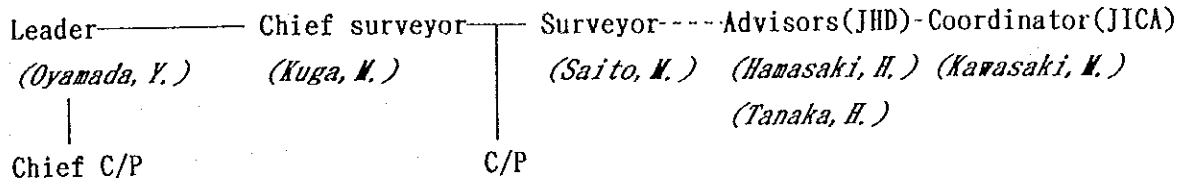


Appendix 3

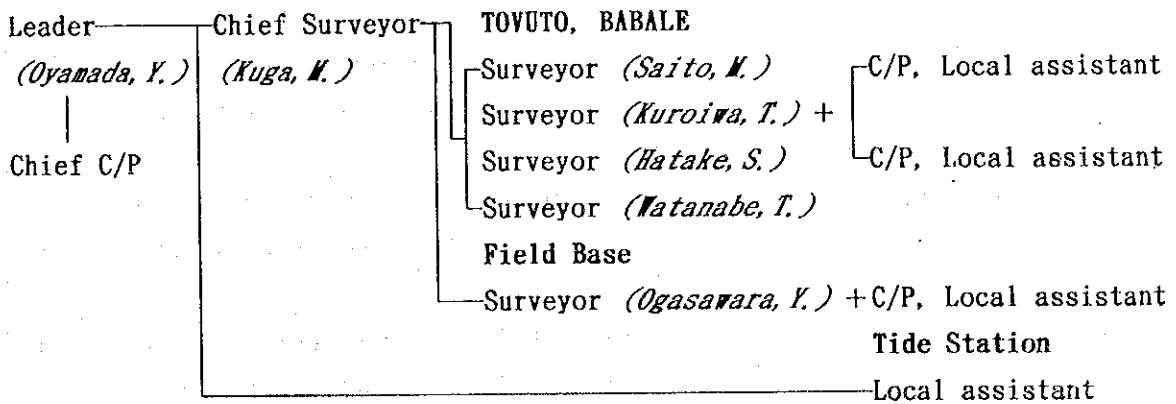
ORGANIZATION OF FIELD STUDY TEAM

(with Japanese members' names)

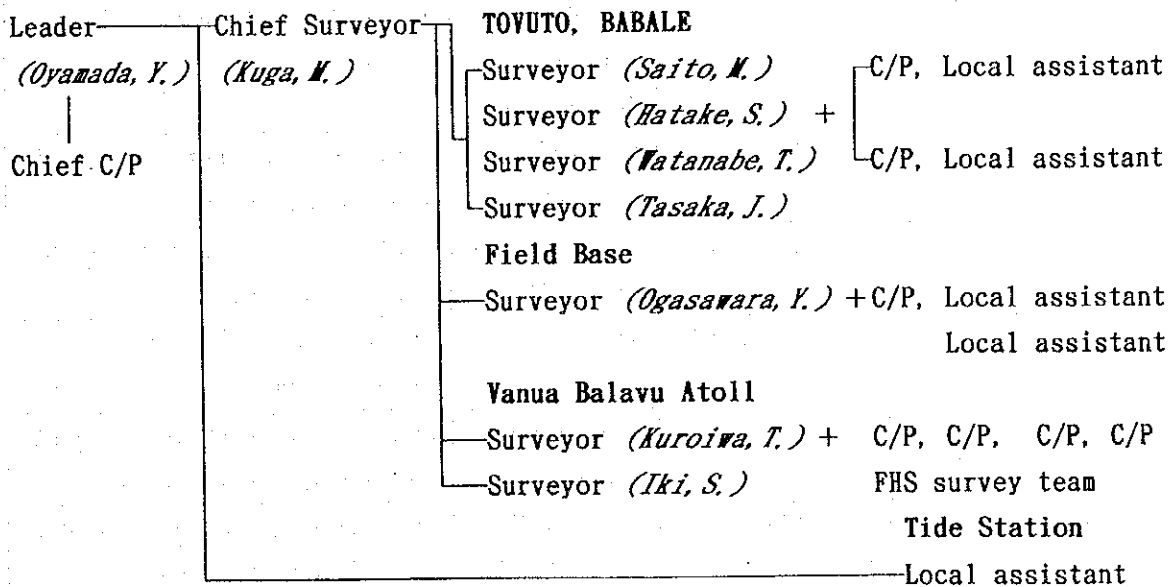
Phase I



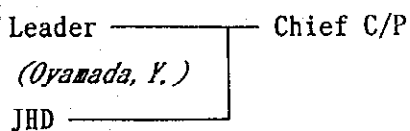
Phase II, Phase IV



Phase III



Phase V



## Appendix 4

## FIELD TASKS OF STUDY TEAM MEMBERS

Position	Name	Post of duty	Task
1. Team leader	Yasuhiro OYAMADA	Survey base in Suva	General managing of overall work of the Study; consultation with Fiji side; supervision of the V.B. tide station; study and analysis of hydrographic surveying and nautical charting system in Fiji
2. Chief surveyor	Masao KUGA	R/V TOVUTO	Supervision of control point survey, sounding and coastlining
3. Surveyor	Masashi SAITO	R/V TOVUTO, SMB BABALE	Control point survey, sounding and coastlining
4. Surveyor	Toshiki KUROIWA	R/V TOVUTO, SMB BABALE; V. B. lagoon (Phase III)	Control point survey, sounding and coastlining
5. Surveyor	Shuhei HATAKE	R/V TOVUTO, SMB BABALE	Control point survey, sounding, coastlining
6. Surveyor	Toshiaki WATANABE	R/V TOVUTO, SMB BABALE	Control point survey, sounding, coastlining
7. Surveyor	Yoshikazu OGASAWARA	Field survey base	Control point survey, tidal observation
8. Surveyor	Shinji IKI	V. B. lagoon (Phase III)	Control point survey, sounding and coastlining
9. Surveyor	Junji TASAKA	R/V TOVUTO, SMB BABALE (Phase III)	Control point survey, sounding and coastlining

## Appendix 5

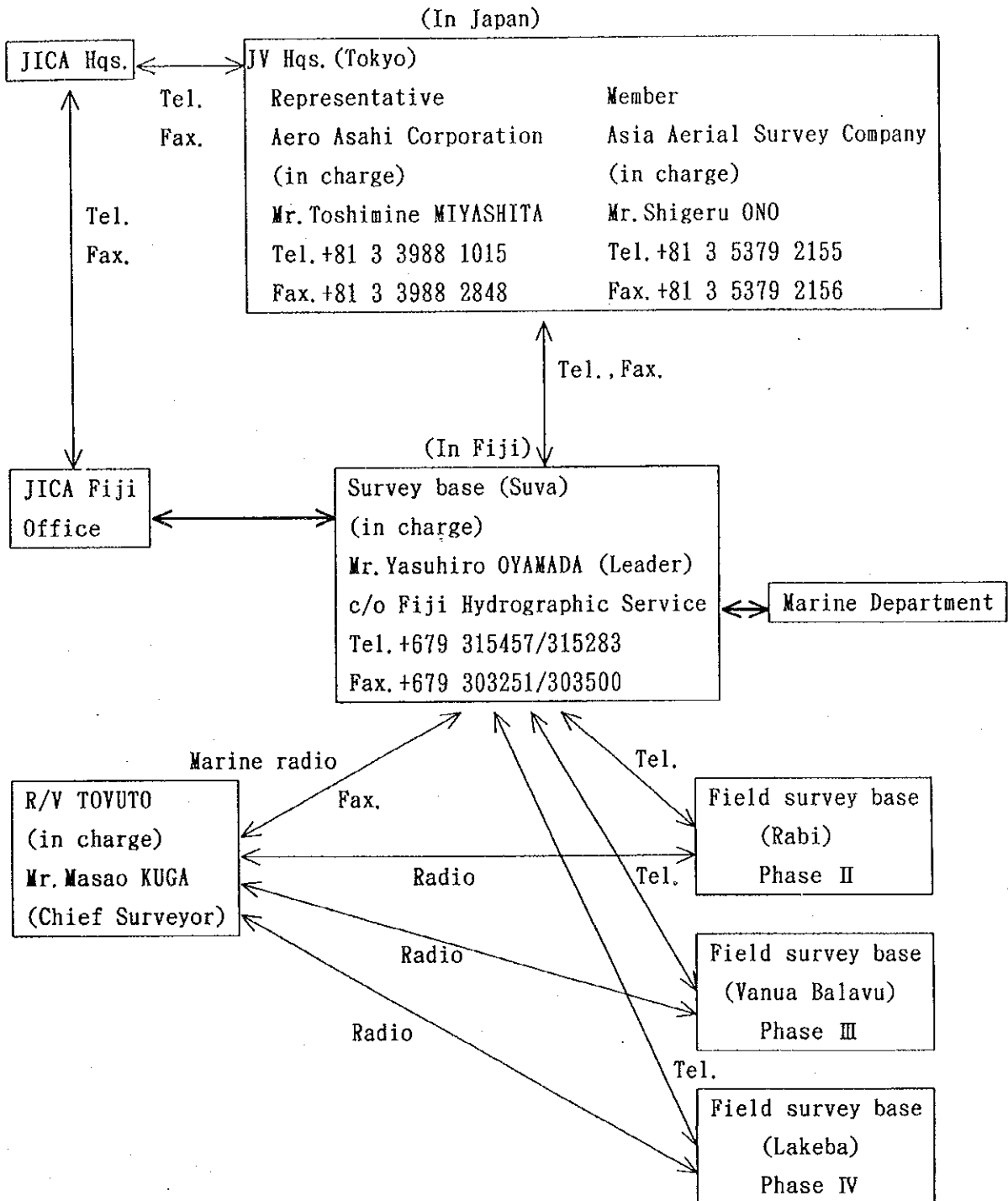
### LIST OF SURVEY EQUIPMENT AND INSTRUMENTS (PHASE II - PHASE IV)

1. Survey vessel
  - R/V TOVUTO
  - SMB BABALE
  - Chartered launch (for V.B. lagoon survey in Phase III)
- 2 Survey instruments (to be provided by the Study Team)
  - 2-1. Control survey
    - GPS receiver (Trimble 4000SSE) 3 sets
    - Total Station (Nikon Model TTM-1) 2 sets
    - Distance meter (Atlas Model LARA 90/205) 2 sets  
(one for V.B. lagoon survey)
  - 2-2. Coastlining
    - GPS receiver (as mentioned in 2-1 above)
  - 2-3. Tidal observation
    - Tidal gauge (YEO-KAL 610 ) 1 set
    - Level (Model B2) 1 set
  - 2-4. Sounding
    - GPS receiver (Sercel NDS 200/NRS 103) 2 sets
    - GPS receiver (Del Norte Model 1009GPS) 3 sets  
(one for V.B. lagoon survey)
    - Echo sounder (Ocean Data BATHY 1000) 1 set
    - Echo sounder (4-beam)(Senbon Denki Model PDR 501) 3 sets  
(one for V.B. lagoon survey)
    - Side-scan Sonar (EG&G Model 260) 3 sets  
(one for V.B. lagoon survey)
    - GPS receiver (navigation) 1 set
    - Plotter (EF 3100) 2 sets  
(one for V.B. lagoon survey)
  - 2-5. Others
    - Personal computer 1 set
    - Laser printer 1 set
    - Radio set 3 sets
    - Battery charger 3 sets

- Power generator	3 sets
- Copying machine	1 set
- Outboard motor	1 set
- Voltage stabilizer	2 sets
- Fax. machine	1 set
- Autopilot	1 set
- Gyrocompass	1 set
- Outboard engine	1 set

Appendix 6.

EMERGENCY COMMUNICATION NETWORK

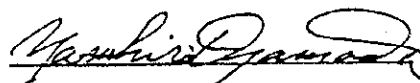


MINUTES OF MEETING  
ON  
THE FIRST YEAR'S PLAN OF OPERATION  
FOR  
THE PREPARATION OF NAUTICAL CHARTING  
IN  
THE NORTHERN LAU ISLANDS REGION  
IN  
THE REPUBLIC OF FIJI  
BETWEEN  
MINISTRY OF INFRASTRUCTURE, PUBLIC WORKS AND TRANSPORT  
AND  
JAPAN INTERNATIONAL COOPERATION AGENCY

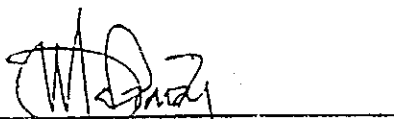
SUVA, 27 JANUARY 1995



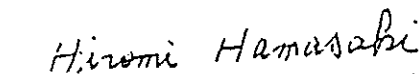
MR. A. VOCEA  
PERMANENT SECRETARY FOR  
INFRASTRUCTURE, PUBLIC WORKS  
AND TRANSPORT



MR. YASUHIRO OYAMADA  
LEADER  
STUDY TEAM  
JAPAN INTERNATIONAL  
COOPERATION AGENCY



MR. F. R. MAHARAJ  
CHIEF HYDROGRAPHER  
FIJI HYDROGRAPHIC SERVICE  
MARINE DEPARTMENT  
MINISTRY OF INFRASTRUCTURE,  
PUBLIC WORKS AND TRANSPORT



MR. HIROMI HAMASAKI  
ADVISOR (SENIOR  
CARTOGRAPHY OFFICER)  
STUDY TEAM  
JAPAN INTERNATIONAL  
COOPERATION AGENCY

The Study Team of Japan International Cooperation Agency (JICA) headed by Mr. Yasuhiro OYAMADA visited the Republic of Fiji on 24 January 1995, to conduct the first year (Phase I) work for the Study on Preparation of Nautical Charts in the Northern Lau Islands Region of the Republic of Fiji.

A series of meetings were held on 25 and 26 January 1995, at the Fiji Hydrographic Service (FHS), Marine Department, Ministry of Infrastructure, Public Works and Transport.

As the result, the following items have been confirmed and agreed by FHS and JICA Study Team.

1. The Plan of Operation (P/O) proposed by JICA Study Team was discussed and in principle agreed by both sides, with the following amendments:

(1) As the numbering of the three Fiji nautical charts to be produced will cause duplication of the numbers of the existing Fiji nautical charts, the chart numbers, and accordingly the Study area numbers, described in the P/O shall be amended to read as follows:

F2 to read F52,  
F6 to read F53, and  
F7 to read F54.

(2) As to the proposed site for establishment of a tide gauge at Vanua Balavu on pages 8 and 15, the wording "at the pier of Vanua Balavu." shall be amended to read "at an appropriate place in Vanua Balavu."

(3) On page 22, in para.2-5-1-1.(2), "JHO" shall be amended to read "JHD".

(4) On page 27, in para.3-1., bottom line, "and land maps" shall be inserted after "charts".

(5) Appendix 5 "LIST OF SURVEY EQUIPMENT AND INSTRUMENTS (PHASE II - PHASE IV)" shall be substituted by "Appendix 5 Revised" annexed hereto.

2. Through good offices of FHS, the Study Team shall receive latest land maps and aerial photographs necessary for drawing coastlines of islands and atolls in the Study area from the Lands and Survey Department before the Study Team leaves Fiji for Japan.

3. In addition to the above, technical matters including procurement and types of equipment were discussed and basic agreements were reached.

LIST OF ATTENDANTS

FIJI SIDE

(Fiji Hydrographic Service)

1. Mr.F.R.MAHARAJ Chief Hydrographer
2. Mr.Aca SILATOLU Senior Hydrographer
3. Mr.Seci LAGIVOLA Hydrographer
4. Mr.Yauka SORO Technical Officer 1 (Cartography)

JAPANESE SIDE

(JICA Study Team)

1. Mr.Yasuhiro OYAMADA Leader
2. Mr.Masao KUGA Chief Surveyor
3. Mr.Masashi SAITO Surveyor
4. Mr.Hiromi HAMASAKI Advisor (Senior Cartography Officer)
5. Mr.Hideo TANAKA Advisor (Senior Coastal Survey Officer)
6. Mr.Mitsuyoshi KAWASAKI Study Management

(JICA Fiji Office)

7. Mr.Hajime WATANABE Assistant Resident Representative

Handwritten marks and signatures at the bottom right of the page, including a circled character and a signature.



## Appendix 5 Revised

## LIST OF SURVEY EQUIPMENT AND INSTRUMENTS (PHASE II - PHASE IV)

## 1. Survey vessel

R/Y TOYUTO

SMB BABALE

Chartered launch (for V.B. lagoon survey in Phase III)

## 2. Survey instruments (to be provided by JICA and the Study Team)

## 2-1. Control survey

- GPS receiver (Trimble 4000SSE) 3 sets
- Total Station (Nikon Model TTM-1) 2 sets
- Distance meter (Atlas Model LARA 90/205) 2 sets  
(one for V.B. lagoon survey)

## 2-2. Coastlining

- GPS receiver (as mentioned in 2-1 above)

## 2-3. Tidal observation

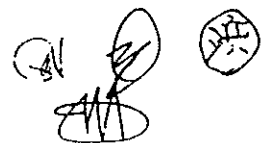
- Tide gauge (YEO-KAL 610 or equivalent) 1 set
- Level (Model B2) 1 set

## 2-4. Sounding

- GPS receiver (Sercel NDS 200/NRS 103 or equivalent) 2 sets
- GPS receiver (Del Norte Model 1009GPS) 3 sets  
(one for V.B. lagoon survey)
- Echo sounder (Ocean Data BATHY 2000 or equivalent) 1 set
- Echo sounder (4-beam) (Senbon Denki Model PDR 501) 3 sets  
(one for V.B. lagoon survey)
- Side-scan Sonar (EG&G Model 260 or equivalent) 3 sets  
(one for V.B. lagoon survey)
- GPS receiver (navigation) 1 set
- Plotter (EF 3100) 2 sets  
(one for V.B. lagoon survey)

## 2-5. Others

- Personal computer 1 set
- Laser printer 1 set
- Radio set 3 sets
- Battery charger 2 sets



- Power generator 3 sets
- Copying machine 1 set
- AC power conditioner 2 sets
- Voltage stabilizer 2 sets
- Fax. machine 1 set
- Autopilot 1 set
- Gyrocompass 1 set
- Outboard engine 1 set

3/11/11

## LIST OF EQUIPMENT TO BE PROVIDED BY JICA

The equipment selected by the Study Team are as listed below:

Equip- ment	Requirements	Selected	No. of set	Price (F\$)	Agent	Delivery
1. Personal Computer	RAM: More than 16Mb Hard disc: More than 250Mb IBM compatible Speed of processor: More than 50MHz	NEC Versa V50 Note- book DX250 Laptop computer	1	6,920.00	ITS (Fiji) Ltd.	2-3 weeks
2. Laser Printer	Speed: More than 4ppm To be connected with personal computer 1 above Good back up service	HP Laser Jet IVL	1	1,458.00	ITS(Fiji) Ltd	2-3 weeks
3. Marine Radio	Range: More than 200km To have legal frequency in Fiji Easily transportable Good back up service Minimum recommended spares	Barrett 550	3	(3,870.00) × 3 11,610.00	Elcom Services (Fiji)	4 weeks
4. Battery Charger	12/24V Minimum charging rate: 40AH Good back up service Minimum recommended spares	Dengen HR Max 40	2	(1,282.90) × 2 2,565.80	Carpenters Motors	3weeks

5. Generator	2kVA-3.3kVA Electric start Good back up service Minimum recommended spares	Robin RGD 3300	3	(3,600.00) × 3 10,800.00	Wing Lee Ltd.	Immediately
6. Copying Machine	A3 size copying Speed: Minimum 15. copies/min Good back up service	Sharp SF7800	1	2,900.00	Paperchase Ltd (Fiji)	Immediately
7. Tide Gauge	Accuracy: 5mm or better Recording: Analog or digital Type: Float or pressure Easy installation and maintenance Good back up service Minimum recommended spares	YEO-KAL610	1	A\$2,935.00	Ocean Technical Services (Fiji)	2weeks
8. Side-Scan Sonar	Range: Adjustable Portable, equipped with auto-tracking Good back up service Minimum recommended spares	EG & G260	1	US\$86,750.00	Elecom Services (Fiji)	6 weeks
9. DGPS	Real time differential system Range: 200km or more Accuracy: Within 5m at 200km distance Integrated GPS receiver and HF tranceiver Printer: RS 232C available Good back up service Minimum recommended spares	Sercel NDS 200/NRS103	1	US\$86,625.00	Elecom Services (Fiji)	6 weeks

10. Outboard Engine	Power:More than 60HP To be reliable Good back up service Minimum recommended spares	Yamaha E60HML	1	5,356.00	Asco Motors (Fiji)	Immediately
11. AC Power Conditioner	Input/output: 240V Voltage fluctuation:<1% Good back up service	Sola 210- 26-650-00	2	(655.00) × 2 1,310.00	Communications Pacific Ltd	3-4 weeks
12. Facsimile	HF radio with facsimile facilities to be installed on the survey ship Good backup service	Codan 9001	1	31,626.00	Professional Electronics Ltd.	3-6 weeks
13. Autopilot/ Gyro- compass	With minimum modification required of existing associated systems. Reliable performance Good backup servise	Tokimec RESCO PR-2000/ TG-5000	1	¥8,839,000	Elcom Services	3 months
14. Echo Sounder	Max.depth:5000m or more Dual frequency Accuracy:Depths<30m: <0.3m, depths>30m:<1% of depth Recording:Analog Good back up service Minimum recommended spares	Bathy-2000P	1	US\$112,855.00	Ocean Technical Services	100-130 days (Partly 64 days)



LIST OF SOURCE MATERIALS AND DATA COLLECTED

**From Fiji Hydrographic Service (FHS)**

1. Film copies of smooth sheets of survey

- (1) Natewa Bay - 1/75,000 (HMS Cook)
- (2) Langalanga River to Tilangitha Pass - 1/25,000 (HMS Cook)
- (3) Natewa Bay - 1/100,000 (HMNZS Lachlan)
- (4) Tasman Strait - 1/50,000 (HMS Cook)
- (5) Sausau Passage to Ringgold Channel (Sheet 1) - 1/75,000 (HMS Cook)
- (6) Sausau Passage to Ringgold Channel (Sheet 2) - 1/75,000 (HMS Cook)

2. Publications

- (1) Fiji Nautical Almanac 1995 (FHS)
- (2) N.P.203-95 Admiralty Tide Tables and Tidal Stream Tables, Volume 3, 1995  
(Hydrographer of the Navy, UK)

**From Department of Lands and Survey (DLS)**

1. Control points

- (1) Southern Lau - Lomaiviti GPS Geodetic Network Survey 1993-1994
- (2) Fiji Geodetic Datum 1986
- (3) Geodetic Station Record - Vanua Levu  
Naviavia, Koroinakoka, Korokalo, Dikeva, Delaikoro, Uluikamali, Vatuvuaka,  
Macanabu, Matana
- (4) Control Point Co-ordinates and Index Map - Vanua Levu  
Matanikalo, Nabonadekadeka, Nadelaibotoidreketi, Vatudraudrau, Valtuli, Uluivutuna,  
Dalice, Matanidaiga, Baleyanilia
- (5) Fiji Map Grid-Coordinates for Natèwa and Taveuni  
Uluikamali, Baleyanilia, Dikeva, Delairabe, Uluigala, Lagitoki, Narata, Naviavia,  
Manuka
- (6) Geodetic Station Record & Control Point Network - Rabi
- (7) Control Point Network  
Vanua Balavu, Lau Controls, Cicia Controls, Mago Controls, Naitauba & Kanacea  
Controls

(8) GPS Observation Results (WGS 1984 & WGS 1972)

Aiwa, GPS USA (Lakeba), Kabara, Komo, Lakeba, Moce, Nayau, Oneata,  
Uluikamali

(9) Control Point Index Map - Lau Group

2. Maps

(1) Land Maps (1/50,000)

Ndrua Ndrua, Vanua Levu, Sheet 1

Undu Point, Vanua Levu, Sheet 2

Sanggan, Vanua Levu, Sheet 7

Matakunea (Vanua Levu)

Mbutha Bay (Vanua Levu)

(2) Land Maps (Manuscript Sheets) (1/50,000)

Natewa Bay (Land Use), Vanua Levu Sheet 8

Taveuni North, Vanua Levu Sheet 15

(3) Aeronautical Charts Series 1501(1/250,000)(DOS, MINDEF, UK) Sheet SE 1-1,

Lauthala Island

Sheet SD 1-13, Nggelelevu

Sheet SE 1-5, Thithia Island

Sheet SE 1-9, Kambara Island

3. Aerial Photographs

551 sheets in total.

**From Mineral Resources Department (MRD)**

(1) 1/250,000 Bathymetry Series

Sheet 3 - Cikobia

Sheet 6 - Lau

Sheet 9 - Ono-i-Lau



## COUNTERPART TRAINING PROGRAMME

(Study on the Preparation of Nautical Charts in the Northern Lau Islands Region)

Name of counterpart : Mr. Aca Silatolu, Senior Hydrographer, FHS.

Period of training : From 20 February to 28 March 1995.

Date	Itinerary/Subject
20 Feb. (Mon)	Leaves Fiji and arrives at Narita.
21 " (Tue)	Orientation at JICA.
22 " (Wed)	do.
23 " (Thu)	Orientation at JHD, visit to various divisions at JHD.
24 " (Fri)	Lecture on organization and function of JHD.
25 " (Sat)	Rest.
26 " (Sun)	do.
27 " (Mon)	Lecture on Notices to Mariners and navigational warnings at JHD.
28 " (Tue)	Lecture on outline of coastal survey.
1 Mar. (Wed)	Visit to JHD survey vessel.
2 " (Thu)	Observation of computer processing of sounding data (at Aero Asahi Corporation).
3 " (Fri)	do.
4 " (Sat)	Rest.
5 " (Sun)	do.
6 " (Mon)	Leaves Tokyo for Kagoshima.
7 " (Tue)	On-job training aboard JHD survey vessel at Kagoshima.
8 " (Wed)	do.
9 " (Thu)	do.
10 " (Fri)	Leaves Kagoshima for Fukuoka.
11 " (Sat)	Rest.
12 " (Sun)	do.
13 " (Mon)	Visit to tidal observation facilities (7th RMSHQ).
14 " (Tue)	Leaves Fukuoka for Tokyo.
15 " (Wed)	Lecture and observation of electronic chart.
16 " (Thu)	Observation of aerial photographing system (at Asia Air Survey Co.).
17 " (Fri)	do.
18 " (Sat)	Rest.
19 " (Sun)	do.
20 " (Mon)	Visit to JHD survey vessel.

---

21	"	(Tue)	Rest.
22	"	(Wed)	Lecture on survey instruments (sounding and positioning).
23	"	(Thu)	Preparation of report.
24	"	(Fri)	Evaluation meeting.
25	"	(Sat)	Rest.
26	"	(Sun)	do.
27	"	(Sun)	Leaves Narita for home.
28	"	(Mon)	Arrives in Fiji.

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## DIARY OF SURVEY WORK

No. of day	Date	Location	Work carried out
1	26/7 (Wed)	Lv. Narita	
2	27 (Thu)	Ar. Suva	Visits to JICA Fiji Office, Embassy of Japan Meeting at FHS to discuss P/O
3	28 (Fri)	Suva	Meeting at FHS to discuss P/O and details of survey schedule and operations
4	29 (Sat)	"	Preparation for survey and equipment tests
5	30 (Sun)	"	Rest
6	31 (Mon)	"	M/M signed; discussions on operation of survey vessel
7	1/8 (Tue)	"	Preparations for survey
8	2 (Wed)	"	Office room for Study Team opened at FHS; Installation of instruments on TOVUTO
9	3 (Thu)	"	Tests of instruments on TOVUTO
10	4 (Fri)	"	Preparations for survey; procurement of materials
11	5 (Sat)	Survey site	Establishment of survey base at Taveuni and tide station at Vanua Balavu (VBV)
12	6 (Sun)	"	Rest
13	7 (Mon)	"	Control survey at primary shore control at survey base; continuous tidal observation started at VBV tide station TOVUTO sailed out Suva Port
14	8 (Tue)	"	TOVUTO arrived at Taveuni; preparations for survey
15	9 (Wed)	"	TOVUTO carried out sea trials along sounding lines; inspection by JHA at primary shore control
16	10 (Thu)	"	Sounding; tide pole established and tidal observation conducted at Rabi Inspection by JHA aboard TOVUTO

17	11	(Fri)	Survey site	Sounding; tide pole observation conducted at Rabi Inspection by JHA aboard TOVUTO and primary shore control
18	12/8	(Sat)	"	Sounding; control survey
19	13	(Sun)	"	Rest Inspection by JHA at Vanua Balavlu tide station
20	14	(Mon)	"	Sounding; control survey
21	15	(Tue)	"	Sounding
22	16	(Wed)	"	Sounding; control survey at Qelelevu lighthouse
23	17	(Thu)	"	No sounding due to rough sea
24	18	(Fri)	"	No sounding due to rough sea
25	19	(Sat)	"	No sounding due to rough sea
26	20	(Sun)	"	Rest
27	21	(Mon)	"	Sounding
28	22	(Tue)	"	Sounding; control survey
29	23	(Wed)	"	Sounding; control survey
30	24	(Thu)	"	Sounding
31	25	(Fri)	"	Sounding; control survey
32	26	(Sat)	"	Sounding; control survey
33	27	(Sun)	"	Rest
34	28	(Mon)	"	Sounding; control survey
35	29	(Tue)	"	Sounding; control survey
36	30	(Wed)	"	Sounding; control survey
37	31	(Thu)	"	Sounding
38	1/9	(Fri)	"	Sounding
39	2	(Sat)	"	Sounding; inspection by JHA at VBV tide station and aboard TOVUTO
40	3	(Sun)	"	Rest
41	4	(Mon)	"	Sounding
42	5	(Tue)	"	Sounding; control survey
43	6	(Wed)	"	Sounding
44	7	(Thu)	"	Sounding
45	8	(Fri)	Suva	TOVUTO returned to Port of Suva
46	9	(Sat)	"	Rest & replenishment

47	10	(Sun)	Suva	Rest
48	11	(Mon)	"	Rest & replenishment
49	12	(Tue)	"	Replenishment; TOVUTO left Port of Suva.
50	13	(Wed)	Survey site	TOVUTO arrived at survey site.
			"	No sounding due to rough sea
51	14	(Thu)	"	Sounding
52	15	(Fri)	"	Sounding
53	16	(Sat)	"	No sounding due to rough sea
54	17	(Sun)	"	Rest
55	18	(Mon)	"	Sounding; control survey
56	19	(Tue)	"	Sounding; control survey
57	20	(Wed)	"	Sounding; control survey
58	21	(Thu)	"	Sounding
59	22	(Fri)↓	"	Sounding; control survey
60	23	(Sat)	"	Sounding; control survey
61	24	(Sun)	"	Rest
62	25	(Mon)↓	"	Sounding; control survey
63	26	(Tue)	"	Tide pole observation at Rabi
64	27	(Wed)	"	Sounding; inspection by JHA aboard TOVUTO; tide pole at Rabi removed
65	28	(Thu)	"	Control survey at Udu Pointlighthouse
66	29	(Fri)	"	Survey base at Taveuni demolished
67	30	(Sat)	"	TOVUTO moved from Taveuni to Qamea
68	1/10	(Sun)	"	Rest
69	2	(Mon)	"	TOVUTO arrived at VBV
70	3	(Tue)	"	VBV tide station removed
71	4	(Wed)	Suva	TOVUTO returned to Port of Suva
72	5	(Thu)	"	Survey equipment dismantled; sorting and packing of survey instruments and data
73	6	(Fri)	"	Packing of survey instruments
74	7	(Sat)	"	Rest
75	8	(Sun)	"	do.
76	9	(Mon)	"	Meeting of Study Team
77	10	(Tue)	"	Concluding meeting by Study Team, FHS and Marine Department
78	11	(Wed)	"	Preparations for returning to Japan

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79	12	(Thu)	Suva	Report to JICA Fiji Office and the Embassy of Japan
80	13	(Fri)	Auckland	Left Suva and arrived in Auckland
81	14	(Sat)		Left Auckland and arrived at Narita

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Note : "↓" indicates that the survey was conducted overnight.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)  
MINISTRY OF INFRASTRUCTURE, PUBLIC WORKS AND TRANSPORT, FIJI

PLAN OF OPERATION  
FOR  
THE STUDY ON THE PREPARATION OF NAUTICAL CHARTS  
IN  
THE NORTHERN LAU ISLANDS REGION  
IN  
THE REPUBLIC OF FIJI  
PHASE II  
(THE SECOND YEAR – F.Y. 1995)

JULY 1995

AERO ASAHI CORPORATION  
ASIA AIR SURVEY CO., LTD.

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## 1. INTRODUCTION

The Government of the Republic of Fiji requested the Government of Japan for technical cooperation in the Study on the Preparation of Nautical Charts in the Northern Lau Islands Region in the Republic of Fiji.

In response to the request, the Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, dispatched a Preparatory Study Team from 15 February to 15 March 1994, and the Scope of Work (S/W) was agreed between JICA and the Ministry of Infrastructure, Public Works and Transport on 15 March 1994.

According to the S/W, the objectives of the Study are:

- (1) To prepare three Fiji nautical charts, Nos.F52, F53 and F54, each on the scale of 1:150,000, covering the Northern Lau Islands region;
- (2) To report the recommendation for improvement of operation and management system of hydrographic surveying and nautical charting; and
- (3) To promote technology transfer through the implementation of the Study with a view to enabling the Fiji counterpart personnel to improve their technique in hydrographic surveying and nautical charting.

The work in the First Year (Phase I) of the Study was conducted from 13 January and completed on 30 March 1995. During this period, a Study Team was dispatched to Fiji for consultation of the Plan of Operations (P/O) to the Fiji Hydrographic Service (FHS), Marine Department, Ministry of Infrastructure, Public Works and Transport, and for making preparations for hydrographic surveys in the forthcoming phases. As the result, the P/O containing an overall plan for the five-year Study and a detailed plan of the Phase I work was agreed upon by JICA and the Ministry of

Infrastructure, Public Works and Transport on 27 January 1995.

In the Phase I work, (1) selection of survey equipment to be used, (2) acquisition of aerial photographs and other source materials for the future work, (3) reconnaissance of survey sites for Phase II work and (4) confirmation of survey implementation and support systems were conducted in Fiji, and tentative drawing of coastlines of islands and atolls of the whole Study area were performed in Japan.

To conclude the Phase I work, the Progress Report (PR/R) of Phase I work was submitted to the Fiji Government from JICA, in which problems encountered and suggestions to the work in Phase II were included.

This Plan of Operations for Phase II is prepared on the basis of the P/O agreed in January 1995 and the PR/R above, giving more detailed plan of hydrographic survey to be conducted for Study Area F52 as well as of the pre-work and post-work to be carried out in Japan, with slight modifications as suggested in the PR/R.

Other than those matters described in this P/O, all the contents of the P/O agreed in January 1995 remains effective and are to be applied to the Study in Phase II.

## 2. GENERAL

### 2-1. Objectives

The objectives of the Study in Phase II are as follows:

- (1) To conduct hydrographic survey in Study Area F52.
- (2) To prepare a smooth sheet of survey for production of Fiji nautical chart No.F52.
- (3) To render technology transfer to Fiji counterpart personnel.

### 2-2. Study period

- (1) Pre-work in Japan  
From 3 July to 25 July, 1995.
- (2) Work in Fiji  
From 26 July to 14 October, 1995.
- (3) Post-work in Japan  
From 15 October, 1995, to 29 March, 1996.

### 2-3. Study area

- (1) Hydrographic survey will be conducted in the Study Area F52 bounded by the following latitudes and longitudes:  
Lat.  $16^{\circ} 46' 58''$  S and  $15^{\circ} 55' 00''$  S  
Long.  $179^{\circ} 32' 57''$  E and  $179^{\circ} 04' 30''$  W  
(As shown in Fig.1)
- (2) Continuous tidal observation will be conducted at Lomaloma, Vanua Balavu (Lat.  $17^{\circ} 17.7'$  S, Long.  $178^{\circ}-59.3'$  W approx.).

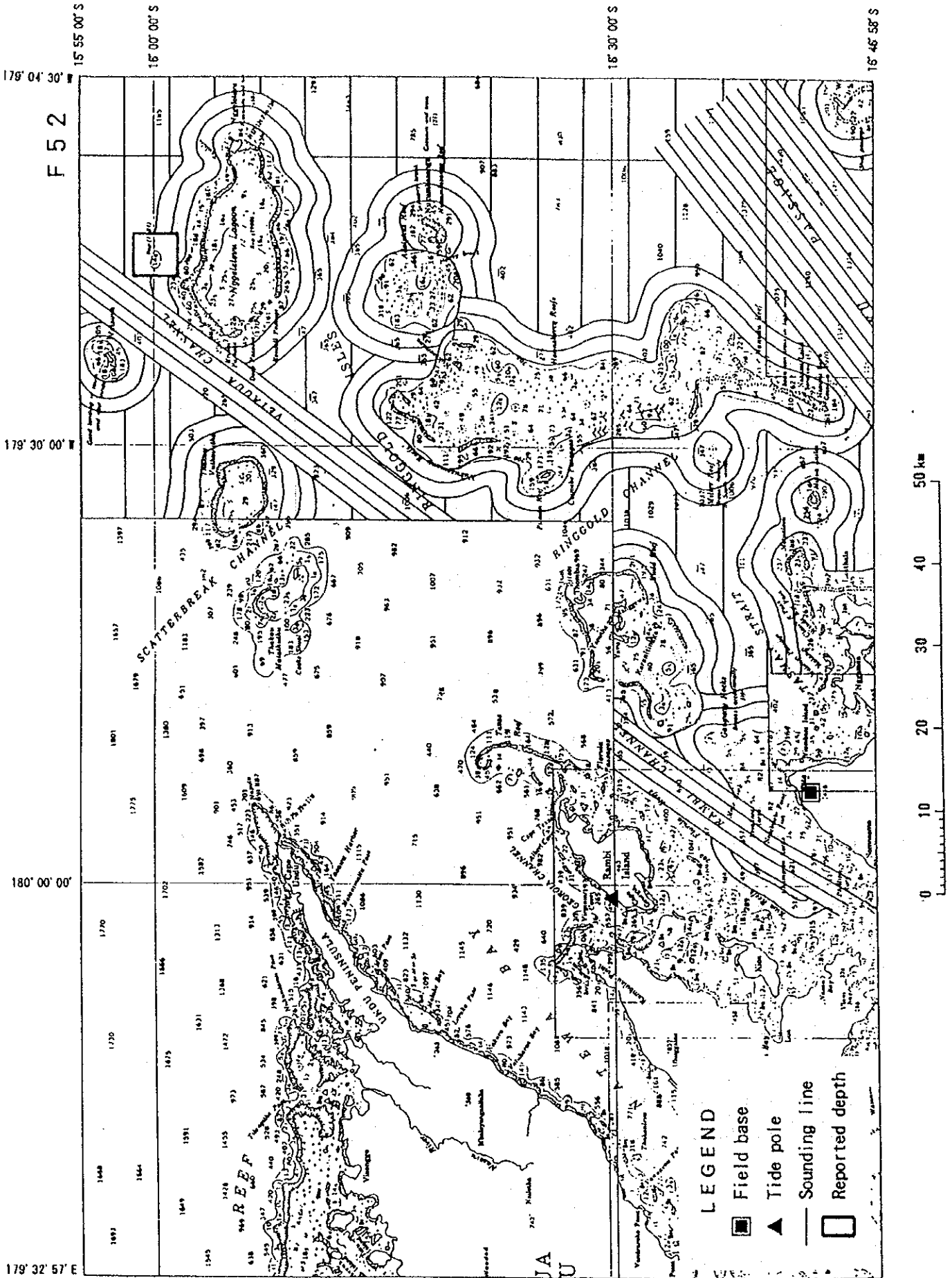
### 2-4. Flow of work

The flow of work to be carried out is as shown in Appendix 1.

### 2-5. Schedule of work

The schedule of work is as shown in Appendix 2.

Fig. 1



### 3. IMPLEMENTATION PLAN OF THE STUDY IN PHASE II

#### 3-1. Pre-work in Japan

##### 3-1-1. Planning and preparations

Based on the information, data and materials collected by the JICA Preparatory Study Team as well as by the Study Team during Phase I, a detailed plan for the Phase II work will be worked out.

Preliminary photo-interpretation of topography will be made on the islands and atolls in the Study area.

Preparations for survey including briefing of survey plan and orientation on Fiji regulations and customs to the Study Team members will thoroughly be made.

##### 3-1-2. Preparation of P/O

P/O for Phase II will be prepared on the basis of S/W and P/O agreed in Phase I, taking into account the suggestions made in the Progress Report of Phase I work.

This P/O will describe details of the hydrographic survey as to methods, amount of work, accuracies, etc., pre-work and post-work in Japan and the survey products from Phase II work, as well as the items for which co-operation from the Fiji side is requested and others.

##### 3-1-3. Procurement, examination and dispatch of instruments

Instruments and materials necessary for the work in Phase II will be procured, examined and dispatched by air to Fiji.

#### 3-2. Work in Fiji

##### 3-2-1. General

- (1) Composition of Study Team is as shown in Appendix 3.
- (2) Survey equipment and instruments to be used in the field work are as listed in Appendix 4.

(3) As for hydrographic survey standards, the International Hydrographic Organization (IHO) Standards for Hydrographic Surveys (S-44) shall in principle be applied unless otherwise stated.

#### 3-2-2. Explanation of P/O and consultation

The P/O thus prepared will be submitted to FHS for explanation by the Study Team, and consultation will be held to reach agreements on the content.

#### 3-2-3. Preparations for field work

The Study Team will proceed to implementation of the Study without delay after arrival in Fiji, such as customs clearance and checking of survey instruments and materials.

The headquarters for the Study Team will be established within the office of FHS in Suva.

#### 3-2-4. Installation and examination of survey instruments aboard the survey vessel

All the necessary survey instruments will be installed on board R/V TOVUTO at Port of Suva, and close examination and adjustment of performance of these survey instruments, inter alia, the echo sounder and DGPS receiver, will be performed at sea in approaches to Port of Suva before leaving for the survey area.

#### 3-2-5. Field work

##### 3-2-5-1. Establishment of a field base

A field base will be established at Taveuni to start the field work, which will be used for accommodation of the Study Team members and Fiji counterparts as well as for storage and maintenance of survey instruments and materials.

3-2-5-2. Control point survey

(1) The standard of survey is as follows:

Ellipsoid of reference : WGS-72

Grid system : FMG (Fiji Map Grid)

Origin of coordinates :  $17^{\circ} 00' 00''$  S,  $178^{\circ} 45' 00''$  E

Values of coordinates : 2,000,000mE and 4,000,000mN

Scale factor : 0.999850

Projection : Transverse Mercator (TM) projection

(2) A primary shore control point for fixing positions of auxiliary shore control points and the survey vessel will be established by DGPS observation with two or more existing control points.

(3) Auxiliary shore control points to be used for coastlining and fixing positions of conspicuous objects will be established by open DGPS observations with an existing control point or the primary shore control point.

(4) Open DGPS observations will also be conducted at the lighthouses at:

- Udu Point ( $16^{\circ} 07.4'$  S,  $179^{\circ} 57.0'$  W)

- Wailagilala Island ( $16^{\circ} 45.0'$  S,  $179^{\circ} 06.0'$  W)

- Qelelevu Island ( $16^{\circ} 05.4'$  S,  $179^{\circ} 08.8'$  W)

(5) Auxiliary shore control points for coastlining will be selected one to three per an island or an atoll where landing is feasible, where open DGPS observations will be conducted. In case of an extensive island or atoll such as Qelelevu and Nanuku, selection of auxiliary control points will be made at a rate one in every 10cm at the scale of survey, in principle.

(6) Transformation parameters from WGS-84 to FMG will be as follows:

Parameter	Value
Shift dX	79.027m
Shift dY	-70.749m
Shift dZ	-102.333m
Rotation about X	-0.852520"
Rotation about Y	-3.876562"
Rotation about Z	2.648162"
Scale	7.420964ppm

(7) Specifications for GPS observation will be as follows:

i) Performance of GPS receiver

Model : Trimble 4000SSE (3 sets)

Receivable frequency : 1,575.42MHz (L1) and 1,227.6MHz (L2)

Capability :  $\pm (5\text{mm} + 1 \times 10^{-6} \times D)$  or more, where D is distance (km)

ii) Observation will be made to more than four satellites of good health status at elevation angles of more than 15 degrees.

iii) Duration of observation will be as follows:

Primary control point/lighthouse : 90 minutes or more.

Auxiliary control point : 20 minutes or more.

iv) The accuracy of the primary control point shall be no more than 1/10,000. The relative positioning error shall be no more than 0.25mm at the scale of survey in case where the survey may cover an extensive area.

The accuracy of an auxiliary control point shall be no more than 0.5mm at the scale of survey.

### 3-2-5-3. Coastlining

(1) For delineation of coastlines, pricking will be made at selected points on the contact print aerial photographs (scale : 1/50,000) after confirming the conformity between picture and actual topography.



- (2) Coastlining will be carried out at such coastlines where considerable changes have been found between the aerial photography and actual topography. It will also be carried out in such places where tentative drawing of coastline was found difficult during the work in Phase I due to clouds, halation or other reasons.
- (3) For a conspicuous object useful to navigation with unknown height, measurement of the height will be carried out as far as possible.

#### 3-2-5-4. Tidal observation

##### 3-2-5-4-1. Tide station at Vanua Balavu

- (1) A self-recording tide gauge will be set at the proposed site on the pier of Lomaloma, Vanua Balavu (Fig.2) prior to the commencement of sounding operation.
- (2) Continuous observation of tide will be conducted throughout the period of sounding operation.
- (3) The type and specifications of the tide gauge to be used will be as follows:

Type : Pressure type tide gauge YEO-KAL Model 610

Recording : Digital

Accuracy : 0.0025m at 0-10m range

Resolution : 0.001m at 0-10m range

Data logging rate : Every 5 minutes

- (4) In parallel with the tide gauge above, the following tide gauge will be set as a backup:

Type : Floating type tide gauge model PFT-II

Recording : Analog

Reduction ratio : 1/20

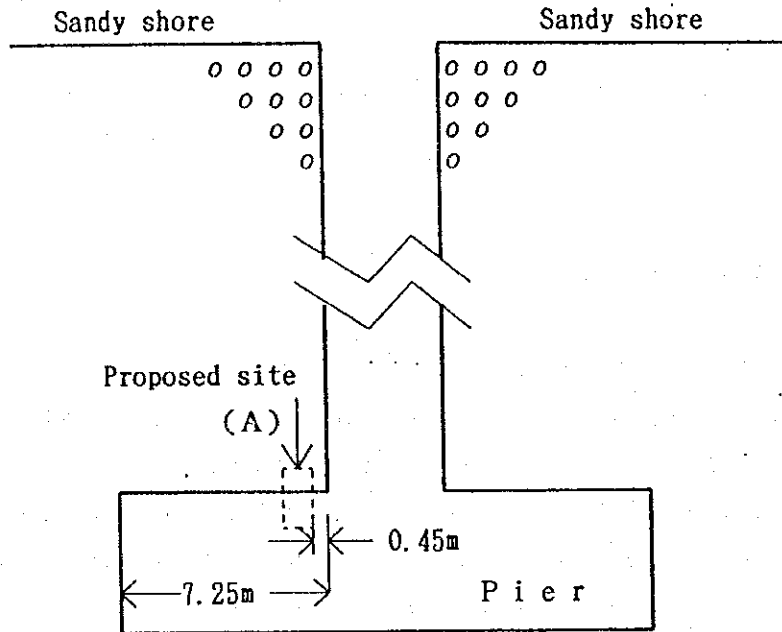
Paper speed : 20mm/h

Recording interval : Continuous

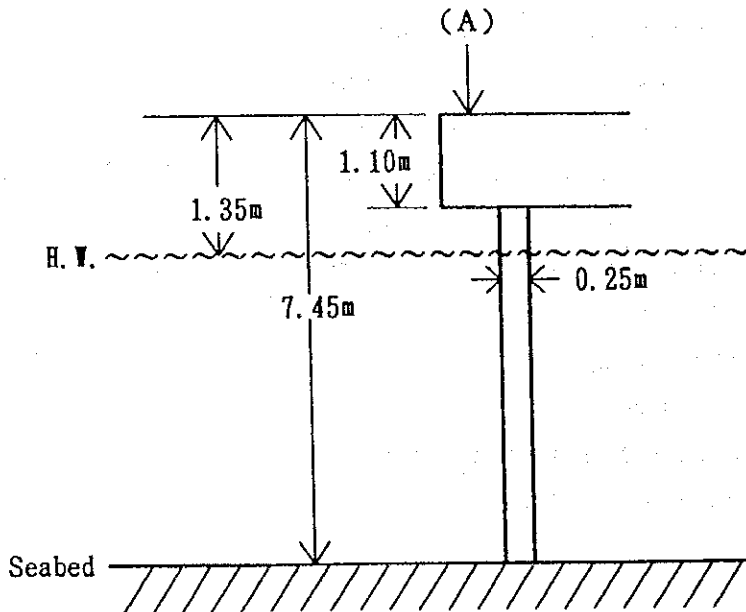
Minimum graduation : 1cm

Fig. 2

PROPOSED SITE FOR TIDE STATION AT PIER, LOMALOMA, VANUA BALAVU



Profile at (A)



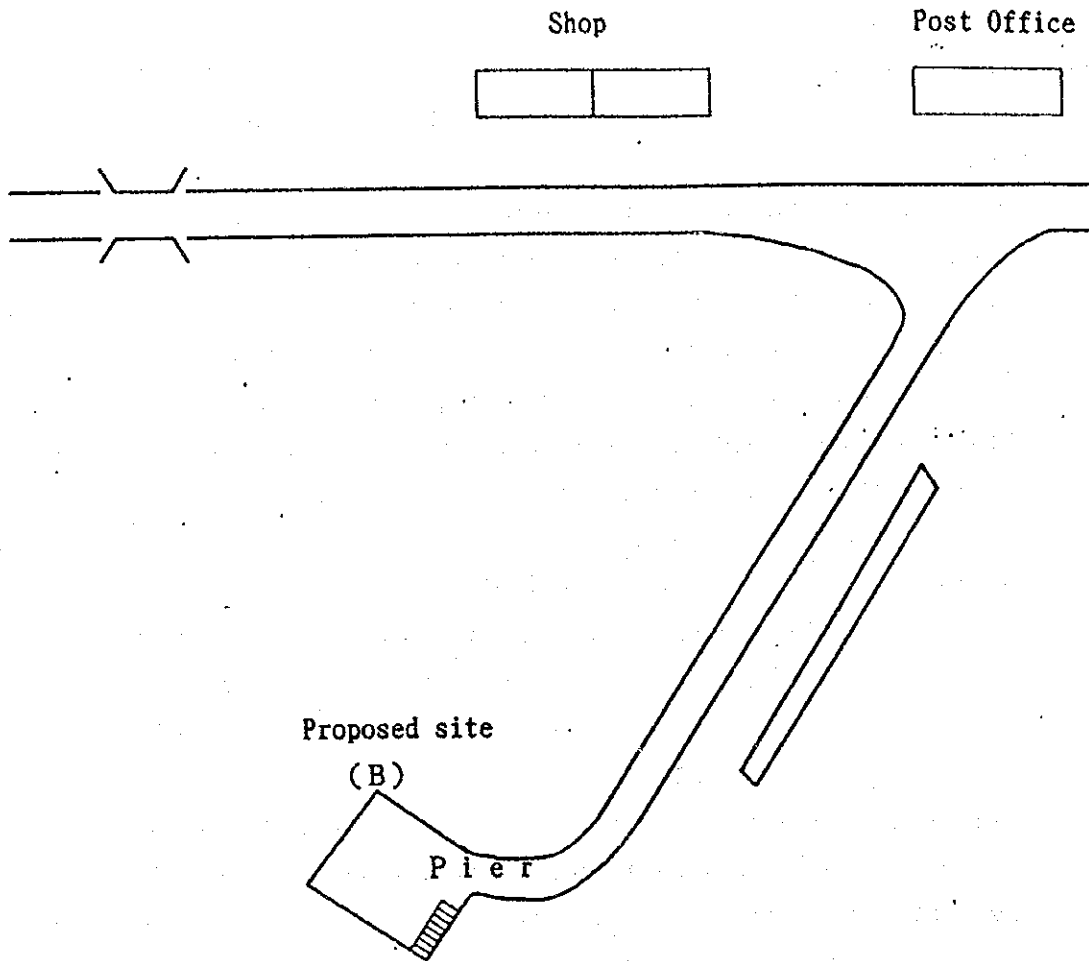
- (5) In order to determine the zero of tide gauge, a bench mark (BM) will firmly be established nearby on land, and levelling will be carried out between the tide gauge and BM.
- (6) The time kept on the recording paper of PFT-II will be checked with the correct local time at least once every day.
- (7) Determination of the Mean Sea Level (MSL) and the Datum Level (DL) will be made as follows:
- i) Suva being the standard port, the necessary tidal data recorded at Suva tide station will be retrieved by connecting a personal computer to it.
  - ii) The following equation will be used for computation of MSL at Vanua Balavu tide station :
 
$$A = A' + (A_0 - A_0')$$
 where  $A_0$  : MSL at Suva tide station  
 $A_0'$  : Short term MSL at Suva tide station  
 $A$  : MSL at Vanua Balavu tide station  
 $A'$  : Short term MSL at Vanua Balavu tide station
  - iii) For computation of short term MSL, tidal data from more than one-month observation will be used.
  - iv) DL will be approximately the level of the Lowest Astronomical Tide (LAT).

#### 3-2-5-4-2. Temporary tide pole at Rabi

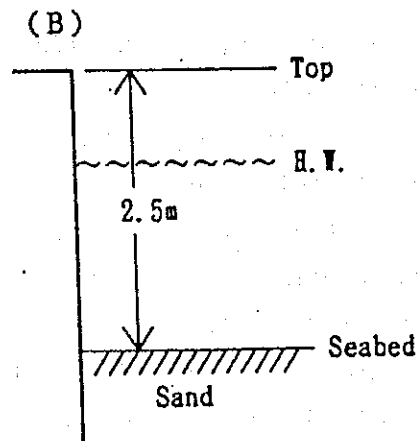
- (1) A tide pole will be erected at the proposed site on the pier at Nuku, Rabi (Fig.3).
- (2) Visual observation of the tide pole will be performed at 20-minute interval, and for 30 minutes before and after the time of high waters and succeeding low waters at 5-minute interval, on three separate days with different states of tides.
- (3) The MSL and DL for the area F52 will be determined from the tidal data at Suva and Vanua Balavu tide stations and the data obtained from the tide pole at Rabi.

Fig. 3

PROPOSED SITE FOR TIDE POLE AT PIER, NUKU, RABI



Profile at (B)



### 3-2-5-5. Sounding operation

#### 3-2-5-5-1. Position fixing

- (1) Ship's positions will be fixed by DGPS observation with the primary shore control point. Real time processing will be made for the observation.
- (2) The following DGPS receivers will be used:
  - (a) Main : Sercel NDS200/NR103
  - (b) Backup : Del Norte 1009/4012
- (3) The interval between the position fixes at the scale of survey shall be 2cm or less in case of a linear sounding line, and in case of a curved one, shall be such that maintains the plotting error of any cut-in sounding to be within a circle with a 1.5mm radius on the sheet.

#### 3-2-5-5-2. Sounding

- (1) The sounding lines planned in the area F52 are as shown in Fig.1.
- (2) The vessel to be used for sounding will be R/V TOVUTO, and in such shallow waters where R/V TOVUTO is unable to navigate, SMB BABALE will be used for sounding.
- (3) The planned sounding distances are as follows:

Deep water areas	: 503km
Shipping routes	: 881km
Around islands and atolls	: 1,413km
Reported shoals, shoals and banks	: 173km
Total distance	: 2,970km
- (4) The sounding line intervals will be as follows:

Deep water areas	: 3M
Shipping routes	: 1.5km
Around islands and atolls	: 1M
Reported shoals, shoals and banks	: 200m or less (with Side Scan Sonar)
- (5) The ship's speed during sounding operations will be as follows in principle:

Deep water areas and shipping routes	: 8-10 knots
Other areas	: 4-6 knots.

However, the speed will be reduced to ensure accurate sounding according to the circumstances.

(6) The echo-sounder Model Bathy-2000P installed on board R/V TOVUTO will principally be used.

For confirmation of the least depth of a shoal, a four-beam echo sounder for shallow water use, Model PDR 601, will be used. Specifications of these echo-sounders are as follows:

	Bathy-2000P	PDR 601
Depth range	0.5 - 6,000m	0 - 140m
Frequency	12/200kHz	90 - 230kHz
Sound velocity	1,400 - 1,540m/sec	1,500m/sec
Accuracy	±10cm to 100m depth, ±0.3% to 6,000m depth	±(0.3+D X 1/500)m
Resolution	180 DPI	--
Minimum reading	--	0.1m

As a backup of Bathy-2000P, the following echo-sounder will also be installed aboard R/V TOVUTO, and will be used when Bathy-2000P is not operational.

Model	Specifications	
Bathy-1000	Depth range	0.5 - 6,000m
	Frequency	12/200kHz
	Accuracy	±10cm to 100m depth, ±0.3% to 6,000m depth
	Resolution	1/2400 over paper width

(7) Correction to soundings

i) Tidal reduction to soundings will be made to the depths of 200m or less.

ii) Correction to soundings for underwater sound velocity will be made by bar-check method down to depths of 50m, and by the echo-sounding correction tables to deeper depths.

(8) The accuracy of sounding shall be as follows:

Depths 30m and shallower : Less than 0.3m

Depths deeper than 30m : Less than 1% of the depth

- (9) For confirmation of the least depth of a shoal, recordings of echo-sounder and Side Scan Sonar will be compared, and if any shallower water is likely to exist, interlines will be sounded.

The following Side Scan Sonar will be used:

EG&G Model 260 Image Correcting Side Scan Sonar

Range (m) : 25 50 75 100 150 200 300 400 600  
(each side)

Scale : 1/(10 X range)

Resolution: 1/400 of range

Another same type Side Scan Sonar will be used as a backup.

- (10) Supplementary sounding or resounding will be conducted as follows:

- i) In case where sounding line intervals have become more than 20% wider than the planned interval, interline sounding will supplementarily be conducted.
- ii) In case where a depth of less than 30m considered to be dangerous to navigation is likely to exist in between the sounding lines, supplementary sounding will be conducted to confirm its least depth.
- iii) Resounding will be conducted in such waters where the sounding record on the echogram is extraordinary, illegible or lacking.
- iv) In case where the difference between soundings at the crossing point of a principal sounding line and a cross-check sounding line exceeds twice the value of the accuracy of sounding, resounding will be carried out when the previous sounding data are considered to have exceeded an allowable error.

### 3-3. Post-work in Japan

#### 3-3-1. Data processing

##### 3-3-1-1. Control point survey

- (1) Computation of control points will be performed by a computer with an approved programme.

- (2) Results of control point survey for preparation of manuscript sheets for F52 will be shown on rectangular coordinates with the following standards:

Ellipsoid : WGS-72

Origin of coordinates : 16° 20' 00" S 179° 45' 00" W

Coordinate values of origin : X = 0.00m, Y = 0.00m

Scale factor : 1.000000

Projection : Transverse Mercator projection

- (3) Latitudes and longitudes of the primary shore control point and auxiliary control points will be computed.

Such computation will also be made to graticule points at every 10cm from the origin of coordinates.

- (4) The results of control point survey will be compiled into floppy discs, field notebooks, observation records, computation books, description of stations, computation books of latitudes and longitudes, control point data lists and index maps of control points.

### 3-3-1-2. Coastlining

- (1) Coastlines will be drawn by adopting those on the existing nautical charts and topographic maps as far as possible. The rest will be drawn according to the coastline drawings prepared during Phase I, which will be based on the results of coastlining conducted in the field.

- (2) Aerial triangulation will be utilized in the following cases for drawing of coastlines:

i) Unfavorable condition of aerial photographs made the tentative drawing of coastlines insufficient during the work in Phase I.

ii) In such atoll areas where establishment of control points for coastlining is difficult, those points will be fixed by aerial triangulation.

- (3) The results of aerial triangulation will be compiled in to Final Results of Aerial Triangulation, Index Map, Coordinate Value Book and Computation Book.



### 3-3-1-3. Tidal observation

- (1) The mutual relationship between the zero of tide gauge at Vanua Balavu tide station, MSL, DL and BM will be compiled into the results of reference measurement of the tide station and data of measurements.
- (2) As for MSL and DL, the method of computation and the data of measurement will be compiled into a reference level determination book.

### 3-3-1-4. Sounding

- (1) Soundings will be read out to 0.1m order for those shallower than 31m, and to 1m order for deeper ones, disregarding fractions.
- (2) Soundings of shallower than 200m will be corrected for tidal heights.
- (3) In reading out the soundings shallower than 50m for which bar-check was carried out, the reading-scale prepared from the results of bar-check will be used for correction of underwater sound velocity. For the correction to deeper soundings, the correction tables will be used.
- (4) Positions of soundings will be selected on the echogram with priorities given to summits and bottoms of seabed undulations and transition points of slopes.
- (5) Intervals of cut-in soundings to be read out will be so selected that they may be less than 10mm on the flat bottom and less than 5mm elsewhere on the sheet.

### 3-3-2. Preparation of manuscript sheets

#### 3-3-2-1. Control point sheet

Projection : Transverse Mercator (TM) projection

Scale : 1/150,000

Material : Plastic sheet with a thickness of 0.125mm  
or more

Items to be shown :

- i) Existing and new control points and auxiliary control points with symbols and names

- ii) Origin of coordinates, coordinate points at intervals of 10cm based on the origin
- iii) Graticule points of every 15 minutes of latitude and longitude
- iv) Positions and symbols for the four corners of the neatline.
- v) Metric scale.

Plotting error : Less than 0.2mm on the sheet.

### 3-3-2-2. Coastline sheet

Scale and material : Same as 3-3-2-1 above.

Items to be shown :

- i) Existing control points and those auxiliary control points necessary for delineation of coastlines
- ii) Coordinate points at 10cm intervals
- iii) Every 15-minute graticule points
- iv) Coastlines taken from aerial photographs and existing source materials, for which any correction to scale and distortion in topography has been rectified by using common points on the coastline sheet.

Symbols and abbreviations : In accordance with those adopted by the Hydrographic Department of Japan Maritime Safety Agency (JHD) for the smooth sheet of survey.

Elevation : Elevation of an object measured in the field will be shown to 0.1m order for less than 10m and to 1m order for 10m or higher.

### 3-3-2-3. Sounding sheet

Scale, projection and material : Same as 3-3-2-1 above.

Items to be shown :

- i) Existing control points and those control points and auxiliary control points necessary for sounding operation
- ii) Coordinate points spaced at 10cm

- iii) Graticule points spaced at every 15 minutes
- iv) Planned sounding lines and outline of coastlines drawn in pencil
- v) All of the positions fixed shall be shown. However, in such an area where dense survey for searching a shoal was conducted so that plotting all of the fixed positions may not be possible, they will be shown on a separate larger-scale sheet.
- vi) Sounding positions will be connected with a firm line according to a chronological order, and the position fix number will be marked against every fifth sounding position.
- vii) The position of a cut-in sounding will be marked with a 1mm-long dash crossing the sounding line at right angles.
- viii) The plotting error of sounding positions shall be less than 0.5mm on the sheet.
- ix) Navigational aids such as buoys and beacons existed within the survey area will be shown with their positions and shapes.

#### 3-3-2-4. Bathymetric plotting sheet

Scale and projection : Same as 3-3-2-1 above.

Material : Plastic sheet with a thickness of 0.075mm or more.

Items to be shown :

- i) Control points, coordinate points, graticule points spaced at every 15 minutes and four corners of the neatline.
- ii) Positions of soundings will be transferred from 3-3-2-3 above, each of which is shown with a red point, and the corresponding sounding value will be

marked against it.

iii) All of those soundings selected in para 3-3-1-4 above shall be shown.

As to such a protruded echo of an object not constituting the sea bottom, it will be marked with an identification note if it is identified, or if not, with an abbreviation "eO".

iv) Should there be charted on existing source materials any sounding, wreck or fishing reef which is shallower than the sounding in iii) above and considered dangerous to surface navigation, the one to be adopted will be determined after careful examination of the previous report concerned and the results of survey conducted in this Study.

v) The depth contours to be shown on the bathymetric plotting sheet shall be those of 2m, 5m, 10m, 20m, 200m, 1000m and every 1000m for deeper waters.

### 3-3-3. Preparation of smooth sheet of survey

#### 3-3-3-1. Smooth sheet of survey

Projection : Transverse Mercator projection

Scale : 1/150,000

Material : Plastic sheet with a thickness of 0.125mm or more

Title : FIJI ISLANDS

VANUA LEVU - NORTHERN PORTION

NATEWA BAY TO NANUKU PASSAGE

Items to be shown:

- i) Control points, graticule points and neatline corner points to be transferred from the control point sheet.
- ii) The neatlines of the smooth sheet will be so drawn that they may be in parallel with the

lines joining the coordinate points in S-N and E-W directions.

iii) Coastlines to be transferred from the coastline sheet.

iv) Soundings in slant figures based on the bathymetric plotting sheet. Standard intervals for soundings to be shown will be 10-20mm on the sheet.

Priorities will be given to the soundings in shallow waters.

Soundings will be so selected that they may well represent the sea bottom configurations.

v) The depth contours to be shown are 2m, 5m, 10m, 20m, 200m, 1000m and every 1000m for deeper waters.

Checking : The contents shown on the smooth sheet should be thoroughly checked with manuscript sheets and source materials used for any erroneous or lacking indication.

Colouring : Colouring of symbols to be shown on the smooth sheet shall be in accordance with those prescribed in the Regulations of the Law for Hydrographic Surveys and Detailed Regulations for the Application of the Law for Hydrographic Surveys specified by JHD.

#### 3-3-3-2. Inspection

The smooth sheet of survey thus prepared shall undergo due inspection by the Japan Hydrographic Association (JHA), which will include on-the-spot inspection by a member of the staff of JHA during the survey operations in the field.

#### 3-3-4. Preparation of Progress Report (PR/R)

The PR/R describing the progress of work up to Phase II Study, problems encountered and countermeasures taken, suggestions to the work in the future, etc. will be prepared and submitted to the Fiji Government.

#### 4. OTHERS

##### 4-1. Technology transfer

Technology transfer to Fiji counterpart personnel will be performed during the field work as well as data processing and preparation of the smooth sheet of survey during the post-work in Japan on the on-job training basis.

##### 4-2. Cooperation by FHS

- (1) FHS will provide four officers/surveyors as counterpart personnel.
- (2) FHS will assist the Study Team as follows:
  - 1) in facilitating customs clearance of instruments and materials and other official procedures,
  - 2) in hiring local assistants to work in the field,
  - 3) in obtaining and purchasing necessary materials for the Study,
  - 4) in proceeding local formalities for the entry and work of the Study Team, and
  - 5) other matters deemed necessary for smooth progress of the Study.

##### 4-3. Operation of survey vessel

- (1) In principle, the survey work on board the survey vessel will be during the daytime only, and there will be no work on Sundays.
- (2) Every 30 days the survey vessel will return to Port of Suva from the survey site for rest and replenishment for four days.

##### 4-4. Working schedule

The working schedule will be discussed and agreed by the Study Team and FHS and informed to JICA Fiji Office prior to commencement of the field work. Any changes necessitated in the schedule during the course of work will be communicated to JICA Fiji Office without delay.

#### 4-5. Concluding meeting

As soon as the field work of Phase II is completed, a meeting will be held by the Study Team and FHS to review and discuss the work done, problems encountered, etc. and to make suggestions to the work in the next phase.

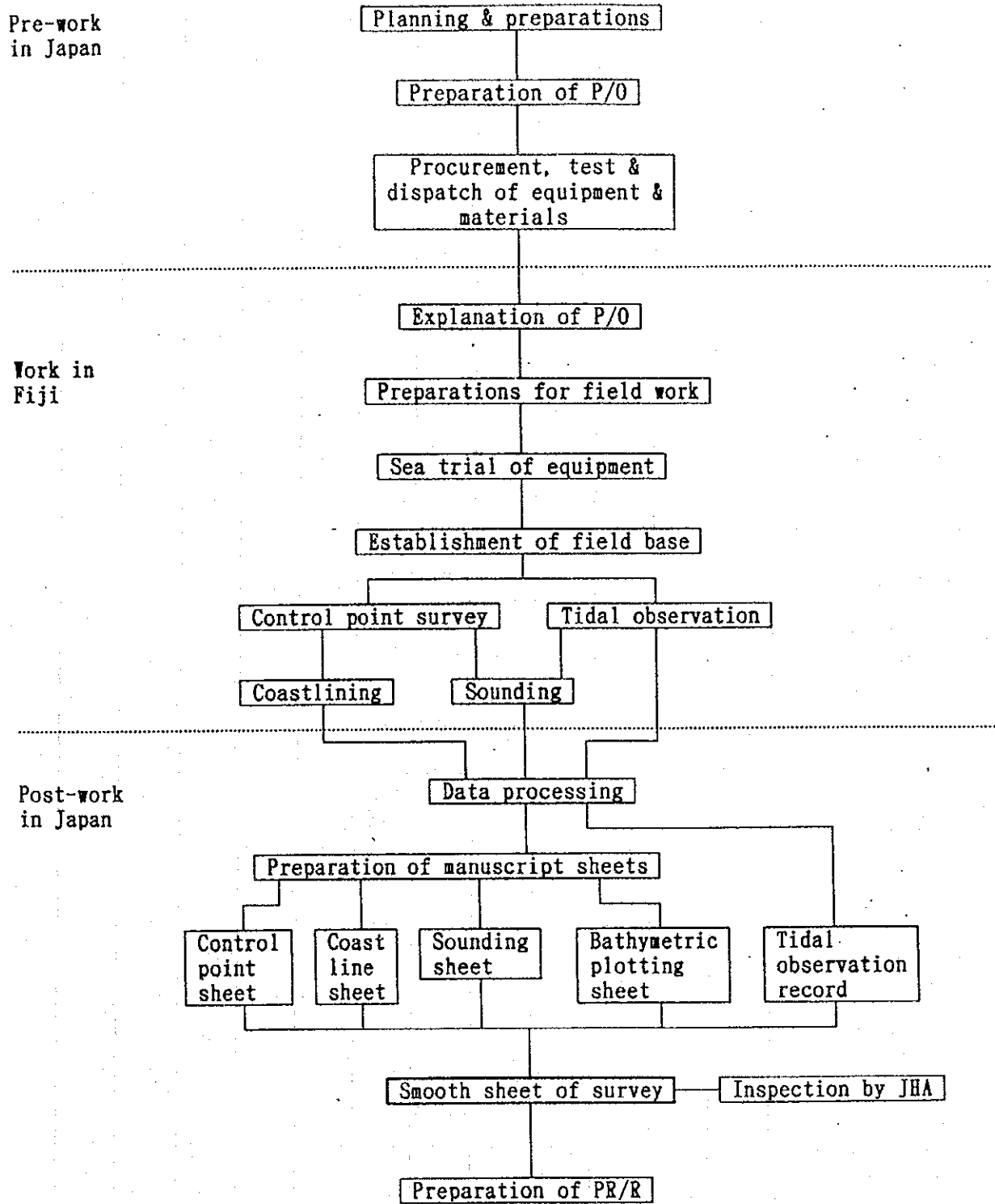
#### 4-6. Emergency communication network

An emergency communication network is shown as in Appendix 5.





FLOW OF WORK FOR PHASE II (FISCAL 1995)

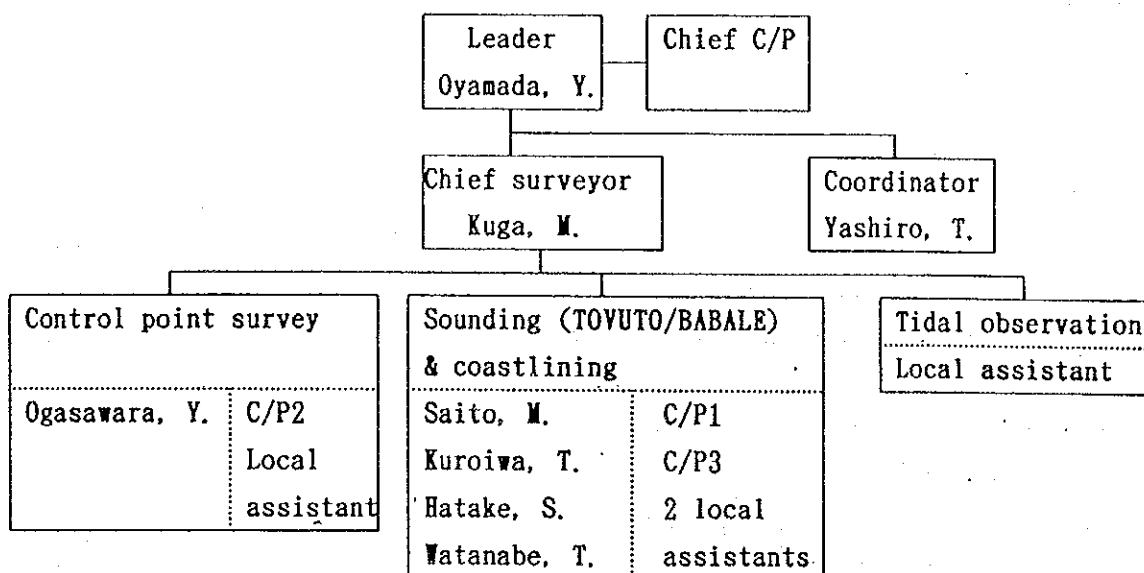


WORK SCHEDULE FOR STUDY IN PHASE II

1995-1996 Work item	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Planning & Preparations			□									
Dispatch of equipment				□								
Preparation of P/O				□								
Explanation of P/O					■							
Installation of equipment					■							
Sea trials					■							
Establishment of survey base					■							
Control point survey Primary station Auxiliary station					■	■	■	■	■			
Tidal observation V.B. Tide station Tide pole at Rabi					■	■	■	■	■			
Coastlining					■	■	■	■	■			
Sounding					■	■	■	■	■			
Data processing								□	□	□		
Manuscript sheets and others									□	□	□	
Smooth sheet of survey										□	□	
Inspection of smooth sheet											□	□
Inspection of survey site					■	■	■					
Preparation of PR/R												□

□ :Pre-work in Japan    ■ :Work in Fiji    □ :Post-work in Japan

## COMPOSITION OF STUDY TEAM



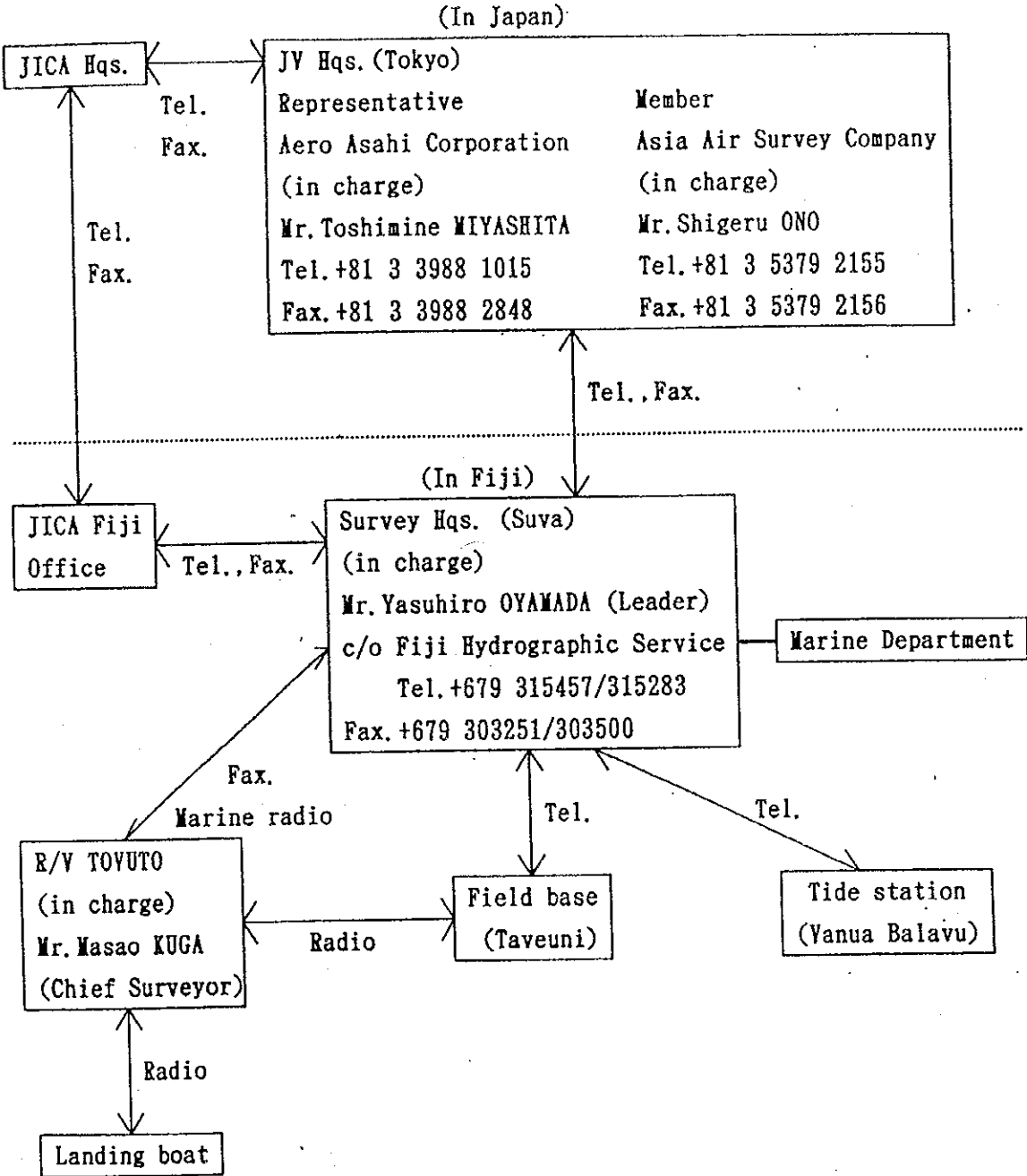
## TASK ASSIGNMENT

	Name	Position	Post of duty	Task
1.	OYAMADA, Yasuhiro	Team Leader	Headquarters in Suva	General managing of overall work; consultation with Fiji side; supervision of YB tide station
2.	KUGA, Masao	Chief Surveyor	R/V TOVUTO	Supervision of control point survey, sounding and coastlining
3.	SAITO, Masashi	Surveyor	R/V TOVUTO SMB BABALE	Control point survey, sounding and coastlining
4.	KUROIWA, Tosiki	Surveyor	do.	do.
5.	HATAKE, Shuhei	Surveyor	do.	do.
6.	WATANABE, Toshiaki	Surveyor	do.	do.
7.	OGASAWARA, Yoshikazu	Surveyor	Field base	Control point survey
8.	YASHIRO, Takashi	Coordinator	Suva	Business coordination

## PRINCIPAL SURVEY EQUIPMENT AND INSTRUMENTS TO BE USED

1. Survey vessel		
R/V TOVUTO		
SMB BABALE		
2. Survey instruments		
2-1. Control point survey		
GPS receiver : Trimble 4000SSE		3 sets
Total Station : Nikon Model DTM-1		1 set
Distance meter : Atlas Model LARA 90/205		1 set
2-2. Coastlining		
GPS receiver : Same as in 2-1 above.		
2-3. Tidal observation		
Tide gauge : Kyowa Shoko Model PFT-II		1 set
YEO-KAL 610		1 set
Level : Sokkia Model B-2		1 set
2-4. Sounding		
GPS receiver : Sercel NDS200/NR103		1 set
Del Norte 1009/4012		1 set
Navigation		1 set
Echo sounder : Ocean Data BATHY 2000P		1 set
Ocean Data BATHY 1000		1 set
Senbon Denki Model PDR 601		2 sets
Side-scan Sonar : EG&G Model 260		2 sets
Plotter : Graphtec Model FP9100		1 set
3. Others		
Personal computer : NEC Versa V50 Notebook		1 set
Laser printer : HP Laser Jet IVL		1 set
Radio set : Barrett 550		3 sets
Battery charger : Dengen		2 sets
Power generator : Robin Model RGD3300		3 sets
Copying machine : Sharp SF7800		1 set
AC power conditioner : Sola 210-26-650-00		2 sets
Facsimile machine : Codan 9001		1 set
Autopilot/Gyrocompass : Tokimec RESCO PR-2000/TG-5000		1 set
Outboard engine : Yamaha E60HML		1 set

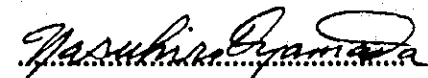
EMERGENCY COMMUNICATION NETWORK

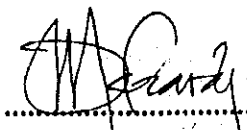




MINUTES OF MEETING  
ON  
THE PLAN OF OPERATION  
FOR  
THE STUDY ON THE PREPARATION OF NAUTICAL CHARTS  
IN  
THE NORTHERN LAU ISLANDS REGION  
IN  
THE REPUBLIC OF FIJI  
PHASE II  
(THE SECOND YEAR - F.Y: 1995)

SUVA, 31 JULY 1995

  
MR YASUHIRO OYAMADA  
LEADER  
STUDY TEAM  
JAPAN INTERNATIONAL  
CO-OPERATION AGENCY

  
MR F. R. MAHARAJ  
CHIEF HYDROGRAPHER  
FIJI HYDROGRAPHIC SERVICE  
MARINE DEPARTMENT  
MINISTRY OF  
INFRASTRUCTURE, PUBLIC  
WORKS & TRANSPORT

The Study Team of Japan International Cooperation Agency (JICA) headed by Mr Yasuhiro Oyamada visited the Republic of Fiji on 27 July 1995, to conduct the second year (Phase II) work for the Study on the Preparation of Nautical Charts in the Northern Lau Islands Region of the Republic of Fiji.

Meetings were held at the Fiji Hydrographic Office, Marine Department, Ministry of Infrastructure, Public Works and Transport on 27 and 28 July 1995, to discuss the Second Year's Plan of Operation and various arrangements for starting survey operations.

As a result, following items have been confirmed and agreed by FHS and JICA Study Team.

1. The Second Year's Plan of Operation (P/O) proposed by JICA Study Team was discussed and in principle agreed by both sides, with the following note :

As the echo-sounder Bathy 2000P (Para 3-2-5-5-2 sub para, (6) will not be available at the commencement of sounding, this will be substituted by Bathy 1000 until its arrival.

2. RV Tovuto will proceed to the survey ground with the Study Team with Fiji counterparts on 7 August 1995.
3. FHS offered to provide four counterparts from its staff to join the Study. It was understood and accepted by the Study Team that some of them would be rotated with other members of the staff so that the technology transfer may be effectuated thoroughly to FHS , provided that the replacement will take place once for each counterpart during the Study period this year.

#### LIST OF ATTENDANTS

##### FIJI SIDE

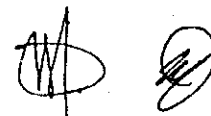
(Fiji Hydrographic Service)

- |                     |                     |
|---------------------|---------------------|
| 1. Mr .F.R. MAHARAJ | Chief Hydrographer  |
| 2. Mr. A. SILATOLU  | Senior Hydrographer |
| 3. Mr. S. LAGIVOLA  | Hydrographer        |

##### JAPANESE SIDE

(JICA Study Team)

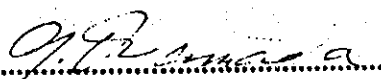
- |                        |                |
|------------------------|----------------|
| 1. Mr Yasuhiro OYAMADA | Leader         |
| 2. Mr Masao KUGA       | Chief Surveyor |
| 3. Mr Masashi SAITO    | Surveyor       |

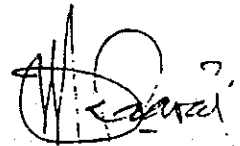




MINUTES OF MEETING  
FOR  
CONCLUSION OF THE FIELD WORK  
FOR  
THE STUDY ON THE PREPARATION OF NAUTICAL CHARTS  
IN  
THE NORTHERN LAU ISLANDS REGION  
IN  
THE REPUBLIC OF FIJI  
  
PHASE II  
(THE SECOND YEAR - F.Y. 1995)

SUVA, 10 OCTOBER 1995

  
.....  
MR YASUHIRO OYAMADA  
LEADER  
STUDY TEAM  
JAPAN INTERNATIONAL  
CO-OPERATION AGENCY

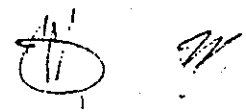
  
.....  
MR F. R. MAHARAJ  
CHIEF HYDROGRAPHER  
FIJI HYDROGRAPHIC SERVICE  
MARINE DEPARTMENT  
MINISTRY OF  
INFRASTRUCTURE, PUBLIC  
WORKS & TRANSPORT

In concluding the field work for the Phase II of the Study on the Preparation of Nautical Charts in the Northern Lau Region, a meeting was held at the Fiji Hydrographic Service (FHS) Office between the JICA Study Team headed by Mr Yasuhiro Oyamada, Team Leader, and Staff of FHS, headed by Mr Felix R. Maharaj, Chief Hydrographer, on the 10th October 1995.

In opening the meeting, the chairman Mr Oyamada thanked all involved in the survey for their whole hearted support and hospitality with which the field work was completed successfully.

Discussions and exchange of opinions were mainly concentrated on the problems encountered during the field work, and agreements were reached on the following matters to enable smoother and more effective implementation of the field work to be carried out in Phase III of the Study next year:

1. It was suggested that the Phase III of the Study would be commenced as early as possible, around May 1996, taking into account adverse sea conditions during August and September.
2. It was also suggested that the days allowed for adverse weather should be increased due to the more exposed survey area in the next phase.
3. The Control Survey team will need a faster and safer boat. It was considered that the aluminium boat displayed at Fiji Customs Craft Co., Ltd. would be suitable.
4. The new shoal discovered was named as "TOVUTO SHOAL" and will be chartered as such.
5. A reconnaissance will be carried out at Lakeba for a few days towards the end of the field work in 1996.
6. The equipment provided by JICA will be kept by FHS safely. It is necessary to obtain by FHS permission from JICA for its use while the Study Team is absent. Auto Pilot/Gyrocompass will need JICA's approval for general purpose use.
7. The echo-sounder BATHY 2000P is to be properly installed in the survey observation room on TOVUTO before the commencement of next year's survey.
8. The air conditioning in the survey observation room on TOVUTO is to be improved before the commencement of Phase III surveying.
9. One FHS personnel and one Study Team member are to be present in the survey observation room at all times during the sounding operation.



10. Bar-checks are to be carried out each day and whenever necessary.
11. The Sercel DGPS is to be made safe from power supply anomalies and electrical interference from other shipboard equipment before the next survey period.
12. The Control Survey team next year will consist of two FHS personnel, one Study Team member and one labour person.
13. Trisponder will be used for Vanua Balavu Lagoon survey next year, and data processing will be done manually, or if possible, by using a plotter and appropriate software.
14. The Vanua Balavu Lagoon survey will commence about one week after the TOVUTO departs from Suva in 1996.

#### LIST OF ATTENDANTS

##### FIJI SIDE

(Fiji Hydrographic Service)

- |                             |                     |
|-----------------------------|---------------------|
| 1. Mr Felix Ranchor MAHARAJ | Chief Hydrographer  |
| 2. Mr Aca SILATOLU          | Senior Hydrographer |
| 3. Mr Seci LAGIVOLA         | Hydrographer        |
| 4. Mr Philip Ronald HILL    | Hydrographer        |

(Marine Department)

- |                           |                     |
|---------------------------|---------------------|
| 1. Mr Pauliasi VAKALOLOMA | Master, R/V TOVUTO. |
|---------------------------|---------------------|

##### JAPANESE SIDE

(JICA Study Team)

- |                        |                |
|------------------------|----------------|
| 1. Mr Yasuhiro OYAMADA | Leader         |
| 2. Mr Masao KUGA       | Chief Surveyor |
| 3. Mr Masashi SAITO    | Surveyor       |



**LIST OF FINAL PRODUCTS OF SURVEY**

1. Control point survey

- Control point sheet
- List of geographical coordinates and index sheet of geographical positions
- Data list of existing control points
- Data list of control point sheet
- Final results of control point survey
- Geodetic station records
- Floppy disks of control observation

2. Coastlininig

- Coastline sheet
- Final results of aerial triangulation
- Data file of height observation

3. Tidal observation

- Book of determination of reference levels of tide stations
- Results of measurement of reference level of temporary tide station
- Description of hydrographic marking
- Comparative tide observation at Vanua Balavu and Rabi tide stations
- Results of harmonic analysis of tides
- Tidal record

4. Sounding

- Bathymetric plotting sheet, eastern portion
- Bathymetric plotting sheet, western portion
- Sounding sheet, eastern portion
- Sounding sheet, western portion
- Enlarged bathymetric plotting sheet, Tovuto Shoal area
- Enlarged bathymetric plotting sheet, Reported Shoal area
- Enlarged sounding sheet, Tovuto Shoal area
- Enlarged sounding sheet, Reported Shoal area
- Sounding book
- Bar-check table
- Check tables of sounding at line crossing

- Raw data from field survey
- Echo sounding records
- Records of Side-Scan Sonar
- Floppy disks of sounding data

5. Preparation of smooth sheet of survey

- Smooth sheet of survey
- Survey report
- Certificate of inspection

## COUNTERPART TRAINING PROGRAMME

(Study on the Preparation of Nautical Charts in the Northern Lau Islands Region, Phase II)

Name of counterpart : Mr. Philip Ronald HILL, Hydrographer, Fiji Hydrographic Service

Training period : 6 November to 15 December 1995

Date	Itinerary/Subject	Attendant	Venue
6 Nov. (Mon)	Leaves Fiji and arrive in Japan		
7 " (Tue)	Briefing at JICA	Coordinator	JICA
8 " (Wed)	Courtesy visit to Hydrographic Department, Maritime Safety Agency	Mr Oyamada	Tsukiji
9 " (Thu)	Courtesy visit to Head Offices of Aero Asahi Corporation (AAC) and Asia Air Survey Co.(AAS)	Coordinator	Ikebukuro & Shinjuku
10 " (Fri)	Visit to AAC Technical Center and Orientation	Mr Oyamada	Sayama
11 " (Sat)	Rest		
12 " (Sun)	do.		
13 " (Mon)	On-job training (OJT) on plotting of control points and preparation of control point sheet	Mr Saito	do.
14 " (Tue)	OJT on processing of sounding data	do.	do.
15 " (Wed)	OJT on preparation of sounding data	do.	do.
16 " (Thu)	OJT on processing of tidal data	do.	do.
17 " (Fri)	OJT on processing of coastlining data	do.	do.
18 " (Sat)	Rest		
19 " (Sun)	do.		
20 " (Mon)	Visit to Hydrographic Department, Maritime Safety Agency	Coordinator	Tsukiji
21 " (Tue)	Visit to survey vessels TAKUYO and TENYO	Mr Oyamada	Tokyo Bay
22 " (Wed)	Orientation to Erosion Prevention Project for	Mr Saito	Sayama
23 " (Thu)	Rest		
24 " (Fri)	Move to Kashima to observe the Project	Mr Saito	Kashima
25 " (Sat)	Returns to Tokyo	do.	
26 " (Sun)	Rest		
27 " (Mon)	OJT on correction of sound velocity to soundings at AAS Technical Center	Mr Kuga, Coordinator	Atsugi

28	"	(Tue)	OJT on shallow water area charting and preparation of coastline sheet	Mr Kuga Coordinator	Atsugi
29	"	(Wed)	do.	do.	do.
30	"	(Thu)	OJT on preparation of tidal analysis and datum level computation	do.	do.
1 Dec.	"	(Fri)	do.	do.	do.
2	"	(Sat)	Rest		
3	"	(Sun)	do.		
4	"	(Mon)	Moves to Hiroshima	Coordinator	Niroshima
5	"	(Tue)	Observation of hydrographic survey (6th RMSHQ.); move to Okayama	do. do.	Okayama
6	"	(Wed)	Visit to Bisan Seto Traffic Advisory Service Center; move to Hiro, Kure	do. do.	Hiro
7	"	(Thu)	Visit to Chugoku National Industrial Research Institute; move to Hiroshima	do.	Hiroshima
8	"	(Fri)	Returns to Tokyo		
9	"	(Sat)	Rest		
10	"	(Sun)	do.		
11	"	(Mon)	OJT on preparation of smooth sheet of survey	Mr Saito	Sayama
12	"	(Tue)	Questions and answers	do.	do.
13	"	(Wed)	Preparation of report on the training		
14	"	(Thu)	Evaluation meeting; leaves for Fiji	Coordinator	JICA
15	"	(Fri)	Arrives in Fiji		



## DIARY OF SURVEY WORK

No. of day	Date	Location	Work carried out
1	8/5 (Wed)	Lv. Narita	Study Team leader and senior surveyor left Japan.
2	9 (Thu)	Ar. Suva	Visits to JICA Fiji Office, Embassy of Japan and Director of Marine; P/O submitted to FHS.
3	10 (Fri)	Suva	Meeting at FHS to explain and discuss P/O.
4	11 (Sat)	"	Preparation of draft survey schedule at hotel.
5	12 (Sun)	"	Rest.
6	13 (Mon)	"	At FHS, M/M prepared and signed; discussions on details of survey schedule.
7	14 (Tue)	"	Seven members arrived from Japan. Meeting by Japanese members at FHS.
8	15 (Wed)	"	Crates of instruments and materials opened. Discussions on operation of survey vessel at FHS.
9	16 (Thu)	"	Installation of instruments on TOVUTO, and preparations for survey.
10	17 (Fri)	"	Preparations for survey; procurement of materials. Charterage of survey boat SCUBA QUEEN (SQ) to be used in Vanua Balavu (VBV) lagoon survey.
11	18 (Sat)	"	Four Japanese members and FHS survey team members left Suva for VBV by RAIYAWA. TOVUTO could not make a scheduled departure from Port of Suva due to failure in generators.
12	19 (Sun)	Suva VBV	Rest. Four Japanese members and FHS survey team members arrived in VBV.
13	20 (Mon)	Suva VBV	Acquisition of materials; preparations for survey on board TOVUTO. Survey base established; control point survey carried out for primary shore control point; tide station reestablished and tidal observation started.
14	21 (Tue)	Suva VBV	Preparations for survey. Preparations for survey.

15	22	(Wed)	Suva VBV	Preparations for survey. Control survey. Survey instruments installed on SQ.
16	23	(Thu)	Suva VBV	Four Japanese members and FHS C/Ps left Suva for survey site by TOVUTO. Instruments tested on SQ.
17	24	(Fri)	VBV	TOVUTO arrived. Test run by SQ.
18	25	(Sat)	"	Checking instruments on TOVUTO and SQ.
19	26	(Sun)	"	Rest.
20	27	(Mon)	Survey site	TOVUTO : Sounding; control survey. SQ : Sounding.
21	28	(Tue)	"	TOVUTO : Sounding; control survey.
22	29	(Wed)	"	TOVUTO : Sounding. SQ : Sounding.
23	30	(Thu)	"	TOVUTO : Sounding; control survey.
24	31	(Fri)	"	SQ : Sounding.
25	1/6	(Sat)	"	No sounding due to rough sea.
26	2	(Sun)	"	Rest; JHA inspector embarked TOVUTO.
27	3	(Mon)	"	No Sounding due to rough sea.
28	4	(Tue)	"	TOVUTO : Sounding. SQ : No sounding due to rough sea.
29	5	(Wed)	"	TOVUTO : Sounding; control survey. SQ : Sounding.
30	6	(Thu)	"	TOVUTO : Sounding; JHA inspector disembarked TOVUTO. SQ : Sounding.
31	7	(Fri)	"	TOVUTO : Sounding; control survey. Echo-sounder Bathy-2000P broken down and replaced by Bathy-1000. SQ : Sounding.
32	8	(Sat)	"	TOVUTO : Sounding. SQ : Sounding.
33	9	(Sun)	"	Rest.
34	10	(Mon)	"	TOVUTO : Sounding. SQ : Sounding.
35	11	(Tue)	"	TOVUTO : Sounding. SQ : Sounding.

36	12	(Wed)	Survey site	TOVUTO : Sounding; control survey. SQ : Sounding.
37	13	(Thu)	"	TOVUTO : Sounding; control survey. SQ : Sounding.
38	14	(Fri)	"	TOVUTO : Sounding; control survey. SQ : Sounding.
39	15	(Sat)	"	TOVUTO : Sounding; control survey; inspection by JHA at VBV tide station and aboard TOVUTO. SQ : Sounding.
40	16	(Sun)	"	Rest.
41	17	(Mon)	"	TOVUTO : Sounding; control survey. SQ : Sounding.
42	18	(Tue)	"	TOVUTO : Sounding; control survey. SQ : Survey instruments dismantled.
43	19	(Wed)	"	TOVUTO : Sounding; control survey. SQ : Left VBV for Suva.
44	20	(Thu)	"	TOVUTO : Sounding; control survey.
45	21	(Fri)	Suva	TOVUTO returned to Port of Suva.
46	22	(Sat)	"	Replenishment.
47	23	(Sun)	"	Rest.
48	24	(Mon)	"	Replenishment. Two Japanese members left Fiji for Japan.
49	25	(Tue)	"	Replenishment; TOVUTO left Port of Suva.
50	26	(Wed)	Survey site	TOVUTO arrived at survey site; no sounding due to rough sea.
51	27	(Thu)	"	Sounding; control survey.
52	28	(Fri)	"	Sounding; control survey.
53	29	(Sat)	"	Sounding.
54	30	(Sun)	"	Rest.
55	1/7	(Mon)	"	Sounding; control survey.
56	2	(Tue)	"	Sounding; control survey.
57	3	(Wed)	"	Sounding; control survey.
58	4	(Thu)	"	Sounding; control survey.
59	5	(Fri)	"	Sounding; control survey.
60	6	(Sat)	"	Sounding; control survey.

61	7	(Sun)	Survey site	A generator of TOVUTO broken down and TOVUTO left survey site for Port of Suva for repair of the generator.
62	8	(Mon)	"	TOVUTO returned to Port of Suva; checking of data.
63	9	(Tue)	"	Checking of data.
64	10	(Wed)	"	Checking of data.
65	11	(Thu)	"	Checking of data.
66	12	(Fri)	"	Preparations for survey.
67	13	(Sat)	"	Preparations for survey.
68	14	(Sun)	"	TOVUTO left Port of Suva for survey site.
69	15	(Mon)	"	Sounding; control survey.
70	16	(Tue)	"	Sounding; control survey.
71	17	(Wed)	"	Sounding; control survey.
72	18	(Thu)	"	Sounding; control survey.
73	19	(Fri)	"	Sounding; control survey.
74	20	(Sat)	"	Sounding; control survey.
75	21	(Sun)	"	Rest.
76	22	(Mon)	"	Sounding; control survey.
77	23	(Tue)	"	Sounding; control survey.
78	24	(Wed)	"	Sounding; control survey.
79	25	(Thu)	Suva	TOVUTO returned to Port of Suva; replenishment.
80	26	(Fri)	"	Replenishment.
81	27	(Sat)	"	Replenishment.
82	28	(Sun)	"	Rest.
83	29	(Mon)	"	Rest (National holiday).
84	30	(Tue)	"	TOVUTO left Port of Suva for survey site; JHA inspector embarked TOVUTO.
85	31	(Wed)	Survey site	TOVUTO arrived in VBV.
86	1/8	(Thu)	"	Sounding; control survey.
87	2	(Fri)	"	Sounding; control survey.
88	3	(Sat)	"	Sounding; control survey.
89	4	(Sun)	"	Rest. JHA inspector disembarked TOVUTO.
90	5	(Mon)	"	Sounding; control survey.
91	6	(Tue)	"	Sounding; control survey.

92	7	(Wed)	Suva	Consultations with JICA Fiji Office and Embassy of Japan regarding TOVUTO.
			Survey site	Sounding.
93	8	(Thu)	Survey site	Sounding.
94	9	(Fri)	"	Control survey; no sounding due to repair of crane aboard TOVUTO.
95	10	(Sat)	"	Control survey; no sounding due to repair of crane aboard TOVUTO.
96	11	(Sun)	"	Rest.
97	12	(Mon)	"	Sounding; control survey.
98	13	(Tue)	"	Control survey; installation of equipment on board BABALE.
99	14	(Wed)	"	Sounding; control survey.
100	15	(Thu)	Suva	Consultations with JICA Fiji Office, Embassy of Japan and Marine Department regarding TOVUTO.
			Survey site	Control survey; no sounding due to rough sea.
101	16	(Fri)	"	Sounding; installation of equipment aboard BABALE; control survey.
102	17	(Sat)	"	Sounding; control survey.
103	18	(Sun)	"	Rest.
104	19	(Mon)	Suva	TOVUTO came back to Port of Suva.
105	20	(Tue)	"	Checking of data.
106	21	(Wed)	"	Checking of data.
107	22	(Thu)	"	Checking of data.
108	23	(Fri)	"	Checking of data.
109	24	(Sat)	"	Checking of data.
110	25	(Sun)	"	Rest.
111	26	(Mon)	"	Checking of data.
112	27	(Tue)	"	Checking of data.
113	28	(Wed)	"	Checking of data; replenishment.
114	29	(Thu)	"	Checking of data; replenishment.
115	30	(Fri)	"	Meeting by Study Team, FHS and TOVUTO for survey schedule; checking of data.
116	31	(Sat)	"	Checking of data.
117	1/9	(Sun)	"	Rest.
118	2	(Mon)	"	Preparations for survey.

119	3	(Tue)	Suva	Preparations for survey; TOVUTO left Port of Suva for survey site.
120	4	(Wed)	Survey site	TOVUTO arrived in VBV.
121	5	(Thu)	"	Sounding by BABALE; reconnaissance at Lakeba
122	6	(Fri)	"	Sounding by BABALE; reconnaissance at Lakeba.
123	7	(Sat)	"	JHA inspector embarked TOVUTO.
124	8	(Sun)	"	Rest.
125	9	(Mon)	"	Sounding; control survey.
126	10	(Tue)	"	Sounding; control survey.
127	11	(Wed)	"	No sounding due to rough sea.
128	12	(Thu)	"	Sounding; JHA inspector disembarked TOVUTO.
129	13	(Fri)	"	Sounding. One member left Japan.
130	14	(Sat)	"	Sounding. One member arrived in Suva.
131	15	(Sun)	"	Rest.
132	16	(Mon)	"	No sounding due to rough sea.
133	17	(Tue)	"	Sounding.
134	18	(Wed)	Survey site	No sounding due to rough sea.
135	19	(Thu)	"	No sounding due to rough sea.
136	20	(Fri)	"	Sounding.
137	21	(Sat)	"	Sounding.
138	22	(Sun)	"	Rest.
139	23	(Mon)	"	Sounding.
140	24	(Tue)	"	Reconnaissance of Study Area IV.
141	25	(Wed)	"	Reconnaissance of Study Area IV.
142	26	(Thu)	"	Reconnaissance of Study Area IV.
143	27	(Fri)	"	TOVUTO arrived at Lomaloma.
144	28	(Sat)	"	Removal of primary shore control station and tide station.
145	29	(Sun)	"	Rest.
146	30	(Mon)	"	Removal of survey base. TOVUTO left Lomaloma.
147	1/10	(Tue)	Suva	TOVUTO arrived in Port of Suva.
148	2	(Wed)	"	Dismantling TOVUTO of survey instruments.
149	3	(Thu)	"	Sorting and packing of instruments and data.
150	4	(Fri)	"	Packing of instruments.
151	5	(Sat)	"	Dispatching of instruments.

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152	6	(Sun)	Suva	Rest.
153	7	(Mon)	"	Rest (National holiday).
154	8	(Tue)	"	Concluding meeting by the Study Team, FHS and Marine Department at FHS. Three Japanese members left Fiji for Japan.
155	9/10	(Wed)	Suva	M/M prepared and signed by Study Team Leader and Fiji Chief Hydrographer; preparation for returning to Japan.
156	10	(Thu)	"	Report to JICA Fiji Office and Embassy of Japan.
157	11	(Fri)	Lv. Suva	Study Team left Suva and arrived in Auckland.
158	12	(Sat)	Ar. Narita	Study Team left Auckland and returned to Japan.

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)  
MINISTRY OF INFRASTRUCTURE, PUBLIC WORKS AND TRANSPORT, FIJI

PLAN OF OPERATION  
FOR  
THE STUDY ON THE PREPARATION OF NAUTICAL CHARTS  
IN  
THE NORTHERN LAU ISLANDS REGION  
IN  
THE REPUBLIC OF FIJI

PHASE III

(THE THIRD YEAR – F.Y. 1996)

APRIL 1996

AERO ASAHI CORPORATION  
ASIA AIR SURVEY CO., LTD.



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## 1. INTRODUCTION

The Government of the Republic of Fiji requested the Government of Japan for technical cooperation in the Study on the Preparation of Nautical Charts in the Northern Lau Islands Region in the Republic of Fiji.

In response to the request, the Japan International Cooperation Agency (JICA), the official agency responsible for implementation of the technical cooperation programmes of the Government of Japan, dispatched a Preparatory Study Team to Fiji from 15 February to 15 March 1994, and the Scope of Work (S/W) was agreed between JICA and the Ministry of Infrastructure, Public Works and Transport on 15 March 1994.

According to S/W, the objectives of the Study are:

- (1) To prepare three Fiji nautical charts, Nos.F52, F53 and F54, each on the scale of 1/150,000, covering the Northern Lau Islands region;
- (2) To report the recommendation for improvement of operation and management system of hydrographic surveying and nautical charting in Fiji; and
- (3) To promote technology transfer through the implementation of the Study with a view to enabling the Fiji counterpart personnel to improve their technique in hydrographic surveying and nautical charting.

The work in the First Year (Phase I) of the Study was conducted from 13 January to 30 March 1995, during which a Study Team was dispatched to Fiji for consultation of the Plan of Operations for Phase I (P/O-I) to the Fiji Hydrographic Service (FHS), Marine Department, Ministry of Infrastructure, Public Works and Transport, and for making preparations for hydrographic surveys in the forthcoming phases. P/O-I containing an overall plan for the five-year Study and a detailed plan of the Phase I work was agreed upon by JICA and the Ministry of Infrastructure, Public Works and Transport on 27 January 1995.

In the Phase I work, (1) selection of survey equipment to be used, (2) acquisition of aerial photographs and other source materials for the ensuing work, (3) reconnaissance of survey sites for Phase II work and (4) confirmation of survey implementation and support systems were conducted in Fiji, and tentative drawing of coastlines of islands and atolls of the whole Study area were performed in Japan.

To conclude the Phase I work, the Progress Report of Phase I work (PR/R-I) was submitted to the Government of Fiji from JICA, in which problems encountered and overcome and suggestions to the work in Phase II were included.

Pursuant to Phase I, the work in the Second Year (Phase II) of the Study was conducted from 13 June 1995 to 29 March 1996. During this period, a Study Team was dispatched to Fiji to conduct the work on: (1) consultation and agreement on the Plan of Operation for Phase II (P/O-II), (2) hydrographic survey in the Study Area F52 to prepare a smooth sheet of survey, and (3) technology transfer to Fiji counterpart personnel. The data obtained by the survey were then processed in Japan and the smooth sheet of survey for Area F52 was prepared. The progress of work in Phase II including suggestions to the Phase III work, was compiled into Progress Report (PR/R-II), which was then submitted to the Government of Fiji from JICA.

Based on P/O-I, P/O-II and PR/R-II above, this Plan of Operation for Phase III (P/O-III) is worked out to give a detailed plan of hydrographic survey for preparation of a smooth sheet of survey for Study Area F53 as well as of the pre-work and post-work in Japan, including the work for preparation of the nautical chart No.F52.

Other than those matters described in this P/O-III, all the contents of P/O-I agreed in January 1995 remain effective and are to be applied to the Study in Phase III.

## 2. GENERAL

### 2-1. Objectives

The objectives of the Study in Phase III are as follows:

- (1) To conduct hydrographic survey in Study Area F53 to prepare a smooth sheet of survey.
- (2) To produce Fiji nautical chart No.F52.
- (3) To render technology transfer to Fiji counterpart personnel during the survey and data processing for Study Area F53 as well as during the large-scale survey in Vanua Balavu by FHS.

### 2-2. Study period

- (1) Pre-work in Japan  
From 23 April to 7 May 1996.
- (2) Work in Fiji  
From 8 May to 5 October 1996.
- (3) Post-work in Japan  
From 8 October 1996 to 31 March 1997.

### 2-3. Study area

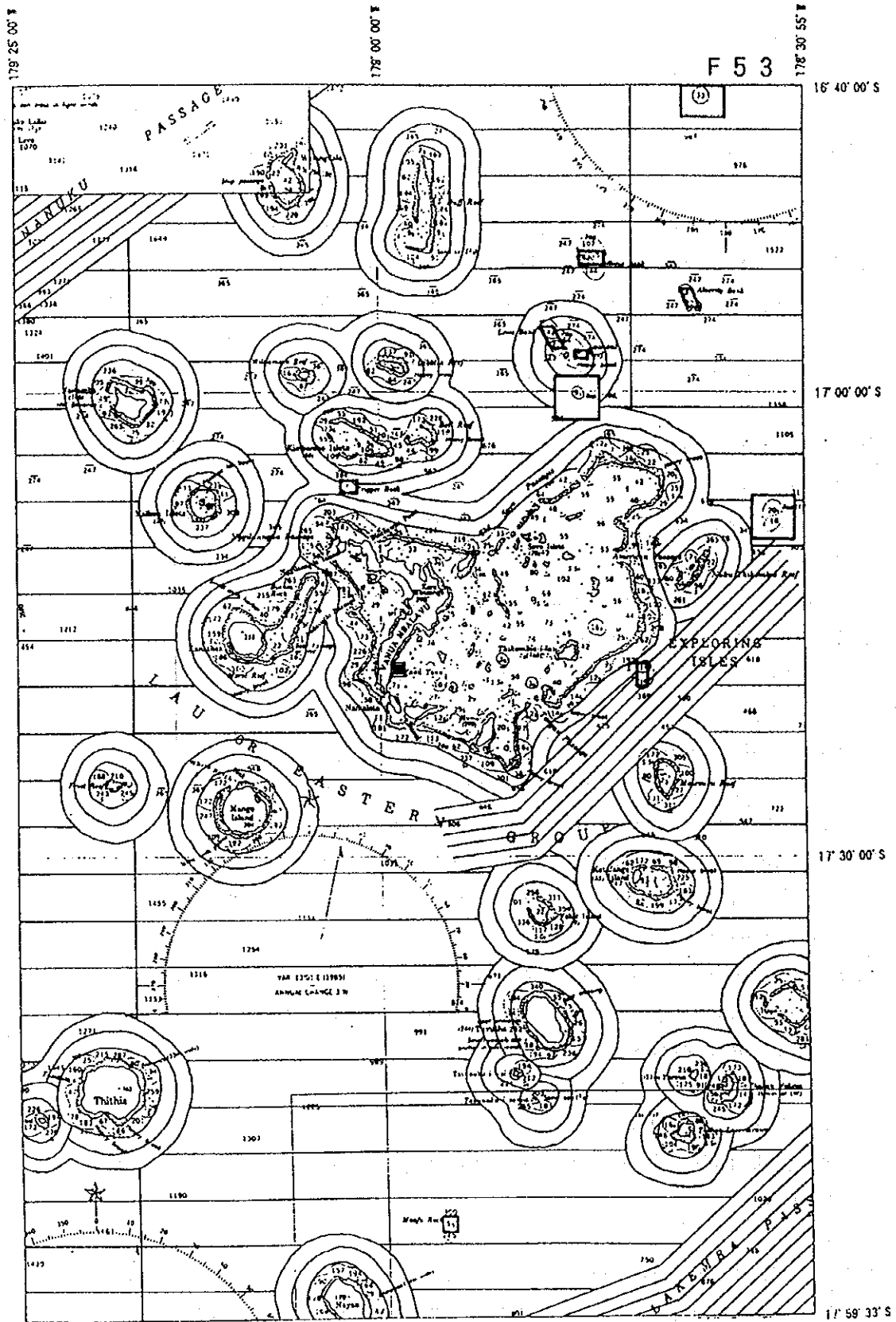
- (1) Hydrographic survey will be conducted in the Study Area F53 bounded by the following parallels and meridians:  
Lat.  $17^{\circ} 59' 33''$  S and  $16^{\circ} 40' 00''$  S  
Long.  $179^{\circ} 25' 00''$  W and  $178^{\circ} 30' 55''$  W  
(As shown in Fig.1.)
- (2) Continuous tidal observation will be conducted at Lomaloma, Vanua Balavu (Lat.  $17^{\circ} 17.7'$  S, Long.  $178^{\circ} 59.3'$  W approx.).

### 2-4. Flow of work

The flow of work to be carried out is as shown in Appendix 1.

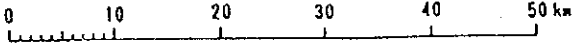
### 2-5. Schedule of work

The schedule of work is as shown in Appendix 2.



F 5 3

- Legend
- Sounding line
  - Field base, Tide gauge
  - Shoal/Reported depth



### 3. IMPLEMENTATION PLAN OF THE STUDY IN PHASE III

#### 3-1. Pre-work in Japan

##### 3-1-1. Planning

Based on the information, data and materials collected by the JICA Preparatory Study Team as well as by the Study Team during Phases I and II, a detailed plan for implementation of the Study in Phase III will be worked out, in which the suggestions made in the Progress Report of Phase II work (PR/R-II) will be taken into account.

##### 3-1-2. Preparation of Plan of Operation (P/O-III)

P/O-III for Phase III Study will be prepared on the basis of S/W, P/O-I, P/O-II and PR/R-II as well as the detailed plan in 3-1-1 above.

P/O-III will describe details of the hydrographic survey as to methods, amount of work, accuracies, etc., pre-work and post-work in Japan and the survey products from Phase III work, as well as the items for which co-operation from the Fiji side is requested and others matters.

##### 3-1-3. Preparations for survey

Preparations for the survey work in Phase III will thoroughly be made. For example, preliminary photo-interpretation of topography will be made on the islands and atolls in the Study area, various boat sheets prepared, computer software supplemented, and instruments and materials necessary for the survey procured, tested, adjusted and dispatched by air to Fiji.

#### 3-2. Work in Fiji

##### 3-2-1. General

- (1) Composition of Study Team is as shown in Appendix 3.
- (2) Survey equipment and instruments to be used in the field work are as listed in Appendix 4.

(3) As for hydrographic survey standards, the International Hydrographic Organization (IHO) Standards for Hydrographic Surveys (S-44) shall in principle be applied unless otherwise stated.

#### 3-2-2. Explanation of P/O-III and consultation

P/O-III thus prepared will be submitted to FHS for explanation by the Study Team, and consultation will be held to reach agreements on the content.

#### 3-2-3. Preparations for field work

The Study Team will proceed to implementation of the Study without delay after arrival in Fiji, such as customs clearance and checking of survey instruments and materials.

#### 3-2-4. Installation and test of survey instruments aboard the survey vessel

All the necessary survey instruments will be installed on board R/V TOVUTO at Port of Suva, and then tested and adjusted before leaving for the survey area.

#### 3-2-5. Field work

##### 3-2-5-1. Establishment of a field base

For starting the field work, a field base will be established at Lomaloma, Vanua Balavu, which will be used for accommodation of the Study Team members and Fiji counterparts as well as for storage and maintenance of survey instruments and materials.

##### 3-2-5-2. Control point survey

(1) The standard of survey will be as follows:

Ellipsoid of reference : WGS-72

Grid system : FMG (Fiji Map Grid)

Origin of coordinates : 17° 00' 00" S, 179° 45' 00" E

Values of coordinates : 2,000,000mE and 4,000,000mN

Scale factor : 0.999850

Projection : Transverse Mercator (TM) projection



- (2) A primary shore control point for fixing positions of auxiliary shore control points and the survey vessel will be established by DGPS observation with two or more existing control points.
- (3) Auxiliary shore control points to be used for coastlining and fixing positions of conspicuous objects will be established by open DGPS observations with an existing control point or the primary shore control point.
- (4) Auxiliary shore control points for coastlining will be selected one to three per an island or an atoll where landing is feasible, where open DGPS observations will be conducted. In case of an extensive island or atoll selection of auxiliary control points will be made at a rate one in every 10cm at the scale of survey, in principle.
- (5) Transformation parameters from WGS-84 to FMG will be as follows:

Parameter	Value
Shift dX	79.027m
Shift dY	-70.749m
Shift dZ	-102.333m
Rotation about X	-0.852520"
Rotation about Y	-3.876562"
Rotation about Z	2.648162"
Scale	7.420964ppm

- (7) Specifications for GPS observation will be as follows:

- 1) Performance of GPS receiver

Model : Trimble 4000SSE (3 sets)

Receivable frequency : 1,575.42MHz (L1) and 1,227.6MHz (L2)

Capability :  $\pm(5\text{mm} + 1 \times 10^{-6} \times D)$  or more, where D is distance (km)

- 2) Observation will be made to more than four satellites of good health status at elevation angles of more than 15 degrees.

3) Duration of observation will be as follows:

Primary control point : 90 minutes or more.

Auxiliary control point : 20 minutes or more.

4) The accuracy of the primary control point shall be no more than 1/10,000. The relative positioning error shall be no more than 0.25mm at the scale of survey in case where the survey may cover an extensive area.

The accuracy of an auxiliary control point shall be no more than 0.5mm at the scale of survey.

#### 3-2-5-3. Coastlining

(1) For delineation of coastlines, pricking will be made at selected points on the contact print aerial photographs (scale : 1/50,000) after confirming the conformity between picture and actual topography.

(2) Coastlining will be carried out at such coastlines where considerable changes have been found between the aerial photography and actual topography. It will also be carried out in such places where tentative drawing of coastline was found difficult during the work in Phase I due to clouds, halation or other reasons.

(3) For a conspicuous object useful to navigation with unknown height, measurement of the height will be carried out as far as possible.

#### 3-2-5-4. Tidal observation

##### 3-2-5-4-1. Tide station at Vanua Balavu

(1) A self-recording tide gauge will be set at the previous site on the pier of Lomaloma, Vanua Balavu, prior to the commencement of sounding operation.

(2) Continuous observation of tide will be conducted throughout the period of sounding operation.

(3) The type and specifications of the tide gauge to be used will be as follows:

Type : Pressure type tide gauge YEO-KAL Model 610

Recording mode : Digital

Accuracy : 0.0025m at 0-10m range

Resolution : 0.001m at 0-10m range

Data logging rate : Every 5 minutes

- (4) In parallel with the tide gauge above, the following tide gauge will be set as a backup:

Type : Floating type tide gauge model PFT-II

Recording mode : Analog

Reduction ratio : 1/20

Paper speed : 20mm/h

Recording interval : Continuous recording

Minimum graduation : 1cm

- (5) To determine the zero of tide gauges, levelling will be carried out between the tide gauges and the BMs established in Phase II.
- (6) The time kept on the recording paper of PFT-II will be checked with the correct local time at least once a day.
- (7) Mean Sea Level (MSL) and Datum Level (DL) of sounding determined in Phase II will be used for the Phase III work, which will be duely checked by the data obtained from the observation during Phase III.

#### 3-2-5-5. Sounding operation

##### 3-2-5-5-1. Position fixing

- (1) Ship's positions will be fixed by DGPS observation with the primary shore control point. Real time processing will be made for the observation.
- (2) The following DGPS receivers will be used:
- (a) Main : Sercel NDS200/NR103
  - (b) Backup : Del Norte 1009/4012
- (3) The interval between the position fixes at the scale of survey shall be 2cm or less in case of a linear sounding line, and in case of a curved one, shall be such that maintains the plotting error of any cut-in sounding to be within a circle with a 1.5mm radius on the sheet.

3-2-5-5-2. Sounding

- (1) The sounding lines planned in the area F53 are as shown in Fig.1.
- (2) The vessel to be used for sounding will be R/V TOVUTO, and in such shallow waters where R/V TOVUTO is unable to navigate, SMB BABALE will be used for sounding.
- (3) The planned sounding distances are as follows:  
Deep water areas : 1,743km  
Shipping routes : 795km  
Around islands and atolls : 2,751km  
Reported shoals, shoals and banks : 691km  
Total distance : 5,980km
- (4) The sounding line intervals will be as follows:  
Deep water areas : 3M  
Shipping routes : 1.5km  
Around islands and atolls : 1M  
Reported shoals, shoals and banks : 200m or less (with Side Scan Sonar)
- (5) The ship's speed during sounding operations will, in principle, be as follows:  
Deep water areas and shipping routes: 8-10 knots  
Other areas : 4-6 knots.  
However, the speed will be reduced to ensure accurate sounding owing to circumstances.
- (6) The echo-sounder Model Bathy-2000P installed on board R/V TOVUTO will principally be used.  
For confirmation of the least depth of a shoal, a four-beam echo sounder for shallow water use, Model PDR 601, will be used. Specifications of these echo-sounders are as follows:

	Bathy-2000P	PDR 601
Depth range	0.5 - 6,000m	0 - 140m
Frequency	12/200kHz	90 - 230kHz
Sound velocity	1,400 - 1,540m/sec	1,500m/sec
Accuracy	±10cm to 100m depth, ±0.3% to 6,000m depth	±(0.3+DX1/500)
Resolution	180 DPI	--
Minimum reading	--	0.1m

As a backup of Bathy-2000P, the following echo-sounder will also be installed aboard R/V TOVUTO, and will be used when Bathy-2000P is not operational.

Model	Specifications	
Bathy-1000	Depth range	0.5 - 6,000m
	Frequency	12/200kHz
	Accuracy	±10cm to 100m depth, ±0.3% to 6,000m depth
	Resolution	1/2400 over paper width

(7) Correction to soundings

- i) Tidal reduction to soundings will be made to the depths of 200m or less.
- ii) Correction to soundings for underwater sound velocity will be made by bar-check method down to depths of 50m, and by the echo-sounding correction tables to deeper depths.

(8) The accuracy of sounding shall be as follows:

Depths 30m and shallower : Less than 0.3m  
Depths deeper than 30m : Less than 1% of the depth

- (9) For confirmation of the least depth of a shoal, recordings of echo-sounder and Side Scan Sonar will be compared, and if any shallower water is likely to exist, interlines will be sounded.

The following Side Scan Sonar will be used:

EG&G Model 260 Image Correcting Side Scan Sonar

Range (m) : 25 50 75 100 150 200 300 400 600  
(each side)

Scale : 1/(10 X range)

Resolution: 1/400 of range

Another same type Side Scan Sonar will be used as a backup.

- (10) Supplementary sounding or resounding will be conducted as follows:

- 1) In case where sounding line intervals have become more than 20% wider than the planned interval, interline sounding will supplementarily be conducted.

- 2) In case where a depth of less than 30m considered to be dangerous to navigation is likely to exist in between the sounding lines, supplementary sounding will be conducted to confirm its least depth.
- 3) Resounding will be conducted in such waters where the sounding record on the echogram is extraordinary, illegible or lacking.
- 4) In case where the difference between soundings at the crossing point of a principal sounding line and a cross-check sounding line exceeds twice the value of the accuracy of sounding, resounding will be carried out when the previous sounding data are considered to have exceeded an allowable error.

#### 3-2-6. Co-operation in technology transfer for Vanua Balavu lagoon survey

##### (1) Co-operation by experts

Two Japanese experts will join the FHS survey team for their hydrographic survey in the Vanua Balavu lagoon (Exploring Isles) to render technology transfer to Fiji counterpart personnel. The survey area is as shown in Fig.2.

##### (2) Provision of equipment

The Study Team will provide the FHS survey team with survey equipment as follows:

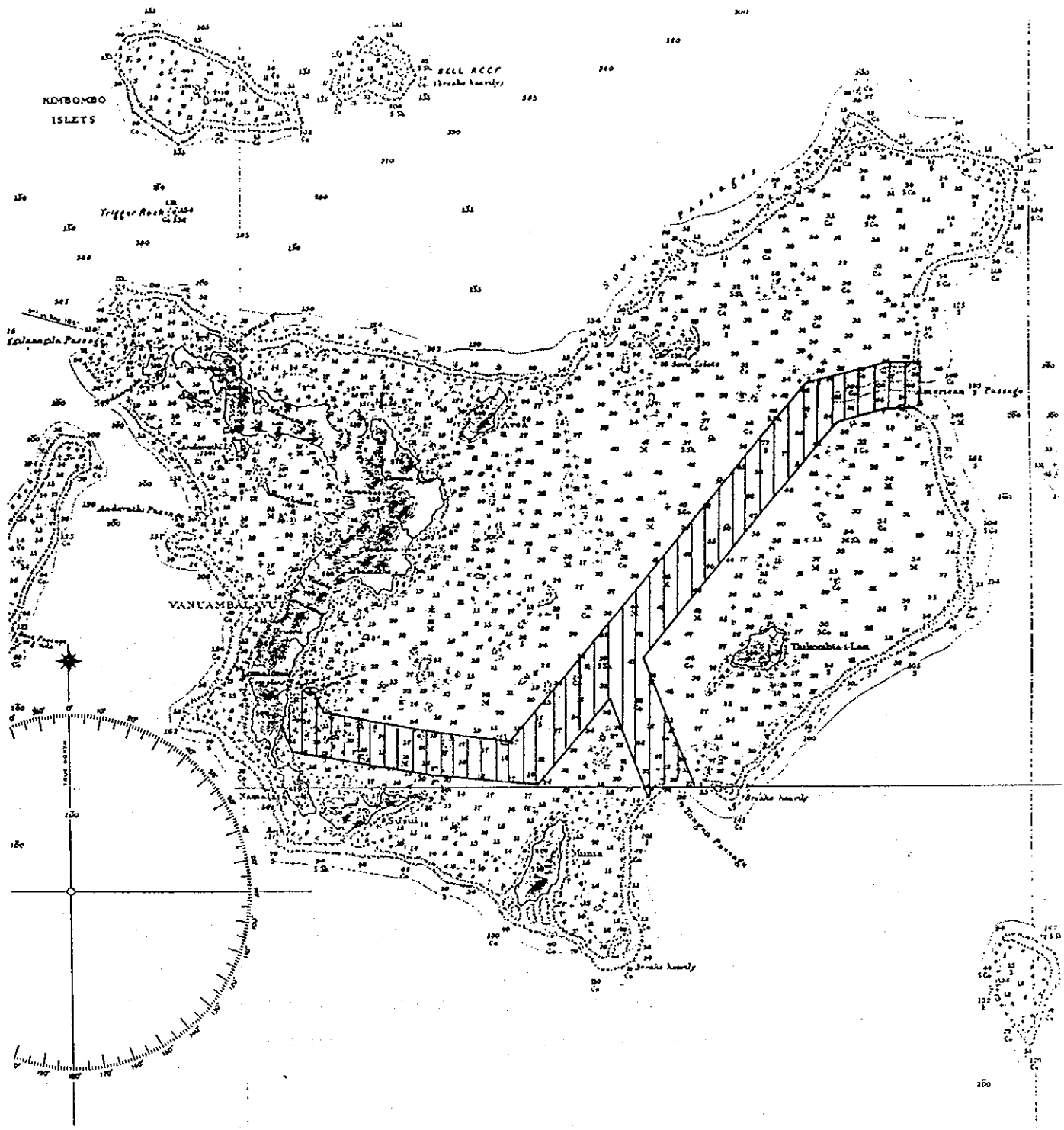
- 1) Survey launch of about 5 tons (locally chartered)
- 2) Four-beam echo sounder for shallow water use (PDR 601)
- 3) Side Scan Sonar (EG&G Model 260)
- 4) Plotter (equivalent to the one used on board R/V TOVUTO during Phase II)

#### 3-2-7 Field inspection


Inspection of the field work will be conducted by a qualified member of JHA.

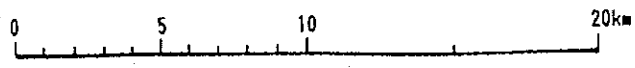
Fig. 2

# HYDROGRAPHIC SURVEY IN VANUA BALAVU LAGOON



Legend

 Survey area



### 3-3. Post-work in Japan

#### 3-3-1. Data processing

##### 3-3-1-1. Control point survey

(1) Computation of control points will be performed by a computer with an approved programme.

(2) Results of control point survey for preparation of manuscript sheets for F53 will be shown on rectangular coordinates with the following standards:

Ellipsoid : WGS-72

Origin of coordinates :  $17^{\circ} 20' 00''$  S  $179^{\circ} 00' 00''$  W

Coordinate values of origin : X = 0.00m, Y = 0.00m

Scale factor : 1.000000

Projection : Transverse Mercator projection

(3) Latitudes and longitudes of the primary shore control point and auxiliary control points will be computed.

Such computation will also be made to graticule points at every 10cm from the origin of coordinates.

(4) The results of control point survey will be stored in floppy disks and compiled into final results of control point survey, list of geographical coordinates and index sheet of geographical positions, data list of control point survey and geodetic station records.

##### 3-3-1-2. Coastlining

Coastlines will be drawn by adopting those on the existing nautical charts and topographic maps as far as possible. The rest will be drawn according to the coastline drawings prepared during Phase I, which will be based on the results of coastlining conducted in the field.

##### 3-3-1-3. Tidal observation

(1) The mutual relationship between the zero of tide gauge at the Vanua Balavu tide station, MSL, DL and BM will be compiled into the results of reference measurement of the tide station and data of measurements.



- (2) As for MSL and DL, the method of computation and the data of measurement will be compiled into a book of determination of reference levels of tide station.

#### 3-3-1-4. Sounding

- (1) Soundings will be read out to 0.1m order for those shallower than 31m, and to 1m order for deeper ones, disregarding fractions.
- (2) Soundings of shallower than 200m will be reduced for tidal heights.
- (3) In reading out the soundings shallower than 50m for which bar-check was carried out, the reading-scale prepared from the results of bar-check will be used for correction of underwater sound velocity. For the correction to deeper soundings, the correction tables will be used.
- (4) Positions of soundings will be selected on the echogram with priorities given to summits and bottoms of seabed undulations and transition points of slopes.
- (5) Intervals of cut-in soundings to be read out will be so selected that they may be less than 10mm on the flat bottom and less than 5mm elsewhere on the sheet.

#### 3-3-2. Preparation of manuscript sheets

##### 3-3-2-1. Control point sheet

Projection : Transverse Mercator (TM) projection

Scale : 1/150,000

Material : Plastic sheet with a thickness of 0.125mm  
or more

Items to be shown :

- 1) Existing and new control points and auxiliary control points with symbols and names
- 2) Origin of coordinates, coordinate points at intervals of 10cm based on the origin

- 3) Graticule points of every 15 minutes of latitude and longitude
- 4) Positions and symbols for the four corners of the neatline.
- 5) Metric scale.

Plotting error : Less than 0.2mm on the sheet.

#### 3-3-2-2. Coastline sheet

Projection, scale and material : Same as 3-3-2-1 above.

Items to be shown :

- 1) Existing control points and those auxiliary control points necessary for delineation of coastlines
- 2) Coordinate points at 10cm intervals
- 3) Every 15-minute graticule points
- 4) Coastlines taken from aerial photographs and existing source materials, for which any correction to scale and distortion in topography has been rectified by using common points on the coastline sheet.

Symbols and abbreviations : In accordance with those adopted by the Hydrographic Department of Japan Maritime Safety Agency (JHD) for the smooth sheet of survey.

Elevation : Elevation of an object measured in the field will be shown to 0.1m order for less than 10m and to 1m order for 10m or higher.

#### 3-3-2-3. Sounding sheet

Projection, scale and material : Same as 3-3-2-1 above.

Items to be shown :

- 1) Existing control points and those control points and auxiliary control points necessary for sounding operation
- 2) Coordinate points spaced at 10cm
- 3) Graticule points spaced at every 15 minutes

- 4) All of the positions fixed shall be shown. However, in such an area where a dense survey for searching a shoal was conducted so that plotting all of the fixed positions may not be possible, they will be shown on a separate larger-scale sheet.
- 5) Sounding positions will be connected with a firm line according to a chronological order, and the position fix number will be marked against every fifth sounding position.
- 6) The position of a cut-in sounding will be marked with a 1mm-long dash crossing the sounding line at right angles.
- 7) The plotting error of sounding positions shall be less than 0.5mm on the sheet.
- 8) Navigational aids such as buoys and beacons existed within the survey area will be shown with their positions and shapes.

#### 3-3-2-4. Bathymetric plotting sheet

Projection and scale : Same as 3-3-2-1 above.

Material : Plastic sheet with a thickness of 0.075mm or more.

Items to be shown :

- 1) Control points, coordinate points, graticule points spaced at every 15 minutes and four corners of the neatline.
- 2) Positions of soundings will be transferred from 3-3-2-3 above, each of which is shown with a red point, and the corresponding sounding value will be marked against it.
- 3) All of those soundings selected in 3-3-1-4 above shall be shown.

As to such a protruded echo of an object not constituting the sea bottom, it will be marked with an identification note if it is identified, or if not, with an abbreviation "e0".

4) Should there be charted on existing source materials any sounding, wreck or fishing reef which is shallower than the sounding in 3) above and considered dangerous to surface navigation, the one to be adopted will be determined after careful examination of the previous report concerned and the results of survey conducted in this Study.

5) The depth contours to be shown on the bathymetric plotting sheet shall be those of 2m, 5m, 10m, 20m, 200m, 1000m and every 1000m for deeper waters.

### 3-3-3. Preparation of smooth sheet of survey

#### 3-3-3-1. Smooth sheet of survey

Projection : Transverse Mercator projection

Scale : 1/150,000

Material : Plastic sheet with a thickness of 0.125mm or more

Title : FIJI ISLANDS

LAU GROUP—NORTHERN PORTION

NANUKU PASSAGE TO LAKEBA PASSAGE

Items to be shown:

- 1) Control points, graticule points and neatline corner points.
- 2) The neatlines of the smooth sheet, drawn in parallel with the lines joining the coordinate points in S-N and E-W directions.
- 3) Coastlines to be transferred from the coastline sheet.

4) Soundings in slant figures based on the bathymetric plotting sheet. Standard intervals for soundings to be shown will be 10-20mm on the sheet.

Priorities will be given to the soundings in shallow waters.

Soundings will be so selected that they may well represent the sea bottom configurations.

5) The depth contours to be shown are 2m, 5m, 10m, 20m, 200m, 1000m and every 1000m for deeper waters.

Checking : The contents shown on the smooth sheet should be thoroughly checked with manuscript sheets and source materials used for any erroneous or lacking indication.

Colouring : Colouring of symbols to be shown on the smooth sheet shall be in accordance with those prescribed in the Regulations of the Law for Hydrographic Surveys and Detailed Regulations for the Application of the Law for Hydrographic Surveys specified by JHD.

#### 3-3-3-2. Inspection

The smooth sheet of survey thus prepared shall undergo due inspection by the Japan Hydrographic Association (JHA),

3-3-4. Preparation of nautical chart No.F52

The preparation of Chart No.F52 will be undertaken by JHD upon receipt of the results of the hydrographic surveys and other relevant materials and data from JICA.

3-3-4-1. Chart specifications, basic factors and principles

- (1) Projection: Mercator Projection
- (2) Geodetic system: Fiji Geodetic Datum (FGD), which is equivalent to WGS 72
- (3) Corner coordinates:  $16^{\circ} 46' 58''$  S,  $15^{\circ} 55' 00''$  S  
 $179^{\circ} 32' 57''$  E,  $179^{\circ} 04' 30''$  W
- (4) Title: FIJI ISLANDS  
VANUA LEVU-NORTHERN PORTION  
NATEWA BAY TO NANUKU PASSAGE
- (5) Scale: 1:150,000 (at Lat.  $16^{\circ} 20'$  S)
- (6) Graticules: Every 15 minutes of latitude and longitude
- (7) Graticules graduated: Parallel of  $16^{\circ} 20'$  S  
Meridians of  $180^{\circ}$  and  $179^{\circ} 30'$  W
- (8) Graduation on the borders: Every 0.2 minute of latitude and longitude
- (9) Chart paper: The same paper as currently used by JHD; size 1,085 x 765mm, weight 140g/m<sup>2</sup>
- (10) Unit of measure for depths: In metres and reduced to Chart Datum, which is approximately the level of Lowest Astronomical Tide (LAT)
- (11) Unit of measure for heights: In metres and above Mean High Water Springs
- (12) Title block including:
  - Title of the chart
  - FHS seal
  - General geographical area and specific geographical reference

- Chart scale
  - Unit of measure for depths and heights
  - Name and date of the horizontal datum used
  - Name of the projection used
- (13) Source diagram : Showing source material data
- (14) Conversion table: For metres/fathoms/feet
- (15) Compass roses: Three compass roses on the chart
- (16) Existing source materials to be adopted: Existing smooth sheets covering the area concerned, Fiji Charts Nos.F50 and F51 and BA Chart No.495 will be adopted for the areas other than those where the hydrographic survey was carried out during Phase II of the Study.

#### 3-3-4-2. Compilation planning

Based on the results of hydrographic surveys as well as the existing data and information collected, the planning sheet and the planning note will be prepared for the chart.

##### (1) Preparation of planning sheet

The following items will be indicated on the planning sheet:

- 1) Borders and neatlines of the chart
- 2) Graticules
- 3) Graduation
- 4) Information on and the coverage of the existing data to be adopted on the chart
- 5) Chart title
- 6) Notes to be given in the title block
- 7) Chart number
- 8) Tidal notes
- 9) Cautionary notes
- 10) Submarine cables
- 11) Source diagram
- 12) Geographical names
- 13) Other data and information to be adopted on the chart

(2) Preparation of planning note

The planning note will be prepared, listing or indicating the following items:

- 1) Type of the chart (new chart or new edition of the chart) to be produced
- 2) Ellipsoid of reference
- 3) Chart scale and projection
- 4) Coverage and neatline dimensions, as well as the corner coordinates
- 5) Units of measures
- 6) List of source materials to be adopted
- 7) Use of colours
- 8) Positions of compass roses, as well as magnetic variations and their annual change
- 9) Other data and information as well as directions and instructions necessary for compilation of the chart

3-3-4-3. Preparation of drawing guide

Based on the planning sheet and the planning note prepared, a drawing guide will be prepared on the plating film exactly on the same scale as that of the chart to be produced.

3-3-4-4. Preparation of chart original

(1) Chart drawing

The chart original (original drawing) of the chart which is a manuscript for platemaking will be prepared based on the drawing guide prepared, in conformity with the IHO Chart Specifications. The chart original will be prepared on the plastic sheets by the scribing method, and sounding figures, chart symbols, compass roses, and geographical names and various type faces to be given on the chart will be prepared by phototypesetting and stuck up on the plastic sheets.

- (2) Two sheets of the chart original will be prepared, one for black colour and the other for magenta colour.



#### 3-3-4-5. Verification and examination of chart original

The chart original will be checked for consistency, accuracy and adequacy according to the contents of the drawing guide. The chart representation will also be examined. Items to be checked and examined will include the following:

- (1) The format as a nautical chart.
- (2) The original drawing is examined to ensure that it does not exceed the maximum possible printing size.
- (3) Whether the original drawing is drafted in accordance with the Chart Specifications of the IHO.
- (4) Whether the contents are adequately checked to suit the purpose of the chart
- (5) Whether the representation of the chart is comprehensive to users.
- (6) To ensure that it is checked up to the latest Notices to Mariners affecting the chart to be printed. The charted information has to be updated according to additional data and/or Notices to Mariners. Such additions or corrections will be made on the original drawing up to the time of the platemaking process.

#### 3-3-4-6. Platemaking

##### (1) Preparation of original plates

By using the chart original completed, the following original plates (negative films) will be prepared:

- 1) Original plate for black colour (for chart borders and neatlines, coastlines, geographical names, etc.)
- 2) Original plate for magenta colour (for distinguishing information superimposed)
- 3) Original plate for buff colour (for land tint)
- 4) Original plate for blue colour (for shallow water areas)

##### (2) Preparation of machine plates

By using each of the four original plates (negative films) prepared, the machine plates will be prepared by printing negative images on the PS plates, for which the final checking and inspection will be made.

### 3-3-4-7. Chart printing

(1) Using the printing plates made from the chart original prepared by JHD, 200 copies of the nautical chart F52 will be printed.

### (2) Printing specifications

- 1) Type of printing : Offset printing
- 2) Colour : Black, magenta, blue and buff

### 3-3-5. Inspection of printed chart

The printed chart No.F52 shall undergo due inspection by JHA.

### 3-3-6. Preparation of Progress Report (PR/R-III)

The PR/R-III describing the progress of work up to Phase III Study, problems encountered and countermeasures taken, suggestions to the work in the future, etc. will be prepared and submitted to the Fiji government.