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THE UNITED REPUBLIC OF TANZANIA

PROGRESS REPORT
ON
FEASIBILITY STUDY AND PRELIMINARY DESIGN
OF
SOUTHERN COASTAL LINK ROAD PROJECT

November, 1975

JAPAN INTERNATIONAL COOPERATION AGENCY

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OF

SOUTHERN COASTAL LINK ROAD PROJECT

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JAPAN INTERNATIONAL COOPERATION AGENCY

国際協力事業団

20536

Nov. 1975

PRINCIPAL SECRETARY
Ministry of Works,
Roads Division,
P.O.Box 104,
Dar es Salaam
The United Republic of Tanzania

Dear Sir;

In compliance with our Inception Report submitted to you on September, 1975, we are pleased to submit you herewith the progress report for Southern Coastal Link Road Project.

With our best wishes,

Faithfully yours,



Hiroshi MORI
Leader of the Japanese Study Team
for the Southern Coastal Link Road
Project

PREFACE

The report presented herewith describes the summary of studies which were carried out from the start of this study up until the completion of field survey.

The contents of this progress report were approved by the Supervisory Committee for this project under JICA.

Nov. 1975



Satoru SONE
Deputy Leader of the Japanese
Study Team for the Southern
Coastal Link Road Project

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PROGRESS REPORT

I. INTRODUCTION

From 6th September to 11th Sept. '75, the Government of the United Republic of Tanzania and we, the Japan International Cooperation Agency, a responsible agency of the Japanese Government for the execution of this study held a meeting at Dar es Salaam for the discussion of Scope of Work for this project. And as a result, the both parties have agreed and defined the Scope of Work of this project.

On the basis of this Scope of Work, our Inception Report was submitted to the Government and the Study was commenced in accordance with this Inception Report.

II. OUTLINE OF WORK

1. Discussion on the Scope of Work

For the discussion of Scope of Work for this project, the meeting was held between members of supervisory committee., i.e., messrs. M. Kikura and T. Dohi and the Government officials concerned of Tanzania, attended by Mr. K. Matsuoka, coordinator of JICA. Then the Scope of Work was determined and agreed by both parties.

2. Submittal of Inception Report

The Inception Report describing the contents of the study to be carried out in this project was submitted by Mr. H. Mori, the Leader of the Japanese Study Team. The study was carried out in Tanzania on the basis of this Inception Report.

3. Preparatory Work

For the purpose of enabling the field survey team to facilitate smooth execution of their study. Mr. Y. Daicho, a soil engineer, and other two team members arrived in Tanzania in advance to carry out necessary preparatory work such as preparation of equipment and materials to be imported from Japan for the field survey, procurement of necessary local materials and arrangement of vehicles.

4. Field Reconnaissance and Survey.

The field reconnaissance was conducted by Mr. H. Mori, the Team

Leader jointly with Mr. T. Dohi, a member of supervisory committee, Mr. S. Aiga, chief surveyor and Mr. Y. Daicho, a soil engineer.

5. Aerophotograph Taking and Topographic Survey

The aerophotograph taking at the scale of 1/12,500 was carried out by means of an aircraft which came from Japan, covering the proposed route in the project area.

Then films taken were developed at Dar es Salaam to prepare a set of aerophotograph to be submitted to the Tanzania Government. And another one set of this photograph was submitted to the Government at the end of November, 1975.

The following works were carried out by the ground survey team, i.e., Mr. S. Aiga and other 6 team members:

- i) Traversing and geolight leveling
- ii) Installation of Permanent surveying stations
- iii) River cross-sectioning of Matandu, Mavuji and Mbwemkuru Rivers
- iv) Field survey on the location and identification of Public facilities, condition of vegetation
- v) Cross-sectioning of existing road

6. Soil and Aggregate Investigation

Soil and aggregate investigation at the proposed Sites were carried out by Mr. S. Sone, chief soil engineer, Mr. Y. Daicho, soil engineer, Mr. N. Takano, geologist, and other 4 team members.

The following investigations were carried out:

- i) Soil investigation at the proposed bridge construction sites by means of borings
- ii) Investigation of the soil distribution by means of test pits and field reconnaissance
- iii) Investigation of the distribution of aggregate by means of field reconnaissance

For the typical soil samples obtained by the field investigation, soil testings were performed at the Materials Laboratory of the Ministry of Works.

7. Survey for Preliminary Design

The survey for preliminary design was carried out by Mr. K. Nagashima, chief highway engineer, Mr. H. Nishikawa, highway engineer, Mr. K. Goto, structural engineer and Mr. K. Watanabe, hydrologic engineer.

The following surveys were carried out:

- i) Highway Engineering
Location, survey for the existing road conditions.
- ii) Hydrologic Engineering
Survey for the Matandu, Mavuji and Mbwemkuru River as well as other medium to small rivers and collection of hydrologic data.
- iii) Structural Engineering
Survey for the existing bridges
- iv) Others
Study on the capability of local contractors and necessary construction materials available in Tanzania.

Also, they have discussed with relevant officials of the Government with regard to the design standard and criteria for this project.

8. Regional Economic Study.

The study for the evaluation of regional economy in the project area was carried out by Mr. A. Asahi, transportation economist.

The study includes, mainly, field reconnaissance, traffic survey and collection of relevant data.

9. Work Schedule

The work schedule in Tanzania are shown in Appendix I. Despite of about 10 days delay behind the schedule in the preparatory stages, the whole work was completed on schedule except for laboratory soil testings.

10. Cooperation of the Tanzania Government and Problems Encountered during the Study

The main obstacles for the smooth execution of the study were, as a general problem, unexpected time lag in the import clearance for equip-

ment and materials from Japan and handling of petrol for vehicles which had to be brought from Dar es Salaam or Lindi.

The cooperation of the Tanzania Government, as described in the Scope of Work, during the course of our study was satisfactory in general. Particularly, we should like to express our sincere gratitude to Tanzania Government for their kind consideration to provide us with the following counterpart staffs despite of busy situation in the Ministry of Works.

These counterparts are:

For highway, structural and hydrologic engineering

Mr. D. J. Mariki

For regional economic study

Mr. J. Komba

Mr. A. Mwakalonge

For topographic survey

Mr. M. Temba

For aggregate investigation

Mr. J. Miema

For soil investigation

Mr. A. Halahala

Mr. C. Ndunguru

For laboratory testing

Mr. M. Kuluva

Mr. A. Halahala

Mr. C. Ndunguru

11. Itinerary and Outline of Activities of the Study Team

Date	Description
August 28th	Mr. Y. Daicho and other 3 team members commenced preparatory work for the study.
September 6th	Mr. Kikura, a member of supervisory committee, explained a draft of Scope of Work prepared by Japanese Study Team to Mr. J. A. Kassamia, a commissioner. And both parties exchanged their comments on this draft. The meeting was attended by Mr. Y. Inagawa, a secretary of Japanese Embassy, Mr. T. Dohi, a member of supervisory committee, Mr. K. Matsuoka, coordinator of JICA, Mr. H. Mori, the team leader and Mr. S. Aiga, a team member.
September 9th	Regarding obligation of the Scope of Work, detailed discussion was held between Mr. J. A. Kassamia and Mr. M. Kikura. And contents of Inception Report was explained. The meeting was attended by Mr. Y. Inagawa, Mr. T. Dohi, Mr. K. Matsuoka, Mr. H. Mori and Mr. S. Aiga.
September 10th	Messrs. H. Mori, T. Dohi, S. Aiga and Y. Daicho left Dar es Salaam for field reconnaissance and survey along the proposed route.
September 11th	The final discussion on the Scope of Work was carried out between Mr. J. A. Kassamia, a commissioner and Mr. M. Kikura, a member of supervisory committee. As a result, the Scope of Work was determined and mutually agreed by both parties. Mr. Inagawa, a secretary of Japanese Embassy attended the meeting. From this day, aero-photograph taking along the proposed route was started.
September 22nd	Topographic Survey Team and Soil Investigation Team commenced field works.
September 28th	The team members for regional economic study, highway, hydrologic, and structural engineering and aggregate investigation commenced their study respectively.

Date	Description
September 29th	The meeting was held between Mr. K. Nagashima, deputy team leader and Mr. Prakash, an engineer of Ministry of Works for the discussion of the matter concerning design standard and criteria in this project. The meeting was attended by messrs. H. Nishikawa, K. Goto and K. Watanabe.
October 2nd	The team members for highway, hydrologic and structural engineering and aggregate investigation proceeded to their field survey.
Oct. 3rd	Mr. S. Aiga submitted contact prints of aerophotographs to the Ministry of Works. At this time Mr. Inagawa of Japanese Embassy has also attended.
Oct. 21st	Messrs. Nishikawa, Goto and Watanabe and Mr. Prakash of Ministry of Work discussed on the route location, utilization of existing bridge and the method of hydrological analysis, etc.
November 18th	Mr. S. Sone, deputy team leader proceeded to field reconnaissance.
November 22nd	Mr. T. Kunihiro, a member of supervisory committee, proceeded to field reconnaissance.
November 28th	Another one set of contact prints was submitted to the Ministry of Works through Mr. Y. Inagawa.
December 1st	Progress Report was submitted by Mr. T. Kunihiro to Mr. J. A. Kassamia of Ministry of Work, at that time Mr. M. Takada, a member of supervisory committee and Mr. S. Sone were also attended.

III TASK DESCRIPTION

III-1 Aerophotograph Taking and Topographic Survey

1. Aerophotograph Taking

i) Aerophotograph Taking

Aerophotographing at a scale of 1/12,500 was carried out for use in 1/2000 topographic map making required for Southern Coastal Link Road Project. An aircraft for photograph taking departed Japan 28th August, 1975 and arrived Dar es Salaam 7th September, 1975. The photography team consisted of a navigator, a photographer and a mechanic. The aerophotograph taking commenced after several adjustments had been made to the aircraft. Aerophotographs covering whole survey area were completed on 27th September, 1975 (on schedule) in spite of unusual (bad) weather conditions and some trouble with the aircraft engine. Additional photography at a scale of 1/12,500 of the area from Lindi to Mingoyo was performed.

Aircraft: Aero Commander 680FL JA5197

Aerial Camera: Zeiss RMK 15/23

Film: Fuji Panchro SS

Photo Scale: 1/12,500

Number of Courses: 24

Date of Photography: From 11th September to 27th September, 1975

ii) Photo Processing Work

Film was developed and printed in the laboratories of the Map Bureau, Ministry of Land, Tanzania. All aerophotographs were inspected promptly and the quality of the photos was found to be good. They submitted a set of contact prints to the Tanzanian Government and to each survey team (e.g. the field survey team), and then they returned to Japan.

2. Topographic Survey

i) Traversing and Geolight Leveling

Traversing and geolight leveling were carried out from Kibiti to Lindi and from Nangurukuru to Kilwa Masoko (total distance of

360 km) in order to establish control points for use in 1/2,000 scale topographic map making.

Six members of the main survey team arrived at Dar es Salaam on 11th September, 1975 and after having gotten the survey equipment and having checked it out and adjusted it, they went to the field and started survey work on 23rd September. The ground control point survey was started in the northern part of the survey area and progressed southward along existing roads. Ground control points for use in aerial triangulation for the 1/2000 topographic maps were measured one point per every 3 km. These points were pricked on the photos.

Equipment: Theodolite: Wild T2

Distance Measurement Meter: Y.H.P. 3805 B

ii) Installation of Permanent Surveying Stations

Installation was done along existing roads for one station per every 50 or 60 km (taking into consideration future construction work). Locations of these stations were measured by traversing. Installation was done at nine places (in Kibiti, the Rufiji River, Somanga, the Matandu River, Nangurukuru, Kilwa Masoko, the Mavuji River, the Mbwemkuru River and around Lindi). These places are shown on Appendix II.

Size of Station: 20 cm x 20 cm

Material of Station: Concrete

iii) River Cross-Sectioning at Bridge Construction Sites

River cross-sectioning was carried out at existing bridge sites and at sites 500 meters upstream and downstream from each existing bridge site on the Mavuji River, the Matandu River and the Mbwemkuru River in order to gather necessary data and information for structural designs.

Cross-sectioning was also used for ground control point survey for the 1/1000 topographic map.

Measurement of cross-sectioning points was done with a theodolite and a distance-meter. The cross-sectioning detailed survey was carried out with a theodolite, a level and a steel tape.

iv) Field Survey - Including Field Identification

The following data and information was gathered in the field in order to complete all items shown on the 1/2000 maps.

- a. Location of public facilities such as police stations, post offices, schools, government offices, etc.
- b. Name, type and size of each bridge
- c. Vegetation conditions along the proposed route

v) **Cross-Sectioning of Existing Roads.**

Cross-sectioning was carried out at a width of 20 meters from the center line in each direction along existing roads every 6 km in order to get necessary data for designing roads.

III-2 Soil and Aggregate Investigation

In the course of field reconnaissance and survey conducted from 10th September by the Team Leader, Mr. H. Mori, the essential points in the conduct of soil and aggregate investigation were instructed by him to Mr. Y. Daicho, soil engineer.

Field soil investigation was commenced from 22nd September by Mr. Y. Daicho and other 4 team members. Aggregate investigation was conducted by Mr. N. Takano, geologist, for the period from 2nd to 24th October. Laboratory tests for soil and aggregate were performed by Mr. F. Masumi, soil testing engineer.

Further, from 18th to 25th November, Mr. S. Sone, chief soil engineer cum Deputy Team Leader conducted the field reconnaissance along the proposed route.

In order to grasp the soil condition along the proposed route, investigation was carried out, which includes test borings, undisturbed samplings and test pits as well as field reconnaissance. Also aggregates, especially coarse aggregates, were surveyed along the proposed route and at other appropriate spots away from the route.

The locations of soil and aggregate investigations performed are shown in APPENDIX II and Fig. 1 of APPENDIX III respectively.

1. Test Boring

Soil condition was investigated by test borings at the proposed Matandu, Mavuji and Mbwemkuru bridge sites for the detailed study of their foundation. Test borings with the same purpose were performed at the typical sites of other bridges to be studied.

Near Malendego there are several marsh lands on which the proposed route will be located. A study shall be conducted for the stability and settlement of the road embankment on these marsh lands. Therefore the typical two sites were selected to be surveyed by test boring.

Standard penetration test (S.P.T.) were carried out in each bore hole. Disturbed samples obtained by means of sampling spoon of S.P.T. were used for observation and physical soil testings. The location and depth of test borings and the numbers of S.P.T. performed are shown in Table-1 of APPENDIX III.

2. Undisturbed Sampling

Soft soils have been found to deposit at the proposed sites of Matandu,

Mavuji and Mbwemkuru bridges and the marsh lands near Malendego. Shear strength and compressibility of these soft soils may affect the stability and settlement of the road embankment to be constructed in such sites. In order to study this problems, undisturbed samples were obtained from bore holes made at these sites, by the thin-wall sampler with stationary piston. And the samples obtained were used for unconfined compression and consolidation test as well as physical test.

The numbers of samples taken are shown in Table-1 of APPENDIX III.

3. Test Pit

Test pits were made to investigate shallow soils condition along the proposed route. Test pits were made also for the investigation of fine aggregates, subgrade and base course Materials. Observation was carried out for the soils encountered in the test pits and disturbed samples were taken. The samples were contained in vinyl bags to keep their natural moisture content. They were used for the test of physical properties, compaction, CBR and stabilization. At some test pit sites, field CBR tests were also performed. The location of test pits carried out, the numbers of samples obtained from test pits and the numbers of field CBR tests performed are shown in Table-2. of APPENDIX III.

4. Reconnaissance for shallow soil distribution

Reconnaissance was carried out to investigate the shallow soil distribution by collating with test pits results. Shallow borings were supplementarily conducted by means of handy auger as required in the reconnaissance.

5. Survey for aggregate material

Aggregate were surveyed by the geological reconnaissance, which was executed not only along the proposed route but away from it. Typical aggregate samples were taken at the sites surveyed. The location of geological survey performed and samples taken is shown in Fig.-1 of APPENDIX III.

6. Testing for soil and aggregate

All samples to be tested were delivered to the Material Laboratory in Dar es Salaam and testings for them were carried out there.

- i) Testing for disturbed and undisturbed soil samples obtained from bore holes

The following tests were carried out for samples obtained from bore holes.

- a. For disturbed samples: Test of physical properties such as natural moisture content, specific gravity of soil particles, grading analysis, liquid limit and plastic limit.
- b. For undisturbed samples: Above mentioned test plus wet density test, unconfined compression and consolidation test.

- ii) Testing for disturbed samples obtained from test pits

The following tests were performed for samples obtained from test pits.

- a. Test of physical properties
Natural moisture content, specific gravity of soil particles, grading analysis, liquid limit, plastic limit and loss of ignition.
- b. Compaction test
- c. CBR test
- d. Tests for stabilization
Compaction and unconfined compression test for soil-cement admixture.

Marshall test for aggregate-asphalt and soil-asphalt admixture.

Aggregate samples were selected from these described in Item 5, "Survey for aggregate materials."

- iii) Testing for aggregate samples

- a. Abrasion test
- b. Compression test for specimen using aggregate samples

The numbers of tests performed are tabulated in Table-3 of APPENDIX III.

III-3 Survey for Preliminary Design

On 26th September, the following three team members arrived at Dar es Salaam :

Mr. H. Nishikawa, highway engineer
Mr. K. Watanabe, hydrological engineer
Mr. K. Goto, structural engineer

They have attended a meeting with the Tanzania Government Officials concerned for the discussion of basic matters concerning roads, hydrologic and structural engineerings. And thereafter, they have conducted a field survey in the period from 2nd October to 15th October. From 16th October, they have investigated recent road construction projects and available construction materials in Tanzania, and left Tanzania on 24th October.

1. Survey for highway engineering

Route location using aerophotograph of 1/12,500 scale and field reconnaissance and survey were carried out along the whole extension of existing roads.

i) Route location

The proposed route shall be located, in principle, along the existing road. However in the following area, i.e., 4 places in the main route and one place in the course of feeder road, the proposed route shall deviate from the existing route.

a. MOHORO Area

According to the hearings in the area, private household alongside of existing road had been inundated in the depths of about 2m at the time of flood in 1974. If the route will be located along the existing road, height of embankment will become 3m including the clearance, thus the construction cost for earth work, drainage structure and slope protection etc., will be increased.

Therefore proposed route shall be changed to be located in the high land at western part.

b. SOMANG Area

New route with good alignment shall be located towards the hill side, because of bad alignment and poor surface

condition of existing road due to existence of black cotton clay.

c. MCHINGA Area

In this area, as the surface and longitudinal alignment is extremely poor, more detailed study shall be carried out by making extensive plan of 1/2,000 scale.

d. MITONGA Area

The alignment shall be greatly modified due to bad plan alignment of the existing road.

e. KILWA KIVINJE Area (Feeder road)

New route shall be located to by-pass Kilwa Kivinje with the purpose of short-cut as the existing road passed through concentrated village with extremely poor alignment.

ii) Survey for the Existing Road Conditions

Field reconnaissance was carried out to investigate the following respects.

a. Conditions of plan and longitudinal alignment

b. Conditions of soils and pavement

c. Condition of drainage

As regards the alignment, it is very good in the flat area, but in the section where the flat area changes into mountainous area, it is very poor particularly at the area of bad soil conditions. And also in the area near dissected valley in the mountainous area of similar soil conditions. Therefore the improvement of both plan and longitudinal alignment will be needed.

As regards the pavement, the survey was conducted to investigate the section where the existing road can be paved without special base course work and the section where the base course work shall be required. However, the detailed study shall be carried out based on the results of soil investigation.

As regards the drainage conditions, overall improvement will be needed as it is extremely eroded by rainfall because only naked ditch is provided.

Also, careful study shall be carried out for the drainage method as it is a important factor in the road design.

2. Survey for Hydrologic Engineering

For the Matandu, Mavuji and Mbwemkuru rivers as well as other medium to small rivers, field investigations were carried out for the purpose of studying the suitable dimentions of bridges, flood opening bridges and drainage structures etc. for the prevention of overflowing and safe discharge of flood.

i) Investigation of the Matandu, Mavuji and Mbwemkuru Rivers

The existing conditions of the areas around bridge construction sites were investigated to estimate the flood scale of past years based on the condition of scouring and vegetation as well as the result of hearings.

As a result of this investigation, it is found that the Matandu River had been innundated in the widths of 1,500m, and the inhabitants had to use a boat as the water depths was more than 1.5m in the river basin. The water level at that time was equivalent to the bridge sheet level of existing right side abutment. Also the movement of the rivers are observed in the basin. Therefore, large scale flood opening bridge shall be considered necessary.

Since the Mavuji River is easily overflowed due to small scale of river channel, recently constructed existing road are provided with drains made of corrugated pipes and protection of slope surface at the up-stream side.

The past flood level was recorded at the midheight of the existing Bailey bridge truss.

As regards the Mbwemkuru River, stability of river channel and condition of cross-sectional area of river are better than that of other two rivers because movement of river channel stopped at the left side hill and the river bed was scored to give enough cross-sectional area to discharge the flood.

And even in the past, no flood was experienced, of which water level reaches truss of existing bridge.

ii) Investigation of Other Medium to Small Rivers

The existing condition of medium to small rivers were surveyed with respect to their drain condition and drainage structures.

Between MOHORO and the Matandu River, there are several

rivers and valleys of comparatively large scale, but almost no structures are existing and the traffic on the existing road are secured by stones set in the river bed.

In the rivers located between Nangurukuru and Lindi, there are some bridges. However since in the river bed of most valley, the drains are handled by installing corrugated pipes, at the time of rainfall the traffic may become impassable by overflowing due to the shortage of drainage capacity.

As regards the drain condition of small waterway existing between Kilwa Masoko and Nangurukuru, the scouring at the down stream side of existing road is remarkable due to the wantage of drainage capacity because the corrugated pipes are embedded in the place where the girders of old bridge were demolished.

iii) Collection of Hydrological Data

As a data for flood calculation, precipitation data and observation records on discharge amount of the Mbwemkuru River were collected.

3. Survey for Structural Engineering

i) Survey for existing bridges

For the effective use of structure of existing roads, the survey was conducted for the condition and procedure of utilization in future.

Structures surveyed are the bridges across the Matandu, Mavuji and Mbwemkuru Rivers, 22 medium to small bridges and 33 culverts.

In this survey, major dimensions of structures were measured and condition of deformation, erosion and cracks were studied. For the sub-structure, the stability against scouring at the time of flood was studied.

As regards the existing Bailay Bridges, the Tanzania Government strongly hopes to replace them by new bridges.

The outline of surveys are as follows:

a. The Matandu River Bridge

Presently, one lane Bailay bridges with approx. 30 m length is under construction at the down-stream side of existing road.

For this bridge construction plan, the following 2 cases shall be studied;

Case 1: Construct the new bridge with one lane in parallel with the bridge under construction. Remove super-structure and replace it by new bridge, but sub-structure shall be remained to be used.

Case 2: Construct the new bridge provided with 2 lanes before removing existing super and sub-structure.

b. The Mavuji River Bridge

One lane Bailey bridge with approx. 20 m length was constructed. Since super and substructure of this bridges were temporarily constructed, the road surface are inundated at the time of flood.

Therefore, new bridge with 2 lanes shall be constructed before removing existing bridge.

c. The Mbwemkuru River Bridge

One lane Bailey bridge with approx. 120 m length was constructed. For this bridge construction plan, following 2 cases will be studied;

Case 1: Construct new bridge with one lane in parallel with existing bridge. Remove existing super-structure and replace it by new bridge, but existing sub-structure shall be remained to be used except the abutment of Lindi side.

Case 2: Construct new bridge provided with 2 lanes, before removing existing super and sub-structure.

d. Medium to Small Bridges and Culverts

In this category, the Mandawa River Bridge, located at 224.5 km away from Kibiti and Likumbula River Bridge, 284.5 km away from Kibiti are included.

The most of medium to small bridges exist near the sea coast of Lindi and Kilwa Kivinje.

For the planning of future use of these bridges, the detailed studies shall be conducted for the condition of

existing bridge, proposed height of road surface and cross-sectional area of rivers for discharging the flood water.

4. Others

As regards the major contractors in Tanzania, there are MECCO and UNICO. We have visited MECCO, the most famous contractor in Tanzania, and investigated the number of engineers, construction facilities and their capability of construction execution.

Also necessary data and informations were collected regarding locally available materials and unit price of major constructional items.

III-4 Survey for Regional Economic Study

In the field of regional economic study the following two works were mainly conducted.

- 1) Collection of data and information
- 2) Traffic survey

Works for item 1) were done by interviewing the related government agency and private firms to obtain the data and information for the completion of questionnaire which have been prepared by the team in advance.

The main items of data and information already collected and the government agencies and private companies already interviewed are as follows :

- i) Main items of data already collected
 - a. Transport conditions of roadway, coastal bus services, coastal shipping line and ferry boat services at Utete and Ndundu.
 - b. Possibility and timing of the Ruvuma river bridge construction
 - c. Vehicle operating cost
 - d. Population
 - e. Agriculture
 - f. Forestry
 - g. Industry
 - h. National economy
- ii) Government agencies and private firms already interviewed
 - a. Ministry of Works
 - b. Ministry of Agriculture
 - c. Ministry of Natural Resources
 - d. Ministry of Treasury

- e. Ministry of Economic Affairs and Development Planning
- f. National Transport Corporation
- g. Regional Engineer in Coastal Region
- h. Tanzania Coastal Shipping Line Ltd.
- i. Teeteeka Bus Company
- j. Tanzania Petroleum Development Corporation
- k. Dealer of Motor Vehicle Company
- l. Regional Development Office in Coast, Lindi and Mtwara Region
- m. Embassy of Japan

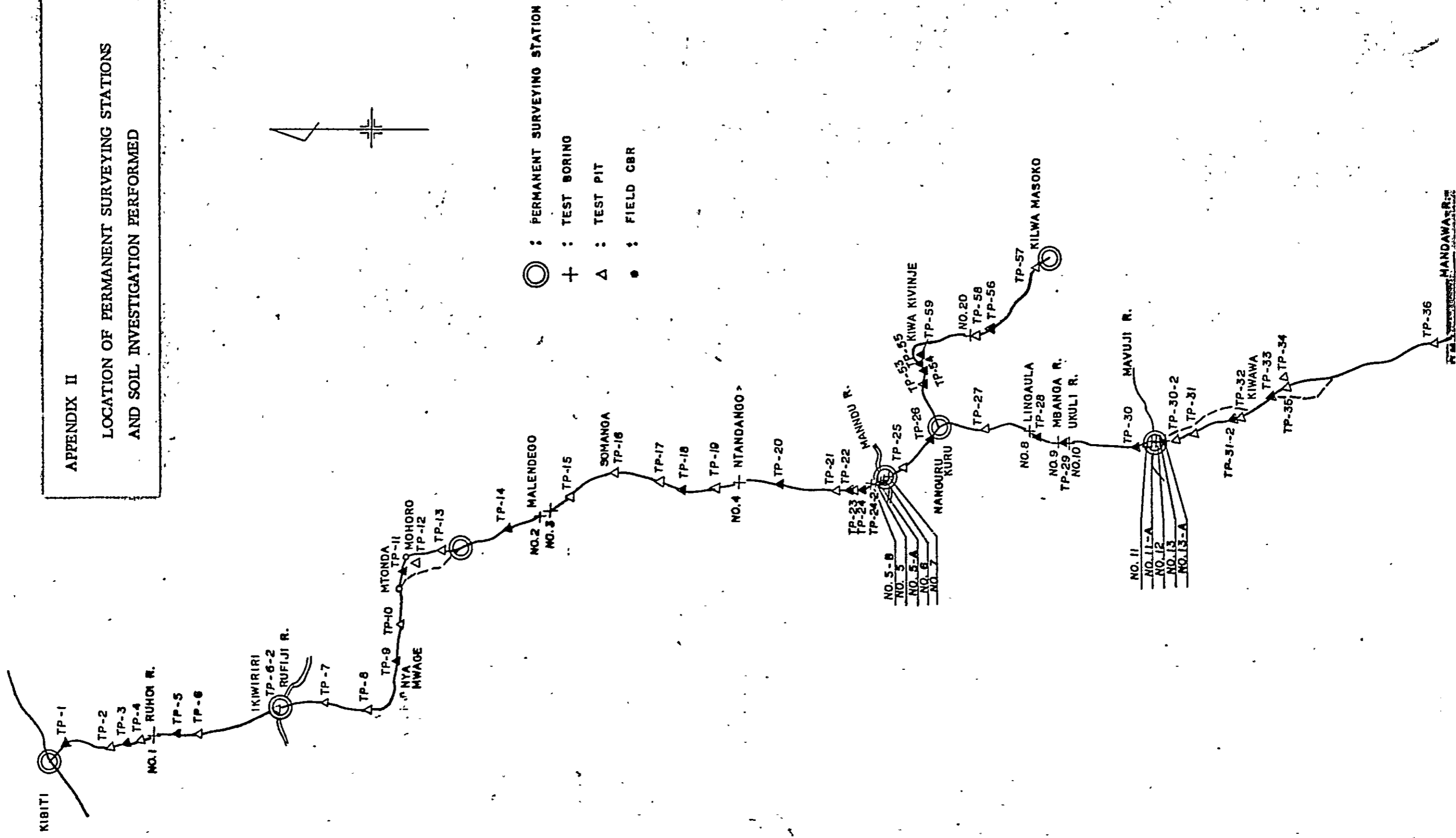
The traffic survey for item 2) was conducted at Utete, Ndundu, Nangurukuru, Kilwa Kivinje, Mtanga and Mchinga from 13th of October up to 20th of October by Mr. A. Asahi, Mr. J. Komba (counterpart), Mr. A. Mmakalonge (counterpart) and Mr. A. I. Haji (Embassy of Japan). The contents of traffic survey are 12 hours traffic counting by vehicle types from 7 A.M. up to 7 P.M. and origin – destination survey.

APPENDICES

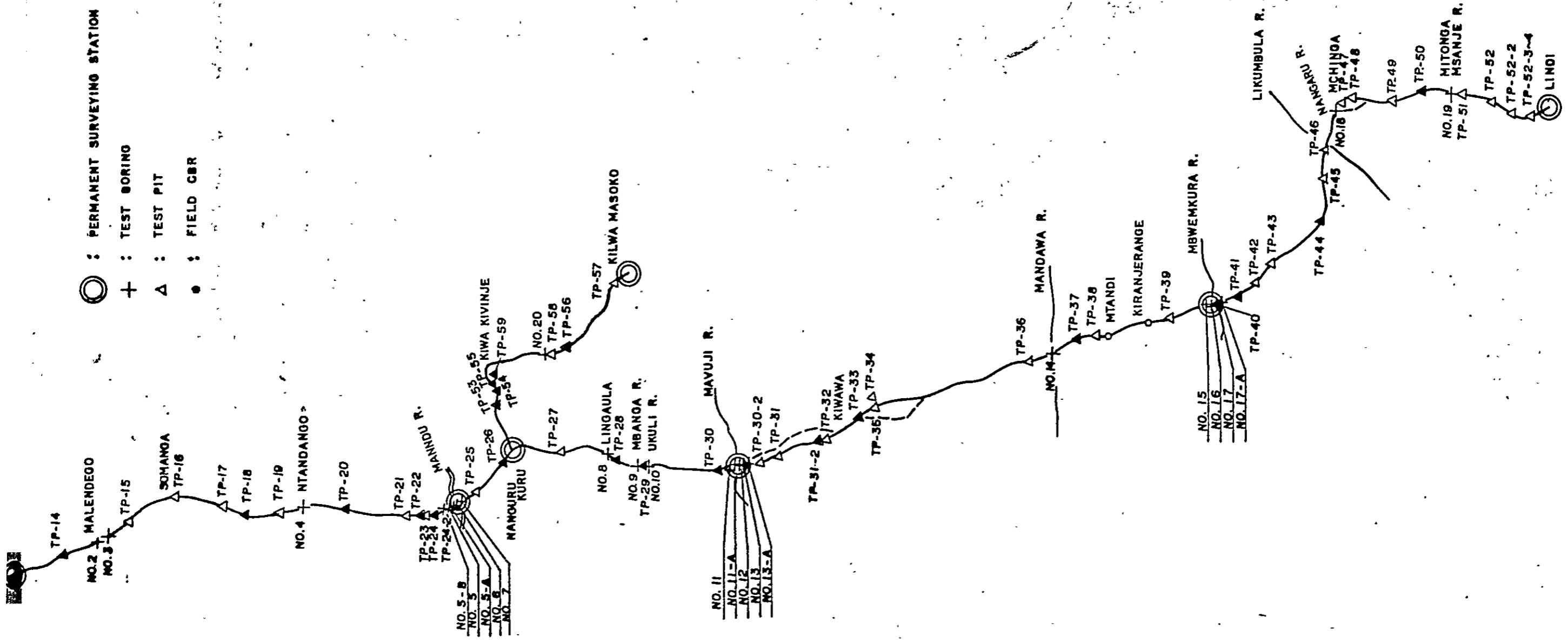
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APPENDIX I. WORK PROGRESS IN TANZANIA						
Item	'75 Augst	September	October	November	December	
1 Preparation	<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>				<input type="checkbox"/> SCHEDULE <input checked="" type="checkbox"/> PROGRESS
2. Survey and Soil Investigation Survey						
Aerophotograph taking		<input type="checkbox"/> <input checked="" type="checkbox"/>				
Topographic survey		<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>		
Soil investigation						
Field investigation for soils		<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>		
Field investigation for aggregates		<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>		
Testing for soils and aggregates		<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>		
3. Field survey for Design						
Survey for route location, alignment and cross sectional design		<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>			
Survey for hydrological engineering		<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>			
Survey for existing bridges and bridges design		<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>			
Survey for construction planning		<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>			
4. Regional Economic Study		<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>		
5. Report		<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> Inception Rep. <input checked="" type="checkbox"/> Progress Rep.

APPENDIX II
LOCATION OF PERMANENT SURVEYING STATIONS
AND SOIL INVESTIGATION PERFORMED



- ⊙ : PERMANENT SURVEYING STATION
- + : TEST BORING
- △ : TEST PIT
- : FIELD CBR



APPENDIX III.

LISTS AND A FIGURE OF SOIL AND AGGREGATE
INVESTIGATION PERFORMED

		<u>Page</u>
Table-1	List of Test Boring, S.P.T. and Undisturbed Sampling Performed	III-1
Table-2	List of Test Pit, Disturbed Sampling and Field CBR Performed	III-2
Table-3	Laboratory Test Performed for Soil and Aggregate	III-5
Fig.-1	Location of Investigation for Aggregate	III-7

Corresponding Station in the Feasibility Report Submitted by OTCA, 1971	Location	Proposed Structure or Site Condition	Quantity of Test Boring		Quantity of S.P.T. and Undisturbed Sampling	
			Nos. of Hole	Total Length in Meter	Nos. of S.P.T.	Nos. of Un- disturbed Sampling
17 + 300	Ruhol River	Bridge	1	15	10	
88 89	Near Malendego	Marsh	2	20	18	2
119 + 150	Ntandango River	Bridge	1	15	11	
138 141	Matandu River	ditto	5	120	74	6
164 + 100	Lingaura River	ditto	1	15	10	
168 + 700	Mbanga River	ditto	1	15	10	
170 + 150	Ukuli River	ditto	1	15	10	
181 182	Mavuji River	ditto	5	98	62	3
221 + 750	Mandava River	ditto	1	10	4	
247 248	Mbwemkuru River	ditto	4	118	70	3
282 + 800	Nangaru River	ditto	1	30	21	
305 + 500	Mbanja River	ditto	1	15	10	
57 + 300	Near Mpara	ditto	1	15	10	
Total			25	501	320	14

Table-2. List of Test Pit, Disturbed Sampling and Field CBR Test Performed				
No. of Test Pit	Corresponding Station in The Feasibility Report Submitted by OTCA, 1971	Depth of Test Pit in Meter	Nos. of Disturbed Sampling	No. of Field CBR Test
TP-1	km No. 3 + 700 m	2.20	One sample was taken from each pit for laboratory test	
TP-2	8 + 800	2.20		
TP-3	11 + 100	2.20		
TP-4	15 + 250	2.20		
TP-5	21 + 500	2.20		
TP-6	25 + 650	2.20		
TP-6-2	36 + 300	2.20		
TP-7	40 + 250	2.20		
TP-8	46 + 200	1.00		
TP-9	53 + 750	2.20		1
TP-10	59 + 550	2.20		
TP-11	65 + 800	1.80		1
TP-12	68 + 150	1.30		
TP-13	70 + 250	1.50		
TP-14	83 + 850	1.80		1
TP-15	92 + 500	2.30		
TP-16	98 + 600	1.50		
TP-17	103 + 900	1.60		
TP-18	107 + 700	2.00		1
TP-19	117 + 0	2.20		
TP-20	124 + 550	1.40		1
TP-21	129 + 750	1.80		

Table-2 (continued)				
TP-22	133 + 50	1.00	One sample was taken from each pit for laboratory test	1
TP-23	135 + 450	1.30		
TP-24	138 + 150	1.50		1
TP-24-2	141 + 150	0.50		
TP-25	143 + 100	0.90		
TP-26	148 + 800	1.00		1
TP-27	158 + 100	1.00		
TP-28	164 + 300	1.00		1
TP-29	170 + 200	1.00		1
TP-30	178 + 250	1.00		1
TP-31	186 + 0	1.70		
TP-31-2	191 + 50	0.60		1
TP-32	191 + 750	2.00		
TP-33	200 + 650	1.30		1
TP-34	212 + 750	0.60		
TP-35	212 + 850	1.00		
TP-36	219 + 100	1.00		
TP-37	226 + 200	1.60		1
TP-38	234 + 750	1.50		
TP-39	242 + 700	0.90		
TP-40	247 + 250	0.50		
TP-41	250 + 500	0.80		1
TP-42	253 + 500	1.00		
TP-43	256 + 550	1.00		
TP-44	267 + 250	0.70	1	

Table-2 (continued)				
TP-45	273 + 850	1.00	One sample was taken from each pit for laboratory test	
TP-46	278 + 200	2.30		
TP-47	284 + 500	0.95		1
TP-48	287 + 300	0.55		
TP-49	293 + 50	0.50		
TP-49-2	293 + 50	2.00		
TP-50	299 + 700	1.70		1
TP-51	305 + 700	0.70		
TP-52	309 + 250	1.80		
TP-52-2	312 + 100	OUTCROP		
TP-52-3	316 + 250 (Borrow Pit)	Ditto		
TP-52-4	316 + 250 (ditto)	Ditto		
Between Nangurukuru and Kilwa Masoko				
TP-53	42 + 450 (Borrow Pit)	0.50		1
TP-54	45 + 800	1.00		1
TP-55	46 + 400	1.50		
TP-56	60 + 100	2.30		1
TP-57	70 + 650	1.00		1
TP-58	57 + 550	1.00		
TP-59	In the Proposed Short-cut near Kilwa Kivinji	2.20		

Table-3 Laboratory Test Performed for Soil and Aggregate

(i) Test for Soil Sample Obtained from Test Boring

Natural Moisture Content	Test for Physical Properties				Unconfined Compression Test	Consolidation Test
	Specific Gravity of Soil Particles	Grading Analysis	Liquid Limit and Plastic Limit	Wet Density		
In TANZANIA 168	168	165	110	14	12	12
In JAPAN*1 30	30	30	10	-	-	-

(ii) Test for Sample Obtained from Test Pit

Natural Moisture Content	Test for Physical Properties				Compaction Test	CBR Test
	Specific Gravity of Soil Particles	Grading Analysis	Liquid Limit and Plastic Limit	Loss of Ignition		
In TANZANIA 65	65	65	42	-	55	A:40*2 B:19*5
In JAPAN*1 -	-	-	-	13	-	-

	Compaction Test		Unconfined Compression Test		Marshall Test
	In TANZANIA	In JAPAN	In TANZANIA	In JAPAN	
for Soil-Cement Admixture	6	-	6	-	-
for Aggregate-Asphalt Admixture	-	-	-	-	3*4
for Soil-Asphalt Admixture	-	-	-	-	3

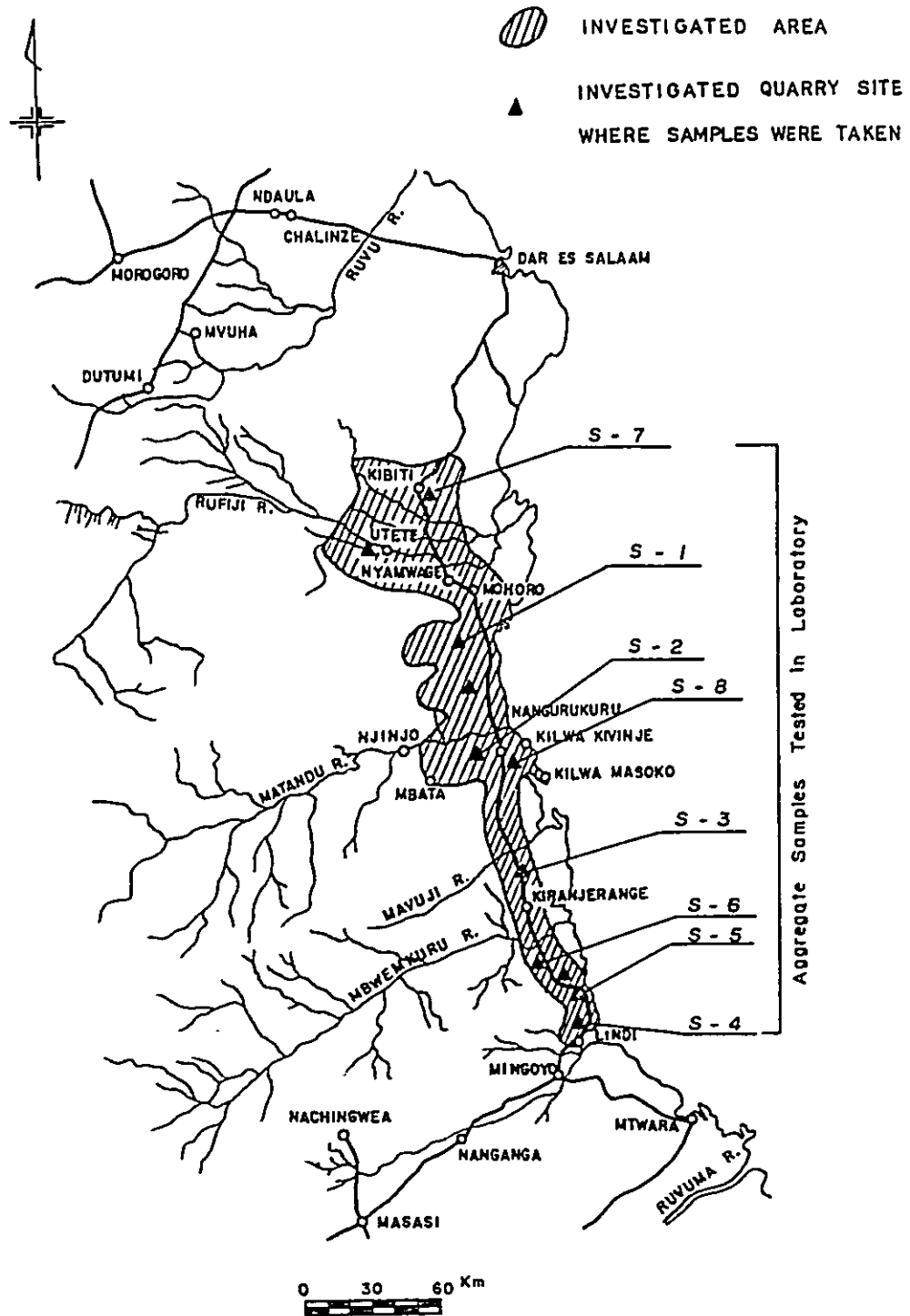
(iii) Test for Aggregate Sample

Abrasion Test		Compression Test for Concrete Specimen Using Aggregate Sample	
In TANZANIA 8	-	for 4 kinds of aggregate samples (7 days strength), [for the same samples (28 days strength)]*4	
In JAPAN -	-	-	

Remarks in Table-3

- *1 : To be tested in Japan.
- *2 : Soaked CBR test for the specimen compacted at the natural moisture content.
- *3 : Soaked CBR test for the specimen compacted at the optimum moisture content.
- *4 : To have been kindly requested to be performed by the Government of Tanzania.
Also, the Government is kindly requested to deliver the test results to Mr. Inagawa, the first secretary of the Embassy of Japan as soon as possible after the tests are performed.

Fig.-1 LOCATION OF INVESTIGATION FOR AGGREGATE



APPENDIX IV. THE HIGHEST WATER LEVEL OF THE
MATANDU, MAVUJI AND MBWEMKURU RIVER

Photo.-1

The heighest Water
Level of the Matandu
River in the past.



Photo.-2

The heighest Water
Level of the Mavuji
River in the past.



Photo.-3

The heighest Water
Level of the Mbwemkuru
River in the past.



