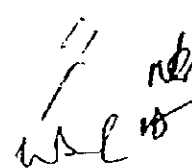


## Necessary Measures to be Taken by the Republic of Ghana

To

1. provide data and information necessary for the Grant Aid,
2. secure the site for the Grant Aid,
3. clear, level and reclaim the site prior to commencement of the Grant Aid,
4. undertake incidental outdoor works such as gardening, fencing, gates and exterior lightning in and around the site,
5. provide facilities for distribution of electricity, water supply, telephone, drainage, sewerage and other incidental facilities to the site,
  - (1) electricity distributing line to the site
  - (2) city water distribution main to the site
  - (3) main city drainage to the site
  - (4) telephone trunk line and the main distribution panel of building
  - (5) general furniture such as carpets, curtains, tables, chairs and others
6. bear commissions to the Japanese foreign exchange bank for its banking service based upon the Banking Arrangement (B/A), namely the advertising commission of the Authorization to Pay (A/P) and payment commission,
7. ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in Republic of Ghana and prompt internal transportation therein of the materials and equipment for the Project purchased under the Grant Aid,
8. exempt Japanese juridical and physical nationals engaged in the Grant Aid from customs duties, internal taxes and other fiscal levies which may be imposed in Ghana with respect to the supply of the products and services under the verified contracts,
9. accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts such facilities as may be necessary for their entry into Ghana and stay therein for the performance of their work,
10. provide necessary permissions, licenses and other authorizations for implementing the Grant Aid, if necessary,
11. assign appropriate budget and teaching and administrative staff members for proper and effective operation and maintenance of equipment procured under the Grant Aid,
12. maintain and use properly and effectively the facilities constructed and the equipment procured under the Grant Aid, and
13. bear all the expenses, other than those to be borne by the Japan's Grant Aid within the scope of the Project





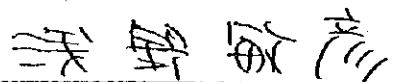
**MINUTES OF DISCUSSIONS  
ON  
THE BASIC DESIGN STUDY  
ON  
THE NOGUCHI MEMORIAL INSTITUTE  
REHABILITATION AND EXTENSION PROJECT  
IN  
THE REPUBLIC OF GHANA  
(CONSULTATION ON DRAFT REPORT)**

In August 1997, the Japan International Cooperation Agency (JICA) dispatched a Basic Design Study team on the Noguchi Memorial Institute Rehabilitation and Extension Project (hereinafter referred to as "the Project"), and through discussions, site surveys, and technical examination of the results in Japan, has prepared the draft report of the study.

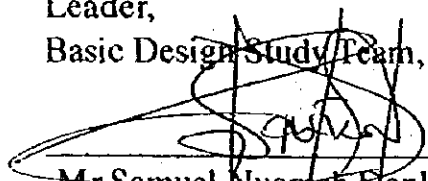
In order to explain and to consult the Ghana side on the components of the draft report, JICA sent to Ghana a study team, which is headed by Dr. Toshihiko ASANO, Chief, Division of Experimental Animal Research, National Institute of Infectious Diseases and stayed in the country from November 3 to November 11, 1997.


As a result of discussions, both parties have confirmed the main items described on the attached sheets.


  
Accra, November 11, 1997  
MR. F. A. BEN-EGHAN  
DIRECTOR ADMIN & FIN

  
\_\_\_\_\_  
Dr. Toshihiko ASANO  
Leader,  
Basic Design Study Team, JICA

FOR: Mr. J. S. Darlrymple Hayfron  
Chief Director,  
Ministry of Education

  
\_\_\_\_\_  
Mr. Samuel Nuamah Donkor  
Dep. Minister of Health,  
Ministry of Health

  
\_\_\_\_\_  
Prof. F. K. Nkrumah  
Director, Noguchi Memorial Institute  
for Medical Research  
University of Ghana  
Legon

  
\_\_\_\_\_  
Dr. William Adote  
Director IERD  
Ministry of Finance

## ATTACHMENT

### 1. Components of the draft report

The Government of Ghana has in principle agreed and accepted the components of the draft report proposed by the Team.

### 2. Items requested by the Government of Ghana.

After discussions with the Team, the following items were finally requested by the Government of Ghana.

#### 1) Extension and Rehabilitation of the Buildings and Facilities:

Details of items are listed in Annex 1

#### 2) Procurement of Equipment:

Details of items are listed in Annex 2

However, the final items of the Project will be decided after further assessment.

### 3. Japan's Grant Aid System

1) The Government of Ghana has understood the Japan's Grant Aid System as described in Annex 3.

2) The Government of Ghana will take necessary measures, as described in Annex 4 for smooth implementation of the Grant Aid, on condition that the Grant Aid by the Government of Japan is extended to the Project.

### 4. Presentation of the final report

JICA will make the final report in accordance with the confirmed items and send it to the Government of Ghana in January, 1998.

### 5. Other Relevant Issues

(1) The Ghana side agreed that the necessary operational and maintenance cost of the P3 Laboratory and Animal Experimental facility shall be secured by the Government of Ghana.

(2) Both sides confirmed the necessity of the biosafety control system to operate and maintain the P3 Laboratory. NMIMR agreed to organize as soon as possible a permanent management system such as Biosafety Committee and Biosafety Observation Committee for handling pathogens.

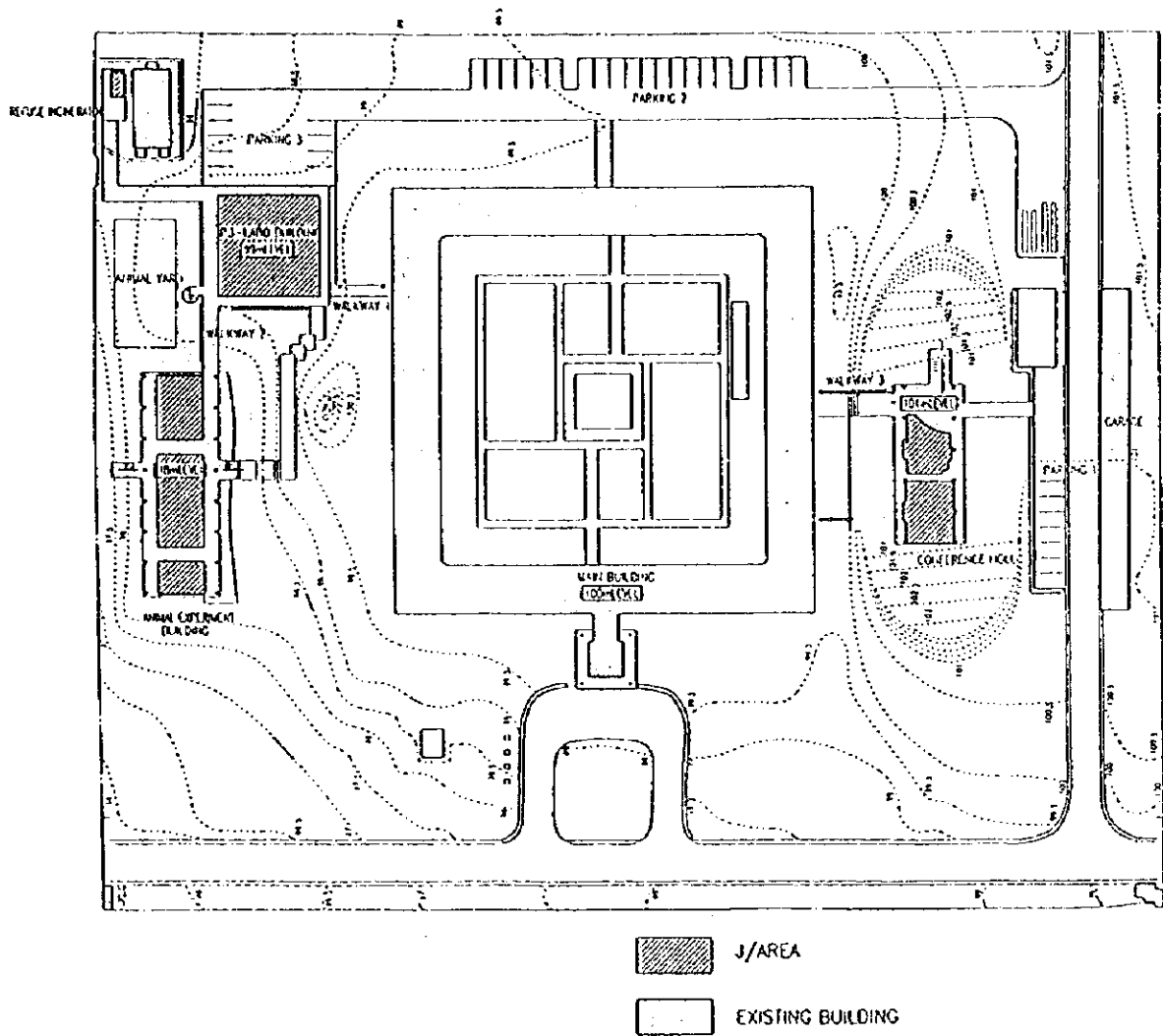
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**Extension and Rehabilitation of the Buildings and Facilities**

1. P3 Laboratory
2. Animal Experimental facility
3. Conference Hall
4. Rehabilitation of the existing facility.

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PROJECT SITE AND TENTATIVE LAYOUT PLAN

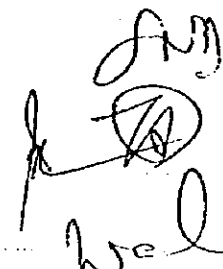


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## Procurement of Equipment

Item No.	Requested Equipment	Requested Quantity
<b>P3 LABORATORY</b>		
<b>Lab. Preparation (1)</b>		
2	Autoclave (middle, vertical)	1
4	Centrifuge (3,000 rpm)	1
5	Incubator	1
6	Biological microscope	1
7	Refrigerator	1
8	Sink	1
9	Side Lab. Table	1
9-2	Corner Table	1
300	Working Chair	2
<b>Lab. Preparation (2)</b>		
11	Autoclave (middle, vertical)	1
12	Side Lab. Table	1
12-2	Corner Table	1
13	Centrifuge (3,000 rpm)	1
14	High speed centrifuge (20,000 rpm)	1
15	Incubator	1
17	Refrigerator	1
20	Safety Cabinet, IIA	1
23	Sink	1
300	Working Chair	2
<b>Freezer Room</b>		
47-2	Freezer (-85°C)	1
41	Liquid Nitrogen Canister	1
<b>P3 Lab. (HIV, Others)</b>		
26	Autoclave (small, horizontal)	1
27	Autoclave (middle, vertical)	1
29	Side Lab. Table (Stainless Steel)	2
30	Bio-Centrifuge (3,000 rpm)	1
31	CO <sub>2</sub> Incubator	1
32	Freezer (-85°C, horizontal, small)	1
34	Bio-High speed centrifuge (20,000 rpm)	1
36	Pass Box	1
37	Phase contrast microscope	1
38	Refrigerator	1
39	Safety Cabinet (IIC type)	1
40	Bio-Ultracentrifuge (40,000 rpm)	1
42	Anemometer	1
300	Working Chair	2
<b>P3 Lab. (TB)</b>		
44	Autoclave (small, vertical)	1
45	Side Lab. Table (Stainless Steel)	1
46	Bio-Centrifuge (3,000 rpm)	1

Item No.	Requested Equipment	Requested Quantity
47-1	Freezer (-85°C, horizontal, small)	1
48	Incubator	1
49	Pass Box	1
50	Biological microscope	1
51	Refrigerator	1
52	Safety Cabinet (IIC type)	1
300	Working Chair	2
Precision Inst. Lab.		
54	Central Table	1
55	Sink	1
56	Side Lab. Table	2
56-2	Corner Table	1
57	Computer	1
59	ELISA Reader	1
22	Equipment Shelf	1
300	Working Chair	4
Training Lab.		
63	Biological Microscope	5
64-1	Central Table(for Training)	2
64-2	Central Table(for Lab.)	1
22	Equipment Shelf	2
65	Sink	2
66	Side Lab. Table	1
300	Working Chair	16
Administration Room		
Workshop (E)		
68	Tool for Maintenance	1

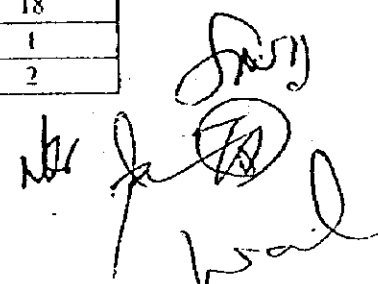
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Item No.	Requested Equipment	Requested Quantity
<b>LABORATORY ANIMAL UNIT</b>		
<b>BREEDING AND GROWING</b>		
<b>Grasscutter</b>		
76	Breeding Rack	1
77	Breeding cage	6
78	Rearing Rack	1
79	Cage	15
80	Grasscutter Balance	1
<b>Rabbit</b>		
87	Rabbit Balance	1
<b>Guinea Pig</b>		
88	Breeding Rack	1
91	Cage (Breeding)	3
90	Breeding Rack	1
91	Cage (Breeding)	16
92	Guinea Pig Balance	1
<b>Rat</b>		
96	Cage (Rat/Hamster)	7
<b>Hamster</b>		
96	Cage (Rat/Hamster)	5
99	Hamster and Rat Balance	1
<b>Mouse</b>		
135	Vinyl Isolator, 3 sets w/operation accessories	1
<b>Clean Stock and Preparation</b>		
103	ERECTA Shelf	2
104	Cleaner	1
105	Working Table	5
106	Feed Container Carry	1
107	Curt	2
108	Hand wash Stand	2
	Spare Cage (Rat/Hamster)	20
	Spare Cage (Mouse)	16
<b>Office</b>		
<b>Diagnostic and Autopsy</b>		
121	Side Lab. Table	2
122	Sink with Drain board	1
123	Working Chair	2
125	Steel Cabinet	1
131	Biological Microscope	1
138	Centrifuge (Table Top)	1
139	Constant Temperature Bath	1
142	Boiling Sterilizer	1
143	Refrigerator	1
144	Incubator	1
<b>Dressing Room</b>		
147	Dressing Locker (Lab. Staff)	2
196	Dressing Locker (Animal Staff)	2
<b>Washing and Sterilizing</b>		

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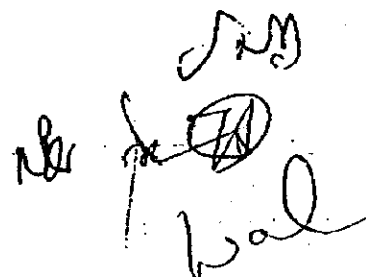
Item No.	Requested Equipment	Requested Quantity
151	Shallow Sink	1
152	Deep Sink	1
153	Drain/Dry Shelf	3
154	Sterilizing Box, for food	5
155	Sterilizing Box, for bedding	5
157	Working Table	2
159	Cart	3
160	Porta Washert	1
Post mortem		
162	Refrigerator for Carcass	1
165	Steel Rack	3
Warehouse		
Dissection/Operation, Animal Experiment		
168	Ice Machine	1
173	Hand wash Stand	1
176	Clean Rack (Rat)	1
177	Rat Cage (Plastic)	16
178	Clean Rack (Guinea Pig)	2
179	Guinea Pig Cage	18
180	Clean Rack (Rabbit)	2
181	Rabbit Cage	18
182	Side Lab. Table	2
183	Working Table	2
185	Mouse Automatic Balance	1
186	Rat Automatic Balance	2
187	Rabbit Automatic Balance	1
188	Boiling Sterilizer	1
189	Dissecting Set	2
190	Mouse Holder	2
191	Rat Holder	2
192	Operating Table	10
193	Dissecting Table for Rabbit	2
195	Animal Hair Clipper with Blades	1
301	Sink	1
22	Equipment Shelf	1
123	Working Chair	3
Infection Experiment		
199	Formalin gas generator	1
209	Negative Rack with Blower	2
210	Mouse Cage	50
211	Negative Rack with Blower	2
212	Rat Cage (Plastic)	32
213	Negative Rack with Blower	2
214	Guinea Pig Cage	18
213	Negative Rack with Blower	2
215	Rabbit Cage	18
216	Biological safety Cabinet (IIA)	1
217	Working Table	2


  
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 Mr. J. (75)
   
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Item No.	Requested Equipment	Requested Quantity
219	Hand wash Stand	1
220	Mouse Automatic Balance	1
221	Rat Automatic Balance	2
222	Rabbit Automatic Balance	1
223	Autoclave, small	1
303	Side Lab. Table	2
304	Equipment Shelf	1
302	Sink	1
123	Working Chair	3
Monkey Quarantine Room		
225	Monkey Rack	1
226	Monkey Cage	4
227	Working Table	1
Monkey Experiment		
229	Side Lab. Table (Stainless Steel)	1
230	Automatic Balance	1
Monkey Ante Room		
231	Boiling Sterilizer	1
233	Catching Gloves	3
234	Catching Net	2
235	Face Guard (Goggles)	2
229	Side Lab. Table (Stainless Steel)	1
304	Equipment Shelf	1
302	Sink	1
Feed Production Room & Storage		
238	Refrigerator	1
239	Steel Rack	2
240	Steel Cabinet	1
241	Pellet Mill	1
243	Working Table	2
244	Digital Balance	1
245	Cart	2
Fowl (Breeding)		
83	Breeding Rack	1
Sheep (Breeding)		

#### EXISTING SITE

Electron Microscope Dept.		
69	Electron Microscope Transmission type, without scanning function	1
70	Specimen Preparation Equipment	1
71	Ultra Microtome	1
300	Working Chair	2
Others		
75	Replacement parts	1


  
 Mr. [Signature]

## Japan's Grant Aid Program

### 1. Japan's Grant Aid Procedures

- (1) The Japan's Grant Aid Program is executed by the following procedures.

**Application** (Request made by a recipient country)

**Study** (Preliminary Study / Basic Design Study conducted by JICA)

**Appraisal & Approval** (Appraisal by the Government of Japan and Approval by the Cabinet of Japan)

**Determination of Implementation** (Exchange of Notes between both Governments)

**Implementation** (Implementation of the Project)

- (2) Firstly, an application or a request for a project made by the recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to see whether or not it is suitable for Japan's Grant Aid. If the request is deemed suitable, the Government of Japan entrusts a study on the request to JICA (Japan International Cooperation Agency).

Secondly, JICA conducts the Study (Basic Design Study), using a Japanese consulting firm. If the background and objective of the requested project are not clear, a Preliminary Study is conducted prior to a Basic Design Study.

Thirdly, the Government of Japan appraises the Project to see whether or not it is suitable for Japan's Grant Aid Program, based on the Basic Design Study Report prepared by JICA and the results are then submitted to the Cabinet for approval.

Fourthly, the Project approved by the Cabinet becomes official when pledged by the Exchange of Notes signed by both Governments.

Finally, for the implementation of the Project, JICA assists the recipient country in preparing contracts and so on.

### 2. Contents of the Study

- (1) Contents of the Study

The purpose of the Study (Preliminary Study/Basic Design Study) conducted on a project requested by JICA is to provide a basic document necessary for appraisal of the project by the Japanese Government. The

contents of the Study are as follows:

- a) to confirm background, objectives, benefits of the project and also institutional capacity of agencies concerned of the recipient country necessary for project implementation,
- b) to evaluate appropriateness of the Project for the Grant Aid Scheme from a technical, social and economical point of view,
- c) to confirm items agreed on by both parties concerning the basic concept of the project,
- d) to prepare a basic design of the project,
- e) to estimate cost involved in the project.

Final project components are subject to approval by the Government of Japan and therefore may differ from an original request.

Implementing the project, the Government of Japan requests the recipient country to take necessary measures involved which are itemized on Exchange of Notes.

## (2) Selecting (a) Consulting Firm(s)

For smooth implementation of the study, JICA uses (a) consulting firm(s) registered. JICA selects (a) firm(s) through proposals submitted by firms which are interested. The firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference made by JICA.

The consulting firm(s) used for the study is (are) recommended by JICA to a recipient country after Exchange of Notes, in order to maintain technical consistency and also to avoid possible undue delay in implementation caused if a new selection process is repeated.

## (3) Status of a Preliminary Study in the Grant Aid Program

A Preliminary Study is conducted during the second step of a project formulation & preparation as mentioned above.

A result of the study will be utilized in Japan to decide if the Project is to be suitable for a Basic Design Study

Based on the result of the Basic Design Study, the Government would proceed to the stage of decision making process (appraisal and approval).

It is important to note that at the stage of Preliminary Study, no commitment is made by the Japanese side concerning the realization of the Project in the scheme of Grant Aid Program.

## 3. Japan's Grant Aid Scheme

### (1) What is Grant Aid?

The Grant Aid Program provides a recipient country with non reimbursable funds needed to procure facilities, equipment and services for

economic and social development of the country under the following principles in accordance with relevant laws and regulations of Japan. The Grant Aid is not a form of donation.

**(2) Exchange of Notes (E/N)**

The Japan's Grant Aid is extended in accordance with the Exchange of Notes by both Governments, in which the objectives of the Project, period of execution, conditions and amount of the Grant etc. are confirmed.

**(3) "The period of the Grant Aid" means one Japanese fiscal year in which the Cabinet approves the Project Within the fiscal year, all procedure such as Exchange of Notes, concluding a contract with (a) consulting firm(s) and (a) contractor(s) and a final payment to them must be completed.**

**(4) Under the Grant, in principle, products and services of origins of Japan or the recipient country are to be purchased.**

When the two Governments deem it necessary, the Grant may be used for the purchase of products or services of a third country origin.

However, the prime contractors, namely, consulting, contractor and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means Japanese physical persons or Japanese juridical persons controlled by Japanese physical persons.)

**(5) Necessity of the "Verification"**

The Government of the recipient country or its designated authority will conclude contracts in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. The "Verification" is deemed necessary to secure accountability to Japanese tax payers.

**(6) Undertakings required to the Government of the recipient country**

In the implementation of the Grant Aid, the recipient country is required to undertake necessary measures such as the following:

- a) to secure land necessary for the sites of the project and to clear and level the land prior to commencement of the construction work,
- b) to provide facilities for distribution of electricity, water supply and drainage and other incidental facilities in and around the sites,
- c) to secure buildings prior to the installation work in case the Project is providing equipment,

- d) to ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid,
- e) to exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts,
- f) to accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified Contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

**(7) Proper Use**

The recipient country is required to maintain and use facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for their operation and maintenance as well as to bear all expenses other than those to be borne by the Grant Aid.

**(8) Re-export**

The products purchased under the Grant Aid shall not be re-exported from the recipient country.

**(9) Banking Arrangement (B/A)**

- a) The Government of the recipient country or its designated authority shall open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by Government of the recipient country or its designated authority under the contracts verified.
- b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an Authorization to Pay issued by the Government of the recipient country or its designated authority.



### Necessary Measures to be Taken by the Republic of Ghana

1. to provide data and information necessary for the Project,
2. to secure the site for the Project,
3. to clear, level and reclaim the site prior to commencement of the Project,
4. to undertake incidental outdoor works such as gardening, fencing, gates and exterior lighting in and around the site,
5. to provide facilities for distribution of electricity, water supply, telephone, drainage, sewerage and other incidental facilities to the site,
  - (1) electricity distribution line to the site
  - (2) city water distribution main to the site
  - (3) drainage city main to the site
  - (4) telephone trunk line and the main distribution panel of building
  - (5) general furniture such as carpets, curtains, tables, chairs and others
6. to bear commissions to the Japanese foreign exchange bank for its banking service based upon the Banking Arrangement (B/A), namely the advertising commission of the Authorization to Pay (A/P) and payment commission,
7. to ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in the Republic of Ghana and prompt internal transportation therein of the materials and equipment for the Project purchased under the Grant Aid,
8. to exempt Japanese juridical and physical nationals engaged in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in Ghana with respect to the supply of the products and services under the verified contracts,
9. to accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts such facilities as may be necessary for their entry into Ghana and stay therein for the performance of their work,
10. to provide necessary permissions, licenses and other authorizations for implementing the Project, if necessary,
11. to assign appropriate budget and teaching and administrative staff members for proper and effective operation and maintenance of equipment procured under the Grant Aid,
12. to maintain and use properly and effectively the facilities constructed and the equipment procured under the Project, and
13. to bear all the expenses, other than those to be borne by the Japan's Grant Aid within the scope of the Project.

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## **5. Cost Estimation Borne by the Recipient Country**



## Annex 5-1 Cost Estimation Borne by the Ghanaian Side

### 1. Estimation of Construction Related Cost

		(cedi)
1) Site Clearance		<u>3,900,000.</u>
- Felling of trees w/in the Area.	1,800,000.	
- Removal of 40 feet containers (3 Nos.)	2,100,000.	
This work shall be done before starting constructions.		
2) Exterior works		<u>3,500,000.</u>
- Removal of Street Lights (5 Nos.)	1,500,000.	
- Removal of Security Lights (3 Nos.)	500,000.	
- Gardening after completion of construction.	1,500,000.	
3) General and Office Furniture		<u>10,800,000.</u>
- Office Furniture (desk, chair, cabinet, etc.)		
for 11 staffs x 6 mil. cedi	6,600,000.	
- Genial Items (Curtain, Blind, etc.)	4,200,000.	
4) Banking Arrangement(B/A)		<u>21,833,000.</u>
Approx. 0.1% of total E/N amount;		
- Construction Phase-I	7,333,000.	
- Construction Phase-II	17,500,000.	
5) Applications for Building Permit		<u>900,000.</u>
Development and Building Permit (Approx. 500 US\$)		
6) Customs Clearance Charges		<u>32,400,000.</u>
40 feet containers (60 Nos.) x 300US\$:	32,400,000.	
7) Shift of Equipment / Furniture		<u>3,000,000.</u>
- to New Buildings	1,500,000.	
- for Renovation works	1,500,000.	
<b>TOTAL:</b>		cedi 76,183,000. (Approx. <u>US\$ 38,000.</u> )

**Table -1 Estimated Cost to be Borne by Ghanaian side (cedi)**

	1998	1999	2000
1) Site Clearance	3,900,000.	-	-
2) Exterior Works	150,000.	150,000.	50,000.
3) Furniture	-	10,800,000.	-
4) Banking Arrangement	24,833,000.	-	-
5) Building Permit	900,000.	-	-
6) Customs Clearance	10,800,000.	21,600,000.	-
7) Shift of Equipment	-	1,500,000.	1,500,000.
Total: (cedi)	40,583,000.	34,050,000.	1,550,000.
(US\$)	20,300 US\$	17,000 US\$	700 US\$

## 2. Estimation of Operation and Maintenance Cost

The estimated annual operation and maintenance cost after the opening of the new facilities is shown the next Table.

**Table - 2 Estimated Annual Operation and Maintenance Cost (US\$)**

Item	P3 Lab. Building	Lab Animal Building	Conference Hall Bldg.	Annual Cost
1. Operation Cost	3,875	9,481	2,452	15,745
a) Electricity	3,694	6,309	2,329	12,332
b) Water	181	1,513	123	1,754
c) Diesel Oil	-	1,659	-	1,659
2. Maintenance Cost				49,359
a) Building				5,302
b) A/C Filter	3,640	9,100	-	12,740
c) A/C Service Contract	6,260	4,714	4,543	15,517
d) Equipment				9,000
f) Animals				6,800
Total				65,104

**1) Operation Cost**

Facility operation cost estimated as condition of attached sheet.

15,745 US\$ / year

**2) Maintenance Cost**

**a) Building**

The level of the building maintenance cost considerably changes with the passage of time. The estimation is conducted based on an assumed average annual repair cost of 2 US\$/m<sup>2</sup>/year for a 30 year span.

$$2 \text{ US\$/m}^2 / \text{year} \times 2,651 \text{ m}^2 = \underline{5,302 \text{ US\$/year}}$$

**b) Building Service Equipment**

The repair cost for building service equipment remains low for the first five years or so of use. Thereafter, parts replacement and equipment renewal due to ageing are gradually required. The average annual repair cost for a 10 year span is estimated to be 0.5% of the building service repair cost.

6,000 US\$/year

**c) Filter exchange for A/C**

Every 3 years, HEPA filters and Middle Performance filters have recommended to exchange. One set of filter estimated 455 US\$/year and there are 8 sets for P3 Laboratory Building and 20 sets for Laboratory Animal Building, hence;

12,740 US\$ / year

**d) Maintenance Contract for A/C system**

A/C system for P3 Labs. and Animal Exp. Labo are recommended to contract services with local Agent. Agent cost in Ghana estimated by 4.55 US\$/MC/month. (MC: Capacity of machine as Mega Calorie)

15,517 US\$/year

**e) Laboratory Equipment**

**i) Maintenance and Repair Cost**

While this cost varies depending on the frequency of equipment use, it is

estimated to be 0.2% of the total equipment cost.

6,000 US\$/year

This is including HEPA filters costs for equipment, such as;

Safety Cabinets(6 sets): 600 US\$/set/every 3 years

Positive/Negative Racks(12 sets): 400 US\$/set/every 2 years

#### ii) Reagents and Consumables

While this cost also considerably varies depending on the frequency of use, it is estimated to be 0.1% of the total equipment cost. This is including cubes for for centrifuges, micro-plates for ELISA Reader, others.

3,000 US\$/year

#### d) Animals

The cost of live animals is estimated based on the number of required animals (indicating the number of experiments) and data obtained during the field survey. It is assumed that small animals will be bought in the first year of operation and will be bred. Poultry, monkeys and sheep will be renewed every year.

##### - Animal purchase

Small animals: 2,000 US\$/year

Poultry and large animals: 500 US\$/year

##### - Feed preparation cost: 3,900 US\$/year

##### - Auxiliary materials: (10% of feed) 400 US\$/year

Total 6,800 US\$/year

### 3. Annual Cost Estimation Born by the Ghanaian side

**Table 3 Total Annual Cost Estimation (US\$)**

	1998	1999	2000	2001
Construction Related Cost	20,300 US\$	17,000 US\$	700 US\$	-
Operation Cost	3,875 US\$	15,745 US\$	15,745 US\$	15,745 US\$
Maintenance Cost	-	-	-	49,359 US\$
Total ( Annual Cost)	24,175 US\$	32,745 US\$	16,445 US\$	65,104 US\$

## Annex 5-2 Recommended Repairing Works for Existing Facility

Effective and safety use of Existing Facilities, and adequate maintenance for Equipment, we recommend following repairing works to be done by self-reliance. Estimated cost are not included Technical/Labour charges, because that Maintenance Staffs can be done.

(1) Building works	(cedi)
1) Exterior works:	<u>35,100,000.</u>
- Repair / fix of Eaves boards.	800,000.
- Repair of Wall panel and repainting.	33,000,000.
- Cleaning and repainting of balcony hand-rail.	1,300,000.
2) Interior works:	<u>5,100,000.</u>
- Repair / exchange of ceiling board (appx.30 bds by stocks)	500,000.
- Repair / repolishment of terrazzo finished floor (5 places)	700,000.
- Repair of Non-slip stair rail at main Stair.	1,600,000.
- Repair of wall clacks (appx. 5 places).	400,000.
- Repair of peeled off wall tiles in WC(3 places).	600,000.
- Repair / repaint of ceiling boards in WC(95 sq.m)	1,300,000.
3) Doors and windows:	<u>6,000,000.</u>
- Repair of Main Entrance Door(one leaf).	1,600,000.
- Repair of Alum. doors / hinges(2 places).	500,000.
- Repair of cracking Wired-glass for Windows(5 places)	2,500,000.
- Cleaning of all outside window glass.	1,200,000.
- Exchange of damaged / broken Louvers(by stock items)	200,000.
4) Furniture and Fixtures:	<u>15,530,000.</u>
- Repair of Doors/Hinges for Labo Table and Cabinets.	
(approx. 20 places)	830,000.
- Repair/Removal of Termite damaged Labo Tables.	
(approx. 5 places)	1,700,000.
- Ditto, installation of new Labo Table(2 places)	13,000,000.

5) Others:	<u>5,000,000.</u>
- Apply of Anti-termite solution around building exterior.	5,000,000.

**(2) Facility Equipment and Electricity Works**

1) Facility Equipment works:	<u>29,880,000.</u>
- Exchange of Compressor for A/C System(appx.8)	13,300,000.
- Ditto, Cleaning and Adjustment of exhaust grills (all)	500,000.
- Dismantle of broken A/C outside units from balcony (approx.20 places)	300,000.
- Temperature adjustment / restrengthen of floor(4 places)	3,300,000.
- Cleaning / adjustment of exhaust duct-fan (5 places)	330,000.
- Ditto to wall type exhaust fan (25 places)	1,650,000.
- Repair of LPG leakage from supply pipes.	xxx
- Exchange of WC Closet (2 places)	2,000,000.
2)Electrical works:	<u>6,160,000.</u>
- Exchange of Battery for Primary Elec. Panel.	5,000,000.
- Ditto, exchange of damaged Meter(2 Nos.).	330,000.
- Repair of Fire Alarm system or change.	xxxx
- Adjustment of Ceiling mounted Lighting Fixture.	830,000.
(3) Experiment Equipment Works:	<u>40,000,000.</u>
- Change damaged parts for repair-able Equipment.	xxx
- Change HEPA Filter units for existing (12 sets)	40,000,000.

---

<b>Total Repair-work Amount:</b>	<b><u>142,770,000. (cedi)</u></b>	<b><u>71,000 US\$</u></b>
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Building Works:	66,730,000.	33,000 US\$
Equipment/Electrical Works:	36,040,000.	18,000 US\$
Equipment Works:	40,000,000.	20,000 US\$

# Annex 5-3 Trial Calculation of Annual Maintenance Cost

THE PROJECT FOR RENOVATION AND EXPANSION OF NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH IN GHANA

## TRIAL CALCULATION OF ANNUAL MAINTENANCE COST

P3 LABORATORY BUILDING						
	Unit	Quantity of Use	Unit Price	Rate for a Month	Rate for a year	Remarks
	788 m <sup>2</sup>				US\$/year	
Electricity (A)		134.7 kW	0.02 US\$/kWh	308	3,694	
City Water (B)	788 m <sup>2</sup>	3 L/(m <sup>2</sup> ·day)	0.29 US\$/m <sup>3</sup>	15	181	22days/month
Sum of (A)+(B) (C)					3,875	
Filter for Air Conditioning (D)		8 sets	455.00 US\$/year/set		3,640	
Maintenance Service Contract (E)		115 Meal/h	4.55 US\$/Meal/month	522	6,260	
Sum of (D)+(E) (F)					9,900	
Cost of Maintenance (C)+(F)					13,775	
ANIMAL EXPERIMENT BUILDING						
	988 m <sup>2</sup>					
	Unit	Quantity of Use	Unit Price	Rate for a Month	Rate for a year	Remarks
				US\$/month	US\$/year	
Electricity (G)		63.0 kW	0.02 US\$/kWh	526	6,309	
City Water (H)	988 m <sup>2</sup>	20 L/(m <sup>2</sup> ·day)	0.29 US\$/m <sup>3</sup>	126	1,513	22days/month
Diesel Oil (I)	150 steam-kg/h	0.08 L/(h·(kg/h))	0.36 US\$/L	138	1,659	8hour/week
Sum of (G)+(I) (J)					9,480	
Filter for Air Conditioning (K)		20 sets	455.00 US\$/year/set		9,100	
Maintenance Service Contract (L)		86 Meal/h	4.55 US\$/Meal/month	398	4,714	
Sum of (K)+(L) (M)					13,814	
Cost of Maintenance (J)+(M)					23,294	
CONFERENCE BUILDING						
	Unit	Quantity of Use	Unit Price	Rate for a Month	Rate for a year	Remarks
				US\$/month	US\$/year	
Electricity (N)		53.4 kW	0.02 US\$/kWh	194	2,329	
City Water (O)	120 person	30 L/(person·day)	0.29 US\$/m <sup>3</sup>	1	13	1day/month
(P)	48 person	30 L/(person·day)	0.29 US\$/m <sup>3</sup>	9	110	22days/month
Sum of (N)+(P) (Q)					2,452	
Maintenance Service Contract (R)		83 Meal/h	4.55 US\$/Meal/month	379	4,543	
Cost of Maintenance (Q)+(R)					6,994	
P3 LAB + ANIMAL EXP + CONFERENCE					44,064	US\$/YEAR
P3 LAB + ANIMAL EXP + CONFERENCE					97,000,000	CEDIS/YEAR

## 6. Other Relevant Data



## Annex 6-1 Siol Investigation Data

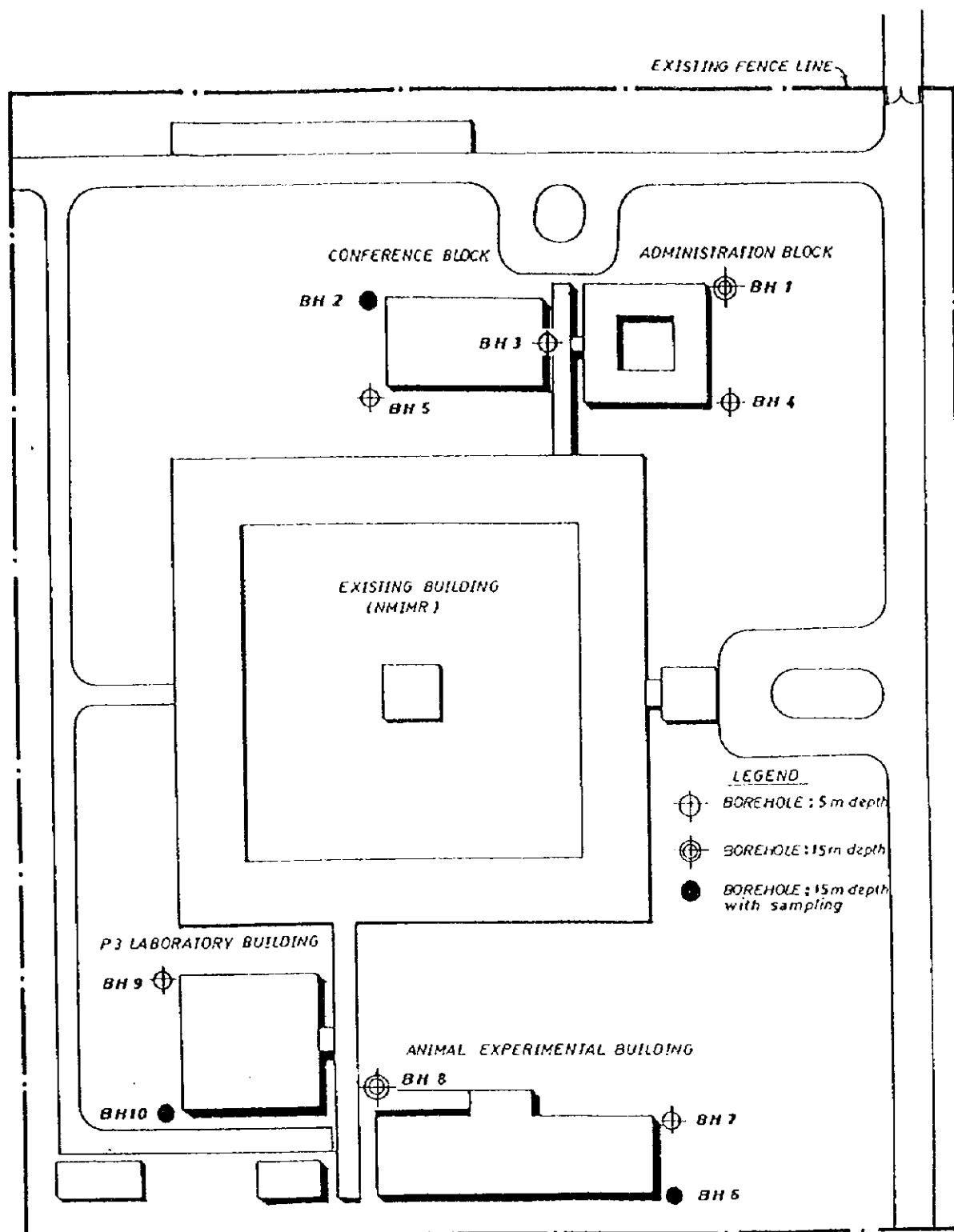


FIG. B-1 SITE PLAN SHOWING THE INVESTIGATION POINTS

CONTERRA LIMITED				LOCATION : LEGON, ACCRA		BOREHOLE No. 2				
						SHEET 1 OF 2				
EQUIPMENT& METHODS :    PILCON WAYFARER 1500 PERCUSSION DRILLING RIG				PROJECT: PROPOSED EXTENSION OF NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH.						
CLIENT: KUME SEKKEI CO. LTD.    ENGINEER: CONTERRA				GROUND LEVEL : 101.655		DATES : 23/08/1997				
DESCRIPTION	R E D U C E D L O A D (kN)	D E P T H (m)	LAYER  THICKNESS ( m )	SAMPLES		SPT		W L A E T V E E R L (m)	LEGEND	
				DEPTH ( m )	TYPE	D E P T H N-value	BLOW COUNT N-value			
Dark-brown, silty SAND with rootlets( topsoil)	100.955		0.1						X X	
Very stiff, Chocolate-brown, sandy CLAY .			0.9	0.5	DS					
	100.055	1.0		1.0- 1.42	DS	1.0- 1.42	125/ 0.42			
Very dense,reddish-brown, clayey sandy GRAVEL becoming hardpan at 2.0m.			1.1							
	98.955	2.0				2.0- 2.12	100/ 0.12			
END OF PERCUSSION DRILLING,FOR CONTINUATION SEE ROTARY DRILL LOG									V	
			3.0							
			4.0							
			5.0							
SPT : Where full 0.3 m penetration has not been achieved, the number of blows for the quoted penetration is given (not N - value)  Depth : All depths and reduced levels in metres  Thickness given in brackets in thickness column  Water : water level observations during boring are given out on test sheet of log				SAMPLE/TEST KEY D Disturbed sample B Bulk sample  W Water sample Piston (p), Tube (t) S Standard penetration test V Vane test C Core recovery (%) r R Q. D. (%)				REMARKS :  Groundwater was not encountered within the depth of exploration		LOGGED BY ASN  CHECKED BY. NNK  SCALE As indicated <b>Fig B-3</b>



CONTERRA LIMITED		LOCATION : LEGON, ACCRA		BOREHOLE No. 6	
				SHEET 1 OF 3	
EQUIPMENT & METHODS :    PILCON WAYFARER 1500 PERCUSSION DRILLING RIG		PROJECT: PROPOSED EXTENSION OF NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH.			
CLIENT: KUME SEKKEI CO. LTD.    ENGINEER: CONTERRA		GROUND LEVEL : 96.506		DATE : 26/08/97	
DESCRIPTION	REDUCED LEVEL (m)	DEPTH (m)	SPT BLOW COUNT N-value	WATER LEVEL (m)	LEGEND
Dark-brown, silty SAND with rootlets( topsoil)	96.306	0.2			X X X
Very dense to hard, reddish-brown, clayey silty GRAVEL with occasional boulders (lateritic gravel)	1.0	1.0-1.45	DS 1.0-1.45	72	X X X
	2.0	2.0-2.2	DS 2.0-2.1	50/0.05	X X X
	3.0	3.0	DS 3.0-3.03	60/0.03	X X X
	4.0	4.0	DS 4.0-4.08	50/0.08	X X X
END OF PERCUSSION DRILLING, FOR CONTINUATION SEE ROTARY DRILL LOG					
SPT : Where full 0.3 m penetration has not been achieved, the number of blows for the quoted penetration is given (not N-value)		SAMPLE/TEST KEY D Disturbed sample B Bulk sample W Water sample P Piston (p), Tube (t) S Standard penetration test V Vane test C Core recovery (%) R Q.D (%)		REMARKS : Groundwater was not encountered within the depth of exploration	
Depth : All depths and reduced levels in metres Thickness given in brackets in thickness column  Water : water level observations during boring are given out on last sheet of log		LOGGED BY ASN  CHECKED BY: NKK  SCALE As indicated Fig 8-7			



<b>ENGINEER: CONTRA LTD.</b>					<b>MACHINE DETAILS: JOY SULLIVAN (128) ROTARY DRILL</b>					<b>BOREHOLE No.6</b>			
<b>CLIENT: KUME SEKKEI CO. LTD, JAPAN</b>					<b>PROJECT: PROPOSED EXTENSION OF NOGUCHI MEMORIAL INST. FOR MEDICAL RESEARCH</b>					<b>Dates: 27-29/8 /97</b>			
<b>Core Sizes: 0.054m</b>			<b>Orientation Vertical</b>		<b>Ground Level 96.506</b>		<b>Location: Legon, Accra</b>			<b>Sheet 3 of 3</b>			
Depth (m)	Drilling Progress	Water Return	Casing Depth	ROCK QUALITY					Thick- ness	Description of Strata	OO Level (m)	Legend	
				Discon- tinuities	I	Cr	r	Core run					
15.4													
17.4		70%				1	0						
19.4													
20													
20.4	29/08/97											76.506	
										END OF ROTARY DRILLING			
I = No. of fractures per metre. Cr = Percentage Core Recovery r = Rock Quality Designation % OS = Disturbed sample All depths & reduced levels are in metres.										Remarks : Borehole was cased down to 8.4m Drillhole was terminated at 15.0m. Quartz veins between 18.0m and 20.0m		Logged by : JKK Checked by : NKK Fig B-7 (cont'd)	

CONTERRA LIMITED		LOCATION : LEGOM, ACCRA		BOREHOLE No. 10 SHEET 1 OF 2					
EQUIPMENT & METHODS : PILCON WAYFARER 1500 PERCUSSION DRILLING RIG		PROJECT: PROPOSED EXTENSION OF NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH.							
CLIENT: KUME SEKKEI CO. LTD.      ENGINEER: CONTERRA		GROUND LEVEL : 97.928		DATES : 21/08/97					
DESCRIPTION	R E D U C E D L	D E P T H (m)	LAYER THICKNESS ( m )	SAMPLES		SPT		W L A E T V E E R L (m)	LEGEND
				DEPTH (m)	TYPE	D E P T H	BLOW COUNT N value		
Dark-brown, silty SAND with rootlets( topsoil)	97.828		0.1						
Stiff dense, reddish-brown, sandy CLAY with occasional gravel	96.728	1.0	1.1	0.5	DS				
				1.0-1.45	DS	1.0-1.45	74		
Very dense, reddish-brown, lateritic GRAVEL (hardpan)	95.828	2.0	1.9	2.0	DS	2.0-2.05	50/ 0.05		
		3.0		3.0	DS	3.0-3.1	40/ 0.04		
END OF PERCUSSION DRILLING, FOR CONTINUATION SEE ROTARY DRILL LOG		4.0							
		5.0							
SPT : Where full 0.3 m penetration has not been achieved, the number of blows for the quoted penetration is given ( not N value  Depth : All depths and reduced levels in metres  Thickness given in brackets in thickness column  Water : water level observations during boring are given out on last sheet of log.		SAMPLE/TEST KEY D Disturbed sample B Bulk sample W Water sample   Piston (p), Tube (t) S Standard penetration test V Vane test C Core recovery (%) r R.O.D (%)		REMARKS : Groundwater was not encountered within the depth of exploration		LOGGED BY ASN  CHECKED BY NCK  SCALE As indicated <b>Fig B-11</b>			





## **C-1.0 INTRODUCTION**

The interpretative report presented in this section is based on the results of the fieldwork and laboratory testing carried out during the investigations, supplemented, where necessary, with experience gained during previous investigations in similar geo-environmental settings.

## **C-2.0 DISCUSSION OF THE RESULTS OF THE FIELDWORK**

### **C-2.1 Nature of the Surficial Soils**

The surficial soils as revealed by the boreholes, can be described as fairly uniform, consisting mainly of very dense to hard, reddish to dark brown, sandy clayey lateritic **GRAVEL** (lateritic hardpan) to depths ranging between 1.0m and 5.0m.

This pattern, however, varied slightly in BH2, BH3 and BH 10 where a stiff, brown sandy **CLAY** was encountered to a maximum depth of 1.5m, before penetration of the lateritic hardpan.

These soils are regarded as competent at the founding depth.

### **C-2.2 Country Rock**

The rotary drilling programme undertaken at the project area failed to establish conclusively the nature of the rocks underlying the site. Previous geotechnical investigations in the vicinity of the project area have however shown that the general area of the site is underlain by rocks of the Togo series consisting mainly of quartzites, schists and phyllites (**HARRIS, 1970**). BH8 yielded a 40% core recovery of fractured, highly weathered and very weak reddish-brown quartzite between 13.5m and 15.0m. BH 10 yielded a core sample of lateritic hardpan between 3.1m and 6.2m, which was underlain by a completely weathered quartzite. Quartz veins were also recovered between 18.0m and 20.0m in BH 6.

### **C-2.3            Groundwater Conditions**

No groundwater was encountered within the depth of exploration, although the investigations were carried out between the major and minor rainy season when groundwater levels were expected to be close to their highest level. The relatively impermeable nature of the lateritic hardpan encountered is likely to give rise to perched water tables particularly in the mid-rainy season.

It would appear unlikely, however, that in the construction of the proposed structures, any serious groundwater problems will be encountered beyond the need to keep the foundation excavations dry should the construction be undertaken during the wet season.

### **C-3.0            RECOMMENDATIONS FOR FOUNDATION DESIGN AND CONSTRUCTION**

#### **C-3.1            Site Utilisation**

The sub-surface exploration programme did not reveal any adverse conditions that could possibly render any portion of the site unsuitable for the proposed development. Site grading involving removal of 0.3m of topsoil may, however, be necessary in parts of the site to be occupied by the proposed structures.

#### **C-3.2            Asseismic Design Consideration**

The rocks underlying the project area are considered relatively good conductors of seismic waves and therefore, constitute excellent foundations for the proposed structures, from the point of view of resistance to seismic forces.

For the type of structures proposed, however, good workmanship and the use of good quality constructional materials are better guarantees of good seismic performance than the adoption of sophisticated seismic design criteria. No special earthquake - resistant design provisions are, therefore, recommended beyond ensuring good quality workmanship.

### C-3.3 Foundation Type and Depth

The surficial soils underlying the project site may be classified as sufficiently competent to be able to provide adequate support for the proposed structures.

A minimum foundation depth of 1.5m below existing ground surface (i.e. within the sandy gravel layer) is recommended for the structures proposed. Typical shallow foundation types such as isolated column footings and strip footings may be used as appropriate.

### C-3.4 Allowable Bearing Capacity

Estimates of the allowable bearing capacity for a strip footing from the N-values obtained from the Standard Penetration Test and relationships between allowable bearing pressure and N-values for various foundation widths (TERZAGHI AND PECK, 1967) yielded values in excess of 400kPa within the sandy gravel layer, which is probably far in excess of the contact pressures likely to be imposed by the types of structures proposed. Triaxial testing on the clay sample recovered in BH9 at a depth of 1.4 metres, however, gave the following shear strength parameters:

$$C_u = 25\text{kPa}$$

$$\phi_u = 15^\circ$$

$$\gamma = 17\text{kN/m}^3$$

which yielded an allowable bearing capacity of the order of 40kPa for a base width of 1.5m. This seam of clay was further revealed at shallower depths (between 1.0 m and 1.4m) in two other boreholes. For the attainment of the recommended minimum depth of 1.5m (that is within the sandy gravel layer) it is further recommended that this clay seam be excavated (when encountered) so as not to have any influence on the foundation.

### C-3.5 Settlements

Given the uniform, compact free-draining gravelly nature of the surficial soils underlying the site, it is anticipated that settlement will largely keep pace with construction. Total and differential settlements are, therefore, expected to be well within tolerable limits.

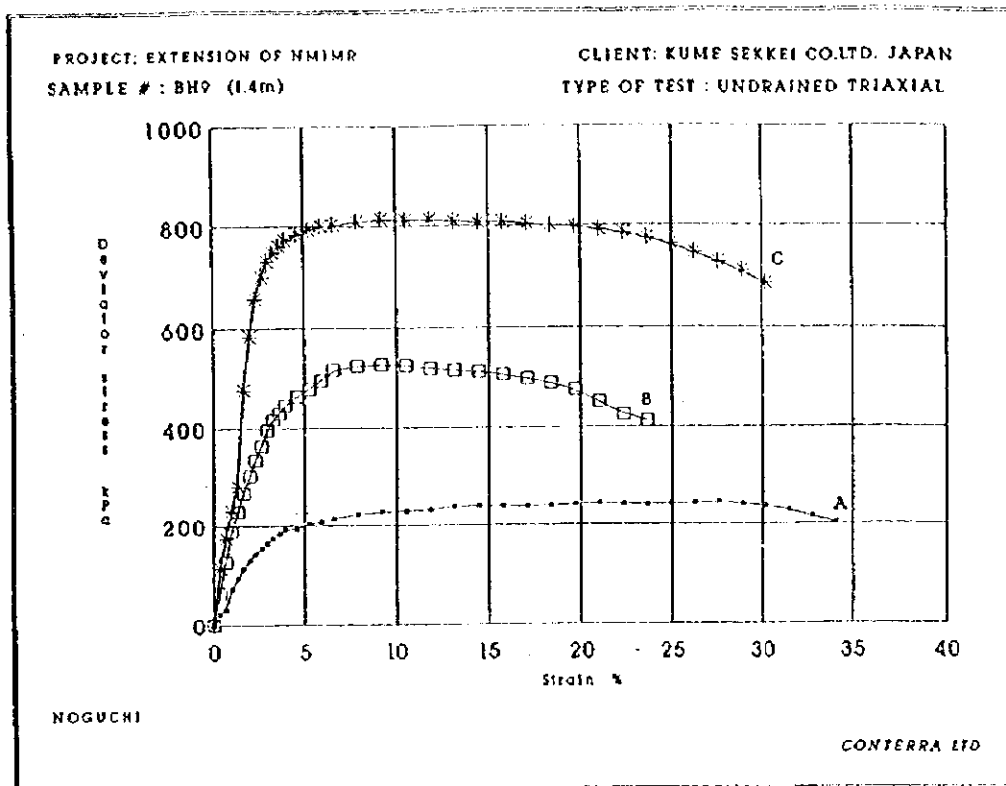
### C-3.6 Foundation Excavations

Manual excavation may be adopted for foundation excavations. Lateral support for excavations may not be required to the recommended foundation depth. For excavations deeper than 3m, however, provision of lateral support is recommended especially when such excavations are carried out in the rainy season. Prolonged inundation of the soils may lead to marked reduction in shear strength and increase in compressibility. Consequently, it is considered good practice to lay the blinding course as soon as the foundation excavation attains the target depth.

Where delays are inevitable, it is recommended that inundated foundation excavations be deepened to depths to which unsoftened materials are encountered and differences in level made good with lean concrete before the blinding course is laid.

### C-3.7 Site Drainage

A study of the topography of the site indicates that seepage through the free-draining surficial soils in the general north-south direction would be considerable especially in the rainy season. An effective drainage system should be provided especially around the structures to prevent infiltration and percolation of waste under the foundation. The structural foundation should be adequately protected against undermining through erosion, by the provision of a well designed concrete apron all around the proposed buildings combined with effective border drains.



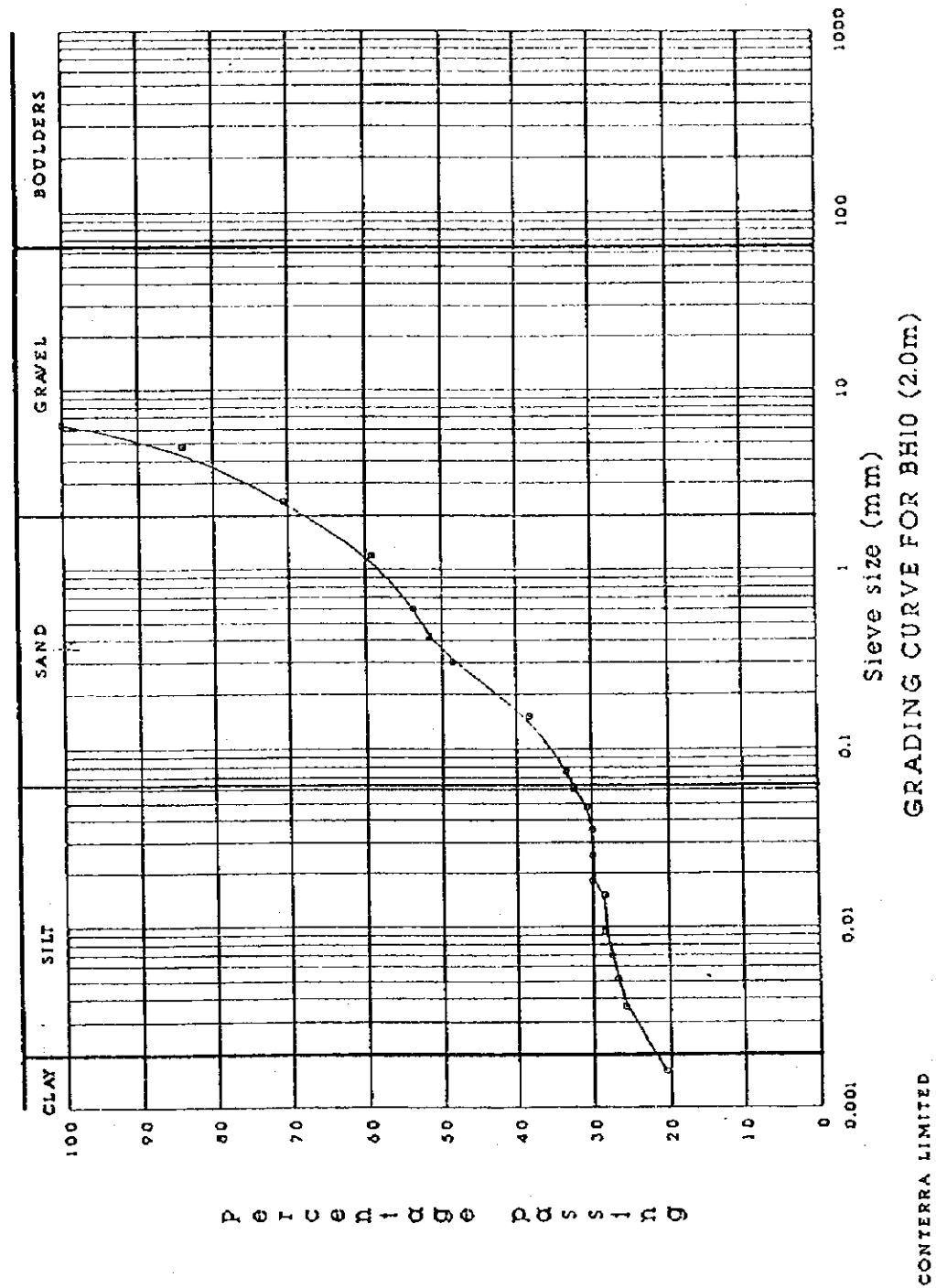
TEST DESIGNATION		A	B	C
	Moisture Content %	15.5	15.5	15.5
	Dry Unit Weight kN/m <sup>3</sup>	16.6	16.8	16.1
	Moisture Content %	16.4	16.8	18.5
	Cell Pressure kPa	200	300	500
	Deviator Stress kPa	244	528	813

FIG. B-23 STRESS - STRAIN CURVES FOR BH9 (1.4m)

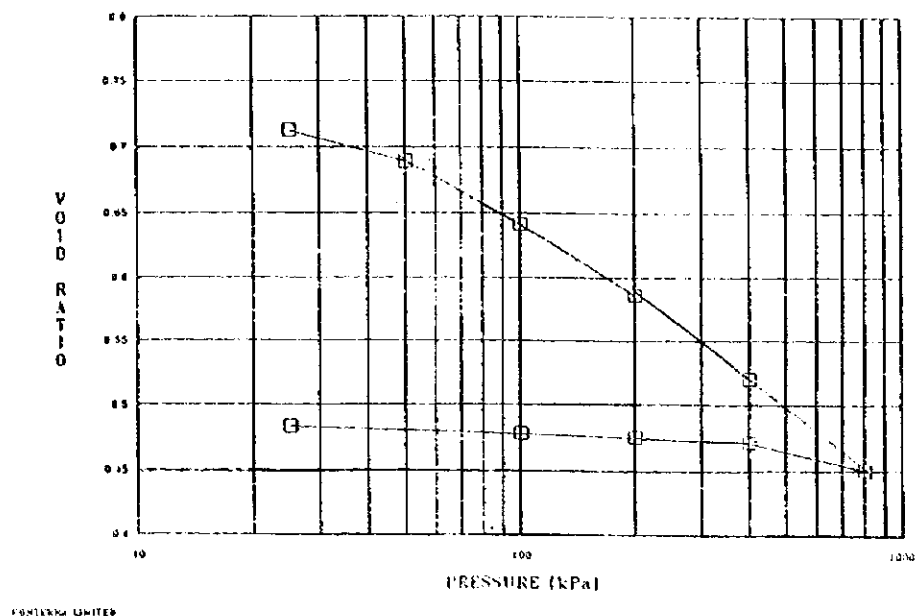
TABLE B - I : SUMMARY OF RESULTS OF ENGINEERING TESTS ON SOIL

PROJECT: NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH												
LOCATION:: LEGON												
CLIENT : KUMIE SEKKEI CO. LTD.												
DATE SAMPLE RECEIVED : 27/08/97												
DATE RESULTS ADVISED : 5/09/97												
BH #	DEPTH OF SAMPLE (m)	NATURAL MOISTURE CONTENT (%)	PARTICLE SIZE DISTRIBUTION (%)					CONSISTENCY LIMITS			SHEAR STRENGTH PARAMETER	
			CLAY <0.002mm	SILT 0.002-0.063mm	SAND 0.063-2.0mm	GRAVEL 2.0-63mm	BOULDERS >63mm	LL %	PI %	CU kPa	Qu deg	
2	0.5	9.2	16	5	74	5	-	26	10			
2	1.0-1.42	4.7	4	2	22	72	-	31	13			
3	1.0-1.45	14.7	27	8	65	-	-	34	20			
4	1.0-1.45	9.4	21	9	53	17	-	25	10			
4	2.0-2.45	8.6	17	11	69	3	-	24	7			
6	2.0-2.2	10.8	11	11	45	33	-	26	11			
7	1.0-1.45	5.1	4	4	27	65	-	28	12			
9	1.4	10.9	26	14	59	1	-	25	11	25	15	
10	0.5	15.5	42	9	48	1	-	28	16			
10	2.0	10.4	21	10	36	33	-	-	-			

PROJECT: NOGUCHI MEMORIAL RESEARCH INST.  
 CLIENT : KUME SEKKEI CO LTD



PROJECT: PROPOSED REHAB. & EXT. WORKS  
CLIENT : KUME SEKKEI CO. LTD



BOREHOLE #		9
DEPTH (m)		1.4
MOISTURE CONTENT	%	16
BULK UNIT WEIGHT	kN/m <sup>3</sup>	19.8
DRY UNIT WEIGHT	kN/m <sup>3</sup>	17.1
SPECIFIC GRAVITY	-	3.13
INITIAL VOID RATIO	-	0.736
INITIAL DEGREE OF SAT.	%	76
SWELL PRESSURE	-	-

Pressure kPa	Coefficient of Consolidation $C_v \times 10^{-2} \text{ m}^2/\text{hr}$	Coefficient of Volume Compressibility $M_v \times 10^{-4}$ $\text{m}^2/\text{kN}$
0 - 25	9.0	5.8
25 - 50	6.8	5.6
50 - 100	5.0	5.5
100 - 200	4.7	3.4
200 - 400	4.1	2.1
400 - 800	3.9	1.2

FIG. 8-22 CONSOLIDATION TEST RESULTS FOR BH9 (1.4m)



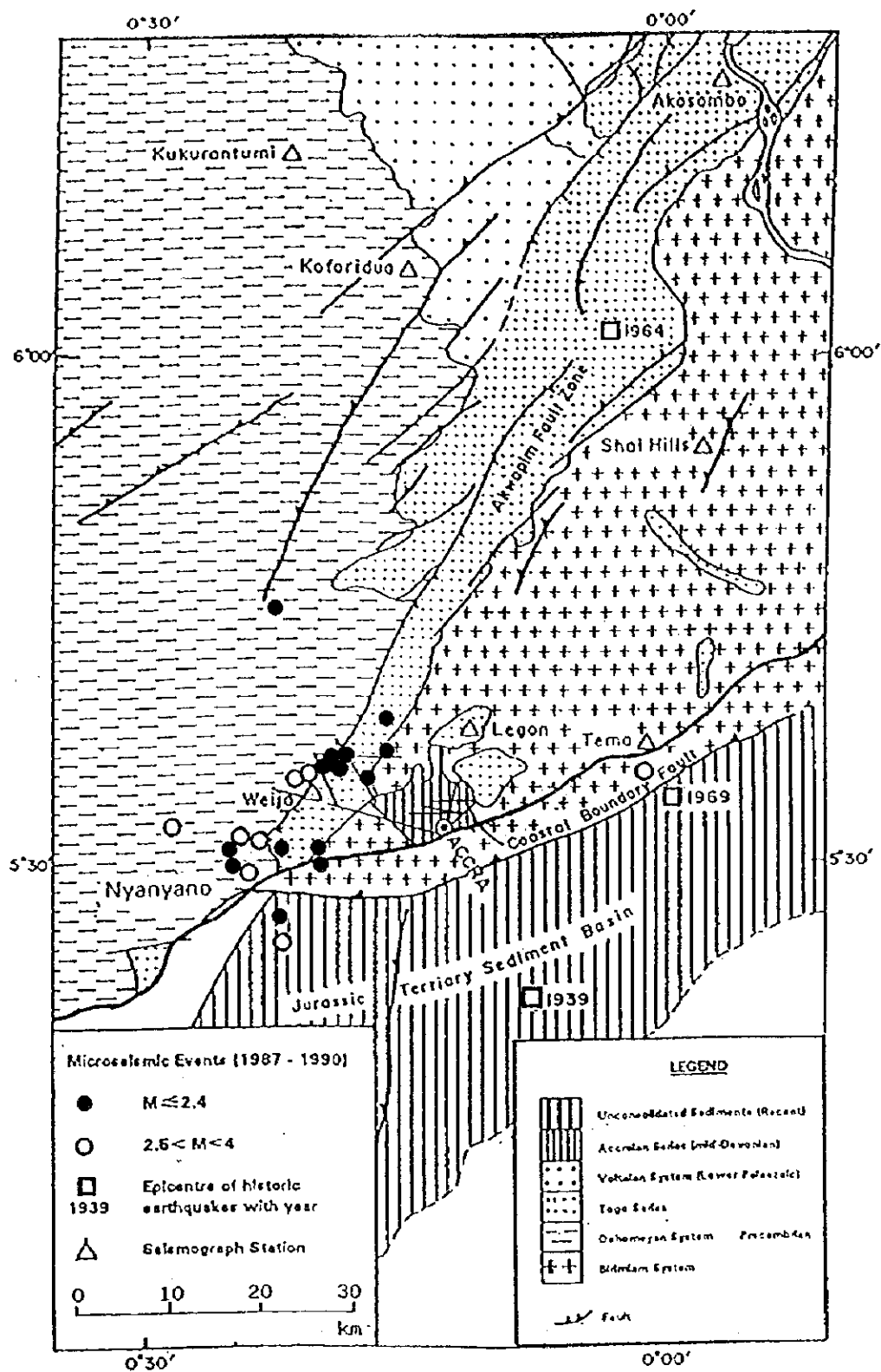


FIG. A-II

GEOLOGY OF THE REGION AROUND ACCRA-TEMA AND THE CONTINENTAL SHELF SHOWING RECENT MICRO-SEISMIC AND HISTORICAL EARTHQUAKE ACTIVITY (Modified after BURKE, 1969)

Table A-1

## HISTORICAL SEISMICITY OF SOUTHERN GHANA

DATE	APPROXIMATE LOCATION OF EPICENTRE	AREA AFFECTED BY THE SHOCK	PROBABLE CAUSATIVE FAULT	REMARKS
1862	Off-shore Near Accra	City of Accra and areas to the east as far as Anecho in Togo	Coastal Boundary Fault	City of Accra reported to be "almost completely destroyed"
1906	Along Akwapim range near Ho	Maximum intensity felt at Ho, Accra and other towns to the east of Akwapim range	Akwapim Fault Zone	Extensive cracks in Govt. buildings. All forts in Accra cracked but not rendered uninhabitable
1st Sept 1923	?	?	?	The seismograph then in operation in Accra recorded a shock with maximum amplitude of 9mm. It was not clear whether this was a local event or a teleseism
22nd June 1939	40 km out sea, SSE of Accra	Most of West Africa, covering an area of 77,000 km <sup>2</sup> .	Coastal Boundary Fault	Seismograph out of operation at time of shock, estimated at M = 6.5. Maximum damage in city of Accra - event recorded by seismological stations all over the World. Main shock followed by numerous after shocks lasting over six months
26th Dec 1966	Weija area	Accra and nearby villages up to 40 km to the north	Akwapim Fault Zone	Shocks attained Intensity IV on the Modified Mercalli Scale in Accra.
9th Feb 1969	Approx 8 km out to sea, south of Tema	City of Accra and its environs.	Coastal Boundary Fault	M 4.9 event recorded by 22 other seismological stations in Europe and Canada. Several cracks developed in large buildings in Accra.
1st March 1977	25 km north of Accra along Akwapim Fault Zone	City of Accra and its environs	Akwapim Fault Zone	M 3.4
5th Sept 1978	5 km north of Weija	City of Accra and its environs.	Akwapim Fault Zone	Main M = 4.7 shock followed by two after-shocks
9th Jan 1979	Weija area	City of Accra	Akwapim Fault Zone	M 3.6
7th Jan 1980	Weija area	City of Accra	Akwapim Fault Zone	M 3.6
25th June 1980	Epicentral distance = 15.66 km	City of Accra	Probably Akwapim Fault Zone	M 3.1
10th May 1985	Epicentral distance = 47 km	City of Accra and its environs	Probably Akwapim Fault Zone	M 4.0
27th Feb 1988	15 km SW of Weija	City of Accra and its environs	Akwapim Fault Zone	M 3.4
14th April 1990	Weija area	City of Accra and its environs	Akwapim Fault Zone	M 3.5
23rd August 1991	Weija area	City of Accra and its environs	Akwapim Fault Zone ?	M 3.9
28th January 1995 (2 shocks within 1 minute)	Weija area	City of Accra and its environs	Akwapim Fault Zone ?	M 3.3 and M 3.4
1st February 1995	Weija area	City of Accra and its environs	Akwapim Fault Zone ?	M 3.8
9th March 1995	Weija area	City of Accra and its environs	Akwapim Fault Zone ?	M 3.4
2nd February 1996	Weija area	City of Accra and its environs	Akwapim Fault Zone ?	M 3.6
8th January 1997	Weija area	City of Accra and its environs	Akwapim Fault Zone ?	M 3.8
14th February 1997	Weija area	City of Accra and its environs	Akwapim Fault Zone ?	M 4.1
6th March 1997	Offshore	City of Accra and its environs	Akwapim Fault Zone ?	M 4.8 ?

## Annex 6-2 List of References

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