CHAPTER 3 THE PILOT PROJECTS

3-1 General

3-1-1 Schedule

The Pilot Projects were conducted by JICA Study Team and NAMRIA in the following work schedule.

Table 3-1 Schedule of the Pilot Projects

Year	Work Item	Work pried
First Year	Pilot Project I	June to September 2006
Second Year	Pilot Project II	Novembe 2006 to March 2007
Third Year	Pilot Project III	May to December 2007
	Examination of Mapping Methods	December 2007

The Pilot Project II and III are continuous from the second year and the third year; therefore, in this report, the Pilot Project II and III are described in one section.

3-1-2 Objectives of the Pilot Project and Its Position

The objectives of the Pilot Project are (1) technological verification of the Specifications for Topographic Mapping at Scale of 1:50,000 and (2)Technology Transfer.

3-1-3 Technological verification of the Specifications for Topographic Mapping at Scale of 1:50,000

The technological verification was carried out from the final results of prepared topographic maps at scale of 1:50,000 using 1) aerial photographs, 2) satellite single (mono) images and 3) satellite stereo images for the Pilot Projects. Method of the technological verification is comparative analysis of method and accuracy of the above three materials and methods for the future operation is evaluated.

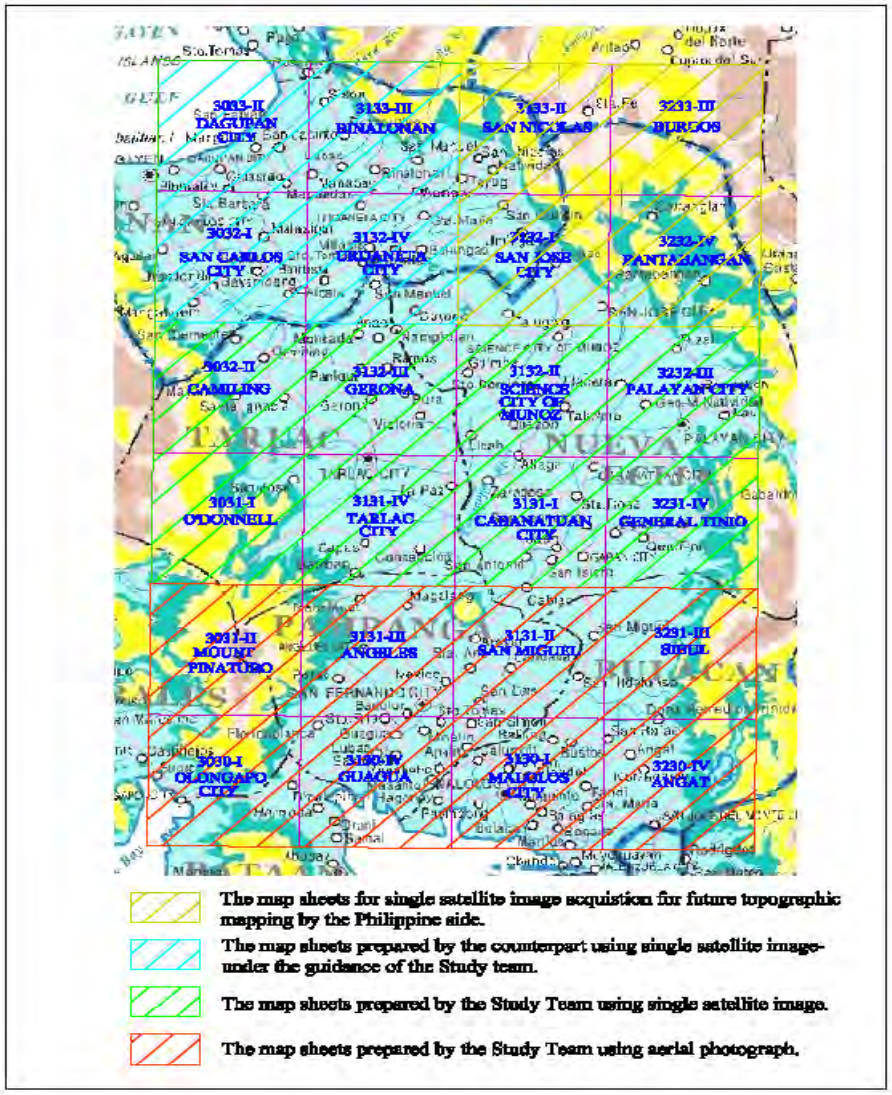
3-1-4 Technology Transfer

Technology transfer was carried out through OJT during the Pilot Projects.

3-1-5 Pilot Project Area

The Pilot Project area is the Pampanga river basin in the Region 3 including PAMPANGA, TARLAC, BATAAN, ZAMBALES and NUEVA ECUJA provinces and Agno River down-stream of Region 1 including PANGASINA province covering about 17,520km^2 with 24 topographic maps at scale of 1:50,000 as follows:

Figure 3-1 Location Map of Pilot Project Area



3-1-6 Aerial Photography and Satellite Images Acquisitions

In order to execute the technological verification of Pilot Projects, the following aerial photography and satellite images were acquired for topographic mapping at Scale of 1:50,000.

3-1-7 Aerial Photography

The aerial photography at scale of 1:40,000 was carried out by a local contractor; FF Cruz Inc in accordance with the terms, conditions, requirement of the Contract and Technical Specifications under the Supervision of the JICA Study Team from at end of March, 2006 and completed at end of January, 2007. Principal data and information of the new aerial photography are as follows.

(1) Aerial photography area

The aerial photography area covers the south part of Pilot Project area of 5,840sq.km equivalent to 8 topographic map sheets at scale of 1:50,000 (Sheet No: 3031-II, 3131-III, 3131-II, 3231-III, 3030-I, 3130IV, 3130-I, 3230-IV) as shown in Figure 3-1 Location Map of Pilot Project Area.

(2) Specifications of aerial photography

Specifications of aerial photography were summarized as follows:

Table 3-2 Specifications of Aerial Photography

a)	Photo scale by flight	About 1:40,000
b)	Type	Pan-Chromatic
c)	The number of courses	13 courses, 647 photographs, total area of 5,840km^2
d)	Specifications of camera	LeicaRC-10 or better in quality (f= 152mm, 23cm x 23cm)
e)	Photography flight height above ground	6,000m with in a rage of ±5% difference from a datum level
f)	The degree of overlap	Overlap 60%±5%, sidelap 30%±5%
g)	Cloud cover tolerance	Within 3% of five consecutive photographs except for a part required for plotting orientation
i)	Flight direction	West – East or East – West

(3) Equipment used in aerial photography

The following equipment was used for the photography:

Table 3-3 Equipment Used for Photography

Aircraft for photography	PIPER NAVAJO PA31 Twin-engine Aircraft
Computer control NkAV system for photography	Leica GPG Navigation System
Camera for photography	RMKA 15/23 CARL ZEISS PEOGON A LENS
	A) Focal length 150mm
	B) Film 230mm x 230mm
	C) Lens official approval document February 4, 2004
Firm Processor	Zeiss, FEIZO
Contact Printer	Zeiss, KG30 Contact Printers
Film	Kodak Pan atomic x 3412
Photographic paper	Kodak RC2

(4) Annotation of aerial photographs (Film labeling)

The following title and information were labeled on the negative film:

(a) Name of Project: NAMRIA/JICA Project

(b) Date of photography

(c) Scale of photography

(d) Photo numbers

(5) Photo scanning

The negative films of the aerial photographs were scanned using a precision scanner, and directly digitized to produce images of aerial photographs. The image data were used for the following processes of aerial triangulation and digital plotting. The scanning work was conducted using a scanner with the following specifications.

Table 3-4 Scanner Specifications

Scanner Name	Photo Scan TD Scanner INTERGRAPH/ZEISS
Definition	21 micron (1200dpi)
Measurement accuracy	±2 micron
Data correction function	Automatic calibration and on-the-fly check function
Gray scale	8 bit
Data format	GeoTIF

(6) List of new aerial photographs and Aerial photo index map

The list of aerial photographs at scale of 1:40,000 is as blow.

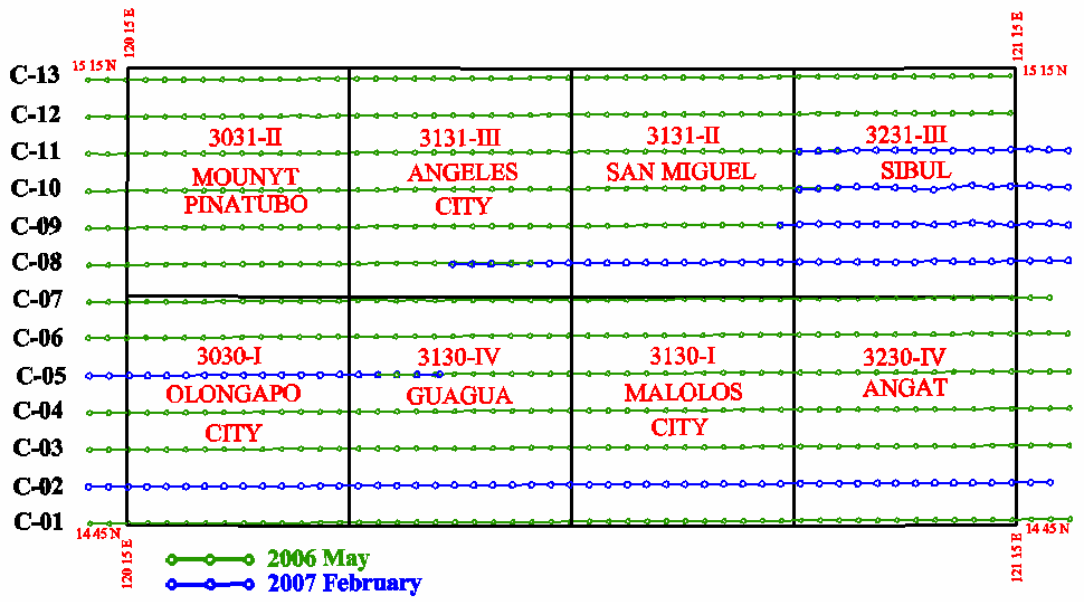
Table 3-5 List of Aerial Photographs at Scale of 1:40,000

Run No	Photo No			No. of Photos
C - 1	470	-	419	52
C - 2	064	-	015	50
C - 3	367	-	418	50
C - 4	366	-	315	52
C - 5	278	-	313	36
C - 5（Re flight）	065	-	083	19
C - 6	555	-	504	52
C - 7	610	-	560	51
C - 8	556	-	579	24
C - 8（Re flight）	131	-	120	12
C - 9	205	-	241	37
C - 9（Re flight）	347	-	357	11
C - 10	204	-	165	40
C - 10（Re flight）	360	-	368	9
C - 11	125	-	164	40
C - 11（Re flight）	378	-	389	12
C - 12	714	-	665	50
C - 13	611	-	660	50
	Total			647

(7) Photo index map

A photo index map was prepared on copy of the existing maps at the scale of 1:250,000 as follows:

Figure 3-2 Aerial Photo Index Map



(8) Inspection of aerial photographs

Qualities of all above aerial photographs of original flight and reflight were inspected by the Expert of the Study Team referring to the accuracy and requirement as specified in the Table 3-2 Specifications of Aerial Photography in this report. Using the contact prints, the quality of photographs was confirmed on: flight altitude; course; adjacent photographs and overlap of courses; range of overlap; clarity of index; tilt; photo processing; and conditions of images. From the results of inspection, the photographs which passed the inspection were accepted as the output. The photographs in same parts of the eastern mountainous area, cloud cover were less than 3% and its is not exceed requirement as specified;

It was judged that the inspection results of final 647 photos covering the 8 topographic map sheets at scale of 1:50,000 (Sheet No: 3031-II, 3131-III, 3131-II, 3231-III, 3030-I, 3130IV, 3130-I, 3230-IV) were acceptable for preparing topographic map at scale of 1:50,000.

(9) Outputs

The final outputs are listed up as follows:

Table 3-6 Outputs of Aerial Photography

Item	Quantity
(1) Contact Prints	One set
(2) Photo scanning image of TIF format on CD-ROM	One set
(3) 2 (Two) Times Enlargement Photos on Coated Paper (A0 size)	One set
(4) Aerial-photo index map	One set
(5) Report	One set

3-1-8 Satellite Images Acquisition

The single satellite images for the Pilot Projects were acquired from Tokyo SPOT Image Co. at the end of May, 2006 and the satellite stereo images was acquired at the end of March, 2007 from CERTEZA Infosys Co., by the JICA Study Team. Principal data and information of the satellite single (mono) images and satellite stereo images are as follows.

(1) Satellite images area

a) Satellite single (mono) images area cover the center and north part of Pilot Project area of 12,410sq.km equivalent to 16 topographic map sheets at scale of 1:50,000 (Sheet No: 3033-I, 3133-III, 3133-II, 3253-III, 3032-I, 3132-IV, 3132-I, 3232-IV, 3032-I, 3132-III, 3132-II, 3232-III) as shown in Figure 3-1 Location Map of Pilot Project Area.

b) Satellite stereo images cover south east part of Pilot Project area of 730sq.km of topographic map sheets at scale of 1:50,000 (Sheet No: 3131-II, 3231-III) as shown in Figure 3-1 Location Map of Pilot Project Area.

(2) Specifications of satellite imagery

Specifications of satellite imagery were summarized as follows:

Table 3-7 Specifications of satellite imagery

(1)Type of satellite imagery	Single (mono) SPOT5 archive imagery
- Resolution /mode	2.5m Panchromatic and 10m color (pan sharp)
- Level of processing	1A
- Format	DIMAP
(2)Type of satellite imagery	Stereo SPOT5 archive imagery
- Resolution /mode	2.5m Panchromatic
- Level of processing	3A
- Format	DIMAP

(3) Acquired satellite imagery

The acquired satellite imagery and its quantity are listed up as follows:

Table 3-8 List of satellite imagery

Satellite imagery	Quantity and ID number
(1) Single (mono) SPOT5 archive imagery	Full scene (6 files on DVD): 1)5 302 317 040210 0242422 AB J SAT9 (42422A) 2)5 302 318 050218 0250551 AB J SAT9 (50551A) 3)5 303 318 030409 0248431 AB J 0 (48431A) 4)5 303 318 060228 0235481 AB J SAT9(35481A) 5)5 303 319 060228 0235561 AB J SAT9(35561A) 6)5 304 319 050203 0239372 AB J SAT1(39372A) 1/2 scene (2 files on DVD): 1)5 302 320 040413 0231571 AB J 0 (31571A) 2)5 304 320 050519 0219262 AB J SAT 1(19262A)
(2) Stereo SPOT5 archive imagery	1/2 scene (2 files on DVD): 1)5 303 319 061121 022051 2B/5 (20512B) 2)5 303 319 061121 040051 2B/5 (40051B)

(4) Inspection of satellite imagery

Qualities of all above satellite images were inspected by the Expert of the Study Team referring to the accuracy and requirement as specified in the above table 3-7 Specifications of satellite imagery.

It was confirmed that the inspection results of the all above satellite image covering the Pilot Project area were acceptable for preparing topographic map at scale of 1:50,000.

3-2 Survey and Mapping Criteria

The following the items of the reference ellipsoid, the horizontal control datum and the original BM, and map projection system of coordinate defined by NAMRIA are used for the survey and topographic mapping work in the Pilot Projects,

3-2-1 Elements of the geodetic survey

The following geodetic and mapping elements are used for topographic mapping.

Table 3-9 Geodetic and Mapping Elements

Item	Element	Description
Reference Ellipsoid	Clarke1866	Semi major radius: 6378,206.400m Flattening: 1/294.9786982
Horizontal Datum	PRS92	
Vertical datum	Mean sea level	Refer to existing BM
Geoid Model	EGM96	OSU
Transformation parameters WGS84 to PRS92	127.62195 m 67.24478 m 47.04305 m –3.06762 sec 4.90291 sec 1.57790 sec 1.06002 x 10^{-6}	Delta X Delta Y Delta Z Rotation around X axis Rotation around Y axis Rotation around Z axis Delta Scale

3-2-2 Mapping elements

The accuracies of plane and elevation of the topographic maps are defined as follows:

Table 3-10 Accuracies of Plane and Elevation of Topographic Maps

Item	Element	Description
Map projection	UTM	Zone 50, 51, 52
Size of map	15 min x 15 min	Refer to Map index
Map symbols	PMS50K (Philippine Map Symbols for 50K)	prepared by this project
Representation of terrain	Contour	20 m interval
Accuracy of Plane	Less than 0.5 mm on map	In USGS
Accuracy of Elevation	σ0=10 m σ0=7 m	1/2 of contour interval for contour line 1/3 of contour interval for spot height
Numbering System of Map sheet		Index of Topographic maps at a scale of 1:50,000 in 701 series

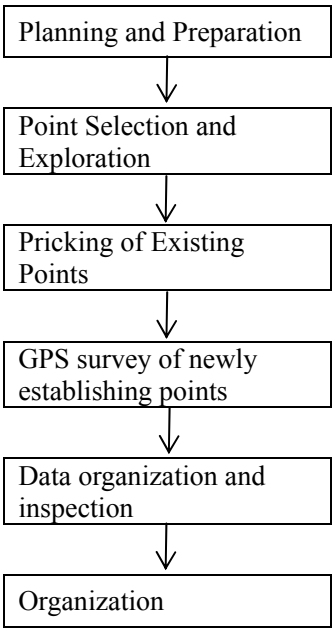
3-3 Pilot Project I (Technical Transfer)

Pilot Project I was carried out through OJT. Field work of the Pilot Project I was carried out by NAMRA in accordance with the Draft Technical Specifications under supervision of the JICA Study Team from 25 June, 2006 and completed 3 September, 2006 and the indoor work was completed at the end of September, 2006. The works in Pilot Project I consist of control point survey, minor order leveling and field identification.

3-3-1 Control Point Survey (GPS Survey)

The GPS survey was conducted to determine the horizontal values of the control points in accordance with the following work flow chart.

Figure 3-3 Work Flow of GPS Survey



(1) Location of control point survey and Survey method

The GPS survey took different approaches in Area A covering the eight topographic map sheets at scale of 1:50,000 (sheet No.: 3031-II, 3131-III, 3131-II, 3231-III, 3030-I, 3130IV, 3130-I, 3230-IV) and Area B covering the 12 topographic map sheets at scale of 1:50,000(sheet No.: 3033-I, 3133-III, 3133-II, 3253-III, 3032-I, 3132-IV, 3132-I, 3232-IV, 3032-I, 3132-III, 3132-II, 3232-III) as shown in Figures 3-4 and 3-5 Location Maps of Pilot Project Area. In Area A, in order to carry out aerial triangulation of aerial photographs, GPS survey was done by a two-wave GPS receiver with static method. In Area B, in order to carry out a rectification of satellite single image for topographic mapping at scale of 1:50,000, GPS survey was done by a handy GPS. The control points in Area A were installed and Area B were marked at bridges and other structures along roads. The total number of new control points in Area A was 39 points and total number of Area B was 60 points. Location map of control points for Areas A and B is as shown in the following Figure 3-4 Location Map of Control Points (Area A) 3-4 and Location Map of Control Points (Area B).

Figure 3-4 Location Map of Control Points (Area A)

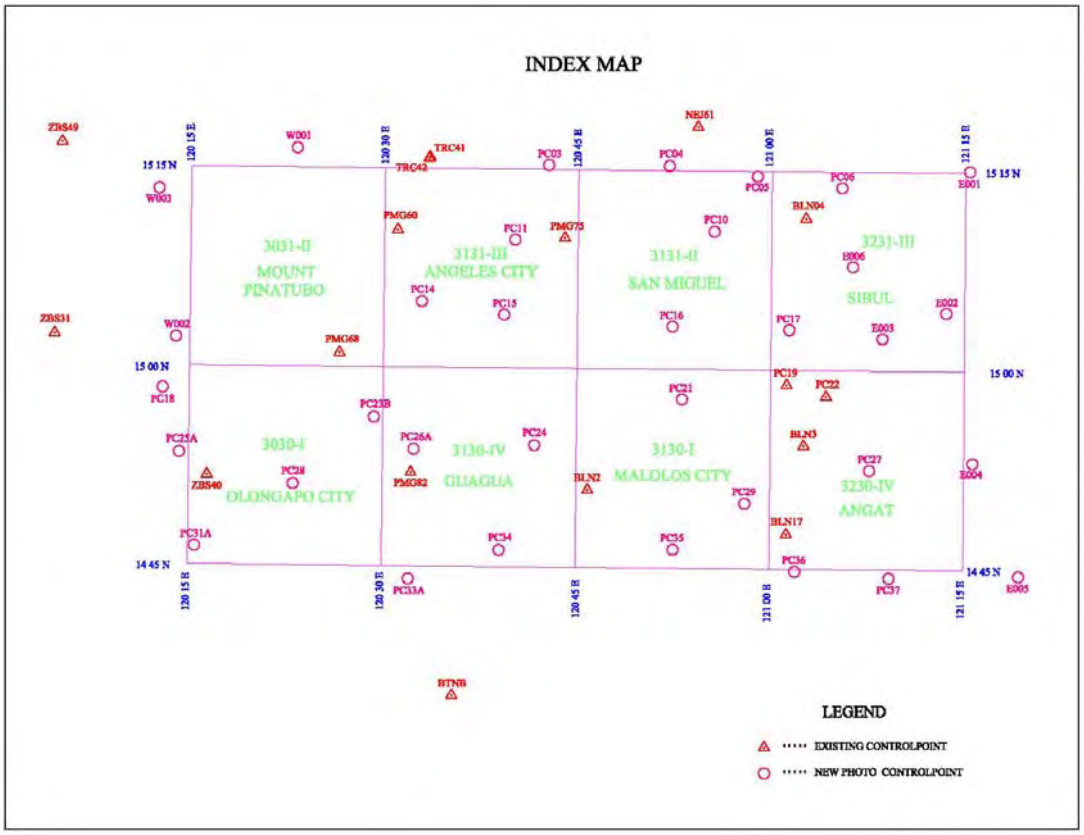
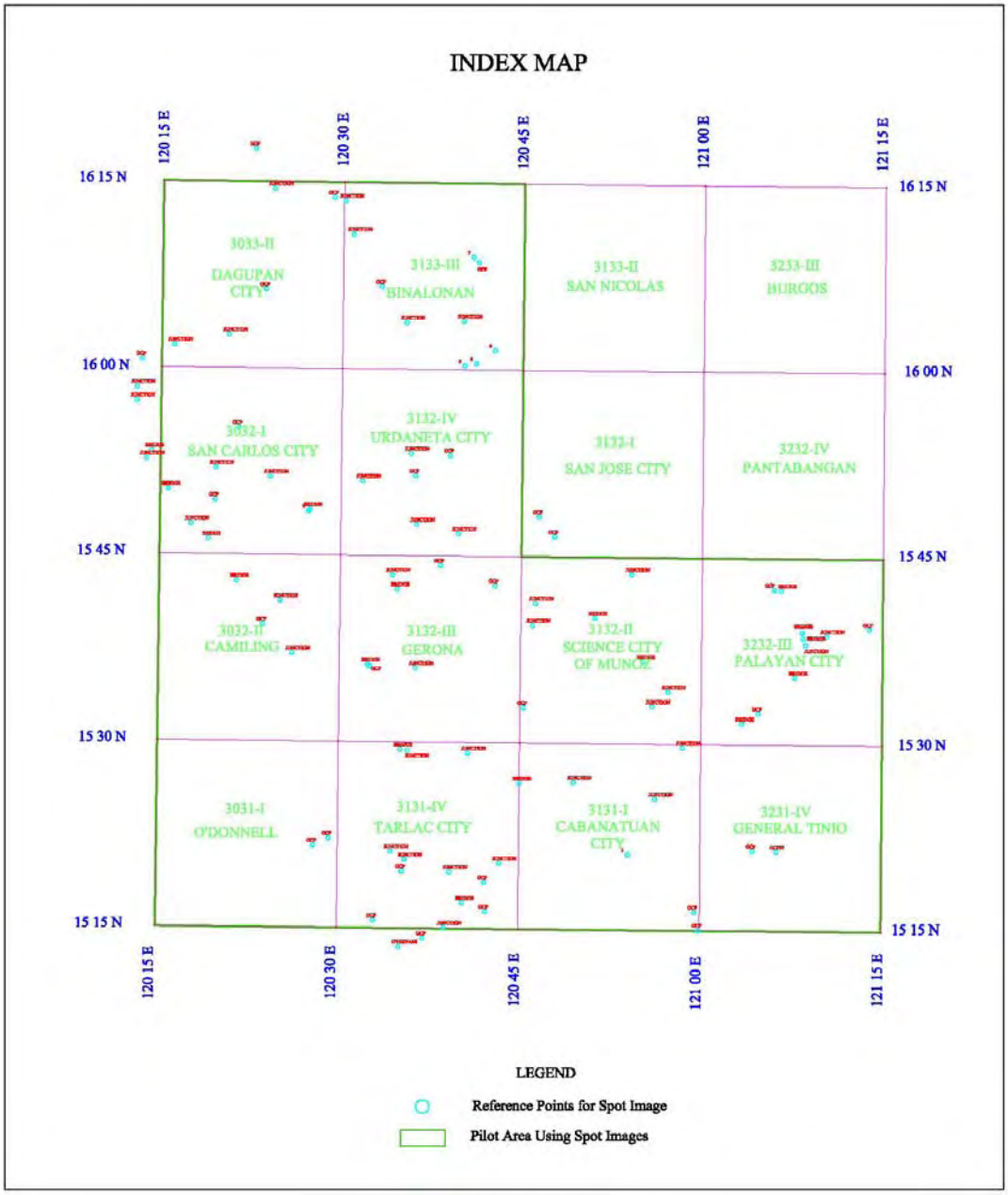


Figure 3-5 Location Map of Control Points (Area B)



(2) Specification of GPS survey

The specifications for the GPS survey are as in the following table:

Table 3-11 Specifications of GPS Survey

Items	Specifications	Remarks
Observation Mode	Static method	1-hour
Observation Hour	One hour	30 sec interval
Identification of control points and eccentric points	Pricking	Making on aerial photographs and satellite images.
Tolerance of residuals	±20 mm	Horizontal components
	±30 mm	Vertical component

(3) Equipment and materials used in GPS survey

The following equipment and materials were used for the GPS survey:

Table 3-12 Equipment and Materials for GPS Survey

Item	Specification	Descriptions
Equipment used	2 waves GPS receiver	Trimble 5700, 4800, 4000 SSI (6 sets in total)
	Handy GPS receiver	Garmin
	PC	DELL
	CAD software	Microstation and AutoCAD
	Coordinate Transformation Software	GEOCALC
	Baseline analysis software	Trimble Geomatics Office
Materials		Existing 1:50,000 topographic maps, aerial photographs, and satellite images.

(4) List of New Control Point Coordinates

A list of UTM coordinates of new control points is in Appendix II Table-8.

(5) Accuracy of Control Points

Accuracy of the control point for preparation of the topographic map at scale of 1:50,000 was within the following standards.

Table 3-13 Accuracy of Control Point

Item	Accuracy (standard deviation)	Remarks
Horizontal Accuracy	±2.5 m	On a sheet 0.05 mm
Vertical Accuracy	±5 m	1/4 of a contour line

(6) Inspection of GPS survey

Computation of GPS survey and its data were inspected by the Expert of the Study Team referring to the requirement as specified in the Table 3-11 Specifications of GPS survey and Table 3-13 Accuracy of Control Point.

Table 3-14 Mis-closure of Each Loop

Observation Date	Total length (m)	Northing (m)	Easting (m)	Height (m)	Mis-closure Vector Length (m)	Precision (PPM)
11-Jul-06	110530.1211	0.1250	-0.0770	0.1110	0.1841	1.6660
12-Jul-06	73337.1083	0.0050	0.0350	0.0070	0.0363	0.4950
13-Jul-06	83986.4197	0.0000	0.0190	-0.0240	0.0305	0.3630
14-Jul-06	85168.8038	0.0120	-0.0180	0.0210	0.0298	0.3500
15-Jul-06	65656.3948	0.0080	0.0080	-0.0190	0.0224	0.3420
17-Jul-06	70600.4593	0.0320	-0.0310	-0.2390	0.2432	3.4450
18-Jul-06 (1)	109514.4129	0.0870	0.0740	-0.2010	0.2312	2.1110
18-Jul-06 (2)	109386.3308	-0.0640	-0.0930	-0.3510	0.3688	3.3710
19-Jul-06	107797.8692	-0.0010	0.0000	-0.0350	0.0349	0.3240
21-Jul-06	75675.9238	0.0000	-0.0030	0.0270	0.0274	0.3620
22-Jul-06	58983.7317	-0.0030	0.0000	0.0200	0.0198	0.3360
24-Jul-06	160299.3038	0.0650	-0.1740	0.1380	0.2313	1.4430
26-Jul-06	200978.2857	-0.0040	0.1170	-0.0510	0.1280	0.6370
27-Jul-06	193274.4356	0.0010	-0.0030	-0.0020	0.0034	0.0180
28-Jul-06	218929.2673	0.0150	-0.0290	0.0200	0.0386	0.1760
29-Jul-06	173613.4759	-0.3370	0.4070	-0.3110	0.6131	3.5316
1-Aug-06	72670.4027	-0.0070	-0.0070	0.0100	0.0139	0.1910

The mis-closure of each loops above did not exceed tolerance of mis-closure ±5 ppm as specified in the above accuracy table. Accordingly it was confirmed that the coordinate values of control points have enough accuracy for horizontal control of topographic mapping at scale of 1:50,000.

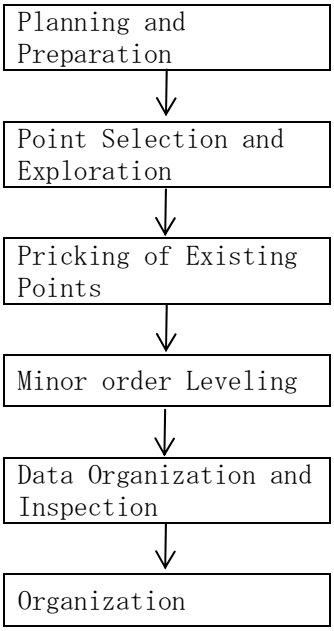
The control point survey for nine points and two existing control points in the eastern and western areas of a total of 39 points within the aerial photography area could not be completed as scheduled due to: weather conditions—influence of typhoon; inaccessibility to the control point survey sites; safety precautions from NPA (Communist insurgents' activities). The control point survey for the ten points were conducted in Pilot Project II in the second year of the Study.

The locations of additional control points on Area A of the Mount Pinatubo and mountainous area of Bulacan Province.

3-3-2 Minor Order Leveling

Minor order leveling (leveling or the leveling) was conducted to obtain vertical values of pricking points of the existing benchmarks along the existing leveling routes, new spot height points along the new leveling route, and existing and new control points for aerial triangulation of aerial photographs for topographic mapping at scale of 1:50,000 in accordance with the following work flow chart:

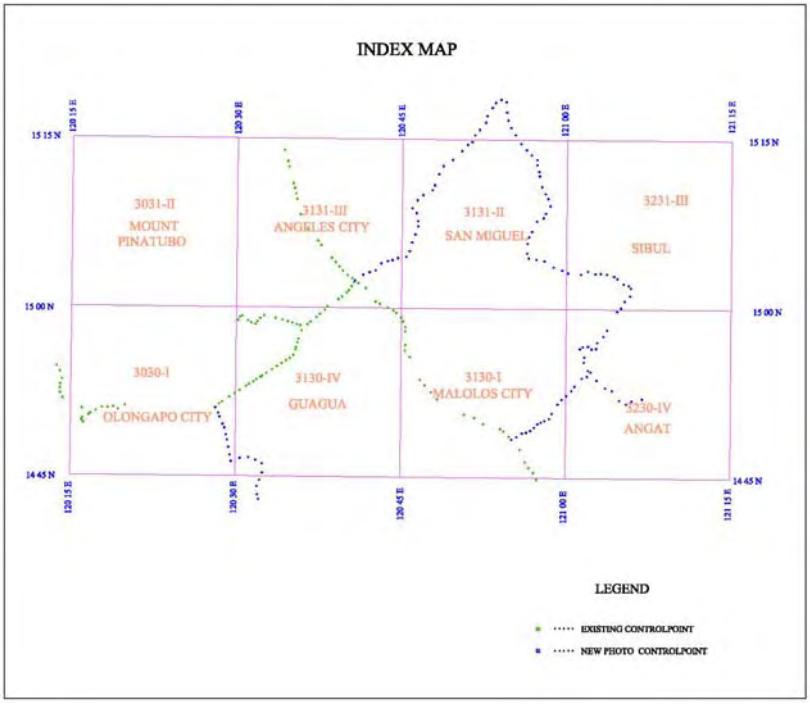
Figure 3-6 Work Flow of Leveling



(1) Leveling routes

The leveling routes were in Area A covering the eight topographic map sheets at scale of 1:50,000 (sheet No.: 3031-II, 3131-III, 3131-II, 3231-III, 3030-I, 3130IV, 3130-I, 3230-IV) as shown in Figure 3-1 Location Map of Pilot Project Area. Total distance of the existing leveling route was 179km and new leveling route was 144km as shown in the following Figure 3-7 Location Map of Leveling Routes.

Figure 3-7 Location Map of Leveling Routes



(2) Specifications of leveling

The specifications for the level are as in the following table:

Table 3-15 Specifications of Leveling

Items	Specifications	Remarks
Observation method	Direct leveling	Set up a temporally benchmark at an interval of 2km along the new leveling route.
Benchmark and spot height point identification	Pricking	ID data obtaining by handy GPS receivers
Tolerance of mis-closure	40 mm √S	S is the observed distance in km.

(3) Equipment and materials used of leveling

The following equipment and materials were used for the leveling:

Table 3-16 Equipment Used and Materials for Leveling

Item	Specification	Descriptions
Equipment used	Digital level	Leica N2002, Sokkia SDL30, Topcon DL 103
	Auto level	Leica NA2,
	Handy GPS receiver	Garmin
	PC	DELL
	CAD software	Microstation and AutoCAD
	Coordinate Transformation Software	GEOCALC
Materials		Existing 1:50,000 (enlarged to 1/25,000) topographic maps, aerial photographs, and satellite images.

(4) List of Height

A list of height, UTM coordinates of existing benchmarks and new-spot-height- points is shown in Appendix II Table-9:

(5) Accuracy and Inspection of leveling

The mis- closure of each leveling route on the data were inspected by the Expert of the Study Team referring to the requirement as specified in the above Table 3-15 Specifications of Leveling and the result was summarized below:

Table 3-17 Accuracy of Minor Order Leveling

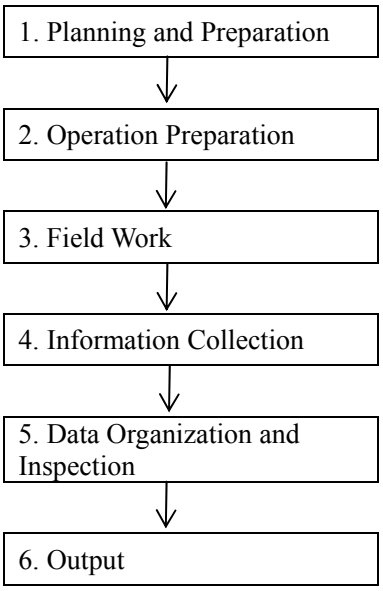
Route No.	Dist.(km)	Mis-closure (mm)	Tolerance(mm)	Leveling Route
9	16.9	42	164	New
10-1	41.1	48	256	New
10-2	73.1	56	342	New
11	12.9	65	144	New
Total=	144 km			

From the above table, the mis-closure of the each loops above was not exceed tolerance of mis-closure ± 40mm/Distance in km as specified in the Table 3-15 Specifications of Leveling. It was confirmed that the height of leveling loops has satisfied the accuracy for vertical control of topographic mapping at scale of 1:50,000.

3-3-3 Field identification

Field identification was conducted to acquire planimetric features which can not be acquired from the images, and to collect necessary information and other information which can support photographic interpretation during the plotting work. The work sequence was conducted as shown in the following chart:

Figure 3-8 Work Flow of Field Identification



(1) Field identification area

The field identification area covering the 20 topographic map sheets at scale of 1:50,000 (sheet No.: 3031-II, 3131-III, 3131-II, 3231-III, 3030-I, 3130IV, 3130-I, 3230-IV, 3033-I, 3133-III, 3133-II, 3253-III, 3032-I, 3132-IV, 3132-I, 3232-IV, 3032-I, 3132-III, 3132-II, 3232-III) as shown in Figure 3-1 Location Map of Pilot Project Area.

(2) Map symbols and the application rules (draft) and Work Method

In order to confirm the planimetric features to be incorporated in the topographic maps created during the Study, the specifications of map symbols and the application rules (draft) were prepared by the JICA Study Team. The following three methods were applied for acquisition of planimetric-feature data by the JICA Study Team and NAMRIA:

- Acquired based on photography (or image) interpretation;
- Acquired from reference materials; and
- Acquired from field identification.

In order to acquire planimetric-feature data from reference materials, the following reference materials were verified by NAMRIA:

- First, second and third triangular control points and benchmarks data;
- Power plant, substation, power-transmission-line location maps;
- Pipeline location maps;
- State, country and city boundaries;
- National parks, natural preserve boundaries;
- Road-network maps;
- Annotation reference material; and
- others.

(3) Equipment and materials used in field identification

The following equipment and materials was used for field identification:

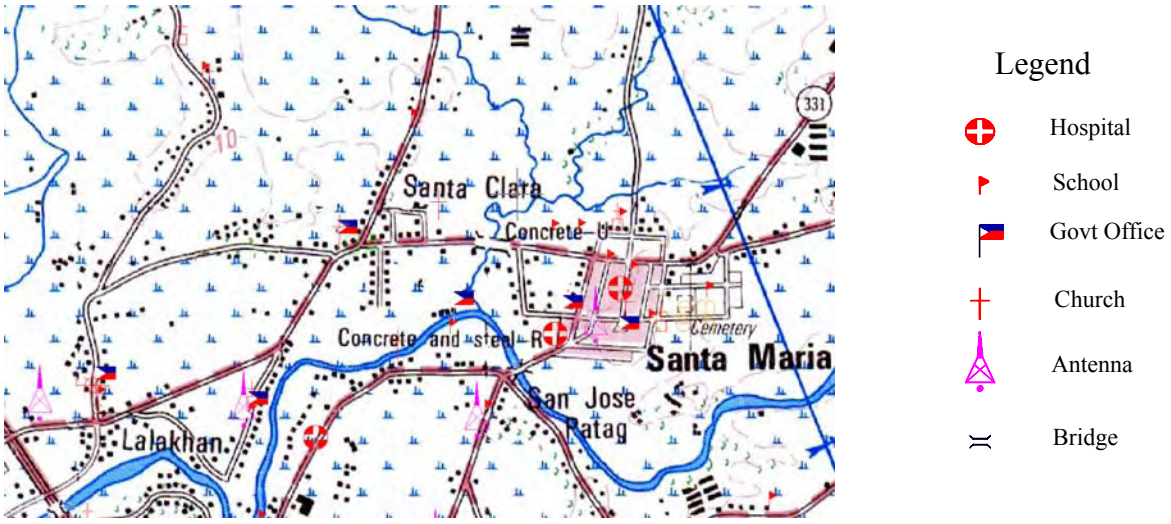
Table 3-18 Equipment Used and Materials for Field Identification

Item	Specification	Descriptions
Equipment used	Handy GPS receiver	Garmin
	PC	IBM Think Pad
	CAD software	Microstation and AutoCAD
	Coordinate Transformation Software	GEOCALC
Materials		Existing 1:50,000 (enlarged to 1/25,000) topographic maps, aerial photographs, and SPOT 5 satellite images.

(4) Arrangement of field identification data

The coordinate values acquired using handy GPS receivers were the coordinate values on the WGS-84 ellipsoid. The values were converted to those on the ellipsoid (PRS92) which was used in the Study. The acquired planimetric-feature data were arranged as Excel data, and the code numbers were checked. Planimetric-features symbols were added to the arranged Excel data and displayed onto the existing topographic maps using CAD to confirm locations.

Figure 3-9 Organization of Planimetric Features



The results of the road and field identification were arranged onto the 1:25,000 SPOT images.

(5) Inspection of field identification

The inspection of field identification data were inspected by the Expert of the Study Team referring to manner as specified in the specifications of map symbols and the application rules (draft). The inspection of data using CAD showed that the total number of points was 9,325 and the number of errors was 113. The rate of error was only 1.2 percent which was considered satisfactory.

(6) Technology Transfer

The technology transfer through OJT was conducted on the control point survey, minor order leveling and field identification in the field in accordance with the Draft Technical Specifications under the Supervision of the JICA Study Team. Attendance of NAMRIA (counterpart) team for each field work is listed up as below:

Table 3-19 List of Field Work Attendance

LEVELLING TEAM

	NAME	Work period	Total days
1	Reyna Carandang	July 5 – August 3, 2006	30
2	Marvi Gale Dayan	July 5 – August 3, 2006	30
3	Flory Ann De Villa	July 5 – August 3, 2006	30
4	Cherry Lene Nuñez	July 5 – August 3, 2006	30

GPS TEAM

	NAME	Work period	Total days
1	Custodio Armengol	July 5 – August 3, 2006	30
2	Joel Martin	July 5 – August 3, 2006	30
3	Eric Nares	July 5 – August 3, 2006	30
4	Xavier Phat Pelare	July 5 – August 3, 2006	30
5	Mike Ben Panis	July 5 – August 3, 2006	30
6	Carolino Damo	July 5 – August 3, 2006	30
7	Diolito Matugas	July 5 – August 3, 2006	30
8	Wilfredo Sangil	July 5 – August 3, 2006	30
9	Stephen Bolaños	July 5 – August 3, 2006	30
10	Felicisimo Fortich	July 5 – August 3, 2006	30
11	Edwin Regencia	July 5 – August 3, 2006	30
12	Antonio Mayagma	July 5 – August 3, 2006	30

FIELD IDENTIFICATION

	NAME	Work period	Total days
1	Jane Roque	July 5 – July 16, 2006	12
2	Roberto Narvaez	July 5 – July 20, 2006	16
3	Maricel De Luna	July 5 – July 20, 2006	16
4	Cecil Enaje	July 5 – July 20, 2006	16
5	Charisma De la Cruz	July 5 – July 16, 2006	12
6	Jose Erickson Targa	July 5 – July 16, 2006	12
7	Rowel Arce	July 5 – July 20, 2006	16
8	Christine Bayona	July 5 – July 20, 2006	16
9	Teddy Gal Bisenio	July 5 – July 16, 2006	12
10	Erwin Orpilla	July 5 – July 16, 2006	12
11	Cleotilde Galicia	July16 – July 29, 2006	14
12	Jose Villanueva	July16 – July 29, 2006	14
13	Gliceria Yarre	July19 – July 29, 2006	11
14	zorayda Aguilar	July16 – July 29, 2006	14
15	Jefferson Mariano	July19 – July 29, 2006	11
16	Marife Valentino	July19 – July 29, 2006	11
17	Mary Jane Montemayor	July16 – July 29, 2006	14
18	Rogelio Dais	July19 – July 29, 2006	11
19	Roger Mercado	July16 – July 29, 2006	14
20	Rommel Ampolitud	July19 – July 29, 2006	11

The Study Team member in charge conducted the OJT sessions on control point survey and its theory and planning; a plan was prepared, a part of the OJT session, as accuracy and efficiency of conducting the work were taken into consideration. As OJT for the minor order leveling and field identification, the team member conducted an OJT session on usage of a handy GPS and on processing of the data for efficiency enhancement of the work on-site and data management method.

The minor order leveling and filed identification work in hazard mapping preparation, NAMRIA has been conducting (map scales of 1:10,000 and 1:50,000), the handy GPS has been used as it was used during the Study for data acquisition and data management. The objective of the OJT sessions were achieved in this regard.

3-4 Results of Pilot Project II, III (Technical Transfer and Work in Japan)

Pilot Project II and III were carried out in Japan and through OJT in accordance with the Draft Technical Specifications under the Supervision of the JICA Study Team from November, 2006 and completed December, 2006. The works in Pilot Projects consisted of additional control point survey, digital plotting and editing scale of 1/50,000 using single satellite images, digital plotting and editing at scale of 1/50,000 using aerial photographs, field compilation, technical transfer and feedback from the Pilot Project,.

3-4-1 Additional Control Point Survey (Additional GPS Survey)

The additional control point survey was carried out by a local contractor, CERTEZA Infosys Co., in accordance with the terms, conditions, requirement of the Contract and Technical Specifications under the Supervision of the JICA Study Team from on 18 December, 2006 and completed at end of January, 2007. The GPS survey was conducted to determine the horizontal values of the control points

Survey method and specification of GPS survey as specified in (1) Control point survey was applied to the Technical Specifications of the Contract.

Principal data and information of the additional GPS survey are as follows:

(1) Location of control points

The location of additional control points on Area A of the Mount Pinatubo and mountainous area of Bulacan province.

(2) Equipment and materials used in additional GPS survey

The following equipment and materials were used for the additional GPS survey.

Table 3-20 Equipment and Materials used for Additional GPS Survey

Item	Specification	Descriptions
Equipment used	2 waves GPS receiver	Topocon, Trimble 4000 SSI (4 sets in total)
	Handy GPS receiver	Trimble
	PC	HP
	CAD software	Microstation and AutoCAD
	Coordinate Transformation Software	GEOCALC
	Baseline analysis software	Trimble Geomatics Office
Materials		Existing 1/50,000 topographic maps, aerial photographs, and satellite images.

(3) List of additional Control Point Coordinates

A list of UTM coordinates of nine new control points (E1, E2, E3, E4, E5, E6, W1, W2 and W3) was shown in Appendix II Table-8 List of New Control Points.

(4) Accuracy of Control Points

The following accuracy of the control point was specified in Technical Specifications of Contract.

Table 3-21 Specifications for Control Points

Item	Accuracy (standard deviation)	Remarks
Horizontal Accuracy	±2.5 m	On a sheet 0.05 mm
Vertical Accuracy	±5 m	1/4 of a contour line

(5) Inspection of additional GPS survey

Results of additional GPS survey were inspected by the Study Team referring to the requirement as specified in Table 3-20 Equipment and Materials used for Additional GPS Survey and Table 3-21 Specifications for Control Points.

Table 3-22 Mis-Closure of Each Loop

Obsevation Date	Total length (m)	Northing (m)	Easting (m)	Height (m)	Mis-closure Vector Length (m)	Precision (PPM)
26-Dce-07	140053.2266	-0.0830	-0.3130	-0.1090	0.3415	2.438
26-Dec-07	86189.5728	0.0370	0.0790	0.2870	0.3002	3.4830
27-Dec-07	85918.3611	-0.0220	-0.2280	-0.0120	0.2290	2.6650

The mis-closure of each loops above was not exceed tolerance of mis-closure ± 5ppm as specified in the above accuracy table. Accordingly it was judged that the coordinate values of control points have the enough accuracy and it was acceptable for preparing topographic map at scale of 1:50,000.

(6) Outputs

The final outputs are listed up as follows:

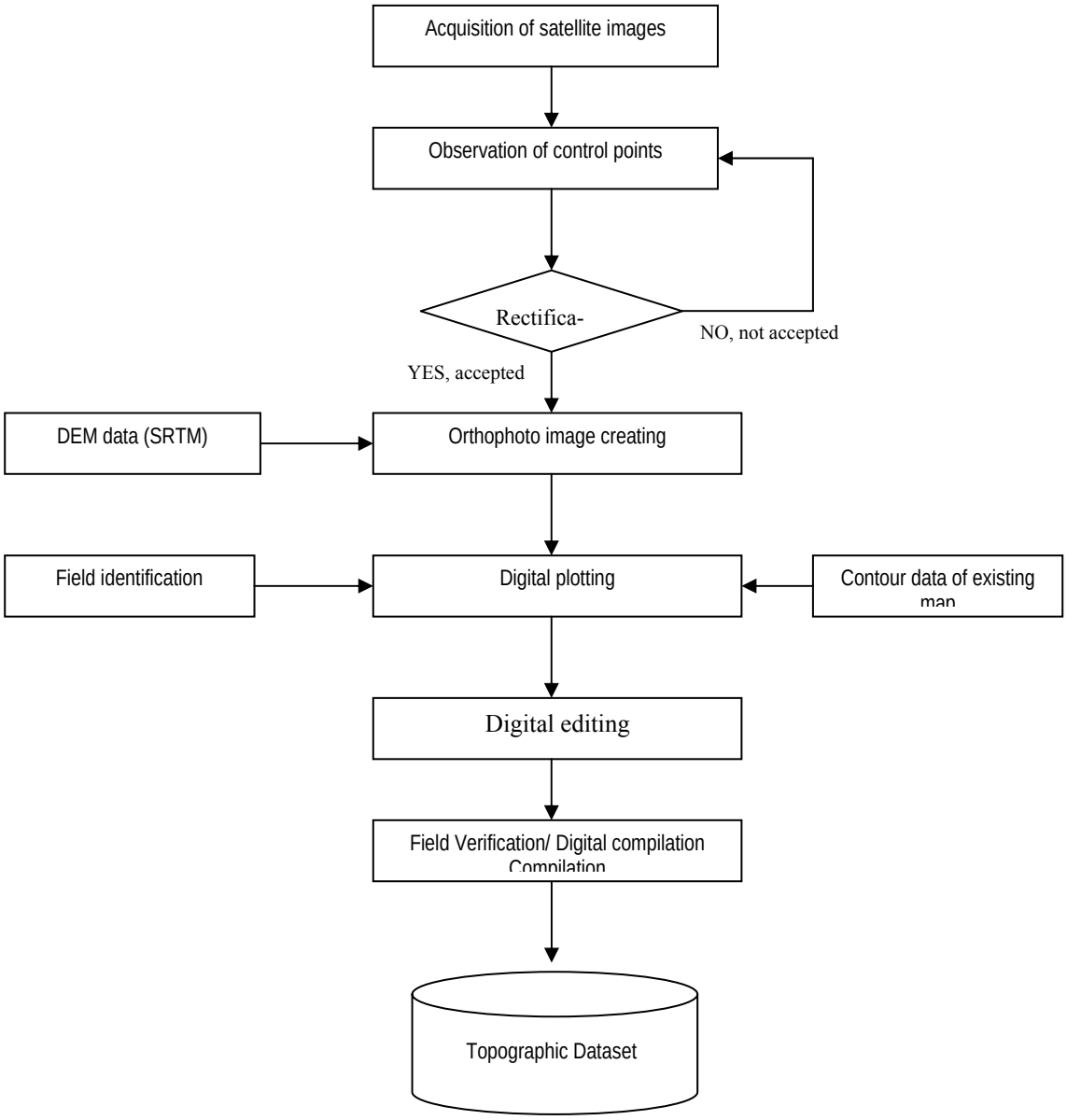
Table 3-23 Outputs of Additional GPS survey

Item	Quantity
(1) Raw data of GPS observation on CD-ROM.	One set
(2) GPS computation data on CD-ROM	One set
(3) Digital files and hard copies of Survey Mark Description	One set
(4) Digital files and hard copies of Diagram of ground control survey	One set
(5) Report	One set

3-4-2 Digital Plotting and Editing at Scale of 1/50,000 Using Single Satellite Images (in Japan)

Digital plotting and editing at scale of 1/50,000 using single satellite images was conducted in accordance with the technological verification plan using the single satellite images and the results of control point survey for Area A. The work flow for topographic mapping at scale of 1:50,000 using the single satellite images is as follows:

Figure 3-10 Work Flow Topographic Mapping by Using Single Satellite Imagery



The following software was used for digital plotting and editing:

Table 3-24 Software Used for Plotting and Eidting

Work Item	Software
Observation of control points	Socetset (IPM)
Aerial triangulation adjustment	Socetset (MST): bundle adjustment software
Orthophoto image creating	Socetset (Mosaic)
Digital plotting	AutoCAD MAP and Microstation V8
Digital editing	AutoCAD MAP and Microstation V8, ArcGIS

The following data and materials were used for digital plotting and editing:

- SPOT Imagery (Pan Sharpen);
- Results of GPS Survey and Leveling;
- SRTM (Three seconds mesh data);
- Contour line data which was digitized from the existing topographic maps; and
- Data from field identification.

(1) Results of rectification of satellite image and its accuracy

Rectification of SPOT5 imageries were completed using SRTM (Three second-mesh data), GPS and the results from leveling, and existing terrain feathures and contours derived from existing 1:50,000 scale topographic map respectively. The total numbers of scenes of rectification of SPOT5 imageries and control points used for the computation of rectification were as follows:

Table 3-25 Used SPOT5 Imagery and Control Points

Spot5 Image	6 scenes
Horizontal control points	97 points in total

Check accuracy results of rectification was as follows.

Table 3-26 Accuracy Results of Rectification

Control point and Discrepancies of tie points		
Horizontal and vertical	Standard deviation	x=4.9m
		y=4.1m

The results of residuals of control point were within 5m.

(2) Preparation of Ortho-photographs

The ortho-photographs are prepared using the imageries with 2.5 meter resolution to satisfy required accuracy of 1:50,000 digital plotting. The results of aerial triangulation and DTM (SRTM-three second mesh) were used and mapping data were prepared by sheet.

(3) Digital Plotting

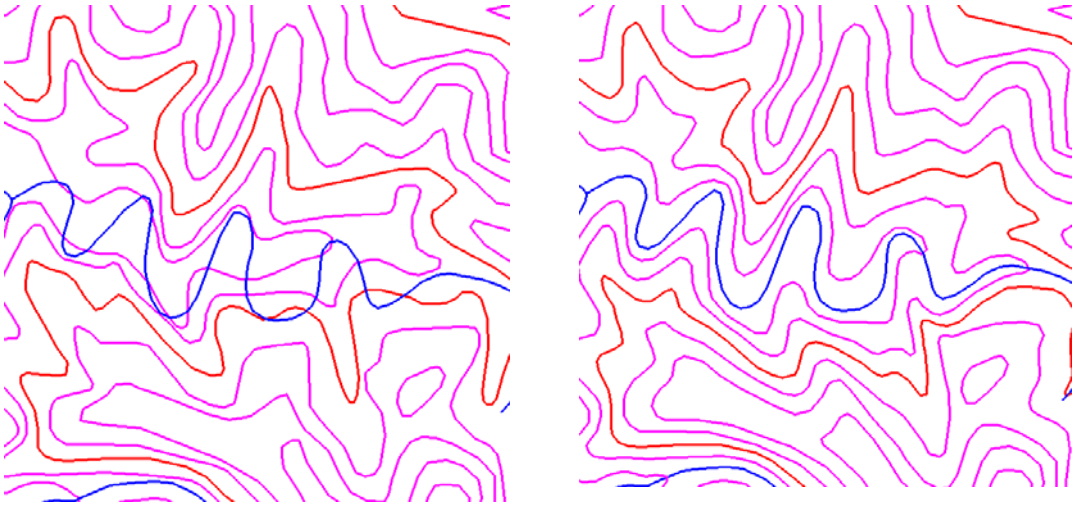
The ortho-photographs were used as background of digitizing using CAD software. Linear elements such as road and river were acquired first; buildings and vegetation followed after extracting the linear elements by referring the results of field identification. The codes of planimetry were extracted in accordance with the Specifications for Digital Topographic Data Acquisition.

(4) Filed Compilation

Based on the data extracted in the process of digital plotting, field compilation was conducted in accordance with the map symbolization rules. Digitized data from the existing

topographic maps were used as contour data. When unreasonable expressions were found due to changes of river courses, the contour lines were corrected using the ortho-photographs.

Figure 3-11 Editing Existing Contour Lines



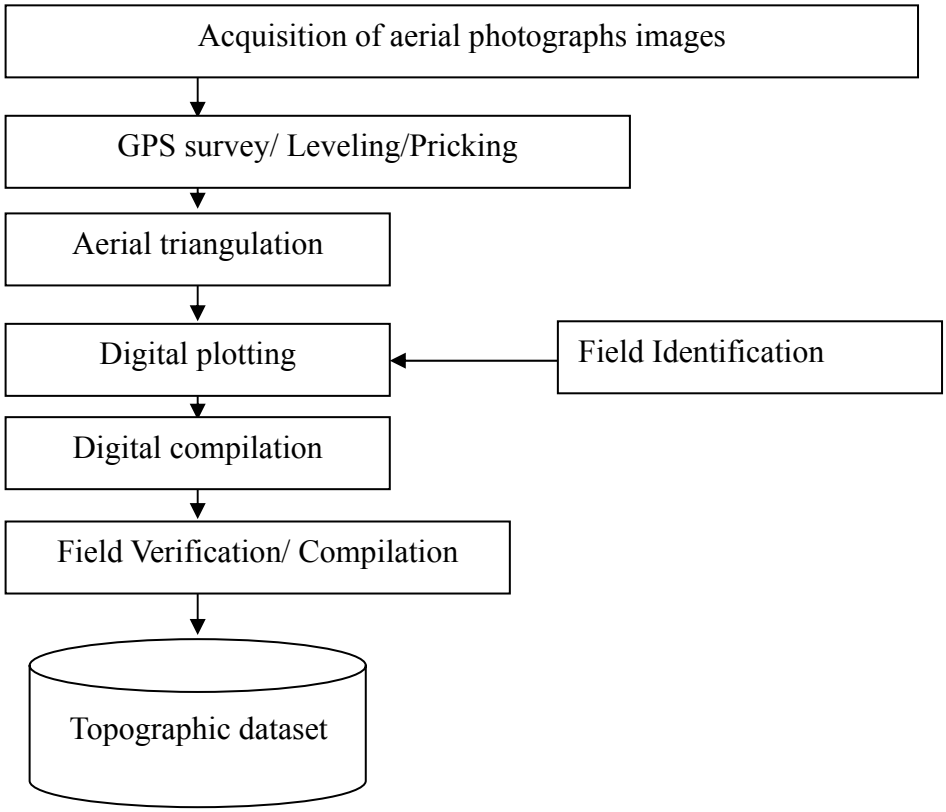
Before Editing

After Editing

3-4-3 Digital plotting and editing at scale of 1/50,000 using aerial photographs (in Japan)

Digital plotting and editing at scale of 1:50,000 using aerial photographs were conducted in accordance with the plan for technical verification; aerial photographs and results of control point survey for Area A were used to conduct the work. The work flow of the method using the aerial photographs are shown in the following figure:

Figure 3-12 Work Flow of Plotting and Editing using Aerial Photographs



(1) Software and data used in digital plotting and editing

The following software was used for digital plotting and editing:

Table 3-27 Software used for Digital Plotting and Editing

Work Item	Software
Observation of control points	Socetset (IPM)
Aerial triangulation adjustment	Socetset (in BLOCK): bundle adjustment software BINGO: bundle adjustment software
Orthophoto image creating	Socetset (Mosaic)
Digital plotting	Summit Evolution and DIAP
Digital editing	AutoCAD MAP and Microstation V8, ArcGIS

The following data were used for digital plotting and editing:

- Results of GPS Survey and Leveling;
- Field identification data; and
- SUBIC-CLARK-TARLAC Highway data.

(2) Results of Aerial Triangulation and its Accuracy

The total numbers of photo models of aerial triangulation and control points used for the computation of aerial triangulation were as follows:

Table 3-28 Photo Models and Control Points

Photo Models	634 models in total
Horizontal control points	51 points in total
Vertical control points	242 points in total

Check accuracy results of aerial triangulation was as follows:

Table 3-29 Inspection Results of Aerial Triangulation

Residuals of Control point		
Horizontal	Standard deviation	x=0.66m
		y=0.69m
	Max	x=2.33m
		y=2.44m
Vertical	Standard deviation	h=1.05m
	Maxh=5.24m	
Discrepancies of tie points		
Horizontal	Standard deviation	x=0.006m
		y=0.006m
Tolerance of Residuals of Control point and Discrepancies of tie points		
Horizontal and vertical	Standard deviation	0.02%(1.26m)
	Max	0.04%(2.52m)

The results of residuals of control point and discrepancies of tie points were within the maximum of 0.04% (2.52m).

(3) Digital plotting

Digital plotting was conducted using the results of aerial triangulation conducted in Japan in the areas where the plotting work was to be conducted using aerial photographs. The plotting work was conducted as the results of the field identification were referred. The linear features such as roads and rivers extracted first. Then, other data were extracted in the orders of buildings, vegetation, and contour lines. The codes for planimetric features were extracted from the Specifications for Digital Topographic Data Acquisition. To secure quality at error prone locations/items and significant elements and to standardize the method of data acquisition, the Plotting Data Acquisition Operation Reference was prepared.

(4) Digital editing

Editing work was conducted in accordance with map symbolization rules for topographic map creation at scale of 1:50,000 using the data acquired during the plotting work and the results of field identification. A rapid orthophoto mosaic preparation was conducted at the resolution of two meters to facilitate the editing work.

Data cleaning

The data cleaning work was conducted using an editing workstation. The work items conducted were:

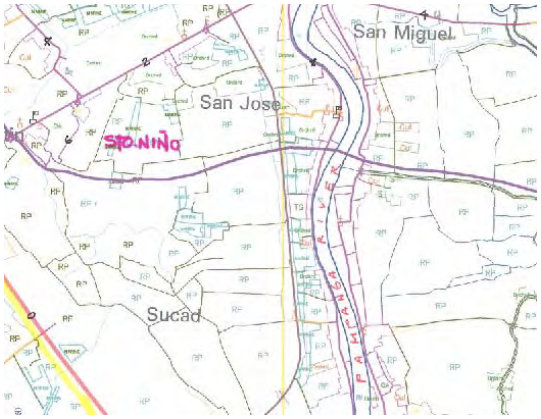
- Error correction such as gap and dangle errors;
- Deletion of duplication; and
- Polygon data completion.

(5) Supplementary digital editing

The field compilation data were added to the digitally edited data. The major work items are as follows:

- Inputting administrative boundaries and names of administrative units;
- Additions and corrections identified in the field compilation; and
- Inputting the lines of Subic-Clark-Tarlac highway under construction.

Figure 3-13 Field Compilation Data



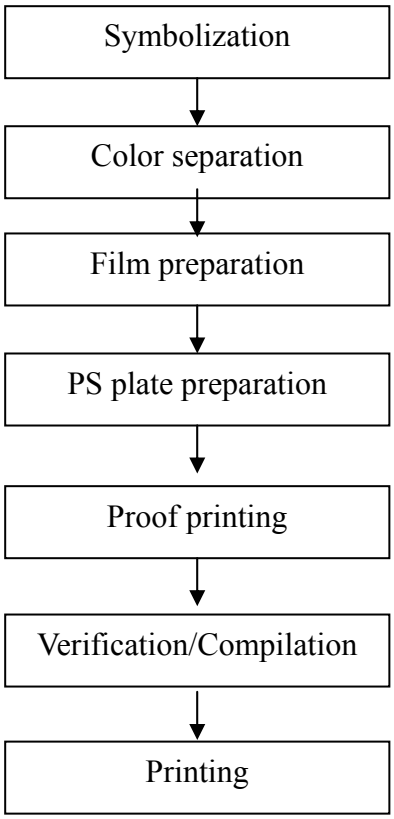
Field Compilation

Subic-Clark-Tarlac Highway Field Compilation Data

3-4-4 Map Printing Data Creation (in Japan) and Map Printing (in the Philippines)

The Study Team conducted the printing data preparation work and printing film preparation in the process of topographic printing work. The printing of topographic maps were conducted by NAMRIA. The work flow of topographic map printing is as in the following flow chart.

Figure 3-14 Flowchart of Printing Process



(1) Software used map printing data creation by the Study Team

The following software was used for map printing data creation:

Table 3-30 Software for Printing Data Creation

Work Item	Software
Map Symbolization	Adobe Illustrator CS2, Adobe Photoshop CS2, Map Publisher

3-4-5 Technology Transfer

The technology transfer through OJT was conducted on: field compilation in accordance with the Draft Technical Specifications and under the Supervision of the JICA Study Team, basic training of aerial triangulation; digital plotting and editing; digital map symbolization; and satellite image processing by the JICA Study Team using the training manuals.

(1) Field Compilation

Field compilation was conducted from February 1, 2007 to September 27, 2007 to correct questionable parts and items, unreasonable objects, and elements that did not conform with existing reference materials during the plotting and editing work that had utilized data from field identification by the personnel from NAMRIA under supervision of the Study Team.

The items of field compilation are:

1. Omission of planimetric data, especially point data, were corrected using a handy GPS and plotted onto the maps;

2. Annotation, spellings, and types of features were re-confirmed on site; and
3. Where a large degree of secular changes is recognized, a handy GPS was used to identify exact locations of the area or items.

Table 3-31 List of Field Work Attendance

FIELD COMPILATION

NAME		Work period	Total days
1	Imelda Cabatay	February 1 – 7, 2007	6
2	Nida Samin	February 1 – 7, 2007	6
3	Brian Josue	February 1 – 7, 2007 February 15 – 21, 2007 June 25 – July 1, 2007	6 6 6
4	Jesus Alcala	February 1 – 7, 2007	6
5	Joselito Eugenio	February 1 – 7, 2007 February 19 – 25, 2007 June 25 – July 1, 2007	6 6 6
6	Paz Bisenio	February 1 – 7, 2007	6
7	Anita Mendrano	February 1 – 7, 2007 February 15 – 21, 2007	6 6
8	Marie Charlene Lagayan	February 1 – 7, 2007 July 9 -15, 2007 July 24 – 31, 2007	6 6 6
9	Eva Valencia	February 1 – 7, 2007 July 9 -15, 2007	6 6
10	Noel Besano	February 1 – 7, 2007	6
11	Celedonio Pili	February 1 – 7, 2007	6
12	Evelyn Mercado	February 1 – 7, 2007	6
13	Brian Dela Cruz	February 1 – 7, 2007 July 24 – 31, 2007	6 6
14	Antonio Quibado	February 1 – 7, 2007	6
15	Cleotilde Galicia	February 1 – 7, 2007	6
16	Teddy Gal Bisenio	February 15 – 21, 2007	6
17	Mark Oliver Manuel	February 15 – 21, 2007	6
18	Felix Aperejo	February 15 – 21, 2007	6
19	Erwin Orpilla	February 15 – 21, 2007 July 24 – 31, 2007	6 6
20	Ismael Ferrer	February 15 – 21, 2007	6
21	Marife Valentino	February 15 – 21, 2007	6
22	Rogelio Dais	February 19 – 25, 2007 June 25 – July 1, 2007 July 24 – 31, 2007	6 6 6
23	Eva Payumo	February 19 – 25, 2007	6
24	Jose Villanueva	February 19 – 25, 2007 June 25 – July 1, 2007 July 24 – 31, 2007	6 6 6
25	Josefina Gaspe	February 19 – 25, 2007	6
26	Ariel Baluyot	February 19 – 25, 2007	6
27	Rowel Arce	February 19 – 25, 2007	6
28	Amelia Dela Cruz	February 19 – 25, 2007	6
29	Maria Victoria Baleta	June 25 – July 1, 2007	6
30	Teddy Gal Bisenio	June 25 – July 1, 2007	6

31	Froilan Cortez	June 25 – July 1, 2007	6
32	Imelda Cabatay	June 25 – July 1, 2007 July 24 – 31, 2007	6 6
33	Rowel Arce	July 9 -15, 2007	6
34	Willie Puquiz	July 9 -15, 2007	6
35	Rommel Ampolitod	July 9 -15, 2007	6
36	Cesar Vallar	July 9 -15, 2007	6
37	Zenaida Aguilar	July 9 -15, 2007	6
38	Nelma Briones	July 9 -15, 2007	6
39	Rogelio Mercado	July 24 – 31, 2007	6
40	Ma. Victoria Baleta	July 24 – 31, 2007	6

FIELD IDENTIFCATION OF BENCHMARKS

	NAME	Work period	Total days
1	Comm. Romeo Ho	September 14 - 27, 2007	14
2	Alvaro Caldona	September 14 - 27, 2007	14

The field compilation work utilized the handy GPS fully; all the counterpart personnel has used the piece of equipment: on site; down loading the in the offices; and exporting the data to CAD software. The staff used the handy GPS as they have learned. The results of field compilation were exported to CAD software in a digital format. The Study Team confirmed the condition of the data; the results were satisfactory. The field compilation work was conducted smoothly as the staff were more experienced through the previous field identification work; weather condition was favoring the work; the work was completed as scheduled.

(2) Basic Training of Aerial triangulation, digital plotting and editing, digital map symbolization and satellite image processing

The Study Team has conducted the basic training of aerial triangulation, digital plotting and editing, digital map symbolization and satellite imange processing using the digital photogrammetry system; digitizing and editing system; and the printing system provide by JICA. The training sessions were conducted from June 12, 2007 to October 10, 2007. The contents and the courses of the training sessions are described as follow:

Basic Training Course in Digital Photogrammetry on SOCET SET version 5.3

Instructor: Nobuhiro SATA

1) Aerial Triangulation

- Image import
- Internal orientation
- Control point data file preparation
- Observation of control points
- Observation and placement of tie points
- Theory of adjustment calculation and evaluation of results of calculation;
- Method of transferring the results of aerial triangulation to the digital plotting and required file formatting.

2) Digital Plotting

- Data acquisition

- Field identification data import
- Method of vegetation interpretation
- Method of acquiring contour data

Basic Training Course in Digital Map Editing by Auto CAD version 2008

Instructor: Kiyofumi TAMARI

3) Editing plotting data

- Data cleaning (gaps and dangles)
- Importing data from filed compilation and editing
- Preparation of polygon data;
- Importing and editing the annotation data;
- Generation of contour lines).

Basic Training Course in Digital Map symbolization by Adobe Illustrator CS2

Instructor: Kozo YAMAYA

4) Map Symbolization

- Importing data structured during the digital editing;
- Data symbolization;
- Shifting the true locations for readability and symbolization;
- Preparation of the neat lines and grid lines;
- Preparation of legend and the border information.

Basic Training Course in Image Processing using ERDAS Imagine

Instructors: Nobuhiro SATA and Ms Ayako SEKIYAMA

5) Satellite image processing（Satellite Image Processing）

- Viewer and Importing data
- Mosaicing
- Image Enhancement and Pan Sharpen
- Image (supervised / unsupervised) Classification
- Geometric Correction
- Adding New Datum
- Model Maker

Attendance of counterpart for each field work is listed up as below.

Table 3-32 List of Basic Training Course **Attendance**

TITLE	PERIOD	NAME
Basic Training Course in Digital Map Editing by Auto CAD version 2008	July 16 – August 10, 2007	Marie Charlene Lagayan
Basic Training Course in Digital Photogrammetry on SOCET SET version 5.3	June 12 – July 13, 2007	Marie Charlene Lagayan
		Maricel De Luna
		Roger De Luna
		Gliceria Yarre
		Imelda Cabatay
		Mary Jane Montemor
Basic Training Course in Digital Map symbolization by Adobe Illustrator CS2	August 13 – September 25, 2007	Rogelio Dais
		Brian Josue
		Josefina Gaspi
		Brian Dela Cruz
Basic Training Course in Image Processing using ERDAS Imagine	October 5 – 10, 2007	Marie Charlene Lagayan
		Roger De Luna
		Ma. Victoria Baleta
		Cecil Enaje

During the counterpart training, the counterpart personnel strongly requested to conduct training on image processing using ERDAS Imagine. The Study Team, responding to the request, added to the Basic Training Course in Image Processing Using EARDAS Imagine to the curriculum. For each training session, the Study Team member conducted a lecture session in the morning and hands-on sessions in the afternoon. The fundamentals of using software for aerial triangulating, digital plotting and digital map symbolization and satellite image processing were instructed by the Study Team.

After the training, the Cartography Division started using the learned technology on the project on hazard mapping at scale of 1:50,000 using technologies--ortho-photographs prepared using satellite images and digital plotting and editing—for digitization of the existing topographic maps. The Photogrammetry Division started the aerial triangulation and digital plotting technologies covered during the technology transfer sessions for preparing 1:10,000 hazard maps in urban areas. At the same time, the Photogrammetry Division has started the staff training using the training manuals which the Study Team had prepared. As stated, the OJT for topographic mapping technology conducted by the Study Team has contributed to enhance capacities of NAMRIA.

The data of analysis on capacities of staff during the training sessions are used for human resource development plan.

3-4-6 Feedback from the Pilot Project

In the course of technical transfer of topographical mapping in the Pilot Projects, using aerial photographs, single satellite images and stereo satellite images, the Study Team identified technical problem areas of the counterpart personnel by processes of operation, and listed them up in a table. Followed by the information collected, the Draft Technical Specifications were revised, and the information was also utilized in the technical training needs assessment, described in Section 3-6, and for preparation training program for human resources development plan. The technical issues were identified by processes of operation for each mapping method as follows:

Table 3-33 Feedback from the Aerial Photography Method

Process	Detail	Issue
Operation Plan	Collection of source materials	None
	Flight planning	The conditions of flight periods were not fully understood.
		The topographic conditions of the area are not understood--setting the basic plane.
		The specifications are not understood fully.
	Airphoto control point distribution planning	Topographic conditions of the sites are not fully considered. Some of the locations cannot be entered.
	Preparation of equipment to be used	Some of the equipments was damaged. The management of equipment was not fully exercised.
	Deployment of engineers/surveyors	The contents of the work are not understood.
	Determination of work schedule	Dependent on the Consultants
	Quality control planning	The process was not included in the inspection process.
Aerial Photography	Confirmation of flight plan	Changes of the specifications have not been considered.
	Preparation of photography	The data the consultants prepared were not fully utilized.
	Implementation of aerial photography	There might have been a problem in the development process.
	Preparation of the index maps	None
	Preparation of contact prints	As far as the outputs are concerned, it cannot be said the quality inspection was conducted.
	Quality checking	As far as the outputs are concerned, it cannot be said the quality inspection was conducted.
	Scanning the image data	There was a problem of the quality of the images.
	Delivery of outputs	As far as the outputs are concerned, it cannot be said the quality inspection was conducted.
GPS Survey	Preparation	The same type of equipment was not prepared.
	Point selection and field work	The locations were different from what was planned.
	Observation planning	A observation plan was not fully prepared. It was changed frequently as reacting to issues arose.
	Pricking of existing point	None
	GPS Observation	The implementation was different from what was planned.
	Data processing and checking	Frequency of re-surveying was high, but the cause was not studied.
	Preparation of the Outputs	The final output files were not prepared.
	Operation planning and preparation	Preparation of equipment (level and foot plate) was delayed.
Leveling	Operation planning and preparation	The preparation of geoid undulation maps were not considered.
	Selection of control points and field work	The preparation of geoid undulation maps were not considered.
	Pricking of the existing benchmarks	None
	Implementation of minor order leveling	10% of the locations of pricking were wrong. No work was conducted for geoid correction.
	Data processing and checking	The inspection was not conducted.
	Preparation of the Outputs	The final output files were not prepared.
Field Identification	Operation planning / preparation	Documents were ready at the commencement of the work.
	Preliminary air-photo interpretation	It was commenced on site.

Process	Detail	Issue
Field Identification	Implementation of field identification	The map symbols were not fully understood.
	Organizing the field identification results	Since the map symbols were not fully understood, the compilation work could not be planned and conducted in a orderly manner.
	Quality checking	Since the map symbols were not fully understood, the quality checking was not adequate.
Aerial Triangulation	Preparation	The documents are not organized.
		Even though, the specifications of the aerial photographs have been changed, nothing work considered on the quantity of work in the process of aerial triangulation
	Data input	The spreadsheet software and text editor could be used more efficiently.
	Internal orientation	None
	Measuring the photograph coordinates	There is less observation experiences in the digital technology.
	Calculation	There is less observation experiences in the digital technology.
	Accuracy control and error correction	When operators get used to the new software, there will be no problem.
	Adjustment calculation	When operators get used to the new software, there will be no problem.
	Preparation of the Outputs	No
Digital Plotting	Preparation	A person in charge is not identified.
	Acquisition of planimetric features	The stereo plotting skills are required. Relatively long period is required for operator training.
	Acquisition of topographic data	The stereo plotting skills are required. Relatively long period is required for operator training.
	Checking	The checking procedure needs to be established.
	Preparation of the Outputs	A person in charge is not identified.
Digital Compilation	Preparation	A person in charge is not identified.
	Inputting plotting data	Understanding on the map symbols is not adequate; there is no discussion regarding the matter within NAMRIA.
	Data cleaning	There was no experience in the process. The map symbols needs to be understood fully.
	Implementation of digital compilation	The compilation work was not conducted in an orderly manner.
	Addition of other data	Layer specific data are not understood.
	Preparation of polygon data	The concept of scale is not understood; a minute polygon which cannot be outputted were extracted as polygons.
	Addition of annotation data	Data such as annotation data was not prepared in advance.
	Checking	Data checking mind is absent.
	Preparation of the Outputs	Data files can be produced when instructed.
Field Compilation	Preparation	The items of field compilation cannot be narrowed down from the inspection results of digital compilation and field identification.
	Implementation of field compilation	Since preparation is inadequate, there was redundancy during the work.
	Organizing field compilation results	Many errors were found regarding layers.
	Compilation of topographic data	There was operation problem using the editing software;
	Preparation of the Outputs	Data files can be prepared when instructed.
Preparation of Topographic Map Data	Creation of meta-data	The term "meta-data" is known, but "how-to" is not known.
	Preparation of the Outputs	None

Table 3-34 Feedback from the Single Satellite Images Method

Process	Detail	Issue
Acquisition of Satellite Images		Dependent on the consultants
Control Point Survey		The control point chart was not preapred.
Geometric Correction	Preparation	The documents on control point details were not prepared.
	Input of Control Points	None
	Measuring image coordinates	None
	Calculation and Checking	None
	Preparation of Ortho-mosaic	None
	Preparation of the Outputs	None
Filed Identification	Implementation of field identification	The map symbols were not fully understood.
	Preparation of the Outputs	Since the map symbols were not fully understood, the compilation work was not conducted in a orderly manner.
Digital Plotting	Digitization of existing maps	Knowledge of topographic maps is required.
	Acquisition of planimetric features	Since the resolution of the images was low, field identification and data collection are important.
	Preparation of the Outputs	Digital plotting experiences are required.
Digital Compilation		The work was not able to be conducted in a orderly manner.
Topographic Data Preparation	Same as above	The meta-data-specifications were not decided.

Table 3-35 Feedback from the Stereo Satellite Image Method

Process	Detail	Issue
Operation plan		Dependent on the consultants
Acquisition of Stereo Images	Programming of aerial photography	Dependent on the consultants
	Acquisition of images	The acquisition of the cropped images was problematic. The next version of the software may resolve the problem.
Control point survey		The process is dependent on the software; there is no problem in SocetSet.
Aerial Triangulation		The process is dependent on the software; there is no problem in SocetSet.
Field Identification		The map symbols were not fully understood.
Digital Plotting	Digitization of existing maps	Knowledge of topographic maps is required.
	Acquisition of planimetric features	The resolution of the images was not high; the work was difficult.
	Addition and compilation of topographic data	It is difficult with the data used for the project.
	Preparation of the Outputs	None
Digital Compilation		The map symbols were not fully understood.
Field Compilation		None
Topographic Data Preparation		The specifications of meta-data has not been decided.

Table 3-36 Feedback from the Map Symbolization and Printing Process

Process	Detail	Issue
Preparation		The specifications of the plotting data were not designed for digital map symbolization.
Map Symbolization	Preparation of polygon data	The data were symbolized; to make them for topographic data, more experiences will be necessary.
	Preparation of line data	The data were symbolized; to make them for topographic data, more experiences will be necessary.
	Preparation of point data	The data were symbolized; to make them for topographic data, more experiences will be necessary.
	Preparation of text data	The data were symbolized; to make them for topographic data, more experiences will be necessary.
	Editing	Detailed specifications were not established.
	Checking	None
Color Separation		The color management required for off-set printing cannot be done.

3-4-7 Equipment for Technology Transfer

The data creation and editing system was installed in one of the rooms in NAMRIA to conduct the technology transfer sessions. The equipment and software installed and used for the technology transfer are as in Appendix II Table-10 Equipment and Software Used for Technology Transfer.

3-5 Technical Coordinating Committee

The Technical Coordinating Committee (TCC) was formed on March 14, 2006 when the Study was commenced. The function of TCC was to support the local operations of the Study.

On July 5, 2007, the Study Team notified the commencement of field work in the Region I to TCC and requested cooperation. TCC responding to the request from the Study Team submitted required information for field identification. TCC also inspected the preliminary maps on annotations and planimetric features. The inspection work was completed at the end of July 2007.

On August 15, 2007, the Study Team started the field work in Region III. The Study Team with the staff from NAMRIA requested coordination and cooperation from TCC. In the Region III, TCC inspected preliminary maps on annotations and planimetric features. The inspection lasted about a month.

The Mines and Geosciences Bureau offered office space; the region offices of NEDA and DPWH mainly worked on infrastructure information, while the city and provincial development offices have worked on annotations and other planimetric features.

3-6 Examination of Mapping Methods

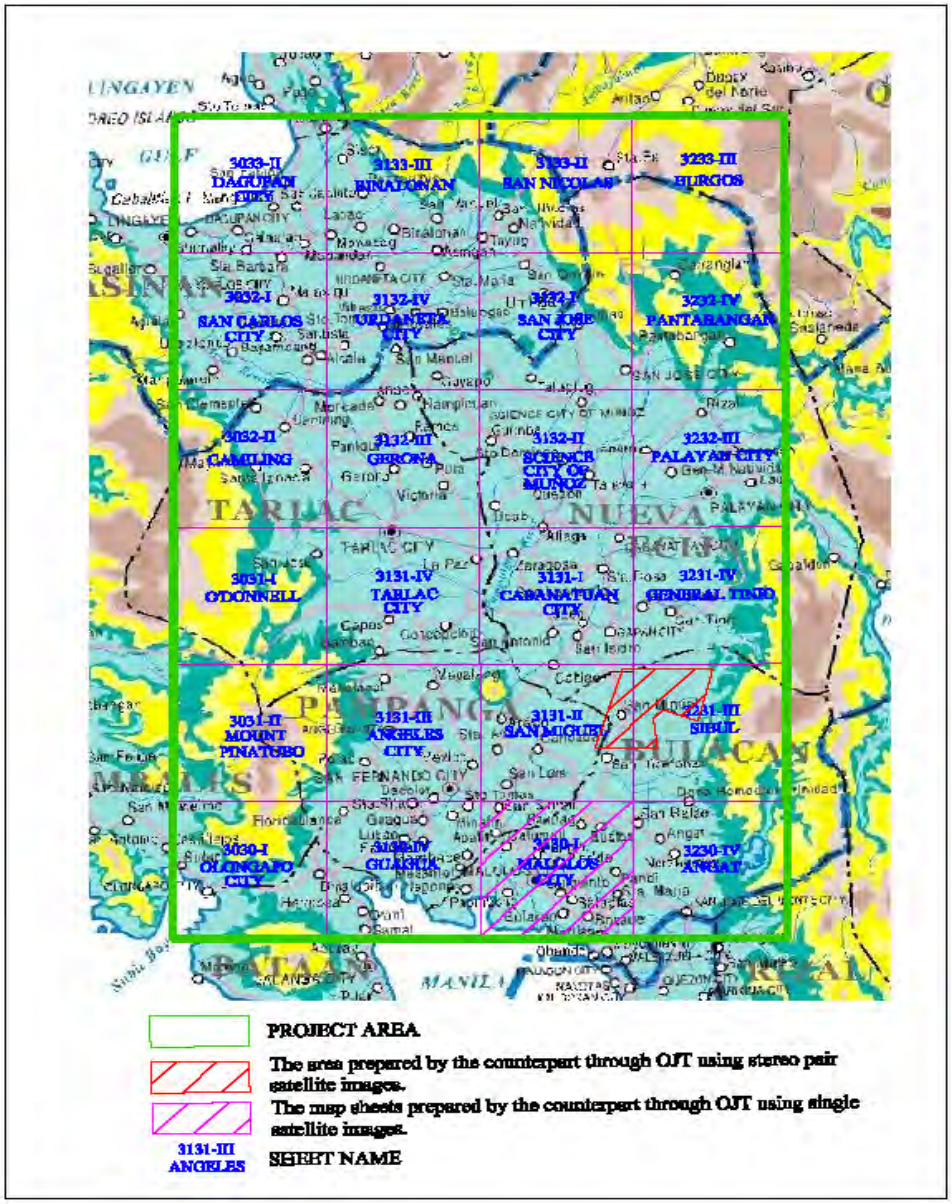
3-6-1 Mapping Methods for Accuracy Inspection

The Study Team conducted accuracy inspection of mapping methods in the Pilot Projects: using aerial photography, single SPOT5 satellite imagery and stereo-pair-SPOT5 imagery; and by comparative analysis and evaluation of coordinate and elevation data in the newly prepared 1:50,000 topographic maps and existing maps.

3-6-2 Target Area of Technical Verification

The area of the comparative study of coordinate and elevation data is shown in the following figure:

Figure 3-15 Area of Comparative Study



3-6-3 Comparative Analysis of Coordinates (Aerial Photography and Single SPOT5 Imagery)

Comparative analysis of coordinates was implemented to cover the 1:50,000 topographic map Sheet No. 3130 I according to the technical verification plan of the Study. Measurement of coordinates was done at the points, which could be clearly identified in 1:50,000 topographic data created by aerial photography and 1:50,000 topographic data created by single SPOT5 imagery, such as at road intersections, bridges, road transition points. Sixty-seven control points were selected and data on coordinates were compared, based on assumption that horizontal coordinates in the 1:50,000 topographic data created by aerial photography are absolutely correct.

The results of discrepancies are shown Appendix II Table-11 Comparison of Horizontal Errors, and summarized in Table 3-37:

Figure 3-16 Locations of Checking Points

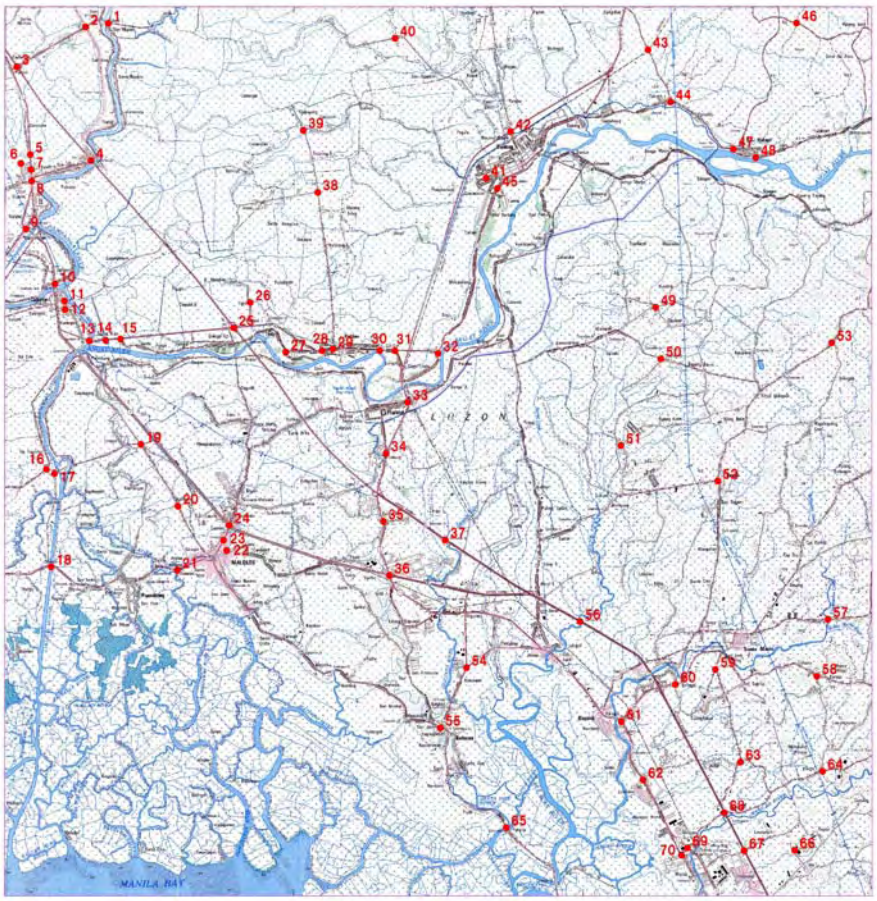


Table 3-37 Horizontal Coordinate Data Comparison

	1:50,000 Topographic Map Data by Aerial Photographs and Single SPOT5 Images
No. of points compared	67 points
Average discrepancy	4.2 m
Max. discrepancy	14.1 m

The same control points were used for aerial triangulation for preparation of 1:50,000 topographic maps by aerial photographs and single SPOT5 images. The residuals of the common control points used by aerial triangulation were compared to verify accuracy of horizontal coordinates:

Table 3-38 Accuracy Verification by Aerial Triangulation

Residuals of Control Points		
Horizontal	Standard Deviation of Aerial Triangulation by Aerial Photographs	X (E) = 0.66m
		Y (N) = 0.69m
		RMS = 0.95m
	Standard Deviation of Aerial Triangulation by Single SPOT5 Images	X (E) = 4.9m
		Y (N) = 4.1m
		RMS = 6.4m

The result of accuracy verification demonstrated that residuals of control point aerial triangulation by aerial photographs were within 0.02% (1.2m) of flying height above ground (6,000m) in standard deviation of horizontal coordinates. This falls into the limit value (tolerance level) of control point residual in single block, as prescribed in operation standard of aerial triangulation in the Draft Technical Specifications prepared by the Study Team.

3-6-4 Comparative Analysis of Elevations (Aerial Photography, Existing Maps and Stereo SPOT5 Imagery)

Comparative analysis of elevations was conducted in the area covering mainly two 1:50,000 topographic maps – Sheet No. 3131 III and adjoining 3131 II – as the targeted area for technical verification of the Study, by selecting points where stereo SPOT5 imagery is clear and not interrupted with clouds. Data compared were 20-meter DEM digitalized from contour lines and spot heights in the existing 1:50,000 topographic maps, 20-meter DEM extracted from contour lines and spot heights of aerial 1:50,000 topographic data, and 20-meter DEM extracted from contour lines and spot heights of stereo satellite 1:50,000 topographic map data. The results of the DEM data comparative analysis and their accuracies are shown as follows:

Figure 3-17 DEM Comparison

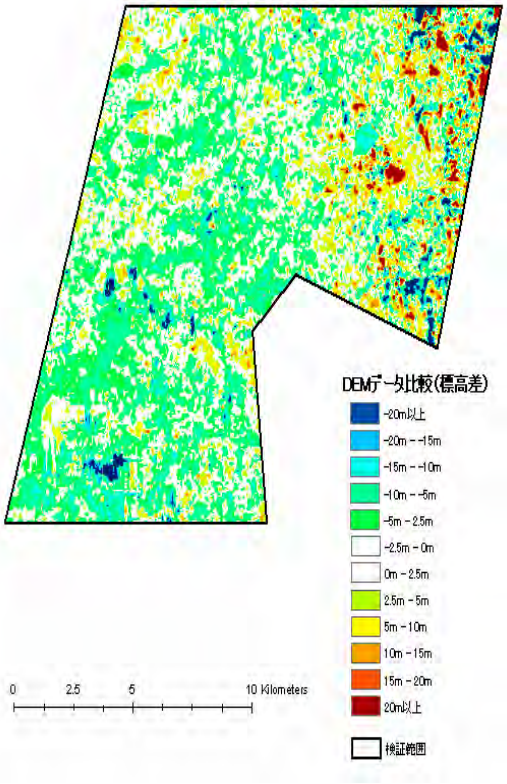
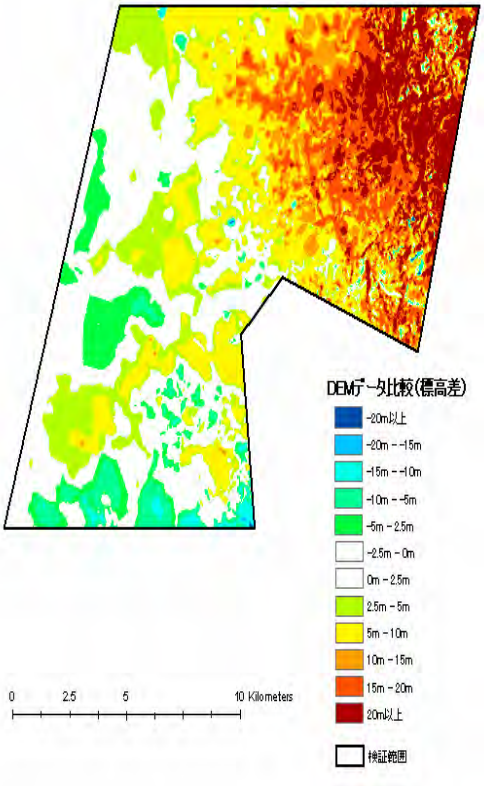
Aerial Photograph-SPOT5 Image	Aerial photographs – Existing Topographic Maps
	

Table 3-39 DEM Data Comparison

	1:50,000 Topographic Map Data by Aerial Photographs and Existing 1:50,000 Topographic Map Data (m)	1:50,000 Topographic Map Data by Aerial Photographs and by Single SPOT5 Images (m)
DEM grid interval	20m	
No. points compared	Approximately 540,000 points	
Average discrepancy	7.00 m	-1.87 m
Max. discrepancy	64.58 m	35.4 m

The results of data comparison of horizontal positions showed that the average-error of scale 1:50,000 topographic-map data and scale 1:50,000 existing-map data created with the aerial photograph had an average error of 25.4 m; roads other than arterial roads had the maximum error of 94.7m. There are areas with high error values in the topographic maps. The errors were generated probably because: the existing topographic maps were prepared using the analogue method; the topographic maps using aerial photographs used the current digital technology; and there are discrepancies in the Specifications of topographic maps.

3-6-5 Evaluation

As described above, the residuals of control point aerial triangulation by single SPOT5 images with resolution of 2.5m/pixel (SPOT5) turned out to be 6.4m in standard deviation of horizontal coordinates. However, the Draft Technical Specifications prepared by the Study Team do not prescribe operation standard (tolerance level of control point residuals) of aerial triangulation by satellite images. The Study Team, therefore, based on the prescription in the Draft Technical Specifications about horizontal coordinate accuracy of planimetric features on 1:50,000 topographic maps, defined as 0.5mm (± 25m), and considered that the 1:50,000 topographic map data by single SPOT5 images have sufficient horizontal coordinate accuracy. The Study Team recommends NAMRIA, therefore, to adopt the topographic mapping method through obtaining planimetric data from single SPOT5 images for the Nationwide Deployment Plan to update 1:50,000 topographic maps.

As for elevations, the maximum discrepancy between 20-meter DEM of 1:50,000 topographic maps prepared from aerial photography and 20-meter DEM of the existing 1:50,000 topographic maps resulted in 64m with the average discrepancy of 7m, and the maximum discrepancy in 20-meter DEM of 1:50,000 topographic maps prepared from stereo SPOT5 imagery was 35m with the average discrepancy of 2m, and both methods did not meet the Draft Technical Specifications which requires accuracy for contour lines and spot heights as 1/2 of contour interval (not more than ± 10m) for contour lines and 1/3 of contour interval (not more than ± 7m) for spot heights.

The results of technical verification were obtained as above, and the way how to utilize the SPOT5 images already possessed by NAMRIA and contour and spot height data in existing 1:50,000 maps for the Nationwide Deployment of 1:50,000 topographic maps was recommended in Paragraph (1) of Section 4-8-1.

3-7 Technical Training Needs Assessment

3-7-1 Summary of Technical Issues

The Study Team has categorized the individual technical and managerial capacity levels for implementation of Nationwide Deployment of topographic maps into three categories: A, B, and C.

A (Chief Engineer)

Staff in this category shall be able: (1) to prepare digital mapping and survey plans, including a series of works, such as control point survey, field studies, digital plotting, digital compilation, field completion and compilation, preparation of map data for printing; (2) to prepare operation manuals and technical specifications; (3) to conduct quantity survey; (4) to manage plans and process control (management and supervising); and (5) to conduct quality control (forms of implementation: direct and outsourcing).

B (Engineer)

Staff in this category shall be able (1) to understand digital mapping and survey plans, and (2) to fulfill assignment in charge among control point survey, field studies, digital plotting, digital compilation, field completion and compilation, preparation of map data for printing, according to survey plans and operation manual or technical specification.

C (Assistant Engineer)

Engineering capacity required for this category of staff is (1) to assist works implemented by engineers, and (2) to conduct survey works under supervision of engineers according to operation manuals and technical specifications.

In light of these criteria for technical and managerial capabilities and the positions required by the JICA Study Team, the technical and managerial capacities of the staff of Cartography and Photogrammetry Divisions for Nationwide Deployment of 1:50,000 topographic maps were identified through OJTs during the Pilot Projects as follows:

Table 3-40 Technical and Managerial Capacity Level Necessary for Nationwide Deployment of 1:50,000 Topographic Maps

Technical and Managerial Capacity Level	Major responsibilities and tasks in charge
A	• To assume the leadership of Division and manage its activities and functions • Production management • Quality control • Coordination with other departments and divisions • Improvement of current situations by reviewing existing methods • Technical implementation management and administration
B	• General production control. Coordination with other divisions. Control over editing works. • Assistance in work planning, adjustment controls • Assistance in work planning, collection and organization of information for works
C	• Control over subordinates in plotting works • Self quality check before reporting to superiors • Self quality check, general works in the group • General works in topographical and thematic maps

3-7-2 Mapping Method

The technical needs of the Mapping Department were identified during the Pilot Projects I, II and III. As well as the technical issues of producing the 1:50,000 topographic maps, the needs as organizational management were extracted from the capacity assessment. With

the consideration of both the technical needs identified by the Study Team and the results of the organizational assessment were considered in designing the training needs. Also, the Study Team has conducted several interviews with the division chiefs to identify training needs. The Pilot Projects are the basis of the technical needs identification, and the organizational assessment is the basis of managerial training needs identification. For the managerial matters, it is often hard to identify training needs, since organizational issues are not only due to lack of skills of managers or division chiefs, since individual matters are often buried in institutional conditions.

Since the training needs are assessed based on the Pilot Projects, basic skills such as basic reading, writing, calculation and cognitive skills were not assessed in the Study. Therefore the needs are skewed toward the tasks for 1:50,000 topographic mapping as in the technical assessment or technical issues of the 1:50,000 topographic mapping.

Table 3-41 Technical Directions for Organizational and Human Resource Development

Process	Issues	Direction	Division	Technical/ Managerial Capacity Level
Field Operation Planning	Lack understanding in flight planning	The theory and principle of photography time and landform conditions, and the interpretation capacity of specification are to be raised.	Aerial Survey Division	B, A
	Insufficient preparation on equipment usage	Establishing preparation procedure with recording rules on equipment usage	Aerial Survey Division , Photogrammetry Division	C
	Lack of the attainment nature which took the local landform into consideration in photo-control-point site planning, and rational arrangement knowledge	It is necessary to make knowledge and basic business of the contents of field work of a photo control point surveying master.	Aerial Survey Division , Photogrammetry Division	B
Control Point Survey (A photo control point surveying, leveling)	Observation of GPS is not performed intentionally but effectiveness is bad.	An understanding of the methodology of an observation plan, acquisition of an actual plan-preparation technique	Photogrammetry Division (Aerial Survey Division)	B, A
	Processing of observational data and inspection of a result are not made, but there is much re-survey.	The technical specification and training manual for recognition of the necessity for fulfilling a specification and the improvement in degree of comprehension are fixed.	Aerial Survey Division	B, A
	Scrupulous [such as creating the list of outputs] is missing.	The judgment of baseline analysis output cannot be performed.		Level B
	The observation result file is not created.	It is necessary to study the meaning of result file creation as adjustment of a result, contents, and an approach.	Photogrammetry Division	Level C
Field identification	The reference material carried there cannot be preparing within the date.	It is necessary to study how to construct the appearance provision finished intentionally beforehand for a local reference material and a preliminary photo interpretation.	Photogrammetry Division Cartography Division	Level C
	The association to consecutiveness work is not recognized but arrangement of local data is inadequate.	Since the leakage of a field identification and recognition of inspection of quality are sweet, accumulation of these	Photogrammetry Division Cartography Division	Level C

Process	Issues	Direction	Division	Technical/ Managerial Capacity Level
		improvement in consciousness and experience is a subject.		
Aerial triangulation	There are many defects in a preliminary step and the relation between a photography specification and a workload is not understood.	Manual preparation of the principle of an aerial triangulation, and an execution procedure. Exact knowledge acquisition of a required reference material	Photogrammetry Division Cartography Division	Level B
	In standardization work, an index may not look clear. (A scan is imperfect)	Upgrading of the scanning data of an original image, experience accumulation		
	In image-coordinate measurement work, it is an observation mistake in planimetric-feature decipherment difficult parts, such as a forest.	Examination of input data is included and they are the improvement in skill for the improvement in a precision of observation, and the complement of knowledge.	Photogrammetry Division Cartography Division	C, B
	The system of calculation and accuracy inspection is not established.	Theory of accuracy management, and thoroughness of a business manual	Photogrammetry Division Cartography Division	C
	There is no conduct on preparation of output lists.	Improvement in the processing technique as an output by preparation of a result book	Photogrammetry Division Cartography Division	C
Digital Plotting	A person in charge is not assigned in planimetric-feature data acquisition.	Stuffing for deepening specialty nature is introduced.	Photogrammetry Division Cartography Division	C
	In planimetric-feature data acquisition, it cannot perform seeing a planimetric feature by three dimensions well. Moreover, a diagrammatic understanding is inadequate.	A 3-dimensional stereoscopy needs an exact understanding of a symbol required for plotting work, and to be improvement in technical trained.	Photogrammetry Division	C
	The person in charge is not decided in acquisition of topographical data.	Stuffing for deepening specialty nature is introduced.	Photogrammetry Division	C
	In an inspection process, a diagrammatic understanding is inadequate and the principle of 1:50,000 is unfamiliar.	It is necessary to become skilled in the fundamental knowledge of the symbol of 1:50,000, and the criteria of application.	Photogrammetry Division	C
	The inspection paper (plotting map) arrangement which is the result of plotting data is not made enough.	The check function of the list of plotting results and inspection paper is systematized. Moreover, the evaluation system of a result is established.		B
	In plotting data file creation, the data origination in a sheet unit is unripe (a clearance produces).	Data origination is carried out not only in the plotting of a model unit but in a sheet unit, and feedback of result data is routinized.	Photogrammetry Division	B
Digital Compilation	A person in charge is not assigned in the input of plotting data.	Stuffing for deepening specialist nature is introduced.	Photogrammetry Division	C
Digital Compilation	In the cleaning process of data, the theory of topology and the reflection to work are mismatches in many cases.	The essence of a landform database, the configuration of data, a layer, and its principle are systematically familiarity-put into practice.	Photogrammetry Division	C

Process	Issues	Direction	Division	Technical/ Managerial Capacity Level
Digital Compilation	The additional leakage of local supplement data etc. is not checked in the case of an annotation of topographical data.	An inspection system is established while mastering systematically the procedure of an exact understanding of the process of a digital editing, and implementation.	Photogrammetry Division Cartography Division	C
	In the annotation data addition process, preparation of creation of annotation data etc. is inadequate in advance.	The procedure of an exact understanding of the process of a digital editing and implementation is mastered systematically.	Photogrammetry Division Cartography Division	C
	Understanding of technique runs short in the creation phase of polygon data; polygon data include errors.	Fundamental understanding of a polygon, and acquisition of the practical application technique	Photogrammetry Division Cartography Division	C
	There is no conducts on preparation of the list of outputs.	The system with the list work rule of a plotting result and Spec compared and evaluated is built with stuffing.	Photogrammetry Division Cartography Division	B
Field completion	The preliminary step of a preliminary photo interpretation is inadequate. Moreover, the defect of a reference material is accepted.	Manual maintenance and an understanding of a preliminary operation The meaning of a preliminary photo interpretation, point familiarity	Photogrammetry Division Cartography Division	C
	In an execution of a field completion, a map cannot be read well (its position cannot be recognized in many cases).	Training in fundamentals of a map, a symbol, and a correspondence technique with a spot is continued.	Photogrammetry Division	C
	Arrangement of a field-completion result is not used.	An understanding of the meaning of a field-completion result and the directions in indoor work is deepened.	Photogrammetry Division Cartography Division	C
Printing	Treatment of digital data is not procedure-ized in a preliminary step.	Acquisition of the required knowledge for digital data handling	Printing Division	C
	At a symbol-ized process, a soft use experience is shallow and required knowledge and skill are not equipped.	Accumulation of experience with symbolization software is a pressing subject.	Printing Division , Cartography Division (Photogrammetry Division)	C
	In creation of a platemaking film, since the imagesetter is not introduced, it depends outside.	Maintenance of the work manual by introduction of an imagesetter	Printing Division	C, B
	Increase in efficiency of a galley proof	Reexamination of the conventional work	Printing Division	C
	In inspection and correction, it depends on experience, and routine-ization is not carried out.	Maintenance of the inspection manual of completion and the correction approach of digital data are mastered themselves.	Cartography Division	C, B
	Printing Implementation	The quality control system of a printed map is established.	Cartography Division	A
Quality control of a result	The system of inspection of a result, accuracy management, and quality evaluation is not established on the way from a local survey data to a plotting, edit, and printing data origination.	It is a subject to study reconstruction of the work of each division, the necessity for quality control, and the theory, and to build the evaluation system of a result.	All sections,	Manager room A

CHAPTER 4 SUSTAINABLE MAP REVISION PLAN FOR 1:50,000 TOPOGRAPHIC MAPS

4-1 Overview

The Sustainable Revision Plan for 1:50,000 Topographic Maps is composed of the Capacity Development Plan and Nationwide Deployment Plan. The Capacity Development Plan includes Institutional Capacity Development, Organizational Development, Human Resource Development, and Promotion.

The Nationwide Deployment Plan is the final output of the Sustainable Map Revision Plan. The Specifications, the results of the Pilot Projects, the technical examination of revision methods, topographic database that were produced in the process, and the Capacity Development Plan are all inputs to the Nationwide Deployment Plan.

4-2 Capacity Development Plan

The concept of capacity development has three components: institutional, organizational, and individual. In the Capacity Development Plan, all three components were considered to prepare the Institutional Capacity Development Plan, Organizational Development Plan, Human Resource Development Plan, and Promotion Plan.

The capacity development concepts are not fully theorized. In the Study, however, the important concepts to be considered in the process of planning are: long-term consideration of effects of planning; participatory approach in plan making processes; the ownership concept of plans and outputs; and consideration of institutional implications to plans.

4-2-1 Institutional Considerations

Three institutional issues can be raised regarding topographic mapping in NAMRIA: labor market; copyright; and rationalization.

The labor market in the Philippines is an export oriented labor market; skilled workers are trained and experienced in the Philippines and work overseas. Unless the fundamental labor market structure is changed, skilled geodetic engineers or photogrammetrists will not remain in NAMRIA without competitive salaries. The division chiefs and leaders in the private sector expressed the same concern.

Copyright is less strictly enforced in the Philippines; unless copyright is protected, it is very hard to sell maps especially in a digital format.

Rationalization is a national agenda. How to reduce government employees is hard to discuss even among politicians. It would be hard to formulate a plan to reduce the number of staff among themselves in the public sector.

4-2-2 Participation/Ownership

The participatory process of the planning was assured in PCM, DCC, the technology transfer and various meeting sessions regarding the Specifications. A staff survey was conducted to support human resource development planning.

The Specifications were already reviewed in the Technical Working Group in NAMRIA; the map symbolization methods and other technologies were already put into practice. In this regard the technology transfer part of the Pilot Project and the Specifications preparation process was inclusive of the participatory processes and the ownership concept of capacity development planning.

4-2-3 Long-term Effects and Commitment

The long-term effects and commitment are the significant planning concepts of the nationwide deployment plan. Two phases were planned: the capacity development phase; and the sustainable revision phase. The phasing strategy was a foundation to the long-term consideration. The human resource planning was to resolve issues raised from the Pilot Projects; at the same time, it was to satisfy the long term requirements from the nationwide deployment planning.

4-3 Institutional Capacity Development

4-3-1 Basic Policies

(1) Positions of Institutions in the Study

Institutional capacity development with regard to the survey and mapping industry can be positioned from three perspectives by three major entities. Data, people (human resources) and technology are inter-related to the three entities of the public sector, private sector including professional organizations, and educational institutions.

With those categorizations, applicability of the three perspectives and the three entities are qualitatively analyzed as shown in the following matrix.

Table 4-1 Positions of Institutions in the Study (View from NAMRIA)

	Public sector	Private sector/professional organizations	Educational institutes
Data user	3	3	3
Data provider	2	2	1
Human resource user	1	3	1
Human resource provider	1	1	3
Technology user	3	3	2
Technology provider	2	3	3

3: Most applicable
2: Applicable
1: Somewhat Applicable

The public sector includes the central government agencies and LGUs. They are the major users of 1:50,000 topographic maps. As some of the agencies are preparing their own thematic maps, they can be considered as data producers. Human resources may be exchanged among the central government agencies. They are the user of technology developed by the private sector or educational institutions.

The private sector/professional organizations are the users of the topographic maps; the role of technology provider is relatively high. The private sector can be considered as human resource users from the point of NAMRIA. An interview survey suggests that one career path for geodetic engineer is to have some experiences in NAMRIA and move to a private sector seeking higher salaries.

The educational institutions are general human resource providers. Geodetic engineers or other remote sensing specialists receive professional education in institutions of higher learning. When research functions of educational institutes are considered, they can be considered as the technology provider for NAMRIA. As for elementary and secondary schools, they are data users (map users) that have potential to provide human resources to NAMRIA. Educating students are to raise promotional aspect topographic mapping and at the same to raise the level of potential human resources for NAMRIA.

(2) Collaboration

The positions of institutions and the Study with regard to the three elements, data, human resource, and technologies, were analyzed. What NAMRIA needs to do is to take leadership in institutional endeavor. Institutional capacity development are to collaborate and lead other institutions to raise overall capacities of the survey and mapping industry in the Philippines with a focus on topographic mapping.

4-3-2 Data Creation and Usage

(1) Leadership in NSDI

The Information Management Department is the leading agency in the NSDI project. The Department shall take leadership in preparing the specifications other than the Specifications for 1:50,000 Topographic Maps. The draft of the GIS standards shall be prepared in the department as soon as possible. The specifications shall used by the LGUs for preparing land use plans and physical framework plans. The data exchange standards shall be back by the data exchange infrastructure being implemented as in the broadband internet connection. By the time internet connections will be reaching to remote areas in the Philippines, the spatial standards need to be ready and used by all the government agencies and the LGUs.

(2) Data from the Private Sector

The proposed Research and Development Section shall continue researching, examining and using privately available data. The SPOT satellite images are already in use; other high resolution satellite images are available. The private sector will be providing higher resolution satellite images and weather free data such as in the IFSAR data. The technology in the field of survey and mapping including remotes sensing is very rapid. The proposed Research and Development Section shall find the best and appropriate technologies for producing 1:50,000 topographic data and data in other scales.

(3) Data and Information to the Educational Sector

The Information Services Division in the Information Management Department shall study possibilities of developing data to be used for educational purposes. Map Sale Office shall study and plan different pricing scheme for educational users of the data.

4-3-3 Human Resource

(1) Human Resource Exchange

The proposed Human Resource Management Section shall conduct a human resource exchange program with the government agencies. The proposed Human Resource Management Section shall plan an internship and scholarship program for potential engineers from the institutes of higher learning to secure human resource in advance.

(2) Instructor Registration

The proposed Human Resource Management Section shall start an instructor registration program as soon as possible as collaborating with the education sector. Instructors in vocational schools are also potential instructors for the human resource development plan proposed in this Study.

(3) Contractors registration

The proposed Human Resource Development Section shall start a professional registration program as collaborating with survey and mapping companies in the Philippines.

(4) Promoting Professionalism

The proposed Human Resource Development Section shall plan a nationwide certificate program in collaboration with representatives from professional associations in the Philippines. Geodetic engineers shall be more motivate by such certificate program when they are to be established. The certificate program shall include each software used in the process of 1:50,000 topographic mapping. Remote sensing work shall be included in such certificate programs.

4-3-4 Technology

(1) Inter-governmental technology exchange

The proposed Research and Development Section in collaboration with the Information Management Department shall study all the technologies available and development in the government agencies in the Philippines. The Research and Development Section shall select advanced methods of mapping, including thematic mapping, in other agencies when they are available. The Research and Development Section shall organize a seminar on the selected advanced technologies and award annually to encourage the staff in NAMRIA.

(2) Use of High Technology

As discussed, the advancement of technologies is very rapid. Such advanced technologies are generally available in the private sector. The proposed Research and Development Section shall assign a personnel for research and testing advanced technologies that will foster increasing capabilities of units of organizations in NAMRIA. The areas of research are in new software or new versions of available application software used in map related data creations. The research shall include not only the production technologies; it shall include management technologies.

(3) Collaborative Research Projects

The Research and Development Section shall produce a collaborative technological research project with institutes of higher learning. Such technology shall not be limited to survey and mapping or remote sensing. They shall include operation management, quality control, human resource management and others. The Research and Development Section shall hold seminars and workshops that are open to the public with media involvement to promote their research and development progress as well as to promote their products externally.

4-4 Organizational Development Plan

4-4-1 Basic Policies

(1) Organizational Direction

The fundamental direction of the organization shall follow the national policy of rationalization. The organization shall raise the function of production management more than

in actual production itself. In this regard, production management, especially quality control, becomes significant; human resources to handle the tasks will become necessary.

What needs to be kept in NAMRIA is the research and development function. NAMRIA shall possess and develop the latest technologies for survey and mapping--remote sensing and GIS are also significant technologies to maintain and develop. The knowledge base shall become the central function that provides standards and specifications on all the aspects on survey and mapping. As NAMRIA aims to become an research institute while maintaining a fundamental functions of map revisions, human resource development functions become significant, since NAMRIA will attract researchers and academics from educational institutions.

(2) Efficient Information Exchange

Data management is fundamental in the digital age of mapping. Necessary systems shall be developed with qualified individuals who manage data and information. As well as the physical data for topographic mapping, memos and instructions shall be managed efficiently. It has been the Information Department that has been providing various systems internally in NAMRIA; it shall have total data management system with a holistic view. System analysis for all the department and sections will be necessary for small fragmented system development may not lead to effective results.

(3) Organizational Strengthening

The Study Team proposes to create following sections directly under the Director: Research and Development Section; Human Resource Management Section; and Quality Control and Data Management Section.

(4) Quality Control

Since the Specifications were newly established during the Study, quality control has not been implemented in a strict sense. The quality control shall be exercised at all the levels of topographic map production. The quality control tables are designed for this purpose. Quality assurance shall be treated as the reason of delaying work; the Study Team propose the map management database to manage progresses of topographic mapping project for higher efficiency.

4-4-2 Lateral Coordination

The functions of the Photogrammetry and Cartography Divisions are similar. The major difference is the scale of maps produced and availability of the stereo plotting system. Similar functions shall be integrated.

(1) Functional Integration

The division chiefs shall study the similar functions in the Photogrammetry and Cartography.

(2) Organization of Work Groups by Functions

The director shall organize working groups by mapping functions such as plotting, map symbolization in the Photogrammetry and Cartography Divisions

4-4-3 Quality Control and Data Management Section

The staff assigned to the quality control shall have at least ten years of experience in the field of data checking. The data management staff shall have the background in database management and maintenance.

The functions of the section shall be limited to 1:50,000 topographic maps. Other quality and data management functions shall remain an appropriate division in an appropriate department.

The quality control and data management section created under or within the Office of the Director shall have the following functions:

- Organizing a technical working group to update the Specifications for 1:50,000 topographic maps;
- Organizing a technical working group to update the teaching manuals that corresponds to the Specifications;
- Coordinating the Officer in Charge for Human Resource Development to revise the quality control courses;
- Preparation, dissemination and education on error reporting system and analyzing common errors quantitatively; and
- Reporting common errors to the division chiefs for work process improvement.

(1) Assigning staff and providing training for the staff

The director shall assign responsible staff for quality control; the director shall assign responsible staff for data management.

(2) Securing facilities and equipment for quality control and data management

The director shall secure facilities and equipment necessary for quality control and data management.

4-4-4 Human Resource Management Section

The Human Affairs & Human Resource Development unit in the Administrative Division, Staff Services Department has a function of human resource management function for NAMRIA; the proposed Human Resource Management Section within the Mapping Department shall have its own management functions:

The functions need to satisfy all the implementation requirement described in the Human Resource Development section of the Study. The OIC for HRD shall be assigned to develop an annual training program that fit into the curriculum. The task shall include securing sufficient budget for implementing the training program. An administrative staff shall be assigned for the purpose of coordinating instructors, lecturers, trainees, facility managers, and chief course administrators.

4-4-5 Research and Development Section

To maintain technological capabilities and to search new technologies for better and faster survey and mapping, the Mapping Department shall establish Research and Development Section. The Research and Development Section shall assign staff for three units: Advanced Survey and Mapping Technologies; Legal Affairs; and Operational Management.

The OIC for advanced survey and mapping technology shall conduct research for advanced software and hardware used in the mapping production systems. As for data sources, there are high-resolution-satellite images available in the market; Utilization of IFSAR shall be studied further.

The OIC for legal affairs shall research on the licensing scheme and legal implication of privatization of map sales in the Philippines. Copy protection technologies shall be studied under the leadership of the OIC for legal affairs.

The OIC for operation management shall establish a time management system in coordination with a proposed human resource management system under the OIC for human resource management. The system shall record all the map related activities in numerical format so that the OIC for operation management will be able to analyze efficiency in each work process. The results of operation efficiency shall be consulted with the OIC for advanced technology and human resources. The OIC for advanced technology shall recommend system improvement from the technological point of view. The OIC for human resource management shall use the time management data for more objective performance evaluation.

4-4-6 Tools for Efficient Administration

(1) Measurement (Time Management)

The time management is significant in project management especially since multiple departments are involved in one project.

The time management tool shall have the management functions and the staff functions. The management functions shall include:

1. Staff data importing;
2. Project data importing (project data registration);
3. Assigned quantity input;
4. Assigned personnel input;
5. Staff timesheet data importing;
6. Project progress analysis;
7. Project progress by person; and
8. Project progress by division.

The staff side functions include:

9. Project data importing;
10. Timesheet data encoding; and
11. Project progress by person.

(2) Map Management Database

A map management database was developed for the purpose of the analyzing the existing conditions of 1:50,000 topographic maps. The map management database can be used for the purpose of managing the progresses of the nationwide topographic data management. The attributes encoded to the database can identify contour density, planimetric density and

land area within map data in one sheet; therefore, it can be used for annual project planning, since difficulties or time needed to revise is different from map sheet to map sheet.

(3) Quality Control Tables

The quality control table were prepared. The Study Team of projects shall utilize the quality control tables. The tables included in the Specifications are:

1. Minor Order Leveling;
2. Control Point Survey;
3. Aerial Photographs;
4. Aerial Triangulation;
5. Digital Plotting; and
6. Digital Editing.

The uses of the quality control tables improve the process of inspection significantly. The tables shall be used for individual performance appraisals. The supervisors shall have additional time management sheets that records attendance and performance of each staff.

(4) Database System for File Management

Neither in the Cartography Division nor in the Photogrammetry Division, a file management system has not been introduced. Introduction of database is not the ultimate solution; it is the administrative system of data management that are important. The file management shall be conducted in general version management. The most popular file management software is Visual Source Safe by Microsoft. The software has the version management functions and data backup functions.

4-5 Human Resource Development Plan

4-5-1 Basic Policies

The individual capacity development can be achieved through the human resource development plan. Expert training shall be provided to seek higher career paths in NAMRIA. Also, as mentioned in the organizational capacity development, research and development functions of NAMRIA shall attract higher skilled individuals from outside even without offering higher salaries. The research and development function of NAMRIA is significant in this respect.

The personal appraisal system, which emphasize less in technical aspects, shall be reviewed to reflect objective skills levels of individuals. For this purpose, training skill levels needs to be measured periodically by an independent section in NAMRIA.

(1) Efficiency in Training

As the division chiefs and leaders in the private sector expressed, skilled workers tend to seek better opportunities overseas. In the environment of the labor market structure, NAMRIA needs to train skilled workers continuously expecting that some of the trained workers will leave as soon as they will have received sufficient experiences to seek better compensations; training which NAMRIA provides needs to be cost effective. To encounter the issue, the Study Team has proposed "self-study using intra-net and internet text materials." The initial development cost may be high, but in the long-run, the method of learning shall be the cost effective way of human resource development.

(2) Motivating Individuals based on Objective Evaluation

Acknowledging a person's achievement motivates the staff. At the completion of the course or expert training on software, a certificate shall be issued. The certificates shall

become mile stones for individuals. The division chiefs and assigned instructor chiefs for the courses shall encourage the staff to acquire necessary skills of their work and also to encourage competition among the staff. The training records shall be written onto the Personal Data Sheet; it is the fundamental source of information for promotion. Linking the human resource development program to the personnel system can simply achieved using the existing system of promotion--when the rationalization plan will have been approved.

(3) Targets

The human resource plan is organized according to the skill levels of the staff. Level A, Level B and Level C are used in the same as in the technological capacity assessment section. Level A includes Engineer V-IV and Cartographer IV; Level B includes Engineer III-II and Cartographer IV; Level C includes Engineer II-I, Cartographer III-I, Photographer III, Photo Lab Technician II, Photographic Processor.

The following table summarized the positions currently used in NAMRIA and the classification of skills involved in the human resource development plan.

Table 4-2 Position and Classification

Capacity Level	Position	Current performance and competency in view of management, professional skills and professional knowledge	Required No. for Sustainable map revision	Available Human Resources
Level A	Engineer V-IV	Engineer with a high level and a wide range of expertise, and also capable of devising and executing solutions to exceptional matters to a certain extent.	7	9
Level B	Engineer III-II Cartographer IV	Mapping experts with a potential ability for carrying out the tasks described in the survey standards and the specifications by himself in response to an order.	22	24
Level C	Engineer I Cartographer III-I Photographer III Others	Mapping engineers with a professional level of expertise and a capability of yielding products in relatively limited field of technology under support of the supervisor or higher-level engineers.	8	61

The required human resources for the nationwide deployment plan in the sustainable map revision plan (Phase II) are: Level A, seven staff; Level B, twenty-two staff; Level C, eight staff. As state in Chapter 2, the total number of Level C staff in the Mapping Department is 61 persons; 59 persons will have to be assigned to sections other than the sustainable revision for 1:50,000 topographic maps. The proposed Quality Control and Data Management Section might require some staff from the Cartography Division.

(4) Method

The methods of providing the programs are: OJT and hands-on-session; seminars and workshops, and self-learning. The OJTs are internally conducted. Hands-on-sessions are also internal OJTs generally with computers. Seminars and workshops are provided both internally and externally. They can be held in one of the conference or meeting rooms in NAMRIA or outside of the office building. Instructors can also be internal and external.

Experiences staff can act like instructors within NAMRIA or external instructors can be invited to hold lectures, seminars or workshops.

1) OJT/Hands-on-Sessions

For software operation training, OJT/Hands-on-session is appropriate. An instructor with one or two staff with one PC terminal is a general setting of the OJT/hands-on-sessions.

The OJT/Hands-on-sessions shall be scheduled and recorded in accordance with the individual training assessment sheets. For each session, an instructor shall record levels of comprehension onto the individual training assessment sheets. When one or more training session cannot be completed as scheduled, the sessions will have to be repeated by the same trainee until a skill level set by the instructor is satisfied. The evaluation methods and standards shall be prepared by the chief instructor of a course. The method of evaluation and standards shall be approved by an officer-in-charge for human resource management (hereinafter referred to as "OIC for HRD").

2) Lecture

A lecture/seminar type of training is a general method for management and administrative type of training. The contents of the lecture/seminar type of training shall be prepared by the chief of the course in general. The contents of lectures shall be approved by the OIC for HRD.

Potential lecturers and trainers shall be selected from institutes of higher learning and professional associations. When general instructions on usages of software and hardware are required, manufacturers or software vendors shall be the instructors for the subjects.

The OIC for HRD shall develop a lecturer/trainer registrations system as he/she consults with institutes of higher learning (vocational schools, colleges, and universities) and professional organizations. The contents of lecture and seminar shall be in line with the curriculum; however, special courses may be added when appropriate or timely subjects arises. Such subjects are new policy matters on survey and mapping or in advanced technologies newly utilized in the production processes of NAMRIA.

3) Peer Training

Peer training is generally conducted informally in daily basis. The peer training is effective for both the staff that teach each other. The pair shall be selected according to the skill levels. The division chiefs and their supervisors shall assign pairs who will be teaching each other. The subjects of peer training shall not be limited to software operation; it shall cover overall administration and operation of the production processes.

4) Self-learning

For computer related operations, self-learning is a daily task. Whenever a trainee has a question, he/she can look up in an operation manual or the manuals that the Study Team has developed. "Help" is generally helpful before asking a coworker or an experienced staff.

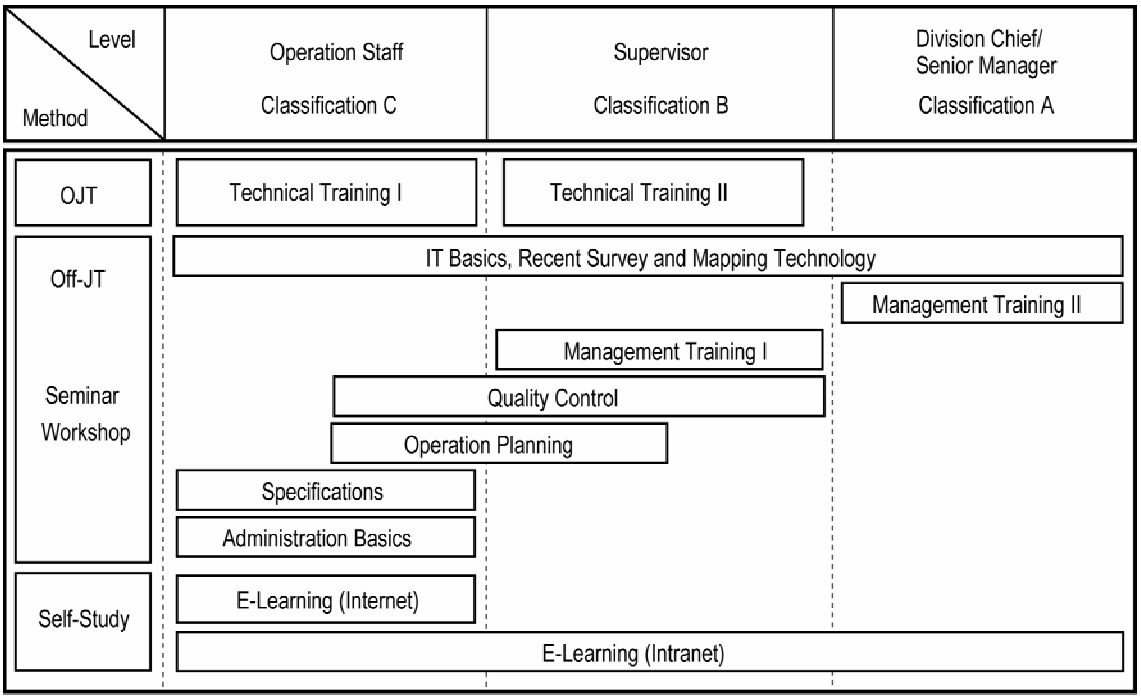
Development of an E-learning application may become costly. Making the text materials available through an intranet would be possible and would not be costly. The text materials that the Study Team has developed and the Specifications for Topographic Mapping shall be available in the intranet of NAMRIA.

4-5-2 Curriculum Framework

The curriculum framework generally shows the relationships between the classification levels and the methods. Generally, technical training is conducted by OJT/hands-on sessions. Management related courses are conducted as seminars and workshops. The self-study is mainly based on e-learning using the intranet and the internet.

The horizontal axis in Figure 4-1 shows career paths from the operation staff to supervisor to senior manager. The classification is the same as in the technological capacity assessment section.

Figure 4-1 Curriculum Framework



4-5-3 Training Structure

The production analysis found that there are similar operational functionalities in the Photogrammetry Division and Cartography Division. In principle, the technical training session shall be conducted regardless of divisions in the Mapping Department.

The training structure of technical part that require the same software shall be conducted across the divisions or department. The conceptual diagram shows that when Expert Training is to be conducted, the training sessions shall be conducted beyond the division borders. The coordinator for implementation is the assistant director of the Mapping Department.

4-5-4 Courses

As discussed previously, all the courses are targeted according to the three levels regardless of the positions for flexibility. The course names, targets, and pre-requisites are summarized in the following table.

Table 4-3 Courses, Targets, and Methods

Course Name	Capacity Level	Method	Prerequisite
Technical Training I	C	OJT/Hands-on	
Technical Training II	B	OJT/Hands-on	Technical Training I
Management Training I	B	Seminar/Workshop	Management Training I
Management Training II	A	Seminar/Workshop	
Quality Control I	C	Seminar/Workshop	Specifications
Quality Control II	B	Seminar/Workshop	Quality Control I
Specification	C	Seminar/Workshop	Administration Basic
Administration Basics	C	Seminar/Workshop	
E-Learning (Internet)	C	Self-Learning	
E-Learning (Intranet I)	C	Self-Learning	
E-Learning (Intranet II)	B	Self-Learning	E-Learning (Intranet I)
E-Learning (Intranet III)	A	Self-Learning	E-Learning (Intranet II)

Technical Training I: Technical Training I targets the junior operation staff. The course offer fundamental of plotting and editing technologies.

Technical Training II: Technology Training II targets advance level of operations of plotting and editing.

IT Basics, Recent Survey and Mapping Technology course is the core course for all the staff in NAMRIA. The basics of business software and survey and mapping technology updates are covered in the course.

Administration Basics: Administration Basics are the courses target to newly assigned personnel. It offers information on workflow of the divisions and fundamental data storage system in the divisions. Basic conducts of as new staff are informed to a new staff. Compliance education such as work ethics and copyrights are included in the course.

Specifications: Specifications is a course to learn the Specifications for Mapping 1:50,000 Topographic Maps. Partial or all the documents are explained to the operators of plotting and editing. Supervisors who are not familiar with the specifications are encourage to attend the course.

Operation Planning: Operation Planning is a course for advanced operators and supervisors. In any operations in the production process, planning is required. The course covers the basics of planning and specific application in the work processes in the divisions.

Quality Control: Quality Control is the very important aspect in the production process. A basic theory of quality control and application to the specific work process are covered.

Management Training I: Management Training I is offered to supervisors who needs to manage operators.

Management Training II: Management Training II is offered to advanced supervisors and the division chiefs.

4-5-5 Curriculum

Based on the courses, a curriculum is developed. The OJT/hands-on sessions are conducted within the divisions; other seminars/workshops are to be conducted in a dedicated seminar/meeting room.

Table 4-4 Subjects

Course Name	Venue	Subject
Technical Training I	In-house	Introduction to database
		Introduction to image processing
Technical Training II	In-house	Art of sorting results from field verification and/or completion
		Understanding the Specifications I
		Acquisition of satellite imagery and confirmation with the specifications
		High accuracy image processing
		Creation of orthophoto mosaic
		Level-up of image orientation
		Understanding the Specifications III
		Technique for plotting of 3 dimensional features
		Creation of data files
		Inventory management
		Operations research-Optimizing operations
		Using the map management database
		Preparing computer operation manuals
		Level-up of Aerial Triangulation
		GIS basic data preparation I
		GIS basic data preparation II
		Understanding the Specifications II
Management Training I	Seminar Room	Preparation of Quality Control Tables
		Project Management I
		Effective meeting
		DTP for long documents using Word
		Introduction to data inspection
		Time management
Management Training II	Seminar Room	How to motivate your staff
		Leadership and Staffing
		Work Process Planning
		Coaching essential
		Methodology of Project Management
		Technical Specification Preparation and Management
		Adaptation of Specification
		Project Management II
		Survey Planning
		How to evaluate your staff
		Outsourcing management I
		Revising the Specifications
		Developing a trainer's manual
		Performance appraisal system
		Writing operation manuals
		Manual management
		Human resource development
		Writing specifications
		Outsourcing management II
		Project Management III
Quality Control I	Seminar Room	Inspection of Plotting Data
		Checking Quality with Specifications
		Using quality control tables I
		Using quality control tables III
		Analysis of Observation Data
		Inspection of Observation Data
		Using quality control tables II
Administration Basics	Seminar Room	Ethics and copy rights
		IT Basics-Unknown features of business software
		Intra-departmental data exchange
		Customer oriented services
		Basic business manner
		Data Exchange

Course Name	Venue	Subject
		Introduction to DTP using Word
		From MS Excel to Database
		Welcome to our division
		Latest Remote Sensing Technology
Illustrator	In-house	Illustrator II
		Map symbolization
		Illustrator I
SocetSet	In-house	SocetSet I
		SocetSet II
		SocetSet III
EARDAS Imagine	In-house	Eardas Imagine I
		Eardas Imagine II
Bingo	In-house	Bingo
Vrone	In-house	Vrone
Autodesk Map 3D	In-house	Autodesk Map 3D I
Map Publisher	In-house	Map Publisher

4-5-6 Instructors

Instructors shall be both internal and external. Senior engineers shall take a role of an instructor in NAMRIA. External instructors are academics in the Philippines and from overseas.

To maintain the standards of the subject matters, there shall be instructors' manuals so that the standards of teaching shall be maintained when different instructors are invited to the same seminars and workshops.

For the technical aspects, the Study Team has certified the staff who have taken the OJT sessions for Socetset, Adobe Illustrator and others. The staff shall be the internal instructors for the computer operation.

(1) Chief Instructor for Courses

The OIC for HRD shall list and chief instructors according to the courses.

(2) Selection of Instructors

The chief instructors shall revise the subjects and select lecturers and instructors appropriate for the subjects. The selected subjects and instructors shall be approved by the OIC for HRD. The potential instructors shall be selected first internally within NAMRIA. Academic institutions and professional organizations shall be contacted to find appropriate instructors.

Instructors for technical course for software shall be selected internally or from the software vendors.

4-5-7 Training Materials

The JICA Study team has prepared the text materials through the course of the Study. Following table summarized the subjects and brief contents of the study materials used in the OJT/hands-on-session during the Study.

Table 4-5 Study Materials Developed by the Study Team

Name of Manuals	Software
Stereo Pair Satellite Image	Socetset Verson 5.3
Single Satellite Image	Socetset Verson 5.3
Aerial Photographs	Socetset Verson 5.3
Map Symbolization for 1:50,000 Topographic Maps	Adobe Illustrator
Photogrammetric Vector Collection	VRONE
Aerial Triangulation with Large Block	BINGO
Image Processing	EARDAS
Importing Map Data	Map Publisher
Topology Creation	AutoDesk Map 3D

For the managerial level of the staff, the Specifications of Topographic Mapping shall be used. Also for the ortho-image preparation, the Operation Manuals for Orhto-image Preparation shall be used other than the technical training materials developed by the Study Team.

The materials provided are printed paper and pdf format. With an help from the IT Department, the learning materials shall available in the intranet of NAMRIA.

The Study Team has provided two major training materials for NAMRIA: the Specifications and the Quality Control Tables.

- Specifications

The Specifications developed in the course of the Study is an important study materials to be utilized.

- Quality Control Tables

The quality control tables are another text materials. How to fill out the forms shall be instructed to supervisors of each work.

(1) Training Materials Preparation

Training material, other than the Study Team has prepared, shall be prepared by the chief instructor for each course. A training material for administrative basics shall be prepared by the OIC of HRDs.

The basic materials for administrative work and business software shall be in the form of self-learning using shared files and intranet web pages. The study materials prepared by the Study Team shall be provided in the .pdf format to be shared in the file servers in the Photogrammetry and Cartography Divisions.

The intranet based e-learning system requires a web server and learning application; an internet based e-learning system does not require a system within NAMRIA. The contents need to be developed, however.

The process of pdf based e-learning system development is to convert file in text or word processor into the pdf format. The pdf files are shared in a file server within a division. An interactive application can be developed using JavaScript or Flash systems. For converting text or word processor files to pdf files, a file conversion software, such as Acrobat, shall be procured and installed in one of the PCs in the proposed Human Resource Management Section. Interactive learning application shall be developed in consultation with the Information Management Department.

(2) Training Material Maintenance

The OIC for HRD shall select a person in charge for maintaining training materials. The training materials or study materials shall be stored in a set locations in the proposed Human Resource Management Section. Digital files of the documents shall be stored in a file server in the proposed Human Resource Development Section.

4-5-8 Annual HRD Program

The OIC for HRD shall prepare an annual HRD program. The annual HRD program shall include the following activities: Orientation; Individual training needs assessment; Selection of chief of courses; Syllabus preparation for courses; Preparation annual schedule for seminars/workshops; Selection and registration of instructors and trainers; Selection and reservation of lecture/seminar rooms; Revision and preparation of text materials with instructor chiefs of courses; and Budgeting.

4-5-9 Monitoring and Evaluation

(1) Individual Training Need Assessment Method

The training need assessment shall be conducted through dialogue: Supervisors assess their operators' training needs; Division chiefs assess the supervisors' training needs; The assistant director assesses the training needs of the division chiefs. All the training needs assessment sheets are stored and managed by the OIC for HRD. For all the staff in the Mapping Department, the individual training needs assessment shall be conducted. The assessment sheet shall be filled initially by an individual and then it is to be approved by the division chiefs. An example of the individual training assessment is shown below:

Table 4-6 Individual Training Assessment (Example)

Individual Training Need Assessment — Assessed date: 2007/7/7
Name Enrique Bonifacio (Pseudo-name) — Assessed by: Supervisor
Position Cartographer I

	Training Needs			Training Plan			
Work Item	Skill Satisfied	Additional Training	Overall Training	Method	Day or Period	Trainer	Place
Inspection I			+	Seminar I	2007/10/8		NGTC
Interpretation I		+		OJT			Field I

The individual training assessment sheet shall be kept by individuals and the divisions chiefs. When necessary training is not available, division chiefs shall request a required subject to the OIC for HRD.

(2) Training Record

After a staff member participated a training session, the training management sheet shall be recorded by the officer in charge of human resource development. A sample format of the individual training record is shown below. The record shall become the proof when a staff member needs to write his/her achievement in Personal Data Sheet.

Table 4-7 Individual Training Record

Training Management Training Record

Name	Position	Division	Training Item	Method	Date	Trainer	Place	Status	Note

The individual training record shall be kept by the OIC for HRD. Feedback of seminars/workshops shall be conducted to monitor effectiveness of lecture/seminar types of training.

4-5-10 Administration

The human resource development program needs to be reviewed annually after measuring the effectiveness of OJT, seminar/workshop, and self-study. As stated the human resource development program needs to be reviewed annually by evaluating the effectiveness of subjects to be learned. The program needs to be in line with the needs derived from the staff and the strategies of the revising the topographic maps at a scale of 1:50,000.

The human resource development includes the feedback process. The subjects to be learned and scheduling shall be reviewed annually at the beginning of a fiscal year to renew an annual human resource development program. The monitoring and evaluation process is also included so that the results of OJT and seminars will be fed back to the manager of the human resource development program to re-evaluate the subjects and instructors.

(1) Officer in Charge for Human Resource Development

The OIC for HRD shall have the following duties:

- Formulation of an annual implementation program including securing budget;
- Selection of trainers and lecturers for each curriculum;
- Arrangement of seminar/lecture rooms and required materials such as projector, screen, markers, etc.;
- Notification of the program to the staff;
- Administration of the training assessment sheets;
- Administration of the training records;

- Preparation of an annual accomplishment report;
- Annual implementation programming;
- Developing and updating teaching materials;
- Developing and updating teachers' manuals;
- Selection of instructors and lecturers;
- Coordination with instructors and lecturers; and
- Securing facilities and equipment necessary for training.

(2) Promoting Participation to Human Resource Development Program

The training program needs to be linked to promotion to encourage the staff to attend the courses. For this purpose, a certificate system is proposed. When a staff member completes a course, a certificate shall be issued by the OIC for HRD. The title of the certificate shall be recorded to the Personal Data Sheet. The hierarchically designed courses encourage the staff to take part in the courses.

The technical training courses are career paths for experts in the divisions. One could become an expert in using a type of software in a division. When one completes all the technical training courses; the staff are invited to trainers' training to be a trainer for the specific software.

What is important is the objective evaluation by an instructor who evaluate skill levels so that the staff learn that attendance does not guarantee a completion of the training sessions.

(3) Trainers' Training

NAMRIA has internal instructors. Generally, the division chiefs are the Resource of human resource development include academics and trainers from software vendors. Also, to keep the program sustainable, a trainer training will be necessary.

(4) Human Resource Management Database

With a help from the Database Management Division or Systems Division of the Directorate for Information Management, human resource management database shall be developed. The functionalities to be included are:

1. Individual Training Needs Assessment;
2. Personal Appraisal Form;
3. Training Record;
4. Training Schedule; and
5. Training Evaluation.

(5) Updating Training Materials

The training or teaching manuals shall be maintained by each division. Whenever necessity arises, the current operation manuals shall be updated. For each manual, a responsible individual shall be assigned, and the contents shall be updated.

(6) Financing and Logistics

The finance and logistics shall include the cost of developing software operation manuals, training manuals (textbook), trainer-training manuals, costs of conducting seminars and others.

4-6 Promotion Plan

4-6-1 General Conditions

The promotion plan for map and associated projects have two components. One is to expand the accessibility of the maps, and the other is to produce products which reflect the needs of the market. As a public entity, the Map Sale Office of NAMRIA shall take into consideration that the products to be developed shall not compete with the products on the market, but to facilitate and augment private production of maps and map related products.

One needs to consider institutional aspects. The association for geodetic engineers was identified. Other associations relating to photogrammetry and cartography are not as active as they should.

Copyright violation is the hindering factor in augmenting actual demand of 1:50,000 topographic maps. NAMRIA's Map Sale Offices are controlling their products fully to prevent possible copyright violation. The market trend is moving more and more toward digital data; it would become contradictory to protect copyrights and promote the products.

4-6-2 1:50,000 Topographic Map Need Assessment

A need assessment, the "Need Assessment Survey for the Updating of National Topographic Maps" was conducted in March 2004 by JICA Philippine Office. In this section, the result of the survey is recaptured from the report.

The survey questionnaire was administered in March 2004 to: academic institutions; national government agencies; private companies; local government units; and donor-assisted offices. The total number of the sample was 103. The shares of the sample by affiliation classification of respondents are: academic institutions (9%); national government agencies (54%); private companies (18%); local government units (9%); donor-assisted office (10%). By professional classification, the shares are: regional planners (32%); infrastructure planner (24%); GIS specialist (15%); engineers (11%); and IT practitioners (7%).

The report concluded that the demand of 1:50,000 topographic maps is high especially in terms of becoming the scale of maps to be the basis of GIS base maps. As for utilization of the maps, almost all the national government agencies utilize the 1:50,000 topographic maps (98%). Others had very high ratios: donor-assisted agencies (89%); academic institutions (100%); and private companies (89%). The scores of LGUs are relatively low with the value of 40%. The issues raised on the topographic maps were unavailability of up-to-date and accurate mid-scale topographic maps.

The client group composition of the year 2001 is: government 16%; private 74%; academic 9%; foreign organizations 1%. The demands of maps, reported in the report, are summarized in the following table:

Table 4-8 Map Need Assessment Result

Rank	Type of Maps	Number of Respondents	Percent
1	Topographic Maps 1:50,000	69	67.0
2	Topographic Maps 1: 10,000	44	42.7
3	Land use map	44	42.7
4	Topographic Maps 1:250,000	37	35.9
5	Administrative Map	25	24.3
6	Others	24	23.3

4-6-3 Target Users

(1) Public Sector

1) Core Agencies of the Philippines National Spatial Data Infrastructure

The main target users are the users in the central governments that are already utilizing the topographic maps. When the data will be updated, they will be the core users of the maps.

The primary targets are government users. The central government agencies, provincial governments and city/municipal governments are the primary targets of maps and maps related products. Among the central government agencies, the following agencies are considered as the core targets that are included in the Philippines National Spatial Data Infrastructure Framework Plan. The agencies included in the plan are: DENR, NAMRIA, DPWH, DOTC, DOST, DOJ, NEDA, DA, DAR, DND, NSO, HLURB, DILG, DOF, NSCB, Academe, LGU, Private Sector, Others. In the technical working group, DENR, DPWH, DOTC, DOST, DOJ, NEDA, DA, DAR, DND, NSO, HLURB, DILG, DOF, and NSCB are targeted as the users of 1:50,000 topographic maps in both paper and digital media. As stated in the Framework Plan, the 1:50,000 topographic maps will be used as the reference system, base cartographic data, natural environment protection and management, built environment management, and socio-economic and administrative tasks.

2) Provincial governments

The primary use of 1:50,000 topographic maps are for infrastructure and facility management of provinces. Currently, all the provincial planning and development offices are required to prepare Provincial Physical Framework Plan; the 1:50,000 topographic maps are the basis to the framework plan. Since provincial governments, also, are shifting their planning and development activities based on GIS, digital data can be promoted .

3) City/Municipal Government

After PD72, cities and municipalities are required to prepared Comprehensive Land Use Plan. The planning period is generally ten years with a five year review process. For city/municipal land use planning, 1/10,000 scale topographic maps are preferred; however, at present, the availability of 1/10,000 are limited. Therefore, in the meantime, the topographic maps at the scale of 1:50,000 are the base maps for preparing Comprehensive Land Use Plans.

(2) Educational Users

The secondary targets are the educational users. They are students and educators from primary schools to universities. The educational users are targeted to raise the number of potential users in the long-run.

The disciplines that utilize the topographic maps are in: geography, history, geology, geophysics, environmental management, tourism development, civil engineering, architecture, regional planning, and others.

(3) Private Sector

According to the map sales records of the year 2001, the 74% of the clients are from the private sector. The report does not indicate that the percent is based on the number of clients or the volume of sale; however, the private sector cannot be disregarded in the promotion plan. The tertiary target is the business sector. They are domestic and international tourists, real estate developers, architecture and civil engineering firms, planning consultants, and others.

The targets are classified into public, private and education. For each targets, products shall be promoted. Lower prices could be set for educational institutions, academics and students. When revised, old versions of topographic maps could be sold at a lower price also.

4-6-4 Marketing Study

The 1:50,000 topographic maps in paper media is the basic product. The information on the basic products are old as studied. In short, product development means map revision; what the customers want is maps with updated information.

According to the need assessment of Section 4-6-2 conducted by JICA in 2004, the needs of GIS data are very high among the central government agencies and academic institutions. The GIS will become the basis of Comprehensive Land Use Plan prepared by cities and municipalities. The GIS development by cities and municipalities are not mandatory; however, HLURB, the responsible agency for CLUPs of city/musicality, has been revising the guideline of comprehensive land use planning. In the newly revised guideline, a volume for GIS development is included. Therefore, in the near future or in a few years, demand of GIS base data will increase substantially.

The basic maps have a major role to be the general public information for the nation. In developing and promoting maps and related products, the product development shall consider the role of the public sector not to compete with the private sector. There are other ministries and agencies that promote their thematic maps or education materials related maps. Tourism maps may be the domain of the Department of Tourism; education materials may be under the domain of the Ministry of Education. The Mapping Department therefore, needs to consider the role of providing the basic maps while finding missing products.

The Information Management Department shall conduct a marketing study to set appropriate prices for each product by the generalized target.

The generalized targets by products are planned as in the following table.

Table 4-9 General Target for Topographic Maps

			Public			Private			Education		
			Central Government Agencies	Provincial Governments	City/Municipal Governments	Developer	Architect	Consultants	College	Secondary	Elementary
1:250,000	Digital	Vector	3	3	3	3	3	3	3	-	-
		Raster	2	2	2	2	2	2	1	1	1
	Analogue		2	2	2	2	1	1	2	3	3
1:50,000	Digital	Vector	3	3	3	3	3	3	3	1	1
		Raster	2	2	2	2	2	2	1	1	1
	Analogue		2	2	2	1	1	1	2	1	1
1:10,000	Digital	Vector	3	3	3	3	3	3	1	1	1
		Raster	2	2	2	2	2	2	1	1	-
	Analogue		1	1	1	1	1	1	2	2	-

3: Very important target
2: Important target
1: General target

4-6-5 Promotional Material Development

Products are available in NAMRIA; availability of products and services shall be notified to potential clients. The potential clients can be analyzed using the map sale records. A generalized relationship between target and promotion method is summarized in the following table.

Table 4-10 Promotional Methods and Targets

	Public			Private			Education		
	Central Government Agencies	Provincial Governments	City/Municipal Governments	Developer	Architect	Consultants	College	Secondary	Elementary
Web Site	3	3	3	3	3	3	3	2	2
Email	2	2	2	1	1	1	-	-	-
Direct Mail	1	1	1	3	3	3	-	-	-
Map Fair/Exhibition	-	-	-	1	1	1	3	3	3

3: Very important target
2: Important target
1: General target

(1) Web Promotion Site Development

NAMRIA already has a web site for promoting maps and map related products. The site, however, needs more user side considerations.

(2) Brochure Development

To private customers such as developers and consultants, brochure and direct mail is one of reaching a potential client.

(3) Email marketing

Email marketing shall be effective to map users in the public sector. Current email message is based on text only; html mail shall be explored to make presentations more effective.

4-6-6 Licensing

Digital products are generally used under the licensing schemes. Copied projects such as movies and software are proliferated in the Philippines; however, since the demand of mapping products will shift or already shifted towards digital products, the product development inevitably needs to focus on digital products. With the HLURB's GIS promotion scheme to LGUs, demand of digital version, especially vector data, will increase.

(1) Legal study for licensing

Copyright is a complex legal subject. How and what to be done to protect the digital products in the government sector, private sector, and educational institutes shall be studied with legal experts.

(2) Privatization of map sales

With the result of the legal study on licensing, a privatization scheme for map sale shall be established.

(3) Product registration

The Map Sales Office shall develop the official digital product licensing registration system to the existing recording system.

4-6-7 Branding

In a private marketing scheme, branding is a key concept of selling. NAMRIA's image as technological center or hub shall be enhanced.

(1) Exhibition

Annual exhibitions have been conducted. In those exhibitions, the name, NAMRIA, shall be effectively used for participants to raise the image of NAMRIA.

(2) Contests

Geography or map symbol contests shall be organized for school children to make them remember NAMRIA and its functions.

(3) DVD Distribution

NAMRIA has developed a promotional application and DVD. These promotional materials shall be distributed to all the research institutions in the Philippines.

4-7 The Specifications for Topographic Mapping at Scale of 1:50,000

Upon preparing the Specifications for Topographic Maps, the JICA's overseas survey and mapping standards created using the standards from the Geographical Survey Institute, were reviewed. And based on the JICA's overseas' specifications, the Study Team prepared draft specifications. The Technical Working Group reviewed the Specifications and the Manual for Orthophotograph Creation.

At the beginning of the Study, the product standards was presented. NAMRIA requested the revised the Standards to the process standards. The Study Team, with the request from NAMRIA, has prepared the process specifications. Since the Cartography Division initiated its own ortho-photo creation, the division chief requested strongly that the ortho-photo manual or specifications be included to the Specification. The Study Team acknowledge the request and prepared the ortho-photo preparation manual as a part of the draft Specifications. The NAMRIA

side accepted the Specifications and began a reviewing procedure in the Technical Working Group.

4-8 Nationwide Deployment Plan

4-8-1 Preparatory Work

(1) SPOT5 Imagery and Contour Data

The Study Team came to a conclusion as the result of technical evaluation of the Pilot Projects (Section 3-5-5) that SPOT5 images have sufficient accuracy and can be used for 1:50,000 topographic mapping. In addition, NAMRIA already acquired SPOT5 images to cover 70% of whole the Philippines for preparation of base maps for the geo-hazard mapping project. The Study Team, therefore, recommends to adopt the topographic mapping method through obtaining planimetric data from single SPOT5 images for the Nationwide Deployment Plan to update 1:50,000 topographic maps, and the cost of SPOT5 images already acquired is treated as a sunk cost and will be deducted from the total cost calculation.

Meanwhile, as the result of the technical evaluation of the Pilot Projects in Section 3-5-5, accuracy of contour lines and spot heights of existing 1:50,000 topographic maps did not satisfy the Draft Technical Specifications. However, 70% of contour data processed and digitalized from existing 1:50,000 topographic maps are already acquired by NAMRIA. The Study Team, therefore, recommends, though having significant errors in contour data in mountainous areas, in the light of cost and period for NAMRIA, to utilize the digitalized data processed from existing 1:50,000 topographic maps for further nationwide deployment of 1:50,000 topographic maps. The contour and spot height data already acquired will also be deducted from the total cost calculation.

(2) Time, Resource, Cost Assignment

In the course of the Pilot Projects, a comparative study of mapping methods and their accuracy was conducted among the subjects of technical verification (method, accuracy, cost, time, and resource) of 1:50,000 topographical maps produced by use of aerial photographs and satellite images. The data of required workdays and man day distribution for each phase of work identified through 1:50,000 topographical mapping of the Pilot Projects are necessary for the analysis. At first, summarizing below the data of workdays for preparation of 20 map sheets produced in the Pilot Projects by each map sheet and by each process of work.

Table 4-11 Workday by Processes: Results from the Pilot Projects

Mapping Scale : 1/50,000
Area of 1 map sheet : About 730 sq. km

Sheet Number	Planimetry Plotting (including aerial triangulation)		Contour Digitizing		Digital Editing	Map sym-boliza-tion	Grade from Pilot Project	
	Spot 5 Imagery	Aerial photo-graphs	Contour digitizing data of existing maps from NAMRIA	Contour plotting from aerial photo-graphs				
	Workday	Workday	Workday	Workday	Workday	Work-day	Planimetry	Contours
3033-Ⅱ	27		12-36		17	28	AB	-
3133-Ⅲ	27		12-36		17	28	AB	-
3032-Ⅰ	27		12-36		17	28	AB	-
3132-Ⅳ	27		12-36		17	28	AB	-
3032-Ⅱ	16		12-36		10	23	C	-
3132-Ⅲ	32		12-36		19	30	A	-
3132-Ⅱ	27		12-36		17	28	AB	-
3232-Ⅲ	21		12-36		14	26	B	-
3031-Ⅰ	18		12-36		12	25	BC	-
3131-Ⅳ	32		12-36		19	30	A	-
3131-Ⅰ	32		12-36		19	30	A	-
3231-Ⅳ	16		12-36		10	23	C	-
3031-Ⅱ		18		45	10	23	C	A
3131-Ⅲ		25		15	17	28	AB	C
3131-Ⅱ		25		15	17	28	AB	C
3231-Ⅲ		36		45	10	23	C	A
3031-Ⅰ		30		38	12	25	BC	AB
3130-Ⅳ		18		15	19	30	A	C
3130-Ⅰ		30		15	19	30	A	C
3230-Ⅳ		32		38	17	28	AB	AB

The Study Team compiled and used contour digitizing data of the existing topographic maps during the Pilot Projects. The Study Team interviewed NAMRIA to find the required number of days to prepare the contour digitizing data. As the result, it was confirmed that contour digitizing work for one sheet of existing 1:50,000 map takes in average from 12 days at the minimum to 36 days at the maximum. The above table, and recorded data about control point surveying/leveling, field identification work, were incorporated

into the following table, showing workdays and man day distribution for each phase of work.

Table 4-12 Total Workdays, Classification of Plotting, Editing Work and Percent Change

Mapping Scale : 1/50,000
Area of 1 map sheet : About 730sq. km

Work item	GCP	Lev-eling	Field ID	Planimetric Plotting (including aerial triangulation)		Contour Digitizing		Field Compilation		Digital Editing		Map symbolization		G	Twd
Work-day(W/D)/percent change	W/D	W/D	W/D	W/D	%	W/D	%	W/D	%	W/D	%	W/D	%		
(1) Mapping by Single Spot Image				32	50	36	50	19	30	19	30	30	15	A	
				27	25	30	25	17	15	17	15	28	7.5	AB	
	4	0	8	21	0	24	0	14	0	14	0	26	0	B	111
				18	-15	18	-25	12	-15	12	-15	25	-7.5	BC	
				16	-25	12	-50	10	-30	10	-30	23	-15	C	
(2) Mapping by Stereo Spot Image				29	50	45	50	19	30	19	30	30	15	A	
				24	25	38	25	17	15	17	15	28	7.5	AB	
	8	12	8	19	0	30	0	14	0	14	0	26	0	B	131
				17	-15	23	-25	12	-15	12	-15	25	-7.5	BC	
				15	-25	15	-50	10	-30	10	-30	23	-15	C	
(3) Mapping by Aerial Photo-graphs				36	50	45	50	19	30	19	30	30	15	A	
				30	25	38	25	17	15	17	15	28	7.5	AB	
	16	12	8	24	0	30	0	14	0	14	0	26	0	B	144
				20	-15	23	-25	12	-15	12	-15	25	-7.5	BC	
				18	-25	15	-50	10	-30	10	-30	23	-15	C	

G: Grade; Twd: Total work day (average)

Table 4-13 Manday Distribution for Mapping Works

Mapping Scale : 1/50,000
Area of 1 map sheet : About 730sq. km

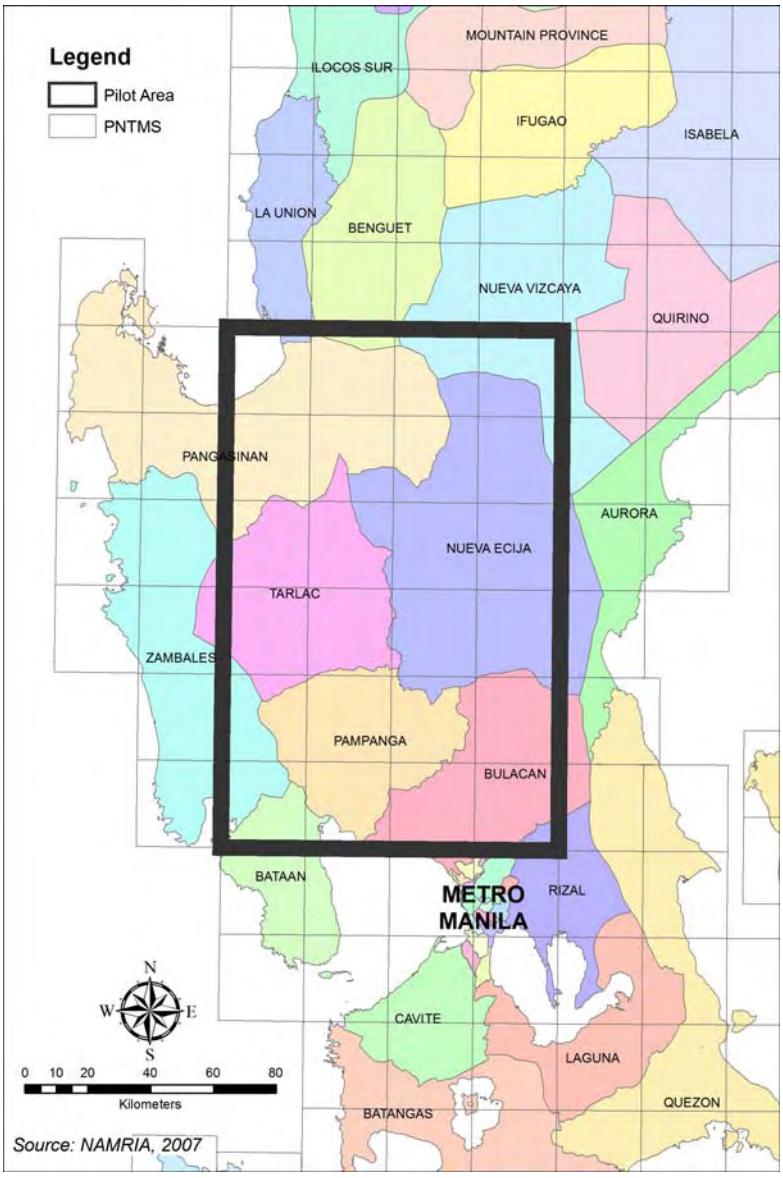
	Work item	GCP	Leveling	Field ID	Planimetric Plotting (including aerial triangulation)	Contour Digitizing	Field Compilation	Digital Editing	Map symbolization	Total Maydays (average)
(1) Mapping by Single Spot Image	Workday	4.00		8.00	21.00	24.00	14.00	14.00	26.00	
	Members									
	Engineer (A)	1.00	0.00	2.00	5.25	6.48	1.80	1.80	6.00	24.33
	Engineer (B)	4.00	0.00	8.00	21.00	24.00	14.00	14.00	26.00	111.00
	Engineer (C)	4.00	0.00	8.00	0.00	0.00	14.00	0.00	0.00	26.00
										161.33
(2) Mapping by Stereo Spot Image	Workday	8.00	12.00	8.00	19.00	30.00	14.00	14.00	26.00	
	Members									
	Engineer (A)	2.00	1.60	2.00	4.75	8.00	1.80	1.80	6.00	27.95
	Engineer (B)	8.00	12.00	8.00	19.00	30.00	14.00	14.00	26.00	131.00
	Engineer (C)	8.00	12.00	8.00	0.00	0.00	14.00	0.00	0.00	42.00
										200.95
(3) Mapping by Aerial Photographs	Workday	16.00	12.00	8.00	24.00	30.00	14.00	14.00	26.00	
	Members									
	Engineer (A)	2.00	1.60	1.00	6.00	8.00	1.80	1.80	6.00	28.20
	Engineer (B)	16.00	12.00	8.00	24.00	30.00	14.00	14.00	26.00	144.00
	Engineer (C)	16.00	12.00	8.00	0.00	0.00	14.00	0.00	0.00	50.00
										222.20

The data of required workdays and man/day distribution for each phase of work for preparation of 1:50,000 topographical maps by aerial photographs and single satellite images was used: for analysis of cost per sheet for altogether 653 sheets of nationwide 1:50,000 topographical maps; for comparative analysis of period and required numbers of engineers; and equipment for nationwide deployment. As for the number of workdays, categories of plotting/editing, and their rates of changes with stereo satellite images, the Study Team determined the required workdays based on the result of plotting/editing training with stereo satellite images conducted by the Study Team as OJT and verification of the mapping method (comparison of elevations) with stereo satellite images.

In order to estimate time, resource and cost requirements to update these maps, the conditions of the land covered by each map sheet were analyzed. The complexity of the land covered by each map sheet would directly affect map update works. To measure complexity of each map sheet, all map sheets were assessed in terms of the planimetric and contour densities found in each map sheet.

The Pilot Project to update 20 map sheets conducted as part of the study produced benchmarks that were used to estimate time, manpower and resource requirements to update the rest of the map sheets.

Figure 4-2 Pilot Area Map Sheets



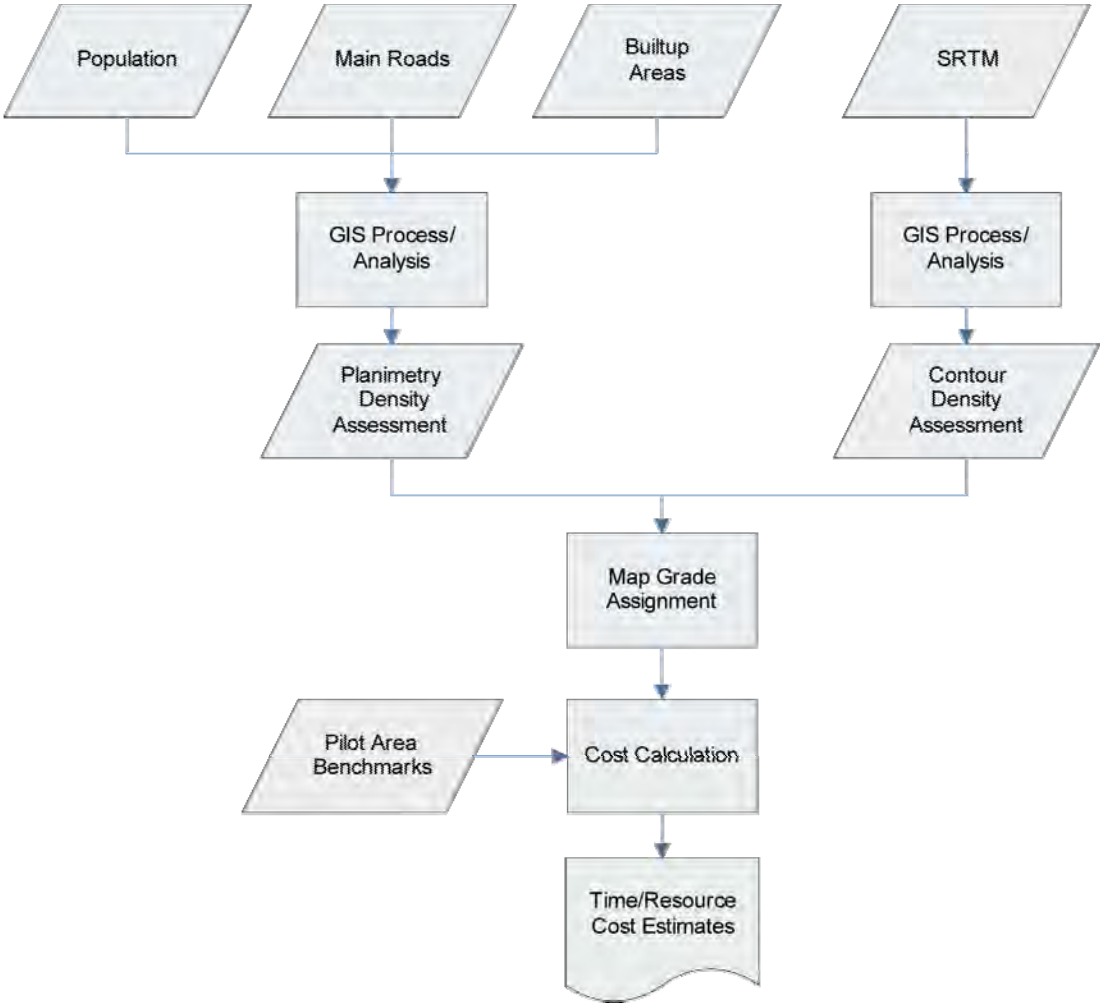
The results of the analysis conducted produced the following outputs:

- Assessment of complexity of each PNTMS map sheet expressed in terms of grades to measure planimetric and contour densities.
- Time, resource and cost estimates to update each map
- Scenarios to update all map sheets within 5, 10 and 15 years:
    - NAMRIA to perform update 100% in-house--an estimate of resource and cost requirements of NAMRIA will be calculated.
    - NAMRIA/Private Sector Combination to perform update while keeping NAMRIA manpower and resource capabilities at current levels--An estimate of how many of the 653 map sheets and the costs NAMRIA and the private sector was calculated.
    - Private sector update--An estimate of the cost of subcontracting the update of all map sheets to the private sector was calculated.
- Future map revision cycle scenario

The outputs of the analysis can be used as reference for planning future programs to update the 1:50,0000 scale maps of the Philippines.

The following flowchart (Figure 4-3) illustrates the steps used in the analysis.

Figure 4-3 Analysis Workflow



(3) Map Sheet Grade Assignment

Based on the planimetry and contour density assessment, grades were assigned to each map sheet. The grades were calibrated to match as much as possible the grade assessment made by the JICA Study Team on the map sheets covered by the pilot area of the project. Each of these factors used were given weights to come up with the final planimetry grade.

To come up with the final planimetry density grades that best matches the grades attained in the pilot area, several iterations were made using different weights for population, built-up areas and major roads were used. To determine the best iteration, the total differences between the grades in the pilot area and the grades achieved using GIS analysis were totaled. The least total difference was selected as the best match. Tables 4-14, 4-15, 4-16, 4-17 and 4-18 shows the different iterations used. Table 4-17 shows the least total difference and therefore selected as the best iteration.

Table 4-14 Planimetry Density Grade Iteration 1

Map Sheet	Planimetry Density Grade assigned by	Planimetry Density Grade assessed by GIS					Difference
		Population	Built-up Areas	Roads	Calculated Grade	Grade (Rounded-off)	
3033 II	2	1	1	1	1.00	1	1.00
3133 III	2	2	3	3	2.70	3	-0.70
3032 I	2	1	2	2	1.70	2	0.30
3132 IV	2	1	1	1	1.00	1	1.00
3032 II	5	4	4	3	3.80	4	1.20
3132 III	1	1	1	2	1.20	1	-0.20
3132 II	2	1	2	2	1.70	2	0.30
3232 III	3	3	1	2	1.80	2	1.20
3031 I	4	5	5	5	5.00	5	-1.00
3131 IV	1	1	1	2	1.20	1	-0.20
3131 I	1	1	1	2	1.20	1	-0.20
3231 IV	5	5	3	4	3.80	4	1.20
3031 II	5	5	5	5	5.00	5	0.00
3131 III	2	1	1	1	1.00	1	1.00
3131 II	2	1	1	1	1.00	1	1.00
3231 III	5	5	5	4	4.80	5	0.20
3031 I	4	5	5	5	5.00	5	-1.00
3130 IV	1	1	1	2	1.20	1	-0.20
3130 I	1	1	1	1	1.00	1	0.00
3230 IV	2	1	1	2	1.20	1	0.80
						Total	5.70
Weight (%)		30	50	20			

Table 4-15 Planimetry Density Grade Iteration 2

Map Sheet	Planimetry Density Grade assigned by	Planimetry Density Grade assessed by GIS					Difference
		Population	Built-up Areas	Roads	Calculated Grade	Grade (Rounded-off)	
3033 II	2	1	1	1	1.00	1	1.00
3133 III	2	2	3	3	2.80	3	-0.80
3032 I	2	1	2	2	1.80	2	0.20
3132 IV	2	1	1	1	1.00	1	1.00
3032 II	5	4	4	3	3.70	4	1.30
3132 III	1	1	1	2	1.30	1	-0.30
3132 II	2	1	2	2	1.80	2	0.20
3232 III	3	3	1	2	1.70	2	1.30
3031 I	4	5	5	5	5.00	5	-1.00
3131 IV	1	1	1	2	1.30	1	-0.30
3131 I	1	1	1	2	1.30	1	-0.30
3231 IV	5	5	3	4	3.70	4	1.30
3031 II	5	5	5	5	5.00	5	0.00
3131 III	2	1	1	1	1.00	1	1.00
3131 II	2	1	1	1	1.00	1	1.00
3231 III	5	5	5	4	4.70	5	0.30
3031 I	4	5	5	5	5.00	5	-1.00
3130 IV	1	1	1	2	1.30	1	-0.30
3130 I	1	1	1	1	1.00	1	0.00
3230 IV	2	1	1	2	1.30	1	0.70
						Total	5.30
Weight (%)		20	50	30			

Table 4-16 Planimetry Density Grade Iteration 3

Map Sheet	Planimetry Density Grade assigned by	Planimetry Density Grade assessed by GIS					Difference
		Population	Built-up Areas	Roads	Calculated Grade	Grade (Rounded-off)	
3033 II	2	1	1	1	1.00	1	1.00
3133 III	2	2	3	3	2.70	3	-0.70
3032 I	2	1	2	2	1.70	2	0.30
3132 IV	2	1	1	1	1.00	1	1.00
3032 II	5	4	4	3	3.70	4	1.30
3132 III	1	1	1	2	1.30	1	-0.30
3132 II	2	1	2	2	1.70	2	0.30
3232 III	3	3	1	2	1.90	2	1.10
3031 I	4	5	5	5	5.00	5	-1.00
3131 IV	1	1	1	2	1.30	1	-0.30
3131 I	1	1	1	2	1.30	1	-0.30
3231 IV	5	5	3	4	3.90	4	1.10
3031 II	5	5	5	5	5.00	5	0.00
3131 III	2	1	1	1	1.00	1	1.00
3131 II	2	1	1	1	1.00	1	1.00
3231 III	5	5	5	4	4.70	5	0.30
3031 I	4	5	5	5	5.00	5	-1.00
3130 IV	1	1	1	2	1.30	1	-0.30
3130 I	1	1	1	1	1.00	1	0.00
3230 IV	2	1	1	2	1.30	1	0.70
						Total	5.20
Weight (%)		30	40	30			

Table 4-17 Planimetry Density Grade Iteration 4 – Best Match

Map Sheet	Planimetry Density Grade assigned by	Planimetry Density Grade assessed by GIS					Difference
		Population	Built-up Areas	Roads	Calculated Grade	Grade (Rounded-off)	
3033 II	2	1	1	1	1.00	1	1.00
3133 III	2	2	3	3	2.67	3	-0.67
3032 I	2	1	2	2	1.67	2	0.33
3132 IV	2	1	1	1	1.00	1	1.00
3032 II	5	4	4	3	3.67	4	1.33
3132 III	1	1	1	2	1.33	1	-0.33
3132 II	2	1	2	2	1.67	2	0.33
3232 III	3	3	1	2	1.99	2	1.01
3031 I	4	5	5	5	5.00	5	-1.00
3131 IV	1	1	1	2	1.33	1	-0.33
3131 I	1	1	1	2	1.33	1	-0.33
3231 IV	5	5	3	4	3.99	4	1.01
3031 II	5	5	5	5	5.00	5	0.00
3131 III	2	1	1	1	1.00	1	1.00
3131 II	2	1	1	1	1.00	1	1.00
3231 III	5	5	5	4	4.67	5	0.33
3031 I	4	5	5	5	5.00	5	-1.00
3130 IV	1	1	1	2	1.33	1	-0.33
3130 I	1	1	1	1	1.00	1	0.00
3230 IV	2	1	1	2	1.33	1	0.67
						Total	5.02
Best Matched Weight (%)		33	34	33			

Table 4-18 Planimetry Density Grade Iteration 5

Map Sheet	Planimetry Density Grade assigned by	Planimetry Density Grade assessed by GIS					Difference
		Population	Built-up Areas	Roads	Calculated Grade	Grade (Rounded-off)	
3033 II	2	1	1	1	1.00	1	1.00
3133 III	2	2	3	3	2.75	3	-0.75
3032 I	2	1	2	2	1.75	2	0.25
3132 IV	2	1	1	1	1.00	1	1.00
3032 II	5	4	4	3	3.75	4	1.25
3132 III	1	1	1	2	1.25	1	-0.25
3132 II	2	1	2	2	1.75	2	0.25
3232 III	3	3	1	2	1.75	2	1.25
3031 I	4	5	5	5	5.00	5	-1.00
3131 IV	1	1	1	2	1.25	1	-0.25
3131 I	1	1	1	2	1.25	1	-0.25
3231 IV	5	5	3	4	3.75	4	1.25
3031 II	5	5	5	5	5.00	5	0.00
3131 III	2	1	1	1	1.00	1	1.00
3131 II	2	1	1	1	1.00	1	1.00
3231 III	5	5	5	4	4.75	5	0.25
3031 I	4	5	5	5	5.00	5	-1.00
3130 IV	1	1	1	2	1.25	1	-0.25
3130 I	1	1	1	1	1.00	1	0.00
3230 IV	2	1	1	2	1.25	1	0.75
						Total	5.50
Weight (%)		25	50	25			

For final contour density grades that best matches the grades attained in the pilot area, several iterations were also made using different ranges of total contour lengths per map sheet were used. The best iteration is the one with the least total difference in grade between the pilot area grades and the GIS analysis grades. Tables 4-19, 4-20, 4-21, 4-22 and 4-23 shows the different iterations used for contour density grade. Table 4-20 was determined to be the best iteration because it shows the least total difference.

Table 4-19 Contour Density Grade Iteration 1

Ranges used for Contour Length (km) per Map sheet

Grade	Min		Max
1	12,000.01		
2	9,000.01	-	12,000
3	6,000.01	-	9,000
4	3,000.01	-	6,000
5		<=	3,000

Results

Map Sheet	Contour Density Grade assigned by	Contour Density Grade assessed by GIS	Difference
3031 II	1	1	0
3131 III	5	5	0
3131 II	5	5	0
3231 III	1	3	2
3031 I	2	3	1
3130 IV	5	5	0
3130 I	5	5	0
3230 IV	2	3	1
Total			4

Table 4-20 Contour Density Grade Iteration 2 – Best Iteration

Ranges used for Contour Length (km) per Map sheet

Grade	Min		Max
1	8,000.01		
2	6,000.01	-	8,000
3	4,000.01	-	6,000
4	2,000.01	-	4,000
5		<=	2,000

Results

Map Sheet	Contour Density Grade assigned by	Contour Density Grade assessed by GIS	Difference
3031 II	1	1	0
3131 III	5	5	0
3131 II	5	5	0
3231 III	1	1	0
3031 I	2	1	1
3130 IV	5	5	0
3130 I	5	5	0
3230 IV	2	1	1
Total			2

Table 4-21 Contour Density Grade Iteration 3

Ranges used for Contour Length (km) per Map sheet

Grade	Min		Max
1	6,000.01		
2	4,500.01	-	6,000
3	3,000.01	-	4,500
4	1,500.01	-	3,000
5		<=	1,500

Results

Map Sheet	Contour Density Grade assigned by	Contour Density Grade assessed by GIS	Difference
3031 II	1	1	0
3131 III	5	4	1
3131 II	5	5	0
3231 III	1	1	0
3031 I	2	1	1
3130 IV	5	5	0
3130 I	5	5	0
3230 IV	2	1	1
Total			3

Table 4-22 Contour Density Grade Iteration 4

Ranges used for Contour Length (km) per Map sheet

Grade	Min		Max
1	7,000.01		
2	5,000.01	-	7,000
3	3,000.01	-	5,000
4	1,000.01	-	3,000
5		<=	1,000

Results

Map Sheet	Contour Density Grade assigned by	Contour Density Grade assessed by GIS	Difference
3031 II	1	1	0
3131 III	5	4	1
3131 II	5	5	0
3231 III	1	1	0
3031 I	2	1	1
3130 IV	5	5	0
3130 I	5	5	0
3230 IV	2	1	1
Total			3

Table 4-23 Contour Density Grade Iteration 5

Ranges used for Contour Length (km) per Map sheet

Grade	Min		Max
1	16,000.01		
2	12,000.01	-	16,000
3	8,000.01	-	12,000
4	4,000.01	-	8,000
5		<=	4,000

Results

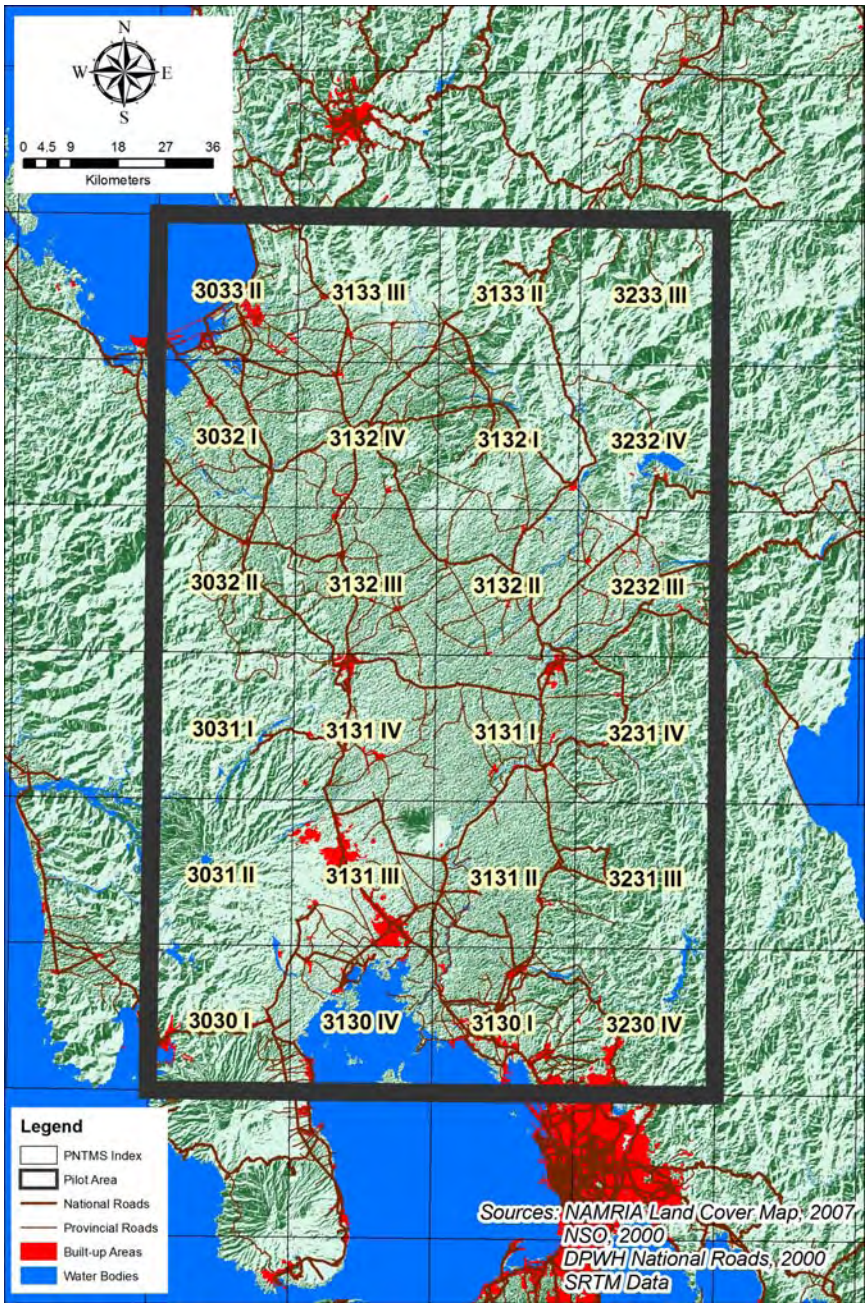
Map Sheet	Contour Density Grade assigned by	Contour Density Grade assessed by GIS	Difference
3031 II	1	1	0
3131 III	5	5	0
3131 II	5	5	0
3231 III	1	3	2
3031 I	2	3	1
3130 IV	5	5	0
3130 I	5	5	0
3230 IV	2	3	1
Total			4

Table 4-24 shows the summary of grades assigned by the Study Team and the grades attained using GIS analysis. The final grades for each map sheet were then used as basis of calculating cost to update each map sheet.

Table 4-24 Best Match Planimetry /Contour grades of Pilot Area

Map sheet	Actual (Based on Pilot Area)		Assessed by GIS				
	Planimetry Density Grade assigned by	Contour Density Assigned by	Planimetry Density Assessment				Contour Density Assessment
			Population	Builtup Area	Roads	Grade	Grade
3033 II	2		1	1	1	1	
3133 III	2		2	3	3	3	
3032 I	2		1	2	2	2	
3132 IV	2		1	1	1	1	
3032 II	5		4	4	3	4	
3132 III	1		1	1	2	1	
3132 II	2		1	2	2	2	
3232 III	3		3	1	2	2	
3031 I	4		5	5	5	5	
3131 IV	1		1	1	2	1	
3131 I	1		1	1	2	1	
3231 IV	5		5	3	4	4	
3031 II	5	1	5	5	5	5	1
3131 III	2	5	1	1	1	1	5
3131 II	2	5	1	1	1	1	5
3231 III	5	1	5	5	4	5	1
3031 I	5	2	5	5	5	5	1
3130 IV	1	5	1	1	2	1	5
3130 I	1	5	1	1	1	1	5
3230 IV	2	2	1	1	2	1	1
Best Matched Weight			33%	34%	33%		

Figure 4-4 Pilot Area Relief and Planimetry Conditions



Figures 4-5 and 4-6 show the final planimetry and contour density grades which will be used as basis for time/resource/cost estimation.

Figure 4-5 Planimetric Density Grades

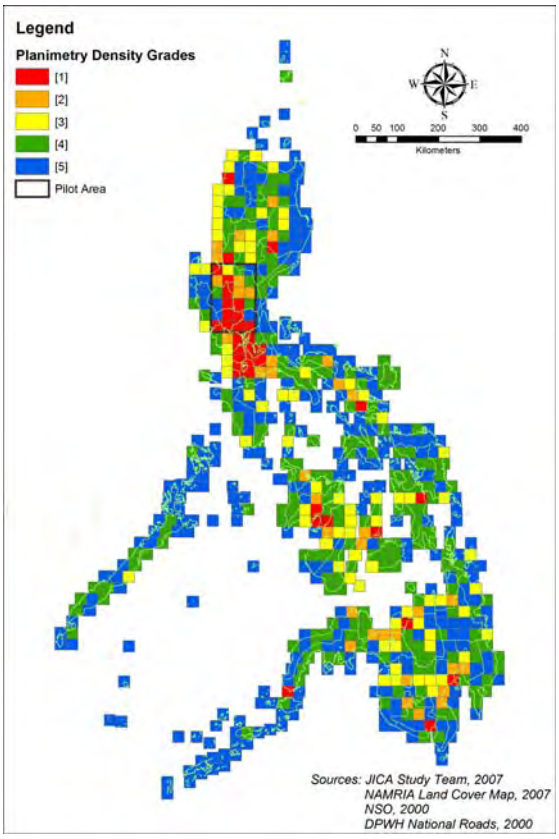
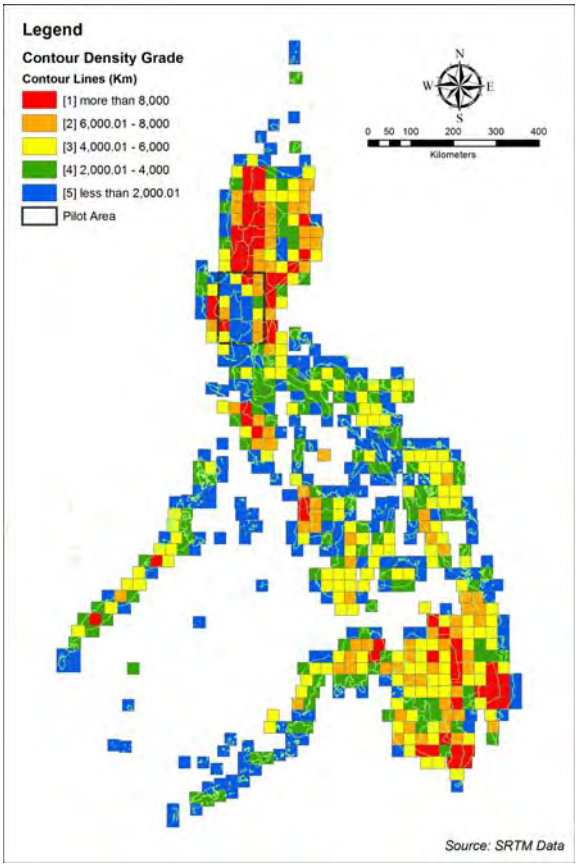


Figure 4-6 Contour Density Grades



4-8-2 Time, Resource, and Cost Calculation

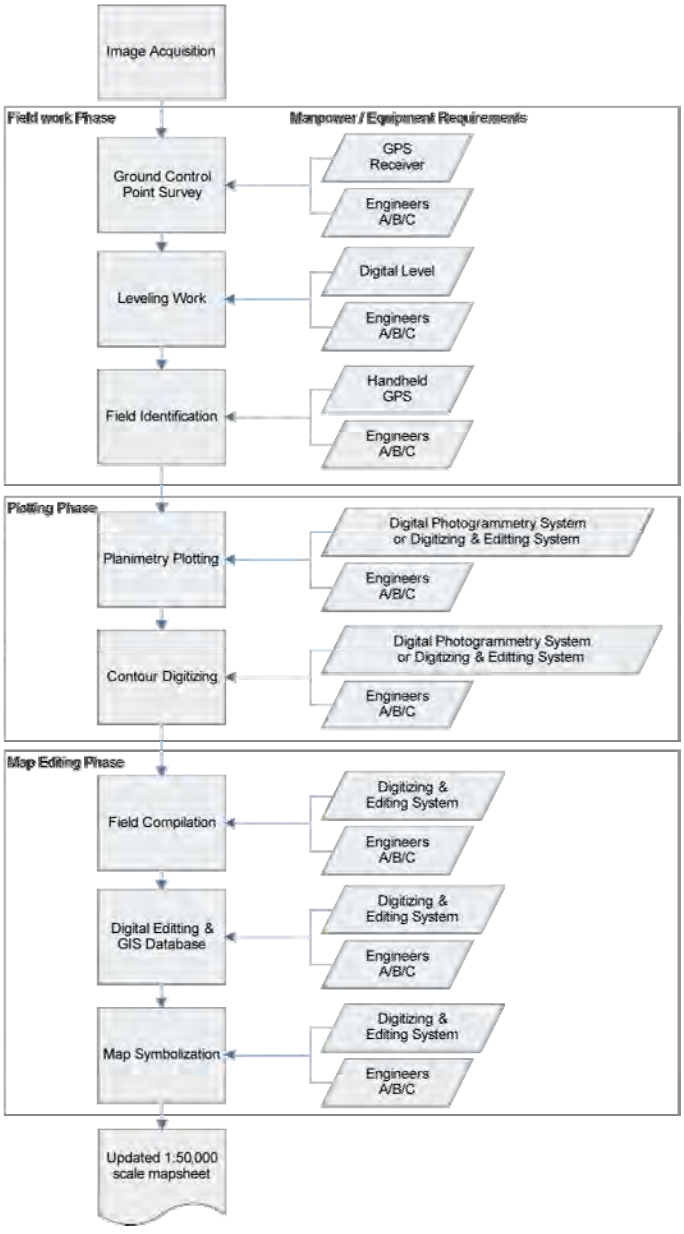
(1) Overview

In calculating the total time/resource/cost requirements to update the 1:50,000 scale maps, three methods of updating were considered. They are:

- Update by using single SPOT imagery;
- Update by using stereo SPOT imagery; and
- Update by using Aerial Photography.

The steps involved in the three methods are basically the same. Figure 4-7 shows the basic workflow to update a 1:50,000 map sheet. The main differences among the different methods of update are in the manpower and equipment used for each method.

Figure 4-7 Process of Updating



(2) Assumptions made in Cost Calculation

To facilitate calculation of time/resource/cost requirements to update the 1:50,000 map sheets, the following assumptions were made:

- Benchmarks resulting from the Pilot Project covering 20 map sheets were used as basis of estimating manpower, equipment, time requirements for each 1: 50,000 map sheet.
- An equivalent of one workstation was used for the update work in the pilot area.
- To perform update work, one workstation has to consist of the following:
    - Digital Photogrammetry System (Used for Stereo Satellite Image or Aerial Photography update methods)
        - Socet Set
        - Bingo
        - VrOne
        - PC
        - Topo mouse
        - Hand wheel
        - Stereo viewer
    - Digitizing and Editing System
        - ArcView
        - PC
        - ERDAS Imagine
        - Autodesk Map 3D 2007
        - Autodesk Raster Design 2007
        - Adobe Photoshop CS2
        - Adobe Illustrator CS2 with Map Publisher
        - Scanner
- The complexity of the map sheet in terms of planimetry and contour density affects the amount of time/resource/cost requirements of updating the map sheet. Grades were assigned to measure the complexity of the map sheets. Based on the grades, lookup tables were used to determine workday and manday requirements each map sheet.
- To simplify calculation of manpower involved in update work, manpower was classified into three types reflecting the position and salary level of the equivalent personnel attached to the Mapping Department in the current NAMRIA organization. It was also observed that the same type of personnel can usually be involved in the different phases of work although the work may require a different set of skills and credentials.
    - Engineer A – generally refers to positions Engineer IV & V in NAMRIA
    - Engineer B – generally refers to positions Engineer II & III in NAMRIA
    - Engineer C – generally refers to positions Carto I to III & Laboratory Technician II in NAMRIA

- In calculating cost of updating mapsheets covered by the "Production of Topographic Base Map for Geo Hazard Mapping" project by NAMRIA (444 mapsheets) and the JICA Study Pilot area (24 mapsheets), the following conditions were adopted:
    - the costs of SPOT 5 imagery for the Single Spot Method of update were excluded from cost calculations.

- the costs of contour generation for the Single Spot Method of update were excluded from cost calculations.

The following table summarizes the conditions adopted in cost calculations.

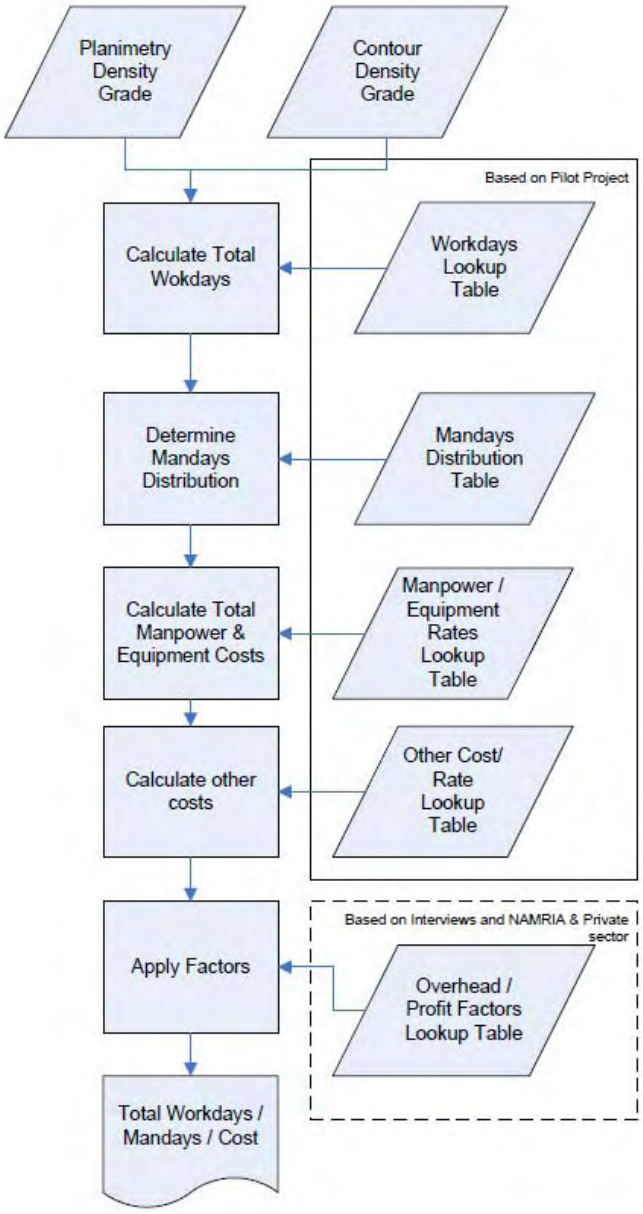
Table 4-25 Conditions for Cost Calculation

Cost Item	Method	GeoHazard (444 sheets) and JICA Pilot (24 sheets)	Others (185 sheets)
Spot 5 Costs	Single Spot	Exclude	Include
	Stereo Spot	Include	Include
	Aerial photo	Not Applicable (No Change)	Not Applicable (No Change)
Contour Generation Costs	Single Spot	Exclude	Include
	Stereo Spot	Include	Include
	Aerial photo	Include	Include

(3) Method of time/resource/cost calculation

The Figure 4-8 shows the steps involved in calculating time/resources/costs requirements. It was observed, based on interviews of NAMRIA and private companies personnel involved in preparation of cost estimation, that the basic methods of cost preparations are the same for both NAMRIA and private companies. The main differences lies in the values used for factors applied to account for overhead and profit. NAMRIA cost estimates do not include a profit factor. Another significant difference is that the factors normally used by the private sector are generally higher.

Figure 4-8 Steps involved in Calculating Time/Resource/Cost



Two spreadsheets were setup to calculate the time/resource/cost requirements to update the map sheets. The two spreadsheets show the calculations applicable to both NAMRIA and private sector respectively. Documentation of the contents and instructions on how to use the spreadsheets are included inside the spreadsheet. In setting up the calculations, several lookup tables were setup to facilitate calculations. They are:

- Workdays Lookup table
    - This lookup table defines the total workdays required in each phase of work. This lookup table is based on the results of the pilot area.
- Man days Distribution Table

  - This table shows the involvement (in ratio of Workdays) of each type of manpower required for each phase of work. This lookup table is based on the results of the pilot area.
- Manpower / Equipment Rates Lookup Table
  - This table lists the salary rates of each type or personnel and equipment rates used in the update work. This lookup table is based on the results of the pilot area.
- Other Costs/Rates Lookup Table
  - This table lists other costs and rates required such as cost of imagery, aerial photography, travel costs per map sheet. This lookup table is based on the results of the pilot area.
- Factors Table
  - This table lists the factors used in calculations such as overhead and profit. This lookup table is based on interviews of personnel in project cost estimation in NAMRIA and the private sector.

The results of calculations to update the map sheets are presented in two ways:

- One Page Format Summary per Map sheet; and
- Table Format showing calculation results for all map sheets.

Table 4-26 shows a sample time/resource/cost estimation for a map sheet using the Single Satellite Image method of update.

Table 4-26 A Sample of Time/Resource/Cost Estimation

CALCULATIONS FOR NAMRIA

Map Number:	**4215 IV**
Map Name:	**SABAKI**
% Land Area:	100.00
Land Area (km2):	764.72
Sheet Area (km2):	764.72
Planimetry Grade:	5
Contour Grade:	1

SINGLE SPOT IMAGE

			Engineer A		Engineer B		Engineer C		Total Work Days	% Land Area	Total Work Days (Full	Total Cost
			Man-Days	Cost	Man-Days	Cost	Man-Days	Cost				
Manpower	Field Work	Ground Control Points	1	1,149	4	3,528	4	2,964	4	100.00	4	7,641
		Leveling	0	0	0	0	0	0	0	100.00	0	0
		Field ID	2	2,298	8	7,056	8	5,928	8	100.00	8	15,282
	Plotting Work	Planimetric Detail	4	4,596	16	14,112	0	0	16	100.00	16	18,708
		Contour Digitizing	10	11,490	36	31,752	0	0	36	100.00	36	43,242
	Map Editting Work	Field Compilation	2	2,298	12	10,584	12	8,892	12	100.00	12	21,774
		Digital Editing	2	2,298	12	10,584	0	0	12	100.00	12	12,882
		Map Symbolization	6	6,894	25	22,050	0	0	25	100.00	25	28,944
	Total Labor		27	31,023	113	99,666	24	17,784	113		113	**148,473**
Overhead (Manpower)	10%											**14,847**
Equipment	Field Work											6,720
	Plotting Work											216,216
	Map Editing Work											203,742
	Printing System											147
	Total Equipment											**426,825**
Overhead (Equipment)	10%											**42,683**
Other Costs	Image Aquisition											215,350
	Negative Film											0
	Printing Materials											0
	Travel Expenses											258,750
	Total Others											**474,100**
Contingency (computed from Manpower, Equipment, Overhead and other costs)	10%											**110,693**
Total Cost												**1,217,621**

Table 4-27 summarizes the results of the time/resource/cost calculations to update all 653 map sheets of the PNTMS using only one (1) workstation to perform all the work:

Table 4-27 Summary of Results of Time/Resource/Cost Calculations

	Single Spot	StereoSpot	AerialPhoto
Total Work Days	44,509	61,984	67,613
Total Work Years	142.66	198.67	216.71
Work Days/Sheet	68.16	94.92	103.54
Engr A Total Mandays	11,322	15,389	16,713
Engr B Total Mandays	44,509	61,984	67,613
Engr C Total Mandays	11,734	18,828	22,160
Engr A Mandays/sheet	17	24	26
Engr B Mandays/sheet	68	95	104
Engr C Mandays/sheet	18	29	34
NAMRIA Total Cost	PHP 446,429,450	PHP 890,815,431	PHP 1,187,210,642
NAMRIA Cost/Sheet	PHP 683,659	PHP 1,364,189	PHP 1,818,087
Private Total Cost	PHP 703,628,532	PHP 1,320,354,117	PHP 1,694,914,007
Private Cost/Sheet	PHP 1,077,532	PHP 2,021,982	PHP 2,595,580

4-8-3 NAMRIA's Financial Resources and Implementation Period

The Study Team examined NAMRIA's budget for the past five years for the nationwide deployment of topographic maps, and estimated realistic financial resources allocated to the production of 1:50,000 topographic maps in the future. Further examined was viability of the five-year scenario of updating nationwide topographic maps and realistic period for its implementation.

(1) NAMRIA's budget of for updating topographic maps (past five years)

NAMRIA's factual budget in total and for topographic base mapping for the past five years appears as follows:

Table 4-28 NAMRIA's Budget (Total/Base Mapping)

Year	NAMRIA's Budget	Budget of Topographic Base Mapping
2003	263,026,000	9,309,000
2004	261,862,000	8,382,000
2005	265,226,000	7,727,000
2006	299,914,000	37,727,000
2007	819,684,000	112,835,000
Total		175,980,000
Average		35,196,000

Note: Budget of Topographic Base Mapping includes updating cost of large-, medium- and small-scale topographic maps, and does not include cost for printing and project cost of geo-hazard mapping and PRS92.

The past record shows sharp increase in the budget for base mapping from 2006. The reason of the increase is that the Government of the Philippines started the geo-hazard mapping project on a large scale in response to recent frequent casualties, such as floods, landslides, etc., and took budgetary actions for NAMRIA to acquire satellite images and to prepare planimetric and contour data from existing maps, which are necessary to produce 1:50,000 topographic maps. The budget of 2007 for topographic base mapping, 112,835,000 pesos, is more than 13 times larger than the average budget of three years from 2003 to 2005, 8,472,000 pesos. The increment was added expenses for procurement of satellite images to cover 70% of whole the Philippines necessary for topographic mapping. NAMRIA secured 37,727,000 pesos as the budget of 2006 for the topographic base mapping project, and 10% of annual increase had been planned after then. This budget

planning has been pursued to date, and NAMRIA already secured 44,830,000 pesos (about 20% increase from 2006) for the topographic base mapping project in 2008.

Based on the average budget of NAMRIA for three years from 2003 to 2005 allocated to topographic mapping, even in case of the least costly production method by NAMRIA itself and by single satellite images as shown in Table 4-27 above (and deducting the sunk cost for procurement of satellite images to cover 70% of the whole country and contour data of existing 1:50,000 topographic maps), implementation of the nationwide deployment of 1:50,000 topographic maps will take 52 years. This period is more than 10 times longer and too far from the five-year scenario of IATFGI. If, based on the past five-year budget results, NAMRIA will be able to secure about 35,000,000 pesos annually for topographic mapping, the nationwide deployment of 1:50,000 topographic maps by use of single satellite images will be completed in 13 years. This is 2.6 times longer than the five-year scenario of IATFGI. Assuming that budget allotment for topographic mapping will further continue to increase at yearly 10% constantly from 2006, the nationwide deployment plan can be accomplished in 8.3 years. However, it is uncertain, whether the 10% of annual budget increase will continue or not after 2010 when the geo-hazard mapping project will be completed.

In view of all those facts that the satellite images covering 70% of the whole country and contour data from existing 1:50,000 topographic maps which were prepared for the geo-hazard mapping project can be utilized, and that NAMRIA secured budget for the further topographic mapping project (37,727,000 pesos for 2006 and yearly 10% increase up until 2010), and also considering the past five-year budget actually allocated to the topographic mapping project, the Study Team recommends NAMRIA to secure realistic budget of 35,000,000 pesos annually for further promotion of the nationwide deployment of updating topographic maps.

In order that NAMRIA will be affordable to complete the nationwide deployment plan on its own, the budget should be secured constantly by the Government of the Philippines for implementation of the nationwide deployment plan at the level proposed as above or at the level allocated to NAMRIA in 2006.

(2) Necessary cost for the nationwide deployment of updating topographic maps

Necessary cost for the nationwide deployment of updating topographic maps was estimated in Section 4-8-2 and summarized in Table 4-27. NAMRIA has already acquired 468 scenes of SPOT5 satellite images for the geo-hazard map project (including 24 obtained in the Pilot Projects) out of 653 scenes to cover all the country, and contour data of 1:50,000 topographic maps can be utilized. The cost calculation allows for these factors, and the corresponding amount was deducted from the total cost for updating topographic maps. The results of the Pilot Projects (the data of required workdays and man day distribution for each phase of work) are also reflected on the calculation. Further, quotations from the private companies for 1:50,000 topographic mapping by use of single satellite imagery were also obtained, and compared and verified with the cost calculation estimated by the Study Team.

Table 4-29 Cost Comparison (NAMRIA/Private)

Cost Estimate for 1:50,000 Topographic Mapping by the Study Team			
	Single Satellite Image	Stereo Satellite Image	Aerial Photo
NAMRIA Total Cost (PHP)	446,429,000	890,815,000	1,187,210,000
NAMRIA Cost/Sheet (PHP)	683,000	1,364,000	1,818,000
Private Total Cost (PHP)	703,628,000	1,320,354,000	1,694,914,000
Private Cost/Sheet (PHP)	1,077,000	2,021,000	2,595,000
Cost Estimate for 1:50,000 Topographic Mapping from Private Companies			
FFC INC	1,172,000	-	-
CERTEZA INFOTEC INC.	1,211,000	-	-

As the result, it was confirmed that 1:50,000 topographic mapping by NAMRIA itself using single satellite imagery was most cost-effective, and the total cost for the nationwide deployment of updating topographic maps amounted 446,429,000 pesos. The estimate of the Study Team for 1:50,000 topographic mapping by the private sector and actual quotations from private companies on the same conditions did not have substantial difference. The Study Team conducted interviews to NAMRIA and private companies as to methods of cost calculation and production cost of topographic maps, and reflected the information to its cost calculation, which produced good results.

(3) Securing financial resources and the period for the nationwide deployment of updating topographic maps

As the result of consideration as above, implementation of the nationwide updating of topographic maps will cost not less than 446,229,000 pesos in total. If NAMRIA will be able to secure around 35,000,000 pesos annually as proposed by the Study Team, which was estimated from the actual budget for the past five years allocated for updating topographic maps, implementation of the nationwide updating of topographic maps is viable within the 13-year period. The Study Team, therefore, recommends, instead of the five-year scenario of IATFGI (chaired by NAMRIA), to base on more realistic budget and period for implementation of the nationwide updating of the topographic maps.

4-8-4 Outline of Sustainable Map Revision Plan

The Nationwide Map Revision Plan has two phases: the capacity development phase (Phase I) and the Sustainable Map Revision Phase (Phase II). The scenarios set for evaluation were: NAMRIA conducts all the topographic mapping work; NAMRIA and the private sector conducts the work; and all the work are conducted by the private sector. The implementation periods of five, ten and fifteen years were simulated.

4-8-5 Capacity Development Phase (Phase I)

(1) Overview

Phase I calls for a complete update of all 653 map sheets of the PNTMS within 13 years as proposed in Section 4-8-3. To achieve this, a study of the current NAMRIA capabilities and three possible update scenarios were made, they are:

- Update shall be conducted by NAMRIA 100%
- Update shall be conducted jointly by NAMRIA and the private sector
- Update shall be conducted by the private sector 100%

(2) Assumptions

To come up with the Phase I scenarios the following assumptions were made:

- To simplify analysis, it is assumed that at present, NAMRIA shall have the equivalent of five (5) workstations. One workstation shall be manned by one each of Engineers A, B and C with varying man days used.
- Work rates are based on results of the pilot area using current technology which be extended for the whole period of the scenarios.
- Update work shall be conducted in two shifts, six days a week, thereby extending the work capacity of one workstation

(3) Complete Update using current NAMRIA capabilities

The following table summarizes the time/resource/cost requirements using only current NAMRIA resources consisting of five workstations working in two shifts o update all 653 map sheets of the PNTMS.

Table 4-30 Time, Resource, Costs to update PNTMS at Current NAMRIA's Capacity

	Single Satellite Image	Stereo Satellite Image	Aerial Photo
Available Workstations in NAMRIA (Workstations)	5	5	5
Max Teams working in 2 shifts in NAMRIA (Teams)	10	10	10
Number of Engineer A needed	3	3	3
Number of Engineer B needed	10	10	10
Number of Engineer C needed	3	4	4
Workdays per Sheet (Workdays/Sheet)	68.16	94.92	103.54
Target Sheets	653	653	653
Total Days Required (Workdays)	4,451	6,198	6,761
Work Days/Year	312	312	312
Total Work Years Required	14	20	22
Cost NAMRIA	PHP 446,429,450	PHP 890,815,431	PHP 1,187,210,642

If NAMRIA keeps five workstations working, it is estimated that it will take NAMRIA from 14 to 22 years to update the entire 1:50,000 map sheets depending on the method of update.

(4) Phase I Scenario I: NAMRIA to conduct update in-house 100%

This scenario looks at the cases where NAMRIA by itself would do all update work in-house within 13 years. The computations show that NAMRIA will require one (1) additional works station.

Table 4-31 Phase I Scenario I: NAMRIA in-house 100%

	Single Spot	StereoSpot	AerialPhoto
Time Limit (Years)	13	13	13
Time Limit (Work Days)	4,056	4,056	4,056
Target Sheets	653	653	653
Required Work Days to finish all sheets	44,509	61,984	67,613
Required Teams to Finish within time limit	11	16	17
Required Workstations to Finish within time limit	6	8	9

Engr A Total Mandays	11,322	15,389	16,713
Engr B Total Mandays	44,509	61,984	67,613
Engr C Total Mandays	11,734	18,828	22,160
Number of Engineer A needed	3	4	5
Number of Engineer B needed	11	16	17
Number of Engineer C needed	3	5	6
Cost NAMRIA	PHP 446,429,450	PHP 890,815,431	PHP 1,187,210,642

(5) Phase I Scenario II: NAMRIA/Private Sector Combination to perform update while keeping NAMRIA manpower and resource capabilities at current levels

This scenario looks at the possibility of NAMRIA and private sector collaboration to complete the map update works while keeping resources at current levels at NAMRIA. Table 4-32 shows the resource and cost requirements to complete the works within 13 years.

Table 4-32 Phase I Scenario II: NAMRIA/Private Sector Combination (NAMRIA's Capacity Constant)

NAMRIA			
	Single Spot	Stereo Spot	Aerial Photo
Time Limit (years)	13	13	13
Time Limit (Work Days)	4,056	4,056	4,056
Available WorkStations in NAMRIA (WorkStations)	5	5	5
Max Teams woking in 2 shifts in NAMRIA (Teams)	10	10	10
Sheets that can be finished within Target Duration (Sheets)	595	427	391
% of Total Sheets	91%	65%	60%
Engr A Total Mandays	10,316	10,063	10,007
Engr B Total Mandays	40,556	40,532	40,485
Engr C Total Mandays	10,692	12,312	13,269
Number of Engineer A needed	3	3	3
Number of Engineer B needed	10	10	10
Number of Engineer C needed	3	4	4
Cost NAMRIA	PHP 406,777,217	PHP 582,508,712	PHP 710,871,916

Private Sector			
	Single Spot	StereoSpot	AerialPhoto
Sheets to be done by Private Sector	58	226	262
% of Total Sheets	9%	35%	40%
Required WorkDays to finish Target sheets (WorkDays)	3,953	21,452	27,128
Required Teams working for Target Duration (Teams)	1	6	7
Required Workstations working in 2 shifts for Target Duration (WorkStations)	1	3	4
Engr A Total Mandays	1,006	5,326	6,706
Engr B Total Mandays	3,953	21,452	27,128
Engr C Total Mandays	1,042	6,516	8,891
Number of Engineer A needed	1	2	2
Number of Engineer B needed	1	6	7
Number of Engineer C needed	1	2	3
Cost Private Sector	PHP 62,496,868	PHP 456,967,887	PHP 680,042,067

Grand Total Cost	PHP 469,274,085	PHP 1,039,476,600	PHP 1,390,913,983

(6) Phase I Scenario III: Private sector to conduct 100% update

This scenario looks at the case where the private sector will conduct all the map update works in 13 years. This will be the most expensive due to higher factors used by the private sector for overhead and profit. The table also shows an estimate of how much resources that private companies must have in order to complete the map update works on time. This can be used by NAMRIA as reference to select which companies would be capable of completing all the work on time.

Table 4-33 Phase I Scenario III: Private Sector (100%)

	Single Spot	StereoSpot	AerialPhoto
Time Limit (Years)	13	13	13
Time Limit (Work Days)	4,056	4,056	4,056
Target Sheets	653	653	653
Required Work Days to finish all sheets	44,509	61,984	67,613
Required Teams to Finish within time limit	11	16	17
Required Workstations to Finish within time limit	6	8	9
Engr A Total Mandays	11,322	15,389	16,713
Engr B Total Mandays	44,509	61,984	67,613
Engr C Total Mandays	11,734	18,828	22,160
Number of Engineer A needed	3	4	5
Number of Engineer B needed	11	16	17
Number of Engineer C needed	3	5	6
Cost Private Sector	PHP 703,628,532	PHP 1,320,354,117	PHP 1,694,914,007

(7) Evaluation and Selection of Scenario

The methods of acquiring the data were evaluated. The important factor to consider is the costs of acquiring the basic data. As shown in the following table, the method of using the single satellite imagery is the lowest unit cost of basic data.

Table 4-34 Cost of Data Acquisition

	Single Satellite (existing contour data)	Stereo Satellite	Aerial Photography
Unit Cost of Data Acquisition (/sheet 730sq.km) in PHP	215,350	692,040	1,308,160

The NAMRIA only, NAMRIA/Private Sector, and Private Sector only scenarios were evaluated. The costs for NAMRIA 100 % and the private 100% are assumed to be constant regardless of years spent for the work.

Table 4-35 Cost Comparison (NAMRIA, NAMRIA/Private, Private)

Implementing Party		Year	Single Satellite	Stereo Satellite	Aerial Photograph
NAMRIA	Cost (PHP)	13	446,429,450	890,815,431	1,187,210,642
	Ratio of Work		100%	100%	100%
NAMRIA/Private	Cost (PHP)	13	469,274,085	1,039,476,600	1,390,913,983
	Ratio of Work by NAMRIA		91%	65%	60%
Private	Cost (PHP)	13	703,628,532	1,320,354,117	1,694,914,007
	Ratio of Work		100%	100%	100%

*The production capacity of NAMRIA is assumed to be the same.

The 13-year scenario with the single-satellite-image method was selected as the best strategy to pursue especially for urgency and cost effectiveness.

Table 4-36 Selected Scenario

	NAMRIA	
	Item	Single Spot
NAMRIA	Time Limit (years)	13
	Time Limit (Work Days)	4,056
	Available WorkStations in NAMRIA (WorkStations)	5
	Max Teams working in 2 shifts in NAMRIA (Teams)	10
	Sheets that can be finished within Target Duration (Sheets)	595
	% of Total Sheets	91%
	Engr A Total Mandays	10,316
	Engr B Total Mandays	40,556
	Engr C Total Mandays	10,692
	Number of Engineer A needed	3
	Number of Engineer B needed	10
	Number of Engineer C needed	3
	Cost NAMRIA	PHP 406,777,217
Private Sector		Single Spot
	Sheets to be done by Private Sector	58
	% of Total Sheets	9%
	Required WorkDays to finish Target sheets (WorkDays)	3,953
	Required Teams working for Target Duration (Teams)	1
	Required Workstations working in 2 shifts for Target Duration (WorkStations)	1
	Engr A Total Mandays	1,006
	Engr B Total Mandays	3,953
	Engr C Total Mandays	1,042
	Number of Engineer A needed	1
	Number of Engineer B needed	1
	Number of Engineer C needed	1
	Cost Private Sector	PHP 62,496,868
	Grand Total Cost	PHP 469,274,085

4-8-6 Sustainable Map Revision Phase (Phase II)

(1) Overview

Scenarios to maintain the 1:50,000 map sheets after the first complete update were also studied. Two revision scenarios were studied:

1) Fixed Time Scenario

The first scenario is based on Philippine Regional Development plan requirements for map updatedness were considered. Based on interviews of NAMRIA personnel, the requirement for map updatedness depend on the characteristics of the area. Map update requirement for different areas can be summarized as follows:

- Urban Area, 5 Years
- Agricultural Area, 10 years
- Other areas, 15 years

2) Fixed Budget Scenario

The second scenario is based on the assumption that NAMRIA shall allocate PHP 35,000,000 annually for the revision of 653 map sheets. This scenario studies how many year it will take to update all 653 map sheets based on a fixed budget to be allocated for the map revision.

(2) Assumptions

In coming up with map revision cycle scenarios, the following assumptions were made:

- Land Cover classes used
  The NAMRIA Philippine land cover map of 2007 offers a convenient way to classify the PNTMS map sheets into Urban, Agricultural and Others. For convenience, the land cover classes were aggregated into the three simplified classes using the following table:

Table 4-37 Land Cover Type Groups

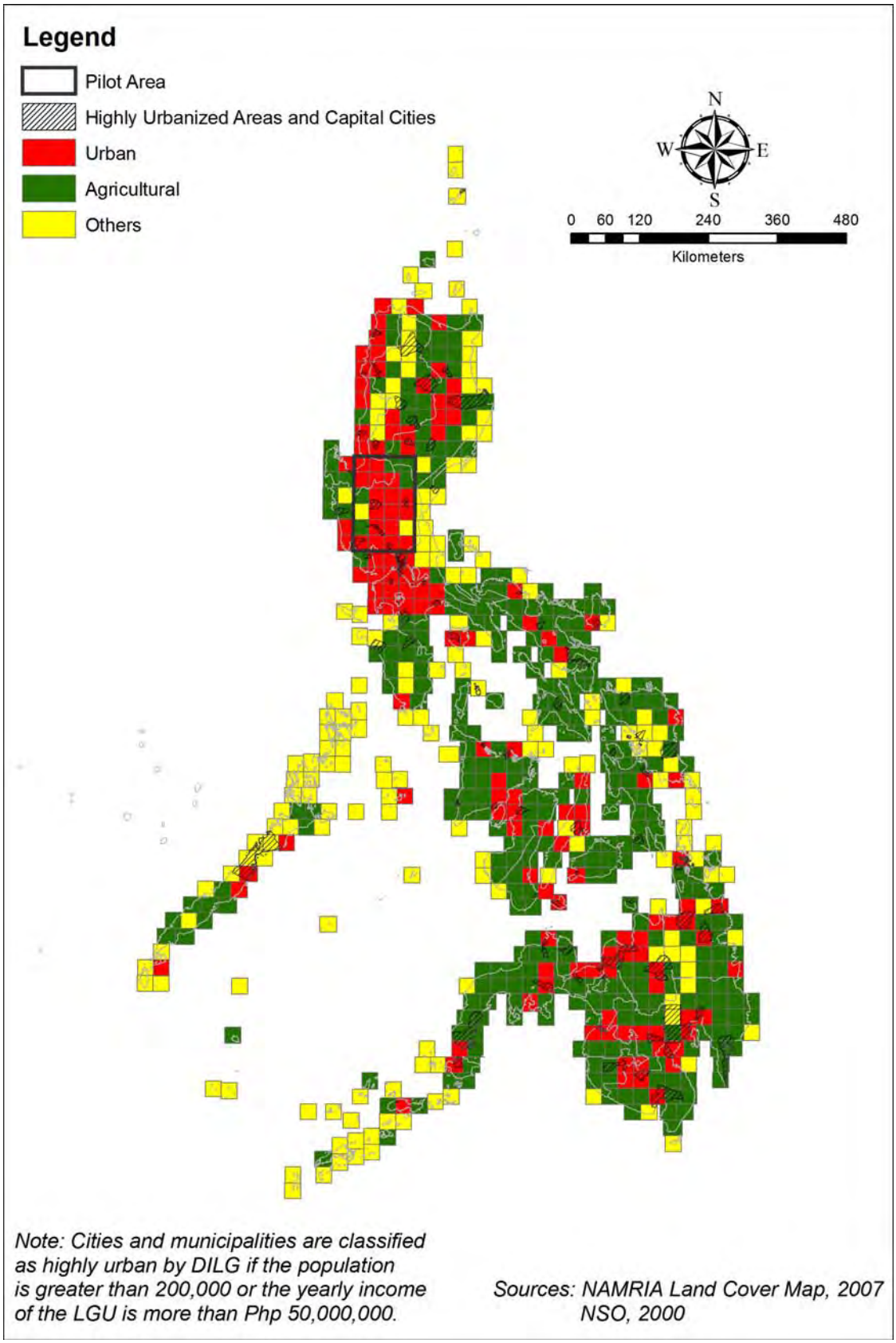
CLASSIFICATION	LAND COVER
Urban	Other land, built-up area
Agricultural	Other land, cultivated, annual crop
	Other land, cultivated, perennial crop
	Forest plantation, broadleaved
	Forest plantation, coniferous
	Forest plantation, mangrove
	Other land, cultivated, pastures
	Other land, cultivated, perennial
	Other land, fishpond
Others	Closed forest, broadleaved
	Inland water
	Mangrove forest
	Open forest, broadleaved
	Other land, natural, barren land
	Other land, natural, grassland
	Other land, natural, marshland
	Other wooded land, shrubs
	Other wooded land, wooded grassland
	Open forest, coniferous
	Closed forest, mixed
	Closed forest, coniferous
	Open forest, mixed
	Other wooded land, fallow
	Bamboo/palm formation
	Other land, natural barren
	Other wooded land, shrubs
	Other wooded lands, shrubs

Using the above aggregations of land cover the following table defines the criteria used to classify the PNTMS map sheets:

Table 4-38 Criteria Used for Map Sheet Type

Map sheet Class	Definition
Urban Map sheets	These are map sheets with significant amounts of built-up areas. The built-up areas in these map sheets should be at least 4 sq km This minimum built-up area was arrived at by overlaying and comparing the built up area map from the land cover map with the areas classified by DILG as highly urban areas. The DILG classifies cities and municipalities as highly urban if the population is greater than 200,000 and the yearly income of the local government exceeds PHP 50,000,000.
Agricultural	These are map sheets with significant amounts of agricultural areas. The agricultural areas in these map sheets should be at least 50 sq km and must not have been classified as Urban using the previous criteria.
Other Area	These map sheets that are neither classified as Urban nor Agricultural

Figure 4-9 Map Sheet Classification by Land Cover Type



- The map revision cycle scenario would assume only NAMRIA will be doing the update in-house. Thus, the analysis will determine the number of workstations required by NAMRIA at different stages of the map update cycle.
- To estimate Time, Resource and Cost Requirements for Sustainable Map Revision, it is assumed that only 15% of each map sheet will require re-plotting. The Plotting work includes plotting of Planimetry and Contours.
- The cost for satellite imagery and aerial photography will remain at 100%.

Max 15% of the above plotting quantity specified in Survery and Mapping Technology and cost estimation by Association of Precise Survey & Technology Japan in 1996 is used for 1:50,000 map updating in Phase II.

(3) Phase II Map revision cycle scenario

1) Fixed Time Scenario

Table 4-39 shows the time/resource/cost requirements for the fixed time map revision scenario. The table lists the required manpower and workstations that NAMRIA needs to acquire to be able to revise the different types of maps regularly.

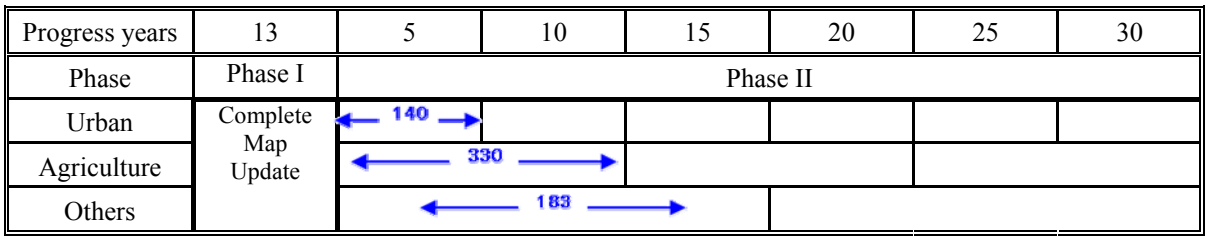
Table 4-39 Time, Resource, Cost Requirements for Sustainable Map Revision (Phase II)

Mapsheet Classi-fication	Total Map-sheets	Revision Cycle (Years)		Single Satellite Image	Stereo Satellite Image	Aerial Photo
Urban	140	5	Total Work Days	8,281	9,980	10,904
			Total Work Years	26.54	31.99	34.95
			Work Days/Sheet	59.15	71.29	77.89
			Engr A Total Man days	2,169	2,508	2,750
			Engr B Total Man days	8,281	9,980	10,904
			Engr C Total Man days	2,709	4,390	5,209
			NAMRIA Total Cost	105,970,227.84	168,965,691.60	242,288,053.33
			NAMRIA Cost/Sheet	756,930.20	1,206,897.80	1,730,628.95
			Time limit (work days)	1,560	1,560	1,560
			Required Teams to finish	6	7	7
			Required Workstations to finish	3	4	4
			Engr A Needed	2	2	2
			Engr B Needed	6	7	7
			Engr C Needed	2	3	4
Agricultural	330	10	Total Work Days	19,087	22,843	24,754
			Total Work Years	61.18	73.21	79.34
			Work Days/Sheet	57.84	69.22	75.01
			Engr A Total Man days	5,037	5,802	6,287
			Engr B Total Man days	19,087	22,843	24,754
			Engr C Total Man days	6,147	9,763	11,506
			NAMRIA Total Cost	245,557,377.86	381,477,264.33	537,667,162.70
			NAMRIA Cost/Sheet	744,113.27	1,155,991.71	1,629,294.43
			Time limit (work days)	3,120	3,120	3,120
			Required Teams to finish	7	8	8
			Required Workstations to finish	4	4	4
			Engr A Needed	2	2	3
			Engr B Needed	7	8	8
			Engr C Needed	2	4	4
Others	183	15	Total Work Days	9,542	10,712	11,257
			Total Work Years	30.58	34.33	36.08
			Work Days/Sheet	52.14	58.54	61.51
			Engr A Total Man days	2,642	2,939	3,066
			Engr B Total Man days	9,542	10,712	11,257
			Engr C Total Man days	2,782	3,887	4,407
			NAMRIA Total Cost	117,442,385.13	158,723,035.41	204,929,941.49
			NAMRIA Cost/Sheet	641,761.67	867,338.99	1,119,835.75
			Time limit (work days)	4,680	4,680	4,680
			Required Teams to finish	3	3	3
			Required Workstations to finish	2	2	2
			Engr A Needed	1	1	1
			Engr B Needed	3	3	3
			Engr C Needed	1	1	1

Figure 4-10 shows the revision cycle scenario for the next 30 years after finishing all map update works in Phase I. The thirty year schedule was selected because 30 is a multiple of 5, 10 and 15 years which are the periods in which Urban/Agricultural/Other map sheet types need to be revised to meet planning requirements. The table shows three teams to be formed to perform revision works continuously. The teams would be responsible to update each of the Urban/Agricultural/Other map sheets types. The schedule assumes current technology to used for the 30 year period. Most likely, future developments in technology would improve rates and costs of doing map revision work. This would necessitate adjustment of the schedule.

The following figure shows the conceptual diagram of the sustainable map revision cycle (urban, agricultural and others – 5, 10 and 15 years respectively).

Figure 4-10 Sustainable Map Revision Cycle (Fixed Time Scenario)



The required numbers of engineers and workstations using the single satellite method and cost for updating map data of urban, agricultural and other areas are summarized in the next table. A total of seven Engineer A, 22 Engineer B, and six Engineer C will be required with 12 workstations.

Table 4-40 Engineers and Workstation Requirement by Map Sheet (Fixed Time Scenario)

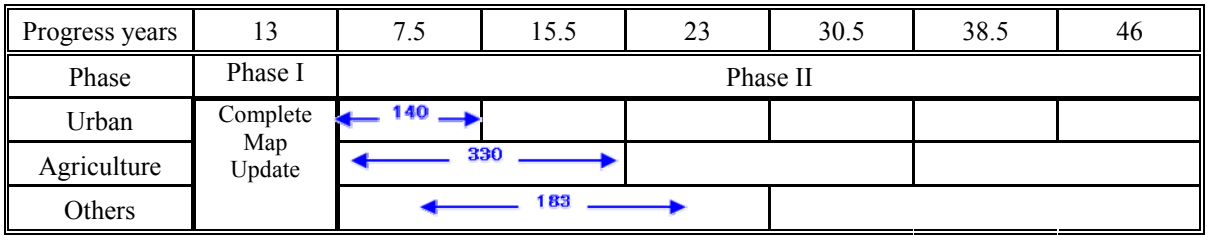
	Map sheets	Engineer A	Engineer B	Engineer C	Work-stations	Cost (PHP)	Cost/year (PHP)	Years
Urban	140	2	6	2	3	105,970,227	21,194,045	5
Agriculture	330	2	7	2	4	245,557,377	24,555,737	10
Others	183	1	3	1	2	117,442,385	7,829,492	15
Total	653	5	16	5	9	468,969,989	53,579,274	15

2) Fixed Budget Scenario

Table 4-41 shows the time/cost requirements for the fixed budget map revision scenario. Based on the single satellite method of update, it will take a total of 23 years to completely update all 653 map sheets.

The following figure shows the conceptual diagram of the sustainable map revision cycle (urban, agricultural and others – 7.5, 15.5 and 23 years respectively).

Figure 4-11 Sustainable Map Revision Cycle (Fixed Budget Scenario)



The required numbers of engineers and workstations using the single satellite method and cost for updating map data of urban, agricultural and other areas are summarized in the next table.

Table 4-41 Engineers and Workstation Requirement by Map Sheet (Fixed Budget Scenario)

	Map sheets	Engineer A	Engineer B	Engineer C	Work-stations	Cost (PHP)	Cost/year (PHP)	Years
Urban	140	2	6	2	3	105,970,227	14,129,363	7.5 (≒ 90 months)
Agriculture	330	2	7	2	4	245,557,377	15,842,411	15.5 (≒ 186 months)
Others	183	1	3	1	2	117,442,385	5,114,519	23.0 (≒ 276 months)
Total	653	5	16	5	9	468,969,989	35,086,293	23

The results of the manpower, workstation and total cost requirements for fixed budget scenario are the same as Table 4-40.

3) Fixed Budget Scenario/Same Duration

Table 4-42 shows the time/cost requirements for the fixed budget/same duration map revision scenario. Based on the single satellite method of update, it will take a total of 13.5 years to completely update all 653 map sheets.

The following figure shows the conceptual diagram of the sustainable map revision cycle (urban, agricultural and others – 13.5 years).

Figure 4-12 Sustainable Map Revision Cycle (Fixed Budget Scenario/Same Duration)

<table>
<tr><td>Progress years</td><td>13</td><td>13.5</td><td>27</td></tr>
<tr><td>Phase</td><td>Phase I</td><td colspan="2">Phase II</td></tr>
<tr><td>Urban</td><td rowspan="3">Complete Map Update</td><td>140</td><td></td></tr>
<tr><td>Agriculture</td><td>330</td><td></td></tr>
<tr><td>Others</td><td>183</td><td></td></tr>
</table>

The required numbers of engineers and workstations using the single satellite method and cost for updating map data of urban, agricultural and other areas are summarized in the next table.

Table 4-42 Engineers and Workstation Requirement by Map Sheet (Fixed Budget Scenario/Same Duration)

	Map sheets	Engineer A	Engineer B	Engineer C	Work-stations	Cost (PHP)	Cost/year (PHP)	Years
Urban	140	2	6	2	3	105,970,227	7,849,646	13.5
Agriculture	330	2	7	2	4	245,557,377	18,189,924	13.5
Others	183	1	3	1	2	117,442,385	8,699,435	13.5
Total	653	5	16	5	9	468,969,989	34,739,005	13.5 (162 months)

The results of the manpower, workstation and total cost requirements for fixed budget scenario are the same as Table 4-40.

(4) Evaluation and Recommendation

1) Cost

According to the analysis results of the first scenario, or "Fixed Time Scenario", based on the Philippine Regional Development plan, it was revealed that the budget of 53,578,000 pesos for nationwide map revision would be needed annually. And as shown the results, the total cost for Phase I amounted 446,429,000 pesos, and Phase II was 468,969,000 pesos. The reason of the increase in the total cost for Phase II is that cost of satellite images and contour data acquired for the geo-hazard mapping project was deducted from the total cost of Phase I, but Phase II included the cost for new procurement of satellite images to cover all over the country. The second scenario (Fixed Budget Scenario) and the third scenario (Fixed Budget Scenario/Same Duration) were analyzed on the same assumptions as the first scenario that the budget of 35,000,000 peso/year for Phase I would be secured for Phase II. Therefore, the total costs of both of the scenarios were 468,969,000 for Phase II.

2) Time

The period of sustainable map revision resulted in 15 years in case of the first scenario (Fixed Time Scenario), based on the Philippine Regional Development plan, and 23 years

in case of the second scenario (Fixed Budget Scenario), based on the premise that the budget for Phase II would be secured at the same level as Phase I. As for the third scenario (Fixed Budget Scenario/Same Duration), the period was 13.5 years under the same premise as the second scenario. Thus, while the annual cost was different among the three scenarios, the difference of the sustainable map revision period between the third scenario (Fixed Budget Scenario/Same Duration) and the first (Fixed Time Scenario) turned out to be only one year. In addition, the 13.5-year period for the sustainable map revision in the first scenario (Fixed Time Scenario) was almost the same as that for the revision plan Phase I, 13-year period.

3) Resource

The number of engineers (A total of 5 of Engineer A, 16 of B and 5 of C) and of equipment (9 workstations) for the sustainable map revision also coincided in the three scenarios.

The period and work volume needed for the sustainable map revision are as follows. 140 maps of urban areas in 5 years, 330 maps of agricultural areas in 10 years and 183 maps of other areas in 15 years in the first scenario (Fixed Time Scenario): 140 maps of urban areas in 7.5 years, 330 maps of agricultural areas in 15.5 years and 183 maps of other areas in 23 years in the second scenario (Fixed Budget Scenario): 140 maps of urban areas in 13.5 years, 330 maps of agricultural areas in 13.5 years and 183 maps of other areas in 13.5 years in the third scenario (Fixed Budget Scenario/Same Duration). Compared to Phase I, where NAMRIA will revise all the planimetric feature data of 653 maps in 13 years, the total work volume in the first scenario seems to be excessive to revise 140 maps of urban areas in 5 years, 330 maps of agricultural areas in 10 years and 183 maps of other areas in 15 years concurrently. However, in reality the average rate of revision per map sheet in urban areas will be up to 15%, and not more than 5% in agricultural and other areas. Judging from this work volume, the sustainable map revision cycle in the first scenario is viable with realistic workload.

As above, the Study Team, as the result of analysis of Phase II, concluded that NAMRIA is able to revise all topographic maps on a minimum 13.5-year cycle within its capabilities after Phase I, provided NAMRIA can secure the budget of 35,000,000 pesos annually for the sustainable map revision. The assumption of the budget was proposed in Section 4-8-3. The Study Team recommends NAMRIA to analyze each work volume and cost for urban, agricultural and other areas based on the second and third scenarios and reexamine more realistic expenses for the sustainable map revision and the nationwide map revision plan.

4-9 Action Programs

The action programs correspond to planning elements: institutions; organizations; individual (human resource); promotion; and the nationwide deployment. For each planning element, practical programs were planned; responsible parties and individuals were tentatively assigned.

Table 4-43 Action Programs

Classification	Group	Actions
Institution/Social		Legalize the Specifications for 1:50,000 topographic maps
		Develop specifications for GIS data and other spatial data at different scales so that other agencies will adopt the same standards and specifications
		Formulate spatial data exchange schemes among LGUs and NAMRIA
		Develop a human resource exchange programs or internship among the private sector and educational institutions
		Establish a professional licensing system for geodetic engineers and remote sensing experts.
		Collaborate with educational institutions to develop text books and other educational materials for school children.
Human Resource Development	Training Material Development	Preparation of Specification Training Manual (text material)
		Preparation of quality control table user manual (text material)
		Preparation of Rules and regulations for using facilities and equipment in NAMRIA
		Selecting and converting of text materials in the pdf format
	Curriculum development	Selection of lecturers and determination of fees
		Development of contents of e-learning and establishing e-learning sites (intra and internet sites)
	Monitoring and Evaluation	Conducting interview sessions with the staff to conduct individual training need assessment and to develop individual training program
		Assigning a training record personnel and development of training recording system
	Facility Development	Location selection and infrastructure study
		System Design and Layout Design
Organizational Development Plan	Lateral Coordination	Preparation of manuals with work flow diagrams by divisions
		Integration of the manuals and work flow diagrams by functions
		Conducting knowledge sharing session among the technical working groups
	Quality Control	Development of quality control table user manuals
		Formulate a working group to review and revise the Specifications;
		Formulate a working group to review the operation manuals;
		Development of an error recording and reporting system
		Development of an integrated data management system for the Photogrammetry and Cartography Divisions
		Facility planning for quality control and data management.
	Research and Development	Development of collaborative research programs with academics and professional organizations
		Organizing legal experts to develop a map sales licensing plan
		Preparation and implementation of a marketing study
		Development of new products for sales promotion
	Operational Tools for Efficiency Enhancement	Map Management System
		Time Management System
		Document Viewing System
		Human Resource Management System
Promotion	Marketing Study	Organizing a marketing group in NAMRIA
		Formulation of a marketing study plan
		Preparation of questionnaire by targets (public, private, and education)
	Promotional Material Development	A text based map search function development in the NAMRIA web site
		Development of a form mail function
		Brochure development for digital products
		Html based email message development
	Licensing	Organization of a legal study team to establish a licensing scheme for digital product promotion
		Development of copy protection system to the digital products
		Development of product registration and licensing system
		Preparation of a map sale privatization plan
	Branding	Brand development planning
Nationwide Deployment	Phase I	Selection of funding method
		Preparation of TOR
	Phase II	System Design
		Procurement of Equipment

Table 4-44 Implementing Organizational Unit and Person in Charge

Code	Action	Implementing individual/party	Person in Charge
I-1	Legalize the Specifications for 1:50,000 topographic maps	Board of Governors	-
I-2	Develop specifications for GIS data and other spatial data at different scales so that other agencies will adopt the same standards and specifications	Research and Development Section*	OIC
I-3	Formulate spatial data exchange schemes among LGUs and NAMRIA	Research and Development Section*	OIC
I-4	Develop a human resource exchange programs or internship among the private sector and educational institutions	Professional Associa-tions/NAMRIA/Educational Institutions	-
I-5	Establish a professional licensing system for geodetic engineers and remote sensing experts.	Professional Associations	-
I-6	Collaborate with educational institutions to develop text books and other educational materials for school children.	NAMRIA/Ministry of Education	Administrator
H-1	Preparation of Specification Training Manual (text material)	Human Resource Management Section*	OIC
H-2	Preparation of quality control table user manual (text material)	Human Resource Management Section*	OIC
H-3	Preparation of Rules and regulations for using facilities and equipment in NAMRIA	Human Resource Management Section*	OIC
H-4	Selecting and converting of text materials in the pdf format	Human Resource Management Section*	OIC
H-5	Selection of lecturers and determination of fees	Human Resource Management Section*	OIC
H-6	Development of contents of e-learning and establishing e-learning sites (intra and internet sites)	Human Resource Management Section*	OIC
H-7	Conducting interview sessions with the staff to conduct individual training need assessment and to develop individual training program	Human Resource Management Section*	OIC
H-8	Assigning a training record personnel and development of training recording system	Human Resource Management Section*	OIC
H-9	Location selection and infrastructure study	Human Resource Management Section*	OIC
H-10	System Design and Layout Design	Human Resource Management Section*	OIC
O-1	Preparation of manuals with work flow diagrams by divisions	Research and Development Section*	Director, Mapping Department
O-2	Integration of the manuals and work flow diagrams by functions	Research and Development Section*	Director, Mapping Department
O-3	Conducting knowledge sharing session among the technical working groups	Research and Development Section*	Director, Mapping Department
O-4	Development of quality control table user manuals	Quality control section*	Director, Mapping Department
O-5	Formulate a working group to review and revise the Specifications;	Quality control section*	Director, Mapping Department
O-6	Formulate a working group to review the operation manuals;	Quality control section*	Director, Mapping Department
O-7	Development of an error recording and reporting system	Quality control section*	Director, Mapping Department
O-8	Development of an integrated data management system for the Photogrammetry and Cartography Divisions	Quality control section*	Director, Mapping Department
O-9	Facility planning for quality control and data management.	Quality control section*	Director, Mapping Department
O-10	Development of collaborative research programs with academics and professional organizations	Research and Development Section*	Director, Mapping Department
O-11	Organizing legal experts to develop a map sales licensing plan	Research and Development Section*	Director, Mapping Department

Code	Action	Implementing individual/party	Person in Charge
O-12	Preparation and implementation of a marketing study	Research and Development Section*	Director, Mapping Department
O-13	Development of new products for sales promotion	Research and Development Section*	Director, Mapping Department
O-14	Map Management Database	Quality control section*	OIC
O-15	Time Management System	Planning Department	OIC
O-16	Document Viewing System	Record Section	OIC
O-17	Human Resource Management System	Human Resource Management Section*	OIC
P-1	Organizing a marketing group in NAMRIA	Information Services Division, Information Management Department	OIC
P-2	Formulation of a marketing study plan	Information Services Division, Information Management Department	OIC
P-3	Preparation of questionnaire by targets (public, private, and education)	Information Services Division, Information Management Department	OIC
P-4	A text based map search function development in the NAMRIA web site	Information Services Division, Information Management Department	OIC
P-5	Development of a form mail function	Information Services Division, Information Management Department	OIC
P-6	Brochure development for digital products	Information Services Division, Information Management Department	OIC
P-7	Html based email message development	Information Services Division, Information Management Department	OIC
P-8	Organization of a legal study team to establish a licensing scheme for digital product promotion	Research and Development Section*	OIC
P-9	Development of copy protection system to the digital products	Research and Development Section*	OIC
P-10	Development of product registration and licensing system	Research and Development Section*	OIC
P-11	Preparation of a map sale privatization plan	Research and Development Section*	OIC
P-12	Brand development planning	Information Services Division, Information Management Department	OIC
N-1	Selection of funding method (Phase I)	Office of the Administrator	Administrator
N-2	Preparation of TOR (Phase I)	Office of the Administrator	Administrator
N-3	System Design (Phase II)	Office of the Administrator	Administrator
N-4	Procurement of Equipment (Phase II)	Office of the Administrator	Administrator

Note: I (Institutional)
H (Human Resource Development)
O (Organizational)
P (Promotion)
N (Nationwide Deployment)
* Proposed by the Study Team

CHAPTER 5 RECOMMENDATIONS

(1) Formulation of Capacity Development Plan

At the institutional level of capacity development, the NSDI is the direction for efficient data exchange at the central level of the governments. The local governments will have to join this endeavourer for their local land use planning. At the organizational level of capacity development, the Mapping Department shall augment its functions on: quality control and data management; human resource management; and research and development. At the individual level of capacity development, efficient and continuous human resource development shall be implemented.

(2) Establishment of "Specifications for Topographic Mapping at Scale of 1:50,000"

Continuous review and revision of the Specifications shall be established under the Director's initiative. A responsible person for maintaining the Specification shall be assigned for this purpose.

The Specification for Topographic Mapping at Scale of 1:50,000 was prepared; the division chiefs shall review and revise the Specifications when necessary. The division chiefs shall prepare specifications for other scales and other products.

(3) Formulation of Human Resource Development Program and Implementation of Technical Training

The Study Team recommends that the OIC for HRD in the Mapping Department conduct an individual-training-needs assessment. The OIC for HRD shall prepare an annual training programming based on the individual training needs assessment.

(4) Implementation of Pilot Projects and Technology Transfer

Through the Pilot Projects, the Study Team has identified issues of operations. NAMRIA shall conduct individual evaluation the same way the Study Team has evaluated.

As for technical verification, the proposed Research and Development Section shall conduct such technical verification when NAMRIA needs to incorporate new technologies.

The Study Team has transferred technologies to individuals; the manuals—teaching materials—were prepared so that the technologies will retain in the organization. The Study Team recommends that NAMRIA shall train the staff using the manuals developed. NAMRIA shall develop additional operation manuals in the same way that the Study Team has prepared.

(5) Formation of Promotion Mechanism for Topographic Mapping at Scale of 1:50,000 and Associated Products

The number of Map Sale Office shall be increased to increase accessibility of maps and map related products. The Information Management Department needs to conduct marketing studies to capture the needs of customers—the process of marketing is to set direction of NSDI strategies along with defining data needs of local government units.

(6) Preparation of Action Program for Nationwide Topographic Mapping at Scale of 1:50,000

The Study Team has developed a cost estimate program for the Nationwide Deployment Program. The Study Team has presented the usage and transferred the map database to NAMRIA; NAMRIA now has the capacity of conducting cost estimate of its own by using the map database with cost factors. The Study Team recommends that NAMRIA examine the validity of the cost estimate for the Nationwide Deployment Plan. As the cost and schedules are refined, the human resource of NAMRIA will have to capacitated during or prior to the implementation of the capacity development phase of the nationwide deployment plan.

(7) Coordination and Cooperation with the Technical Coordinating Committee (TCC)

TCC functioned well during the Pilot Project. The coordination and cooperation with the local authorities will be inevitable in pursuing implementation of the Nationwide Deployment Plan. The Study Team recommends that after the completion of the Study, the structural formation shall be remained to conduct further topographic mapping projects.

(8) Mapping Technology

The Study Team recommends the single satellite images for planimetric feature revision for 1:50,000 topographic mapping with thorough application of quality control based on the Specifications. When more funds are available, utilization of stereo satellite images and aerial photographs shall be considered.

As for other technologies, there are examples of success with IFSAR data obtained. This technology should be applied for updating contour lines in the future after their updating by single satellite images. ALOS, satellite imagery, is another alternative to the IFSAR and SPOT combination to be explored in the future.

(9) Revision of and Exemption to the Rationalization Plan

The rationalization plan needs to be revised. The revision needs to address higher technical requirement for managers' positions and quality control positions. The overall number of staff will have to be reduced or re-training measures to relocated staff need to be addressed. If the approval of the current rationalization takes longer, there shall be certain exemptions of promotion and recruitment to fill critical positions.

(10) Manual Preparation

A documentation skill in English is necessary for all the staff in the Mapping Department. Especially, the division chiefs shall have the sufficient documentation skills to prepare manuals and specifications for operational management, so that each process of operation shall be standardized with operators and supervisors located at appropriate places at appropriate time.

The manual preparation skills will require systematic and logical thinking with technological understandings on each process of operation. The human resource development program shall cover management training which includes operation manual preparation.

(11) Comprehensive System Design

The Database Management Division has developed useful tools for management for other departments. The system development effort needs to be linked with overall organizational direction of NAMRIA. The Database Management Division shall coordinate with the Mapping Department, Administrative Division, and Plans & Operational Division to establish overall system deign for entire NAMRIA. The initial design cost may be high; overall development cost shall be substantially lower than the case without the comprehensive system design. The roles and process of operations will have to be defined before the comprehensive system design analysis.

(12) Staff Retraining

As the personnel analysis identified, some of the staff in the Cartography Division will have to be assigned to other divisions. The proposed Quality Control and Data Management Section will be a candidate section for those staff. The Human Resource Management Section shall select the staff in the Cartography Division and target the training efforts to quality control and data management.

(13) Securing Funds

The Study Team prepared the nationwide deployment plan together with NAMRIA. For the initial phase of the nationwide deployment plan to update nationwide 1:50,000 topographic maps, in order to implement the proposed 13-year updating plan, NAMRIA has to secure the total budget of 446 million pesos. The Study Team recommends that NAMRIA secures the amount and implement the nationwide deployment program.

CHAPTER 6 CONCLUSION

The six objectives were: (1) Formulation of Capacity Development Plan; (2) Establishment of "Specifications for Topographic Mapping at Scale of 1:50,000"; (3) Formulation of Human Resource Development Program and Implementation of Technical Training; (4) Implementation of Pilot Projects and Technology Transfer; (5) Formation of Promotion Mechanism for Topographic Mapping at Scale of 1:50,000 and Associated Products; and (6) Preparation of Action Program for Nationwide Topographic Mapping at Scale of 1:50,000. All the objectives were achieved; the Study was completed in time.

A policy study in the field of survey and mapping was the first attempt as an international cooperation project of JICA. The capacity development plan component was vaguely understood in the initial phase of the Study. The diagnostics of corporate culture (DCC) was also new to the counterparts. The Study Team had explained the new concepts through continuous dialogue with the counterparts.

DCC identified the organizational characteristics of NAMRIA. Although the organizational culture cannot be changed in a short period within a scope of the Study, a common goal of completing the Geo-hazard mapping project at the Mapping Department has raised "vitality" of the organization. The same vitality shall be attained while the mission of revising the topographic maps at scale of 1:50,000 will have been prioritized in the national development planning which requires updated geographic information at least at a scale of 1:50,000 for land use planning at the provincial and the city/municipal levels.

The results of the PCM helped to organize organizational issues involved in the Study. At the same time, it showed certain organizational directions by showing the actions programs as outputs.

The capacity-development-plan concept included the institutional, organizational, and individual aspects. In the initial phase of the study, the Study Team has reviewed legal aspects, educational institutions, and interviewed key informants in the private sector. Significant institutional issues identified were on rationalization of the public sector, international labor market, and copyright. The Study Team has formulated the capacity development plan considering those institutional issues. As rationalization process is already put into practice as in the consolidation of the Aerial and Spatial Survey Division to the Photogrammetry Division. Losing skilled and experienced staff are a common concern for the division chiefs; Protecting intellectual property of maps and map related products, is a vital for promoting maps and map related products. The Study Team has proposed efficient operation and human resource development and licensing, product registration, as key concepts to resolve the institutional issues.

Development of the topographic map management database was critical in the Study. The database was used for analyzing current conditions of the topographic maps. It was used for the formulation of the nationwide deployment plan. It approximated the costs of development as well. The database was also used as a tool for internal efficiency of the human resource development plan to strengthen the ownership concept of the capacity development. The database is transferred to the Mapping Department to be used for project management which is to be included in the monthly reporting system of projects in NAMRIA. The database is to be integrated to the current database in the Information Management Department.

The ownership concept of capacity development was fully considered in the process of technology transfer. The project of Layte initiated by NAMRIA using the method recommended by the Study Team was the another sign of ownership. Socetcet, introduced through OJT by a member of the Study Team in charge of digital mapping and editing, became the technology of NAMRIA to be used even before the completion of the Study is remarkable accomplishment of the NAMRIA side. The mono-satellite planimetric data revision method, which is introduced by the JICA Study Team, will remain in the Cartographic Department as long as the revision of the topographic maps will be continued. The map symbolization technology was further

strengthened especially in the area of library creation for objects and patterns. The method of object library contributed to efficient work in the process of map symbolization in the Photogrammetry Division and Cartography Division. The Specifications were discussed or even argued among the division chiefs and related staff of the Mapping Department several times. The staff in NAMRIA has already started to use the study materials which the Study Team had prepared.

Two phases: the initial short-term revision phase and the long-term cyclical revision phase were planned for the nationwide deployment plan. The short-term revision planning period (capacity development phase) is set at 13 years due to restricted financial resources of NAMRIA. In the long-term cyclical revision planning period (sustainable map revision phase), the period of the first scenario is 5 years for urban, 10 years for agricultural and 15 years for others, based on the revision cycles by land use and in line with regional development plans of the Philippines. Regarding the period of the second scenario, it is 7.5 years for urban, 15.5 years for agricultural and 23 years for others calculated from the budget for map revision. The third period is 13.5 years for urban, agricultural and others respectively, based on the budget for map revision and same duration. Future revision plans were recommended in consideration of the above second and third revision cycles. The mapping method for the period of capacity development phase shall be single satellite imagery for updating planimetric features and utilization of contour data processed from existing maps. IFSAR technology was also recommended for long-term cyclical revision of contour lines in the future. Based on the short-term revision and the long-term cyclical revision, the human resource requirement was calculated for implementation of map revision works.

The 1:50,000 topographic maps are the basis of national level planning. Planning activities by cities and municipalities, ideally, conducted using 1:10,000 or larger; however, in the meantime until all the 1:10,000 topographic maps will be prepared in urban area, the scale of 1:50,000 will become the base map for most cities and municipalities. The scale would be most appropriate in formulating provincial physical framework plans. The GIS ready data or topology added data shall be provided through the Map Sales Office. The revision cycle is sustainable within the capacity of NAMRIA, with nine (9) workstations after finishing the initial phase of revising all the topographic maps in 13 years.

The organizational direction of NAMRIA was set forth to be technological core of spatial data production and management. NAMRIA shall be equipped with higher capacity of intelligence; database and its application to serve more with less manual operation. The shift of paradigm mentioned in the rationalization is not only a policy statement, but also an inevitable future of NAMRIA.

The Study has focused on the effort to 1:50,000 topographic maps, but the method of research and development in other scales can be explored by NAMRIA itself. The Study Team would be grateful, if NAMRIA would expand its horizon of human resource development in other department, other scales and other technologies.

The direction of NAMRIA is become the human resource development center with a research and development function in geodetic engineering and remote sensing. The Study Team has recommended the single satellite imagery method with the IFSAR contour line data acquisition (existing contour data will be used in the initial phase); however, the technologies may become obsolete in the future when new replacement technologies will have been advanced. NAMRIA as the institute that have all the technological bases for survey and mapping shall continue to update not only the topographic maps at scale of 1:50,000 but also technologies of the staff with flexible organizational system that could adapt to new technologies.

Each member of the counterpart was very cooperative in conducting the Study. The Study Team is sure that the Study and the Sustainable Topographic Map Revision Plan for 1:50,000 Topographic Maps shall be fully incorporated to the existing plans and programs in NAMRIA under leaderships of the Administrator, Directors and Division Chiefs. The ownership of the plan now is under NAMRIA.

The Study Team has developed a database for 1:50,000 topographic maps. When it is integrated into other spatial data available and developed in other government agencies, such spatial data will become a powerful tool for planning and development at the national, provincial, city/municipal levels of governments. The applications of using the integrated data will have substantial positive effects to the nation's economy. In this manner, the Study shall become the basis of spatial data integration which the Philippines intend to achieve in the future.

The Study was completed; the implementation is yet to come. As recommended, the implementation of the nationwide deployment plan in proposed 13-year period of updating topographic maps will require a large total budget of estimated 446 million pesos. The Study Team strongly hopes that the Government of the Philippines, who ordered NAMRIA to update topographic maps, will take budgetary steps for this project to put the nationwide deployment plan into practice in the near future.