

**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)  
THE UNITED NATIONS TRANSITIONAL ADMINISTRATION  
IN EAST TIMOR (UNTAET)**

**SUMMARY OF FINAL REPORT**

**FOR**

**THE STUDY ON URGENT ESTABLISHMENT OF**

**TOPOGRAPHIC MAPPING**

**IN EAST TIMOR**

**August 2000**



**ASIA AIR SURVEY CO., LTD. (AAS)**

<b>SFF</b>
<b>JR</b>
<b>00-147</b>

## **Preface**

In response to a request from the United Nations Transitional Administration in East Timor (hereinafter referred to as “UNTAET”), the Government of Japan decided to conduct “The Study on Urgent Establishment of Topographic Mapping in East Timor” and entrusted the Study to Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. WATANABE Toru of Asia Air Survey Co., Ltd. to East Timor, twice between February and September 2000.

The team held discussions with the officials concerned of UNTAET and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project in East Timor.

Finally, I wish to express my sincere appreciation to the officials concerned of the UNTAET for their close cooperation extended to the Team.

August, 2000

Kimio FUJITA

President

Japan International Cooperation Agency

## Letter of Transmittal

August, 2000

Mr. Kimio FUJITA  
President  
Japan International Cooperation Agency

Dear Mr. Fujita

It is my great pleasure to submit herewith the Summary of Final Report for the Study on Urgent Establishment of Topographic Mapping in East Timor.

The study team which consists of Asia Air Survey Co., Ltd. (AAS) conducted field survey in East Timor between February 2000 and March 2000, and office work such as digital topographic mapping between May 2000 and August 2000 as per the contract with the Japan International Cooperation Agency.

During the field survey in East Timor, discussion with the officials of the United Nation Transitional Administration in East Timor (UNTAET) were held. Based on the results of the discussion with UNTAET, digital topographic maps, other final results and summary of final report were prepared.

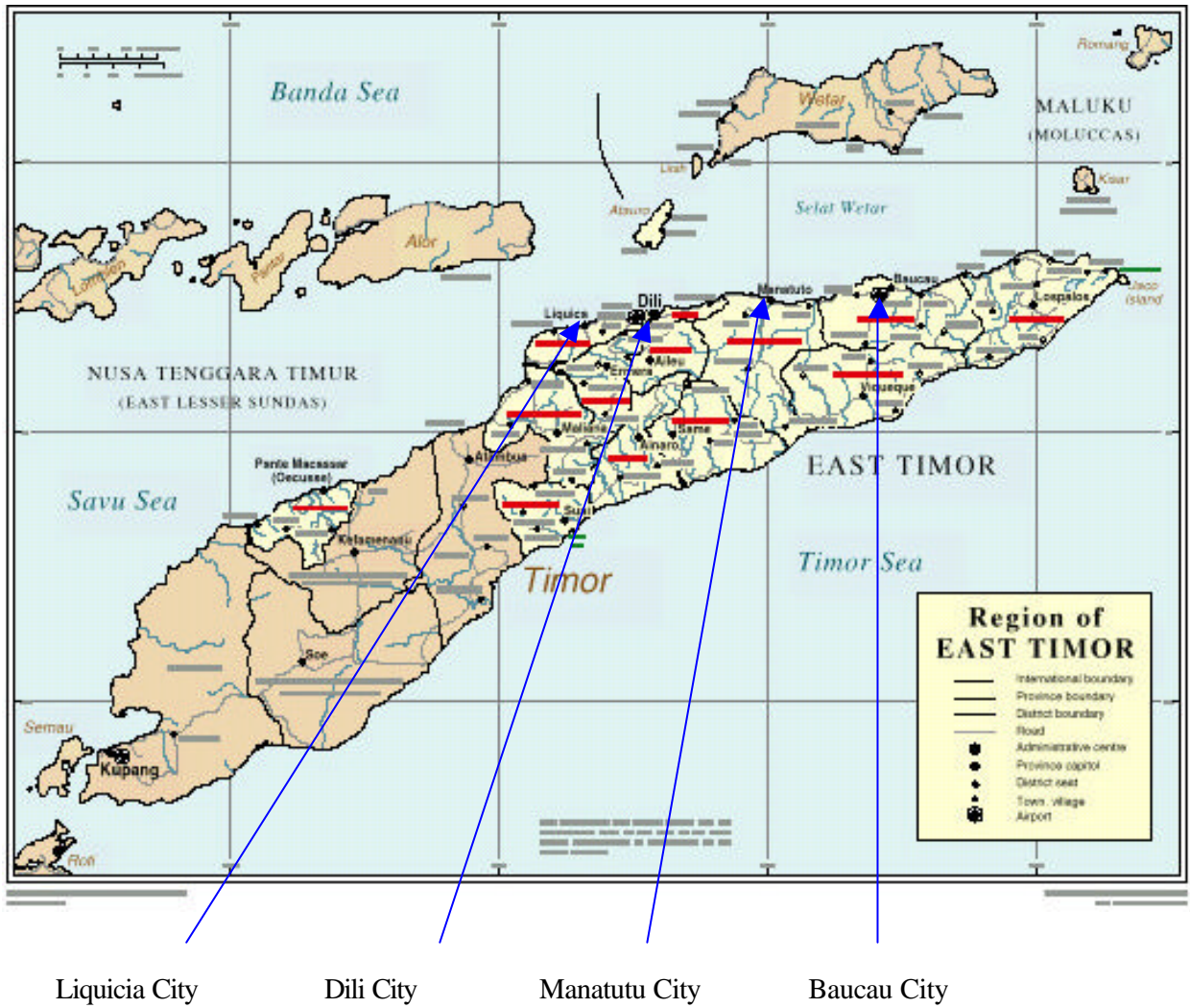
On behalf of the study team, I would like to express my heartfelt appreciation to the United Nation Transitional Administration in East Timor and other authorities concerned for their diligent cooperation and assistance and for the heartfelt hospitality which they extended to the study team during our stay in East Timor.

I am also greatly indebted to the Japan International Cooperation Agency, the Ministry of Foreign Affairs and the Embassy of Japan in Indonesia and Australia for giving us valuable suggestion and assistance during the preparation of this report.

Yours faithfully,

Toru Watanabe  
Team Leader for the Study of Urgent Establishment  
on Topographic Mapping in East Timor

## Location Map of East Timor



### The Study Area

#### 1. Aerial photography area

- |                  |                     |
|------------------|---------------------|
| 1) Dili City     | 107 km <sup>2</sup> |
| 2) Manatutu City | 50 km <sup>2</sup>  |
| 3) Baucau City   | 72 km <sup>2</sup>  |
| 4) Liquicia City | 28 km <sup>2</sup>  |

#### 2. Digital topographic mapping and GIS data preparation area

- |              |                                 |
|--------------|---------------------------------|
| 1) Dili City | 107 km <sup>2</sup> (83 sheets) |
|--------------|---------------------------------|

## Aerial Photo at The Center of Dili City



Dili Port

Building without roof

UNTAET GPA

Container

Open Market

Date of aerial photography: 12:15 PM, 11 April 2000

Photo scale: Approx. 1:4,000

## Outline of the Study

Item	Sub-item	Content
1. Aerial Photography		
Photo scale		1:8,000
Aerial photography area	Dili City	107 km <sup>2</sup>
	Liquicia City	28 km <sup>2</sup>
	Manututu City	50 km <sup>2</sup>
	Baucau City	72 km <sup>2</sup>
	Total	257 km <sup>2</sup>
2. Ground Survey	Dili City only	
Monumentation	New point	11 points
Pre-marking	GPS point	13 points
	Leveling point	16 points
GPS observation	Existing point	2 points
	New point	11 points
Leveling	Length of route	88.4 km
Field identification	Dili City	107 km <sup>2</sup>
3. Aerial Triangulation	Dili City only	
Aerial triangulation	Number of model	202 models
4. Digital Topographic Mapping	Dili City only	
Scale		1:2,000
Mapping area		107 km <sup>2</sup>
Number of sheet		83 sheets
Contour interval	Flat area	2.0 m
	Mountain area	10.0 m
5. Orthophoto Mapping	Dili City only	
Scale		1:2,000
Mapping area		107 km <sup>2</sup>
Number of sheet		83 sheets
Contour interval	Flat area	2.0 m
	Mountain area	10.0 m
6. Creation of Output	Dili City only	
Topographic map	Paper output	83 sheets, 5 sets
	Plastic sheet output	83 sheets, 5 sets
Land condition map	Paper output	83 sheets, 5 sets
Land use map	Paper output	83 sheets, 5 sets
Urban facility map	Paper output	83 sheets, 5 sets
7. Creation of CD-ROM	Dili City only	
Digital topographic map data		100 sets
Data base file		5 sets
8. Two Times Enlarged Aerial Photos		
Two times enlarged aerial photos	Dili City	2 sets
	Liquicia City	2 sets
	Manatutu City	2 sets
	Baucau City	2 sets
9. Additional Request from Land & Property Section	Dili City only	
Creation of compiled topographic map	1:1,000, Paper output	9 sheets, 2 sets
Creation of CD-ROM of compiled topographic map		2 sets
Creation of orthophoto map without contours	1:2,000, Paper output	5 sheets, 2 sets
Creation of CD-ROM of orthophoto map		2 sets

# The Study on Urgent Establishment of Topographic Mapping in East Timor

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## **1 General**

### **1.1 Introduction**

In Response to the request of the UNTAET, the Government of Japan decided to conduct “The Study on Urgent Establishment of Topographic Mapping in East Timor” (hereinafter referred to as the “Study”).

This Study was carried out by Japan International Cooperation Agency, the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan. Agriculture Affairs Section of the UNTAET acted as the counterpart to the Study Team. The Study area covers Dili City and its surrounding area of East Timor and total Study area is 107 km<sup>2</sup> for 1:2,000 scale digital topographic mapping and digital GIS data preparation. The Study also includes 1:8,000 scale aerial photography in Manatutu City, Baucau City and Liquicia City.

The scope of the Study agreed upon between the UNTAET and JICA is included in the document “Scope of Work for the Study on Urgent Establishment of Topographic Mapping in East Timor” on 12 January 2000 in Dili. However, the scope of the Study was modified based on the preliminary field check in and around Dili City by JICA study team and discussion with the UNTAET.

Final scope of the Study agreed between the UNTAET and the JICA Study team is described in the Document “Inception Report for the Study on Urgent Establishment of Topographic Mapping in East Timor” and “Minutes of Meeting for the Study on Urgent Establishment of Topographic Mapping in East Timor” on 10 March 2000.

### **1.2 Modification of scope of the Study**

Immediately after its arrival at Dili, the JICA Study team executed the preliminary field check of the study area and collection of the existing data and information necessary for the implementation of the Study. Based on the results of the preliminary field check and data and information collection, several meeting was held between the UNTAET and the JICA Study Team, and the JICA Study team prepared the Inception Report and submitted to the UNTAET on 6 March 2000.

The main points of modification of the scope of the Study agreed between the UNTAET and JICA Study Team are listed in Table 1.1 “Main Point of the

Modification of the Scope of The Study”.

**Table 1.1 “Main Points of the Modification of Scope of the Study”**

<b>Item of Work</b>	<b>Original Scope of Work</b>	<b>Inception Report and M/M</b>
1. Aerial photography		
Scale of aerial photos	1:10,000	1:8,000
Area to be covered	Dili City and its surrounding area: 400 km <sup>2</sup>	Dili City: 107 km <sup>2</sup> Liquica City: 28 km <sup>2</sup> Manatutu City: 50 km <sup>2</sup> Baucau City: 72 km <sup>2</sup> Total: 257 km <sup>2</sup>
2. Topographic mapping		
Scale of topographic map	1:5,000	1:2,000
Area to be mapped	Dili City and its surrounding area: 400 km <sup>2</sup>	Dili City: 107 km <sup>2</sup>
Contour interval	2.5 m for flat area 10.0 m for mountain area	2.0 m for flat area 10.0 m for mountain area
3. GIS data		
Digital land use data Digital land condition data Digital urban facilities data	Non	Dili City: 107 km <sup>2</sup> 1:2,000
4. Enlarged aerial photos		
2 time enlarged photos	Non	Liquicia City: 2 sets Manatutu City: 2 sets Baucau City: 2 sets

## 2 Scope of The Study

The scope of the Study originally planned on the Inception Report and the Minutes of Meeting, and the results actually performed by the JICA Study team are shown in Table 2.1 “Scope of the Study and the Results”.

**Table 2.1 “Scope of the Study and the Results”**

Items	Planned	Performed
1. Aerial photography		
Scale of aerial photos	1:8,000	1:8,000
Area to be covered	Dili City: 107 km <sup>2</sup> Liquicia City: 28 km <sup>2</sup> Manatutu City: 50 km <sup>2</sup> Baucau City: 72 km <sup>2</sup> Total: 257 km <sup>2</sup>	Dili City: 107 km <sup>2</sup> Liquicia City: 28 km <sup>2</sup> Manatutu City: 50 km <sup>2</sup> Baucau City: 72 km <sup>2</sup> Total: 257 km <sup>2</sup>
2. Monumentation and pre-marking		
Monumentation	12 points for new points	11 points
Pre-marking	13 points for GPS points Approx. 17 points for elevation points	13 points for GPS points Approx. 16 points for elevation points
3. GPS survey	13 points	13 points
4. Leveling	Approx. 50 km	Approx. 88.4 km
5. Field check for topographic mapping and GIS data	Dili City: 107 km <sup>2</sup>	Dili City: 107 km <sup>2</sup>
6. GPS aerial triangulation	Approx. 180 models	202 models
7. Digital topographic mapping	Dili City: 107 km <sup>2</sup>	Dili City: 107 km <sup>2</sup>
8. Orthophoto mapping	Dili City: 107 km <sup>2</sup> Total: 83 sheets	Dili City: 107 km <sup>2</sup> Total: 83 sheets
9. Preparation of GIS data		
Digital topographic data Land use data Land condition data Urban facilities data	Dili City: 107 km <sup>2</sup> Total: 83 sheets	Dili City: 107 km <sup>2</sup> Total: 83 sheets

### 3 Organization and Work Schedule

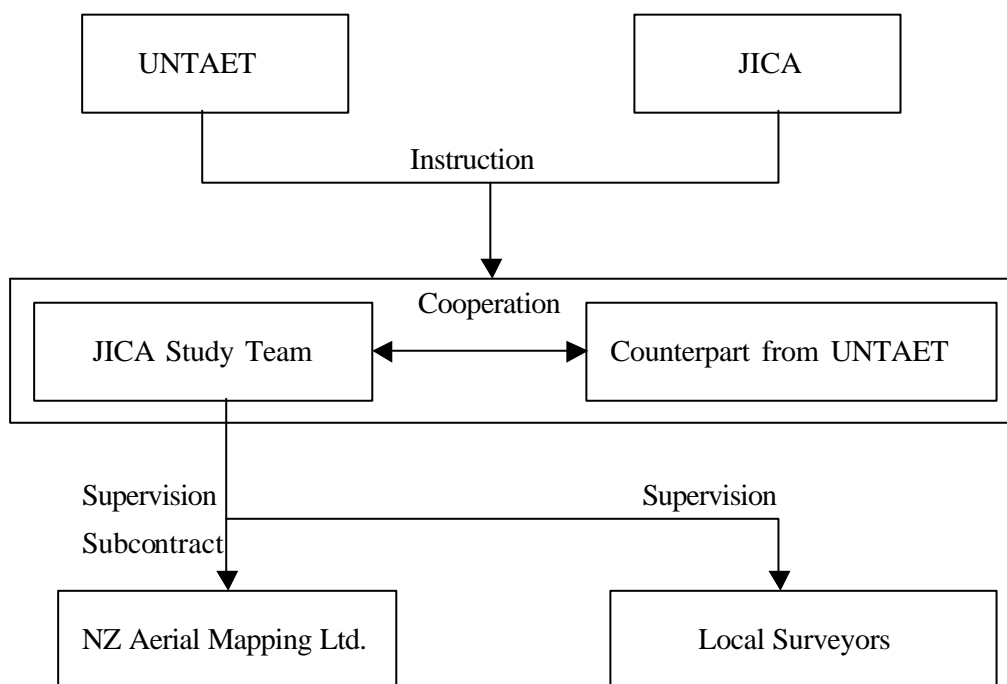
#### 3.1 Study organization

GPS survey, GPS aerial photography and aerial triangulation were carried out by the subcontractor, NZ Aerial Mapping Ltd. under the supervision of the JICA Study team.

Monumentation, Pre-marking, leveling, field identification and other necessary field survey for land use, land condition and urban facilities data were carried out by the JICA Study Team with the cooperation of hired surveyors in East Timor.

Office work such as 1:2,000 scale digital topographic mapping, 1:2,000 scale orthophoto mapping, preparation of digital data for GIS were executed in Japan. The organization of the implementation of field operation is shown in Figure 3.1 “Study Organization”.

Figure 3.1 “Study Organization”



#### 3.2 Organization of the JICA Study team

The JICA Study team consisted of the following experts for original assignments and actual assignment schedule as shown in the Table 3.1 “Assignment and Assignment Schedule of JICA Study Team”.

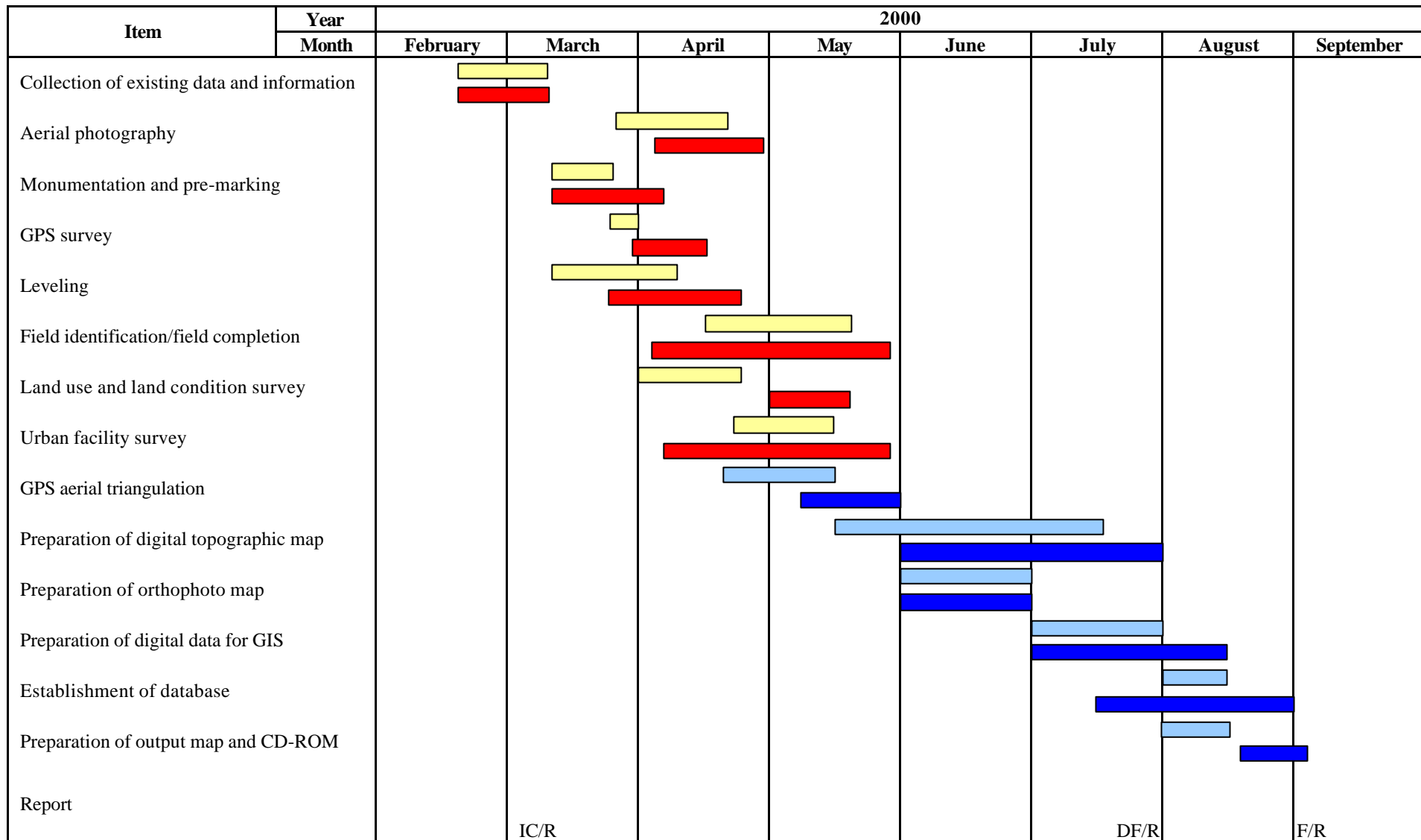
**Table 3.1 “Assignment and Assignment Schedule of JICA Study Team”**

<b>Assignment</b>	<b>Member</b>	<b>Original Assignment Period</b>	<b>Actual Assignment Period</b>	<b>Days</b>
Team leader/Field Identification	Toru Watanabe	2000.2.17~2000.5.31 2000.7.10 ~2000.7.19	2000.2.17~2000.5.31 2000.7.30~2000.8.8	105 days 10 days
Ground control survey /Aerial photography	Manabu Kawaguchi	2000.2.22~2000.5.21	2000.2.22~2000.5.31	100 days
Land condition/ Urban facilities	Hajime Goto	2000.3.13~2000.4.26	2000.4.2~2000.5.30	59 days
Database	Kazumi Suwabe	2000.3.19~2000.4.4	2000.3.19~2000.4.4	15 days
GIS	Yositaka Gomi	2000.5.2~2000.5.31 2000.7.10~2000.7.19	2000.7.30~2000.8.8	10 days
Coordinator	Junichi Umezawa	2000.2.25~2000.3.10 2000.5.17~2000.5.31	2000.2.25~2000.3.10 2000.5.14~2000.5.30	15 days 17 days

### **3.3 Work progress**

The original work schedule and the actual work progress are shown in Table 3.2 “Original Work Schedule and Actual Work Progress of the Study”. Due to the reason of the modification of scope of the Study, the starting date of actual field operations were delayed approximately one month and JICA Study team started the actual work of field operation from the middle of Mach 2000.

Table 3.2 "Original Work Schedule and Actual Work Progress of the Study"



Note:

Field work in East Timor (Original plan)

Field work in East Timor (Actual)

Submission of report (Original plan)

Office work in Japan (Original plan)

Office work in Japan (Actual)

Submission of report (Actual)

IC/R

DF/R

F/R

#### **4. Field Work in East Timor**

##### **4.1 Preliminary field check and data collection**

The JICA Study team collected the existing geodetic control point data such as GPS points and benchmarks that will be used as a reference point(s) of horizontal coordinates and elevation for ground control point survey. Research was done in Dili City and Jakarta City of Indonesia in parallel.



Existing benchmark at TTG-0220 established by BAKOSURTANAL (In front of the sub-district office at Fatuhada village)

##### **4.2 Monumentation**

Prior commencement of GPS aerial photography, the location of horizontal and vertical control points necessary for execution of aerial triangulation were selected and checked at the site. Concrete monuments were established on the selected horizontal and vertical points (GPS points). 13 concrete benchmarks including 2 existing benchmarks were established by BAKOSURTANAL and BPN of the Government of Indonesia.



Establishment of concrete monument at JICA-2 point



### 4.3 Pre-marking

Just before starting GPS aerial photography, pre-marks were established on the established horizontal and vertical control points (GPS points) and vertical control points (leveling points) necessary for GPS aerial triangulation.



Establishment of pre-mark  
at TTG-0157  
(In front of the main office  
of the UNTAET)

### 4.4 Leveling

The direct leveling was carried out to decide the elevation of horizontal and vertical control points (GPS points), and vertical control points (leveling points) necessary for implementation of aerial triangulation. The reference points to the direct leveling were the existing benchmarks established by BAKOSURTANAL of the Republic of Indonesia.

The leveling route executed by the JICA Study Team is shown in Figure 4.1 “Location of GPS Points and Benchmarks, and Leveling Routes”. The number of benchmarks and elevation of the reference points are shown in the Table 4-1 “Reference Points for Elevation”.

**Table 4.1 “Reference Points for Elevation”**

Number of Benchmark	Elevation
TTG-0157	3.636 m
TTG-0158	13.846 m
TTG-0219	22.098 m
TTG-0220	5.652 m

### 4.4 GPS observation

The GPS satellite survey was carried out to provide the horizontal coordinates of

established concrete monuments (GPS points) necessary for GPS aerial triangulation by New Zealand Aerial Mapping Ltd. The static differential GPS observation method was applied to the survey. The location of GPS points is shown in Figure 4.2 “Location of GPS Points and GPS Observation Network”.



GPS observation in front of the control Tower at Comoro Airport  
(Reference point for horizontal coordinates)

The reference points for horizontal coordinates are the GPS points established by the Australian Army. These GPS points are located in front of the control tower of Comoro Air Port and top of the Building of East Timor University. The coordinates of reference points for horizontal coordinates are shown in Table 4.2 “Reference Point for Horizontal Coordinates”.

**Table 4.2 “Reference Points for Horizontal Coordinates”**

Name of Point	Latitude	Longitude
Airport	-8 32 57.35070	125 31 19.245
University	-8 33 37.64770	125 34 21.270

Note: WGS-84

#### **4.6 Field Identification and Inventory survey**

Field identification was carried out to identify all natural and artificial terrain features that are necessary to the 1:2,000 scale digital topographic mapping but difficult or impossible to identify by the photo interpretation.

In addition to the ordinary field identification, further detailed data and information were acquired to be used for the urban facilities maps and GIS database. The field photographs of the terrain features were also taken and attached to the field data

sheets.

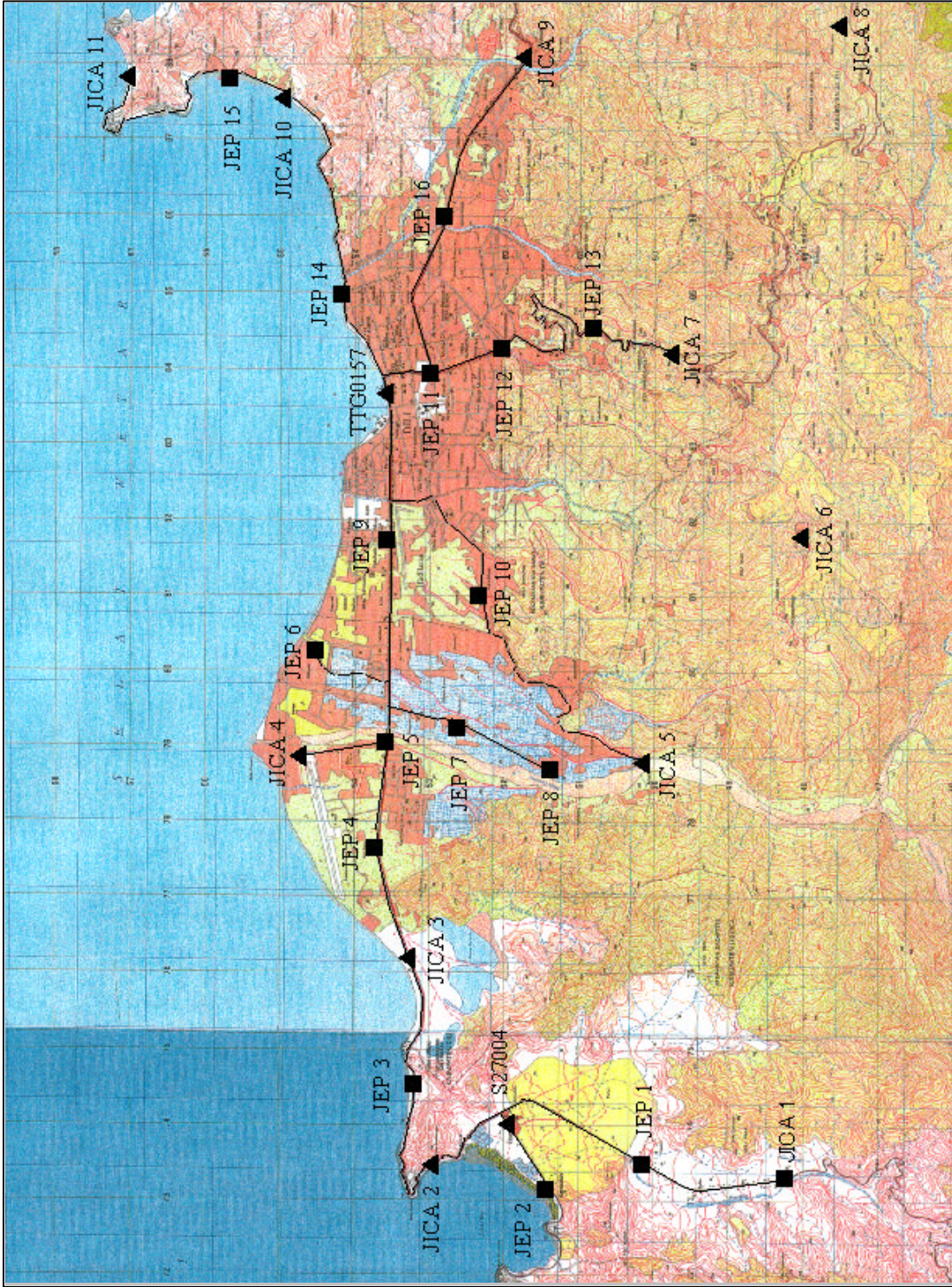
#### **4.7 GPS Aerial Photography**

1:8,000 scale GPS aerial photography at Dili City, Manatutu City, Baucau City and Liquicia City were executed by NZ Aerial Mapping Ltd. Flight index of each aerial photography areas is shown in Figure 4.3 “Flight Index Map of Dili City”, Figure 4.4 “Flight Index Map of Manatutu City”, Figure 4.5 “Flight Index Map of Baucau City” and Figure 4.6 “Flight Index Map of Liquicia City”.



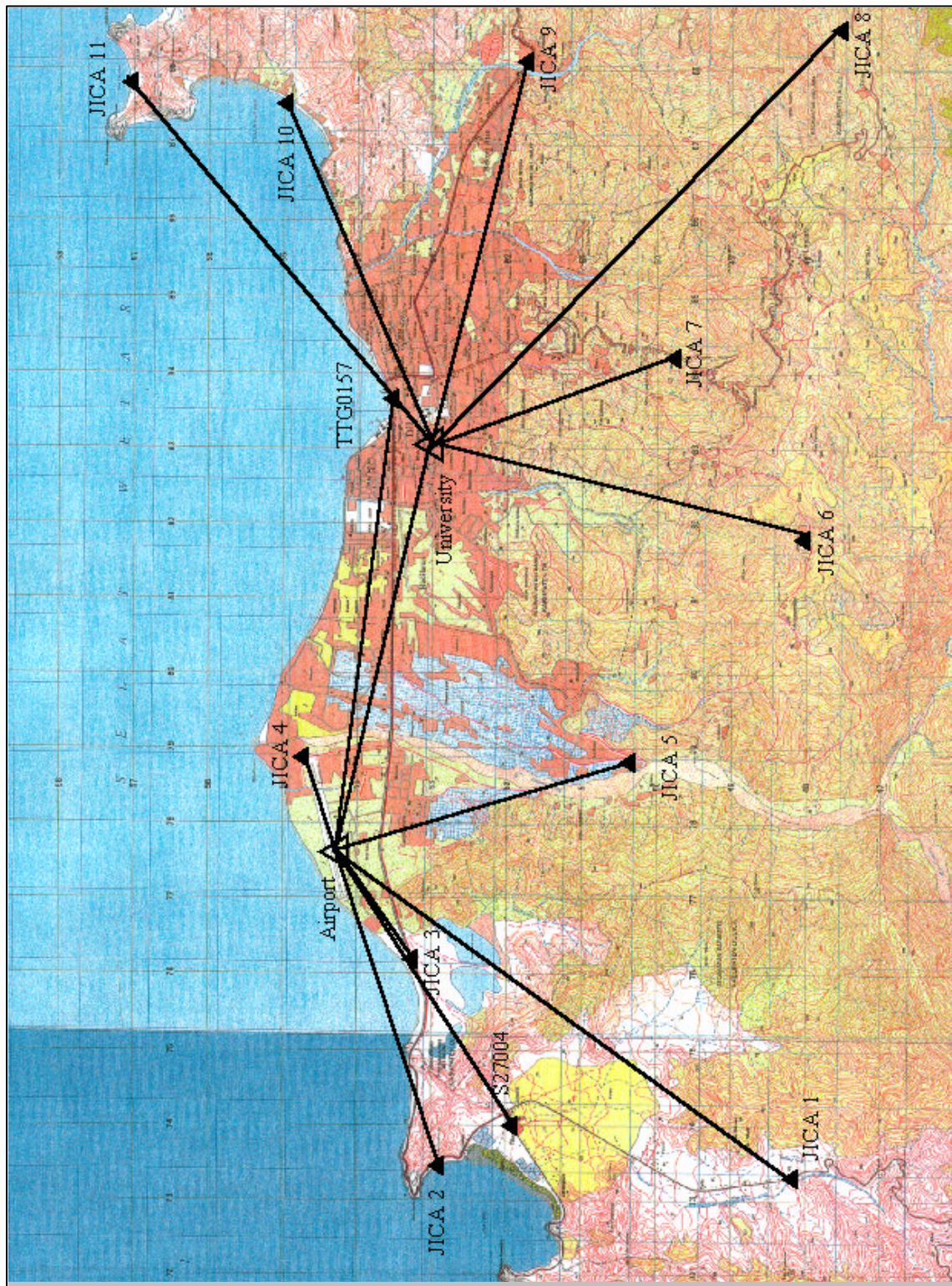
Aircraft of NZ Aerial Mapping Ltd. for aerial photography  
(At Comoro Air Port)

Figure 4.1 "Location of GPS Points and Benchmark, and Leveling Route"



Note:  GPS point  Benchmark  
 Leveling route executed by JICA Study Team

Figure 4.2 "Location of GPS Points and GPS Observation Network"



New GPS Point by JICA Study Team

Existing GPS point established by Australian Army

GPS observation line

## **5. Office Work**

### **5.1 Aerial triangulation**

The aerial triangulation established photo control points as the stereo models covering the mapping area (Dili City). The stereo models were corrected and adjusted its tilts and scales with the vertical and horizontal ground controls previously established by the ground control survey. 1:8,000 scale aerial photos of 202 stereo models in 15 flight runs and PATB aerial triangulation program were used for the aerial triangulation.

### **5.2 Digital topographic mapping**

Based on the 1:8,000 scale aerial photos, field survey data and the result of aerial triangulation, 1:2,000 scale digital topographic maps were prepared. The outline specifications of the 1:2,000 digital topographic mapping are as follows:

1) Mapping scale	1:2,000
2) Total number of sheet	83 sheets
3) Mapping area	107 km <sup>2</sup>
4) Sheet size	50 cm × 80 cm
5) Contour interval	2 m for flat area 10 m for mountain area
6) Sheet Index	Shown in Figure 5.1 “Sheet Index of 1:2,000 Scale Digital Topographic Map”

### **5.3 Digital orthophoto map**

Based on the results of aerial triangulation and digital data from positive film scanning, digital terrain model were prepared. 1:2,000 scale digital orthophoto maps were created using the digital terrain models and 1:8,000 scale aerial photo images.

### **5.4 Preparation of Digital Data for GIS**

#### **a) Urban facilities map**

The Study team made efforts to collect the existing materials related to the urban facilities in Dili City, but most of all these materials had been abandoned during the dispute in September 1999 except that only the existing materials related to drainage canals could be collected.

1:2,000 scale urban facility maps were created mainly based on the survey field results

executed by the Study Team.

**b) Land use map**

Land use map were created by classifying the status of land use on the basis of the 1:2,000 scale digital topographic maps in accordance with the classification items. The area covered by land use map is same as 1:2,000 scale digital topographic mapping area.

**c) Land condition map**

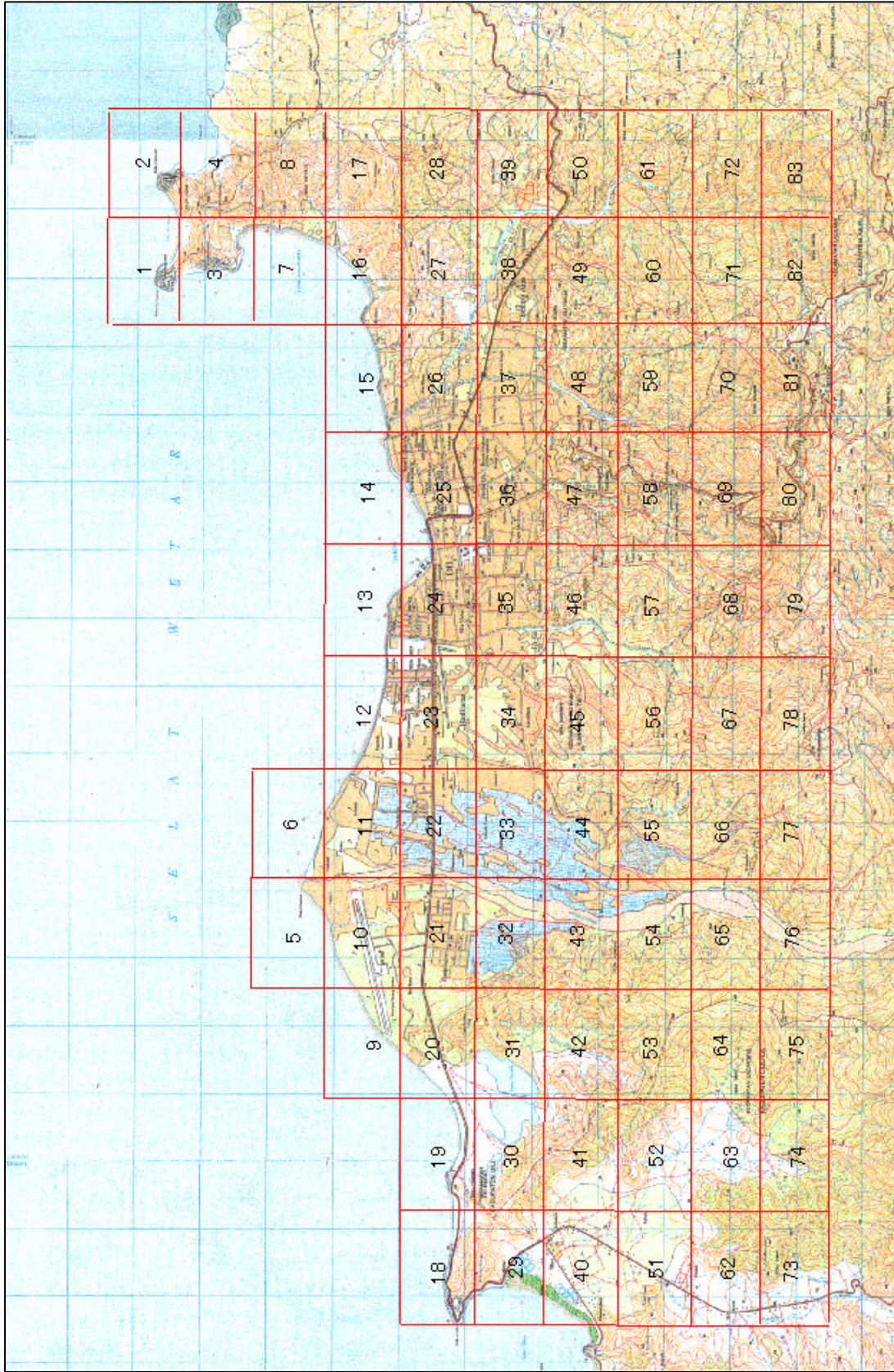
Land condition map were created on the basis of the 1:2,000 scale digital topographic maps created in the Study, especially based on the topographic map sheets using mainly slope items and aerial photo interpretation. The area covered by land condition is same as 1:2,000 scale digital topographic mapping area.

**5.5 GIS system**

For this Study, GIS software Arc View (Ver.3.1) has been selected. Arc View is a desktop geographic information system made by Environmental System Research Institute, Inc. (ESRI). With Arc View, maps, any data can be loaded and linked to geographic locations and displayed it graphically as maps, charts and tables.

GIS system established in the Study is shown in “Figure 5.2 “Flow Showing Map Features and Their Attributes Using GIS in the Study”.

Figure 5.1 "Sheet Index of 1:2,000 Scale Digital Topographic Map, Urban Facility Map, Land Use Map and Land Condition Map"



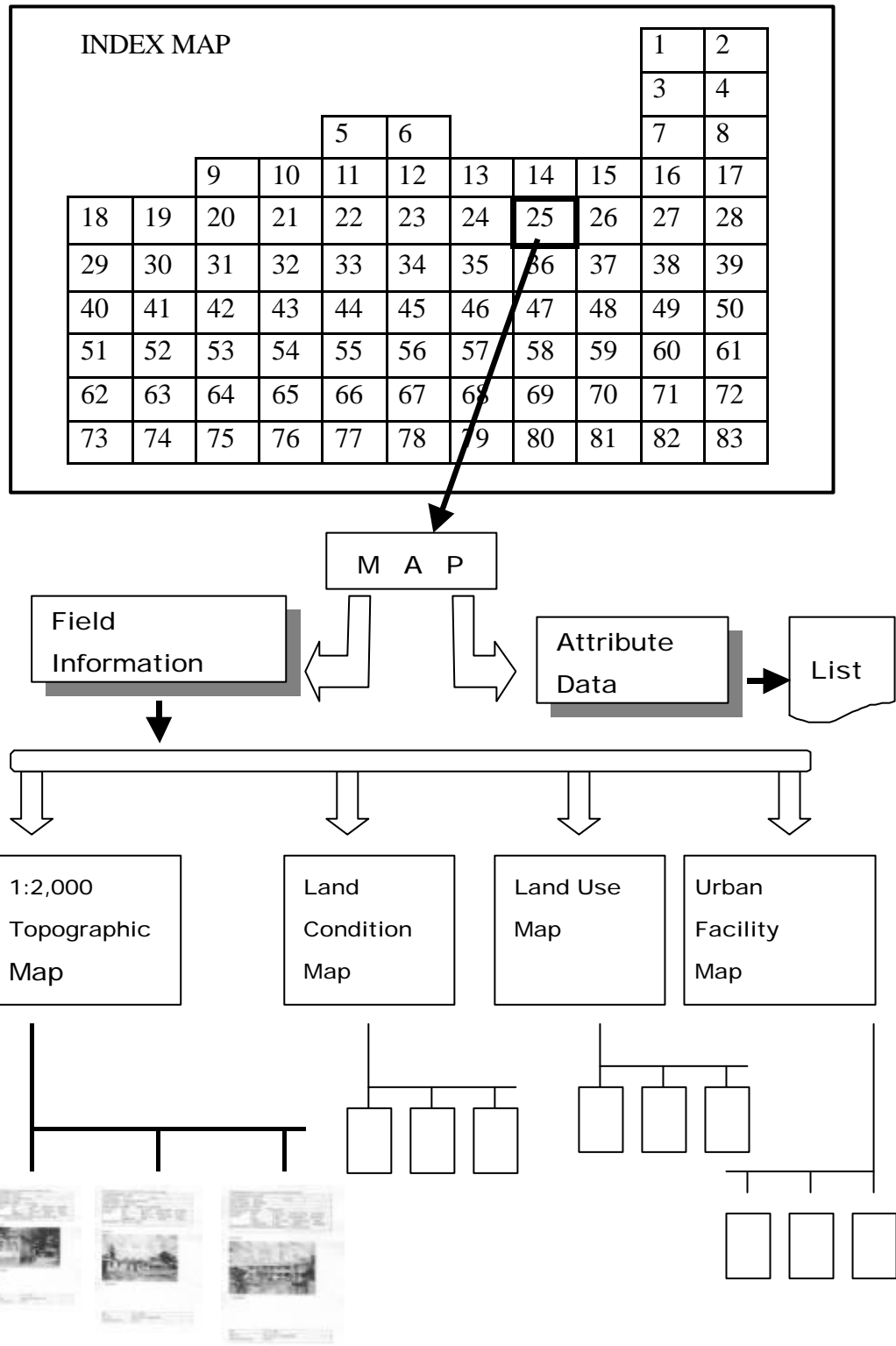
Note:

25

Sheet size and sheet number



**Fig. 5.2 “Flow Showing Map Features and Their Attributes Using GIS in the Study”**

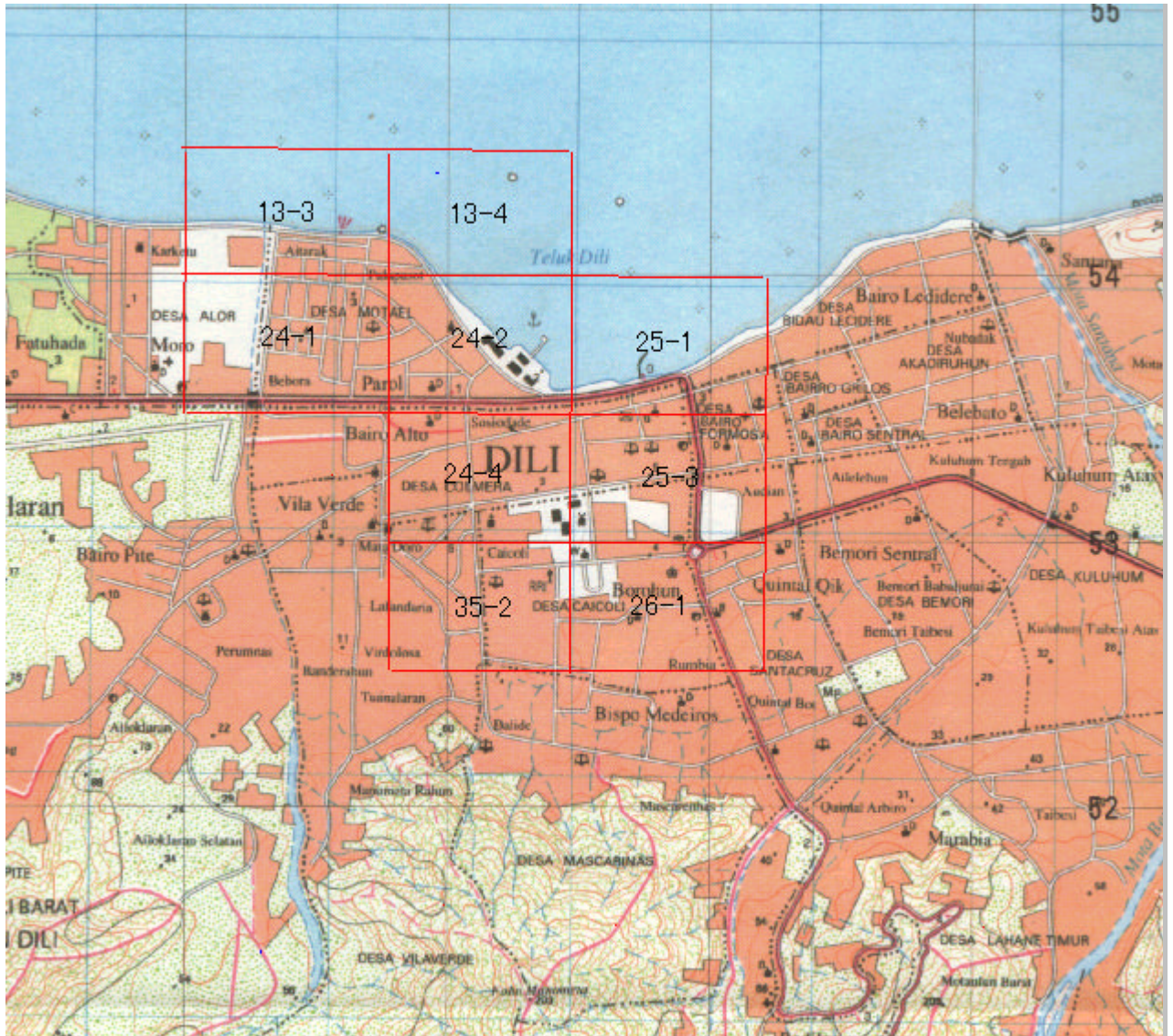


(Field data sheet)

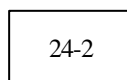
**6. Additional Request from the Land and Property Section of UNTAET**

By the additional request from the Land and Property Section of UNTAET, 1:1,000 scale to digital topographic maps were compiled from the 1:2,000 scale digital topographic maps, and 1:2,000 scale orthophoto map without contour lines were created. The Location of 1:1,000 scale compiled digital topographic map area is shown in Figure 6.1 “Sheet Index of Compiled 1:1,000 Scale Compiled Digital Topographic Maps”.

Figure 6.1 “Sheet Index of Compiled 1:1,000 Scale Digital Topographic Map”



Note:



Sheet size and sheet number

## 7. Final Products

Following final products were delivered to JICA and the UNTAET from the JICA Study Team by the middle of September 2000 at Dili and Tokyo.

### 7.1 Survey and mapping data

- 1) Aerial photos
  - a) Negative film 1 set
  - b) Contact print 3 sets (2 sets for JICA)
  - c) 2 times enlarged photo 2 sets  
(Manatutu, Baucau and Liquicia City)
  - d) Flight index map 1 set
- 2) Ground control point survey (Dili City)
  - a) Table of coordinates of control points 1 set
  - b) Description of control points 1 set
- 3) GPS aerial triangulation (Dili City)
  - a) Final results of GPS aerial triangulation 1 set
- 4) 1:2,000 scale digital topographic map
  - a) CD-ROM (EPS Format) 100 sets (4 sets for JICA)
- 5) Database file
  - a) CD-ROM (Arc View Format) 5 sets
- 6) Output of digital data for GIS (Paper sheet)
  - a) 1:2,000 scale topographic map 5 sets
  - b) 1:2,000 scale land use map 5 sets
  - c) 1:2,000 scale land condition map 5 sets
  - d) 1:2,000 scale urban facility map 5 sets
- 7) Output of topographic map (Transparent plastic sheet)
  - a) 1:2,000 scale topographic map 5 sets
  - b) 1:2,000 scale land use map 5 sets
  - c) 1:2,000 scale land condition map 5 sets
  - d) 1:2,000 scale urban facility map 5 sets
- 8) Output of orthophoto map (Paper sheet)
  - a) 1:2,000 scale orthophoto map 5 sheets (4 sets for JICA)

### 7.2 Additional request from the Land and Property of UNTAET

- 1) 1:1,000 scale compiled digital topographic map

- a) Paper output 2 sets
- b) Digital data (CD-ROM)(EPS format) 2 sets
- 2) 1:2,000 scale orthophoto map without contour line
  - a) Photo image 2 sets
  - b) Digital data (CD-ROM)(EPS format) 2 sets

### **7.3 Report**

- 1) Inception Report 30 sets (10 sets for JICA)
- 2) Outline of field survey 5 sets (2 sets for JICA)
- 3) Draft final report
  - a) Main report (English) 30 sets (10 sets for JICA)
  - b) Summary (English) 30 sets (10 sets for JICA)
  - c) Summary (Japanese) 10 sets (10 sets for JICA)
  - d) Manual (English) 30 sets (10 sets for JICA)
- 4) Final report
  - a) Main report (English) 40 sets (10 sets for JICA)
  - b) Summary (English) 30 sets (10 sets for JICA)
  - c) Summary (Japanese) 10 sets (10 sets for JICA)
  - d) Manual (English) 30 sets (10 sets for JICA)
  - e) MO of above reports 1 set (1 set for JICA)

## **8. Conclusion and Recommendation**

### **8.1 Conclusion**

The usable topographic maps for Dili City in East Timor had basically been only the 1:25,000 scale topographic maps that were made up by BAKOSURTANAL, Indonesia in 1990's (two type of aerial photos taken in the 1980's and the 1990's). In addition, other topographic maps of larger scale had also been partly available, but those maps had been expanded and compiled from the 1:25,000 scale topographic maps.

Therefore, one of the important objectives for creation of the 1:2,000 scale topographic maps and GIS data in this Study was that those maps should be prepared as soon as possible for use as basic materials to promote the reconstruction of urban facilities in Dili City which is about start to solve the problems (especially dispute related to land ownership) that the Dili City, the largest city in East Timor has.

However, the existing materials necessary for creation of digital topographic maps, especially GIS data mostly been lost since the dispute in September 1999 and usable existing materials were not available. Thus, the Study team had to collect various types of information necessary for creation of digital topographic maps and GIS data through field verification.

As described above, there were many difficulties in this Study for creation of digital topographic maps and GIS data in terms of the required time and its contents compared with the works for other ordinary area. However, it is expected that the created digital topographic maps and GIS data will be effectively use as the basic materials for the reconstruction of the urban facilities and solution of various problems in Dili City and its environs.

### **8.2 Recommendation**

After transit from UNTAET to the East Timor government, it is expected to make the effective use of GIS system as a supporting tool for the national development programs. For this purpose, it is essential to implement the centralized management and data gathering of the information related to the development in various fields. So it is important to organize any section having the responsibility for maps and GIS operation within UNTAET. Updating of topographic map data should be preferably undertaken by such responsible section in order to avoid possible distribution and

confusion due to independent data updating by different organization.

For the use and development of GIS data that UNTAET will continue by itself after completion of this Study, it is necessary for it to make efforts to improve the technical and practical levels for the GIS technology and survey technology. For this purpose, it is necessary for GIS experts to furnish education and training of the counterpart's personnel through practical jobs in order to make continuous and effective use of the introduced GIS system, and it is also the important work to cope with organizational improvement within UNTAET.

East Timor has lost most of geographic information and data as the base of national development during the conflict. In order to make efficient data development for the national basic information including topographic maps, it is necessary to make effective use of the materials removed to Indonesia. Therefore, it is important to make an official request to the Indonesian Government through the United Nations that removed material and data will be returned to East Timor and to receive advice from the expert familiar with the Indonesian circumstances.