

Japan International Cooperation Agency (JICA)
Ministry of Civil Affairs, Bosnia and Herzegovina

THE STUDY
ON
ESTABLISHING DIGITAL TOPOGRAPHIC MAPS
FOR
BOSNIA AND HERZEGOVINA

FINAL REPORT

Volume II

Main Report

October 2005

Pasco Corporation

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Preface

In response to the request from the Government of Bosnia and Herzegovina, the Government of Japan decided to conduct the Study on Establishing Digital Topographic Maps for Bosnia and Herzegovina and entrusted the study to the Japan International Cooperation Agency (JICA).

The JICA organized and dispatched a study team headed by Mr. Eisaku Tsurumi of Pasco Corporation to Bosnia and Herzegovina seven times from February 2003 to October 2005.

The study was completed as scheduled with submission of the digital topographic maps and associated products. The study also included technology transfer to the country. I hope that the digital topographic maps will contribute to national and regional planning of the country especially on demining activities and housing planning for refugees and internally displaced persons. I also hope that this report will contribute to promote future projects and to enhance friendly relationship between our two countries.

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

Kazuhisa MATSUOKA

Vice President

Japan International Cooperation Agency



March 28, 2003 Ministry of Foreign Affairs, Sarajevo



March 12, 2003 Ministry of Foreign Affairs, Sarajevo



A thematic map produced by the counterparts using the data created during the study

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1. Scope of Work for the Study on Establishing Digital Topographic Maps for BiH, October 23, 2002

Minutes of Meetings

1. Minutes of Meeting on Scope of Work for the Stud on Establishing Topographic Maps for BiH, October 23, 2002
2. Minute of Meetings on the Inception Report and Others, March 28, 2003
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5. Minutes of Meetings on Implementation of the Works for the Third Phase, November 17, 2004
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Volumes

Volume I Summary

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Main Report

Specifications

Scope of Work for the Study

Minutes of Meetings

Volume III Manuals

1. Aerial Photograph Inspection Manual
2. Field Identification and Supplemental Survey Manual
3. Aerial Triangulation and Digital Plotting Manual
4. GIS Data Preparation Manual
5. Digital Map Symbolization Manual

Abbreviations and Acronyms

AIT	Advanced Intelligent Tape
ASCII	American Standard Code for Information Interchange
BHMAC	Bosnia and Herzegovina Mine Action Center
BiH	Bosnia and Herzegovina
CAD	Computer Aided Design
DTM	Digital Terrain Model
DXF	Data Exchange Format
FBH	Federation of Bosnia and Herzegovina
GCP	Ground Control Point
GDP	Gross Domestic Product
GIS	Geographic Information System
GPS	Global Positioning System
HATS	Helava Automated Triangulation System
HDD	Hard Disk Drive
JICA	Japan International Cooperation Agency
LAN	Local Area Network
NATO	North Atlantic Treaty Organization
OJT	On - the - Job - Training
SFOR	Stabilization Force in Bosnia and Herzegovina
RS	Republic of Srpska
TM	Transverse Mercator
USB	Universal Serial Bus
UTM	Universal Transverse Mercator

Volume II
Main Report

1 INTRODUCTION

The Government of Bosnia and Herzegovina requested the Government of Japan to establish digital topographic maps for Bosnia and Herzegovina (BiH) in October 2001. In response to the request, the Government of Japan decided to conduct "The Study on Establishing Digital Topographic Maps for Bosnia and Herzegovina" (hereinafter referred to as "the Study").

The Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the technical international cooperation programs of Japan, dispatched a preparatory study team to investigate the situation of topographic mapping in BiH. After a thorough investigation by the preparatory study team, the scope of work for the Study was agreed upon between Ministry of Civil Affairs and Communication, BiH, and the JICA on October 23, 2002. (Scope of Work, and Minutes of Meetings 1)

JICA organized the JICA Study Team (hereinafter referred to as "the Team") as the execution body. The Study, as a three - year (four - phase) project, started in February 2003 and ended in October 2005.

At the beginning of the Study, the Team presented the Inception Report including the work plan to the Coordinating Committee Meeting and the report was agreed between the BiH side and the Team. According to the plan, the works were performed with the BiH side's close cooperation. The Team presented the Interim Report in February 2004, reporting the progress of the Study during the first and second phases. In January 2005, the Team presented the Progress Report reporting the progress during the third phase.

This Final Report includes the processes and results of the digital topographic mapping and technology transfer. It also presents recommendations to the Government of BiH on its future data updating and servicing.

1 - 1 Objectives

The objectives of the Study are:

- (1) To take new aerial photographs of the whole country of BiH;
- (2) To prepare new digital topographic maps on a scale of 1:25,000 covering the forty - seven (47) map sheets for the cities which are; Sarajevo, Mostar, Tuzla, Zenica, Bihac, Travnik, Citluk, Livno, Jajce, Siroki Brijeg, Gorazde, Banja Luka, Bijeljina, Prijedor, Doboj, Trebinje, Zvornik, Derventa, Gradiska, Visegrad, and Brcko (herein - after referred to as "the Principal 21 Cities".);

1/ structured: In this report, "to structure" means to define layer codes and data type of GIS data and/or to put topology information to the GIS data.

(3) To prepare digital topographic maps (structured, ^{1/} but not symbolized) covering the whole country of BiH except the forty - seven (47) map sheets for the Principal 21 Cities, based on the existing 1:25,000 scale topographic maps; and

(4) To pursue technology transfer in the course of implementation of the Study.

In addition to the above objectives, ten (10) sheets of 1:25,000 scale topographic maps, sixteen (16) sheets of large scale topographic maps and so on were prepared using the new aerial photos taken in this project for providing basic topographic data for the JICA study project on Sustainable Development Through Eco - tourism (hereinafter referred to as "the Eco - tourism Study").

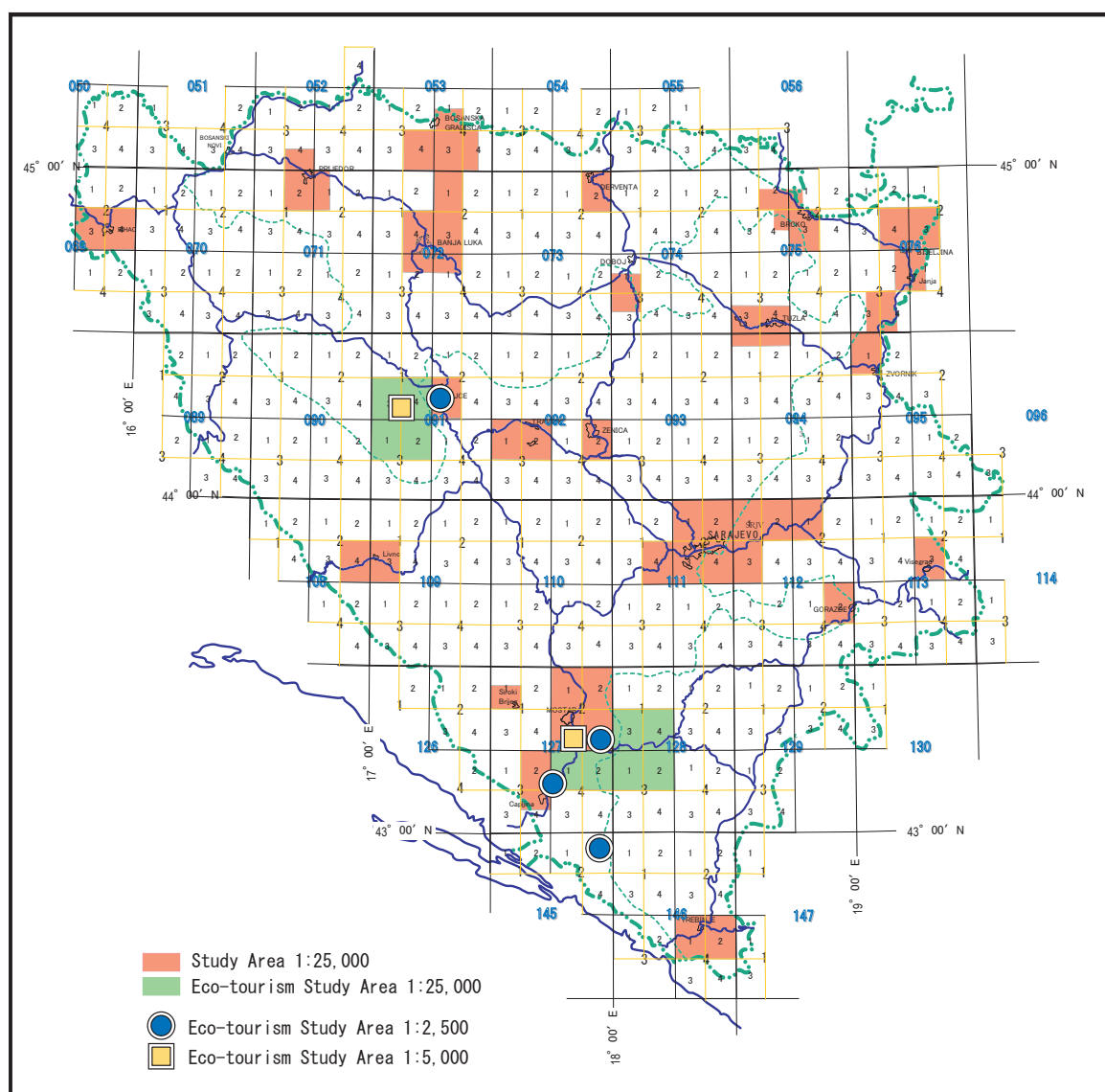


Figure 1 - 1 Study Area

1/ GIS data: In this report, a term of "GIS data" is especially used as vector data for GIS, DXF data and/or ArcInfo coverage to be exact.

1 - 2 Study Area

The Study areas are shown in Figure 1 - 1. New aerial photographs cover the whole country. Orange - colored quadrangles show the new mapping areas for the Principal 21 Cities. Green - colored quadrangles show the additional mapping areas. The rest of the quadrangles are covered by GIS data ^{1/} compiled from the existing 1:25,000 scale topographic maps. The blue circles and yellow squares show additional large scale topographic mapping areas.

1 - 3 Organization of the Study

JICA organized the JICA Study Team (hereinafter referred to as "the Team") as the execution body. The assigned members are listed in Table 1 - 1.

Table 1 - 1 Study Team Members

Mr. Eisaku Tsurumi	Leader
Mr. Daikichi Nakajima	Supervisor of Aerial Photography
Mr. Yutaka Nakada	Supervisor of Control Point Survey
Mr. Sadao Matsumoto	Supervisor of Photo Interpretation, Field Identification and Field Completion, and Coordinator
Mr. Takeo Muto	Supervisor of Additional Control Point Survey, Photo Interpretation, Field Identification and Field Completion
Mr. Minori Onaka	Supervisor of Digital Plotting
Mr. Nobuhiro Sata	Supervisor of Digital Plotting
Mr. Takashi Shimono	Supervisor of Digital Map Symbolization
Mr. Toshinori Otsu	Supervisor of Digital Map Symbolization, and Coordinator
Mr. Hidetoshi Kakiuchi	Supervisor of GIS Data Creation
Mr. Kazunobu Kamimura	Coordinator
Mr. Fujio Ito	Coordinator
Mr. Kei Sato	Coordinator
Mr. Kohei Yamamoto	Coordinator
Mr. Atsushi Saito	Interpreter
Mr. Koichi Karasawa	Interpreter

The Government of BiH (the BiH side) assigned the Ministry of Civil Affairs as the counterpart agency. The Coordinating Committee was organized in the BiH side for smooth implementation of the Study. The Team executed the Study in close contact with the Committee. The Committee comprises the following organizations.

- Ministry of Civil Affairs, Bosnia and Herzegovina
- Ministry of Foreign Affairs, Bosnia and Herzegovina
- Federal Administration for Geodetic and Real Property Affairs, the Federation of Bosnia and

Herzegovina

- Republic Administration for Geodetic and Real Property Affairs, the Republic of Srpska
- Department of Public Records, the Government of Brcko District

A member from the Ministry of Civil Affairs takes the chair.

The members are listed in Table 1 - 2.

Table 1 - 2 Coordinating Committee Members (2005)

Mr. Srdjan Arnaut	Adviser and Chief of Cabinet of Minister of Civil Affairs, Bosnia and Herzegovina
Mr. Sefik Rizvanovic	Adviser to the Minister of Civil Affairs, Bosnia and Herzegovina
Mr. Haris Cengic	Assistant to the Minister of Civil Affairs, Bosnia and Herzegovina
Ms. Biljana Grujic	First Secretary, Department for Economic Multilateral Relations and Reconstruction, Ministry of Foreign Affairs, Bosnia and Herzegovina
Mr. Eldin Donlagic	Assistant director of Federal Administration for Geodetic and Real Property Affairs, Federation of Bosnia and Herzegovina
Mr. Vladimir Bojat	Director of Republic Administration for Geodetic and Real Property Affairs, Republic of Srpska
Mr. Lazo Sikimic	Assistant director of Republic Administration for Geodetic and Real Property Affairs, Republic of Srpska
Mr. Hajrudin Jusufovic	Head of Public Records Department, Brcko District of Bosnia and Herzegovina
Ms. Senada Hamidovic	Head of Division of Cadastre Books and Archive of Public Records Department, Brcko District of Bosnia and Herzegovina
Mr. Kemal Karkin	Director of Project Implementation Directorate, Ministry of Communications and Transportation, Bosnia and Herzegovina

The following persons participated in the meetings as the members in 2003 and 2004.

Table 1 - 3 Coordinating Committee Memebers (2003 - 2004)

Mr. Mirza Pinjo	Ministry of Foreign Affairs, Bosnia and Herzegovina
Mr. Todor Panic	Republic Administration for Geodetic and Real Property Affairs, Republic of Srpska
Mr. Nikola Ristic	Public Records Department, Brcko District of Bosnia and Herzegovina
Mr. Stanko Tomic	Public Records Department, Brcko District of Bosnia and Herzegovina

1 - 4 Flow of the Study

According to the work plan agreed upon between the BiH side and the Team in March 2003, the Team conducted the Study from 2003 through 2005 in cooperation with the BiH side. The works were performed in BiH and Japan with some additions to the original plan and completed in October 2005. Chronological process of the Study is shown in Figure 1 - 2.

The objectives of the Study, described in Section 1 - 1, can be divided into topographic data production and technology transfer. And topographic data production is divided into new mapping and digitization of existing topographic maps.

The process adopted for the new topographic data production in this project is briefed below.

New Mapping for 21 Principal Cities

1. Signalization of existing control points were performed in the new mapping areas to prepare ground control points for aerial triangulation. In addition, control point survey with GPS and

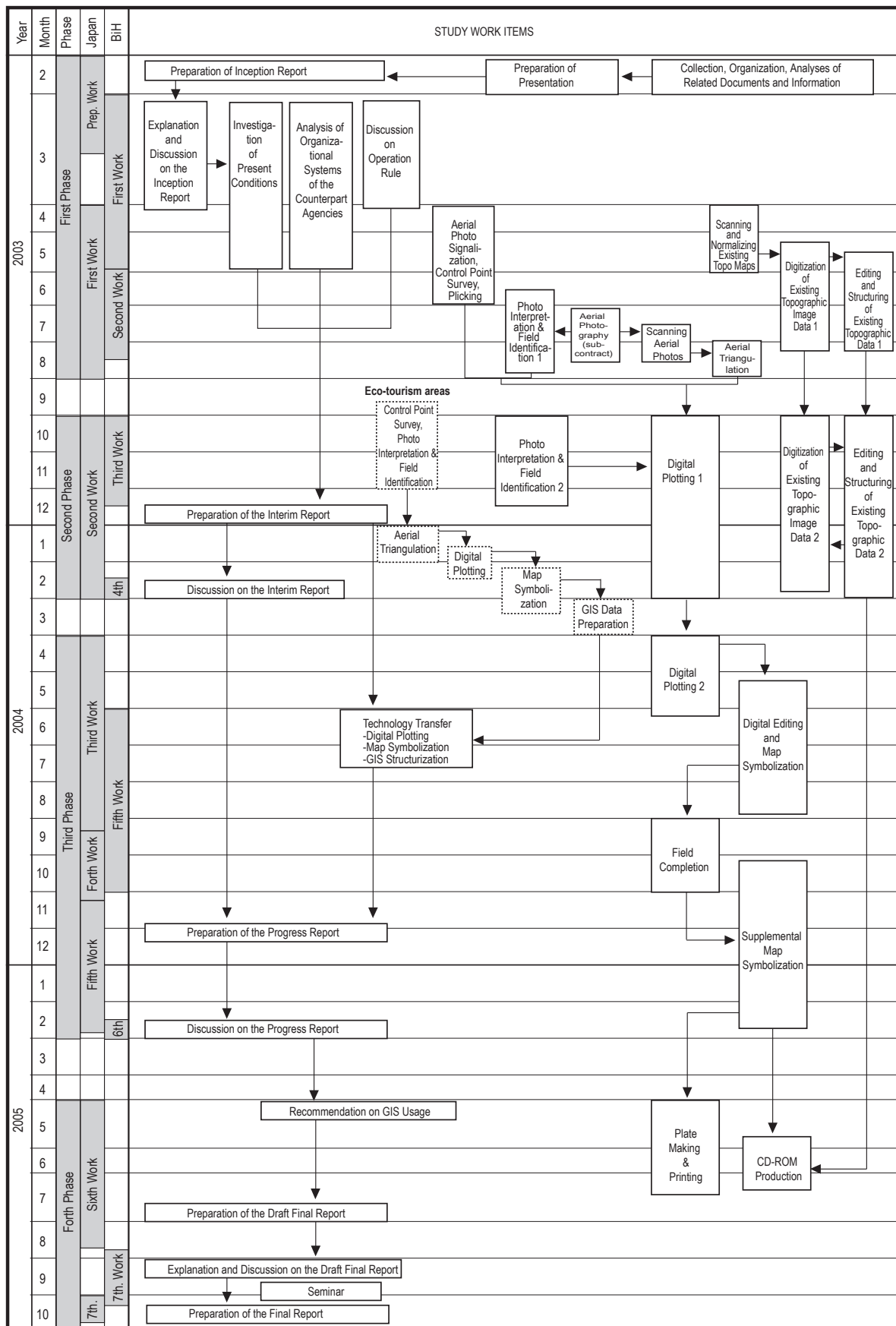


Figure 1 - 2 Overall Study Flow

- signalization of new points were performed.
2. Aerial photography was carried out for the whole country.
 3. With the progress of aerial photography, photo interpretation and field identification for the new mapping areas were performed using enlarged photo prints.
 4. On the other hand, aerial photos were scanned to make photo image data (scanned data).
 5. Aerial triangulation was performed, using the result of control point survey and the scanned data of photos.
 6. Digital plotting was carried out using three - dimensional photo images, based on the results of aerial triangulation, photo interpretation and field identification.
 7. Based on the plotted data, draft analogue maps were compiled through digital map symbolization. National boundaries and letters of place names, etc. were included.
 8. After completion of draft analogue maps, field completion was carried out using the outputted draft map sheets. National boundaries and letters were also checked.
 9. Based on the results of field completion, supplementary works of digital plotting, digital map symbolization and lettering were performed. Outputted draft map sheets are finally checked to finalize the symbolized map data.
 10. From the finished symbolized map data, plate films of each map sheet were processed for printing.
 11. The new map sheets were printed with offset printer and these symbolized data were stored into media.

Digitization of Existing Topographic Maps

The process of digitizing the existing topographic maps in this project is briefed below. .

1. All the existing topographic map sheets were scanned and then the scanned data were geo - referenced.
2. Based on the geo - referenced map image, topographic map features and contour lines were digitized to make vector data except for the newly mapped areas.
3. The vector data were topologically structured into GIS data. From the contour data, digital terrain model (DTM) was generated.
4. The vector data resulted from the supplementary digital plotting for the new mapping areas were also structured into GIS data.
5. All the GIS data were finally checked and stored into media.