CANADIAN TIDAL MANUAL

Prepared under contract by
WARREN D. FORRESTER, PH.D.*

DEPARTMENT OF FISHERIES AND OCEANS
Ottawa 1983

*This manual was prepared under contract (FP 802-1-2147) funded by The Canadian Hydrographic Service. Dr. Forrester was Chief of Tides, Currents, and Water Levels (1975–1980). Mr. Brian J. Tait, presently Chief of Tides, Currents, and Water Levels, Canadian Hydrographic Service, acted as the Project Authority for the contract.

Wake behind Turret Island (locally called Tremble Island) at maximum ebb tidal stream in Nakwakto Rapids at the entrance to Seymour and Belize Inlets, British Columbia (51°06′N, 127°30′W). Maximum ebb stream is about 16 knots, while maximum flood stream is about 13 knots in the opposite direction. (Photo by M.J. Woodward, Canadian Hydrographic Service, 1982.)

Published by

Government of Canada
Fisheries and Oceans

Scientific Information
and Publications Branch

Publié par

Gouvernement du Canada
Pêches et Océans

Direction de l'information
et des publications scientifiques

The Canadian Hydrographic Service produces and distributes *Nautical Charts, Sailing Directions, Small Craft Guides, Tide Tables,* and *Water Levels* of the navigable waters of Canada.

Director General	S.B. MacPhee
Director, Navigation Publications and Maritime Boundaries Branch	H.R. Blandford
Chief, Tides, Currents and Water Levels	B.J. Tait

Available by mail from:

Canadian Government Publishing Centre,
Supply and Services Canada,
Hull, Que., Canada K1A 0S9

or through your local bookseller

or from

Hydrographic Chart Distribution Office,
Department of Fisheries and Oceans,
P.O. Box 8080, 1675 Russell Rd.,
Ottawa, Ont.
Canada K1G 3H6

Canada $20.00
Other countries $24.00

Cat. No. Fs 75-325/1983E
ISBN 0-660-11341-4

Correct citation for this publication:

FORRESTER, W.D. 1983. Canadian Tidal Manual. Department of Fisheries and Oceans, Canadian Hydrographic Service, Ottawa, Ont. 138 p.

CONTENTS

PART II
Instruments and Procedures

List of Plates

PREFACE

Fluctuations in the water level along the shores of any body of water are of obvious interest and concern to those who inhabit those shores — interest in the cause and the nature of the fluctuations, and concern over the possibility of flooding, dried-out jetties, exposed water intakes, increased erosion, reduced irrigation, etc. People who work on or in the water or travel upon it are also concerned with fluctuations in water level, although they may think of them more as fluctuations in depth, being involved in such tasks as navigating a vessel in shallow water, drilling from an oil rig, or setting a lobster pot. Of equal importance to some is the horizontal flow, or current, the fluctuations in which are frequently related to those in the water level.

Along ocean coasts and in bays and estuaries connected to the ocean the tide is usually the major cause of fluctuations in water levels and currents, but non-tidal phenomena such as wind stress, storm surges, and atmospheric pressure may play important roles as well. In lakes, even in large lakes such as the Great Lakes, the tide has no significant effect on the water levels. There is, however, one place in the Great Lakes where the current is significantly influenced by the tide. In Little Current Channel, the narrow and shallow connection between Georgian Bay and the North Channel of Lake Huron, a reversing tidal stream of more than one knot in amplitude may be observed in the absence of wind and other non-tidal disturbances. This is an exceptional situation, and usually in lakes and rivers the fluctuations in currents, as well as in water levels, result from variations in precipitation, evaporation, runoff, atmospheric pressure and wind, and from basin oscillations called seiches. In some inland systems the water level and flow may, of course, be controlled by dams, or temporarily backed up by ice or log jams.

The hydrographer's interest in water level fluctuations relates to his responsibility to provide accurate depth information on charts. Since the actual depths at a particular time depend on the water level at that time as well as on the bathymetry, the depths shown on a chart must be referred to a standard reference surface, or datum. This chart datum is chosen as a surface below which the water level will seldom fall, so that only rarely could the actual depth be less than the charted depth. Choice of a suitable chart datum requires a knowledge of the nature of the water level fluctuations over the region being charted: this knowledge can usually be obtained only from lengthy observations of the water level. During the hydrographic sounding survey the height of the water surface above the chart datum must be determined, to permit each sounding to be reduced by that amount to provide the chart depth below chart datum. After the chart is produced and in service, mariners, surveyors, or engineers may still require to know the water level above chart datum so they may add it to the charted depths to obtain the actual depths.

Water level information for sounding reduction is usually provided from temporary gauges established in the immediate vicinity of the survey by the hydrographic field party. Permanent water level gauges are maintained at major ports and other selected sites around the coast and on major inland waterways to provide continuous water level information for these localities. The data accumulated over the years from the permanent and temporary gauges provide the basis for interpretation of the water level characteristics, selection of chart datums, and prediction or estimation of future water levels. These data are available to the public in a variety of formats through a central data bank at the Marine Environmental Data Service (MEDS), through various bulletins and publications (see Bibliography under Canadian Hydrographic Service), and in some cases as real-time data through direct telephone communication with tele-announcing gauges. For tidal waters, predicted times and heights of high and low water are provided annually in the *Canadian Tide and Current Tables*. A tidal block on the navigation chart tabulates the extreme and average heights of high and low water for various locations on the chart. On navigation charts of non-tidal waters a hydrograph is usually provided to show the average and the extreme monthly mean water levels that have been observed. No predictions are made for water levels in non-tidal waters, but a *Monthly Water Level Bulletin* for the Great Lakes and Montreal Harbour gives, along with statistics of past observations, a forecast of the monthly mean water levels for the next 6 months within an envelope of error.

The hydrographer is also required to provide information on currents where they may be of concern to navigation, particularly in restricted and difficult passages. The gathering and publication of information are more complicated and difficult for currents than for water levels. This is because currents may vary in direction as well as intensity, they may change in a very short distance under the influence of the bathymetry, they may differ considerably between the surface and the bottom, and their observation usually involves offshore moorings. Current information is provided on the navigation charts where this is feasible. For many important tidal passages the times and speeds at maximum flood and ebb and the times of slack water are predicted and published annually in the *Canadian Tide and Current Tables*. Current information is also published in *Sailing Directions* and *Small Craft Guides* in more descriptive form, particularly when the information is difficult to quantify or is based only on superficial observations or reports. In regions where the currents display great temporal and spatial variation, and where these variations are understood, publication of a *Current Atlas* may be required to represent the information adequately.

The material contained in this *Tidal Manual* is designed to provide the theoretical background (Part I) and the technical instruction (Part II) necessary for the effective performance of the tasks involved in gathering and using tide, current, and water level information on hydrographic field surveys. In treating instrumentation and techniques the emphasis is mainly on principles, with reference to manuals or other documentation for the specifics of particular instruments or routines. It is hoped that this will retard the advent of the Manual's obsolescence in the face of advancing technology. A minimum of mathematics has been employed, and an attempt has been made to discuss the results in simple terms following any mathematical development. A reader who is not comfortable with mathematics is advised to read between the formulae and to try to absorb the basic ideas, but not to skip the sections completely.