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Foreword

CANADIAN HYDROGRAPHIC SERVICE

Each year in attempting to summarize the significant factors affecting the Hydrographic Service, I am struck by the number of events that have brought about a shift in priorities, or caused us to look at our tasks with a new perspective.

At Headquarters, the reorganization that was in a conceptual stage at the end of 1973, is almost completed, bringing about a much better understanding of the needs of the Regions and an atmosphere of teamwork between draftsmen and compilers in their job of chart production and maintenance. Much remains to be done in improving communications and developing effective training, including rotational assignments, between Headquarters and the Regions.

The first steps have been taken to establish an appraisal board for the drafting and design occupational group, the second largest group within the Hydrographic Service. The broad objectives of this new Board are to formalize the assessments, establish career patterns, develop guidelines for position levels, effect promotions and transfers, and to ensure, insofar as possible, that all DDs receive the training and experience necessary to achieve their full potential within the new organization.

The Hydrographic Interdepartmental Steering Committee has been strengthened through the establishment of regional committees with representation from regional elements of the Departments of Public Works, Transport, Defence, and the Small Craft Harbours Branch of the Fisheries and Marine Service. A working agreement with the Department of Energy, Mines, and Resources on the planning and conduct of offshore interdisciplinary surveys is close to completion.

I am deeply concerned over the Service's ability to meet its primary objective of publishing nautical charts and publications essential to the safety of shipping in Canadian waters, considering the requirements that they must be available in both official languages by 1978. I am also concerned about achieving metric conversion by 1980, as proposed by the Metric Commission.

Departmental submissions to Treasury Board have been prepared, seeking the additional resources needed for simultaneous metric conversion and publication in bilingual format of all charts using the new international standards being developed. These requests must be granted if we are to meet the minimal requirements of new policies and at the same time maintain a satisfactory service to meet the mariners' requirements. The mariner's safety must at all times be our primary concern.

There are certain items in the following Regional reports that I feel deserve special note.

In the Atlantic Region, a major initiative by the navigation unit has brought into existence an interdepartmental working group to study the total Canadian need for electronic positioning systems over the next 25 years. The survey of the eastern portion of the Northwest Passage was completed in 1974. The work remaining to be done in Viscount Melville Sound requires the use of a major icebreaker.

Earlier, CSS *Baffin* had carried out a combined production and training survey, funded by the Canadian International Development Agency, of the offshore approaches and entrance to Georgetown harbor in Guyana.

The Regional Hydrographer, Mr R. C. Melanson, was Chief Canadian scientist on the second phase of the multinational Global Atmospheric Research Program (GARP) — Atlantic Tropical Experiment.

The hazards of surveying in uncharted waters was disastrously exemplified by the grounding and subsequent loss of the chartered vessel, *M. V. Minna* at Resolution Island. This ship was outfitted with the latest containerized instrumentation packages for integrated hydrographic/geophysical surveys, including three gravimeters. Although almost all the equipment was salvaged it sustained much damage. This will cause a 3- to 4-year set-back in the development of integrated survey techniques.

In the Central Region, the survey of Chesterfield Inlet was completed in 1 year, rather than the 2 years as had been anticipated. Planning was started for a major hydrographic/geophysical survey of Hudson Bay in 1975.

Mr A. J. Kerr, Central Regional Hydrographer, has continued as Chairman of the Working Group on Oceanic Cartography of the International Cartographic Association. A meeting of the group was held in Madrid in the spring, when special oceanic cartography examples of different countries, including Canada, were exhibited. Mr Kerr has also served on the training committee of the Fédération International Géomètre. It is anticipated that this group will soon integrate its activities with those of the training committee of the International Hydrographic Organization.

In the Pacific Region, the approval by the United States late in 1973 to construct the Aleyeska Pipeline has had a serious effect on Regional priorities. The completion of the pipeline system, anticipated in 1978, will mean that large supertankers will be sailing over the continental shelf off Vancouver Island before transitting Juan de Fuca Strait. This has required a complete reallocation of resources to bring surveys to modern standards. Approval was given this year for the construction of the Patricia Bay Institute of Ocean Sciences on Saanich Inlet. Construction of the wharf has already started. Construction of a new offshore resource survey vessel, to replace CSS *William J. Stewart*, was approved for completion in 1978.

Mr M. Bolton, Regional Hydrographer, carried an exceptionally heavy load as deputy coordinator for Canada's participation in the GARP Atlantic Tropical Experiment. He received well-deserved praise for ensuring Canada's successful participation. He also served as senior Canadian scientist on the first phase of this multinational program.

In conclusion, I would emphasize that the Canadian Hydrographic Service has, through the efforts of all personnel, developed a well-recognized competence in modern hydrographic surveying; earned a solid reputation for assistance to developing nations; participated very effectively in international hydrographic affairs, and at the same time, continues to provide an excellent service to international and national shipping in Canadian waters. The Service, through the Dominion Hydrographer, now reports directly to an Assistant Deputy Minister. This in itself, provides confirmation of the growth in stature and importance the Canadian Hydrographic Service has achieved.

G. N. Ewing
Dominion Hydrographer
Canadian Hydrographic Serivce

Hydrography Branch

TERRITORIAL WATERS SECTION

This section continued to provide support and an advisory service on hydrography and matters related to the Law of the Sea to the Department of External Affairs.

During the first 6 months efforts were devoted largely to preparatory work for the third Law of the Sea Conference held in Caracas, Venezuela in June, July, and August and attended by Mr E. J. Cooper as an adviser to the delegation.

Research studies on some subjects and issues before the conference were conducted in collaboration with Professor D. Pharand of Ottawa University and Professor D. Green of the University of Alberta.

The section provided assistance to the Department of External Affairs in the publication of a booklet, *The Future of the Oceans.*

Preparatory work in connection with the next session of the Law of the Sea Conference, to be held in Geneva in March 1975, was started.

An investigation of the inaccuracies that might result from the enlargement of existing 1:50,000 topographic maps to a scale of 1:25,000 was conducted by N. Cleary, Assistant Territorial Waters Officer.

HYDROGRAPHIC PLANNING AND DEVELOPMENT

Planning of Coordination Unit

During the spring of 1974, the head of this unit, J. O'Shea, participated in the combined training–production survey of Georgetown, Guyana and its approaches. Assistance was also provided in the preplanning of this project.

A report, Small Craft Charting Priorities in Central Canada, was released and brief reports were prepared on arctic and Hudson Bay survey priorities.

Progress reports were also presented to the Canadian Council on Surveying and Mapping and to MCAPP (Mapping. Charting, Aerial Photography).

Survey requests upon evaluation were forwarded to the Regions for action. A major request, Miramichi Bay and River, N.B., was contracted to private industry.

Photogrammetric plots were prepared and air photographs ordered for the various Regional field parties and liaison was maintained with the Canadian Coast Guard for the allocation of vessels for CHS surveys. Department of National Defence also responded to requests to establish horizontal control for the assistance of northern parties.

Cooperation was extended to the Department of Justice by providing a historical inventory of mapping and air photography for an area on Lake St. Clair over which a legal dispute is ensuing.

Chart schemes were provided for chart construction and Regional staff and the Status of Survey indexes were kept up to date.

Survey data submitted by the Coast Guard was evaluated and processed prior to its inclusion on arctic charts.

Standards and Inspection

The head of this unit, P. Corkum, also participated in the Guyana cruise and provided assistance to the Atlantic Region Labrador Coast Offshore program by checking and verifying the numerous lattices prepared at headquarters.

Field sheet inspections continued and numerous queries from the Regional offices and various units at Headquarters on survey standards were answered.

Reviews were made of critical Standing Orders and field sheets were prepared for the Miramichi contract survey.

Assistance was provided to the training committee on the preparation of a brief for the Dominion Hydrographer and liaison on survey standards continued with the Regional offices.

Sailing Directions

During 1974, the following publications were completed and issued: Sailing Directions — Nova Scotia (SE Coast and Bay of Fundy) Sixth Edition; Sailing Direction — Newfoundland, Fourth Edition; Sailing Directions — Great Slave Lake and Mackenzie River, Third Edition; Sailing Directions — Gulf & River St. Lawrence, First Edition, French Language; Sailing Directions — British Columbia, Vol. I, Ninth Edition; Small Craft Guide — British Columbia Vol. I, Second Edition; Supplement No. 5, Great Lakes Pilot, Vol. I, Sixth Edition; Supplement No. 4, Great Lakes Pilot Vol. II, Third Edition; Supplement No. 4, Pilot of Arctic Canada, Vol. III, Second Edition.

At the end of 1974, the following publications were being printed: Sailing Directions — Labrador & Hudson Bay, Third Edition; Sailing Directions — British Columbia, Vol. II, Sixth Edition; Supplement No. 3, Pilot of Arctic Canada, Vol. II, Second Edition.

New editions of publications started in 1974 were: Sailing Directions — Gulf & River St. Lawrence, Second Edition; Sailing Directions — Labrador & Hudson Bay, Third Edition, French Language; Sailing Directions — Nova Scotia (SE Coast of Bay of Fundy) Sixth Edition. French Language; Sailing Directions — Newfoundland, Fourth Edition, French Language; Sailing Directions — Great Lakes, Vol. I, Seventh Edition; Sailing Directions — Great Lakes, Vol. II, Fourth Edition; Small Craft Guide — Trent–Severn Waterway, Second Edition.

Staff Training

Field training for new recruits was carried out in conjunction with the production foreign aid program in Guyana. Field training for the 10 trainees (including 2 members of the Guyanese Hydrographic Office) followed the completion of the hydrography course.

Ten new recruits participated in a Hydrography 1 course at Algonguin College, Ottawa, Ont.

During May, a 1-week basic hydrography course was given to cadets of the Canadian Coast Guard College, Sydney, N.S., to familiarize cadets with the principles of hydrography so they can assist hydrographic officers assigned to Coast Guard vessels.

A 3-week course was given by CHS training personnel, in close cooperation with the U.S. Army Corps of Engineers at Vicksburg, Miss. A total of 24 candidates from various parts of the U.S. participated in the course which introduced students to the uses of electronic and automated aspects of hydrography.

Eleven hydrographers, including a senior hydrographer from the Guyanese Hydrographic Office, attended a 6-week Hydrography II course.

Bathymetric Research

In 1974, this unit produced 19 Natural Resource Series maps, bathymetric editions. These included maps of west coast, eastern arctic, and Atlantic coast areas. Geophysical publications produced included 29 free air gravity maps, 41 total field magnetic maps, 7 Bouguer gravity maps, and 7 magnetic anomaly maps.

Several research projects were undertaken during the year. These included an innovative morphology map of the Flemish Cap area, and initiation of a similar map of an area of Newfoundland.

Bathymetric, morphological, and surficial sediment maps of Hamilton Bank were commenced, using data obtained from industry as well as government.

A bathymetric map of Canada's west coast was begun. The scale of this map is at 1:1,000,000. In addition, a review of requirements for a new series of fisheries charts was undertaken and work begun on the first charts of this series.

A paper was presented to the 13th Annual Canadian Hydrographic Conference in Burlington, Ont., and another was published in *Geology of Offshore Eastern Canada*, a Geological Survey of Canada publication.

Displays of the Natural Resource Series and related maps were sent to several conferences, including the Candian Society of Exploration Geophysicists Convention in Calgary, Alta., the Geological Association of Canada Symposia in St. John's, Nfld., and the American Association of Petroleum Geologists in Calgary.

A member of the Bathymetric Research Unit, M. M. Finlayson, took part in Phase 3 of *Hudson* cruise 74-026 in Lancaster Sound and Baffin Bay.

General Bathymetric Charts of the Oceans

Three GEBCO plotting sheets (115A, 005B, 005C) of the arctic islands were compiled, and a new series of Master Collection Sheets, north of latitude 48°N., was prepared on the west coast.

Assistance was provided to the GATE project of CCGS *Quadra* by preparing plotting sheets, and the bathymetric data obtained on the project specifically for GEBCO purposes was evaluated and processed.

A prototype of a GEBCO chart was presented at the first session of the joint IOC/IHO guiding committee for GEBCO held in Paris, France, April 25–26, 1974. To prepare this chart 20 plotting sheets, including some outside Canada's area of responsibility, had to be evaluated and compiled.

Complying with the 1963 agreement between CHS and Surveys and Mapping Branch, the unit provided advice to those responsible for the International Map of the World series. The availability of bathymetric contours and isobaths, the reliability of bathymetric data, and information on coastlines were the main inputs from this unit.

A critique of the "Proposed Classification Criteria for Deep Ocean Soundings" was prepared for Mr R. M. Eaton, Chairman of the IHO working group on this subject, and revisions were made to the Proposed Data Catalogue, the Bathymetric Data Collection Forms, and the Navigation Log Forms. In addition, the format of the source sheets for areas 001 and 006 were improved.

Preliminary research was initiated for the compilation of reliable source data and for bathymetric data of the arctic, including the Greenland coast.

Some experimentation was carried out with new computer programs aimed at improving data processing and a report, Short Range GEBCO Planning for Computer Program Development and Utilization, was prepared.

In accordance with GEBCO exchange agreements, data were forwarded to Germany, the USA, and France. Data were also provided to Canadian Government departments.

Seven cruises resulted in additional GEBCO data: this information was also evaluated and processed by the unit.

Nautical Geodesy

As hydrographic surveys expanded into new areas, liaison with the Regional offices intensified, resulting in a greater monopolization of this unit's work effort.

Work continued towards a better assessment of radio wave propagation velocities for navigation and survey systems. The observed fixed error corrections to two DECCA Navigation Charts in the Magdalen Islands area were evaluated and published and computer programs were developed for a general assessment of fixing accuracies.

The unit continued to adjust hydrographic control surveys by least squares to reduce anomolies that can build up. Areas of the Great Lakes and St. Lawrence Seaway were united and adjusted under this program.

Developments in automated cartography called for participation by Nautical Geodesy staff and assistance was provided to the Guyana Survey by participating in the planning of horizontal control requirements.

Notices to Mariners and Aids to Navigation

This unit processed 366 jobs related to the provision of aids to data for production units, the processing of information for corrected reprints and the NRC series of charts. Notices to Mariners for the year totalled 1128 paragraphs.

In addition 118 patches were issued by CHS in the Notices to Mariners bulletins.

Although there was a decrease in hand amendments compared to the previous year, the number was still high; 2,168,244 were applied to published charts.

Technical Information Services

Chart Distribution: Approximately 492,000 charts were distributed from Ottawa and Victoria in 1973; of this total 425,000 were navigation charts. The Service presented exhibits at the Toronto International Boat Show; the convention of the Canadian Society of Exploration Geophysicists, Calgary, Alta; Geological Association of Canada Symposia, St. John's, American Association of Petroleum Geologists, and the 14th International Congress of Surveyrs, Washington, D.C.

CHART PRODUCTION

Chart Construction

A major organizational change in the Canadian Hydrographic Service was the creation of a chart construction section. Production units are based on Regional concept and requirement, and correspond to Regional areas established for survey operations — Pacific, Central, and Atlantic. Personnel engaged in drafting or compilation specialization were assigned to the newly created regional production units to handle about 500 work projects.

The main thrust in chart compilation was updating existing charts and scheduling corrected reprints to avoid the depletion of chart stocks.

The establishment of marine traffic routing systems by the Ministry of Transport required compilation of new editions to chart the traffic separation schemes in Placentia Bay, Nfld. (to extend the scheme from the mouth of the St. Lawrence River to the pilot station at Anse aux Basques) and the scheme at Cap aux Oies. On the Pacific coast, the scheme in Juan de Fuca Strait was compiled and published and work is progressing on the extension of this routing system to Vancouver.

The compilation of new charts continued to provide new coverage and reconstructed charts to include new surveys and improve the presentation. The commitment by CHS to publish three charts in the $3\frac{1}{2}$ million scale International Chart series is nearly completed, the last chart to be published early in 1975. The recharting of the arctic area continued with the compilation of data for 12 new charts in metric format. A start was made on the new chart series for the Labrador Coast and three charts were compiled and published. The charts on the eastern side of James Bay were completed to include survey information obtained during the 1973 season. A new metric chart of Hamilton Harbour is being compiled.

A detailed study was made to develop a plan of metric conversion for the navigational series to complete the conversion of all charts by 1980. Three prototype charts are being compiled to obtain users' comments on various styles of data presentation. The charts are scheduled for printing early 1975 and will be discussed at the 1975 Hydrographic Conference.

The compilation of small craft charts continued, to complete the series for Lake of the Woods, and the Ottawa River upstream from Chat Falls. A new series has been compiled for Playgreen Lake. A new chart has been added to the Georgian Bay series to provide coverage from Killarney to Little Current. The compilation of a chart for the yachting events of the 1976 Olympics has been started in cooperation with the Olympic Committee.

Five compilers participated in the revisory survey program in Lake Superior, Lake Huron, and the east coast of Newfoundland. Reports of this activity indicate that it is beneficial to the Regions and chart production in publishing up-to-date information for existing charts.

Thirty-eight new editions of the Mackenzie River strip charts were updated from 1973 survey data and published for the opening of the 1974 navigation season. The series was produced in black only to facilitate production and annual maintenance requirements. The charts of Chesterfield Inlet were also updated and issued as new editions.

The drafting maintenance program for the Mackenzie River series started about January 1, and continued for approximately 3 months. To avoid overcommitting the printing facilities, 16 charts are "ozalid printings" only (150 copies of each), and the remaining 22 charts are printed by the Surveys and Mapping Branch of Energy, Mines, and Resources.

Chart 812H, Geology of the Scotian Shelf and Adjacent Waters, was produced to complement scientific reports. The base map was derived from bathymetric chart of the Scotian Shelf and adapted to fit the geological coverage. Thirty-one color overlays were required to portray the geological information and were combined by screening to seven color plates for printing. Four thousand copies were printed, 3500 being folded for insertion in the report.

DECCA/Loran lattices and projection plots produced by the automated system continue to be of excellent quality and represent a substantial saving in man-hours over the manual method of production.

In the reprographic area one new piece of equipment has been added, an Ascrolux 5KW metal halide printing lamp, which has cut the exposing time in the preparation of color proofs by half. An even greater saving has been realized with other contact media (wash-offs, etches, etc.) with the exposure time cut to approximately one-tenth. Other equipment under study is the Comp/Set 500 phototypesetter seen for the first time at the Chicago '74 Graphic Arts Show, and an automated film processor. Purchase of this or similar equipment could be a requirement of metric/bilingual programs and the anticipated increase for additional reprographic services from the Regions and other sectors within the Branch.

Automated Cartography

The Automated Cartography Section is responsible for implementing the automated drawing techniques developed throughout the last few years, and to form a bridge between chart production and cartographic research section, where new and additional compilation and drafting programs are being developed.

Use of the present automated drawing system increased substantially in the latter part of 1974 and development work on this particular system is being curtailed.

A new cursor for the digitizing system has been designed and should be ready for use by March 1975. The addition of a numeric keyboard and a small digital display unit built in should reduce the man-hours required for sounding digitization and the occurence of human errors.

More cartographers have been trained in the use of the digitizing system and emphasis has shifted to digitization of the compilation sheets for new charts. This allows the chart negatives to be drawn automatically, thus reducing the requirements for manual drafting.

As well as the digitization of the manual compilation, an older chart with soundings in fathoms and feet was digitized and automatically converted to meters and drawn. The results were excellent and more charts will be converted in this manner.

A new minicomputer system was acquired in May 1974. This system (a PDP 11/40 computer with 24K core, two disk cartridges, and magnetic tape transports) is primarily used by the computer programers to develop new programs for compilation and processing of hydrographic data. It is hoped to add a CRT graphic display in the near future so that programs for interactive editing can also be developed.

During the year a total of 189 production jobs were processed on the automated drawing system: 69 chart bases (various projections with skeleton or full graduated borders), 23 lattices (DECCA and Loran), 2 film plots (digitized soundings — Chart 4620), 8 Territorial waters plotting sheets, and 87 latticed field sheets (DECCA Lambda, Rho-Rho LORAN-C).

The total automatic processing time, which includes keypunching, drawing system preparation time, and checking, amounted to approximately 625 hours (83 man-days). The estimated manual production time, had this work been undertaken by chart compilation and drafting, would have been approximately 900 days. The automated processing figure is a little high because some of the programs are being run by compilers and draftsmen who are not yet fully trained in the use of program guides, and are not adept at keypunching. In addition to

the production drawing done on the system, 71 development plots were run for a total of 202 hours plotting time.

Users Guides for the Mercator Border, Skeleton, and hyperbolic lattice programs are available. These guides provide the necessary information for compilers and draftsmen to carry out the work.

As part of the metric program, it was decided that Chart 4620 would be converted using a straight numerical conversion (contours relabelled and soundings converted to meters and decimeters). It this production process the soundings on the chart, which were shown in fathoms and feet, were digitized and plotted on film. The digitized soundings were checked against the soundings on the chart for content and accuracy of position and then replotted using a conversion program that automatically converted the soundings to meters and decimeters. This plot was then incorporated into the reproduction material for the chart. Total time required to produce the converted sounding plot, including the digitization and plotting of the data on film, was about 22 hours. In this case only the soundings were digitized. Shoreline, topographic, and bathymetric contours will be digitized as required, when digitization becomes an integral part of the production process.

Production and Quality Control

Four hundred and twenty-four various types of charts, maps, and indexes were printed for the Hydrographic Service by the Map Reproduction Division of the Department of Energy, Mines, and Resources.

New publications included 27 nautical charts, 95 natural resource maps, and 13 special charts. From the 1400 charts in stock, 128 were published as new editions and 161 were reprints. Included are 10 charts in metric format, 3 new fisheries charts, 7 with new lattices, 1 small craft, 1 bilingual nautical chart, 62 bilingual natural resource maps, 1 bathymetric chart of Lake Superior, 1 in the international format, 5001 Strait of Belle Isle to Davis Strait, and 4 with traffic separation schemes in the St. Lawrence River and Placentia Bay. One bilingual nautical chart and 62 natural resource maps were published in a bilingual format in 1974.

It was a busy year for the Quality Control Unit. Three hundred and fifty projects were edited and reviewed in 1974, comprised of 17 new nautical charts, 18 proofs of charts, 110 new editions, 127 reprints, 53 natural resource maps, 5 NSC charts, and 20 miscellaneous projects.

Nomenclature

The appointment of G. N. Ewing, Dominion Hydrographer, as an official member of the committee was confirmed at the annual meeting of the Canadian Permanent Committee for Geographical Names (CPCGN).

One commitment made by the CHS at the annual meeting was to transmit local information obtained by hydrographers to the CPCGN more quickly. Hydrographers are urged to include stories and information on the origin of new geographical names, when available. Similar information on thousands of established names is also needed. Field inquiries and conversations with old-timers are excellent sources of information.

Tides and Water Levels

With the creation of the Marine Environmental Data Service and the transfer of most TWL (Tides and Water Levels) staff to this service, the role of the headquarters Tides and Water Levels Group has changed from a production oriented to a monitoring role to set and maintain suitable standards for tidal activities in Canada.

Throughout the year, efforts were made to cooperate with Marine Environmental Data Service (MEDS) and the regional tidal offices to ensure an orderly transition of responsibilities and to maintain an adequate standard of service. Various meetings of interested parties were held to formulate policies and establish schedules.

The development of a new successive tide method of presenting tides with strong diurnal influence was completed and reviewed independently to confirm its suitability for use in Canadian waters.

Throughout the year the predictions for the 1976 edition of the tide tables were prepared by MEDS and have been reviewed and approved, when appropriate, for publication.

Water Levels 1973 volumes 1 and 2 were completed in July and November.

Regional participation in the supply of chart data has been encouraged and training programs established. Completion of microfilming of TWL information files, and the subsequent transfer of these and the appropriate chart files to the region, will permit this activity to become regionalized. Throughout the year, the required information was prepared by MEDS and verified before being passed to chart production.

Preparation of the monthly Water Level Bulletin for the Great Lakes has been transferred from MEDS to the Central Region. Negotiations for the transfer of the weekly advance Water Level Bulletin are now in hand.

Measurement and dissemination of tides and water levels at 143 gauging stations along the coasts and in the Great Lakes–St. Lawrence River System were continued. The routine levelling between gauge zeros and benchmarks was carried out at all gauges. First order levelling at gauges in the Great Lakes–St. Lawrence River area were made by the Geodetic Survey of Canada.

The expanding water level telemetry and announcing system continued to provide real time data for navigation, water management, and forecasting purposes.

The International Hydrographic Bureau has requested the establishment of a computerized world-wide tidal constituent file, based on the system developed by Tides and Water Levels. The file will include data from onshore and open sea measurements, and will eventually be extended to include tidal streams. The project is being carried out with support from the Marine Environmental Data Service of Ocean and Aquatic Affairs.

Measurement of tides in the open sea, using submersible tide gauges, has increased in all three regions of the Canadian Hydrographic Service. Atlantic Region experimented with existing oil drilling platforms to make such measurements and obtained satisfactory results.

A paper, A Method of Presenting the Predicted Tides of a Mixed Type with Strong Diurnal Influence, has been accepted by IHB for publication. The recommendation given in a paper, Evaluating the Stability of Tidal Constituents Computed by Different Methods, was accepted by IAPSO/UNESCO Working Group 27 to be included in their report.

CARTOGRAPHIC DEVELOPMENT

This report covers the major developmental and production implementation work during 1974 in three main sections: cartographic studies, hardware, and cartographic computer program development.

Cartographic Studies

A study of size changes to the depth digits shown on published charts was completed. This included the features directly related to depth values such as the awash symbol and the symbol for rock with less than 6 feet of water over it. The study endeavored to determine when and under what circumstances these feature symbols changed size. This information is necessary for the conception of algorithms and the design of the computer programs to automatically change symbol size when the situation requires it. Similarly, a study of the bottom sample abbreviations used, their frequency, and the depths at which they are shown on charts was made. The design of the symbols, their location and size for a production symbol disc No. 1 for use with the Barr and Stroud light projector mounted on the Gerber 32 automatic drawing table was carried out. Eighty-sevent negatives of symbols were made at 40, 60, or 80 times larger than the final chart size and sent to Barr and Stroud in Scotland for the manufacture of the disc. Similarly, the 79 negatives for disc No. 2 were prepared for the purchase of a second disc. Disc No. 1 was received late in November and disc No. 2 is expected by mid January, 1975. Disc No. 1 includes all the land feature symbols required for a standard, navigational chart; disc No. 2 will be for all the water features.

In the digitization of field documents to convert graphical data into computer compatible digital form, another two portions of field sheets were digitized. This process was valuable for obtaining better knowledge of the problems involved in digitizing the foreshore features and to garner more field data in digital form for testing and experimentation in the development of computer programs such as sounding selection. More experimental digitizing was conducted with deep-etch scribed sheets and as result it was found that flat-tip, conical-point, scribe tip with the edges rounded was acceptable and much better than the normal flat-tip scribe points.

A design of a new type of cursor for the Gradicon digitizer was completed and an order for its construction was made. This cursor should expedite the digitization of soundings. However, the most important gain will be the reduction of manpower required to digitize soundings from two men to one man. In addition a heavier cursor than the one presently in use for deep-etch scribe line digitization has been ordered.

A study was also conducted to determine the adequacy of obtaining metric contours directly from the soundings shown on charts. The results indicated that the contours determined in this manner were not adequate.

A second experimental digitization of a manually compiled chart and automatic drawing of the features was conducted. The results have proved to be satisfactory for production utilization. It appears that this approach to automate chart production will be beneficial. The estimates indicate this method is faster and more economical than the manual scribe drawing of the chart especially after receipt of the new cursor, completion of the feature generation program, and the digitized data error correction programs.

A digitization manual is being delayed because of changes and revisions to the digitizing system.

Hardware

A PDP-11/40 computer system was leased in April. This system will be utilized in developing computer programs for editing, revision, and addition of data to computer compiled charts or to digitized compilations, and for the development of input/output programs required in a data base. The system is also to be employed for experimental work in determining the feasibility of utilizing a small computer system for control of several digitizers or CRT displays and the possibility of utilizing the system for data base development.

A PDP-8/F mini computer system with 8,192, 12 bit words of memory was acquired to replace the original PDP-8 control computer with 4,096, 12 bit words of memory in the drawing system. The new computer has been installed but additional testing and a minor fault has to be located and rectified before the old PDP-8 can be removed. The new computer will provide greater potential and reliability to the system, and it will permit through assembler language programs better communication between the teletype and the drawing system which in turn will facilitate the drawing operation.

The PDP-8/E system with a Tektronix 611 storage display was returned from the University of Saskatchewan. This system was utilized at the University with the expectation of developing a computer aided compilation and name placement system.

Cartographic Computer Programs

Many computer programs developed and in production or developmental use were tested and modified, but only the main programs under development will be mentioned.

The design and development of the computer programs to carry out the sounding selection function continued off and on throughout the year. A paper was given on this computer program at the Canadian Hydrographic Conference in Burlington, Ont. At that time the program could select soundings in open, deep waters with few shoals and has now been developed so that soundings touching the shoreline at chart scale will be eliminated, and selection of soundings in fairly uniform shallow areas gradually sloping off into deep waters can be adequately selected. The next level will be to improve selection of soundings in inlets, straits, channels, and in areas with many shoals and islets. Figure 1 shows soundings computer selected and Fig. 2 shows the original field data for Fig. 1, plotted at chart scale and projection.

The following programs have been modified for PDP-11/40 processing instead of the CYBER-74 computer: a random access sounding file, a program to locate soundings within an area, and read and write on magnetic tape and sounding selection. Two new routines have been written on the PDP-11/40 — a general purpose magnetic tape sort capable of handling up to 175,000 soundings, and a routine to manipulate random access shoreline file. Development of the programs to carry out error and omission corrections to digitized data are also being carried out on the PDP-11/40, and are nearing initial completion.

A rudimentary cartographic data processing system, ACCS-2, capable of inputting a file of digital cartographic data, performing one or more conversion processes, and outputting the converted data as a file for a plotting system has been developed. The conversion processes are: (1) conversion to any scale; (2) conversion to X Y, plane coordinates in any of five projections; (3) conversion of sounding units from fathoms and feet to meters and decimeters or vice versa; (4) extraction of data inside a geographic or plane X Y rectangle.

ACCS-2 is written in the FORTRAN language on the CYBER 74 computer of the Department of Energy, Mines, and Resources. It consists of a suite of 15 utility programs. HAAPS data can be handled through this system for plotting field sheets.

Extensive work and substantial progress has been made on the feature generation program. It can now handle 63 features as well as 20 symbols from the symbol disc. This program, essentially through subroutines for each feature, ensures that the features are drawn according to specifications or standards. Figure 3 shows an example of the features drawn to specification and standards. Figure 4 shows the original data as digitized.

Work Outside Cartographic Automation

As well as producing graphics of chart bases and lattices for various users, an analyst–programmer provided assistance to the aerial hydrography group working at the Canada Centre for Remote Sensing, EMR. In just over 45 days, three main computer programs and about 12 small subroutines for the airborne data acquisition system were designed and written.

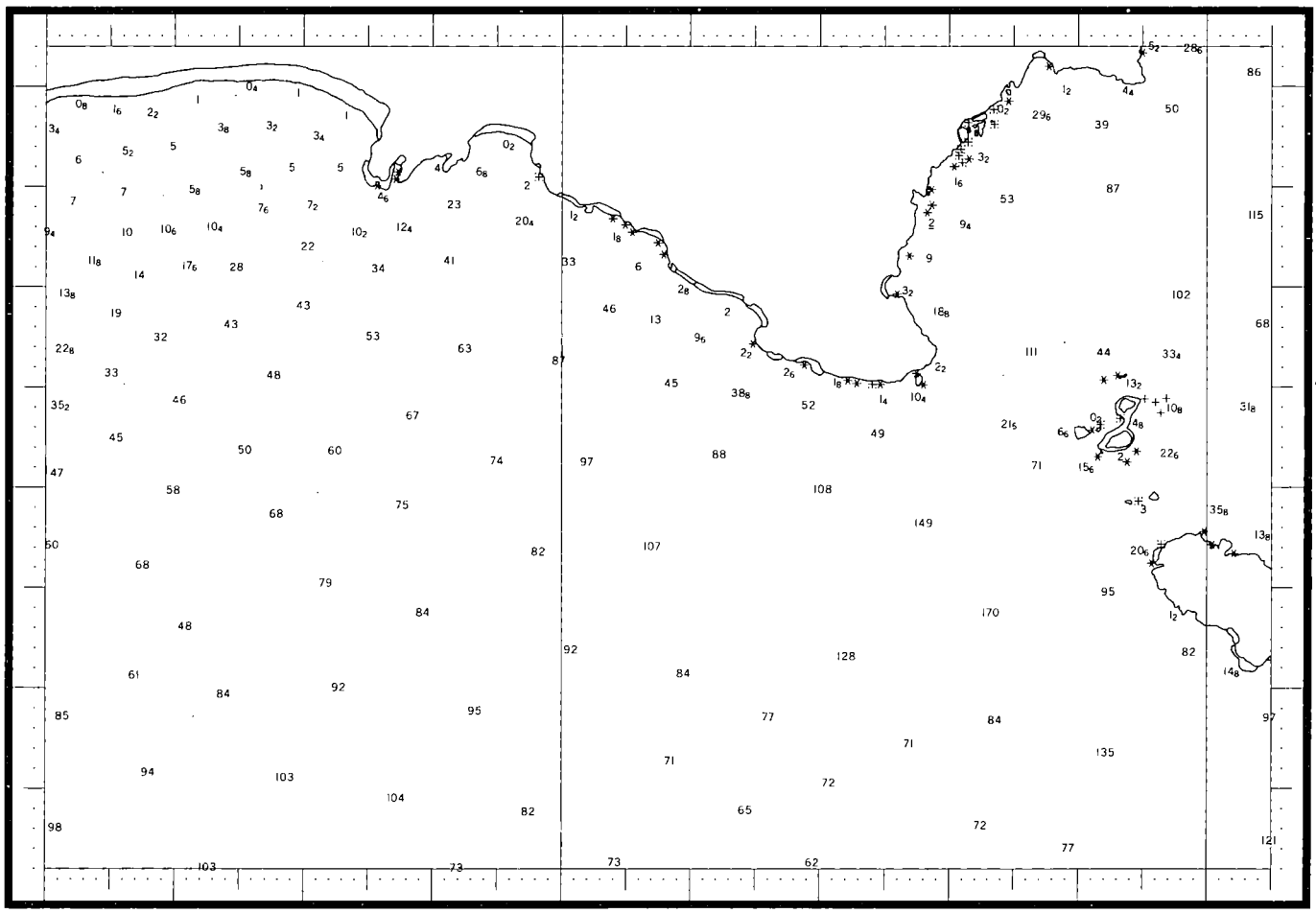


FIG. 1. Computer-selected soundings.

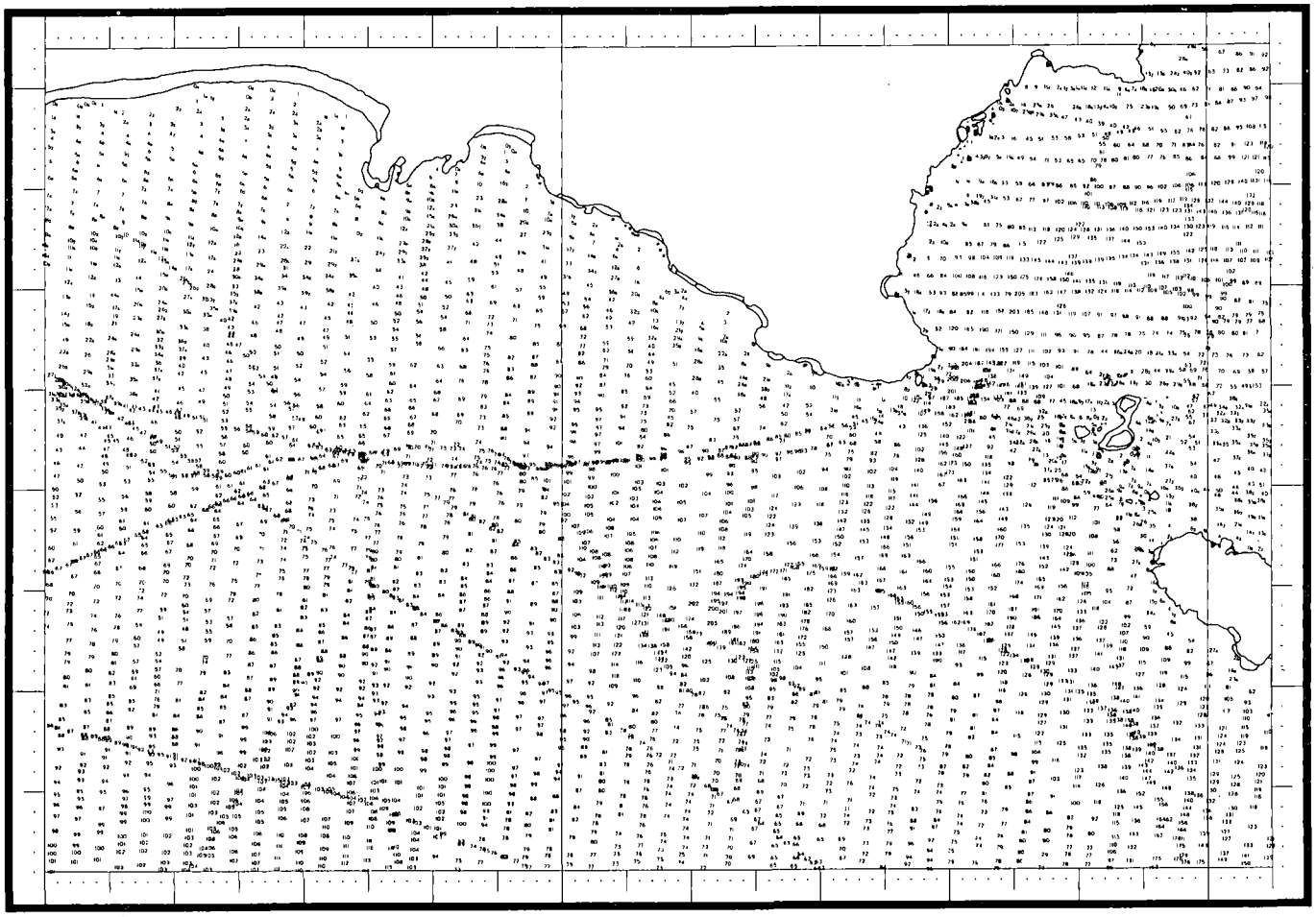


FIG. 2. Original field data for Fig. 1.

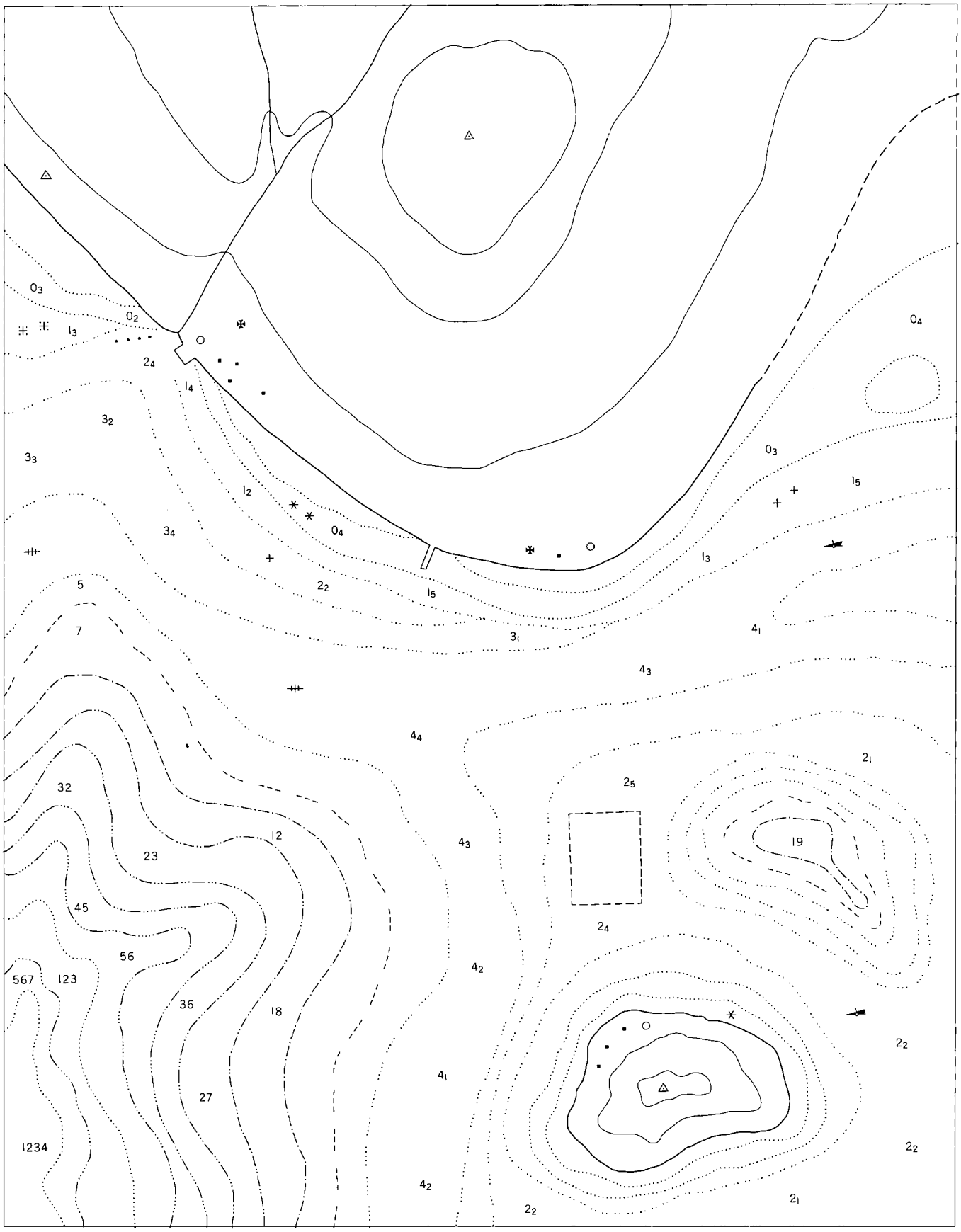


FIG. 3. Features drawn to specification and standards.

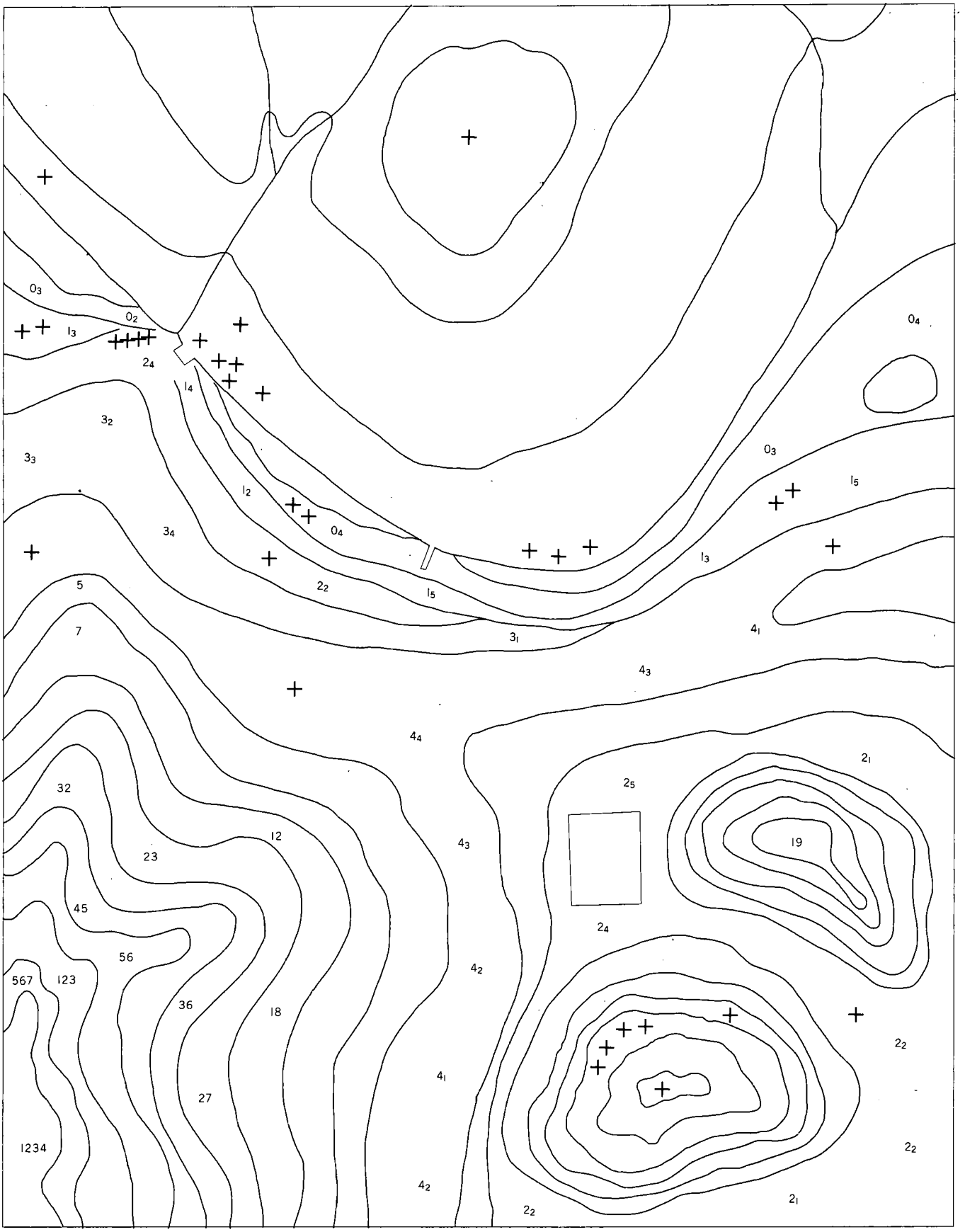
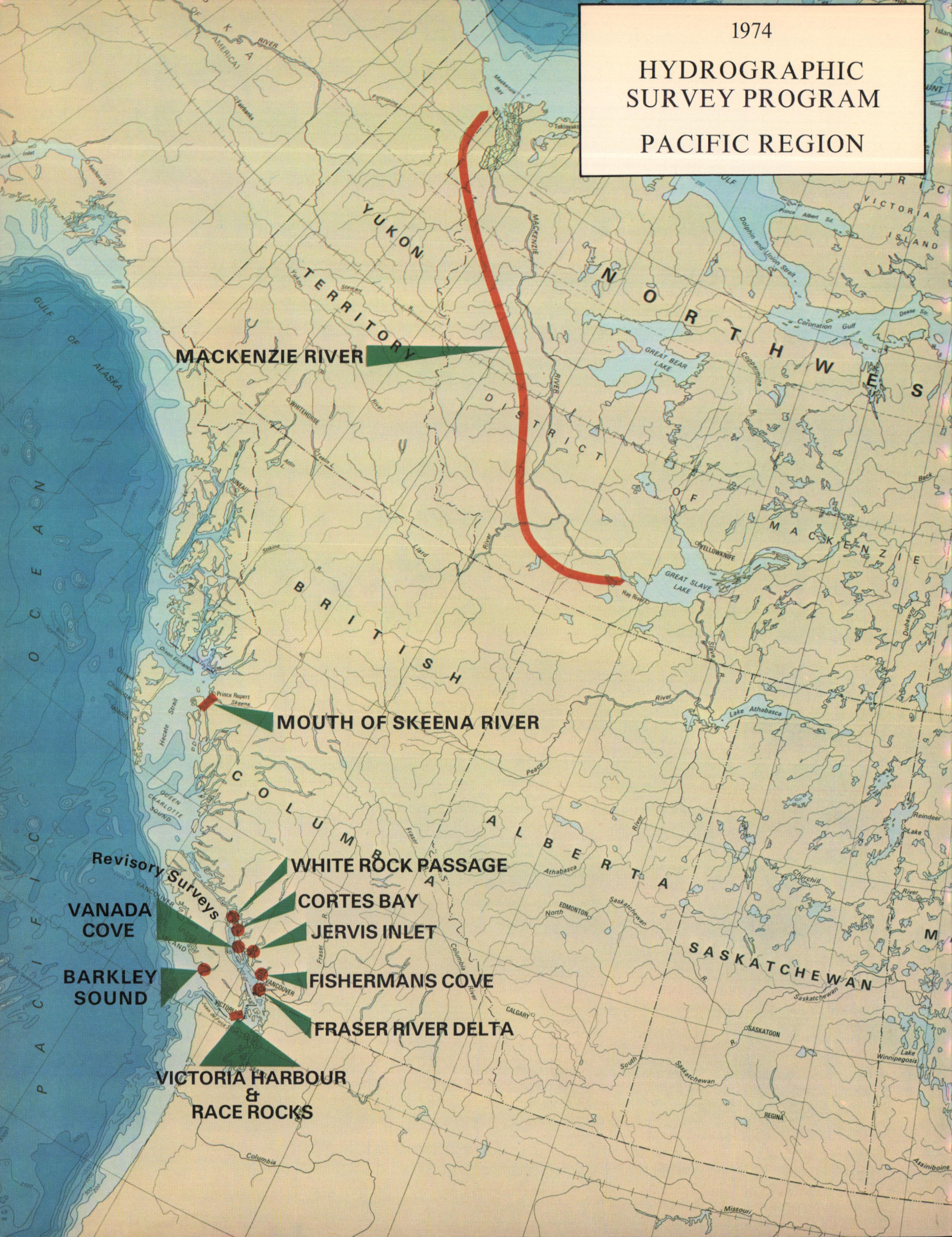


FIG. 4. Original data as digitized.


1974
HYDROGRAPHIC SURVEY PROGRAM
PACIFIC REGION
MACKENZIE RIVER
MOUTH OF SKEENA RIVER
Revisory Surveys
WHITE ROCK PASSAGE
CORTES BAY
VANADA COVE
JERVIS INLET
BARKLEY SOUND
FISHERMANS COVE
FRASER RIVER DELTA
VICTORIA HARBOUR & RACE ROCKS
YUKON TERRITORY
NORTHWEST
DISTRICT OF MACKENZIE
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
PACIFIC OCEAN
GULF OF ALASKA
VICTORIA ISLAND
GREAT BEAR LAKE
GREAT SLAVE LAKE
Lake Athabasca
Lake Winnipegosis
Reindeer Lake
WHITEHORSE
YELLOWKNIFE
JUNEAU
PRINCE RUPERT
EDMONTON
CALGARY
SASKATOON
REGINA
VANCOUVER
VICTORIA
Mackenzie R.
Peace River
Athabasca River
Fraser R.
Columbia River
Saskatchewan R.
South Saskatchewan
Churchill River
Hay River
Liard River
Stikine R.
Yukon R.
Stewart R.
Porcupine R.
Dease Str.
Coronation Gulf
Dolphin and Union Strait
Prince Albert Sd.
Queen Charlotte Sound
Hecate Strait
Dixon Entrance
Missouri
Assiniboine

Pacific Region

INTRODUCTION

The hydrographic survey program in 1974 was influenced to a large extent by two external factors: the Beaufort Sea project and the GARP Atlantic tropical experiment. Regional participation in these activities necessitated major changes in the scheduled hydrographic programs. The electronic positioning system in the western arctic, operated by the Polar Continental Shelf Program, was located in the Beaufort Sea covering an area already surveyed, and the Canadian commitment to GATE necessitated the withdrawal of CSS *Parizeau* from normal survey duties as a replacement on Ocean Station Papa from May through October.

Other impacts of these unique programs included syphoning of some Tidal and Current Survey effort into the Beaufort Sea Project to provide essential baseline data on tides and current. Mr M. Bolton, Regional Hydrographer, spent 60% of his time planning and participating in GATE, during 1974.

Much of the thrust in chart construction and hydrographic development was directed to the metric conversion of navigational charts. Preliminary analyses of modes of conversion and of various chart formats were investigated.

A policy has been developed to transfer some of the drafting and printing of regional charts to the Pacific Region. This policy has been formulated to provide greater flexibility and capabilities in chart production.

FIELD HYDROGRAPHY SECTION

In 1974 CSS *Parizeau* was not available to the Hydrographic Service. There was, therefore, no hydrographic work done in the western arctic but a greater than usual effort was made on the British Columbia coast. In cooperation with Geological Survey an intensive survey was made of the Fraser River delta front, both before and after freshet, and this is expected to yield valuable information in the field of delta studies. Victoria Harbour and an area off Race Rocks that had not been properly looked at since leadline days were resurveyed. Revisory surveys covered the southern B.C. coast and approximately 200 low altitude aerial photos were taken from chartered Beaver aircraft. Large scale surveys were completed of Fisherman's Cove, Whiterock Passage, Cortez Bay, and Vananda Cove. The same party, employing a chartered Bell Jet Ranger helicopter, extended geodetic control from the mountain peaks to the shoreline in Seymour and Belize inlets.

The *William J. Stewart* spent the greater part of the season in Barkley Sound, Malaspina Strait, and Jervis Inlet. Work will continue in Barkley Sound but the entire Strait of Georgia, Malaspina Strait area has now been resurveyed to modern standards. This party also completed surveys of the Skeena River mouth and approaches, finding major changes in banks and shoals that will require recharting as soon as possible.

Valuable revisory and new work was continued on the Mackenzie River where surveys were completed for five new charts and a large portion of previously unsurveyed Mackenzie Bay was surveyed. A short reconnaissance was made up the Liard River.

In October, the ninth edition of Sailing Directions British Columbia Coast (south portion) Volume 1 was published, and increased from 344 to 401 pages. The manuscript of Volume 2 was completed, and the second edition of British Columbia Small Craft Guide, Volume 1 was updated and published. The first draft of Volume 2 has been started.

TIDAL AND CURRENT SECTION

The Tidal and Current Section conducted major programs in the Arctic and Pacific regions. On the north coast, Aanderaa tide gauges and current meters were flown to locations in the Beaufort Sea in May. Holes were blasted through the ice and the instruments, with moorings, were lowered by helicopter to the sea bed. Recovery of instruments by ship in August was greatly impeded by continuing ice cover, but, in spite of this two gauges were retrieved. The records from the stations, with data from gauges successfully operated along the coast, are being used in the numerical modelling of tide and storm surge progression. From this model will come a definition of critical areas and design criteria for offshore oil production, and improved information for navigation.

On the Pacific Coast, tidal and current surveys continued in Juan de Fuca, Haro, and Rosario straits, waterways of prime interest in fishing and subject to possible oil pollution from tanker traffic. Effective

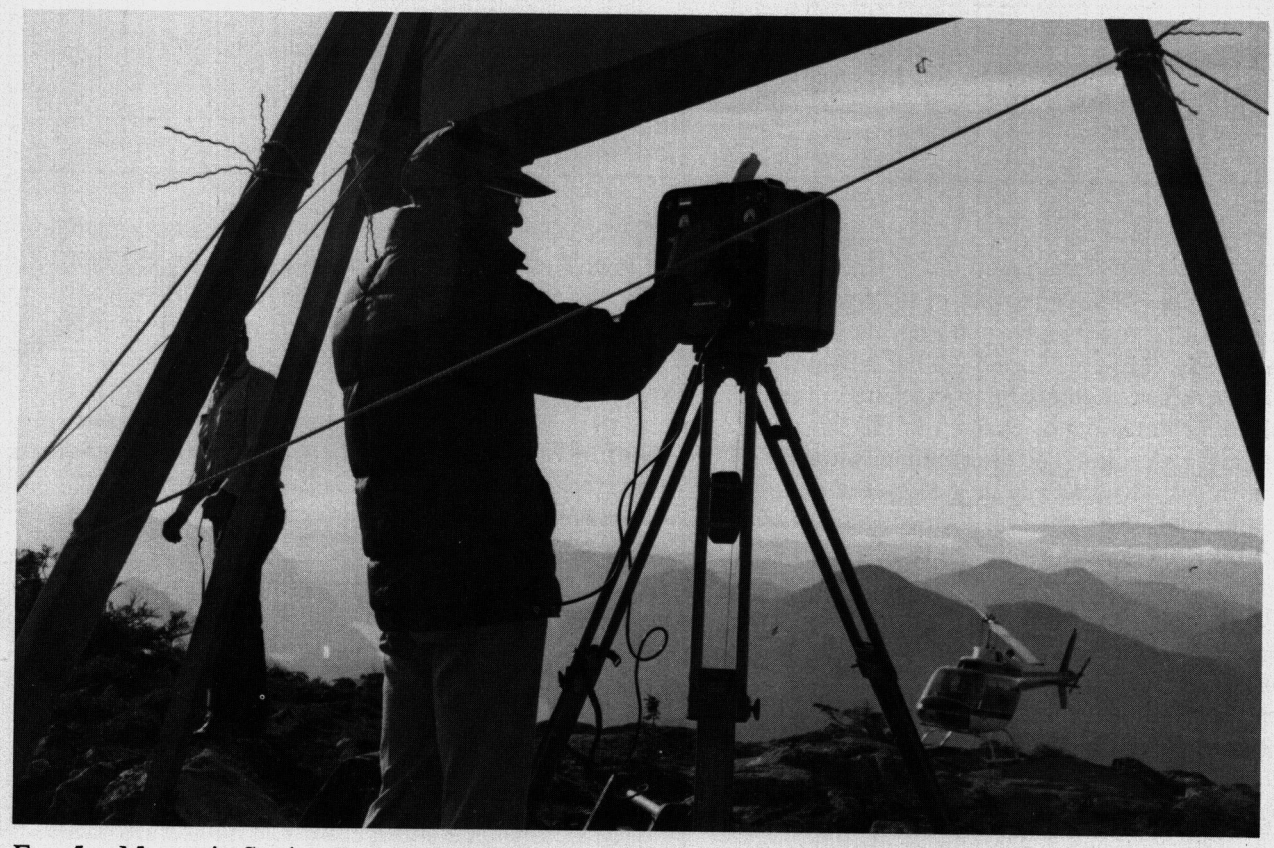


FIG. 5. Mountain Station Parson and Bell jet ranger helicopter.

FIG. 6. Better-than-average traverse station on Belize Inlet.

cooperation between Canadian and U.S. agencies has helped to develop an understanding of total water movement in the system.

Tidal predictions for the Fraser Estuary have been improved through the use of the recently completed numerical model. Modelling of Burrard Inlet is now under way.

Underwater tide gauges are being operated on four seamounts in the northeast Pacific, to provide a greater understanding of tidal movements influencing the B.C. coast.

CHART CONSTRUCTION SECTION

The chart compilation unit completed the following first editions in 1974: 3060 (Pitt River), 3985 (Approaches to Prince Rupert Harbour), 3992 (Approaches to Portland Inlet), 3993 (Work Channel). It has continued to supply graphic arts services for Directorate reports and displays, photography and printing requirements for charting and other uses.

The chart revision unit has compiled and drawn new hydrography for the publishing of seven new editions; 46 chart correction patches were published for the correction of nautical charts. There were 62 Notices to Mariners promulgated for national publication and 180 MAREP reports were received from the Canadian Power Boat squadrons with the appropriate action taken. Nomenclature queries were handled by this section with 16 new names submitted to the Canadian Board on Geographic Names; 4 amended and 5 rescinded.

The chart correction unit has hand-corrected 213,000 charts which required 2,043,000 corrections before distribution to authorized dealers.

This section constructed and staffed several displays for the Department. Displays were shown at the Vancouver International Boat and Sport Show for a 2-week period in February and a boat show at Park Royal for 2 weeks in June.

Overview of charting activities for 1975 will be oriented to the conversion of charts to metric. This will be done by rescribing charts that have not advanced too far in chart compilation, and reconstructing new editions wherever possible. The first metric conversion of a standard chart — Approaches to Vancouver Harbour, 3481 — will be shown at the Vancouver Boat Show in 1975.

HYDROGRAPHIC DEVELOPMENT GROUP

In the spring of 1973 J. Watt (engineer) and D. Gregson (electronics technician) transferred to Ottawa for a 1-year assignment with The Canada Centre for Remote Sensing (CCRS) to work on the airborne data acquisition system for the Aerial Hydrography Project. The object of this project is to develop an airborne surveying system for coastal hydrography. The aircraft installation consists of an inertial navigation platform, an aerial camera, a barometric altimeter, and a magnetic tape data logging system. Flight tests were conducted in June and August over the NRC photogrammetric test range near Sudbury, Ont. Analysis of the data is underway to determine if the positional and rotational parameters are sufficiently accurate. The analysis is being conducted jointly with the Pacific Region and The University of New Brunswick.

The second stage of this mapping system is the measurement of hydrographic parameters on the aerial photographs. This is accomplished using an analytical stereo plotter. Further development of this technique and, in particular, the evaluation of the numerical model to correct for refraction is continuing with another set of color photographs flown this year by CCRS with Pacific Region establishing the control.

Over the next few years approximately 200 charts are to be converted to metric. A thorough analysis of the alternative methods of conversion was completed. The results include a new metric chart format which will be developed using computer-assisted methods of compilation and drafting. The first chart of this series will be produced by the Chart Construction Section and published by the end of the year.

CCRS completed flights of shallow water aerial photography using Kodak's new water penetration film. This film is presently being evaluated to determine if it achieves greater penetration than the existing standard color photography.

Minimum level range/accuracy evaluations up to 21 km of the short range positioning systems were completed in 1973. Further evaluations are being conducted to refine the evaluations within 20 km and to extend the evaluations to a range of 100 km. A baseline has been established to take readings at 100 m intervals to 12 km and at 10 km intervals to 100 km.

Development of two offshore tide gauges was completed in the summer of 1973. These instruments were constructed as a M.A.Sc. thesis project at the University of B.C. The offshore gauge rests on the ocean floor and senses tidal fluctuations by measuring absolute water pressure to an equivalent depth resolution of 1 mm. Maximum depth of the gauge is 1000 m and, for a 12-month installation, samples are recorded on magnetic tape at 5-minute intervals. Subsequent to successful field trials, the two gauges were installed in the Beaufort Sea in October 1973. Due to severe ice conditions in 1974, only one gauge was recovered, but this instrument provided 6 months continuous tidal data.

FIG. 7. Ships and boats working on Seymour traverse.

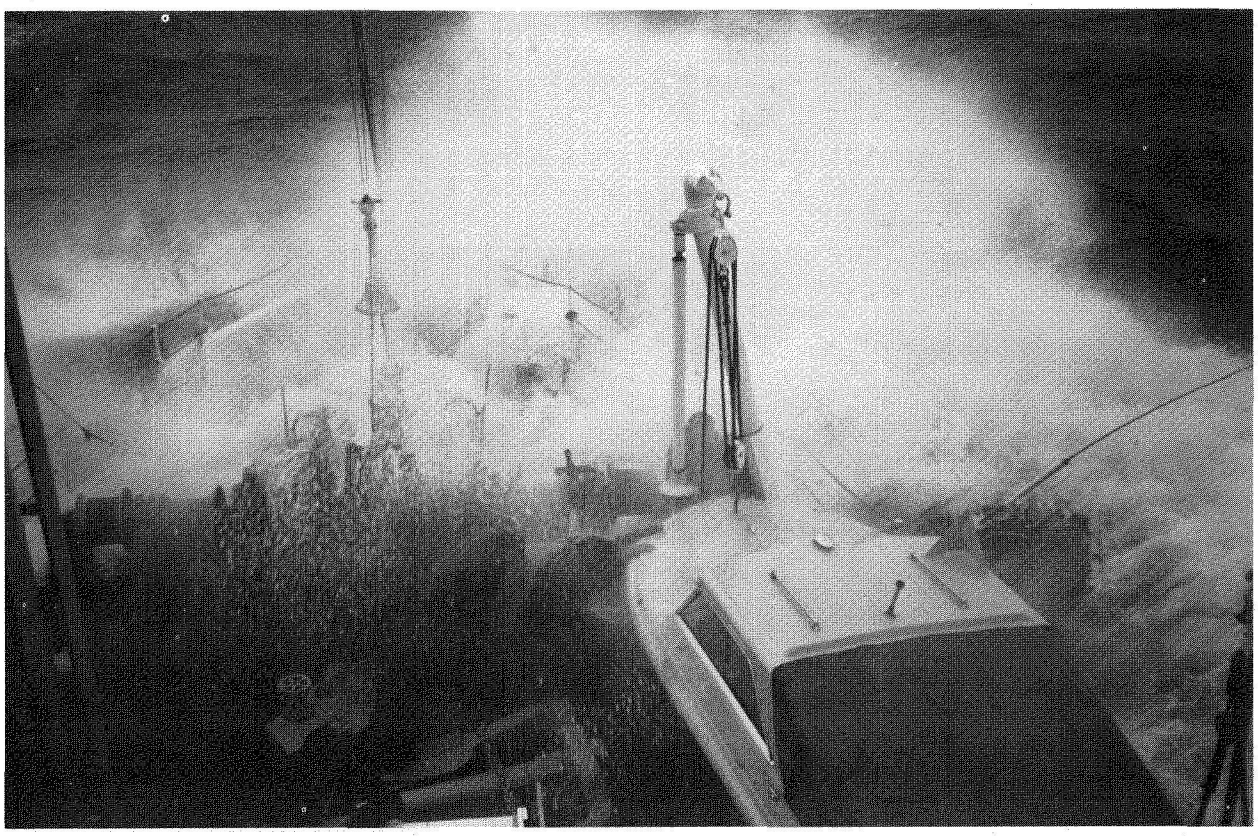


FIG. 8. The CSS *William J. Stewart* ships a green one as seamen gripe down the *Wren* on passage down the west coast of Vancouver Island.

1975

PROGRAMME DE LEVÉS HYDROGRAPHIQUES

HYDROGRAPHIC SURVEY PROGRAM

DEPUIS OCTOBRE 1974 AS OF OCTOBER 1974

1 2 3 3A 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 27A 28 29 30 31 32 33 34 35 36 37 38 39 40

QUEEN ELIZABETH ISLANDS
CANADA BASIN
BEAUFORT SEA
GREENLAND
BAFFIN BASIN
DAVIS STRAIT
HUDSON STRAIT
LABRADOR SEA
LABRADOR BASIN
NEWFOUNDLAND BASIN
SOHM ABYSSAL PLAIN
ATLANTIC OCEAN
NEW ENGLAND SEAMOUNT CHAIN
PACIFIC OCEAN
GULF OF ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND AND LABRADOR
NEW BRUNSWICK
PRINCE EDWARD ISLAND
NOVA SCOTIA
THE GRAND BANKS OF NEWFOUNDLAND
HUDSON BAY
JAMES BAY
FOXE BASIN
UNGAVA BAY
GULF OF ST. LAWRENCE
GULF OF MAINE
LAKE SUPERIOR
LAKE HURON
LAKE ONTARIO
LAKE ERIE
LAKE MICHIGAN
UNITED STATES OF AMERICA

Central Region

1.	Nares Strait	Navigational requirement, winter program supported logistically by polar continental shelf project.
2.	Belcher Channel	Horizontal control project for use in future hydrographic surveys, supported logistically by polar continental shelf project.
3.	Hudson Bay	Navigational–scientific requirements, reconnaissance commencement of long-range standard program.
3A.	Povungnituk	Navigational requirement, completion of former survey program.
4.	James Bay	Navigational–scientific requirements, winter reconnaissance program.
5.	Lake Winnipeg	Navigational requirements, continuing program to complete northern portion of the lake and harbours used by commercial and pleasure craft.
6.	Lake Huron and harbors	Navigational requirements, surveys will replace outdated survey data.
7.	Lake Erie	Navigation–scientific requirements.
8.	Lake Erie–Georgian Bay	Navigational requirements, revisions to existing charts.
9.	Toronto Harbour	Navigational requirement.
10.	Lake Ontario–St. Lawrence River	Navigational requirements, revisions to existing charts.
11.	Lower St. Lawrence River	Navigational requirement, new surveys will replace outdated leadline data.
12.	Lac St. Jean	Navigational requirement, possible contract survey.

Atlantic Region

13.	St. Lawrence Estuary	Navigational-scientific requirements, surveys will replace outdated leadline data.
14.	Miramichi Bay	Navigational–engineering requirements.
15.	Northumberland Strait (central portion)	Navigational requirement, surveys will replace outdated leadline data.
16.	Souris, P.E.I.	Navigational requirement, post-dredging survey.
17.	Bras D'or Lake	Navigational requirement, surveys will replace outdated leadline data.
18.	Halifax to Pictou	Navigational requirement, revisions to existing charts.
19.	Eastern Shore, N.S.	Navigational requirement, surveys will replace outdated leadline data.
20.	Halifax Harbour	Navigational requirement, surveys of ocean terminal wharves.
21.	St. Marys Bay	Navigational requirement, surveys, will replace outdated leadline data.
22.	Strait of Belle Isle	Navigational requirement, surveys will replace outdated leadline and French data.
23.	Labrador Sea	Navigational–fisheries–scientific requirements, long range program.
24.	Makkovik to Hopedale	Navigational requirement, coastal route.
25.	Cape White Handkerchief to Cape Chidley	Navigational requirement, Positioning of hazards to navigation in vicinity of coastal route.

Pacific Region

26.	Mackenzie River	Navigational requirement, revisions to existing charts.
26.	Liard River	Navigational requirement, no data available.
27.	Strait of Juan De Fuca and approaches	Navigational–scientific requirements.
27A	Strait of Juan De Fuca	Tidal current survey
28.	Barkley Sound	Navigational requirement, survey will replace outdated leadline data.
29.	Malaspina Inlet, Sabine Channel and Tucker Bay	Navigational requirements, surveys will replace outdated leadline data.
30.	Nanaimo Harbour	Navigational requirement, survey will replace outdated leadline data.
31.	Pitt Lake	Navigational requirement, unsurveyed, dense pleasure craft traffic.
32.	Vancouver Harbour, Strait of Georgia, and Fraser River	Navigational requirements, revisions to existing charts.
33.	Okanagan Lake	Navigational requirement, dense, pleasure craft traffic
34.	Skidegate Inlet	Navigational requirement, survey will replace outdated leadline data.
35.	Queen Charlotte Is.	Navigational requirements, revisions to existing charts.

Arctic

Tentative programs dependent upon available CHS resources and deployment of Canadian Coast guard vessels.

36.	Beaufort Sea	Navigational–scientific requirements, will complete surveys of Beaufort Sea.
37.	Victoria Strait	Navigational requirement, hazardous area, existing data is of very poor quality.
38.	Viscount Melville Sound	Navigational–scientific requirements, continuation of Northwest Passage survey.
39.	Wellington Channel, Queens Channel, and Penny Strait	Navigational requirement, existing data is of very poor quality.
40.	Foxe Basin	Navigational requirements, harbor surveys.

(See map following pages)

SURVEY ELECTRONICS SECTION

The Survey Electronics Section continued to provide technical support to the hydrographic field operations and engineering support to the Development Group and various divisions and sections within the Region. The Development Group has received support on the Aerial Hydrography Project and on many aspects of HAAPS and launch acquisition system studies. Efforts to support other divisions have been rewarded with completed projects and with a mechanism for keeping all technicians abreast of the latest developments in their field. Typical projects have been an Electronic Bathy-thermograph for coastal oceanography and various interface projects for the Ocean Chemistry Division.

The section worked with other groups in consultation on specifications for new systems and equipment and assistance during acceptance tests. The recent acquisition of the Midas system by the Remote Sensing Group provides an example of such efforts and resulted in a system which meets the requirement of the type of data acquisition system needed to carry out aerial hydrography in addition to the remote sensing requirements.

Survey Plans for 1975

It is anticipated that hydrographic survey work will continue at roughly the same level as in previous years. *CSS Parizeau* will again be available for Natural Resource charting in Hecate Strait and, dependant on the overall Beaufort Sea Program, for survey work in the western arctic.

It is hoped that a program on a contract basis can be undertaken to survey a deep draught tanker route in Juan de Fuca Strait and up the west coast of Vancouver Island.

CSS William J. Stewart will continue hydrographic surveys in Barkley Sound, including large scale surveys of Bamfield and Ucluelet and new surveys of Malaspina Inlet. Work on the Mackenzie River will continue with the *Radium Express*, including a reconnaissance of the Liard River.

The revisory survey program will continue from *CSS Richardson* and/or *Revisor*. Surveys of Nanaimo Harbour, Okanagan Lake, and possibly some small boat harbors will be undertaken as resources become available. A strong development effort is anticipated in the field of data logging and processing.

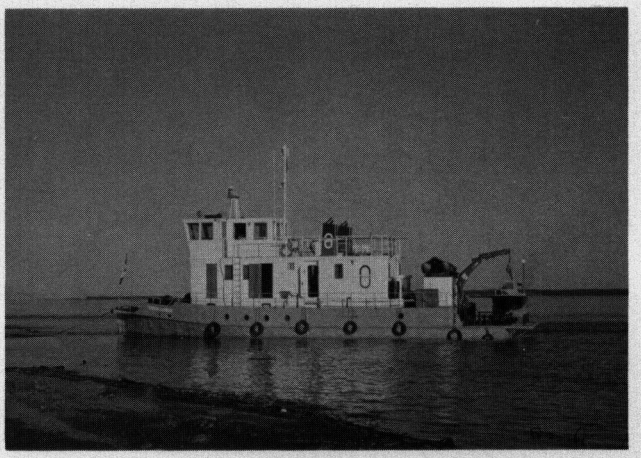


FIG. 9. Chartered vessel *Radium Express* secured for the night at Mile 559 on the Mackenzie River.


1974
HYDROGRAPHIC SURVEY PROGRAM
CENTRAL REGION
P.C.S.P. spot sounding
Eureka & Nansen Sound
CHESTERFIELD INLET
LAKE WINNIPEG
THUNDER BAY
REVISORY SURVEYS
Lake Superior & North Channel
CONTROL SURVEYS
LOWER ST. LAWRENCE R.
REVISORY SURVEYS
Montréal to Pte des Monts
BATHYMETRY & HARBOUR SURVEYS
TORONTO HARBOUR
FRENCHMAN BAY
LIMNOGEOLOGY

Central Region

INTRODUCTION

The Central Region is located at the Canada Centre for Inland Waters at Burlington, Ont. This large research institute provides laboratories and working areas for scientists and technical staff studying various aspects of water resources and management. Situated on the shore of Lake Ontario, it provides an ideal home for the Regional Hydrographic Division. Facilities for the survey fleet, computers, and drafting space are provided conveniently in one location.

Central Region's hydrographic activities encompass an area from the Saskatchewan–Manitoba border in the west to the St. Lawrence estuary in the east. In the north, regional activities cover Hudson and James bays and extend to the Arctic Islands.

The Hydrographic Division is one of three divisions, which with the Ship Division and Research and Development Division, plus Administration, make up the marine sciences organization at Burlington.

The work of the Central Region Hydrographic Division is primarily the collection and preliminary processing of hydrographic data. In addition, some attention is given to providing navigational assistance and advice to other groups working at the Centre for Inland Waters.

Hydrographic operations are directed into three main geographic thrusts and are supported by three types of technical support. The three geographic thrusts are: (1) surveys of the St. Lawrence River and Great Lakes System for commercial navigation; (2) surveys of the inland lakes and waterways to produce charts and publication for recreational boating; (3) surveys of arctic waters for navigation and resource development.

In the first of these areas much of the original survey work has been completed, although there remains extensive areas where soundings were collected by leadline. The emphasis is placed on maintaining the charts by resurveys and revisory surveys. In the second area, surveys are needed to produce special charts and publications to meet the needs of recreational boating. This sport has become increasingly popular, particularly in Ontario. In the third area, the search for hydrocarbons and the use of better vessels is opening the arctic to commercial navigation. The survey program must be accelerated to provide safe navigation and to map the undersea resources.

Associated with the hydrographic surveys is the provision of information on tides, tidal currents, and water levels. A small cartographic unit provides a graphic capability and a strong Technical Development Group ensures that surveys are provided with equipment and software to assist in efficient operations.

Survey Projects — Review

In the St. Lawrence River, a large survey unit worked out of Montmagny, surveying the channels in the vicinity of Ile aux Oies and Crane Island. Later in the season a survey of Chenal de l'île d'Orleans was carried out under contract. The surveys of the Lower St. Lawrence River were started in 1969, aimed at completion and the provision of new charts from the Saguenay to Quebec by 1976. This will coincide with completion of the deep-dredging of the North Traverse, southeast of Ile d'Orleans.

In the Great Lakes work was carried out in conjunction with inshore surficial geology studies along the north shore of Lake Erie in the general vicinity of Point Pelee. In Lake Huron a new program was started to survey the offshore bathymetry to improve knowledge of these large basins. This survey successfully used the high speed cutter *Advent* and utilized HAAPS. A survey of Frenchman's Bay near Toronto was completed, and a survey of Toronto Harbour was started.

The program of chart revision has been arranged in a cyclic system. Every second year charts of the parts of the lake that undergo frequent change are revised, and every fourth year charts of areas that are less changeable are revised. The large survey launches *Vedette* and *Verity* work in Lake Superior and the Lower St. Lawrence River respectively.

The program in Lake Winnipeg was in its second year. This operation has two components. The northern half of the lake itself is being surveyed and the harbors are being surveyed. The chartered vessel *Lady Canadian*, equipped with the latest automated equipment, measured many productive survey miles. Surveys of Hecla, Gull Harbour, Manigotogan River, and Gimli were completed.

An active program was maintained in the arctic. Hydrographers working with the Polar Continental Shelf Project and utilizing helicopters and through-ice sounding methods, surveyed almost the entire fiord system of Eureka Sound and Nansen Fiord.

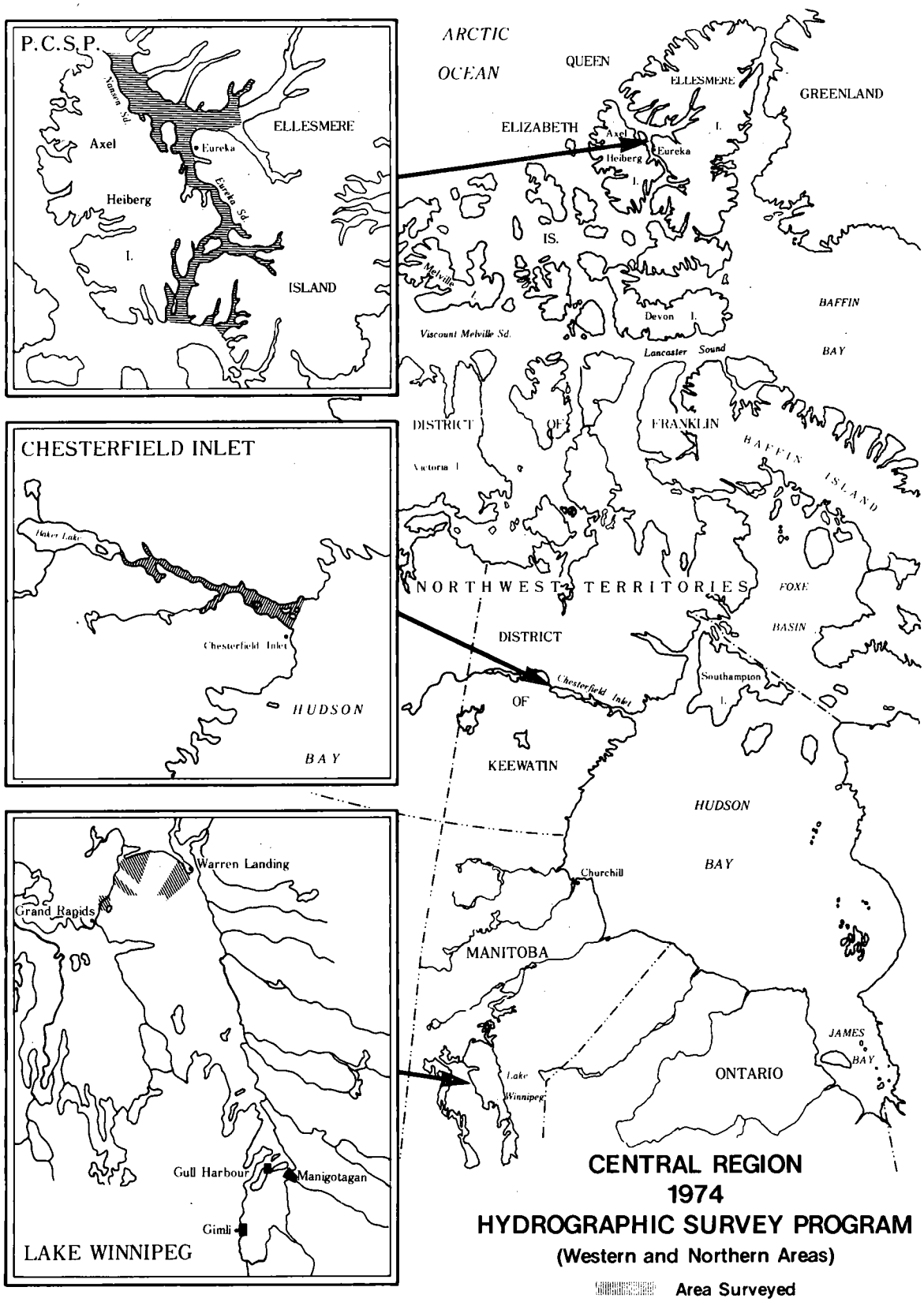


FIG. 10. Survey program of western and northern areas.

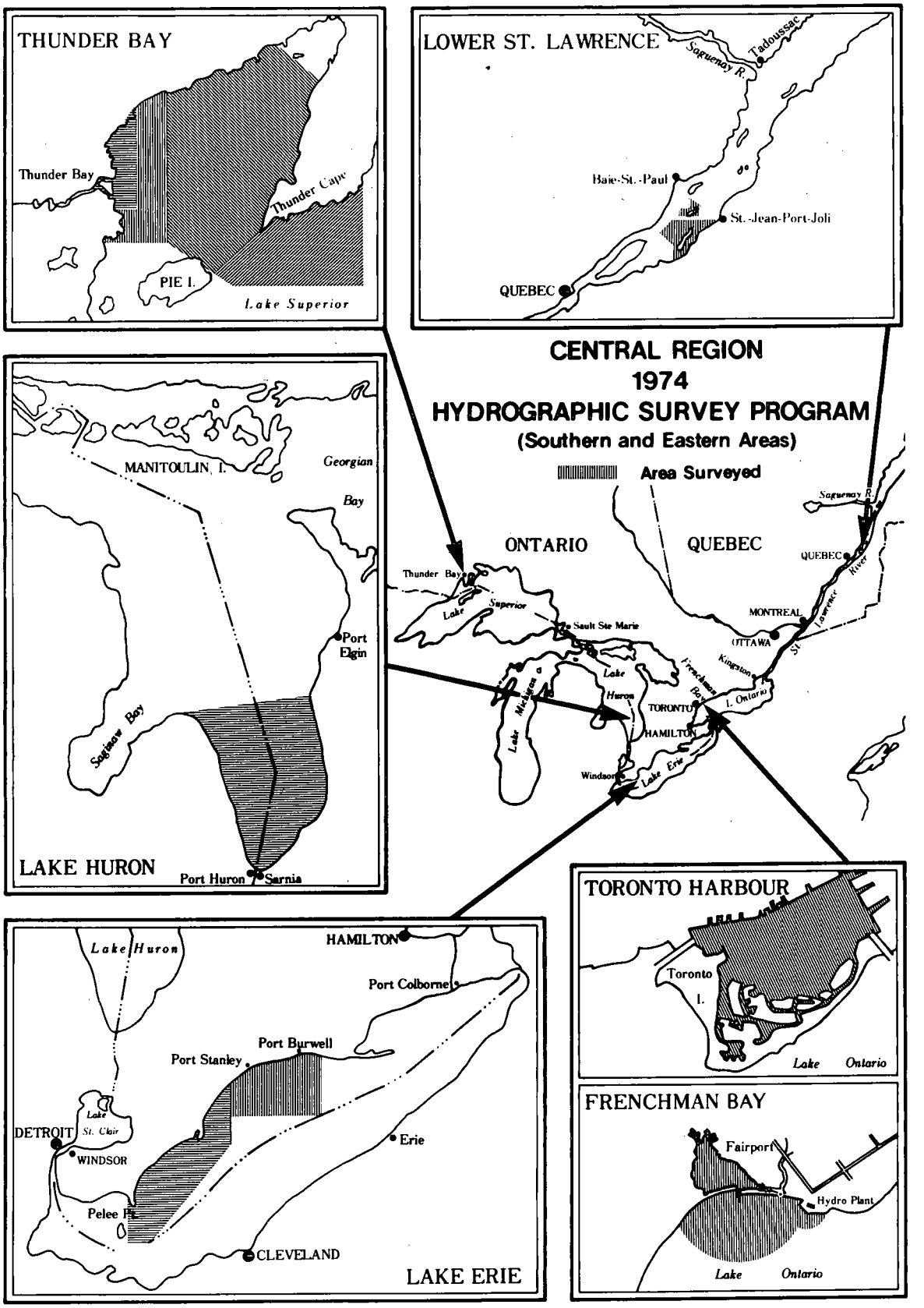


FIG. 11. Survey program of southern and eastern areas.

In Hudson Bay, a survey was completed of Chesterfield Inlet from the sea to Baker Lake. As a result, the *Narwhal* reached the settlement at Baker Lake, the largest ship to make this passage to date. The *Narwhal*, a Ministry of Transport vessel, provided an ideal base as a mother ship for two large launches and later as an oceanographic platform in James Bay. For a summary of the survey program see Table 1.

TIDES, CURRENTS, AND WATER LEVELS

The responsibility for tidal matters concerning navigation was returned to the Hydrographic Division, and a tidal instrument development group was transferred to the Region from Headquarters. The new tidal support group has been established with three men. Their responsibility will be to provide advice and assistance to the hydrographic survey parties on location of gauges, preparation of cotidal charts, data, and the analysis of data. The monthly and weekly water level bulletins for the Great Lakes have been redesigned and are now produced by this group. Assistance was provided in running a current survey in the St. Lawrence utilizing the *Bayfield*.

The tidal instrument group has undergone the administrative turmoil of reestablishing itself. Work has continued on a system to retransmit data via satellite. Responsibility for monitoring a major contract to maintain the permanent gauge telemetering network has been transferred to this group. A future program thrust has been developed.

SIGNIFICANT DEVELOPMENT PROJECTS

The Regional Office continues to promote an active program of technical development. Two major projects have been the development of a new automatic data collection and processing system, designated INDAPS (Integrated Navigation, Data Acquisition, and Processing System) and the evaluation of a Magnavox Satellite Doppler Sonar Integrated Navigation System. The INDAPS development has the record of being designed, built, and put into production within the year. It is an improved design on HAAPS. The Satellite Doppler Sonar System will provide navigation of a high order of accuracy for research ships on the Great Lakes but to date has not reached its specifications.

The GERBER 22 plotter has again been used extensively in the preparation of the final field sheets. The side scan sonar has been used in several areas but has had considerable electronic trouble.

Staff Exchange Program

Once again staff has been exchanged with National Ocean Survey to encourage the exchange of ideas and technical information.

TABLE 1. Summary of the survey program and some significant equipment used.

Survey area	Vessels	Positioning system	Field data processing
Lower St. Lawrence	2 × 35 ft 4 Botved 22 ft	Mini-ranger, Hydrodist	HAAPS (part time)
Lake Erie	Bertram 25 ft	RPS, Mini-ranger Minifix	Manual
Lake Huron	*Advent* (77 ft) *Bruce* (31 ft) *Vedette* (48 ft)	Minifix	HAAPS
Toronto Harbour	1 Botved 22 ft	Hydrodist	Manual
Thunder Bay	Contract		
L. Winnipeg offshore	4 Hydros. (25 ft) *Lady Canadian*	Minifix	INDAPS
L. Winnipeg Hbrs.	3 × 20–25 ft	Hydrodist	Manual
Polar Shelf	3 × 206 helicopters	RPS	Manual
Chesterfield Inlet	2 × 35 feet 1 × 20 feet	Mini-rangers	HAAPS
Revisory–St. Lawrence	*Verity*	Hydrodist	Manual
Revisory–Superior	*Vedette*	Hydrodist	Manual

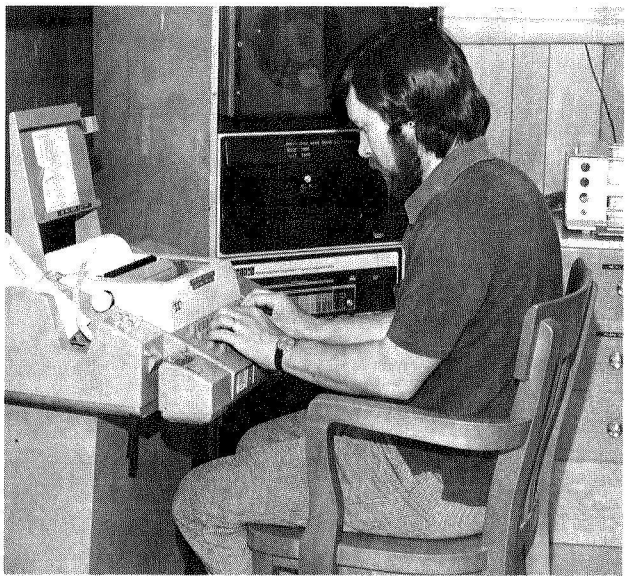


FIG. 12. The HAAPS processing system.

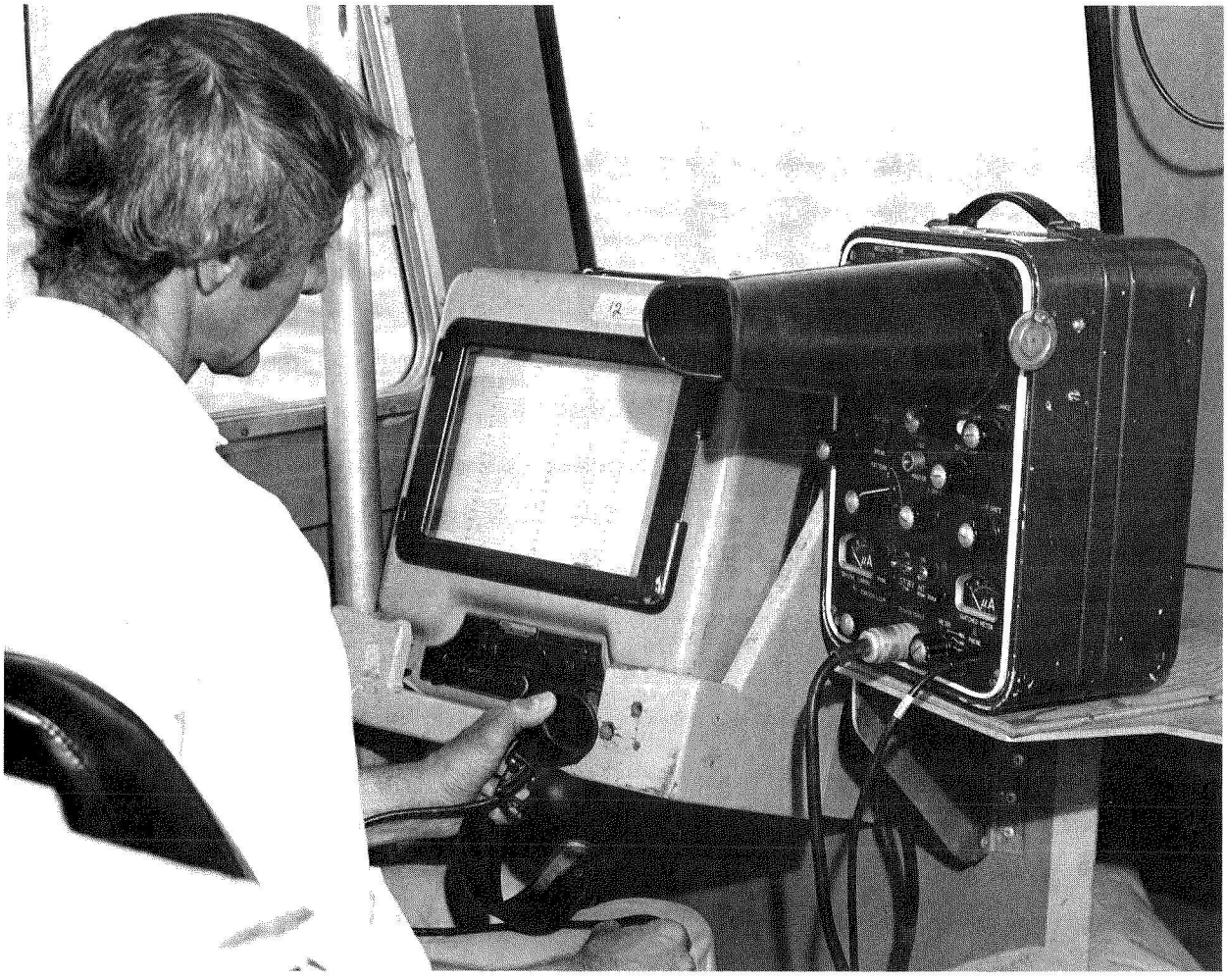


FIG. 13. MRB 2 hydrodist and Ratheon echo sounder.

Hydrographic Conference

The Annual Hydrographic Conference was sponsored by Central Region CHS/CHA (Canadian Hydrographers' Association) this year. The Conference, held in March, attracted a large delegation of U.S. hydrographers and several European hydrographers.

PLANS FOR 1975

The survey of the Lower St. Lawrence is to be completed. In the Great Lakes, hydrographers will continue to work with geologists in the western end of Lake Erie. The bathymetric survey of Lake Huron will continue. Revisory surveyors will be working in Georgian Bay, Lake Ontario, and the Upper St. Lawrence. The survey of Toronto Harbour will be completed.

Surveys in Lake Winnipeg will continue. It is planned to complete the harbor surveys but the offshore area will take several more years.

In the arctic, hydrographers will be working with the Polar Continental Shelf Project in Nares Strait. The most important new project will be a major offshore bathymetric/geophysical survey of Hudson Bay. Associated with that survey will be a shore-based survey at Povungnituk. Another new project will take place in the spring in James Bay. Working with the Dominion Observatory, a through-ice survey is planned for the area, extending over 2 years.

It is planned to use the Satnav/Doppler System for navigation on the Hudson Bay multiparameter survey. Based on the success of the INDAPS it is planned to equip both the Lake Huron and Lake Winnipeg surveys with that equipment. The HAAPS will be used with the St. Lawrence surveys.

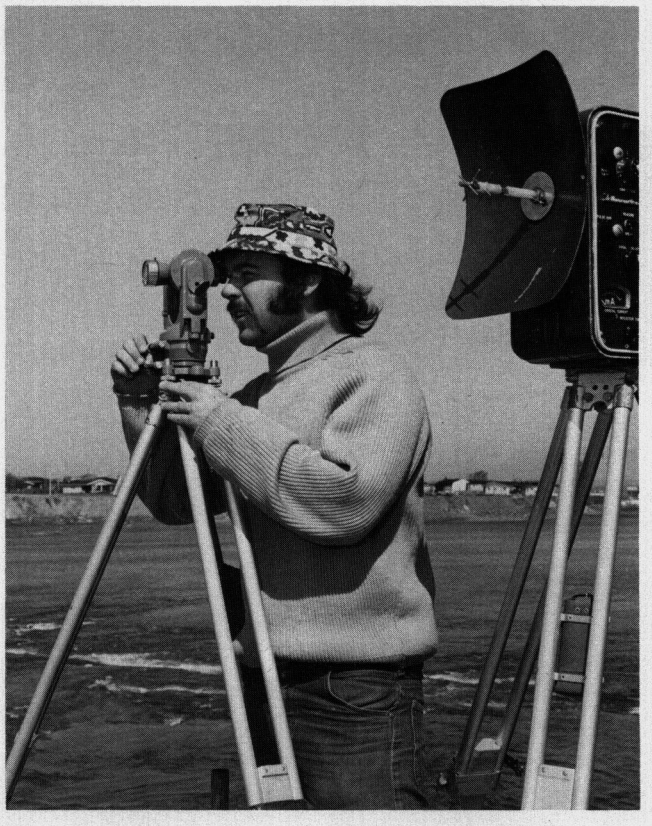


FIG. 14. MRB 2 hydrodist shore station when used in range/bearing mode.

FIG. 15. The *Lady Canadian*, a charter vessel used for Lake Winnipeg surveys. In spite of its elderly appearance, this vessel was filled with the latest INDAPS automated equipment. (Note the outboard transducer strut.)


1974
HYDROGRAPHIC SURVEY PROGRAM
ATLANTIC REGION
Reconnaissance track soundings by Canadian Coast Guard vessels.
LANCASTER SOUND
PANGNIRTUNG
INNUIT HEAD
Frobisher Bay
LABRADOR SEA
DAVIS INLET TO NAIN
GOOSE BAY NARROWS
ALEXIS RIVER
NATASHQUAN BANK
ST. LAWRENCE ESTUARY
DALHOUSIE
SHIPPEGAN
MIRAMICHI BAY
SAINT JOHN RIVER
SAINT JOHN HARBOUR
YARMOUTH HARBOUR & APPROACHES
ST. JOHN'S HARBOUR TO SACRED BAY
PLACENTIA BAY
ST. MARY'S BAY
STEPHENVILLE POND
GRAND BAY
NORTH SYDNEY
BRAS D'OR LAKE
NICHOL I. TO DUCK I.
SHOAL COVE
Blandford
SHELBURNE
BAFFIN ISLAND
DAVIS STRAIT
HUDSON STRAIT
HUDSON BAY
GREENLAND (DENMARK)
REYKJANES RIDGE
LABRADOR BASIN
NEWFOUNDLAND
NOVA SCOTIA
NEW BRUNSWICK
PRINCE EDWARD ISLAND
ONTARIO
QUEBEC
LAKE SUPERIOR
LAKE HURON
LAKE MICHIGAN
LAKE ONTARIO
NEW ENGLAND SEAMOUNTS
ATLANTIC

Atlantic Region

INTRODUCTION

The Hydrography Division is one of five program divisions within the Atlantic Oceanographic Laboratory of the Bedford Institute of Oceanography. The prime responsibility of the A.O.L. Hydrography Division is the charting of all navigable waters within the region to satisfy the requirements of the mariner. A further responsibility is the survey of the Continental Margin, in close cooperation with the Atlantic Geoscience Centre, for the production of natural resource maps.

Two new departures in the Atlantic Region program evolved in 1974. The first is surveys of the Labrador Sea to secure data for a regional outlook of the entire area which will allow the efficient execution of detailed surveys. The second departure is the management of contract surveys and the operation responsibility of a production-training survey in Guyana, South America.

To fulfill the regional and national responsibilities the division is composed of four sections — charting, development, navigation, and tidal. The activities of the division are discussed under these general headings.

CHARTING

The Charting Section has the responsibility of planning and conducting field surveys of navigable waters within the Atlantic Region for the production of navigational charts and related publications. In 1974, seven survey establishments were placed in the field. The field season began in early May and terminated in late October. The main charting area was concentrated in the eastern Arctic–Subarctic, St. Lawrence Estuary, and the Labrador Sea. In addition to the normal survey program, the Atlantic Region had the operational responsibility

TABLE 2. Projects of the various establishments during 1974.

Establishment	Area	Type of Survey
CSS *Baffin*	Guyana, S.A.	Navigational charting, engineering studies, and training
	St. Lawrence Estuary	Navigational charting, gravity and magnetics
	Lancaster Sound	Standard charting and magnetics
Charter vessel I	Labrador Sea	Regional multidisciplinary survey. Bathymetry, gravity, and magnetics 20 mile line spacing, seismic 40 mile line spacing
Chapter vessel II	St. Mary's Bay, Nfld.	Standard charting
	Davis Inlet to Nain, Lab.	Route
CSS *Maxwell*	Yarmouth Harbour, N. S.	Chart revision
	Saint John Hbr., N.B.	Chart revision
	Dalhousie, N.B.	Channel survey
	Grand Bay, Nfld.	Standard charting
	Placentia Bay, Nfld.	Anchorage & engineering surveys
Shore party	Eastern Shore, N.S.	Nichol I. to Duck I.
	Bras d'Or Lake, N.S.	Standard charting
		Standard charting
Chapter III	Pistolet Bay to St. John's, Nfld.	Revisory and range surveys
Eastern arctic surveys	Eastern arctic	Track soundings from CCGS *Louis St. Laurent*, CCGS *John A. Macdonald*, CCGS *Labrador*, and CCGS *Norman McLeod Rogers*

for a production-training cruise in Guyana, South America, operating under a grant from the Canadian International Development Agency. A further responsibility was the management of a contract survey for engineering and navigational purposes in the Miramichi River, N. B.

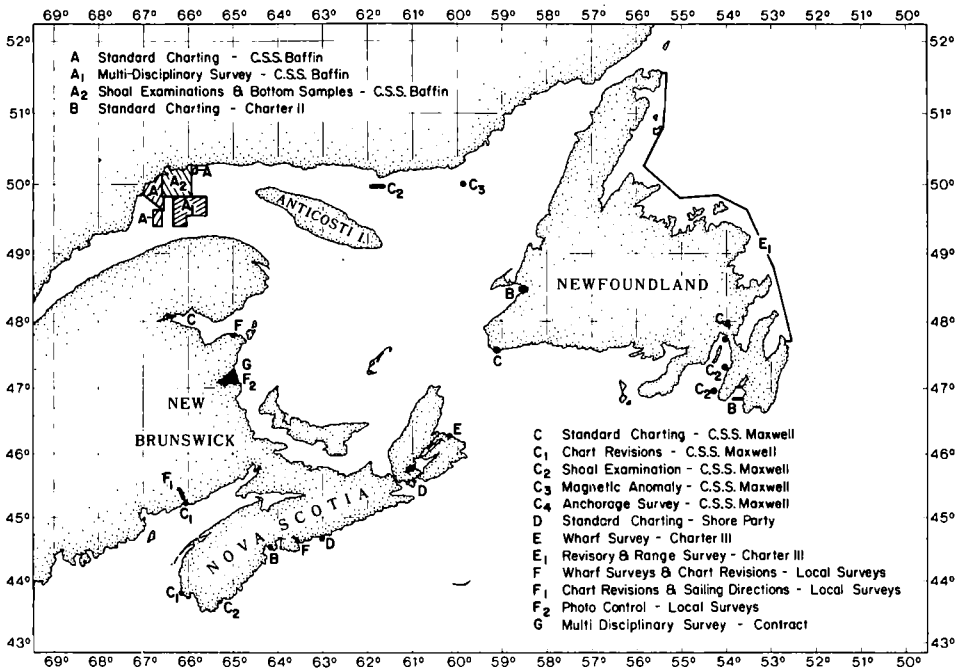


FIG. 16. Some projects undertaken by Atlantic Region.

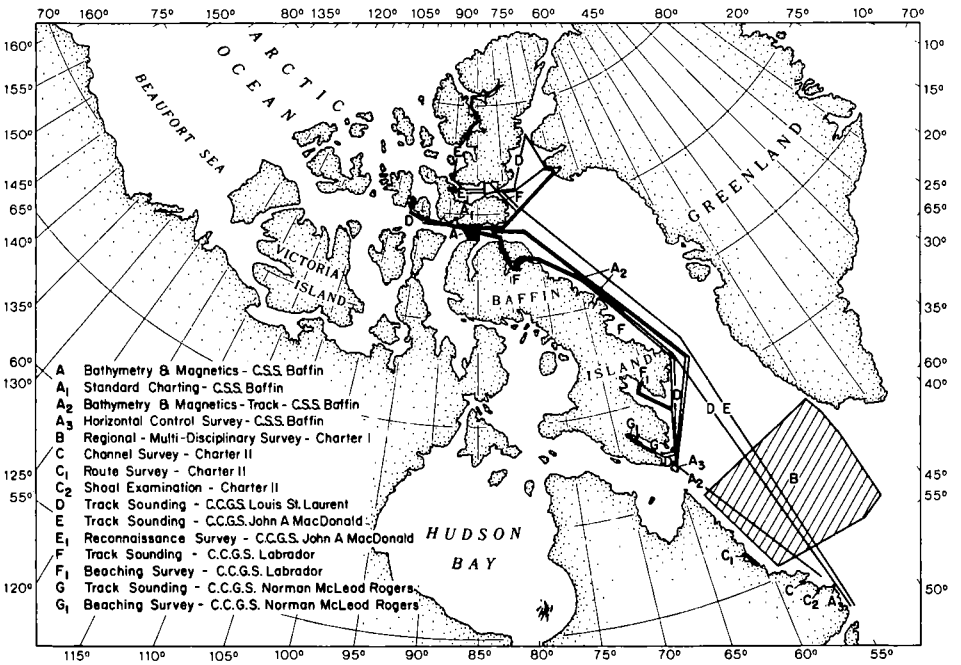


FIG. 17. Surveys of Labrador Sea.

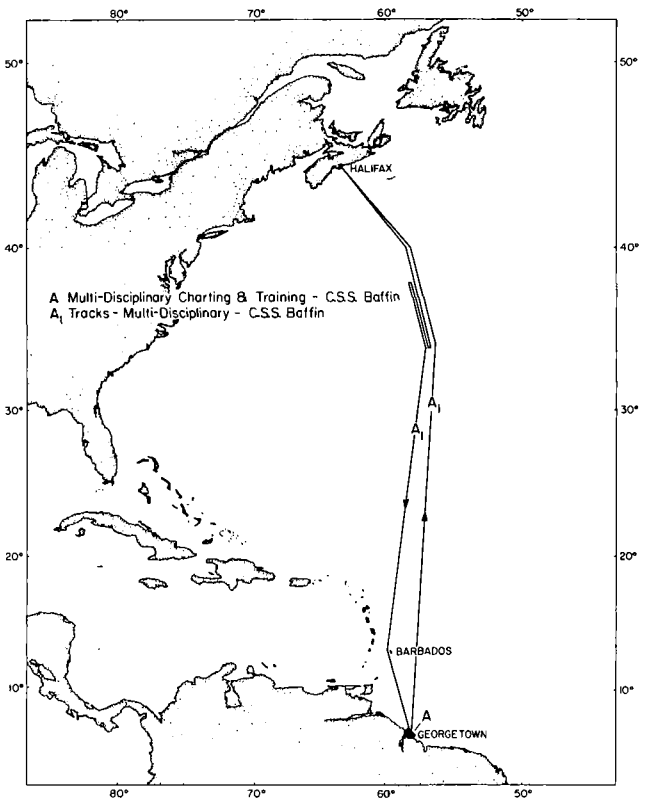


FIG. 18. Production–training survey, Guyana, South America.

A brief outline of the projects carried out by the various establishments in 1974 is shown in Table 2. Many projects of a minor nature were undertaken and completed as shown in Fig. 16, 17, and 18. Many projects were conducted by the local surveys establishment.

The field season was successful as evidenced by the large number of completed projects. The only mar on this successful program was the unfortunate grounding of Charter I (M.V. *Minna*) and subsequent loss at Resolution Island, N.W.T.

In 1975, a similar program is envisaged for the charting section with the exception of the Guyana cruise and the contract survey. The Gulf of St. Lawrence, Labrador Coast, northeast Newfoundland Shelf, and Fox Basin will be the main areas of concentration.

NAVIGATION GROUP

Interest in LORAN-C as a permanent long-range aid to navigation was increased by the announcement May 16 by the U.S. Department of Transportation that 12 new transmitters will be built to cover the entire U.S. coastal zone by 1980. As one of the few regular users in Canada, the navigation group has investigated the possible extension of the LORAN-C network into Canada, which would be of great benefit to hydrographic surveying, and has spread information about the characteristics of LORAN-C among hydrographers and other potential users.

It was significant that the surveying done by Charter No. 1 in the Labrador Sea July and August was positioned entirely by the Satellite Navigation (Satnav)/Rho-Rho LORAN-C combination.

A Sperry 2 MHz Doppler sonar speed log was installed in *Minna* and functioned well in rough weather and, very importantly for BIO operations, in ice-covered waters. Evaluation of an Edo 450 kHz Doppler speed log showed accuracy of better than $\pm$ 1% and bottom lock to 125 m.

A chapter on the characteristics and accuracy of radio positioning systems has been contributed for new edition of the *Workshop on Offshore Surveys*, published by the Department of Energy, Mines, and Resources.

An evaluation of Satnav accuracy showed a standard deviation of $\pm$ 120 m between ranges measured by Lambda DECCA compared with ranges calculated from high quality Satnav fixes.

Courses in Satnav and LORAN-C have been given for ship's officers, hydrographers, and scientists, and seminars have been given at the University of New Brunswick and the Canadian Coast Guard College.

TIDAL

The Tidal Section has the responsibility of directing the tidal, tidal current, and water levels work carried out by the CHS in the Atlantic Region.

The current meter program consisted of moorings in almost every corner of the region, ranging from the Bay of Fundy to the arctic. The total number of moorings will be about 12. As before, H.W. buoyant meters are used.

The data processing capability of the section was enhanced by the acquisition of a Gradicon coordinate digitizer. Software was developed to permit trouble-free processing of tidal charts. In addition, further work on tidal data management, using both the in-house CDC 3150 and the Dalhousie CDC 6600, has been undertaken to permit faster data processing.

Early in the year, the section acquired an Aanderaa offshore tide gauge, Model TG-1A. After preliminary testing, a program of measurement of the tides on the self areas was embarked upon. Due to the high loss factor with ocean moorings and the fact that the section has only one tide gauge, arrangements were made with Mobil Oil and Shell Oil to use their semi-submersible drill rigs as mooring platforms. Moorings were made at three locations: Sable Bank,

Cabot Strait, and Lehave Bank. As there were no instrument failures, data returns were 100%.

The telemetry system for the in situ tide gauge was completed by Systems Engineering early in the summer, and reasonably successful field trials were held. The system only requires some small modifications to the gauge itself to become fully operational.

HYDROGRAPHIC DEVELOPMENT

The primary role of the Hydrographic Development Section is to investigate and implement instrumentation and techniques designed to increase the efficiency and accuracy with which a hydrographic survey can be conducted. A variety of projects were carried out in 1974.

In addition, a number of utility routines have been written to facilitate the manipulation and editing of data on a Hewlett-Packard 2100 computer system. Paper tape, the basis of the current PDP-8 processing system, has proved to be somewhat of a data processing bottleneck. It is hoped that a Hewlett-Packard 2100 system, with disc, magnetic tape, and line printer, will be phased into the HAAPS operation over the next few years. The increased speed and flexibility of a disc operating system can eliminate many present problems.

A high precision flat bed plotter will be acquired in 1975. This will be used to plot grids, projections, and lattices for field operations and to post bathymetry for automated surveys. System evaluations are in progress and software has been written to facilitate the composition and editing of computerized title blocks.

The Region has acquired a Gradicon Digitizer table. Programs are now available to digitize shoreline data from UTM and Polyconic projections. Another role for this instrument will be the digitization of the portions of field surveys that cannot be conveniently handled by automated data logging systems. Table effectiveness will be greatly increased if the new cursor under investigation by the Charting Development Division in Ottawa is developed.

Addendum

NEW CHARTS RELEASED 1974

No.	Title	Scale	Ed date	Remarks
812 H	Scotian Shelf and adjacent areas	1,000,000	1974	Bathy
885	L. Superior	600,000	21/12/73	Bathy
2315	Harbors on the east shore, L. Superior	Various	31/05/74	
3454	Gabriola Passage to Ballenas I.	40,000	05/07/74	
3532	Baynes Sound & approaches	40,000	07/09/74	
3703	Plans in vicinity of Prince Rupert Harbour	Various	07/06/74	
4141	Saint John to Evandale	30,000	15/02/74	Small craft
4531	Carmanville to Bacalhao I. and Fogo	40,000	24/05/74	
5001	Strait of Belle Isle to Davis Strait	3,500,000	31/05/74	Metric INT 110
5150	White Bear I. to Ragged I.	100,000	30/08/74	
5151	Ragged I. to Turnavik I.	100,000	25/10/74	
5705	Cape Dufferin to Broughton I.	250,000	21/06/74	
5706	Broughton I. to Belanger I.	250,000	21/06/74	
5707	Belanger I. to Long I.	250,000	21/06/74	
6213	Whitefish Bay	40,000	09/11/73	
6441	West Channel including Anderton, Ministcog, and Moose channels to Shoalwater Bay	50,000	01/03/74	Metric
7302	Lady Ann Strait to Smith Sound	500,000	14/06/74	Metric
7619	Dease Strait	200,000	03/05/74	Metric
7651	Toker P. to Capes Lyon and Kellett	500,000	14/06/74	Metric
7954	Cape Stallworthy to Cape Discovery	500,000	17/05/74	
L,D2 8012	Flemish Pass	350,000	09/11/73	Fisheries
L,D2 8013	Flemish Cap	350,000	30/11/73	Fisheries
L,D2 8014	Grand Banc partie nord-est/Grand Banks N.E. portion	350,000	07/06/74	Bilingual fisheries
10028	Establishments & areas of responsibility	15,840,000	1973	Special

NEW EDITIONS PUBLISHED 1974

No.	Title	Scale	Ed date	Remarks
D9 1204	I. du Bic to I. Verte (Green I.)	79,000	16/08/74	Traffic separation
1207 D9	Cap aux Oies à/to Grosse I.	77,800	12/07/74	Bilingual
1210 D9	R. Betsiamites (Bersimis to I. du Bic Pointe des Montes à/to R. Saguenay	94,300 260,000	30/08/74 16/08/74	Traffic separation Traffic separation
1225				
1325	R. Richelieu-Sorel to Beloeil Bridge	31,800	17/05/74	
1326	R. Richelieu-Bassin de Chambly to L. Champlain	31,800	26/04/74	
1336	Champlain au/to L. Saint-Pierre	36,000	24/05/74	
1418	McDonald Pt. to Grenadier I.	25,000	19/04/74	
1419	Grenadier I. to Grindstone I.	25,000	20/09/74	
1421	Carleton I. to Charity Shoal	30,000	21/06/74	

No.	Title	Scale	Ed date	Remarks
1459	Kingston Harbour & approaches	12,000	23/11/73	
1513	Smiths Falls to Kingston	20,000	19/04/74	Small craft
2021	Trenton to Healey Falls Lock	20,000	17/05/74	Small craft
2031	Murray Canal–Presqu'ile Bay to Trenton	20,000	17/05/74	Small craft
2060	Main Duck I. to Scotch Bonnet I.	77,700	14/06/74	
2064	Kingston to False Ducks I.	61,200	28/07/74	
2070	Harbors in L. Ontario	Various	01/03/74	
2183	Pelee Passage to Detroit R.	75,000	23/11/74	
2294	Little Current & approaches	12,000	03/03/74	
3051	Shuswap L.	75,000	21/09/73	Small craft
3470	Plans in the vicinity of Saltspring I.	Various	21/06/74	
3482	Vancouver Harbour (western portion)	10,000	19/04/74	
3585	Nanoose Harbour & approaches	16,680	03/05/74	
3607	Juan de Fuca Strait	158,100	18/10/74	Traffic separation
3609	Alberni Inlet	38,800	10/05/74	
3663	Esperanza Inlet	40,000	31/05/74	
3736	Kitimat & Kemano Bay	12,200	21/06/74	
3804	Masset Harbour & approaches	20,100	07/09/73	
L,D-4012	Yarmouth to Halifax	300,000	23/11/73	
D7-4320	Egg I. to West Ironbound I.	145,000	28/09/73	Instruction
4347	Charles I. to Osborne Head	58,000	29/03/74	
4384	Pearl I. to Cape la Have	39,000	31/05/74	
4613	Argentina & Ship harbours	25,000	19/07/74	
D6-4622	Cape St. Mary's to Argentia Harbour & Jude I.	80,000	25/10/74	Traffic separation
5430	Entrance to Chesterfield Inlet	30,000	18/01/74	
5431	Black Rocks Pt. to Imilit I.	31,700	18/01/74	
5432	Imilit I. to Dangerous Pt.	31,700	18/01/74	
5433	Dangerous Pt. to East Pt.	31,700	18/01/74	
5434	East Pt. to Promise Pt.	31,700	18/01/74	
5435	Promise Pt. to Primrose I.	31,700	18/01/74	
5436	Primrose I. to Cross Bay	31,700	18/01/74	
5437	Cross Bay to Bowell I.	31,700	18/01/74	
5438	Baker L. (eastern portion)	36,000	18/01/74	
5439	Baker L.	100,000	18/01/74	
5800	James Bay	500,000	19/07/74	
5801	Long I. to Fort George	150,000	24/05/74	Metric
5820	Loon I. et approaches/& approaches	30,000	21/06/74	Metric bilingual
6023	Lake of Bays	25,000	19/04/74	
6371	Harbors in Great Slave L.	Various	01/03/74	Metric
6375	Pt. Desmarais to Matheson I.	21,100	14/06/74	
6376	Matheson I. to Willow Pt.	21,100	14/06/74	
6377	Beaver L.	31,700	14/06/74	
6405	Dory Pt. to Meridian I.	25,000	01/03/74	Metric
6406	Meridian Is. to Axe Pt.	50,000	01/03/74	"
6407	Axe Pt. to Cache I.	50,000	01/03/74	"
6408	Cache I. to Rabbitskin R.	50,000	01/03/74	"
6409	Rabbitskin R. to Fort Simpson	25,000	01/03/74	"
6410	Fort Simpson to Trail R.	50,000	01/03/74	"
6411	Trail R. to Camsell Bend	50,000	01/03/74	"
6412	Camsell Bend to McGern I.	50,000	01/03/74	"
6413	McGern I. to Wrigley R.	50,000	01/03/74	"
6414	Wrigley R. to Three Finger Creek	50,000	01/03/74	"
6415	Three Finger Creek to Saline I.	50,000	01/03/74	"
6416	Saline I. to Police I.	50,000	01/03/74	"
6417	Fort Norman–Police I. to Halfway I.	50,000	01/03/74	"

No.	Title	Scale	Ed date	Remarks
6418	Norman Wells–Halfway I. to Rader I.	50,000	01/03/74	Metric
6419	Norman Wells to Svenson I.	50,000	01/03/74	"
6420	Svenson I. to Hardie I.	50,000	01/03/74	"
6421	Hardie I. to Fort Good Hope	50,000	01/03/74	"
6422	Fort Good Hope to Askew I.	50,000	01/03/74	"
6423	Askew I. to Bryan I.	50,000	01/03/74	"
6424	Bryan I. to Travaillant R.	50,000	01/03/74	"
6425	Travaillant R. to Adam Cabin Creek	50,000	01/03/74	"
6426	Adam Cabin Creek to Pt. Separation	50,000	01/03/74	"
6427	Pt. Separation to Aklavik Channel	50,000	01/03/74	"
6428	Aklavik Channel to Napoiak Channel including Aklavik Channel to Aklavik	50,000	01/03/74	"
6429	Mile 975 to Mile 1015 including East Channel	50,000	01/03/74	"
6430	East Channel	50,000	01/03/74	"
6431	East Channel Lousy Pt. to Tuktoyaktuk	50,000	01/03/74	"
6432	Mile 925 to Inuvik East Channel	50,000	01/03/74	"
6433	West Channel, Aklavik to Mackenzie Bay	50,000	01/03/74	"
6434	Reindeer Channel, Tununuk Pt. to Shallow Bay	50,000	01/03/74	"
6435	Middle Channel, Tununuk Pt. to Mackenzie Bay	50,000	01/03/74	"
6436	Napoiak Channel including Schooner and Taylor channels	50,000	01/03/74	"
6437	Mackenzie Delta, Peel Channel including Husky and Phillips Channel	50,000	01/03/74	"
6438	Peel R., Mackenzie R. to Road I.	50,000	01/03/74	"
6439	Peel R., Road I. to Snake R.	50,000	01/03/74	"
6440	Arctic Red R. to Martin House	50,000	01/03/74	"
6451	Sans Sault Rapids	20,000	01/03/74	"
L-7011	Hudson Strait to Gronland (Greenland)	1,500,000	01/03/74	
7051	Cumberland Sound	450,000	14/12/73	
7220	Eastern approaches to Parry Channel	500,000	14/06/74	
7225	Clyde Inlet	63,400	28/06/74	
7371	Alexandra Fiord	25,000	14/12/73	Metric
7410	Spicer I. to Fury & Hecla straits	200,000	17/05/74	
7527	Erebus & Radstock bays	50,000	12/04/74	Metric
7605	Toker Pt. to Cape Dalhousie	150,000	03/05/74	
7606	Cape Dalhousie to Baillie I.	150,000	19/07/74	
7650	Barter I. to Toker Pt.	500,000	03/05/74	
7670	Bernard Harbour to Lady Franklin Pt.	75,000	14/12/73	Metric
7830	Cornwallis I. to Stefansson I.	500,000	21/06/74	
7930	Hell Gate & Cardigan Strait	75,000	15/03/74	
7940	Eureka Sound & southern approaches	300,000	14/06/74	
7950	Jones Sound Norwegian Bay & Queens Channel	500,000	12/07/74	
S-200	Chenal Maritime du Saint-Laurent/St. Lawrence Ship Channel	125,000	1974	

IBs AND CHART INDEXES PUBLISHED 1974

No.	Title	Ed Date
IB 1	Great Lakes & adjacent waterways	Jan. 74
IB 5	St. Lawrence R.	Sept. 73
IB 6	Northwestern Canada, Mackenzie R. Basin	Sept. 73
IB 7	Island of Nfld. and north shore Gulf of St. Lawrence	Sept. 73
IB 8	Nova Scotia, New Brunswick, and Prince Edward Island	Sept. 73
IB 13	Southern British Columbia including Vancouver I.	Sept. 73
IB 14	Northern British Columbia Coast including Queen Charlotte I.	Jan. 74
IB 15	Canadian Arctic	Jan. 74
IB 20	Atlantic Coast — Index of fisheries & coastal charts	Feb. 74
Plate IX	Index to charts — Nova Scotia (S.E. coast) & Bay of Fundy Pilot	1974
Plate XVIIA XVIIB	Index to Charts — Labrador and Hudson Bay Pilot Index des cartes — Labrador et la baie d'Hudson	1974

NRS MAPS PUBLISHED 1974

No.	Scale	Ed date	Remarks
830A	500,000	1974	
M	"	"	
14928B	250,000	"	Bilingual
C	"	"	
14938B	"	"	"
C	"	"	"
14958B	"	"	"
C	"	"	"
14962B	"	"	"
C	"	"	"
14964B	"	"	"
C	"	"	"
14966A	"	1973	
B	"	1974	Bilingual
C	"	"	"
14968B	"	"	"
C	"	"	"
14972B	"	"	"
C	"	"	"

No.	Scale	Ed date	Remarks
14974B	250,000	1974	Bilingual
C	"	"	"
14976	"	"	
A	"	"	Bilingual
14982B	"	"	"
C	"	"	"
14984B	"	"	"
C	"	"	"
14986	"	"	
A	"	"	Bilingual
15020B	"	"	"
C	"	"	"
15030B	"	"	"
C	"	"	"
15032A	"	1973	
B	"	1974	Bilingual
C	"	"	"
15042	"	1973	
A	"	"	
15044A	"	1973	
15050B	"	1974	Bilingual
C	"	"	"
15056B	"	"	"
C	"	"	"
15058B	"	"	"
C	"	"	"
15060B	"	"	"
C	"	"	"
15076A	"	1973	
15078C	"	1974	Bilingual
15088C	"	"	"
15098C	"	"	"
15124B	"	"	"
C	"	"	"
15126B	"	"	"
C	"	"	"
15130	"	1973	
A	"	"	
15132A	"	"	
15134B	"	1974	Bilingual
C	"	"	"
15136B	"	"	"
C	"	"	"
15144	"	"	
A	"	"	Bilingual
15146	"	"	
A	"	"	Bilingual
B	"	"	"
C	"	"	"
15152A	"	1973	
15154	"	1974	
A	"	"	Bilingual
15160A	"	1973	
15162A	"	"	
15164A	"	"	
15170C	250,000	1974	Bilingual
15172C	"	"	"
15174A	"	1973	
15180C	"	1974	Bilingual
15182C	"	"	"
15184A	"	1973	
15186A	"	"	
15190C	"	1974	Bilingual
15192A	"	1973	
18606C	"	1974	Bilingual
18608C	"	"	"
18616C	"	"	"
23092	"	1973	
A	"	"	
23096A	"	"	
26508	"	"	
A	"	"	
26602	"	"	
A	"	"	
26606A	"	"	