U.S. EXCHANGE - 1976
FINAL FIELD REPORT
JUNE - OCTOBER

R. TRECIOKAS

CANADIAN HYDROGRAPHIC SERVICE
CENTRAL REGION
AND
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SURVEY
ATLANTIC MARINE CENTER - NORFOLK, VIRGINIA

STAFF EXCHANGE
1976
(JUNE TO OCTOBER)

R. TRECIOKAS
HYDROGRAPHER
CANADIAN HYDROGRAPHIC SERVICE
CENTRAL REGION

CONTENTS

ASSIGNMENTS

Vertical Control Surveys	Bay City, Michigan	June 14-26
Horizontal Control Surveys	Lorain, Ohio	June 28-July 10
Hydrographic Surveys	Conneaut, Ohio	July 12-24
Revisory Surveys	Oswego, New York	July 26-Aug. 7
Hydrographic Survey of Baltimore Harbour	Baltimore, Maryland	August 9-20
Atlantic Marine Center	Norfolk, Virginia	August 23-27
Automated Hydrographic Surveys	St. Marks, Florida	Aug. 30-Sept. 10
Automated Hydrographic Surveys	Banana and Indian Rivers Florida	Sept. 13-24
Ship/Launch Hydrographic Surveys	Buzzards Bay, Mass.	Sept. 27-Oct. 7

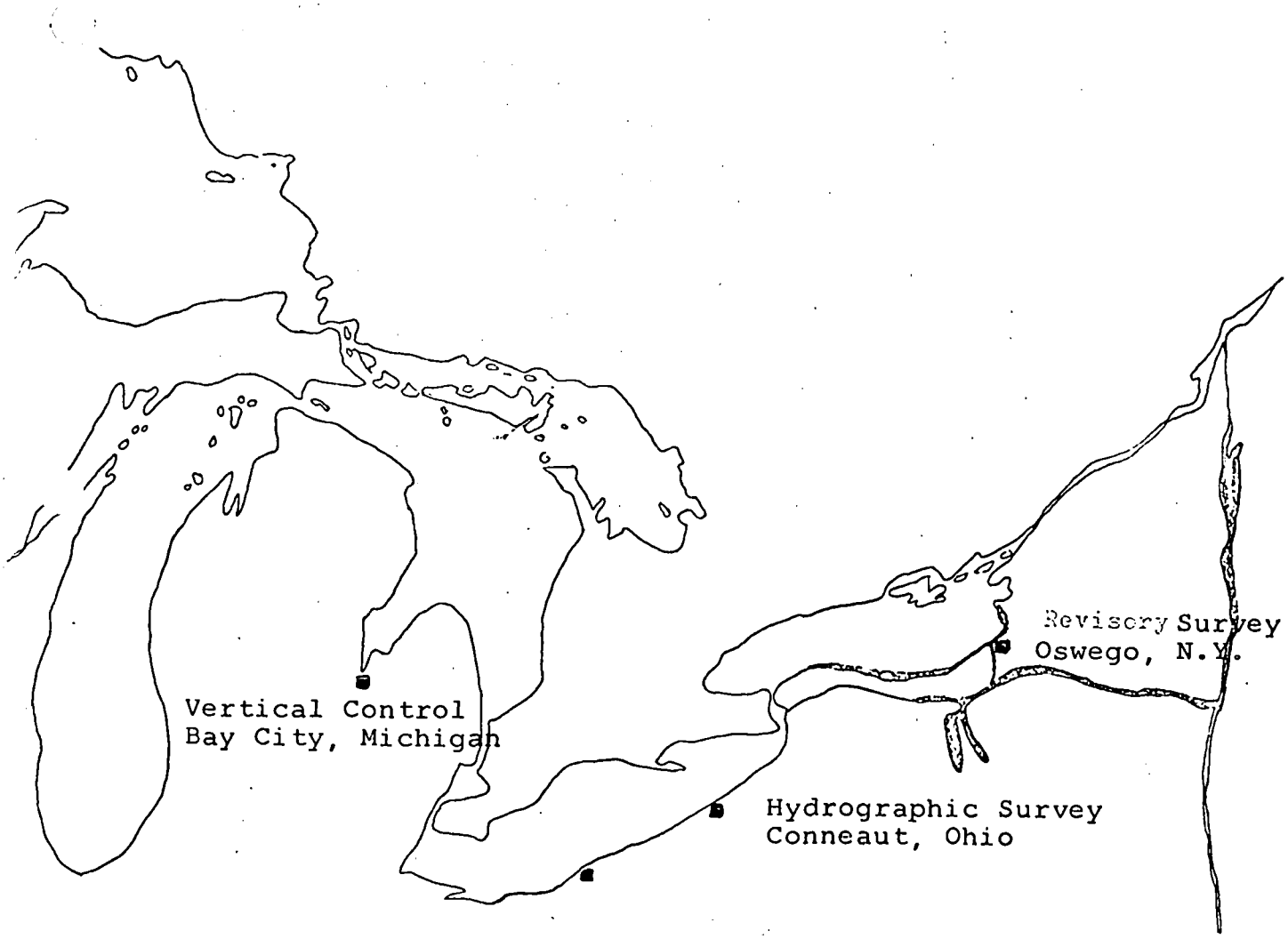
ITINERARY

Vertical Control Survey ..... June 14 - 26
Bay City, Michigan

Horizontal Control Survey ..... June 28 - July 10
Lorain, Ohio

Hydrographic Survey ..... July 12 - 24
Conneaut, Ohio

Revisory Survey ..... July 26 - August 7
Oswego, New York



ITINERARY

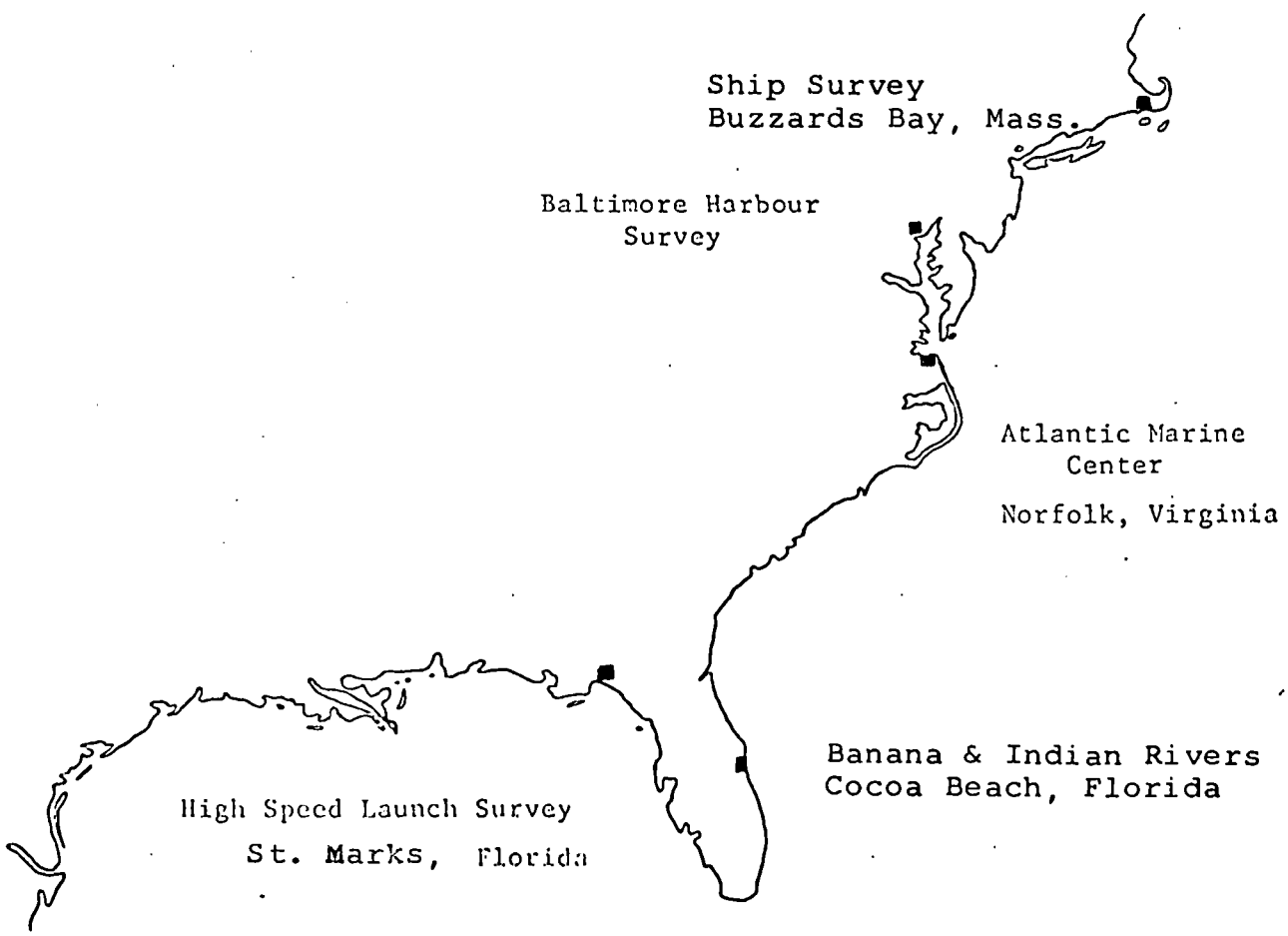
Baltimore Harbour Survey ..... August 9 - 20
Baltimore, Maryland

Atlantic Marine Center ..... August 23 - 27
Norfolk, Virginia

High Speed Launch Survey ..... August 30 - Sept. 10
Launches No. 1255 & 1257
St. Marks, Florida

Banana & Indian Rivers Survey ..... September 13 - 24
Cocoa Beach, Florida

Ship Survey .....September 27 - Oct. 8
Buzzards Bay, Massachusetts



SUMMARY

The 1976 field season saw a continuation of the technical exchange program between the National Ocean Survey (NOS) of the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce, and the Canadian Hydrographic Service of the Department of Fisheries and the Environment.

The purpose of the exchange is to further our knowledge and experience by exchanging ideas.

This report covers a four month technical exchange between the National Ocean Survey and the Canadian Hydrographic Service.

Mr. R. Cram, of Atlantic Marine Center (AMC), Norfolk, Virginia, was the participant from NOAA in the exchange.

INTRODUCTION

The agency, NOAA, the National Ocean and Atmospheric Administration was established October 3, 1970 in the U.S. Department of Commerce. The purpose of forming NOAA was to create a civil center of strength for expanding effective and rational use of ocean resources for monitoring and predicting conditions in the atmosphere, ocean and space, and for exploring the feasibility and consequences of environmental modification.

The major elements of NOAA are: National Ocean Survey (NOS), National Marine Fisheries Service, National Weather Service, Environmental Data Service, National Environmental Satellite Service, Environmental Research Laboratories, Office of Sea Grant and Office of Coastal Environment.

The components of National Ocean Survey (NOS) are: National Geodetic Survey, Fleet Operations, Marine Surveys and Maps, Aeronautical Charting and Cartography, Marine Technology, National Oceanographic Instrumentation Center, NOAA Data Buoy Office, Atlantic Marine Center (AMC), and Pacific Marine Center (PMC). The National Ocean Survey (NOS) combined the functions of the former Coast and Geodetic Survey, Great Lake s Survey, National Oceanographic Instrumentation Center and National Data Buoy Development Project.

The exchange program covered a four month period from June 14th to October 7th. A total of eight field parties were visited. Two weeks were spent with each party and one week at the Atlantic Marine Center (AMC).

The report will be presented in chronological order as the field parties were visited.

VERTICAL CONTROL

INTRODUCTION

The technical exchange program began with vertical control surveys (June 14-26) in Bay City, Michigan. The project consisted of running a level line from Essexville, Michigan to Sawginaw, Michigan, along the east side of Saginaw River, a distance of about 15 miles.

The vertical control party consisted of a party chief, Mr. A.M. Christenson, and five assistants.

OPERATIONS

The procedures and techniques used by the vertical control party are outlined in "LEVELS WITH AUTOMATIC INSTRUMENTS", by Elmer F. Kulp (see Mr. B. Eidsforth's 1975 Exchange Report).

Major equipment included:

1 - 30' office trailer
3 - vehicles
3 - telescopic rod sets
3 - Zeiss NI-2 automatic levels
2 - plane parallel plate micrometers

A levelling party consists of four persons: an instrument man, head rodman, rear rodman, and a notekeeper. The instrument man reads both rods and transmitts the information to the notekeeper on a PT-300 Motorola radio. The rodmen use Kern rods, graduated in centimetres and millimetres, complete with a fish eye buble and two telescoping legs. Each rodman carries a portable turning point. The rear rodman paces off to ensure that back sight and foresight distances are of near equal length and marks a point for the next set-up of the instrument. The notekeeper follows in a vehicle and if the computations check, gives the go-ahead to the instrument man.

Under ideal conditions, 4 to 5 miles can be run during a day. Specifications call for a double-run, forward and backward for each section with a section length of 1 to 2 km; maximum length of sight 50 metres; maximum difference in lengths between back sight and foresight per set-up is 2 metres and per section (cumulative) 4 metres and maximum closure for a section is 2.0 mm $\sqrt{K}$, where K is distance in kilometres.

Preceding a level party, a team recovers existing bench marks, lays out the level route and establishes temporary bench marks about every kilometer with a steel rod driven into the ground. Permanent bench marks, if none exist, are set every 6 kilometres.

Permanent marks consist of 5 foot sections connected to steel rods driven into the ground with a cobra drill or until bedrock is reached. The plug is stamped, krimped and welded to the steel rod. A 4 foot, 12 inch diameter plastic tube is placed around the steel rod and plug. Ground is replaced and compacted around the tube and the inside is filled with gravel. No concrete is used.

During my stay with the vertical control survey, I had the opportunity to observe and participate in a water level crossing. It is used to determine differences in elevations between widely separate points, as a river crossing. The equipment needed consists of:

1 base plate
2 rotary wedge attachments
1 Tribrach
1 target column
2 targets
1 auxiliary level scale
1 plane mirror auto-collimation attachment
1 illumination ocular prism
2 Zeiss Ni 2 automatic levels with tripods
1 level rod
1 plane-parallel micrometer for Ni 2 level

To obtain accurate results, all precautions against error must be taken. Two instruments on one tripod are set up on both sides of the river and readings taken simultaneously. This eliminates the effect of collimation, refraction and curvature. For precise details in crossing water spans, see "THE ZEISS APPARATUS FOR CROSSING WATER SPANS IN PRECISE LEVELLING", by R.M. Berry (Appendix A).

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY

Lake Survey Center
630 Federal Building & U. S. Courthouse
Detroit, Michigan 48226

Date : March 18, 1976

Reply to Attn. of: CLS132:HAL

To : Arthur M. Christenson, Party Chief
Vertical Control Section

THRU: Chief, Water Levels Branch OWR

From : Harry A. Lippincott Harry A. Lippincott
Chief, Vertical Control Section

Subject: Project Instructions, OPR 003-2-76, Vertical Control Surveys

1.0 General

1.1 To support the responsibility for maintaining vertical control in the Great Lakes area you are directed to conduct First-Order leveling surveys in the Grand River and Saginaw River areas in Michigan.

1.2 The project will commence on or about May 10, 1976 and must be completed prior to June 30, 1976.

1.3 Data necessary to complete this project will be furnished by this office.

2.0 Project Description

2.1 This project will consist of running First-Order level lines in the two areas listed below.

The lines will be run in the priority sequence as listed.

2.1.a. Gage site at Grand Haven, Michigan along the Grand River to the head of navigation.

2.1.b. Gage site at Essexville, Michigan along the Saginaw River to the gage site at Saginaw, Michigan.

3.0 Technical Specifications

3.1 First-Order levels will be run based on a closure accuracy of 2.0 mm $\sqrt{K}$ between the forward and backward run of a section. Maximum sight length will not exceed fifty meters.

3.2 Wherever bench marks exist from other surveys a diligent search for them should be made and all recovered marks tied into the new level line.

3.3 Establishment of new bench marks will be maintained at 1-mile intervals.

3.4 An automatic water level recorder will be installed at Grand Haven, Michigan. This gage will be in operation so as to provide data for the June through September period. Levels will be run to 2-bench marks and ZETG (B.M. A7 at an elevation of 591.530 feet on IGLD 1955 will be included in the run).

Pertinent information will be supplied to this office as soon as the gage is established.

4.0 Miscellaneous

4.1 The following reports will be submitted as required:

4.1.a Daily narrative of progress (weekly).

4.1.b Accomplishment (monthly).

4.1.c Time and attendance (bi-weekly by PP).

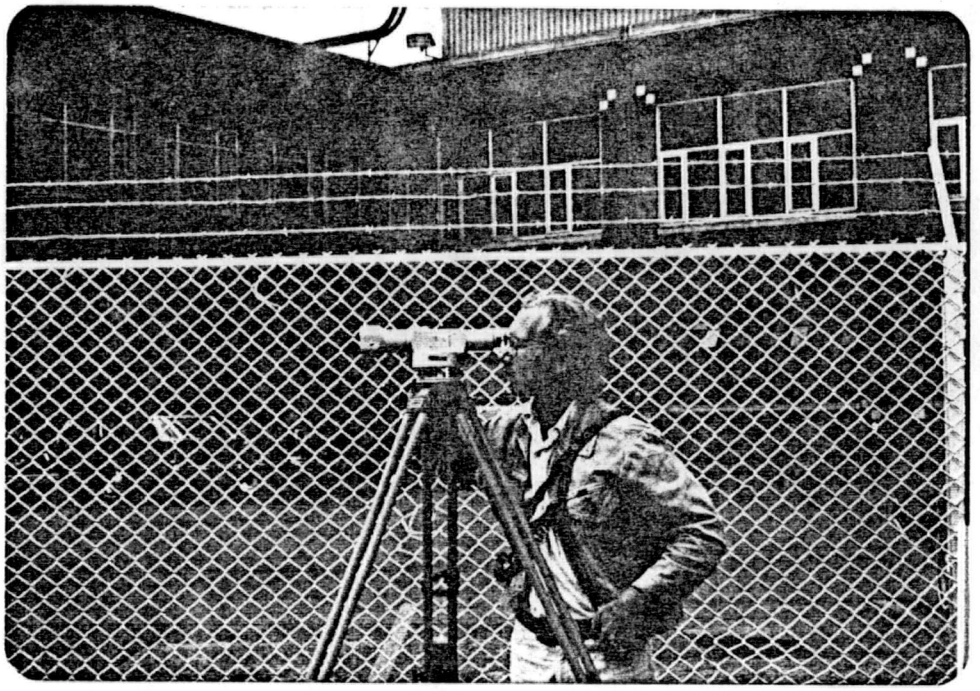
4.1.d Vehicle report (monthly).

4.1.e Imprest account (monthly).

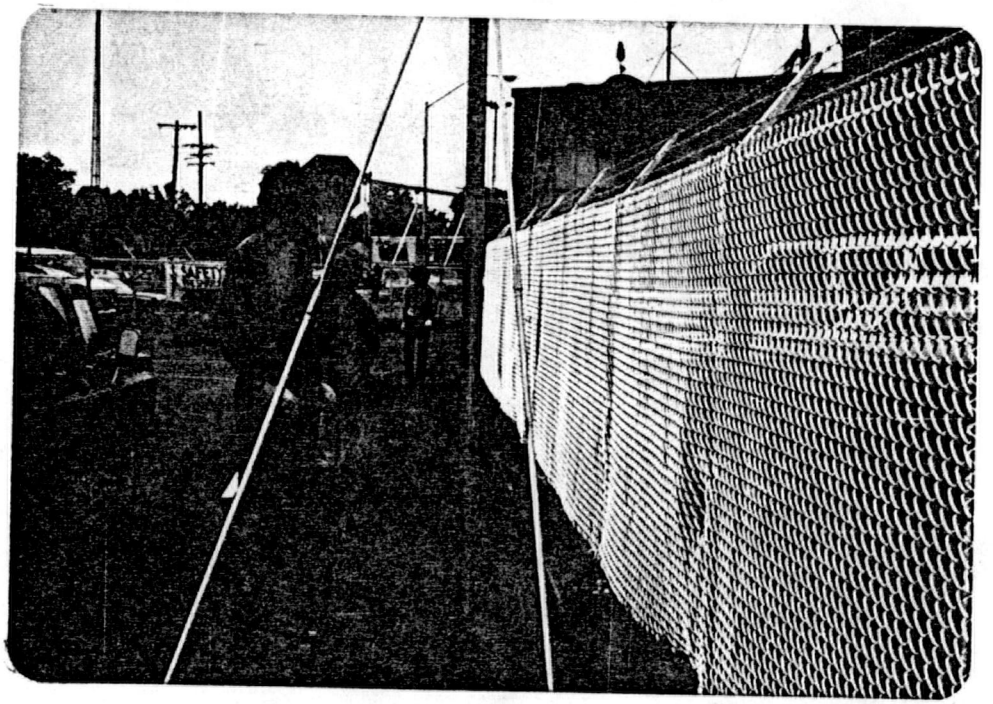
4.2 You will keep this office informed as to your physical location, mailing address, and a telephone number where you can be reached if an emergency arises.

4.3 Applicable portions of the Great Lakes Pilot will be reviewed to the extent possible and suggested revisions forwarded to this office.

4.4 All expenses incurred on this project shall be charged to CLS 132, Organization Code C11320, Project No. 83431003.

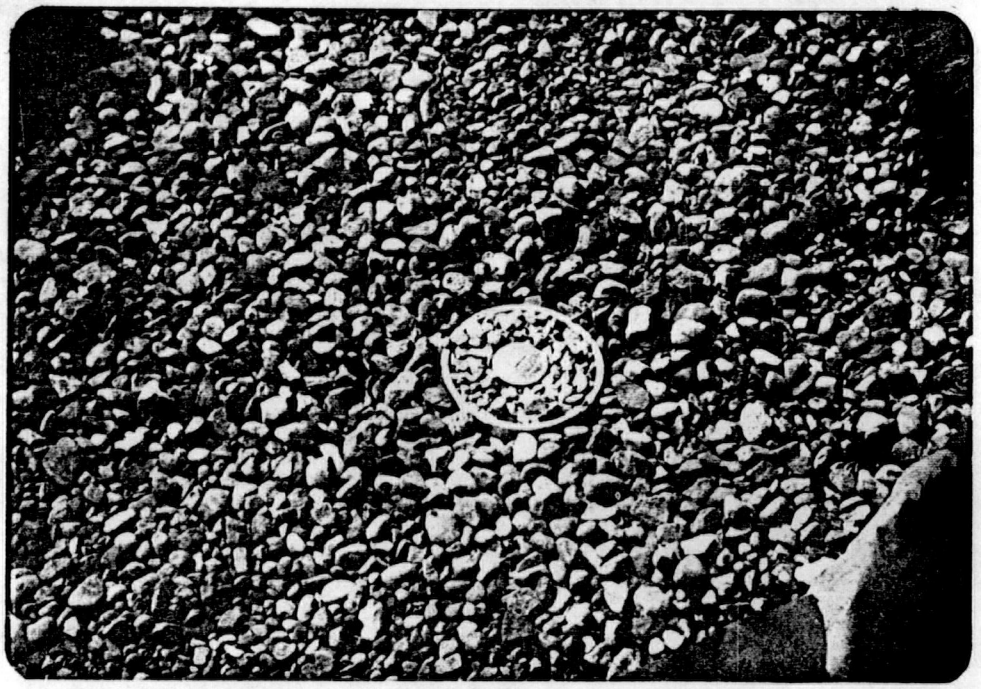


ZEISS NI 2 Level with Plane-Parallel Micrometer attachment.

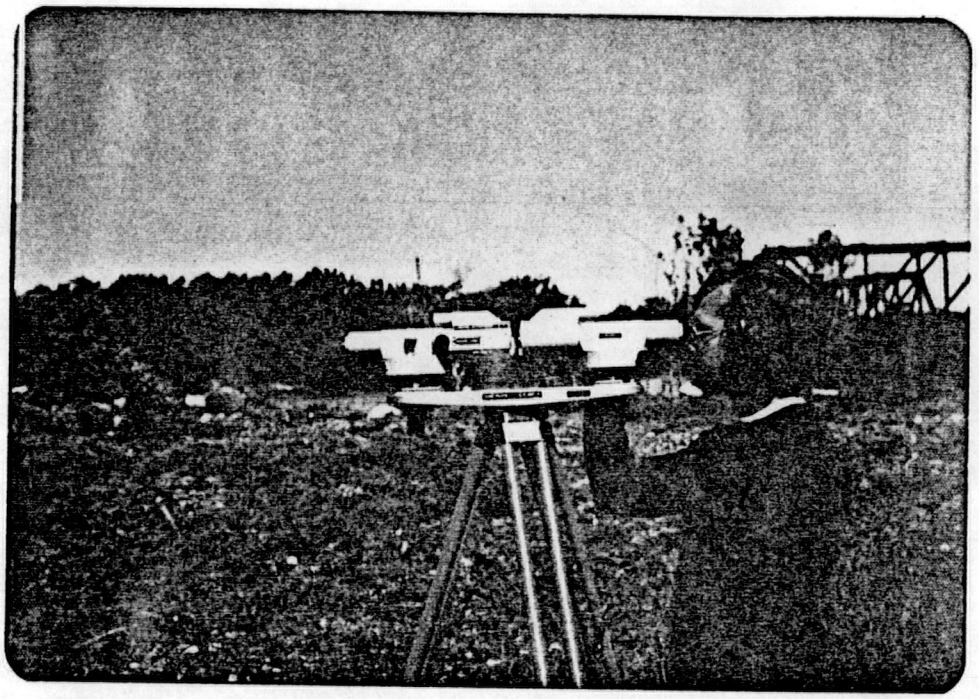


KERN ROD

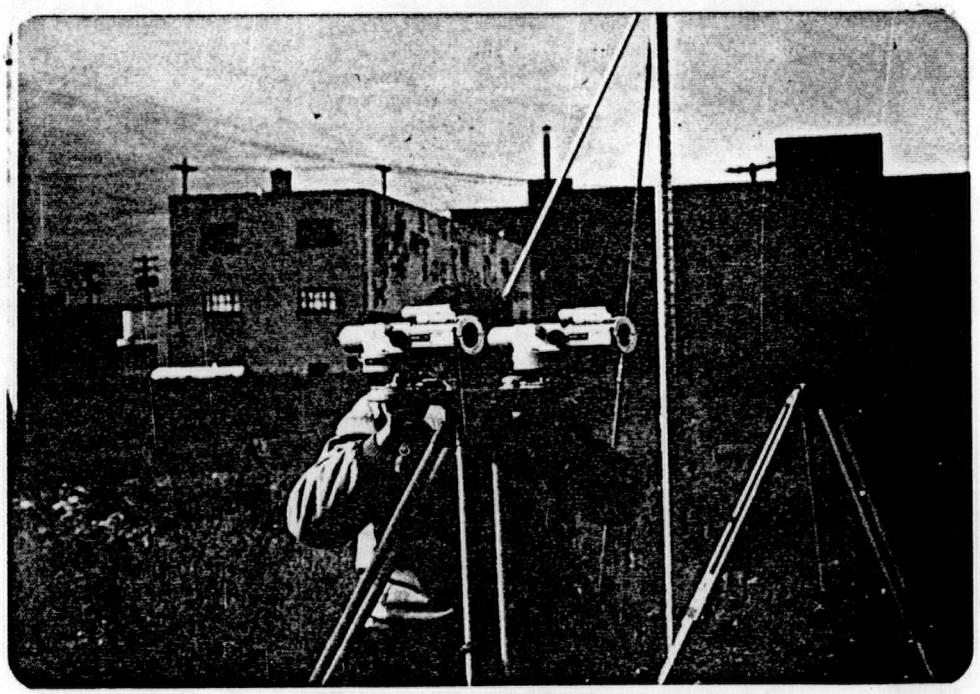
Establishing permanent Bench Mark



Permanent Bench Mark



Eliminating instrument error for water span crossing.



Water span crossing observations

HORIZONTAL CONTROL

INTRODUCTION

The next stop on the exchange program was with the horizontal control surveys (June 28 - July 10) at Port Clinton and Lorain, Ohio. The project consisted of running horizontal control from Monroe, Michigan to Cleveland, Ohio, a distance of about 125 miles.

The horizontal control party consisted of a party chief, Mr. R. Stachon, and eight assistants.

OPERATIONS

The procedures and techniques used by the horizontal control party are outlined in the project instructions and 'Specifications of Geodetic Control Surveys'.

Major equipment included:

1 International "Deuce and a half"
2 International travelalls
2 portable 25 foot towers on trailers
1 24 foot Monarch with twin 40 h.p. outboards
1 Wang #700 desk top calculator
2 AGA geodimeter Model 8L and 6L
2 Wild T-3 theodolites
3 Wild T-2 theodolites

The purpose of the project was to establish second order horizontal control from Monroe, Michigan to Cleveland, Ohio. All aids to navigation and land marks suitable for charting purposes were positioned to third order accuracy. Specifications called for angles to be read to 0.2 seconds, 12 sets and not to be more than 4 seconds from the mean; distance to be measured to 1 part in 300,000.

Angle observations were done with a Wild T-3 theodolite on 8 inch Parkhurst lights powered by 12 volt batteries. Distances were measured with a Geodimeter Model 8L with a range of 60 kilometers.

All computations were done on a Wang #700 calculator. Programs are written so that all initial measurements are printed out, giving another set of field notes.

Because of persistant haze in and around the Cleveland area during the day, measurements and observations had to be done in the evening. The Geodimeter requires a clear line of sight for the light to be reflected back to the instrument.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Lake Survey Center
630 Federal Building & U. S. Courthouse
Detroit, Michigan 48226

Date : April 27, 1976

Reply to Attn. of: CLS11:WJM

To : Chief, Horizontal Control Section - CLS113

From : Director, Lake Survey Center - CLS

Subject: Project Instructions: OPR-302-3-76, Geodetic Horizontal Control Surveys; Lake Erie, (Cleveland, Ohio to Mouth of the Detroit River).

1.0 General

1.1 Work on this project shall not begin until work under existing separate project instructions (Job CM-7608, dated 29 March 1976, and Job CM-7609, dated March 1976) is completed.

1.2 Work on this project shall begin upon the direction of the Chief, Surveys Branch (CLS11).

1.3 Responsibilities for program direction and technical guidance will be transferred to the Operations Division (CAM1), Atlantic Marine Center, on or before June 30, 1976, in accordance with plans to close the Lake Survey Center. Administrative details will be provided to you as soon as they become available.

1.4 This project is a continuation of horizontal control surveys performed during the period 1972 through 1975 along the south and west shores of Lake Erie and will close out the remaining gap between the Lower Detroit River/Toledo area and Cleveland, Ohio - thus completing all main-scheme geodetic control requirements on Lake Erie.

1.5 Project: This project involves the primary performance of geodetic Third-order horizontal control surveys along the south and west shores of Lake Erie in direct support of the National Ocean Survey nautical charting program. In particular, the control established will be used to control new chart construction and the supportive photogrammetric and hydrographic data acquisition programs. Wherever a void of necessary First or Second-order horizontal control exists which would make it difficult to achieve Third-order control accuracies, Second-order horizontal control shall be established at density intervals in the project area consistent with national network requirements. You are also instructed to position all charted or chartable landmarks within the project area which are not currently being positioned by a separate analytic aerotriangulation project in C342.

1.6 Plan of Operations: It is estimated that field operations under these project instructions will commence on/about May 3, 1976, and shall be completed on/about September 4, 1976. The area of the surveys shall extend from Cleveland, Ohio west and north to the vicinity of the mouth of the Detroit River. Ties to existing First or Second-order geodetic control in the contiguous near shore area of Lake Erie shall be made whenever possible (See Attachment 1).

2.0 Specific Objectives.

2.1 To provide control support to the NOS photogrammetry operations in stereo-compiling/analytic aerotriangulation programs scheduled for the south shore of Lake Erie.

2.2 To provide control support to hydrographic data acquisition surveys scheduled for the south and west shores of Lake Erie.

2.3 To densify Second-order control, consistent with National network specifications prepared by NGS, in the contiguous or near-lake areas along the south and west shores of Lake Erie.

2.4 To resolve any questions concerning Corps of Engineers harbor line or maintenance dredging control, and control used by NOS in producing nautical charts of the Lake Erie waters. To connect CoE control to national network control.

2.5 To provide definitive positional control on all charted landmarks and fixed or permanent navigation aids.

2.6 To reestablish and upgrade the accuracy of previously established horizontal control; a majority of which have been either destroyed or washed out during recent high water levels on Lake Erie.

2.7 To complete a tie with similar surveys conducted along the south shore and in the western end of Lake Erie by the LSC in 1973 to 1974.

2.8 To provide the IBC with recovery information on any control stations encountered which have significance to the defining or location of the International Boundary.

2.9 To provide a base control scheme to assist USCG buoy tenders in deployment of floating navigation aids in the waters along the south shore of Lake Erie. To provide supportive information for verifying USCG data used to position these aids, or for determining positional strength of the aid when placed.

3.0 Project Description

This project shall be conducted in accordance with the sequence of operations listed below:

3.1 A recovery/reconnaissance investigation of the project area to determine the need of Second-order control and to properly identify site areas for all Second and Third-order control to be established, as well as to identify those landmarks or navigation aids which require positioning.

3.2 An EODM traverse between the mouth of the Detroit River and Cleveland, Ohio to Second-order, Class I specifications. To facilitate the establishment of Third-order control, main scheme stations should be spaced to 8 to 15 km intervals. The traverse shall commence at station MONROE EDISON LSC, 1975 (with fixed azimuth to LOWER DETROIT RIVER LSC, 1975) and head in a southerly and easterly direction through the west end of Lake Erie where it will terminate at station BELL CRGS, 1943 (with fixed azimuth to HALE CRGS, 1943). (See Attachment 1 and Table 1). The Second-order, Class II station MAUMEE BAY LSC, 1975 shall be reoccupied and repositioned as part of the proposed Class I scheme.

3.3 Schemes of Second-order, Class II, or Third-order, Class I accuracy stations shall be established at approximately 2 to 6 km intervals between the main scheme traverse (Section 3.2) stations; to satisfy in themselves or to derive therefrom, the requirements specific in the lesser priorities listed hereafter. These stations may in some instances, be controlled during the main scheme (Second-order, I) observations; however, given the lesser priority assigned to this work, and subsequent priorities, a judicious allocation of the allowable time frame for the overall project must be considered in combining any main scheme and densification observation - it is imperative that the main scheme Second-order, Class I network be completed during this period. In cases where observing towers are erected, it would be expeditious to complete any secondary (densification) observations prior to teardown of the tower. (See Attachment 1 for a tentative breakdown of this project control.)

3.4 All fixed or permanent navigation aids and landmarks suitable for charting purposes, shall be positioned to Third-order, Class I or II accuracy standards by either traverse, intersection, or spur-intersect techniques. (See Table 2.) Sub-priorities for survey response are as follows:

3.4.1 All features utilized by USCG buoy tenders in visually resecting buoy positions. Enclosed under separate cover are 5 charts and associated support data received from the USCG which list or describe stations observed and angles used in the placement of aids. You should determine Third-order positions for these objects and verify the angles used by the Coast Guard.

3.4.2 Conspicuous landmarks or objects utilized for offshore navigation in Lake Erie.

3.4.3 Landmarks or cultural features utilized primarily for near-shore, localized piloting.

3.5 Corps of Engineers project control stations and/or reference marks shall be connected by Third-order, Class I accuracy standards.

3.6 In accordance with established LSC policy, and upon direction by the Chief, Surveys Branch, you shall maintain designated water level gaging stations and their associated vertical reference networks within the survey area.

4.0 TECHNICAL SPECIFICATIONS

4.1 All geodetic control survey procedures, techniques, and accuracy standards shall be strictly in accordance with the following USC&GS/NGS publications:

4.1.1 "Manual on Geodetic Triangulation" (C&GS SP 247).

4.1.2 "Classification, Standards of Accuracy and General Specifications of Geodetic Control Surveys" (NOAA-NOS).

4.2 Some portions of reference 4.1.1 (above) are superseded by the following NGS (USC&GS) publications/directives; these shall be adhered to as indicated/referenced:

4.2.1 "Second-order, Class I Electro-Optical Traverse Specifications" (Priority 3.1, 3.2 and 3.7).

4.2.2 "Second-order Highway Traverse Specifications" (Priority 3.3).

4.2.3 "Intersection Stations," "Supplemental Stations" (Priority 3.4, 3.5, 3.6 and 3.8). (Some higher-order criteria contained within these directives may be relaxed for lower-order work.)

4.3 All angulation work on the main-scheme Second-order, Class I traverse shall be performed at night; all other angulation and distance measurements may be conducted during the day.

4.4 Second and Third-order stations will be monumented in accordance with the latest NOS/NGS specifications therefor ("Monumentation of Less than Second-order Surveys," C1x1, memo of July 17, 1974).

4.5 All instrumentation and equipment will be calibrated prior to and during the survey in accordance with NGS and/or manufacturer specifications and procedures.

5.0 MISCELLANEOUS

5.1 Reports: Field Weekly Project Status Reports will be submitted as required; they shall consist of a written narrative (daily) and a progress sketch at a scale of 1:250,000. Additional reports shall include: Monthly Narrative, Imprest Account, and Vehicle; all submitted as required and to satisfy organizational deadlines established for same.

5.2 Expenses: All expenses incurred on this project shall be charged to Project Number 83222302 (Organization Code C11130).

5.3 Travel: Travel and per diem expenses are authorized for this project. Prepare the required Trip Authorizations and submit through CLS11 prior to April 26, 1976.

5.4 Overtime: Submit overtime requests through CLS11 prior to April 26, 1976.

5.5 Personnel: Proper procedures have started to accomplish hiring of seasonal Schedule A employees prior to start of field surveys.

5.6 Material/Vehicle Support: The Engineering Division (CLS3) will provide assistance to this project as required. CLS3 has been notified of specific material and vehicular requirements prior to date of these instructions.

5.7 Disposition of Data: Preliminary, unadjusted data will be provided to CAM1 at the completion of the survey. All observational, positional, and descriptive data will be compiled, and forwarded to NGS in accordance with established NOS procedures.

5.8 Amendments: Any amendments or revisions to these instructions will be issued by the LSC in the established manner. Deviations from these instructions must be approved and attached as amendments therein.

5.9 Address: Keep the Surveys Branch (CLS11) or Operations Division (CAM1) informed of the party's physical location, mailing address, and emergency phone contact at all times.

5.10 Acknowledgements: Acknowledge receipt of these instructions in writing.

Attachments

TABLE 1

WEST END LAKE ERIE

SECOND-ORDER TRIANGULATION STATIONS: TENTATIVE LOCATIONS

1. TOLEDO CRIB
2. LOCUST PT.
3. PERRY
4. CEDAR PT. LT.
5. HURON RIVER
6. VERMILION
7. LORAIN
8. AVON BASIN

WEST END LAKE ERIE

THIRD-ORDER TRIANGULATION STATIONS: TENTATIVE LOCATIONS

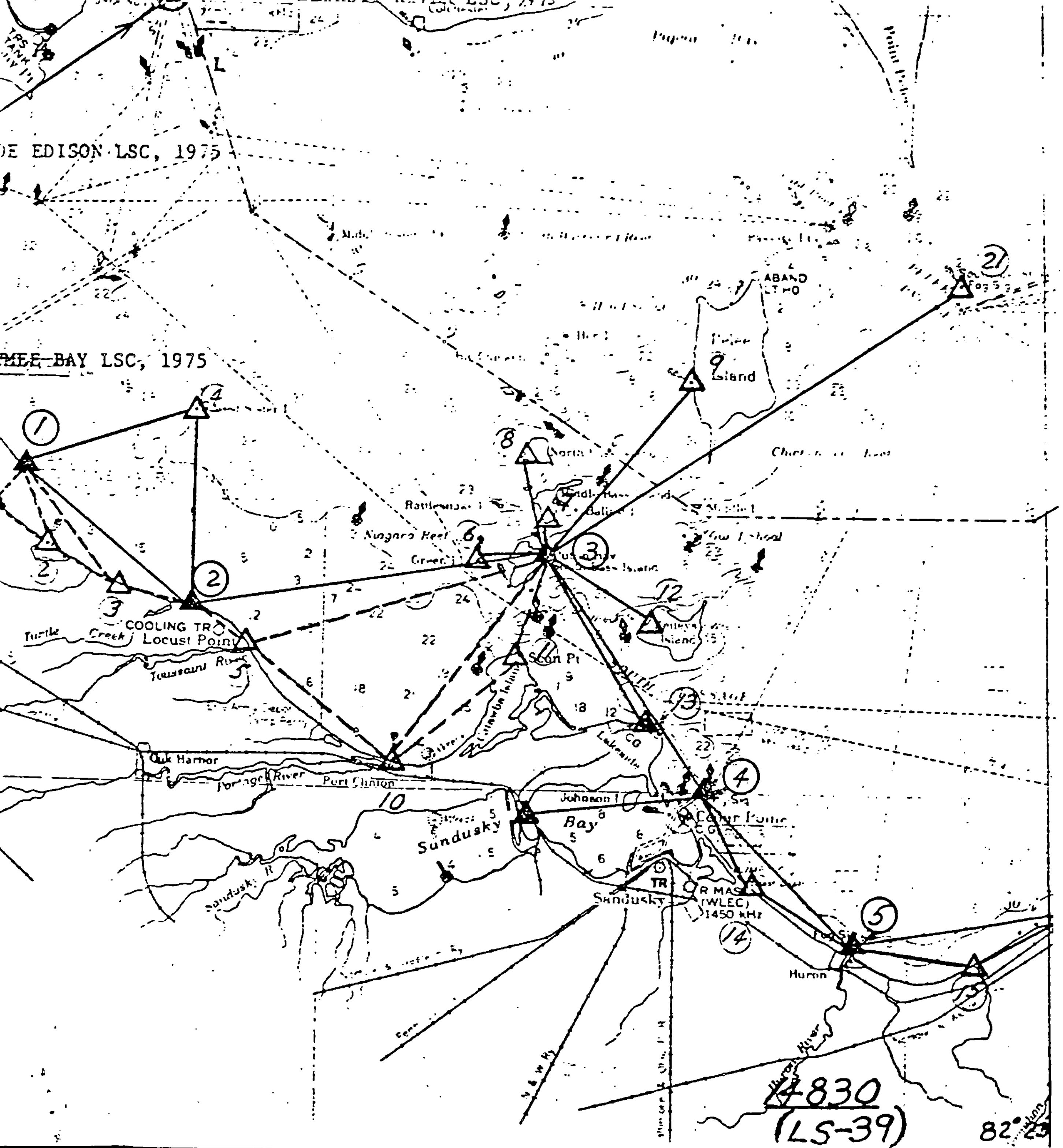
1. LAKEMONT
2. RENO
3. CRANE CREEK
4. WEST SISTER I.
5. TOUSSAINT
6. GREEN I.
7. MIDDLE BASS I.
8. NORTH BASS I.
9. PELEE I.
10. PORT CLINTON
11. SCOTT PT.
12. CARPENTER PT.
13. LAKESIDE
14. RYE BEACH
15. CHAPPEL CREEK
16. BEAVER CREEK
17. SHEFFIELD
18. AVON POINT
19. HUNTINGTON
20. ROCKY RIVER
21. SOUTHEAST SHOAL CT.

TABLE 2

WEST END LAKE ERIE

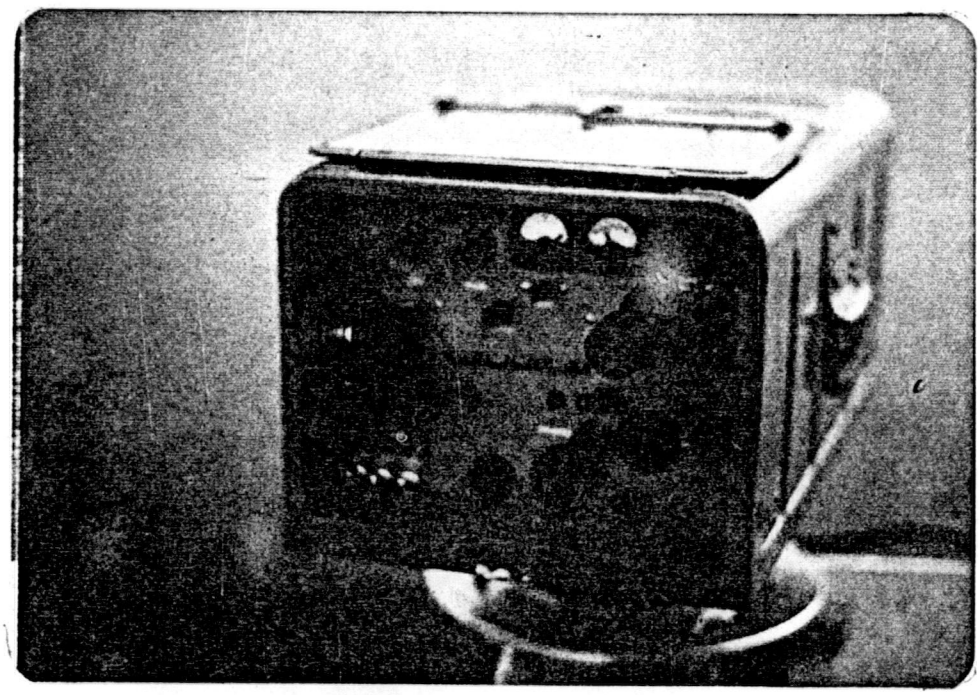
SELECTED NAVIGATIONAL AIDS TO BE CONTROLLED

1. One radio mast, four TV masts, east of Toledo, west of Cedar Point.
2. Selected points within Reno Beach.
3. One cooling tower, one radio mast, within Locust Point near Long Beach.
4. One lookout tower, two tanks, one stack within Camp Perry.
5. Selected points within Port Clinton.
6. One tower within South Bass Island.
7. Lighthouse (Aband. Lt. Ho.) One radio mast within Pelee Island.
8. One tank within Kelleys Island.
9. One tank within Catawba Island.
10. Selected points within Sandusky Bay and City of Sandusky.
11. Selected points within Cedar Point.
12. One tank west of Huron City on Bogart Road, between Camp Road and Rye Beach Road.
13. Selected points within Huron City.
14. One stack near Oberlin Beach at junction of Highway 6 and 61.
15. One stack near Beulah Beach at junction of Highway 6 and Tappa Road.
16. Selected points within Vermilion area.
17. One tank east of Baumhart Road and west of Quarry Creek.
18. Two radio masts, east of Beaver Creek and West of Lorain.
19. Selected points within Lorain.
20. One stack, three tanks, near Cleveland Electric Illuminating Co., west of Avon Point.
21. One tank within Avon Point area.
22. One spire, one tower, within Bay Village west of Cahoon Creek.
23. Selected points within Rocky River.
24. Any other structures which would be good navigational aids that are not listed.



DE EDISON LSC, 1975
MEE BAY LSC, 1975
COOLING TR
Locust Point
Turtle Creek
Toussaint River
Oak Harbor
Portage River
Port Clinton
Sandusky
Sandusky Bay
Johnson I
Cedar Point
Sandusky
TR
R MAS (WLEC) 1450 kHz
Huron
Huron River
Niagara Reef
Rattlesnake I
Green I
Pelee Island
ABAND LT HO
Catawba Island
Scott Pt
N & W Ry
4830
(LS-39)
82° 23

WILD T3 Theodolite



GEODIMETER Model 8L

HYDROGRAPHIC SURVEY - LAKE ERIE

INTRODUCTION

The next visit was with the hydrographic surveys (July 12-24), at Conneaut, Ohio. The project was to conduct a hydrographic survey from 3½ miles east of Ashtabula, Ohio to 6 miles east of Erie, Pennsylvania on Lake Erie.

The survey party consisted of Mr. R. Bagalay, party chief, and twelve assistants.

OPERATIONS

The Lake Erie hydrographic survey is a continuation of a project started in 1973. The water area to be surveyed lies between the land/water interface and the 10 fathom depth curve. The project requires a total of eight field sheets at a scale of 1:10,000 and five additional field sheets at 1:5,000 scale. The project called for detailed harbour surveys at Conneaut, Ohio and Erie, Pennsylvania, as well as two dumping grounds at a scale of 1:5,000. The hydrographic data from these surveys will provide a new data base for proposed recreational craft charts of the near shore waters along the shore of Lake Erie. Additional horizontal control required to support survey operations was done to third order accuracy. Line spacing at 1:10,000 scale was 100 metres and 200 metres between 8 and 10 fathom contours.

Major equipment included:

1 - 54 foot launch - S/V LAIDLY
2 - Del Norte trisponders 2020A systems
1 - 24 foot diesel Monark launch
1 - 30 foot office trailer
1 - 12 foot storage trailer
3 - vehicles
1 - set geodimeters
4 - transits
1 - Wild T-2 theodolite
2 - Wild T-1 theodolites
1 - 12 foot aluminum dingy

The main sounding launch was the S/V LAIDLY, equipped with a HYDROPLOT system. The launch was positioned with Del Norte in range-range mode. The system was calibrated twice daily by azimuth, with three theodolites, each reading the angle simultaneously. A total of 15 cuts are taken and position computed onboard the launch. Depth sounding was done with Raytheon 723D and Ross 5000 sounders, calibrated twice daily. Bottom samples were taken with a SHIPEK grab. Collected samples were forwarded to Smithsonian Institute in Washington, D.C.

An auxiliary, 24 foot Monark, equipped with a HYDROLOG system, was used to sound shallow water and inshore. The launch was positioned by range-azimuth and carried Raytheon 723D depth recorder. All sounding lines were run perpendicular and straight to the shoreline on a compass course.

All collected data were processed the following day in an office trailer equipped with PDP-8/E computer, teletype Model ASR-33 and Complot Model DP3 plotter.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY

CAM1
CAM101 ✓
CAM102 ✓
CAM102W
CAM100
CAM100G
CAM104
CAM11

Date : April 1, 1976

Reply to Attn. of: CLS11:WJM

To : Chief, Hydrographic Section -CLS112

From : Associate Director
Marine Surveys and Maps -C3

Subject: Project Instructions: OPR-300-LA-76, Lake Erie (3 ½ miles East of Ashtabula, Ohio to 6 miles East of Erie, Pa.)

1.0 GENERAL

1.1 All previous instructions for OPR-300 are hereby superseded.

1.2 Work on this project shall begin upon the direction of the Chief, Surveys Branch (CLS11) and with corresponding concurrence of the Chief, Charting Operations Division (CLS1).

1.3 Responsibilities for program direction and technical guidance will be transferred to the Operations Division (CAM1), Atlantic Marine Center, on or before June 30, 1976, in accordance with plans to close the Lake Survey Center. Administrative details will be provided to you as soon as they become available.

1.4 This project is a continuation of 1975 Lake Erie inshore hydrographic surveys (OPR-300-LA-75) conducted southwest of this area (See Attachment 1).

1.5 Project: This project involves the performance of basic hydrographic surveys of the inshore waters of Lake Erie from 3 ½ miles east of Ashtabula, Ohio to 6 miles east of Erie, Pa. Inshore waters shall be defined as the water area between the land/water interface and the 10-fathom depth curve. The project also includes detailed harbor surveys at Conneaut, Ohio and Erie, Pa., as well as densified survey coverage over two authorized dumping grounds within the project area; one being about 5 miles northwest of the harbor entrance at Conneaut and one being about 3 miles north of the harbor entrance at Erie. The project area will require a total of eight field sheets at a scale of 1:10,000 (LA-10-1-76 thru LA-10-8-76); and an additional five field sheets at 1:5000 to properly cover the identified special areas of investigation within the project limits (See Attachment 2). The hydrographic data from these surveys will provide a new data base for proposed recreational craft charts of the near shore waters along the southerly shore area of Lake Erie. Bottom samples will be required over the complete area surveyed in 1975 and defined by the limits of field sheets H-9584 thru H-9586 (See Attachment 1). Curtailment of 1975 field operations as a result

of combined funding limitations and equipment breakdowns prevented bottom samples from being obtained last field season. This project will also include review, verification and revision of information in the Great Lakes Pilot covering the area of the hydrographic surveys; minor water level gage maintenance services at the permanent NOS water level gaging station at Erie, Pa., as well as on temporary water level gages installed at Ashtabula and Conneaut, Ohio and operated in support scheduled hydrographic surveys; vertical control surveys in support of maintenance of permanent and temporary water level gages; and horizontal control surveys in support of hydrographic surveys, and to position chartable landmarks and/or aids to navigation.

1.6 Plan of Operations: Bottom sampling operations are scheduled to begin May 3, 1976 in the vicinity of the westerly limits of field sheet H-9584 (about 8 miles east of Fairport, Ohio) and proceed in an easterly direction through the limits of H-9586 (about 3 ½ miles east of Ashtabula, Ohio). Operations in support of scheduled 1976 inshore hydrographic surveys easterly of 1975 survey area shall commence on/about May 3, 1976 also. It is recommended that initial survey operatio be based out of Ashtabula, Ohio until all bottom sampling within the area of 1975 surveys has been completed at which time the base of operations should be moved to Conneaut, Ohio. Upon completion of all hydrographic work west of Longitude 80° 20', the base of operations would be moved to the U. S. Coast Guard Station at Presque Isle, Erie, Pa. from which all remaining survey work will be accomplished. It is estimated operations scheduled under these instructions will be completed on/about October 30, 1976 (See Attachments 1 and 2).

1.7 Junctions: A junction consistent with specification in the Hydrographic Manual shall be made with H-9586 (LA-10-3-75).

1.8 Copies of prior surveys have been furnished for comparison purposes.

2.0 GEODETIC CONTROL

2.1 All necessary data and information on horizontal control stations required to support hydrographic and associated survey operations under these instructions have been provided to you by CLS113. You are in turn required to provide C185x1 with standard recovery notes on these stations.

2.2 Any additional horizontal control required to support survey operations under these instructions, such as for supplemental electronic positioning stations, to position fixed or permanent navigational aids or prominent landmarks, to positio special photo control points, etc., shall be to Third-order, Class I or II accuracy standards by conventional EDM traverse, intersection, or spur-intersect techniques or methods. All geodetic control survey procedures, techniques, and accuracy standards shall be in strict conformance with the specifications listed in the "Manual on Geodetic Triangulation" (C&GS SP 247) and the "Classification, Standards of Accuracy and General Specifications of Geodetic Control Surveys" (NOAA-NOS), dated February 1974 (Reprint May 1974). Monumentation of third-order stations shal be performed in accordance with the latest specifications detailed in NOA/NGS Memo "Monumentation of Less Than Second-Order Surveys," dated July 17, 1974 (C1x1). All directions, distances, and descriptions shall be submitted to CAM 1 for review, recomputation and possible transmittal to C1 for archiving and publication.

2.3 Other supplementary control which may be required, such as for calibrating the electronic positioning system, shall be established to Third-Order, Class II accuracy standards, but need not be monumented.

2.4 All instrumentation and equipment used in establishing horizontal control shall be checked and calibrated prior to beginning field operations and again as soon as possible upon termination of the surveys under these instructions.

3.0 PHOTOGRAMMETRY

3.1 You have been provided all the latest aerial photography covering the project area defined within these instructions.

3.2 Planimetric data of the open-lake shoreline area described within these project instructions has not been photogrammetrically compiled, consequently T-sheets will not be available to supplement the hydrography obtained.

3.3 A planimetric manuscript of Erie Harbor from a recent photogrammetric project will be available to supplement all hydrographic data collected of this area. This manuscript has been field verified and edited by CLS 111 and it is not anticipated any additional field work of this nature will be required by CLS 112. Should work be required, separate instruction will be provided.

4.0 HYDROGRAPHY

4.1 Hydrographic data shall be acquired to specifications for near shore or inshore surveys detailed in the 1975 provisional copy of the Hydrographic Manual. Surveys shall further comply with LSC Operations Instructions for Inshore Hydrographic Surveys, and conform to "special instructions" contained herein. A cognizance must be continually maintained that data acquired shall form the base for new chart construction.

4.2 Control: Hydrography shall be controlled by electronic, electronic-visual, or by visual methods. It is intended that electronic shall mean by range-range positioning methods; electronic-visual shall mean by range-azimuth methods; and visual shall mean by transit-cutoff or sextant location methods. It should be clearly understood that to the maximum degree possible, vessel positioning shall be by either electronic or electronic-visual methods. An electronic control report will be prepared in conformance with prescribed NOS requirements.

4.3 Special Instructions: The S/V LAIDLY, equipped with a HYDROPLOT system, shall be positioned to the maximum degree possible by range- range positioning methods. The auxiliary 24-foot MONARK, equipped with a first-generation HYDROLOG system, shall be positioned to the maximum degree possible by range-azimuth methods to permit efficient nearshore (shoal water) operations, thereby permitting maximum utilization of the LAIDLY in deeper water areas. All hydrographic data collected under a range-azimuth positioning mode shall be field processed with the newly acquired trailer-based processing hardware. A maximum processing effort should be made to generate a boat sheet plot of all hydro acquired under a range-azimuth mode while the party is still in the field. This is considered critical to effective field determination of survey adequacy.

4.4 The basic scale of the survey(s) shall be 1:10,000. The harbor areas at Conneaut, Ohio and Erie, Pa. (Inner harbor and outer approach areas thereto); as well as two authorized dumping grounds within the prescribed survey area, shall be surveyed (plotted) at a scale of 1:5000 (or larger if survey density so requires)

4.5 Line Spacing: Line spacing shall not exceed 100 meters on any 1:10,000 scale survey inside the eight fathom curve; nor 200 meters between the eight and 10 fathom (outer limit of survey area) curves. Line spacing shall not exceed 50 meters on any 1:5000 scale survey to properly delineate/define the bottom configuration. Line spacing over any area requiring special densification of survey coverage shall be at the discretion of the Section Chief, but in accordance with specifications or provision in the Hydrographic Manual.

4.6 Sounding lines shall be run in accordance with Section 4.3 of the Hydrographic Manual, except as noted in these instructions. Crosslines shall be run in accordanc with Section 4.3.6 of the Manual.

4.7 Only at the ultimate discretion of the Section Chief, and by corresponding acknowledgement on his Weekly Report, shall near inshore surveys be positioned by other than range-azimuth methods. This will eliminate the need for closely spaced control stations to support range-range operations along or close-to the shore area which is relatively straight or concaved inward. Range-range positioning from stations established to position the survey vessel effectively in the deeper water areas would produce unacceptable positioning errors in the near shore survey area.

4.8 Any submerged wrecks and obstructions encountered, such as an uncharted shoal which may pose a hazard to navigation, or which heretofore have not been positioned accurately, or for which at least depth has not been adequately determined, shall be investigated by wire sweeping. A report of the findings, whenever warranted, shall be made immediately to the 9th Coast Guard Headquarters. Corresponding additional recommended actions required thereto, such as reporting the findings in a "local notice to mariners, etc.," shall be made to CLS11 or CAM 1.

4.9 Primary calibration of the SHF electronic positioning system shall be by approved methods described in Section 4.4.3.3 of the provisional Hydrographic Manua The preferred calibration procedure is that performed over a measured base. Howeve it is also important to calibrate the system within the open lake or harbor survey areas. In response to this operational requirement, and considering that range-azimuth operations are generally being conducted in the near-shore area, it is considered operationally efficient to employ theodolite cuts as the method for effective and accurate system calibration.

System calibration shall be performed twice daily unless system stability indicates daily calibration would suffice. Justification for daily calibration shall be the sole responsibility of the Section Chief and shall be reported in his weekly report of operations submitted to CLS11 or CAM 1.

4.10 Calibration checks, or bar checks, of the sounding machine shall be made not less than three times each sounding day. Should stability of the sounder output versus true depth remain consistent from day to day, the Section Chief, at his descretion, may reduce the number of bar checks from three to one per day. Bar checks however, should only be made when sea conditions will permit reliable depth measurements. It is important that the depth displayed on the digital readout be

recorded for subsequent utilization in generating sounder corrector tapes any deviation shall be noted in the weekly report.

4.11 Settlement and squat tests will be made for each sounding vessel using recommended NOS procedures and with the vessels performing at stop, full and intermediate sounding speeds.

4.12 Bottom samples shall be taken in accordance with Section 4.7 of the Hydrographic Manual. Because of equipment breakdowns, bottom samples were not obtained in the area of surveys performed in 1975 under Project Instructions OPR-300-LA-75. Consequently, bottom samples obtained during 1976 operations will include the area of the 1975 surveys.

4.13 Hydrographic data shall be recorded and processed in accordance with recommended procedures described in the Hydrographic Manual. As survey boat sheets are completed, the sheets, data tapes and related reports shall be forwarded to CAM 11 for processing. Final verification of smooth sheets shall be the responsibility of CAM 31.

4.14 A permanent record shall be made of the geographic positions of all objects used for calibration. A report of calibration checks shall be made in accordance with Section 4.4.3.3 of the Hydrographic Manual. The report shall be made a part of the hydrographic survey records and included in the Descriptive Report for each survey sheet.

5.0 WATER LEVELS

5.1 Seasonal inspection and maintenance services shall be performed on the telemetering water level recorder located at Erie, Pa. in support of normal operations of the Water Levels Branch (CLS13). Instructions for accomplishing these services have been provided previously by CLS13. You shall provide written reports on NOAA Form 77-612, dated 10-12, to CLS13, detailing the maintenance work or services performed. This work is required in the Spring and again in the Fall.

5.2 Reference gages for data reduction within the survey area shall be those permanent NOS automatic recorders located at Cleveland, Ohio and Erie, Pa., support by water level records received from temporary seasonal gages located at Ashtabula and Conneaut, Ohio. You are requested to provide copies of these seasonal gage records to the State of Ohio Geological Survey located in Sandusky, Ohio.

5.3 Vertical control histories and related bench mark data have been provided for each of the above gages.

6.0 GREAT LAKES PILOT

6.1 The Great Lakes Pilot text information covering the entire project area shall be carefully reviewed and special revision reports submitted thru CAM 11 to C324. All revisions, deletions, or additions required to the text shall be made in accordance with specific instructions provided by C324.

7.0 SALES AGENTS

7.1 In addition to normal survey operations, you may be requested to conduct

an inspection of authorized chart sales agents locations in the vicinity of the 1975 project area. Instructions for inspecting these sales agents shall be provided by CLSx2. All inspection data resulting therefrom shall be reported on NOAA Form 49-601, dated 8-71, which in turn shall be forwarded to CAM 1 for review.

8.0 MISCELLANEOUS

8.1 A listing of possible safety hazards to your field party will be maintained and posted where easily visible to all concerned. At least once a month, a meeting of all field party personnel will be conducted to discuss avoidance of these hazards and to identify possible additional hazards.

8.2 A weekly narrative report of daily operations shall be submitted to CLS11/ CAM 11 on NOAA Form 12-602, dated 3-72, so as to be received by first working day of the following week.

8.3 Responsive public service requires that every reasonable effort be made to keep the public aware of NOS activities and their results. A conscientious effort should be made in inform local U. S. Power Squadrons, Great Lakes Pilot Associations, USCG Stations, U. S. Coast Guard Auxiliaries, Marinas, Chart Agents, and local newspapers of the mission objectives of the LSC's charting programs. Contact should be made with any local person reporting suggested changes to the charts. Copies of any articles which might appear in local newspapers should be forwarded to CAM 11. Information on visitors or on specific contacts with the public should also be reported.

8.4 A Season's Report of field operations shall be prepared upon completion of this project in accordance with instruction contained in Section 5 of the Hydrographic Manual.

8.5 Upon receipt of these instructions, you shall immediately contact:

(1) The Ninth Coast Guard District, Cleveland, Ohio regarding permission for berthing and leasing survey operations out of the U. S. Coast Guard Station, Presque Isle, Erie, Pa. Request for access permission to various harbor light structures in the survey area (Ashtabula, Conneaut, and Erie Harbors) should also be made.

(2) The Production Superintendent, Ashtabula Waterworks, 4540 Park Avenue, Ashtabula, Ohio for permission to establish a survey base of operations on property of the city waterworks.

(3) The Harbormaster, Conneaut, Ohio, for permission to establish a survey base of operations in the city owned lakefront park and to utilize city owned berthing facilities in the near area.

All requests should include approximate survey dates requiring the use of the specific facility.

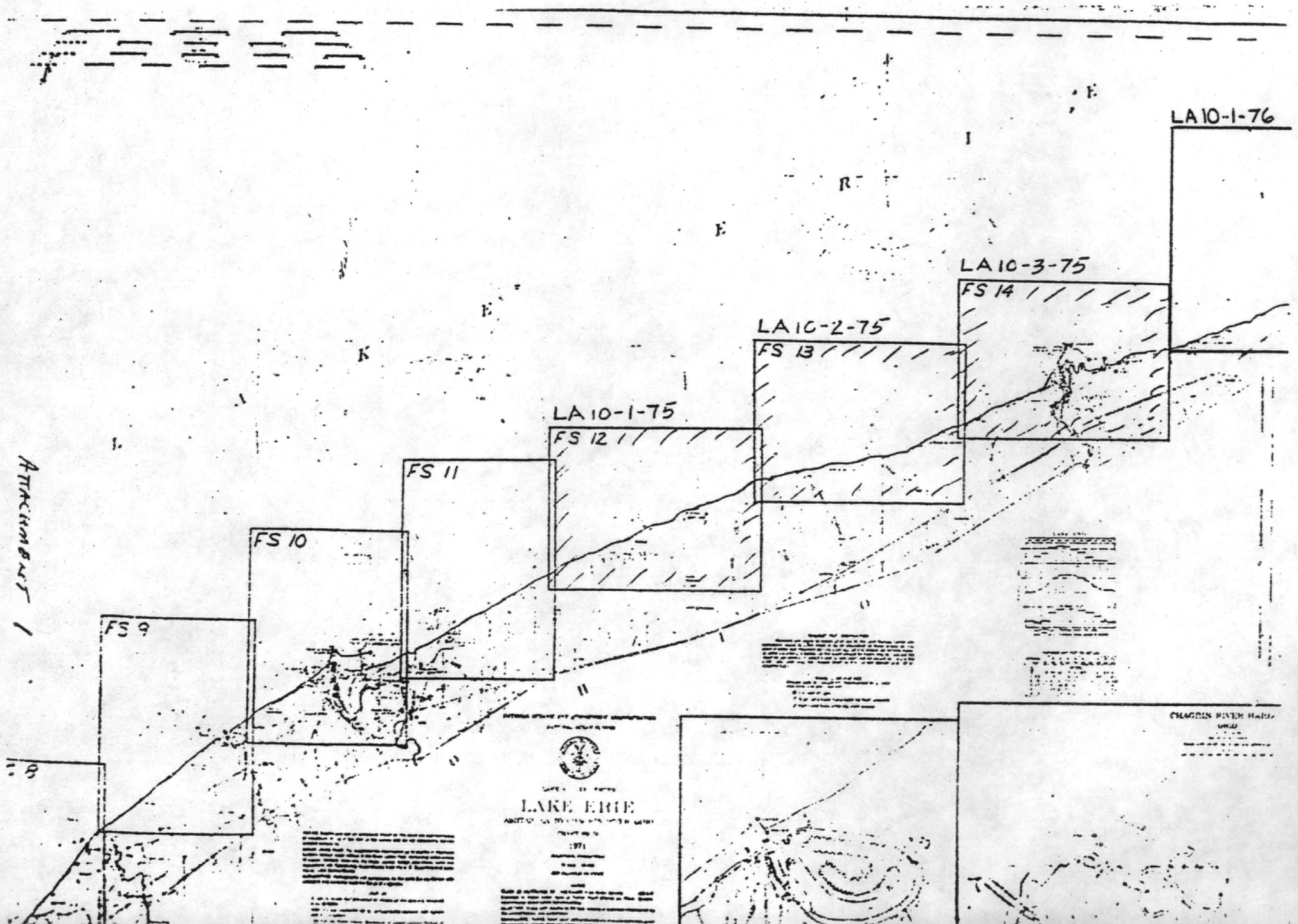
8.6 Upon receipt of these instructions, you shall immediately proceed with outfitting of equipment and supplies, including the related preparation and assembling of required support data, such as horizontal control files, copies of previous survey, recent aerial photography, etc.

8.7 If it appears necessary to amend these instructions, you shall submit your recommendations in writing to CLS11/CAM11 for approval. Any clarification required on the intent of these instructions shall also be requested of CLS11/CAM11 in writing.

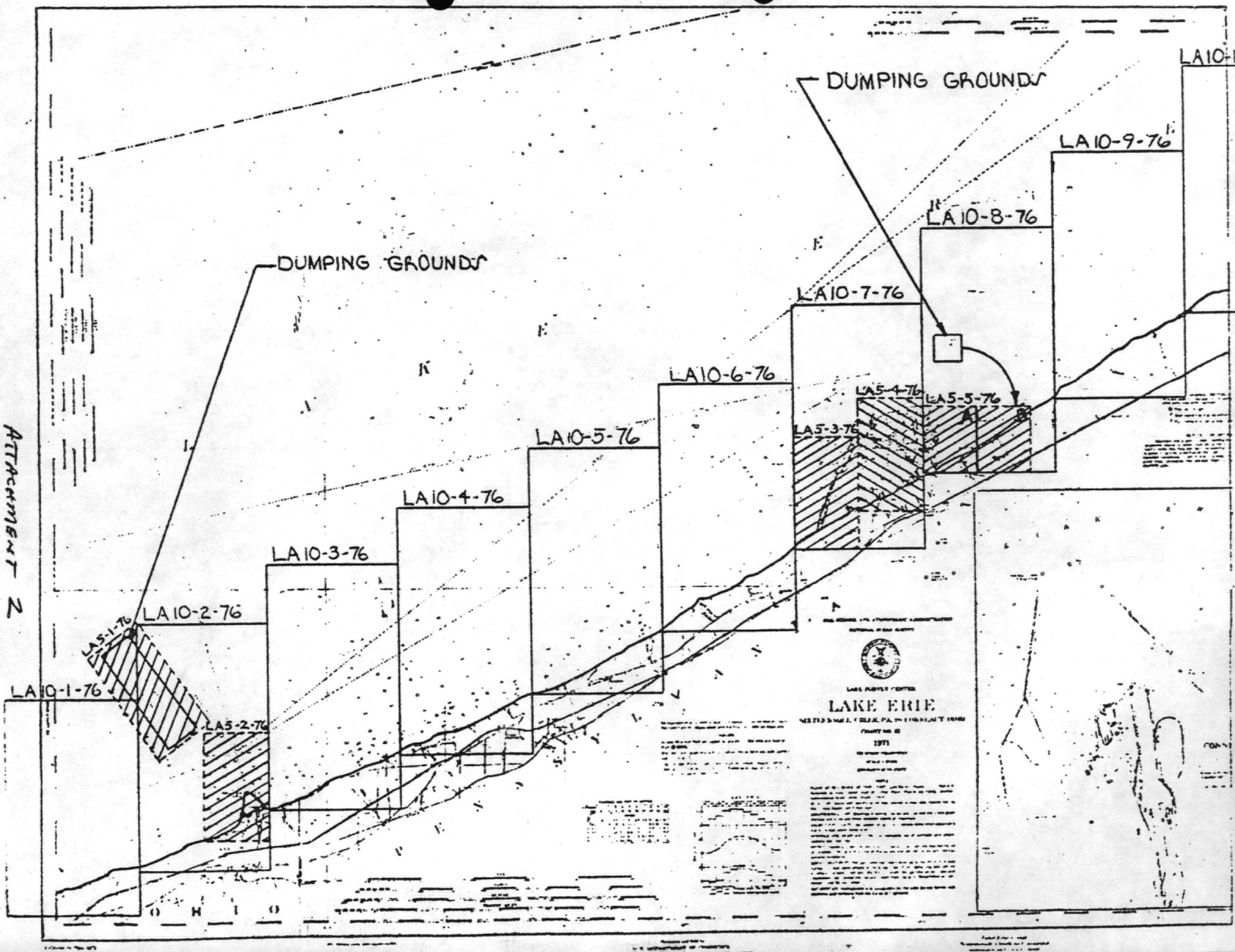
8.8 Expenses on this project shall be charged to Task Number 83222300 (Organization Code C11120).

8.9 Receipt of these instructions shall be acknowledged in writing.

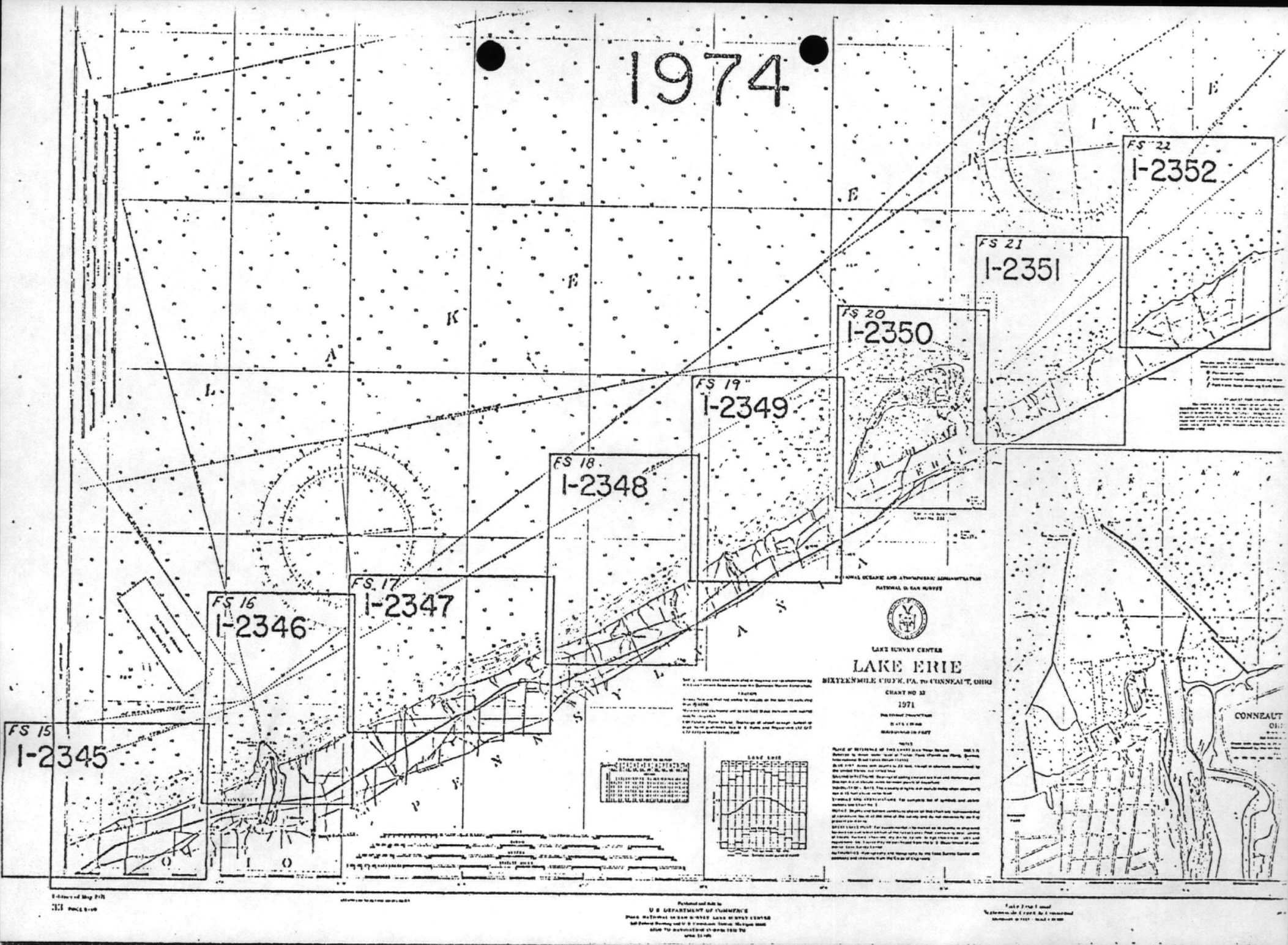
Attachments 2

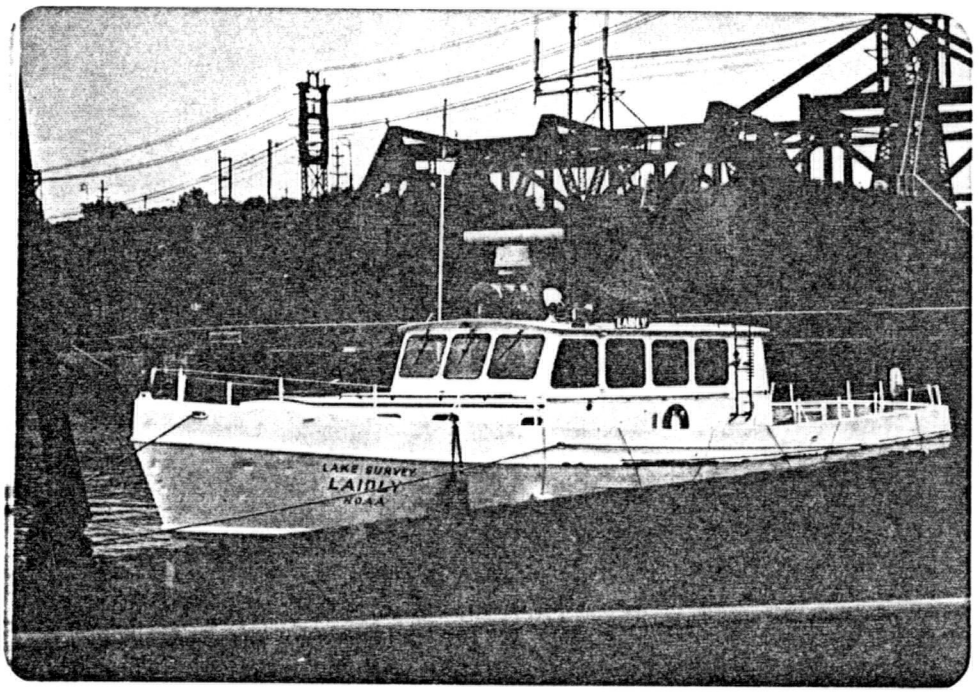


ATTACHMENT 1

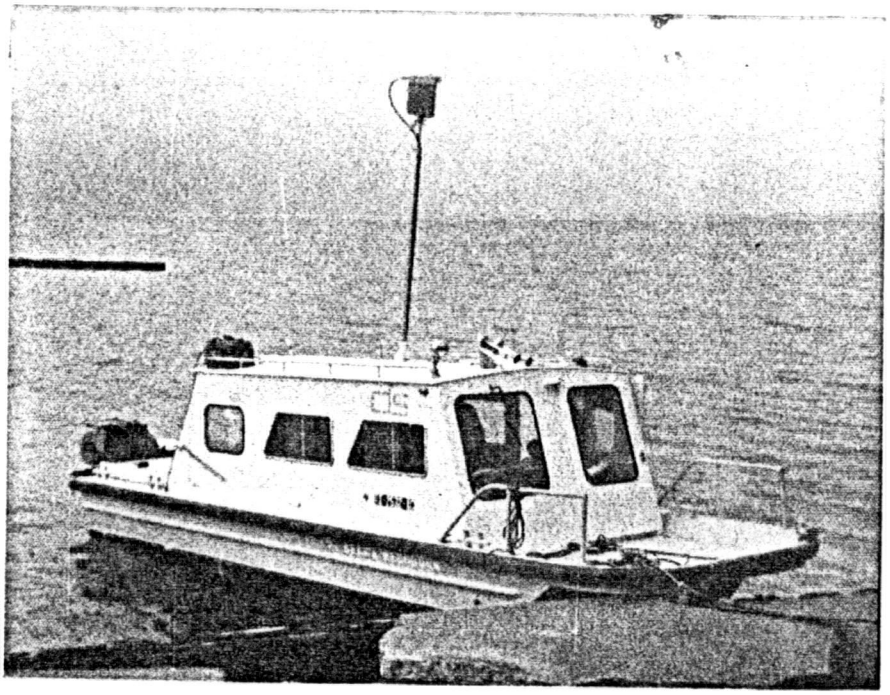


ATTACHMENT 2

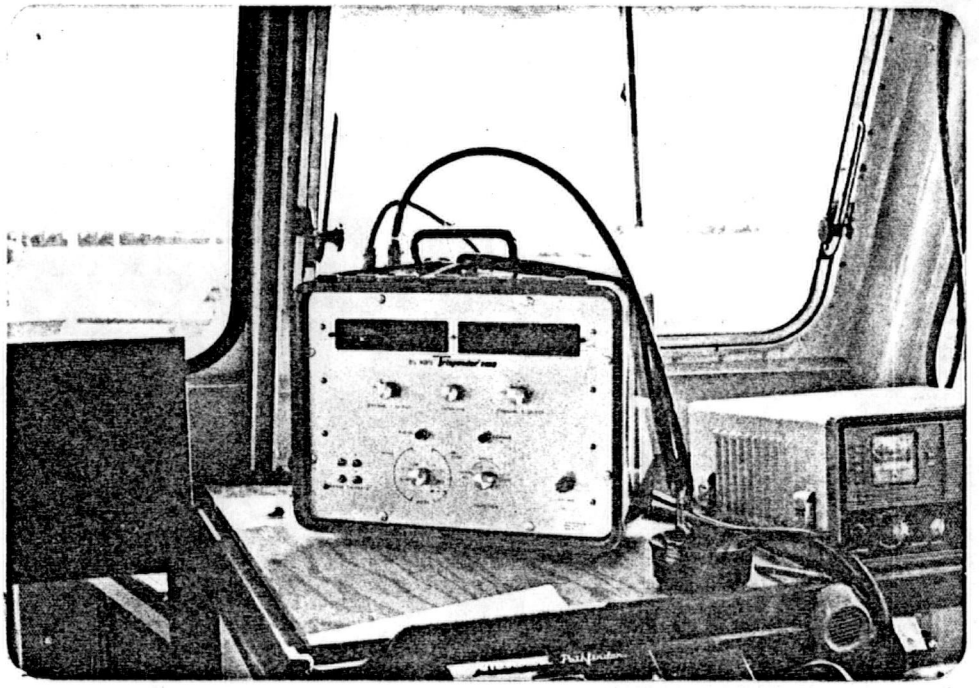

1974
FS 22
I-2352
FS 21
I-2351
FS 20
I-2350
FS 19
I-2349
FS 18
I-2348
FS 17
I-2347
FS 16
I-2346
FS 15
I-2345
LAKE ERIE
SIXTEENMILE CREEK, PA. to CONNEAUT, OHIO
CHART NO 12
1971
CONNEAUT



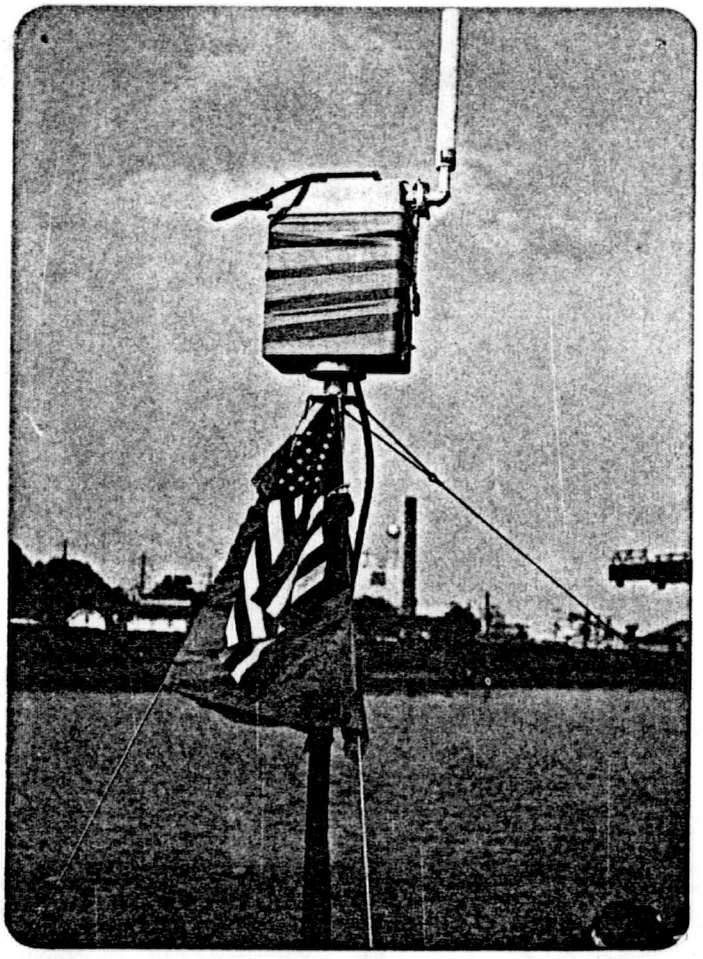
Sounding launch S/V LAIDLY with Hydroplot/Hydrolog system.



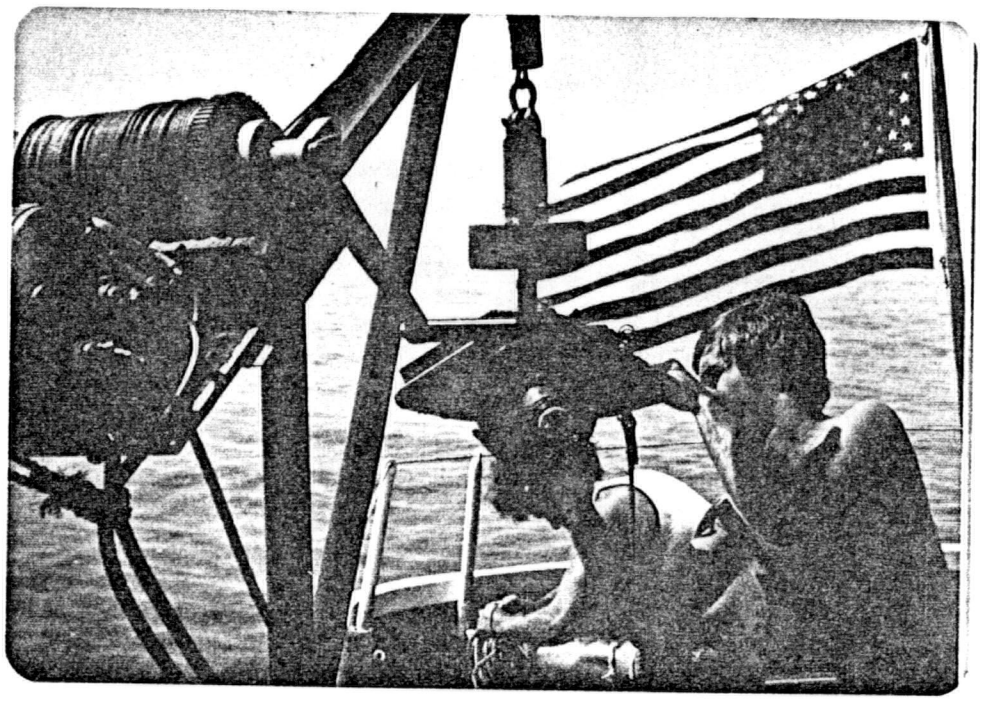
MONARK with Hydroplot/Hydrolog system for inshore work.



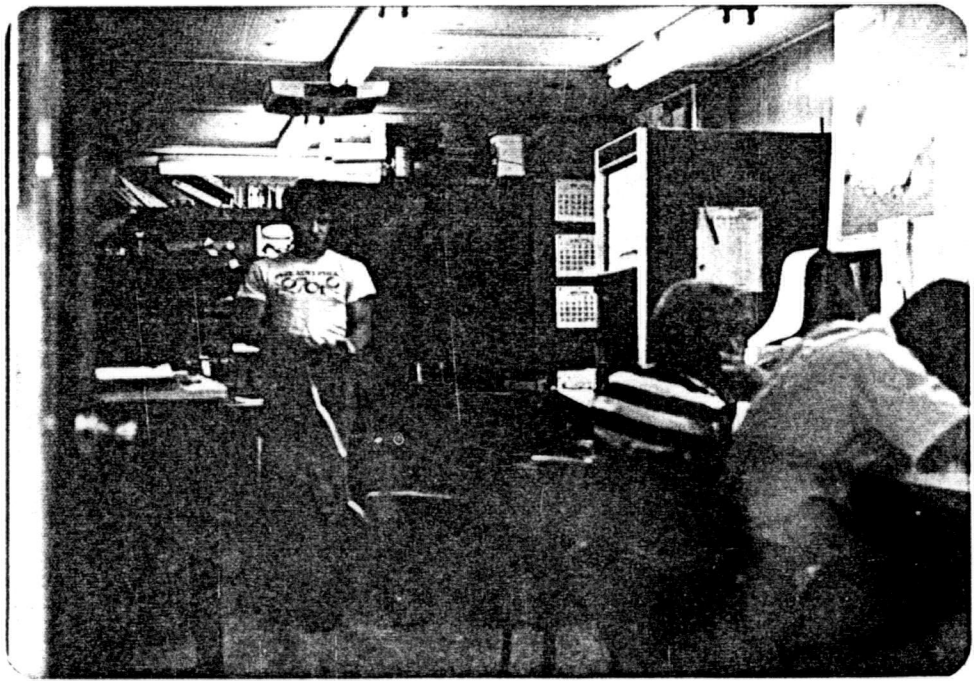
DEL NORTE Trisponder



DEL NORTE Transponder



SHIPEK Bottom Sampler



Office Trailer

REVISORY SURVEYS

INTRODUCTION

The Revisory Survey (July 26 - August 7) initially was located at Rochester, New York. On July 28th, the survey moved to Oswego, New York, where the party remained for the duration of my visit. The 1976 program called for revisory work on Lakes Erie, Ontario, Champlain, Oneida, Cayuga and Seneca; Niagara and St. Lawrence Rivers, and New York State Barge Canal System.

The survey party consisted of Mr. T. Kuchciak, party chief, and eleven assistant.

OPERATIONS

The revisory survey operates on a 3 year cycle (Figure I). The last revision of the area was in 1973. During my stay with the survey, revisions were carried out in Rochester, Sodus Bay, Fair Haven and Oswego. All pertinent material, such as copies of prior surveys, shoreline manuscripts, aerial photography, horizontal and vertical control data were supplied to the survey party. The project involved revisory surveys, maintenance and installation of water level gauging stations, vertical control for gauges by single wire levelling to 0.01 foot for sections requiring more than three set-ups, and third order horizontal control for sounding and for positioning chartable landmarks. A pre-survey review was carried out in the office, with findings detailed on the "Future Field" copy of each chart to be revised. All items listed on the "Future Field" copy reflect areas for investigation as reported from information received from other authoritive sources. Hydrographic surveys were of an investigative nature and concentrated around entrances to the major commercial harbours or recreational facilities developed for small craft, extend into inlets and cover federally navigable rivers and waters and include commercially developed areas outside of federally maintained channels. The hydrographic surveys are controlled by theodolite/transit cut off methods. The scales used in the various revision surveys were generally the scale of the chart or manuscript being verified or revised.

Line spacing did not exceed 100 meters in areas of investigation within harbours, bays, passages, channels and rivers. In narrow channels, either dredged or natural, the line spacing did not exceed 50 meters to adequately delineate the bottom configuration. Sounding lines were run along wharves, along the line likely to be occupied by the keels of vessels berthing and along ranges in the approach of harbour channels.

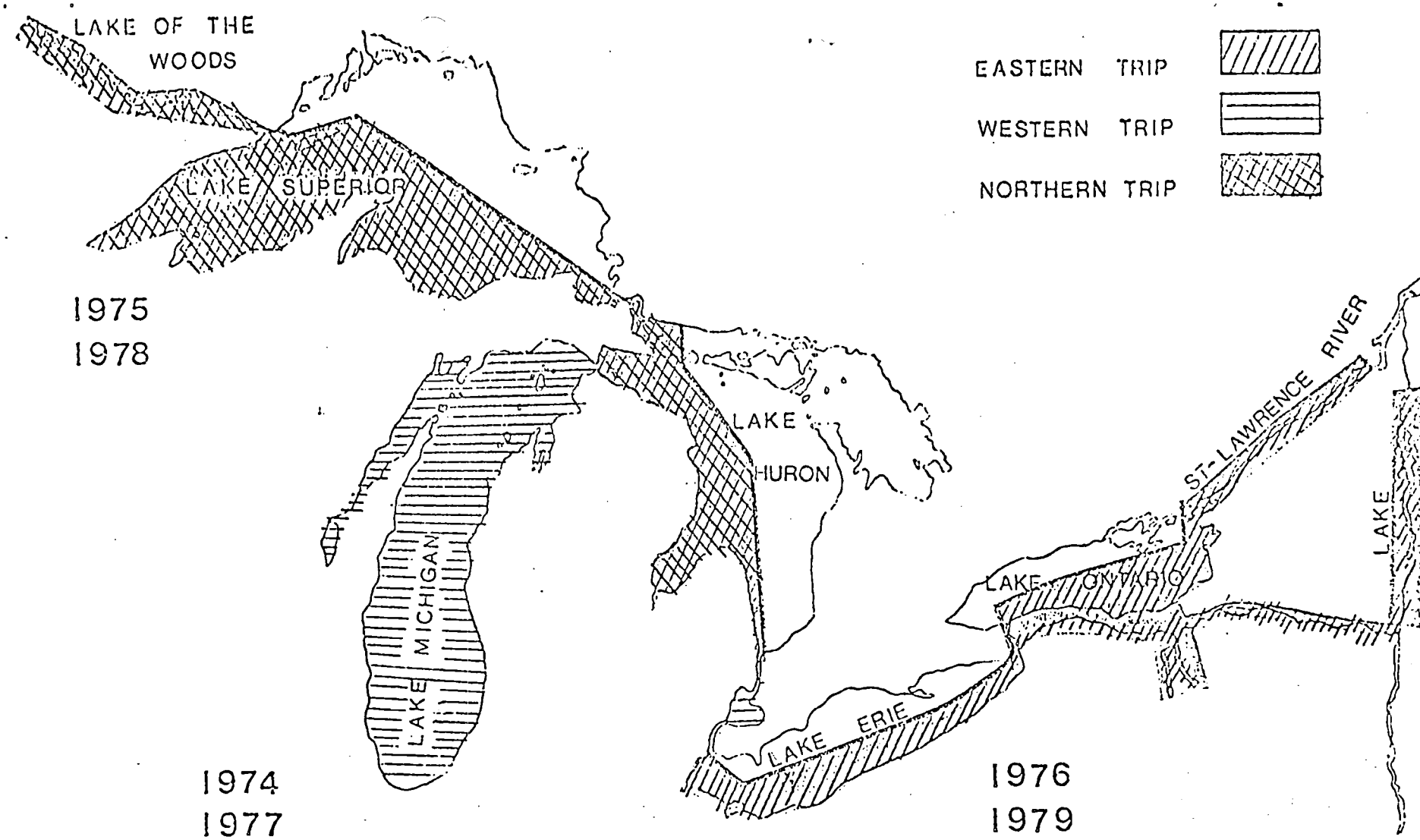
Major equipment included:

2 - 24 foot Monarks w/2 - 35 h.p. Evinrude outboards
1 - office trailer
3 - vehicles
3 - Wild T-1 theodolites
1 - Wild T-2 theodolite
2 - Bludworth Marine ES130 sounder
1 - drafting machine and portable table
2 - Zeiss Ni 2 automatic levels
1 - Geodimeter Ranger IV

The sounding is done with a 24 foot Monark powered by twin 35 h.p. Evinrude outboards and equipped with Bludworth Marine Model ES130 sounder. Two persons are used in the boat, one on the sounder, the other drives the launch. Three instruments are set up over known points, which already exist or are established by stadia and angles, either along the shoreline or on the breakwalls. All existing landmarks are cut in to establish a local control and orientation related to the chart. A portable drafting table is located onshore to plot both the fixes and soundings relayed from the launch. Portable VHF radios are used to maintain communication between plotter, launch and persons occupying the three control points. The plotter cons the launch and notes are recorded by a notekeeper on shore. Two of the three angles, for best cut, are used to plot the fix with a drafting machine. The third is used for a check fix or to plot if one angle is missed.

The revisory survey includes a truck check and a boat check to verify existing features on the chart, such as place names, land marks, waterfront construction, shoreline, marinas, aids to navigation, etc.

The field schedule is set up in the office with the base of operations being moved every week (Figure II, a, b,).



REVISORY TRIENNIAL CYCLE

Figure I

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Lake Survey Center
630 Federal Building & U.S. Courthouse
Detroit, Michigan 48226

Date : March 12, 1976

Reply to Attn. of: CLS-13

To : Chief, Revisory Section - CLS111
Thru: Chief, Surveys Branch

From : Chief, Water Levels Branch

Subject: Support Project Instructions: OPR-003-1-76, Seasonal Gage Installation, Gage Maintenance and related support activities.

1.0 GENERAL

1.1 To support the responsibility for maintaining vertical control in the Great Lakes area, you are requested to install seasonal gages and perform maintenance tasks at permanent gage sites on Lakes Erie and Ontario and on Niagara and St. Lawrence Rivers. You will also perform general maintenance and calibration checks on water temperature recorders in the area.

2.0 PROJECT DESCRIPTION

2.1 The seasonal gages will be installed according to accepted Lake Survey procedures so as to provide data for the months of June, July, August, and September. Gage observers will be recruited and properly instructed as to the required tape readings (nearest .01 foot) and procedures for the submission of records. Common or single wire levels will be required at time of gage installation (ZETG and 2 bench marks) and all site marks including the controlling mark will be tied in sometime during the season. At time of gage removal the ZETG and 2 bench marks will again be tied in.

2.2 The common leveling will be double run with closure accuracy not to exceed 0.01 foot for sections requiring more than three set-ups and proportionately less for shorter sections. The closure accuracy will be the sole criteria for determining the adequacy of the leveling.

2.3 Level summaries will be prepared and reflect the elevation of the master mark as the controlling elevation.

3.0 SEASONAL GAGES

3.1 Following is a listing of harbors by lakes requiring seasonal (tri-daily) gages and levels. Included is the controlling mark and its published elevation.

LAKE ERIE

Bolles Harbor, Michigan - FENCE 573.313. Huron, O. - POWER 578.339
Cooley Creek, O. - LAMP 577.081. Vermillion, O. - BANK 598.325
A Turtle Creek, O. - SHED 574.973. Rocky River, O. - COD 575.139
A Port Clinton, O. - WL106 579.589. Lorain, O. - WL110 599.763 A
West Harbor, O. - COTTAGE 575.025. Mentor Harbor, O. - F. RANGE 12 574.046
East Harbor, O. - EAST 573,766. Ashtabula, O. - BRASS DISK 570.853 A
Sandusky, O. - EXPRESS 583.325. Conneaut, O. - WL 116 A 581.272 A
Cedar Point, O. - GATE 576.059. Dunkirk, N.Y. - WL 119 600.717
Lackawana, N.Y. - FURNACE 585.706

LAKE ONTARIO

A Fort Niagara, N.Y. - PIT 248.478. Little Sodus Bay, N.Y. - WL 132 261.931
Wilson, N.Y. - Harbor 263.262. (Fair Haven)
A Oak Orchard, N.Y. - HOTEL 254.554. Port Ontario, N.Y. - LIGHT 248.749
A Sodus Bay, N.Y. - ~~WL131 264.990.~~ SECOND 248.273 Sackets Harbor, N.Y. - MILITIA 246.528 A

4.0 PERMANENT GAGES

4.1 The following gaging sites will require complete maintenance unless otherwise indicated. The controlling mark and its elevation are also listed.

DETROIT RIVER

Gibraltar, Michigan - D-54 582.793

LAKE ERIE

Fermi, Michigan - POWER 581.946
Monroe, Michigan - REAR RANGE 578.099
Toledo, O. - ~~CORNER 575.545~~ (2 pages) WL 105 577.698
Marblehead, O. - CELL 576.526
Cleveland, O. - GORDON 576.385 (levels only)
Fairport Harbor, O. - LIGHTHOUSE 612.781
Erie, Pa. - RANGE 573.319
Barcelona, N.Y. - KAY 577.129
Sturgeon Point, N.Y. - STURGEON 583.163
Buffalo, N.Y. - BUFFALO L.H. 588.375

NIAGARA RIVER

Ontario St., Buffalo, N.Y. - SUN 575.493
Niagara Intake, Niagara Falls, N.Y. - WL 139 572.316
American Falls, Niagara Falls, N.Y. - FALLS 563.292
Ashland Ave., Niagara Falls, N.Y. - N 32 A 369.474

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Lake Survey Center
630 Federal Bldg. & U.S. Courthouse
Detroit, MI 48226

Date : April 1, 1976 Reply to Attn. of: C3

To : Chief, Revisory Section
CLS111

From : Associate Director
Marine Surveys & Maps C3

Subject: Project Instructions: OPR-301-RS-76, Lakes Erie, Ontario, Champlain, Oneida, Cayuga and Seneca; Niagara and St. Lawrence Rivers; and New York State Barge Canal System

1.0 GENERAL

1.1 All prior instructions for OPR-301 are hereby superseded.

1.2 Work on this project shall begin upon the direction of the Chief, Surveys Branch (CLS11), and with the concurrence of the Chief, Charting Operations Division (CLS1).

1.3 Responsibilities for program direction and technical guidance will be transferred to the Operations Division (CAM1), Atlantic Marine Center, on or before June 30, 1976, in accordance with plans to close the Lake Survey Center. Administrative details will be provided to you as soon as they become available.

1.4 CLS12 will furnish all pertinent material for the charts scheduled for revision of Lakes Erie and the Niagara River, which will include, but not be limited to, copies of all prior surveys, shore line manuscripts, aerial photography, horizontal and vertical control data, etc. All material supportive to remaining revisory surveys scheduled for the 1976 field season (See Attachment 1), will be provided by C3217 upon written request by CLS111. You should allow a minimum of three weeks for C3217 to respond to such a request including time to transmit these data to the appropriate field location of the survey party.

1.5 Project: This project involves the performance of revisory surveys on the waters of Lakes Erie, Ontario and Champlain, the Niagara and St. Lawrence Rivers and the New York State Barge Canal System; the maintenance of NOS water level gaging stations located along Lakes Erie and Ontario; and along the Detroit, Niagara and St. Lawrence Rivers; the installation and maintenance of special seasonal water level gages along Lakes Erie and Ontario; the maintenance and calibration of water temperature recorders on Lakes Erie and Ontario, and the Niagara and St. Lawrence Rivers; the performance of vertical control surveys in support of the permanent and seasonal gaging stations; and the performance of Third-order horizontal control surveys in support of routine revisory surveys and for the determination of geographic positions of all chartable landmarks. The revision

surveys are a continuation of a triennial program of updating the navigational charts of the Great Lakes and their connecting rivers. This program has been used effectively since 1937 to keep the charts of these waters as current and accurate as possible. Water level gage maintenance and supportive vertical control surveys are performed to satisfy the needs of the National Ocean Survey's gaging program on the Great Lakes. This accrued data is used in various hydraulic and hydrographic programs by NOS as well as other federal and private agencies. Standard operating procedures consistent with the Hydrographic Manual, National Geodetic Survey methods, and instructions contained in other NOS operations manuals, shall be employed in accomplishing all aspects of revisory surveys required under these project instructions. Deviation from these standards, or the instructions herein, will not be permitted unless authorized and approved in writing by the Associate Director, Office of Marine Surveys & Maps (C3).

1.6 Plan of Operations: Operations are scheduled to commence on May 3, 1976 at Toledo, Ohio and proceed easterly along the south shore of Lake Erie to the head of the Niagara River at Buffalo, New York; thence along the Upper and Lower portions of the Niagara River to the mouth of the Niagara River at Lake Ontario; thence easterly along the south shore of Lake Ontario to the head of the St. Lawrence River at Cape Vincent; and from this point, traversing along the St. Lawrence River through the Iroquois, Eisenhower and Snell Locks to St. Regis, Ontario.

Operations will then shift to Lake Champlain where proceeding in a southerly direction revisory surveys will be completed along the east and west shores of the lake to the vicinity of Port Henry, New York; thence southerly along the Champlain Barge Canal and Hudson River to the junction with the Mowhawk River at Troy, New York; thence westerly along the New York State Barge Canal System (Mowhawk River, Lake Oneida, Oswego Canal and Cayuga and Seneca Lakes) to the limits of NOS charting at Lyons, New York. Operations should be completed by October 22, 1976, whereupon the survey party will move to the Atlantic Marine Center offices in Norfolk, Virginia. A copy of the proposed 1976 survey schedule is provided in Attachment 1.

1.7 Junctions: Comparisons of 1976 hydrographic, planimetric and topographic surveys performed collectively as revision surveys should be compared with the latest chart depictions. Where changes or revisions are indicated, they shall be made in accordance with the techniques and revision procedures detailed in the latest revisory survey operating instructions included as an Appendix to the provisional Hydrograhic Manual.

1.8 Copies of manuscripts from the most recent two revisory surveys of the geographic areas to be surveyed shall be retained in the field files of the Revisory Section for on-site comparisons with conditions found in 1976.

2.0 GEODETIC CONTROL

2.1 Geodetic Control stations required for revision operations shall be searched for and recovery notes submitted to C185x1. Copies of existing geodetic control data required to support revisory surveys under these instructions will be furnished by CLS113.

2.2 Major geodetic control field support shall be furnished as needed by CLSLC. It is not anticipated that such support will be required for this project.

2.3 Third-order, Class I or II, horizontal control surveys shall be performed to determine the geographic positions of all charted or chartable landmarks. Priority of this work and the survey effort expended will depend on two varying factors: Existence of base control published by the National Geodetic Survey, and the time available within the revisory field schedule to accomplish the work. Control efforts should comply with Section II (3) a. of SOP for Revisory Surveys (see provisional Hydrographic Manual). All geodetic control survey procedures, techniques, and accuracy standards shall be in strict conformance with the specifications listed in the "Manual on Geodetic Triangulation" (C&GS SP-247) and the "Classification, Standards of Accuracy and General Specifications of Geodetic Control Surveys" (NOAA-NOS), dated February 1974 (Reprint May 1974). Monumentation of Third-order stations shall be performed in accordance with the latest specifications detailed in NOS/NGS Memo "Monumentation of Less Than Second-Order Surveys", dated July 17, 1974 (C1x1). All directions, distances and descriptions shall be submitted to CAM1 for review, computation, verification and possible transmittal to C 1 for archiving and publication.

2.4 Other supplementary horizontal control which may be required to facilitate calibration of electronic positioning system shall be established to Third-order, Class II accuracy standards, but need not be monumented.

2.5 The U.S. Coast Guard has recently requested field support by NOS-LSC in the following areas: (1) verification of the deployed positions of all floating navigation aids, (2) verification of the charted position of the specific object used (sextant signal) to position the aid, (3) verification of the sextant angles used by the Coast Guard in placing the aid in the position charted, or determination of sextant angles necessary to deploy the aid in the charted position, and (4) make recommendations on changes to current signals or angles used which would strengthen the deployed aid position. All field parties under the Surveys Branch are affected by this request. Of concern to the Revisory Section are the landmarks/aids/angles on the following charts. Also noted are the respective Coast Guard entities (or buoy tender) which submitted the requests for LSC field support. You should make direct contact with the Commanding Officer therewith for clarification and to personally advise on the survey response being made by the LSC.

REQUEST SOURCE	CHART/NAVIGATION AID SHEETS
1. Group Headquarters, Detroit	370 - Sheet 34 360 - Sheet 36
2. Commanding Officer USCGC Bramble	3,39,374,365,364,363,35.357, 354,34,342,332,32,31,314
3. Group Headquarters, Buffalo	32,314,312,238,234,21,211

The above charts and other pertinent data are to be forwarded under separate cover. Due to the magnitude of this request, it is not expected that you will be able to fully respond to the complete project. Work accomplished will be reported to the U.S. Coast Guard upon completion of your field surveys along with copies of the data you acquire. It should be recognized that some of the work performed in 2.3 above will impact the work required in this section.

2.6 Recovery notes shall be prepared for all International Boundary Commission stations and/or reference marks recovered or used during 1976 revisory surveys. Upon completion, these recovery notes shall be immediately forwarded through C18 to the U.S. Section, International Boundary Commission, ATTN: Capt. F. Popper. Revisory survey time under these project instructions will not permit special recovery efforts for the International Boundary Commission, and the total recovery effort in this area is expected to be minimal.

3.0 PHOTOGRAMMETRY

3.1 Prints of the latest aerial photography of all the harbor areas scheduled for revision, and at general scales of 1:10,000 and 1:30,000 have been provided by the photogrammetry group under CL511.

3.2 A photogrammetric manuscript of Erie Harbor, PA has been provided for you to field check. Primary emphasis should be on verification of landmark positions which have been identified on the manuscript. Verification will be by EDM traverse in accordance with instructions in the SOP for Revisory Surveys in the Hydrographic Manual (Provisional).

3.3 All newly positioned landmarks for each chart being revised shall be tabulated on NOAA Form 76-40, "Report on Nonfloating Aids or Landmarks for Charts"; in accordance with the procedures outlined in Section 5.5 of the 1975 provisional Hydrographic Manual.

4.0 HYDROGRAPHY

4.1 Hydrographic Surveys shall (generally) be of an investigative nature and performed in accordance with the Hydrographic Manual and existing LSC standard operating instructions for revisory surveys. Surveys shall be concentrated around the entrances to the major commercial harbors or recreational facilities developed for small craft, shall extend into inlets and cover federally navigable rivers and waterways, and include commercially developed areas outside of federally maintained channels as described in LSC standard operating procedures.

4.2 Hydrographic surveys shall be controlled by either electronic positioning or by conventional theodolite/transit cutoff methods. Hydrographic investigations in the inshore areas should extend as close to shore as safe navigation and other survey conditions permit.

4.3 Reduction for lake stage shall occur in real-time or as the hydrographic inspection or verification of charted detail progresses. Lake stage shall be determined from water level gages and related information detailed herein in Section 5, Water Levels.

4.4 Presurvey Review: Presurvey review will be performed by CLS12x2 and C3217 with findings detailed on the "Future Field" copy of each chart to be revised. All items listed on the "Future Field" copy will generally reflect areas for investigation as reported from information received from other authoritive sources.

4.5 Scales: The scales used in the various revision surveys performed will be selected to comply most satisfactorily with the scale of the chart or manuscript being verified and/or revised. Overlays will be encouraged where necessary to show detail adequately. Scales chosen should be large enough to allow for expected development in the depths encountered in any area where densification of survey is considered justified and warranted. All sounding overlays and associated fathograms will constitute basic revision information and shall be attached to the revised chart for forwarding to the Marine Chart Division (C3217).

4.6 Line Spacing: Line spacing shall not exceed 100 meters in areas of investigation within harbors, bays, passages, channels and rivers. In narrow channels, either dredged or natural, the line spacing shall not exceed 50 meters to adequately delineate the bottom configuration. In addition to any other sounding lines which may be run along wharves or docks, soundings shall be taken along the line likely to be occupied by the keels of vessels berthing there, and along any ranges in the approach of harbor channels. Deviations from these specifications may be made at the discretion of the party chief so long as quality of the revision data does not suffer.

4.7 Sounding Lines: Sounding lines shall be run in accordance with Sections 4.3 thru 4.3.5.4, inclusive, of the provisional Hydrographic Manual except as noted in these instructions. Crosslines shall be run in accordance with Section 4.3.6.

4.8 Any submerged wrecks and obstructions encountered which may pose as hazards to navigation and which heretofore have not been positioned accurately nor has there been a least depth determined previously, shall be investigated by wire sweeping. A report of the findings shall be immediately made to the Ninth Coast Guard Headquarters, with corresponding subsequent action required, such as reporting the findings in a "Local Notice to Mariners," etc., shall be made in writing to CLS11 and C32.

4.9 Hydrographic data shall be recorded and processed in accordance with existing LSC procedures. As the revised charts are completed, the charts and all related source and pertinent data shall be forwarded as soon as possible to C3217 for continued processing. Field compilation of data should be afforded the same priorities as the acquisition of data. All data transmitted to C3217 shall be reported on NOAA Form FL 77-605, dated 3-72 with a copy of this form forwarded to CAMIL. It is essential that priority of effort be directed to chart revision surveys, and the necessary processing of the data derived therefrom, so that the proposed "send-in dates" on the revisory survey schedule are met (Attachment 1).

5.0 WATER LEVELS

5.1 It is the responsibility of the Revisory Section to perform standard seasonal inspections and maintenance services on any of the NOS automatic water level recorders which may be located within the geographic reach of the scheduled surveys. These gaging stations collectively comprise a part of the total NOS gaging network located throughout the Great Lakes area. This work will be performed in direct support of the operations of the Water Levels Branch (CLS13). Previously established procedures shall be followed to effect this support properly and written reports on NOAA Form 77-612, dated 10-72, detailing specific findings and maintenance work performed, shall be submitted to CLS13. It is anticipated that these reports will be forwarded to C33 after July 1, 1976. During the period of these project instructions, Spring and Fall services to the gaging stations listed in Section 4.0 of Attachment 2 shall be accomplished.

5.2 You are required to install temporary gages at the sites listed in Section 3.0 of Attachment 2, and to hire gage observers for the period June 1 through September 30, 1976. These gages shall be removed by the Revisory Section after September 30. Each gage shall be read three times daily during the operating period with the tri-daily readings recorded on NOAA Form 77-600, dated 2-73. Levels shall be run to determine the zero of each gage when it is installed, midway in the operating period, and before it is removed in the Fall. All gage observers hired will be paid on a quarterly basis; one payment for FY76 and one for FY77 observation periods.

5.3 Vertical control histories and related bench mark data have been provided for all the above gage sites.

5.4 You are required to perform standard maintenance services and calibration checks on eight (8) special water temperature recorders located on Lakes Erie and Ontario, and along the Niagara and St. Lawrence Rivers as defined in Section 5.0 of Attachment 2. It is important that this support work for the Water Levels Branch (CLS13) be accomplished prior to June 30, 1976. Any operational delays which might prevent this deadline from being met should be reported to CLS11 as soon as the difficulty become apparent.

5.5 You have full responsibility for effective solution of routine maintenance problems encountered in the field which are directly related to the above work. When non-routine or unusual problems are encountered, you should immediately contact by telephone or in writing, the Chief, Surveys Branch (CLS11) or Chief, Water Levels Branch (CLS13) for technical assistance in determining a proper solution.

5.6 The processing of all records from the seasonal gages will be accomplished by CLS13. Copies of the reduced data will be provided the Revisory Section for necessary updating of their field support files. A summarization of the seasonal gage records, including the associated records, will be performed by CLS13 prior to archiving of these data by C33. Processing of records from gaging stations comprising the permanent NOS Great Lakes water levels network will also be handled by CLS13/C33 with final archiving of all data included as an integral part of the processing.

6.0 GREAT LAKES PILOT

6.1 The Great Lakes Pilot description or narrative of the entire project area shall be carefully reviewed and special revision reports submitted to C324 ATTN: Mr. S. Bente. Revision reports shall be prepared upon completion of revisions to each chart. Reports shall follow a reporting format established by the LSC in prior years, unless advised by C324 that a change in reporting method or format is desired. You attention is directed to the SOP for Revisory Surveys, Section II (2) and to Section 5.8 of the Hydrographic Manual.

7.0 MISCELLANEOUS

7.1 In conjunction with normal chart revision surveys, the Revisory Section may be required to periodically inspect authorized sales agents located in the vicinity of designated field operations. Special instructions and reporting forms will be issued for required inspection visits. All inspection data shall be listed on NOAA Form 49-601, dated 8-71, and shall be forwarded to C44. Reference is made to the provisional Hydrographic Manual, Section 5.11.

7.2 A listing of possible safety hazards to the revisory field party will be maintained and posted where easily visible. At least once a month, a meeting of all field party personnel will be held to discuss avoidance of these hazards and to identify possible additional hazards. Mention of these meetings will be made in the weekly narrative report of operations (Section 7.3).

7.3 A weekly narrative report of daily operations shall be submitted on NOAA Form 12-602, dated 3-72, to CLS11 so as to be received by COB on the first working day of the following week. These reports will be submitted to CAM11 when operational responsibility for the survey program is transferred to the Atlantic Marine Center.

7.4 A monthly narrative report of major or significant work accomplishments achieved during the current month, as well as a statement of work planned for the following month, shall be submitted to CLS11 so as to be received by COB on the 21st day of the current month. Statements on professional meetings attended, non-field trips made, visitors to the Section, and other operationally aligned problems should also be included. These reports will be submitted to CAM11 in accordance with operational changes cited in section 7.3.

7.5 Responsive public service requires that every reasonable effort be made to keep the public aware of NOS activities and the results. A conscientious effort should be made to inform local U.S. Power Squadrons, Great Lakes Pilots Associations, USCG Stations, U.S. Coast Guard Auxiliaries, Marinas, Chart Agents, and local newspapers of the mission objectives of the LSC's revisory surveys program. Contact should be made with any local person reporting suggested changes to the charts. Copies of any articles which might appear in local newspapers should be forwarded to C513. Information on visitors or on specific contact with the public should also be reported (See 7.4 above).

7.6 A report of field operations shall be prepared upon completion of this project in accordance with instructions contained in Section 5.1 of the provisional Hydrographic Manual.

7.7 Expenses on this project shall be changed to Task Number 83222301 (Organization Code C11110).

7.8 Submit recommendations if it appears advisable to amend these Instructions.

8.0 ACKNOWLEDGEMENT: Receipt of these instructions shall be acknowledged in writing.

Enclosures
Attachments 1 & 2

Charting Operations
Division

LAKE SURVEY CENTER
National Ocean Survey
Revisory Section
Field Schedule
1976

Surveys Branch

Harbor	Miles		Arrival Date		Chart No.	Send In Date	
	Land	Water	Sched	Actual		Sched	Actual
Detroit							
Monroe	36	33	Apr 30				
Toledo	23	22	May 3	May 3			
Port Clinton	38	40	5	6			
Sandusky	23	40	8				
Huron	10	10	10				
Vermilion	11	10	11		(14826)		
Lorain	11	10	12		14841, (14826)	Jun 2	
Rocky River	17	20	17		(14826)		
Cleveland	8	8	18		14839, 14826	15	
Chagrin River	19	18	Jun 1		(14825)		
Mentor	6	6	2		(14825)		
Fairport	7	7	3		14837, (14825)	21	
Ashtabula	29	26	7		14836, 14825	24	
Conneaut	13	14	10		(14824)		
Erie	23	32	14		14835, 14824	Jul 3	
Barcelona	32	28	19		(14823)		
Dunkirk	17	19	21		14823	7	
Lackawanna	38	33	23		(14832) (14833) (14822)		
Buffalo	8	8	25		(14832) 14833 (14822)		
Tonawanda	10	18	Jul 5		(14832) (14822)		
Niagara Falls	15	14	6		14822 14832 (14806) (14816)	23	
Fort Niagara	14	15	9		(14822) (14806) 14816	26	
Wilson	13	15	12		14822 (14806)	27	
Olcott	7	7	13		14806	29	
Oak Orchard	28	27	15		(14805)		
Rochester	41	34	16		14805, 14815 (14804)	Aug 11	
Sodus Bay	40	35	22		14804 14814	12	
Fair Haven	28	18	24		(14803)		
Oswego	17	16	27		(14803) 14813	20	
Port Ontario	21	19	31		(14803)		
North Pond	7	8	Aug 2		14803	23	
Henderson Harbor	23	28	3		(14802) (14811)		
Sackets Harbor	12	10	4		(14802) 14811	24	
Cape Vincent	24	26	9		14802, 14768 (14767)	30	
Clayton	15	16	12		14773, 14774 14767, (14766)	Sep 2	
Alexandria Bay	11	11	16		14772, 14771 14766, (14765)	6	
Morristown	35	26	19		14765, (14764) 14770	8	
Ogdensburg	11	12	20		14764, 14763	9	
Waddington	20	19	24		14762	13	
Massena	17	24	25		14761	14	

Figure IIa

Charting Operations
Division

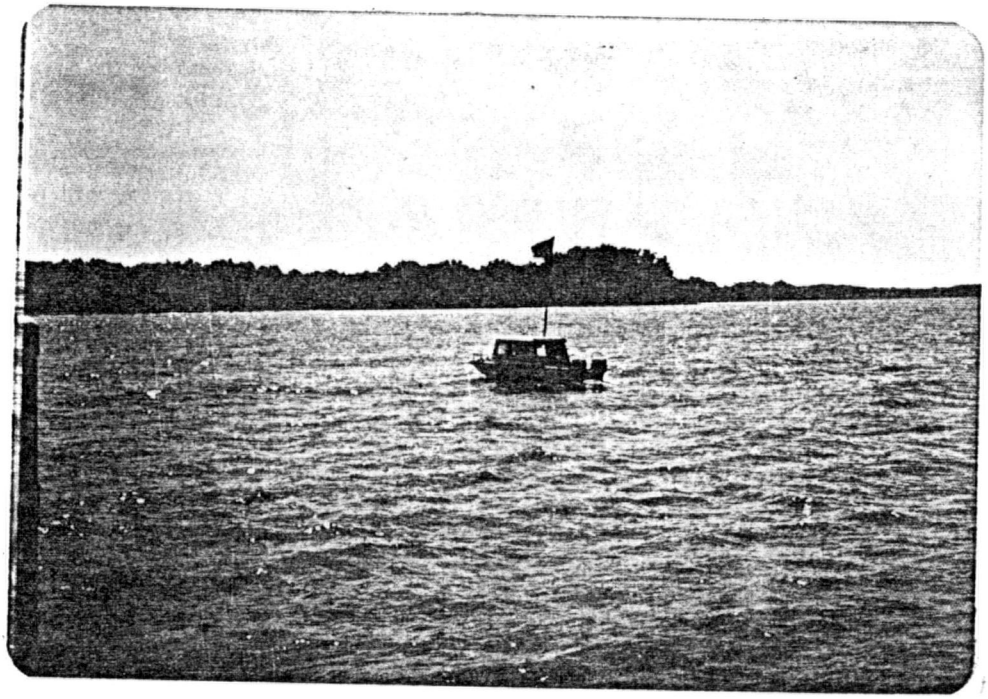
LAKE SURVEY CENTER
National Ocean Survey
Revisory Section
Field Schedule

Surveys Branch

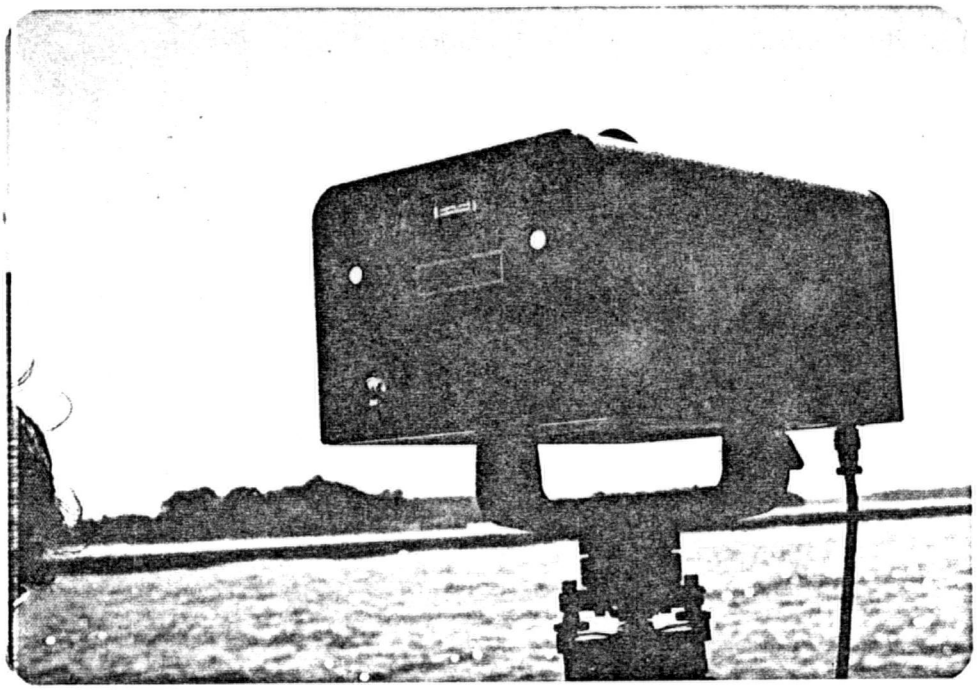
Harbor	Miles		Arrival Date		Chart No.	Send In Date	
	Land	Water	Sched	Actual		Sched	Actual
Rouses Point	70	--	Aug 31		14781	Oct 1	
Plattsburgh	24	20	Sep 1		(14782)		
St. Albans	51	30	4		(14782)	4	
Burlington	30	30	8		14785, (14783) 14782	8	
Port Henry	45	32	10		(14784), 14783	11	
Whitehall	37	35	13		(14786), 14784	13	
Schuylerville	34	35	16		(14786)		
Waterford	24	24	18		(14786)		
Schenectady	20	19	21		(14786)		
Fonda	28	29	24		(14786)		
Herkimer	35	26	27		(14786)		
[illegible]	32	28	29		(14786)		
Brewerton	48	36	Oct 1		(14786), 14788	Nov 1	
Baldwinsville	49	35	3		(14786)		
Ithaca	20	--	Oct 6		(14786) (14791)		
Watkins Glen	98	81	6		(14786), 14791	6	
Lyons	79	72	15		14786	15	
Norfolk	483	--	22				

Figure IIb

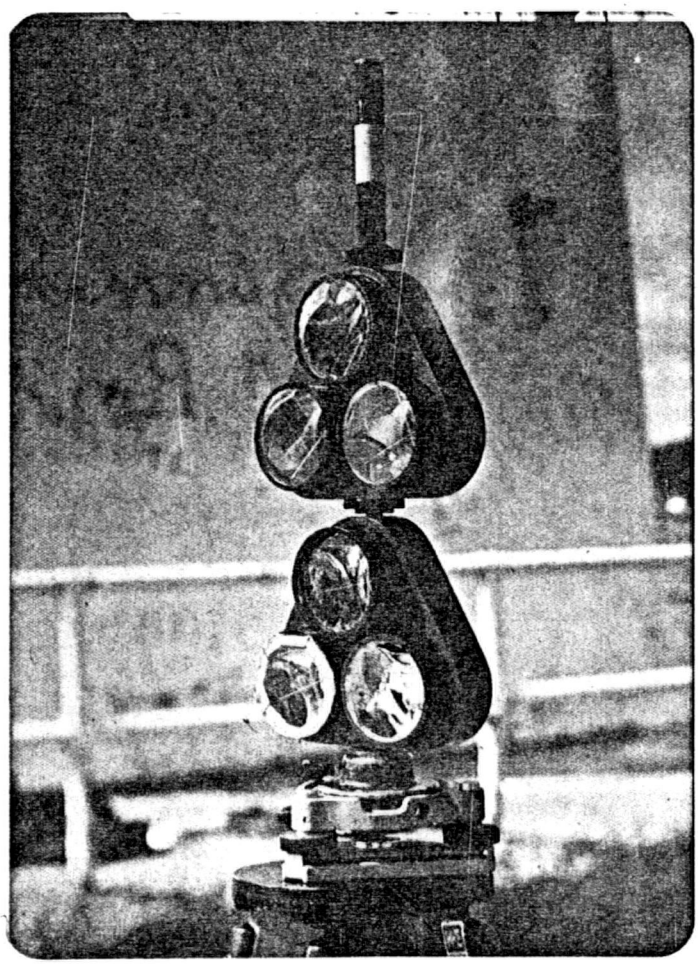
MONARK sounding launches - 'LAKE DIVER'(foreground) and 'LITTLE TOOT'.



MONARK sounding - positioned by three Theodolites.



GEODIMETER Ranger IV



Prism reflectors for Geodimeter

BALTIMORE HARBOUR SURVEY

INTRODUCTION

The period August 9-20th was spent with the Baltimore Harbour Survey. Operations base for the survey party was in Glen Burnie, Maryland. This year's survey is a continuation of a project started in 1975. The main sounding was done in 1975. The work remaining includes sounding of creeks, bays, inlets, bottom samples, aids to navigation, etc. (Figure III).

The survey party consisted of Lt. K. Perrin, party chief, and five assistants.

OPERATIONS

Baltimore Harbour is covered by seventeen field sheets, four at 1:10,000 scale and thirteen at 1:5,000 scale. Line spacing was 100 meters for 1:10,000 scale and 50 meters for 1:5,000 scale.

Major equipment consisted of:

1 - 24 foot Monark launch w/twin 35 h.p. Johnsons
1 - 20 foot Boston Whaler
1 - office trailer
2 - vehicles
3 - Del Norte trisponder 202A
4 - sextants
1 - Wild T-2 theodolite

Sounding was done with a 24 foot Monark, powered by twin 35 h.p. Johnson outboards, equipped with Raytheon 723 sounder. The launch was positioned with sextants or range/azimuth using Del Norte and Wild T-2 theodolite. Notes were hand recorded. Fixes are called by the sounder man on an eventime mark on the sounding roll. The next day, fixes were hand plotted on a master boatboard and put on tape using a data logger.

Del Norte was calibrated twice daily over two known horizontal control points. A barcheck was done once a day.

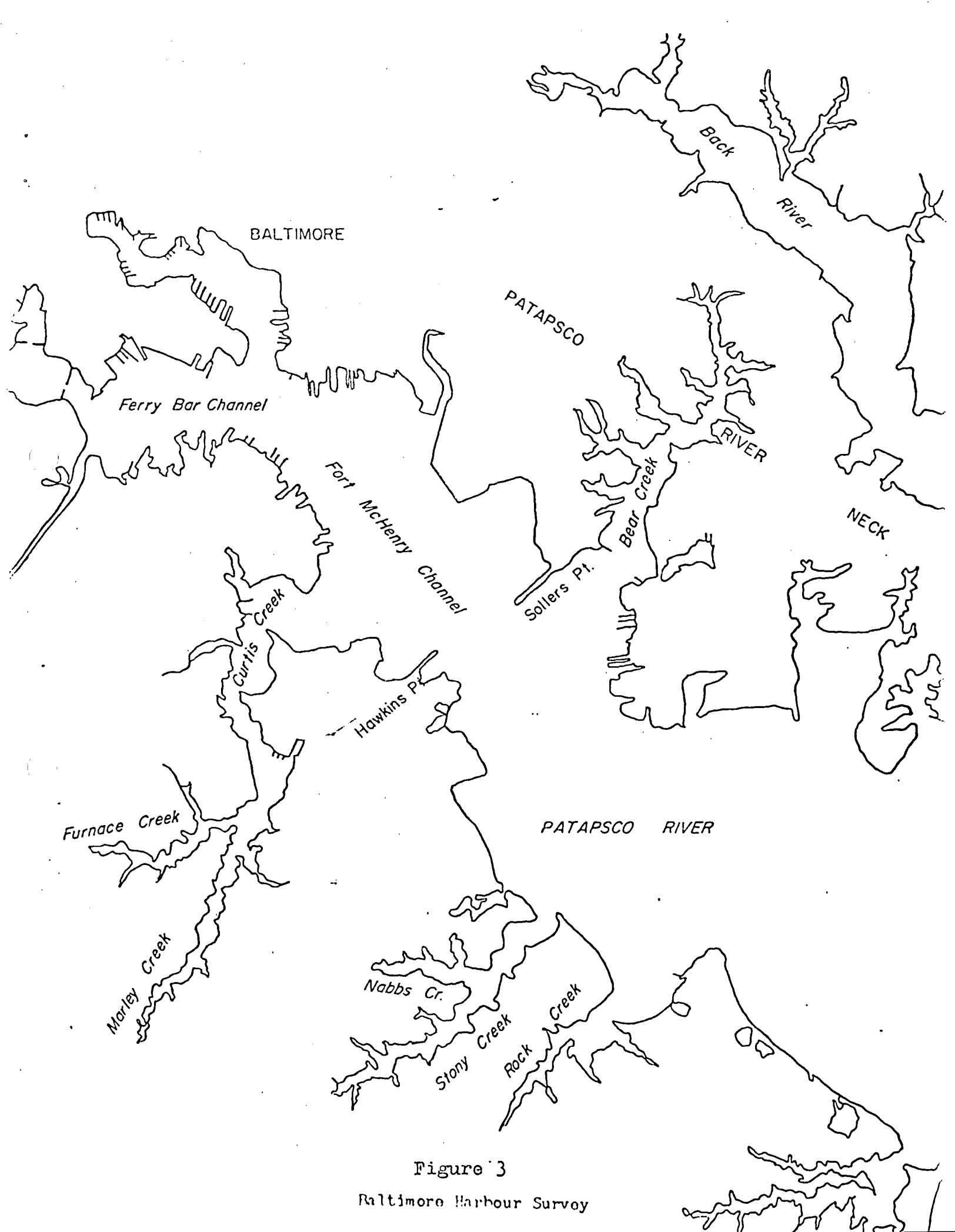


Figure 3

Baltimore Harbour Survey

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md. 20852

Date: JUL 9 1975

Reply to Attn of: C3x4

Subject: PROJECT INSTRUCTIONS: OPR-514-AHP-75, Baltimore Harbor, Maryland

To: Director, Atlantic Marine Center

Subject Instructions are forwarded for issuance to the Chief, Atlantic Hydrographic Party.

The copies required for distribution by this Office have been retained.

for Donald R. Tibbet

Robert C. Munson
Associate Director
Office of Marine Surveys
and Maps

Attachment

July 11, 1975

1ST ENDORSEMENT

TO: Chief, Atlantic Hydrographic Party

Forwarded for your compliance.

Alfred C. Holmes
Director, Atlantic Marine Center

cc: CAM02
CAM101, 102
CAM3
CAM5
CAM6, 4, XO

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md. 20852

JUL 9

C3x4

Chief
Atlantic Hydrographic Party

PROJECT INSTRUCTIONS: OPR-514-AHP-75, Baltimore Harbor, Maryland

1.0. GENERAL

1.1. Plan of Operations: Work on this project will begin about August 1. Atlantic Hydrographic Party launches will conduct a basic hydrographic survey of the entire Patapsco River area, including Bear Creek, Curtis Creek, and all other Patapsco River tributaries, to the head of navigation. Operations will proceed in a manner to be determined by the Chief, Atlantic Hydrographic Party, and continue until completion of all requirements.

1.2. Junctions: No junctions are required.

2.0. PHOTOGRAMMETRY

2.1. The Director, Atlantic Marine Center, will assign an experienced photogrammetrist to provide support. Administrative supervision of the photogrammetrist will remain with the Coastal Mapping Division, AMC. The support unit will build signals only to the extent that this task does not interfere with photogrammetric operations.

2.2. The Chief of Party shall be responsible for agreement between the field sheet and the field edit data where the two surveys cover common details. Resolve all discrepancies before field edit records are shipped. Cronaflex copies used for locating signals and cronaflexes needed for processing smooth sheets shall be made a part of the hydrographic records after they are returned from Coastal Mapping Division, AMC.

2.3. All Coastal Mapping Support data for Baltimore Harbor (CM-7415) will be furnished on a timely basis to allow launch work to proceed without hindrance. Seventeen shoreline manuscripts will be furnished, TP-00836 through TP-00852, four at 1:10,000 scale and 13 at 1:5,000 scale. The following data will be supplied for each manuscript:

2 stable base film copies;

3 ozalid prints;

1 set matte ratio prints for field edit;

Notes to the Hydrographer;

Discrepancy Print.

2.4. Field edit is required for all manuscripts. All field edit notes shall be made in violet ink on the field ratio prints. Each correction, or group of corrections, shall be cross-referenced by the appropriate photograph number on an ozalid print of the affected survey.

2.5. All field edit support data shall be forwarded to the Chief, Coastal Mapping Division, AMC, Attention: CAM521. Clearly mark all items that are to be returned to be made a part of the hydrographic records. Forward one copy of each transmitting letter to the Chief, Coastal Mapping Division, Rockville, Attention: C3415.

3.0. HYDROGRAPHY

3.1. Hydrography shall be basic and in accordance with the AMC and Provisional Hydrographic Manuals.

3.2. Control: Hydrography shall be controlled by approved visual and/or electronic methods. If electronic control is used, a report is required.

3.3. Visual signals and electronic control stations may be located by any approved method. Computations and locations shall be checked and final accepted signal locations determined.

3.4. The area covered by chart 12281 (formerly C&GS 545) will be surveyed at 1:5,000 scale, while the area outside the limits of chart 12281 will be at 1:10,000.

3.5. In the area covered by 1:5,000-scale surveys, line spacing shall not exceed 50 meters. Sounding line spacing in all other areas shall not exceed 100 meters. Line spacing shall be reduced where necessary to adequately delineate bottom configuration. The use of development overlays is encouraged.

3.6. Crosslines shall be run in accordance with the Provisional Hydrographic Manual.

3.7. Bottom samples shall be taken in accordance with the Provisional Hydrographic Manual and AMC Manual.

3.8. An approved sheet layout has been furnished by AMC.

3.9. Hydrographic data shall be recorded and processed in accordance with the Hydrographic Manual, Provisional Hydrographic Manual, and AMC Manual, Chapter 3.

3.10. A permanent record shall be made of the geographic positions of all objects used for calibration. A report of calibration checks shall be made in accordance with the Provisional Hydrographic Manual. The report shall be made a part of the hydrographic records.

3.11. The Presurvey Review will be compiled and forwarded.

4.0. COAST PILOT

4.1. The Coast Pilot description of the project area shall be carefully reviewed and a special report submitted in accordance with AMC Manual, Chapter 02, Section 09.

5.0. TIDES

5.1. It is the responsibility of the Chief of Party to ascertain that proper field monitoring of all tide gages in support of this project is carried out. A line of communication must be established between the party and any contract observer to ensure prompt notification of gage malfunctions or changes in the staff-gage relationship. Breaks or invalid tide records from any gage in excess of three continuous days cannot be interpolated. This might result in a loss of tide control to the extent that a resurvey of the area involved would be required. Time and staff comparisons are required whenever a gage is checked.

5.2. The reference station for predictions will be Baltimore. Corrections for local areas will be from Table 2, Stations 2113-2121, of the East Coast Tide Table. The Baltimore, Maryland, tide station will provide control for the determination of tidal datums for the tide gages listed under Section 5.5. Servicing of the Baltimore tide gage is not required. A copy of the station report, giving the name and address of the observer, will be furnished.

5.3. Portable tide gages will be installed at the following locations. These stations will operate throughout the entire period of the survey.

Station	Approximate Lat. (N)	Long. (W)
North Point	39°11.8'	76°26.7'
Hawkins Point	39°12.5'	76°32.0'

5.4. Bench mark data will be furnished for North Point. There are no data available for Hawkins Point.

5.5. Portable tide gages will be installed in each of the tributaries to be surveyed. A minimum of 30 days of usable data and five permanent bench marks are required at the listed locations:

Station	Approximate Lat. (N)	Approximate Long. (W)
a. Bodkin Creek, Graveyard Point	39°07.5'	76°27.0'
b. Rock Creek, Fairview	39°09.3'	76°30.0'
c. Stony Creek, MD Route 173 Bridge	39°09.8'	76°31.6'
d. Curtis Creek, Point Pleasant	39°11.2'	76°34.8'
e. Middle Branch, Western Shore	39°16.0'	76°37.6'
f. Bear Creek, B&O Railroad Bridge	39°15.0'	76°29.4'

Bench mark data will be furnished for stations a and e. Bench mark data are not available for the other locations.

5.6. During the periods of hydrography, staff observations will be made in the vicinity of the upper reaches of each tributary. Chief of Party may elect to operate a gage. Levels to three recoverable fixed points are required. The tide staffs should be read at 15-minute intervals, over a minimum of one tidal cycle, during hydrographic operations.

Station	Approximate Lat. (N)	Approximate Long. (W)
a. Main Creek	39°07.5'	76°28.6'
b. Rock Creek	39°08.5'	76°31.2'
c. Stony Creek	39°08.9'	76°33.0'
d. Marley Creek	39°09.3'	76°36.0'
e. Bear Creek	39°16.2'	76°28.8'
f. North Point Creek	39°13.6'	76°26.3'

5.7. The hydrographer should be alert for changes in river features which would alter tidal conditions. These should be identified and well described in the tide notes.

5.8. For each tide gage location, NOAA Form 77-12 (C&GS 681) shall be submitted for installation and removal of all tide stations. In addition, a nautical chart section indicating the location of the tide gage, staff, and bench marks shall be provided for each location. A description of each new bench mark established shall be included in NOAA Form 76-77 (C&GS 258).

5.9. All tidal work shall be in accordance with the Provisional Hydrographic Manual, AMC Manual, and the Manual of Tide Observations.

5.10. Assistance with tidal zoning will be provided by the Oceanographic Division, C331, upon request. Geographic limits of each tide zone, tide gage used, and any time and range corrections shall be in the tide note for the descriptive report. A copy of the tide note shall be sent to the Oceanographic Division, C331.

6.0. MISCELLANEOUS

6.1. Chart Deficiencies may exist in the project area. As surveys progress, the charts shall be compared with existing features and significant differences shall be resolved by specific investigations.

6.2. Reports shall be submitted in accordance with Chapter 5 of the Provisional Hydrographic Manual.

6.3. Accomplishments shall be reported on NOAA Form 12-8b (rev. 8-71) under Work Identification Code 0132050.

6.4. Responsive public service requires that every reasonable effort be made to keep the public aware of NOS activities and the results. Upon completion of your project, contact shall be made with the NOS Public Affairs Officer (PA11), phone (301) 496-8708, to report newsworthy accomplishments. It is suggested that you maintain a logbook of the results of investigated items.

6.5. Monthly progress sketches shall be submitted to AMC at the scale of chart 12278 (formerly C&GS 549). Progress sketches shall include the sheet layout and assigned field and registry number.

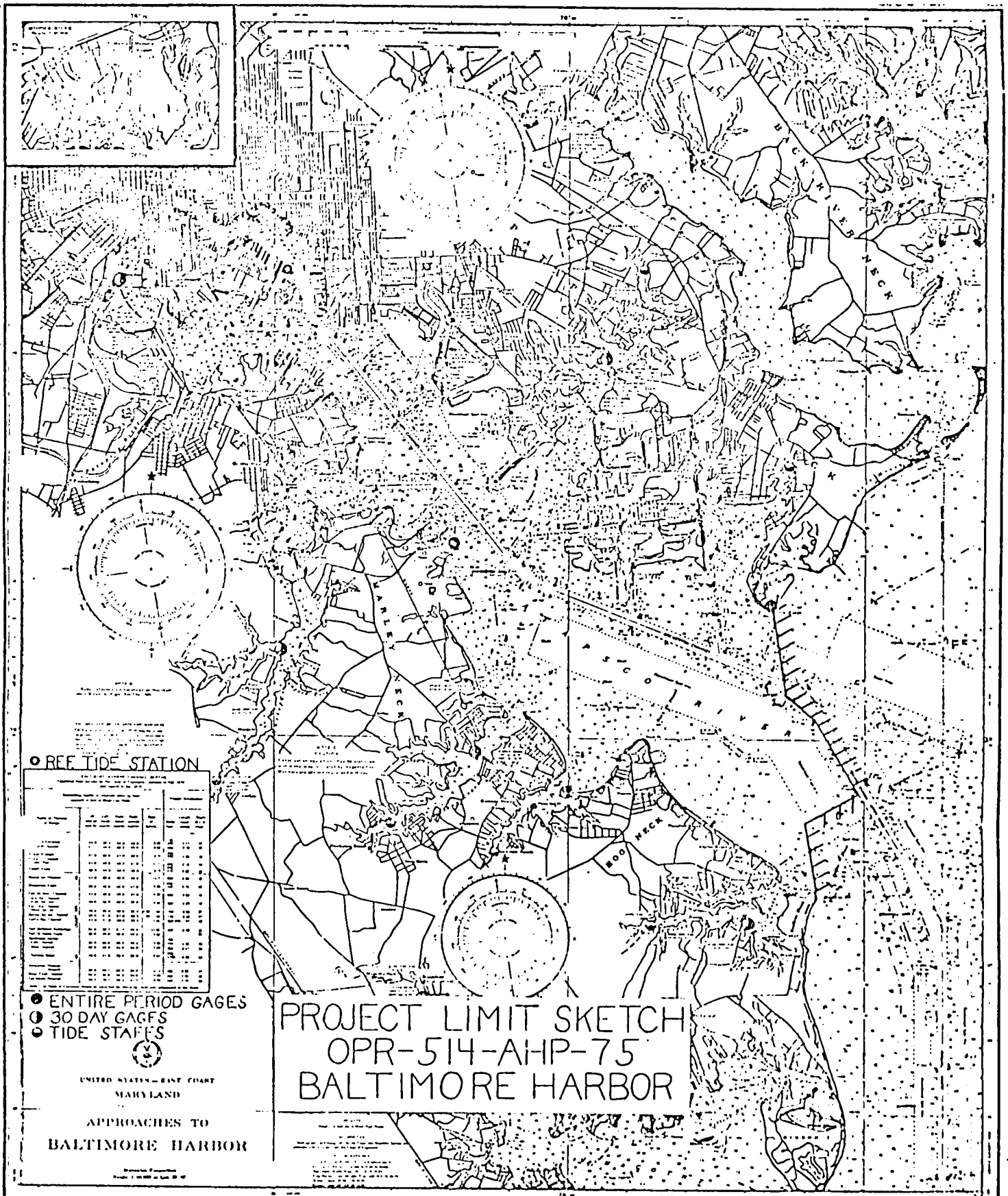
6.6. Submit recommendations if it appears advisable to amend these instructions.

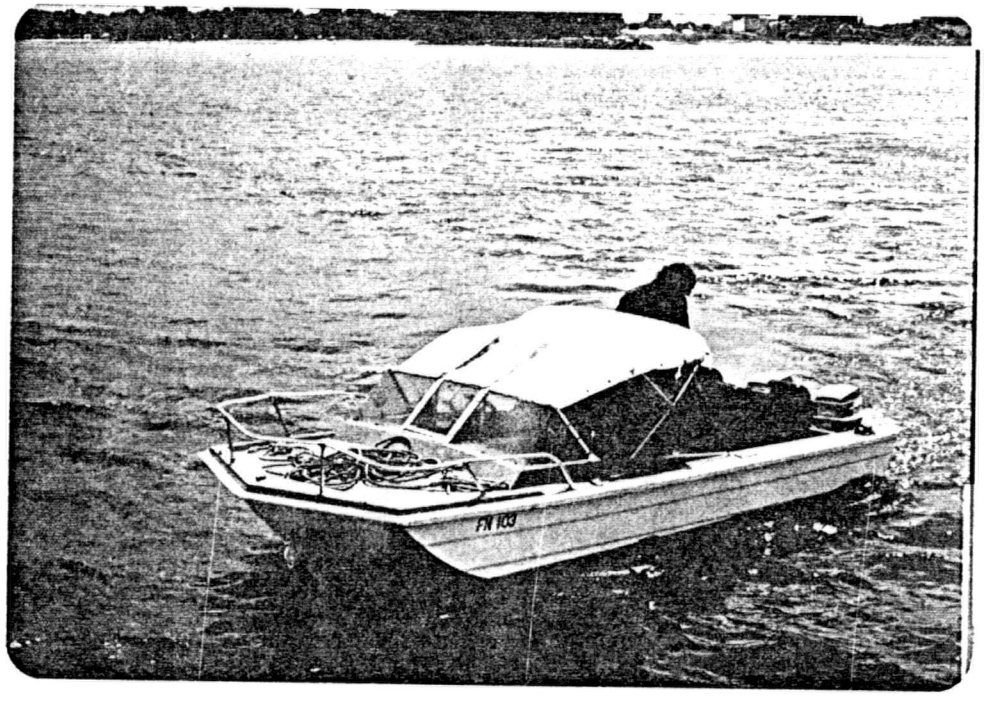
6.7. Receipt of these instructions shall be acknowledged.

for Donald K. Talbot

Robert C. Munson
Associate Director
Office of Marine Surveys
and Maps

SOUNDINGS IN FEET





MONARK sounding launch

ATLANTIC MARINE CENTER (AMC)

INTRODUCTION

The week of August 23-27th, was spent at Atlantic Marine Center (AMC) in Norfolk, Virginia. Atlantic Marine Center is the headquarters for the Eastern Region of NOS, NOAA. The entire east coast of the United States, Gulf of Mexico, Puerto Rico and the Virgin Islands fall under the charting responsibilities of AMC.

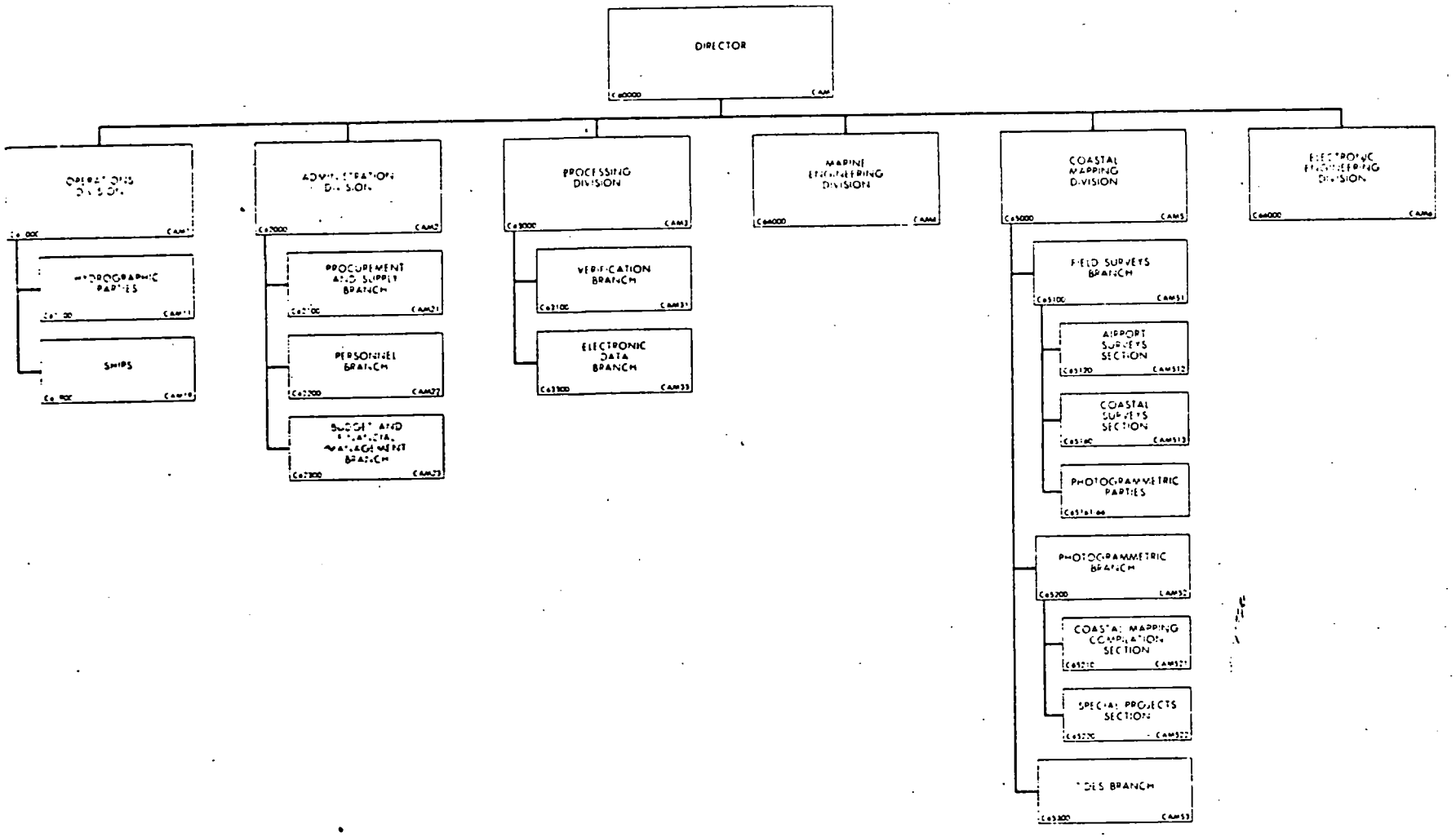
What at AMC, I was given an initial tour of the different sections and later spent more time with some of the sections. For organization chart of AMC, see Figure IV.

ATLANTIC MARINE CENTRE (AMC)

AMC directs the operation of ocean-going survey, ships, maintains ship's bases at Norfolk and Miami with support facilities at Woods Hole, Massachusetts; Sandy Hook, New Jersey and Pascagoula, Mississippi, to meet operating needs; operates shore facilities for processing all types of oceanographic data and compiling photogrammetric survey data. It also conducts and supports other shore based field operations as assigned; conducts activities including research activities that support the integrated environmental research of NOAA and its major components. Manages and provides technical guidance for photogrammetric field units in accordance with general policies and programs for headquarters. Co-ordinates with federal, state, local government agencies, private organizations and individuals for the purpose of collecting and disseminating data, promoting co-operative efforts in areas of mutual interests and representing the NOS and NOAA.

U.S. DEPARTMENT OF COMMERCE
NOAA
NATIONAL OCEAN SURVEY

ATLANTIC MARINE CENTER



DECEMBER 12, 1975
MANAGEMENT ANALYSIS DIVISION, OMCS

Figure 4

OPERATIONS DIVISION

Operations Division provides operational supervision and technical guidance for all hydrographic and oceanographic operations. Develops and recommends regional surveys. Assists in planning and co-ordination of national scope. Directs field programs, co-ordinates field operations and conducts on-site field inspections of hydrographic and oceanographic operations. Analyses needs and requests for new surveys. Co-ordinates and evaluates chart correction information and emergency navigational dangers. Provides emergency planning for all fleet and AMC requirements and co-ordinates the program with NOAA and civil defence activities.

PROCESSING DIVISION

Processing Division inspects and reviews raw data for completeness and adequacy. Plans and supervises the office processing hydrographic, oceanographic and photogrammetric field surveys. Processes and analyses current field work. Inspects and reviews finished field work and forwards to NOAA headquarters. Collaborates with Operations Division in appropriate phases of original and follow-up field work. Assists Operations Division in evaluation of current field work being performed.

VERIFICATION BRANCH

Verification Branch verifies hydrographic smooth sheets produced by the Electronic Data Branch to ensure accuracy of field data and electronic processing and plotting, from original field notes. Completes hydrographic smooth sheets including inking of projections, signals, shoreline, offshore details, depth curves, geographic names and a verifier's report on all requirements of a hydrographic survey. Submits completed work to NOAA headquarters. Trains vessel personnel in hydrographic processing. Completes verification backlog of manually processed hydrographic surveys and maintains this capability.

ELECTRONIC DATA BRANCH

Electronic Data Branch processes the hydrographic and oceanographic survey records received from ships and field parties that are suitable for automated processing methods. Makes necessary corrections and adjustments to original data. Plots hydrographic smooth sheets by automated methods. Submits completed material to Verification Branch. Trains vessel employees in automated processing techniques and raw data requirements for more effective processing. Assists other agencies in utilizing the Branch for their needs. The Branch processes all raw hydrographic data recorded on paper tape and plots all overlays required by the Verification Branch (Figure V). Colour coded pens are used for soundings on smooth sheets:

blue	0-6
red	7-12
black	13-18
green	19-31

The coloured soundings aid in contouring and show up obvious errors due to scaling or positioning. For plotting standards, see Figure VI.

MARINE ENGINEERING DIVISION

Marine Engineering Division plans, organizes and directs all vessel repairs and vessel modifications, including the installation of oceanographic engineering equipment and electronic equipment. Prepares specifications for equipment to meet qualifications of vessels in accomplishing their missions. Provides technical guidance for the operation and maintenance of oceanographic sensing and computer recording systems. Directs training programs for all systems. Gives advice and assistance to Director, AMC, and advises Operations Division as to characteristics and capabilities of vessels and equipment.

LISTINGS THAT MUST BE GIVEN TO VERIFICATION

1. Along with the signal overlay for a visual survey, make listings of:

   Signal cards (SIGØ1)

   Signals used (SIGØ2)

2. Along with the position overlay, make listings of:

   Parameters (PARSL)

   Positions versus record numbers (XREFF)

   Position information (POSPR)

   Statistics (STATR)

3. Before the sounding overlay, make listings of:

   Hourly heights and the correctors (TPPR and TIDØ6)

   Velocity tape (VELØ4)

   TC/TI tape (TPPR)

   Statistics (STATR)

   TRA and velocity table changes (TRACK)

   All reduced soundings before the excess (SNDPR)

4. Along with the sounding overlay, make listings of:

   Sounding information (SNDPR)

   Statistics (STATR)

   Positions versus record numbers (XREFF)

   TRA and velocity table changes (TRACK)

5. Along with the smooth sheets:

   A listing of just the areas of the corrections (SNDPR and/or POSPR)

6. After the smooth sheets:

   Clean position and sounding listings when requested by Verification

Figure 5

SUPPLEMENT I

ATLANTIC MARINE CENTER
PLOTTING STANDARDS

Signal Overlay

Plotted on mylar with ballpoint pen
Black projections
Red signals, signal numbers, and triangulation stations

Preliminary Position Number Overlay (PPO)

Plotted on mylar with ballpoint pen
Black projections
Black position numbers, dots, and lines
Red Pattern 1 arcs
Blue Pattern 2 arcs
If second set of arcs:
Brown Pattern 1 arcs
Purple Pattern 2 arcs
Red signals, signal numbers, and triangulation stations
(unless instructed otherwise)

Preliminary Sounding Overlay (PSO)

Plotted on mylar with ballpoint pen
Black projections
Black soundings (excessed)
Red dots (no numbers, no lines, use liquid ink)
Red signals, signal numbers, and triangulation stations
(unless instructed otherwise)
(If color plot: Pen 1 black, Pen 2 red, Pen 3 blue,
Pen 4 green ballpoint)

Excess Overlay Level 1 (XO1)

Plotted on mylar with ballpoint pen
Black projections
Red soundings (Excess Level 1)
(If PSO was a color plot, then this should be colors too)

Excess Overlay Level 2 (XO2) - plotted only when requested

Plotted on mylar with ballpoint pen
Black projections
Blue soundings (Excess Level 2)
(If PSO was a color plot, then this should be colors too)

Figure 6

SUPPLEMENT I

Smooth Position Number Overlay (SPO)

Plotted on mylar with liquid ink and .02 mm pen
Black projections with "wire drag" ticks
Black position numbers, dots, and lines
Red Pattern 1 arcs
Blue Pattern 2 arcs
If second set of arcs:
Brown Pattern 1 arcs
Purple Pattern 2 arcs
No signals (unless specified in verifier's note)

Smooth Sounding Plot (Smooth Sheet)

Plotted on smooth sheet mylar with liquid ink
Blue projections (ballpoint)
Black tickmarks with .02 mm pen
Black soundings (excessed) with .03 mm pen
Red dots (no numbers, no lines)
Signals, signal numbers, triangulation stations, and electronic control stations with .02 mm pen - colors to be specified in verifier's note (red if no note)
Black stamp with .02 mm pen

Boat Sheets - requested from field units

Plotted on mylar with liquid ink and .02 mm pen
Black projections
Red Pattern 1 arcs
Blue Pattern 2 arcs
If second set of arcs:
Brown Pattern 1 arcs
Purple Pattern 2 arcs
Red signals, signal numbers, triangulation stations, and electronic control stations

State Plane Grid and Projection - requested from Photogrammetric Branch

Plotted on mylar (furnished by Photogrammetric Branch) with liquid ink and .02 mm pen
Black projections (PROJT)
Black state grid (SGRID) - ticks or solid black lines to be specified in request (if not specified, use ticks)

Figure 6

COASTAL MAPPING DIVISION

Coastal Mapping Division provides operational supervision and technical guidance for coastal mapping, compilation and the tides program on the east and gulf coasts. Co-ordinates and supervises the national airport survey program, field survey portions of the Coastal Inundation Mapping Program (H.U.D.), Storm Evacuation Mapping Program (N.W.S.) and the seaward boundary mapping program for the State of Florida. Conducts on-site field inspection of photogrammetric operations and evaluates equipment needs for field operations.

PHOTOGRAMMETRIC BRANCH

Photogrammetric Branch supervises the inspection, compilation and review of photogrammetric data. Compiles and revises topographic and planimetric maps, tidal current and airport obstruction charts by photogrammetric methods from data furnished by field surveys, aerial photography and aerotriangulation.

The photo-bathymetry survey around the Virgin Islands is continuing in 1976. By using colour aerial photography and precise stereometric techniques, accurate contouring to 20 feet was obtained. Foul and shoal areas were contoured by this method.

Vertical control is solved by a two media block aero-triangulation in areas where tidal stations are non-existent. In other areas where water levels exist, additional stations are established to determine accurate tidal datums. Once this is done, tide controlled photography is flown. By relating the time of photography with the stages of the tide, the mean high water line and the mean low water line can be established.

This section is also involved in the construction of airport 'Obstruction Charts' and 'Tidal Current Charts'. The airport charts give precise positions and heights for all obstructions within the airport boundary. Takeoff clearances are calculated using length of runway, height of obstruction, size and weight of plane.

For 'Tidal Current Charts' a series of arrows and figures are displayed for each hour of the tidal cycle. By setting out a series of floating targets or dropping one pound water soluble bags of aluminum power in the area, the movement is tracked by black and white photography flown at full tide and 1, 2 and 3 hours before and after full tide, giving direction and distance travelled over a time lapse interval. For organization of AMC and more detail on different sections, see Appendix B.

HIGH SPEED LAUNCH SURVEY

INTRODUCTION

The automated hydrographic high speed launch survey was based at St. Marks, Florida. August 30 to September 10th was spent with the survey. The project was started in 1972 near Tampa, Florida and progressed, with interruptions, north along the west coast of Florida.

The survey party consisted of Lt. S. Theberge, party chief, and three NOAA officers, with three survey technicians.

OPERATIONS

The primary purpose of the survey is the collection of data for the publication of new nautical charts and the updating of existing nautical charts.

On my arrival, the survey party was setting up operations at St. Marks, Florida to conduct surveys westward along the coast of Florida. The field sheets were at a scale of 1:20,000 with a line interval spacing of 200 metres, from seaward to the 10 foot contour. Inshore areas will be surveyed at a later date.

Major equipment included:

- 2 - 59 foot launches capable of 22 knots
- 2 - hydroplot/hydrolog systems
- 1 - Raydist chain range/range
- 1 - travelall

NOAA's high speed launches were equipped with a hydroplot/hydrolog system. Its primary purpose is the collection and plotting of hydrographic survey data. The heart of the system is the PDP-8/E Digital Equipment computer with a specially designed hydroplot controller. Depth information is obtained from a Raytheon DE-723D echo sounder. Fix information is obtained from the Hastings-Raydist electronic navigation system.

Raydist is calibrated by sextant angles. See Appendix C for more information on Raydist. Depth information and concurrent fix information is channelled to the computer which, in turn, corrects the depths for tide level and converts the fix information to XY co-ordinates. The corrected depth is then plotted in its true geographic position by a Houston Instrument complot plotter which receives its drive instructions from the computer.

Peripheral to this system are two teletype units, one to give the computer instructions and the other to print out all data received by the computer. In addition to the teletype data copy, there is a paper tape punch copy of all data accumulated. A paper tape photo sensitive reader is used to read program tapes and data tapes for processing as required. A remote left-right indicator is used by the coxswain to steer and maintain the boat on a straight line.

The survey launch is a 59 foot Equity Equipment Corporation water taxi, powered by a twin Detroit diesel 480 h.p. V12 engine. The launch attains a survey speed of 19 knots. Auxiliary power for running electronic gear is obtained from a 12 kw Onan marine generator. In addition, the launch is equipped with radar, magnetic compass, VHF radios with marine frequencies as well as NOAA working frequencies, a heat activated CO_2 system in the engine room and after hold, and facilities for the comfort of crew and officers.

With high speed launch running at 20 knots, mileages of 120 miles per day were not uncommon. The launches remain in the field for 12 months of the year.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md. 20852

C3x4

AUG 2 0 1974

Chief
Atlantic Hydrographic Party

PROJECT INSTRUCTIONS: OPR-508-AHP-74, Northwest Coast of Florida

1.0. GENERAL

1.1. The purpose of this survey is to provide hydrographic data needed to respond to expressed user requirements for improved charting.

1.2. Work on this project is scheduled to resume in early November 1974. Hydrography shall begin at a junction with the 1973 surveys and proceed systematically north and northwest, remaining within Area I. Area II is scheduled for completion by other field elements and/or by photobathymetry.

1.3. The Special Investigation of the approaches to Tampa Bay, as outlined in Section 5.0, shall be completed prior to the resumption of basic hydrography on OPR-508.

2.0. GEODETIC CONTROL

2.1. Geodetic control data and required support will be furnished by the Atlantic Marine Center.

3.0. HYDROGRAPHY

3.1. A project limit sketch has been furnished.

3.2. Hydrography shall be basic and in accordance with the Hydrographic and AMC Manuals.

3.3. Hydrography will be controlled by electronic methods.

3.4. Depth Unit: Soundings shall be recorded in feet.

3.5. Junctions: Satisfactory junctions shall be made with all contemporary surveys. Copies of the sheets H-9390 (746-20-2-73) and H-9391 (746-20-3-73) will be furnished by AMC.

3.6. Inshore Limit: Hydrography should be run as close to shore as conditions permit but not so far as to reduce the effectiveness of the operation. The inshore limit of Area I should be, if possible, in an area with a regular bottom to facilitate junctioning when the inshore hydrography in Area II is accomplished.

3.7. Scales: The basic scale for the project area will be 1:20,000. Larger scales are authorized where considered necessary.

3.8. Line Spacing: Sounding line spacing shall not exceed 200 meters in Area I. Line spacing shall be reduced as necessary to develop shoals and to show bottom configuration adequately.

3.9. Presurvey Review: The Presurvey Review dated September 26, 1972, has been examined and no additional items have been found. The Presurvey Review is now considered to be updated to July 30, 1974.

3.10. Crosslines: Hydrography shall be verified by crosslines to the extent of 8-10 percent of the principal system of sounding lines, exclusive of development.

4.0. TIDES

4.1. It is the responsibility of the Officer-in-Charge to see that proper field monitoring of all tide gages in support of this project is carried out. A line of communication must be established between the party and any contract observer to ensure prompt notification of gage malfunctions or changes in the staff-gage relationship. Breaks or invalid tide records from any gage in excess of three continuous days cannot be interpolated. This might result in a loss of tide control to the extent that a resurvey of the area involved would be required. Time and staff comparisons are required whenever a gage is checked.

4.2. St. Marks and St. Petersburg, Florida, will serve as the reference stations for predictions. The tide stations operating at Clearwater Beach, Cedar Key, and Shell Point will provide additional basic control, and will also be used for datum determination in smooth reduction of soundings in the vicinity. Copies of the latest NOAA Form 77-12 (Report - Tide Station) will be furnished by the Rockville Office. Servicing of these tide gages is not required.

4.3. As field work progresses, tide gages shall be installed and operated during the entire period of hydrography in the vicinity. In addition to this requirement, the gage at St. George Island (d.) should be operated for a minimum of 30 days.

	Station	Approx. Lat. (N)	Approx. Long. (W)
a.	Indian Rocks Beach	27°52.4'	82°51.1'
b.	Anclote Lighthouse, Anclote Keys	28°09.9'	82°50.6'

	Station	Approx. Lat. (N)	Approx. Long. (W)
*c.	Lighthouse Point	29°55.0'	84°20.0'
d.	St. George Island, East End	29°41.2'	84°47.2'
*e.	Dog Island, East End	29°49.0'	84°35.0'
f.	Sand Island, West Pass	29°37.6'	85°05.6'

*No tidal bench mark data are available.

4.4. Servicing and proper operation of these gages must be assured by the hydrographic party.

4.5. Levels will be required to a minimum of five permanent bench marks (standard disks), for all 30-day stations and three permanent bench marks for stations operating for less than 30 days. Three additional bench marks shall be established at Anclote Lighthouse and Anclote Keys. Previously established bench marks were destroyed.

4.6. For each tide gage location, a NOAA Form 77-12 (C&GS 681) shall be submitted. In addition, a nautical chart section indicating the location of the tide gage, staff, and bench marks shall be provided for each location. A description of each new bench mark established shall be included in NOAA Form 76-77 (C&GS 258).

4.7. All tidal work shall be in accordance with the Hydrographic Manual, AMC Manual, and the Manual of Tide Observations.

4.8. Geographic limits of each tide zone, tide gage used, and any time and range corrections shall be included in the Tide Note of the Descriptive Report. A copy of the Tide Note shall be sent to the Oceanographic Division, C331. Assistance with tidal zoning will be provided by the Oceanographic Division, C331, upon request.

5.0. SPECIAL INVESTIGATION

5.1. Reports have been received concerning shoaling in the approaches to Egmont Channel at the entrance to Tampa Bay. Shoaling to a depth of 30 feet has been reported in the "Safety Fairway" approaches to this channel where the general charted depths range from 40 to 60 feet.

5.2. Because of these potentially serious discrepancies, a basic survey of this area shall be conducted before regular progression resumes on

OPR-508. Surveys shall begin at the entrance to the channel marked by buoys "1" and R"2" and proceed westward, while remaining within the "Safety Fairway," to the 11-fathom curve or until depths are encountered that corroborate those portrayed on the chart. Should this occur, inshore of the 11-fathom curve, reconnaissance hydrography should then be run over the remaining area.

If extensive changes are found within the Fairway west of Egmont Channel buoys "1" and R"2," basic survey work should be expanded to a larger area, bounded by the following limits:

Limits: 27°30'N to 27°40'N
82°50'W to the 11-fathom depth curve

5.3. Hydrography shall be basic and in accordance with the specifications of the Hydrographic and AMC Manuals.

5.4. Hydrography shall be controlled by electronic methods.

5.5. Scale: The scale of this Special Investigation shall be 1:20,000.

5.6. Line Spacing: Sounding line spacing shall not exceed 200 meters in the areas of basic hydrography. Line spacing shall be reduced as necessary to develop shoals and to show bottom configuration adequately.

5.7. Tides: St. Petersburg, Florida, will serve as the reference station for predictions. Corrections for the approaches to Egmont Channel (Tampa Bay) will be from Table 2, No. 3074 Egmont Key, Egmont Channel, of the East Coast Tide Table.

5.8. A tide gage shall be installed at Egmont Key and shall be operated during the period of the survey. Bench mark descriptions and a sketch showing their location are provided.

5.9. If serious shoaling is discovered, appropriate Notice to Mariners action should be initiated and pertinent field records forwarded to headquarters through AMC at once.

6.0. MISCELLANEOUS

6.1. Reports shall be submitted in accordance with Sections 2-36 through 2-44 of the Hydrographic Manual.

6.2. The Coast Pilot description of the project area shall be carefully reviewed and a special report submitted in accordance with the Hydrographic Manual and Section 9 of the Coast Pilot Manual, Third (1969) Edition.

6.3. Accomplishments shall be reported on NOAA Form 12-8b under Work Identification Code 0132050 (Hydrographic Surveys).

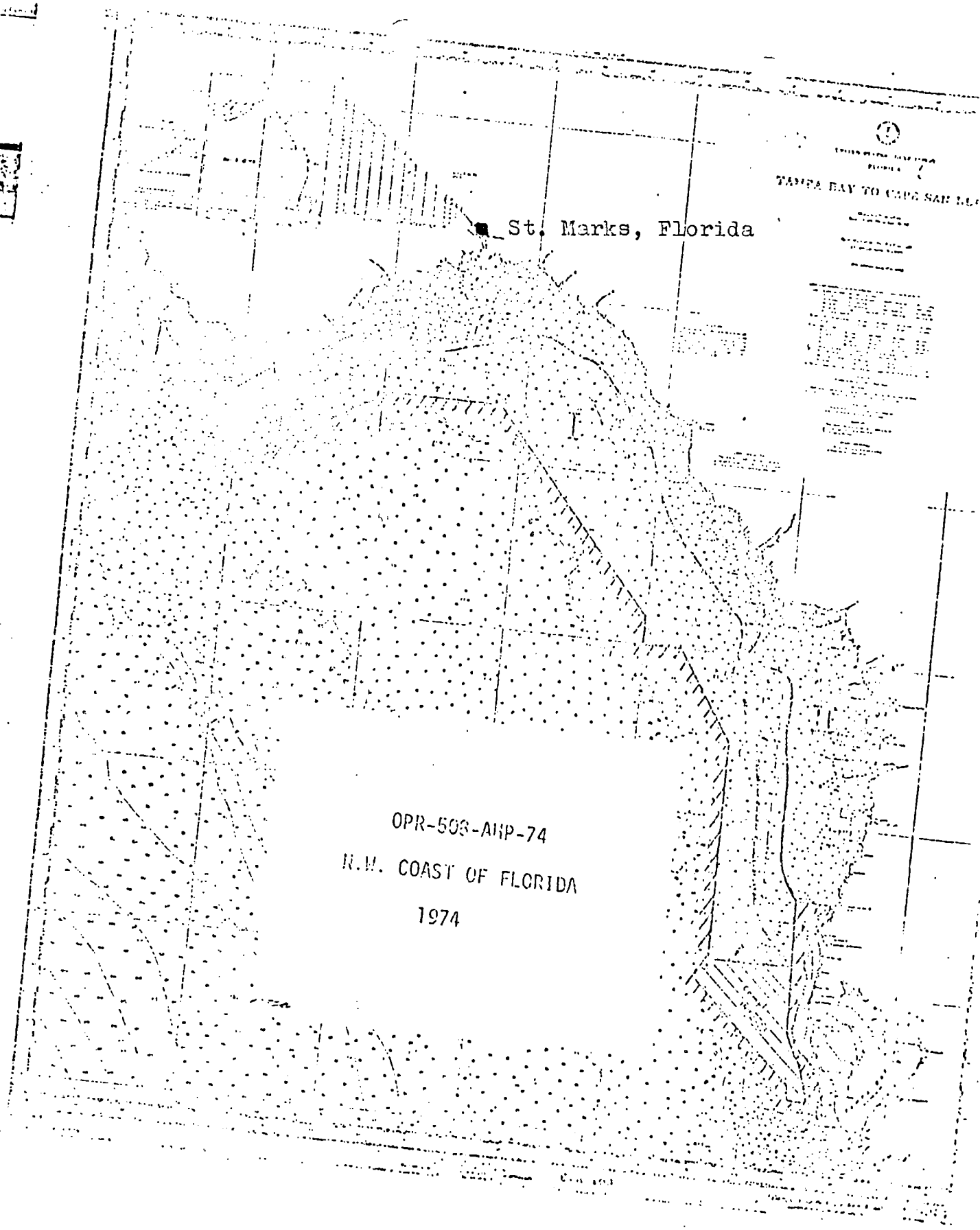
6.4. Monthly progress sketches shall be submitted to AMC at the scale of chart C&GS 1114. Progress sketches shall include the sheet layout and the assigned field and registry numbers.

6.5. Responsive public service requires that every reasonable effort be made to keep the public aware of NOS activities and the results. Upon completion of your project, contact shall be made with the NOS Public Affairs Officer (PA11), phone (301) 496-8708, to report newsworthy accomplishments.

6.6. Submit recommendations if it appears advisable to amend these instructions.

6.7. Receipt of these instructions shall be acknowledged.

Robert C. Munson
Associate Director
Office of Marine Surveys
and Maps


St. Marks, Florida
OPR-503-AHP-74
N.W. COAST OF FLORIDA
1974

High Speed Launch # 1255

BANANA AND INDIAN RIVERS SURVEY

INTRODUCTION

The period from September 13-24th was spent on the Banana and Indian Rivers Survey located at Cocoa Beach, Florida. The purpose of the survey was to update existing nautical charts.

The survey party consisted of Lt. W. Wert, party chief, and three survey technicians.

OPERATIONS

The primary purpose of the party was to conduct surveys on the Banana and Indian Rivers for recreational and pleasure craft. The scale of the survey was 1:10,000 and 100 metre line spacing or denser where necessary to adequately delineate the bottom configuration.

Major equipment included:

1 - 26 foot MonArk with jet drive
1 - hydroplot/hydrolog system
3 - Del Norte trisponders
1 - 20 foot Boston Whaler
2 - travelalls

The major sounding launch was the MonArk jet boat powered by 6 cylinder Detroit diesel, equipped with Raytheon DE-723D sounder, hydroplot/hydrolog system, and an Onan generator. Soundings were positioned by Del Norte trisponders in the range/range mode. With a depth of 6 feet or less for most of the survey area, the jet boat with a 2 foot draft, made it an ideal survey launch for shallow areas. Major disadvantages being its low speed of 8 knots and tendency to wander off line, making it necessary to anticipate and turn the steering wheel constantly. During the day, the

water intake would get clogged with weeds and material in the water, making it necessary to stop and clean it out three or four times a day.

Additional soundings were done with the Boston Whaler, using a sounding pole and positioned by range/azimuth. Notes were kept and data logged on tape the following day which meant setting all parameters for each fix on the logger.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md. 20852

C3x4

OCT 1975

TO: Director, Atlantic Marine Center

FROM: Robert C. Munson
Associate Director
Office of Marine Surveys and Maps

SUBJECT: PROJECT INSTRUCTIONS: OPR-499-AHP-76, Banana and Indian Rivers, Florida

Subject Instructions are forwarded for issuance to the Chief, Atlantic Hydrographic Party.

The copies required for distribution by this Office have been retained.

Attachment

October 6, 1975

1ST ENDORSEMENT

TO: Chief, Atlantic Hydrographic Party

Forwarded for your compliance.

Alfred C. Holmes
Director, Atlantic Marine Center

cc:
CAM02
CAM101, 102
CAM3
CAM5
CAM6, 4, XO

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md. 20852

C3x4

OCT 1 1975

Chief
Atlantic Hydrographic Party

PROJECT INSTRUCTIONS: OPR-499-AHP-76, Banana and Indian Rivers, Florida

1.0. GENERAL

1.1. Purpose: This project is in response to numerous requests, through the Cooperative Charting Program, to update the existing nautical chart coverage and provide data for a planned 1:40,000-scale coverage of the Banana River.

1.2. Plan of Operations: AHP launches shall begin field operations on this project in January 1976. Work will begin in the Banana River at the Eau Gallie bridge (latitude 28°08'N) and progress northward to the river's northern extremities. Second priority is the southern portion of the Indian River from the Eau Gallie bridge to latitude 28°28'N. The northern portion of the Indian River is the third priority; from latitude 28°28'N to latitude 28°49'N. All tributaries entering the rivers will be surveyed to the head of navigation. A project limit sketch, indicating the above areas by priority, is attached.

2.0. PHOTOGRAMMETRY

2.1. Photogrammetric support will be in the form of completed coastal zone orthophotomaps at 1:10,000 scale as follows:

PH-6716

TP-00103 through TP-00106 and TP-00108 through TP-00115.

PH-6910, Part 1

TP-00133 through TP-00135 and TP-00137 through TP-00143.

One stable base film copy of each of the above twenty-two maps covering the three priority areas will be furnished by December 1, 1975, for use in locating signals. These maps shall be made part of the hydrographic records.

One each, published paper copies of the same maps will also be furnished. These are for annotations and planning purposes, but they shall not be used for locating signals because of their dimensional instability.

2.2. Field edit is not required within the project area.

3.0. HYDROGRAPHY

3.1. Hydrography shall be basic and in accordance with the AMC and Provisional Hydrographic Manuals.

3.2. Junctions: No junctions are required.

3.3. Control: Hydrography shall be controlled by approved visual and/or electronic methods. If electronic control is used, a report will be required.

3.4. Visual signals and electronic control stations may be located by any approved method. Computations and locations shall be checked and final accepted signal locations determined. Signal locations may be established from the maps provided in section 2.1.

3.5. The scale for the entire project shall be 1:10,000 unless development requirements dictate the need for larger scales.

3.6. Sounding line spacing shall not exceed 100 meters. Line spacing will be 50 meters in narrow channels in accordance with section 4.3.4.1 of the Provisional Hydrographic Manual. Where necessary to adequately delineate bottom configuration, line spacing shall be reduced. The use of development overlays is encouraged.

3.7. Sounding lines and crosslines shall be run in accordance with the Provisional Hydrographic Manual.

3.8. Bottom samples shall be taken in accordance with the Provisional Hydrographic Manual and AMC Manual.

3.9. A sheet layout will be furnished by AMC.

3.10. Hydrographic data shall be recorded and processed in accordance with the Provisional Hydrographic Manual and AMC Manual, Chapter 3.

3.11. A permanent record shall be made of the geographic positions of all objects used for calibration. A report of calibration checks shall be included in the Descriptive Report in accordance with section 5.3.4(G) of the Provisional Hydrographic Manual.

3.12. Verification of Charted Features: The attached chart letters will be investigated as well as all other charted features and particular dangers to navigation such as piling, shoals, rocks, etc. All items shall

be verified or disproved and a positive disposition recommended in accordance with section 4.5.15 of the Provisional Hydrographic Manual.

3.13. Prohibited and Restricted Areas: Three areas within the project limits, a prohibited area centered at latitude 28°27.4', longitude 80°35.8', and two restricted areas at latitude 28°30.8', longitude 80°35.6', and latitude 28°14.2', longitude 80°37.0', are described in paragraphs 207.171 a, d, and e of Coast Pilot 4. All unauthorized watercraft are directed to stay clear of the areas at all times. Permission to enter the areas will be obtained from the Commander, Air Force Missile Test Center, Patrick Air Force Base, Florida, and Director, John F. Kennedy Space Center, NASA, Cocoa Beach, Florida, before survey operations begin.

4.0. COAST PILOT

4.1. The Coast Pilot description of the project area shall be carefully reviewed and a special report submitted in accordance with AMC Manual, Chapter 02, Section 09.

5.0. TIDES

5.1. It is the responsibility of the Chief, AHP, to ascertain that proper field monitoring of all tide gages in support of this project is carried out. A line of communication must be established between the party and any contract observer to ensure prompt notification of gage malfunctions or changes in the staff-gage relationship. Breaks or invalid tide records from any gage in excess of three continuous days cannot be interpolated. This might result in a lost of tide control to the extent that a resurvey of the area involved would be required. Time and staff-gage comparisons are required whenever a tide station is checked.

5.2. The periodic tide in the Indian River north of Eau Gallie and in the Banana River is less than 0.2 foot and is frequently masked by non-tidal effects. Therefore, the tidal datums of mean high water and mean low water are not computed. The low water datum is taken as a plane 0.5 foot below mean water level, which is computed from the hourly stages of the water level.

Predicted tides are not applicable for those waters since the periodic tide is so small. However, changes in water level of approximately 1 foot of monthly means and several feet for any given day will occur.

5.3. Tide gages (ADR) shall be installed at the following locations:

Station	Location Lat. (N)	Long. (W)
a. Eau Gallie	28°08.0'	80°37.5'
b. Port Canaveral Locks	28°24.5'	80°38.5'
c. Titusville	28°37.2'	80°48.0'

Tidal bench mark data and installation reports are furnished for all of the above stations.

5.4. Since tidal datums were established from previous observations at the above locations, tide gages will be required only during the times of hydrography in these areas, provided a minimum of three existing bench marks can be recovered and connected by levels to the tide staff. The Titusville tide gage is to remain in operation for an indefinite period and will require a contract tide observer.

5.5. Tide staffs shall be installed at the following locations:

Station	Location Lat. (N)	Long. (W)
d. Sykes Creek	28°24.5'	80°42.0'
e. Banana Creek	28°35.4'	80°39.5'
f. Scottsmoor	28°48.3'	80°51.5'

Tidal bench mark data are furnished for e and f. Bench mark data are not available for Sykes Creek.

5.6. In addition to the above, staffs will be required in each creek during periods of hydrography. The site of each staff should be near the upper limit of hydrography in the creek.

5.7. If, in the opinion of the Chief, AHP, it would be more convenient, a bubbler tide gage installation may be substituted for a tide staff installation in the above case.

5.8. A minimum of three recoverable points (not standard disk) is required for each staff-only site. Staff observations need only be made during periods of hydrography in the vicinity. Since the periodic tides are masked by nontidal effects in this area, a minimum of seven hours

of observations will be required in lieu of one tidal cycle. Tide staff observations shall be recorded on Form 277.

5.9. For each tide gage location, a NOAA Form 77-12 (C&GS 681) shall be submitted for installation and removal of all tide stations. In addition, a nautical chart or USGS quad sheet section indicating the location of the tide gage, staff, and bench marks shall be provided for each location. A description of each new bench mark established shall be included in NOAA Form 76-77 (C&GS 258). For each tide staff, a description of the location of the recoverable points shall be included in NOAA Form 76-77 (C&GS 258) along with a sketch of the locations of the tide staff.

5.10. All tidal work shall be in accordance with the Provisional Hydrographic Manual, AMC Manual, and the Manual of Tide Observations.

5.11. Assistance with tidal zoning will be provided by the Oceanographic Division, C331, upon request. Geographic limits of each tide zone, tide gage used, and any time and range corrections shall be included in the Tide Note of the Descriptive Report. A copy of the Tide Note will be sent to the Oceanographic Division, C331.

6.0. MISCELLANEOUS

6.1. Reports shall be submitted in accordance with Chapter 5 of the Provisional Hydrographic Manual.

6.2. The Presurvey Review for the project area will be forwarded. All presurvey review items will be absolutely resolved. A statement shall be made in the Descriptive Report as to the disposition of each item.

6.3. Accomplishments shall be reported on NOAA Form 12-8b (rev. 8-71) under Work Identification Code 0132050.

6.4. Responsive public service requires that every reasonable effort be made to keep the public aware of NOS activities and the results. Upon completion of your project, contact shall be made with the NOS Public Affairs Officer (PA11), phone (301) 496-8708, to report newsworthy accomplishments. It is suggested that you maintain a logbook of the results of investigated items.

6.5. Monthly progress sketches shall be submitted to AMC at the scale of charts 11484 and 11476 (formerly C&GS 1245 and 1246). Progress sketches shall include the sheet layout and assigned field and registry numbers.

6.6. Submit recommendations if it appears advisable to amend these instructions.

6.7. Receipt of these instructions shall be acknowledged.

Robert C. Munson
Associate Director
Office of Marine Surveys
and Maps

"E" 1:10,000
36 × 60

SOUNDING

Miscellaneous Distance

Distance To and From

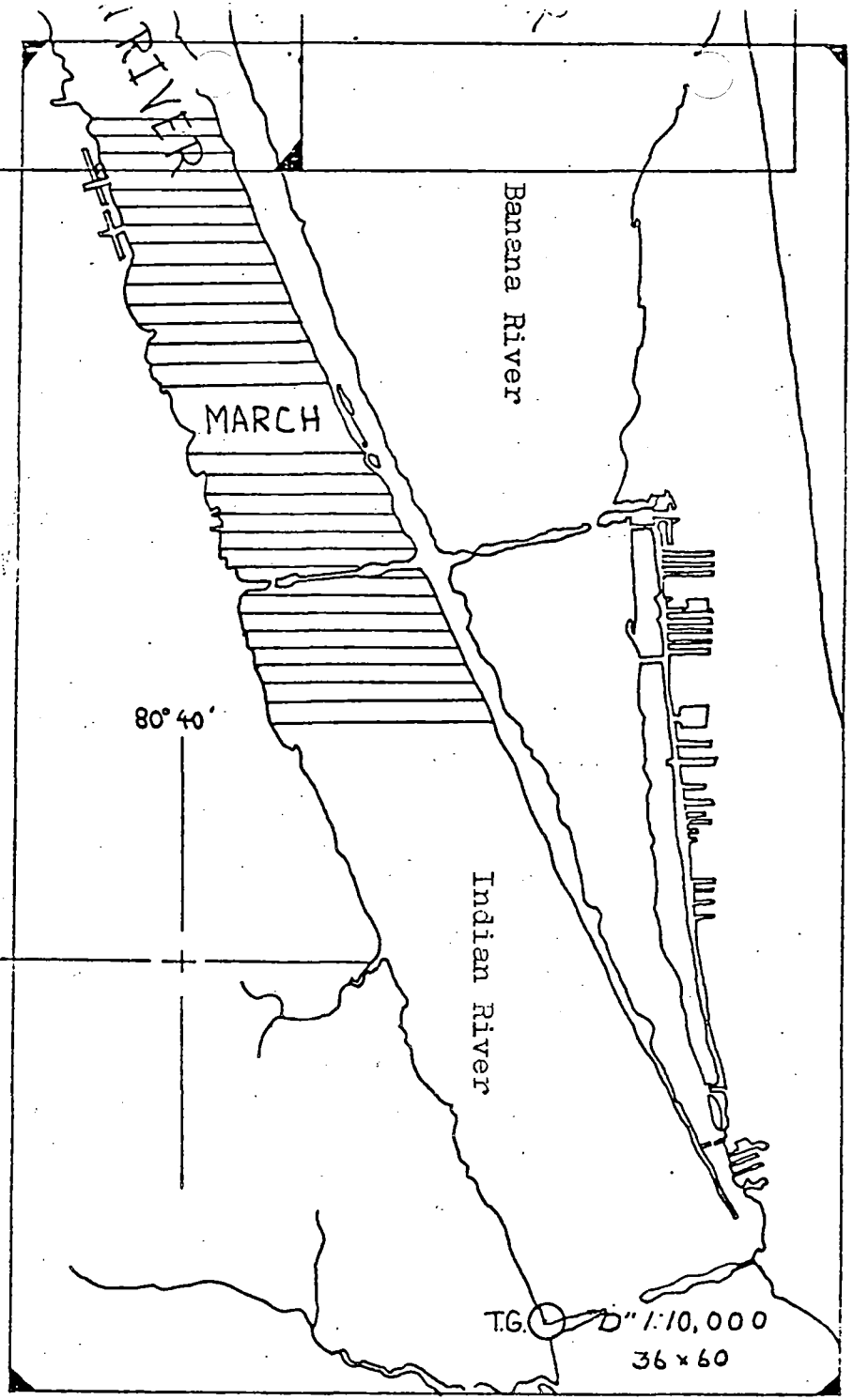
ounding Line

m Samples

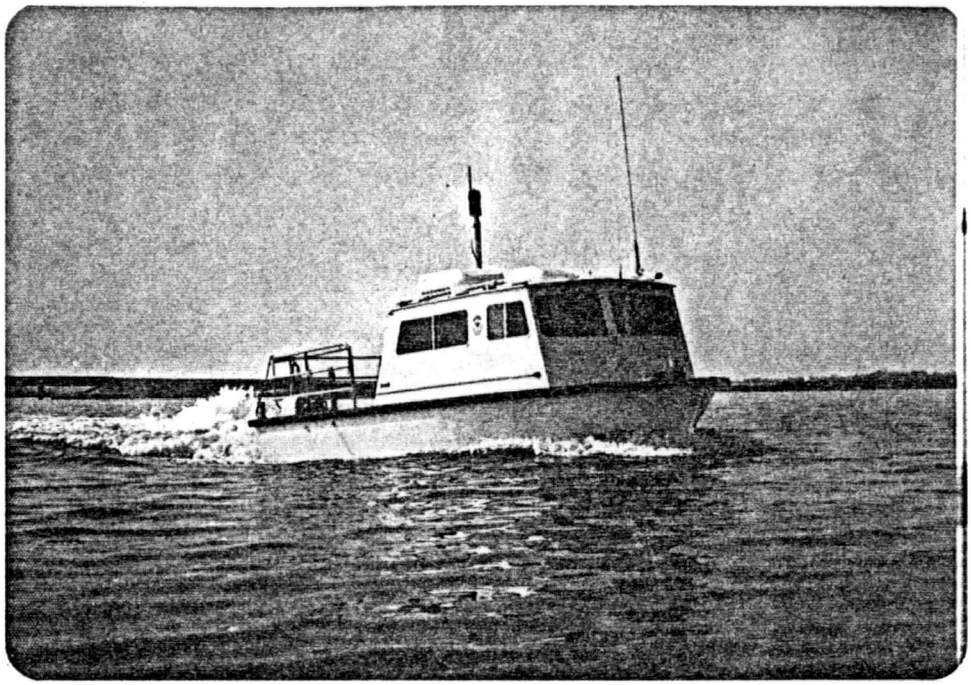
ol Stations

ages

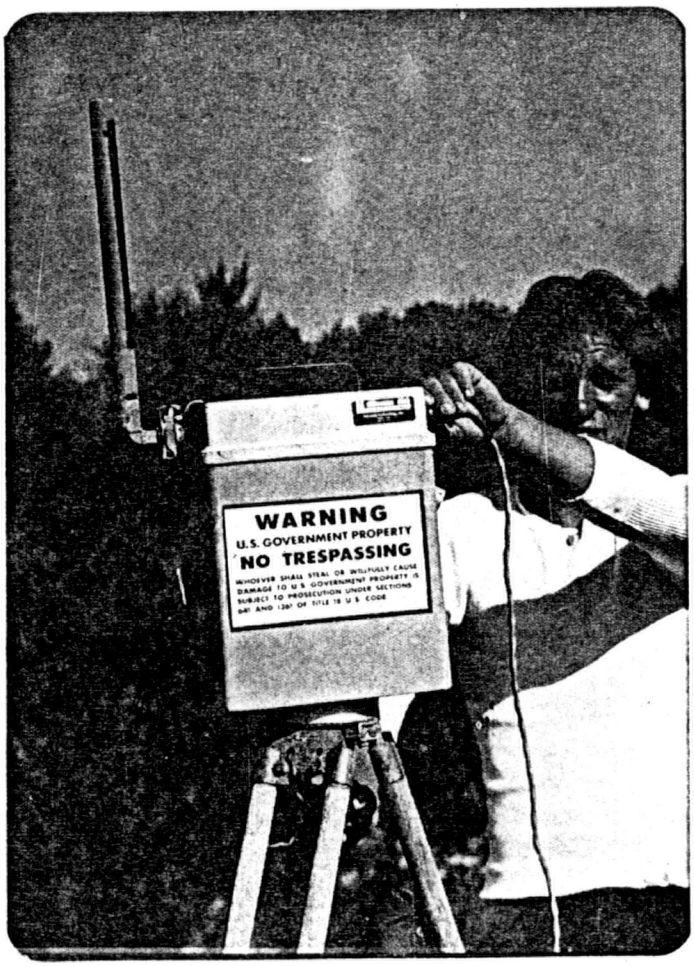
Marks



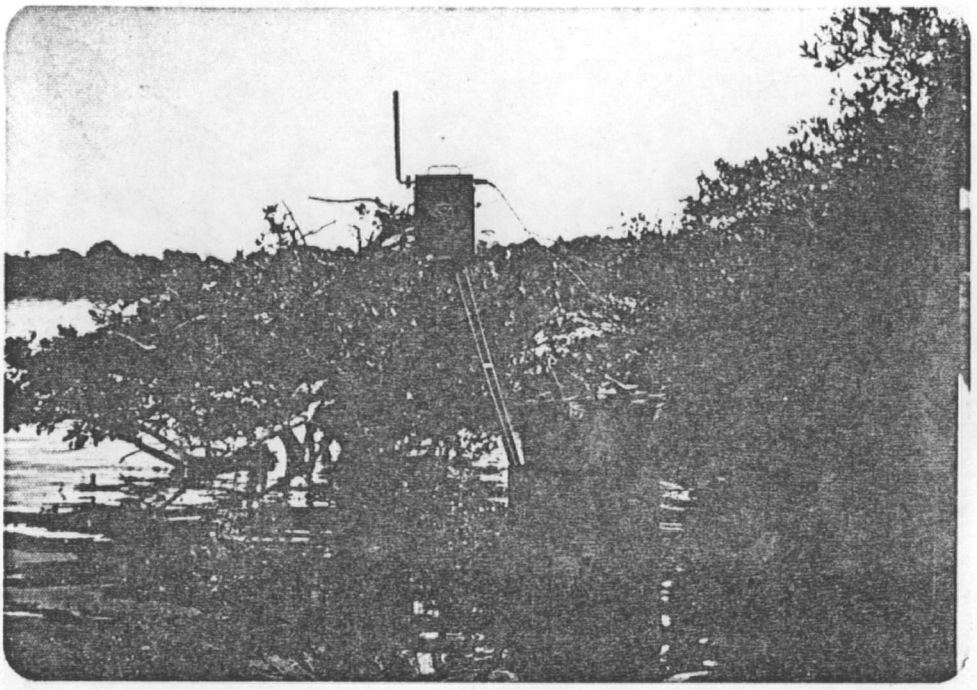
OPR-409



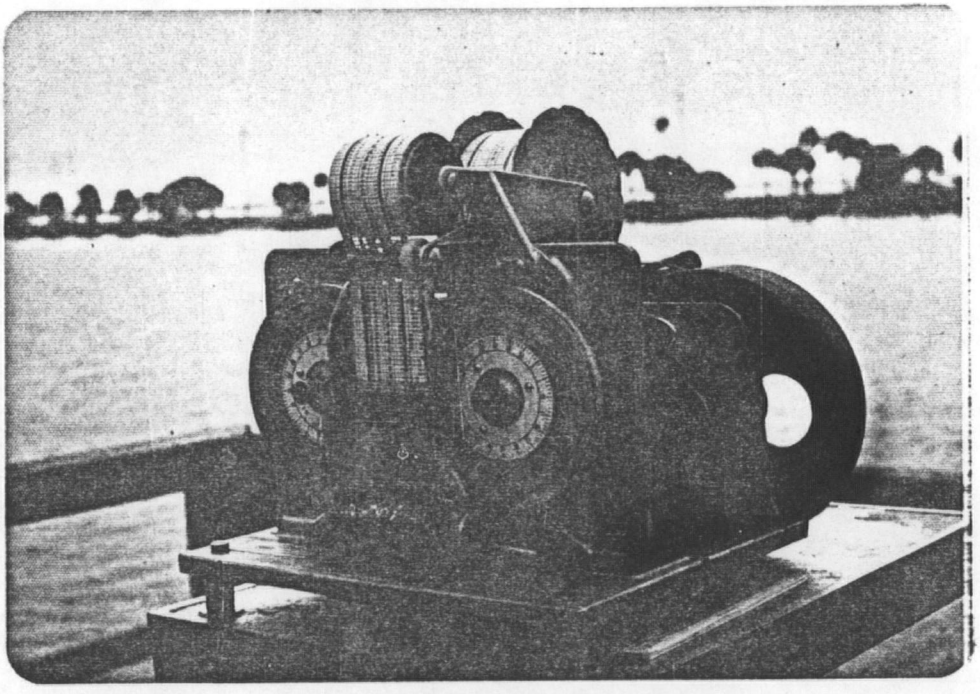
MONARK JET BOAT with Hydroplot/Hydrolog system



DEL NORTE Transponder



DEL NORTE transponder setup - control point underwater.



Tide gauge re-corder

SHIP SURVEY

INTRODUCTION

The last two weeks of the exchange program from September 27th to October 8th were spent on board S/V PIERCE and S/V WHITING at Buzzards Bay, Massachusetts. The primary purpose of the survey was to collect survey data for the updating and maintenance of existing charts.

Each vessel has a complement of 8 officers and 32 crew members. The Commanding Officer of the ship is also the Chief-of-Party and the officers are hydrographers.

OPERATIONS

The S/V PIERCE and S/V WHITING are identical sister ships. Apart from surveying different areas of Buzzards Bay, their equipment and operations are similar. The operations of one ship will be detailed.

Field operations began in early May and continued to mid-November. All areas were surveyed at 1:10,000 except for the offshore area which was 1:20,000 scale (for field sheet layout, see Figure VII).

Major equipment included:

2 - 26 foot survey launch 'Plastic Pig'
2 - 16 foot Boston Whalers
1 - 13 foot Boston Whaler
2 - hydroplot/hydrolog systems
1 - travelall

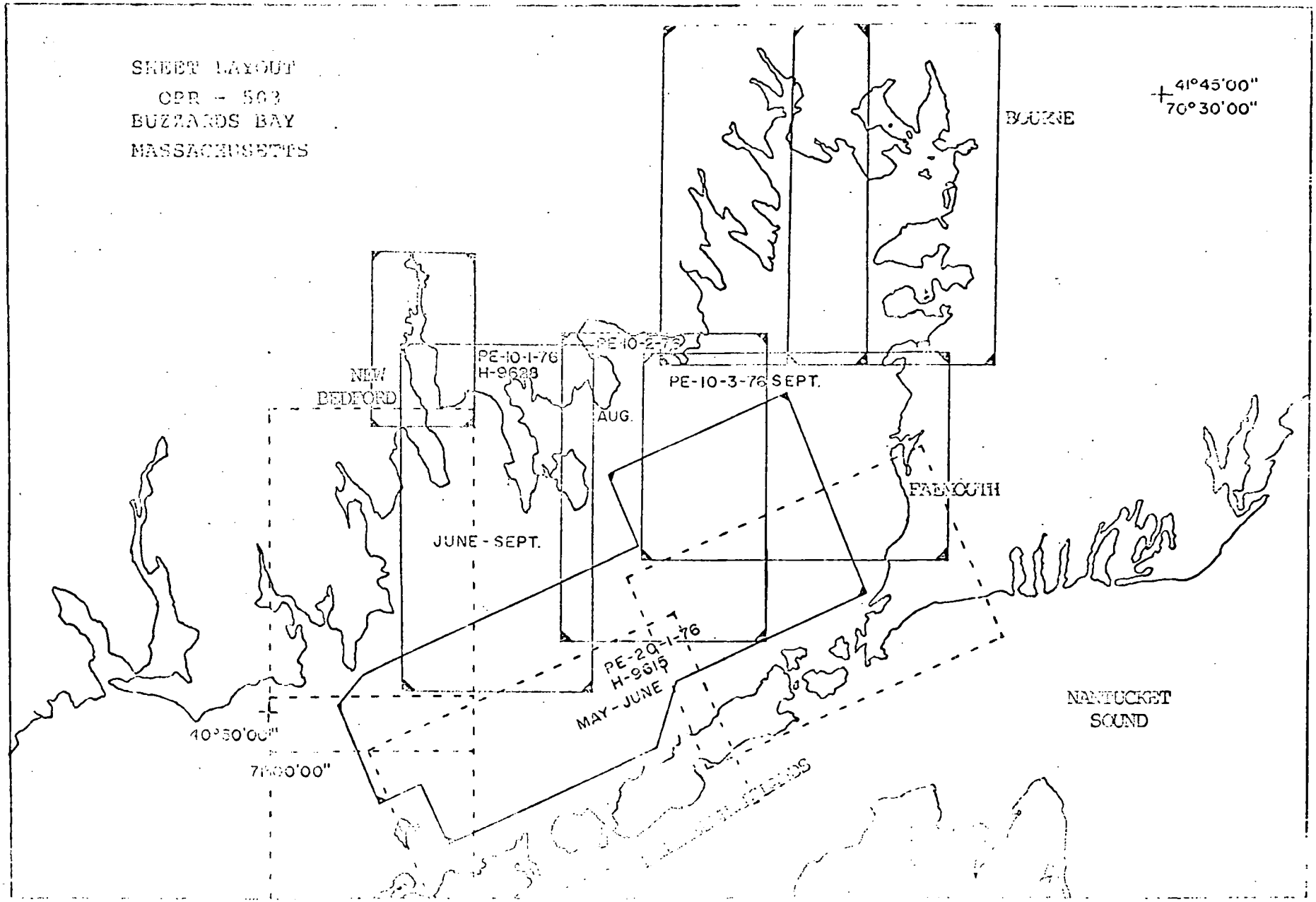
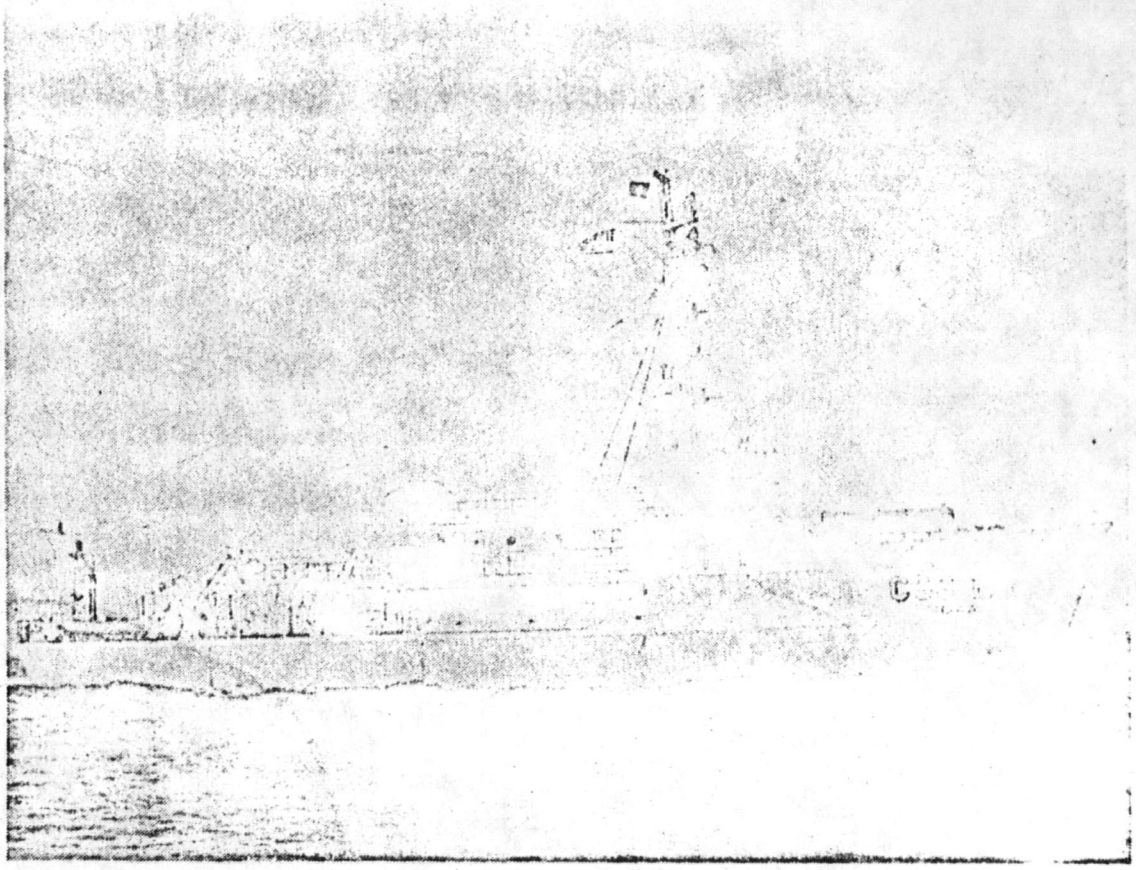

SHEET LAYOUT
OPR - 503
BUZZARDS BAY
MASSACHUSETTS
41°45'00"
70°30'00"
BOURNE
PE-10-1-76
H-9628
PE-10-2-76
PE-10-3-76 SEPT.
NEW
BEDFORD
AUG.
FALMOUTH
JUNE - SEPT.
PE-20-1-76
H-9615
MAY - JUNE
NANTUCKET
SOUND
41°30'00"
70°30'00"

Figure 7

The NOAA ship is a Class III vessel, 163 feet in length, displacement of 760 tons and 10 foot draft. She has a cruising speed of 12 knots with a range of 4,500 nautical miles and endurance of 10 days. Power is provided by a twin-screw diesel, 800 SHP each, with controllable-pitch propellers. For more information and specifications, see Figure VIII (a-d). She carried two 26 foot survey launches (Plastic Pigs) and three Boston Whalers. The sounding launches are constructed of eight layers of plastic, weighing six and one-half tons and capable of six knots.

Both sounding launches are equipped with hydroplot/hydrolog systems, a Raytheon DE-723 sounder, and use Del Norte for positioning. Processing was done on the parent ship. See Figure IX for daily processing check list.

Both ships anchor off in their survey areas and serve as base of operations for the survey launches, returning to port every two weeks. The ships were not used for running check lines or bottom sampling.



PEIRCE CSS 28

Specifications			Performance	Accommodations
Type			**Speed (knots)**	**Commissioned Officers**
Hydrographic surveys Steel hull, ice strengthened			Cruising 12	8
Class			**Range (nautical miles)**	**Ship's Officers**
III			4,500	8
Horsepower Tonnage			**Endurance**	**Technicians**
2,296			10 days	12
Year Built				**Crew**
1963				12
Length	**Beam**	**Draft**		
163′	33′	10′		
Displacement		**Tonnage**		
760 tons		Gross 696 Net 151		

Figure 8a

Propulsion

Twin-screw diesel, 800 SHP each, controllable-pitch propellers

Electrical Power

Two 220-KW, 450-VAC,60-Hz,3-phase generators
115-VAC, 60-Hz, single-phase electronic regulated
115-VAC, 60-Hz, single-phase controlled frequency
One 60-KW, 450-VAC, 60-Hz, 3-phase emergency generator

Navigation Equipment

One deep-water depth recorder
Two shoal-water depth recorders
One precision depth recorder
Two surface search radars
Two electronic positioners
One electromagnetic underwater log
One gyrocompass system w/7 repeater outputs

Communication Equipment

One 500-watt SSB/FSK transceiver
Four 10-watt transceivers
Nine 5-watt VHF portable transceivers
Two radio communication receivers
One 25-watt transceiver
One 60-watt AM transceiver

Electronic Data Processing Equipment

Four Teletype manual logging systems

Winches

One electric BT w/drum capacity 4,000' of 3/32" 7 x 7 stainless steel wire rope
One electrohydraulic double drum
1 drum w/capacity 6,000' of 0.298", 6-conductor electric cable w/8-conductor slip-ring device
1 drum w/capacity 15,000' of 3/16", 3 x 19 wire rope

Cranes

One telescoping boom, radius 13' to 25' w/wt. capacity 3,000 lbs. minimum radius, 2,500 lbs. maximum radius
One A-frame, radius varies w/block used
Two boat davits, rated for weight of boats, approximately 13,000 lbs.

Laboratories

Chart and plotting room: 256 sq. ft.
Radio room and workshop: 154 sq. ft.
Field operations and data processing: 154 sq. ft.

Habitability

Air conditioned
Fresh water capacity 5,768 gals.
One 2,000 gals./day distilling plant

Pollution Control

Sewage: 2-hour holding
Solid waste:
Oily bilge water:

Types of Observations

Continuous bottom profile
BT (0-900 ft.)
Bottom samples
Current observations
Nansen casts
Plankton casts
Gravity
XBT (0-450 m)

Miscellaneous

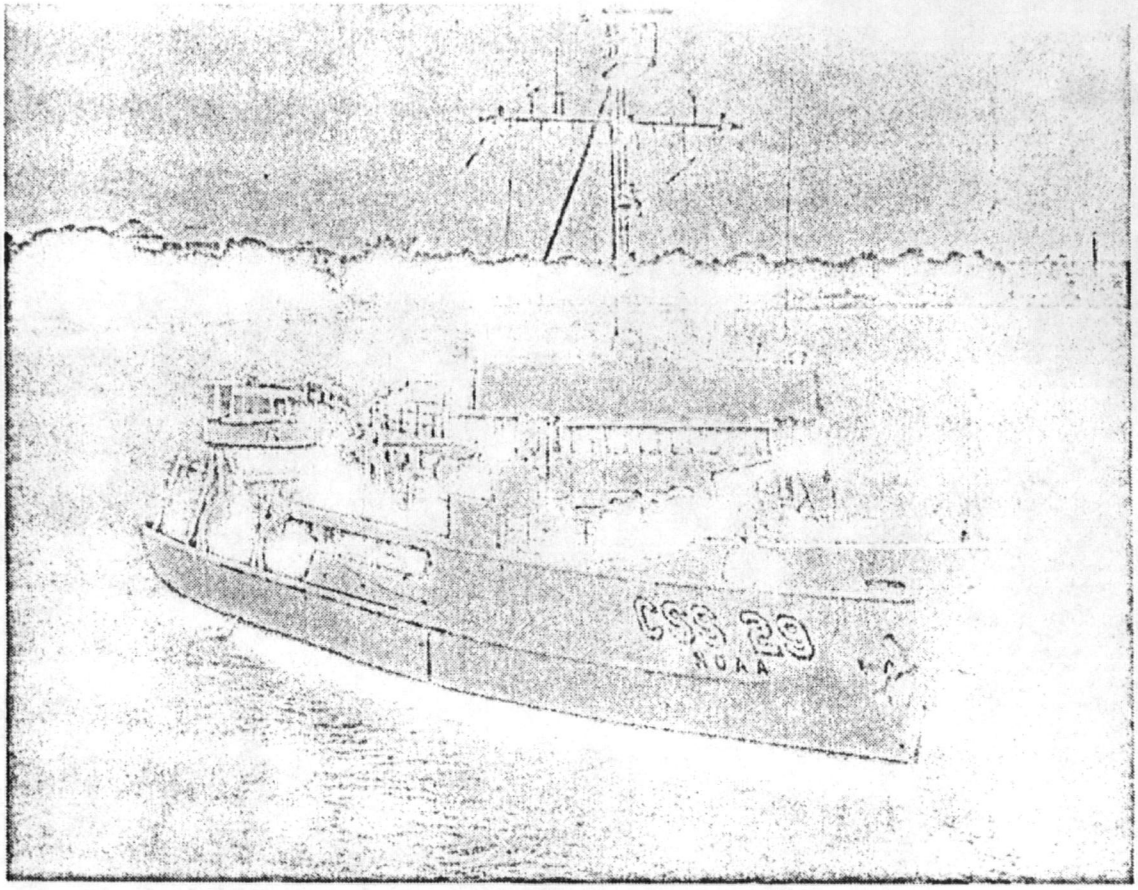
Two 26' hydrographic survey launches
Two 16' Boston whalers
One 13' Boston whaler

History

Designer: Maritime Administration
Builder: Marietta Manufacturing Co., Pt. Pleasant, W.Va.
Launched: October 15, 1962
Delivered: May 6, 1963
Commissioned: May 6, 1963

Call Letters: WTEQ
Radiotelephone
Call letters: WZ 2598 to 2602

Figure 8b



WHITING CSS 29

Specifications			Performance	Accommodations
Type			**Speed (knots)**	**Commissioned Officers**
Hydrographic surveys Steel hull, ice strengthened			Cruising 12 Maximum 12	8
Class			**Range (nautical miles)**	**Ship's Officers**
III			4,500	8
Horsepower Tonnage			**Endurance**	**Technicians**
2,296			10 days	12
Year Built				**Crew**
1963				12
Length	**Beam**	**Draft**		
163′	33′	10′		
Displacement		**Tonnage**		
760 tons		Gross 696 Net 151		

Figure 8c

Propulsion

Twin-screw diesel, 800 SHP each, controllable-pitch propellers

Electrical Power

Two 220-KW, 450-VAC, 60-Hz, 3-phase generators
115-VAC, 60-Hz, single-phase
electronic regulated
115-VAC, 60-Hz, single-phase
controlled frequency
One 60-KW, 450-VAC, 60-Hz, 3-phase
emergency generator

Navigation Equipment

One deep-water depth sounder
One precision depth sounder
Two shoal-water depth sounders
One Loran A
One electronic positioner
One gyrocompass w/7 repeater outputs
One electromagnetic underwater log

Communication Equipment

One 500-watt SSB/FSK transceiver
One 1,000-watt SSB transceiver
Two 50-watt SSB transceivers
Three 5-watt VHF portable transceivers
Two radio communication receivers
One 60-watt AM transceiver

Electronic Data Processing Equipment

Two Teletype manual logging systems
One NOS hydroplot system w/CALCOMP 502 plotter
(See Figure A)

Winches

One electric BT w/drum capacity 4,000' of
3/32", 7 x 7 stainless steel wire rope
One electrohydraulic double-drum
1 drum w/capacity 6,000' of 0.298",
6-conductor electric cable w/8-conductor
slip-ring device
1 drum w/capacity 15,000' of 3/16",
3 x 19 wire rope

Cranes

One telescoping boom, radius 13' to 25'
w/capacity 3,000 lbs. minimum radius;
2,500 lbs. maximum radius
One A-frame, radius varies w/block used
Two boat davits, rated for weight
of boats approximately 13,000 lbs.

Laboratories

Field work office: 40 sq. ft.
Chart and plotting room: 256 sq. ft.

Habitability

Air conditioned
Fresh water capacity 5,768 gals.
One 2,000 gals./day distilling plant

Pollution Control

Sewage: Chlorinator,
12-hour holding
Solid waste:
Oily bilge water:

Types of Observations

Continuous bottom profile
BT (0-900 ft.)
Bottom samples
Current observations
Nansen casts
Plankton casts

Miscellaneous

Two 26' hydrographic launches
One 16' Boston whaler
One 13' Boston whaler

History

Designer: Maritime Administration
Builder: Marietta Manufacturing Co.,
Pt. Pleasant, W.Va.
Launched: November 20, 1962
Delivered: July 8, 1963
Commissioned: July 8, 1963

Call Letters: WTEW
Radiotelephone
Call Letters: WZ 2603 to 2607

Figure 8d

DAILY PROCESSING CHECKLIST

FIELD NUMBER:

	DAY	DAY	DAY	DAY	DAY	DAY	DAY	DAY	DAY	DAY	DAY
1) Sounding Volume/Printout/Fatho reviwed for completeness;i.e., Labeling, Line Identification(lat/lon,LB,etc.), Courses & Speeds, DP's & PSR described and indexed.....											
2) Master logger tape checked/reformatted....											
3) Fatho scanned, "strays" logged.....											
4) Del Norte check computed & logged.....											
5) Boatsheet reviewed for position busts.....											
6) Corrector Tape prepared/checked.....											
7) Hydro rough plotted.....											
8) Bottom sample "M Sheets" prepared/checked.											
9) Statistics & Position Data Sheets.....											
10) TRA Correction Abstract completed for speed changes.....											
11) Bar Checks abstracted/checked/logged.....											
12) Smooth Plotting Log--enter day, position numbers, type of control & tide tape.....											
VESNO.....											

INITIAL WHEN WORK COMPLETED! IF "NOW", SO STATE. MARK THE BLOCK APPLICABLE IF MORE THAN ONE VESSEL.

Figure 9

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md. 20852

C3x4

JAN 13 [illegible]

TO: Director, Atlantic Marine Center

FROM: for Robert C. Munson
Associate Director
Office of Marine Surveys and Maps

SUBJECT: PROJECT INSTRUCTIONS: OPR-503-PE,WH-76, Buzzards Bay, Massachusetts

Subject Project Instructions are forwarded for issuance to the Commanding Officers, NOAA Ships PEIRCE and WHITING.

The copies required for distribution by this Office have been retained.

Attachment

January 16, 1976

1ST ENDORSEMENT

TO: Commanding Officer
NOAA Ship PEIRCE
NOAA Ship WHITING

Forwarded for your compliance.

Alfred C. Holmes
Director, Atlantic Marine Center

cc:
CAM02
CAM10, 102
CAM3
CAM5
CAM6, 4, XO

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md. 20852

JAN 13 1976

C3x4

Commanding Officers
NOAA Ships PEIRCE and WHITING

PROJECT INSTRUCTIONS: OPR-503-PE,WH-76, Buzzards Bay, Massachusetts

1.0. GENERAL

1.1. Purpose: This project is designed to provide modern survey data for the maintenance of existing charts in view of the increase of both vessel traffic and draft of the vessels transiting the area.

1.2. A basic hydrographic survey will be conducted by NOAA Ships PEIRCE and WHITING as indicated on the attached project limit sketch. The progression of work shall be arranged by the Commanding Officers of the PEIRCE and WHITING. Such progression will be by that method which best assures the operational objectives of the vessels.

1.3. Field operations by the PEIRCE are planned to begin in early May 1976 and continue to mid-October 1976. The WHITING will join the PEIRCE in early June and continue operations to completion, by or before mid-November.

2.0. GEODETIC CONTROL

2.1. Triangulation stations shall be established, searched for, and recovery notes submitted in accordance with the Provisional Hydrographic Manual and the AMC Manual. If it becomes necessary to mark a station of Second Order, Class II or less accuracy, it shall be done with the appropriate disk and the required description submitted.

2.2. Atlantic Marine Center will furnish all geodetic data for the project area. To ensure that current geodetic control information is used, AMC shall contact the National Geodetic Survey Information Center (C18) for up-to-date data. This would preclude using erroneous or outdated material.

2.3. Raydist stations and other navigational aids established during the survey within 150 meters of existing triangulation stations shall be named reference marks of the existing station.

2.4. Third-order horizontal control surveys transmitted to NGS will conform to "Third-Order Control Specifications," an attachment to the memo from the Director, NOS; Subject: Third-Order Surveys, dated October 31,

1974. Higher order surveys will conform to the specifications outlined in "Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys," February 1974.

2.5. All horizontal control data submitted to NGS will be complete and in the format specified in the Submission of Data paragraph in "Third-Order Control Specifications."

3.0. PHOTOGRAMMETRY

3.1. Photo-hydro support will be furnished by the Atlantic Marine Center.

3.2. Photo-hydro support data for (CM-7407) manuscripts TP-00695 at 1:5,000 scale and TP-00761 through TP-00776 at 1:10,000 scale will be furnished by February 15, 1976.

3.3. Field edit is required within the project area for all manuscripts. Field edit is also needed for the shoreline mapping bordering Vineyard Sound on TP-00772 through TP-00776. Aerial photographs obtained in 1974 will be furnished for field edit use. All field edit notes shall be made in violet ink on photographs. Each correction, or group of corrections, shall be cross-referenced by the appropriate photograph number on an ozalid print of the affected survey.

3.4. The Commanding Officer shall have final authority, and the responsibility, for agreement between the hydrographic and the field edit data. As Chief-of-Party, he is responsible for all project work. Resolve all discrepancies before field edit records are shipped. Cronaflex copies used for locating signals and cronaflexes needed for processing smooth sheets shall be made a part of the hydrographic records after they are returned from Coastal Mapping Division, Rockville.

3.5. All field edit and/or photo-hydro support data for manuscripts shipped from the field shall be forwarded to the Chief, Coastal Mapping Division, AMC, Attention: CAM521. Clearly mark all items that are to be returned to be made a part of the hydrographic records. Forward one copy of each transmitting letter to the Chief, Coastal Mapping Division, Rockville, Attention: C3415.

4.0. HYDROGRAPHY

4.1. Hydrography shall be basic and in accordance with the Provisional Hydrographic Manual.

4.2. Control: Control shall be by visual and/or electronic methods, whichever is most effective and commensurate with accuracy requirements.

4.3. Junctions: Satisfactory junctions are required with the following prior surveys (indexed on the project limit sketch), which shall be made part of the hydrographic records.

Registry No.	Scale	Year Surveyed
H-8905	1:20,000	1966
H-8904	1:10,000	1966
H-8903	1:10,000	1966
H-8170	1:5,000	1954

Particular care should be taken when junctioning in Quicks Hole, Robinsons Hole, Canapitsit Channel, and Sow and Pigs Reef.

Copies of all prior surveys shall be considered project records and shall be forwarded to the Processing Office.

4.4. Depth Unit: Soundings shall be recorded in feet.

4.5. Sheet Layout: A smooth sheet layout will be furnished by AMC.

4.6. Scales: All areas shall be surveyed at a scale of 1:10,000 except for the offshore area of Buzzards Bay, which will be 1:20,000 scale. Larger scales are authorized where necessary to show adequate detail.

4.7. Line Spacing: Sounding line spacing shall be in accordance with the Provisional Hydrographic Manual, section 4.3.4.2. This area is considered open coast with irregular bottom. Line spacing shall be reduced as necessary to adequately define the bottom configuration.

4.8. Presurvey Review: A Presurvey Review will be furnished and shall be made part of the hydrographic records. All presurvey review items will be absolutely resolved in the field. A statement shall be made in the Descriptive Report as to the disposition of each item.

4.9. Bottom Samples: The frequency of bottom samples shall be governed by the requirements outlined in section 1.6.3 of the Provisional Hydrographic Manual. A copy of Log Sheet M shall be included in the Descriptive Report.

4.10. Verification of Charted Features: All charted features, particularly dangers to navigation such as piling, shoals, rocks, etc., shall be verified and a positive disposition recommended in accordance with section 4.5.15 of the Provisional Hydrographic Manual.

5.0. TIDES

5.1. It is the responsibility of the Commanding Officers to ascertain that proper field monitoring of all tide gages in support of this project is carried out. A line of communication must be established between the ship and any contract observer to ensure prompt notification of gage malfunctions or changes in the staff-gage relationship. Breaks or invalid tide records from any gage in excess of three continuous days cannot be interpolated. This might result in a loss of tide control to the extent that a resurvey of the area involved would be required. Time and staff-gage comparisons are required whenever a tide station is checked.

5.2. Newport, Rhode Island, will serve as the reference station for predicted tides. The tide station at Buzzards Bay, Cape Cod Canal (T-10), will provide control for datum determination for the subordinate tide stations. A copy of the latest inspection reports with the names and addresses of the observers will be furnished by AMC.

5.3. As field work progresses, tide gages shall be installed, operated for a minimum of 30 days of observations, and leveled to five permanent bench marks at each of the following locations:

Station	Approximate Location Lat. (N)	Long. (W)
T-1 Penikese Island	41°26.9'	70°55.0'
T-4 Quicks Hole (middle)	41°26.5'	70°51.3'
T-5 Kettle Cove	41°28.7'	70°46.6'
T-6 Chappaquoit Point	41°36.3'	70°39.1'
T-7 Stoney Point ~~Dike~~	41°41.7'	70°40.3'
T-8 Monument Beach	41°42.9'	70°37.0'
T-9 West Mooring Basin	41°43.6'	70°38.0'
T-12 Onset	41°44.5'	70°39.5'

Station	Approximate Location Lat. (N)	Long. (W)
T-15 Marion	41°42.3'	70°45.7'
T-16 Mattapoisett	41°39.4'	70°48.8'
T-18 New Bedford (Clark Point)	41°35.8'	70°54.0'
T-22 Mishaum Point	41°30.8'	70°57.2'
T-22A Barneys Joy Point	41°30.5'	70°59.0'

Tidal bench mark data are furnished where available. T-8 is required to investigate large change in time and range observed between T-8 and T-9. T-22A is an alternate site for T-22 if a suitable location is not available near Mishaum Point. These stations will be used to determine datums for the reductions of soundings.

5.4. As field work progresses, tide gages shall be installed and operated during hydrography in the vicinity and leveled to three recoverable points at the following locations. These tide gages shall be operated simultaneously with the listed 30-day stations.

30-Day Station	Station	Location Lat. (N)	Long. (W)
T-1	T-2 Cuttyhunk Pond Entrance	41°25.5'	70°55.4'
T-4	T-3 Quicks Hole (North Side)	41°27.0'	70°51.4'
T-12	T-11 Sears Point	41°44.2'	70°38.2'
T-7	T-13 Wareham	41°45.4'	70°42.8'
T-7	T-14 Great Hill	41°42.7'	70°42.9'
T-7	T-24 Wings Neck	41°41.7'	70°38.8'
T-16 or T-18	T-17 West Island	41°35.9'	70°50.3'
T-18	T-19 New Bedford	41°38.4'	70°55.1'
T-18	T-20 New Bedford (Nashawena Mills)	41°40.2'	70°55.2'
T-18	T-21 South Darmouth	41°35.2'	70°56.7'
T-22	T-23 Slocums River	41°32.3'	70°58.9'

in NOAA Form 76-77 (C&GS 258). All original records shall be submitted directly to the Rockville Office, Attention: C331. Copies of the NOAA Form 77-12 and chart sections showing the location of the tide stations shall be sent to AMC, Attention: CAM53.

5.7. All tidal work shall be in accordance with the Provisional Hydrographic Manual, AMC Manual, and the Manual of Tide Observations.

5.8. Geographic limits of each tide zone, tide gage used, and any time and range corrections shall be included in the Tide Note of the Descriptive Report. A copy of the Tide Note shall be sent to the Oceanographic Division, C331. Assistance with tidal zoning will be provided by the Oceanographic Division, C331.

5.9. At the conclusion of a survey sheet, the field unit should initiate a memorandum to C331 requesting that AMC be furnished tide data for inclusive hours of hydrography.

6.0. MAGNETIC REQUIREMENTS

6.1. Magnetic observations in accordance with the Provisional Hydrographic Manual, section 2.3.1.7, are to be made at the approximate locations shown on the attached copy of chart 13230 (formerly C&GS 249) by large black circles.

6.2. Existing horizontal control stations may be utilized for magnetic stations if suitable.

6.3. Where observed values of declination differ by more than two degrees from the expected values, as determined from the 1970 Isogonic Chart of the United States, additional magnetic stations should be established in the vicinity in order to determine the extent of the magnetic disturbance and the maximum departure from the normal value. Such additional stations should be established at intervals of 1/2 mile to 2 miles.

6.4. Transit magnetometers and/or compass declinometers should be tested for provisional index corrections before and after the survey by making four complete sets of declination at Fredericksburg Geomagnetic Center, Virginia.

7.0. MISCELLANEOUS

7.1. Field operations and field data processing shall be coordinated such that all project data will be submitted to AMC within six weeks of completion of field operations.

7.2. A monthly progress sketch shall be submitted at the scale of chart 13230 (formerly C&GS 249). The sketch shall include the sheet layout with field and registry numbers indicated.

7.3. Reports shall be submitted in accordance with Chapter 5 of the Provisional Hydrographic Manual.

7.4. Coast Pilot: Coast Pilot description of the project area shall be carefully reviewed and a special report submitted in accordance with the Provisional Hydrographic Manual and section 9 of the Coast Pilot Manual, Third (1969) Edition.

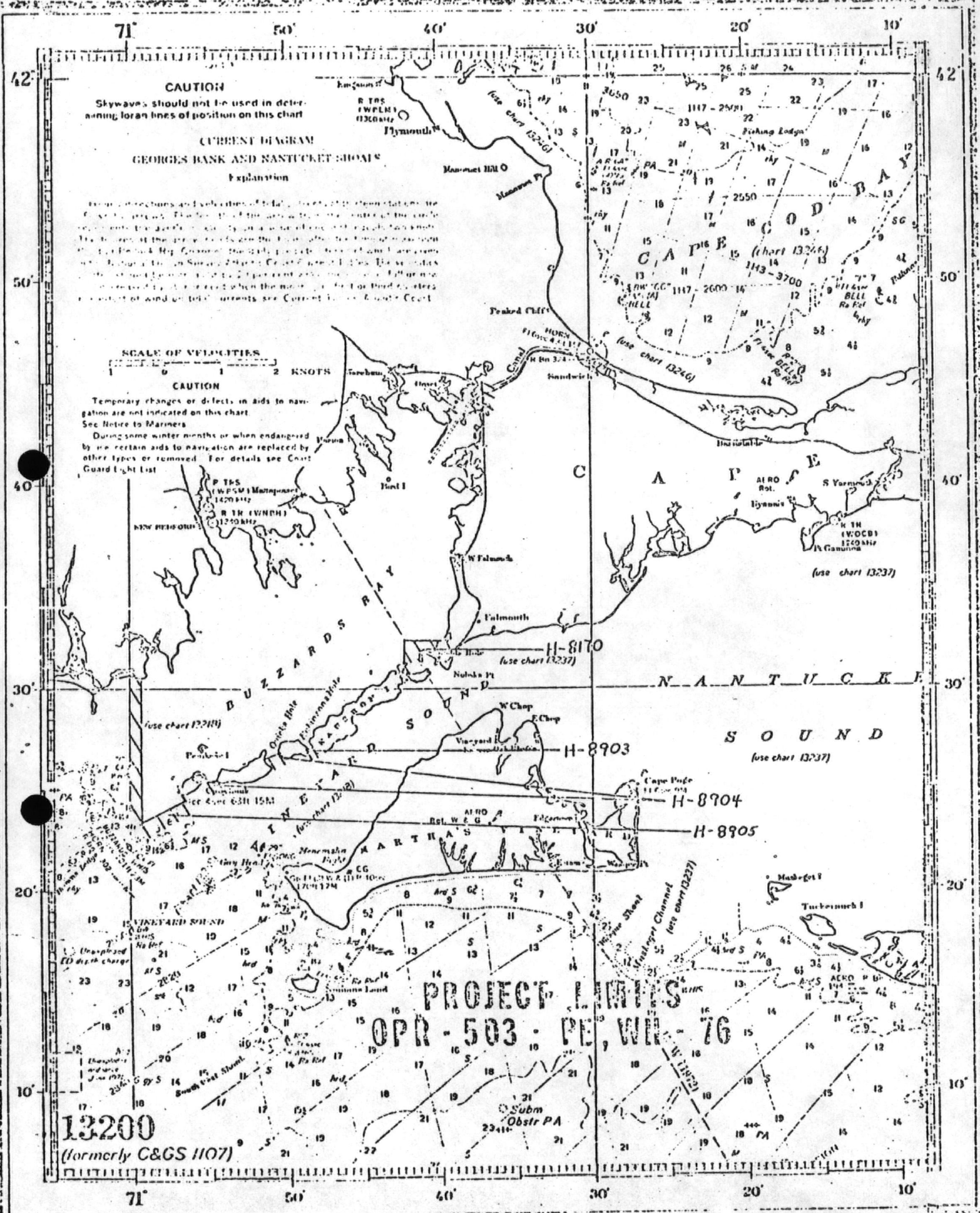
7.5. Public Affairs: Responsive public service requires that every reasonable effort be made to keep the public aware of NOS activities and the results. Upon completion of your project, contact shall be made with the NOS Public Affairs Officer (PA11), phone (301) 443-8708, to report newsworthy accomplishments.

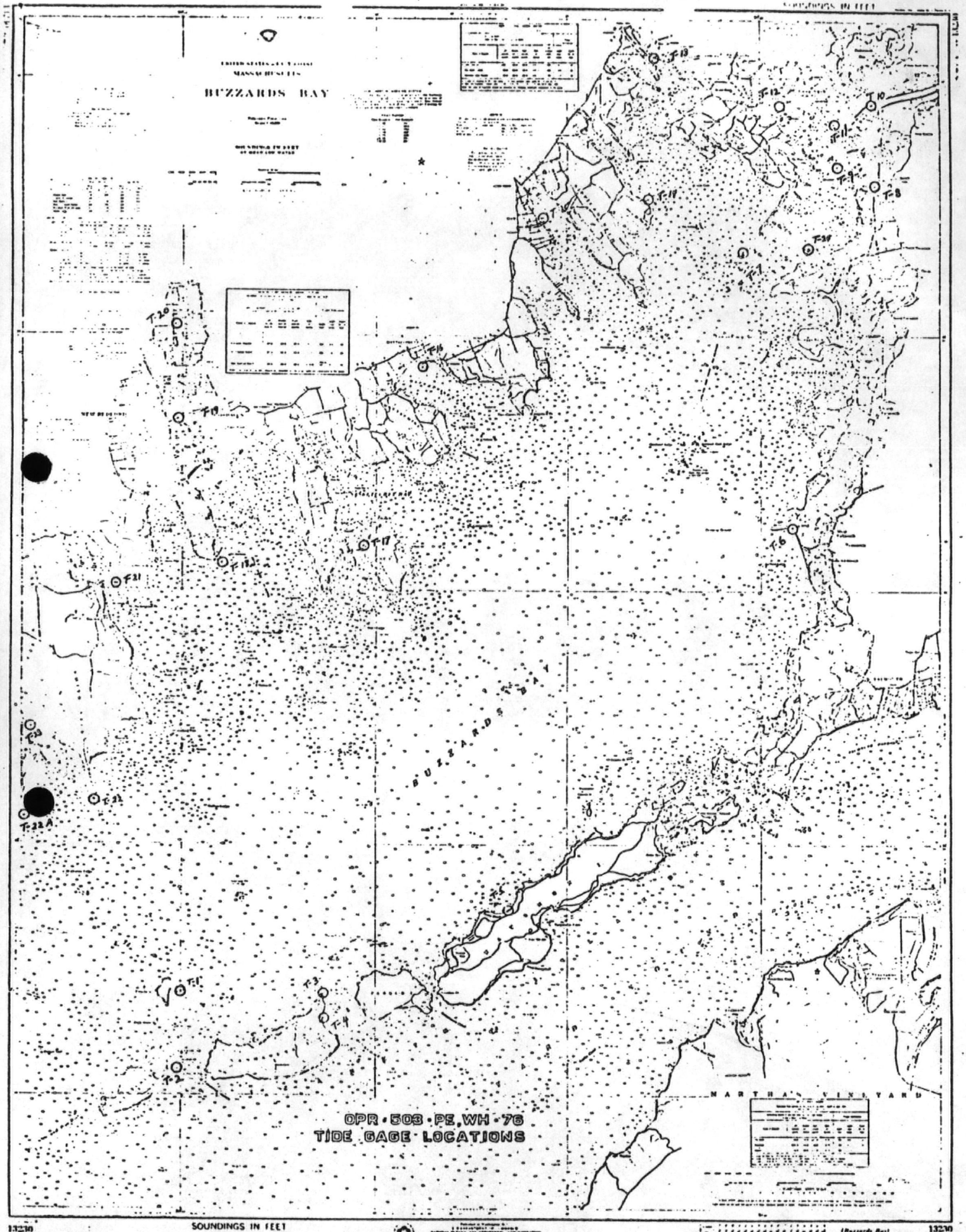
7.6. Monthly Accomplishment will be reported under Work Identification Code 0132050 (Hydrographic Surveys).

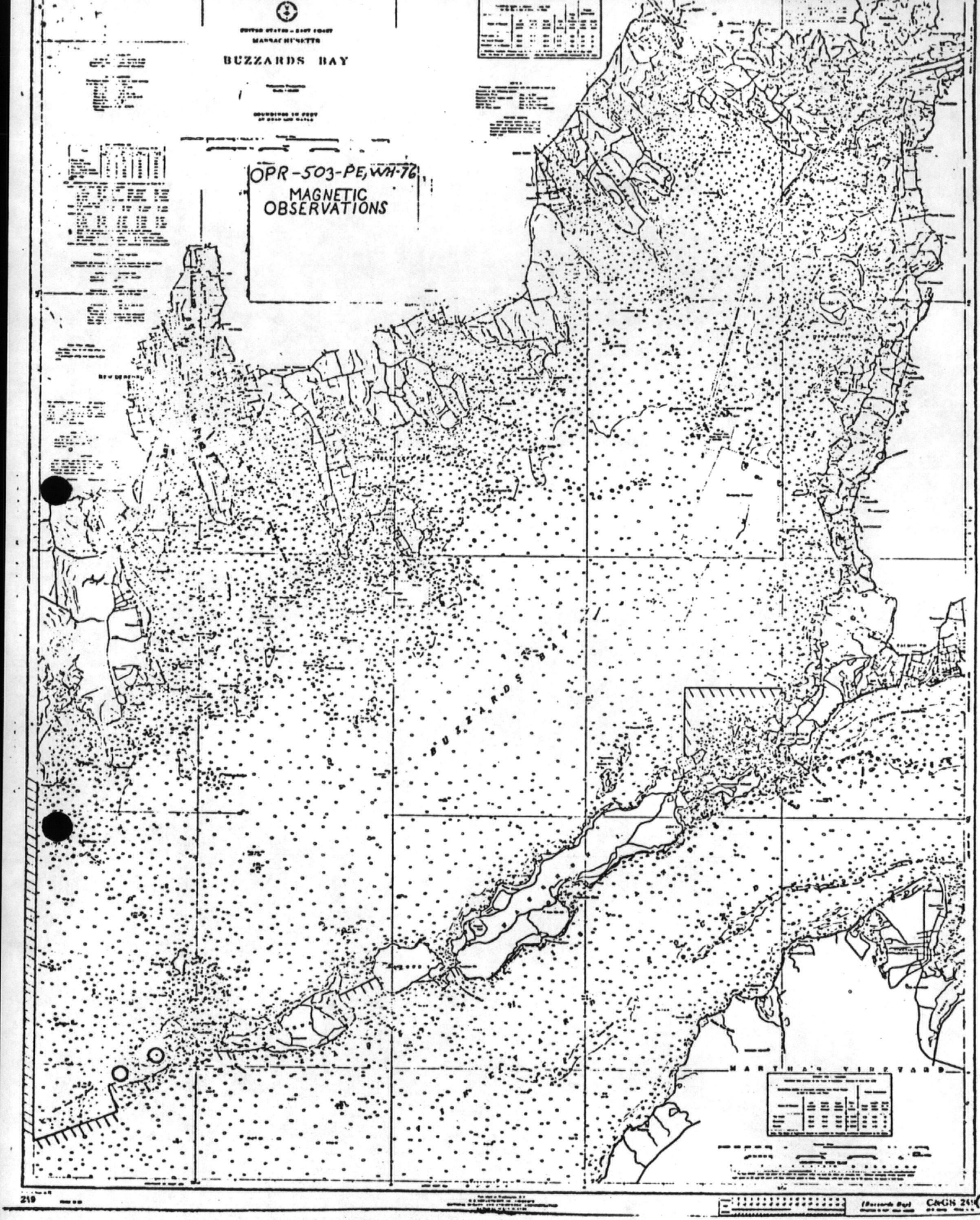
7.7. Submit recommendations if it appears advisable to amend these instructions.

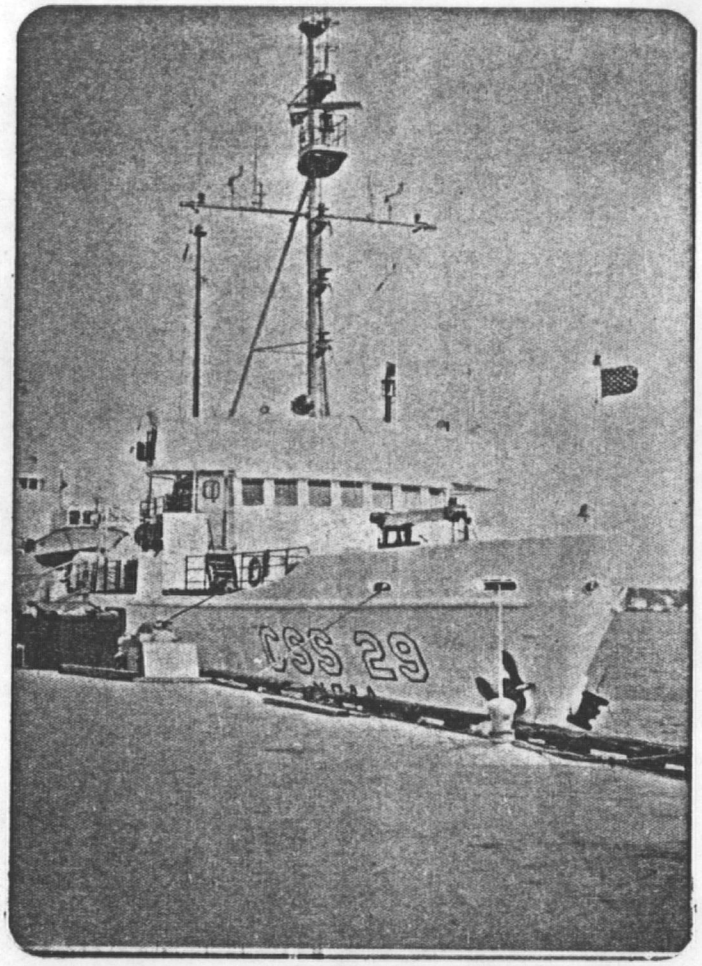
7.8. Receipt of these instructions shall be acknowledged.

for Robert C. Munson
Associate Director
Office of Marine Surveys
and Maps

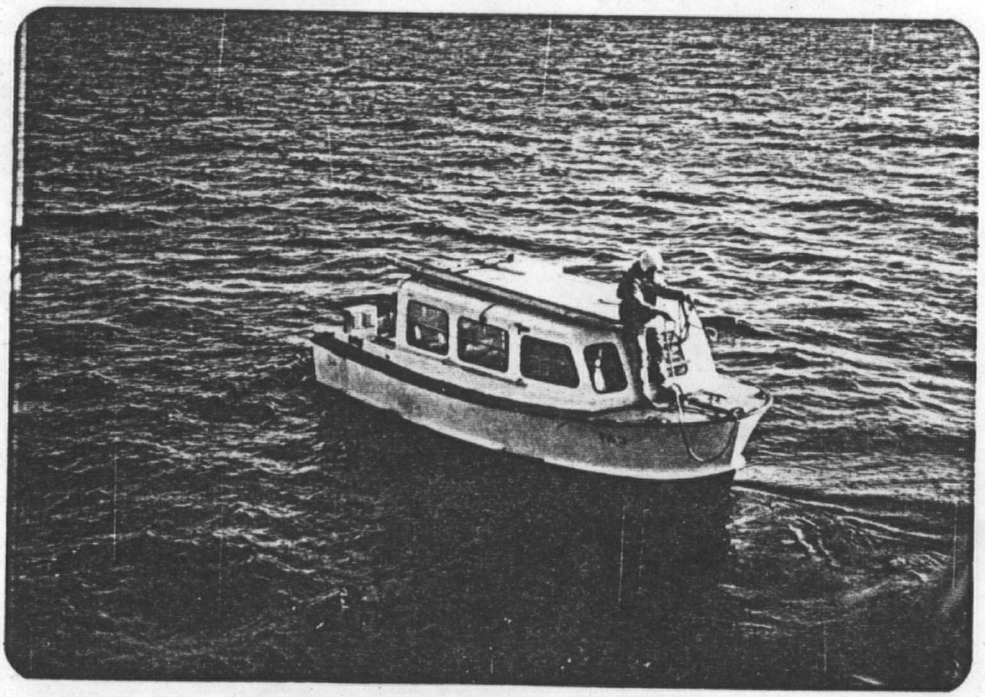

CAUTION
Skywaves should not be used in determining loran lines of position on this chart
CURRENT DIAGRAM
GEORGES BANK AND NANTUCKET SHOALS
Explanation
SCALE OF VELOCITIES
1 0 1 2 KNOTS
CAUTION
Temporary changes or defects in aids to navigation are not indicated on this chart. See Notice to Mariners.
During some winter months or when endangered by ice certain aids to navigation are replaced by other types or removed. For details see Coast Guard Light List.
Plymouth
CAPE COD BAY
BUZZARDS BAY
NANTUCKET SOUND
VINEYARD SOUND
MARTHA'S VINEYARD
CAPE
Falmouth
Hyannis
Sandwich
Barnstable
W Falmouth
Tuckernuck I
Muskeget I
H-8170
H-8903
H-8904
H-8905
(use chart 13246)
(use chart 13237)
Subm Obstr PA
PROJECT LIMITS
OPR - 503 - PE, WH - 76
13200
(formerly C&GS 1107)
71°
50'
40'
30'
20'
10'
42°


BUZZARDS BAY
MASSACHUSETTS
SOUNDINGS IN FEET
BUZZARDS BAY
MARTHA'S VINEYARD
OPR-503-PE,WH-76
TIDE GAGE LOCATIONS
SOUNDINGS IN FEET

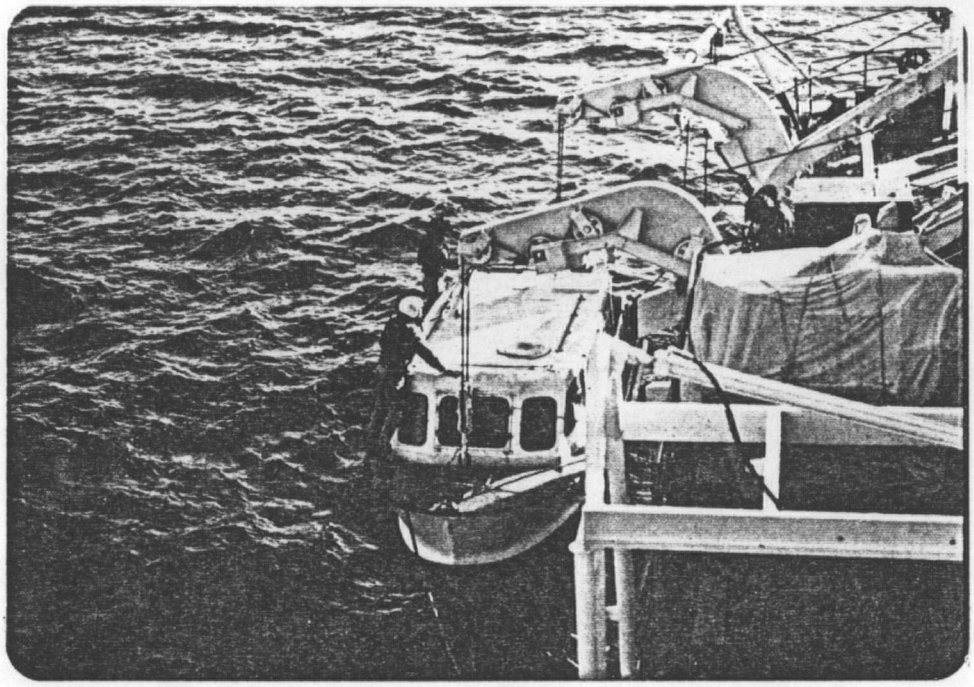

BUZZARDS BAY
OPR-503-PE,WH-76
MAGNETIC
OBSERVATIONS
BUZZARDS BAY
MARTHA'S VINEYARD



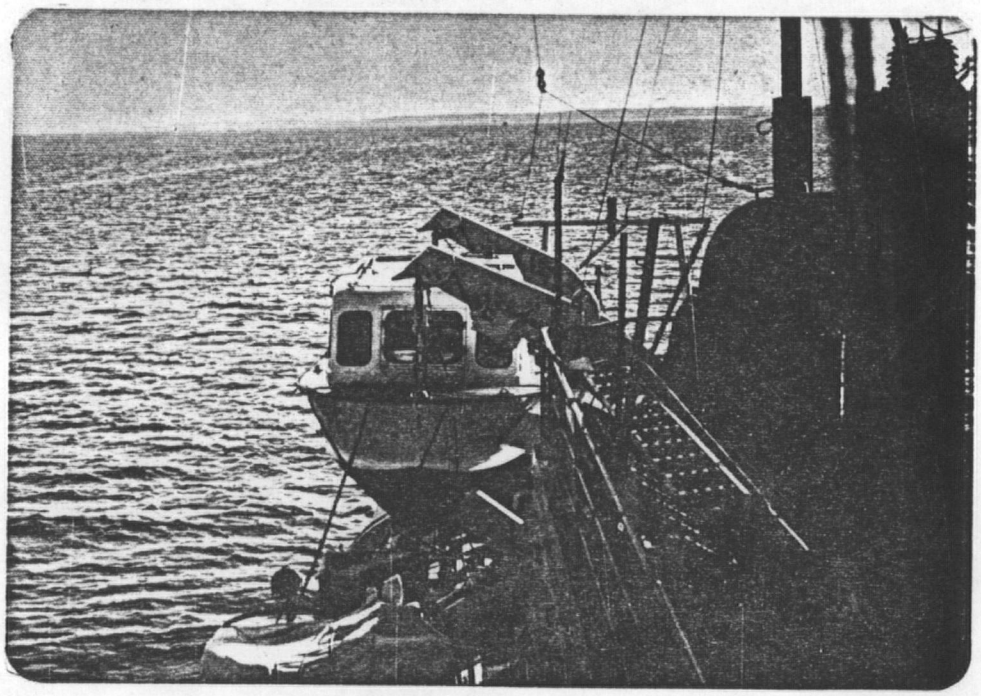
NOAA Ship 'WHITING'

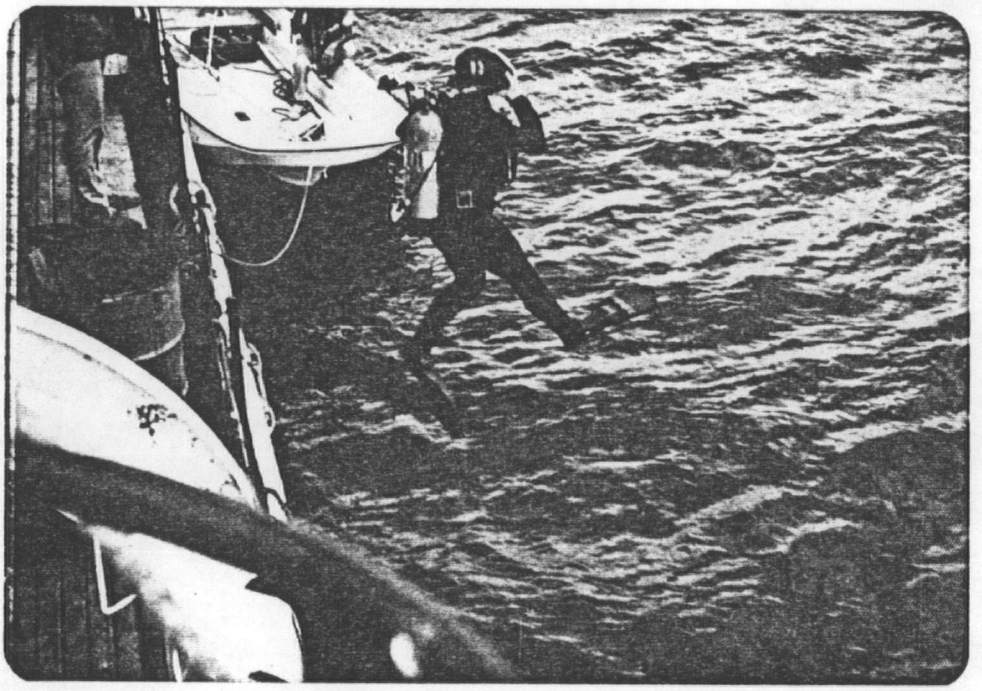


Sounding launch 'PLASTIC PIG' with Hydroplot/
Hydrolog system.

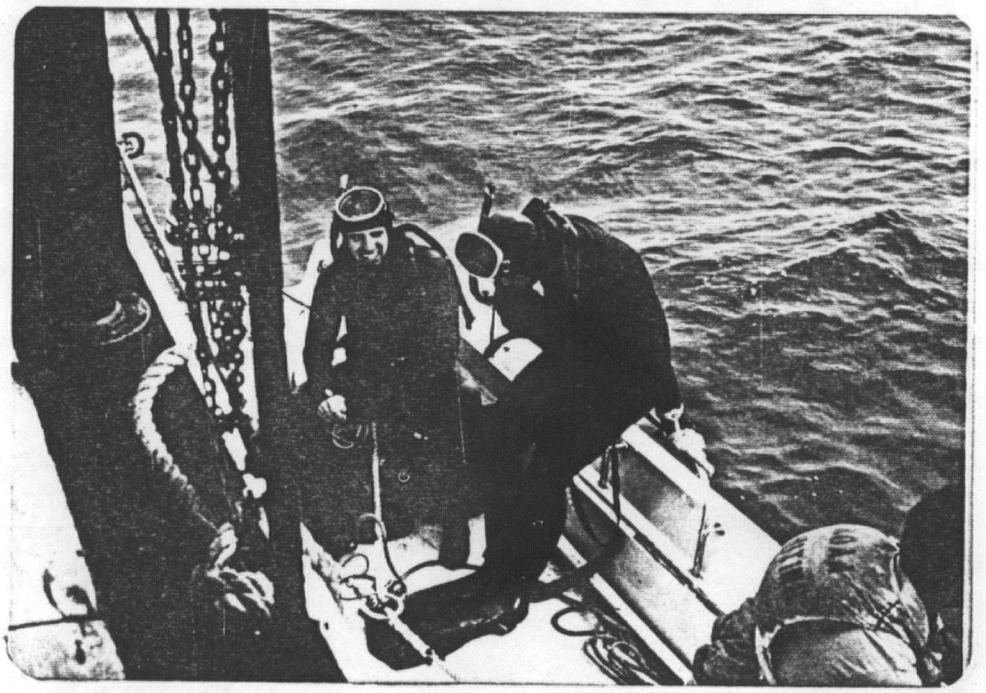


'PLASTIC PIG' made secure aboard ship





Diving to inspect ship



OBSERVATIONS - GENERAL

1. Hydroplot/hydrolog system plots soundings at specific intervals and records on tape. Therefore, all sounding rolls must be hand scaled for shoals, deeps and logged tape.

2. For range/azimuth positioning, parameters are entered for each fix manually and logged on tape. For photo sounding (point to point), position co-ordinates are approximated and each fix manually logged on tape. This time-consuming operation could be speeded up by using a lattice to plot the fixes on a master boatboard for inking on a field sheet.

3. Verification Branch checks and verifies all field work from original field notes and sounding rolls. All control is checked, position fixes plotted and sounding rolls re-scaled. Any ambiguities are referred back to the field party for checking. This detail checking establishes good quality control. When all information has been verified, this Branch produces the final field sheet.

4. Pre-survey items, shown on a chart, are supplied to each field party for checking. Information from all sources are collected on wrecks, shoals, cribs, etc. for verification.

5. Calibration of electronic positioning systems is done by setting the receiver and transponder over known horizontal control points, a series of theodolite cuts or by sextant.

6. Barchecks are done twice a day to once a week, depending on the survey party.

7. The Master of a survey ship is also the party chief of the survey. Hydrographic work is done by the ships officers. Officers are usually assigned for two years to a project and could be transferred from Region to Region.

8. No helicopters are used on any party for reconnaissance, control, establishing electronic positioning systems or its maintenance.

9. None of the survey parties had a gas engineer and only the Lake Erie hydrographic party had an electronic technician. No party had a back-up survey launch and very few parties had spare equipment such as outboard motors, radios, or sounders. This resulted in lost operational days and working with half functional equipment, such as on one engine or sounders with fluctuating frequency. The Lake Erie hydrographic party had an idle hydroplot/hydrolog system for two weeks, waiting for the survey launch to be repaired.

10. Members of a field party do not have specific duties. Depending on requirements, a person could be a hydrographer, seaman, coxswain, gas engineer, or electronic technician for the day.

11. Sounding in shallow water was done with a Boston Whaler, positioned by range/azimuth. Depth was taken with a sounding pole when the fix was called. This method did not give a continuous profile of the bottom but only spot fixes. Problems arose when in spots no depths were obtained with the sounding pole. The area was re-sounded using a MonArk launch with Raytheon DE-723 sounder. A Raytheon DE-719 installed in the Boston Whaler could have prevented this situation.

12. Shoal examination was done by reducing the line spacing. A detailed examination was not done using a reference buoy.

13. The revisory surveys of NOS and Central Region use different approaches. The NOS party travels by land, uses an office trailer and does extensive gauge work. The Central Region party travels by launch, which is used as an office.

14. NOS fields separate horizontal and vertical control parties. In Central Region, each survey party does its own control work.

15. Some of the field projects were over-staffed. Like six people doing sextant sounding in a launch; three or four would have been sufficient.

These are some of the points observed during the exchange program. Overall, the methods of collecting and displaying the bathymetry are quite similar to those in the Canadian Hydrographic Service.

CONCLUSIONS

During my exchange with NOAA, the following points were observed that are worth considering by C.H.S., Central Region. They are:

1. The use of Motorola 'Motrac' portable radios in field vehicles. Mounted on the dashboard, they provide good communication to launch and office for exchange of information.

2. Each survey party should be supplied with pre-survey items on charts for their area to be verified as the survey progresses. These items can be collected from all agencies and include such things as potential hazards from older surveys, reported shoals, wharf ruins, piles and wrecks.

The exchange program should not be longer than four months and two weeks on each survey party is sufficient time to get acquainted with new techniques and equipment. It is a worthwhile experience in meeting people, exchanging ideas, comparing methods and approaches, establishing a working relationship and gaining new insight into hydrography.

APPENDIX A

- THE ZEISS APPARATUS FOR CROSSING WATER SPANS IN PRECISE LEVELLING -

BY

RALPH MOORE BERRY

THE ZEISS APPARATUS FOR CROSSING WATER SPANS IN PRECISE LEVELING

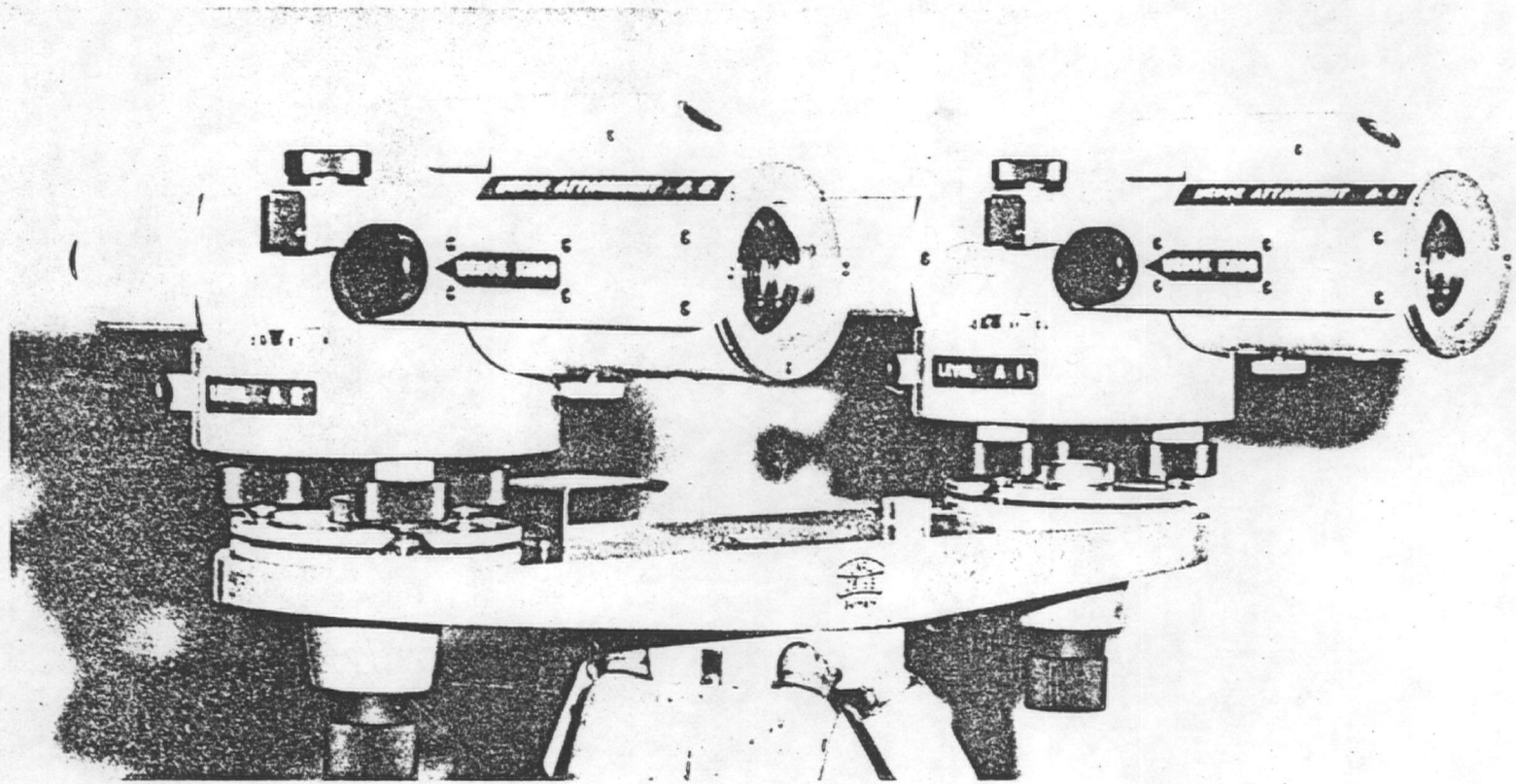
by

Ralph Moore Berry F.ASCE

Descriptors: Vertical Control - Leveling - Surveying - Water Crossing - Geodesy - Great Lakes

U. S. Lake Survey

October 1969



ZEISS "VALLEY CROSSING" EQUIPMENT

CONTENTS

LIST OF ILLUSTRATIONS

THE ZEISS APPARATUS FOR CROSSING WATER SPANS IN PRECISE LEVELING

by

Ralph Moore Berry F.ASCE
Geodetic Consultant
Hydrographic Branch
Lake Survey District,
Corps of Engineers
Detroit, Michigan

INTRODUCTION

In connection with its program of levels of high precision along the shores of the Great Lakes and their connecting waters[1], the U. S. Lake Survey must make connections between Lake Survey lines and similar level lines established along the Canadian shores by the Geodetic Survey of Canada. These connections are necessarily made over comparatively wide water spans such as the St. Lawrence River, Detroit River, etc. where suitable rigid bridges are not available and the span is considerably greater than the maximum tolerable sight distance for standard leveling procedures.

Similar situations have been encountered frequently in the past during the process of control leveling (e.g. by the U.S. Coast and Geodetic Survey) for which special "water crossing" techniques were developed. These techniques were applicable to the older procedures where leveling was accomplished through the

---

[1] Feldscher, C. B. and Berry, R. M., The Use of Geopotential Heights for Great Lakes Vertical Datum, U. S. Lake Survey, Miscellaneous paper 68-6, p. 18, Detroit, 1968.

use of "spirit" levels in which the attitude of the line of sight was set ("leveled", or the bubble centered) by use of a fine vertical slow-motion "tilting screw" with a micrometer calibration. A short description of a version of the spirit-level technique for water-crossing is quoted from the instructions of the U. S. Coast and Geodetic Survey[2]:

> "The general scheme of this method of observing is that simultaneous reciprocal observations are made at each of two points, one on each side of the river. Instead of moving a single target into the line of sight, two targets are set on each rod, one above and the other below that point on the rod which is crossed by the middle horizontal wire when the bubble is centered. The graduated head of the micrometer screw is read with the telescope in each of three positions: First, with the middle horizontal wire bisecting the top target; second, with the telescope level (bubble centered); and third with the middle horizontal wire bisecting the bottom target. The reading on the rod given by the line of sight when the telescope is level can be determined, for the distance from this point to the two targets will be proportional to the corresponding differences in the readings on the micrometer head."

---

[2] Rappleye, Howard S., Manual of Geodetic Leveling, U. S. Coast and Geodetic Survey Special Publication No. 239, Washington, D. C., 1948, p. 51.

The recently-developed Lake Survey techniques for levels of high precision[3] involve the use of an "automatic" level instrument (Zeiss Ni 2 with plane-parallel plate micrometer, Fig. 1). This instrument has no spirit bubble to control the line of sight, but, instead, depends on a gravity-controlled "compensator" to set the line of sight. Details of the theory of this instrument, and the action of its compensator have been discussed by Karren[4]. There is no tilting screw involved and, hence, the spirit-level technique of water-crossing is not applicable. The new technique, however, by use of a "Rotary Wedge" (Fig. 2) attachment to the level[5], retains the same principle of setting on a pair of targets on the opposite shore, with the line of sight being tilted under carefully-controlled conditions. The principal variations are:

a. Use of a rotating optical wedge to control tilt of line of sight.

b. Use of two instruments, set in "reciprocal collimation" to compensate for effects of imperfection in vertical adjustment of line of sight.

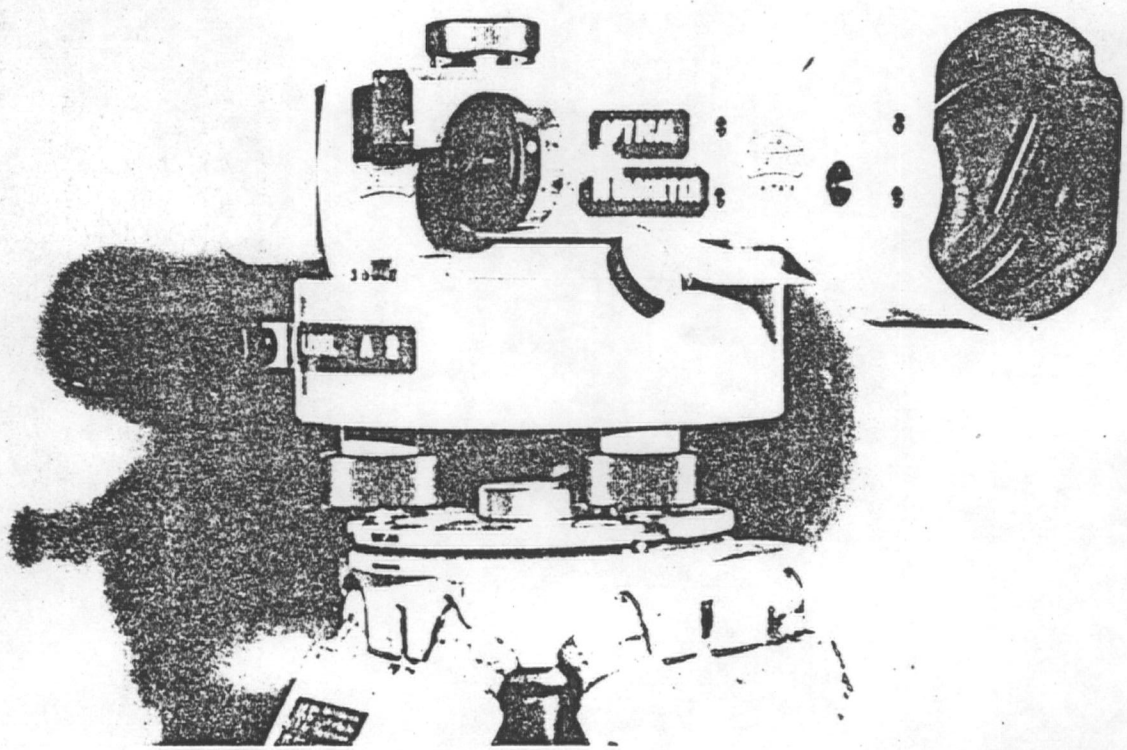
The rotating wedge consists essentially of a slightly deviating prism, cut to circular outline, and arranged in a mount so that it can be rotated about an axis parallel to the optical axis of the level, when mounted in front of the objective (Fig. 3).

---

[3]Berry, Ralph Moore, Experimental Techniques for Levels of High Precision, Using the Zeiss Ni 2 Automatic Level, U. S. Lake Survey, Miscellaneous Paper 69-4, Detroit, 1969.

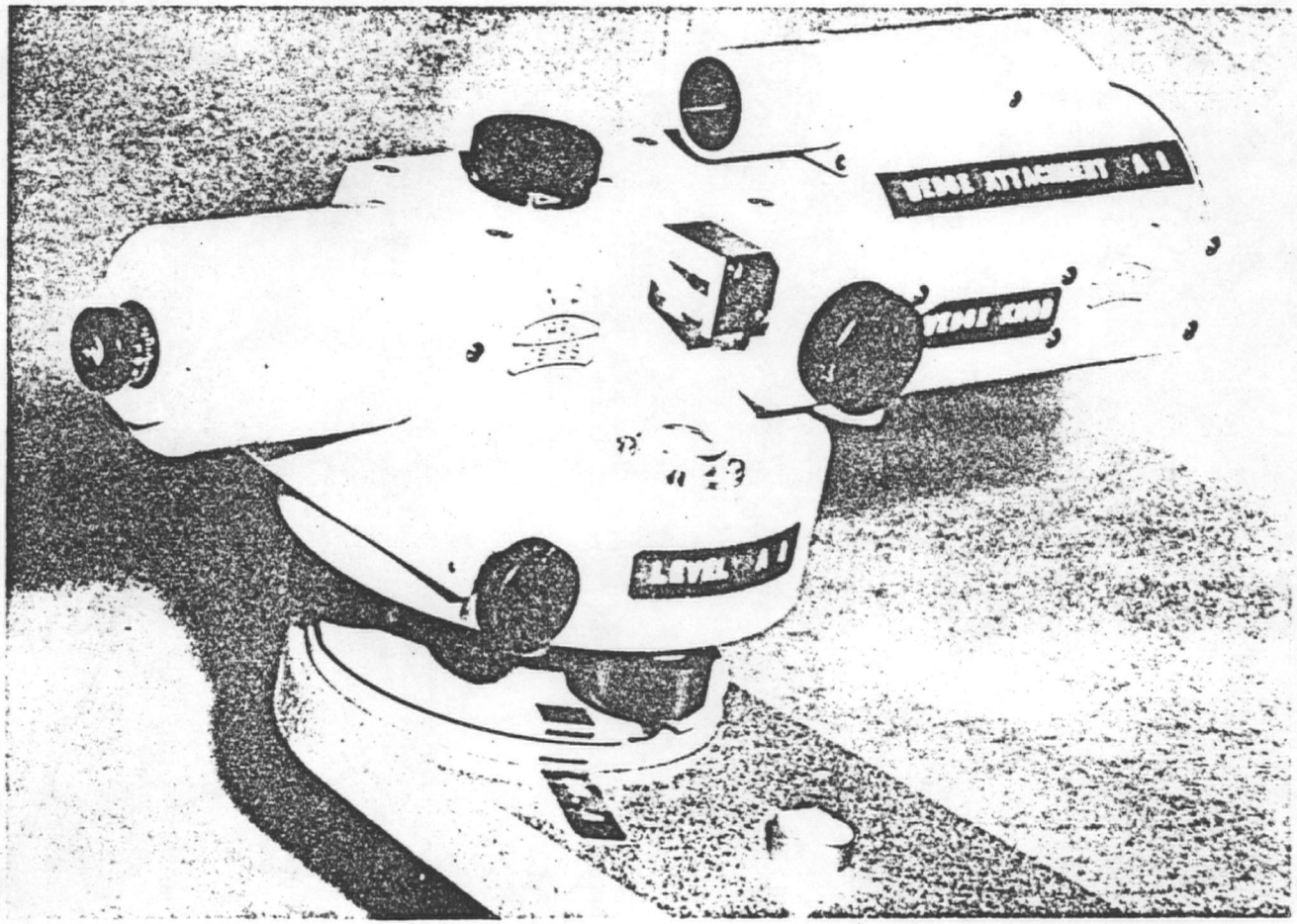
[4]Karren, Robert J., Recent Studies of Leveling Instrumentation and Adjustment, SURVEYING AND MAPPING, Vol. XXIV, No. 3, 1964.

[5]Drodofsky, Martin, Leveling Across Wide Rivers with the Zeiss Level Ni 2, ZEITSCHRIFT FUR VERMESSUNGSWESEN, 85. Jahrgang 1960, Heft 7, Stuttgart.



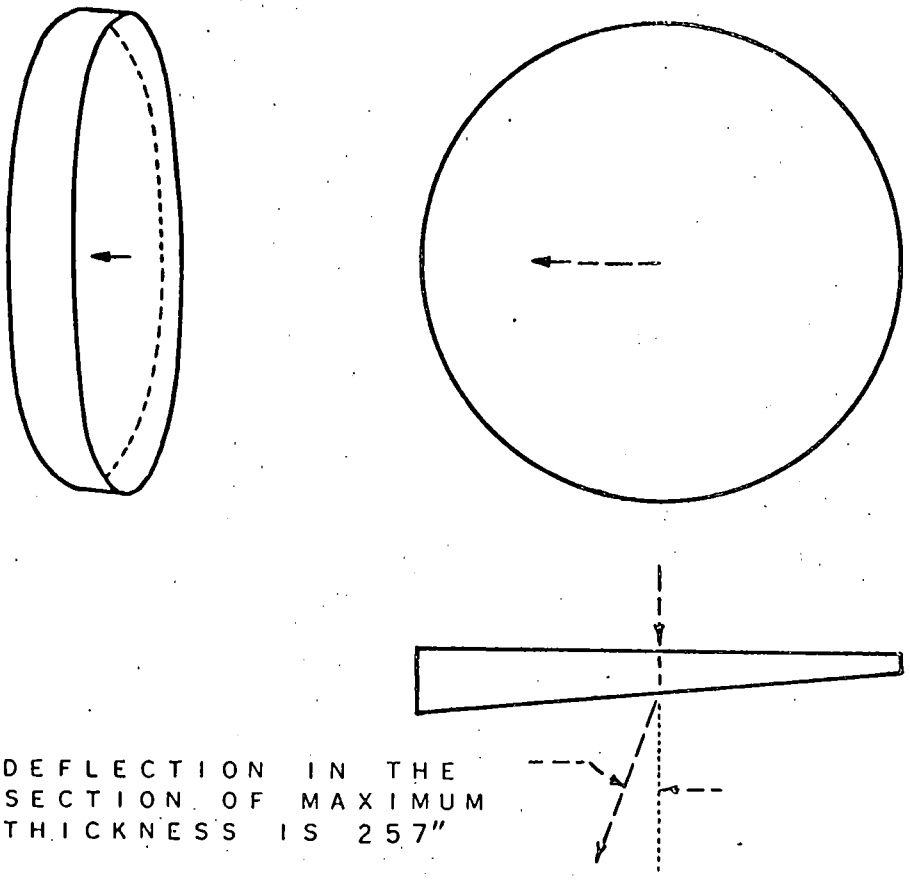
ZEISS Ni2 AUTOMATIC LEVEL WITH OPTICAL MICROMETER

Figure 1



ZEISS Ni2 LEVEL WITH ROTARY WEDGE ATTACHMENT

Figure 2



ROTATING OPTICAL WEDGE

Figure 3

An attached graduated optical scale provides an indication of the position to which it is rotated. This is similar in principle to the rotating wedge mounted in front of the objective of some precise levels, to provide a sensitive means of adjusting the inclination of the line of sight.

The wedge deflects the line of sight by a small angle (257 seconds) which deflection is in a direction perpendicular to the line of intersection of its two main faces. As indicated above, this line of intersection (or "edge") does not exist physically since the prism is cut to a circular shape, of about the same diameter as the telescope objective and the edge is thus cut away.

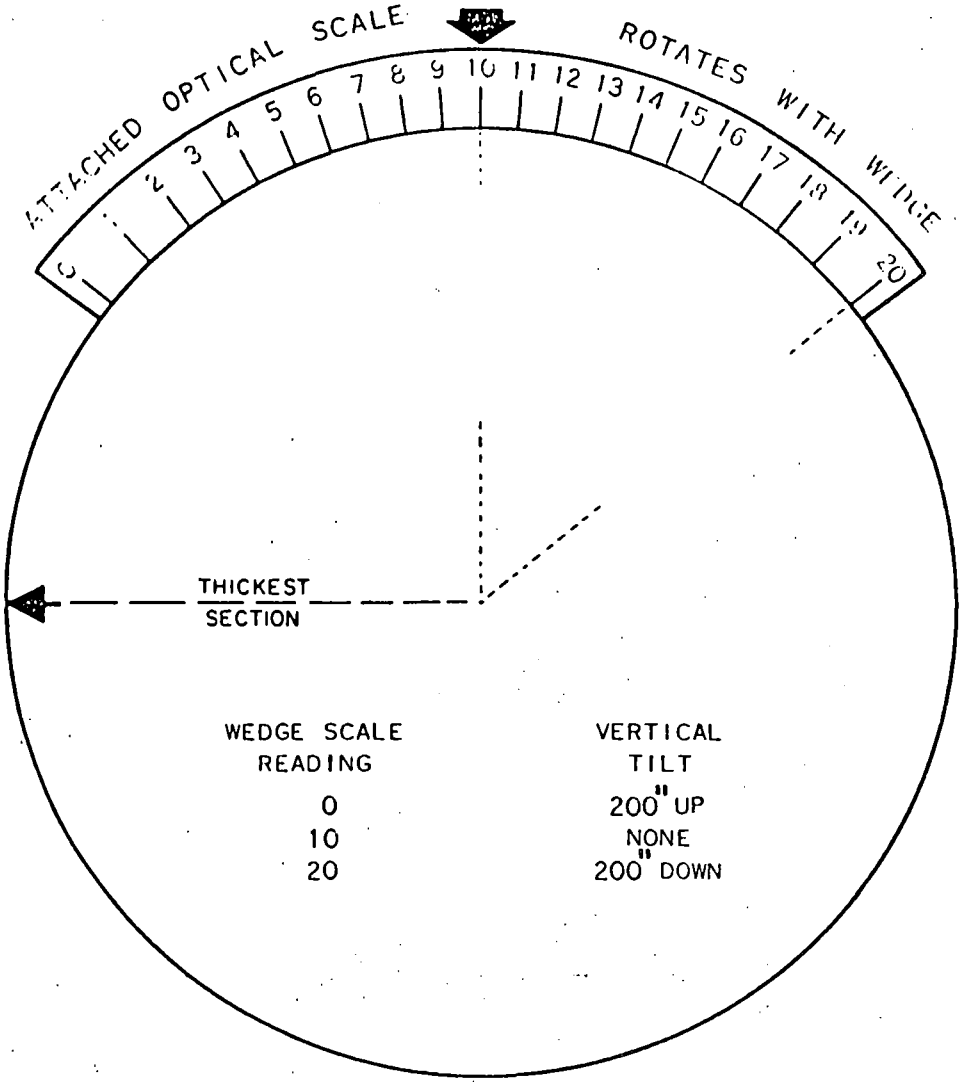
If the wedge is rotated so that its theoretical "edge" is vertical, the line of its thickest section will be horizontal, the deflection will be entirely in the horizontal plane, and the vertical attitude of the line of sight, as set by the compensator, will not be changed. It will merely be deflected horizontally with no effect on its vertical reading.

If, however, the wedge be rotated to some other position, the line of sight will be deflected, either up or down, at some angle with the horizontal. This deflection can be resolved into two components, a vertical tilt which is proportional to the sine of the rotation angle, and a horizontal deflection which is proportional to the cosine of the rotation angle. The wedge is designed to give a total deflection of 04'17" (257"), and its range of rotation is $51^{o}06'$ above or below the horizontal. With this maximum rotation the line of sight has a vertical tilt of $3^{o}20'$ (200") above or below the compensated line of sight. Rotation of the wedge through its limits then provides a smoothly

variable change of the vertical attitude of the line of sight through a range of 400 seconds. By thus rotating the wedge, the line of sight can be accurately set to a pair of targets, of known vertical separation and relation to an adjacent bench mark, one above and one below the compensated line of sight. Graduations on an attached optical scale (Fig. 4), in units of equal increments of sine of the rotation angle, permit reading of the vertical tilts, and their relation to the compensated line of sight, with a precision of 0.2 second of arc. The position of the intercept of the compensated line of sight, between the two targets on the opposite shore, is calculated by simple proportion. To avoid difficulty with algebraic signs, the unrotated position of the wedge (no vertical tilt) is numbered "10" with the position of maximum upward tilt graduated "0" and the position of maximum downward tilt graduated "20".

The above procedure gives a precise determination of the intercept of the compensated line of sight between the targets, but its accuracy is directly influenced by the adjustment condition of the instrument and the corresponding deviation of the line of sight from a true "level" attitude. This problem is essentially solved by use of the principle of "Reciprocal Collimation," involving use of two Ni 2 levels mounted on the same tripod, through use of a base plate with provision for attachment of the two levels.

The two levels, attached to a Base Plate mounted on the head of the tripod(on which they remain set for the entire set of water-crossing observations) are turned to face each other, objective to

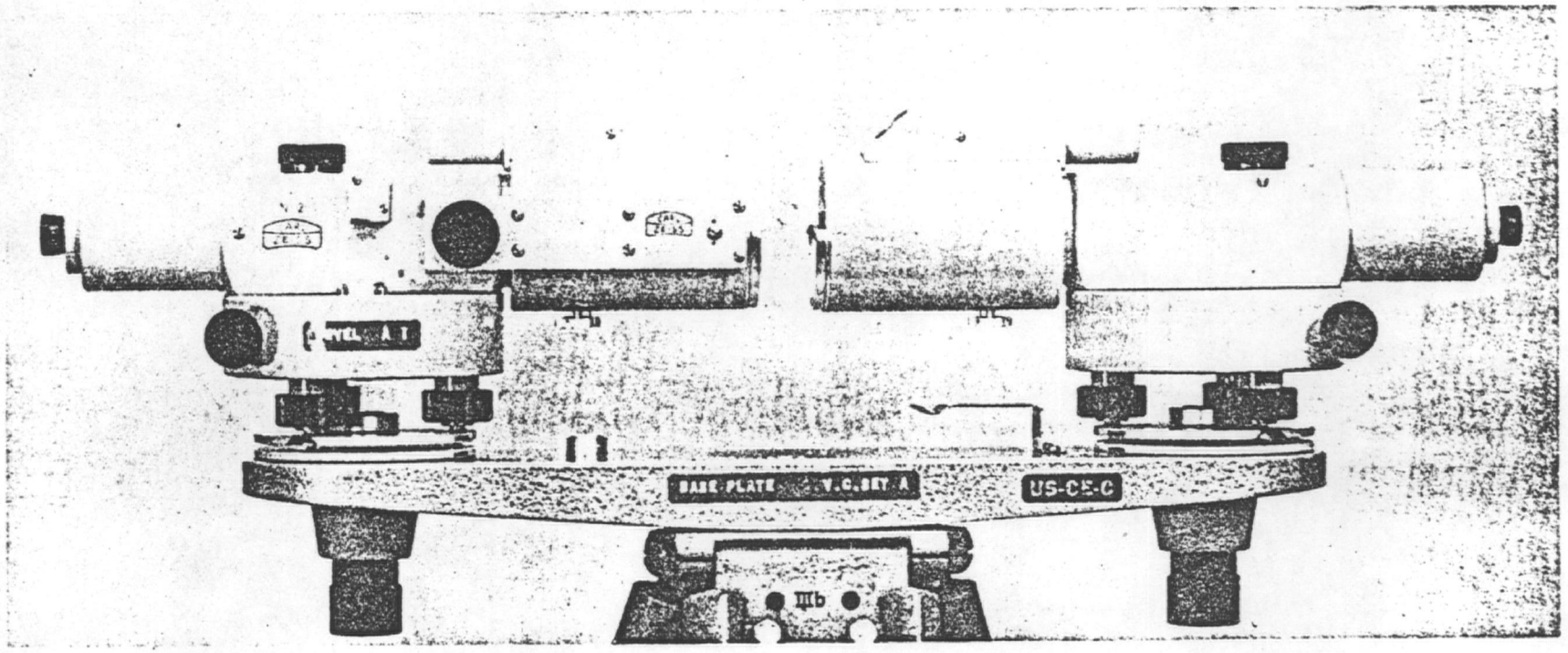


OPTICAL WEDGE SCALE

Figure 4

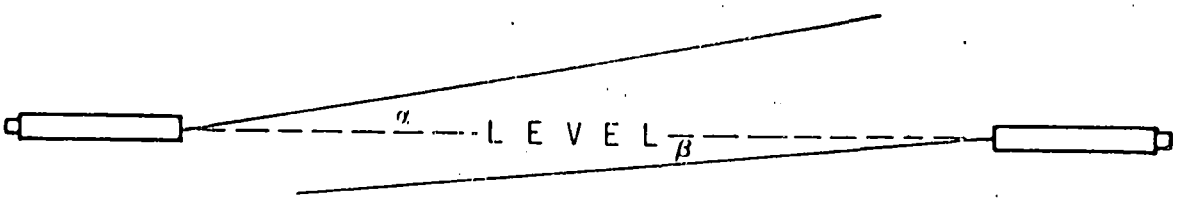
objective (Fig. 5). One instrument is focused to infinity and the other one focused so that the reticle lines of the first instrument are seen sharply in the field of view of the second instrument. The wedge on the first instrument is set to read "10.00" precisely, thus introducing no tilt in the line of sight (Because of adjustment error, this does not mean that the line of sight is level. It merely means that the wedge is not introducing any tilt). When viewing this in the field of view of the second instrument, the horizontal reticle line of the first instrument will usually appear somewhat above or below the horizontal reticle line of the second instrument because the two instruments will not generally have the same adjustment error. The two instruments are then set in Reciprocal Collimation by rotating the wedge of the second instrument until the two horizontal reticle lines are in coincidence (Fig. 6). The reading of the wedge scale of the second instrument is noted, and this position becomes the reference from which its intercept between the two distant targets is computed.

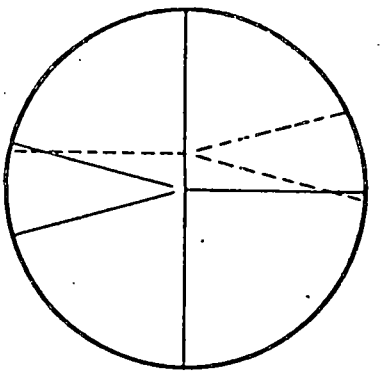
By this Reciprocal Collimation, the lines of sight of the two instruments are set parallel, not level, but with the same (undetermined) inclination, one above "level" and the other quite accurately below "level" by the same amount. When turned toward the targets, the computed mean intercept of the lines of sight of the two instruments (thus collimated) between the two targets is essentially free from error of adjustment, even though the two instruments may be at slightly different elevations (due to base-screw positions, etc.) It is however, still influenced by the very considerable effects of refraction and earth curvature. These latter effects are essentially cancelled by



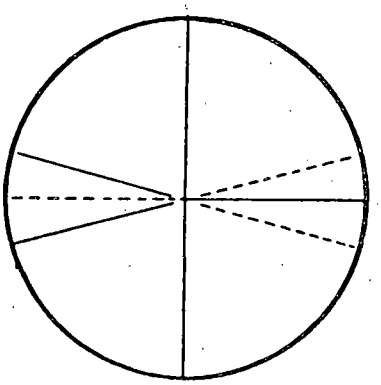
PAIR OF ZEISS Ni2 LEVELS IN POSITION FOR RECIPROCAL COLLIMATION

Figure 5





BEFORE RECIPROCAL COLLIMATION
Level Lines of Reticles Not Coincident
LINES OF SIGHT NOT PARALLEL



AFTER RECIPROCAL COLLIMATION
Level Lines of Reticles Set Coincident
LINES OF SIGHT PARALLEL

Figure 6

making simultaneous observations with another set of Ni 2 levels (four, in all) set on the opposite shore. If conditions are favorable, refraction and curvature effects for this other determination will be equal in magnitude but opposite in sign, so the mean determination from the two simultaneous observations in opposite directions will be essentially free of error due to these causes.

To obtain accurate results, all precautions against error must be taken, and the quite detailed procedures must be strictly followed. A detailed description of the instruments, the precautions and reconnaissance procedures, and detailed instructions for observations are set forth on the following pages.

ZEISS VALLEY CROSSING EQUIPMENT

*1. VALLEY CROSSING EQUIPMENT, Purpose:

The Carl Zeiss (West Germany) equipment, listed as the "Valley Crossing Equipment," is a set of accessories intended to be used with a pair of Zeiss Ni 2 "automatic" levels. It facilitates the determination of differences of elevation between widely separate points, as across a river, where determination by standard leveling procedures using balanced sight lengths is precluded by physical conditions. Since the situation seldom arises except where water prevents the use of intermediate "turning points," the terminology "water crossing" is usually applied to this technique.

2. VALLEY CROSSING EQUIPMENT, List of items:

As supplied, one set of equipment consists of:

2 Rotary Wedge Attachments

1 Base Plate

1 Tribrach

1 Target Column

2 Targets

1 Auxiliary Level Scale (half-centimeter(semi-centimeter), E-pattern graduations)

1 Plane Mirror Auto-Collimation Attachment

1 Illumination Ocular Prism

*Since the following material constitutes the complete instructions, independent of the foregoing INTRODUCTION, the series of reference numbers begins at this paragraph.

3. ADDITIONAL EQUIPMENT:

Additional required equipment for a single set includes:

2 Zeiss Ni 2 automatic levels, with tripods, designated and marked as "No. 1" and "No. 2"

1 Level rod, precise, with half-centimeter (semi-centimeter) graduations

1 Plane-parallel micrometer for Ni 2 level, compatible with rod graduation

4. ROTARY WEDGE ATTACHMENT, Purpose:

The Rotary Wedge Attachment slips over the objective end of the Ni 2 level and provides an optical means of changing the vertical inclination of the line of sight of the level through a small accurately-controlled range. It is similar to the rotatable prism placed in front of the objective of some precise level instruments for the purpose of providing a precise means of adjustment of the vertical inclination of the line of sight. As used with the Valley Crossing Equipment, however, it is a means of setting and reading the attitude of the line of sight.

5. ROTARY WEDGE ATTACHMENT, Description:

The Rotary Wedge Attachment provides the basis for the system of operation and must be made with the highest quality of craftsmanship and precision. It consists of a freely-rotatable prism attached to an optical scale which can be read by the observer from his position at the ocular end of the level. As the prism (wedge) is rotated in front of the objective of the level, through a linkage connected to the Wedge Knob, the line of sight, as

defined by the horizontal ("Level") line of the reticle, is tilted slowly through a vertical range of approximately six and a half minutes of arc. The attached optical scale is non-linear in graduation but the graduation intervals indicate equal vertical angular changes in the inclination of the line of sight. The prism has a rotation range of approximately 102^{o} and the optical scale range is 20 main units to cover this rotation. Each main scale unit is subdivided into ten sub-units. The space between each sub-unit is wide enough to permit easy estimation of tenths of a sub-unit. The optical scale can thus be read to an estimated hundredth of a main unit. The line of sight is tilted vertically two seconds for each sub-unit of the optical scale. Thus the vertical attitude of the line of sight is estimated to 0.2 second . When the optical scale is set to read precisely 10.0 units, no vertical tilt is being introduced by the prism. Thus the range of tilt is approximately 200 seconds above (scale reading 0.00) to 200 seconds below (scale reading 20.00) the untilted line of sight. The readings of the optical scale are assumed to be in a linear relationship to actual linear displacement at the rod or target, and are used for proportional computation of the relationship of the untilted line of sight.

6. ROTARY WEDGE ATTACHMENT, Rotation:

Rotation of the prism is accomplished by turning the Wedge Setting Knob. When the attachment is in place on the objective end of the telescope on the Ni 2 level, rotation of the wedge

effects a change in the vertical attitude of the line of sight. The optical scale is correspondingly rotated, with the readings changing by an amount that is proportional to the angle of tilt. The Wedge Knob is provided with a selective coarse and fine motion, similar to the objective focusing device on the level. The coarse mode is available for the entire range of the rotation. When in coarse mode, the knob is slightly hard to turn. Mode is shifted from coarse to fine by merely reversing the direction in which the knob is being turned. The knob is much easier to turn when in fine mode. The fine mode is "in gear" for only about 0.5 to 1.0 scale unit (depending on which part of the optical scale is being used) after which it reverts to coarse mode. Setting can be made much more accurately with the device in fine mode, and <u>all final</u> settings must be so made.

7. BASE PLATE, Description:

The Base Plate is an elongated metal casting which can be screwed onto the head of a standard European level or theodolite tripod. It is provided with appropriate clamp screws so that two Zeiss Ni 2 levels can be mounted on it, providing a means for mounting the two instruments adjacent on the same tripod and at nearly the same elevation. Red index marks have been provided to indicate the placement of the two Ni 2 levels, designated "No. 1" and "No. 2."

8. BASE PLATE, Set-up:

When the tripod and Base Plate are set up at a station, the Base Plate should be nearly level as indicated by the circular level mounted at its center. This will assure that the elevations

of the lines of sight of the two Ni 2 levels will be nearly equal. The Base Plate should be oriented with its long axis approximately perpendicular to the line of sight to the opposite target and with the indexed position of Instrument No. 1 on the left before leveling it. There are no leveling screws or similar device on the Base Plate, and the leveling must be effected by changing the positions of the tripod feet in the ground or by varying the lengths of the tripod extension legs. Leveling is not critical but the bubble should be inside the ring. The set-up should be very firm in the ground as it will be assumed not to move during the extended observations.

9. BASE PLATE, Placement of Ni 2 Levels:

The Ni 2 levels are attached to the Base Plate by use of the clamp screws similar to the direct attachment to a tripod head. The two levels should be appropriately located in the positions marked "No. 1" and "No. 2," and the red index marks on the leveling base of the levels should be aligned with the numbered index marks on the Base Plate. This will place one leveling screw of each instrument approximately on the long axis of the Base Plate, the other two screws then being aligned perpendicular to the long axis. Immediately after setting up, the three leveling screws on each instrument should be set to the mid-position of their range of movement. This is accomplished by turning each leveling knob until its top edge is aligned with the indexing ring marked on the dust skirt. This will minimize difference of elevation of the two instruments. After this setting is made all subsequent leveling adjustments of each instrument are made by

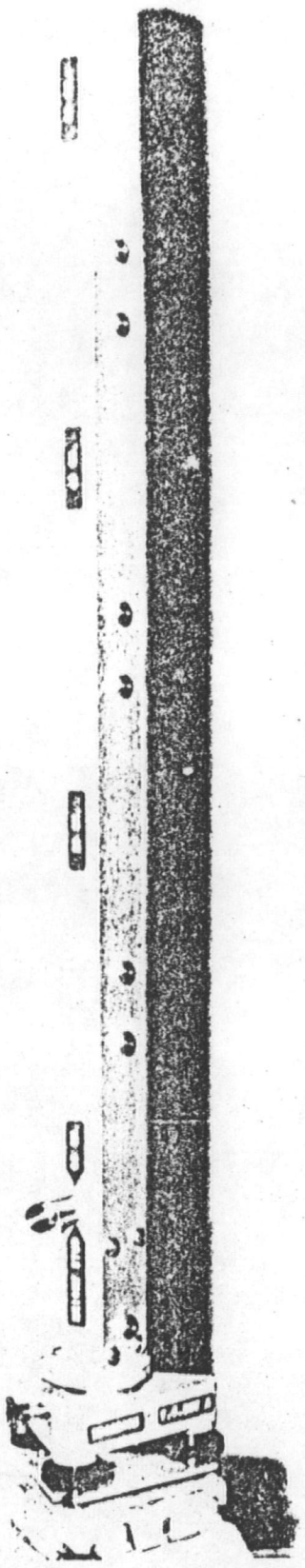
using only the two leveling screws which are aligned perpendicular to the long axis of the Base Plate. On each instrument the leveling screw that is on the long axis of the Base Plate is not touched again during the entire observation series.

10. TRIBRACH, Description:

The Tribrach is essentially a typical standard German, separate, three-screw, leveling base intended to be used with any surveying instrument provided with the standard stub for mounting. In this application, it provides a means for mounting the Target Column on a standard European tripod, and setting it vertical by use of the leveling screws.

11. TARGET COLUMN, Description:

The Target Column is a member of "channel" section, with a standard German surveying instrument stub by means of which it can be secured in a vertical attitude in the Tribrach. A circular level bubble at the foot of the Column provides a reference for setting the Column precisely vertical by use of the leveling screws in the Tribrach. It contains four pairs of precisely spaced studs on which the two Targets can be racked at vertical spacings of 40, 80, 120 semi-centimeters (Fig. 7). A "Height Stud" is set horizontally near the base of the Column, terminating in a spherical knob, the top of which is at precisely the same elevation as the target center defined by the lowest pair of studs. The top of the knob is therefore the reference point by means of which the target pair is related to an adjacent bench mark.



TARGET COLUMN

Figure 7

12. TARGET, Description:

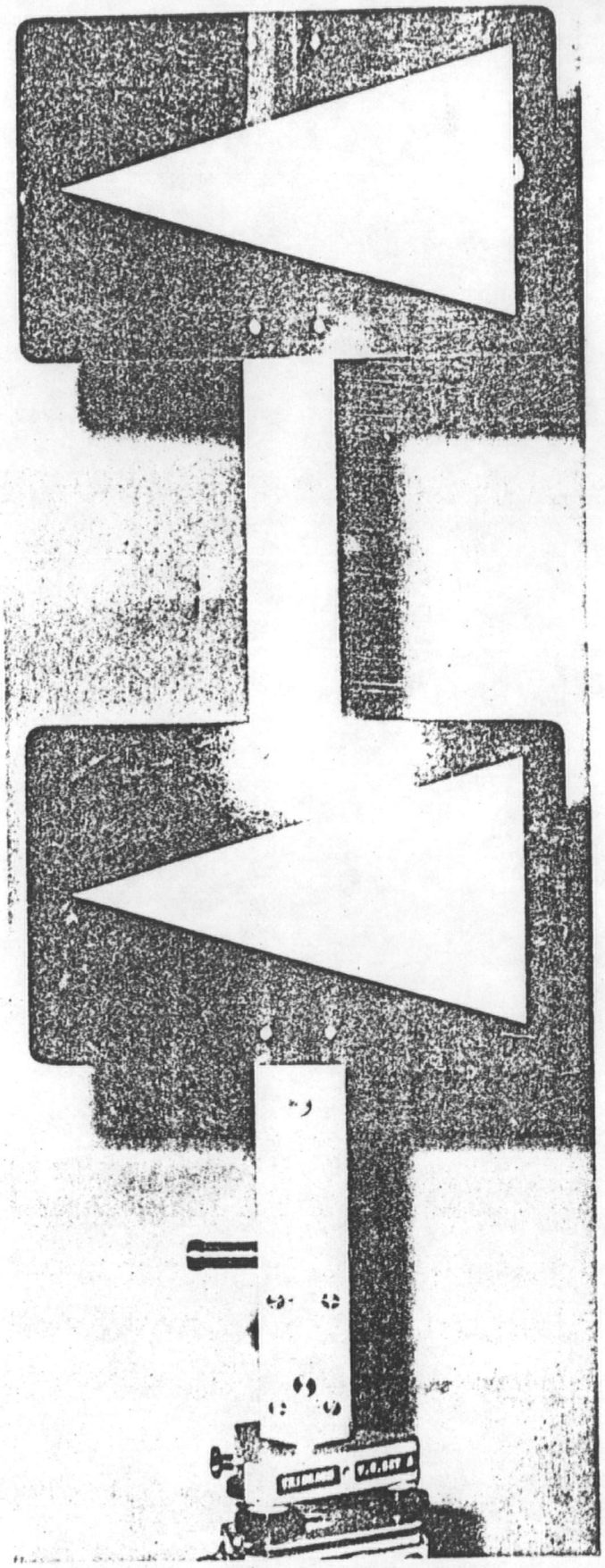
Two metal target plates (20 x 30 cm) are provided with the set. Each plate is black with white horizontal triangular target painted on it. This pattern is very well adapted to the setting of the horizontal level line of the reticle at a considerable distance.

13. TARGET, Placement:

The Target Column, (Par. 11), is provided with four sets of studs on its front face, each pair constituting a means of mounting a Target. The horizontal centerlines of the Targets are thus located on the Target Column at 0, 40, 80, or 120 semi-centimeters above the Height Stud. The placement of the Targets is at the observers discretion (Fig. 8). In use, they must be placed so that one Target is above the instruments "level" (untilted) line of sight and one is below. The lower target is not necessarily set in the lowest position (Zero distance above Height Stud). The positions of the Targets must be noted and recorded (par. 21d).

14. AUXILIARY LEVEL SCALE, Description:

The Auxiliary Level Scale is a short separate wooden level rod, 0.6 meters long, graduated in semi-centimeter divisions, in the "checkerboard" or "E-Pattern" style. It can be considered to be graduated to hundredths of semi-meters. The graduations are grouped and numbered in sets of ten divisions. The units are blocks of alternate black and white, similar to the pattern of the standard Coast and Geodetic Survey precise level rod, except



TARGETS IN PLACE

Figure 8

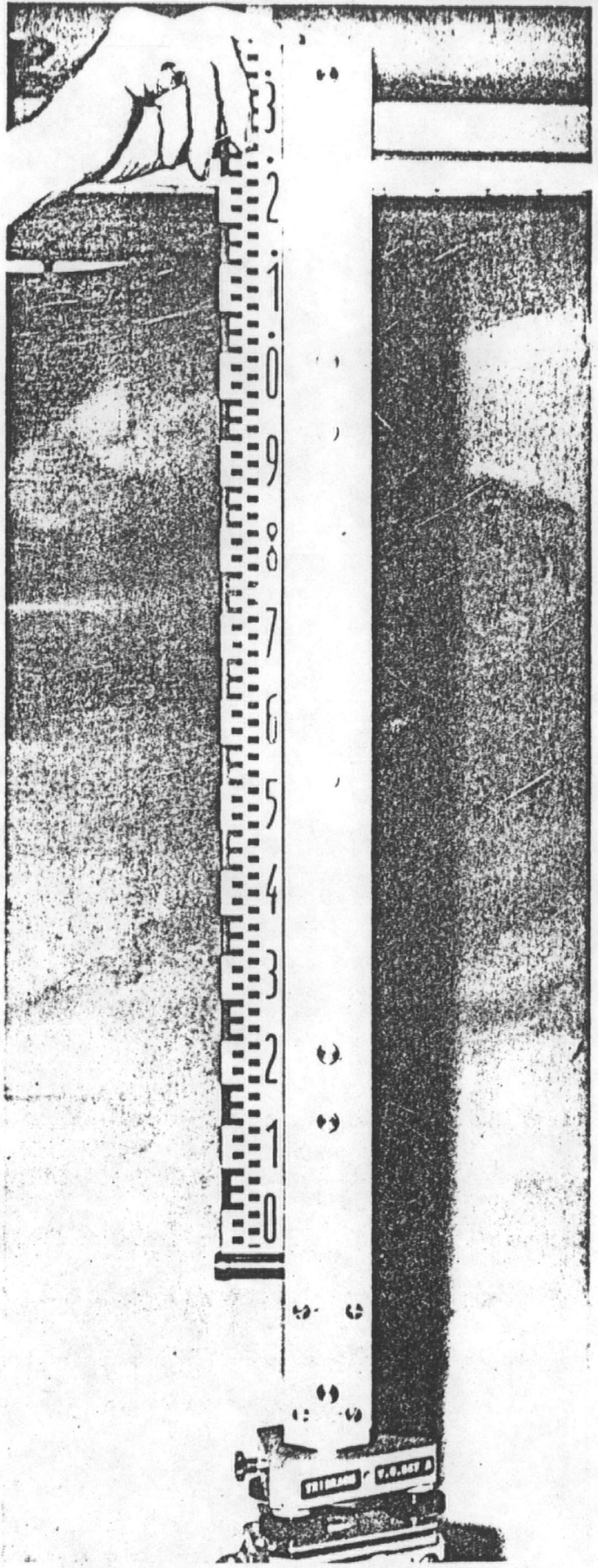
that the units are semi-centimeters instead of centimeters. The first ten groups of divisions are numbered from 0 through 9, which should be read as tenths of a half-meter with a leading zero preceding the decimal point, thus: 0.1, 0.7, 0.9, etc. The second series consists of only four groups of divisions, numbered from 0 through 3 but with a large dot over each number to indicate that, in reading, it should be preceded by "1.," thus: 1.0, 1.1, 1.2, 1.3. Each block within a group is a hundredth of a half-meter unit, and is read as the second decimal place.

15. AUXILIARY LEVEL SCALE, Use:

The Auxiliary Level Scale is used in the determination of the difference in elevation between the bench mark and the Height Stud on the Target Column adjacent to it. (NOT the Target Column at the opposite station of the Crossing) In use, the Auxiliary Target Scale is held (by hand) vertically against the Target Column with its zero end resting on the top of the knob of the Height Stud (Fig. 9). In this use it serves as a precise level rod, and reading is made with the Ni 2 level with the plane-parallel plate micrometer. The reason for use of this special scale is that it would be very awkward to hold a standard precise level rod on the Height Stud without disturbing the set-up, as the stud will be about 1 1/2 meters above the ground.

16. ASSEMBLY, Instrument Outfit:

The Instrument Outfit consists of two Ni 2 levels, mounted on the Base Plate, with Rotary Wedge Attachment on each, screwed onto a standard tripod. This outfit is used at the "Instrument Station."



AUXILIARY LEVEL SCALE

Figure 9

17. ASSEMBLY, Target Outfit:

The Target Outfit consists of two Targets, attached to the Target Column which is set into the Tribrach. The Tribrach is screwed onto a standard tripod. The Auxiliary Level Scale should be available. This outfit is used at the "Target Station."

PRELIMINARY PREPARATION

18. BENCH MARKS:

As stated in par. 1, the primary purpose of the Valley Crossing Equipment is to make an accurate determination of the difference in elevation across comparatively long spans, as across a river, where the conventional techniques of "levels" cannot be used. In practice, a bench mark, which may be either permanent or temporary (but more secure than an ordinary "turning point") is set on each side of the span, in such situation that the "crossing" operation will determine the difference in elevation between them. Bench marks must be so placed that the relationships to the equipment, as stated in the following paragraph, will be observed.

19. EQUIPMENT, Distribution:

In use, the Instrument Outfit is placed on one side of the span, and the Target Outfit on the other side. Careful reconnaissance should be made in order to accomplish the most practicable compliance with the following:

a. Line of sight crossing span at approximately right angles in order to minimize length of span.

b. Selection of location of crossing at site with minimal span consistent with location of level line and general vicinity of required crossing.

c. Location accessible to main lines of levels being connected or extended, to minimize length of connecting lines.

d. Location at highest practicable clearance over land or water. Avoid near-grazing line of sight.

e. Terrain characteristics similar at both stations, e.g., avoid steep bank on one side and gentle beach on other.

f. Target Outfit when set up must have one target above and other target below "level" (reciprocal collimated) line of sight of both levels at Instrument Station.

g. Bench mark adjacent to Instrument Station must be between five and fifty meters from instruments and at such elevation that both instruments can read a standard precise level rod held on it.

h. Bench mark adjacent to Target Station should be at such position and elevation that the Auxiliary Level Scale held on the Height Stud and a standard precise level rod held on the bench mark can be observed from a single level set-up equidistant from the points and between five and fifty meters distant. This requirement may be overlooked if necessary in order to comply with other requirements listed above.

i. Reciprocal lines adjacent and at nearly same elevation and length, as stated in par. 20.

20. SIMULTANEOUS RECIPROCAL OBSERVATIONS:

The theoretical basis for this system of observations assumes that errors due to the effects of refraction and earth

curvature are compensated by observing the difference of elevation in both directions. If only one set of equipment (two levels, one target outfit) is available, equipment must be interchanged across the span and observations made in the opposite direction. It must then be assumed that refraction conditions did not change in the interim, but this cannot be safely assumed. Better practice is to use two complete sets of equipment and make simultaneous observations in both directions. (cf. par. 30) This involves setting an Instrument Outfit on each end of the span, observing to its own Target Outfit on the opposite side. There is no difference in the actual observing procedure followed. Care must be taken to avoid confusion in recording and computing. The main source of confusion lies in the fact that the difference in elevation between the bench mark and the Target Outfit, adjacent to the Instrument Outfit, though determined by the observer at the Instrument Outfit, are not part of his determination of difference across the span. He will use only the similar difference determined by the observer on the OPPOSITE side. For the assumption of equal refraction to be valid, the two observed lines should be adjacent, should not differ in elevation by more than approximately one meter, and should not differ in length by more than approximately a half-meter.

21. PRELIMINARY OPERATIONS:

Prior to actual observations, the following preliminary operations should be completed:

a. Reconnoiter for station sites (par. 19)

b. Establish a bench mark adjacent to each set-up (par. 18). A single bench mark on each side will suffice for both the Instrument Station and the adjacent reciprocal Target Station on the same side.

c. Set up Instruments and Targets on each side.

d. Set Targets to proper positions on Target Column (each set). This must be done carefully to insure that the pair of targets will properly bracket the "level" line of sight from the opposite instrument pair (par. 13). Enter target positions (T,t) on the Target Column (0, 40, 80, 120 scm) in the appropriate set of field notes. This will usually mean that this must be communicated by radio to the Instrument Station on the opposite side. The position of the lower target is designated "T", and the position of the upper target is the quantity designated "t". The distance between them (t-T) is the quantity "D".

e. Run closed line of levels on each side between the bench mark and the Height Stud (par. 11) of the adjacent Target Outfit. Even if the difference of elevation can be observed with a single set-up, it must be "closed" by changing the set-up and observing the difference a second time. A precise level rod is observed at the bench mark and the Auxiliary Level Scale (par. 15) observed on the Height Stud. Since the two levels have already been set up on the Base Plate (item "c" above, also pars. 7, 8, and 9) at the Instrument Station, it will be helpful to have an extra level tripod available for use in determining this difference by merely removing one Ni 2 level from the Base Plate instead of completely breaking down the Instrument set-up.

The plane-parallel plate micrometer should be used in this operation. This difference in elevation, between the Height Stud of the Target Column and the adjacent bench mark, is the quantity designated "L".

22. SET-UP, Instrument Outfit:

The set-up for the Instrument Outfit must be very secure. Observe the requirements noted in pars. 8 and 9, regarding the situation of the Base Plate and the placement of the two Ni 2 levels.

23. SET-UP, Target Outfit:

The Target Outfit must be set-up after careful reconnaissance (par. 19). The Tribrach is attached to the tripod by use of the central clamping screw. The stub of the Target Column is inserted in the socket of the Tribrach and secured and leveled (pars. 10 and 11). The two Targets are placed on the mounting studs at the spacing (par. 13) appropriate to the elevation and distance of the Instrument Station. The upper Target MUST be ABOVE the "level" (untilted) line of sight of BOTH levels, and the lower Target MUST be BELOW the untilted line of sight of both levels and their positions on the Target Column entered in the field notes (par. 21d).

OBSERVATIONS

24. LEVELING:

Turn both instruments away from the Target Station. This is indicated on the note form as position " ↓ ". Then carefully

center each circular level bubble. First, equalize the leveling screws, and subsequently use only two leveling screws on each instrument for this and subsequent levelings, as stated in par. 9.

25. RECIPROCAL COLLIMATION:

Perform the Reciprocal Collimation operations as follows:

a. Focus Instrument No. 1 to infinity by turning the focusing knob in the direction indicated by the pointers on the edge of the knob until it comes against the infinity "stop". (The setting of this stop can be adjusted by turning the screw marked with a red dot, located on the right side of the body of the instrument about 1 cm below the "Carl Zeiss" trademark). Then adjust focus of Instr. No. 2 so that, when the two instruments are directed into each other, objective to objective, the reticle lines of Instr. No. 1 are sharply seen through the eyepiece of Instr. No. 2. Both instruments will then be set at infinity focus. (In equipment presently used, Instr. No. 2 does not have an infinity focus "stop", and must be focused against Instr. No. 1).

b. Rotate the Wedge Knob on Instr. No. 1 until the optical scale is set precisely to 10.00. This must be done carefully with the Wedge Knob mechanism in fine mode (par. 6). Then, rotate the Wedge on Instr. No. 2 to bring the horizontal reticle line into precise coincidence with the image of the horizontal line of Instr. No. 1. Make the final setting by moving the Wedge Knob in a clockwise direction in fine mode. Record the reading of the optical scale on Instr. No. 2. Then move the coincidence off a small amount and reset the coincidence, but this second

time make the final setting by moving the Wedge Knob in a counterclockwise direction (but still in fine mode). Record this second reading. This pair of readings after setting the circular level bubbles constitutes a Reciprocal Collimation setting. By this operation, the vertical lines of sight of the two instruments are adjusted to a parallel situation by optical collimation. (This does not mean that they are both truly "level", but merely that they are quite precisely parallel.) In effect, by setting the optical scale of Instr. No. 1 to 10.00, the line of sight of that instrument is not deviated significantly from the attitude imposed by the adjustment situation of its compensator and reticle. The line of sight of Instr. No. 2 is then tilted into parallelism with Instr. No. 1. Thus, when the two instruments are both directed toward the Target Station, one line of sight is directed slightly above true level (adjustment of Instr. No. 1 can NEVER be PERFECT) and the other is tilted by precisely the same angle below true level. The mean determination of these two lines of sight is thus a precise measure of where a line of sight free of collimation error would intercept the space between the targets. The mean of the scale readings of Instr. No. 2 is the quantity designated "r".

26. BENCH MARK, Instrument Station Observations:

Observations must be made from the Instrument set-up to a precise level rod held on the adjacent bench mark, in order to determine the height of the Instrument Station (mean of the line of sight heights of the two levels) above the bench mark. This observation is made by use of the Rotary Wedge, by setting

the horizontal line of the reticle on each of two graduation lines on the level rod, one above and one below the "level" line of sight, with each of the two instruments. For efficient accomplishment and effective use of the fine mode of the Wedge Knob (par. 6), the following procedure is recommended:

a. Turn the instruments (from their Reciprocal Collimation positions) and point on the level rod held on the bench mark. Refocus carefully for sharp image.

B. Set optical scale of Instr. No. 1 to 20.0 by turning Wedge Knob clockwise in coarse mode (optical scale moves counter-clockwise). Setting is not critical and fine mode is not required.

c. Reverse and turn the Wedge Knob counterclockwise until the horizontal reticle line has been moved upward on the rod to a position very slightly above the first rod graduation encountered on the "main" scale. The setting motion will probably be in coarse mode.

d. Reverse and turn the Wedge Knob clockwise (it will now be in fine mode) and set precisely on the rod graduation. Record the rod graduation ("G") and the reading of the optical scale.

e. Continue turning the Wedge Knob in clockwise direction until the reticle line is very slightly below the rod graduation. Release fingers from the knob and take hold of it in another place. Then reverse direction of turning (to counterclockwise) and again set on the rod graduation. Record reading of optical scale. The mean of this scale reading and that obtained in "d", above, is the quantity "ℓ_1".

f. Set optical scale to a reading of 0.0 by turning the Wedge Knob counterclockwise in coarse mode. Setting is not critical and fine mode is not required.

g. Reverse and turn the Wedge Knob clockwise until the horizontal reticle line has been moved downward to a position very slightly below the first rod graduation encountered on the "main" scale. The setting motion will probably be in coarse mode.

h. Reverse and turn the Wedge Knob counterclockwise (now in fine mode) and set precisely on the rod graduation. Record the rod graduation ("g") and the reading of the optical scale.

i. Continue turning the knob in counterclockwise direction until the reticle line is very slightly above the rod graduation. Release fingers from the knob and take hold of it in another place. Then reverse direction of turning (to clockwise) and again set on the rod graduation. Record reading of optical scale. The mean of this reading and that obtained in "h", above, is the quantity "u_1".

j. Repeat steps (a) through (i), with Instr. No. 2, on the same rod graduations. The corresponding quantities "ℓ_2" and "u_2" are thus obtained.

If the above procedure is carefully and precisely followed, the range of the fine movement will be sufficiently long to permit both settings on a rod graduation to be made without reverting to the coarse mode. The fine mode is obvious to the observer because the effort required to turn the knob is significantly less. It is <u>important</u> that all <u>final</u> settings be made with the Wedge Knob in <u>fine</u> mode. It is <u>also</u> <u>important</u> that settings with both instruments be made on the <u>same</u> <u>graduations</u>, both in this set of readings and in the closing set (par. 32).

(The data obtained from this operation, combined with the data from settings of par. 25, provide the quantity "R", par. 38.) The relationships of the quantities observed in this operation are shown in Fig. 10.

27. RELEVELING:

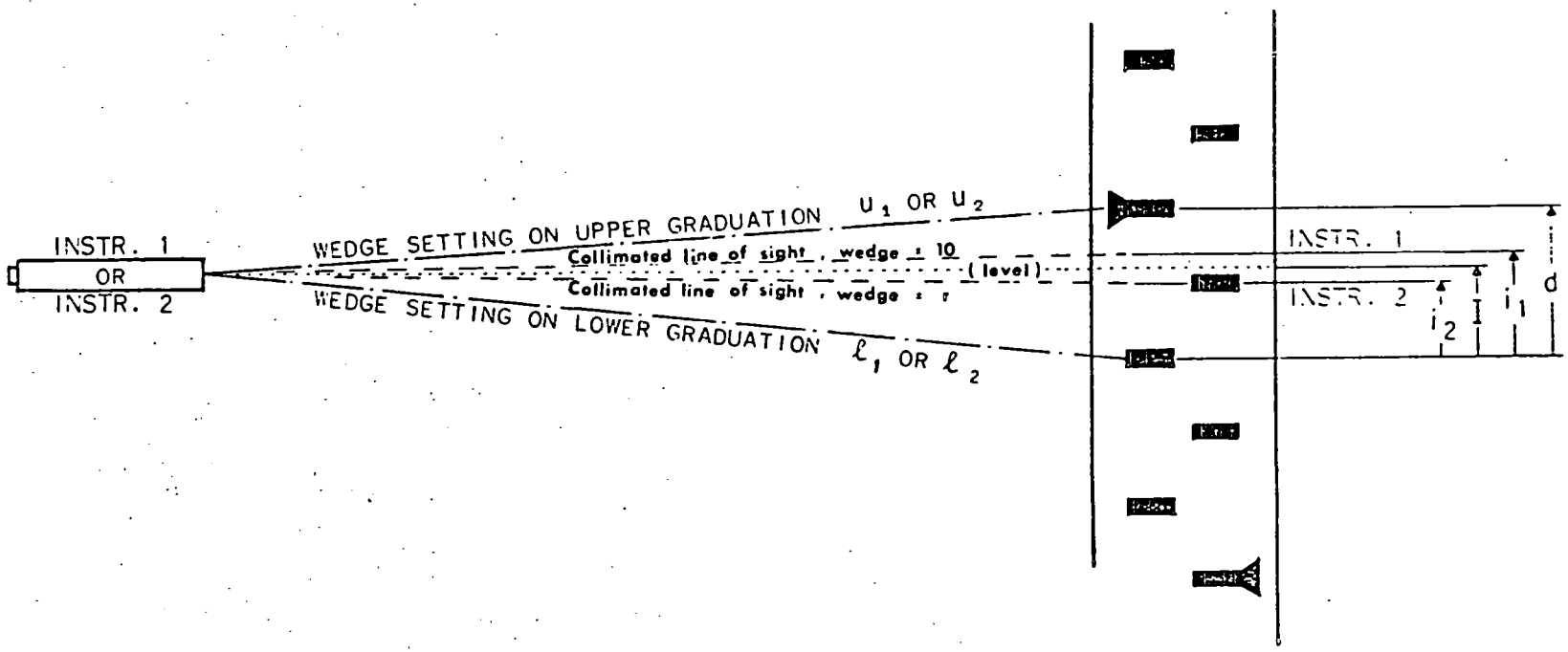
On completion of the rod readings on the bench mark, turn both instruments toward the Target Station. This is the position indicated on the field note form with " ↑ ". Then displace the circular bubbles on both instruments so that the bubbles are decentered in the direction toward the Target Station. Then carefully re-center them. This basic operation is repeated a number of times during the complete series of operations, but the instruments are alternately turned toward and away from the Target Station in successive operations. The bubble is always decentered toward the Target Station.

28. RECIPROCAL COLLIMATION, Repeat:

Repeat operations of par. 25. This procedure does not change, but is repeated a number of times during the complete series of operations.

29. TARGETS, Instrument Station Observations:

After Reciprocal Collimation, proceed to make a set of observations on the two targets on the Target Station (Pars. 10-13, 17, 19f) at the opposite end of the line. (No observations are made on the targets of the adjacent Target Outfit. They are observed only by the party at the Instrument Station at the opposite end of the line, making the reciprocal observations.) For efficiency and to eliminate confusion, the following procedure should be followed:



$$i_1 = (d)\,\frac{\ell_1 - 10}{\ell_1 - u_1} \qquad i_2 = (d)\,\frac{\ell_2 - r}{\ell_2 - u_2} \qquad I = (i_1 + i_2)/2$$

WEDGE SETTINGS ON ROD GRADUATIONS

Figure 10

With Instr. No. 1 pointed on the Target Outfit:

a. Turn Wedge Knob clockwise until the horizontal reticle line is moved very slightly below the lower target. If reticle line is already below lower target, move it to a position substantially above target before starting.

b. Reverse Wedge Knob (now in fine mode) and turn counterclockwise until the reticle line (moving upward) is set precisely on the lower target. Record optical scale reading.

c. Turn Wedge Knob counterclockwise until reticle line is raised slightly above target.

d. Release fingers from Wedge Knob and take hold of it in a different place.

e. Turn Wedge Knob clockwise, remaining in fine mode, and reset reticle line (moving downward) precisely on lower target. Record optical scale reading.

f. Make new setting in counterclockwise direction by repeating steps (a) and (b). Record reading.

g. Make new setting in clockwise direction by repeating steps (c), (d) and (e). Record reading.

h. Repeat steps (f) and (g), in sequence, until a total of ten settings has been made (and recorded) with Instr. No. 1, on the lower target. (The mean of these ten readings is the quantity "b_1".)

i. Turn Wedge Knob counterclockwise (reticle line moves upward) until the reticle line is slightly above the upper target.

j. Reverse Wedge Knob (now in fine mode) and turn clockwise until the reticle line (moving downward) is set precisely on the upper target. Record optical scale reading.

k. Turn Wedge Knob clockwise until reticle line is moved slightly below upper target.

l. Release fingers from Wedge Knob and take hold of it in a different place.

m. Turn Wedge Knob counterclockwise, remaining in fine mode, and reset reticle line (moving upward) precisely on upper target. Record optical scale reading.

n. Make new setting in clockwise direction by repeating steps (i) and (j). Record reading.

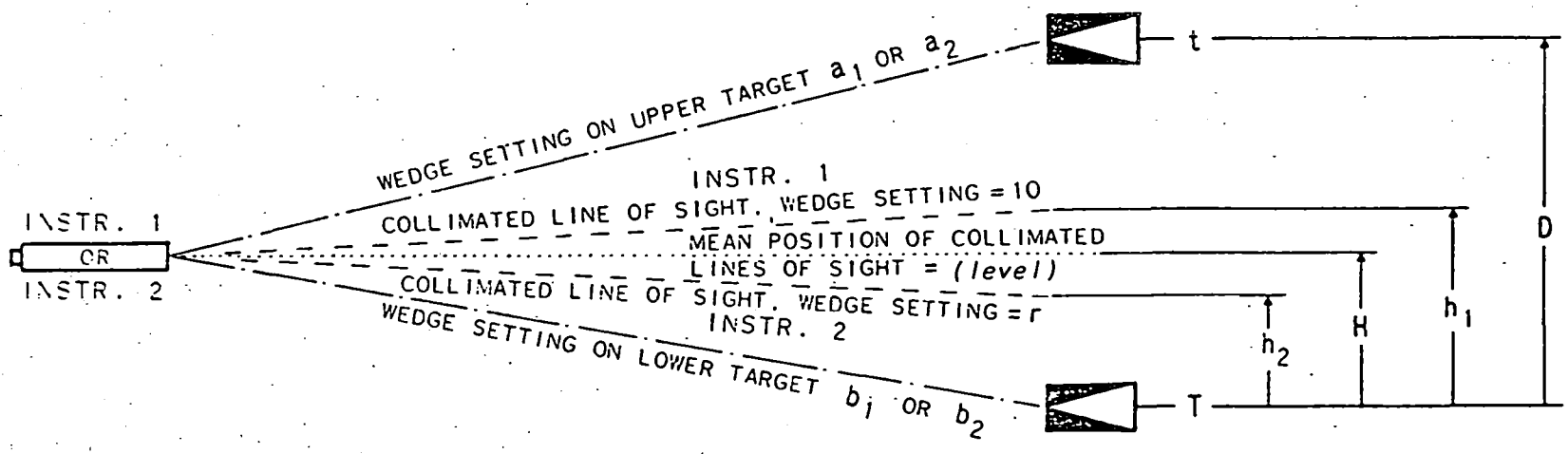
o. Make new setting in counterclockwise direction by repeating steps (k), (l), and (m). Record reading.

p. Repeat steps (n) and (o), in sequence, until a total of ten settings has been made (and recorded) with Instr. No. 1, on the upper target. (The mean of these ten readings is the quantity "a_1".)

q. Repeat sequence of (a) through (h) with Instr. No. 2 until a series of ten settings, in counterclockwise-clockwise sequence has been made on the lower target. (The mean of these ten readings is the quantity "b_2".)

r. Repeat sequence of (i) through (p), with Instr. No. 2 until a series of ten settings, in clockwise-counterclockwise sequence, has been made on the upper target. (The mean of these ten readings is the quantity "a_2".)

The above series of operations (a) through (r), preceded by a Releveling (par. 27) and a Reciprocal Collimation setting (par. 25), constitutes a "Set" of observations. The relationships of the observed quantities are shown in Fig.11. Four such sets of observations shall be made to constitute a "series".



$$h_1 = (D)\frac{b_1 - 10}{b_1 - a_1} \qquad h_2 = (D)\frac{b_2 - r}{b_2 - a_2} \qquad H = (h_1 + h_2)/2$$

WEDGE SETTINGS ON TARGETS

Figure 11

Each set must be preceded by a Releveling (par. 27) and a Reciprocal Collimation setting (par. 25). It is emphasized that, as stated in par. 27, in the Releveling operation, in successive sets, the telescopes of both instruments must be alternately pointed toward (↑) and away (↓) from the Target Station. These positions are indicated, for a reminder, on the field note form. In every case, the circular bubble shall first be displaced (decentered) toward the Target Station.

30. COORDINATION, Reciprocal Observations:

As stated in par. 20, simultaneous reciprocal observations should be made with a second complete set of Valley Crossing Equipment over an adjacent course, referring to the same bench marks if practicable. Each set of observations should be started at the same time with each outfit, with starting time coordinated by radio.

31. RELEVEL and RECIPROCAL COLLIMATION, Final:

After completion of the fourth set of Target Observations (par. 29), the Releveling operation (par. 27) is repeated, with the telescopes pointed toward (↑) the Target Station, followed by a Reciprocal Collimation (par. 25).

32. BENCH MARK, Final Observation:

After the final Releveling and Reciprocal Collimation, the observations of a series are concluded by repeating the readings on a precise level rod held on the adjacent bench mark, as outlined and described in par. 26. The number of series to be observed depends on the length of the crossing and will be stated

in the specific project instructions. The settings must be made on the same rod graduations set on in the initial bench mark observations (par. 26).

33. METEOROLOGICAL OBSERVATIONS:

Since the refractive index of air is a function of air density which, in turn, varies with barometric pressure and temperature, it might be helpful in evaluating results to have values of these quantities. Therefore, at each Reciprocal Collimation, except the first, barometric pressure and air temperature shall be observed and recorded. These quantities are not used in the field computations, but will be considered during evaluation and adjustment in the office.

COMPUTATION

34. RECORDING:

Recording of all observations shall be made on the form entitled "VALLEY CROSSING NOTES". A specially annotated copy has been prepared (Fig. 12) with explanatory notes which, together with these instructions, should suffice.

35. HEIGHT OF INSTRUMENT ABOVE LOWER TARGET:

Each "set" of observations provides a determination of the mean height of the two levels at the Instrument Station above the lower target at the Target Station, which is the quantity designated "H". This meaning process eliminates the effect of any slight difference in elevation between the two levels as mounted on the Base Plate as well as providing a result that is, because

TARGET POSITIONS ON COLUMN: Upper (t) = scm Lower (T) = scm D = scm

		INSTRUMENT No. 1	INSTRUMENT No. 2	V. C. SET COMPUTATIONS			
	↓	RECIPROCAL COLLIMATION	1 2 r				
BM	ROD	LOWER G 1 2 ℓ_1	LOWER G 1 2 ℓ_2	$\ell_1 - 10$	$\ell_1 - u_1$	i_1	I
		UPPER g 1 2 u_1	UPPER g 1 2 u_2	$\ell_2 - r$	$\ell_2 - u_2$	i_2	S
	↑	RECIPROCAL COLLIMATION	1 2 r_{BEFORE}	BAROM	TEMP		
SET 1	TARGET	1 3 5 7 9 / 2 4 6 8 10 / 1 3 5 7 9 / 2 4 6 8 10 — LOWER b_1 10.00 a_1 UPPER	1 3 5 7 9 / 2 4 6 8 10 / 1 3 5 7 9 / 2 4 6 8 10 — LOWER b_2 r_{MEAN} a_2 UPPER	$b_1 - 10$	h_1		
				$b_1 - a_1$		-	S
				$b_2 - r$	h_2		
				$b_2 - a_2$			
	↓	RECIPROCAL COLLIMATION	1 2 r_{AFTER}	BAROM	TEMP		
SET 2	TARGET	10 WEDGE SCALE SETTINGS, LOWER TARGET, INSTR. 1 — 10 WEDGE SCALE SETTINGS, UPPER TARGET, INSTR. 1 — LOWER 10.00 UPPER	10 WEDGE SCALE SETTINGS, LOWER TARGET, INSTR. 2 — 10 WEDGE SCALE SETTINGS, UPPER TARGET, INSTR. 2 — LOWER UPPER				
	↑	RECIPROCAL COLLIMATION		BAROM	TEMP		
SET 3	TARGET	LOWER 10.00 UPPER	LOWER UPPER				
	↓	RECIPROCAL COLLIMATION		BAROM	TEMP		
SET 4	TARGET	LOWER 10.00 UPPER	LOWER UPPER				
	↑	RECIPROCAL COLLIMATION		BAROM	TEMP		
BM	ROD	LOWER	LOWER				
		UPPER	UPPER				

VALLEY CROSSING NOTES

LOCATION ..... FIELD PARTY ..... WEATHER .....

REMARKS *FIELD NOTES FORM - Annotated copy showing entry locations of field data and computed quantities* ..... DATE .....

Figure 12

of the Reciprocal Collimation process (par. 25), compensated for the effects of vertical collimation error in the instruments. This determination is, however, subject to the effects of refraction and earth curvature (par. 20), but these effects are compensated by observing a similar height difference with a second set of equipment, simultaneously, but in the opposite direction (par. 30). In taking the mean of two such simultaneous sets, the curvature and refraction effects, being of opposite algebraic sign, will be compensating.

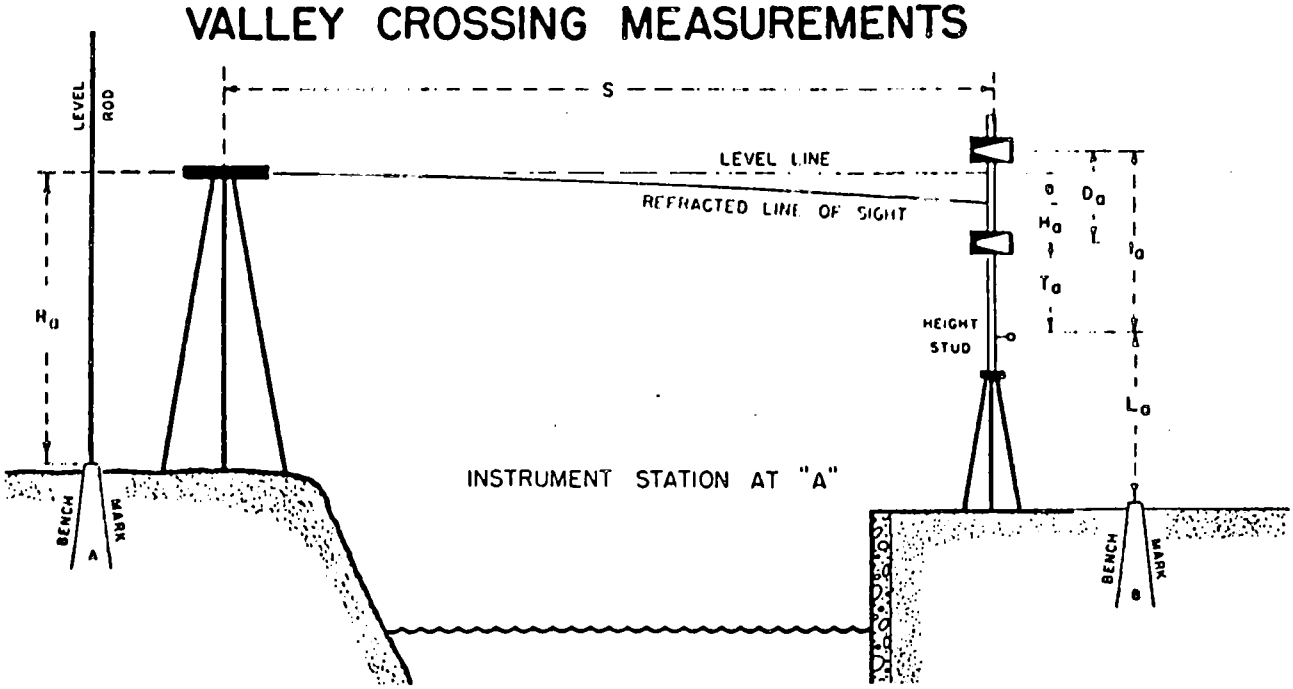
36. GEOMETRICAL RELATIONSHIPS:

Figure 13 shows the geometrical relationships of the various observed and computed quantities involved in a set of simultaneous reciprocal observations (par. 30). The difference of elevation is determined from Bench Mark "A" to Bench Mark "B" in both indicated situations, but in Measurement "a" the Instrument Station is adjacent to Bench Mark "A" while, in Measurement "b", a reciprocal observation is made with the Instrument Station adjacent to Bench Mark "B". The various corresponding quantities in both situations are indicated with common notations, but subscripted "a" or "b" for the appropriate observation. For the sake of clarity, in each situation a single instrument is symbolized, but this is intended to indicate the mean situation of a pair of instruments in a typical Instrument Station set-up (pars. 8, 9, and 16).

37. NOTATION:

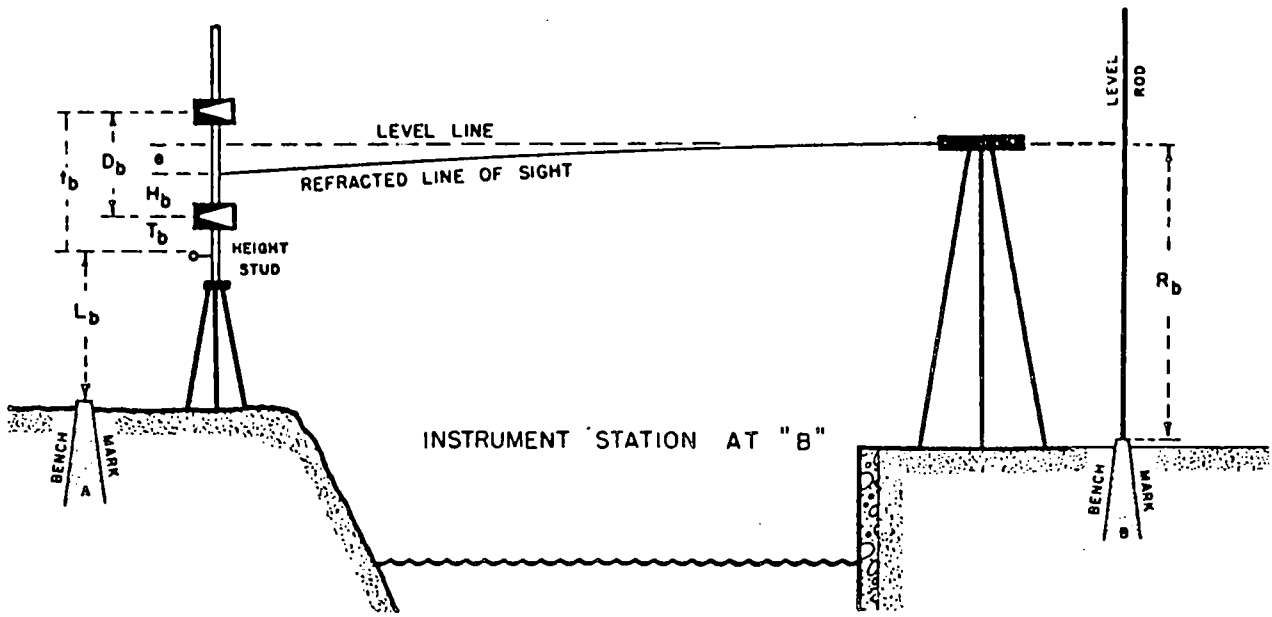
The notation to indicate the various observed and computed quantities is as follows (subscripts "1" and "2" are used in the

VALLEY CROSSING MEASUREMENTS



MEASUREMENT "a" FROM A TO B

DIFFERENCE ELEVATION $= \Delta_a = R_a - e - [H_a + (T_a + L_a)]$



MEASUREMENT "b" FROM A TO B

DIFFERENCE ELEVATION $= \Delta b = [H_b + (T_b + L_b)] + e - R_b$

FIGURE 13

text to denote quantities applicable to Instr. No. 1 or Instr. No. 2):

b = Mean of 10 wedge scale readings of level when set on lower target (par. 29, a-h or q). Units are graduations of the wedge scale (par. 5).

a = Mean of 10 wedge scale readings of level when set on upper target (par. 29, i-p or r). Units as in "b" above.

r = Mean of Reciprocal Collimation readings on Instr. No. 2 (par. 25), mean of two readings (one clockwise and one counter-clockwise) before, and two more readings after a set (par. 29, following item "r") of readings on lower and upper targets ("b" and "a", above, with Instr. No. 1 and Instr. No. 2). Units are graduations of the wedge scale. Take note that the comparable reading of Instr. No. 1 is always set to 10.00. (par. 25, b), so there is no need to subscript "r".

h = Intercept of collimated line of sight of an instrument, above Lower Target; a computed quantity. Subscripted 1 or 2. Semi-centimeter units.

ℓ = Mean of two wedge scale readings of level when set on lower graduation ("G") of level rod held on bench mark adjacent to Instrument Station (par. 26, i and j). Units are graduations of the wedge scale.

u = Mean of two wedge scale readings of level when set on upper graduation ("g") of level rod held on bench mark adjacent to Instrument Station (par. 26, i and j). Units are graduations of the wedge scale.

i = Intercept of collimated line of sight of an instrument, above the lower rod graduation ("G") on which wedge settings "ℓ" were made (semi-centimeters).

Following quantities are not subscripted to identify an individual instrument, but may be subscripted "a" or "b" to identify the corresponding separate quantities obtained from a pair of simultaneous reciprocal observations (par. 30, 36, and Fig. 13):

T = Position of lower target above Height Stud on Target Column (pars. 11 and 21d). Units are semi-centimeters; 0, 40, or 80.

t = Position of upper target above Height Stud on Target Column (pars. 11 and 21d). Units are semi-centimeters; 40, 80, or 120.

D = Interval between centers of upper and lower target.
= t-T (semi-centimeters)

H = Intercept of mean of collimated lines of sight of Instr. Nos. 1 and 2, above the Lower Target. It is the mean of h_1 and h_2 for any given set (par. 35).

I = Intercept of mean of collimated lines of sight of Instr. Nos. 1 and 2, above the lower sighted graduation. It is the mean of i_1 and i_2 for any set of pointings on the level rod held on the bench mark adjacent to the Instrument Station (par. 26).

R = Intercept of mean collimated lines of sight of Instr. Nos. 1 and 2, on a level rod held on the bench mark adjacent to the Instrument Station (par. 26).

L = Difference of elevation between bench mark adjacent to Target Station and the Height Stud on the Target Column, determined by standard precise level techniques (par. 21e).

G = Value of lower graduation (semi-centimeters) of level rod (held on bench mark adjacent to Instrument Station) on which wedge settings ("ℓ", par. 26, e and j) are made.

g = Value of upper graduation (semi-centimeters) of level rod (held on bench mark adjacent to Instrument Station) on which wedge settings ("u", par. 26, i and j) are made.

d = Interval between graduations of level rod on which wedge settings are made.

= g-G (semi-centimeters).

38. COMPUTATION OF ROD INTERCEPT ("R")

As shown in Fig. 13, the Rod Intercept is the mean height of the two levels (Nos. 1 and 2) above the bench mark adjacent to the Instrument Station. It is obtained from the observations described in par. 26.

First compute i_1 and i_2 for the beginning observations:

$$i_1 = (d)\ \frac{\ell_1 - 10}{\ell_1 - u_1}$$

$$i_2 = (d)\ \frac{\ell_2 - r}{\ell_2 - u_2}$$

(r is the mean reciprocal collimation setting made with Instr. No. 2 <u>before</u> pointing on the level rod)

Then compute the mean:

$$I = \frac{i_1 + i_2}{2}$$

Then:

$$R = G + I \qquad \text{(starting value)}$$

Then:

Repeat above computation using data obtained from the final observations on the level rod held on the adjacent bench mark. This should agree with the first value of "R" within about 0.3 semi-centimeter.

The mean of the two values of "R" (starting and final) should be used for the series of observations.

39. COMPUTATION OF TARGET INTERCEPT ("H")

As shown in Fig. 13, the Target Intercept is the mean height of the intercepts of the collimated lines of sight of the two levels (Nos. 1 and 2) above the Lower Target. It is obtained from the observations described in par. 29.

First compute h_1 and h_2 for the first set of observations:

$$h_1 = (D)\,\frac{b_1 - 10}{b_1 - a_1}$$

$$h_2 = (D)\,\frac{b_2 - r}{b_2 - a_2}$$

(r is the mean of four reciprocal collimation settings made with Instr. No. 2, two <u>before</u> the set of readings on the targets and two <u>after</u> the set of target readings)

Then compute the mean:

$$H = \frac{h_1 + h_2}{2}$$

40. COMPUTATION OF HEIGHT OF TARGET INTERCEPT ABOVE ADJACENT BENCH MARK ("Z")

As is obvious from Fig. 13, the height of the Target Intercept above the adjacent bench mark is equal to the difference in elevation between the bench mark and the Height Stud ("L", par. 21e) plus the height of the Lower Target above the Height Stud ("T", par. 21d) plus the Target Intercept ("H", par. 39) thus:

$$Z = H + T + L \qquad \text{(semi-centimeters)}$$

This difference is subject to the error caused by refraction and earth curvature ("e").

41. DIFFERENCE IN ELEVATION:

Still referring to Fig. 13, it can be seen that the difference in elevation between two bench marks, as from "A" to "B", computed from the data obtained with the Instrument Station adjacent to "A" is:

$$\Delta_a = R_a - e - (H_a + T_a + L_a)$$

Considering a set of reciprocal observations made simultaneously with the Instrument Station adjacent to "B"; the difference in elevation from "A" to "B" (in the same sense of direction as above) is:

$$\Delta_b = (H_b + T_b + L_b) + e - R_b$$

"e" is assumed to be the same for each one of the simultaneous reciprocal observations. Hence, taking the mean:

$$\Delta_{mean} = \frac{\Delta_a + \Delta_b}{2} = 1/2\ (R_a - e - Z_a + Z_b + e - R_b)$$

Since the "e" is the same, the effect is cancelled, and

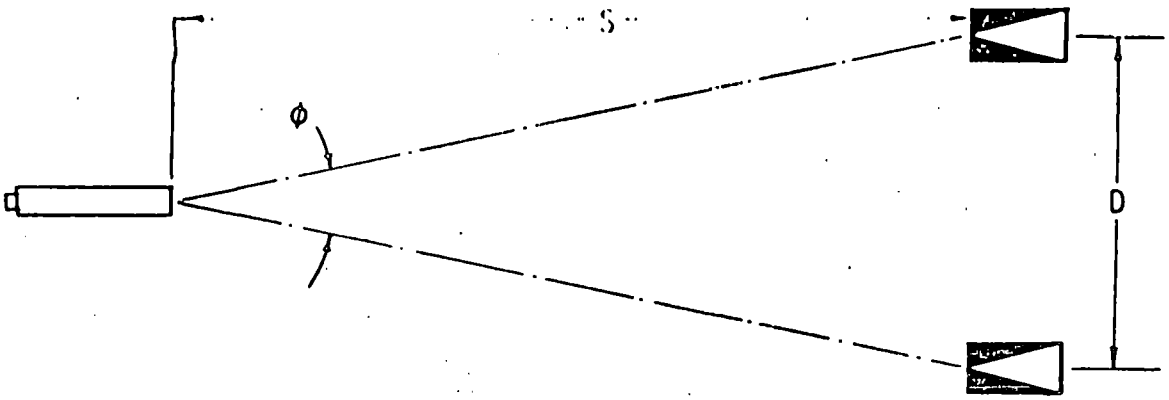
$$\Delta_{a,b} = 1/2\ \ (Ra - Za) + (Z_b - R_b)$$

A difference in elevation (observe the "from-to" sense carefully) can be computed thus from each pair of simultaneous reciprocal observations (semi-centimeter units)

No attempt should be made to evaluate the accuracy of the results obtained by comparing (R_a - Za) with (Zb - Rb). These quantities are affected by the unknown value of "e", and are not supposed to be equal. The only way to evaluate the results is to compare the values of the mean differences obtained from several sets.

42. COMPUTATION OF DISTANCE ("S"):

The assumption that the values of "e" from the two observations in a simultaneous set are equal is based on the assumption that the distance from Instrument to Target is the same with both sets of equipment. The set-ups should be made so as to effect this condition but a check may be made by using the Target set as a vertical subtense bar, using the wedge-scale readings as an accurate reading of the vertical angle subtended by the target pair, whose vertical spacing is accurately known. Considering the approximate sketch on the following page.



To a sufficient approximation:

$$S = D/\phi \quad (\phi \text{ is small angle})$$

when D and S are in the same units and ϕ is in radians.

On the Zeiss V. C. apparatus, the angle (b - a) is in wedge-scale units, 1 unit - 20 seconds = $1 \cdot 10^{-4}$ radian (to a sufficient approximation)

D is in semi-centimeters, or:

$$D \text{ (meters)} = D \text{ (semi-centimeters)} /200$$
$$= \frac{D}{2} \text{ (semi-centimeters)} .10^{-2}$$

Hence:

$$S \text{ (meters)} = \frac{1/2D \cdot 10^{-2}}{\phi \cdot 10^{-4}}$$

$$= \frac{50D}{\phi}$$

The "D" is as defined in par. 37 (the target spacing).

"ϕ" is the appropriate value, mean of $(b_1 - a_1)$ and $(b_2 - a_2)$

43. ACCURACY ATTAINABLE:

The accuracy obtainable with the V. C. apparatus seems to be routinely compatible with that attainable by the conventional balanced-sight techniques used with the plane-parallel plate micrometer and precise level rods, that is:

$$1.5 \text{ mm} \quad \sqrt{K}$$

(K is length of water crossing in kilometers)

This accuracy, however, can be attained only by strict observance of all the detailed routines outlined herein. Furthermore, all settings on targets, reciprocal collimations, etc. must be made with the utmost care, similar to that required for pointings and micrometer readings made with a first-order theodolite. Any less care will vitiate the process and negate the fine design of this equipment.

SUMMARY

44. SUMMARY OF OBSERVATIONAL PROCEDURES:

On the following page is a summary "check-list" of the process of making a series of water crossing observations.

CHECK LIST OF WATER CROSSING PROCEDURES

PRELIMINARY

1. Reconnoiter for sites.
2. Establish bench mark adjacent to each instrument set-up.
3. Set up instruments.
4. Adjust target settings on column.
5. Run closed set of level on each side, between bench mark and height stud on target.

OBSERVATIONS (each side)

1. Set levels on base plate. Set leveling screws to mid-range positions.
2. Point both instruments away (↓) from opposite station. Level. Set infinity focus. Set reciprocal collimation (2 settings at Instr. No. 2)
3. Point on two graduations, with each instrument, on level rod held on bench mark (2 settings, each instrument on each graduation)
4. Point both instruments toward (↑) opposite station, Delevel and relevel. Set infinity focus. Set reciprocal collimation.
5. Make "set" of observations on targets on opposite shore:

   a. 10 pointings, Instrument No. 1, upper target
   b. 10 pointings, Instrument No. 1, lower target
   c. 10 pointings, Instrument No. 2, upper target
   d. 10 pointings, Instrument No. 2, lower target

6. Point both instruments away (↓) from opposite station. Delevel and relevel. Set infinity focus. Set reciprocal collimation.
7. Make second set of target pointings as in (5).
8. Point both instruments toward (↑) opposite station. Delevel and relevel. Set infinity focus. Set reciprocal collimation.
9. Make third set of target pointings as in (5).

10. Point both instruments away (↓) from opposite station. Delevel and relevel. Set reciprocal collimation.

11. Make fourth set of target pointings as in (5).

12. Point both instruments toward (↑) opposite station. Delevel and relevel. Set reciprocal collimation.

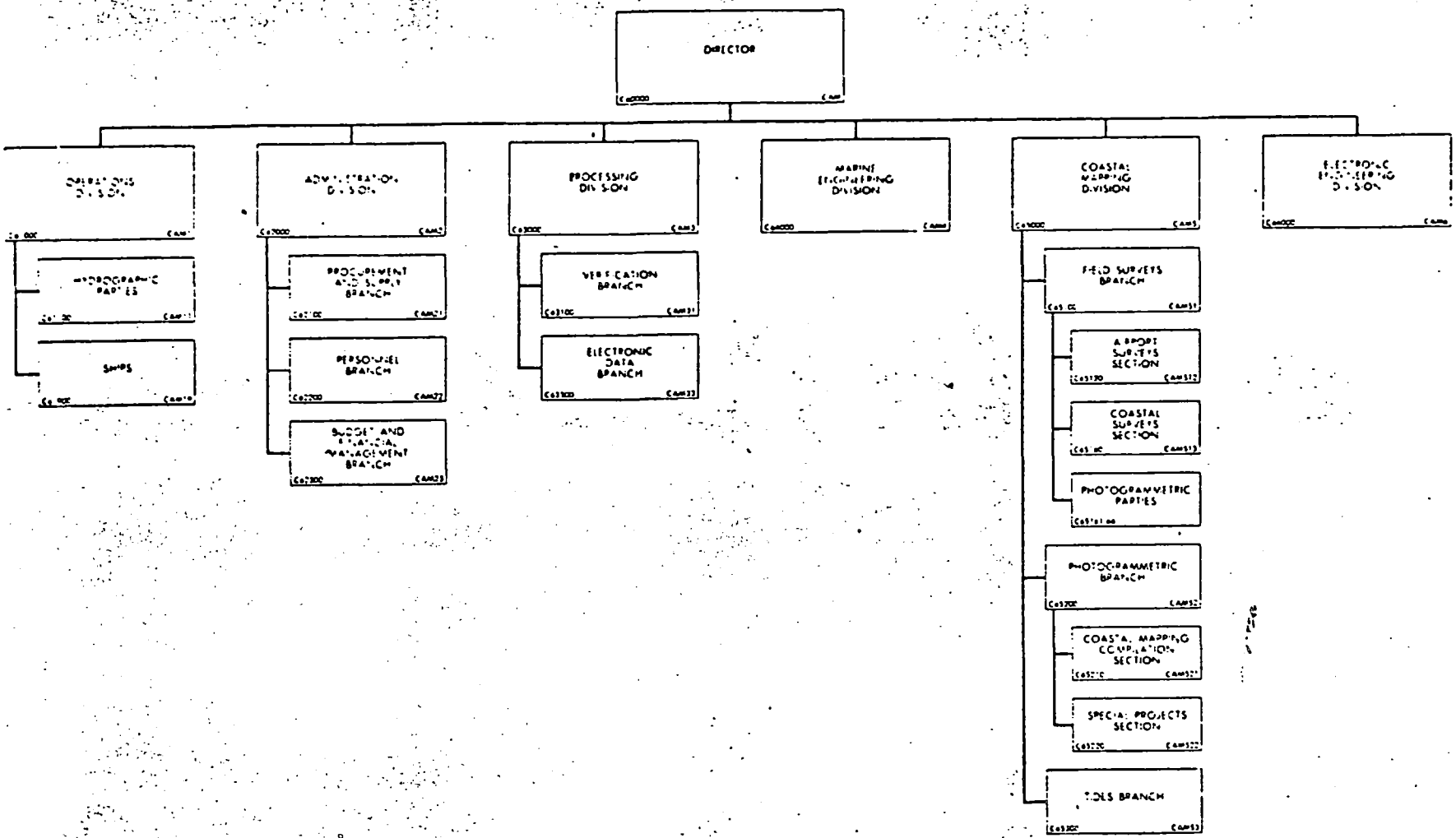
13. Make another set of pointings on level rod held on adjacent bench mark as in (3).

APPENDIX B

- NOAA ORGANIZATION HAND BOOK -

U.S. DEPARTMENT OF COMMERCE
NOAA
NATIONAL OCEANIC SURVEY

ATLANTIC MARINE CENTER



DECEMBER 10, 1975
MANAGEMENT ANALYSIS DIVISION, OMCS

CAM1

Organ. Code	Issue Date
C60000	6-3-76

NOAA Organization Handbook

C60000 ATLANTIC MARINE CENTER — CAM

Directs the operation of oceangoing survey ships. Maintains ships bases at Norfolk and Miami with support facilities at Woods Hole, Massachusetts, Sandy Hook, New Jersey, and Pascagoula, Mississippi, to meet operating needs. Operates shore facilities for processing all types of oceanographic data and compiling photogrammetric survey data. Conducts and/or supports other shore-based field operations as assigned. Conducts activities, including research activities, that support the integrated environmental research of NOAA and its major components. Manages and provides technical guidance for photogrammetric field units in accordance with general policies and programs for headquarters. Coordinates with Federal, state, local government agencies, private organizations and individuals for the purpose of collecting and disseminating data, promoting cooperative efforts in areas of mutual interest, and otherwise representing the NOS and NOAA.

C61000 OPERATIONS DIVISION — CAM1

Provides operational supervision and technical guidance for all hydrographic and oceanographic operations in the Atlantic area. Develops and recommends regional surveys. Assists in planning and coordination of national scope. Directs field programs, coordinates fleet operations and conducts on-site field inspections of hydrographic and oceanographic field operations. Analyzes needs and requests for new surveys. Coordinates and evaluates chart correction information and emergency navigational dangers. Provides mail service and emergency planning for all fleet and Atlantic Marine Center requirements, and coordinates the program with NOAA and Civil Defense activities.

C61100 HYDROGRAPHIC PARTIES — CAM11

Conducts investigative hydrographic surveys with specially equipped mobile units for inshore operations.

C61900 SHIPS — CAM19

Performs hydrographic surveys, oceanographic surveys, current surveys, fisheries research, and other field operations as directed. Processes field work aboard to the extent time, facilities, and personnel permit.

C62000 ADMINISTRATION DIVISION CAM2

Manages programs of administrative services which include budget, contracts, procurement and supply, property accountability, personnel management, safety employee welfare, space requirements, warehouse operation, forms supply, including central repository for all common use NOAA forms; travel and transportation of personnel, equipment, and supplies; reports and other miscellaneous support services. Consults with and advises the Director, Atlantic Marine Center, and his staff on matters concerning management, organization, policy regulations and procedures as prescribed by NOAA.

C62100 PROCUREMENT AND SUPPLY BRANCH CAM21

Procures or contracts for supplies, equipment and services; conducts the property management program involving the maintenance of property accountability records, reconciliation of inventory reports, analysis of property utilization practices, review of supply and equipment requirements and disposal of excess property; receives, stores, and issues equipment and supplies; maintains and operates a motor vehicle pool; provides communications and logistics services.

C62200 PERSONNEL BRANCH CAM22

Performs the personnel administration function within the delegated authority from higher echelons. Plans and executes programs in recruitment, placement, and employee service, examining health actions, reports, and records. Conducts on-the-job training programs for wage marine personnel, and coordinates training programs for general schedule employees. Interprets and applies statutes, policies, regulations and procedures applicable to these programs. Provides advice and guidance to operating officials and recommends solutions to personnel management problems.

C62300 BUDGET AND FINANCIAL MANAGEMENT BRANCH CAM23

Develops, prepares and coordinates the necessary budgets, cost operating plans, evaluation and execution of all budgetary-accounting data relative to ship operations, maintenance and repair, ship construction, coordinated procurement data, coordinated personnel cost data, purchase of equipment relative to salary and expense funding for ships in support of NOS programs, funding in support of NMFS programs, suspense funds, reimbursable funds and special funds.

C63000 PROCESSING DIVISION CAM3

Inspects and reviews raw material for completeness and adequacy. Plans and supervises the office processing of hydrographic, oceanographic and photogrammetric field surveys. Processes and analyzes current field work. Inspects and reviews finished field work and forwards to NOAA headquarters. Collaborates with the Operations Division in appropriate phases of original and follow up field work. Assists Operations Division in evaluation of current field work being performed.

C63100 VERIFICATION BRANCH CAM31

Verifies hydrographic smooth sheets produced by the Electronic Data Branch to insure accuracy of field data and electronic processing and plotting. Completes hydrographic smooth sheets including inking of projections, signals, shoreline, offshore details, depth curves; geographic names, and a verifier's report on all requirements of a hydrographic survey. Submits completed work to NOAA Headquarters. Trains vessel personnel in hydrographic processing. Completes verification backlog of manually processed hydrographic surveys and maintains this capability.

C63300 ELECTRONIC DATA BRANCH CAM33

Processes the hydrographic and oceanographic survey records received from ships and field parties, that are suitable for automated processing methods. Makes necessary entries for correction and adjustment to original data. Plots hydrographic smooth sheets by automated methods. Submits completed material to the Verification Branch. Trains vessel employees in automated processing techniques and raw data requirements for more effective processing. Assists other organizational elements in utilizing the Branch for their needs.

C64000 MARINE ENGINEERING DIVISION CAM4

Plans, organizes and directs all vessel repairs and vessel modifications, including the installation of oceanographic engineering equipment and electronic equipment. Prepares specifications for particular equipment to meet the unique qualifications of vessels in accomplishing their missions. Provides technical guidance for the operation and maintenance of the oceanographic sensing, and computer and recording systems. Directs training programs for operating personnel to be able to operate and maintain these systems. Furnishes expert advice and assistance to the Director, Atlantic Marine Center, and advises the Operations Division as to the characteristics of vessels, cruising radius, or various parameters of the vessels as they affect the accomplishment of the vessels missions, vessel capabilities, status, and the specialized equipment aboard the ships.

C65000 COASTAL MAPPING DIVISION CAM5

Provides operational supervision and technical guidance for coastal mapping field and compilation activities, and the Tides Program on the East and Gulf Coasts. Coordinates and supervises the national Airport Survey Program and the field survey portions of the Coastal Inundation Mapping Program (HUD), the Storm Evacuation Mapping Program (NWS), and the Seaward Boundary Mapping Program for the State of Florida. Conducts onsite field inspection of photogrammetric and support operations. Evaluates and programs equipment needs between field and support activities.

C65100 FIELD SURVEYS BRANCH CAM51

Plans and accomplishes all photogrammetric field survey operations for the compilation of coastal maps and charts, airport obstruction charts, and other products of the Coastal Mapping Division. Directs and provides personnel and logistical support for combined field activities between the Field Surveys Branch and other elements of the National Ocean Survey.

C65120 AIRPORT SURVEYS SECTION CAM512

Performs all field surveying operations required for the production of airport obstruction charts in accordance with Federal Aviation Administration specifications. Locates all aeronautical aids to navigation. Reviews and verifies all field data prior to aerotriangulation and compilation of the finished chart and the reporting of related information.

C65160 COASTAL SURVEYS SECTION CAM513

Performs all field survey operations that are required to compile coastal maps, charts, and special projects in the coastal zone. Reviews and verifies all field data prior to aerotriangulation and compilation. Field edits completed maps for accuracy and completeness.

C65161-66 PHOTOGRAMMETRIC PARTIES

Performs field photogrammetric operations. Conducts onsite field inspection of photogrammetric and support operations.

C65200 PHOTOGRAMMETRIC BRANCH CAM52

Supervises the inspection, compilation, and review of incoming photogrammetric data for completeness and adequacy. Compiles and revises topographic and planimetric maps, tidal current, and airport obstruction charts by photogrammetric methods from data furnished by field surveys, aerial photography, and results of aerotriangulation.

C65210 COASTAL MAPPING COMPILATION SECTION CAM521

Compiles topographic and planimetric maps and tidal current charts by photogrammetric methods from data furnished by field surveys and results of aerotriangulation. Prepares copies of manuscripts for field parties for the support of hydrography. Revises map manuscripts from aerial photographs for up-to-date maintenance of nautical charts.

C65220 SPECIAL PROJECTS SECTION CAM522

Compiles airport obstruction charts by photogrammetric methods from data furnished by field surveys and results of aerotriangulation. Revises airport obstruction charts from current field surveys and up-to-date photographs. Compiles maps and charts for unique and special purpose projects assigned to the Atlantic Marine Center, such as underwater mapping, etc.

C65300 TIDES BRANCH CAM53

Supervises and provides logistic support to Tidal Field Parties responsible for the installation and maintenance of tide stations on the East and Gulf Coasts and other areas as assigned. Trains and supervises local tide observers in technical phases of the work; monitors equipment repairs and provides cost estimates for reimbursable tide gage installations. Analyzes incoming tidal data for malfunctions in the gages.

C66000 ELECTRONIC ENGINEERING DIVISION CAM6

Provides total technical support for NOAA vessels and other officially assigned field data acquisition, transmission, processing, recording, and general electronic equipment used for land, sea, and air investigations. Total technical support includes, but is not limited to: establishment and operation of a maintenance policy, a maintenance reporting system, an equipment failure reporting system, and field check out, inspection, calibration, small scale development, repair/maintenance of electronic equipment and components. Provides adequate training and guidance for personnel, plans and compiles budget requests, provides management information, and provides for the interchange of technical information.

APPENDIX C

- RAYDIST -

RAYDIST

INTRODUCTION

Raydist is a radio-positioning system in which the phases of two continuous-wave radio signals determine the position of a moving vehicle. The frequencies chosen are not limited to line-of-sight operation and generally fall in the band from 1.6 MHz to 5 MHz. Many geometric configurations are possible and include position measurements by hyperbolic mode, elliptical mode, range-range or the unique Halop mode.

The frequencies selected for Raydist operations are based on the best compromise of a number of factors. The frequencies are sufficiently high to permit the use of small antennas and small efficient transmitters and low enough to retain the important non-line-of-sight characteristic to permit operations beyond the horizon. This choice of frequency permits the use of small base stations which may be transported and installed with a minimum of personnel and equipment.

As a radio-positioning system Raydist has been in worldwide use for over 20 years. During this time it has appeared in many forms and constant development over this period has resulted in the two systems in widest use today. The "DR-S" system and the "T" system. The DR-S type, being primarily a range-range system with a limited number of users, is a precision system used for hydrographic surveying and geological exploration. The "T" type was designed primarily as a navigational instrument but can also be used for large scale hydrographic surveys or any other type of research where a high degree of positional accuracy is required.

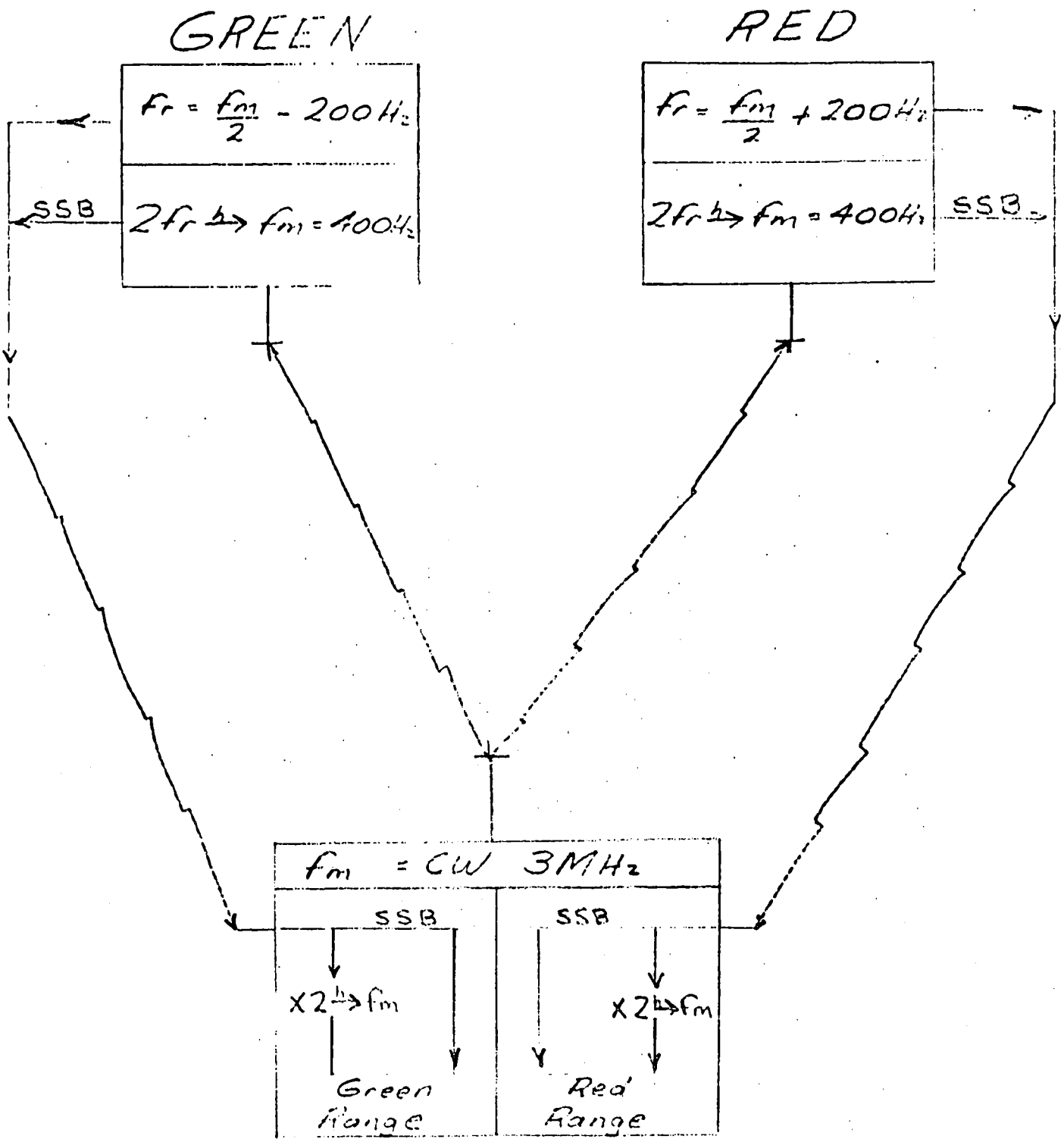
OPERATING PRINCIPLE

All forms of Raydist employ the same basic principle of phase comparison. Two continuous-wave transmitters are placed at separate points. Receivers are placed at various stations and detect the audio heterodyne generated between the two continuous-wave transmitters. The heterodyne received at each receiver is retransmitted to a convenient point where phase measurements are made between the heterodynes to give the position of the mobile station.

The Raydist "DR-S" and the "T" are closely related in theory of operation so only the "DR-S" type will be analysed in detail here.

The "DR-S" system measures true range from using vessels to each of two base stations, designated "RED" and "GREEN", utilizing a CW transmitter aboard each vessel. This "active" form of Raydist limits the number of permissible simultaneous users since each user is transmitting. In the range-range mode a CW signal at approximately 3 MHz is transmitted from the vessel. A reference signal is also generated at the shore station at a frequency equal to one-half the mobile transmitter frequency plus or minus an audio difference of approximately 200 Hz. The shore station reference frequency is doubled and heterodyned with the received signal from the mobile transmitter to obtain an audio beat note of approximately 400Hz.

To obtain "RED" range, the audio tone generated at the "RED" base station is returned to the mobile installation, together with the base station reference signal. This is done with minimum use of frequency spectrum by incorporating the audio tone as single sideband modulation on the basesstation reference carrier. The audio tone information is extracted from the received signal on the vessel and the base station reference is again doubled and heterodyned with the mobile CW signal within



DR-5 RANGE-RANGE

figure 1.

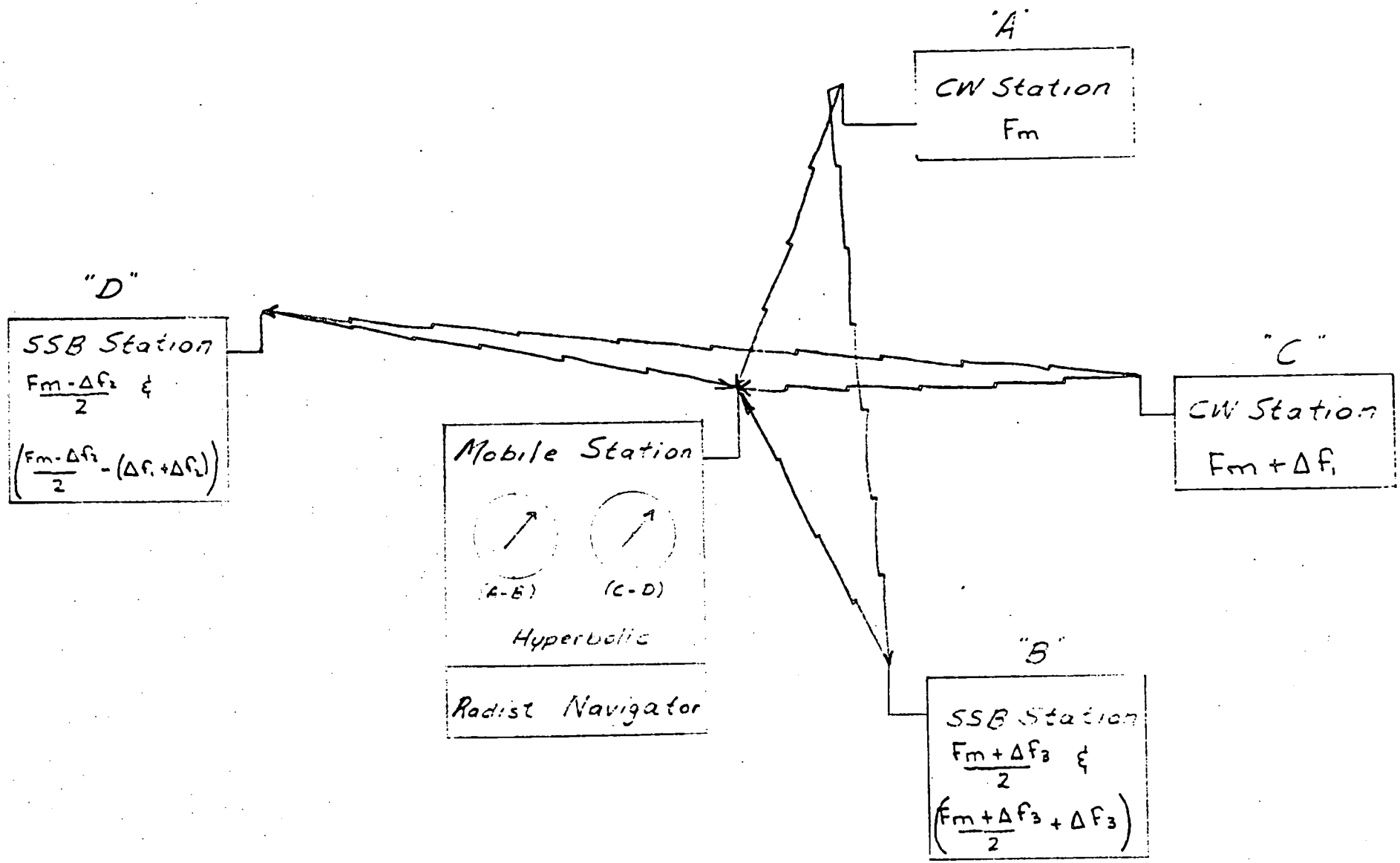

"A"
CW Station
Fm
"D"
SSB Station
Fm - Δf₂ / 2 ξ
(Fm - Δf₂ / 2 - (Δf₁ + Δf₂))
"C"
CW Station
Fm + Δf₁
Mobile Station
(A-B)
(C-D)
Hyperbolic
Radist Navigator
"B"
SSB Station
Fm + Δf₃ / 2 ξ
(Fm + Δf₃ / 2 + Δf₃)

figure 2

the navigator. This locally generated audio tone has precisely the same frequency as the one derived at the base station, and the two tones exhibit a phase relationship proportional to distance between the vessel and the base station. The two audio tones are then applied to a precision electromechanical phasemeter to obtain "RED" range. The process is repeated with the "GREEN" shore station to obtain the "GREEN" range co-ordinate.

In the Raydist "T" configuration, the CW Mobile transmitter is placed ashore, establishing a baseline with respect to the "RED" shore transmitter. For optimum coordinate geometry, a second CW transmitter is positioned to form a baseline with the "GREEN" base station so that the four stations form an approximate rectangle. The resulting independent hyperbolic baselines provide an easy to interpret hyperbolic geometry as shown in figure 3. The alternate Halop pattern, shown in figure 4, exhibits even more favourable coordinate geometry.

DESCRIPTION OF EQUIPMENT

RAYDIST DR-S

The DR Raydist system is composed of two independent distance measuring systems. It has the advantage that the measurement of the second distance is completely independent of the first and a further advantage that no transmission is required from one shore station to the other. This characteristic is of value when there is a long absorbent path, such as a long land path, between stations making transmission difficult. This system established the practicality of operating two SSB base stations with a carrier frequency separation of only a few hundred Hertz. Up to four simultaneous users (CW transmitters) can be served, each producing corresponding sidebands at the base stations.

The new Raydist DR-S system is a small lightweight battery powered Raydist system which can be transported and installed in a short period of time at any suitable location. It is classified as an all-weather system and comes as either the Long Range DR-S or the Medium Range DR-S. The Long Range system operates at ranges in excess of 250 miles during daylight and 150 miles at night. The Medium Range DR-S utilizing the same electronic components as the Long Range system operates with a shorter antenna and lower transmitter output power to provide ranges up to 75 miles or more. Both systems are powered by two ordinary automobile batteries or other convenient 24 volt DC source.

The Raydist DR-S system offers sensitivities of 1/3 metre and a claimed accuracy of a few metres and provides position data continuously and automatically in terms of range to each of two base stations. Incremental digital output to feed a variety of peripheral equipment such as the Raydist Track Plotter, electronic computers, automatic data print-out equipment, remote indicators, etc. is provided plus pure binary or binary coded decimal outputs, the latter two at extra cost.

The base stations are small and lightweight, the transmitter itself weighing only 29 lbs. The size of the antenna varies with the range used and with the medium range system this is comprised of a telescopic aluminum whip supplied with the necessary guys and ground plane wires. The long range system requires a 100 foot aluminum tower and a whip weighing 120 lbs.

The mobile equipment is equally light, consisting of a small strip chart recorder, a CW transmitter, and the Navigator. The transmitter weighs 23 pounds and the Navigator 35 pounds. Total power required is 7 amperes at 24 Volts D.C.

RAYDIST "T"

The Raydist "T" radionavigation system is an outgrowth of Raydist DR-S and earlier Raydist systems. It is a multi-user system which uses phase comparison of continuous audio tones and therefore only requires a receiver at the mobile site.

The system is a four station arrangement providing two independent baselines, resulting in a hyperbolic pattern (figure 3) or the unique Halop geometry (figure 4) which is generated without the need for a separate digital computer. This Halop geometry provides almost rectangular intersections throughout the coverage area and nearly straight lines of position even for short baseline lengths.

Three independent lines of position are available from the four station arrangement, providing a convenient means for automatic or manual lane identification. This feature can be used for lane determination by a ship approaching from outside the coverage area.

The claimed range for the "T" system is 150 miles on an around the clock basis while during the daytime the useful range is extended to 300 miles.

Each shore station uses a 95 foot antenna consisting of a 35 foot aluminum whip atop a tower comprised of six ten-foot sections. The ground plane is formed by 16 radial wires extending 100 feet from the base of the antenna. The CW transmitters require approximately 130 watts at 24 Volts DC and the sideband stations use 40 watts also at 24 Volts DC.

Two mobile receivers are available for Raydist "T", the ZA-75 and the ZA-81. The former can be used for both the DR-S type Raydist as well as for "T". The latter is a low cost unit developed solely for the "T" system. It weighs only 12 pounds

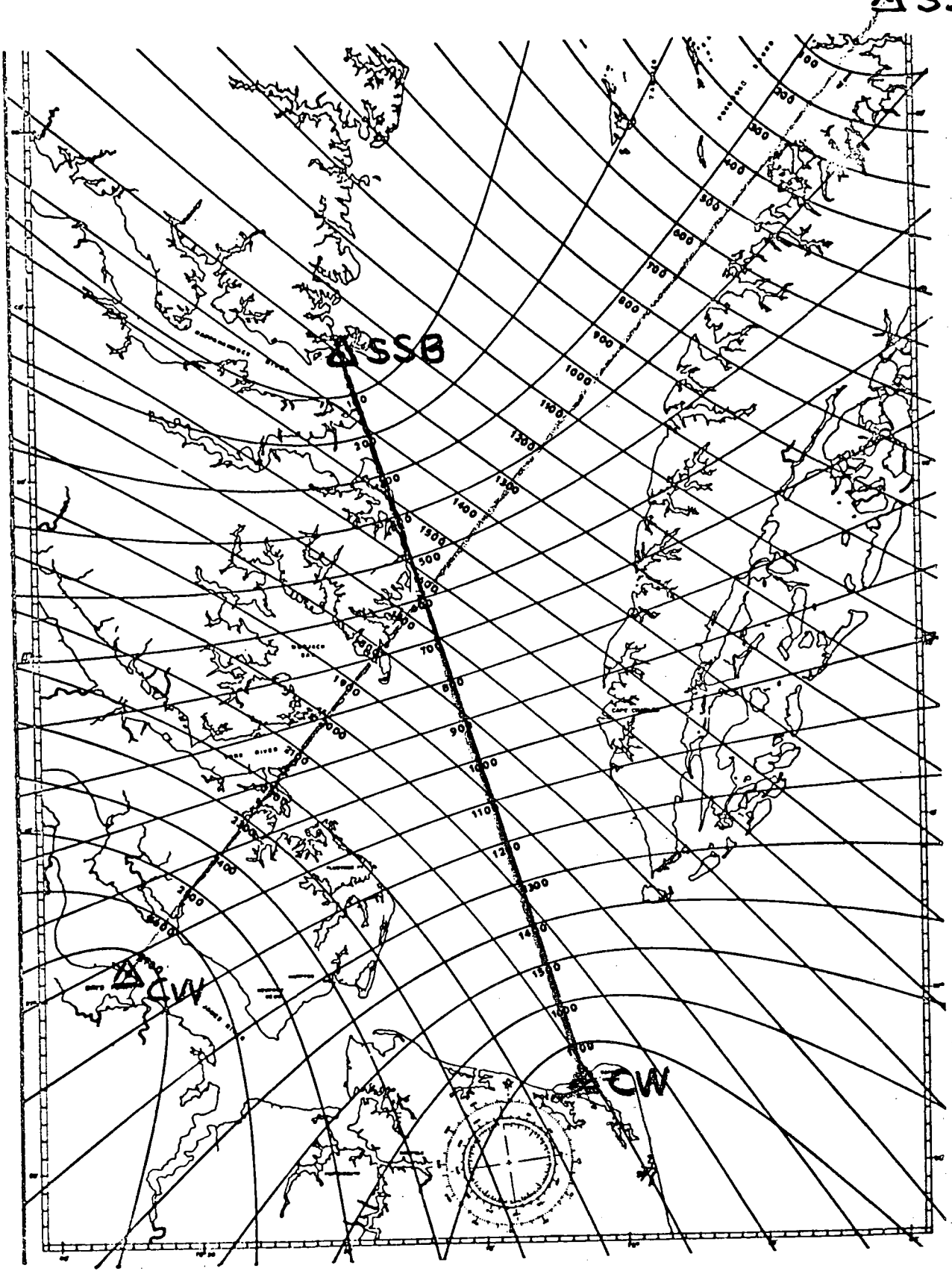


Figure 3. Lower Chesapeake Bay Coverage, Hyperbolic Geometry

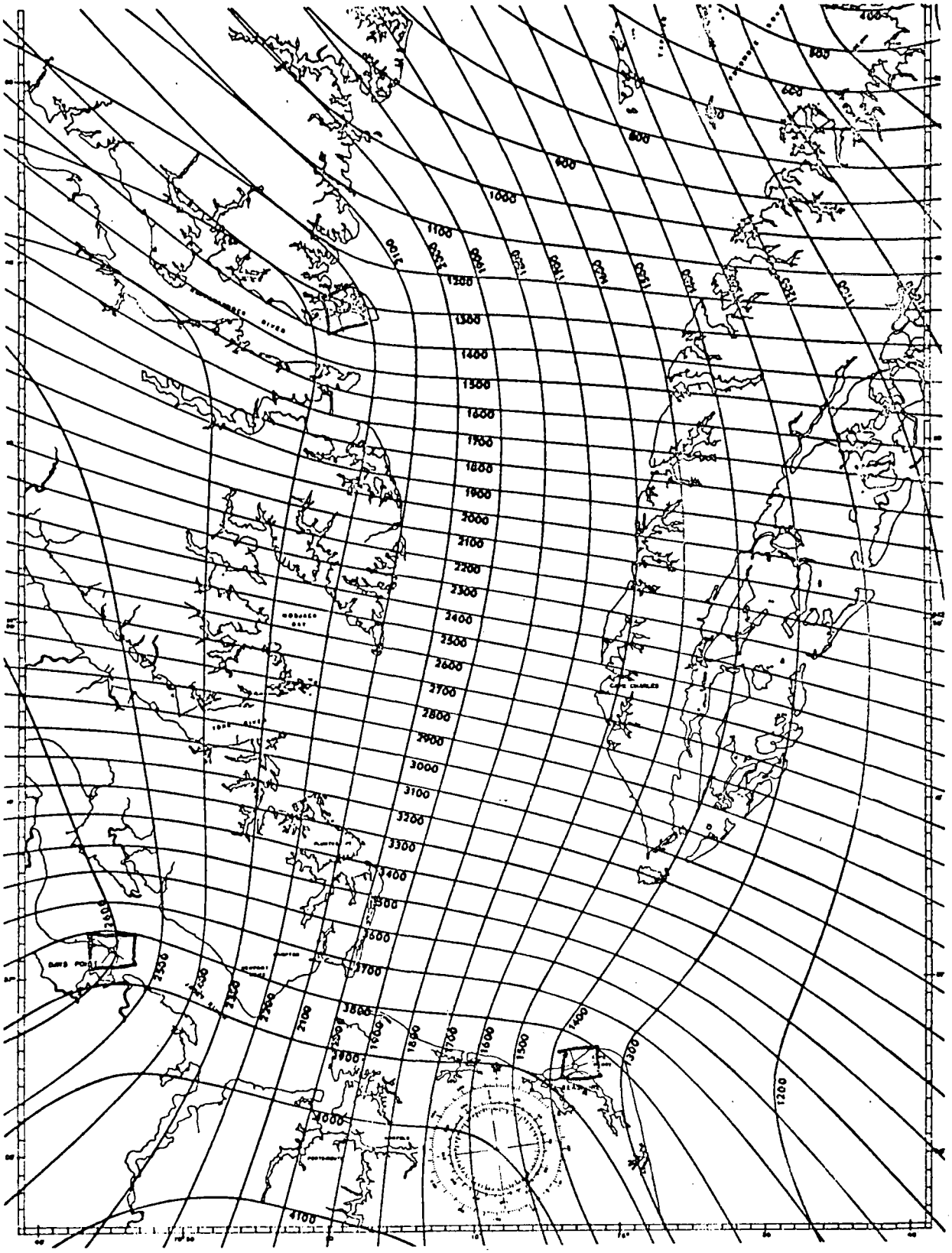


Figure 4. Lower Chesapeake Bay Coverage,Halop Geometry

and requires 1.2 amps at 12 Volts DC. It is 100 per cent solid state unit utilizing 19 plug-in printed circuit cards.

Also available is the GA-52, a remote display of Raydist coordinates, and the VC-19 Line Follower which displays left-right guidance command signals for manual navigation of a selected hyperbolic or Halop line of position.

ACCURACY AND REPEATABILITY

Great claims are made by the manufacturer for the overall accuracy and the repeatability of the Raydist "DR-S" and the "T" systems. A proposed layout for a "T" chain for the IFYGL coverage of Lake Ontario claimed continuous radiolocation with an accuracy of ten feet throughout the Lake, plus repeatability, accuracy at better than 3 feet. The "DR-S" system claims sensitivities of 1/3 metre and accuracies of a few metres.

It would be wise to accept these figures for what they are -- figures claimed by a manufacturer intent on making sales of his equipment. They are truly exceptional figures, no doubt arrived at under exceptional conditions. To quote Henry W. Bigelow, Director, Geodesy Division, U.S. Naval Oceanographic Office, "...under exceptional conditions almost anything can be made to work after a fashion."