REPORT
ON
THE GEODETIC SURVEY OF CONTROL POINTS FOR JOINT PRODUCTION OF COMMON DATUM CHARTS OF THE STRAITS OF MALACCA AND SINGAPORE

PHASE II

April 1981

JOINT SURVEY TEAM
INDONESIA, JAPAN, MALAYSIA & SINGAPORE

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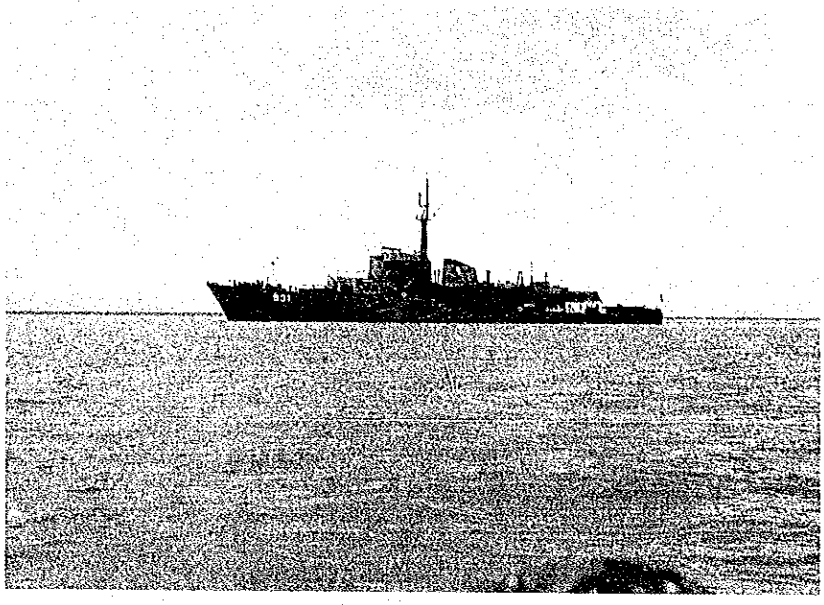
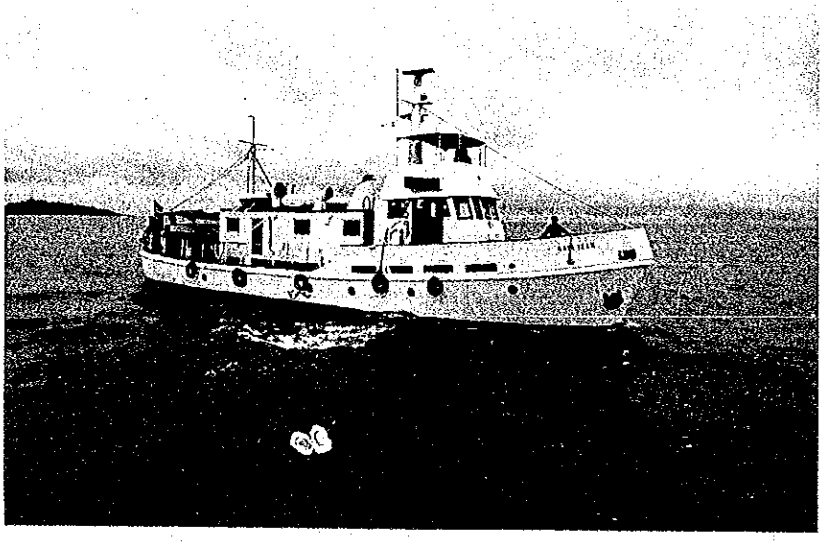
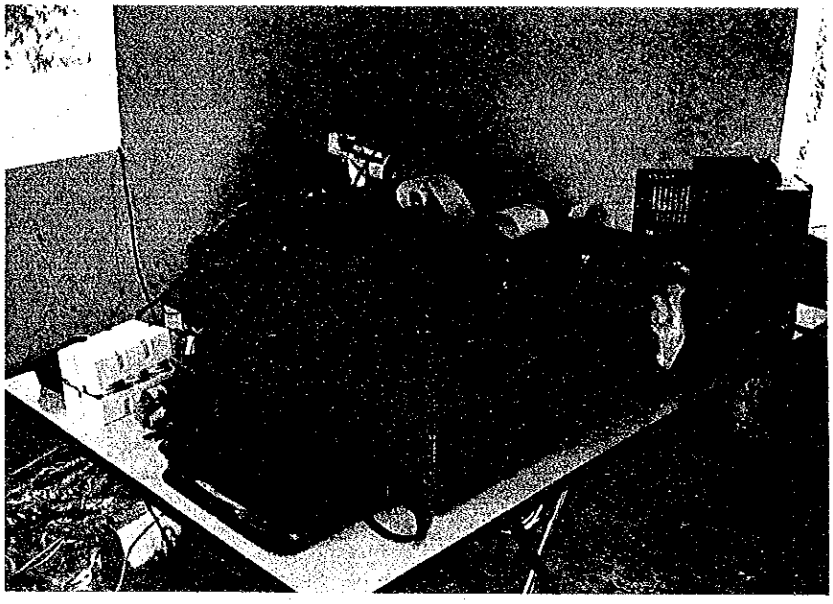


KRI BURUJULASAD

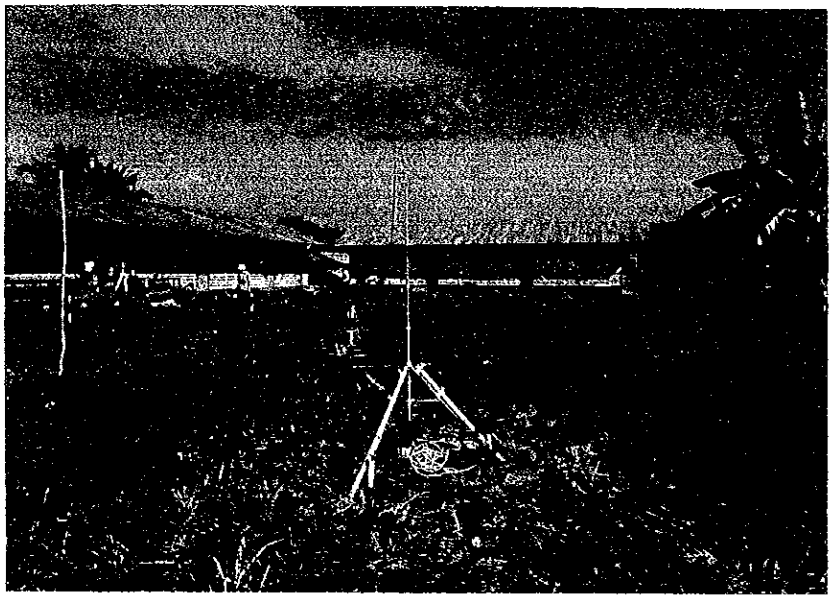


MV MATA IKAN



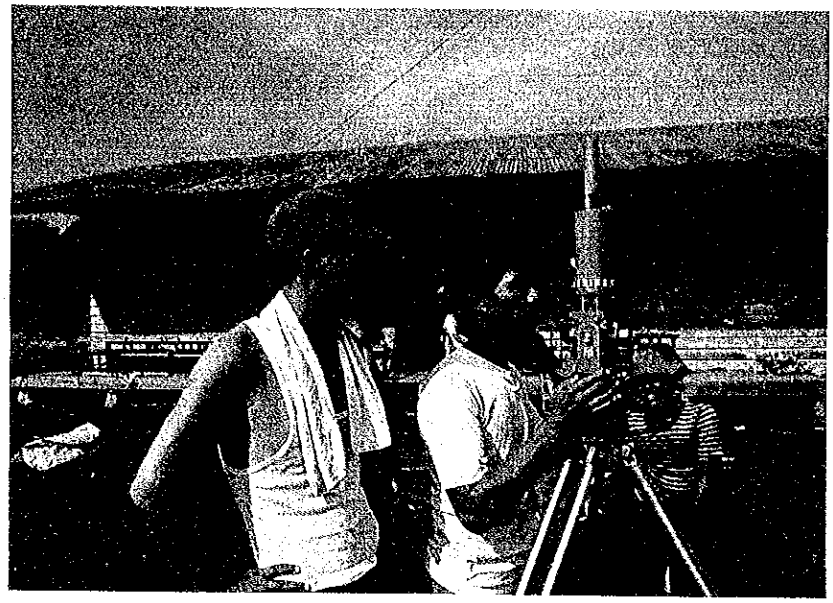
NNSS receiver
at Pulau Pisang station

NNSS receiving antenna
at Tg. Sekudi



Plane table survey
at Pulau Pisang

True north observation
using
Gyro-theodolite



Traversing
at AS 107 station,
Teluk Merbau

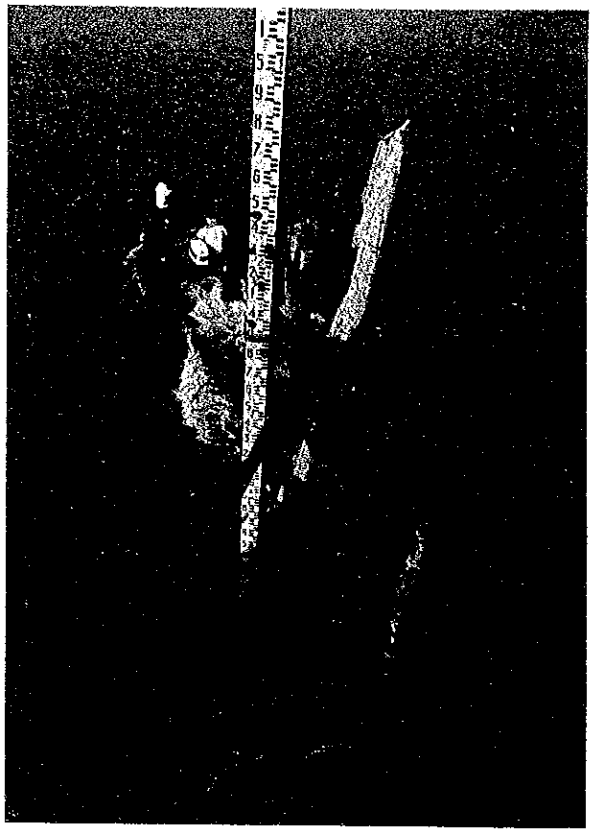
CDC control point
at Tg. Sekudi

Indonesian and Japanese
inspection teams
on board KRI BURUJULASAD

Survey team members
going back to
KRI BURUJULASAD
after completion of
daily field work

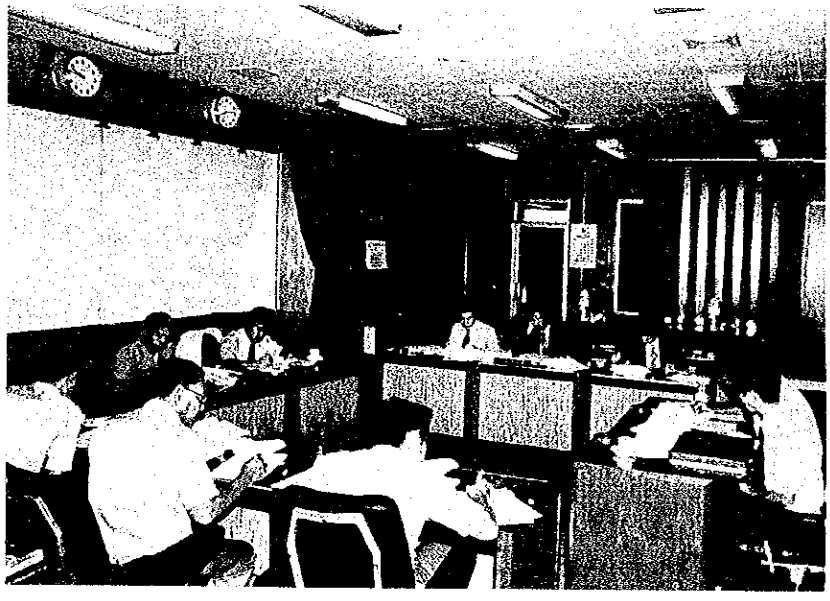
Landing craft
transporting materials
to a survey station

Levelling at Bengkalis



Tide pole at Tg. Sekudi

Data processing at the Hydrographic Department,
Port of Singapore Authority



Meeting of the Data Processing and Preparation of Report
Indonesian Hydro-Oceanographic Office, Jakarta
19 – 25 April 1981

REPORT ON THE GEODITIC SURVEY OF CONTROL POINTS FOR JOINT PRODUCTION OF COMMON DATUM CHARTS OF THE STRAITS OF MALACCA AND SINGAPORE

CONTENTS

1. GENERAL

1-1. Introduction

The Governments of the Republic of Indonesia, Japan, Malaysia and the Republic of Singapore reached an understanding in April 1977, to produce Common Datum Charts (CDC) covering the Straits of Malacca and Singapore.

Based on the above understanding, Phase I of the Joint Project was successfully completed in 1979, and three sheets of CDC, covering the Singapore Strait were produced.

During the Phase I of the Project, it was confirmed that the control points on the smooth sheets covering the east coast of Sumatera were not connected to the Fundamental Point at Pulau Pisang. A reconnaissance of these control points indicated that it would be possible to make such connection by carrying out a geodetic survey of the control points required for production of CDC of Phase II.

On 19th June 1980, a Joint Technical Meeting was held in Kuala Lumpur, and the Memorandum of Procedure (MOP) for the Joint Production of Common Datum Charts of the Straits of Malacca and Singapore, Phase II, was concluded. It was agreed that another three sheets of CDC would be produced. These charts would cover the area from the north-western approaches of One Fathom Bank to the eastern entrance of the Singapore Strait.

In accordance with the MOP above, the field work of the geodetic survey was successfully carried out from 25th August to 9th December 1980.

This Report gives a descriptive account of the implementation and results of the geodetic survey.

1-2. Summary of the Reconnaissance of Control Points in Phase I.

The reconnaissance of control points in Phase I was carried out by the joint team of the four participating countries using the Indonesian Survey Ship KRI JALANIDHI from 23rd January to 21st February 1979.

The purpose of this reconnaissance was to confirm the existence of marker stones of the control points (astronomical observation spots) used for construction of Indonesian charts, as well as to collect necessary information for landing, transporting, setting and operation of instruments to be used for Doppler sattellite observations to Navy Navigation Satellite System (NNSS) at these stations.

The reconnaissance of eleven control points on the east coast of Sumatera was carried out and it was found that eight of them were still in existence.

The results of the reconnaissance are as shown in Table 1.

Table 1. Results of Reconnaissance

Name of Spot	No.	Latitude	Longitude	Results
Tanjung Medang	AS 190	02°07'06".50N	101°38'40".19E	Found
Tanjung Ketam	AS 193	02°00'01".80N	101°19'08".59E	Found
Pangkalen Sesai	AS 195	01°41'47".80N	101°24'44".39E	Found
Tanjung Jati	AS 198	01°36'36".40N	101°59'09".69E	Missing
Merambung	AS 197	01°36'23".10N	101°49'13".39E	Missing
Tanjung Parit	AS 185	01°31'34".20N	102°26'24".29E	Missing
Bengkalis	AS 121	01°27'57".20N	102°06'37".89E	Found
Bukit Batu	AS 120	01°27'33".50N	101°59'19".79E	Found
Tanjung Sekudi	AS 122	01°15'36".00N	102°29'30".19E	Found
Tanjung Kedabu	AS 180	01°05'38".10N	102°58'15".99E	Found
Tanjung Bakau	AS 182	00°49'44".50N	103°06'39".59E	Found (submerged)

1-3. Plan of Execution of Geodetic Survey in Phase II

1-3-1. Objective

To determine the geodetic coordinates of the control points on the World Geodetic System 1972 (WGS-72), necessary for construction of CDC in Phase II. Doppler satellite observations to Navy Navigation Satellite System (NNSS) would be made.

1-3-2. Control Points to be Reconnoitred and Surveyed.

The control points to be reconnoitred and surveyed would be as shown in Table 2.

Table 2. List of Control Points

Name of Point	No.	Latitude	Longitude	Remarks
Fundamental Point				
Pulau Pisang	--	01°28'08".1158N	103°15'22".6890E	
Control Points				
Bengkalis	AS 121	01°27'57".20N	102°06'37".89E	
Tg. Ketam	AS 193	02°00'01".80N	101°19'08".59E	
Tg. Sekudi	AS 122	01°15'36".00N	102°29'30".19E	
Tg. Medang	AS 190	02°07'06".50N	101°38'40".19E	
Cape Rachado	--	02°24'26".284N	101°51'12".879E	
Teluk Merbau	AS 107	02°04'12".40N	100°38'19".29E	Marker stone to be reconnoitred
or				
Bagan Siapi-api	AS 106	02°09'5N	100°48'.5E	
Tg. Kedabu	AS 180	01°05'38".10N	102°58'15".99E	
Tg. Bakau	AS 182	00°49'44".50N	103°06'39".59E	

1-3-3. Period of Survey

For 107 days from 25th August to 9th December 1980.

1-3-4. Composition of Survey Team

Indonesia	: 6 plus Survey Ship's complement
Japan	: 8
Malaysia	: 3
Singapore	: 3
Total	: 20 plus Survey Ship's complement (see Annex B)

1-3-5. Survey Ships

(1) Indonesian Survey Ship KRI BURUJULASAD (2,150 tons), Indonesian Naval Hydro-Oceanographic Office.

(2) Singapore Survey Vessel MV MATA IKAN (125 tons), Port of Singapore Authority.

The KRI BURUJULASAD would be employed mainly as an operational headquarters and supply base for control points, while the MV MATA IKAN as a supply vessel for the Fundamental Point at Pulau Pisang.

1-3-6. Detailed Plan of Survey

1-3-6-1. Survey Methods

(1) Satellite Geodesy

An NNSS receiver would be set at the Fundamental Point at Pulau Pisang, and continuous observations of Doppler shifts would be carried out. Simultaneously at each of the control points, continuous observations of Doppler shifts would also be carried out using the same type of receiver.

(2) Survey of the Relationship between Old and New Control Points.

In case where satellite observation by NNSS receiver is not advisable at a control point, a new CDC marker stone would be established near the control point for the observation.

The relationship between the old and new stations would be determined by traversing.

(3) Levelling

The elevation above mean sea level of the Fundamental Point and control points would be measured by tide observations and levelling.

(4) Other Survey

Traversing would be carried out from AS 190 to Tg. Medang Lighthouse in order to obtain the geodetic coordinates of the Lighthouse.

1-3-6-2. Communications

Continuous communications using SSB transceivers would be maintained among the KRI BURUJULASAD, Pulau Pisang and the control points when the NNSS receivers were set up for simultaneous satellite observations.

1-3-7. Details of Work

1-3-7-1. Work of Survey Team

(1) Fundamental Point (Pulau Pisang)

a) Establishment and dismantling of the survey station.

b) Craft to be used for transportation:

i) Landing craft to carry heavy materials.

ii) Rubber boats mainly for transportation of survey team members between KRI BURUJULASAD and the station.

iii) MV MATA IKAN for supply of food and fresh water as well as transportation of joint team members for Singapore.

c) Members to be stationed: 7 persons

1 each from participating countries (1 NNSS engineer from Japan)	: 4
Assistant surveyors (from Indonesia)	: 2
Cooking and miscellaneous service (from Indonesia)	: 1

d) Tasks

i) To carry out continuous NNSS observation.

ii) To maintain continuous SSB communications.

iii) To carry out traversing between the Fundamental Point and Pulau Pisang Lighthouse.

iv) To carry out levelling between the Fundamental Point and the B.M. established during the Joint Tidal and Current Studies.

(2) Control Points

a) Craft to be used for the establishment and removal of survey stations

i) One landing craft to carry heavy materials.

ii) Four rubber boats.

iii) Survey boat carried on board the KRI BURUJULASAD for guard and rescue work.

b) Materials and expendables necessary for the operation and maintenance of the survey station would be supplied from the KRI BURUJULASAD.

c) Members to be stationed: 13 persons

2 from Indonesia and 1 each from Japan, Malaysia and Singapore	: 5
NNSS engineers (from Japan)	: 2
Assistant surveyors (including three for tidal observation) (from Indonesia)	: 4
Cooking and miscellaneous service (from Indonesia)	: 2

d) Tasks

i) To determine and clear the sites for establishing NNSS antenna and camping facilities.

ii) To establish a marker stone, tide pole, temporary B.M. and tide gauge for each station.

iii) To carry out continuous NNSS observation.

iv) To maintain continuous SSB communications.

v) To carry out azimuth observation at new control points. Positions of conspicuous landmarks suitable for navigation would also be fixed by traversing.

vi) To determine short-term mean sea level.
(No tidal observation would be carried out at the site where B.M. already exists).
The difference in heights between the graduation of the tide pole and the temporary B.M. would be correlated by direct or indirect levelling.

vii) To carry out direct levelling between the new control point and the temporary or established B.M.

viii) To prepare descriptions of new control points.

(3) Ship Party

a) Members to be stationed on board KRI BURUJULASAD:
9 persons.

Indonesia : 3
Japan : 4
Malaysia : 1
Singapore : 1

b) Tasks

i) To maintain continuous SSB communications with the shore stations.

ii) To hold operation meeting.

iii) To carry out data processing.

iv) To carry out repair of equipment.

v) To render other supporting services.

1-3-7-2. Deployment of Radio Communication Facilities

(1) SSB transceivers

1 each at Pulau Pisang, control points and KRI BURUJULASAD.

(2) Walkie-talkies

3 at Pulau Pisang, 9 on KRI BURUJULASAD, supporting craft and control points.

1-3-7-3. Details of Survey

(1) Geodetic Survey

a) Pulau Pisang station: 72-day continuous observation.

b) Each control point station: 5-day continuous observation.

c) Satellites expected to be used: 5 satellites, Nos. 30110, 30130, 30140, 30190 and 30200.

d) For determination of geodetic positions, Translocation and Point Positioning Methods would be used.

e) Number of passes expected to be received: 8-9 passes/day for Point Positioning: 3 passes/day for Translocation.

f) Accuracy:

i) Point Positioning Method: Better than 10 metres with 40 passes.

ii) Translocation Method: Better than 3 metres with 40 passes.

(2) Azimuth Observation

a) Instruments to be used: Wild T2 and T16 Gyro-theodolite.

b) Accuracy: Better than 20".

(3) Traversing

a) Instruments to be used: Wild T2 Theodolite and YHP 3800 B distance meter.

b) Accuracy: Better than 20 cm horizontally and vertically.

(4) Determination of Mean Sea Level

Short-term mean sea level would be obtained from 5-day tide observation.

(5) Determination of height based on local geoid

a) Instrument to be used: Wild N2 level.

b) Accuracy: Better than 5 cm.

1-3-7-4. Data Processing

(1) Common Datum Point

The Common Datum Point would be the Fundamental Point at Pulau Pisang with Doppler satellite derived coordinates based on the WGS-72, obtained by Joint Survey of Australia and Indonesia in 1974: 01°28'08".1158N, 103°15'22".6890E.

(2) Ellipsoid of reference

The reference ellipsoid to be used would be the World Geodetic System 1972 (WGS-72) with a=6378135.00 metres and f=1/298.26.

(3) Data Processing in the field

a) On board KRI BURUJULASAD

i) Computation of latitude and longitude by Point Positioning Method from satellite observations.

ii) Computation of azimuth observations.

iii) Computation of traversing.

iv) Determination of mean sea level.

v) Computation of levelling.

vi) Preparation of station descriptions of control points.

vii) Preparation of photo albums.

b) Upon completion of field work of survey (from 4th to 6th December 1980)

i) Preparation of a field survey report.

ii) Preparation of photo albums.

(4) Work to be done in Japan by the Japanese members after completion of field survey.

a) Final checking of data obtained from the survey.

b) Final computation of each control point by Point Positioning and Translocation Methods.

c) Preparation of the results of survey.

d) Preparation of a draft final report of geodetic survey.

2. OUTLINE OF OPERATIONS

2-1. Summary of Operation

The field survey was carried out in four stages as follows:

2-1-1. Stage One

The survey in Stage One commenced on 31st August and was completed on 22nd September 1980 at Bengkalis and Tg. Ketam. "Translocation Method" of computing the position for Tg. Ketam was not possible between 15th to 20th September because the cassette recorder of the NNSS receiver at the Fundamental Point was found to be faulty. Accordingly, "Point Positioning Method" only could be employed for the computation at Tg. Ketam.

2-1-2. Stage Two

The survey in Stage Two commenced on 27th September and was completed on 15th October 1980, at Tg. Sekudi and Tg. Medang. During the period of survey at the Tg. Sekudi station, an NNSS engineer Mr. Tateyama from Japan became seriously ill and was sent to Singapore for hospitalization on 8th October.

2-1-3. Stage Three

The survey in Stage Three commenced on 19th October and was completed on 8th November 1980, at Cape Rachado and Teluk Merbau (Muara Kubu). The Indonesian and Japanese inspection teams arrived in Singapore on 17th October to inspect the field work on the KRI BURUJULASAD. The Japanese inspection team also called at Cape Rachado on 21st October for a field inspection of actual survey work being carried out. On 26th October Mr. Sasaki, an NNSS en-

gineer from Japan, embarked the KRI. BURUJULASAD at Port Dickson to replace Mr. Tateyama. Few instrumental faults occurred during the survey. On 29th October the SSB transceiver at Muara Kubu broke down. Temporary repairs were made and communications re-established. The NNSS receiver again went defective at Pulau Pisang on 30th October. The defective set was replaced by two working receivers from the KRI BURUJULASAD on 1st November. Here again "Translocation Method" of position computation was not possible for those two days.

Communications between the KRI BURUJULASAD and shore station was cut off from 6th November onward with the breakdown of SSB transceiver on board the KRI BURUJULASAD. Owing to the non-availability of spare parts the SSB could not be repaired.

2-1-4. Stage Four

The survey in Stage Four commenced on 11th November and was completed on 1st December 1980 at Tg. Kedabu and Tg. Bakau. While at the Port of Belawan for rest and replenishment another inspection was made on the KRI BURUJULASAD by the Indonesian inspection team on 8th November.

The cassette recorder of the NNSS receiver unit at the Pulau Pisang station stopped functioning from 18th November, but as all data received were recorded on paper printout, the translocation method of computation could still be used.

2-2. Daily Progress Report

2-2-1. Daily Progress for the Survey of Control Points

25 Aug.	KRI BURUJULASAD left Jakarta with Indonesian Survey Team.
26 Aug.	Japanese Survey Team arrived in Singapore.
27 Aug.	Malaysian Survey Team arrived in Singapore.
28 Aug.	KRI BURUJULASAD arrived in Singapore. First Joint Operation Meeting held on board KRI BURUJULASAD.
29 Aug.	Loading of equipment on board KRI BURUJULASAD.

30 Aug. All survey teams joined KRI BURUJULASAD.

Stage One

31 Aug. KRI BURUJULASAD and MV MATA IKAN sailed for and arrived at Pulau Pisang.
Transportation of survey equipment and camping gear to Pulau Pisang.
Setting up and testing of NNSS receiver and SSB sets.

1 Sept. Commenced satellite and azimuth observations, levelling, and plane table survey.

2 Sept. KRI BURUJULASAD sailed for Bengkalis.

3 Sept. KRI BURUJULASAD arrived at Bengkalis.
Transportation of survey equipment and camping gear to Bengkalis. Setting up and testing of NNSS receiver and SSB sets.

4 Sept. Commenced satellite observation, construction of marker stone, traversing, azimuth and tide observations, levelling, and plane table survey at Bengkalis.

5 Sept. KRI BURUJULASAD sailed for Bagan Siapi-api.

6 Sept. KRI BURUJULASAD arrived at Bagan Siapi-api.
Carried out reconnaissance to select a site for new control point.

7 Sept. Survey operations in progress at Bengkalis.

8 Sept. KRI BURUJULASAD sailed for Bengkalis.

9 Sept. KRI BURUJULASAD arrived at Bengkalis.

10 Sept. Completed survey operations at Bengkalis.
Transportation of survey equipment and camping gear back to KRI BURUJULASAD.

11 Sept. KRI BURUJULASAD sailed from Bengkalis and arrived at Dumai.

12 Sept. Loading of equipment on chartered boats.

13 Sept.	Transportation of survey equipment and camping gear to Tg. Ketam. Setting up and testing of NNSS receiver and SSB sets. Commenced construction of marker stone, azimuth observations, plane table survey at Tg. Ketam.
14 Sept.	Commenced satellite observation, traversing, tide observation and levelling.
15 Sept. – 19 Sept.	Survey operations in progress at Tg. Ketam.
20 Sept.	Completed survey operations at Tg. Ketam. Transportation of survey equipment and a camping gear back to KRI BURUJULASAD.
21 Sept.	KRI BURUJULASAD sailed for Singapore.
22 Sept.	KRI BURUJULASAD arrived in Singapore.
23 Sept.	Joint Operation Meeting.
24 Sept. – 26 Sept.	Rest and replenishment in Singapore.

Stage Two

27 Sept.	KRI BURUJULASAD sailed for Tg. Sekudi.
28 Sept.	KRI BURUJULASAD arrived at Tg. Sekudi. Transportation of survey equipment and camping gear to Tg. Sekudi.
29 Sept.	Setting up and testing of NNSS receiver and SSB sets. Commenced construction of marker stone, satellite and tide observations, plane table survey at Tg. Sekudi.
30 Sept.	Commenced levelling. Survey operations in progress at Tg. Sekudi.
5 Oct.	Completed survey operations at Tg. Sekudi. Transportation of survey equipment and camping gear back to KRI BURUJULASAD.

KRI BURUJULASAD sailed for Tg. Medang.

6 Oct. KRI BURUJULASAD arrived at Tg. Medang.
Commenced construction of marker stone.

7 Oct. Transportation of survey equipment and camping gear to Tg. Medang.
Setting up and testing of NNSS receiver and SSB sets.
Commenced satellite observation, traversing, plane table survey at Tg. Medang.

8 Oct. – 12 Oct. Survey operations in progress at Tg. Medang.

13 Oct. Completed survey operations at Tg. Medang.
Transportation of survey equipment and camping gear back to KRI BURUJULASAD.

14 Oct. KRI BURUJULASAD sailed for Singapore.

15 Oct. KRI BURUJULASAD arrived in Singapore.

16 Oct. Indonesian and Japanese inspection teams arrived in Singapore.

17 Oct. Indonesian and Japanese inspection teams visited KRI BURUJULASAD.

18 Oct. Rest and replenishment in Singapore.

Stage Three

19 Oct. KRI BURUJULASAD sailed for Cape Rachado.

20 Oct. KRI BURUJULASAD arrived at Cape Rachado.
Transportation of survey equipment and camping gear to Cape Rachado.

21 Oct. Setting up and testing of NNSS receiver and SSB sets.
Commenced satellite and azimuth observations, plane table survey at Cape Rachado.

22 Oct. – 26 Oct. Survey operations in progress at Cape Rachado.

27 Oct. Completed survey operations at Cape Rachado.
Transportation of survey equipment and camping gear back to KRI BURUJULASAD.
KRI BURUJULASAD sailed for Muara Kubu.

28 Oct. KRI BURUJULASAD arrived at Muara Kubu.
Transportation of survey equipment and camping gear to Muara Kubu.
Setting up and testing of SSB sets.

29 Oct. Commenced construction of marker stone, traversing, tide observation, levelling and plane table survey.

30 Oct. Setting up and testing of NNSS receiver and commenced satellite observation.

31 Oct. KRI BURUJULASAD sailed for Pulau Pisang to despatch two NNSS receiver sets.

1 Nov. KRI BURUJULASAD arrived at Pulau Pisang.
Survey operations in progress at Muara Kubu.

6 Nov. KRI BURUJULASAD sailed from Pulau Pisang to Muara Kubu.
Survey operations completed at Muara Kubu.

7 Nov. KRI BURUJULASAD arrived at Muara Kubu.
Transportation of survey equipment and camping gear back to KRI BURUJULASAD.
KRI BURUJULASAD sailed for Belawan.

8 Nov. KRI BURUJULASAD arrived at Belawan.
Indonesian inspection team on board KRI BURUJULASAD.
Rest and replenishment at Belawan.

9 Nov.

Stage Four

11 Nov. KRI BURUJULASAD sailed for Pulau Pisang.

13 Nov. KRI BURUJULASAD arrived at Pulau Pisang to disembark satellite observation team at Pulau Pisang.
KRI BURUJULASAD sailed from Pulau Pisang and arrived at Tg. Kedabu.

14 Nov.	Transportation of survey equipment and camping gear to Tg. Kedabu. Commenced construction of marker stone, setting up and testing of SSB sets.
15 Nov.	Setting up and testing of NNSS receiver. Commenced satellite observation, traversing, azimuth and tide observations, levelling and plane table survey at Tg. Kedabu.
16 Nov. – 19 Nov.	Survey operations in progress at Tg. Kedabu.
20 Nov.	Completed survey operations at Tg. Kedabu. Transportation of survey equipment and camping gear back to KRI BURUJULASAD.
21 Nov.	Transportation of survey equipment and camping gear to Tg. Bakau.
22 Nov.	Setting up and testing of NNSS receiver and SSB sets. Commenced construction of marker stone, satellite observation, traversing, azimuth and tide observations, levelling and plane table survey at Tg. Bakau.
23 Nov. – 26 Nov.	Survey Operations in progress at Tg. Bakau.
27 Nov.	Completed survey operations at Tg. Bakau.
28 Nov.	Transportation of survey equipment and camping gear back to KRI BURUJULASAD.
29 Nov.	KRI BURUJULASAD sailed from Tg. Bakau and arrived at Pulau Pisang. Transportation of survey equipment and camping gear from Pulau Pisang back to KRI BURUJULASAD.
30 Nov.	Data processing.
1 Dec.	KRI BURUJULASAD sailed and arrived in Singapore.
2 Dec.	Data processing.

Unloading of survey equipment from KRI BURUJULASAD.

3 Dec. – 4 Dec. Data processing

5 Dec. – 6 Dec. Final Joint Operation Meeting.

7 Dec. Malaysian Team and KRI BURUJULASAD left for home countries.

8 Dec. Survey equipment and data were sent to Japan.

9 Dec. Japanese Team left for Japan.

2-2-2. Daily Progress for the Survey at Fundamental Point (Pulau Pisang).

Stage One.

31 Aug. KRI BURUJULASAD and MV MATA IKAN sailed from Singapore to Pulau Pisang.
Transportation of survey equipment and camping gear to Pulau Pisang.
Setting up and testing of NNSS receiver and SSB sets.

1 Sept. Commenced satellite and azimuth observations, levelling and plane table survey.

2 Sept. – 20 Sept. Replenishment by MV MATA IKAN.
Satellite observations in progress.

21 Sept. Completed satellite observations in Stage One at Pulau Pisang.

22 Sept. MV MATA IKAN sailed from Pulau Pisang to Singapore with Pulau Pisang Joint Survey Team.

23 Sept. Joint Operation Meeting.

24 Sept. – 26 Sept. Rest and replenishment in Singapore.

Stage Two

27 Sept.	MV MATA IKAN sailed to Pulau Pisang from Singapore with Joint Survey Team and replenishment.
28 Sept.	Commenced satellite observations in Stage Two.
29 Sept. – 4 Oct. – 13 Oct.	Replenishment by MV MATA IKAN. Satellite observations in progress.
14 Oct.	Completed satellite observations in Stage Two at Pulau Pisang. MV MATA IKAN sailed from Pulau Pisang to Singapore with Joint Survey Team.
16 Oct. – 18 Oct.	Rest and replenishment in Singapore.

Stage Three

19 Oct.	MV MATA IKAN sailed to Pulau Pisang from Singapore with Joint Survey Team and replenishment.
20 Oct. – 29 Oct.	Commenced satellite observations in Stage Three Satellite observations in progress. Replenishment by MV MATA IKAN.
30 Oct.	NNSS receiver defective, no satellite observations.
31 Oct.	No satellite observations.
1 Nov. – 5 Nov.	Received a replacement of NNSS receiver from KRI BURUJULASAD and resumed satellite observations. Satellite observations in progress.
6 Nov.	Completed satellite observations in Stage Three. Replenishment by MV MATA IKAN.
7 Nov. – 10 Nov.	Rest and replenishment at Belawan.

Stage Four

11 Nov.	Joint Survey Team on board KRI BURUJULASAD.
12 Nov.	KRI BURUJULASAD on passage for Pulau Pisang.
13 Nov.	KRI BURUJULASAD and MV MATA IKAN arrived at Pulau Pisang. Commenced satellite observations in Stage Four.
14 Nov.	Replenishment by MV MATA IKAN.
19 Nov.	Satellite observations in progress.
25 Nov.	Replenishment by MV MATA IKAN.
27 Nov.	Satellite observations in progress.
28 Nov.	Completed satellite observations in Stage Four.
29 Nov.	Transportation of survey equipment and camping gear to KRI BURUJULASAD. Pulau Pisang Joint Survey Team embarked KRI BURUJULASAD.

2-3. Conduct of Survey

2-3-1. Fixing of Control Points

Most of the existing control points were found to be unsuitable for erecting the antenna of NNSS receiver on them. Accordingly, new control points were established nearby and connected to the old control points by traversing.

2-3-2. Establishment of Marker Stones

No Marker stone was constructed at Pulau Pisang. The original "Fundamental Point" constructed for the Joint Geodetic Survey by Indonesia and Malaysia in March 1972 was adopted as the "CDC Fundamental Point" for the CDC Joint Survey in Phase II. Seven marker stones in all were constructed. They were all sited in Sumatera. A type "B" marker stone was adopted according to the specifications of the National Coordination Agency for Survey and Mapping of Indonesia. (See Annex C).

For each marker stone, a bronze disc bearing the Doppler Station Number was embedded on the top of the structure. Each marker stone also has a marble plaque cemented to one of its sides

with the CDC control point number engraved on it.

2-3-3. Satellite Observation

An NNSS receiver (Geodetic Survey System JMR-3), manufactured by JMR Instruments Inc. was set up at the Fundamental Point and continuous observation of Doppler shifts was carried out. Using the same type of receiver simultaneous observation was also carried out in turn for a period of five days at each of the control points.

2-3-4. Traversing

A loop traverse using theodolites (Wild T2 and Sokkisha TM10) and electronic distance meter (YHP 3800B) was carried out to connect the new and old control points. The total distance traversed throughout this geodetic survey was 5.882 km.

(1) Azimuth Observation by Gyro-Theodolite Method (using Wild T16 and GAK 1)

a) Initial orientation was first made by "Two Reversal Point Method", and then precise observations were made by "Transit Method".

b) For "Transit Method", one set of observations was made along each of the collimation axis to the east and west from the true north direction.

c) In the case where the difference between the sets of observations exceeded 40 seconds, the observations were repeated.

(2) Angle Measurement

a) At every traverse station, two sets of angle measurements were made, one setting at 0° and the other at 90°. The difference in the measured angles was less than 20 seconds. The mean value of the two observations was adopted.

b) The angular mis-closure in each traverse was better than $20'' + 15''\sqrt{n}$ (n = number of stations).

(3) Distance Measurement

a) Distance measurement was made using the YHP 3800B distance meter or steel tapes.

b) For every traverse-leg two sets of measurement were made in each direction. Where the difference between two sets in one direction exceeded 2 cm, the measurements were repeated. The mean value of the four sets of measurements for each leg was adopted.

c) Slope distances were corrected from vertical angles measured. MSL correction was omitted as it was found to be negligible.

(4) Computation

a) For the computation of traverses, a plane rectangular coordinates system was adopted. The direction towards the true north passing through the starting point was taken as the X-axis and perpendicular to it as the Y-axis. Linear adjustment at each station was made to its coordinate values (X, Y). The scale factor used was 1.0000.

b) The ratio of misclosure error of distance obtained in one loop traverse was expressed as follows:

$$E/\Sigma S < 1/5{,}000$$

where $E = \sqrt{(\Sigma dx)^2 + (\Sigma dy)^2}$

S = measured distance of each traverse.

Σdx and Σdy were differences in northing and easting at the closing point.

c) The allowable error of closure of coordinates for traversing was adopted as $(20 + 5\sqrt{m})$ cm.
Where m is the number of legs of the traverse.

d) In the case where observation at eccentric station was inevitably carried out as at Cape Rachado, computation for eccentric reduction was made.

e) Computation of geodetic coordinates of the "CDC" and "AS" control points were based on the plane rectangular coordinate system.
From the field observations the direct azimuth angles and direct distances from the antenna of NNSS receiver to the "CDC" and "AS" control points were calculated. Computa-

tions for their geodetic coordinates from the antenna positions based on the WGS-72 ellipsoid were then carried out using "Puissant's Coast and Geodetic Survey Formula".

2-3-5. Determination of Heights of Control Points.

The heights of new and old control points from the mean sea level were determined by the following methods:

(1) Tide observations

a) A tide pole was erected at a suitable location.

b) Tide reading on the pole was taken at 10 minute interval for period of 5 days.

(2) Levelling

A total distance of 4.354 km of levelling was carried out between the tide pole, "CDC" and "AS" control points.

a) A temporary bench mark was established near the coast above the high water line.

b) Direct levelling between the graduation of the tide pole and the temporary B.M. was carried out.

c) Direct levelling was made between the temporary B.M. and the control point.

d) A loop circuit observation was made for each levelling route. For homeward observation, the staffs were interchanged.

e) For each route, turning points were selected to ensure that the line were as straight as possible and about equidistant.

f) The distance between two staffs was approximately 60 metres.

g) The distance between turning points on the route was roughly measured in advance. At the places where staffs were held, the marks were made on the ground.

h) The closure error for levelling was less than 3 cm.

2-3-6. Descriptions of New Control Points.

A local survey by plane table in the vicinity of every control point was carried out.
(For descriptions of control points, see Annex E).

3. DATA PROCESSING

3-1. General

3-1-1. Preliminary Data Processing

During the period of field work of the geodetic survey, preliminary data processing was carried out by the Joint Survey Team on board the KRI BURUJULASAD.

During the preliminary data processing satellite data of less than 50 passes observed at each station was used in computation by Two-Dimensional Method (Point Positioning) to obtain the position of the NNSS receiving antenna.

The geodetic coordinates of the antenna positions were calculated on the WGS-72 ellipsoid of reference. Based on these results, the geodetic coordinates of the old and new control points and other marks were calculated by azimuth and distances. The heights of these control points above mean sea level obtained by tidal observation and levelling were adopted as the heights on local geoid.

Station description of the CDC control points and photo albums showing the field work were prepared.

At the final stage of the field work, the data processing was further carried out at the Hydrographic Department, Port of Singapore Authority, to prepare the Field Report on the Geodetic Survey of Control Points.

3-1-2. Data Processing in Japan

After completion of the field work, all the data obtained by the NNSS observations were processed by the Japanese team members using an electronic computer in Tokyo, and the geodetic computation was made to finally determine the coordinates of the Fundamental Point and the control points on the WGS-72 ellipsoid of

reference. In computer processing of the data, the coordinates of the electrical centre of the NNSS receiving antenna at each station were first determined by both Point Positioning and Translocation Methods, and the geodetic coordinates of astronomical spot and/or control point at each station were then calculated. In the computation the electronic computer FACOM M-150F was employed with the computer programs SP-2P (Point Positioning) and SP-2T (Translocation) developed by JMR Instruments Inc.

A draft Report on the Geodetic Survey of Control Points incorporating the results of the above-mentioned computation was prepared by the Japanese team members in Tokyo and sent to the other three participating countries for their examination before the Data Processing and Preparation of Survey Report held in Jakarta from 19 to 25 April 1981.

3-1-3. Final Data Processing

The final data processing was carried out at the Indonesian Hydro-Oceanographic Office, Jakarta, from 19 to 25 April 1981, and the Report on the Geodetic Survey of Control Points for Joint Production of Common Datum Charts of the Straits of Malacca and Singapore was prepared and finalized. The participants of the final data processing and preparation of survey report held in Jakarta are as shown in Annex F.

3-2. Results of Field Survey.

3-2-1. True North Survey and Traversing

The positional relationship between the antenna's electrical centre and the control point and astronomical observation spot (AS) at each station were calculated by using the results of the true north surveys and traversings, which are as shown in Table 3-2-1.

Table 3-2-1. Positional Relationship between NNSS Receiving Antenna and CDC or AS Points

Station Name	Control points	Azimuth	Distance (metre)
Pulau Pisang	Fundamental Point	65°00'00"	0.220
	Lighthouse	299°12'33"	69.152
Bengkalis	CDC 8021	231°39'54"	1.100
	AS 121	51°39'54"	42.771
Tg. Ketam	CDC 8022	351°48'41"	23.015
	AS 193	53°42'24"	0.570
Tg. Sekudi	CDC 8023	240°25'12"	84.836
	AS 122	249°01'23"	656.965
Tg. Medang	CDC 8024	131°25'47"	29.453
	AS 190	240°47'02"	1360.036
	Lighthouse	277°36'19"	162.783
	Bench Mark	275°20'45"	169.764
Cape Rachado	Lighthouse	181°10'24"	21.000
Muara Kubu	CDC 8025	238°36'08"	19.176
	AS 107	213°16'14"	2464.594
Tg. Kedabu	CDC 8026	185°17'13"	2.315
	AS 180	97°24'37"	89.492
	Stn 2	185°43'49"	90.765
Tg. Bakau	CDC 8027	216°09'09"	13.104
	AS 182	193°29'47"	373.974
	Stn T1	224°22'06"	94.903

Note: The position of Lighthouse is the centre of light.

3-2-2. Height of NNSS Receiving Antenna above M.S.L.

The height above the local mean sea level of the electrical centre of NNSS receiving antenna set up at the Fundamental Point or each of the control points was determined as the height above the local geoid by using the results of tidal observation and levelling.

The antenna height of each station is as shown in Table 3-2-2.

Table 3-2-2. Antenna Height above M.S.L. at Each Station

Station name	Antenna height (metre)
Pulau Pisang	131.08
Bengkalis	2.52
Tg. Ketam	3.97
Tg. Sekudi	2.65
Tg. Medang	2.58
Cape Rachado	104.26
Muara Kubu	4.15
Tg. Kedabu	2.46
Tg. Bakau	2.74

3-3. Computation of NNSS Positioning Data

3-3-1. Data obtained

The NNSS positioning data were obtained from five Transit Satellites, Nos. 30110, 30130, 30140, 30190 and 30200.
Table 3-3-1 gives the summary of the observation carried out.

Table 3-3-1. Summary of observation

Station name	Period of obs.	Number of obs. days	Total number of passes received	Number of passes used for computation	
				P. Positioning	Translocation
Pulau Pisang	2 Sep.-28 Nov.	48.5	592	252	(180)
Bengkalis	4 Sep.-9 Sep.	5.6	56	42	30
Tg. Ketam	14 Sep.-19 Sep.	5.5	57	39	-
Tg. Sekudi	29 Sep.-5 Oct.	5.7	57	43	19
Tg. Medang	7 Oct.-13 Oct.	5.4	63	41	28
Cape Rachado	21 Oct.-27 Oct.	6.2	67	39	23
Muara Kubu	30 Oct.-6 Nov.	6.5	70	33	18
Tg. Kedabu	15 Nov.-20 Nov.	4.5	57	43	29
Tg. Bakau	22 Nov.-27 Nov.	4.9	59	32	33
Total		92.8	1,078	564	180

Note: The figure in ( ) shows the total number of passes used for computation in Translocation Method between Pulau Pisang and other control points.

As shown in Table 3-3-1, a total of 1,078 passes were obtained in 92.8 days giving an average of about 12 passes per day. In the computation, the number of data passes used was reduced since those data which did not satisfy various conditions required were rejected. In Translocation Method, Satellite passes had to be received simultaneously at two stations, therefore the total number of valid passes used in the computation was further reduced.

The average number of valid data passes used for computation was 6 passes per day in Point Positioning, and 3.8 passes per day in Translocation. Only Broadcast Ephemeris was used in the computation.

3-3-2. Results of Point Positioning

Table 3-3-2 shows the data used for Point Positioning computation of each station, the coordinates of the electrical centre of the NNSS receiving antenna on the WGS-72 ellipsoid, and the standard deviations.

In Point Positioning the mean standard deviation of computed values at each station was as follows:

$SD_\phi = \pm 1.45$ metres
$SD_\lambda = \pm 2.10$ metres
$SD_H = \pm 1.53$ metres

Accordingly, the horizontal deviation in position of these points was ±2.55 metres. The Independent Point Positioning Convergence with respect to latitude, longitude, height and the number of passes for each station is as shown in Annex D.

3-3-3. Results of Translocation

Tables 3-3-3 (a) and (b) show the data used for Translocation computation obtained simultaneously at the Fundamental Point at Pulau Pisang and the control points, the coordinates of the electrical centre of antennae on the WGS-72 and the standard deviations.

Table 3-3-2. Results of Point Positioning

	Pulau Pisang	Bengkalis	Tg. Ketam	Tg. Sekudi	Tg. Medang	Cape Rachado	Muara Kubu	Tg. Kedabu	Tg. Bakau
Total number of data passes used	592	56	57	57	63	67	70	57	59
Number of data passes accepted	252	42	39	43	41	39	33	43	32
On north-going orbit	134	20	21	24	22	22	17	21	17
On south-going orbit	118	22	18	19	19	17	16	22	15
On east of the zenith	105	22	17	23	21	20	18	21	16
On west of the zenith	147	20	22	20	20	19	15	22	16
Number of data passes rejected	340	14	18	14	22	28	37	14	27
High elevation	0	0	0	0	0	0	0	0	0
Low elevation	25	3	1	2	1	5	1	0	5
Non-symmetric or insufficient	33	0	0	0	2	0	10	4	3
Exceeded probability test	282	11	17	12	19	23	26	10	19
Cartesian coordinates (metre)									
X =	-1462099.90	-1337801.74	-1251263.40	-1380018.66	-1287835.07	-1308838.08	-1178245.32	-1431523.94	-1446907.71
Y =	6206296.36	6234146.48	6250263.50	6225491.15	6242330.44	6236799.26	6264091.26	6214241.43	6211179.60
Z =	162413.30	161995.62	221155.14	139477.87	234832.81	266115.29	230782.86	120852.93	91920.40
Geodetic coordinates									
Latitude (ϕ)	01°28'08".190N	01°27'54".698N	02°00'01".642N	01°15'41".374N	02°07'27".230N	02°24'26".345N	02°05'15".288N	01°05'34".873N	00°49'52".777N
Longitude (λ)	103°15'22".391E	102°06'41".644E	101°19'14".173E	102°29'55".595E	101°39'25".059E	101°51'07".020E	100°39'09".340E	102°58'20".827E	103°06'47".911E
Height on WGS-72 (H)	141.13 m	8.56 m	6.82 m	13.38 m	9.45 m	110.58 m	9.01 m	12.16 m	15.22 m
Standard deviation (metre)									
ϕ =	±0.70	±1.33	±1.50	±1.33	±1.49	±1.64	±1.66	±1.48	±1.88
λ =	±1.03	±1.93	±2.37	±2.09	±2.09	±2.35	±2.22	±2.29	±2.56
H =	±0.79	±1.48	±1.61	±1.39	±1.59	±1.64	±1.74	±1.55	±1.98

Table 3-3-3 (a). Results of Translocation

	Bengkalis	Tg. Sekudi	Tg. Medang	Cape Rachado
Total number of date passes used	51	39	53	57
Number of data passes accepted	30	19	28	23
On north-going orbit	14	10	14	12
On south-going orbit	16	9	14	11
On east of the zenith	16	11	11	8
On west of the zenith	14	8	17	15
Number of data passes rejected	21	20	25	34
High elevation	2	0	0	1
Low elevation	0	0	1	0
Non-symmetric or insufficient	0	0	0	0
Exceeded probability test	19	20	24	33

	Pulau Pisang	Bengkalis	Pulau Pisang	Tg. Sekudi	Pulau Pisang	Tg. Medang	Pulau Pisang	Cape Rachado
Cartesian coordinates (metre)								
X =	-1462109.39	-1337804.13	-1462099.45	-1380016.26	-1462096.09	-1287825.30	-1462103.83	-1308843.96
Y =	6206283.40	6234141.35	6206292.00	6225488.32	6206293.81	6242334.25	6206287.91	6236798.55
Z =	162414.93	161997.49	162406.15	139473.32	162420.83	234848.14	162419.59	266129.46
Geodetic coordinates								
Latitude (ϕ)	01°28'08".113N	01°27'54".624N	01°28'08".113N	01°15'41".380N	01°28'08".113N	02°07'27".402N	01°28'08".113N	02°24'26".517N
Longitude (λ)	103°15'22".683E	102°06'41".651E	103°15'22".683E	102°29'55".812E	103°15'22".683E	101°39'25".118E	103°15'22".683E	101°51'07".317E
Height above MSL (H)	131.08 m	4.42 m	131.08 m	4.47 m	131.08 m	4.87 m	131.08 m	108.80 m
Standard deviation (metre)								
ϕ =	±1.620	±1.572	±2.181	±2.116	±1.800	±1.773	±2.321	±2.400
λ =	±2.639	±2.517	±3.494	±3.472	±2.868	±2.846	±3.500	±3.693
H =	±1.811	±1.757	±2.524	±2.359	±2.070	±1.969	±2.872	±2.764

Table 3-3-3 (b). Results of Translocation

	Muara Kubu	Tg. Kedabu	Tg. Bakau
Total number of data passes used	28	52	55
Number of data passes accepted	18	29	33
On north-going orbit	11	12	16
On south-going orbit	7	17	17
On east of the zenith	10	14	14
On west of the zenith	8	15	19
Number of data passes rejected	10	23	22
High elevation	0	0	4
Low elevation	0	0	0
Non-symmetric or insufficient	1	0	0
Exceedec probability test	9	23	18

	Pulau Pisang	Muara Kubu	Pulau Pisang	Tg. Kedabu	Pulau Pisang	Tg. Bakau
Cartesian coordinates (metre)						
X =	-1462100.88	-1178242.56	-1462102.08	-1431528.31	-1462105.75	-1446905.37
Y =	6206298.78	6264091.12	6206296.65	6214237.69	6206304.33	6211183.99
Z =	162421.80	230796.09	162422.74	120874.28	162414.35	91914.81
Geodetic coordinates						
Latitude (ϕ)	01°28'08".113N	02°05'15".367N	01°28'08".113N	01°05'35".186N	01°28'08".113N	00°49'52".489N
Longitude (λ)	103°15'22".683E	100°39'09".532E	103°15'22".683E	102°58'21".217E	103°15'22".683E	103°06'47".972E
Height above MSL (H)	131.08 m	-4.01 m	131.08 m	-1.18 m	131.08 m	-0.29 m
Standard deviation (metre)						
ϕ =	±2.338	±2.372	±1.816	±1.900	±1.789	±1.827
λ =	±3.850	±3.487	±3.095	±3.206	±2.709	±2.720
H =	±2.710	±2.672	±2.044	±2.089	±2.032	±2.013

In Translocation the mean standard deviation of computed values at Fundamental Point and each control point was as follows:

SD_{ϕ} = ±1.99 metres
SD_{λ} = ±3.15 metres
SD_{H} = ±2.26 metres

Accordingly, the horizontal deviation in position of these points was ±3.72 metres.

4. RESULTS OF SURVEY

4-1. Geodetic Coordinates

4-1-1. Results of Point Positioning Method

The geodetic coordinates of the control points on the WGS-72, calculated from the electrical centre of NNSS receiving antenna (see Table 3-3-2.) obtained by the Point Positioning Method are as shown in Table 4-1-1.

Table 4-1-1. Geodetic Coordinates on WGS-72 (Point Positioning)

Station name	Control points	Latitude (N)	Longitude (E)
Pulau Pisang	Fundamental Point	01°28'08".193	103°15'22".397
	Lighthouse	01°28'09".289	103°15'20".438
Cape Rachado	Lighthouse	02°24'25".661	101°51'07".006
Tg. Medang	CDC 8024	02°07'26".595	101°39'25".774
	AS 190	02°07'05".617	101°38'46".645
	Lighthouse	02°07'27".931	101°39'19".837
	Bench Mark	02°07'27".745	101°39'19".589
Muara Kubu	CDC 8025	02°05'14".963	100°39'08".810
	AS 107	02°04'08".200	100°38'25".587
Tg. Ketam	CDC 8022	02°00'02".384	101°19'14".067
	AS 193	02°00'01".653	101°19'14".188
Bengkalis	CDC 8021	01°27'54".676	102°06'41".616
	AS 121	01°27'55".562	102°06'42".729

Station name	Control points	Latitude (N)	Longitude (E)
Tg. Sekudi	CDC 8023	01°15'40".011	102°29'53".208
	AS 122	01°15'33".717	102°29'35".752
Tg. Kedabu	CDC 8026	01°05'34".798	102°58'20".820
	AS 180	01°05'34".497	102°58'23".697
	Stn 2	01°05'31".933	102°58'20".534
Tg. Bakau	CDC 8027	00°49'52".433	103°06'47".661
	AS 182	00°49'40".938	103°06'45".088
	Stn T_1	00°49'50".568	103°06'45".765

Note: The position of Lighthouse is the centre of light.

4-1-2. Results of Translocation Method

The geodetic coordinates of the control points on the WGS-72, calculated from the electrical centre of NNSS receiving antenna (see Table 3-3-3 (a) and (b)) obtained by the Translocation Method are as shown in Tables 4-1-2, 4-1-3 and 4-1-4.

The geodetic coordinates of the Fundamental Point at Pulau Pisang 01°28'08".1158N, 103°15'22".6890E on the WGS-72, were used for computation in Translocation Method.

Table 4-1-2. Geodetic Coordinates of Old Control Points on WGS-72 (Translocation)

Station name	Control Points	Latitude (N)	Longitude (E)
Pulau Pisang	Fundamental Point	01°28'08".1158	103°15'22".6890
Tg. Medang	AS 190	02°07'05".789	101°38'46".704
Muara Kubu	AS 107	02°04'08".279	100°38'25".779
Tg. Ketam	AS 193	(See Para 2-1-1)	(See Para 2-1-1)
Bengkalis	AS 121	01°27'55".488	102°06'42".736
Tg. Sekudi	AS 122	01°15'33".723	102°29'35".969
Tg. Kedabu	AS 180	01°05'34".810	102°58'24".087
Tg. Bakau	AS 182	00°49'40".650	103°06'45".149

Table 4-1-3. Geodetic Coordinates of Lighthouses on WGS-72 (Translocation)

Station name	Position	Latitude (N)	Longitude (E)
Pulau Pisang	Centre of light	01°28'09".212	103°15'20".730
Cape Rachado	"	02°24'25".833	101°51'07".303
Tg. Medang	"	02°07'28".103	101°39'19".896

Table 4-1-4. Geodetic Coordinates of New Control Points on WGS-72

Station name	Control Points	Latitude (N)	Longitude (E)
Tg. Medang	CDC 8024	02°07'26".767	101°39'25".833
"	Bench Mark	02°07'27".917	101°39'19".648
Muara Kubu	CDC 8025	02°05'15".042	100°39'09".002
Tg. Ketam	CDC 8022	(See Para 2-1-1)	(See Para 2-1-1)
Bengkalis	CDC 8021	01°27'54".602	102°06'41".623
Tg. Sekudi	CDC 8023	01°15'40".017	102°29'53".425
Tg. Kedabu	CDC 8026	01°05'35".111	102°58'21".210
"	Stn 2	01°05'32".246	102°58'20".924
Tg. Bakau	CDC 8027	00°49'52".145	103°06'47".722
"	Stn T_1	00°49'50".280	103°06'45".826

4-2. Heights above M.S.L. at Control Points

The heights above the local mean sea level of the control points obtained using the results of tidal observation and levelling are shown in Table 4-2-1, 4-2-2, and 4-2-3.

Table 4-2-1. Heights above M.S.L. of AS and CDC Points

Station name	Control Points	Height (m)	Control Points	Height (m)
Pulau Pisang	Fundamental Point	130.34		
Tg. Medang	AS 190	1.72	CDC 8024	3.19
Muara Kubu	AS 107	3.04	CDC 8025	4.05
Tg. Ketam	AS 193	1.17	CDC 8022	3.17
Bengkalis	AS 121	1.76	CDC 8021	2.50
Tg. Sekudi	AS 122	1.70	CDC 8023	3.23
Tg. Kedabu	AS 180	1.89	CDC 8026	3.05
Tg. Bakau	AS 182	-1.39	CDC 8027	3.58

Table 4-2-2. Heights above M.S.L. of Lighthouses

Station name	Position	Height (m)
Pulau Pisang	Centre of light	149.43
Cape Rachado	"	117.87
Tg. Medang	"	52.73

Table 4-2-3. Heights above M.S.L. of Additional Control Points

Station name	Control Points	Height (m)
Tg. Kedabu	Stn 2	2.74
Tg. Bakau	Stn T_1	2.56

4-3. Old and New Control Points in Sumatera

The positional relationship between the old control point (Astronomical Observation Spot (AS)) and the new CDC control points established in Sumatera obtained from the results of Translocation Method, are shown in Table 4-3-1.

Table 4-3-1. Positional Relationship between Old and New Control Points

Station name	Azimuth		Distance (m)
	Old to New Points	New to Old Points	
Tg. Medang	61°56'47".1	241°56'48".5	1370.06
Muara Kubu	33°04'39".1	213°04'40".6	2447.22
Tg. Ketam	(350°32'41".3)	(170°32'41".3)	(22.76)
Bengkalis	231°39'24".3	51°39'24".3	43.87
Tg. Sekudi	70°17'25".8	250°17'26".2	573.21
Tg. Kedabu	275°56'02".8	95°56'02".8	89.42
Tg. Bakau	12°41'52".4	192°41'52".4	361.91

Note: The values in ( ) are obtained from the results of Point Positioning

4-4. Cape Rachado and Tg. Medang Lighthouses

The positional relationship between Cape Rachado (Peninsula Malaysia) and Tg. Medang (Sumatera) Lighthouses obtained from the results of Translocation Method, is shown in Table 4-4-1.

Table 4-4-1. Positional Relationship between Cape Rachado and Tg. Medang Lighthouses

Station name	Azimuth	Distance (m)
Cape Rachado Lighthouse	214°57'56".3	38142.57
Tg. Medang Lighthouse	34°57'28".3	"

4-5. Station Descriptions

The description of stations in this survey are as in Annex E.

5. FINDINGS

5-1. Differences of Coordinates on the Malaysian Side

The Revised Kertau Datum based on the Modified Everest ellipsoid of reference (a=6377304.063 metres; f=1/300.8017) with its origin in 03°27'50".71N, 102°37'24".55E is used in the geodetic system in the Peninsula Malaysia and Singapore.

The coordinates of the control points at Pulau Pisang and Cape Rachado are available on the Revised Kertau Datum, while those on the WGS-72 have been obtained by this geodetic survey. Accordingly, the amount of displacement to be applied on the Common Datum Charts can be obtained directly from the differences between these two sets of coordinates as shown in Table 5-1-1.

Table 5-1-1. Coordinates on Rev. Kertau Datum and WGS-72

Station name	Rev. Kertau Datum	WGS-72	Differences
Fundamental Point at Pulau Pisang	01°28'08".504N	01°28'08".116N	-0".388
	103°15'29".102E	103°15'22".689E	-6".413
Cape Rachado Lighthouse	02°24'26".284N	02°24'25".833N	-0".451
	101°51'12".879E	101°51'07".303E	-5".576

From Table 5-1-1, the mean of the differences in latitude and longitude on the Revised Kertau Datum and WGS-72 are $\Delta\phi$=-0".420 and $\Delta\lambda$=-5".995.

Therefore, to convert the coordinates on Revised Kertau Datum to WGS-72, a difference of $\Delta\phi$=-0".420 and $\Delta\lambda$=-5".995 may be applied, which is equivalent to a shift in position of 13 metres to the south and 180 metres to the west.

5-2. Differences of Coordinates on the Sumatera Side

The control points situated in northeastern Sumatera are all independent astronomical observation spots which are not connected

to the geodetic system adopted by Indonesia. These spots, however, are currently used as the control points for construction of Indonesian charts. The ellipsoid of reference used is Bessel 1841 (a=6377397.155 metres; f=1/299.1528).

By this Joint Geodetic Survey, the coordinates of these control points on the WGS-72 have been made available. Accordingly, the amount of displacement to be applied on the CDC can be obtained directly from the differences of these coordinates, as shown in Table 5-2-1.

Table 5-2-1. Coordinates on Bessel 1841 and WGS-72

Station name	AS No.	Bessel 1841 (Astronomical)	WGS-72	Differences
Tg. Medang	AS 190	02°07'06".50N	02°07'05".789N	-0".71
		101°38'40".19E	101°38'46".704E	+6".51
Muara Kubu	AS 107	02°04'12".40N	02°04'08".279N	-4".12
		100°38'19".29E	100°38'25".779E	+6".49
Tg. Ketam	AS 193	02°00'01".80N	(02°00'01".653N)	(-0".15)
		101°19'08".59E	(101°19'14".188E)	(+5".60)
Bengkalis	AS 121	01°27'57".20N	01°27'55".488N	-1".71
		102°06'37".89E	102°06'42".736E	+4".85
Tg. Sekudi	AS 122	01°15'36".00N	01°15'33".723N	-2".28
		102°29'30".19E	102°29'35".969E	+5".78
Tg. Kedabu	AS 180	01°05'38".10N	01°05'34".810N	-3".29
		102°58'15".99E	102°58'24".087E	+8".10
Tg. Bakau	AS 182	00°49'44".50N	00°49'40".650N	-3".85
		103°06'39".59E	103°06'45".149E	+5".56

Note: The values in ( ) are obtained by Point Positioning

From the values obtained in the Translocation Method the standard deviations of positions in the Point Positioning Method was found to be ±0".241 which corresponds to about ±7.2 metres in actual distance. This amount of displacement which is appreciably large in term of position control is equivalent to only ±0.036 mm on a chart at the

scale of 1/200,000, and in practical charting this is acceptable. Therefore the position of Tg. Ketam obtained in the Point Positioning is considered acceptable for use in CDC compilation.

From table 5-2-1, the mean of the differences in latitude and longitude between the two ellipsoids of reference are $\Delta\phi$=-2".30 and $\Delta\lambda$=6".13. Therefore, to convert coordinates on the Bessel 1841 to WGS-72 a difference of $\Delta\phi$=-2".30 and $\Delta\lambda$=6".13 may be applied which is equivalent to a shift in position 70 metres to the south and 180 metres to the east.

5-3. Overall assessment of survey result

From the results of true north surveys and traversings it is estimated that the horizontal error in the measurement of the control points does not exceed ±20 cm in actual distance. As for the accuracy in position fixing by the NNSS Doppler observations, the mean value of standard deviations in the horizontal control for each point is ±2.55 metres in Point Positioning and ±3.72 metres in Translocation.

The standard deviation in Point Positioning is derived from computation of the satellite data and it is estimated that the actual observational error may slightly be larger due to the deviation of the satellite from its predicted orbits.

In Translocation Method, the relative positional accuracy between two stations should be better because the error in satellite's orbit is compensated as satellite passes are observed simultaneously at these stations.

The reason why the value of the standard deviation in Translocation in this report is comparatively larger than that in Point Positioning is due to the small number of passes used in computation.

As for the AS spots in Sumatera, the standard deviations of the astronomical coordinates of the seven control points calculated against the results of those obtained in Translocation are ±1".53 in latitude and ±1".04 in longitude. The overall horizontal deviations is ±1".85 which is ±56 metres in distance.

From these results, it is considered that the positional data obtained in this survey is sufficiently accurate for use in the construction of CDC in Phase II.

The height of control point above mean sea level was obtained by tidal observations and levellings. The error in height was found not exceeding ±3 cm. However, due to the short period of tidal observation carried out (5 days) it is considered that the height of these control points may have an error of ±10 cm. The mean value of the standard deviation of the geoidal height with reference to the WGS-72 ellipsoid obtained from the results of NNSS observations in Translocation Method is ±2 metres. These results showed that the relationship between the local geoid (mean sea level) and the geodetic height on the reference ellipsoid is insufficient in terms of accuracy, so that further examination could not be made. In case where datum transformation is made to another ellipsoid by using the results obtained by the present survey the accuracy of the horizontal position will not be affected.

The control points of Cape Rachado and Tg. Medang Lighthouses are located within direct sighting of each other.

The true azimuths between the two stations obtained by direct visual angle observations at each station agreed well with those calculated from the results of satellite geodetic survey.

The final results of the present geodetic survey are based on the fact that the geodetic coordinates of the Fundamental Point at Pulau Pisang are the Doppler Satellite derived coordinates 01°28'08".1158N, 103°15'22".6890E on the WGS-72 ellipsoid of reference determined by the Joint Geodetic Survey of Indonesia and Australia in 1974.

The geodetic coordinates of the Fundamental Point on the same ellipsoid obtained only from the results in Point Positioning of the NNSS satellite observations were 01°28'08".193N, 103°15'22".397E.

The differences between these two coordinates (former minus latter) are $\Delta\phi$=-0".077 in latitude and $\Delta\lambda$=0".292 in longitude, i.e. approximately 2.3 metres and 8.8 metres in actual distances, respectively. This difference in coordinates is to be expected as in this geodetic survey only Broadcast Ephemeris was used in computation of the position.

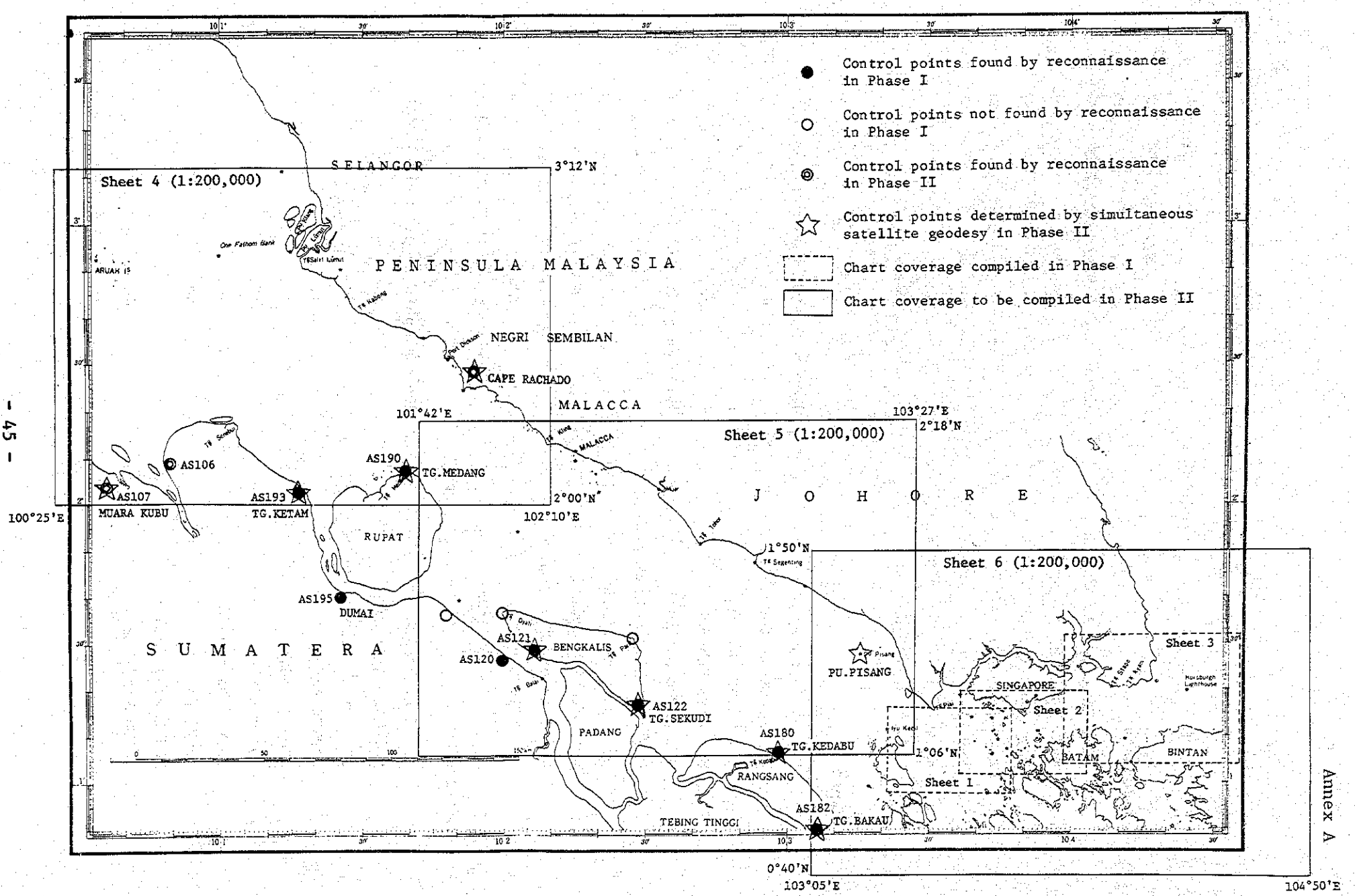
5-4. Conclusion

During the survey a lot of problems were encountered, however, this did not affect the progress of the survey as scheduled.

The survey was carried out in high spirit of cooperation with special mention to the officers and crew of the KRI BURUJULASAD who very efficiently tackled the logistic problems.

The joint geodetic survey has further enhanced the friendship and cooperation that exist among the four participating countries.

With the succesful completion of the geodetic survey of control points, it is now possible to proceed on to the compilation of three more Common Datum Charts of the Straits of Malacca and Singapore.


Control points found by reconnaissance in Phase I
Control points not found by reconnaissance in Phase I
Control points found by reconnaissance in Phase II
Control points determined by simultaneous satellite geodesy in Phase II
Chart coverage compiled in Phase I
Chart coverage to be compiled in Phase II
Sheet 4 (1:200,000)
Sheet 5 (1:200,000)
Sheet 6 (1:200,000)
Sheet 1
Sheet 2
Sheet 3
SELANGOR
PENINSULA MALAYSIA
NEGRI SEMBILAN
MALACCA
JOHORE
SUMATERA
3°12'N
101°42'E
103°27'E
2°18'N
2°00'N
102°10'E
100°25'E
1°50'N
1°06'N
0°40'N
103°05'E
104°50'E
CAPE RACHADO
AS106
AS107
MUARA KUBU
AS193
TG.KETAM
AS190
TG.MEDANG
RUPAT
AS195
DUMAI
AS121
BENGKALIS
AS120
AS122
TG.SEKUDI
PADANG
PU.PISANG
AS180
TG.KEDABU
RANGSANG
AS182
TG.BAKAU
TEBING TINGGI
SINGAPORE
BATAM
BINTAN
ARUAH IS
One Fathom Bank

Annex A

LIST OF JOINT SURVEY TEAM MEMBERS

Indonesia

Ltk. Laut (P) A. Muhammad P.	Naval Hydro-Oceanographic Office
May. Laut (P) Soejadi	do.
May. Laut (P) Katiman	do.
May. Laut (P) Sofyan Rawi	do.
May. Laut (E) A. Kurnia	do
Kpt. Laut (P) M. Sanusi Arief	do.
Kpt. Laut (P) Handoko	do.

Japan

Mr. Akira Nakanishi	Hydrographic Department, M.S.A.
Mr. Motosuke Fukushima	do.
Mr. Masayoshi Hirao	do.
Mr. Akio Uchida	do.
Mr. Haruo Suzuki	Malacca Strait Council
Mr. Takashi Yokokawa	do.
Mr. Jun'ichi Koseki	do.
Mr. Kazuhiro Yamaji	do.
Mr. Tomonobu Tateyama	do.
Mr. Yuji Sasaki	do.

Malaysia

Lt. Cdr. Hamdan	Hydrographic Department, R.M.N.
Lt. Mohd Aminudin	do.
Lt. Twinny Wooi Chuan Peng	do.
CPOSVR Annuar	do.
CPOSVR Sadir	do.
POSVR Idris	do.
POSVR Abdul Hadi	do.
POSVR Ram Dev	do.
POSVR Mohd Salleh	do.
POSVR Mohd Nazar	do.

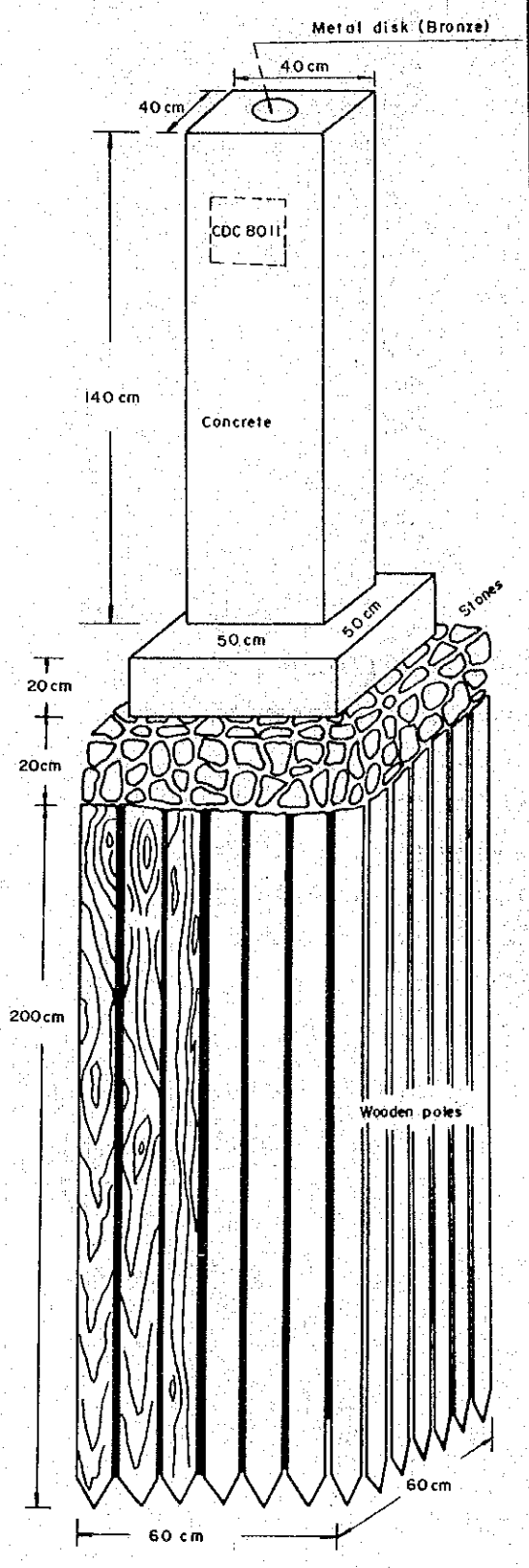
Singapore

Mr. Chua Ngiap Foo	Hydrographic Department, P.S.A.
Mr. Maik Seck Hoe	do.
Mr. Yang Keng Num	do.
Mr. Choy Kum Weng	do.
Mr. Yeoh Oon Hock	do.
Mr. Michael Soong	do.
Mr. Lam Swee Kiong	do.
Mr. Teo Chin Seng	do.
Mr. Chua Keng Guan	do.
Mr. Abdullah Sarmani	do.
Mr. Lee Sam Leng	do.
Mr. Seetoh Hon	do.
Mr. Wong Chee Kwong	do.
Mr. Lu See Keong	do.

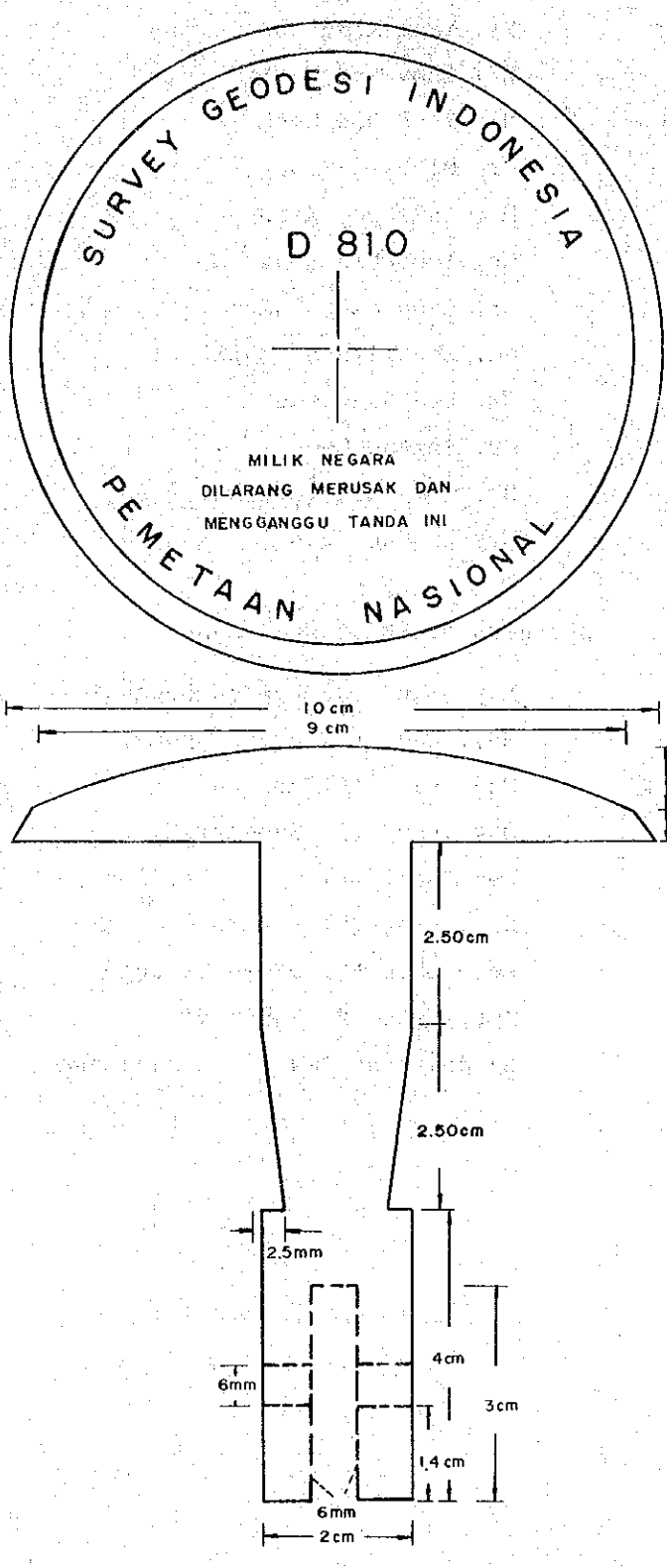
Officers of KRI BURUJULASAD

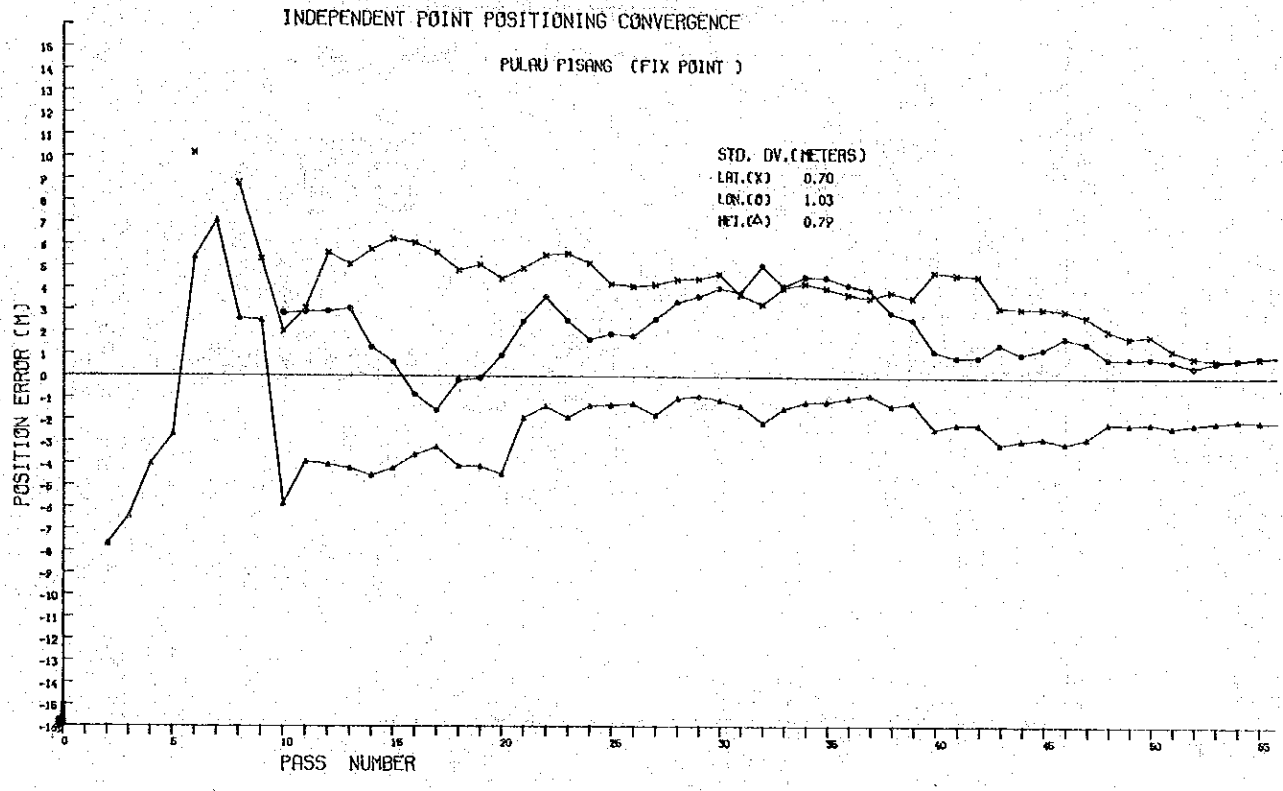
May. Laut (P) Achmad Suwandi	Commanding Officer
May. Laut (P) Asnul Venus	Ex-Commanding Officer
May. Laut (P) Rahyono	Executive Officer
May. Laut (T) Subekti S.	Chief Engineer
Kpt. Laut (T) Marcus Delima	1st Engineer
Kpt. Laut (P) Zahardi	Navigation/Operation Officer
Kpt. Laut (P) Djoko Sarwono	Survey & Deck Officer
Kpt. Laut (P) Supiyadi	Supply Officer
Letda. Laut (KH) A. Mansuranga	Electronic Officer

MARKER STONE OF CDCII-'80

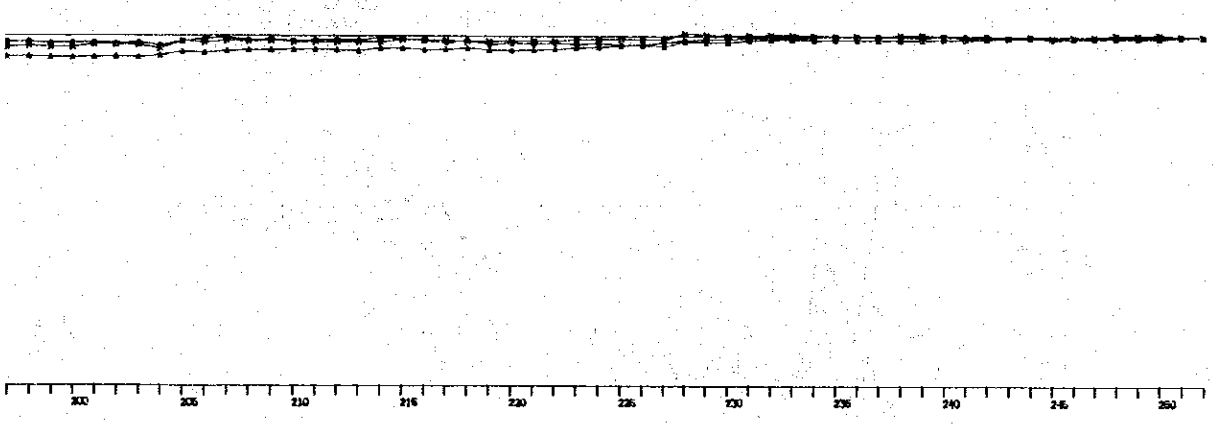


METAL DISK (BRONZE)

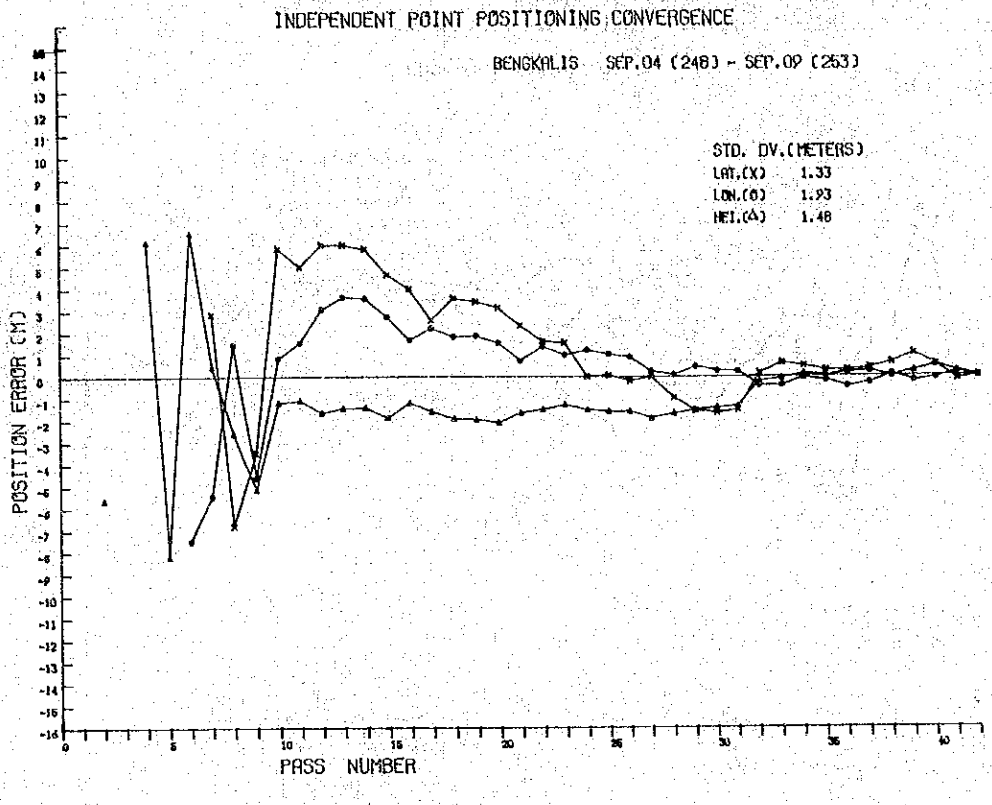




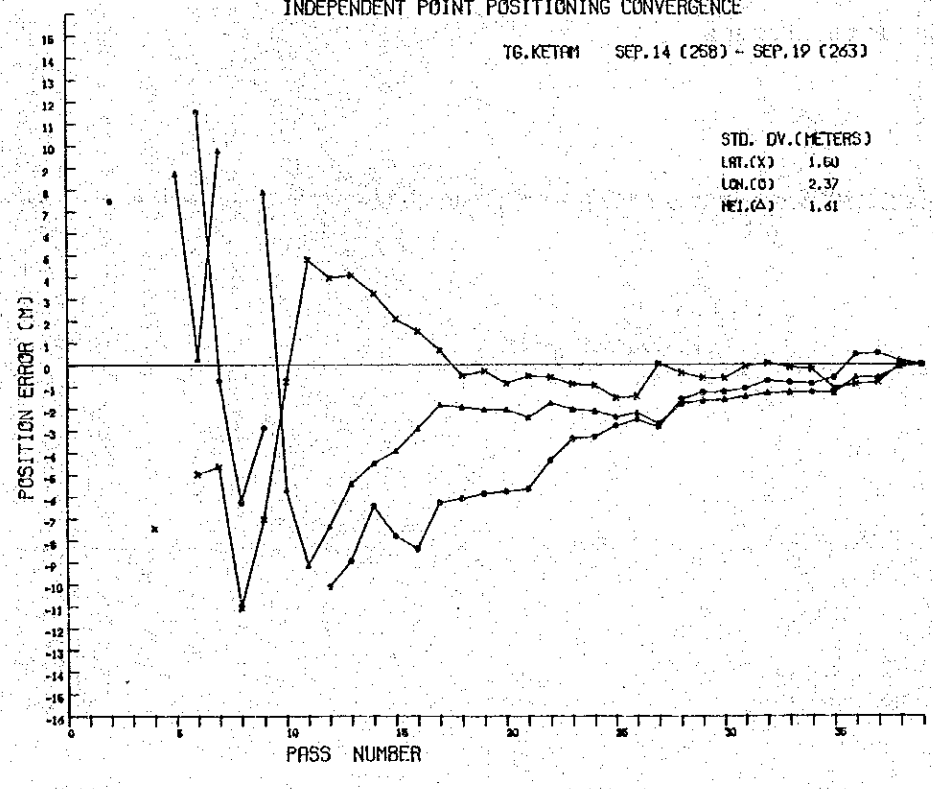
Continuous of Pu. Pisang



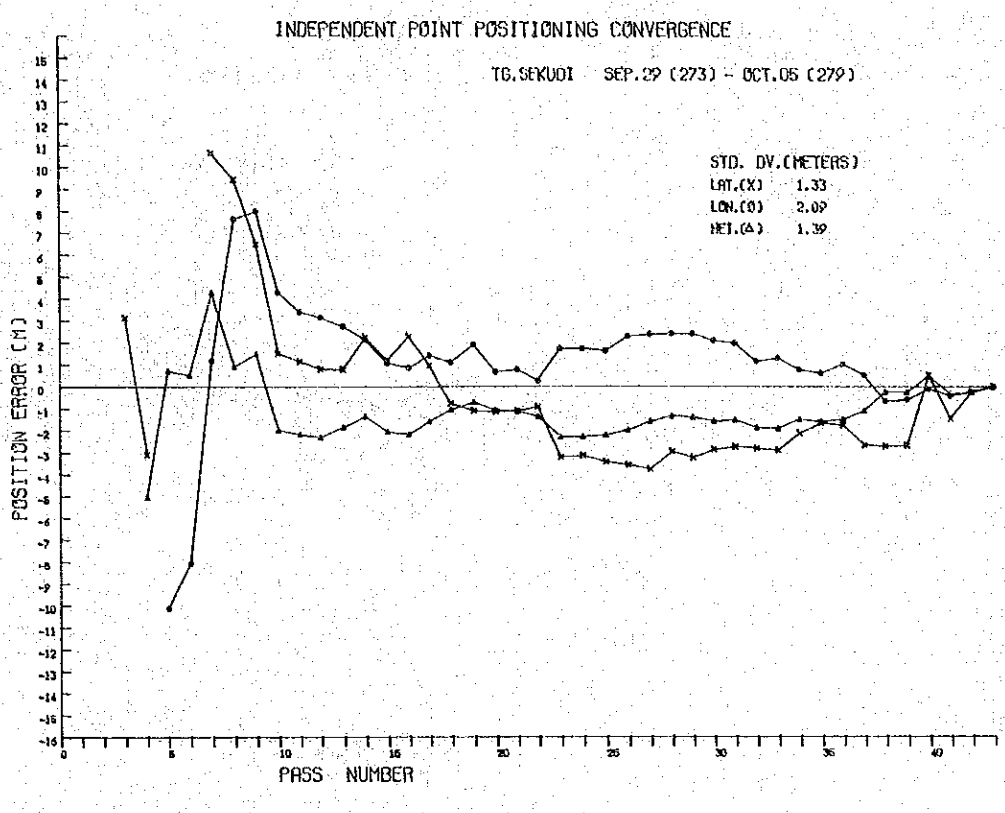
Annex D-2



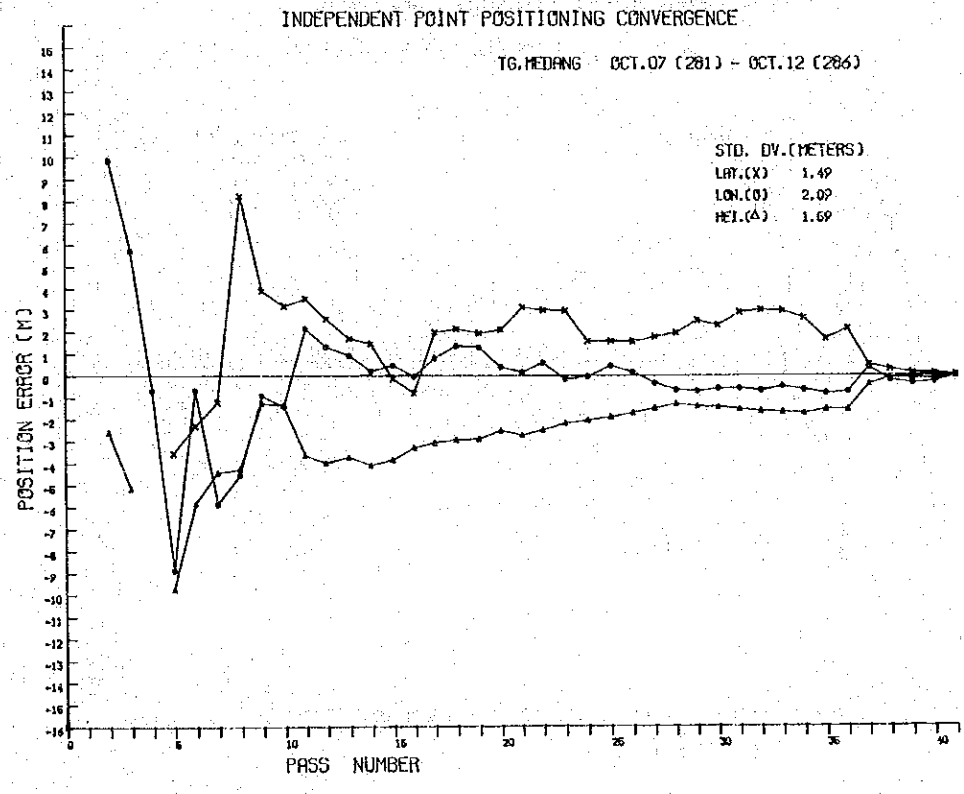
Annex D-3



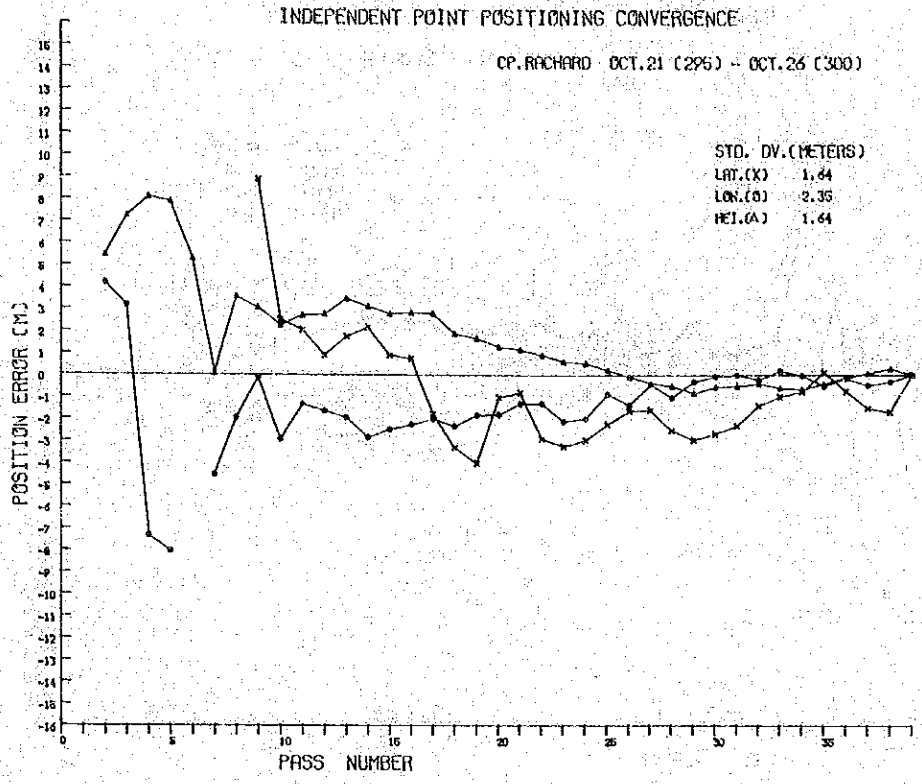
Annex D-4



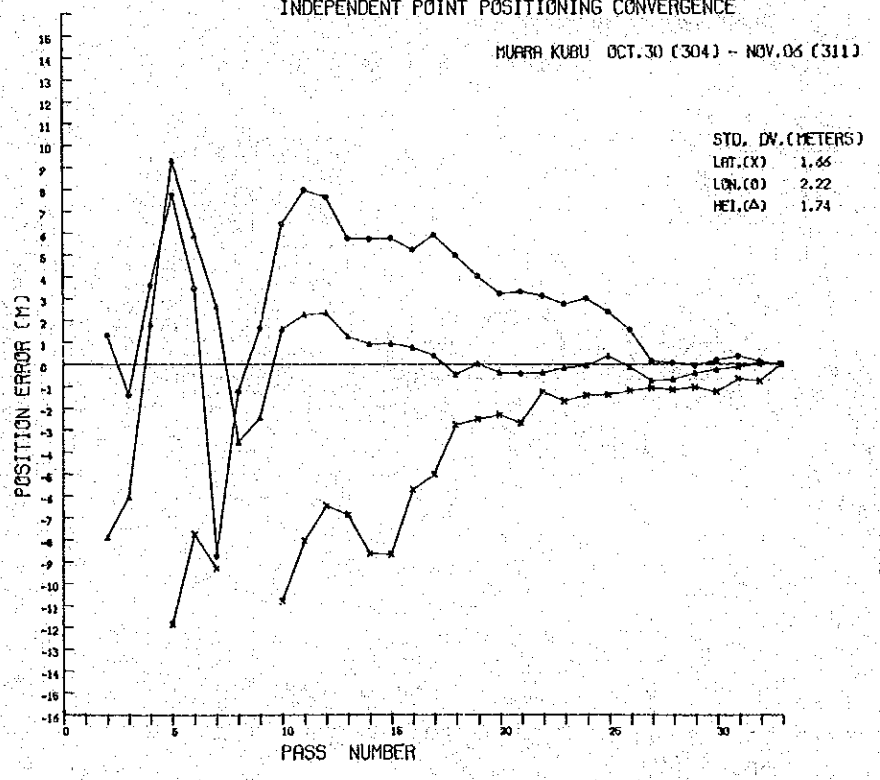
Annex D-5



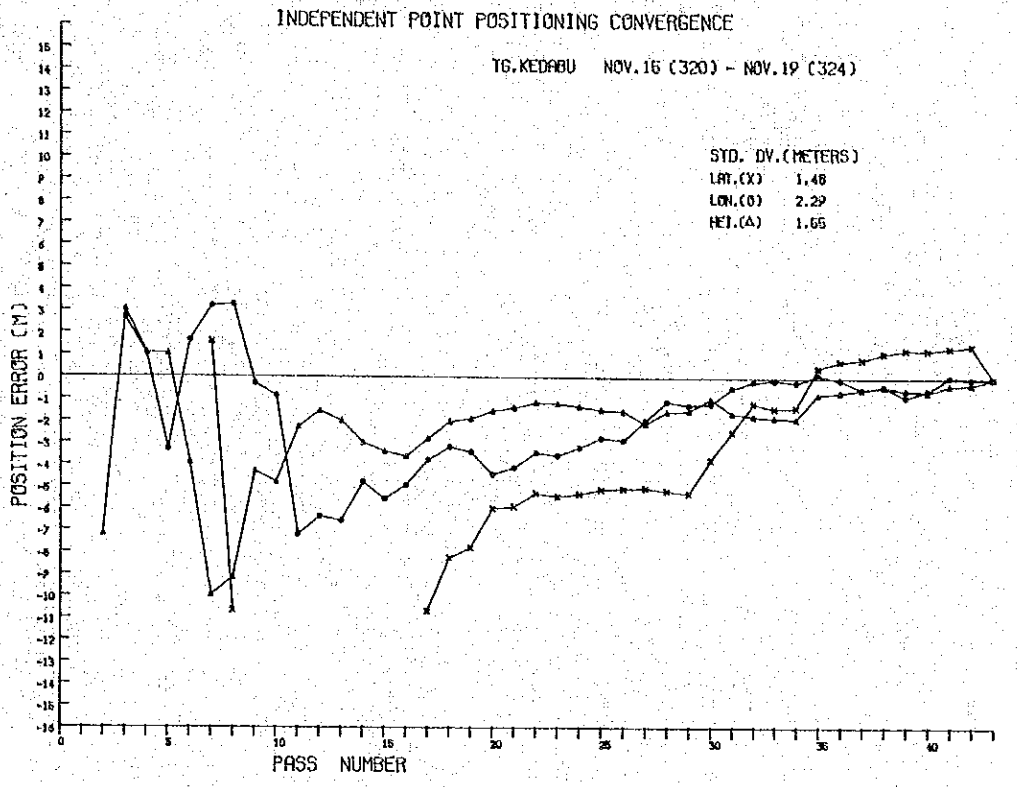
Annex D-6



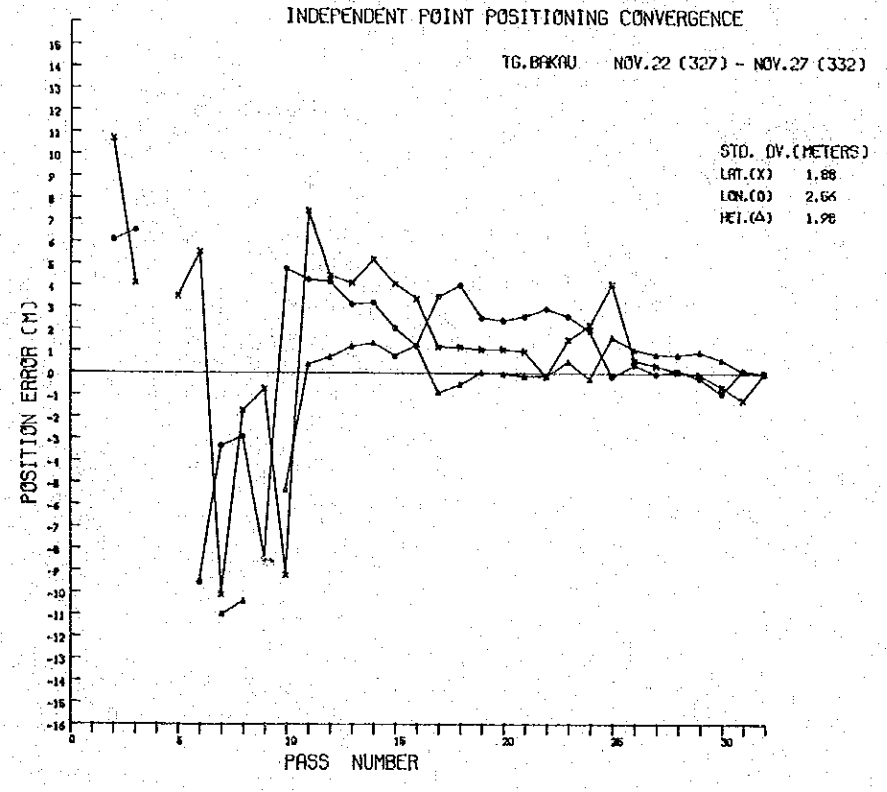
Annex D-7



Annex D-8



Annex D-9

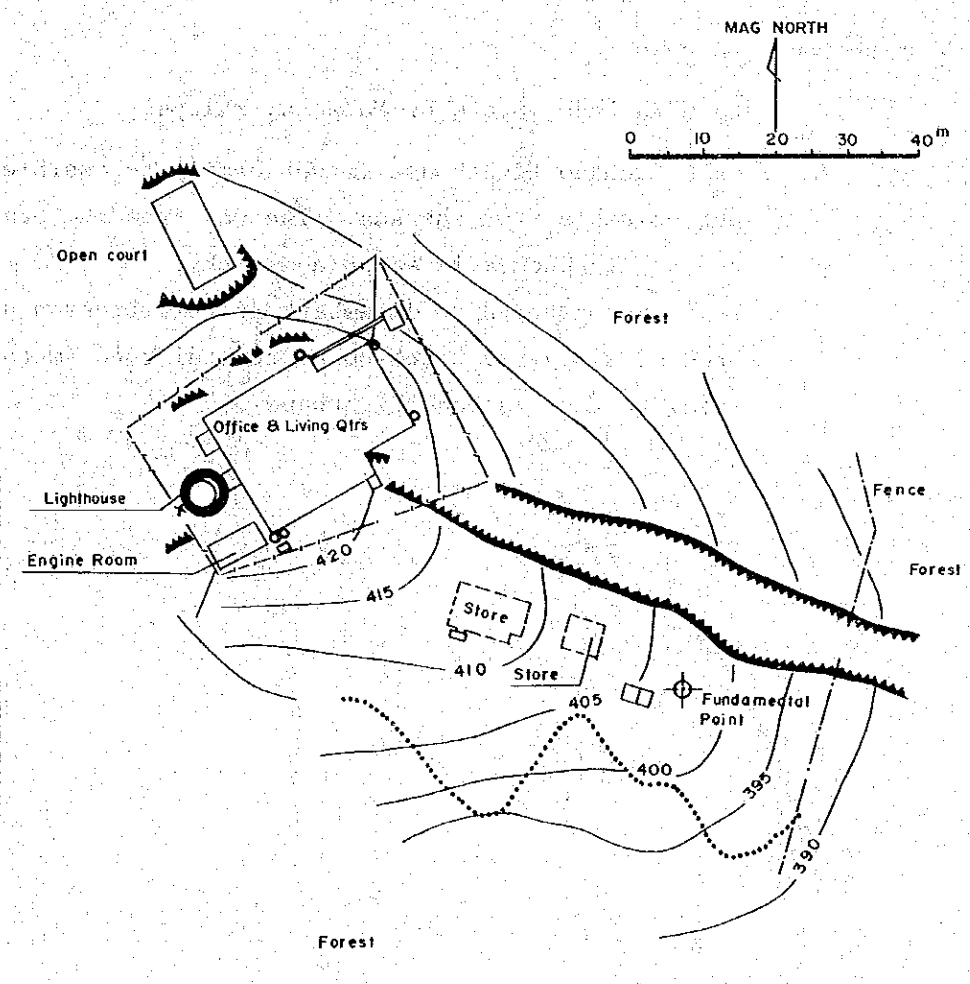


Annex E

Description of Fundamental Point

Spot No.	: Nil
Name	: Pulau Pisang Fundamental Point
Geodetic coordinates	: 01°28'08".116N, 103°15'22".689E
Ellipsoid	: WGS-72
Height above M.S.L.	: 130.34 metres
Date of construction	: The Fundamental Point is an old marker stone constructed in March 1972 for the Joint Geodetic Survey by Indonesia and Malaysia.
Locality	: Pulau Pisang, State of Johore, Malaysia
Accessibility	: Approach by small craft to the concrete jetty situated at the eastern tip of Pulau Pisang. Follow the footpath to the lighthouse. This marker stone is 60 m southeast of the lighthouse.

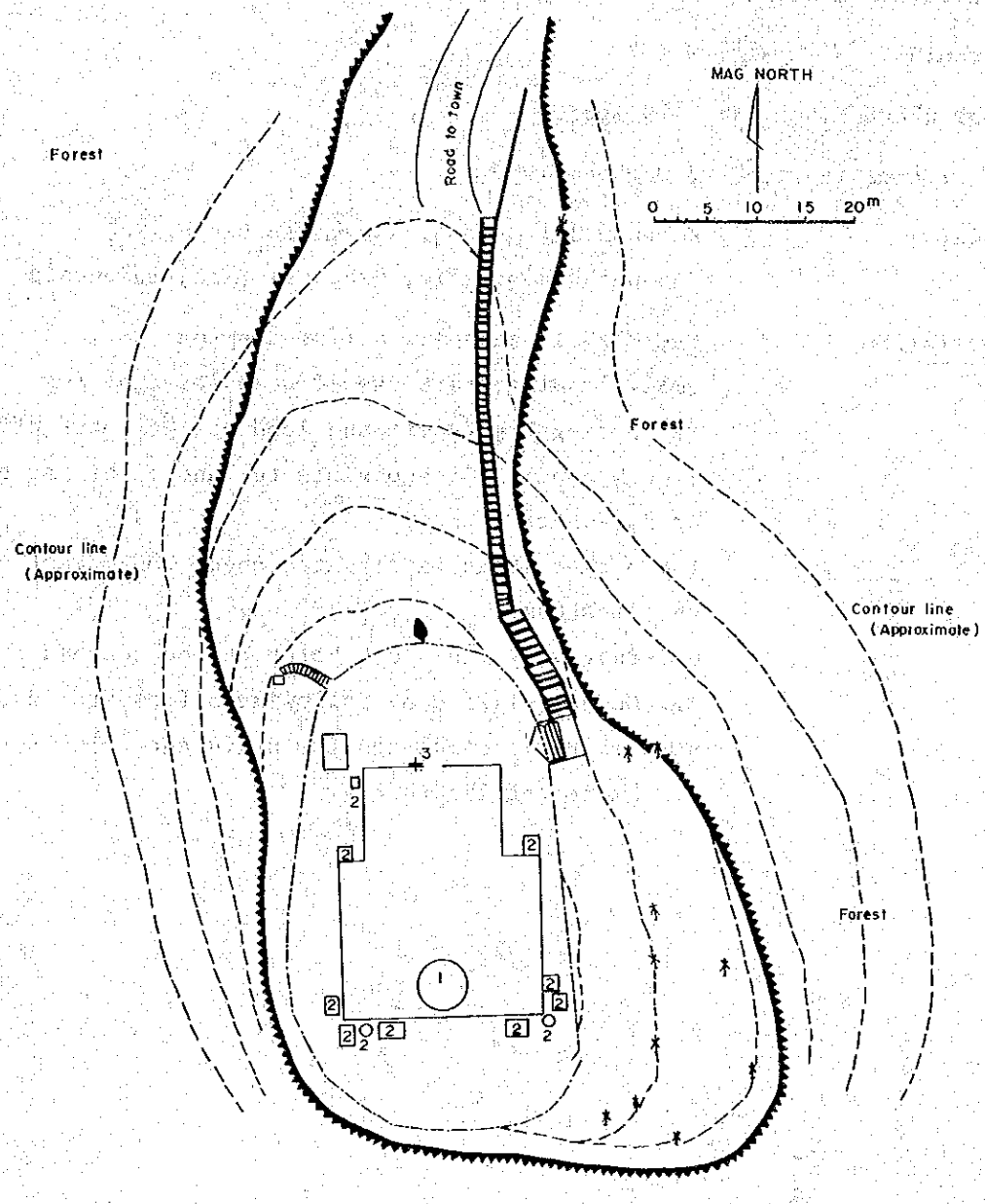
FUNDAMENTAL POINT OF CDC II'80
PU. PISANG FUNDAMENTAL POINT



Description of Cape Rachado CDC Control Point

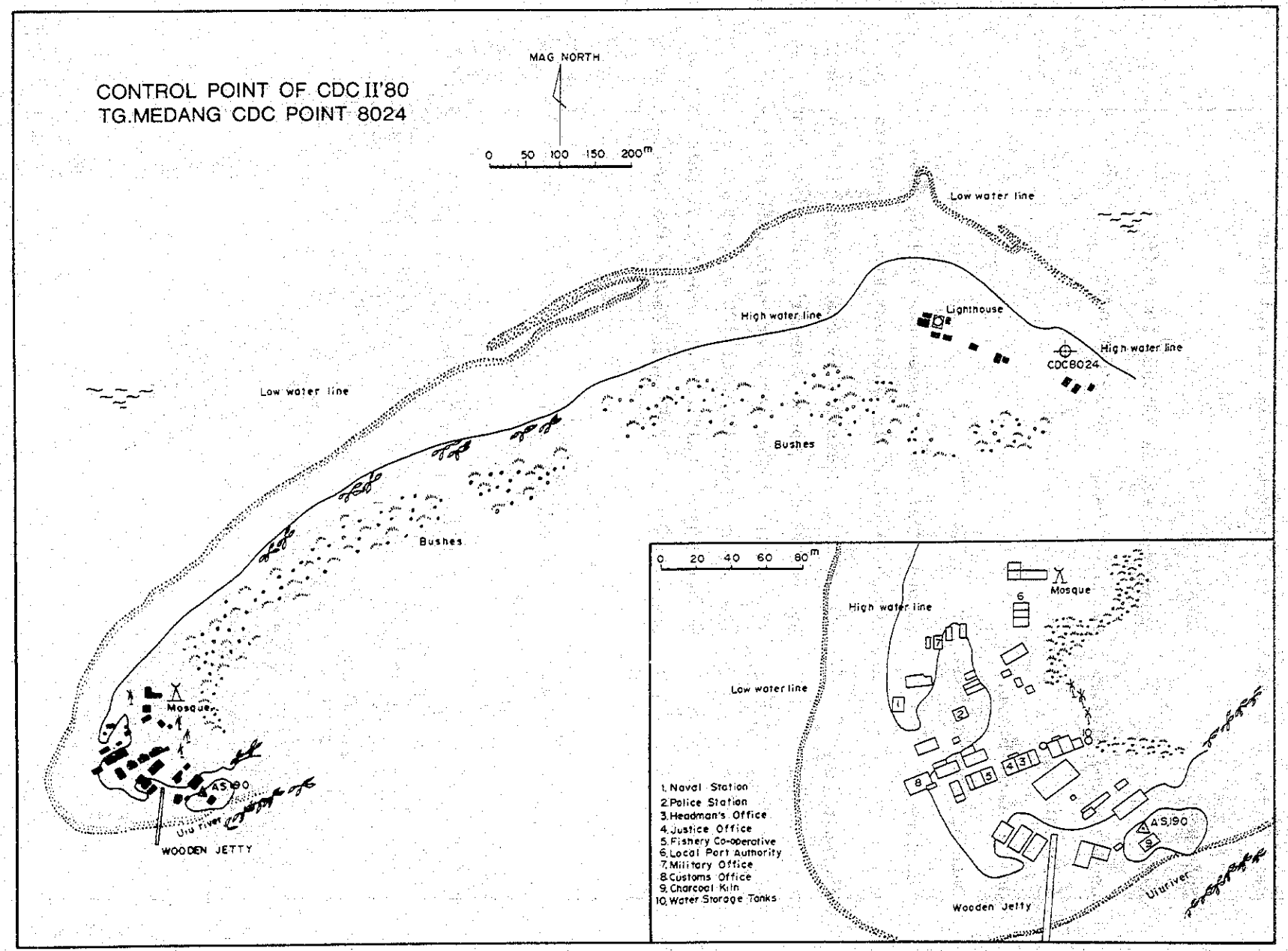
Spot No.	:	Nil
Name	:	Cape Rachado Lighthouse
Geodetic coordinates	:	02°24'25".833N, 101°51'07".303E
Ellipsoid	:	WGS-72
Height above M.S.L.	:	117.87 metres (Centre of light)
Date of construction	:	Unknown
Locality	:	Cape Rachado, State of Malacca, Malaysia
Accessibility	:	Cape Rachado Lighthouse is not easily accessible but possible from the sea. The way from the beach to the lighthouse is steep and rocky. It is recommended to disembark at Port Dickson and proceed along the south bound coastal road (metalled road) to Cape Rachado Lighthouse.

CONTROL POINT OF CDC II'80
CAPE RACHADO LIGHTHOUSE



Description of Tg. Medang CDC Control Point

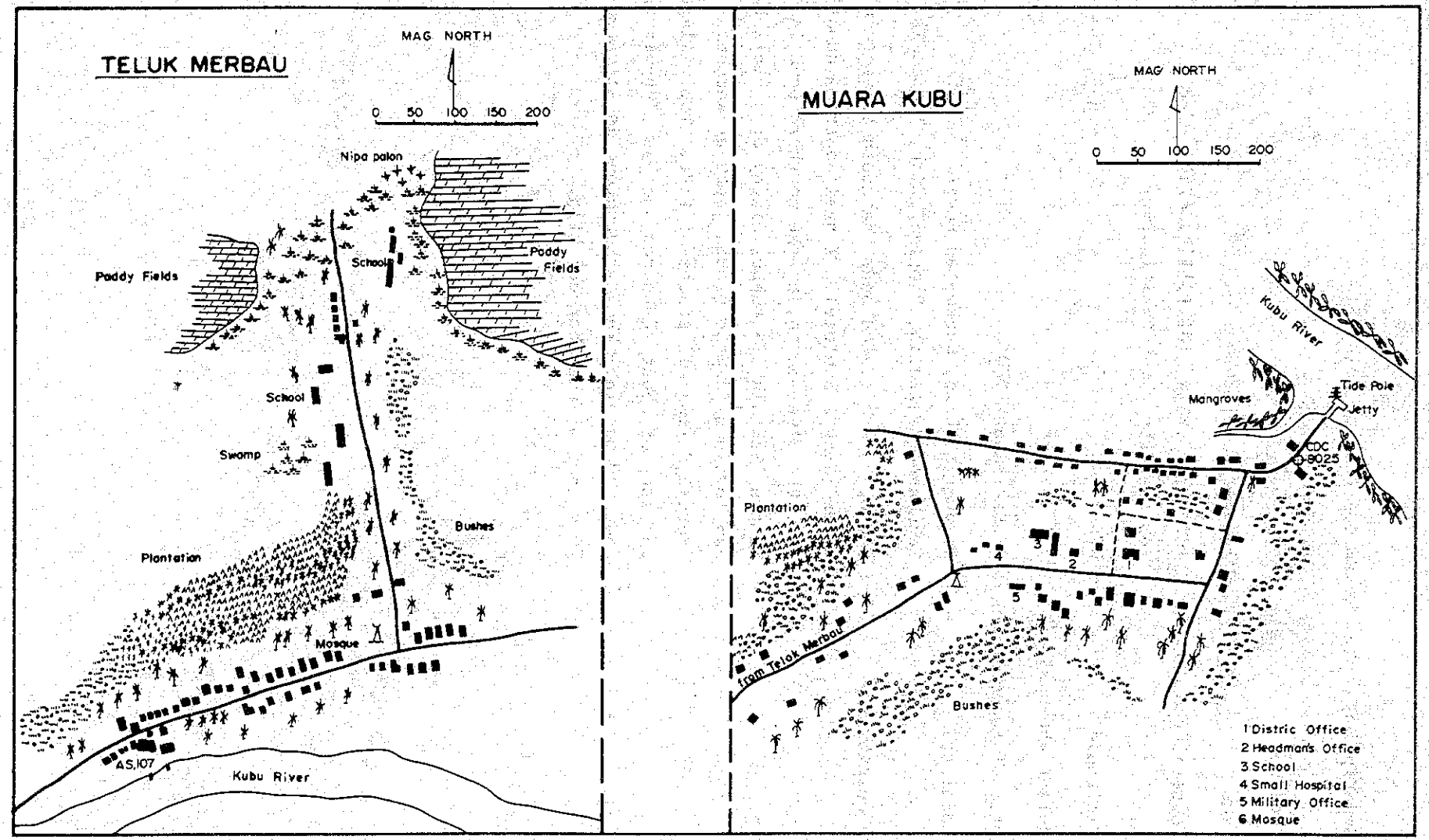
Spot No.	:	CDC 8024
Name	:	Tg. Medang CDC Point
Geodetic coordinates	:	02°07'26".767N, 101°39'25".833E
Ellipsoid	:	WGS-72
Height above M.S.L.	:	3.19 metres
Date of construction	:	7 October 1980
Locality	:	Kampung Tg. Medang, Kecamatan Bengkalis, Kabupaten Bengkalis, Propinsi Riau, Indonesia
Accessibility	:	CDC 8024 is accessible from the sea. Small landing craft should head straight for Tg. Medang Lighthouse and land at the beach off the lighthouse. It is possible to land either at high or low water. The marker stone is situated about 200 m east of the lighthouse. Alternatively, this CDC Point can be reached from Tg. Medang village by following a footpath in a northeasterly direction for a distance of about 1.5 km to the lighthouse.


CONTROL POINT OF CDC II'80
TG.MEDANG CDC POINT 8024
MAG. NORTH
0 50 100 150 200m
Low water line
High water line
Lighthouse
CDC8024
Bushes
Mosque
A.S.190
Urid River
WOODEN JETTY
0 20 40 60 80m
1. Naval Station
2. Police Station
3. Headman's Office
4. Justice Office
5. Fishery Co-operative
6. Local Port Authority
7. Military Office
8. Customs Office
9. Charcoal Kiln
10. Water Storage Tanks
Wooden Jetty
Uturivet

Description of Muara Kubu (Teluk Merbau) CDC Control Point

Spot No.	: CDC 8025
Name	: Muara Kubu (Teluk Merbau) CDC Point
Geodetic coordinates	: 02°05'15".042N, 100°39'09".002E
Ellipsoid	: WGS-72
Height above M.S.L.	: 4.05 metres
Date of construction	: 30 October 1980
Locality	: Kampung Muara Kubu, Kecamatan Tanjung Kubu, Kabupaten Bengkalis, Propinsi Riau, Indonesia
Accessibility	: CDC 8025 is accessible by small craft from the sea up Kubu River. About 3 km from the river mouth land at the wooden jetty at Muara Kubu village. The marker stone is about 100 m southwest of this wooden jetty. Walking from the jetty, this control point is to the left, just beside the footpath.

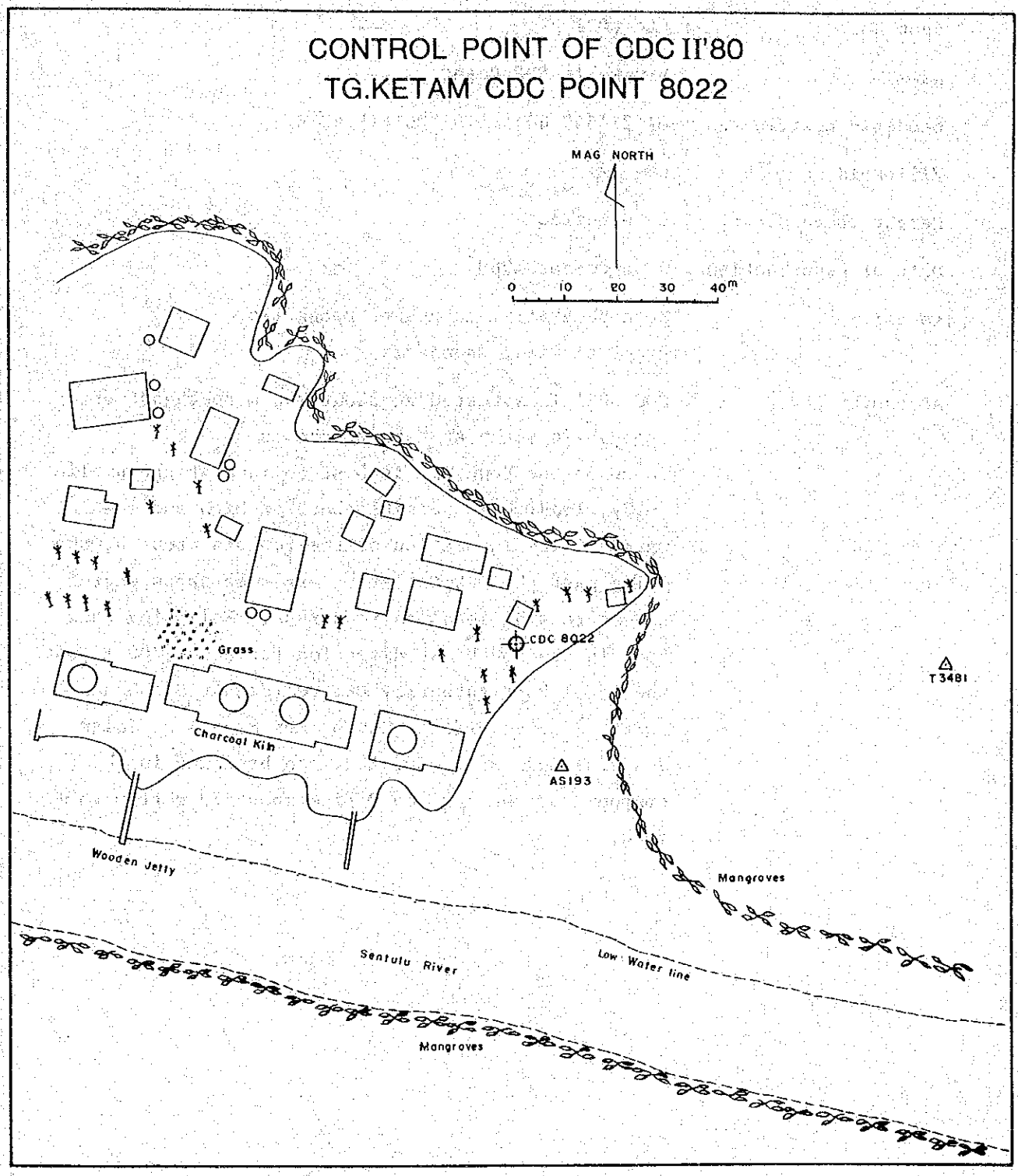
CONTROL POINT OF CDCII'80
MUARA KUBU CDC POINT 8025



Description of Tg. Ketam CDC Control Point

Spot No.	:	CDC 8022
Name	:	Tg. Ketam CDC Point
Geodetic coordinates	:	(02°00'02".384N, 101°19'14".067E) (obtained by Point Positioning)
Ellipsoid	:	WGS-72
Height above M.S.L.	:	3.17 metres
Date of construction	:	13 September 1980
Locality	:	Kampung Sentulu, Kecamatan Dumai, Kabupaten Bengkalis, Propinsi Riau, Indonesia
Accessibility	:	CDC 8022 is situated near the mouth of Sentulu River (Sungai Sentulu). Travel upstream about 200 m from the river mouth, on the northern bank is Kampung Sentulu. A rubber dinghy or a small boat can go alongside the wooden jetty at Kampung Sentulu during all states of tide. The village consists of about 20 houses and has a population of about 30 people. The marker stone is situated about 20 m east of the charcoal kiln.

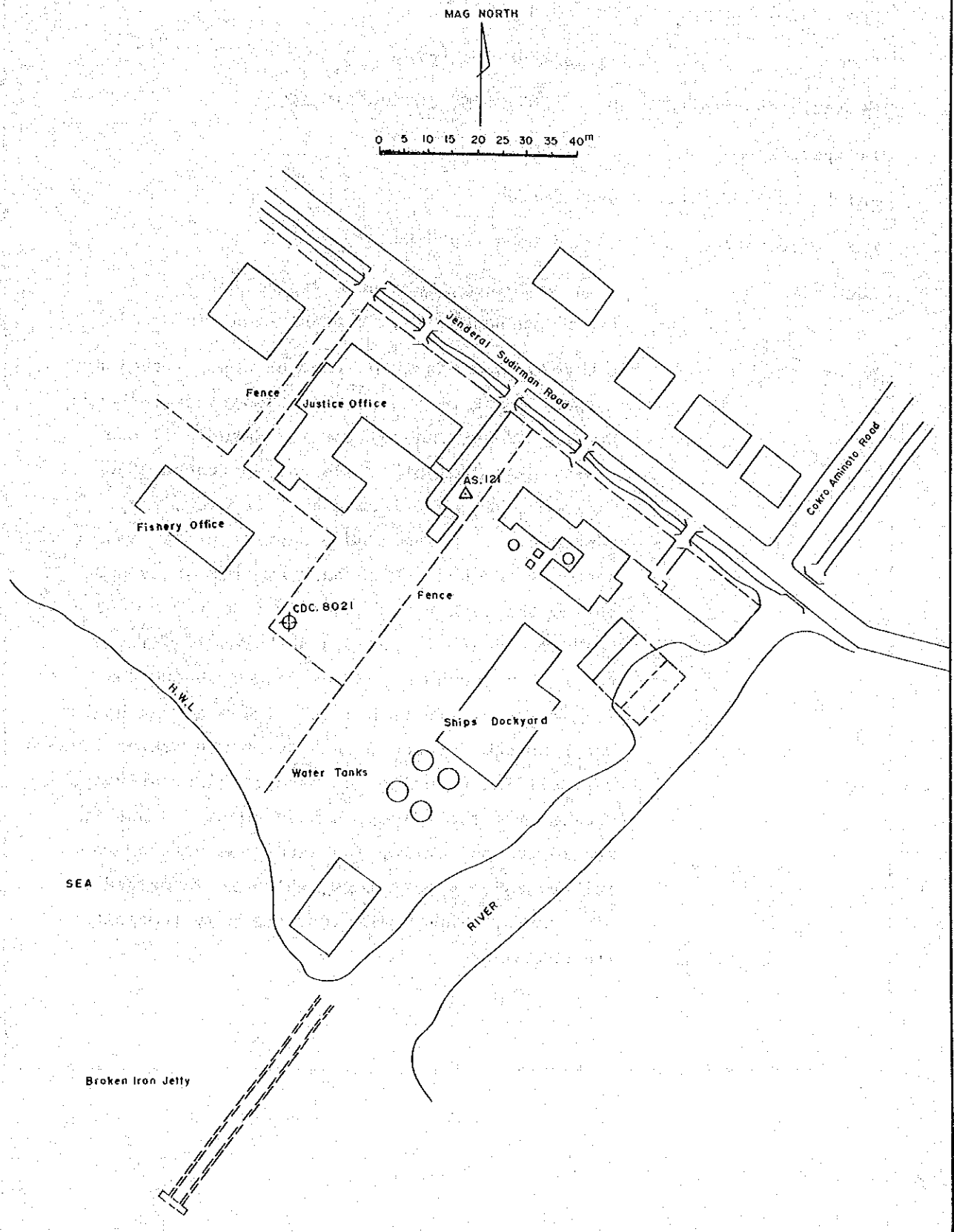
CONTROL POINT OF CDC II'80
TG.KETAM CDC POINT 8022



Description of Bengkalis CDC Control Point

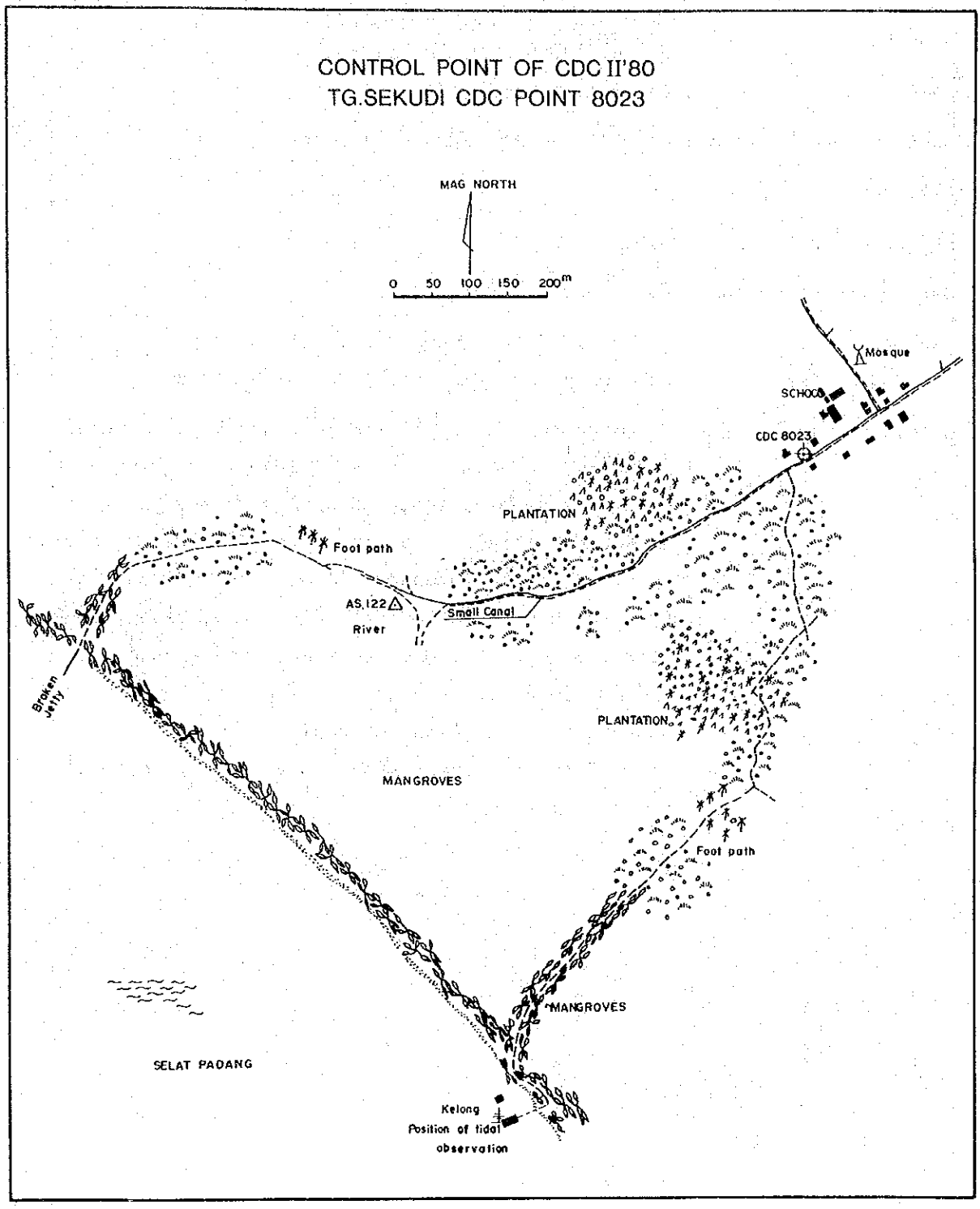
Spot No.	: CDC 8021
Name	: Bengkalis CDC Point
Geodetic coordinates	: 01°27'54".602N, 102°06'41".623E
Ellipsoid	: WGS-72
Height above M.S.L.	: 2.50 metres
Date of construction	: 4 September 1980
Locality	: Kota Bengkalis, Kabupaten Bengkalis, Propinsi Riau, Indonesia
Accessibility	: CDC 8021 is situated at about 700 m southeast of the public jetty at Kota Bengkalis. To reach the town, it is best to land at the public jetty, landing is possible both at high and low waters. The population of the town is about 6,000. Going past the public jetty, are some shops where a 4-metre wide metalled road runs. Following this road in the southeast direction for about 700 m past the Local Port Authority Office (Kantor Syahbandar) is the Justice Office (Kantor Kejaksaan) at Jalan Jenderal Sudirman. CDC 8021 can be found in the compound of the Justice Office about 70 m from the road.

CONTROL POINT OF CDC II'80
BENGKALIS CDC POINT 8021



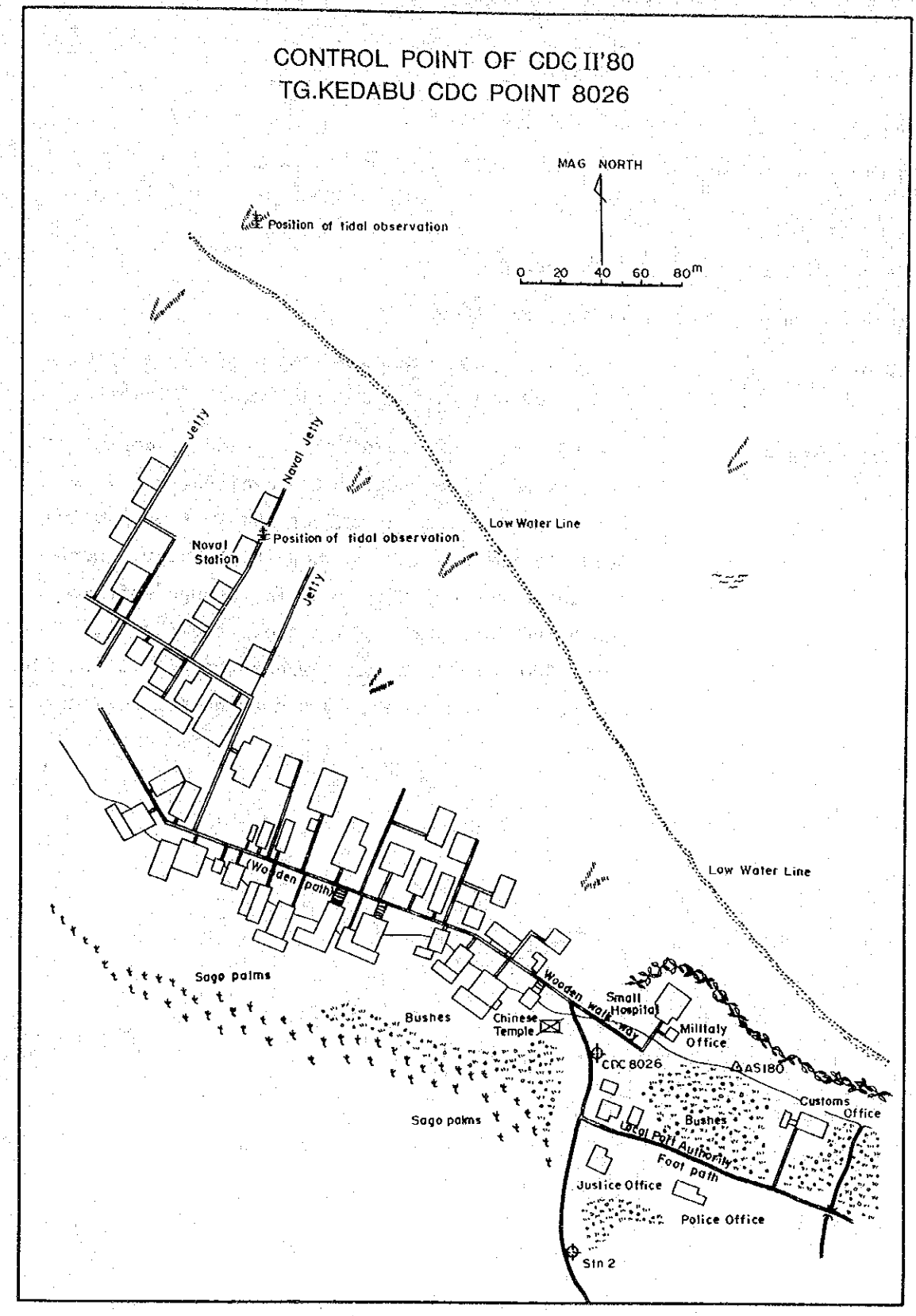
Description of Tg. Sekudi CDC Control Point

Spot No.	:	CDC 8023
Name	:	Tg. Sekudi CDC Point
Geodetic coordinates	:	01°15'40".017N, 102°29'53".425E
Ellipsoid	:	WGS-72
Height above M.S.L.	:	3.23 metres
Date of construction	:	30 September 1980
Locality	:	Kampung Sekudi, Kecamatan Bengkalis, Kabupaten Bengkalis, Propinsi Riau, Indonesia
Accessibility	:	CDC 8023 is accessible from the sea. Travel by a small craft to the southeast entrance to Padang Straits (Selat Padang) for Tg. Sekudi village (local name "Sekodi"). As one approaches "Sekodi" village a kelong (fishing hut) is seen. Continue for another 750 m until a broken wooden jetty is reached. Disembark at this jetty and follow the path for about 1 km till the school "Sekolah Dasar" is reached at "Sekodi" village. About 50 m southwest of the school is CDC 8023 marker stone. It is best to arrive during high water as the foreshore is of soft mud making landing very difficult during low water. Alternatively, access from the kelong is also possible, but it should be done during low water, as part of the walkway is on wooden logs, which is submerged at high water. Then walk along the only footpath to the school.


CONTROL POINT OF CDC II'80
TG.SEKUDI CDC POINT 8023
MAG NORTH
0 50 100 150 200m
Mosque
SCHOOL
CDC 8023
PLANTATION
Foot path
AS.122
River
Small Canal
Broken Jetty
PLANTATION
MANGROVES
Foot path
MANGROVES
SELAT PADANG
Kelong
Position of tidal observation

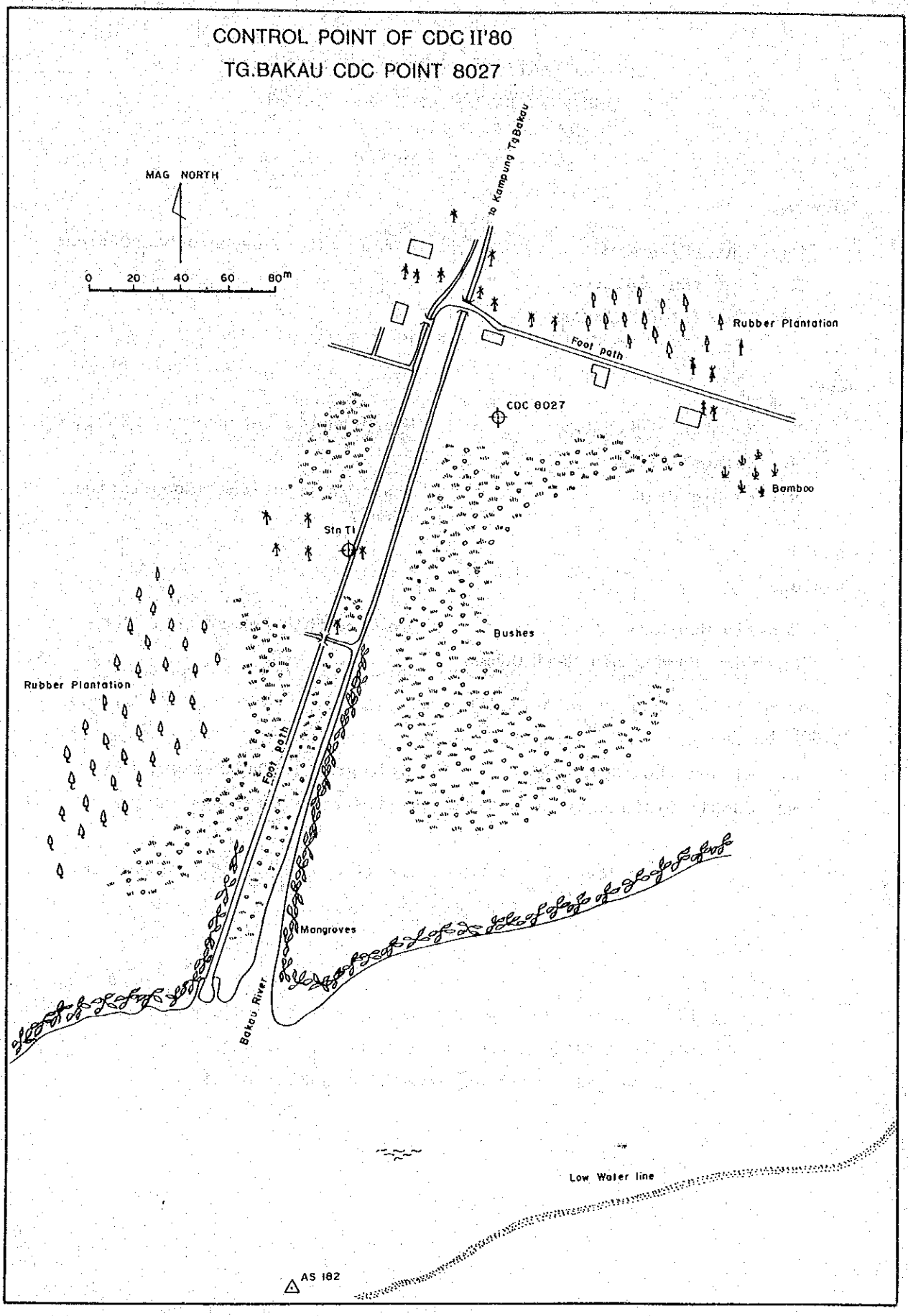
Description of Tg. Kedabu CDC Control Point

Spot No.	:	CDC 8026
Name	:	Tg. Kedabu CDC Point
Geodetic coordinates	:	01°05'35".111N, 102°58'21".210E
Ellipsoid	:	WGS-72
Height above M.S.L.	:	3.05 metres
Date of construction	:	15 November 1980
Locality	:	Kampung Kedabu, Kecamatan Selat Panjang, Kabupaten Bengkalis, Propinsi Riau, Indonesia
Accessibility	:	CDC 8026 is accessible from the sea by small craft (small wooden boat or rubber dinghy). During high water it is possible to go alongside the Naval Jetty at Kedabu village. Landing during low water is also possible as the foreshore is of clay and sand. From the Naval Station walk along the raised wooden walk-way until the Chinese temple is reached. The CDC 8026 marker stone is situated about 20 m southeast of the Chinese temple. The old AS 180 marker stone is about 90 m east of CDC 8026 marker stone.


CONTROL POINT OF CDC II'80
TG.KEDABU CDC POINT 8026
MAG NORTH
Position of tidal observation
0 20 40 60 80m
Jetty
Naval Jetty
Low Water Line
Naval Station
Position of tidal observation
Jetty
Low Water Line
Wooden path
Sago palms
Bushes
Chinese Temple
Wooden walk way
Small Hospital
Militaly Office
CDC 8026
ASI80
Customs Office
Bushes
Sago palms
Local Port Authority
Foot path
Justice Office
Police Office
Sin 2

Description of Tg. Bakau CDC Control Point

Spot No.	: CDC 8027
Name	: Tg. Bakau CDC Point
Geodetic coordinates	: 00°49'52".145N, 103°06'47".722E
Ellipsoid	: WGS-72
Height above M.S.L.	: 3.58 metres
Date of construction	: 21 November 1980
Locality	: Kampung Tanjung Bakau, Kecamatan Tanjung Samak, Kabupaten Bengkalis, Propinsi Riau, Indonesia
Accessibility	: CDC 8027 is accessible from the sea by small craft. Land at the river mouth of Sungai Bakau. It is possible to reach the end of the foot path which leads to Kampung Tg. Bakau at high water. During low water one may have to walk through soft mud to reach the foot path. Walk along the foot path for about 300 m until a small wooden bridge is reached and turn to the right, 40 m away is CDC 8027 marker stone.


CONTROL POINT OF CDC II'80
TG.BAKAU CDC POINT 8027
MAG NORTH
0 20 40 60 80m
To Kampung TgBakau
Rubber Plantation
Foot path
CDC 8027
Bamboo
Stn T1
Bushes
Rubber Plantation
Foot Path
Mangroves
Bakau River
Low Water line
AS 182

LIST OF PARTICIPANTS OF DATA PROCESSING AND PREPARATION OF SURVEY REPORT

Indonesia	
May Laut (P) Katiman	Naval Hydro-Oceanographic Office
May Laut (KH) Sutarto	do
Kpt Laut (P) Aditiawarman	do
Japan	
Mr. Motosuke Fukushima	Hydrographic Department, MSA
Mr. Shigeshi Mimura	do
Mr. Yoshio Ueda	Japan International Cooperation Agency
Malaysia	
Captain Goh Siew Chong	Hydrographic Department, RMN
Lt. Cdr. Hamdan bin Haji Othman	do
Singapore	
Mr. Wilson Chua Ngiap Foo	Hydrographic Department, PSA
Mr. Jasbir Singh	do

Record of the Meeting
of the Data Processing and Preparation of Report
on the Geodetic Survey of Control Points
for Joint Production of Common Datum Charts
of the Straits of Malacca and Singapore
Jakarta, 19th - 25th April 1981

1. A Meeting of the Data Processing and Preparation of Report on the Geodetic Survey of Control Points for Joint Production of Common Datum Charts of the Straits of Malacca and Singapore was held in Jakarta from 19th to 25th April 1981. The meeting was attended by participants from Indonesia, Japan, Malaysia and Singapore. The list of participants appears as Annex 1.

2. The leader of Indonesian participants was unanimously elected as chairman of the meeting.

3. The Meeting examined and amended where necessary the Draft Report on the Geodetic Survey of Control Points for Joint Production of Common Datum Charts of the Straits of Malacca and Singapore prepared by Japan.

4. The report adopted by the Meeting appears as Annex 2*.

5. The Meeting was held in a friendly and cordial manner.

* Annex 2 : Report on the Geodetic Survey of Control Points for Joint Production of Common Datum Charts of the Straits of Malacca and Singapore, Phase II, April 1981.

Annex 1.

LIST OF PARTICIPANTS OF DATA PROCESSING AND PREPARATION OF SURVEY REPORT

Indonesia

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May Laut (KH) Sutarto	do
Kpt Laut (P) Aditiawarman	do

Japan

Mr. Motosuke Fukushima	Hydrographic Department, MSA
Mr. Shigeshi Mimura	do
Mr. Yoshio Ueda	Japan International Cooperation Agency
Mr. Mitsuo Nakamoto	Embassy of Japan (Observer)
Mr. Susumu Takahashi	Japan International Cooperation Agency (Observer)
Mr. Kinzo Ochiai	Malacca Strait Council

Malaysia

Captain Goh Siew Chong	Hydrographic Department, RMN
Lt. Cdr. Hamdan bin Haji Othman	do

Singapore

Mr. Wilson Chua Ngiap Foo	Hydrographic Department, PSA
Mr. Jasbir Singh	do