking with the local weather office is recommended.

For all lakes where no weatheradio or single sideband are available, monitoring commercial radio and/or periodically checking with the local weather office is recommended.


Great Slave Lake
Hay River Transport Canada
Marine Broadcast
Lake Athabasca
Longpoint Coast Guard
Marine Broadcast
Jackhead Coast Guard
Marine Broadcast
Fraserwood Coast Guard
Marine Broadcast
Lake Winnipeg
Riverton Weatheradio
Winnipeg Weatheradio
Lake Nipigon
Lake of the Woods

WHO TO CONSULT ABOUT MARINE FORECASTS

In addition to the Weather Centres in Edmonton and Winnipeg with their professional meteorologists, Environment Canada has Weather Offices staffed by specially trained weather specialists who disseminate forecasts and answer inquiries about weather. These weather offices often use their knowledge of local conditions to fine-tune the regional or area forecasts. The weather offices below can assist you.

for Great Slave Lake

- Arctic Weather Centre (Edmonton)	403 468-7922
- Yellowknife Weather Office	403 873-4027

for Lake Athabasca

- Prince Albert Weather Office	306-953-8640
- Saskatoon Weather Office	306-975-4255
- Yellowknife Weather Office	403-873-4027

for Lake Winnipeg

- Winnipeg Weather Office	204-983-2070

for Lake of the Woods

- Winnipeg Weather Office	204-983-2070
- Thunder Bay Weather Office	807-577-3921

for Lake Nipigon

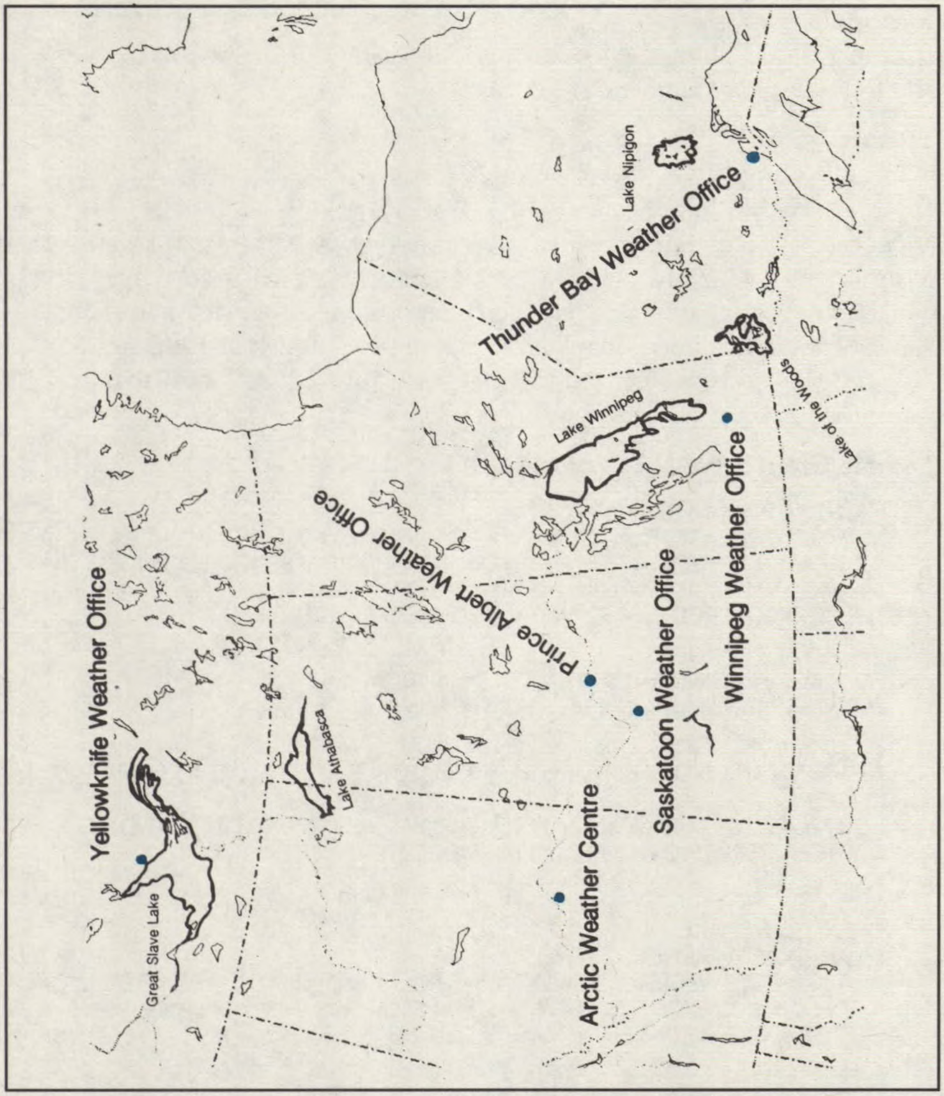
- Thunder Bay Weather Office	807-577-3921

WHAT DO THE MARINE FORECASTS INCLUDE AND WHEN ARE THEY ISSUED?

Each of the marine areas has its own unique forecast. Be aware of the units used for your particular area. Are winds in knots or km/h? (most but not all forecasts give winds in knots). How is visibility handled?

Are the times given in the forecasts local times or Universal Time Co-ordinated (UTC) times (also called "Greenwich Mean Time)?. To convert from UTC to local time, subtract 5 hours from UTC to get Central Daylight Time (CDT) and 6 hours from UTC to get Mountain Daylight Time (MDT).

When there are changes in wind conditions, or when the meteorologist expects changes that are not described in the latest forecast, the meteorologist will issue a new forecast, called an amended or updated forecast. In some cases, the updated or amended forecast will be in the form of a warning. See Warning Section.



Great Slave Lake

Issue Period -

15 May to 30 October inclusive

Issue Times

0500 AM MDT

1700 PM MDT

Synopsis

A synopsis describing the present and forecast weather systems to midnight the following day is given.

Forecasts

Wind Direction - to 8 points of the compass

Wind Speed - in knots

Weather - Cloudy, Sunny, Showers, Thundershowers, Fog, Mist, etc

Visibility - is given only when the precipitation event will reduce the visibility to less than 6 nautical miles. The meteorologist does not give visibilities for fog or mist because a header statement defines fog to have visibility values of less than 5/8 nautical miles, and mist a value of 5/8 to 6 nautical miles.

Sample Great Slave Lake Forecast

FPCN20 CWEG 181030
MARINE FORECASTS FOR ARCTIC WATERS ISSUED BY ENVIRONMENT CANADA AT 05.00 AM MDT TUESDAY 18 SEPTEMBER 1990 FOR THE PERIOD ENDING AT MIDNIGHT TONIGHT WITH AN OUTLOOK FOR WEDNESDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 05.00 PM.

WINDS ARE IN KNOTS.
FOG IMPLIES VISIBILITY LESS THAN 5/8 NAUTICAL MILES.
MIST IMPLIES VISIBILITY 5/8 TO 6 NAUTICAL MILES.

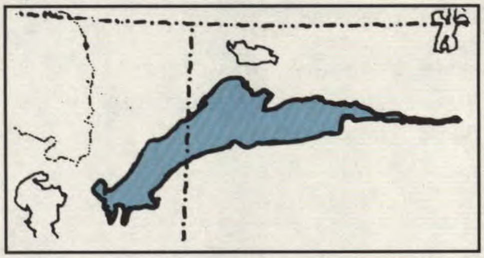
TECHNICAL SYNOPSIS FOR MACKENZIE INLAND WATERS.
AT 180600 UTC NORTH TO SOUTH RIDGE ALONG 120W MOVING EASTWARD 15 KNOTS.
LIGHT TO MODERATE NORTHWESTERLY FLOW EAST OF THE RIDGE AND LIGHT SOUTHEASTERLY FLOW WEST OF THE RIDGE.

END

GREAT SLAVE LAKE.
SMALL CRAFT WARNING ENDED.
WINDS NORTHWESTERLY 15 BECOMING SOUTHEASTERLY 10 THIS AFTERNOON.
A FEW CLOUDS EXCEPT CLOUDY EASTERN SECTIONS THIS MORNING.
OUTLOOK FOR WEDNESDAY WINDS SOUTHEASTERLY 10.

END

Lake Athabasca



Issue Period - open water season

Issue Times

0800 AM MDT
1700 PM MDT

Forecasts

Wind Direction -
to 8 points of the compass

Wind Speed - in knots

Weather - Cloudy, Sunny, Showers, Thundershowers, Fog, Mist, etc

Visibility - Good (greater than 6 nautical miles), Fair (1 to 6 nautical miles), and Poor (less than 1 nautical miles) used

Synopsis

A synopsis describing the present and forecast weather systems to midnight the following day is given.

Sample Lake Athabasca Forecast

FPCN22 CWWG 181215

MARINE FORECAST FOR LAKE ATHABASCA ISSUED BY THE PRAIRIE WEATHER CENTRE OF ENVIRONMENT CANADA AT 7.00 AM CST TUESDAY 18 SEPTEMBER 1990 FOR TODAY AND WEDNESDAY.

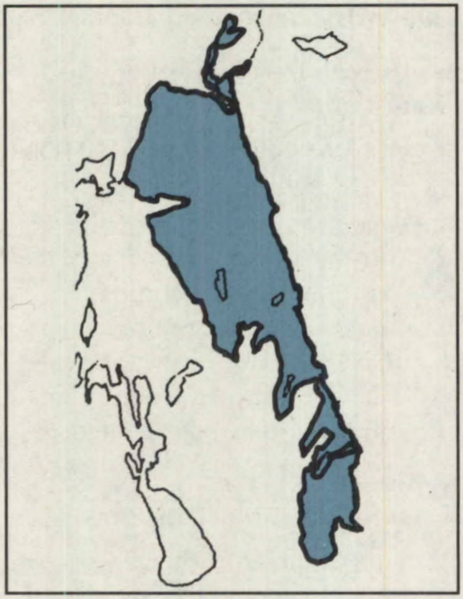
LAKE ATHABASCA
WIND NORTHWEST 20 TO 25 KNOTS THIS MORNING DIMINISHING TO LIGHT NORTH
DURING THE AFTERNOON. WINDS VEERING TO LIGHT EAST OVERNIGHT AND THEN SOUTHEAST 10 ON WEDNESDAY. CLOUDY WITH SOME DRIZZLE THIS MORNING. GRADUAL CLEARING THIS AFTERNOON. SUNNY WITH INCREASING CLOUDINESS LATE IN THE DAY ON WEDNESDAY. GOOD VISIBILITIES EXCEPT FAIR AT TIMES IN DRIZZLE THIS MORNING. LITTLE TEMPERATURE CHANGE.

END

MARINE SYNOPSIS FOR LAKE ATHABASCA.
STRONG NORTHWEST WINDS AND CLOUDY SKIES REMAIN IN THE WAKE OF A LOW PRESSURE SYSTEM NOW ENTERING HUDSON BAY. A RIDGE OF HIGH PRESSURE FROM NORTHWESTERN ALBERTA TO SOUTHWEST SASKATCHEWAN EARLY THIS MORNING WILL CROSS LAKE ATHABASCA LATE THIS AFTERNOON. WITH THE APPROACH OF THE RIDGE SKIES WILL CLEAR AND WINDS WILL DIMINISH. WINDS WILL SWITCH TO LIGHT SOUTHEAST BEHIND THE RIDGE ON WEDNESDAY.

END

Lake Winnipeg



Issue Period - through the year
Issue Time during Summer
0530 AM CDT
1130 AM CDT
1630 PM CDT

Issue Time during Winter
0530 AM CST
1730 AM CST

Format of the Lake Winnipeg forecast parallels that for Lake Athabasca during the summer. During the winter, the Lake Winnipeg Forecast is directed to operations on the ice.

Forecasts
Wind Direction - to 8 points of the compass
Wind Speed - in knots
Weather - Cloudy, Sunny, Showers, Thundershowers, Fog, Mist, etc
Visibility - Good (greater than 6 nautical miles), Fair (1 to 6 nautical miles), and Poor (less than 1 nautical miles used)

Synopsis
A synopsis describing the present and forecast weather systems to midnight the following day is given.

Sample Lake Winnipeg Summer Forecast

FPCN20 CWWG 241630
MARINE FORECAST FOR LAKE WINNIPEG ISSUED BY THE PRAIRIE WEATHER CENTRE OF ENVIRONMENT CANADA AT 11.30 AM CDT MONDAY 24 SEPTEMBER 1990 FOR TODAY AND TUESDAY.

LAKE WINNIPEG SOUTH BASIN.
WINDS SOUTHWEST 15 KNOTS SHIFTING TO WESTERLY 10 THIS EVENING. WINDS WESTERLY 15 TO 20 ON TUESDAY. SKY MAINLY CLEAR BOTH DAYS.

LAKE WINNIPEG NORTH BASIN.
WINDS NORTHWESTERLY 15 TO 20 KNOTS BECOMING WESTERLY 10 THIS EVENING. WINDS WESTERLY 15 ON TUESDAY. A FEW CLOUDS TODAY AND TUESDAY.

LAKE WINNIPEG WEATHER CONDITIONS OBSERVED AT 11.00 AM.
GIMLI SUNNY VSBY 15 TEMP 17 WIND W 10 KNOTS
VICTORIA BEACH WIND SW 12 KNOTS
ARNES WIND WSW 9 KNOTS
GRAND RAPIDS TEMP 18 WIND NW 9G17 KNOTS
BERENS RIVER SUNNY VSBY 15 TEMP 14 WIND SW 8 KNOTS
GEORGE ISLAND TEMP 14 WIND NW 14G19 KNOTS
NORWAY HOUSE CLOUDY VSBY 15 TEMP 15 WIND NW 4 KNOTS
END

MARINE SYNOPSIS FOR LAKE WINNIPEG
A LOW PRESSURE SYSTEM MOVING OVER NORTHERN LAKE WINNIPEG THIS MORNING WILL GIVE MODERATE SOUTHWESTERLY TO NORTHWESTERLY WINDS OVER THE LAKE THIS AFTERNOON. WINDS WILL BECOME LIGHTER AND MORE WESTERLY THIS EVENING AS AN AREA OF HIGH PRESSURE APPROACHES FROM THE WEST. ON TUESDAY MODERATE WESTERLIES WILL ONCE AGAIN PREVAIL.
END

Lake of the Woods

The Lake of Woods Marine Forecast is part of the Whiteshell-Kenora Region Public Forecast.
As a modified public forecast it is different from the other marine forecasts.
WINDS ARE IN KILOMETRES PER HOUR.

Issue Period -
included during the summer only

Issue Times of the Public Forecast
0600 AM CDT
NOON CDT
1700 PM CDT
2200 PM CDT

Forecasts
Wind Direction - to 8 points of the compass
Wind Speed - in km/h
Weather - Cloudy, Sunny, Showers, Thundershowers, Fog, Mist, etc
Visibility - Not given.

Synopsis
The synopsis is for Manitoba and northwest Ontario as a whole.

Sample Lake of the Woods Forecast

FPCN11 CWWG 181613
URBAN AND RURAL FORECASTS FOR SOUTHERN MANITOBA ISSUED
BY THE PRAIRIE WEATHER CENTRE OF ENVIRONMENT CANADA AT
11.30 AM CDT TUESDAY 18 SEPTEMBER 1990 FOR TODAY AND WEDNESDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 4.00 PM.

Forecast includes many other areas.. Only WHITESHELL-KENORA REGION given here.

WHITESHELL-KENORA REGION
INCLUDING LAKE OF THE WOODS MARINE AREA.
TODAY..DRIZZLE AND FOG AT FIRST. CLEARING BY LATE AFTERNOON.
WINDS WESTERLY 30 KM/H. HIGH 17.
TONIGHT..A FEW CLOUDS. WINDS NORTHWESTERLY 20 KM/H. LOW 4.
WEDNESDAY..MAINLY SUNNY. WINDS NORTHWESTERLY 20 KM/H. HIGH NEAR 18.
POBABILITY OF PRECIPITATION IN PERCENT 60 TODAY
20 TONIGHT AND 10 WEDNESDAY.
END

FPCN10 CWWG 220230
SYNOPSIS FOR MANITOBA ISSUED BY THE PRAIRIE WEATHER CENTRE
OF ENVIRONMENT CANADA AT 9.30 PM CDT FRIDAY 21 SEPTEMBER 1990.

COOL SHOWERY WEATHER WAS REPORTED OVER MOST OF THE PROVINCE FRIDAY IN THE WAKE OF A WEATHER SYSTEM IN NORTHWESTERN ONTARIO. BRISK NORTHERLY WINDS AND CLOUDY SKIES WILL PERSIST OVERNIGHT ACROSS THE SOUTH AND ALTHOUGH THE AIR TEMPERATURE WILL DROP TO NEAR FREEZING..GROUND FROST REMAINS UNLIKELY. A HIGH PRESSURE AREA BUILDING INTO THE PROVINCE WILL BRING CLEARING SKIES TO NORTHERN AREAS TONIGHT AND EARLY MORNING TEMPERATURES SHOULD BE WELL BELOW FREEZING. THE CLEARING WILL SPREAD ACROSS THE SOUTHERN REGIONS ON SATURDAY AND FROST IS VERY LIKELY IN THE RED RIVER VALLEY AND EASTWARD SATURDAY NIGHT. A SOUTHWESTERLY FLOW IS EXPECTED TO DEVELOP OVER MOST OF THE PROVINCE ON SUNDAY BRINGING SUNNY SKIES AND NEAR NORMAL TEMPERATURES.
END

Lake Nipigon

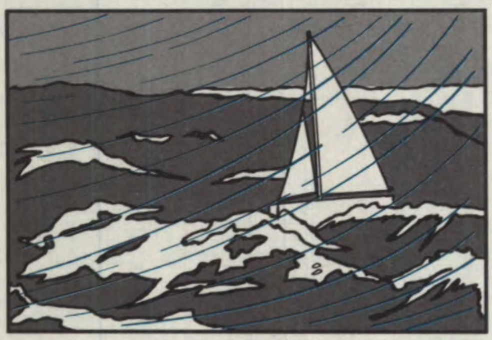
Please consult the Nipigon Region Public Forecast.
There was no specific marine forecast for Lake Nipigon during the 1990 season.

WHAT WARNINGS ARE ISSUED?

The meteorologists at the Arctic Weather Centre and the Prairie Weather Centre issue MARINE WARNINGS when the following conditions are forecast to occur:

WARNINGS FOR WHICH THE WEATHER CENTRES ISSUE SPECIAL BULLETINS AND WHICH ARE BROADCAST IMMEDIATELY:

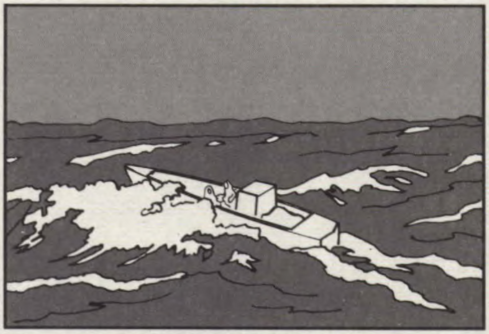
GALE WARNING - issued for mean wind speeds in the range 34 to 47 knots



STORM WARNING - issued for mean wind speeds in the range of 48 to 63 knots

HURRICANE FORCE WIND WARNING - issued for mean wind speeds equal to or in excess of 64 knots

WARNINGS WHICH ARE NOT ISSUED AS A SEPARATE BULLETIN BUT RATHER ARE INCLUDED IN EITHER OR BOTH THE FORECAST AND THE SYNOPSIS:



SMALL CRAFT WARNING - issued when winds are expected to be in the 20 to 33 knot range.

Note - A forecast wind of 15 to 20 knots does not require a small craft warning.

FREEZING SPRAY WARNING - issued when moderate or heavy vessel icing is expected due to freezing spray.

SEE ICING SECTION.

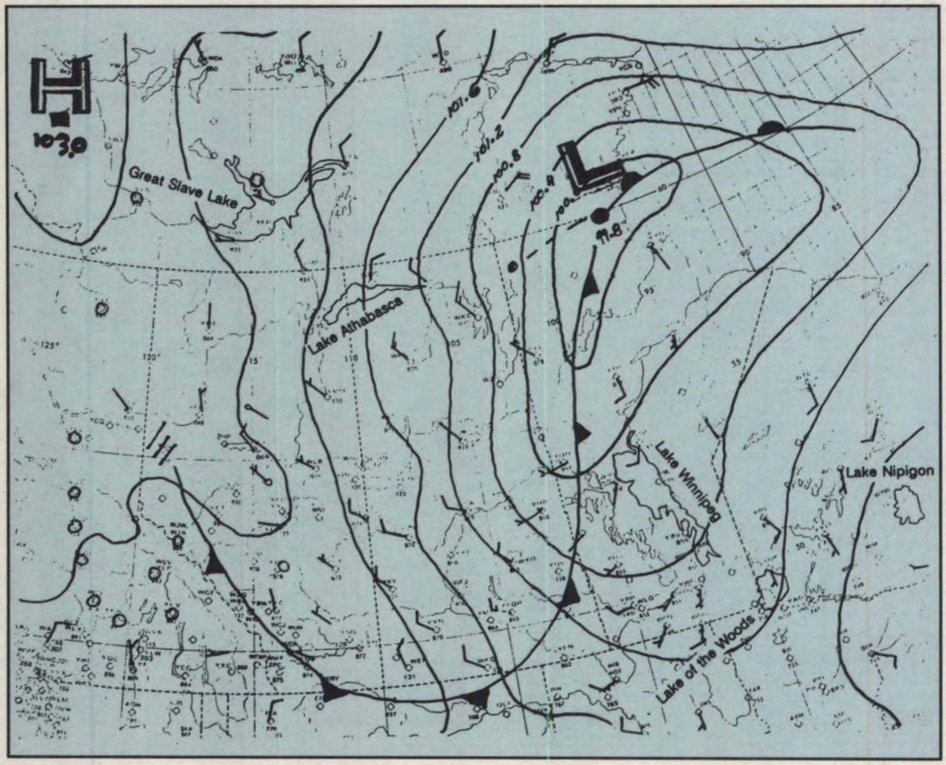
WARNING SUMMARY SHEET

WARNING if applicable	GREAT SLAVE LAKE	LAKE ATHABASCA	LAKE WINNIPEG	LAKE OF THE WOODS
GALE	yes	yes	yes	yes
STORM	yes	yes	yes	yes
HURRICANE FORCE WIND	yes	yes	yes	yes
SMALL CRAFT	yes	yes	yes	yes
FREEZING SPRAY	yes	yes	no	no

UNDERSTANDING WEATHER MAPS

Meteorologists have a language of their own. To understand and visualize what they are saying, it is important to know how to read a weather map and to be able to do a little forecasting yourself.

This section will explain what the various lines and symbols on a weather map show. Forecasting tips will be given element by element - wind, wave, and icing - in later sections.



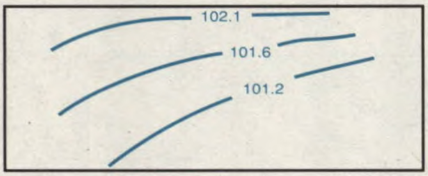
Some Weather Forecasting Symbols: We will be using these symbols throughout the rest of the manual.

Centre of High Pressure

Pressure decreases in all directions out from centre.

Centre of Low Pressure

Pressure increases in all directions out from centre.

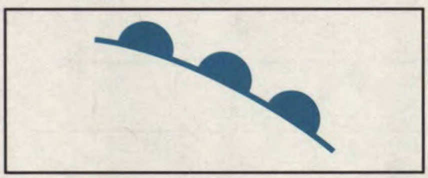


Isobars

Lines joining places of equal pressure drawn at intervals of .4 kilopascals (4 millibars). The closer the isobars, the stronger the theoretical wind.

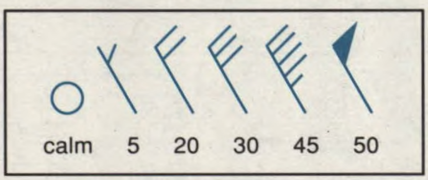
Cold Front

Leading edge of an advancing cold air mass. Usually moves southeastward. 'Icicles' on the map point to the warm air.



Warm Front

Traling edge of a retreating cold air mass. Usually moves northeastward. 'Raindrops' on the map face the cold air.



Wind Speed

Shaft of the arrow represents the direction from which the wind blows. The wind speed, in knots, is shown by the number of barbs and/or flags on the shaft. Small barb - 5 knots.
Large barb - 10 knots each.
Flags 50 knots. Circle - calm wind

NOTES

WIND

WIND

The overall patterns of the winds are quite well understood. It is the daily variation of the winds, where they blow and how strong, that remains a constant problem for meteorologists to forecast.

If mariners can understand why the winds are much stronger in some areas during certain weather patterns, they can more effectively use the marine forecasts. Mariners will also be better able to interpret the observations available from weather reporting stations, which reflect the influence of the neighbouring topography. Under certain conditions, the local weather observations may not be representative of the surrounding marine area.

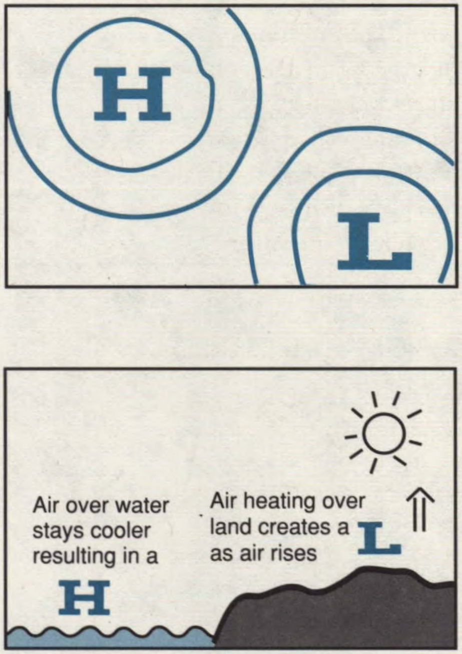
Strong, sometimes gusty winds, develop from time to time across the lakes discussed in this manual. These strong gusty winds have the potential to affect boating activities. Small craft such as canoes can get swamped, boats can capsize, sailboats can get pushed over, and waves which make boat handling difficult can develop. Offshore winds, even light ones, can take the novice sailor or windsurfer offshore only for them to find it difficult to make it back to the shore.

BASICS

Wind is simply air in motion. In the following section, we will outline how winds get started and the forces that steer and change wind speed.

1. **Unequal heating of the earth's surface causes Highs and Lows of pressure.**
   This can be on the grand scale of the entire earth or on the small scale of the heating of land versus the heating of the a lake (The winds from small-scale heating will be discussed in the LOCAL EFFECTS section.) On a weather map, lines called isobars are drawn between lines of equal pressure.

global scale



small scale

Fig. 1

2. **Air tries to move from Highs to Lows in an effort to balance pressure.**
The greater the difference in pressure between two points, the more forcefully the air tries to move. If the earth were not rotating, the air could move directly from the High to the Low across the isobars.

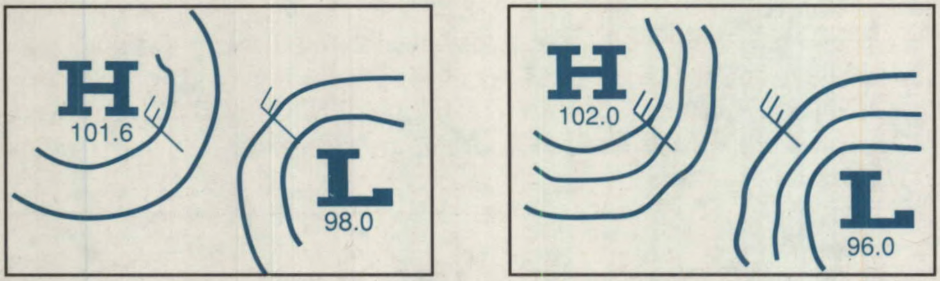


Fig. 2: These diagrams illustrate how differences in pressure affect winds. In the left, the difference in pressure is 3.6 kp; the resultant wind may be 15 knots. A larger difference in pressure between the High and Low yields stronger winds.

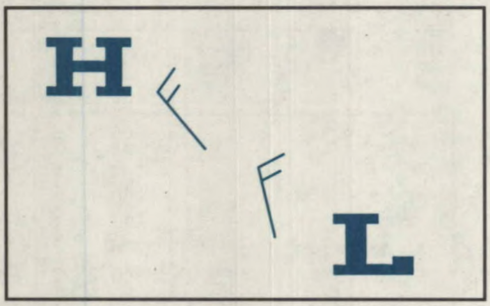


Fig. 3

3. **The earth is rotating so the air gets turned further and further to the right.** (Air is turned to the left in the southern hemisphere.) The scientific term for this is Coriolis Force. If the Coriolis force did not exist, the wind would be able to blow directly from the High to the Low per Fig. 2.

4. **If there were no other factors affecting the air, it would continue flowing parallel to the isobars and never get ting from the High to the Low.**

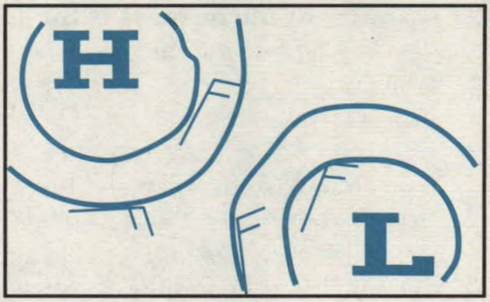


Fig. 4

5. **However, friction acts as spoiler and partially counteracts the turning caused by the earth's rotation. The resulting balance is such that the air blows slightly out of a high and slightly into a low.**

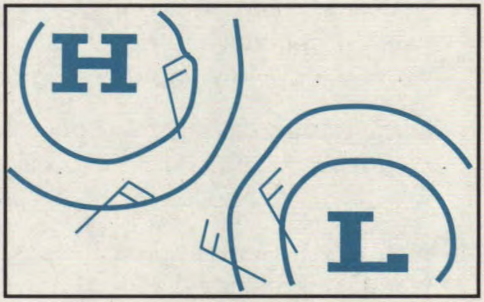
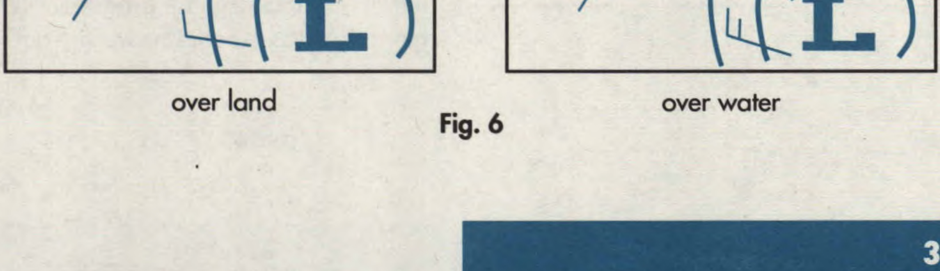


Fig. 5

6. **Consider an identical pressure regime of a high and a low over water versus over land. There is less friction over the water than over the land so the wind over the water is stronger than that over land and the direction is closer to the lines of equal pressure.**



over land

over water

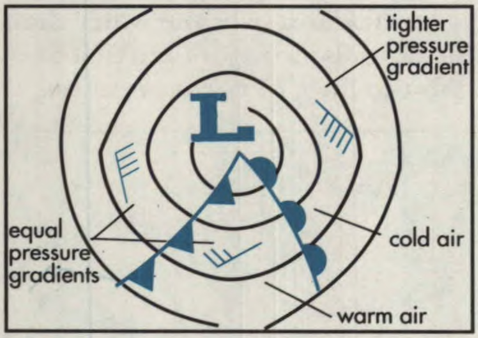
Fig. 6

7. **Stability of the airmass is the next factor to consider.**
The stability of the air over open water is largely determined by the temperature difference between the water and the air. When warm air moves over colder water, the water cools the air near the surface. This sets up a "stable" pattern. There is no tendency for either the warm or cold air to move to change this pattern. However, when cold air moves over warmer water, the lowest layer of the air is heated up. The warmer air, which is lighter than the cold air, then begins to rise so that it is above the cold air. The air in this situation is unstable and commonly occurs in the fall after the passage of a cold front over a body of warmer water.

Winds become stronger and more unpredictable with unstable air masses; updrafts and downdrafts occur as the colder air replaces the warmer air below. Strong downdrafts cause gusty winds.

During sunny days, particularly in the summer, the land is heated, which in turn heats the air near the surface. The air becomes unstable and gusty winds can be expected on land and very close to shore.

As frontal systems approach lakes, they often bring an area of relatively warmer air making the airmass over the lake progressively more stable. To the west and northwest of the cold front, the airmass becomes unstable.



When the isobars are equally spaced in both the cold air and the warm air, the winds will be stronger in the cold air due to its instability. Please note, however, that the isobars often pack closely together ahead of a warm front so that the winds in this area can be as strong as those in the cold airmass to the west and north of the cold front in spite of the airmass to the east and northeast of the warm front becoming progressively more stable as its nears the warm front.

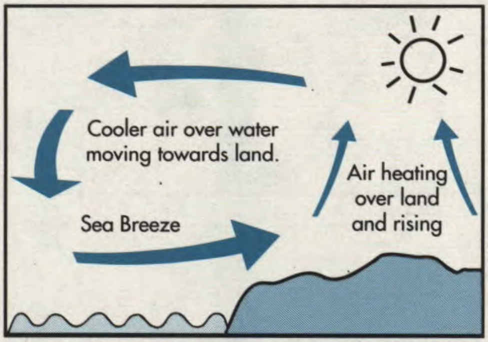
LOCAL EFFECTS

Local effects may either supercede or enhance the basic High and Low pressure pattern wind regime when the pressure situation is weak.

1. Land and Sea Breezes

Land and sea breezes are observed when the prevailing winds are light and when strong daytime heating occurs. This is often the case in the summer when a large area of high pressure dominates the weather pattern. Land and sea breezes are frequently noticed on Lake Winnipeg during weak pressure situations. At Hay River on Great Slave Lake, sea breezes are noticed both during weak pressure regimes and during periods when there is an easterly gradient as an additive feature.

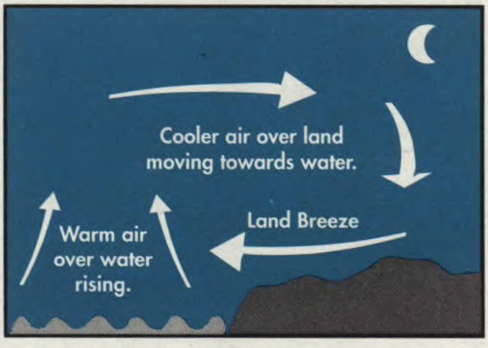
The **sea breeze** blows from lake to land and occurs when the air over land is heated more rapidly than the air over the adjacent water surface. As a result, the warmer air rises and the relatively cool air from the sea flows onshore to replace it. As the day progresses, the sea breeze circulation gradually strengthens and draws air from further offshore. By late afternoon, speeds of 10 to 15 knots can extend 15 miles out from the coast. The wind direction generally veers (turns clockwise) as it strengthens. During the evening, the sea breeze subsides.



Sea Breeze

The irregularity of a coastline can add many complications to this simple pattern of sea breezes. For example, sea breezes can be funnelled by an inlet.

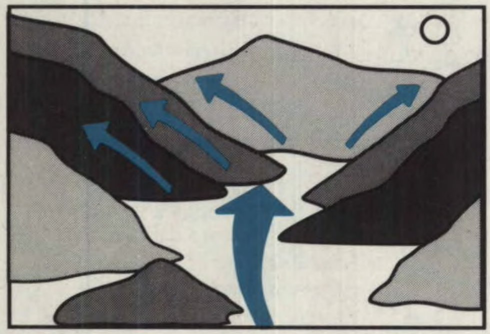
At night, as the land cools, a **land breeze** develops in the opposite direction to the sea breeze and flows from the land out over the water. It is generally not as strong as the sea breeze, but can be quite gusty.



Land Breeze

2. Valley Winds

The geography around the lakes in this manual is relatively flat but there are ravines and river valleys which can affect the overall winds. Valley winds can contribute to the land and sea breezes described on the previous page and result in increased wind speeds. Sudden strong downslope valley winds can be an unpleasant surprise the morning after a mariner anchors overnight in a secluded cove that was calm the night before.



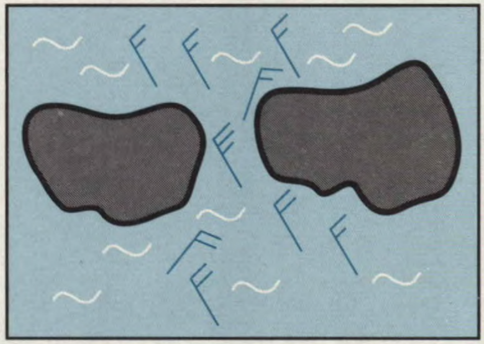
During the day, the sides of valleys become warmer than the valley bottoms since they are more exposed to the sun. As a result, the winds blow up the slopes. These daytime winds are called **anabatic** winds.

At night, the air cools over the higher terrain and sinks to the valley floor. The cool night winds are called **drainage** winds or **katabatic** winds and are often quite gusty and usually stronger than the daytime anabatic winds.

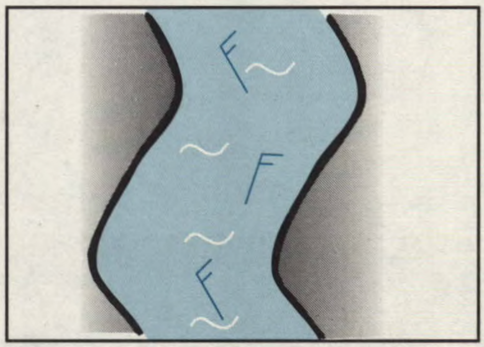
3. Channelling and Funnelling

In some cases, physical geography deflects or blocks winds, much like rivers that turn or speed up in response to the shape of their banks

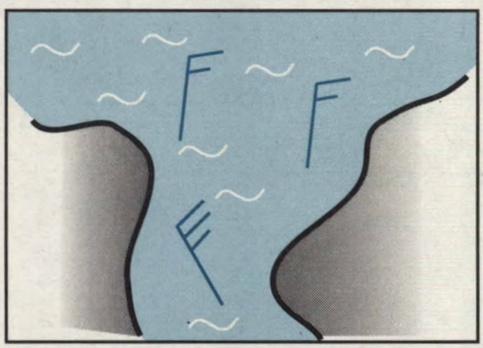
When winds are forced to flow through a narrow opening or gap, such as through an inlet or between two islands, the wind speed may increase and may even double in strength. This effect, called **funnelling**, is similar to pinching a water hose to create higher speeds.



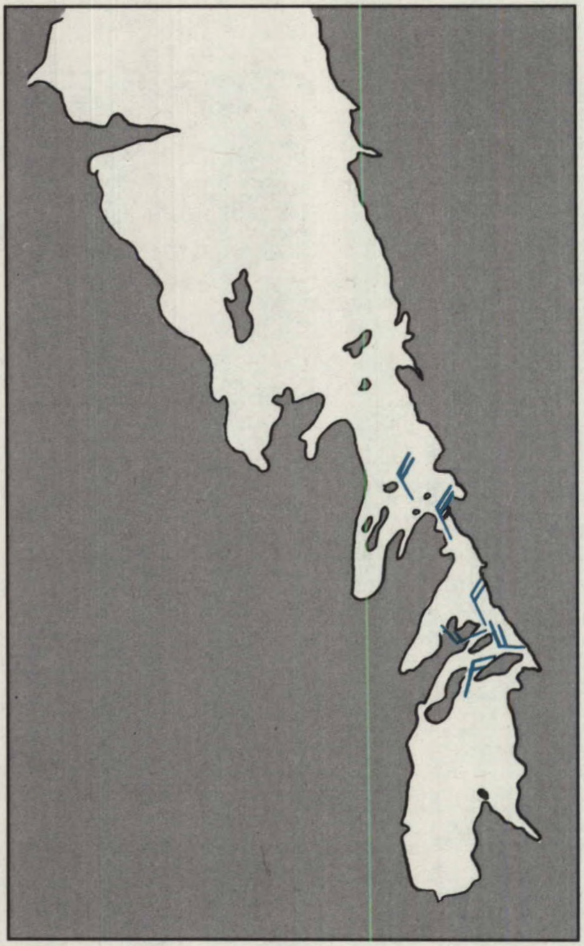
Topography along a coastline can also change the direction of the wind by forcing it to flow along the direction of a pass. This is referred to as **channelling**.



When winds have been modified by both funnelling and channelling, they are called **gap winds**.



In the example, for a northwesterly flow, funnelling is depicted at the narrows between the North and South Basins of Lake Winnipeg. Channelling is depicted around the islands at the north end of the South Basin.

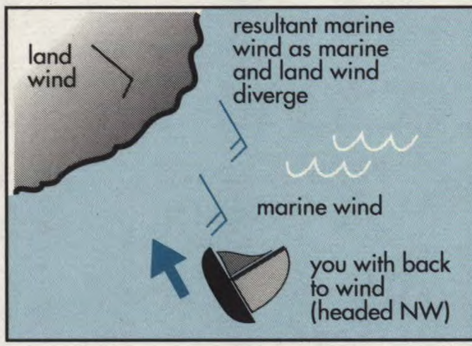


4. Corner Winds

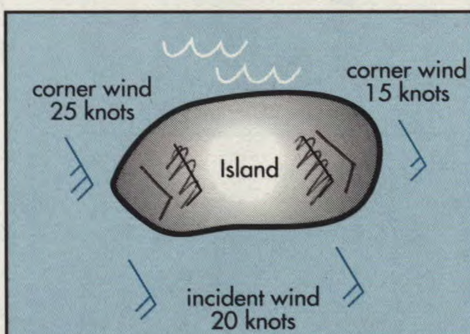
Differences in wind direction because of decreased friction over water result in corner winds as the winds from the land and water either converge (move together) or diverge (move apart).

When the wind is at your back and the coast is on your right, the different angles of the surface winds over water and land due to friction cause the airstreams to converge. This convergence creates a band of wind which is about 25 percent stronger a few miles offshore

In the opposite case, when the wind is at your back and the coast is on your left, a divergence of the airstream results in a band of lighter winds.

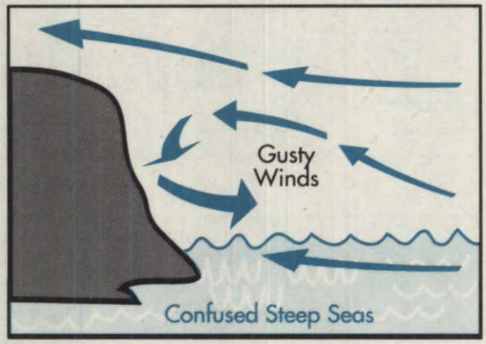


These effects are often seen when the wind blows past an island or around a headland.

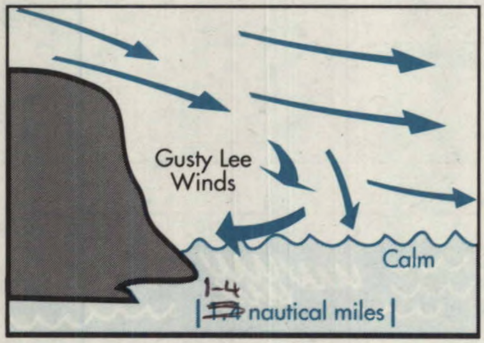


5. Lee Effects

When the winds blow against a steep shoreline bluff or over rugged terrain onto the water surface, gusty turbulent winds result. Eddies often form downstream of the cliff face which create stationary zones of lighter and stronger winds. The zones of strong winds are fairly predictable and usually remain stationary as long as the wind directions and stability of the airmass do not change. The lighter winds, which occur in areas called wind shadows, can vary in speed and direction, particularly downwind of higher cliffs. The varied wind regime can result in confused steep seas.



On
~~Off~~shore winds



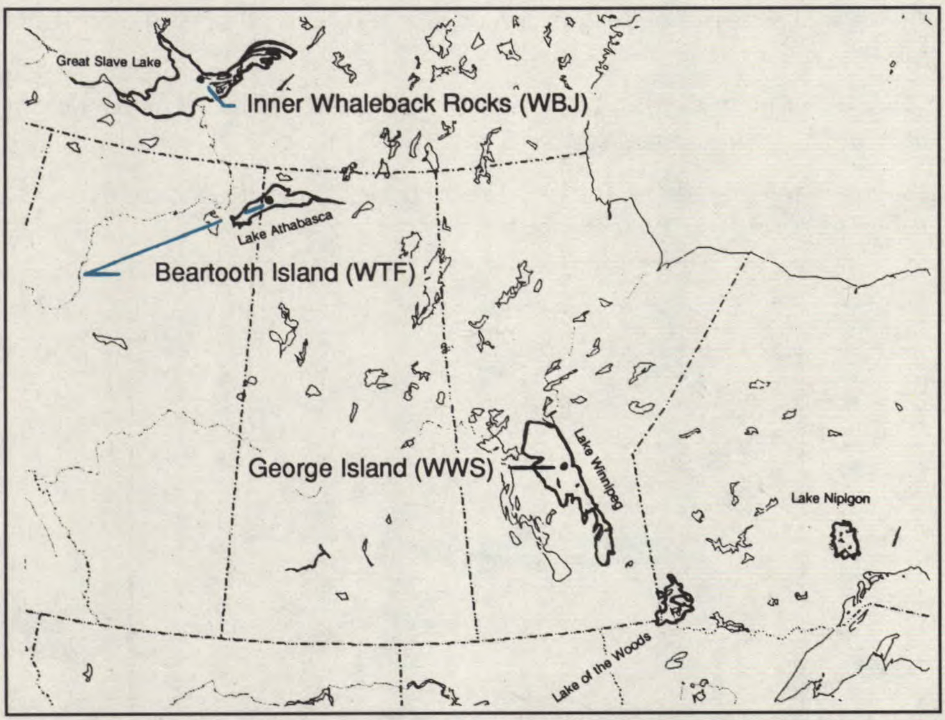
Off
~~On~~shore winds

ESTIMATING PRESENT WIND SPEED

METHOD A. MARINE WIND FROM ISLAND STATIONS

In the past few years, Environment Canada, with the support of agencies such as the Canadian Coast Guard, has begun to deploy unmanned weather stations on islands or peninsulas. Environment Canada looks for small flat barren islands and barren terrain so that the unmanned stations will be sampling the wind over the body of water and not wind which has been altered by friction or terrain. Hourly wind data from these weather stations are available by phone from the Weather Offices listed in the WHO TO CONSULT ABOUT MARINE FORECASTS section.

Please note - On the larger lakes such as Great Slave, Lake Athabasca, and Lake Winnipeg, the 'island-marine' wind observations will be representative of the winds for the part of lake where the island is located but may not represent the wind situation across the entire lake.



METHOD B. USING WIND DATA FROM COASTAL OR NEARBY LAND STATIONS TO ESTIMATE MARINE WIND

TIP 1

In general, winds over water are stronger than those over land because there is less friction over water than there is over land. With a land wind of 5 to 10 knots, winds over water can be 50 to 100% stronger. So, if it is windy over land, it is likely windier over the water.

TIP 2

For a strong wind and when the air temperature is colder than the water temperature, expect the wind over land and over water to be similar.

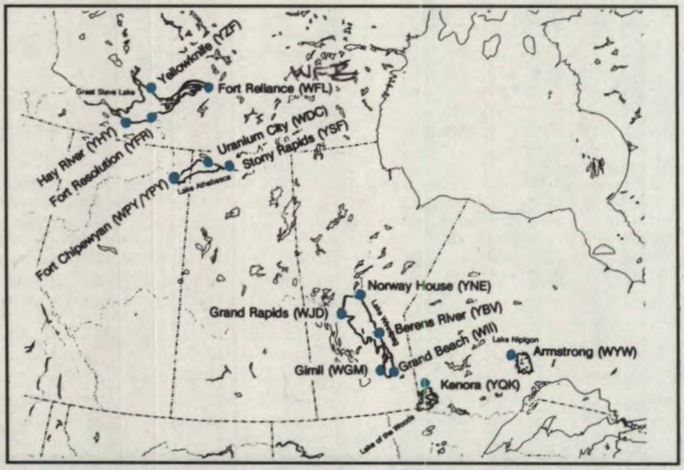
This situation can occur in the summer, but is more common in the fall with a northwesterly flow.

TIP 3

When the air is warmer than the water and the wind is moderate (15 to 19 knots) to strong (20 to 33 knots) expect the wind over water to be 20% to 30% stronger than the measurements at the land stations. But...if the land station is downwind of you and on or near the shore, the wind over water will be similar to the wind over land.

This is a common occurrence during the spring and summer. The conditions are common with easterly to southeasterly wind.

The following map shows the locations of coastal and land stations that were available during the 1990 marine season.



METHOD C. ESTIMATING WIND FROM ITS EFFECTS ON LAND AND WATER PER THE BEAUFORT WIND SCALE

The Beaufort Wind Scale was devised in the 19th century by the British Navy as a means of estimating wind speed from its action on ships. The scale is still useful as a method of estimating wind speed from its effects on land and water.

BEAUFORT SCALE	Wind Speed (knots)	Description	Effect on land	Effect on water	Effect on Boats
0	0	Calm	Calm: smoke rises vertically	Sea like a mirror	Flat calm
1	1-3	Light Air	Direction of wind shown by smoke drift but not by vanes	Scale-like ripples; no crests	Few perceptible ripples
2	4-6	Light Breeze	Wind felt on face; leaves rustle; vanes moved by wind	Small wavelets; glassy crests do not break	Ripples general, sails fill; small boats move slowly
3	7-10	Gentle Breeze	Leaves, small twigs in constant motion; wind extends light flag	Large wavelets; crests breaking; foam glassy; scattered white horses	Small pleasant waves; sailboats heel and move slowly
4	11-16	Moderate	Raises dust, loose paper; small branches moved	Small waves become larger; fairly frequent white horses	Moderate waves; occasional whitecaps; comfortable sailing breeze
5	17-21	Fresh	Small trees in leaf begin to sway; crested wavelets form on inland waters	Moderate waves form many white horses; spray	Moderate whitecaps on open waters; small sailboats shorten sail; rowboats and canoes in difficulty
6	22-27	Strong	Large branches in motion; whistling heard in wires; umbrellas used with difficulty	Large waves form; foam crest more extensive; some spray	High waves on open waters; small boats in dificulty
7	28-33	Near Gale	Whole trees in motion; inconvenient walking against wind	Sea heaps up; some foam from waves blows streaks	Small boats in harbour; large sailing ships reduce sail
8	34-40	Gale	Breaks twigs off trees; impedes progress	Moderately high waves; well-marked streaks of faom	Open water very rough
9	41-47	Strong Gale	Slight structural damage occurs	High waves. Dense foam streaks; spray may affect visibility	Large ships slowed down and heeled over if wind abeam
10	48-55	Storm	Trees uprooted; considerable damage occurs	Very high waves, long overhanging crests; white foam; has white appearance.	Large sailing ships close-reefed or running with lower topsails
11	56-63	Violent Storm	Widespread damage	Exceptionally high waves;sea covered with foam patches; edges of wave crests blow into froth everywhere	Large sailing ships hove to or running under fore topsails; steamships hove to
12	64-71	Hurricane	Widespread damage	Air filled with foam and spray; sea completely white with driving spray. Visibility very seriously affected	Storm sails only; largest ships hove to with steerage way only or running before wind

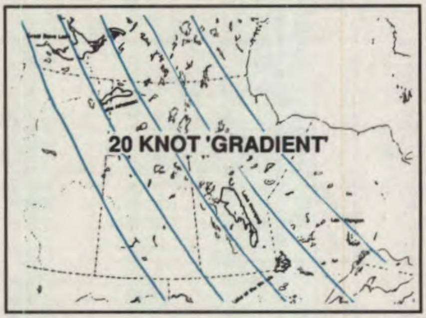
METHOD D. ESTIMATING WIND FROM WEATHER MAPS

Step 1 - Pressure Gradient Wind

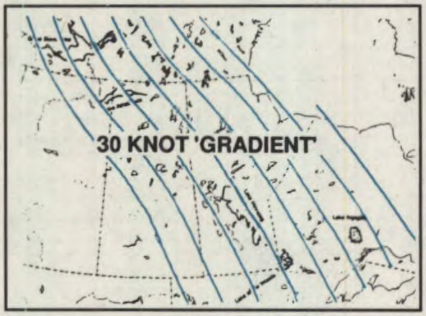
The closer the lines of pressure are together, the stronger the wind is, in theory. Meteorologists in Canada usually analyze the lines of pressure at a 0.4 kilopascal separation (which is equivalent to 4 millibars). The following maps show what 20 knot, 30 knot and 40 knot pressure gradient winds look like over the lakes.

Step2 - Adjusting for Stability

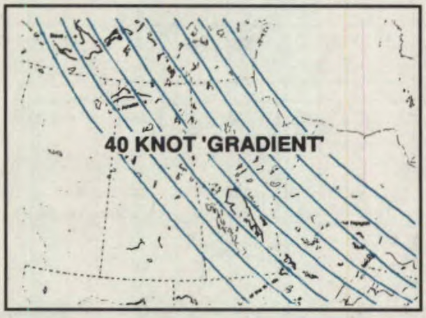
Once the pressure gradient wind is known (see diagrams for depictions of 20 knot, 30 knot and 40 knot pressure gradients), we must consider the stability of the airmass. For identical pressure gradients, winds will be stronger and gusts more frequent with an unstable air mass than they will be with a stable airmass.



When the air temperature is colder than the water temperature, expect the wind over the lake to reach values close to 100% of the gradient wind. The airmass in this case is labelled UNSTABLE. Northwesterly winds frequently cause UNSTABLE flows. The northwesterlies often develop following the passage of a low and a cold front across the area.



When the air temperature is warmer than the water temperature, expect the wind over the lake to be less than the gradient wind-perhaps only 60 to 70% of the gradient wind. The air mass in this case is labelled STABLE. Easterly to southeasterly winds are the winds most often linked to STABLE flows. The easterlies/southeasterlies often occur with the approach of a low pressure system.



FORECASTING WIND

Environment Canada meteorologists have computer-generated charts which predict the pressure gradient and other meteorological factors out to a period of time. These charts, along with an understanding of current conditions, allow the meteorologist to provide the mariner with a wind forecast valid through to that period of time.

TAKING WIND ESTIMATION AND FORECASTING TWO STEPS FURTHER

The meteorologist takes other factors into consideration after he or she has gone through the steps of measuring the pressure gradient and applying a stability factor. The other primary factors are *curvature* and *the rate at which the pressure is changing across a given area.*

1. **CURVATURE FACTOR**
   When the lines of equal pressure are very tightly packed around a low, the wind value can be adjusted downward. When the flow is out of a high, the wind value is often stronger than you would expect.

2. **RATE OF PRESSURE CHANGE FACTOR**
   When the pressure is rising rapidly across an area, winds are often stronger than the pressure gradient alone would suggest. For example, if pressures are rising rapidly behind a storm which is moving quickly eastward, then the northwesterly winds in the wake of the storm will be stronger than what you would expect based solely on the packing of the isobars.

NOTES

WIND CLIMATOLOGY

In this section, the percentage frequency of wind direction to eight points of the compass and the relative windiness through the May to October period will be presented for Great Slave Lake and for land stations on the coast or near Lake Athabasca, Lake Winnipeg, Lake of the Woods and Lake Nipigon. The percentage frequency of wind direction climate is common to all the lakes. For the wind speed, a frequency of winds of small craft and gale warning strength was derived from ship wind reports for Great Slave Lake. For the other lakes, ship reports were not available and the reports from the land stations did not lend themselves to this type of analysis. In its place, mean wind speeds by month for the land stations are given.

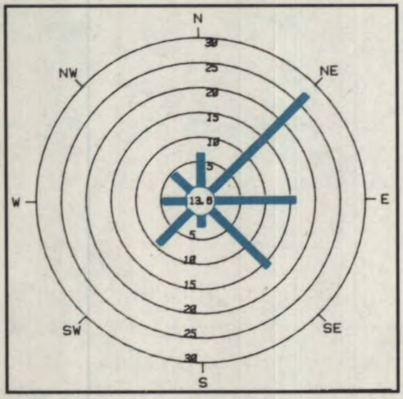
Ship reports from 1980 to 1988 inclusive were used for the Great Slave Lake climatology.

For the North Basin of Lake Winnipeg, the wind climatology given is that for George Island, a manned lighthouse site for which the wind measuring device was on a 77-foot tower. Due to the height of the old tower, the mean wind data for George Island shows values higher than other sites. For the South Basin of Lake Winnipeg, the data from Gimli was used. Similarly, data from Fort Chipewyan was used for Lake Athabasca and Kenora for Lake of the Woods. The data from Armstrong was used for Lake Nipigon. When using land-based data to estimate wind speeds over water, remember that your results are estimates only and may not be accurate in all circumstances.

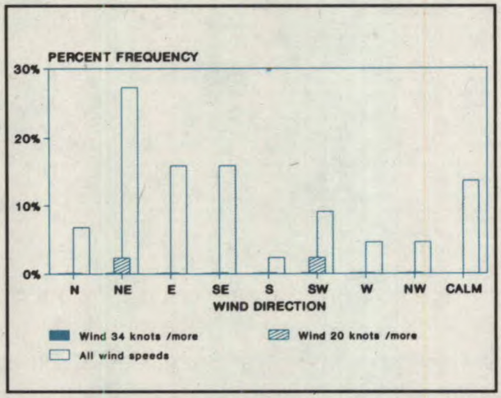
GREAT SLAVE LAKE WIND CLIMATOLOGY

MAY - per 1 observation in 1981, 26 observations during 1983 and 17 observations during 1988 (ice is just starting to break-up in late May).

PERCENT FREQUENCY BY DIRECTION



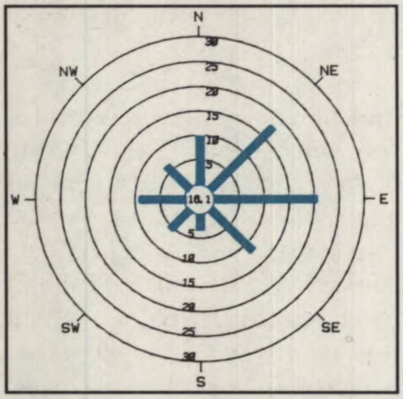
WIND SPEED CLASSES BY DIRECTION



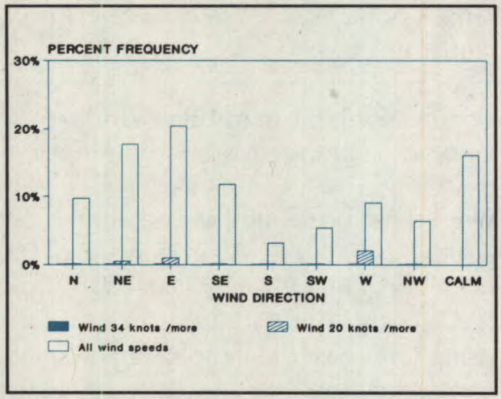
The favoured wind direction for Great Slave Lake during May is from the NE. The favoured wind directions for winds of small craft warning strength are from the NE and SW.

JUNE - per 186 observations during 1980-1988 period (shipping activity just begins to pick up during June)

PERCENT FREQUENCY BY DIRECTION



WIND SPEED CLASSES BY DIRECTION

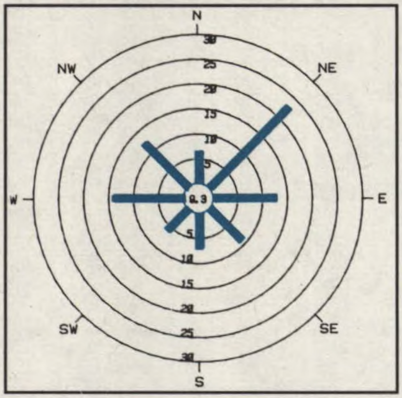


The favoured wind directions for Great Slave Lake during June are from the NE and E. The favoured wind directions for winds of small craft warning strength are from NE, E, and W.

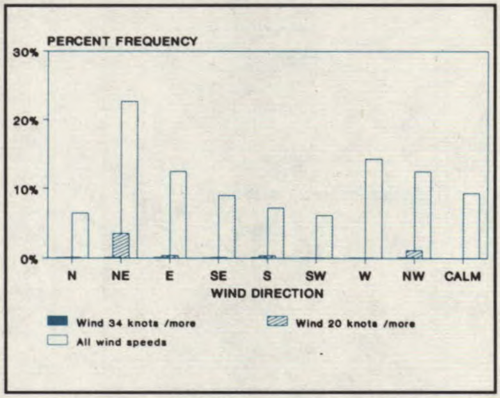
GREAT SLAVE LAKE WIND CLIMATOLOGY

JULY - per 279 observations during 1980-1988 period

PERCENT FREQUENCY BY DIRECTION



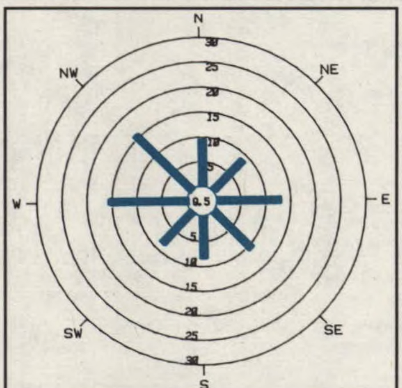
WIND SPEED CLASSES BY DIRECTION



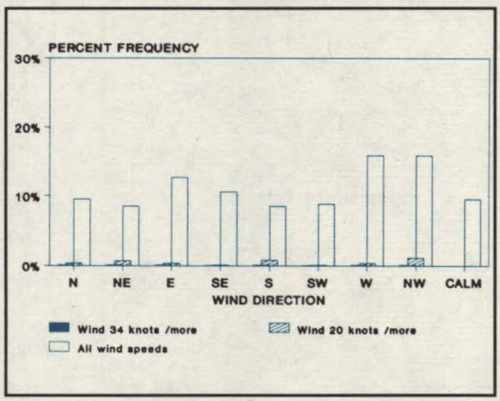
The favoured wind direction for Great Slave Lake during July is from the NE. NE is also the favoured wind direction for winds of small craft strength.

AUGUST - per 283 observations during 1980-1988 period

PERCENT FREQUENCY BY DIRECTION



WIND SPEED CLASSES BY DIRECTION



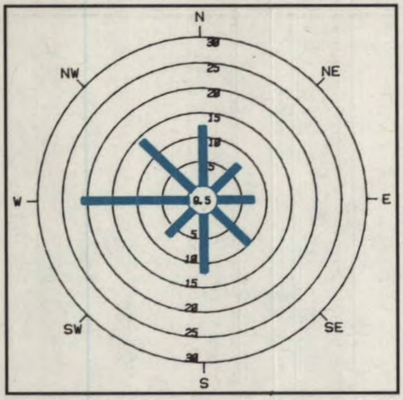
The favoured wind directions for Great Slave Lake during August are from the W and NW.

Winds form the N, NE, E, S, W, and NW all show occurrences of winds of small craft warning strength.

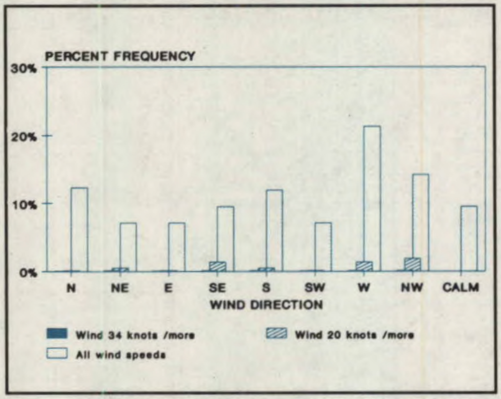
GREAT SLAVE LAKE WIND CLIMATOLOGY

SEPTEMBER - per 211 observations during 1980-1988 period

PERCENT FREQUENCY BY DIRECTION



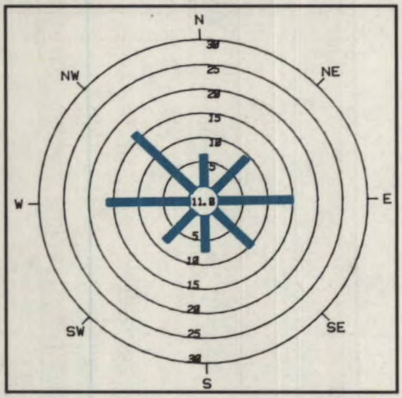
WIND SPEED CLASSES BY DIRECTION



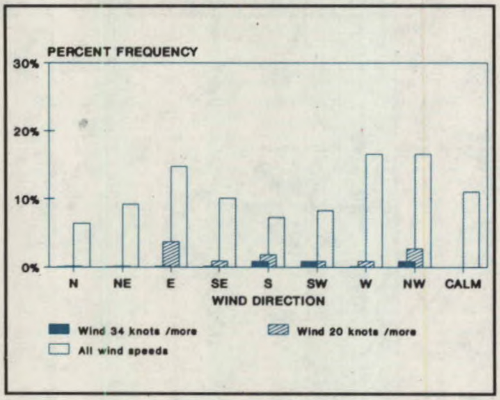
The favoured wind direction for Great Slave Lake during September is from the W. The favoured wind directions for winds of small craft warning strength are from the SE or S and from the W or NW.

OCTOBER - per 109 observations during 1980-1988 period

PERCENT FREQUENCY BY DIRECTION



WIND SPEED CLASSES BY DIRECTION

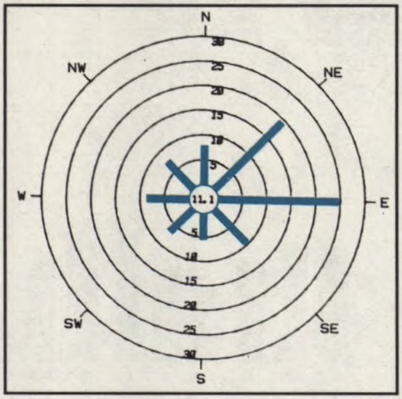


The favoured wind directions for Great Slave Lake during October are from the E and from the NW or W.
The favoured wind direction for winds of small craft is from the E. The favoured directions for winds of gale warning strength are from the S, SW, and NW.

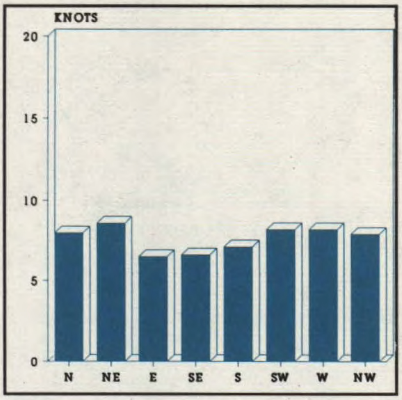
FORT CHIPEWYAN WIND CLIMATOLOGY (LAKE ATHABASCA)

MAY - Fort Chipewyan data 1968-1988

PERCENT FREQUENCY BY DIRECTION



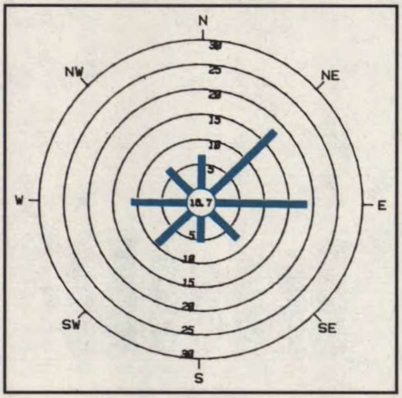
MEAN WIND SPEED BY DIRECTION



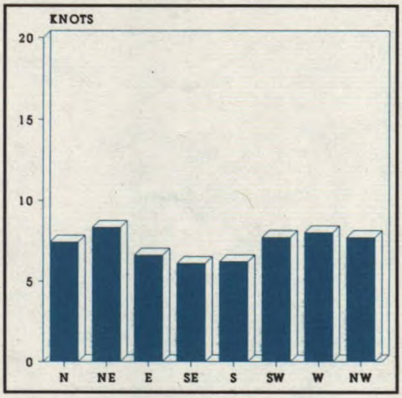
Winds from the NE and from the E are the prevailing winds at Fort Chipewyan during May.

JUNE - Fort Chipewyan data 1980-1988

PERCENT FREQUENCY BY DIRECTION



MEAN WIND SPEED BY DIRECTION

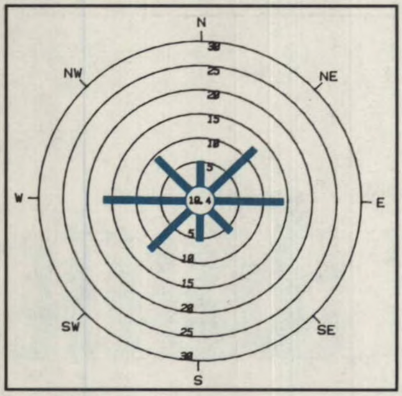


The prevailing wind directions during June are from the E and NE.
Winds from the S are much less frequent. Winds from the E through S tend to be slightly lighter than from other directions.

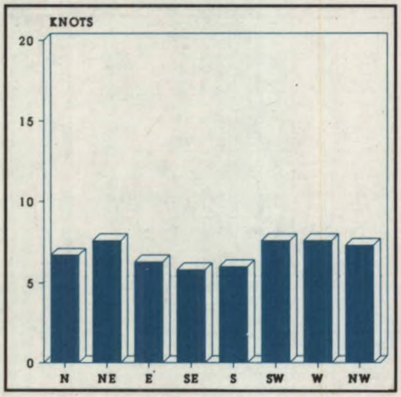
FORT CHIPEWYAN WIND CLIMATOLOGY (LAKE ATHABASCA)

JULY - Fort Chipewyan data 1968-1988

PERCENT FREQUENCY BY DIRECTION



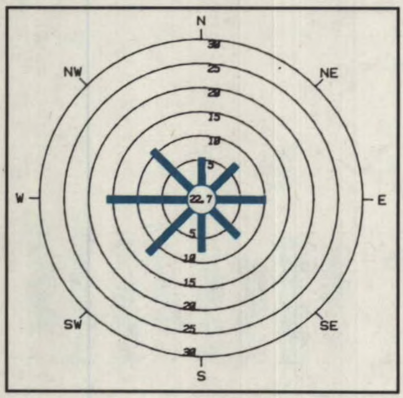
MEAN WIND SPEED BY DIRECTION



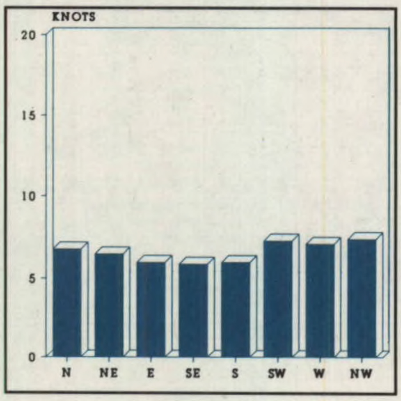
Winds from the E and W are the prevailing winds during July at Fort Chipewyan.

AUGUST - Fort Chipewyan data 1980-1988

PERCENT FREQUENCY BY DIRECTION



MEAN WIND SPEED BY DIRECTION

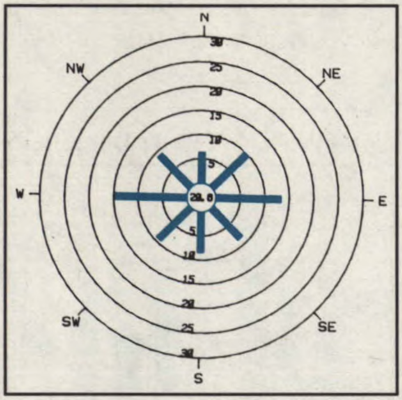


Winds from the W are the prevailing winds during August.

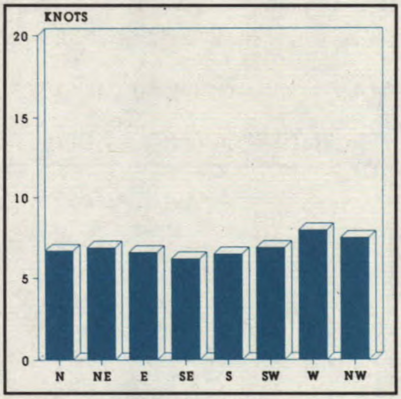
FORT CHIPEWYAN WIND CLIMATOLOGY (LAKE ATHABASCA)

SEPTEMBER - Fort Chipewyan data 1968-1988

PERCENT FREQUENCY BY DIRECTION



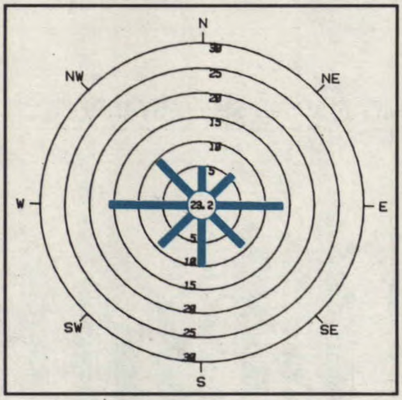
MEAN WIND SPEED BY DIRECTION



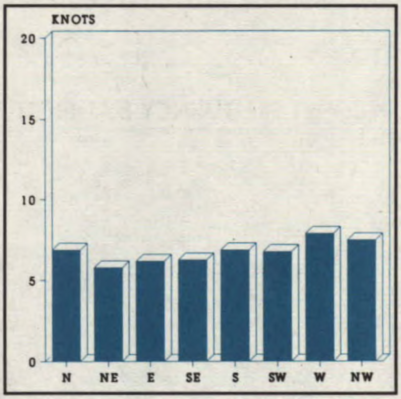
Winds from the W and from the E are prevailing wind directions during September.

OCTOBER - Fort Chipewyan data 1980-1988

PERCENT FREQUENCY BY DIRECTION



MEAN WIND SPEED BY DIRECTION



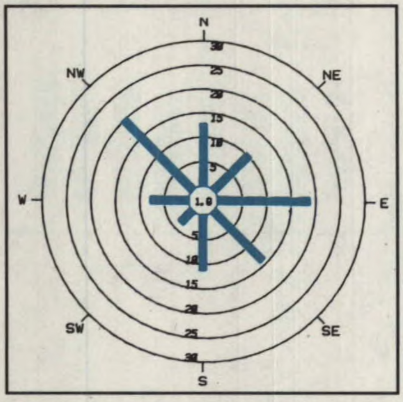
Winds from the W and from the E are prevailing wind directions during October.

GEORGE ISLAND WIND CLIMATOLOGY (LAKE WINNIPEG - NORTH BASIN)

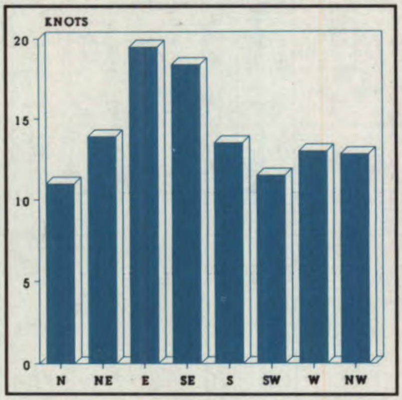
Please note: The following charts have been compiled from 1966-1983 data at George Island's former site atop a 77-foot lighthouse tower (in 1984 Environment Canada installed a new station at a lower height). Our meteorological staff cautions users of this data that the mean winds shown will be stronger than the actual winds experienced over the lake.

MAY - George Island data 1972-1983

PERCENT FREQUENCY BY DIRECTION



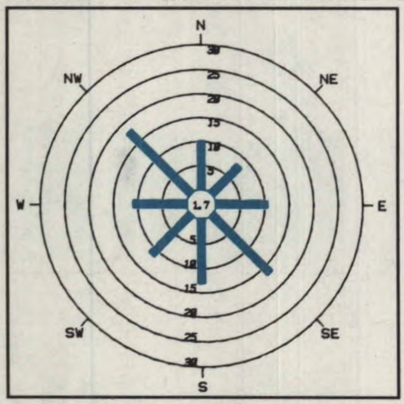
MEAN WIND SPEED BY DIRECTION



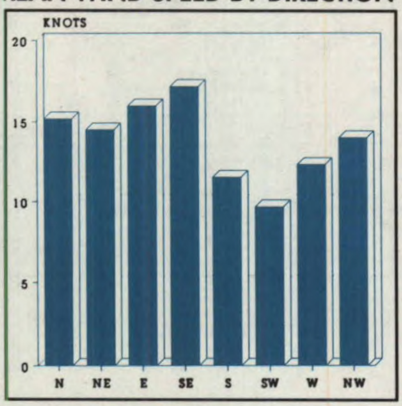
Winds from the NW and from the E or SE pair are the prevailing wind directions during May per the George Island lighthouse data.

JUNE - George Island data 1966-1983

PERCENT FREQUENCY BY DIRECTION



MEAN WIND SPEED BY DIRECTION

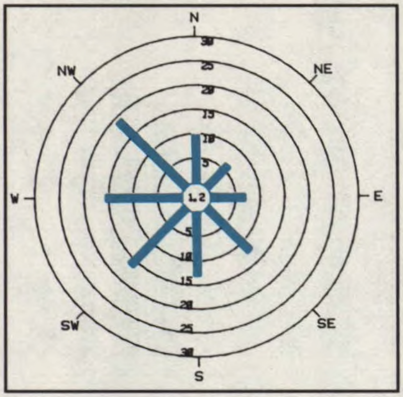


Winds from the N~~E~~W and from the SE remain prevailing directions.

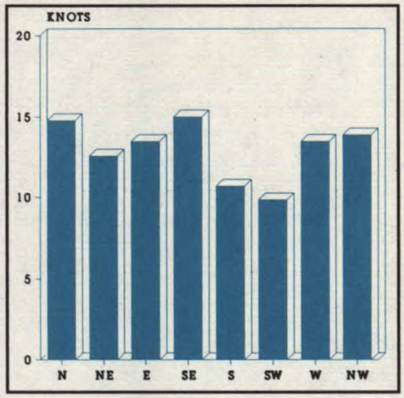
GEORGE ISLAND WIND CLIMATOLOGY
(LAKE WINNIPEG - NORTH BASIN)

JULY - George Island data 1966-1983

PERCENT FREQUENCY BY DIRECTION



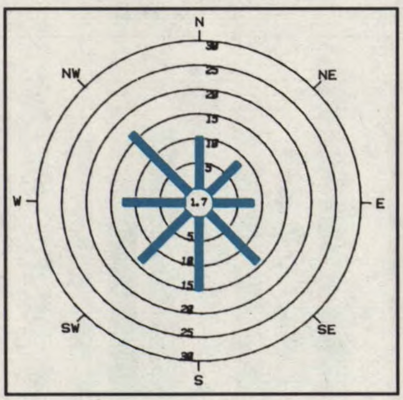
MEAN WIND SPEED BY DIRECTION



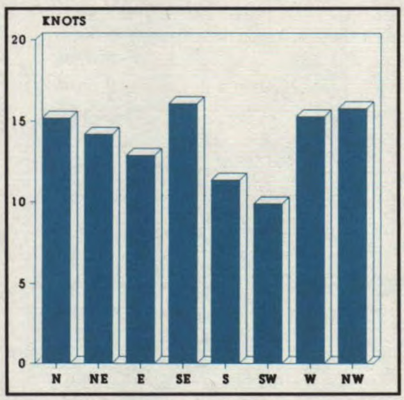
Winds from the W quadrant are the prevailing winds during July.

AUGUST - George Island data 1966-1983

PERCENT FREQUENCY BY DIRECTION



MEAN WIND SPEED BY DIRECTION

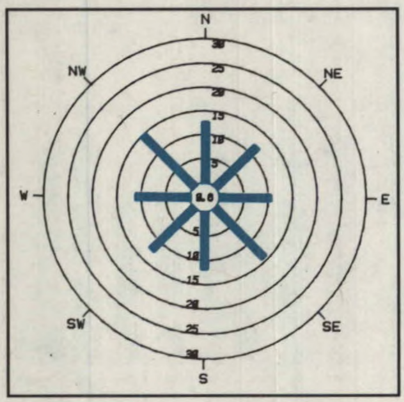


Wind direction favours all directions except from the NE and from the E.

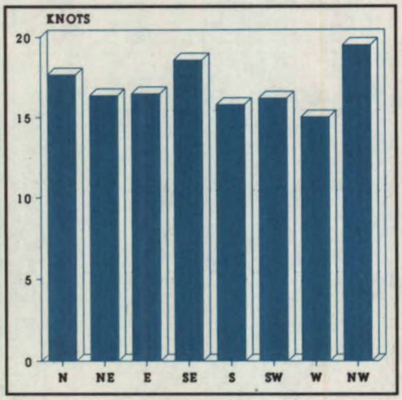
GEORGE ISLAND WIND CLIMATOLOGY (LAKE WINNIPEG - NORTH BASIN)

SEPTEMBER - George Island data 1966-1983

PERCENT FREQUENCY BY DIRECTION



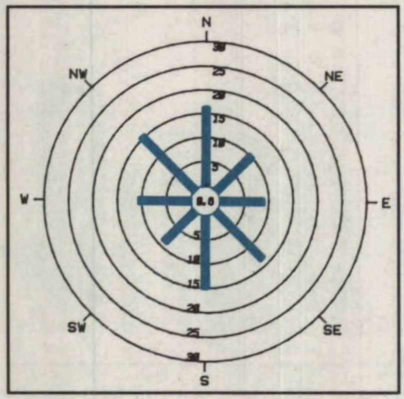
MEAN WIND SPEED BY DIRECTION



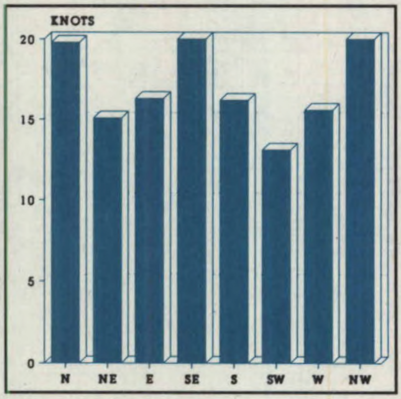
Mean wind speeds through September are greater than those experienced through the summer.

OCTOBER - George Island data 1965-1983

PERCENT FREQUENCY BY DIRECTION



MEAN WIND SPEED BY DIRECTION

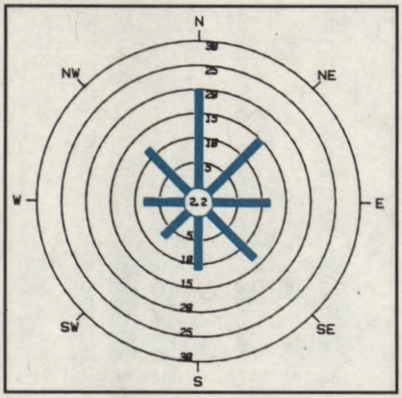


Winds from the N, NW and SE all show mean winds near 20 knots.

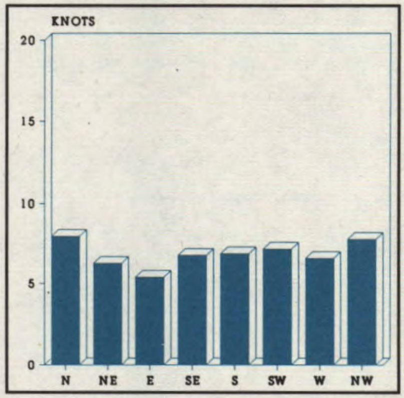
GIMLI WIND CLIMATOLOGY (LAKE WINNIPEG - SOUTH BASIN)

MAY - Gimli data 1972-1988

PERCENT FREQUENCY BY DIRECTION



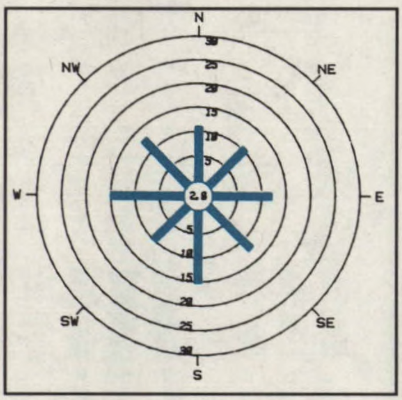
MEAN WIND SPEED BY DIRECTION



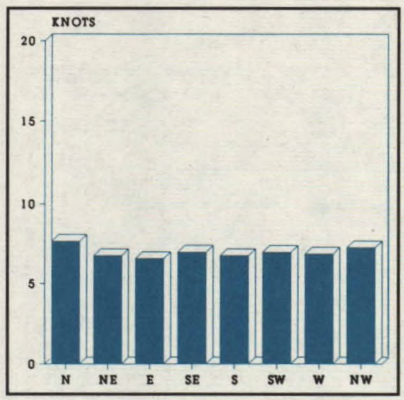
Winds from the N winds are the prevailing winds at Gimli during May.

JUNE - Gimli data 1972-1988

PERCENT FREQUENCY BY DIRECTION



MEAN WIND SPEED BY DIRECTION

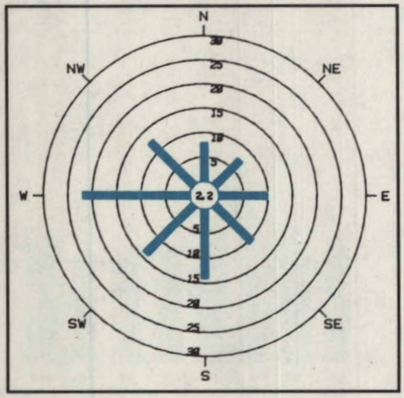


Winds from the SW and from the W are the prevailing wind directions during June at Gimli.

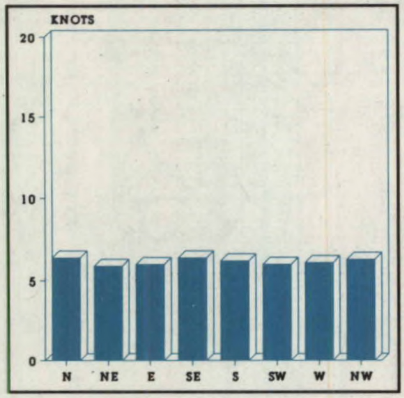
GIMLI WIND CLIMATOLOGY (LAKE WINNIPEG - SOUTH BASIN)

JULY - Gimli data 1972-1988

PERCENT FREQUENCY BY DIRECTION



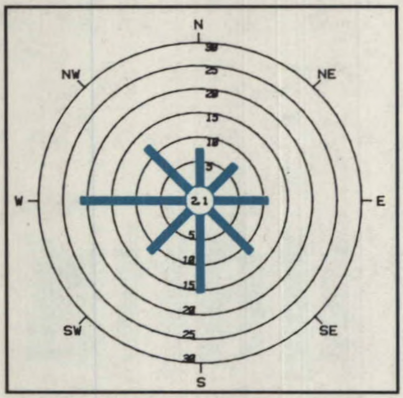
MEAN WIND SPEED BY DIRECTION



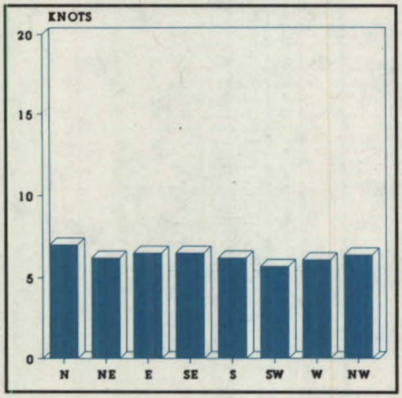
Winds from the W are the prevailing winds during July at Gimli.

AUGUST - Gimli data 1972-1988

PERCENT FREQUENCY BY DIRECTION



MEAN WIND SPEED BY DIRECTION

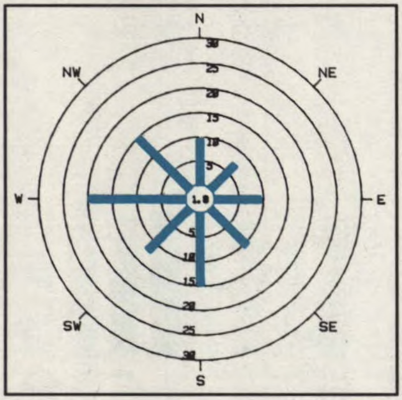


As during July, the prevailing wind direction during August at Gimli is from the W.

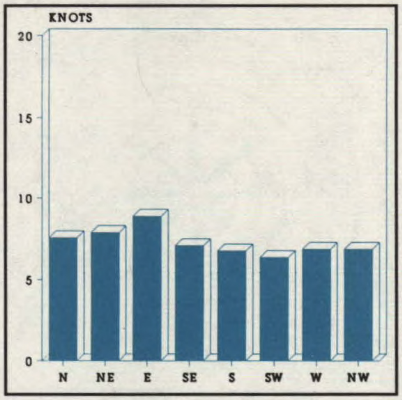
GIMLI WIND CLIMATOLOGY (LAKE WINNIPEG - SOUTH BASIN)

SEPTEMBER - Gimli data 1972-1988

PERCENT FREQUENCY BY DIRECTION



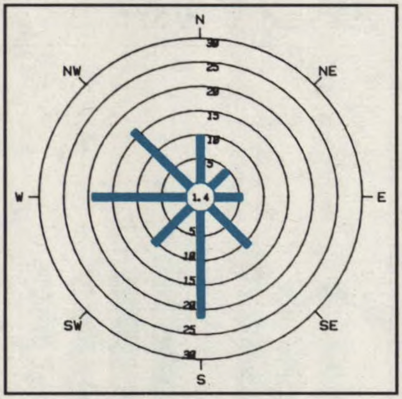
MEAN WIND SPEED BY DIRECTION



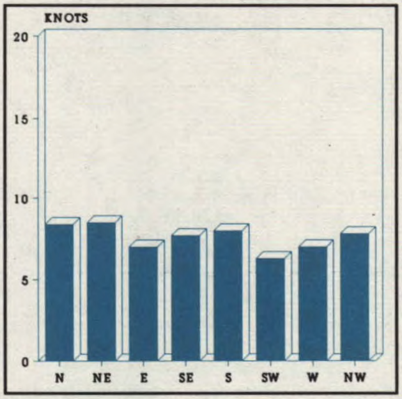
During September, the W winds prevail in terms of direction while winds from the E show the greatest mean wind speed value.

OCTOBER - Gimli data 1972-1988

PERCENT FREQUENCY BY DIRECTION



MEAN WIND SPEED BY DIRECTION

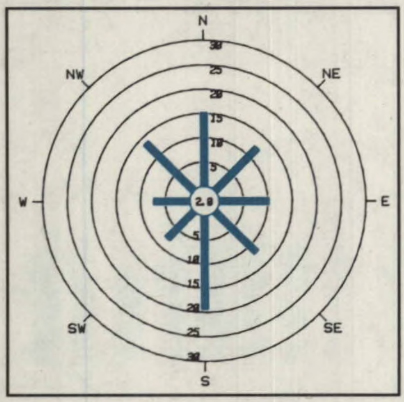


Winds from the S and winds from the W are the prevailing wind directions during October at Gimli.

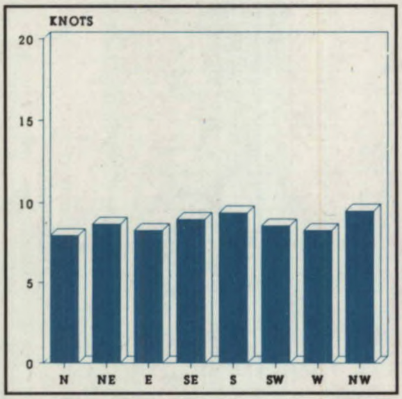
KENORA WIND CLIMATOLOGY (LAKE OF THE WOODS)

MAY - Kenora data 1953-1988

PERCENT FREQUENCY BY DIRECTION



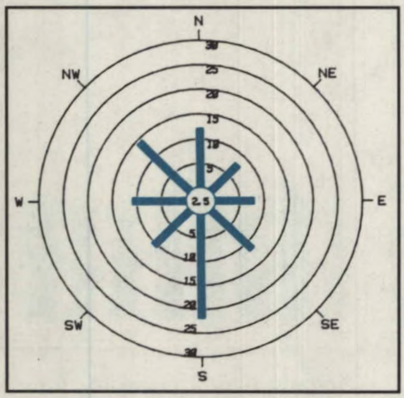
MEAN WIND SPEED BY DIRECTION



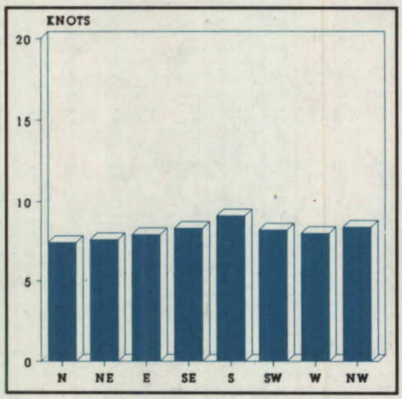
Winds from the S are the prevailing winds during May. Winds from the S also have mean wind speeds equal to those of NW winds and higher than those of the other directions.

JUNE - Kenora data 1953-1988

PERCENT FREQUENCY BY DIRECTION



MEAN WIND SPEED BY DIRECTION

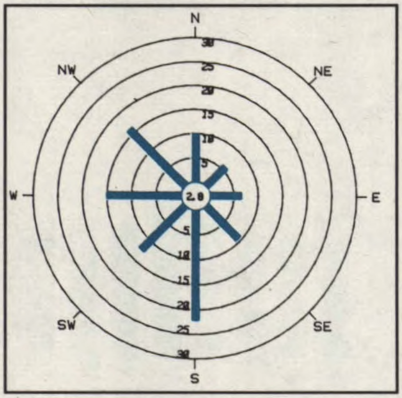


Winds from the S prevail and have the highest mean wind speed.

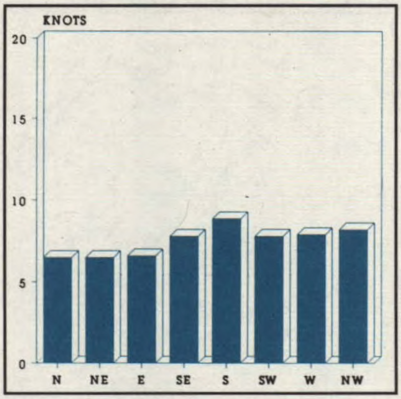
KENORA WIND CLIMATOLOGY (LAKE OF THE WOODS)

JULY - Kenora data 1953-1988

PERCENT FREQUENCY BY DIRECTION



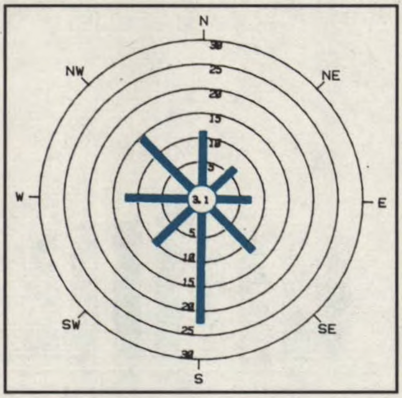
MEAN WIND SPEED BY DIRECTION



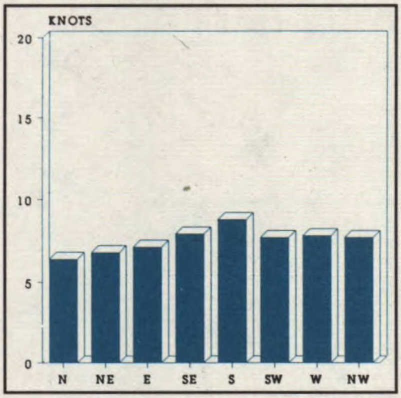
Winds from the S followed by winds from the NW and W are prevailing wind directions during July.

AUGUST - Kenora data 1953-1988

PERCENT FREQUENCY BY DIRECTION



MEAN WIND SPEED BY DIRECTION

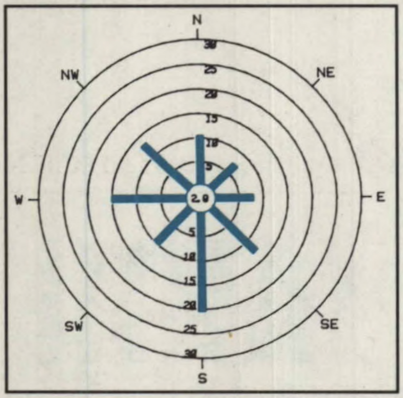


The frequency of the various wind directions for August parallels those for July.

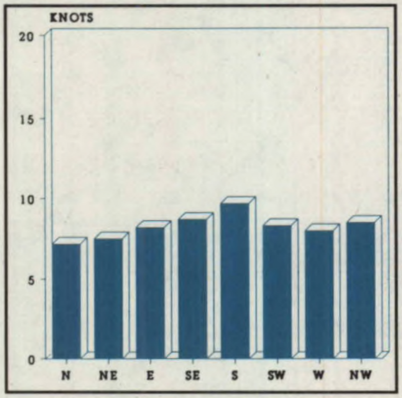
KENORA WIND CLIMATOLOGY (LAKE OF THE WOODS)

SEPTEMBER - Kenora data 1953-1988

PERCENT FREQUENCY BY DIRECTION



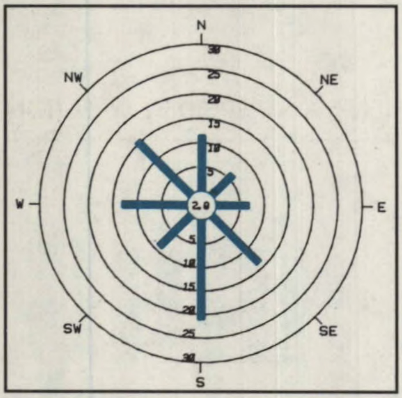
MEAN WIND SPEED BY DIRECTION



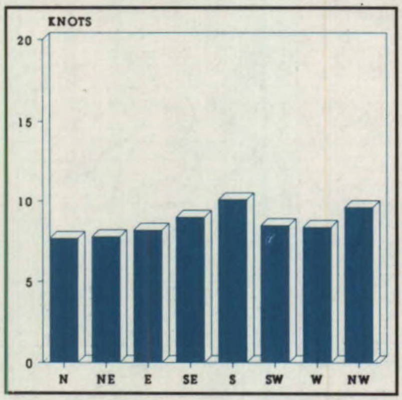
Winds from the S and from the W are the prevailing winds during September at Kenora.

OCTOBER - Kenora data 1953-1988

PERCENT FREQUENCY BY DIRECTION



MEAN WIND SPEED BY DIRECTION



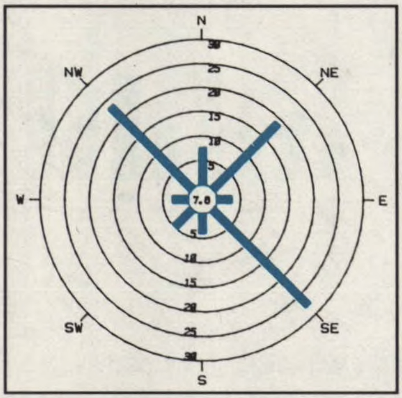
Winds from the S and from the NW are the prevailing winds during October at Kenora.

ARMSTRONG WIND CLIMATOLOGY (LAKE NIPIGON)

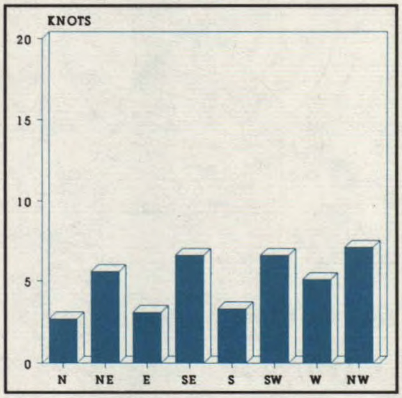
Please note: Environment Canada does not maintain an automatic weather station on Lake Nipigon at present. The data below, from our Armstrong observing site, does provide some insight to the wind regime in the area; however, the authors caution that the strong NW - SE direction bias is likely not present on the lake.

MAY - Armstrong data 1969-1975

PERCENT FREQUENCY BY DIRECTION

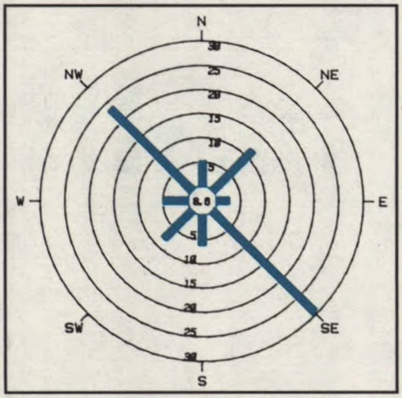


MEAN WIND SPEED BY DIRECTION

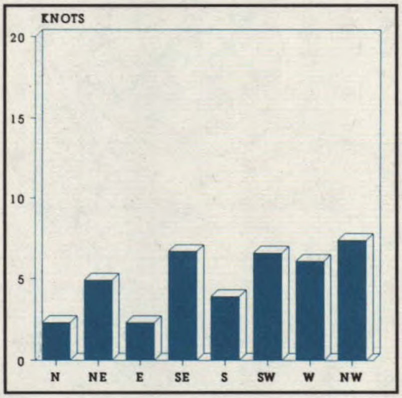


JUNE - Armstrong data 1969-1975

PERCENT FREQUENCY BY DIRECTION



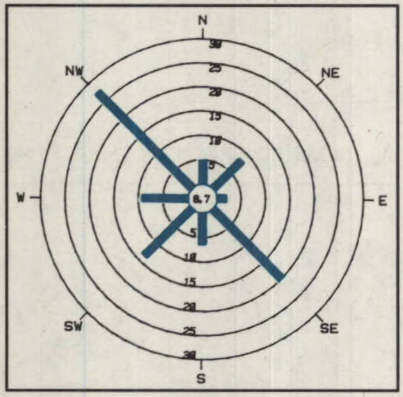
MEAN WIND SPEED BY DIRECTION



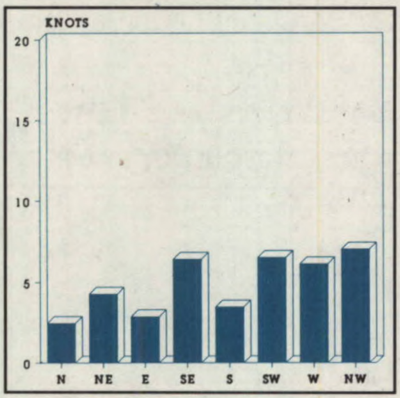
ARMSTRONG WIND CLIMATOLOGY (LAKE NIPIGON)

JULY - Armstrong data 1968-1975

PERCENT FREQUENCY BY DIRECTION

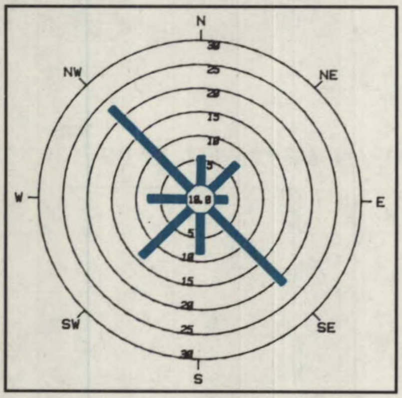


MEAN WIND SPEED BY DIRECTION

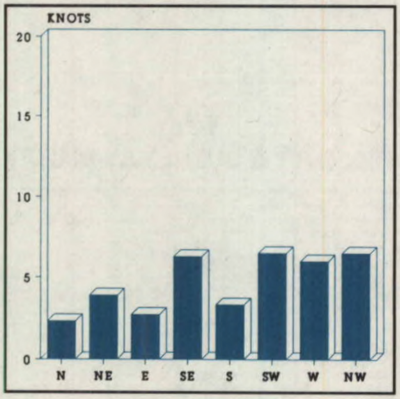


AUGUST - Armstrong data 1968-1975

PERCENT FREQUENCY BY DIRECTION



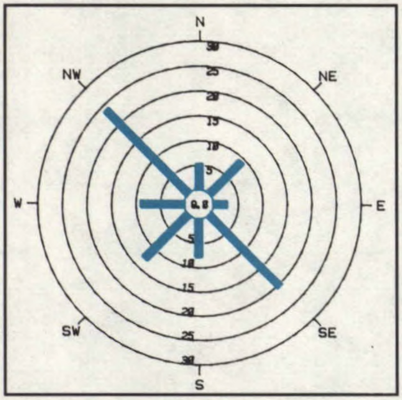
MEAN WIND SPEED BY DIRECTION



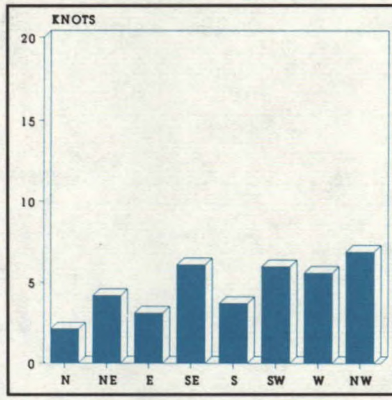
ARMSTRONG WIND CLIMATOLOGY (LAKE NIPIGON)

SEPTEMBER - Armstrong data 1968-1975

PERCENT FREQUENCY BY DIRECTION

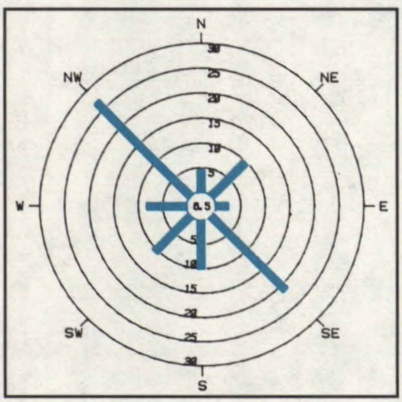


MEAN WIND SPEED BY DIRECTION

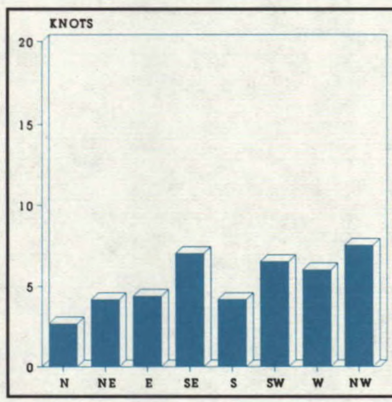


OCTOBER - Armstrong data 1968-1975

PERCENT FREQUENCY BY DIRECTION



MEAN WIND SPEED BY DIRECTION



NOTES

CLOUDS

CLOUDS

Clouds provide one of the keys to understanding the weather. By observing cloud patterns as well as changes in temperature, wind, and barometric pressure, the mariner can become more aware of weather processes and can better anticipate change.

Clouds form when air is cooled. Often the cooling process takes place when the air is lifted by winds forcing it up a hill or mountain. This is an important mechanism in British Columbia. For the areas covered by this manual, frontal systems are important in the formation of clouds. The leading edge of the warmer airmass is marked by a warm front. The warm air overrides the colder air ahead of it, cooling as it lifts, thereby forming clouds. The colder airmass, the leading edge of which is marked by a cold front, takes on the shape of a dome. Air which is forced up over the dome is cooled in the rising, thereby forming clouds.

The following photos show the main types of clouds associated with an approaching warm front and with a cold front.

The names of four main types of cloud, originally named by Luke Howard in 1803, can be combined to include all the cloud types used by meteorologists today.

Cirrus

Cirrus clouds form in the upper realms of the sky and often precede the lower clouds of an approaching storm. The wispy, ethereal nature of cirrus clouds changes into the layered cirrostratus or cirrocumulus as the warm front nears.

Stratus

Stratus is a low, uniform, featureless layer of cloud, which is sometimes accompanied by drizzle. When stratus touches the ground or lake surface, it is called fog.

When the stratus layered cloud form occurs in the mid levels of the atmosphere, it is called altostratus and when it occurs at high levels, it is called cirrostratus.

Cumulus

Cumulus cloud has a flat base, like stratus, but builds upward toward the cirrus. Fair weather cumulus have little buildup but can produce showers when they develop into tall towers.

When the cumulus form occurs in layered clouds at low levels, it is called stratocumulus. When it occurs at mid levels it is called altocumulus and when it occurs at high levels it is called cirrocumulus.

Nimbus

Nimbus is a rain cloud. It occurs in two forms: nimbostratus which is layered to great heights ahead of a front and produces steady rain, and cumulonimbus which has grown upward from a smaller cumulus cloud and produces heavy rain showers, thunder, lightning, sometimes hail, and in extreme cases, waterspouts.

RAIN, DRIZZLE AND SHOWERS

The marine forecast mentions rain, drizzle or showers when they are expected to significantly restrict visibility. Each of these forms of precipitation fall from different types of clouds.

Rain - Continuous rain or snow is usually associated with a frontal system which spreads an extensive blanket of low, dark looking cloud over the region and often gives several hours of continuous precipitation. Continuous rain or snow often fall from nimbostratus clouds which can extend to a height of 20,000 to 30,000 feet above the ground.

Drizzle - Drizzle is a fine, almost mist-like precipitation, which often occurs with the passage of a front. However, drizzle can also fall from a thinner layer of stratus clouds found between frontal systems.

Showers - Showers differ from continuous rain in that they occur for short periods of time with breaks in the precipitation. Showers fall from well-developed cumulus clouds. The heaviest showers occur with cumulonimbus clouds and are often associated with hail, thunder, and lightning. For the lakes in this manual, the heaviest showers generally occur just ahead of or accompany a cold front passage.

NOTES

STORMS AND SPECIAL WEATHER SITUATIONS

STORMS

Meteorologists classify intense, fully-developed low pressure systems as storms. The diagram on the following page shows a storm as you would see it on a weather map. From the weather map, a cross-section along the line A to B has been constructed. This cross section shows the clouds and weather that would be experienced along this line. If an observer were stationed on this line as the low passed by, the different types of weather would be experienced, in order, from right to left. The times and distances shown would apply to a storm moving at a typical speed of 25 knots.

The first indication of the approaching storm is the appearance of high cirrus clouds slowly thickening until a halo forms around the sun. This cloud continues to thicken so that the sun becomes dimly visible. By this time southerly winds are picking up.

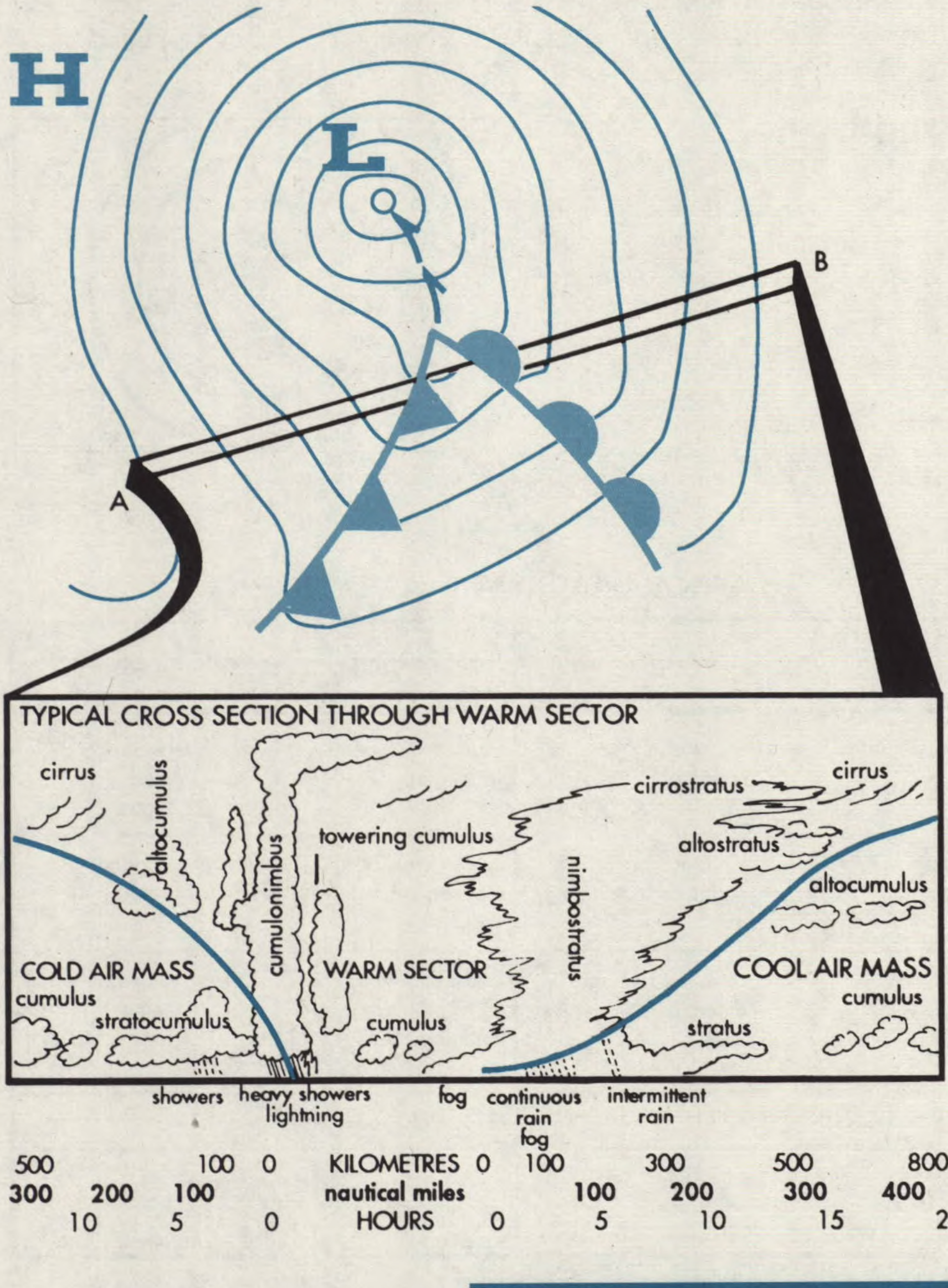
The cloud continues thickening until the sun can no longer be seen. Southerly winds will now be moderate or stronger. The barometer will be noticeably lower. Rain may begin.

As the warm front approaches, rain will become continuous and fog may form from the added moisture. The cloud will be dark and low. With the arrival of the warm front, the rain will end and the wind will shift to southwesterly. Cloud may dissipate at the front or may linger into the warm sector.

In the warm sector, skies will generally be sunny and winds moderate. The barometer will be nearly steady. Temperatures will be warm and humidity high.

The approach of the cold front may be invisible or may be marked by a line of tall cumulus clouds or thunderstorms. The weather at the frontal passage can be violent with sudden wind shifts, gusty winds, heavy showers or lightning. Please refer to the section on cold fronts and the section on squall lines. If the system is moving quickly, these 'foul weather' conditions will soon pass and skies will clear rapidly. The winds will remain strong as long as the barometer is rising rapidly. As pressures begin to level off, winds will weaken.

MATURE LOW PRESSURE AREA WITH FRONTAL SYSTEM

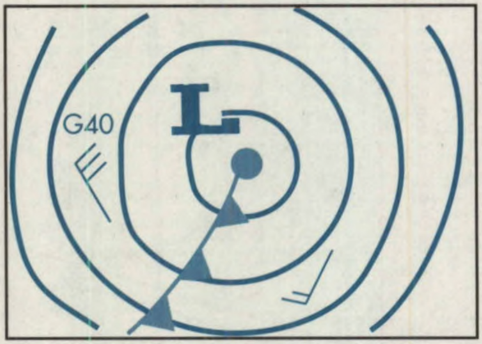


SPECIAL WEATHER SITUATIONS

Some types of weather systems generate more wind than others. You should be on the alert for the following weather conditions and listen for information on them during marine forecasts.

FRONTS

Fronts, particularly cold fronts, result in sharp changes in wind direction and speed with their passage.



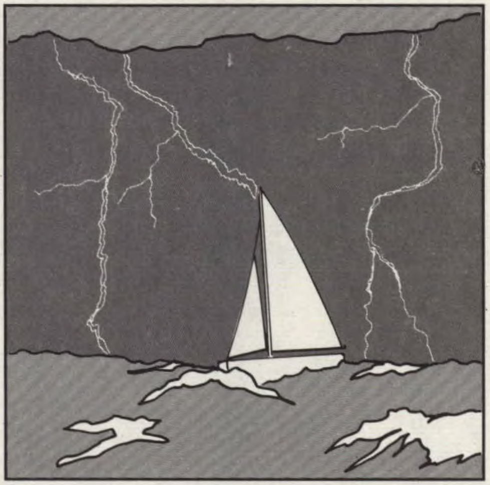
TYPICAL WEATHER WITH A COLD FRONT

	Front Approaching	Front Passing	In cold air behind front
WIND	backs and increases near front	sudden veer often with squall	direction becomes steady, speed stronger & gusty
CLOUD	not much but becomes visible as front nears	convective cloud including thunder-shower cloud	often clears, then convective cloud develops
RAIN	none but becomes visible as front nears	showers at times heavy, thunder, lightning likely, hail a possibility	showers clear away then redevelop
VISIBILITY	fair	poor in showers	good
PRESSURE	falls near front	sudden rise	rise levels off
TEMPERATURE	little change	sudden fall	fall gradually levels off

THUNDERSTORMS

Thunderstorms pose many potential hazards to mariners. The following sections describe the hazards and give a recommended response.

LIGHTNING



Lightning can be a problem for mariners since thunderstorms target tall, free-standing objects, such as masts, for their electrical discharge to the earth. Note that lightning may strike several kilometres away from the parent cloud.

Response - Go ashore immediately and seek shelter.

HEAVY RAIN SHOWERS - MOST THUNDERSTORMS

Heavy rain showers occur directly under the thunderstorm cloud, leading to poor visibility. Heavy rain showers last from 5 to 15 minutes.

Response - Slow down if visibility is reduced. Cover yourself and your gear.

WATERSPOUTS - RARE THUNDERSTORMS

Waterspouts may occur during a thunderstorm. A waterspout is a tornado over water; a vertical rotating funnel of cloud that extends down from the base of a thunderstorm to the lake surface.

The first sign that a waterspout may form is a sagging of the cloud in one area. If this bulge continues downward to the lake surface and forms a vortex, lake water can be carried a hundred or more feet into the air.

The average diameter of a waterspout is less than 50 feet, much smaller than the average diameter of a tornado. However, waterspouts can reach several hundred feet across.

Waterspouts forming on Lake Winnipeg.

Waterspouts usually last less than 15 minutes. Although immature waterspouts may be small, they can become extremely violent without warning.

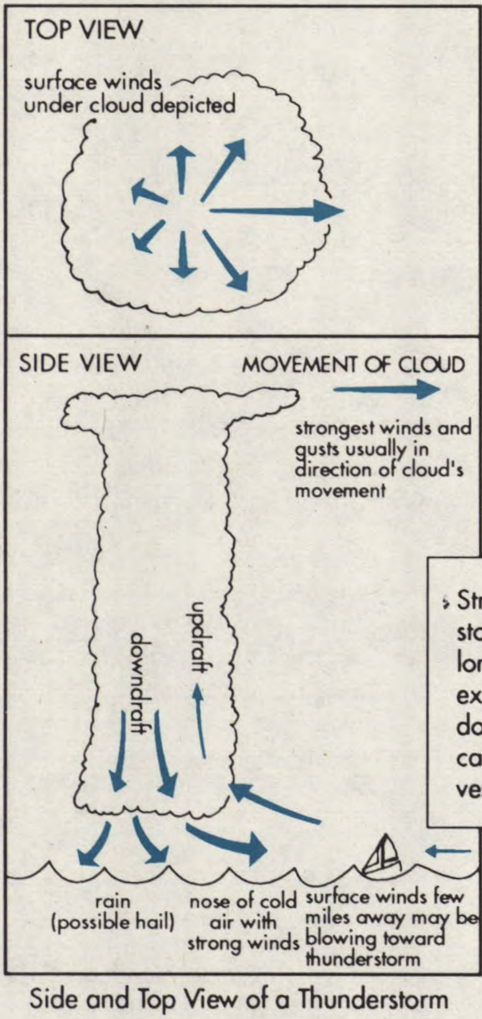
Response - Avoid if you can manoeuvre freely. If the waterspout is veering to either side or appears motionless while diminishing in size, there is no danger as the spout is moving away from you.

If the spout appears motionless or moving to either side while growing in size, the waterspout is coming toward you. When this happens, steer a course directly away from its projected track as quickly as you can. If contact with the waterspout appears inevitable, ensure you are securely fastened in your lifejacket, all gear is tied down, sails are furled and ports and hatchways are open. If you are in a small boat and the waterspout is about to make contact, get into the water on the side of the boat away from the waterspout and try to maintain as low a profile as possible.

Apart from the tornadic waterspouts which drop from thundershowers, squall lines or the leading edges of a cold front, there is a second and more common type of waterspout - the fair-weather spout. The fair-weather spout forms over water, such that it appears to develop over the sea surface and progress skyward. These fair-weather spouts are usually small, of short duration, and less dangerous than tornadic waterspouts.

WINDS - INDIVIDUAL THUNDERSTORMS

Cold air within a thunderstorm rushes down from great heights, picking up speed and spreading out at the base of the storm cloud. Meteorologists refer to this as a 'downdraft'. The resulting gusty winds can extend 2 to 3 miles in advance of the cloud and rain area. The gusty winds are followed by heavy rain showers lasting up to 15 minutes.



Side and Top View of a Thunderstorm

Response - Ensure life jackets are securely fastened. Trim the sails, tie down loose gear, prepare for a period of strong gusty winds and chaotic seas.

- Strongest winds usually precede the storm centre in a zone up to 3 miles long. Gusts to 50 knots can be expected in this zone. The winds blow downward from the cloud and they can be especially dangerous for small vessels.

ESTIMATING WIND GUST STRENGTH OF INDIVIDUAL THUNDERSTORMS

To estimate the strength of maximum wind gusts, add 15 knots to the estimated speed of the cloud. Add another 10 knots if the cloud base looks low.

Example

Cloud approaching at 10 knots from SW

Gust speed = cloud speed + 15 knots
= 10 knots + 15 knots
= 25 knots

but...if cloud base is very low over the water, add 10 knots more
25 knots + 10 knots = 35 knots

WINDS - SQUALL LINE THUNDERSTORMS

Thunderstorms often form in organized lines. The lines are labelled squall lines. Squall lines can form along a cold front, or in a line ahead of the cold front. There may be one or more squall lines ahead of the cold front and one with the front itself. Squalls lines (and cold fronts) across Great Slave Lake, Lake Athabasca, Lake Winnipeg, Lake of the Woods, and Lake Nipigon usually approach from the west or northwest. Squall lines are usually quick to pass.

Squall lines that can be seen nosing above the horizon can be expected to reach you in about an hour and a half. They approach and move through an area at a speed of about 25 knots. If there is a 'trailing' squall line, it will usually arrive in 3 to 5 hours. Winds of 40 to 60 knots are common.

Example A check with our formula for gusts from individual thunderstorms follows.

Squalls typically move at 25 knots.

Gust speed = squall speed + 15 knots
= 25 knots + 15 knots
= 40 knots

It should not surprise us that squalls, being much more dynamic than individual storm cells, produce gusts that are in excess of our formula for individual cells.

SATELLITE PHOTOS SHOWING SQUALL LINES
GREAT SLAVE LAKE / LAKE ATHABASCA

2:30 PM MDT Monday
06 August 1990

Squall line from southern Great Slave Lake to Lake Athabasca.

Second squall line from western Great Slave Lake south-southeastward into Alberta.

4 hours later...

6:30 PM MDT Monday
06 August 1990

First squall line has moved east and cleared both Lake Athabasca and Great Slave Lake.

Cloud from second squall line has become obscured on this particular satellite photo by a larger general cloud area but strong gusty surface winds, lightning, and rainshowers confirm its existence.

SATELLITE PHOTOS SHOWING SQUALL LINE LAKE WINNIPEG

2:20 PM CDT
Saturday 09 June 1990

Squall line from east of Lake Winnipeg - North Basin southwestward across the South Basin. The squall line is headed toward Lake of the Woods.

COLD OUTBREAKS

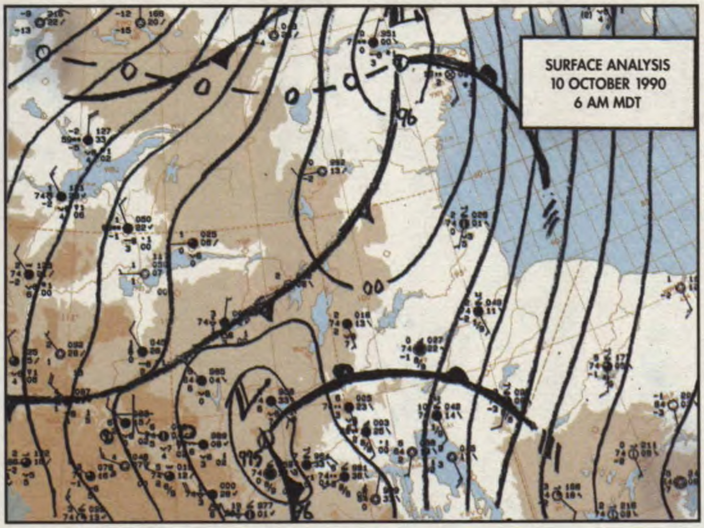
During September and through October and November, until the lake freezes over, cold frontal passages bring temperatures which can be significantly colder than the lake water temperatures. This results in an unstable airmass. Instability combined with strong gradients often gives gale force winds.

During September, the air being driven south is sometimes cold enough to trigger snowflurries. During October and November, the combination of temperatures below freezing and strong to gale force winds can generate freezing spray in addition to snowflurries. See Vessel Icing section, page 112.

The air associated with a cold outbreak may be unstable enough to generate waterspouts in the absence of thundershowers. The air is sometimes unstable to a great height, triggering the development of 'cold-air funnels'. Cold-air funnels are less severe than thunderstorm waterspouts.

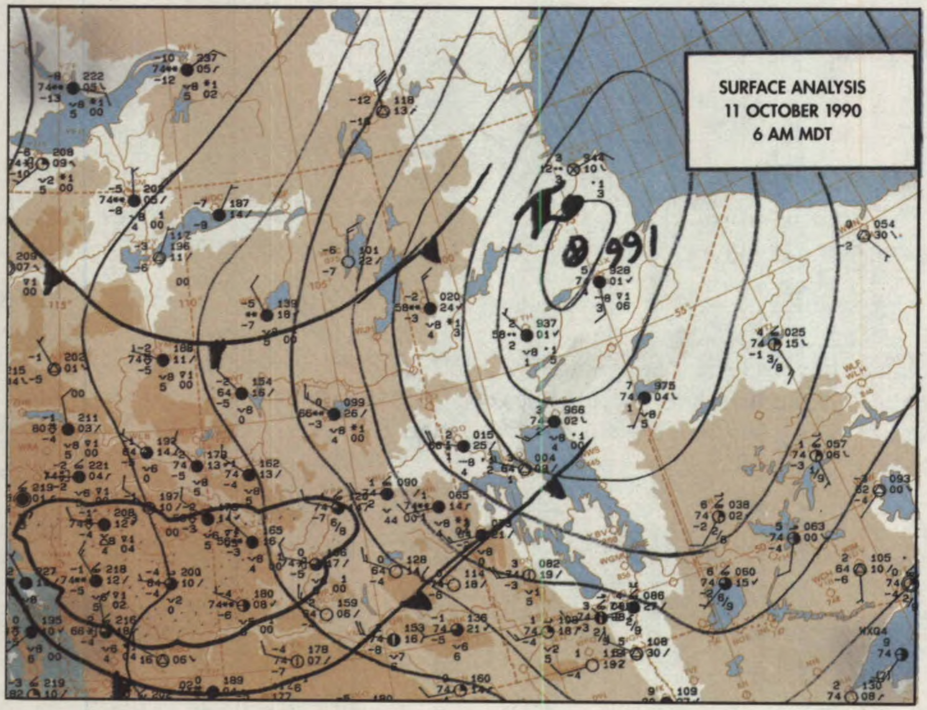
COLD AIR OUTBREAK OVER GREAT SLAVE LAKE AND LAKE ATHABASCA

The following surface analysis shows the pressure pattern across Great Slave Lake and Lake Athabasca 6 AM MDT Wednesday 10 October 1990. Northwesterly winds have already bought cold air and snowflurry activity to Great Slave Lake and even stronger northerly to northeasterly winds are pushing still colder air into the area. The automatic weather station on Inner Whaleback Rocks indicated steady winds in the mid to upper twenties with gusts to gale force strength through the early morning.



COLD AIR OUTBREAK OVER LAKE WINNIPEG

This weather map shows the pressure pattern analyzed across the prairies 6 AM MDT (5AM CDT) Thursday 11 October 1990, 24 hours after the map just presented. The cold northwesterly flow which enveloped Great Slave Lake and Lake Athabasca is about to envelop Lake Winnipeg. The North Basin of the Lake will experience snowflurries with the northwesterlies.

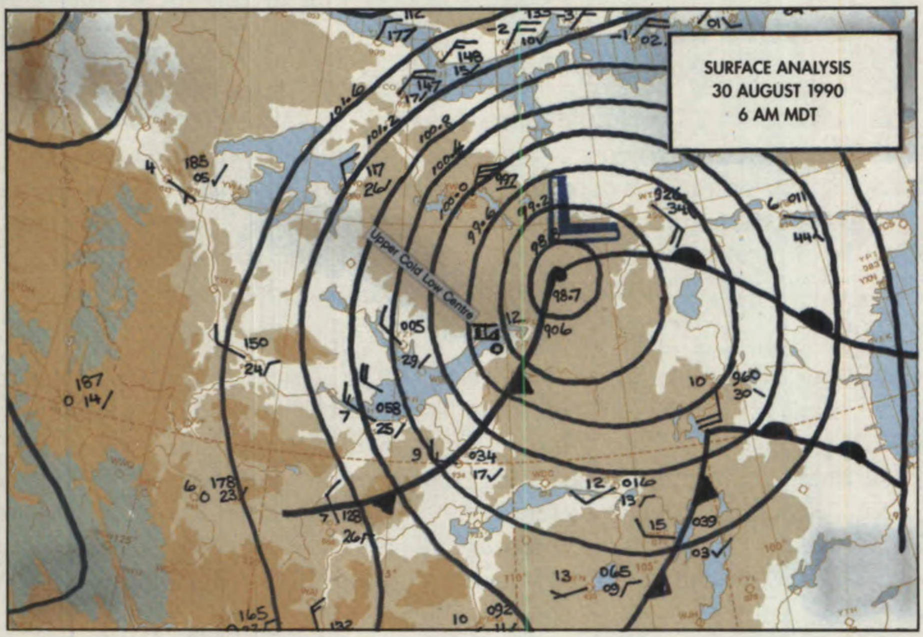


UPPER COLD LOWS

Meteorologists use the term cold low when they see a low pressure centre at upper levels with very cold temperatures. The surface reflection of these cold lows is often an intense low pressure system with pressure lines closely packed. The surface low literally gets trapped by the upper low and in the process of getting trapped creates even tighter packing of the pressure lines. Cold lows result in an area of very strong winds and an extensive area of precipitation. 'Cold low' events happen, on average, a few times each summer.

Cold lows are often difficult to forecast. The meteorologist will see and forecast the wind regime around the low pressure area but may have little advance notice that the low is a cold low in which the pressure gradient will pack much more tightly than the gradient around an 'ordinary low', thus producing stronger winds. Here is where a radio receiver which receives either weatheradio or Coast Guard broadcasts can help. The meteorologist will issue updated or amended forecasts and warnings as necessary to reflect changing conditions.

An analysis of a surface cold low event is presented on the next page.



SURFACE ANALYSIS OF A COLD LOW EVENT OVER GREAT SLAVE LAKE

A low pressure centre developed over the Mackenzie Valley and then moved eastward. An upper cold low centre caught up with the surface low over Great Slave Lake and in the process of capturing the surface low, the upper low slowed the surface low down and helped it deepen. This intensified the gradient around the low, particularly to the north through west of the surface low centre. Winds to 55 knots and resultant high seas were reported by sailing vessels overnight as they endeavoured to complete the Yellowknife to Hay River leg of the annual Commissioner's Cup Yacht Race. The following map shows the pressure gradient across the lake at 6 AM MDT while the winds were still strong.

FOG

Fog is a weather phenomena which not only obscures visibility but also distorts sound. There are four main types of fog you should be aware of. In all cases, the air becomes saturated either by cooling so it can no longer hold its moisture or it is fed moisture until it can no longer hold any more. The relative humidity of the air is 100% when the air becomes saturated.

Response - Proceed with caution.

RADIATION FOG

Radiation fog forms over land generally under clear skies and light wind conditions. It is usually an early morning event but can be a late evening event, particularly late season. Radiation fog, once formed, may move over water! It usually doesn't spread too far offshore. The fog burns off over the land with daytime heating and sunshine but is usually slow to burn off over the water.

SEA FOG

Sea fog can result when warm air moves over colder lake water when... the water temperature is colder than the dewpoint of the warm air.

Example 1. - Fog Possible

Air Temperature........ 23°C
Air Dewpoint........... 13°C
Water Temperature...... 11°C

Example 2. - No Fog

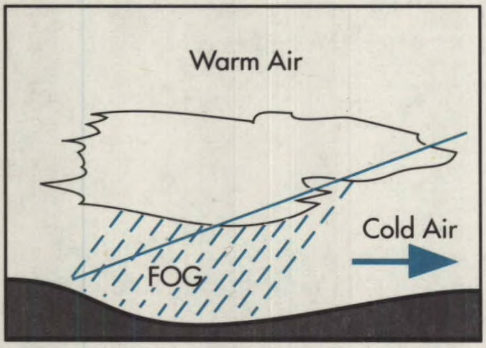
Air Temperature........ 23°C
Air Dewpoint........... 10°C
Water Temperature...... 11°C

Air Temperature does not figure in our calculations. The 'key' in Example 1. is that the water temperature is colder than the dewpoint of the air. Thus, the water has the potential to cool the air to its dewpoint. If this happens the air is 100% saturated and fog may result.

Looking at Example 2. we see that even if the water cools the air to its temperature of 11°C, the air won't be saturated because its dewpoint is 10°C.

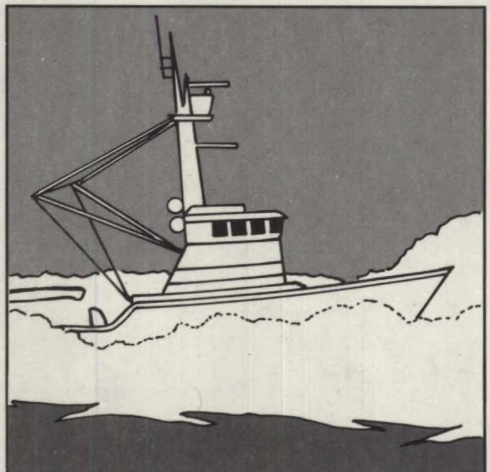
PRECIPITATION OR FRONTAL FOG

When precipitation falls down through a cooler layer near the ground, the cooler layer can, with enough precipitation, become saturated. The resultant fog is labelled precipitation or frontal fog.

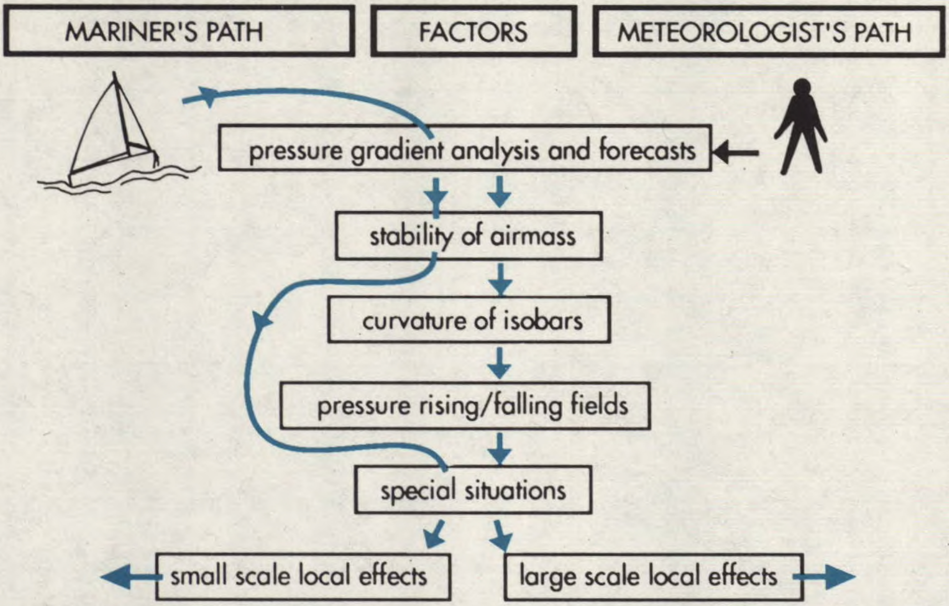


ARCTIC SEA SMOKE

When very cold arctic air moves over warmer water, moisture evaporates from the sea and saturates the air. The air is very cold so its capacity to hold moisture is small and the excess condenses into fog. The resultant arctic sea smoke is usually only a few feet thick but can be thick enough and cold enough to give vessel icing. See VESSEL ICING section on page 112.



SUMMARY SHEET OF FACTORS USED TO ESTIMATE AND FORECAST WIND



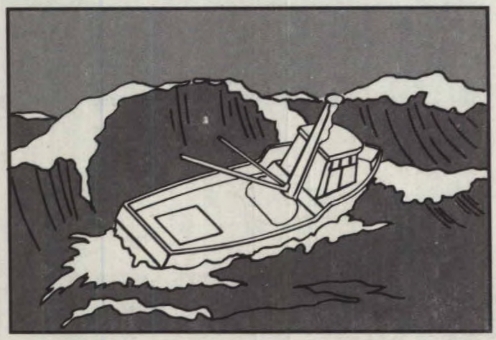
pressure gradient analysis	-the tighter the gradient, the stronger the winds
stability factor	-if the air is warmer than the water, take 60 to 70 % of gradient -if the water is warmer than the air, take 100% of gradient
curvature	-out of a High, curvature factor adds to the wind -into aLow, winds are a little weaker
pressure rising and falling fields	-strong rises 'lined up' with pressure gradient give stronger winds -falling fields can also line up to contribute to the wind
special situations	-cold fronts, squall lines, thunderstorms, and cold lows all can give the wind extra knots
local effects	-channelling, funnelling, shoreline convergence, etc. give the wind an extra push

NOTES

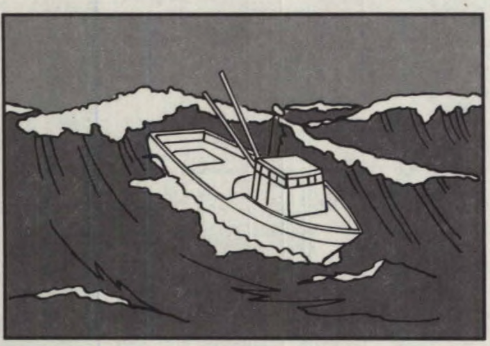
SEAS

SEAS

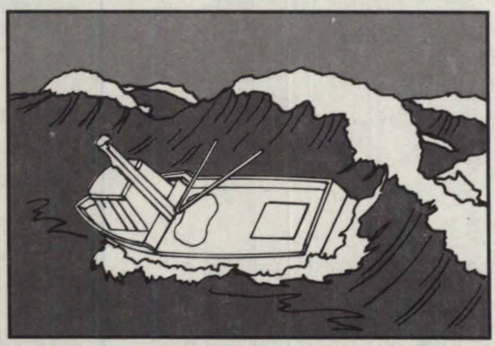
Severe seas of any kind can be dangerous.
You should take special care in the following situations:



Beam Seas - In beam seas excessive roll can cause cargo to shift, creating a dangerous list. This could cause the vessel to capsize. Some breaking waves could also capsize the vessel.



Following Seas - In following seas, a vessel may lose stability on a wave crest. If the vessel is overtaken by a wave crest, broaching may occur.

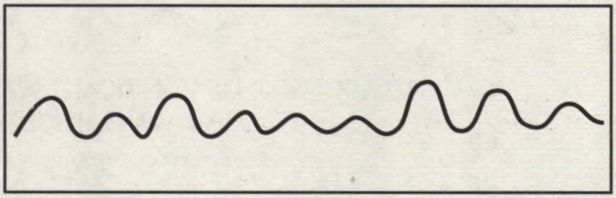


Quartering Seas - In quartering seas, the problems of beam and following seas are combined. Quartering seas represent the most dangerous situation in severe weather.

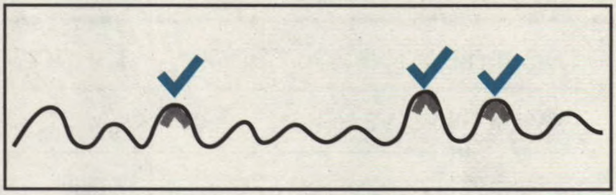
WAVE PATTERN AND THE SIGNIFICANT WAVE HEIGHT

There are graphs one can use to determine wave heights but first we must be aware of what the graphs are computing for us and the relationship of the resulting wave to other waves. A definition and some relationships between waves follow.

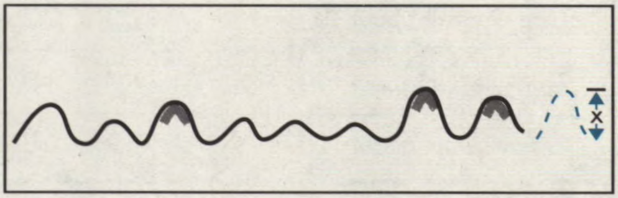
Sample Wave Pattern of 9 waves.



Wave Pattern with Highest One Third of the Waves 'checked off'



Highest One Third of the Waves and their Average Height



The average height of the third highest waves is labelled the significant wave height.

SIGNIFICANT WAVE HEIGHT RELATIONSHIPS

The wave used in marine forecasts, and the wave reported by marine vessels, is the SIGNIFICANT WAVE HEIGHT. The following table relates this wave to other waves.

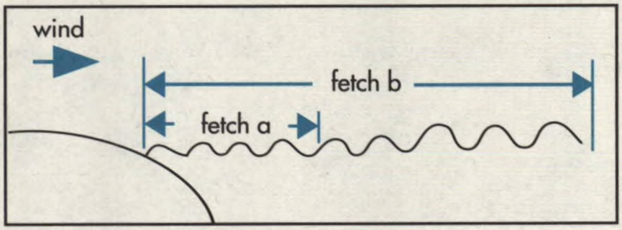
RELATIONSHIP OF SIGNIFICANT WAVE HEIGHT TO OTHER WAVE HEIGHTS
(values are approximate)

MOST FREQUENT WAVE HEIGHT	.5 x SIGNIFICANT WAVE HEIGHT
AVERAGE WAVE HEIGHT	.6 x SIGNIFICANT WAVE HEIGHT
SIGNIFICANT WAVE HEIGHT	SIGNIFICANT WAVE HEIGHT
One wave in about 10	1.3 x SIGNIFICANT WAVE HEIGHT
One wave in about 1000	1.7 x SIGNIFICANT WAVE HEIGHT
One wave in about 1200	1.9 x SIGNIFICANT WAVE HEIGHT

FORECASTING SIGNIFICANT WAVE HEIGHTS

The wave height that can be reached for a given wind speed depends on:

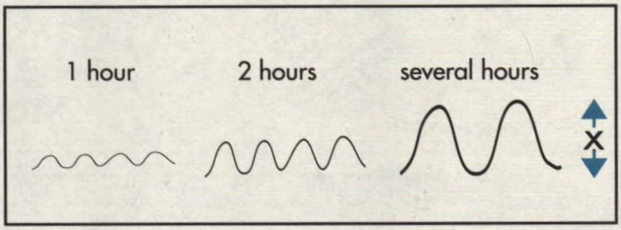
- the distance the wind has to blow unobstructed on the water. This distance is called the fetch distance.



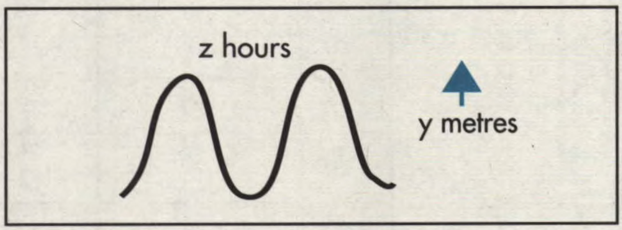
and

- the time the wind has to work on the water.

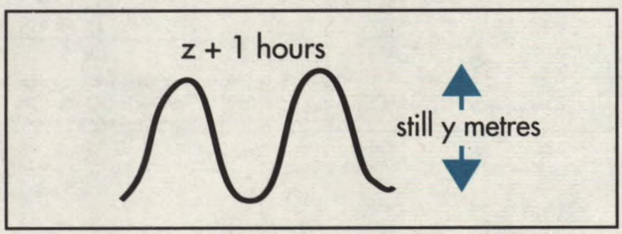
For a given wind speed, waves reach x metres after several hours.



Waves reach y metres by z hours.



After z hours, the waves will not reach any higher. Thus, the waves at z + 1 hours will be the same as those at z hours.

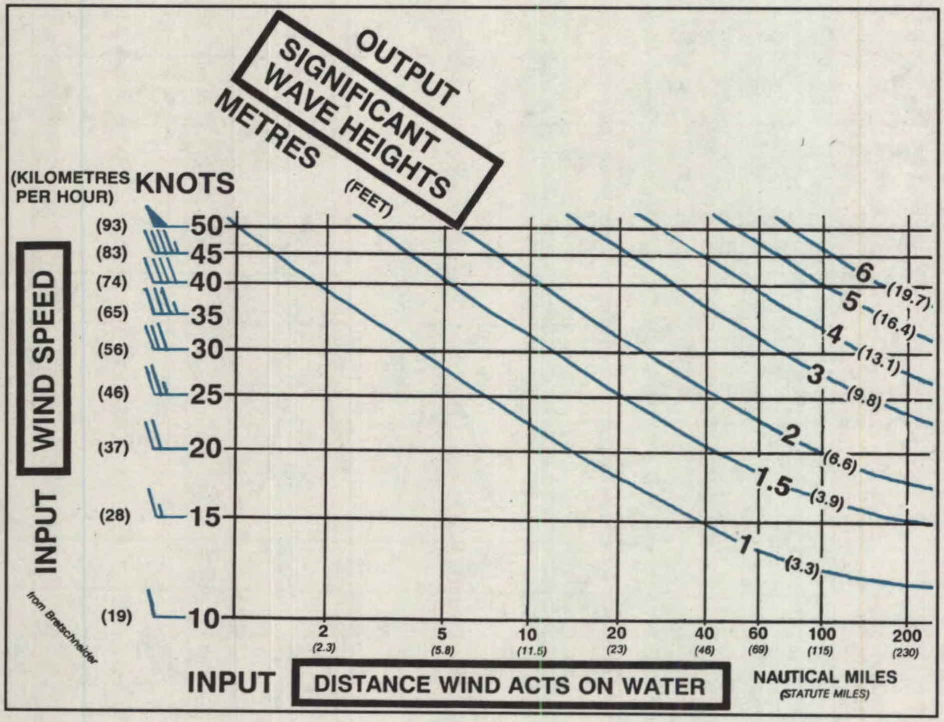


Graphs on the following pages can be used to estimate significant wave heights.

GRAPH TO USE WHEN ONLY THE DISTANCE OVER WHICH THE WIND HAS BEEN BLOWING COUNTS
(because the wind has been blowing so long that more time won't give increased wave heights)

Follow along the applicable wind speed line until it reaches the line showing the distance over which the wind has been blowing.

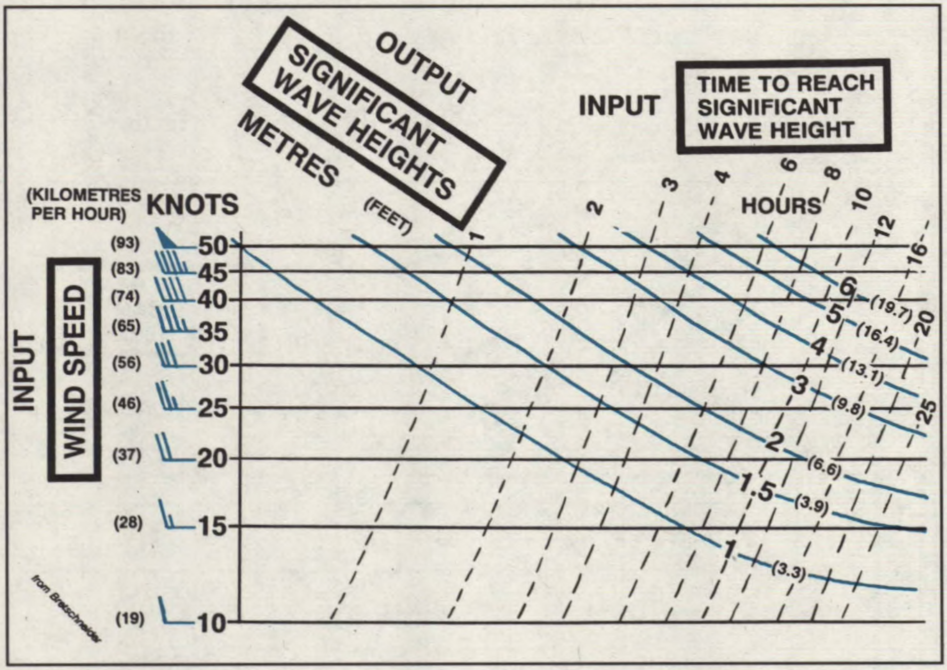
Read the 'significant wave height' at the intersection.



GRAPH TO USE WHEN ONLY THE TIME THE WIND HAS BEEN BLOWING COUNTS

Follow along the applicable wind speed line until it reaches the line showing the number of hours the wind has been blowing.

Read the 'significant wave height at the intersection.

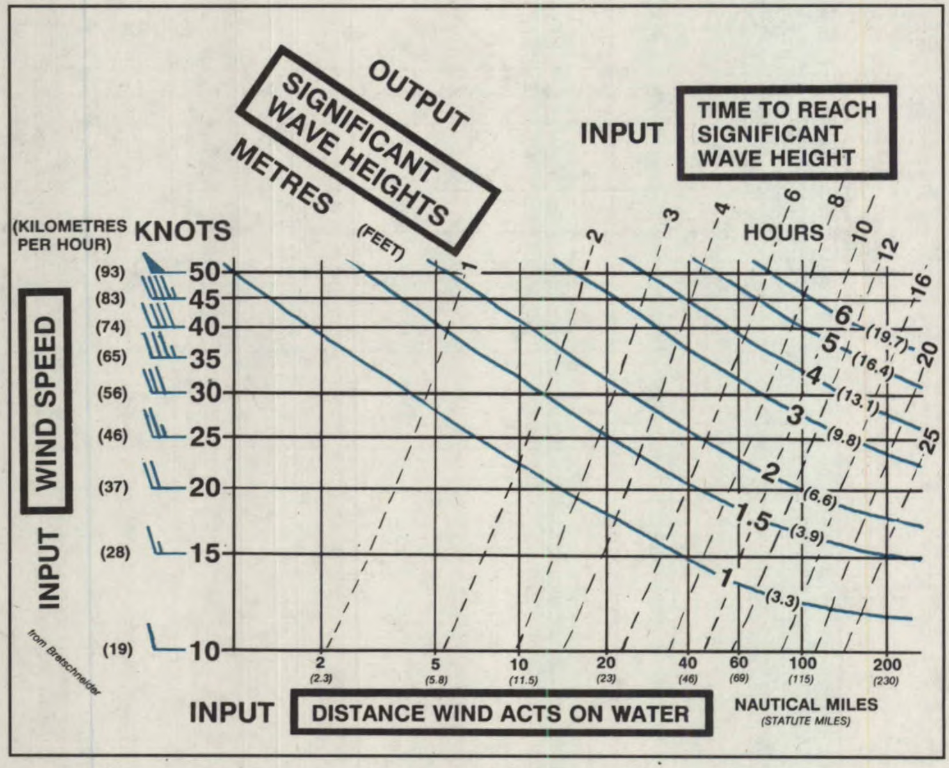


The two preceding graphs can be used together to obtain the significant wave height, which will be the lower of the wave heights given by either the distance only or the time only graphs. The following graph combines the two graphs.

GRAPH TO USE WHEN BOTH THE TIME THE WIND HAS BEEN BLOWING AND THE FETCH COUNTS

Follow along the applicable wind speed line until it reaches whatever comes FIRST: the line showing the number of hours the wind has been blowing, or the line showing the distance over the water that the wind has been blowing.

Read the 'significant wave height' at the FIRST intersection.



ESTIMATED SIGNIFICANT WAVE HEIGHTS FOR SELECTED POINTS WITH 20-, 30-, 40-, AND 50-KNOT SUSTAINED WINDS

per Wave Graph using fetch distance only

Middle of Great Slave Lake

Wind	20 Knots	30 Knots	40 Knots	50 Knots
N	1.6 m	2.7 m	4.0 m	5.2 m
NE	1.5 m	2.6 m	3.7 m	4.8 m
E	1.6 m	2.7 m	4.0 m	5.2 m
SE	1.3 m	2.1 m	2.9 m	3.9 m
S	1.3 m	2.1 m	2.9 m	3.9 m
SW	1.6 m	2.7 m	4.0 m	5.2 m
W	1.4 m	2.4 m	3.5 m	4.6 m
NW	1.3 m	2.2 m	3.1 m	4.1 m

Vicinity Hay River, Great Slave Lake

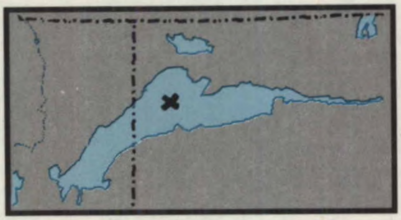
Wind	20 Knots	30 Knots	40 Knots	50 Knots
N	1.3 m	2.2 m	3.1 m	4.2 m
NE	2.0 m	3.5 m	5.0 m	6.6 m
E				
SE				
S				
SW				
W				
NW	1.3 m	2.2 m	3.1 m	4.2 m

North Arm, Great Slave Lake outside of Yellowknife Bay

Wind	20 Knots	30 Knots	40 Knots	50 Knots
N				
NE				
E				
SE	1.8 m	3.0 m	4.3 m	5.6 m
S	1.8 m	3.1 m	4.7 m	6.1 m
SW	1.2 m	1.9 m	2.7 m	3.6 m
W	1.3 m	2.1 m	2.9 m	3.9 m
NW	1.4 m	2.4 m	3.5 m	4.6 m

Middle of Lake Athabasca

Wind	20 Knots	30 Knots	40 Knots	50 Knots
N	1.1 m	1.8 m	2.4 m	3.1 m
NE	1.2 m	1.9 m	2.5 m	3.4 m
E	1.5 m	2.5 m	3.4 m	4.6 m
SE	1.0 m	1.7 m	2.4 m	3.0 m
S	0.8 m	1.4 m	1.9 m	2.6 m
SW	1.8 m	2.9 m	4.1 m	5.4 m
W	1.2 m	1.9 m	2.5 m	3.4 m
NW	1.0 m	1.7 m	2.3 m	3.0 m



Lake Winnipeg, North Basin
Nelson River Exit

Wind	20 Knots	30 Knots	40 Knots	50 Knots
N				
NE				
E	0.6 m	1.2 m	1.6 m	2.0 m
SE	0.9 m	1.4 m	1.9 m	2.4 m
S	2.0 m	3.3 m	4.7 m	6.2 m
SW	1.6 m	2.8 m	3.9 m	5.1 m
W	1.4 m	2.8 m	3.2 m	4.3 m
NW				

Lake Winnipeg North Basin
Centre of Lake

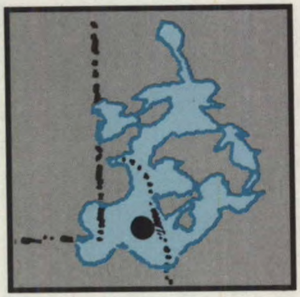
Wind	20 Knots	30 Knots	40 Knots	50 Knots
N	1.6 m	2.8 m	3.9 m	5.1 m
NE	1.3 m	1.9 m	2.6 m	3.5 m
E	1.3 m	1.9 m	2.6 m	3.5 m
SE	1.5 m	2.3 m	3.0 m	4.7 m
S	1.7 m	2.8 m	4.0 m	5.3 m
SW	1.3 m	1.7 m	2.9 m	4.0 m
W	1.4 m	1.8 m	3.0 m	4.1 m
NW	1.6 m	2.8 m	3.7 m	5.0 m

Lake Winnipeg, ~~North~~ South Basin
Mouth of Red River

Wind	20 Knots	30 Knots	40 Knots	50 Knots
N	1.4 m	2.3 m	4.0 m	5.0 m
NE	1.4 m	2.3 m	3.1 m	4.3 m
E				
SE				
S				
SW				
W				
NW	0.9	1.4 m	2.0 m	2.6 m

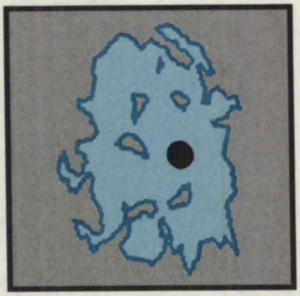
Lake of the Woods
Middle of Big Traverse Bay

Wind	20 Knots	30 Knots	40 Knots	50 Knots
N	1.1 m	1.7 m	2.4 m	3.0 m
NE	0.7 m	1.1 m	1.3 m	1.9 m
E	0.8 m	1.4 m	1.8 m	2.4 m
SE	0.9 m	1.4 m	1.9 m	2.6 m
S	0.9 m	1.4 m	1.9 m	2.6 m
SW	0.7 m	1.1 m	1.3 m	1.9 m
W	1.1 m	1.7 m	2.3 m	3.0 m
NW	0.9 m	1.4 m	1.9 m	2.6 m



Lake Nipigon
Vicinity Bison Island

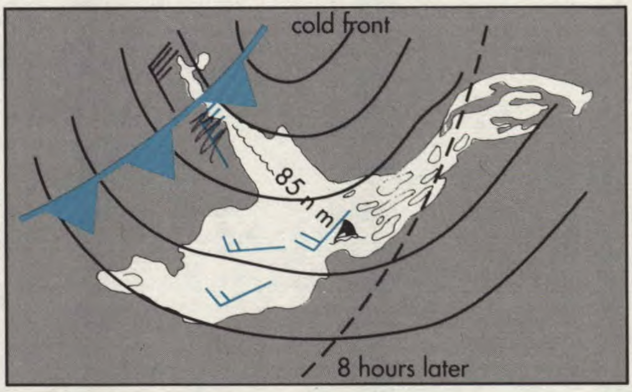
Wind	20 Knots	30 Knots	40 Knots	50 Knots
N	1.0 m	1.5 m	2.2 m	2.7 m
NE	1.3 m	1.8 m	2.4 m	3.0 m
E	1.0 m	1.5 m	2.2 m	2.7 m
SE	1.0 m	1.5 m	2.3 m	2.8 m
S	0.5 m	1.3 m	1.6 m	2.0 m
SW	1.0 m	1.5 m	2.2 m	2.7 m
W	0.5 m	1.3 m	1.6 m	2.0 m
NW	0.9 m	1.4 m	2.1 m	2.6 m



STRONG WINDS AND HIGH WAVES ARRIVING ALL AT ONCE

For all of the lakes in this guide, a cold frontal passage has the potential to bring not only an onset of strong gusty winds but also to bring seas immediately with its passage. Consider a vessel to the northeast of Fort Resolution ~~Reliance~~ on Great Slave Lake. Winds are from the southwest at 15 knots and significant waves heights are about 1.3 metres (4 feet). On the depiction below, a cold front lies at the head of the Northwest Arm of the Lake. Strong gusty winds to the west of the cold front have already started working on the water at the head of the arm. In this example winds of 35 knots are depicted. The front is moving southeastward and is expected to reach the vessel 8 hours later bringing not only strong gusty northwesterly winds but also significant wave heights over 3 times as large as those being experienced with the southwesterly 15 knots winds.

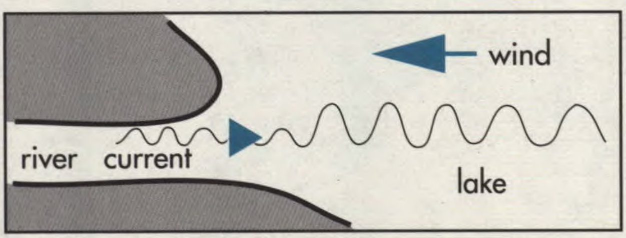
When the cold front reaches the vessel, there will have been 8 hours of 35 knot winds across a fetch of 85 nautical miles. Per preceding wave estimation graphs, the mariner could expect waves to 4 metres (13 feet) to 'arrive' with the front.



WAVES AT THE MOUTHS OF RIVERS

When the current from a river feeding into a lake meets oncoming waves, the waves become steeper and closer together.

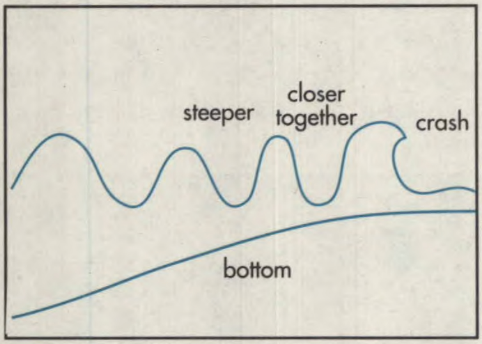
A steepening of the waves and the waves becoming closer together can be observed at the mouth of the Red River during periods of northerly winds.



WAVES COMING ASHORE OR PASSING OVER SHALLOW AREAS OFFSHORE

When waves come ashore or pass over shallow areas offshore, the waves are changed. The two main terms used to describe what happens are *shoaling* and *refraction.*

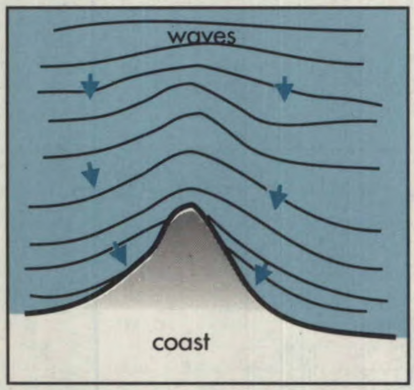
Response - It is important for you to study the wave regimes for various winds in your area to remove the surprise factor of what waves to expect.

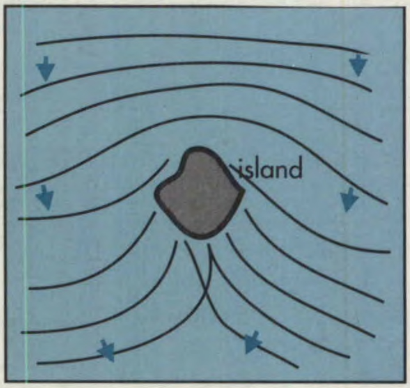


1. Shoaling - When a wave becomes steeper and the distance between waves decreases, we say shoaling is occurring. As the shoaling waves continue into shallower water, they crash into breakers and surf.

On the plus side, the increase in wave height and subsequent breaking of waves due to shoaling is potentially beneficial as it shows you where the shallow areas are located. On the negative side, the waves you experience in the middle of a lake may not be representative of the waves you experience if you head to windward shores where shoaling can enhance the waves.

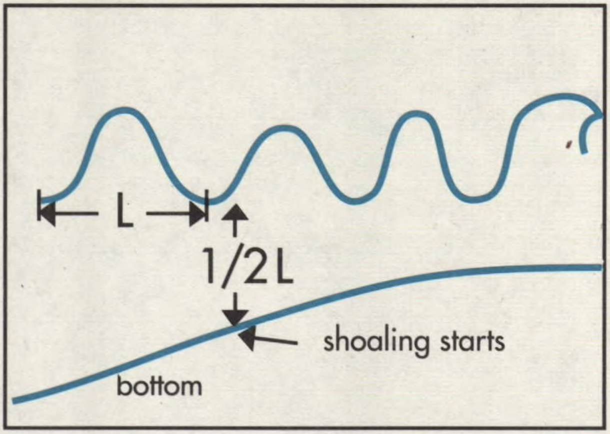
2. Refraction - The coastline and adjacent bottom areas have shapes that bend waves. Waves tend to converge to the lee of islands while points of land tend to cause saves to pile up and bays cause waves to diffuse.





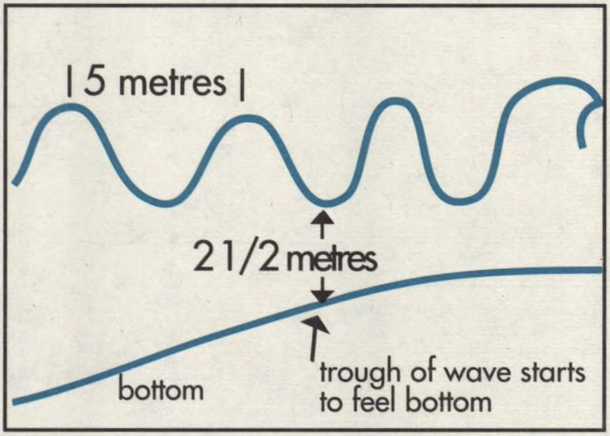
WHEN DO WAVES MEET THE BOTTOM?

Deep water waves start to feel the bottom when the distance from the bottom to that part of the wave is 1/2 of L, the wavelength.



Example

L (distance between trough) = 5 metres
(16 feet)



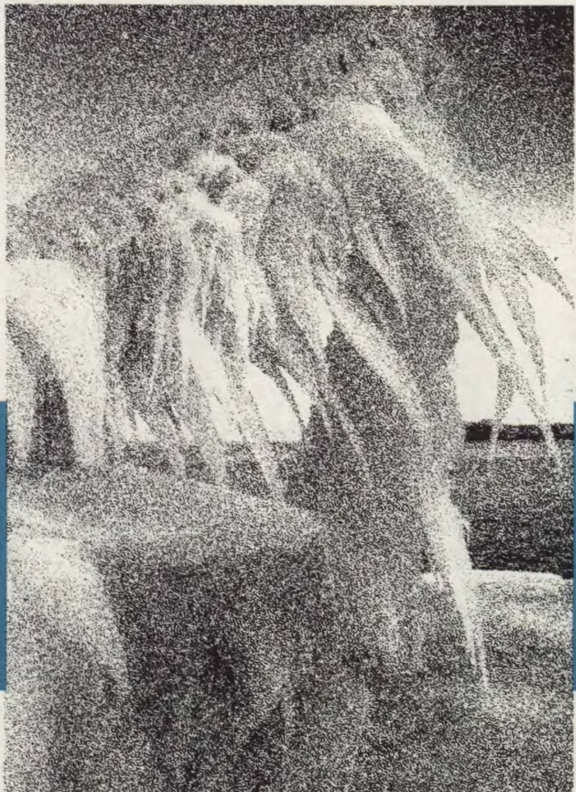
1/2 L = 5/2
= 2 1/2 metres

(16/2 = 8 feet

Answer - The waves will start to feel the bottom starting at the 2 1/2 metre (8 feet) depth.

NOTES

LATE SEASON HAZARDS



LATE SEASON HAZARDS

VESSEL ICING

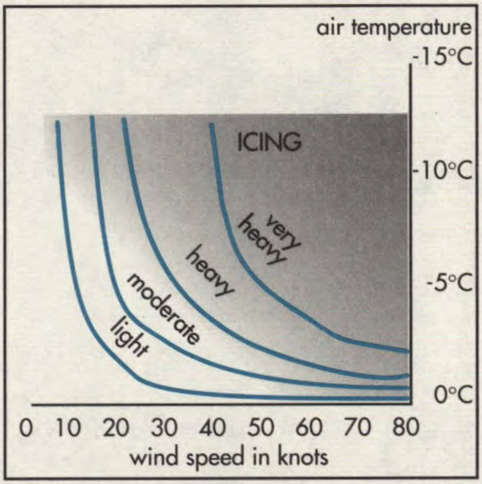
Icing is the process of ice build-up on a surface from one or a combination of freezing spray, supercooled fog, freezing rain or drizzle, and wet snow. If sufficient ice accumulates, it can affect stability and handling, while under extreme conditions, enough ice may accumulate to capsize a vessel. Freezing spray is the most dangerous type of vessel icing because large accumulations (greater than 25 cm) can build up very rapidly. Generally speaking, atmospheric icing in Canadian marine areas is characterized by lower accumulation rates, and ice thicknesses which rarely exceed 5 cm.

There are three main ways a boat can get 'iced up':
Freezing Spray
Freezing Rain
Arctic Sea Smoke

1. Freezing Spray

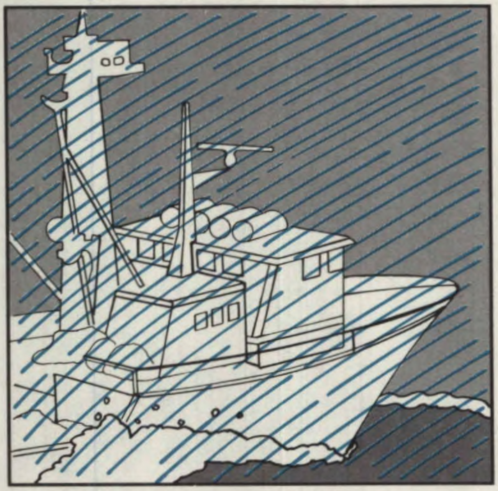
Late in the boating season before freeze-up it is possible to encounter below freezing air temperatures and high winds. Under these conditions, spray produced by the vessel-wave impact can freeze on the deck and superstructure.

The main factors involved in how rapid ice build-up takes place (the 'icing rate') is how much spray is being shipped by a vessel, and how quickly this water can be frozen. Ship icing data have shown that the two most important factors determining the icing rate are air temperature and wind speed. Thus, the simple graph to the left can be used to give some idea of icing severity as a function of these two variables. It should be stressed that a vessel's icing potential depends strongly on its size and spray generating characteristics. The curves at left were derived for 96-ton class Japanese fishing vessels operating in the NW Pacific. Smaller vessels may experience more severe icing conditions than indicated by the diagram.



Response - If possible, avoid late-season boating during periods with a potential for freezing spray. However, if you are caught in freezing spray conditions, the best counter-measure is to reduce the amount of water shipped over the bows by reducing speed, finding shelter, or running downwind. If none of these are possible, the only remaining response is to remove the ice manually from the rigging and superstructure.

2. Freezing Rain



Sometimes a situation develops in which temperatures aloft are above freezing while at the surface temperatures are below freezing. Rain from the warm air falls into the freezing air below, becomes supercooled, and will freeze on impact with any solid surface which happens to be in the way such as a vessel.

With freezing rain, a film of ice forms over the decks, railings and stairways. This form of icing is the least likely to cause stability problems, but it can be a serious hazard for the crew moving on deck.

3. Arctic Sea Smoke

Supercooled fog can form over water when the air temperature is very cold. The resulting fog forms through evaporation, and is usually quite thin and wispy, hence the name "sea smoke," which is often used to describe the phenomenon. Because this type of fog is usually thin, it rarely results in large amounts of accreted ice.

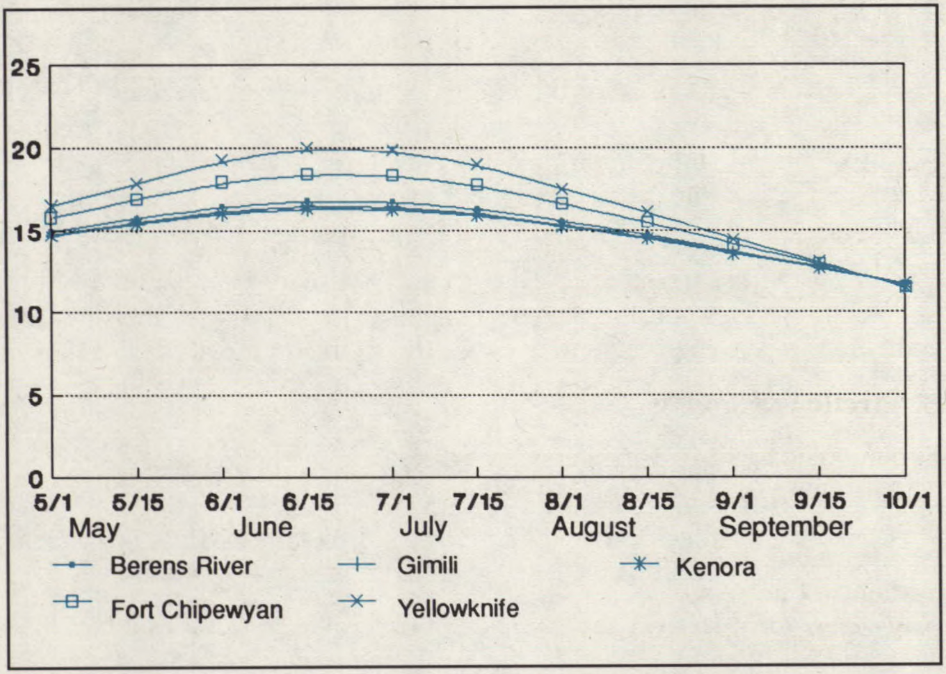
SNOW

Snow reduces visibility. It can be especially hazardous if it falls as melting snow. Melting snow interferes with radar signals making radar less effective.

Response - Proceed with caution.

HOURS OF DAYLIGHT

As the boating season progresses, the amount of daylight decreases. The following graph outlines the number of hours of daylight available through the boating season at a specific locations for each of the lakes.



BREAK-UP AND FREEZE-UP

BREAK-UP

Dates for the ice break-up at specific locations on the lakes is shown. The earliest, the mean, and the latest date are given. The source for this information is somewhat dated. It is possbile that in more recent years, earlier break-up events may have occurred.

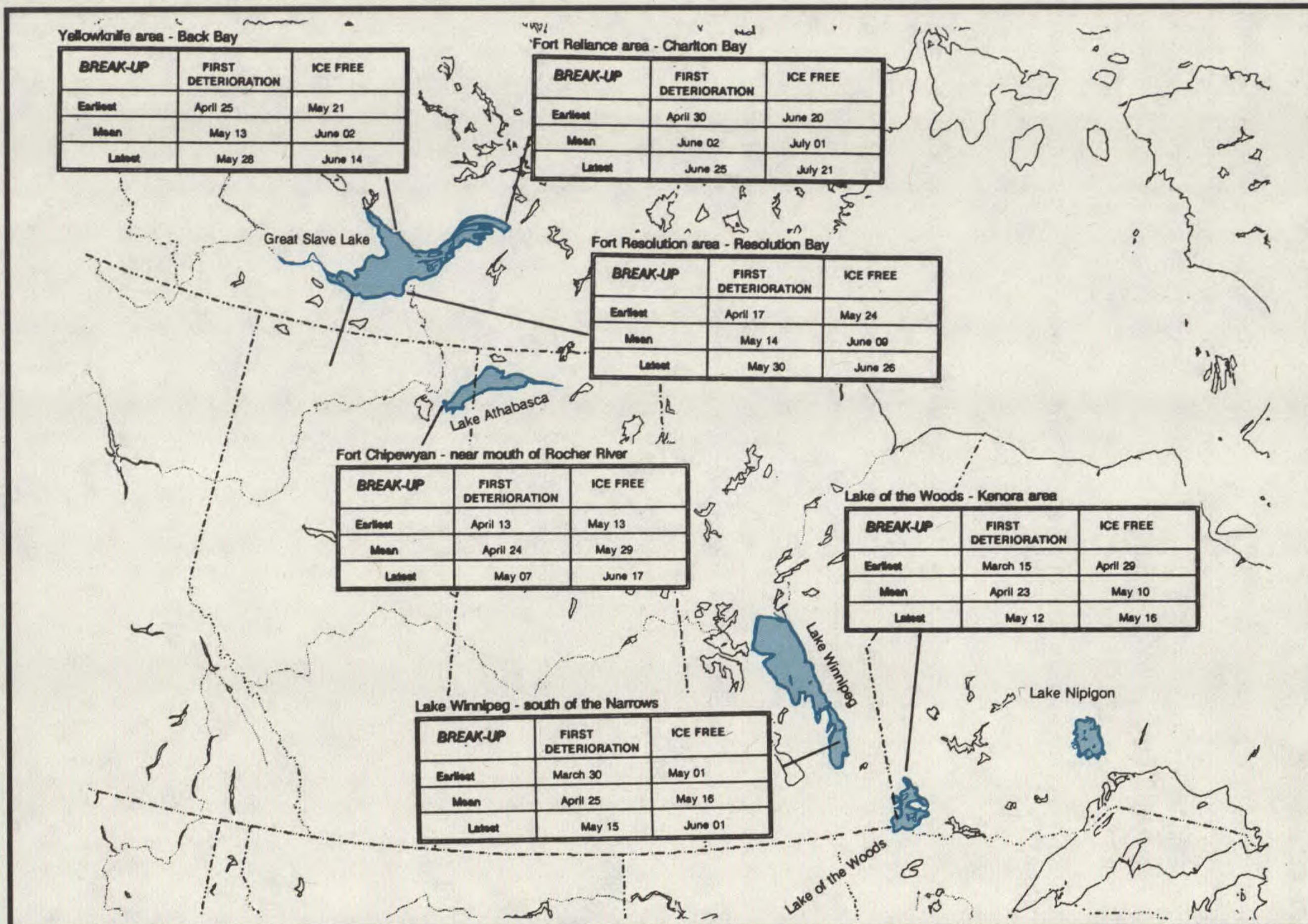
Break-up is highly dependant on the temperature regime, snow cover (heavy snow cover retards break-up), and wind (which may either free or pack shore with ice; indeed rafting and ridging of the ice can lead to damage as ice is driven ashore while a strong wind can crush candled ice and hasten clearing).

The decay of the ice cover on a lake begins prior to air temperature reaches the melting point of the ice and melting begins when the thawing temperatures are high enough to cause the ice to change to a liquid.

A typical break-up scenario is:

- shore lead develops
- snow-melt runoff increases the water level in the lake
- ice floats free from the shore
- lake ice becomes candled and porous as melting process continues
- candled and porous ice loses it strength, shatters, and dissolves.

The outflow from a river can accelerate the breakup process as it brings in water which is warmer than that in the lakes and helps increase lake water levels or floods the shore ice.



Yellowknife area - Back Bay

BREAK-UP	FIRST DETERIORATION	ICE FREE
Earliest	April 25	May 21
Mean	May 13	June 02
Latest	May 28	June 14

Fort Reliance area - Charlton Bay

BREAK-UP	FIRST DETERIORATION	ICE FREE
Earliest	April 30	June 20
Mean	June 02	July 01
Latest	June 25	July 21

Fort Resolution area - Resolution Bay

BREAK-UP	FIRST DETERIORATION	ICE FREE
Earliest	April 17	May 24
Mean	May 14	June 09
Latest	May 30	June 26

Fort Chipewyan - near mouth of Rocher River

BREAK-UP	FIRST DETERIORATION	ICE FREE
Earliest	April 13	May 13
Mean	April 24	May 29
Latest	May 07	June 17

Lake of the Woods - Kenora area

BREAK-UP	FIRST DETERIORATION	ICE FREE
Earliest	March 15	April 29
Mean	April 23	May 10
Latest	May 12	May 16

Lake Winnipeg - south of the Narrows

BREAK-UP	FIRST DETERIORATION	ICE FREE
Earliest	March 30	May 01
Mean	April 25	May 16
Latest	May 15	June 01

FREEZE-UP

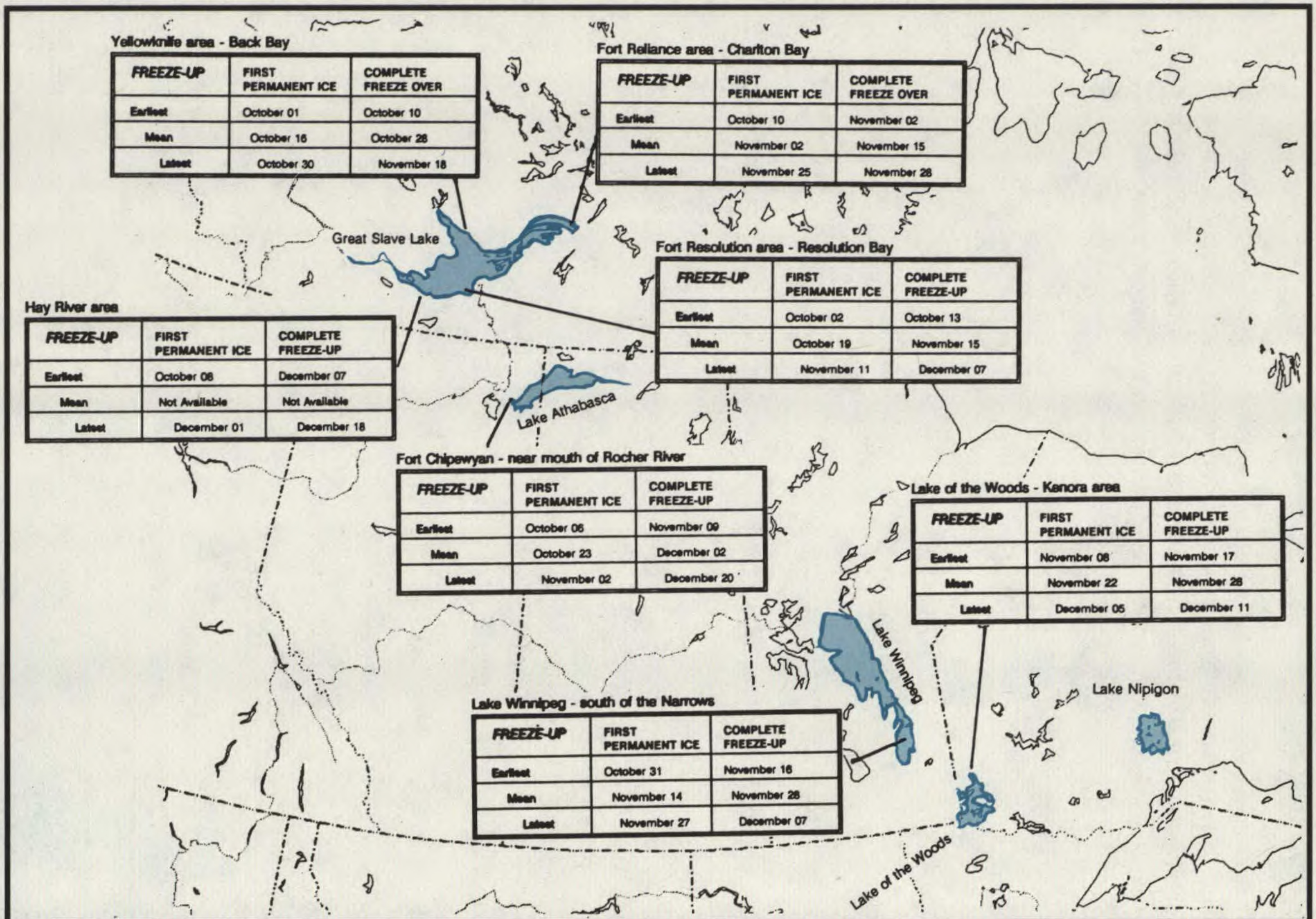
Dates for first permanent ice forming and complete freeze-over at specific locations across the lakes follow. Specifically, the earliest, the mean and the latest dates are shown. The source for this information is somewhat dated. It is possbile that earlier or later freeze-up events have occurred in more recent years.

Freeze-up is dependant on the temperature regime, wind, and size of water body.

A typical scenario is:

- shore ice develops when the mean daily air temperature drops below 0°C.
- ice builds outward as the surface water temperature drops below 0°C
- deepest parts of the lake are the last to freeze

Light to moderate winds speed up the freeze-up process as they remove heat from the water and cause cooling, due to increased evaporation. Ice formation is retarded by strong winds which prevent ice formation. Large volumes of water in the deeper lakes also retard ice formation because the large volumes of water are slow to give up the heat they acquired during the summer.



Yellowknife area - Back Bay

FREEZE-UP	FIRST PERMANENT ICE	COMPLETE FREEZE OVER
Earliest	October 01	October 10
Mean	October 16	October 28
Latest	October 30	November 18

Fort Reliance area - Charlton Bay

FREEZE-UP	FIRST PERMANENT ICE	COMPLETE FREEZE OVER
Earliest	October 10	November 02
Mean	November 02	November 15
Latest	November 25	November 28

Fort Resolution area - Resolution Bay

FREEZE-UP	FIRST PERMANENT ICE	COMPLETE FREEZE-UP
Earliest	October 02	October 13
Mean	October 19	November 15
Latest	November 11	December 07

Hay River area

FREEZE-UP	FIRST PERMANENT ICE	COMPLETE FREEZE-UP
Earliest	October 08	December 07
Mean	Not Available	Not Available
Latest	December 01	December 18

Fort Chipewyan - near mouth of Rocher River

FREEZE-UP	FIRST PERMANENT ICE	COMPLETE FREEZE-UP
Earliest	October 06	November 09
Mean	October 23	December 02
Latest	November 02	December 20

Lake of the Woods - Kenora area

FREEZE-UP	FIRST PERMANENT ICE	COMPLETE FREEZE-UP
Earliest	November 08	November 17
Mean	November 22	November 28
Latest	December 05	December 11

Lake Winnipeg - south of the Narrows

FREEZE-UP	FIRST PERMANENT ICE	COMPLETE FREEZE-UP
Earliest	October 31	November 16
Mean	November 14	November 28
Latest	November 27	December 07

FROSTBITE

Frostbite is defined as the actual freezing of living tissues. It is symptomized by a feeling of numbness and a whiteness of skin (which can also be yellow-white or mottled blue-white). Affected areas become cold and insensitive to touch. The nose, cheeks, ears, and chin usually are affected first and, in severe cases, the feet and fingers may also be affected.

TREATMENT OF FROSTBITE

DOs

- do seek shelter
- do include, as part of your first aid, padding, splints, or whatever else can be done on the spot to prevent further injury
- do handle the damaged tissues carefully
- do cleanse affected areas gently with antiseptic soap and water either during or after thawing
- do transport to a medical centre, where immediate emergency treatment includes monitoring of body temperature and the treatment of shock
- do use rapid rewarming - shown to cause earlier healing and less injury to supporting tissue.

Rewarming should be done by immersing the body in water starting at a comfortable hand temperature and subsequent increases over the following 15-30 minutes to a maximum of 40-42°C.

The treatment is quite painful! It may require use of pain suppressants.

DO NOT's

- do NOT attempt to thaw frozen tissue unless there is absolutely no chance that the area will be refrozen
- do NOT massage a frozen part or rub it with snow... this only increases any damage.

CAUTION - RAPID REWARMING IS <u>NOT RECOMMENDED</u> WHEN THE PART HAS BEEN FROZEN, THAWED, AND RE-EXPOSED TO EITHER FREEZING OR VERY COLD TEMPERATURES.

HYPOTHERMIA

Hypothermia is the major killer of outdoor recreationalists. Unconsciousness can occur when the deep body (or core) temperature drops from the normal of 37°C to 30°C. Cardiac arrest is the usual cause of death when the core body temperature falls to 28°C.

Hypothermia - what used to be called 'exposure' - describes the progressive mental and physical collapse that accompanies the chilling of the vital internal organs of the body.

Causes - IMMERSION IN COLD WATER or exposure to the cold and aggravated by dampness, wind, and exhaustion.

Symptoms - uncontrollable fits of shivering, slurred speech, and confusion or delirium.

Cold water is much more dangerous than cold air because it drains away body heat more quickly than air does.

EFFECT OF WATER TEMPERATURE ON HYPOTHERMIA
(Times are approximate)

Water Temperature	Exhaustion or Unconsciousness	Expected Time of Survival
0°C	15 minutes	15-45 minutes
0°C - 5°C	15-30 minutes	30-90 minutes
5°C - 10°C	30-60 minutes	1 - 3 hours
10°C - 15°C	1 - 2 hours	1 - 6 hours
15°C - 20°C	2 - 7 hours	2 - 40 hours
20°C - 25°C	3 - 12 hours	3 - indefinite hours
25°C	indefinite	indefinite

MINIMIZING THE CHANCE OF CONTRACTING HYPOTHERMIA

SCHEDULE WATER RELATED HOLIDAYS FOR PERIODS WHEN THE WATER IS AT ITS WARMEST (usually end of July through early August) and then, schedule your day to day marine activities when weather conditions are favourable. Any strong winds expected or any thunderstorms developing that may catch you out in the open, far from shore, vulnerable to waves?

TAKE ALONG ADEQUATE CLOTHING for the activity you are planning and keep the clothing dry until you need it. Waterproof gear is a must if you are expecting lots of spray from the lake or rain from the skies above.

DON'T DRINK ALCOHOL - Alcohol causes decreased sensitivity to cold and causes the body's heat production to drop.

DON'T OVERLOAD YOUR BOAT to the extent waves can easily fill your boat and cause it to capsize.

EXTENDING 'SURVIVAL TIME' IN THE WATER

PROTECT CRITICAL HEAT LOSS AREAS through proper behaviour and proper clothing.
Note - Proper behaviour can only be executed if you are wearing a life jacket.

Proper Clothing
-life jacket
-floater coat or similar clothing which has protection such as a flap for the groin area and hood to minimize heat loss around the head

Proper Behaviour
-Alone - upper arms firmly against sides of the chest, thighs together, raise knees to protect groin area
-Group - people face one another and keep as close together as possible

STAY WITH YOUR VESSEL. Wait for rescue. Don't try to swim to safety unless you are sure you can make it. Heat loss INCREASES when you swim.

TREATMENT OF HYPOTHERMIA

REWARMING AFTER MILD HYPOTHERMIA

If person is conscious, talking clearly and sensibly but shivering vigorously...

- -get person out of the water to a dry sheltered area;
- -remove wet clothing and, if possible, put on layers of dry clothing; cover the head and neck
- -apply hot, wet towels and water bottles to the groin, head, neck and sides of the chest
- -provide hot drinks but NEVER ALCOHOL

REWARMING AFTER SEVERE HYPOTHERMIA

If person is becoming stiff and is unconscious or showing signs of clouded consciousness, such as slurred speech...immediately, if possible, transport the person to medical assistance where aggressive rewarming can be initiated.

Once shivering has stopped, there is no use wrapping the person in blankets as this merely keeps the person cold, unless there is a nearby source of heat.. Rather, another way of warming the person must be used.

Some methods used in different situations are:

- -place the person in a sleeping bag or blankets with one or two warm persons, with upper clothing removed
- -per the treatment with mild cases, apply hot wet towels and water bottles to the groin, head, neck, and sides of the chest
- -warm the person's lungs by mouth to mouth breathing

CAUTION. Warm the chest, head and neck but not the extremities of the body. Warming the extremities can draw heat from the area of the heart, sometimes with fatal results. For his reason, do NOT rub the surface of the body. Furthermore, handle the person gently to avoid damaging the heart.

NOTES

GLOSSARY

AIR MASS - A large volume of air with uniform properties of temperature and moisture.

BACKING - A counterclockwise change in wind direction; opposite of Veering.

BEAUFORT SCALE - A scale of wind force, based on behaviour of the sea under varying degrees of wind speed.

COLD FRONT - A boundary separating cold and warm air masses at which the cold air is advancing.

CORIOLIS FORCE - A force exerted on moving objects due to the earth's rotation.

DEWPOINT - The temperature at which the air, at constant pressure, becomes saturated with water vapour.

FETCH - The distance over which winds blow from a constant direction and with constant speed.

FOG - Tiny water droplets suspended in the air that reduce surface visibility. Fog is cloud on the ground.

FRONT - The boundary between two different air masses. A cold front is the leading edge of an advancing cold air mass. A warm front is the trailing edge of a retreating cold air mass.

GALE - A sustained wind speed of 34 to 47 knots.

GUST - A sudden, brief increase in wind speed, generally lasting less than 20 seconds.

HIGH - A region of high pressure. Air flows outwards and clockwise around high pressure areas.

HURRICANE FORCE WINDS - Winds which are greater than 63 knots.

INVERSION - More fully known as temperature inversion. An inversion occurs when warm air resides over colder air. Inversions result in stable conditions.

ISOBAR - Line on a weather map joining points of equal pressure.

KNOT - A unit of speed equal to one nautical mile per hour.

LAND BREEZE - A small-scale wind circulation set off by differences in water and land temperatures along the shore. The land breeze develops at night and always blow from the land to the lake. The counterpart of the land breeze is the Sea Breeze.

LEEWARD - Downwind, situated away from the wind.

LIGHT WINDS - Light winds are defined as winds of 14 knots or less, in Environment Canada reports and forecasts.

LOW - A region of low pressure. Air flows inwards and counterclockwise around a low. A low centre is usually accompanied by fronts, moderate to strong winds, and an area of precipitation.

MILLIBAR - A unit used to express atmospheric pressure.

MODERATE WINDS - Moderate winds are defined as winds of 15 to 19 knots, in Environment Canada weather reports and forecasts.

OCCLUSION - The end result of a cold front overtaking a warm front. It marks the dying stages in the life of a low.

PRESSURE - The force exerted by the weight of the atmosphere, also known as atmospheric or barometric pressure.

PRESSURE GRADIENT - The difference in pressure between two points divided by the distance between them. On a weather map, the closeness of the isobars is a measure of the pressure gradient.

PRESSURE GRADIENT WIND - The wind which results solely from the Pressure Gradient. The greater the pressure gradient between two points, the greater the wind. The pressure gradient winds blow parallel to the isobars with lower pressure on the left.

REFRACTION OF WAVES - The change in direction and size of waves which encounter shallow water.

RIDGE - An elongated area of high pressure extending from a centre of high pressure.

SEA-BREEZE - A small-scale wind circulation set off by differences in water and land temperatures along the coast. The seas breeze develops during the daytime, and always blows from the lake. Its counterpart is the *Land Breeze*.

SEAS - In the true form, the term "seas" refers to combined wind-waves and swell. Mariners often use the term seas to describe wind-waves only. Swell is a not a factor on the lakes in this manual and thus seas and waves have been used interchangeably herein.

SHALLOW WATER - Water depths less than or equal to one half the wavelength of a wave. Therefore, water may be shallow for some waves, but not for others.

SHOALING - The process whereby waves coming into shallow water become closer and steeper.

SIGNIFICANT WAVE HEIGHT - Average height of the highest 1/3 of the waves present.

SQUALL - A brief, violent windstorm, usually but not necessarily associated with rain or snow. Practically all squalls come from cumulonimbus clouds (thunderstorm clouds).

SQUALL LINE - A line of thunderstorms, or other heavy weather, running parallel to, and often ahead of, a cold front.

STABLE - A non-turbulent state in the atmosphere, induced by a temperature inversion (warm air over cold air).

STORM FORCE WINDS - Sustained wind speeds in the range of 48 through 63 knots.

SWELL - Long waves formed by winds blowing over a distant area which move into another area. Swell is not a factor on the lakes in this manual.

SYNOPTIC SCALE - A scale of distance used by meteorologists to describe large weather disturbances. Weather systems which span thousands to millions of square miles and which exist for several days on the synoptic scale.

TROUGH - An elongated area of low pressure, often associated with a wind shift and showery weather.

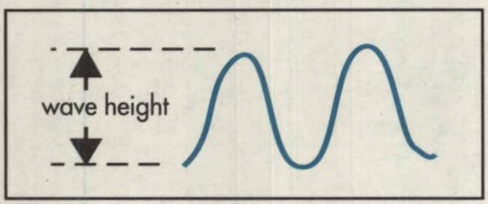
TROWAL - A *tr*ough *o*f *w*arm *a*ir a*l*oft. The stage in the occlusion process where the warm air lifts completely off the surface. The significant weather stays with the trowal as it pulls away from the parent low pressure centre.

UNSTABLE - A turbulent state in the atmosphere, often caused by cold air moving over warmer water.

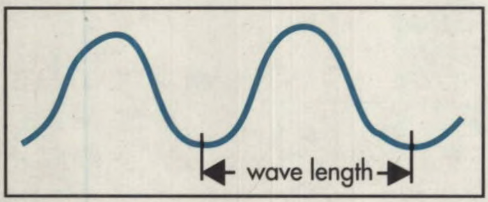
VEERING - A clockwise change in wind direction; opposite of Backing.

WARM FRONT - A boundary separating cold and warm air masses at which the cold air is retreating.

WATERSPOUT - A small whirling storm over water which can either be spawned from the base of a thunderstorm, or form in a cold outbreak of Arctic air. Waterspouts are similar to, but generally not as severe as, tornadoes.



WAVE HEIGHT - The height of a wave is defined as the distance from the top of a wave to the bottom of the trough between waves.



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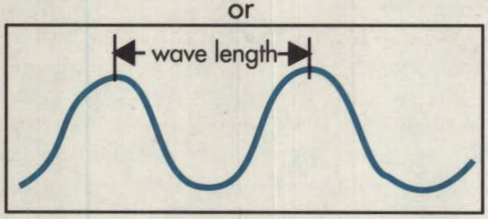

WAVE LENGTH - Definition - Distance from wave top to wave ~~bottom~~ top or, alternatively, from wave trough to wave trough.

WAVE STEEPNESS -The ratio of wave height to wave length.

WINDWARD - Upwind, or in the direction from which the wind is blowing; the opposite of Leeward.

CONVERSIONS

FOR WAVES

1/2 metre	1.6 feet
1 metre	3.3 feet
1 1/2 metres	4.9 feet
2 metres	6.6 feet.
2 1/2 metres	8.2 feet
3 metres	9.8 feet
3 1/2 metres	11.4 feet
4 metres	13.1 feet
4 1/2 metres	14.8 feet
5 metres	16.4 feet
5 1/2 metres	18.0 feet
6 metres	19.6 feet

FOR WIND

KNOTS	MI/H	KM/HN
1 knot	1.2 mi/h	1.9 km/h
5 knots	5.8 mi/h	9.3 km/h
10 knots	11.5 mi/h	18.5 km/h
15 knots	17.3 mi/h	27.8 km/h
20 knots	23.0 mi/h	37.0 km/h
25 knots	28.8 mi/h	46.3 km/h
30 knots	34.5 mi/h	55.6 km/h
35 knots	40.3 mi/h	64.8 km/h
40 knots	46.0 mi/h	74.1 km/h.
45 knots	51.8 mi/h	83.3 km/h
50 knots	57.5 mi/h	92.6 km/h

FOR PRESSURE

INCHES	MILLIBARS or	KILOPASCALS
28.05	950	95.0
28.20	955	95.5
28.35	960	96.0
28.50	965	96.5
28.65	970	97.0
28.80	975	97.5
28.95	980	98.0
29.10	985	98.5
29.25	990	99.0
29.40	995	99.5
29.55	1000	100.0
29.70	1005	100.0
29.82	1010	101.0
29.92	1015	101.5
30.10	1020	102.0
30.25	1025	102.5
30.40	1030	103.0
30.55	1035	103.5
30.70	1040	104.0
30.85	1045	104.5
31.00	1050	105.0
31.15	1055	105.5
31.30	1060	106.0
31.45	1065	106.5

REFERENCES

ALLEN, W.T.R. (1977): Freeze-up, Break-up and Ice Thickness in Canada: Atmospheric Environment Service, Minister of Supply and Services. 185 p.

BROWN, ROSS (1990): personal communication re Vessel Icing in Fresh Water Lakes.

BURNS (1974): The Climate of the Mackenzie Valley - Beaufort Sea Volumes I and II: Atmospheric Environment Service, Minister of Supply and Services.227 and 239 p.

CANADIAN COAST GUARD (1989); Small Fishing Vessel Safety Manual, Canada Minister of Supply and Services.

ENVIRONMENT CANADA (1983): Hypothermia; Minister of Supply and Services.

ENVIRONMENT CANADA (1987): Marine Hazards Along the British Columbia Coast: Minister of Supply and Services. 112 p.

ENVIRONMENT CANADA (1989): East Coast Marine Weather Manual: Minister of Supply and Services. 88 p.

ENVIRONMENT CANADA (1990): Marine Hazards Along the British Columbia Coast Update; Unpublished.

ENVIRONMENT CANADA (1990): Supplement to East Coast Marine Weather Manual Draft; Unpublished.

HOUGHTON, DAVID and SANDERS, FRED (1988); Weather at Sea, Highmark Publishing Company, Camden, Maine. 197 p.

LILLY, KENNETH E. (1983): Marine Weather of Western Washington; Starpath, Seattle, Washington. 150 p.

NATIONAL OCEANOGRAPHIC DATA CENTER (1990); Mariners Weather Log, July,August and September 1990; Vol 34, No 3; Washington, D.C.; 84 p.

SANDERSON, RAY (1986): Weather for Sailing; Stanford Marine Limited, London, England. 124 p.

SKINNER, WALTER (1990): personal conversation re Break-up Freeze-up and Water Temperatures Great Slave Lake et. al.

THOMSON, RICHARD E. (1981): Oceanography of the British Columbia Coast. Fisheries and Oceans, Minister of Supply and Services. 291 p.

As this is the first edition of our Marine Guide to prairie and northern lakes, we'd appreciate your comments.

Please fill in the questionnaire to your right and mail it to:

ED HUDSON,
MARINE
METEOROLOGIST
c/o ARCTIC WEATHER
CENTRE
ENVIRONMENT CANADA
TWIN ATRIA BUILDING
2nd FLOOR
4999 - 98th AVENUE
EDMONTON, ALBERTA
T6B 2X3

cut along line

MAIL-IN QUESTIONNAIRE AND UPDATE CARD

Name______________________________

Mailing Address________________________

City, Province ________________________

Postal Code __________________________

1. Which of the following best describes you?

- ☐ Commercial fisherman
- ☐ Pleasure fisherman
- ☐ Pleasure boater/sailor
- ☐ Other (describe)__________________

2. What kind of boat(s) do you have?

____

____

3. Which of the lakes in this manual do you frequent?________________________

____

4. Where did you obtain a copy of this manual?________________________

____

5. Did the manual help you to better understand marine weather forecasts?

____

____

____

(over)

6. Is there anything missing from the manual that you think should have been included?

Explain:____________________________________

7. Are there any corrections you think should be made?

Explain:____________________________________

8. Please let us know of any MARINE WEATHER HAZARDS or LOCAL EFFECTS that you know of that we might include in a future edition of this manual. Please provide maps if possible.

Thank you for completing this questionnaire.
"SAFE BOATING"

QC 985 H83 1991 Marine guide to local conditions and forecasts: great slave lake, lake athabasa, lake... / ...
4007953

MARINERS' WEATHER CH

☐ **WHAT IS THE PRESENT WEATHER?**

Listen to weather reports from along the route you are planning. Keep a "weather eye" open.

☐ **WHAT IS THE FORECAST TREND? WORSE? THE SAME? BETTER?**

Consider how long you will be out on the lake.

☐ **WHAT MARINE WARNINGS ARE IN EFFECT? WHAT MARINE WARNINGS ARE FORECAST?**

Keep a "weather eye" open.

☐ **WHAT IS THE WEATHER SUMMARY?**

Consider the location of fronts and pressure systems as described in the marine synopsis.

☐ **WHERE ARE YOU? WHERE ARE YOU GOING?**

If you are near one end of Great Slave Lake, Lake Athabasca, or Lake Winnipeg, you may need to adjust the time when the weather will affect you. If you are moving into a different section of these large lakes, is the forecast different?

☐ **WHERE IS THE WEATHER COMING FROM?**

Listen to weather reports from areas where the significant weather is presently located.

☐ **ARE YOU OFFSHORE OR NEAR SHORE?**

If you are offshore (a few kilometres away from the lakeshore) you can probably use the forecast with only a few minor adjustments.

If near shore, you may need to make your own small-scale adjustments to the forecast. See Local Effects section.

☐ **DO YOUR ACTIVITIES REQUIRE ONSHORE OR OFFSHORE WINDS?**

Offshore winds can carry novice windsurfers and sailors offshore. Trying to make it back to shore can be difficult.

Canada