5.2. The Second Year's Work (1998)

5.2.1. Consultation with MINOPU

The Study team headed by Mr. Takeshi Hirai had meetings with MINOPU and IGCA from 17th June 1998.

Prior to the meetings, "Progress Report 1" were presented to MINOPU by the Study Team and explained the works done during the First Phase work in Japan and in Angola. Then the Report was accepted by the Angolan side

Successively, the Study Team requested the following undertakings for this year's work by the Angolan side to MINOP.

① Cooperation of implementation for field verification of 1:25,000 scale maps by IGCA staff
② Collection of the cost estimation for GIS room's related facilities by MINOPU
③ Preparation for reproduction of the existing aerial photos by IGCA
④ Preparation of existing original maps for digitizing on this phase
⑤ Presentation of GIS application and their attribute data prepared by MINOP

The Study Team explained the process of digital mapping for 1:25,000scale referring to sample plotting sheet.

The request of the Angolan side were as follows.

① To complete the environment settlement of the GIS facilities to utilize the facilities fully for many application purpose.
② To produce the new color printing maps at scale of 1:25,000 for general users.

5.2.2. Data Acquisition in Angola

(1) Original maps to be digitized

As for the base map for 1,000,000 scale digital map, appropriate general existing map covering the whole country are did not found. The Study Team collected the following existing maps as the reference map for this digital map production.

- 1:1,000,000 scale road map covering eastern country
- 1:1,500,000 scale road map covering western country
- 1:1,500,000 scale administrative map covering whole country
- 1:500,000 scale topographical maps covering northern half country

The 1:500,000 scale topographic maps are reduced to drawings of 100,000 scale maps, the contents are too detail for 1,000,000 scale map.

Regarding to the original printing manuscripts for map digitizing at scale of 1:100,000 existing maps, it was impossible to prepare these copies in good condition in IGCA. The

Study Team, therefore gave their duplicating.

(2) Reproduction of existing aerial photos

Reproduction of existing aerial photos of photo scale of 1:30,000, were implemented to prepare the interpretation key for the secular change of 1:100,000 scale digital maps from the satellite images, that should be executed at the next phase together with the air-snap photos. For this purpose, there were selected 7 sheets areas from 53 map sheets covering 120,000 km^2.

The original films for duplication of the existing aerial photographs cannot be taken out of IGCA, which should keep them. The duplication were sub-contracted to IGCA.

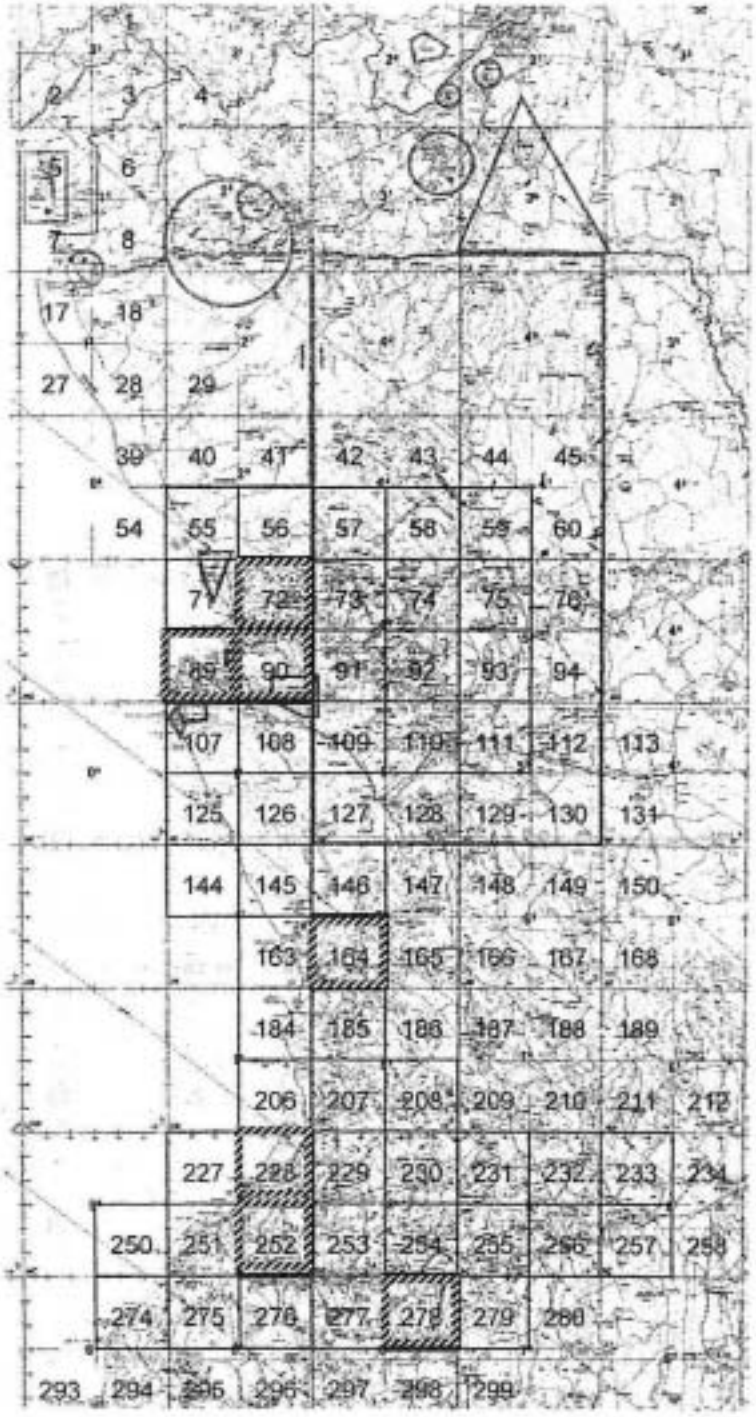
After conclusion of the contract, IGCA arranged the printing papers and photo-processing chemicals used for their duplication from South-African agent.

However they could not prepare the 30cm x 30cm format printing papers which suit the existing film format. Therefore IGCA had no choice but to order 25cm x 25cm format papers.

The areas duplicated and the quantities were as follows (Figure 5.2.1).

Sheet No.	Quantity	
72	153	
89	71	
90	134	
164	143	
228	124	
252	146	
278	211	Total 982 photos

Figure 5.2.1 Covering Sheets of Existing Duplication Photos



(3) Others

Through this field study, the Study team intended to collect the attribute data should be contributed to GIS, also asked to each department in MINOPU and visited the Statistic Office. However, under the situation just after long-term internal disturbance, no effective data for GIS were found.

5.2.3. Aerial Photography

Aerial photography was took effect by Aircraft Operation Company (AOC) in South Africa, as a subcontractor at previous phase.

AOC mobilized their air craft in the middle of June 1998 to Luanda, and stayed for the chance to photograph until the end of October 1998. However, during this period the chance was very few because of "Cacimbo" weather conditions of dry season that last deep mist until around two to three o'clock in the afternoon every day, and getting violent UNITA's activity in southern area in addition.

Although the black & white photography in Luanda was completed, the color photographs were not taken the one-third of objective area (Figure 5.2.2 / Figure 5.4.1).

The other black & white aerial photographs taken were 7% of Zaire West area at the south portion (Run-34,35,36) and 3% of Cuanza-Sul area at the north portion (Run-1-5) only. Cabinda area was no progress.

The aerial survey camera used was Zeiss, RMK TOP 15 with Pleogon lens (152.840 mm).

There are many difficulties of continuation for these remaining photography from the viewpoint of weather conditions and domestic disturbance by anti-establishment groups.

5.2.4. Field Verification for 1/25,000 Map Data

The field verification was conducted on the area of new digital plotting of 1:25,000 scale using the double enlarged aerial photographs of 1:30,000 scale black and white newly taken for this purpose.

Prior to the field reconnaissance, the technical group of MINOPU (IGCA counterpart) studied the map symbols to be shown for the 1:25,000 scale digital map and the application standards, following the draft of map symbols prepared by Study Team based on existing maps, and agreed to the contents. These map symbols were more simplified reflecting this study's objectives of GIS than existing military use map. At the same time the map symbols for 1:100,000 scale digital map were consulted between IGCA authorities and the Study Team, and were agreed by both sides. The symbols are what eliminated the detailed symbols for 1:25,000 scale map description from the 1:25,000 scale map symbols.

Following the preliminary study conducted in accordance with the " Work Manual" prepared by the Study team, the field study was conducted by the counterparts of IGCA

with survey assistants under the supervisor of the Study Team.

Following were surveyed based on the map symbols decided;

- Collection of geographical names and their verification in the field
- Verification of road, railways, public buildings, river bridges, other objective structures
- Verification of fireproof buildings and non-fireproof buildings areas
- Administrative boundaries
- Vegetation, terrain features
- Location of control points

Field verification results were compiled on the two-time's enlarged aerial photographs (approx. 50 sheets) of every second successive strip photos with red ink and also pricked the location of ground control points on the other enlarged photos.

5.2.5. Aerial Triangulation

For the digital mapping at scale of 1:25,000, aerial triangulation was executed with 1:30,000 scale aerial photos taken newly.

Aerial triangulation is to generate 6 points, called pass-point, used for mapping control point in each stereo pair model which is generated from successive 60% over-lapped images in each aerial photo strip.

These process was implemented analytically by computer after the preparation of aerial triangulation such as points selection, the pricking on the positive images printed on stable films and measuring of optional photo-coordinates of the pricked points.

Each stereo pair model was combined with adjacent stereo pair models, then a run of stereo strip model was created in a computer. Each photo strip's stereo image was combined together with 30% over-lapped upper or lower strip model standing between tie-points.

After that, block model adjustment computation on all models were performed accurately by computer, referring existing known ground control points such as leveling points, triangulation points and GPS points surveyed last phase.

Prior to the aerial triangulation, photo coordinates of pass-points and tie-points connecting the flight courses selected on the stereo pair duplicated photographs, which were to be used for map plotting, were measured by a stereo comparator using aerial photos printed on dia-positives (positive films) with a micron order accuracy, and then block adjustment computations based on independent models, analytical aerial triangulation was executed to obtain model orientation elements as well as geodetic coordinates of pass-points and tie-points as follows (Figure 5.2.2).

(1) Specifications

- Photo scale used:	Approx. 1:34,000
- Number of courses:	7
- Number of models:	99
- Number of control points:	Vertical; 103 level points
	Horizontal; 20 GPS points
	(include 3 national geodetic points)
- Adjustment computation:	PAT M-43 program
	(based on independent models)

(2) Instruments used

- Pricking device:	PUG-4 (Wild)
- Comparator:	Stecometer (Zeiss Jena)
- Computer:	FACOM 1600/2 (Fujitsuu)

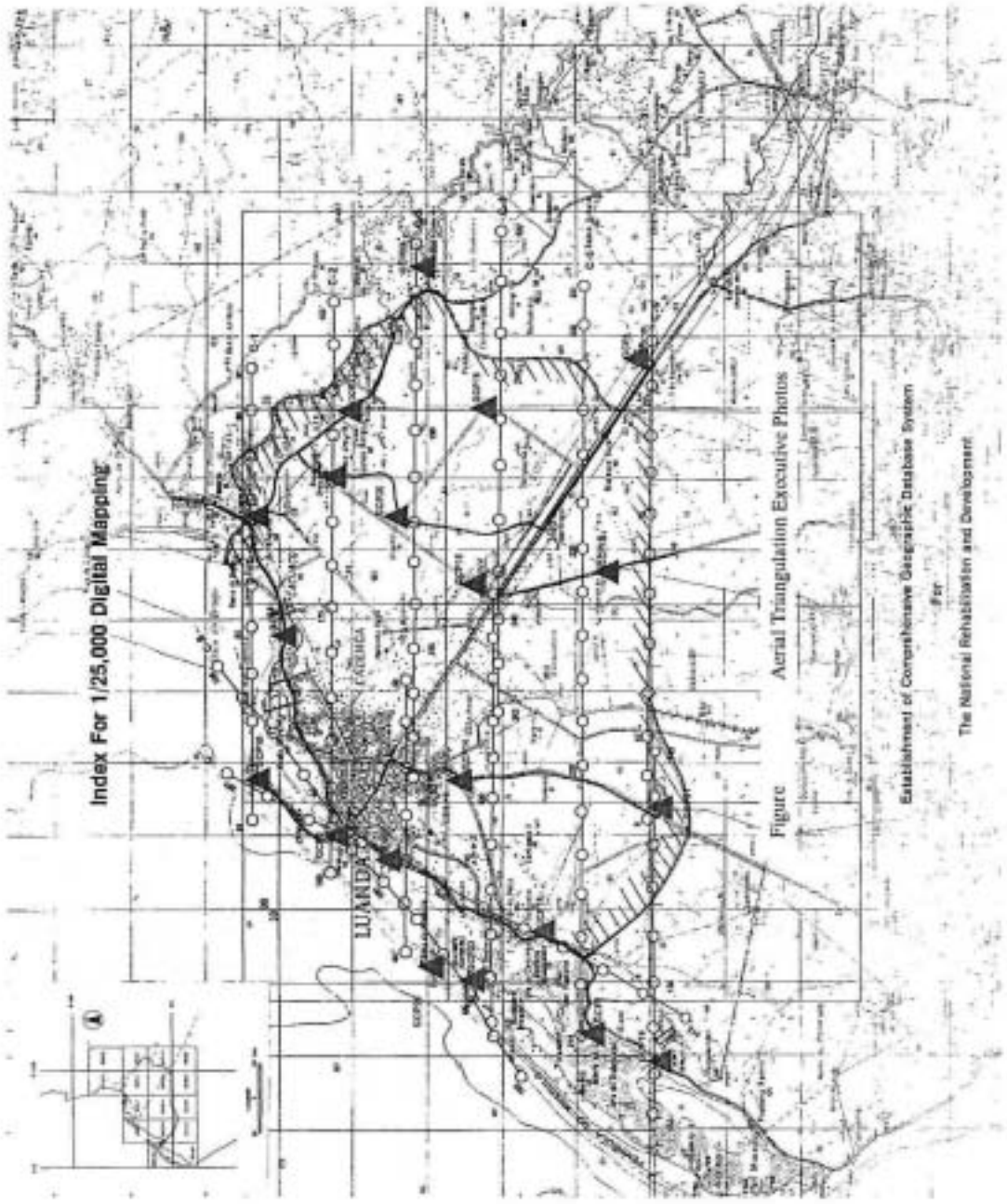
(3) Aerial camera

- Model:	Zeiss RMK TOP 15
- Lens:	Pleogon A3 4/153
- Focal length:	152.840mm

(4) List of aerial triangulation models

List of flight courses and aerial triangulation models were shown on table 5.2.1.

Figure 5.2.2 Aerial Triangulation Executive Photos



(5) Results of aerial triangulation

Six pass points were selected in every model. The measurement for photo coordinates of geodetic control points, pass-points and tie-points were performed twice independently. Tolerance of discrepancy of measurements was 0.02mm, then average values were adopted. Stereo model orientation and adjustment computation were executed within the following tolerance requirements.

- Measurement residual of photo's fiducial marks: 0.03mm (on the photo)
- Residuals of stereo model's relative orientation: 0.02mm
- Discrepancies between adjacent models of pass-point, tie-point coordinates: 2.5 m

As a results, root mean square values of the discrepancies of model points in meter were as follows.

X = 0.126 m, Y = 0.120 m, Z = 0.199 m

And, on control points.

X = 0.187m, Y = 0.210 m, Z = 0.191 M

Table 5.2.1 Aerial Triangulation Execution Model

Flight course	Photo number	Model
C – 1	82 ~ 90	8
C – 2	169 ~ 182	13
C – 3	44 ~ 49	5
	198 ~ 186	12
C – 4	115 ~ 125	10
	241 ~ 233	8
C – 5	214 ~ 230	16
C – 6	152 ~ 145	7
C – 7	8 ~ 19	11
C – 8	156 ~ 165	9
	Total	99 models

5.2.6. Digital Mapping

Digital mapping is to generate new maps of Luanda area enclosing 1,000 km^2 (Figure 5.2.2) at scale of 1:25,000 by newly taken 1:34,000 scale aerial-photographs.

These were implemented by means of interactive CAD-system computers referring the results of field survey data, field verification and aerial triangulation. The software of CAD-system was applied "Micro-Station".

Digital mapping was executed stereoscopically by stereo photo-models classifying the layer based on map symbols agreed.

Each layer was verified and coded whether there are point, line or polygon data as digital map data. However, there are many difficulties of map digitizing comparing with large scale map as larger than 1:5,000 or small scale map such as smaller than 1:50,000, because of mixture data with actual shapes and symbols.

Mapping was enforced along following data classification and cording.

Table 5.2.2 - 1 Layer Classification for Map Symbols by "Micro-station"

File	Object	Code	Layer	Color	Line W.	Line T.	Cell No.	Abbrev.	Data
c	Roads	2101	1	4	1	0	No-cell	road	Line
		2102	3	3	1	0		unpaved	
		2103	5	5	0	0		unpaved5	
		2104	6	5	0	3		track	
		2105	7	3	0	2		footpath	
		2106	8	11	0	0		street-a	
		2107	9	12	0	0		street-b	
		2108	10	14	0	0		street-c	
	Rail-ways	2301	11	0	1	1		rail-s	
		2302	12	4	0	0		rail-a	
		2303	13	5	0	0		sidig	
		3549	14	0	0	9		power-b	
		3543	15	5	0	3		pline-a	
		3545	16	5	0	5		pline-un	
	Buildings	3110	2	6	0	0		town-a	Poly
		3111	4	4	0	0		town-b	
	Topography	7169	17	30	0	2		dry_r-a	Line
		7170	18	30	0	0		dry_r-b	
		7171	19	30	0	1		dry_ r-c	
	Hydrography	5101	20	1	2	0		River-a	
		5102	21	1	0	0		River-b	
		5103	22	7	0	0		River-c	
		5104	23	7	0	0		lake	
		5105	24	0	0	0		river-e	
		5107	25	5	1	3		tmpriv-a	
		5108	26	5	0	3		tmpriv-b	
		5109	27	5	0	3		tmpriv-c	
		5110	28	5	0	3		tmp_lake	
		5111	29	0	0	3		tmpriv-e	
		5113	30	1	0	0		canal17	

Table 5.2.2 - 2

File	Object	Code	Layer	Color	Line W.	Line T.	Cell No.	Abbrev.	Data
c	Hydrography	5114	31	7	1	0	No-cell	canal10	Line
		5115	32	31	0	0		canal3	
		5117	33	1	0	0		wpipe	
		5118	34	1	0	0		wpipe_un	
		5000	35	1	0	0		sho_line	
		5421	36	1	1	0		st_cliff	
		5121	37	7	0	1		sandbank	
		15121	37	7	0	0	5122	1sandban	Point
		5122	38	7	0	0	No-cell	saltpan	Line
		15122	38	7	0	0	5122	1saltpan	Point
		6345	39	7	0	0	No-cell	swamp_i	Line
		6346	40	11	0	0		swamp_e	
	Roads	2201	41	3	1	0	No-cell	bridge	Line
		12201	41	3	0	0	2201	1bridge	Point
		2203	42	3	0	0	2203	culvert	
	Topography	7134	43	2	2	0	No-cell	sand_ter	Line
	Vegetation	6310	44	2	1	0	No-cell	forest	Line
		16310	44	2	0	0	6310	1forest	Point
		6311	45	2	1	0	No-cell	palm	Line
		16311	45	2	0	0	6311	1palm	Point
		6312	46	2	1	0	No-cell	grass	Line
		16312	46	2	0	0	6312	1grass	Point
		6317	47	2	1	0	No-cell	gr-tree	Line
		16317	47	2	0	0	16317	1gr-tree	Point
		6316	48	2	1	0	No-cell	gr-shrub	Line
		16316	48	2	0	0	16316	1gr-shru	Point
		6318	49	2	1	0	No-cell	gr-tr-sh	Line
		16318	49	2	1	0	6318	1gr-tr-s	Point
		6401	50	2	1	0	No-cell	tline	Line
		6340	51	2	1	0		mangrove	
		16340	51	2	0	0	6340	1mangrov	Point
		6341	52	2	1	0	No-cell	papyrus	Line
		16341	52	2	0	0	6341	1papyrus	Point
		6325	53	2	1	0	No-cell	cult	Line
		16325	53	2	0	0	6325	1cut	Point
		6326	54	2	1	0	No-cell	cut_mix	Line
		6330	55	2	1	0		coffee	
		16330	55	2	0	0	6330	1coffee	Point
		6331	56	2	1	0	No-cell	s_cane	Line
		16331	56	2	0	0	6331	1s_cane	Point
		6301	57	2	1	0	No-cell	boundary	Line
		6402	58	2	0	0	6402	i_tree	Point
		6332	59	2	1	0	No-cell	orchard	Line
		16332	59	2	0	0	6332	1orchard	Point
		6333	60	2	1	0	No-cell	plant	Line
		16333	60	2	0	0	6333	1plant	Point
		6334	61	2	1	0	No-cell	park	Line
		26316	62	2	0	0	6316	1shurub	Point

Table 5.2.2 - 3

File	Object	Code	Layer	Color	Line W.	Line T.	Cell No.	Abbrev.	Data
c	Vegetation	26317	62	2	0	0	6317	1tree	Pont
i	Small Object	3587	1	19	0	0	No-cell	bombeir	Poly
		3588	2	19	0	0		bomb	
	Buildings	3112	3	6	0	0		villa-a	Line
		3113	4	4	0	0		villa-b	
		3010	5	15	0	0	3010	house	Point
		3011	6	15	0	0	3011	hut	
		3012	7	15	1	0	No-cell	building	Poly
	Small Object	3033	8	15	1	0		factoly	
		13033	9	19	0	0	3033	1factory	Point
		3542	10	19	0	0	3542	gas_sta	
		3571	11	15	1	0	No-cell	pow_sta	Poly
		13571	11	19	0	0	3571	1pow_sta	Point
		3115	12	19	0	0	3115	airport	
		3116	13	20	0	0	No-cell	runway	Line
		3015	14	19	0	0	3015	tower	Point
		3020	15	19	0	0	3020	mine	
		5501	16	19	0	0	5501	light_h	
		5502	17	19	0	0	5502	beacon	
		5422	18	22	1	0	No-cell	dam-a	Line
		5423	18	22	1	5		dam-b	
		5205	19	17	0	0	5205	wtank	Point
		5206	20	17	0	0	5206	wtower	
		5407	21	22	1	0	No-cell	port	Line
		5408	22	19	0	0	5408	anchor	Point
		5409	23	19	0	0	5409	warf	
		5410	24	21	0	0	No-cell	pier	Line
		7131	25	20	0	0	7131	b_rock	Point
		3022	26	15	1	0	No-cell	church	Poly
		13022	26	19	1	0	3022	1church	Point
		3023	27	19	0	0	3023	chapel	
		3001	28	19	0	0	3001	chimney	
		3003	30	15	1	0	No-cell	f_chim	Poly
		13003	30	19	0	0	3003	1f_chim	Point
		2304	31	15	1	0	No-cell	station	Poly
		12304	31	19	0	0	2304	1r_sta-a	Point
		2305	32	19	0	0	2305	1r_sta-b	
		2306	33	19	0	0	2306	1r_sta-c	
		3547	34	19	0	0	3547	substa	
		3550	35	19	0	0	3550	rad_sta	
		3551	36	19	0	0	3551	rad_tow	
		3540	37	19	0	0	3540	gas_well	
		5411	38	18	0	0	No-cell	Tetrapod	Line
		3539	39	19	0	0	3539	gas_tow	Point
		3541	40	19	0	0	3541	gas_tank	
		3553	41	18	1	0	No-cell	cemetry	Poly
		5425	41	0	0	0		wfall-s	Line
		13553	41	19	0	0	3553	1cemeter	Point

Table 5.2.2 - 4

File	Object	Code	Layer	Color	Line W.	Line T.	Cell No.	Abbrev.	Data
i	Small Object	3555	42	19	0	1	No-cell	ruin	Poly
	Hydrography	5426	42	0	0	0		wfall-b	Line
	Small Object	3556	43	19	0	0		market	Poly
		13556	43	19	0	0	3556	1market	Point
		3557	44	19	0	0	No-cell	wall	Line
		3558	45	19	0	0	3558	monument	Point
		3559	46	19	0	0	3559	meteoro	
		3560	47	19	0	0	3560	look_tow	
		3581	48	19	0	0	No-cell	school	Poly
		13581	48	19	0	0	3581	1school	Point
		3582	49	19	0	0	No-cell	hospital	Poly
		13582	49	19	0	0	3582	1hospita	Point
		3583	50	19	0	0	No-cell	hotel	Poly
		13583	50	19	0	0	3583	1hotel	Point
		3584	51	13	0	0	No-cell	deep	Poly
		13584	51	19	0	0	3584	1desp	Point
		3585	52	19	0	0	No-cell	estad	Poly
		13585	52	19	0	0	3585	1estad	Point
		3586	53	19	0	0	No-cell	armz	Poly
		13586	53	19	0	0	3586	1armz	Point
		5202	62	17	0	0	5202	well	
		5203	62	17	0	0	5203	well_p	
		5204	62	17	0	0	5204	wind_p	
		5406	62	17	0	0	5206	source	
t	Topography	7310	1	27	0	0	7301	geo_po	Point
		7308	5	25	1	0	M7312	spot_h	
		7101	11	28	1	0	No-cell	index	Line
		7102	12	30	0	0		contour	
		7103	13	29	0	0		supple	
		d7101	14	24	1	0		d_index	
		d7102	15	26	0	0		d_cont	
		d7103	16	27	0	0		d_supple	
		7198	17	6	0	0		rockwall	
		7182	18	6	0	0		talus	
		7132	19	0	2	0	7132	sca_rock	Point
		7133	20	2	2	0	7133	rock_out	
		7180	24	0	2	0	No-cell	escarpme	Line
		7193	25	2	2	0	7193	pit	Point
		7194	26	2	2	0	7194	small_hill	
		7195	27	6	2	0	7195	salient	
		7196	28	6	2	0	No-cell	cavernt	Line
		7197	29	6	2	0		levee	
		7111	30	6	2	0		embank	
		7112	31	2	2	0		cutting	
		7176	32	2	0	0	7176	Iso_rock	Point
c		7134	43	2	2	0	No-cell	sand_ter	Line

The topographic maps were made with eleven sheets with both the longitude and the latitude of 7.5'. UTM method was adopted as projection method and the same standards of spheroid elements, horizontal coordinates and the origin of elevation with existing maps were used . The sheet numbers in Figure 5.2.4 are the same with existing maps.

As to the captured data, linear features on the ground such as roads or railway were put into the net work and the plane feature on the ground such as vegetation boundaries or marshes were poligonized by dividing the information on planimetric features to the GIS software into each format layer of line, plane and point coverage as digital data for GIS. The out-put of these digital data are shown on Figure 5.2.4.

After data collection using the Microstation, the data was saved in a common format, accessible to both the softcopy system and the planned GIS system. For the Project, the GIS system chosen was Arc/Info (ESRI: Redlands CA, USA). The data format used was DXF, as defined by AutoDesk (Sasulito CA, USA).

The data in the DXF file was extracted and converted by using various commands within the GIS. These commands facilitate data conversion and management. For initial data conversion, both the DXFINFO and DXFARC commands of Arc/Info were used.

The DXFINFO command provides a report about the various layers and blocks and feature types contained within the DXF file. Although Arc/Info has the capability to directly display DXF formatted data, additional processing steps were planned for the Project, therefore, the DXF data was converted into Arc/Info formatted data. The DXFARC command was used to extract selected layers from the DXF file and create Arc/Info coverages. Additional processing to create topology was also performed.

The layers to be extracted were selected from Table 5.2.2. As more of the 1:25,000 scale data is finished, it will be possible to determine the total grouping of the layers. Presently, data which could be extracted from the completed 1:25,000 scale DXF files were placed into the Arc/Info coverages as described in Table 5.2.3, below. This table represents proposed coverages for the finalized 1:25,000 scale data. As the Project continues, additional data layers may be defined or these layers modified to make use of new or changed data.

Table 5.2.3 Proposed 1:25,000 GIS Layers

Cover Name	Layer Description
an_90_p	General Annotations (as codes)
an_95_t	General Annotations (as strings)
bm_72_p	Benchmarks and Elevation Points
ct_71_a	Contours
dn_51_c	Hydrology (complex)
dn_52_p	Hydrology (points)
dn_53_t	Hydrology (annotation labels)
dn_54_a	Hydrology (cartographic – points)
dn_54_p	Hydrology (cartographic – points)
dn_56_s	Hydrology (cartographic shapes)
if_30_p	Infrastructure (points)
if_31_s	Infrastructure (shapes)
po_80_s	Administration (shapes)
po_81_a	Administration (cartographic – lines)
rd_21_a	Roads and Paths
rd_22_a	Road Facilities (lines)
rd_22_p	Road Facilities (points)
rr_23_a	Railway (lines)
rr_23_p	Railway Facilities (points)
tp_73_c	Topographic Symbols (complex)
tp_74_p	Topographic Symbols (Points)
tp_75_t	Topography (annotation labels)
ut_35_a	Utilities (lines)
ut_35_p	Utilities (points)
vg_62_p	Vegetation Cover (points)
vg_63_c	Vegetation Cover (complex)
vg_64_a	Vegetation Cover (cartographic - lines)

The processed coverages are then available for direct use within Arc/Info or ArcView. Additional attribute data can then be added directly to the specified coverage, or can be contained in separate tables and can be a related based on a common item within each database table (Table 5.3.9 / Table 5.3.10).

On the other hand, these captured map data were compiled to prepare the six color map printing plates. These map compilation were generated on computers installed draw software, Adobe “Illustrator ver.8.0”, applying digital map data. And also the marginal information agreed by Angolan side were compiled. After this map compilation, these digital map data file format (ex. .ai / .eps) - raster data - are the different file format at all from the vector file format used for GIS. The compiled printing digital map data classified according to the symbols and finally composed to the same color symbol file (Figure 5.2.5).

Figure 5.2.3 Index for 1:25,000 Scale Map

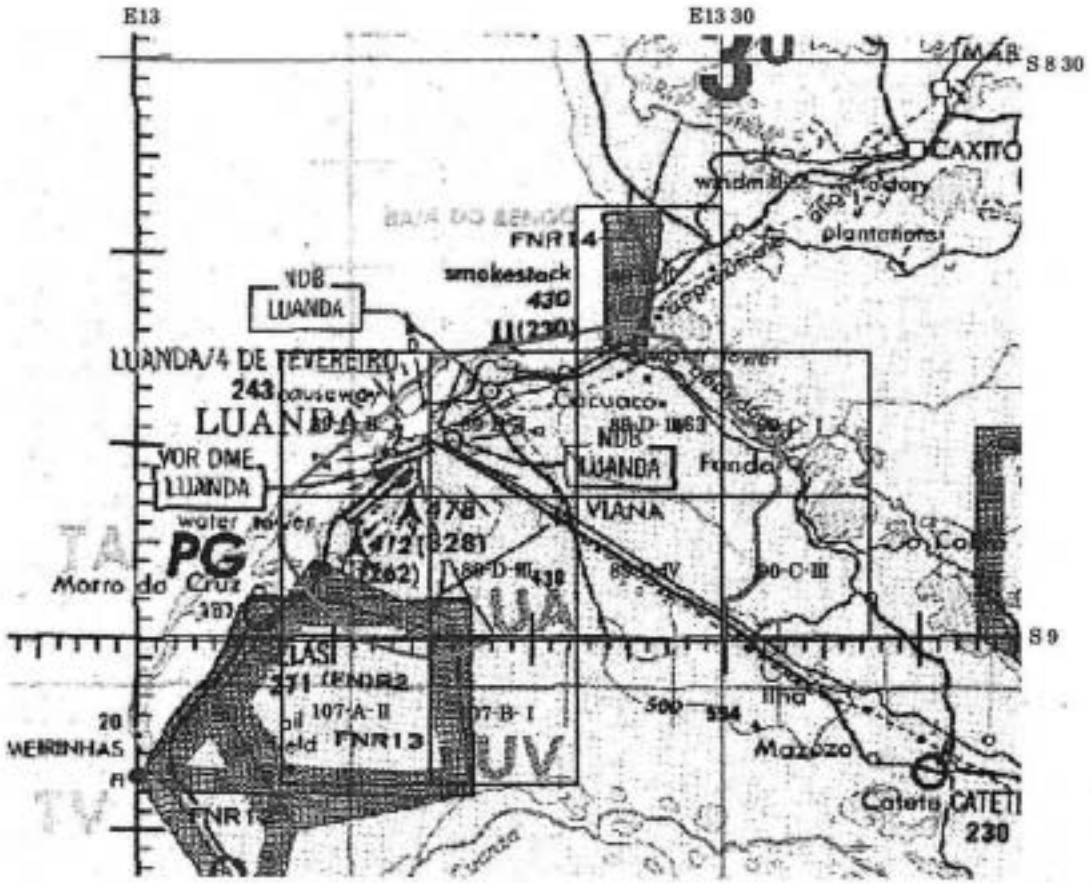


Figure 5.2.4 Vector Digital Map for GIS

Figure 5.2.5 Raster Digital Map for Printing

5.2.7. Map Digitizing

(1) 1/1,000,000 scale map dizitizing

The purpose of the creation of the 1:1M scale dataset for the country of Angola is to provide the counterpart agency a comprehensive dataset suitable for small scale planning, unified statistical analysis and GIS training. When completed the dataset will contain relatively detailed total country coverage which can be openly shared with other organizations and parties to encourage use of a unified and managed dataset.

The lack of sufficient source data has been a hindrance for the 1:1M scale data project. Only two 1:1M scale topographic maps could be obtained along with one 1:500K sheet. The Study Team was told that total national topographic map sheets at 1:1M scale were planned but were not completed or are not in stock. Additional maps obtained through the counterpart agency will be used for this project. These maps are described in Table 5.2.4.

Table 5.2.4 1:1M Scale Source Maps

Map Name:	MAP-1.0
Map Title:	'Republica Popular de Angola – Divisao Politico Administrativa'
Scale:	1:1 500 000
# of Sheets:	1 (one)
Source:	Instituto De Geodesia E Cartograpfia De Angola
Date:	1989
Projection:	not stated
Description:	A0 approx, multi-colored, legend on bottom, surrounding countries yellow, in color; the entire country of Angola is shown.
Map Name:	MAP-2.0
Map Title:	'mapa rodoviario' (in low ease outlined characters)
Scale:	1:1 500 000
# of Sheets:	1 (one)
Source:	Da Direccao Provincial Dos Services Geograficos E Cadastrias ?
Date:	not stated
Projection:	not stated
Description:	A1 vertical long in size, light browns and tans overall; background elevation coloring; only the western half of the country is shown. The other sheet, (the eastern side) was not found.
Map Name:	MAP-3.0, MAP-3.1
Map Title:	'Republica Popular de Angola – Carta Rodoviaria'
Scale:	1: 1 000 000
# of Sheets:	2 (two)
Source:	not stated
Date:	not stated
Projection:	not stated
Description:	80cm x 80cm light yellow background; details eastern half of Angola in two sheets; lower sheet untitled.

In addition to the four paper maps described in the previous table, digital data from the 'Digital Chart of the World' dataset produced by the US Department of Defense were used for supplemental data, namely contour lines and hydrographic features.

1) 1:1M Scale Digitzied Layers

This following section describes the layers which were digitized, item coding schemes, and other procedural specifications. These descriptions exist for each group of the paper map used for digitizing in the 1:1M scale data project.

MAP-1.0:	All political boundaries shown in the legend will be input and coded as:
Coverage name:	Admin
Coverage type:	complex (arc/pat)

Cov.	Type	Item Name	Schema	Description	Value
admin	AAT	CODE	3,4,I	Capital do pais*	105
admin	AAT	CODE	3,4,I	Limite de provincia	110
admin	AAT	CODE	3,4,I	Limite de municipio	120
admin	PAT	PAIS	40,40,C	Country Name	Angola
admin	PAT	PROVINCIA	40,40,C	Provincia Name	Varies
admin	PAT	MUNICIPIO	40,40,C	Muncipio Name	Varies
admin	PAT	CAP_CITY	40,40,C	Sede de municipio	Varies
admin	PAT	IS_PROV_CAP	1,1,I	1 = Prov. Cap; 0 = Municipio Cap.	Varies

MAP-1.0:	Non administrative villages will be coded as follows:
Coverage name:	pop_pnt
Coverage type:	Point

Cov.	Type	Item Name	Schema	Description	Value
pop_pnt	PAT	COMUNA	40,40,C	Sede de comuna	Varies
pop_pnt	PAT	POVOACOES	40,40,C	Outras povoacoes	Varies

MAP-2.0, MAP-3.0, MAP-3.1:	Road features will be coded as follows:
Coverage name:	rd_lin
Coverage type:	Line

Cov.	Type	Item Name	Schema	Description	Value
rd_lin	AAT	REVESTIR	2,3,I	Road Surface	Pavimentadas = 10

					Terraplenadas = 12 Terra Natural = 14 Em Construcao = 16 Picadas = 18
rd_lin	AAT	ESTADO	2,3,I	Surface Status	Bom = 21 Regular = 23 Mau = 25 Em Construcao = 27 Picadas = 29

MAP-2.0, MAP-3.0, MAP-3.1:	Railroad features will be coded as follows:
Coverage name:	rr_lin
Coverage type:	Line

Cov.	Type	Item Name	Schema	Description	Value
rr_lin	AAT	DE_COMBOIO	2,3,I	Caminhos de ferro	40

2) DCW Data Layers

The following DCW data layers were incorporated into the final data set. These layers are:

Description	DCW Coverage Name	ARC/INFO Feature Type
Admin. Boundaries	PONET	(AAT/PAT)
Drainage	DNNET	(AAT/PAT)
Drainage	DNPOINT	(PAT)
Drainage Supplemental	DSPOINT	(PAT)
Hypsography	HYNET	(AAT/PAT)
Hypsography	HYPOINT	(PAT)
Hypsography Supplemental	HSLINE	(AAT)
Hypsography Supplemental	HSPOINT	(PAT)

In order to make the 1:1M scale dataset more uniform, it was decided that the international bounadry of Angola be taken from the DCW PONET layer and then merged into the admin coverage created for MAP 1.0. It is only necessary to take the AAT data form PONET. That data should then be coded as the following schema when merged into the admin coverage.

Cov.	Type	Item Name	Schema	Description	Value
admin	AAT	CODE	3,4,I	Limite do pais	100

3) Map Projection

As described above, the map projections of all the paper maps obtained for this project are not described. This makes the task of data conversion difficult when trying to assign the type of projection which the maps were originally based on. After digitizing and editing, the data were adjusted and transformed so that either a Lambert Azimuthal Equal Area projection or a UTM projection may be used. This is a temporary solution. Thus, during the course of the Project, more map projection related information will be searched for by the Project Team and also with the Counterpart Agency or other affiliates.

4) Workflow Overview

The digitizing of the paper maps described in Table 5 was carried out using an in-house created software package called VecEdit. This Windows 95/NT based program allows data to be captured with a scanned image in the background, or directly from a digitizer. The paper maps for the 1:1M scale data project were digitized using VecEdit and an A0 digitizer. Additional attribute input and checking was also carried out using VecEdit. The data was then transformed and projected using Arc/Info GIS software. Additional editing and coorelation between the DCW data (international country boundary) was also done using Arc/Info.

(2) 1:100,000 scale map digitizing

The purpose of the creation of the 1:100,000 scale dataset for the country of Angola is to prepare an up-to-date topographic base covering a large area of Angola which has been impacted the most from refugee migration during the country's civil war. Data for the study area will be updated rapidly using "SPOT" 10 meter panchromatic digitally ortho-rectified satellite imagery. These newly updated maps will provide a comprehensive and current moderate scale topographic base for the government to use for planning, coordination and relief activities. It is the hope of the Project Team that this data will be managed by the counterpart and that it will be easily shared with other governmental and non-governmental organizations. This data will serve as a foundation on which the Angolan government can continue to update existing maps, not covered within the scope of this Study.

1) Source Data

As compared to the 1:1M scale data project, there was no difficulty in finding suitable 1:100,000 scale data. The 1:100,000 topographic map series produced and maintained by IGCA is the main source of data. These highly detailed and superior cartographic quality maps are representative of both the Portuguese and Russian training which members of the Cartographic Institute received. In addition to the maps being principally for military use, detailed information about infrastructure can be easily added to the GIS database in addition to the graphic components. This additional information helps to create a more usable GIS database. A simple diagram to show the sheet numbers is shown on Figure 5.2.6.

The cover name of layer is same with 1:25,000 GIS Layer shown on Table 5.2.3. There are twenty-seven defined layers.

Within each layer there are assigned codes which are used to distinguish the features. Presently there are 160 defined feature codes within the 1: 100 000 scale GIS database. These layers and codes are shown in detail in Appendix 3 in Progress Report 2, 1:100,000 Scale Data Capture Specifications.

Figure 5.2.6 1:100,000 Scale Study Area Maps