

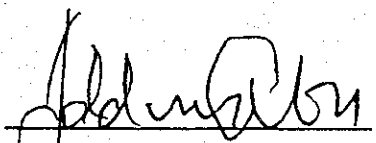
5-6 第3年次現地作業終了時の協議議事録



APPENDIX 2

MINUTES OF MEETINGS  
AT  
THE END OF THE THIRD YEAR (SECOND STAGE) FIELD WORKS  
FOR  
THE TOPOGRAPHIC MAPPING  
OF  
SOUTHERN PART OF THE REPUBLIC OF GHANA  
BETWEEN  
SURVEY DEPARTMENT OF GHANA  
AND  
JICA STUDY TEAM

ACCRA GHANA, 12<sup>th</sup> MARCH 1998



NA AL-HAJI IDDIRISU ABU  
DIRECTOR OF SURVEYS  
SURVEY DEPARTMENT OF  
GHANA  
MINISTRY OF LANDS AND  
FORESTRY



TOKIHIRO KAMINISHI  
LEADER  
JICA STUDY TEAM

Survey Department of Ghana (SDG) and JICA Study Team (Team) had a series of meetings at the end of the third year's field works for the "Topographic Mapping of Southern Part of the Republic of Ghana" from March 9<sup>th</sup> to 12<sup>th</sup> 1998.

At the meetings the following items were confirmed by both sides.

1. Twenty (20) copies of Addendum Third Year Plan of Operation were submitted to SDG by the Team. The Plan of Operation was discussed and accepted by both sides.
2. Team reported briefly the progress of the third year field work for the study, and presented the "Progress Report of the Field Work of the Third Year (Second stage) for Topographic Mapping of Southern Part of the Republic of Ghana" prepared by the Team (attachment), SDG accepted the report.
3. Both sides have promised to continue the discussion of the digital mapping code production.
4. SDG requested that the representation of contour lines in the updating work area (20 sheets, approx. 14,400 km<sup>2</sup>) should be indicated in metric (contour interval 10 meters, mountainous area 20 meters) based on the existing contour lines represented in feet.  
Team promised to convey the request to Tokyo JICA Head Office.

## LIST OF ATTENDANTS

### SDG side

Na Al-haji Iddirisu Abu	Director of Surveys	Headquarters
Mr. E.S. Sai	Ag. Deputy Director	'
Mr. J. Dotse	Asst. Director	Great Accra Region
Mr. R. Brimah	Asst. Director	Headquarters
Mr. J.A. Abbosey	Headquarters Staff	'
Mr. Marcus A. Tabil	Examiner	Examination Section
Mr. K.N. Arku-Lawson	Chief Cartographer	Cartographic Section
Mr. I. Andoh-Kesson	Chief Photogrammetrist	Photogrammetric Sec.
Mr. E.R. Tetteh	Chief Lithographer	Lithographic Section
Mr. S. Oppong-Antwi	D.M. Planner	Digital Mapping Sec.
Mr. E. Addo-Tawiah	D.M. Planner	Digital Mapping Sec.
Mr. J. Ofori-Boadu	Data Examiner	Great Accra Region
Mr. Ian K. Isaacs	Observer	Terra Surveys

### Team side

Mr. Tokihiko KAMINISI	Team Leader
Mr. Koichi MIKI	Deputy Leader
Mr. Kozo OKUMURA	Mapping Planner
Mr. Hitoshi YOSHIDA	Chief Surveyor
Mr. Hideaki SAKAI	Coordinator

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ATTACHMENT

PROGRESS REPORT

OF

THE FIELD WORK OF THE THIRD YEAR ( SECOND STAGE )

FOR

TOPOGRAPHIC MAPPING OF SOUTHERN PART

OF

THE REPUBLIC OF GHANA

MARCH , 1998

STUDY TEAM

OF

TOPOGRAPHIC MAPPING OF SOUTHERN PART

OF

THE REPUBLIC OF GHANA

JAPAN INTERNATIONAL COOPERATION AGENCY

## 1. INTRODUCTION

The topographic mapping of the southern part of the Republic of Ghana started in January, 1996, in a five year plan, as a technical cooperation program of JICA.

In compliance with the Scope of Work and the Minutes of Meeting agreed between the Survey Department of Ghana and JICA on 18th December, 1997, the JICA Study Team arrived in Accra on 2nd of February, 1998, for implementation of the second stage of third year's field work. After consultation with the SDG, the team set up the field headquarters in Accra for the field verification and a part of ground control survey works. Meanwhile Ghana counterparts from the SDG joined the work from time to time. In accomplishing the field work of second stage of the third year, hereinafter, the summary of the progress of the work is reported.

## 2. OUT LINE OF THE THIRD YEAR WORK ( Second Stage )

### 2-1 Objective

The objective of the Study are : (1) To prepare 1/50,000 topographic map covering an area of approximately 25,500 km<sup>2</sup> in the southern part of the Republic of Ghana, (2) To transfer technology to the counterparts personnel of SDG through the implementation of the work, and (3) To promote the friendship between Ghana and Japan through the implementation of the Study.

The second stage of third year's work is consisting of the additional ground control survey, field verification (west zone) and office work.

### 2-2 Period of Survey Work

#### Field work

( Ground control survey )      1<sup>st</sup> February, '98 ~ 11<sup>th</sup> February, '98

( Field verification )          11<sup>th</sup> February, '98 ~ 20<sup>th</sup> March, '98

### 2-3 Formation of the Study Team

Leader	Mr. Tokihiko KAMINISHI	3 <sup>rd</sup> Mar.'98 ~ 18 <sup>th</sup> Mar.'98
Deputy Leader	Mr. Koichi MIKI	1 <sup>st</sup> Feb.'98 ~ 18 <sup>th</sup> Mar.'98
Mapping Planner	Mr. Kozo OKUMURA	
Chief Surveyor	Mr. Hitoshi YOSHIDA	1 <sup>st</sup> Feb.'98 ~ 20 <sup>th</sup> Mar.'98



D.M. Planner	Mr. Fujio ITO	1 <sup>st</sup> Feb.'98	~	15 <sup>th</sup> Feb.'98
Mechanical Engr.	Mr. Shinpei ISHIWATA	1 <sup>st</sup> Feb.'98	~	18 <sup>th</sup> Mar.'98
Surveyor	Mr. Masahiko OHASHI	1 <sup>st</sup> Feb.'98	~	20 <sup>th</sup> Mar.'98
'	Mr. Kouzou ASANO			'
'	Mr. Tuyoshi YAMASAKI			'
'	Mr. Michio SATOJI	1 <sup>st</sup> Feb.'98	~	27 <sup>th</sup> Feb.'98
'	Mr. Minori OHNAKA	1 <sup>st</sup> Feb.'98	~	20 <sup>th</sup> Mar.'98
'	Mr. Masaru TERADA			'
'	Mr. Masaaki MIZUOCHI			'
'	Mr. Takesi NEMOTO			'
Coordinator	Mr. Hideaki SAKAI	4 <sup>th</sup> Mar.'98	~	20 <sup>th</sup> Mar.'98

#### 2-4 Amount of the Survey Work ( Plan and Results )

Survey progress are as follows.

Item	Original plan	Results
Ground control survey		
Additional GPS survey	4 points	4 points
Pricking (GPS points)	20 points	20 points
' (leveling points)	230 km	230 km
Field verification (West zone)	6,830 km <sup>2</sup>	6,830 km <sup>2</sup>

#### 2-5 Counterparts of SDG

Headquarters :

Na Al-haji Iddirisu Abu	Director of Surveys	Headquarters
Mr. E.S. Sai	Ag. Deputy Director	'
Mr. J. Dotse	Asst. Director	Great Accra Region
Mr. R. Brimah	Asst. Director	Headquarters
Mr. J.A. Abbosey	Headquarters Staff	'
Mr. Marcus A.Tabil	Examiner	Examination Section
Mr. K.N.Arku-Lawson	Chief Cartographer	Cartographic Section
Mr. I.Andoh-Kesson	Chief Photogrammetrist	Photogrammetric Sec.
Mr. E.R.Tetteh	Chief Lithographer	Lithographic Section
Mr. S.Oppong-Antwi	D.M. Planner	Digital Mapping Sec.

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Mr. E.Addo-Tawiah	D.M. Planner	Digital Mapping Section
Mr. J. Ofori-Boadu	Data Examiner	Great Accra Region
Mr. Ian K. Isaacs	Observer	Terra Surveys
Field Work ;		
Mr. Paul Essien	Surveyor	Western Region
Mr. Daniel Asiedu	'	'
Mr. Seth Korangteng	'	'
Mr. Francis Sodokey	'	'

### 3. FIELD WORK

#### 3-1 Additional Ground Control Survey

Additional ground control point survey was executed by satellite geodesy applying Global Positioning System (GPS). Three Trimble 4000SSE instruments of dual frequency model were used for the simultaneous observation at the control points.

##### (1) Placement

Four additional control points were established in the field based on the enlarged aerial photographs. Each point was selected for easier location for succeeding pricking work for the aerial triangulation.

##### (2) Observation

GPS observation was executed at three points (two known points & one new point) simultaneously. To take account of obtaining height accuracy, five or six satellites were observed two hours and the elevation angle of satellites were adopted more than 15 degrees.

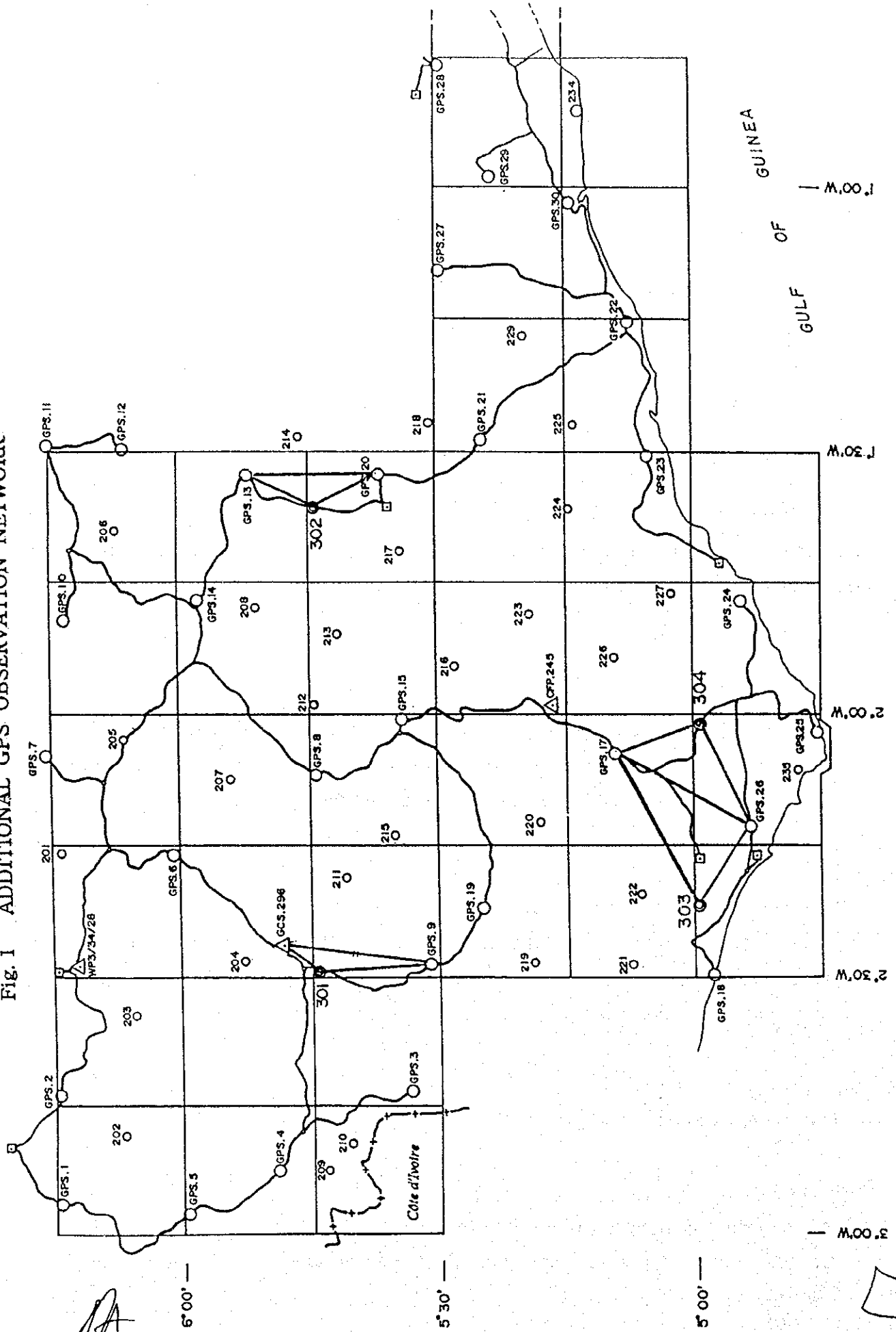
##### (3) Observation scheme

The observation network is shown in Fig. 1.

##### (4) Results

The coordinate closures of each group were calculated in the field to check the reliability of the observation. The results are tentatively obtained as follows.

Fig. 1 ADDITIONAL GPS OBSERVATION NETWORK



Closure error

Observation st.	Station	Distance	Closure error
301/296/9	301 ~ 296	9,178.465m	Total dist.=66,231.011m dx=-0.0114m, dy=+0.0132m dz=-0.0325m Ratio=0.5562ppm
	296 ~ 9	32,022.304m	
	9 ~ 301	25,030.241m	
302/13/20	302 ~ 13	15,197.265m	Total dist.=59,631.815m dx=-0.0046m, dy=-0.0077m dz=+0.0114m Ratio=0.2433ppm
	13 ~ 20	28,382.447m	
	20 ~ 302	16,052.102m	
303/17/26	303 ~ 17	33,460.373m	Total dist.=82,975.844m dx=+0.0069m, dy=-0.0076m dz=+0.0069m Ratio=0.1494ppm
	17 ~ 26	32,855.475m	
	26 ~ 303	16,659.996m	
304/26/17	304 ~ 26	25,348.159m	Total dist.=78,018.068m dx=+0.0128m, dy=-0.0045m dz=-0.0162m Ratio=0.2708ppm
	26 ~ 17	32,855.475m	
	17 ~ 304	19,814.434m	

Double observation difference

Station (year)	dx	dy	dz
296 ~ 9 ('96)	+ 2,899.106m	- 4,136.354m	-31,621.387m
('98)	+ 2,899.124m	- 4,136.386m	-31,621.407m
difference	- 0.018m	+ 0.032m	+ 0.020m
13 ~ 20 ('96)	+ 2,837.442m	+ 396.848m	-28,237.463m
('98)	+ 2,837.456m	+ 396.844m	-28,237.469m
difference	- 0.014m	+ 0.004m	+ 0.006m
17 ~ 26 ('96)	+ 1,950.879m	-15,277.521m	-29,021.966m
('98)	+ 1,950.883m	-15,277.534m	-29,021.944m
difference	- 0.004m	+ 0.013m	- 0.022m
17 ~ 26 ('98)	+ 1,950.883m	-15,277.534m	-29,021.944m
('98)	+ 1,950.920m	-15,277.534m	-29,021.949m
difference	- 0.037m	0.000m	+ 0.005m

### 3-2 Pricking ( continuation )

Pricking of the horizontal and vertical control for aerial triangulation was executed using third year's first stage aerial photographs.

#### (1) GPS points

Positions of twenty(20) GPS points were pricked on the enlarged aerial photos, and the eccentric elements were measured by sun azimuth observation method, if necessary.

#### (2) Leveling points

Leveling points (approx.230 km) conducted period of second year's work were pricked on the enlarged aerial photos at every 4 to 5 km interval for aerial triangulation vertical control.

### 3-3 Field Verification

Field verification (second stage ; West zone ) was started by the team members and SDG counterparts in compliance with the map symbols and their application rules agreed between SDG and JICA study team on the first stage of the third years work.

Confirmation and investigation of various expressions and names specified by map symbols were conducted. The survey results were described on two times enlarged aerial photographs to be used as data for succeeding digital stereo plotting and compilation work.

#### (1) Implementation

Main items verified in the field are as follows, and the results were indicated on the enlarged aerial photographs.

- ① Classification of roads and their attributes.
- ② Public buildings and structures.
- ③ Linear structures (railway, power transmission line, etc.).
- ④ Key for photo-interpretation of vegetation and topographic features.
- ⑤ Collection of toponomy and designation of ground features (village, mountain, river, etc.).
- ⑥ Other necessary items for map representation in accordance with the map symbols and their application rules.

### 3-4 Topological Data Structure

Based on the Ghana Environmental Resource Management Project ( GERMP ) code table and SDG's map symbols and application rules, new application rules were discussed with SDG and JICA study team.

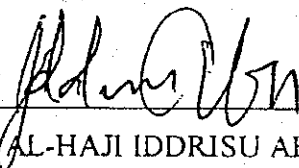
The above progress report covered the field work period from 1<sup>st</sup> of February, 1998 to 20<sup>th</sup> March, 1998.



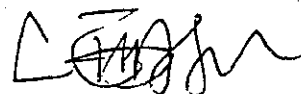
5-7 第4年次現地作業開始時の協議議事録

MINUTES OF MEETINGS  
FOR  
THE TOPOGRAPHIC MAPPING  
OF SOUTHERN PART OF THE REPUBLIC OF GHANA  
BETWEEN  
SURVEY DEPARTMENT OF GHANA  
AND  
JICA STUDY TEAM

ACCRA GHANA, 1<sup>ST</sup> SEPTEMBER 1998



NA AL-HAJI IDDRISU ABU  
DIRECTOR OF SURVEYS  
SURVEY DEPARTMENT OF  
GHANA  
MINISTRY OF LANDS AND  
FORESTRY



TOKIHIKO KAMINISHI  
LEADER  
JICA STUDY TEAM

The JICA Study Team headed by Mr. Tokihiko KAMINISHI visited the Republic of Ghana from 23<sup>rd</sup> August, 1998 to carry out the fourth year programme for the Study on Topographic Mapping of Southern Part of the Republic of Ghana.

Prior to the commencement of the fourth year survey work, a series of meetings were held from 25<sup>th</sup> to 31<sup>st</sup> August, 1998 and the following items have been confirmed and agreed by Survey Department of Ghana (SDG) and JICA Study Team.

1. Twenty (20) copies of Third Year Reports were submitted to SDG by JICA Study Team.
2. Twenty (20) copies of Fourth Year Plan of Operation were submitted to SDG by JICA Study Team. The Fourth Year Plan of Operation was discussed and agreed as the attachment by both sides.
3. The digital mapping code table attached to plan of operation was accepted by SDG and the additional and / or revised code table shall be submitted to JICA Study Team later.
4. SDG requested that three persons of counterpart consisting of an approving authority, a digital mapping specialist and a photogrammetrist be despatched for checking the final sheets from SDG to JICA in 1999 and JICA Team took note for conveying this request to JICA Head Office of Tokyo. However, JICA Team explained that the number of counterpart to be accepted annually per any development study is usually one.





## LIST OF ATTENDENTS

### 1. Ghanaian Side (SDG)

Na Al-haji Iddrisu Abu	Director of Surveys	Headquarters
Al-haji Ridwan Brimah	Assistant Director	Headquarters
Mr. J. Dotse	Assistant Director	Great Accra Region
Mr. J. A. Abossey	Staff Surveyor	Headquarters
Mr. Marcus Tabil	Examiner	Examinations Section
Mr. K. N. Arku-Lawson	Chief Cartographer	Cartographic Section
Mr. I. Andoh-Kesson	Chief Photogrammetrist	Photogrammetric Sec.
Mr. E. R. Tetteh	Chief Lithographer	Lithographic Section
Mr. Jones Ofori Boadu	Assistant Staff Surveyor	Examinations Section
Mr. S. Opong-Antwi	Assistant Staff Surveyor	Digital Mapping Sec.
Mr. F. Manu-Adabor	Assistant Staff Surveyor	Digital Mapping Sec.
Mr. George Frimpong	Assistant Staff Surveyor	Digital Mapping Sec.
Mr. J. Adu Baiden	Surveying Technician	Digital Mapping Sec.

### 2. Japanese Side (JICA Study Team)

Mr. Tokihiko KAMINISHI	Team Leader
Mr. Kouichi MIKI	Deputy Team Leader
Mr. Kozo OKUMURA	Mapping Planner
Mr. Kazushi ENDO	Digital Mapping Planner
Mr. Hitoshi YOSHIDA	Chief Surveyor
Mr. Minoru OHNAKA	Surveyor
Mr. Katsumi TERADA	Surveyor
Mr. Hideaki SAKAI	Coordinator

### 3. Mr. C. Nuoyel

Programme Officer (JICA/Gh.)

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ATTACHMENT

PLAN OF OPERATION  
FOR  
TOPOGRAPHIC MAPPING OF SOUTHERN PART  
OF  
THE REPUBLIC OF GHANA  
  
(FOURTH YEAR)

AUGUST, 1998

JAPAN INTERNATIONAL COOPERATION AGENCY



## I. INTRODUCTION

In February 1995, the Government of the Republic of Ghana (hereinafter referred to as Ghana) made a request to the Government of Japan (hereinafter referred to as Japan) to provide technical cooperation for the Topographic Mapping of Southern Part of Ghana (hereinafter referred to as the Study) after recognizing the importance it has as basic survey for planning and implementation of various projects. In view of the heavy concentration of socioeconomic and cultural activities in the southern part of Ghana, the need for up-to-date maps and mapping data cannot be over-emphasized as the present ones are totally out of data.

In response to the request of the Government of Ghana, the Preparatory Study Team was dispatched by the Japan International Cooperation Agency, the official agency responsible for the implementation of the technical cooperation programs of the Japanese Government (hereinafter referred to as JICA) in March 1995 and in December 1997, to discuss in detail with the Survey Department of Ghana, the official agency of Ghana (hereinafter referred as SDG), and the Scope of Work and Minutes of Meetings were agreed between JICA and SDG.

Based on the S/W and the M/M, the Study is being carried out for the five year period as shown in Fig. 1.

## II. OBJECTIVE OF THE STUDY

The objective of the Study is to prepare the 1/50,000 new topographic maps covering an area of approximately 25,500 square kilometers and to transfer technology to the counterpart personnel of Ghana.

The mapping area is shown on Fig.2 and the first page of this report.

## III. SCOPE OF WORK

The scope of work to achieve the captioned objective is as follows.

[First year ~ Third year]

Aerial photography (scale 1/60,000), ground control point survey, leveling, pricking, field verification (20 map sheets), aerial triangulation (ditto), digital stereo plotting (ditto), SPOT image production.

[Fourth year]

Field verification, additional aerial photography (partial, S=1/10,000), stereo plotting (partial), existing map data revision (updating), digital compilation.

[Fifth year]

Field completion, map data output, printing.

Work volumes for the fourth and fifth year are as follows.

ITEM	VOLUME	REMARK
[Fourth year]		
1. Field verification	approx. 14,400 km <sup>2</sup>	20 sheets, by SPOT images
2. Additional aerial photography	approx. 170 line/km /200 photos	Scale 1/10,000, for use of changes over years
3. Digital stereo plotting (partial)	approx. 100 km <sup>2</sup>	-ditto-
4. Existing map data revision (updating)	approx. 14,400 km <sup>2</sup>	20 sheets, inc. conversion of contour lines
5. Digital compilation	approx. 11,100 km <sup>2</sup> , 14,400 km <sup>2</sup>	New mapping area (20 sheets) Existing maps updating area (20 sheets)
[Fifth year]		
1. Field completion	approx. 25,500 km <sup>2</sup>	40 sheets
2. Map data output	40 sheets	Inc. CD-ROM 10 copies each
3. Printing	40 sheets	5 colors, 1,000 copies each

#### IV. GENERAL UNDERTAKINGS

The Study shall be conducted in close cooperation between the two countries of Ghana and Japan. Responsibilities of each side set forth in S/W are summarized as follows.

1. Ghana side :

-Necessary arrangements to ensure the entry, exit and stay of the team members as well as personnel of an aerial photography company contracted by the Team for the Study together with related materials and equipment to be brought in and out of Ghana.

-Assistance to facilitate the issuance of permits necessary for implementation of the Study.

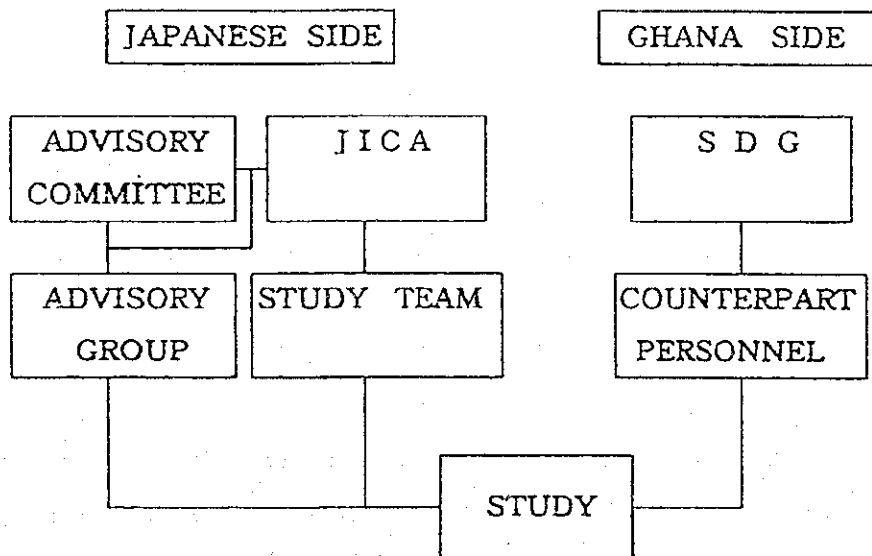
2. Japanese side :

-Implementation of the Study in Ghana and Japan.

-Technology transfer through the execution of the Study.

3. Organization :

Parties involved in this Study shall be organized as follows ;



V. STUDY SCHEDULE

The Study shall be planned for five years from January, 1996 to March, 2000 as shown in Fig. 1.

VI. REPORT AND FINAL PRODUCTS

An annual report shall be prepared by the Study Team at the beginning of each field survey stage. The report on the final year (fiscal) shall cover all of the activities in this Study.

The final products to be delivered to the Government of Ghana are as follows ;

- (1) Aerial photo original negatives ----- 1 set
- (2) Aerial triangulation diapositives----- 1 set
- (3) Contact prints (including aerial triangulation photos)----- 2 sets

- (4) Photo index map ----- 1 set
- (5) GPS control points descriptions & results ----- 1 set
- (6) Vertical control (leveling) results ----- 1 set
- (7) Field verification data (aerial photos & SPOT images) ----- 1 set
- (8) Aerial triangulation results ----- 1 set
- (9) Digital topographic CD-ROM data ----- 10 copies each
- (10) Color separation combined negatives or positives ----- 1 set each
- (11) 1/50,000 topographic maps ----- 1,000 copies each

VII. PROGRESS OF THIRD YEAR WORK

The progress and details of the third year work are described in Report III.

VIII. PLAN OF OPERATION FOR FOURTH YEAR WORK

The field work in Ghana and the laboratory work in Japan for the fourth year (field verification, additional aerial photography, partial digital stereo plotting, existing map data revision and digital compilation) shall be carried out for a period from August, 1998 to March, 1999. The members of the Study Team and their assignment for the fourth year field work are as shown in Table 1.

1. Preliminary Work in Japan

Prior to the start of the work as above, Chief Engineer together with other responsible engineers shall prepare a detailed plan and equipment for each work process so as to facilitate the field work.

2. Preliminary Work in Ghana

Upon arrival in Ghana, the Study Team shall start preparing for the field operations. Team Leader and his staff shall discuss administrative matters as done in the previous year's work with SDG.

3. Field Verification

In compliance with the map symbols specifications, necessary items to indicate on the map shall be collected and identified in the field using SPOT images.

Map symbols and application rules shall be used as agreed to by SDG. The results shall be inscribed on the SPOT images for succeeding mapping works.

### 3-1 Planning and preparation

Prior to the survey, preliminary study for photo interpretation shall be made to the best possible extent fully utilizing photos and other available materials.

Administrative boundaries and place names, etc. necessary for annotations on the map shall be based on the information to be supplied by SDG.

### 3-2 Implementation

Following items shall be confirmed and/or surveyed in the field.

- Confirmation of the results of pre-interpretation.
- Keys for photo-interpretation of topography and geographical features.
- Items difficult to interpret on the SPOT images.
- Total-station/GPS surveying of the changes after the time of the SPOT images.
- Items necessary for the application of map symbols, such as roads, railways, rivers, buildings, specified areas, vegetation, etc.
- Collection of materials at local administrative offices.

## 4. Additional Aerial Photography

Additional aerial photography shall be carried out for the limited area where planimetric features/ground elevations are widely changed after making the base maps (1972~73) or after SPOT images (1994~95) for the use in updating work.

### 4-1 Specifications for aerial photography

Main specifications for the additional aerial photography shall be as follows;

- Camera : Wide angle camera
- Photo scale : approx. 1/10,000
- Flight length : approx. 170 km
- Coverage : approx. 300 km<sup>2</sup>
- Film : Panchromatic film
- Forward overlap: 60 ± 5%
- Lateral overlap: 30 ± 10%
- Crab : Less than 10 degrees
- Tip & tilt : Less than 5 degrees

- Cloud coverage: Amount of cloud shall not exceed approx. 5% in successive 5 photos. However, important areas for orientation and cartography shall not be covered with clouds.

#### 4-2 Implementation of photography

- Base airport : The flight plan shall be made with Accra Airport as the base.
- Test flight : Test flights and test photographing shall be made over the site before launching the scheduled operations.
- Checking : Supervisor for aerial photography inspects developed photos to ensure sidelaps, overlaps and other specified items. If the results do not fulfill the specifications, the aerial photography company shall re-fly the same portions.
- Film editing : Course numbers and photo numbers, etc. shall be annotated on the negatives.
- Index map : The photo index map shall be prepared on the existing topographic map by assigning principal points of photos.

#### 5. Digital Stereo Plotting (Partial)

Using the above aerial photographs, partial digital mapping shall be done by means of analytical stereo plotting instruments. The existing topographic maps shall be used for the stereo models orientation.

Detailed terrain features shall be carefully measured, and also contour lines shall be drawn. Specifications for measurement are as follows ;

- Stable polyester sheet shall be used for plotting materials, if necessary.
- Neat lines shall be 15' (longitude) x 15' (latitude)
- Map projection shall be Ghana modified transverse mercator.
- For the absolute orientation, existing map data shall be used as much as possible for the sake of accuracy of height and position.
- Stereo measurement shall be executed in accordance with the map symbols and their application rules in the order of linear elements, such as roads, rivers, buildings, vegetation and contour lines.
- Contour lines shall be drawn every 10 meters (20 meters for mountainous area).
- Care must be taken of the representation of micro topography, like hills, plains, forests, seasonal rivers, cultivated lands , etc.



## 6. Existing Map Data Revision (Updating)

### 6-1 Production of SPOT image orthophotos

As in aerial photographs due the optical characteristics where high rise buildings appear leaning away from the center, the satellite images to be used are composed of many central projections to make scenes and therefore the same phenomenon as in the aerial photograph is observed.

Based on the digital data of the existing maps and SPOT images, orthophotos are produced to show the planimetric features at their true geographic locations and to serve as basic images for interpretation/transfer, and digitizing for updating work.

Instruments and software to be used for production of SPOT image orthophotos are as follows;

- ① DTM production
  - Sun SS20 (SUNMICROSYSTEM)
  - Arc/Info ver. 7 (ESRI)
- ② Orthophoto image production
  - Sun Ultra Sparc 1 (SUNMICROSYSTEM)
  - Socet Set ver. 3.2.0 (LHZ Systems)

### 6-2 Revision of changes over years

Digital data from existing maps as made by the SDG and ortho-data of SPOT images are fed into a computer and by overlaying both data on the display, changes in planimetric features over the years are identified and updated. Satellite image interpretation is to be made based on the findings from the field survey. Care must be taken to see that both linear features such as roads and railways and polygons features like vegetation and ponds adequately relate to the existing maps. Applicable code classifications are as specified and agreed by the SDG.

Instruments and software to be used for the revision are as follows.

- Sun SS20 (SUNMICROSYSTEM)
- Arc/Info ver. 7 (ESRI)

### 6-3 Conversion of contour lines

The contour data in meter shall be compiled, using the TIN/CIP program based on the digital elevation data and the river system data of the existing maps in

foot. When there is a large blank in the existing map data, it shall be manually modified through visual estimation.

## 7. Digital Compilation

Based on the digital map data generated in the previous year and on the revisions made this year updating changes over years, digital compilation is undertaken according to map symbol application rules and the code numbers as already set to produce digital compilation manuscripts. This process of digital compilation is designed so the SDG will be able to follow up on their own in the future. Digital compilation involves two steps :GIS data integration and Cartographic design & feature symbolization. Initially, data are architecturally compiled to make them applicable to a GIS, to be followed by the plotting compilation in which data are compiled for plotting according to the map symbols and application rules.

### 7-1 GIS data integration

GIS data is created by integration of the data acquired in the process of digital mapping. The work items are explained as follows.

- All the digital mapping data which was stored as a DXF format are imported to an ARC/INFO coverage.
- Data in a same category but recorded in separate coverages, a road with paved or unpaved portions for example, are joined and topology is created in order to store the data in polygon, line and point coverages.
- Topologic errors are corrected.
- Database scheme definition is defined in order to correspond with existing GIS database.
- Tagging the attributes to the defined attribute table. The existing feature codes will be taken into consideration.
- Map boundaries are created using longitudes and latitudes of four corners.
- For each coverage, edges are matched among adjacent map sheets for consistency.
- Hard copy of the coverage shall be prepared for checking and errors are corrected.



## 7-2 Cartographic design and feature symbolization

The coverages are processed using the map editing software to produce the map. Cartographic design and feature symbolization are carried out in this stage. The work items are explained as follows.

- Layers and data are selected to prepare coverages for symbolization of features.
- The coverage files are then converted to the illustrator formats with scales specified.
- When internal annotation texts are necessary, text files shall be exported from an attribute table.
- Legend and external annotation are prepared using a map editing software.
- The files for mapping are exported to the map editing workstation such as, MAC/PC. If there are annotation files, the files are also exported.
- The mapping data is loaded into a map editing software.
- Colors and symbols by layer are specified in accordance with the map symbol specifications.
- Map symbols specified by scale are transferred.
- Annotation texts, external map symbols and boundary information are prepared.
- After all the works are completed, check plots are printed using a color ink-jet plotter or a color electrostatic plotter. The colors of printers for inspection are specified differently. When errors are found, they are corrected.

## IX. TENTATIVE WORK PLAN FOR SUCCESSIVE WORK

Following is the work plan covering succeeding work. It is tentative at this time because it is subject to change depending on the progress of a preceding process or due to unexpected reasons.

### 1. Field Completion

Field completion shall be carried out on the items which are unidentified in the preceding process. Also important changes that have happened in the meantime, if any, shall be incorporated and modified.

At the time of the field completion, test printed sample sheet shall be made

for discussion with SDG to finalize the colors and other matters.

## 2. Final D/M Data Production and Output

Based on the field completion data, D/M data shall be finalized and the five color separation original sheets for printing shall be produced. Also ten copies of CD-ROMs which contain digital topographic data for all the study area shall be made as final products. Map style and symbols shall be those adopted by SDG. Annotation shall be in English (Latin alphabet). Every map sheet to be product in this survey work shall have the following annotation printed at the lower margin the following ;

"This map was prepared jointly by Japan International Cooperation Agency (JICA) under the Japanese Government Technical Cooperation Programme and Ministry of Lands and Forestry, Survey Department of the Government of Ghana."

## 3. Printing

Printing plates shall be prepared by photo lithography using 1/50,000 out put original. Color applied for printing shall be five, and 1,000 final copies shall be printed for each map sheet.

Specification of printing paper to be used shall be determined through talks with SDG.

The plates for reproducing paper maps shall be delivered to the SDG after finishing the Study.

TABLE 1. MEMBERS OF STUDY TEAM AND THEIR ASSIGNMENT IN THE FOURTH YEAR WORK

NAME	ASSIGNMENT	DURATION	CONTENTS
Tokihiko KAMINISHI	LEADER	22 <sup>nd</sup> Aug.'98 ~ 5 <sup>th</sup> Sep.'98 9 <sup>th</sup> Oct.'98 ~ 23 <sup>rd</sup> Oct.'98	1. Total Management 2. General Discussion
Koichi MIKI	SUBLEADER	22 <sup>nd</sup> Aug.'98 ~ 23 <sup>rd</sup> Oct.'98	1. Sub Management 2. General Discussion 3. Assistance of Leader 4. General Supervision
Kozo OKUMURA	MAPPING PLANNER	22 <sup>nd</sup> Aug.'98 ~ 23 <sup>rd</sup> Oct.'98	1. Fundamental Map Planning 2. General Coordination 3. Reporting
Hitoshi YOSHIDA	CHIEF SURVEYOR	22 <sup>nd</sup> Aug.'98 ~ 23 <sup>rd</sup> Oct.'98	1. Planning of Implementation 2. Supervision of Works 3. Coordination of Works 4. Quality Checking
Tosio MIZUTANI	MECHANICAL ENGINEER	22 <sup>nd</sup> Aug.'98 ~ 23 <sup>rd</sup> Oct.'98	1. Management of Vehicle 2. Maintenance of Vehicle
Kazushi ENDOH	D/M PLANNER	22 <sup>nd</sup> Aug.'98 ~ 10 <sup>th</sup> Sep.'98	1. Digital Mapping Data Discussion & Design
Masahiko OHASHI	SURVEYOR	22 <sup>nd</sup> Aug.'98 ~ 23 <sup>rd</sup> Oct.'98	1. Field Verification
Kouzou ASANO	"	"	
Tuyoshi YAMASAKI	"	"	
Michio SATOJI	"	"	
Minori OHNAKA	"	"	
Masaru TERADA	"	"	
Masaaki MIZUOCHI	"	"	
Takeshi NEMOTO	"	"	
Hideaki SAKAI	COORDINATOR	22 <sup>nd</sup> Aug.'98 ~ 5 <sup>th</sup> Sep.'98	1. Coordination

Fig. 1 REVISED WORKING SCHEDULE

YEAR MONTH	1ST YEAR 1996			2ND YEAR 1996 - 1997			3RD YEAR 1997 - 1998			4TH YEAR 1998 - 1999			5TH YEAR 1999 - 2000																	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3			
CORRECTIONAL SURVEY																														
AERIAL PHOTOGRAPHY																														
LEVELING SURVEY																														
TRANGULATION SURVEY																														
AERIAL TRIANGULATION																														
FIELD VERIFICATION																														
SPOT CHECK PRODUCTION																														
ADDITIONAL PHOTOGRAPHY																														
STEREO PLOTTING																														
EXISTING MAP/ DATA REVISION																														
DIGITAL COMPUTATION																														
FIELD COMPLETION																														
DATA REVISION																														
ORIGINAL MAP OUTPUT																														
MAP PRINTING																														
EXPORT																														
INSPECTION																														
RELAY OF CODES																														

LEGEND — PREPARATION    FIELD SURVEY    WORK IN JAPAN

Fig. 2 TOPOGRAPHIC MAPPING CHART

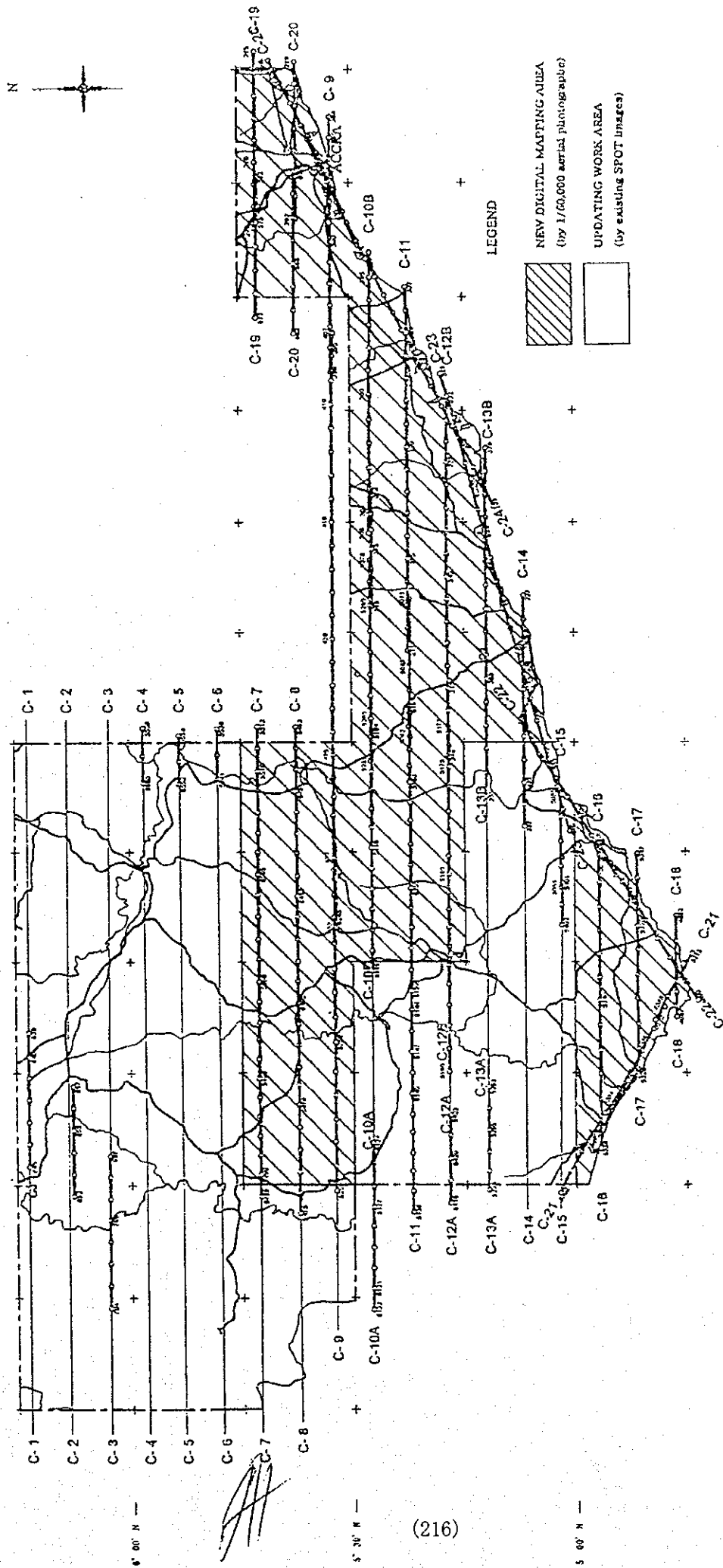
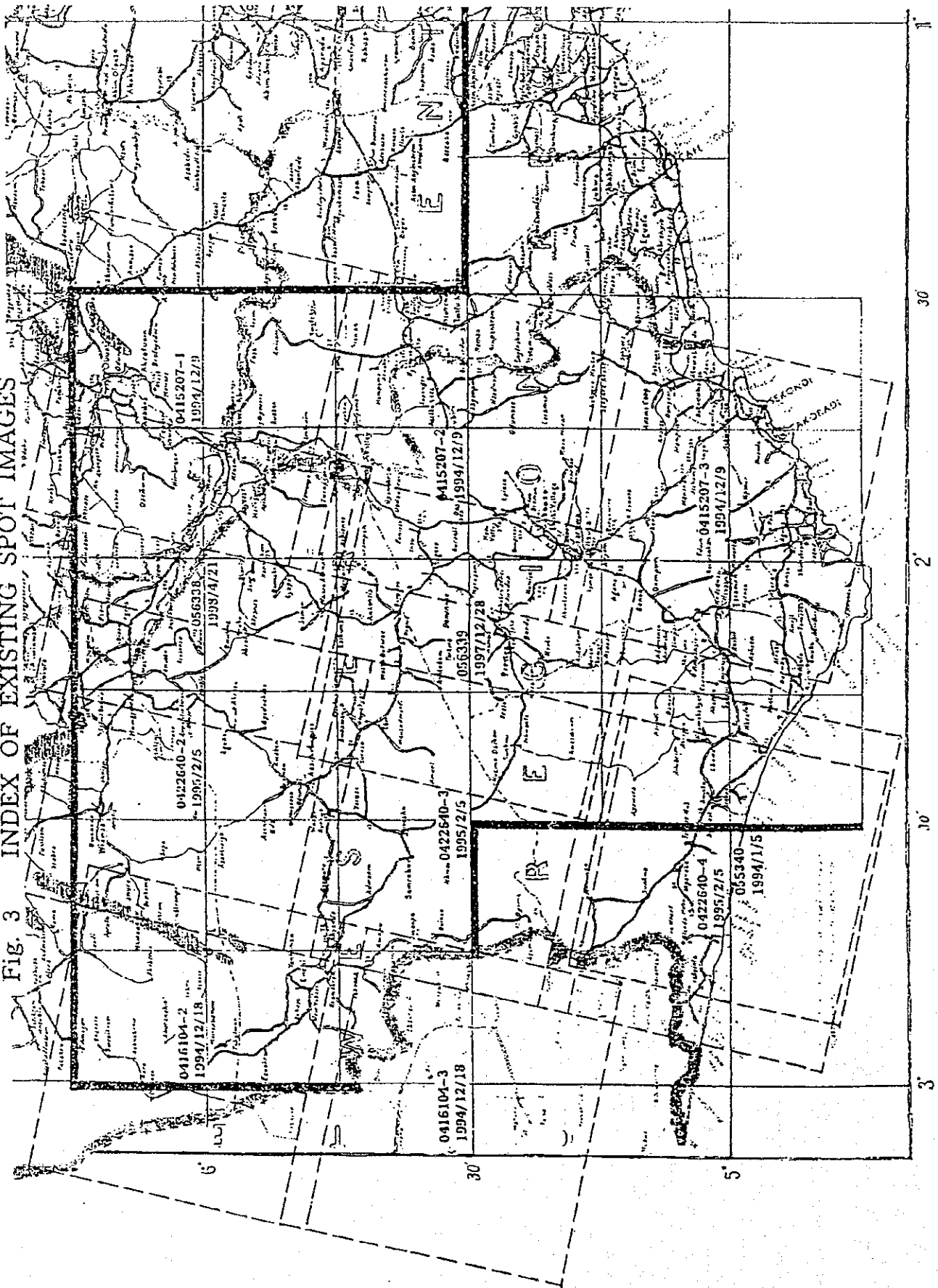


Fig. 3 INDEX OF EXISTING SPOT IMAGES





ATTACHMENT

CODE TABLE FOR THE TOPOGRAPHIC MAPPING OF  
SOUTHERN PART OF THE REPUBLIC OF GHANA

-DRAFT-

*AA*

□

Existing CODE

Final Code Table					
Layer	Feature	Code	Name	Cartographic Symbol	Attributes
01 Cult-poly	Centroid	2044	Salt Ponds (Centroid)	63'	
01 Cult-poly	Centroid	2050	Prominent Building	24(b)	
01 Cult-poly	Centroid	2051	City, Town	22	
01 Cult-poly	Centroid	2051	Village	23	
01 Cult-poly	Centroid	3008	Mine Dump ( Mineral Working Centroid)	54	
01 Cult-poly	Centroid	3015	Gravel Pit Centroid		
01 Cult-poly	Line	2005	Prominent Building	24(b)	
01 Cult-poly	Line	2006	City, Town	22	
01 Cult-poly	Line	2008	Village	23	
01 Cult-poly	Line	2034	Salt Ponds	63'	
01 Cult-poly	Line	3005	Mine Dump ( Mineral Working outline)	54	
01 Cult-poly	Line	3016	Gravel Pit Outline		
02 Cultural	Line	2041	Dry Dock		
02 Cultural	Line	3002	Cut line	19	
02 Cultural	Line	3007	Quarry (Line)	57	
02 Cultural	Line	3012	Cable ways, Conveyer belt	10	
02 Cultural	Line	3012	Fence , Concrete or block wall	21	
02 Cultural	Line	3012	Ancient wall	41(b)	
02 Cultural	Line	3012	Jetty	42(a)	
02 Cultural	Line	3012	Quay	42(b)	
02 Cultural	Line	3012	Wharf	42(c)	
02 Cultural	Line	3012	Sports ground ( to Scale)	36	
02 Cultural	Line	4007	Boundary : International	13	
02 Cultural	Point	1001	Waterhole, Well, Spring (Borehole)	64	
02 Cultural	Point	1028	Water tower (works)	64'	
02 Cultural	Point	2001	Navigation beacon	38(b)	
02 Cultural	Point	2003	Compound & Huts	24(a)	
02 Cultural	Point	2004	Prominent Building	24(b)	
02 Cultural	Point	2008	Church	28(a)	
02 Cultural	Point	2009	Court House	27(d)	



02 Cultural	Point	2010	Dam	63(c)	angle
02 Cultural	Point	2012	Hospital	26(a)	
02 Cultural	Point	2014	Light House	38(a)	
02 Cultural	Point	2015	Market	25	
02 Cultural	Point	2016	Barracks	27-1(b)	
02 Cultural	Point	2019	Mosque	31	
02 Cultural	Point	2020	Police Station	27(c)	
02 Cultural	Point	2021	Post Office	33(a)	
02 Cultural	Point	2022	Station	8	
02 Cultural	Point	2024	Hotel	27(a)	
02 Cultural	Point	2025	School	27(b)	
02 Cultural	Point	2026	Post & Telecommunication Office	33(c)	
02 Cultural	Point	2033	Wireless Station		
02 Cultural	Point	2035	Ruin	41(a)	
02 Cultural	Point	2036	Health Post		
02 Cultural	Point	2037	Clinic	26(b)	
02 Cultural	Point	2040	Tank Symbol		
02 Cultural	Point	2043	Cemetery	32	
02 Cultural	Point	3004	Mine	44	
02 Cultural	Point	4002	Boundary Pillar		
02 Cultural	Point	4012	Survey Pillar		
02 Cultural	Point	4016	Trig Station		
02 Cultural	Point	7002	Photo Principal Points	48(b)	(Course & No)
03 Forest	Centroid	4021	Forest Reserve	17	
03 Forest	Line	4006	Boundary : Forest Reserve	17	
04 Hydrog-Poly	Centroid	1007	Area liable to flood (Centroid)	61(a)	
04 Hydrog-Poly	Centroid	1003	Island Centroid		
04 Hydrog-Poly	Centroid	1009	Lake ( Centroid)	63(a)	
04 Hydrog-Poly	Centroid	1011	Marsh or Swamp (Centroid)	61(b)	
04 Hydrog-Poly	Centroid	1015	Sand or Mud ( Centroid)	55	
04 Hydrog-Poly	Line	1005	Area liable to flood	61(a)	
04 Hydrog-Poly	Line	1010	Marsh or Swamp	61(b)	
04 Hydrog-Poly	Line	1014	Sand or Mud (Flats)	55	
04 Hydrog-Poly	Line	1016	Lake ( Shoreline)	63(a)	
04 Hydrog-Poly	Line	1017	Shoreline Virtual Segment		
04 Hydrog-Poly	Line	1018	Coastline	67	

04 Hydrog-Poly	Line	1019	Coastline Virtual Segment		
04 Hydrog-Poly	Line	1023	Water sources(Line)	60	
04 Hydrog-Poly	Line	1042	Pond	63(b)	
05 Hydrographic	Line	1025	Watercourse Virtual Segment		
05 Hydrographic	Line	1018	Coastline	67	
05 Hydrographic	Line	1024	Water sources(indefinite streams)	60(a)	
05 Hydrographic	Line	1027	Reservoir		
05 Hydrographic	Line	2011	Dam to scale	63(c)	
05 Hydrographic	Line	3009	Sand Bar		
05 Hydrographic	Line	3010	Sand/Mud Outline		
06 Hypsographic	Line	8001	Approximate Index Contour	50(a)	elevation
06 Hypsographic	Line	8002	Approximate Intermediate Contour	50(b)	elevation
06 Hypsographic	Line	8004	Depression Index Contour	51(a)	elevation
06 Hypsographic	Line	8005	Depression Intermediate contour	51(a)	elevation
06 Hypsographic	Line	8006	Index contour	50(b)	elevation
06 Hypsographic	Line	8007	Contour line	50(a)	elevation
06 Hypsographic	Point	8008	Spot Height	48(a)	elevation
07 Landform	Line	1003	BoulderRock(Area)	67-1(b)	
07 Landform	Line	1004	Flat Rock(Area)	67-1(a)	
07 Landform	Line	1013	Rapids to Scale	60(b)	
07 Landform	Line	1022	Water fall to scale	60(e)	
07 Landform	Line	3001	Cliffs(outline)	52(c)	(direction)
07 Landform	Line	3008	Outcrop Rock(outline)	52(a)	
07 Landform	Point	1002	Boulder		
07 Landform	Point	1005	Flat Rock		
07 Landform	Point	1012	Rapids	60(c)	angle
07 Landform	Point	1021	Waterfall	60(d)	angle
08 Neatline	Centroid	4022	International Centroid		
08 Neatline	Line	4003	Boundary : Regional	14	
08 Neatline	Line	4003	Boundary : District	15	
08 Neatline	Line	4003	Boundary : City,Municipal or town	16	
08 Neatline	Line	4003	Boundary : National Park	17	
08 Neatline	Line	4003	Boundary : Hunting area	17	
08 Neatline	Line	4003	Boundary : Other	17	
08 Neatline	Line	7001	Neatline		

09 Transport	Line	5001	Ferry	66(e)	
09 Transport	Line	5002	Ford	66(d)	
09 Transport	Line	5004	Railway		
09 Transport	Line	5005	Railway L.G.		
09 Transport	Line	5006	Railway U/C		
09 Transport	Line	5007	Roads : Class 1	2	
09 Transport	Line	5008	Roads : Class 2	3	
09 Transport	Line	5009	Roads : Class 3	4	
09 Transport	Line	5010	Railway Siding		
09 Transport	Line	5012	Tracks and Major Footpaths	6	
09 Transport	Line	5013	Trail		
09 Transport	Line	5014	Airstrip	46(b)	
09 Transport	Point	2002	Bridge	66(a)	angle
09 Transport	Point	2039	Culvert	66(c)	angle
09 Transport	Point	4008	Mile Post		angle
09 Transport	Point	5003	Level Crossing		
10 Utility	Line	2042	Pipeline		
10 Utility	Line	6001	Telephone line	12	
10 Utility	Line	6002	Telegraph V/S		
10 Utility	Line	6003	Power transmission line	11(a)	
10 Utility	Line	6003	Power transmission line	11(b)	
10 Utility	Line	6003	Power transmission line	11(c)	

## (ADDENDUM)

Coverage	Code	Type	Description	Jica Notes	SD Notes
Cultural	****		Quarry Centroid	57	(2)
Cultural	NONE	Line	Embankment	53	
Cultural	2013	Point	Barrier	27(e)	
Cultural	2016	Point	Military Station	27-1(a)	(1)
Cultural	2008	Point	Mission	28(b)	(1)
Cultural	2019	Point	Temple	28(c)	(1)
Cultural	2017	Point	Silo	29	
Cultural	2026	Point	Telecommunication Office	33(b)	(1)
Cultural	2018	Point	Electric substation	34	
Cultural	2023	Point	Sports ground	36(Angle)	
Cultural	2027	Point	Shed	37	
Cultural	2028	Point	Fort	39(a)	
Cultural	2028	Point	Castle	39(b)	(4)
Cultural	2029	Point	Palace	39(c)	
Cultural	2030	Point	Tower	40	
Cultural	2035	Point	Ancient site	41(c)	(1)
Cultural	2033	Point	Radio transmission station	43	(1)
Cultural	2038	Point	Aerodrome	46(a)	
Hydro	1015	Cent.	Dunes ( Centroid)	56	
Hydro	1009	Cent.	Water cources(centroid)	60	(1)
Hydro	1009	Cent.	Pond( Centroid)	63(b)	(1)
Hydro	3009	Line	Dunes ( Area)	56	
Hydro	NONE	Line	Trench Gutter	62	
Hypso	8005	Line	Basin shallow Depression	51(b)	Contour
Cultural	4016	Point	Geodetic point (Triangle)	47	(3) (5)
Cultural	4012	Point	Geodetic point	47	(3) (5)
Cultural	4012	Point	Bench mark	49	(3) (5)
Landform	NONE	Line	Steep slopes	52(b)	
Landform	****		Outcrop Rock (Centroid)	52(a)	
Landform	****		Rapids to Scale	60(c)	
Landform	****		Flat Rock (centroid)	67-1(a)	
Landform	****		(Centroid)	67-1(b)	
Transport	5007	Line	Motorway	1	(1)
Transport	5008	Line	Street & main roads	4	(1)
Transport	5011	Line	Road under construction	5	
Transport	5013	Line	Other Footpaths	7	(1)
Transport	5005	Line	Railway (double line)	8(a)	(1)
Transport	5005	Line	Railway (single line)	8(b)	(1)
Transport	5015	Line	Railway (Discontinued)	8(c)	
Transport	NONE	Point	Footbridges	66(b) angle	
Transport	NONE	Point	Rotary	USE APPROPRIATE ROAD CODE	
Utility	2042	Line	Water pipe	65	(1)
Forest	4022	Cent.	Thick Forest (Centroid)	68	
Forest	4023	Cent.	Light Forest (Centroid)	69	
Forest	****	Cent.	Savannah (Centroid)	70	
Forest	4030	Cent.	Plantation (Centroid)	72	text(ex. cocoa)
Forest	4031	Cent.	Cultivation (Centroid)	77	
Forest	4006	Line	Thick Forest (area)	68	
Forest	4006	Line	Forestetation boundary		(1)
TEXT Annot.	NONE		Aerodrome	46(a)	Name

## SD Notes.

- (1) Existing code
- (2) Feature not required in the digital data
- (3) Change in coverage from JICA proposal
- (4) Same as Fort
- (5) Elevation is not an attribute. It is annotation only.

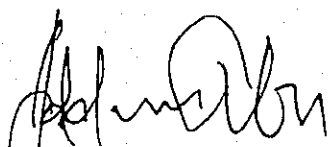
5-8 第4年次現地作業終了時の協議議事録






MINUTES OF MEETINGS  
FOR  
THE STUDY ON TOPOGRAPHIC MAPPING  
OF  
SOUTHERN PART OF THE REPUBLIC OF GHANA  
BETWEEN  
SURVEY DEPARTMENT OF GHANA  
AND  
JICA STUDY TEAM

ACCRA GHANA, 19<sup>th</sup> October, 1998



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NA AL-HAJI IDDIRISU ABU  
DIRECTOR OF SURVEYS  
SURVEY DEPARTMENT OF  
GHANA  
MINISTRY OF LANDS AND  
FORESTRY




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TOKIHIKO KAMINISHI  
LEADER  
JICA STUDY TEAM

Survey Department of Ghana (SDG) and JICA Study Team (Team) had a series of meetings at the end of the fourth year's field work for the "Topographic Mapping of Southern Part of the Republic of Ghana" from October 12<sup>th</sup> to 16<sup>th</sup> 1998.

At the meeting, the following items were confirmed by both sides.

1. Team reported briefly the progress of the fourth year field work for the study, and presented the "Progress Report of the Field Work of the Fourth Year for Topographic Mapping of Southern Part of the Republic of Ghana" prepared by the Team (attachment), SDG accepted the Report.
2. Team received the Magnetic Declination Data prepared by SDG to be indicated on each map sheet.
3. Team found discrepancies in some of the digital data which were prepared by the SDG. Therefore, Team requested that the digital data need to be corrected by SDG. However, due to the shortage of human resources and hardware/software resources in SDG, SDG requested that data correction shall be carried out by Team. Team agreed that the request will be conveyed to JICA Headquarters by the Team.
4. SDG requested to the Team to leave the survey equipment including software to be used for technology transfer on Digital Mapping in Ghana after the study of next year.



## LIST OF ATTENDANTS

### SDG Side

Na Al-haji Iddirisu Abu	Director of Surveys	Headquarters
Al-haji R. Brimah	Asst. Director	Headquarters
Mr. J. Dotse	Asst. Director	Great Accra Region
Mr. J.A. Abbosey	Staff Surveyor	Headquarters
Mr. Marcus A.Tabil	Examiner	Examination Section
Mr. K.N.Arku-Lawson	Chief Cartographer	Cartographic Section
Mr. I.Andoh-Kesson	Chief Photogrammetrist	Photogrammetric Sec.
Mr. E.R.Tetteh	Chief Lithographer	Lithographic Section
Mr. S.Oppong-Antwi	Asst. Staff Surveyor	Digital Mapping Sec.
Mr. F.Manu-Adabor	Asst. Staff Surveyor	Digital Mapping Sec.

### Team Side

Mr. Tokihiko KAMINISI	Team Leader
Mr. Koichi MIKI	Deputy Leader
Mr. Kozo OKUMURA	Mapping Planner
Mr. Hitoshi YOSHIDA	Chief Surveyor

EA

D

ATTACHMENT

PROGRESS REPORT

OF

THE FIELD WORK OF THE FOURTH YEAR

FOR

TOPOGRAPHIC MAPPING OF SOUTHERN PART

OF

THE REPUBLIC OF GHANA

OCTOBER, 1998

STUDY TEAM

OF

TOPOGRAPHIC MAPPING OF SOUTHERN PART

OF

THE REPUBLIC OF GHANA

JAPAN INTERNATIONAL COOPERATION AGENCY

## 1. INTRODUCTION

The topographic mapping of the southern part of the Republic of Ghana started in January 1996, in a five-year plan, as a technical cooperation program of JICA.

In compliance with the Scope of Work agreed between the Survey Department of Ghana and JICA on 17th March, 1995, and the Minutes of Meetings on 18th December, 1997, the JICA Study Team arrived in Accra on 23rd of August, 1998, for the implementation of the fourth year field work. After consultation with the SDG, the Team set up the field headquarters in Accra for the field work. Meanwhile Ghana counterparts from the SDG joined the work from time to time. In accomplishing the field work of fourth year, hereinafter, the summary of the progress of the work is reported.

## 2. OUT LINE OF THE FOURTH YEAR WORK

### 2-1 Objective

The objective of the Study are : (1) To prepare 1/50,000 topographic map covering an area of approximately 25,500 km<sup>2</sup> in the southern part of the Republic of Ghana, (2) To transfer technology to the counterparts personnel of SDG through the implementation of the work, and (3) To promote the friendship between Ghana and Japan through the implementation of the Study.

The fourth year work is consisting of the field verification using existing satellite image, additional aerial photography(supporting data for field survey), Digital stereo plotting(partial), existing map data revision(updated) and Digital compilation.

### 2-2 Period of Field Work

( Field verification )	22nd August,'98 ~ 23rd October,'98
( Additional aerial photography)	1st September,'98 ~ 13rd November,'98

### 2-3 Formation of the Study Team

Leader	Mr. Tokihiko KAMINISHI	22 <sup>nd</sup> Aug.'98	~ 5 <sup>th</sup> Sep.'98
	"	9 <sup>th</sup> Oct.'98	~ 23 <sup>rd</sup> Oct.'98
Deputy Leader	Mr. Koichi MIKI	22 <sup>nd</sup> Aug.'98	~ 23 <sup>rd</sup> Oct.'98

Mapping Planner	Mr. Kozo OKUMURA	22 <sup>nd</sup> Aug,'98 ~ 23 <sup>rd</sup> Oct,'98
Chief Surveyor	Mr. Hitoshi YOSHIDA	22 <sup>nd</sup> Aug,'98 ~ 23 <sup>rd</sup> Oct,'98
D.M. Planner	Mr. Kazushi ENDOH	22 <sup>nd</sup> Aug,'98 ~ 10 <sup>th</sup> Oct,'98
Mechanical Engr.	Mr. Toshio MIZUTANI	22 <sup>nd</sup> Aug,'98 ~ 23 <sup>rd</sup> Oct,'98
Surveyor	Mr. Masahiko OHASHI	"
"	Mr. Kouzou ASANO	"
"	Mr. Tuyoshi YAMAZAKI	"
"	Mr. Michio SATOJI	"
"	Mr. Minori OHNAKA	"
"	Mr. Masaru TERADA	"
"	Mr. Masaaki MIZUOCHI	"
"	Mr. Takeshi NEMOTO	"
Coordinator	Mr. Hideaki SAKAI	22 <sup>nd</sup> Aug,'98 ~ 5 <sup>th</sup> Sep.'98

#### 2-4 Amount of the Field Work ( Plan and Results )

Progress until 18<sup>th</sup>Oct.'98 are as follows

Item	Original plan	Results
Field verification ( by existing SPOT images )	14,400km <sup>2</sup>	14,400km <sup>2</sup>
Additional air photography Photo scale Number of photos	1/10,000 200 photo	N/A

#### 2-5 Counterparts of SDG

Headquarters;

Na Al-haji Iddirisu Abu	Director of Surveys	Headquarters
Al-haji Ridwan Brimash	Asst. Director	Headquarters
Mr. J. Dotse	Asst. Director	Great Accra Region
Mr. J.A. Abbosey	Staff Surveyor	Headquarters
Mr. Marcus A. Tabil	Examiner	Examination Section
Mr. K.N. Arku-Lawson	Chief Cartographer	Cartographic Section
Mr. I. Andoh-Kesson	Chief Photogrammetrist	Photogrammetric Sec.
Mr. E.R. Tetteh	Chief Lithographer	Lithographic Section
Mr. J.C. Acquah	Staff Surveyor	Great Accra Region
Mr. J. Ofori Boadu	Asst. Staff Surveyor	Examination Section
Mr. S. Oppong-Antwi	"	Digital Mapping Section

Mr. F. Manu-Adabor	Asst. Staff Surveyor	Digital Mapping Section
Mr. George Frimpong	"	"
Field Work ;		
Mr. J. Adu Baiden	Asst. Staff Surveyor	Digital Mapping Section
Mr. Paul Essiem	Survey Technician	Western Region
Mr. F.K. Sodokey	"	"
Mr. S.O. Koranteng	"	"

### 3.FIELD WORK

#### 3-1 Field Verification

Field verification using existing SPOT images were started by the team members and SDG counterparts in compliance with the map symbols and their application rules agreed between SDG and JICA Study Team.

Confirmation and investigation of various expressions and names specified by map symbols were conducted. The survey results were described on the SPOT images to be used as data for succeeding digital stereo plotting and/or compilation work.

#### (1)Implementation

Main items verified in the field are as follows, and the results were indicated on the scale of 1/50,000 SPOT images.

- ① Confirmation of the results of pre-interpretation.
- ② Classification of road and their attributes.
- ③ Public buildings and structures.
- ④ Linear structures (railway, power transmission line, etc.).
- ⑤ Key for photo interpretation of vegetation and topographic features.
- ⑥ Collection of place-name and designation of ground features (Village, river, mountain , etc).
- ⑦ Other necessary items for map representation in accordance with the map symbols and their application rules

#### (2)Kinematic GPS Survey

In the case when survey team found a new wide road or important features on the field and where some details could not be found in the SPOT image, kinematic GPS survey method was applied for the data collection. The reference control points

for the kinematic GPS survey were carefully selected for the interpolation on the existing maps or SPOT images.

Survey result is an example shown in Fig. 1.

### 3-2 Additional Aerial Photography

While the Study Team was still in Ghana, additional aerial photography was conducted in a limited area of the Study area. Despite many trials, the results did not meet the standards because of unsuitable weather conditions. It was agreed by both sides that this situation is hereby served as notice to JICA Headquarters <sup>for</sup> actions to be taken regarding the matter with the officials in-charge.



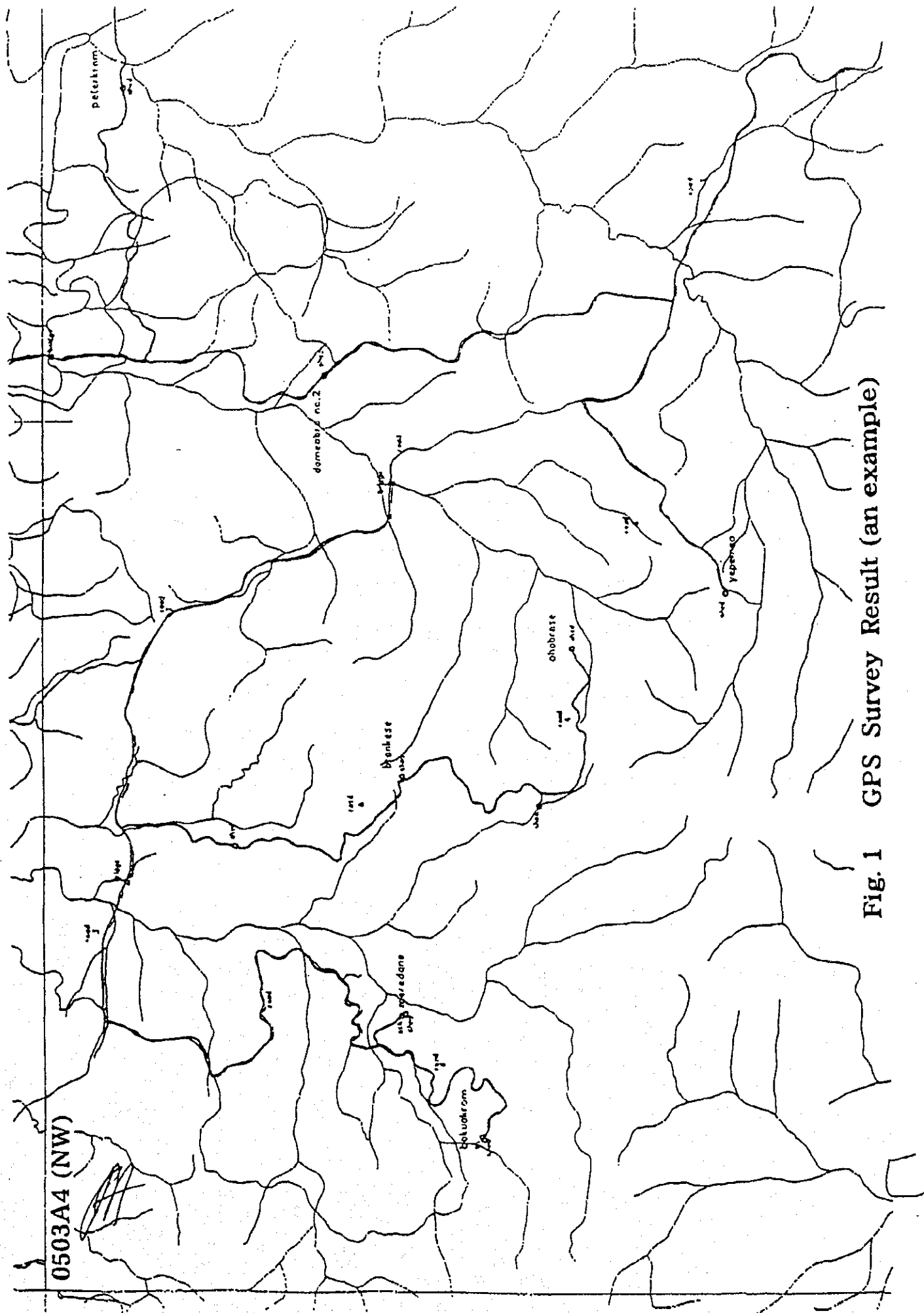


Fig. 1 GPS Survey Result (an example)

**SECTION III**  
**TECHNICAL SPECIFICATIONS**

**3.1 GENERAL**

These Technical Specifications shall apply to the Aerial Photography for Topographic Mapping of Southern Part of the Republic of Ghana.

**3.2 SCOPE OF THE WORK**

The Work shall be executed in Ghana in accordance with the terms, conditions and requirements of this Contract and Specifications and under the supervision of the Engineer.

The services to be provided by the Contractor are summarized as follows:

- (a) Mobilization/demobilization of Aircraft and Crew  
Lump Sum
- (b) Aerial Photography  
170 line km/300km<sup>2</sup> consisting of approximately 10 locations within the area specified in the attached map, Fig. 1 FLIGHT AREA, at 1:10,000 scale, Black and White photographs
- (c) Photo Processing  
200 photo frames

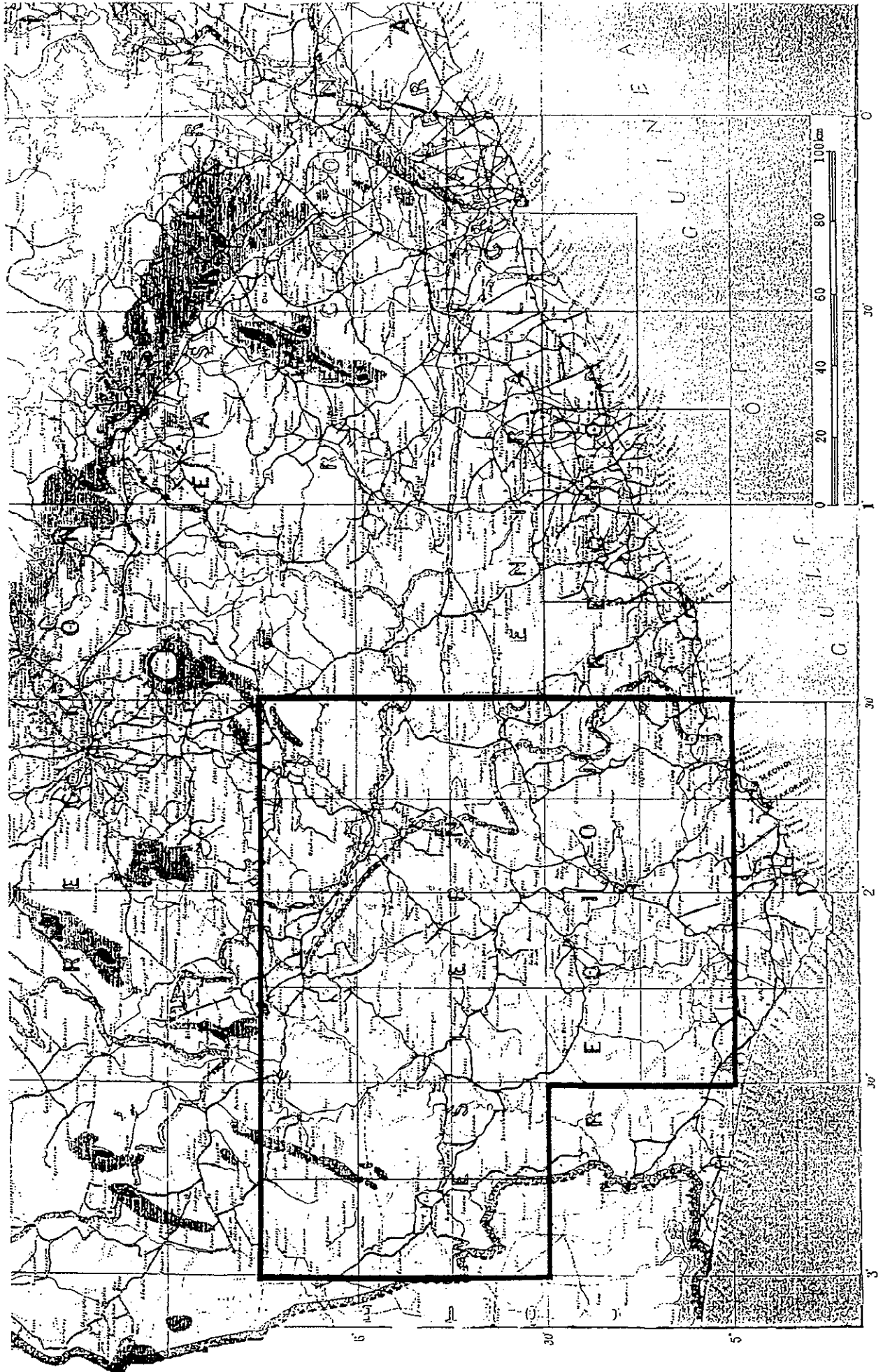
**3.3 FLIGHT PLAN**

The flight plan, showing the flight courses and the required coverage, shall be presented by the Engineer to the contractor prior to the commencement of the Work.

**3.4 WORK SCHEDULE**

All works shall be completed within the period from 1 September 1998 to 31 October 1998.

# FLIGHT AREA



### 3.5 AERIAL PHOTOGRAPHY

#### 3.5.1 Mobilization (and Demobilization)

A photographing team, airplane, their crew and other necessary equipment and materials shall be mobilized to Accra and/or other suitable airports, and all the necessary site arrangements, checking and maintenance of equipment, and test flight(s) shall be completed prior to the execution of the Work.

#### 3.5.2 Aerial Photographing

##### (1) Equipment and Materials

- 1) A Cessna 206 and/or equivalent airplanes shall be used.
- 2) A Zeiss RMK, a Wild RC10 and/or equivalent aerial survey cameras with a wide-angle lens cone (152 mm) shall be used.

The calibration report for the camera and the lens tested within the past five (5) years shall be submitted to the Engineer. The calibration report shall include;

- i) Camera number and lens number,
  - ii) Position of the principal point relative to fiducial marks (in 0.01 mm),
  - iii) Calibrated focal length (in 0.01 mm),
  - iv) Radial distortion, and
  - v) Observer's name and the number of report.
- 3) The aircraft shall be equipped with the proper navigation aids, such as GPS navigation system or similar which is essential for accurate navigation.
  - 4) Kodak XX or similar distortion free aerial films shall be used.
  - 5) Kodak aerographic duplicating film 4421 or equivalent shall be used for the production of film positives.

##### (2) Aerial Photographing

Photographic flying is required to be conducted as follows.

- 1) Aerial photographic work shall be performed to cover the areas specified in Clause 3.2 Scope of the Work hereof.

- 2) Aerial photographs shall be taken at nominal scales specified in Clause 3.2 Scope of the Work hereof.

Datum height(s) for flying above Mean Sea Level shall be instructed by the Engineer.

- 3) The tolerable shifting error of flight runs shall not exceed plus or minus 5 percent of the designated flight altitude.
- 4) The forward overlap between successive exposures in each run shall be a standard between 55 percent and 65 percent except where specified otherwise.

The lateral overlap between adjacent runs shall be a standard between 20 percent and 40 percent.

- 5) Crab shall not exceed 10 degrees when measured between the base line and a line parallel to the frame of the negative nor be such that stereoscopic gaps in the photography result from it.
- 6) Tip and Tilt shall not exceed 5 degrees.
- 7) Photographs shall only be taken when haze, mist and/or smoke, etc. does not substantially impair the tone of reproduction of negatives.
- 8) Although cloud free photographs shall be required, in the case of unfavorable weather conditions, the tolerable volume of clouds shall not exceed 3 percent of five consecutive photographs. However, on the effective stereoscopic photographs, the important areas for photo verification, orientation and mapping shall not be covered with clouds.
- 9) If a designated run is divided into two or more runs for any reason, the overlap for the runs shall consist of at least three photographs.
- 10) Flying for aerial photographs shall be carried out only when the angle of the sun with the horizon is 30 degrees or more, or at other times agreed by the Engineer.
- 11) Approximately 1 m at both ends of the film roll shall be left unexposed.

### 3.5.3 Photographic Processing

Followings are processing procedures.

- (1) The film shall be developed to ensure homogeneous tone and clear contrast in the negatives.
- (2) Fixing shall be done with sufficient time to thoroughly remove unexposed emulsion.

- (3) Washing shall also be done with sufficient time to thoroughly remove any remaining fixing solution.
- (4) Drying shall be carefully done to avoid film distortion caused by rapid heating, etc.
- (5) One set of rush prints for all flight courses shall be delivered to the Engineer for checking.
- (6) The style and specification of the film annotation and flight index shall be instructed by the Engineer.

#### 3.5.4 Negative Numbering

The following annotations shall be recorded on each frame of negative film by the Contractor in accordance with the instruction by the Engineer.

- (1) Name of job
- (2) Date of photography
- (3) Scale of photography
- (4) Flight course number
- (5) Serial number of camera and lens
- (6) Flight altitude
- (7) Photo number

#### 3.5.5 Flight Course Index

Flight course index shall be prepared for all flight courses and photo centers on the existing map at a scale of 1:50,000.

### 3.6 WORK RESULTS

Followings are results of the Work to be delivered to the Engineer.

- |                         |             |
|-------------------------|-------------|
| (1) Aerial Photography  |             |
| Original film negatives | one (1) set |
| Film positives          | one (1) set |
| Contact prints          | one (1) set |

Original flight index map                      one (1) set

Flight records                                      one (1) set

(2) Final Report

Some of above listed results may be contained in the Final Report.

### **3.7 SUPERVISION OF THE WORK**

All works, regardless of whether they are carried out in the field or indoors, shall be supervised by the Engineer.

### **3.8 MEASUREMENT SYSTEM AND LANGUAGE**

All measurements shall be expressed in the metric system and the language to be used shall be English.

### **3.9 SUBMISSION OF SURVEY RESULTS AND FINAL REPORT**

The Contractor shall submit the survey results and final report required under the Contract. The final report shall contain all the contents and results of aerial photographing works. The Engineer shall accept such survey results and final report after verifying that the contents are correct and satisfactory.

As soon as the whole work is satisfactorily completed and all the survey results and final report required under the Contract are accepted, the Engineer shall issue a Certificate of Completion of the Work.

### **3.10 ADHERENCE TO SPECIFICATIONS**

The Contractor shall carry out the Work in strict accordance with the Specifications. When the Contractor plans to do the Work by methods or with equipment not specified herein, he shall submit such alternative plan to the Engineer for prior approval. If the Contractor fails to obtain such prior approval, the Engineer reserves the right not to accept the Contractor's results done by a method or equipment not specified herein and order the Contractor at the Contractor's expense to re-conduct that portion or all of the Work in accordance with the Specifications.

### **3.11 ITEMS NOT SPECIFIED IN THE SPECIFICATIONS**

Items not specified in the Specifications shall be ordered by the Engineer as a variation order.

### 3.12 SAFETY

The Contractor shall be responsible for the safety of his employees and laborers. He shall be conversant with and responsible for all safety regulations applicable to the type of work to be performed and shall comply with all local and national regulations.

### 3.13 ACCIDENTS

The Contractor shall report promptly in writing to the Engineer all accidents whatsoever, arising out of or in connection with the performance of the Work, whether on or adjacent to the site, which cause death, personal injury or property damage, giving full details and statements of witnesses.

Death, serious injuries or serious damages shall be reported immediately by telephone to the Engineer and the owner of the property involved.

Damage to property, roads, structure and others due to negligence of the Contractor shall be compensated by the Contractor at his own expense.

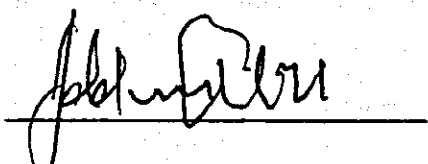


5-9 第5年次現地作業開始時の協議議事録



**MINUTES OF MEETINGS**  
**FOR**  
**THE STUDY ON TOPOGRAPHIC MAPPING**  
**OF**  
**SOUTHERN PART OF THE REPUBLIC OF GHANA**  
**BETWEEN**  
**SURVEY DEPARTMENT OF GHANA**  
**AND**  
**JICA STUDY TEAM**

**ACCRA GHANA, 9<sup>th</sup> November 1999**



**NA AL-HAJI IDDIRISU ABU**

**DIRECTOR OF SURVEYS**

**SURVEY DEPARTMENT OF  
GHANA**

**MINISTRY OF LANDS AND  
FORESTRY**



**TOKIHIKO KAMINISHI**

**LEADER**

**JICA STUDY TEAM**

Survey Department of Ghana (SDG) and JICA Study Team (Team) had a series of meetings at the end of the fifth year's field work for the "Topographic Mapping of Southern Parts of the Republic of Ghana" from November 1<sup>st</sup> to 8<sup>th</sup> 1999. At the meeting, the following items were confirmed by both sides.

1. Team reported briefly to SDG the progress of the fifth year field work for the study, and presented the "Progress Report of the Field Work of the Fifth Year for Topographic Mapping of Southern Part of the Republic of Ghana" prepared by the Team. P / R was discussed and agreed by both sides.
2. Final codes of Topographic map data were discussed according to the Fifth Year P / O, and final code table was confirmed by both sides. Data format is delivered by the Arc/Info Ver.7.0 format and supplied as seamless data.
3. Both sides discussed and agreed on colour density on the printing for 1/50,000 topographic map based on the three kinds of each colour test prints, and SDG requested again to the Team that the following annotation should be printed at the lower margin of every map;  
"This map was prepared jointly by Japan International Cooperation Agency (JICA) under the Japanese Government Technical Cooperation Programme and Ministry of Lands and Forestry, Survey Department of the Government of Ghana".  
Team took note again of this request and confirmed to convey this request Tokyo JICA Head Office.
4. Team received the Administrative Boundaries Data prepared by SDG to be indicated as marginal information on each map sheet.

## LIST OF ATTENDANTS

### SDG Side

Na Al-haji Iddirisu Abu	Director of Surveys	Headquarters
Mr. Jean Dotse	Asst. Director	Greater Accra Region
Mr. J.A. Abbosey	Senior Staff Surveyor	Headquarters
Mr. J.C. Acquaaah	Staff Surveyor	Greater Accra Region
Mr. K. N. Arku-Lawson	Chief Cartographer	Cartographic Section
Mr. Andoh-Kesson	Chief Photogrammetrist	Photogrammetric Section
Mr. Marcus A. Tabil	Examiner	Examination Section
Mr. Opong-Antwi	Staff Surveyor	Digital Mapping Section
Mr. George Frimpong	Staff Surveyor	Digital Mapping Section

### Team Side

Mr. Tokihiko KAMINISHI	Team Leader
Mr. Koichi MIKI	Deputy Leader
Mr. Kozo OKUMURA	Mapping Planner
Mr. Hitoshi YOSHIDA	Chief Surveyor
Mr. Fujio ITOH	Coordinator

**PROGRESS REPORT**  
**OF**  
**THE FIELD WORK OF THE FIFTH YEAR**  
**FOR**  
**TOPOGRAPHIC MAPPING OF SOUTHERN PART**  
**OF**  
**THE REPUBLIC OF GHANA**

**NOVEMBER, 1999**

**STUDY TEAM**  
**OF**  
**TOPOGRAPHIC MAPPING OF SOUTHERN PART**  
**OF**  
**THE REPUBLIC OF GHANA**

**JAPAN INTERNATIONAL COOPERATION AGENCY**



## 1. INTRODUCTION

The topographic mapping of the southern part of the Republic of Ghana started in January 1996, in a five-year plan, as a technical cooperation program of JICA. In compliance with the Scope of Work agreed between the Survey Department of Ghana and JICA on 17<sup>th</sup> March, 1995, and the Minutes of Meetings on 18<sup>th</sup> December, 1997, the JICA Study Team arrived in Accra on 28<sup>th</sup> of September, 1999, for the implementation of fifth year field work. After consultation with the SDG, the Team set up field headquarters in Accra for the field work. Meanwhile Ghana counterparts from the SDG joined the work from time to time. In accomplishing the field work of fifth year, hereinafter, the summary of the progress of the work is reported.

## 2. OUTLINE OF THE FIFTH YEAR WORK

### 2-1 Objective

The objectives of the Study are:

- (1) To prepare 1/50,000 topographic map covering an area of approximately 25,500 km<sup>2</sup> in the southern part of the Republic of Ghana,
- (2) To transfer technology to the counterpart personnel of SDG through the implementation of the work and
- (3) To promote friendship between Ghana and Japan through the implementation of the Study.

The fifth year work consists of the field completion based on the draft final map, revision of digital data, out put of final data and printing.

2-2 Period of Field Work

(Field completion) 27<sup>th</sup> September, '99 – 12<sup>th</sup> November, '99

2-3 Formation of the Study Team

Leader	Mr. Tokihiko KAMINISHI	29 <sup>th</sup> Oct. '99 - 12 <sup>th</sup> Nov. '99
Deputy Leader	Mr. Koichi MIKI	27 <sup>th</sup> Sep. '99 - 12 <sup>th</sup> Nov. '99
Mapping Planner	Mr. Kozo OKUMURA	27 <sup>th</sup> Sep. '99 - 12 <sup>th</sup> Nov. '99
Chief Surveyor	Mr. Hitoshi YOSHIDA	27 <sup>th</sup> Sep. '99 - 12 <sup>th</sup> Nov. '99
Mechanical Engr.	Mr. Tosio MIZUTANI	27 <sup>th</sup> Sep. '99 - 12 <sup>th</sup> Nov. '99
D. M. Planner	Mr. Kozo YAMAYA	23 <sup>rd</sup> Oct. '99 - 12 <sup>th</sup> Nov. '99
Surveyor	Mr. Masahiko OHASHI	27 <sup>th</sup> Sep. '99 - 12 <sup>th</sup> Nov. '99
"	Mr. Kouzou ASANO	27 <sup>th</sup> Sep. '99 - 12 <sup>th</sup> Nov. '99
"	Mr. Tuyoshi YAMASAKI	27 <sup>th</sup> Sep. '99 - 12 <sup>th</sup> Nov. '99
"	Mr. Michio SATOJI	27 <sup>th</sup> Sep. '99 - 12 <sup>th</sup> Nov. '99
"	Mr. Minoru OHNAKA	27 <sup>th</sup> Sep. '99 - 12 <sup>th</sup> Nov. '99
"	Mr. Masaru TERADA	27 <sup>th</sup> Sep. '99 - 12 <sup>th</sup> Nov. '99
"	Mr. Masaaki MIZUOCHI	27 <sup>th</sup> Sep. '99 - 12 <sup>th</sup> Nov. '99
"	Mr. Takesi NEMOTO	27 <sup>th</sup> Sep. '99 - 12 <sup>th</sup> Nov. '99
Coordinator	Mr. Fujio ITOH	23 <sup>rd</sup> Oct. '99 - 12 <sup>th</sup> Nov. '99

2-4 Amount of the Field Work ( Plan and Results)

Progress until 12<sup>th</sup> Nov. '99 are as follows:

Item	Original plan	Results
Field completion	25,500 km <sup>2</sup>	25,500 km <sup>2</sup>

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2-5 Counterparts of SDG

Headquarters:

Na Al-haji Iddirisu Abu	Director of Surveys	Headquarters
Mr. Jean Dotse	Asst. Director	Greater Accra Region
Mr. J. A. Abbosey	Staff Surveyor	Headquarters
Mr. J. C. Acquaaah	Staff Surveyor	Greater Accra Region
Mr. I. Andoh-Kesson	Chief Photogrammetrist	Photogrammetric Sec.
Mr. K. N. Arku-Lawson	Chief Cartographer	Cartographic Section
Mr. Marcus A. Tabil	Examiner	Examination Section
Mr. S. Oppong-Antwi	Asst. Staff Surveyor	Digital Mapping Section
Mr. George Frimpong	Asst. Staff Surveyor	Digital Mapping Section
Mr. E. Addo-Tawiah	Asst. Staff Surveyor	Digital Mapping Section
Mr. J. Ofori-Boadu	Asst. Staff Surveyor	Examination Section
Mr. J. Adu-Baiden	Asst. Staff Surveyor	Digital Mapping Section
Mr. Kofi Wemegah	Survey Technician	Examination Section
Mr. F. O. Boadu	Survey Technician	Examination Section
Mr. F. N. Malm	Prin. Tech. Officer	Cartographic Section
Mr. C. D. Nanzonige	Senior Tech. Officer	Cartographic Section

Central Region:

Mr. E.S Obodai  
Mr. K.G. Sapon  
Mr. P. Edison Attah  
Mr.A.E.Logosu-Gatsi

Western Region:

Mr. Paul Essiem  
Mr. Daniel Asiedu  
Mr. G.Aye Bekoe  
Mr. David Totimeh

3. FIELD WORK  
3-1 Field Completion

Field completion using draft final map was started by the team members and SDG counterparts in compliance with the map symbols and their application rules agreed between SDG and Study Team.

Reconfirmation of various expressions and names specified by map symbols were finally checked in the field survey. The survey results were described on the draft final maps to be used as data for succeeding revision work.

(1) Implementation

The following items were confirmed and surveyed in the field, and the results were indicated on the scale of 1/50,000 draft final maps.

1. Checking of the draft final maps to find out the omission and uncertainty of important items at the time of stereo plotting or updating work.
2. Clarification of uncertain points at the time of laboratory work in Japan.
3. Verification of uncertain points in the field.
4. Revision of changes after field verification work.
5. In the case when survey team found a newly constructed road and so on, Differential GPS (DGPS) survey method was applied for the data collection.
6. Checking and supplementing of annotation.
7. Representation and use of other map symbols and application rules.



## (2) Differential GPS Survey

When a survey team found a new wide road or important features during the field completion, the DGPS survey method was applied for the data collection. The reference control points for the DGPS survey were carefully selected for the rover GPS surveying.

SoKKIA GSR 2300 and 1000 were used for DGPS.

### 4. Work in Accra

#### 4-1 Discussion of Final code of Topographic map data

Final code of Topographic map data was discussed based on the Plan of Operation ( P/O ) of the Fifth year.

As a result of discussion, the final code table was confirmed by both sides. The table is attached to this report.

As for the data format and style , it was discussed and decided to be delivered by the Arc/Info Export File and it should be supplied as seamless data

#### 4-2 Installation of the Digital map data and Testing

The updated data in the Fifth year were installed into GIS System and tested at the Survey department, and SDG requested to the Team to supply the Map data as Arc/Info Export File.

New Desk Top GIS software (Arc/View Ver.3.2) was introduced by the Japanese Team.

#### 4-3 On the Job Training (O.J.T.) for Digital Cartography by Adobe Illustrator

The digital Cartography technique for map symbolization is the new trend in place of Analogue scribing method. This is the reason why the Survey Department requested for transfer of the technology to edit the digital map data.

A lecture for the digital Cartography was given in Digital Mapping Section at SDG from 26<sup>th</sup> Oct. to 5<sup>th</sup> Nov. by the Japanese expert of the Team.

Several computers of SDG and Computer projection panel of the Team were used for twenty participants. During the lecture, one of DTP Software, Adobe Illustrator Ver 8.0 was introduced.

The above progress report covered the work period from 27<sup>th</sup> September 1999 to 12<sup>th</sup> November 1999.

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ATTACHMENT I

CODE TABLE FOR THE TOPOGRAPHIC MAPPING OF  
SOUTHERN PART OF THE REPUBLIC OF GHANA

- FINAL -



Thematic Layer	GIS Code No.	Feature type	Description	Catographic reference
Cult_poly	2005	Line	Building to Scale	24
Cult_poly	2006	Line	Built Up Area(Village)	23,22
Cult_poly	2034	Line	Salt Pond	63
Cult_poly	2044	Centroid	Salt Pond	63
Cult_poly	2050	Centroid	Building	24
Cult_poly	2051	Centroid	Built Area (City and Town)	22
Cult_poly	3005	Line	Mineral Working Area(including Mine dump)	44
Cult_poly	3006	Centroid	Mineral Working Area(including Mine dump)	54
Cult_poly	3015	Centroid	Gravel pit centroid	
Cult_poly	3016	Line	Gravel pit outline	
Cult-poly	2054	Centroid	Village	23
Cultural	1001	Point	Borehole/Waterhole	64-1
Cultural	1028	Point	Water Works	64-2
Cultural	2001	Point	Beacon	38-1
Cultural	2003	Point	Building (Round)	24-1
Cultural	2004	Point	Building (Square)	24
Cultural	2007	Point	Mission	28-1
Cultural	2008	Point	Church	28
Cultural	2009	Point	Court House	27-3
Cultural	2010	Point	Dam Single	63(c)
Cultural	2012	Point	Hospital	26
Cultural	2013	Point	Barrier	27-4
Cultural	2014	Point	Light House	38
Cultural	2015	Point	Market	25
Cultural	2016	Point	Military Barracks	27-6
Cultural	2017	Point	Silo	29
Cultural	2018	Point	Electric Substation	34
Cultural	2019	Point	Mosque	31
Cultural	2020	Point	Police Station	27-2
Cultural	2021	Point	Post Office	33
Cultural	2022	Point	Railway Station	8-3
Cultural	2023	Point	Sports Ground(angle)	36
Cultural	2024	Point	Rest House,Hotel	27
Cultural	2025	Point	School	27-1
Cultural	2026	Point	Post & Telecommunications	33-2
Cultural	2027	Point	Shed	37
Cultural	2028	Point	Fort	39
Cultural	2029	Point	Palace	39-2
Cultural	2030	Point	Tower	40
Cultural	2033	Point	Radio Transmission Station,Wireless Station	43
Cultural	2035	Point	Ruin	41
Cultural	2036	Point	Health Post	
Cultural	2037	Point	Clinic	26-1
Cultural	2040	Point	Tank Symbol	
Cultural	2041	Line	Dry Doc	
Cultural	2043	Point	Cemetery	32
Cultural	2053	Point	Ancient Site	41-2
Cultural	2061	Point	Military Station	27-5
Cultural	2063	Point	Telecommunication Office	33-1
Cultural	2082	Point	Castle	39-1
Cultural	2091	Point	Temple	28-2
Cultural	3002	Line	Cutline	19
Cultural	3004	Point	Mineral Working(including Mine)	44
Cultural	3007	Line	Quarry	57
Cultural	3012	Line	Feature Outline (Misc.)	
Cultural	3013	Line	Embankment	53
Cultural	3031	Line	Sports Ground (to Scale)	36
Cultural	3032	Line	Cable Ways, Conveyor Belt	10
Cultural	3033	Line	Fence, Concrete or Block Wall	21
Cultural	3034	Line	Ancient Wall	41-1
Cultural	3035	Line	Jetty	42(a)
Cultural	3036	Line	Quay	42(b)
Cultural	3037	Line	Wharf	42(c)
Cultural	4002	Point	Boundary Pillar	
Cultural	4007	Line	International Boundary	

Cultural	4012	Point	Survey Pillar, Bench Mark	49
Cultural	4016	Point	Geodetic Point, Trig Station	47
Cultural	4016	Point	Trig Station	
Cultural	7002	Point	Photo Centre	48(b)
Forest	4006	Line	Forest Reserve Boundary	17
Forest	4021	Centroid	Forest Reserve	17
Forest	9109	Line	Boundary (National Park)	17
Forest	9110	Line	Boundary (Hunting Area)	17
Forest	9111	Line	Boundary (Other)	17
Hydrographic	1006	Line	Flooded Land Area	61-1
Hydrographic	1007	Centroid	Flooded Land	61-1
Hydrographic	1008	Centroid	Island	
Hydrographic	1009	Centroid	Lake, river	63-1(a), 60-1
Hydrographic	1010	Line	Marsh Area	61-2
Hydrographic	1011	Centroid	Marsh	61-2
Hydrographic	1014	Line	Sand or Mud Flats	55
Hydrographic	1015	Centroid	Sand/Mud Flat and Dunes	55, 56
Hydrographic	1016	Line	Shoreline	60-1, 63-1(a)
Hydrographic	1017	Line	Shoreline Virtual Segment	
Hydrographic	1018	Line	Coastline	67-1
Hydrographic	1019	Line	Coastline Virtual Segment	
Hydrographic	1023	Line	Watercourse	60-2-1
Hydrographic	1024	Line	Watercourse Indefinite	60-2-2
Hydrographic	1025	Line	Watercourse Virtual Segment	
Hydrographic	1027	Line	Reservoir	63-1(a)
Hydrographic	1042	Line	Pond	63-1(b)
Hydrographic	1104	Centroid	Pond	63-1(b)
Hydrographic	1105	Line	Trench Gutter	62
Hydrographic	2011	Line	Dam to Scale	63-1(c)
Hydrographic	3009	Line	Sand Bar, Dunes	56
Hydrographic	3010	Line	Sand/Mud Outline	55
Hypsographic	8001	Line	Approximate Index Contour	50-1
Hypsographic	8002	Line	Approximate Intermediate Contour	50
Hypsographic	8004	Line	Depression Index Contour	51(a)
Hypsographic	8005	Line	Depression Intermediate Contour	51(a), 50
Hypsographic	8006	Line	Index Contour	50-1
Hypsographic	8007	Line	Intermediate Contour	50
Hypsographic	8008	Point	Spot Height	48(a)
Hypsographic	8050	Line	Basin Shallow Depression	51(b)
Landform	1002	Point	Boulder Area	67-3
Landform	1003	Line	Boulder Rock Area	67-3
Landform	1004	Line	Flat Rock Area	67-2
Landform	1005	Point	Flat rock Area	67-2
Landform	1012	Point	Rapids Single	60-4-1
Landform	1013	Line	Rapids to Scale	60-4-2
Landform	1021	Point	Water Fall Single	60-3-1
Landform	1022	Line	Water Fall to Scale	60-3-2
Landform	3001	Line	Cliff Outline	52-2
Landform	3008	Line	Rock Outcrop	52
Landform	3109	Line	Steep Slope	52-1
Landform	3116	Centroid	Outcrop Rock	52
Landform	3117	Centroid	Water Courses Rapids to Scale	60-4-2
Landform	3118	Centroid	Flat Rock	67-2
Landform	3119	Centroid	Boulder Rock	67-3
Neat Line	4003	Line	Boundary Virtual Segment	
Neat Line	4022	Centroid	International Centroid	13
Neat Line	7001	Line	Neatline	
Transport	2002	Point	Bridge	66-1-1
Transport	2038	Point	Airport, Aerodrom	46(a)
Transport	2039	Point	Culvert	66-2
Transport	4008	Point	Mile Post	
Transport	5001	Line	Ferry	66-4

Transport	5002	Line	Ford	66-3
Transport	5003	Point	Level Crossing	
Transport	5004	Line	Railway (Double line)	8
Transport	5005	Line	Railway L.G.(Single line)	8-1
Transport	5007	Line	Road #1	2
Transport	5008	Line	Road #2	3
Transport	5009	Line	Road #3	4
Transport	5010	Line	Siding Railway	8-1-1
Transport	5011	Line	Road Under Construction	5
Transport	5012	Line	Track	6
Transport	5013	Line	Trail, other footpaths	7
Transport	5014	Line	Airstrip, Runway	46(C)
Transport	5015	Line	Railway (discontinued)	8-2
Transport	5016	Point	Airstrip	46(b)
Transport	5070	Line	Motorway	1
Transport	5080	Line	Streets & Main Roads	4-1
Transport	5102	Point	FootBridges	66-1-2
Utility	2042	Line	Pipeline	65
Utility	6001	Line	Telegraph/Telephone	12
Utility	6002	Line	Telegraph V/S	12
Utility	6003	Line	Transmission Line	11(a)
Utility	6004	Line	Power Transmission Line	11(b)
Utility	6005	Line	Power Transmission Line	11(c)
Vegetation	4023	Centroid	Light Forest	69
Vegetation	4024	Centroid	Savannah	71
Vegetation	4030	Centroid	Plantation	72
Vegetation	4031	Centroid	Cultivation	77
Vegetation	4025	Centroid	Thick Forest	68

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