REPUBLIC OF KENYA

MINISTRY OF WATER DEVELOPMENT

SECTORAL REPORT
(H)

DAM DEVELOPMENT PLAN

JULY 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF KENYA

MINISTRY OF WATER DEVELOPMENT

THE STUDY

ON

THE NATIONAL WATER MASTER PLAN

SECTORAL REPORT
(H)

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PREFACE

Interpretation of Report

The original objective of this NWMP Study is to propose a nationwide framework for orderly planning and development of water resources in the country. The Study also deals with the formulation of individual development schemes. However, it should be noted that the plans formulated in this Study remain at a national level and do not provide complete details at local level. Further details should be examined in subsequent studies on each river basin, district, and project basis which are separately recommended in this Study.

Administrative Division of Districts

In this Study, the original 41 districts were considered and various statistical data, particularly socio-economic information, were collected for these districts. During the progress of the Study, six districts were detached from the original ones and established as new districts. In the report, the data on these new districts are grouped together with the corresponding original districts as shown below.

	Original Districts	New Districts	Data included in:
1.	Machakos	Makueni	Machakos/Makueni
2.	Kisii	Nyamira	Kisii/Nyamira
3.	Kakamega	Vihiga	Kakamega/Vihiga
4.	Meru	Tharaka-Nithi	Meru/Tharaka-Nithi
5.	Kericho	Bomet	Kericho/Bomet
6.	South Nyanza	Migori	South Nyanza/Migori

(Note: The last three Districts were established very recently.
The report refers only to the names of the original 41 districts.)

The administrative boundary map used in this Study is the latest complete map set covering the whole country (41 Districts, 233 Divisions and 976 Locations), prepared in 1986 by the Survey of Kenya, Ministry of Land, Housing and Physical Planning.

Data and Information

The data and information contained in the report represent those collected in the 1990-1991 period from various documents and reports made available mostly from central government offices in Nairobi and/or those analyzed in this Study based on the collected data. Some of them may be different from those kept in files at some agencies and regional offices. Such discrepancies if any should be collated and adjusted as required in further detailed studies of the relevant development projects.

Development Cost

The cost and benefit estimate was based on the 1991 price level, and expressed in US$ equivalent according to the exchange rate of US$1 = KShs25.2 prevailing at that time. The same exchange rate was used in calculating the development cost in K£/KShs currency.

THE STUDY ON THE NATIONAL WATER MASTER PLAN

SECTORAL REPORT (H)
DAM DEVELOPMENT PLAN

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H1. INTRODUCTION

This sectoral report deals with the dam development plan for the National Water Master Plan and the National Water Master Action Plan (hereinafter referred to as "the Study") toward the years 2010 and 2000, respectively.

The dam development plan for the Study aims at selecting the potential surface water sources in the country, namely, prospective dam schemes for the Study and alternative potential dam schemes for future development.

Besides large dams, this study included a planning of other water sources such as small dams and sub-surface flow dams. The results of study on development plans of these sources are described in the Sectoral Report (M), Integrated Water Resources Development Planning, for rural water supply.

Chapter H2 describes the present situation of large, small and sub-surface flow dams throughout the country which are under operation, construction and planning stages. Inventories of these dam schemes prepared and inter-basin water transfer plans with dam identified in previous studies are compiled in this chapter.

Chapter H3 presents the inventories of dam schemes together with information of the proposed characteristics such as storage-area curve and dam embankment volume, the methodology and procedures of screening for the selection of prospective damsites. The selected prospective dam schemes were incorporated in the Integrated Water Resources Development Planning in Sectoral Report (M).

Chapter H4 presents the preliminary layout design and rough estimates of construction costs of the prospective dam schemes.

Besides the prospective damsites, other potential damsites for future development were also selected for purposes of water supply, irrigation, hydropower, flow augmentation in downstream and so on. These schemes are defined here as dams which were not selected for prospective dams foreseen towards year 2010 but might have potential for future development on the basis of the further detailed study in future before or after the year 2010. These potential schemes are discussed in Chapter H5.

A flow chart showing overall procedure of this dam development study is shown in Figure H1.1. Location of all the damsites examined in the Study, including existing (under operation) and ongoing (under-construction and in detailed design stage) damsites as well as alternative potential sites are shown in the Location Map attached to this report.

H2. EXISTING DAM SCHEMES

2.1 General

All data and information available on dam schemes in the country were collected from the relevant ministries and agencies through questionnaires distributed during the study period and also from previous study reports. An inventory of dam schemes, including both large and small dams, was prepared based on the data and information collected.

The government ministries and agencies related to dam schemes are as follows:

(a) Ministry of Water Development (MOWD) including Dam Construction Units (DCU, Unit No. 1 to Unit No. 5)

(b) Ministry of Energy (MOE)

(c) Ministry of Agriculture (MOA)

(d) Ministry of Regional Development (MORD)

(e) Ministry of Reclamation and Development of Arid, Semi-Arid and Wasteland (MORDASAW)

(f) National Water Conservation and Pipeline Corporation (NWCPC)

(g) Tana and Athi River Development Authority (TARDA)

(h) Lake Basin Development Authority (LBDA)

(i) Kerio Valley Development Authority (KVDA)

(j) Nairobi City Commission (NCC)

(k) National Irrigation Board (NIB)

(l) Kenya Power Company Ltd. (KPC)

(m) Kenya Power and Lighting Company Ltd.(KPLC)

2.2 Large Dam Schemes

Based on the available data and information on dam schemes throughout the country, an inventory of large scale dam was prepared. In this study, a large dam is defined to be a dam of 15 m high or more.

2.2.1 Existing and ongoing dam schemes

A list of existing large dams (under operation) and committed schemes (dams under construction and in detailed design stage) is shown in Table H2.1.

As shown in the table, there are 17 existing dams, 5 under construction and 5 under detailed design. Of the completed projects, representative large dams in terms of dam height and reservoir scale are Turkwel Dam (arch type, 1,650 mcm gross storage, 155 m high) on the Turkwel River, and Masinga Dam (rockfill type, 1,560 mcm gross storage, 70 m high) and Kiambere Dam (rockfill type, 585 mcm gross storage, 112 m high) on the Tana River.

They are mainly for hydropower generation, while the other existing dams are for domestic/industrial water supply and irrigation development purposes. The location of existing (under operation) and ongoing (under-construction and in detailed design stage) dams is presented in Figure H2.1.

The ministries and agencies related to the existing large dam schemes so far are MOWD, MOE, MCWPC, KVDA, TARDA, LBDA, NCC and KPC.

2.2.2 Dam schemes under planning stage

There are some 100 dam schemes identified in previous studies (in the stages of feasibility, pre-feasibility and master plan studies). Most of the schemes are for domestic and industrial water supply and hydropower generation. An inventory of these schemes is compiled in Appendix H.1, together with the principal features such as catchment area, purpose, related agencies, and storage capacity.

2.2.3 Number of large dams

The total number of large dam schemes is summarized by major drainage area as follows:

Number of Large Dams

Drainage Area	U/O	U/C	D/D	F/S	Pre-F/S	M/P	Total
Lake Victoria	3	2	2	3	8	28	46
Rift Valley	2	1	2	3	4	12	24
Athi River	6	1	1	3	2	12	25
Tana River	6	1	0	1	3	12	23
Ewaso N'giro North	0	0	0	1	0	7	8
Total	17	5	5	11	17	71	126

U/O=Under Operation, U/C=Under Construction, D/D=Detailed Design,
F/S=Feasibility Study, Pre-F/S=Pre-feasibility Study, M/P=Master Plan

2.3 Small Dam Schemes and Subsurface Flow Dams

In this Study, a small dam is defined as a dam having a height of less than 15 m. A water pan which is smaller in scale than the concept of small dam used here is included in the category of small dam. Its pond can be constructed in a depression where rainwater flow can be pooled.

There are quite a number of small dam schemes mainly for domestic water supply and livestock use in the rural areas. The planning, designing and implementation of the schemes are carried out by MOWD, NWCPC, MOA and other agencies.

Subsurface flow dams are classified into two: subsurface dam and sand dam. Typical designs of these dams are presented in Sectoral Report (M).

(1) Number of small dams and subsurface flow dams

The exact number of existing small dams and subsurface flow dams is hardly known, but the following figures by drainage area were estimated based on the data made available from MOWD and numbers counted on 1:50,000 topographic maps. The number of existing small dams by drainage area is summarized in Table H2.2.

Estimated Number of Small Dam and Subsurface Flow Dam

Drainage Area	Small Dam	Subsurface Flow Dam
Lake Victoria	769	-
Rift Valley	392	-
Athi River	703	14
Tana River	286	24
Ewaso N'giro North	510	3
Total	2,660	41

Source: MOWD, 1/50,000 topographic map

Note : The above is based on limited data and information made available during the study. The actual number of dams may be more than the above.

(2) Location of small dams

The location of existing small dams (including water pans) and subsurface flow dams in the above table are as shown in Figures H2.2 to H2.11, while Figure H2.12 shows country-wide distribution of small dams, and figure H2.13 shows a soil texture map indicating the distribution of heavy and medium texture areas (impermeable soil areas). From the figures the following were found:

(a) Many small dams and subsurface flow dams are concentrated in semi-humid and semi-arid areas such as the districts of Machakos, Kitui, Samburu, Trans Nzoia, Uasin Gishu, and so on. On the other hand, some exist at scattered

locations in arid area such as lands in lower Tana River, North Kitui, and a part of Rift Valley. It is read on the map that the existing small dams and pans are within the areas receiving more than 400 mm of annual rainfall (see Figure H2.12).

(b) Most of the existing small dams are located in heavy soil texture (fine texture) distributed areas. It means that the suitable construction area for small dams and pans are heavy soil texture distributed areas because of the availability of embankment materials and reservoir retainity of storage water. This index(heavy soil texture distributed area) will be an useful indicator to assess the development potential of small dam water sources in the country. This will be discussed in detail in Sectoral Report (M).

(c) General reading of Figures H2.2 to H2.11 indicates that most of the small dams including water pans are located in the upstream area of tributaries, which is supposedly to obtain uncontaminated water. The catchment areas are generally small, ranging from a few km^2 to a few tens. of km^2.

(3) Inventory of small dams/pans

An inventory of small dams based on data from MOWD was compiled as shown in Appendix H.2. For the Kitui district, an inventory of existing small dams (though most of them are water pans) and subsurface flow dams constructed in the period between 1975 and 1986 in the Kitui District was prepared based on the data obtained from MOWD and shown in Appendixes H.3 and H.4. The inventories are indicative to show examples of averaged figures of the small dams/water pans and subsurface flow dams in terms of catchment area, dam height, storage capacity and construction materials, which are summarized as follows:

Typical Characteristics of Small Dams/Subsurface Flow Dams

Small dams/ water pans (91 dams/pans)	catchment area	- about 1 km^2
	dam height	- about 2 m
	dam type	- concrete or earthfill
	reservoir area	- less than 1 ha
	storage volume	- 2,200 m^3
Subsurface flow dams (23 dams)	catchment area	- about 2 to 3 km^2
	dam height	- about 2 m
	dam type	- concrete
	reservoir area	- less than 100 m^2
	storage volume	- less than 800 m^3

2.4 Inter-Basin Water Transfer Plan

Various inter-basin water transfer plans with dam schemes have been planned for the supply of domestic/industrial and irrigation water and for hydropower generation of which some have been implemented. The total number of inter-basin water transfer plans with and without dam schemes so far identified was 23 projects as shown in Table H2.3. The locations are shown in Figures H2.2 to H2.11.

Out of all the plans above, 18 plans are with dam schemes of which two (2) are now under construction and expected to be completed in 1992; i.e., the Thika dam scheme being implemented by NCC for water supply to Nairobi city and the Turasha dam scheme by NWCPC for supplying water to Nakuru and Gilgil areas. Others are either in the design or feasibility study stage; Chemususu dam and Malewa dam schemes for Nakuru area water supply by NWCPC, Sondu/Miriu dam scheme for hydropower generation by KPLC and irrigation by LBDA.

In some cases, inter-basin water transfer schemes with a dam will result in the disturbance of ecological balance at both water-abstracted basin area and water-receiving basin area, especially in case where inter-basin water transfer scheme is planned from closed basin to closed basin. Therefore, it is very important that inter-basin water transfer scheme with dam be carefully planned taking this aspect into consideration.

For the Study, inter-basin water transfer scheme with dam is discussed in more detail in Sectoral Report (M)-Integrated Water Resources Development Planning and Sectoral Report (N)-Environmental Conservation.

H3. SELECTION OF PROSPECTIVE DAM SCHEMES FOR THE MASTER PLAN AND THE MASTER ACTION PLAN

3.1 Methodology and Procedures

The selection of prospective dam schemes for the Study was examined through four steps of screening procedures (refer to the screening criteria, Subsections 3.3.1 to 3.3.4 hereinafter). Methodology and procedure adopted for the selection of prospective damsites are as follows:

(1) Listing of all dam schemes studied and named in previous studies.

(2) Identification of new potential damsites through map study.

(3) Ranking of dam schemes in screening evaluation.

   (a) Schemes already committed (defined herein as the schemes under construction and in detailed design stage) were excluded from the evaluation since they are already on the line of development programme.

   (b) Schemes accorded a high viability in the previous studies (feasibility study, pre-feasibility) were retained irrespective of indices evaluated in the screenings.

(4) Preparation of basic planning data for newly identified schemes, i.e., catchment area, reservoir surface area - storage curve, dam embankment volume and so on.

(5) Screenings of identified/potential dam schemes

   (a) Preliminary Evaluation

      - first screening
      - second screening
      - third screening

   (b) Final Evaluation

      - fourth screening

(6) Selection of prospective damsites for the Study

3.2 Identification of New Potential Damsites

Prior to the screenings, efforts were made to identify additional potential damsites in the whole country through a study on 1/50,000 contour maps. The map study was carried out paying attention to the following:

(a) Damsites having favorable topographical features (e.g., narrow damsite valley, large catchment)

(b) Damsites located near high water demand areas of urban centres such as major cities and towns in relation to domestic and industrial water supply schemes.

(c) Damsites having a development viability of water supply for irrigation and hydropower generation.

About 130 additional damsites were newly identified through the map study. Location and coordinates of the identified damsites as well as damsites named in previous studies are compiled together in Appendix H.5.

3.3 Screening Criteria for Selection of Prospective Damsites

3.3.1 Criteria for first screening

The criteria for the first screening were as follows:

(a) Damsites having storage efficiency (SE) index of more than 15 are selected through the first screening and passed to the second screening.

(b) SE index does not take into account a factor of water head which is an important factor for hydropower generation. Therefore, no exclusion of hydropower schemes were made.

Storage efficiency is defined as below:

$$SE = (\text{active storage capacity in } m^3) / (\text{dam embankment volume in } m^3)$$

A larger value of SE presents a higher storage efficiency of dam scheme. The marginal point of SE was assumed to be 15 in consideration that the SE values for the dam schemes taken up in previous feasibility studies distribute in a range of over 15.

Definition of terms used here are as follows:

(1) Dam Height

(a) In case of dams for which the planning features are defined at feasibility studies or pre-feasibility studies:

Dam height = proposed FSL + freeboard

where, FSL : Full Supply Level
freeboard: tentatively set out as follows
(including the spillway overflow depth at
a dam design flood);

dam height > 30 m : freeboard = 5 m
dam height < 30 m : freeboard = 3 m

(b) In case of other dams:

Whichever is the lower, comparing the following two:

- topographically maximum possible height, or
- maximum dam height assumed at 150 m.

Where the FSL is defined as follows:

FSL = (dam crest elevation) -
freeboard (5 m or 3 m as above)

(2) Active Storage Capacity: Gross Storage Capacity minus Dead Storage Capacity.

(3) Dead Storage Capacity: Annual sediment yield (m3/km2/year) is based on the results of sediment study estimated for each basin area (see Sectoral Report (B)-Hydrology). Reservoir life was assumed to be 50 years.

(4) Dam Type: Rockfill type with centre core was assumed for all schemes for comparison on a uniform basis. In fact, previously identified dams (including existing, ongoing, under-planning dams) were planned mainly as rockfill type dam. The typical cross section of rockfill dam is shown in Figure H3.1.

(5) Dam Embankment Volume: Dam embankment volume is calculated by a formula given below which is based principally on the damsite valley profile data extracted from the maps.

Embankment Volume = 1/2 BH (L1 + L2) + 1/6 (m + n)
* H^2 (L1 + 2L2)

where, B = dam crest width (10 m)
m = upstream slope of dam embankment (3.0)
n = downstream slope of dam embankment (2.5)
H = dam height (m)
L1 = dam length at crest (m)

L2 = dam length at bottom (m)

Note 1: Foundation excavation is assumed to be 5 m below the ground line.

Note 2: Dam embankment volume obtained by the above formula was verified with the volume calculation derived from profile data surveyed at 11 damsites in this Study. The difference was found to be within an acceptable range (+/-95%).

Note 3: Dam embankment slopes, upstream and downstream, are assumed to be 1:3 and 1:2.5, respectively, as typical design referring to the designs proposed in previous studies and Design Manual (Ref.H.3).

3.3.2 Criteria for second screening

The following were the criteria for the second screening:

(a) Firstly, reservoir yield was estimated on a reservoir storage - draft curve (refer to Sectoral Report (B)- Hydrology) predetermined for each river basin/dam scheme. In determining the dam development scale, an assumption used was that the most likely optimum scale would appear at a point where the curve turns upward. Reservoir yield and corresponding active storage requirement were read out at the point on the curve.

(b) The above storage requirement was compared with maximum active storage volume available at the damsite. If the latter is smaller than the former, the scheme is discarded in view of the fact that the site would not be suitable for the development of a large dam.

(c) A further comparison was made to assess the relative attractiveness among damsites within the same basin, based on a reservoir yield (RY) index (= reservoir yield/dam embankment volume). Schemes showing higher figures were passed to the third screening.

3.3.3 Criteria for third screening

The following exclusion criteria was applied:

(a) Exclusion of dam schemes remote from demand centers/areas or subbasins where water deficit was foreseen on the basis of the results of the first preliminary water balance study.

(b) Exclusion of dam schemes having a relatively low reservoir yield (RY) index among alternative schemes envisaged for the same demand.

3.3.4 Criteria for fourth screening

The following was the fourth screening criteria:

(a) Potential damsites selected by the preliminary evaluation (first/second/third screenings) and some sites previously discarded through the preliminary screening were re-evaluated to select prospective damsites based on the final water balance study (Refer to Sectoral Report (M)).

(b) Prospective dam schemes having multiple purposes were selected on the basis of the study results of water balance and study results of each sector, i.e., Agriculture and Irrigation (Sectoral Report (E)), Power Development Plan (Sectoral Report (L)), and Flood Control Plan (Sectoral Report (G)).

(c) Schemes accorded a high viability in the previous studies and schemes remaining at the third screening but not finally selected as prospective sites were to be left as alternative potential sites for subsequent detailed studies for each region.

3.4 Results of Screening Evaluation

3.4.1 Results of preliminary evaluation

The results of the preliminary evaluation (first/second/third screenings) are shown in Table H3.1 and summarized below.

Number of Damsites that Passed Screening

Drainage area	No. of damsites	Remaining after 1st Screening	Remaining after 2nd Screening	Remaining after 3rd Screening *
Lake Victoria	94	55	31	13 (2 hydro)
Rift Valley	48	27	18	10 (3 hydro)
Athi River	27	18	15	13
Tana River	40	18	10	7 (5 hydro)
Ewaso N'giro North	18	11	5	2
Total	227	129	79	45

* Preliminarily selected potential schemes

Through the above preliminary evaluation, 45 schemes were selected for further examination in the forth screening.

3.4.2 Potential damsites for multipurpose planning

Potential damsites having purposes of irrigation, hydropower and flood control proposed by each sector are discussed hereunder.

(1) Irrigation Purpose

Out of 18 large scale irrigation schemes proposed by the irrigation development plan (Sectoral Report (E)), the following 8 potential dam/reservoirs were proposed as schemes for irrigation. These potential damsites were to be put into the final water balance study.

Irrigation Scheme	Dam/Reservoir
Upper Nzoia	Hemsted Bridge
Yala Swamp/Kano Plain	Nandi Forest
Kano Plain	Magwagwa
Arror	Sererwa
Lower Ewaso N'giro	Oldorko
Kanzalu	Munyu
Kibwezi Extension	Yatta
Mwea Extension	Thiba

(2) Hydropower Purpose

The study result of power development plan has four recommended hydropower dam schemes towards the year 2010, i.e., Sondu/Miriu, Low Grand Falls, Oldorko, Mutonga and Magwagwa. Sondu/Miriu scheme is an ongoing scheme in detailed design stage. Hence, the other three were selected as prospective dam schemes for hydropower generation purpose.

The other hydropower damsites already proposed by previous studies were alternatives for hydropower potential as described in Sectoral Report (L).

(3) Flood Control Purpose

A cost comparison study was carried out to examine the relative merit of flood control dam plans through comparison of (i) river improvement only and (ii) river improvement and flood control dam. The study was made for basins where flood mitigation schemes are planned as reported in Sectoral Report (G)-Flood Control Plan.

The process of the comparative study was as follows:

(a) Selection of Basins for the Comparative Study

The study results of the Flood Control Plan (Sectoral Report (G)) indicate the following five (5) flood prone areas for the implementation of flood mitigation schemes up to the year 2010.

- Kano Plain
- Yala Swamp

- Nairobi City
- Kuja River Mouth
- Lumi River Mouth

Out of the above flood prone areas, three (3) areas were selected for the comparative study between flood control with dam and flood control with river improvement works, considering the availability of identified damsites which were studied in Chapters H2 and H3 and compiled in Appendixes H.6 and H.7. The flood prone areas and the related river basins selected for the comparative study are as follows:

Flood Prone Area	Related River Basins
Kano Plain	Nyando/Sondu Rivers
Yala Swamp	Yala/Nzoia Rivers
Kuja River Mouth	Kuja River

(b) Selection of Representative Damsite for the Comparative Study

Of the dam schemes identified in each river basin, the schemes having comparatively large catchment areas were selected taking an advantage of their large share against the catchment area of the flood prone area in view of their large effect to flood discharge (refer to Appendix H.8) and also considering the results of preliminary screening evaluation which showed the larger reservoir storage efficiency and economical advantages.

The representative damsites selected for the comparative study are as follows:

River	Damsite
Nzoia	Rambula
Yala	Mushagumbo
Nyando	Nyando
Sondu	Magwagwa
Kuja	Katieno

(c) Evaluation Criteria

In the comparative study on flood control with dams or with river improvement works, the following evaluation criteria was applied (refer to Table H3.2):

(i) Flood protection level/regulating flood flow level

The flood protection level for river improvement works was 25-year which was taken from the study on Flood Control Plan. (Ref. Sectoral

Report (G)). The flood in flow at the reservoir was assumed to be of the same return period.

(ii) Flow cut ratio

Flow cut ratio at damsite was assumed to be 0.5, except for Rambula Reservoir for which 0.3 was assumed in consideration of its large inflow discharge.

(iii) Inflow design discharge

Inflow design discharge at damsites was estimated based on a design discharge at downstream point for river improvement works.

(iv) Flood control storage

Duration of flood runoff was assumed to be 10 days. Then flood control storage was assumed with inflow design discharge.

(v) Design discharge at downstream point after controlling by reservoir

$$Q = Q_1 \{ [1- (1 - r)^2] a/A \}^{0.5}$$

where,

Q : Design discharge at downstream point for river improvement works after controlling reservoir routing,
Q_1: Inflow design discharge at downstream point without dam,
r : Cut ratio at dam site,
a : Catchment area of dam, and
A : Catchment area of downstream point

(vi) Dam embankment volume

Dam embankment volume was calculated based on the same criteria shown in Subsection 3.3 of this report.

- In case of multipurpose dams, incremental dam embankment volume associated with flood control storage capacity was estimated.

- In case of flood control by single purpose dams, the dam embankment volume was estimated independently based on the sediment volume, flood storage capacity, and storage capacity - area curves.

(d) Comparison Method

For comparison between flood control by dam and river improvement works, the construction cost required for each structural measure was compared in consideration of the following:

Cost of Flood Control by Dam

Increment of dam construction cost was estimated as the difference between the cost of dam with- and without-flood control function.

Cost of Flood Control by River Improvement Works

Decrease in construction cost of river improvement works was estimated as the difference between the cost with- and without-flood control dam.

Conceptual diagrams of flood control by dam and by river improvement works are shown in Appendix H.9.

The results of the comparative study are shown in Table H3.2. As shown in the table, flood control with dam is expensive by about 6 to 25 times that with river improvement works.

Therefore, none of the dam schemes was proposed for flood control single purpose or as multi-purpose schemes. The flood control by river improvement works was recommended under this study. However, further comparative study on flood control with dam and with river improvement works should be done in more detail for each basin when the final features of flood mitigation plan is to be determined.

3.4.3 Selected prospective damsites

Based on the fourth screening criteria and the results of the final water balance study, 28 damsites were selected as schemes envisaged towards year 2010. They are listed in Table H3.3. The table includes five committed projects presently under design stage; namely, Moiben, Sondu/Miriu, Chemususu, Kirandich, and Ruaka (Kiambaa) dams. The selection process of these 28 damsites in the final water balance study is described in detail in Sectoral Report (M).

Out of the 28 dams, 19 dams are for domestic, industrial and livestock water supply, 2 dams for hydroelectric power generation, and 2 dams are for irrigation. Then, 5 dam schemes (Sondu/Miriu, Magwagwa, Oldorko, Ndarugu and Chania-B) are for multiple purposes of hydropower, irrigation and/or water supply.

Figures H3.2 (Serial Nos.(1/18) to (18/18)) shows the reservoir storage capacity and surface area by elevation of the prospective damsites together with other damsites examined in the Study.

H4. PRELIMINARY LAYOUT DESIGN AND ROUGH ESTIMATES OF CONSTRUCTION COSTS OF PROSPECTIVE DAM SCHEMES

4.1 Preliminary Layout Design of Prospective Dams

The location of 28 prospective damsites selected as well as existing and ongoing damsites is shown in Figure H4.1. Preliminary design of 28 dams (excluding 4 dams for which definite design is already prepared; i.e. Sondu/Miriu, Chemususu, Kirandich and Ruaka [Kiambaa] dams) was made on the basis of the topo-maps of 1:50,000 scale and preliminary design criteria described in Section 3.3. In case the design is already delineated in previous studies, the same design was adopted in the Study. The plan, profile dam axis and typical cross section of each prospective dam are shown in Figures H4.2 to H4.24. The principal features of the prospective dams are shown in Table H4.1.

Brief descriptions by drainage area of the prospective damsites are given below.

4.1.1 Lake Victoria drainage area

In this drainage area, Moiben dam has already been committed for supplying water to Eldoret Municipality by NWCPC. The detailed design of the dam was completed in 1992, but the final features of dam and reservoir was still under examination as of December 1991. In the Study, therefore, this dam was included in a group of prospective dams.

(1) Moiben Dam

This damsite is located on the Moiben River near Chebara Village at elevation of 2,325 m. The scheme proposed in a previous study (Ref.H.10) has an advantage of enabling gravity water supply for domestic and industrial purposes to Eldoret municipality and surrounding areas.

The catchment area of this site is around 188 km2. The yield at the damsite is proposed to be 58,700 cmd (0.68 cms). In this Study the water of 51,000 cmd (0.59 cms) for supplying domestic and industrial water demands to Eldoret area and domestic water of 3,500 cmd (0.04 cms) to Iten town are planned for meeting the demand toward the year 2010, and the remaining yield for the downstream flow. A dam about 42 m high above riverbed and gross storage capacity of 19.6 mcm is conceived.

(2) Mukulusi Dam

This dam is located on the Isiukhu River about 6 km east of Kakamega town. The river originates from Kakamega Forest and the runoff yield at damsite is 95,000 cmd (1.1 cms). The scheme envisages to supply 49,300 cmd (0.57 cms) of water to Kakamega town to meet the water demand in 2010, and the remainder for the downstream maintenance flow. The dam is less than 15 m in height but its

gross storage capacity may be about 17 mcm. This dam is a newly proposed scheme for supplying water to Kakamega town and environs.

(3) Londiani Dam

This damsite proposed in a previous study (Ref.H.18), is located on the Kipchorian River at 2,286 a.m.s.l., about 5 km north of Londiani town. In this Study the scheme is planned for water supply to Londiani town meeting demand of 20,800 cmd (0.24 cms) towards the year 2010. The scheme was previously planned for water supply to the Greater Nakuru areas by inter-basin water transfer, however it was found in this Study that reservoir yield would not be large enough to meet the water demend in the year 2010 at Nakuru. The reservoir will have a gross storage capacity of about 50 mcm with a dam 50 m high above the riverbed.

(4) Kibos Dam

This dam is located on the Kibos River at about 1,450 m.a.s.l., some 20 km northeast of Kisumu town and immediately north of Nyando Escarpment. It was proposed by previous studies (Refs. H.9 and H.14) for supplying water to Kisumu town area. This Study envisages water supply of 70,000 cmd (0.81 cms) to Kisumu and Maseno towns for meeting the demand towards the year 2010. A 40 m high dam will create a reservoir having 7 mcm of gross storage.

(5) Itare Dam

The site is located on the Itare River just downstream of the confluence of Ndoinet and Songol rivers, about 3 km inside the boundary of South Western Mau Nature Reserve area. This scheme is being investigated and studied at a prefeasibility study level by NWCPC for water supply to Greater Nakuru areas through Molo.

The Study conceived, out of total yield of 149,500 cmd (1.73 cms) at the damsite, 123,500 cmd (1.43 cms) of water will be supplied for meeting the demand towards the year 2010 in several urban centers such as Molo, Elburgon, Njoro, Mogotio, Rongai and part of Nakuru, and the remaining yield for downstream maintenance flow. For this purpose the plan envisages to build a dam of about 36 m high above riverbed and a reservoir of 14.6 mcm of gross storage capacity.

(6) Sondu/Miriu Dam

This dam is proposed at a gorge in the downstream pat of the Sondu River. The dam, 18 m in height, is to provide a pondage for daily flow regulation primarily for power generation and to divert the water to Kano plain irrigation area. Installed capacity of the proposed Sondu/Miriu powerhouse is 60 MW. The detailed design was completed by KPC in 1991. The plan envisages to provide an additional powerhouse (19 MW) in the future.

(7) Magwagwa Dam

This site is located on the Sondu River about 5 km downstream from the confluence of two major tributaries; Yurith and Kipsonoi rivers. Feasibility study of this scheme for hydropower generation was just completed in 1991. The proposed Magwagwa hydroelectric power project has an optimal installed capacity of 120 MW for commissioning in year 2003. The dam is of a concrete facing rockfill type, 100 m high and about 4.4 million m3 of embankment volume. The gross storage capacity is about 808 mcm and active storage capacity 701 mcm.

The water released from Magwagwa power station will further be used at the Sondu/Miriu power station located downstream and finally conveyed to the Kano Plain irrigation area.

The optimal development project scale was derived by maximizing the net benefit gained from Magwagwa and Sondu/Miriu hydropower schemes and Kano Plain irrigation scheme (Ref.H.11). The features of the scheme assumed in this Study are identical to those proposed in the feasibility study.

(8) Bunyunyu Dam

This damsite is located on the Kuja River about 11 km westward from the town of Kisii. The reservoir is planned for regulation of river flows and the water is taken at an existing water intake located downstream of the dam for supplying 8,700 cmd (0.1 cms) to Kisii and environs for meeting demand towards the year 2010. A 17 m high dam with 4.8 mcm of gross storage reservoir is conceived.

4.1.2 Rift Valley drainage area

In this drainage area there are two committed dam schemes at the detailed design stage, Chemususu dam and Kirandich dam. These dam schemes were proposed by NWCPC.

(1) Chemususu Dam and Kirandich Dam

The detailed design of Chemususu dam was completed in 1989. The site is situated within the Lembus Forest and has about 63 km2 of catchment area. The dam will supply 35,000 cmd (0.4 cms) to the Greater Nakuru water supply project. A rockfill dam 45 m high above the riverbed with 0.76 mcm embankment volume and 10.9 mcm of gross storage capacity is planned (Ref.H.17).

(2) Kirandich Dam

The design of Kirandich dam was completed in 1989. The site is located on the Kirandich River. The dam is planned for supplying 11,000 cmd (0.127 cms) to Kabarnet town. A rockfill dam, 50 m high and 0.4 mcm of embankment volume, will provide a 4.52 mcm of gross storage capacity (Ref.H.28).

(3) Malewa Dam

The dam is located on the Malewa River about 8 km upstream from the confluence of Malewa and Turasha rivers. This scheme is proposed in combination with Turasha intake dam for water supply to Gilgil, Naivasha, and Nakuru areas. The feasibility study of Malewa dam was completed in 1990, while Turasha dam is under construction for completion in 1992. A rockfill dam 80 m high and 68.9 mcm of gross storage is designed for supplying water of 115,800 cmd (1.34 cms) for meeting water demand towards the year 2010 (Ref.H.24).

As the results of inter-basin water transfer from subbasin 2GB to subbasin 2FC, there will be lowering of water level at Lake Naivasha, vice versa there will be rise of water level at Lake Nakuru which will give some impacts on the ecosystem in both subbasins. Further detail is given in Sectoral Report N.

(4) Upper Narok Dam

The site is located about 300 m downstream from the confluence of two rivers, Engare Narok and Olokurto. The scheme was proposed in a MOWD's study (Ref.H.27) for supplying water to Narok town by gravity. In this Study water demand in Narok town towards year 2010 was estimated to be 53,600 cmd (0.62 cms). A dam of 29 m high with 10 mcm of gross storage capacity is planned to meet this water supply requirement.

(5) Oldorko Dam

This site is located on the main stream of Ewaso N'giro South River near Nguruman Escarpment. The scheme was proposed primarily for hydropower generation together with Leshota dam which is located upstream of the Oldorko damsite (Ref.H.2). Based on the updated national power development plan up to year 2010, Oldorko dam was favored as a prospective scheme having a generating capacity of 72 MW.

This Study adopted the same features of the dam and reservoir plans as designed in the previous study. Water flowing out from the power station will be utilized for irrigation (Lower Ewaso N'giro South Irrigation scheme) and as a future water source for domestic supply to Magadi town. The irrigation water supply is conceived at 13.4 cms and the supply of domestic water for Magadi town is 10,400 cmd (0.12 cms) towards the year 2010.

The irrigation scheme involves a major abstraction of water, reducing the river flow in the downstream reaches. The inclusion of irrigation scheme will be subject to further study of environmental aspects in the downstream reaches as well as the Lake Natron.

4.1.3 Athi River drainage area

In this drainage area, the Kiserian dam is under construction by NWCPC for water supply to Kajiado town. The dam is 21 m high and will supply 6,000 cmd (0.07 cms) of water. A potential environmental problem is that the reservoir water may be subject to pollution due to effluents from Kiserian township.

There is Ruaka (Kiambaa) dam scheme on the Ruaka River. The detailed design of the dam was completed in 1980 for water supply to environs of the site. Recently the scheme was raised and will be re-evaluated by NWCPC for water supply to the environs.

(1) Upper Athi Dam

The site is located on the Athi River about 10 km northwest from Athi River town. The dam and reservoir are situated in the boundary of Nairobi National Park. The scheme was proposed for supplying domestic and industrial water to the Athi River town (Ref.H.36).

In this Study, a dam 27 m high above riverbed with 10 mcm of gross storage reservoir was planned for supplying 28,500 cmd (0.33 cms) of water for meeting demand towards the year 2010.

(2) Ruiru A Dam

The damsite is located on the Ruiru River about 2 km downstream of the existing Ruiru dam which is one of the present water sources for Nairobi through pipeline supply. The site was proposed in a MOWD's study (Ref.H.30) as one of the water development sources in the Chania and Thika river basins.

The scheme is tentatively proposed in this Study for supplying 2,600 cmd of water (0.03 cms) to Nairobi towards the year 2010. The dam height is 69 m and the gross storage capacity will be 19 mcm.

(3) Kikuyu Dam

The site is located on the upstream reach of the Nairobi River near Kikuyu town. The dam will yield about 20,000 cmd (0.23 cms) of water for domestic and industrial uses in Kikuyu town and environs towards the year 2010. A 25 m high dam with 11 mcm of gross storage capacity is tentatively proposed in the Study. However, it is noted that the further investigations are required to clarify the impact on the flow of the Nairobi River.

(4) Ndarugu Dam

This site is located on the Ndarugu River just downstream the confluence of two rivers; Komu and Ndarugu. The dam was proposed for supplying water to Nairobi and environs (Ref.H.29).

In this Study a multipurpose dam scheme is considered; domestic and industrial purposes for meeting the water demand towards the year 2010 in Nairobi, Ruiru and Kiambu, and also for Kanzalu irrigation scheme. The water yield is 407,000 cmd (4.71 cms) for domestic and industrial water supply and 102,000 cmd (1.18 cms) for irrigation.

Munyu dam which is located on the Athi River about 1.5 km downstream from Ndarugu damsite is an alternative site for the same development objectives. Munyu dam will be discussed in the Chapter H5.

(5) Yatta Dam

The site is located on the middle reach of Athi River about 1 km downstream of the confluence of two rivers; Kikuu/Kiboko and Athi. The site was proposed for a source reservoir of Kibwezi Extension irrigation scheme (Ref.H.29).

Regulated flow of about 12 cms from the reservoir can only be sufficient to irrigate 13,200 ha of crop fields, out of the total irrigation area of 30,000 ha in the Kibwezi Extension irrigation scheme. The reservoir has 380 mcm of gross storage capacity at a maximum development scale (52 m high dam).

(6) Rare Dam

The site is located on Rare River which is a seasonal river with a catchment area of 6,246 km2. The dam is planned as an off-stream reservoir to store water taken from the Galana-Sabaki River by an intake weir to be built downstream Sala village and conveyed through an open canal during the rainy season. The reservoir also collect water drained from its upstream area (Ref.H.33).

This off-stream reservoir is planned for supplying water of 32,800 cmd (0.38 cms) to Malindi towards the year 2010. About 37 mcm of gross storage reservoir and a dam of 21 m high are planned.

(7) Mwachi Dam

The site is located on the Mwachi River. The dam was proposed for water supply to Mombasa (Ref.H.33). According to the previous study the scheme was recommended as a potential source subject to further investigation of hydrological features at the site to estimate the reservoir yield. At present, however, no additional data have been available. In this Study the dam was planned based on the limited data. A 77 m high dam with 113 mcm of gross storage capacity is planned for supplying 205,000 m3 (2.37 cms) of water to Mombasa towards the year 2010.

(8) Pemba Dam (Intake weir)

The site is located on the Pemba River at a gorge near Maluganji Forest. A run-of-river type intake weir is considered for supplying water of 19,900 cmd (0.23 cms) to Mombasa and south coastal area towards the year 2010. The intake weir is to be provided with a sediment wash-out gate near intake channel, considering the huge amount of sediment production from the drainage area. Actually, an existing intake weir located about 8 km upstream of the proposed Pemba dam suffers from heavy sedimentation in the pond.

4.1.4 Tana River drainage area

(1) Chania B Dam

The site is located on the mid-stretch of Chania River. The site was identified as one of potential sites in the Chania and Thika river basins (Ref.H.30).

The reservoir is tentatively proposed in the Study as the water source for domestic/industrial water supply to Nairobi and small scale irrigation schemes. Water of 65,700 mcm (0.76 cms) is for domestic and industrial purpose and 15,600 cmd (0.18 cms) for irrigation towards the year 2010. A 100 m high dam with 51 mcm of gross storage reservoir is required for the purposes. It is noted that the scheme is subjected to further examination in subsequent detail studies on project basis.

(2) Thiba Dam

The dam is located on the Thiba River about 1 km upstream of the waterlevel gaging station 4DA11. The dam and reservoir are planned for water source of Mwea Extension irrigation scheme (Ref.H.35). Feasibility study of the dam was completed in 1988. The dam features proposed in the feasibility study are adopted for the Study, wherein a 33 m high dam and 17.4 mcm of gross storage reservoir are designed for the irrigation development purpose.

(3) Mutonga Dam

The damsite is located on the main stream of the Tana River about 1 km downstream of the confluence of Mutonga and Tana rivers. The dam is proposed for hydropower generation together with Low Grand Falls dam scheme in the updated national power development plan. A 42 m high dam and 286 mcm of gross storage capacity are planned for generating 60 MW of power (Ref.H.2).

(4) Low Grand Falls Dam

The dam is situated on the Tana River about 3 km downstream of the confluence of Tana and Kathita rivers. This scheme is proposed for hydropower generation of 120 MW installed capacity. A 79 m high dam with 742 mcm of gross storage capacity is planned.

An alternative plan is High Grand Falls dam, which would be mutually exclusive with the development of Low Grand Falls and Mutonga dams. The High Grand Falls dam will be discussed in Chapter H5.

4.1.5 Ewaso N'giro North River drainage area

Two damsites, Rumuruti and Nyahururu, were identified in the upstream reaches in the Ewaso Narok river basin for water supply to urban centres in the neighbouring area. According to the results of water balance study, it was found that the inflows into these reservoirs might not be sufficient to attain their effective developments. However, in a context that hydrological features used in the water balance study were based on limited data, the Study presumed that the findings in the previous studies represent the attractiveness of schemes more accurately and hence retained these schemes for further study. Another reason is that there are no other competitive schemes in this region.

(1) Rumuruti Dam

The dam was proposed in a previous study (Ref.H.41). The site is located on the Ewaso Narok North River about 10 km downstream of Nyahururu town and about 25 km upstream of Rumuruti town. In this Study, the scheme was planned for supplying 2,600 cmd (0.03 cms) of water to Rumuruti town to meet the demand towards year 2010. A 16 m high dam with a 3 mcm of gross storage capacity is planned.

(2) Nyahururu Dam

The site is situated on the Nyahururu River, which is a tributary of the Ewaso Narok North River, about 5 km upstream of Nyahururu town. The scheme was tentatively proposed in the Study for supplying 22,500 cmd (0.26 cms) of water to the Nyahururu town for meeting the demand towards year 2010. A 20 m high dam with 10 mcm of gross storage capacity was planned.

4.2 Cost Estimates for Prospective Dam Schemes

Construction cost of the prospective dams was estimated based on the estimated dam construction cost curve prepared in this Study as shown in Figure H4.25. The cost curve was based on cost information made available from various studies and designs of major dam projects (about 40 dam schemes). The cost was adjusted to the price level of February 1992 after incorporating the price escalation.

The cost consists of direct construction costs (dam embankment, spillway, intake facilities, diversion works and preparatory works), indirect construction costs (land acquisition/ compensation, administration and engineering service) and physical contingency.

The estimated construction cost of each dam as well as water cost are tabulated in the Table H4.2. In the table, the estimated construction cost of Magwagwa, Malewa, Oldorko, Thiba, Mutonga and Low Grand Falls dams are based on the cost estimated in the previous design studies (Refs. H.5, H.11, H.24 and H.35). The prices were adjusted to 1992 price.

H5 FUTURE DAM DEVELOPMENT POTENTIAL

Chapter H4 selected 28 dam schemes as candidate schemes to be implemented towards year 2010. On top of those, there are a number of schemes worthy of further consideration as alternatives to the selected schemes and/or schemes to be added in development programme when new demands arise or if the economic viability is justified in further studies. This Chapter describes the schemes requiring further investigations in this regard. Table H5.1 lists those potential schemes.

5.1 Multipurpose Dams

Some of dam schemes listed in Table H5.1 have the potential of multipurpose development, out of which eight major dams, i.e., Nyando and Nandi Forest dams in the Lake Victoria drainage area, Kimwarer and Sererwa dams in the Rift Valley drainage area, Munyu dam in the Athi river basin, High Grand Falls, Adamson's Falls and Kora dams in the Tana river basin are briefly discussed hereunder.

(1) Nyando Dam

This site is located on the Nyando River about 5 km upstream of Muhoroni. The dam scheme was proposed in the previous studies (Refs. H.5 and H.9) for the purposes of domestic and industrial water supply, irrigation and flood control, and also as a dam for Greater Rift Water Transfer Plan by NWCPC.

An investigation of the scheme of Muhoroni Reservoir on the Nyando River and Water Supply to Timboroa was carried out in 1990 and the report was completed in July 1991 by NWCPC (Ref. H.12). This scheme was studied primarily for water supply purpose for the Greater Nakuru through Timboroa. According to the report, it was concluded as follows:

(a) The suitable scale of development is to build a 85 m high dam (3.6 million m3 of dam embankment volume) which creates a reservoir having a gross storage capacity of 250 mcm.

(b) The water transfer pipeline is of 63 km long, with a gross lift of 1,537 m. To pump up 5 m3/s, about 114 MW of power is necessary.

(c) The construction of water transfer system appears to be very difficult because of mountainous topography in the area, a large quantity of pumping water and a high head.

(d) More investigation is required in further study, particularly to determine an optimum water quantity to be pumped up.

As concluded in the report, a further detailed study on the Nyando multipurpose dam scheme is required, focussing on:

(a) determination of the adequite quantity of water to be pumped,

(b) provision of cheap power source and reduction of power capacity required for water pumping, presently designed 144 MW is nearly equal to the output capacity of Magwagwa hydropower scheme (120 MW). A great investment is required for the provision of power source,

(c) study on the other development potentials such as irrigation and flood control purpose.

In case the water transfer scheme (above items (a) and (b)) is not feasible, the dam should be evaluated as multipurpose reservoir for flood control, irrigation and water supply to downstream areas.

(2) Nandi Forest Dam

This potential site is located within the Nandi Forest just downstream of the confluence of two major tributaries of the Yala River; Kimondi and Sirua rivers. The dam is planned for multi-objectives; hydropower generation of 45 MW utilizing about 500 m head via a 15 km tunnel from the reservoir (183 mcm in storage capacity) to the Nyando river basin, irrigation of 15,000 ha of mainly sugarcane in the Kano Plain and water supply to Kisumu (Ref.H.5).

For further study on this dam scheme, the following are noted:

(a) In principal, the priority of water use should be given to meeting the water demand in the downstream areas. Preliminary water balance calculation in this Study presumed that maximum transferrable water may be 11 m^3/s in terms of average reservoir yield.

(b) This dam will cause loss of valuable and irreplaceable indigenous forest (refer to Sectoral Report N). This aspect should be assessed in more detail.

(3) Kimwarer Dam

The site is located on the Kimwarer River which is a tributary of the Kerio River and situated in the upper part of the Kerio Valley. The preliminary design of the dam was made for the purposes of hydropower generation, rural water supply and small scale irrigation schemes near the damsite by KVDA (Ref.H.23).

A rockfill dam of 40 m high with 21.3 mcm of gross storage capacity was proposed for the above purposes. KVDA intends to proceed with a further study on this dam for multipurpose development.

(4) Sererwa Dam

The site is located on the Arror River. Feasibility study of the dam for hydropower generation, Arror irrigation scheme and rural water supply was completed in 1990 (Ref.H.25). A 97 m high dam with 58 mcm of live storage capacity is planned for 70 MW of power generation and 1,340 ha of irrigable area through pipelines from tailwaters of the power station.

This dam scheme was not selected in the updated national power development plan for 1991 to 2010, but it seems to be the most promising project forthcoming next to the selected four schemes (see (2) of sub-section 3.4.2) in the future hydropower development programme.

(5) Munyu Dam

This site is located on the main stream of the Athi River about 2 km downstream of the confluence of Athi and Ndarugu rivers. The site has 5,590 km2 of catchment area which covers all the upper drainage area of the Athi river basin including Nairobi city area.

This dam has been formulated for multipurpose development comprising water supply to Nairobi and environs, hydropower generation and Kanzalu irrigation scheme (Ref.H.29). Munyu dam and Ndarugu dam on the Ndarugu River are mutually exclusive and the selection between them is one of the most important decisions to be taken in the development of the Athi river basin.

In this Study, Ndarugu dam was selected for the above development purposes, and Munyu dam was considered as an alternative to Ndarugu dam, because of some advantages of Ndarugu dam as follows:

(a) higher water quality of the Ndarugu River; i.e., lower water purification requirement, while Munyu dam receives effluents from Nairobi area,

(b) larger number of resettlement and land acquisition due to submergence by the reservoir of Munyu dam, and

(c) lower construction cost of Ndarugu dam: it was assessed that the construction cost of Munyu dam would be more expensive by about 35 % than that of Ndarugu dam to store an active storage of 190 mcm for water supply to Nairobi areas and to Kanzalu irrigation scheme.

(6) High Grand Falls Dam

As mentioned in the subsection 4.1.4, this site is mutually exclusive with the developments of Low Grand Falls and Mutonga dam. The dam was proposed

chiefly for hydropower generation of 177 MW by a 117 m high dam with 22 mcm of dam embankment volume and 5,325 mcm of gross reservoir storage capacity (Ref.H.2).

As this dam scheme was excluded by the updated national power development plan towards year 2010, it was not selected as a prospective hydropower dam for the Study. It is, however, recommended that a further detailed study on High Grand Falls dam scheme be taken up to examine the merit of multipurpose development aiming irrigation schemes, flood control, augmentation of river flow, stability of river course and so on in the downstream area of the Tana river basin.

(7) Adamson's Falls and Kora Dams

These damsites are located on the main stream of the Tana River, downstream of Low/Grand Falls damsite. Adamson's Falls dam is planned as a dam of 50 m high having 1,009 mcm of gross storage capacity for installed generation capacity of 80 MW, while Kora dam is of 55 m high with 1,172 mcm of gross storage capacity for power generation of 92 MW (Ref.H.2). These dams are also potential schemes to be noted in a long-term development in the lower basin of the Tana River.

5.2 Water Supply Damsites

There are a number of damsites for water supply purpose still needing further investigation and study. They will be alternatives to or additional to the schemes selected in Chapter H4.

Kibolo Damsite
Objective: Alternative to Moiben dam
Service area: Eldoret town and environs
Location: on the Sosiani River

Timbilil Damsite
Objective: Alternative to intake weir on the Timbilil River
Service area: Kericho town and environs
Location: Timbilil River

Sisei Damsite
Objective: Alternative to intake weir on the Sisei River
Service area: Sotik town and environs
Location: Sisei River

Katieno Damsite
Objective: Alternative to Bunyunyu damsite
Service area: Kisii town and environs
Location: Kuja River

Amala Damsite

Objective: Water supply to Sigor-Longisa area (also examined in this Study as a tentative alternative to Itare damsite)

Service area: Sigor-Longisa area (or alternatively Nakuru, urban centers and environs)

Location: Amala River

Kipsang Damsite

Objective: Domestic water supply in subbasin 2CB area as alternative to water sources proposed in the Study (grandwater etc.)

Service area: Rural demand centres in the neighbouring area

Location: Kipsang River

Arror Damsite

Objective: Domestic water supply in subbasin 2CC area, either as a part of multipurpose development or a single purpose scheme, as alternative to water sources proposed in the Study (grandwater, etc.)

Service area: Rural demand centres

Location: Sererwa River

Waseges Damsite

Objective: Domestic water supply in subbasin 2EB area, as alternative to water source proposed in the Study (grandwater etc.)

Service area: Rural demand centers in the neighbouring area

Location: Waseges River

Kamukuny Damsite

Objective: Domestic water supply in subbasin 2CC area as alternative to water sources proposed by the Study (grandwater etc.). Subsurface dam at the site is also conceived.

Service area: Rural demand centres in the neighbouring area

Location: Kerio River

Aram Damsite

Objective: Alternative to Chemususu/Chemeron damsites

Service area: Marigat town and environs

Location: Perkerra River

Ratat Damsite

Objective: Alternative to Chemususu/Chemeron damsites

Service area: Marigat town and environs

Location: Perkerra River

Mbuuni Damsite

Objective: Alternative to intake weir on the Athi River proposed in the Study. Also subsurface dam at the site is conceivable. (NB: Another

alternative site is on the Ikiwe River near Machakos town. However, this site was discarded since the river water is highly contaminated by sewerage and industrial waste from the town area.

Service area: Machakos town and environs
Location: Thwake River

Kiteta Damsite
Objective: Domestic water supply in subbasin 3EB area as alternative to water sources proposed in the Study (grandwater etc.)
Service area: Rural demand centres in the area
Location: Ngaa River, a tributary of Thwake River

Thwake Damsite
Objective: Alternative to Yatta damsite
Service area: Yatta irrigation scheme area and rural demand centres around damsite
Location: Thwake River

Tsavo Damsite
Objective: Flow augmentation in the downstream reaches dependent on the abstraction of Mzima spring water
Service area: Supply of water to Baricho intake
Location: Tsavo River

Baricho Damsite
Objective: Alternative to Sabaki intake weir/Rare dam
Service area: Malindi, Mombasa and environs
Location: Sabaki River

Maragua 8 Damsite
Objective: Alternative to water sources proposed in the Study (surface water etc.)
Service area: Maragua /other towns and environs
Location: Maragua River

Ndiara Damsite
Objective: Alternative to water sources proposed in the Study (surface water etc.)
Service area: Rural demand centres around damsite
Location: Ndiara River

Nundoto Damsite
Objective: Addition to existing intake weir (increase of proposed storage capacity)
Service area: Mararal and environs
Location: Nundoto River

In Kitui district, there are plans for three (3) potential damsites around Kitui town for water supply to Kitui town and environs (proposed by MOWD). These are

Mutui, Kitimui and Umaa sites. Mutui and Kitimui were planned at a master plan level, while Umaa scheme is under investigation at prefeasibility study level but no detailed information available. In this Study these are considered to belong to a group of small dams for water supply development in the area (Ref.H.40).

In the Ewaso N'giro North River drainage area, some potential damsites including small damsites and pans which are proposed by MOWD are conceived for water supply to towns and environs situated near the sites as listed in the Table H5.1.

5.3 Flow Augmentation by Dam

Water use in upstream areas tends to reduce the water yields in the downstream area. A primary measure to avoid this adverse effect is to exercise water use management in the upstream area. Nevertheless, there will still be a great concern arising from water shortage in the downstream area. More positively, the development in the downstream area could be achieved with augmentation of river flows in the area. This is particularly important with rivers in relatively dry area, where, however, the development need and/or potential are foreseen.

The following damsites are envisaged for future development of flow augmentation by dams in view of their large undeveloped downstream areas for irrigation and water supply.

(a) Kerio River: Kamukuny damsite for the downstream development potential of the Kerio river basin. The site is located on the main stream of the Kerio River, the river turns to seasonal river during dry season. The site is also conceived as a subsurface damsite.

(b) Athi River: Yatta damsite for the downstream development potential of irrigation in the middle and lower basin of the Athi River and water supply to the coast area.

(c) Ewaso N'giro North River: Kihoto damsite and Achers Post damsite for downstream development potential of irrigation, water supply and hydropower in the middle (including Isiolo) and lower basin of the Ewaso N'giro North River.

5.4 Large Scale Water Transfer Plan with Dam

In the country, more than two-thirds of the total land area is arid and semi-arid where effective and efficient agricultural irrigation is at present not possible in view of unavailability of local water. If some inter-basin water transfer is planned between basins where adequate water is available and where insufficient is experienced, some possibilities of development of irrigation as well as domestic and livestock water supply and hydropower generation will come out.

In this Section, several damsites for inter-basin water transfer scheme are introduced based on plans proposed in the previous studies.

(1) Greater Rift Water Transfer Plans

This is a plan envisaged by NWCPC. The plan has examined three (3) damsites identified on the map of 1:50,000 scale, but no detailed information and study reports are available except for Nyando dam scheme.

(a) Hemsted Bridge Dam Scheme: water transfer from Nzoia River to Kerio Valley.

(b) Kimondi Dam Scheme: water transfer from Kimondi River to Kerio Valley.

(c) Nyando Dam Scheme: water transfer from Nyando River to Greater Nakuru through Timboroa .

(2) Nzoia-Suam and Nzoia-Kerio Water Transfers (Ref.H.26)

This is a double water transfer plan; (i) from the Nzoia River to the Suam river basin and (ii) from the Nzoia River to the Kerio River for multipurpose development. The proposed damsite is Moi's Bridge Dam which is located on the Nzoia River just downstream of the confluence of the Koitobos River with the Nzoia River. According to a preliminary report on this double water transfer project, the following are concluded:

(a) Through a tunnel of 17 km long to the Suam river basin and a tunnel of 42.5 km long to the Kerio River, total power of 500-760 MW will be generated and more than 140,000 ha of irrigation development will be expected both in the Suam and Kerio basins.

(b) The project consists of four stages adopting their construction to the growth of electric demand.

(c) Before adopting a decision on this project the following are recommended:

- to study the project at a preliminary design level with hydrological and geological investigation.

- to complete the energy and irrigation development studies at the feasibility level for this multipurpose project.

- to clarify the amount of water that can be transferred to both the Suam and Kerio rivers without any future detriment of the Nzoia basin, the source of the water.

  In this Study, approximately 15 cms of water was estimated to be transferrable to the basins at a maximum development scale of the dam.

Therefore, the scheme is regarded as technically viable (hydrological aspect). The economic viability is to be examined in future studies.

(3) Water transfer from Amala River to Ewaso N'giro North River

This plan is still at a preliminary idea stage. The plan envisages to build a dam on the Amala River (Amala dam) for supplying water to Oldorko dam reservoir through Ewaso N'giro River. No detailed information is available.

The scheme will cause reduction in Mara River and hence give a great impact on the ecology of wildlife in the two world-wide famous parks (Masai Mara and Serengeti) situated in the downstream part of the Mara river basin. The planning should take this into account.

(4) Water transfer from Tana River to Ewaso N'giro North River Basin

This is an idea of inter-basin water transfer from an intake weir on the Tana River at Mbalambala to the lower basin of the Ewaso N'giro North River through a tunnel of about 50 to 70 km for the development in the lower Ewaso N'giro North river basin. This water transfer will reduce future development potential in the lower basin of the Tana River. This aspect should be examined further.

Besides the above mentioned inter-basin water transfer plans, there are also some plans, identified in previous studies which involve transfer of water from Lake Victoria basin to Rift Valley basin. They are summarized in Appendix H.10.

All the plans listed above are huge projects requiring extensive investment. In the present Study, these were not included in the list of implementation project towards year 2010. The first approach to these plans would be to look into more detail the technical and economic viabilities. The Study presumes that, among the plans, the Nzoia-Suam/Kerio Double Water Transfer Plan may be accorded a priority for further study.

H6. RECOMMENDATION

This Study dealt with the dam development plans to clarify, the following aspects:

- Preparation of an inventory list of dams in the country, both large and small dams, covering existing dams (under operation), ongoing dams (under construction and in detailed design stage) and dams under planning (feasibility, prefeasibility and master plan stages).

- Identification of newly potential damsites through studies on the maps of 1:50,000 scale.

- Screening and evaluation of prospective dam schemes for development by the year 2010.

- Listing of alternative potential damsites for future development.

For further study of dam development, the following are recommended:

(a) Updating of dam inventory list

- The Study had to collect information separately from several agencies for preparation of an inventory list of dams. It is recommended to accumulate the information at a central agency. MOWD would be in a position since its in charge of the administration of rivers and the associated facilities including dams. The inventory information shall cover all existing and committed dams and weirs.

- Inventory of schemes under planning and design should also be kept on a file and updated periodically by each development agency. This will facilitate in exchanging information among the agencies.

(b) Concept of multi-purpose dam development

- For future dam development, there will arise an increasing need for formulating the multiple purpose dam development schemes to effectively use the country's water resources. Inter-agencies coordination becomes more important.

(c) Further studies

- This report listed a number of schemes for future undertaking (Chapter H4) and consideration (Chapter H5). Positive investigation and study should be made for these schemes to determine the definite development programmes.

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Ref.No.	Title
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TABLES

Table H2.1 Principal Features of Existing and On-going Dams by Drainage Area

As of December 1991

Item No.	Name of Dam	River Basin	Sub -basin	River (damsite)	Catchment Area (km2)	Purpose	Related Agency/ Owner	Stage/ Const. Year	Dam Type	Gross Storage (mcm)	Dam Height (m)	Remarks
I. Lake Victoria Drainage Area												
1	*Moiben**	*Moiben*	1BA	*Moiben*	188	W	NWCPC	D/D	Rockfill	-	-	W/S to Eldoret town/environs
2	Twin Rivers	Kipkarren	1CB	Sosiani	305	W	MOWD	1962	Gravity	-	-	W/S to Eldoret town/environs
3	Ellegirini	Kipkarren	1CB	Ellegirini	63	W	MOWD	1989	Earth	2	24	W/S to Eldoret town/environs
4	Kipkarren	Kipkarren	1CC	Olare Onyonkie	59	W	NWCPC	U/C	Earth	3	22	to be completed in 1991
5	Lessos	Yala	1FD	Cheptelach	6	W	MOWD	U/C	Earth	1	25	to be completed in 1993
6	Gogo Falls	Kuja	1KB	Kuja	3,022	P	KPC	1958	Gravity	-	25	Station power 2 MW
7	Sondu/Miriu*	Sondu	1JG	Sondu	3,360	P,I	KPC/LBDA	D/D	Gravity	-	Weir	Installation capacity 106 MW
II. Rift Valley Drainage Area												
8	Turkwel	Turkwel	2BC	Turkwel	5,900	P,I	MOE/KVDA	1991	Arch	1,650	155	Installation capacity 106 MW
9	Chemususu*	Perkerra	2ED	Perkerra	81	W,I	NWCPC	D/D	Rockfill	11	45	W/S to Nakuru town
10	Chemeron	Perkerra	2EH	Nasagun	63	W,I	MOWD	1984	Earth	5	31	W/S to Central Baringo/Marigat town
11	Kirandich*	Perkerra	2EH	Kirandich	28	W,I	NWCPC	D/D	Rockfill	5	49	W/S to Kabarnet town
12	Turasha+	Malewa	2GC	Turasha	711	W	NWCPC	U/C	Gravity	-	17	W/S to Nakuru town
III. Athi River Drainage Area												
13	Kiserian+	Athi	3AA	Kiserian	49	W	NWCPC	U/C	Rockfill	3	21	W/S to Kajiado town/environs
14	Ruaka(Kiambaa)*	Ruaka	3BA	Ruaka	100	W	MOWD/NWCPC	D/D	Earth	-	16	W/S to Kiambu town/environs
15	Ruiru	Ruiru	3BC	Ruiru	131	W	NCC	1950	Gravity	3	18	W/S to Nairobi town/environs
16	Bathi	Ruiru	3BC	Bathi	15	W	MOWD	1980	Rockfill	1	22	W/S to adjacent communities
17	Mulima	Thwake	3EA	Mulima	-	W	MOWD	1982	Earth	1	17	W/S to adjacent communities
18	Manooni	Athi	3EB	Manooni	-	W	MOWD	1987	Earth	1	17	W/S to adjacent communities
19	Muoni	Thwake	3EB	Muoni	20	W	MOWD	1987	Earth	1	22	W/S to adjacent communities
20	Kikoneni	*Ramisi*	*3K*	*Mkanda*	*72*	W	*MOWD*	*1981*	*Earth*	*1*	17	*W/S to adjacent communities*
IV. Tana River Drainage Area												
21	Sasumua	Tana	4CA	Chania	65	W	NCC	1956	Earth	16	45	W/S to Nairobi city
22	Thika+	Tana	4CB	Thika	71	W	NCC	U/C	Earth w/core	70	65	Construction started in Sept. 1990
23	Masinga	Tana	4DE	Tana	7,335	P	TARDA	1981	Rockfill	1,560	70	Station power 40 MW
24	Kamburu	Tana	4ED	Tana	9,520	P	TRDC	1975	Rockfill (*1)	150	56	Station power 94.4 MW
25	*Gitaru*	*Tana*	4ED	*Tana*	9,525	P	TRDC	1978	Rockfill	20	30	Station power 147 MW
26	Kindaruma	Tana	4ED	Tana	9,807	P	TRDC	1968	Rockfill (*1)	16	24	Station power 44 MW
27	Kiambere	Tana	4ED	Tana	11,975	P	TARDA	1988	Rockfill	585	112	Station power 144 MW
V. Ewaso Ngiro North River Drainage Area												
	None											No existing and on-going dam schemes

Source: MOWD, NWCPC, MOE, TARDA, NCC, Ref.Nos.

Notes : Abbrebiations: W (domestic/industrial water supply), I (irrigation), P (hydr U/C (under-construction), D/D (detailed design)
TARDA is a related agency for all dam schemes proposed in or within the Athi and Tana River drainage areas.
(*1) Rockfill dam with asphalt facing.
On-going dam : Committed project either under construction(+) or at detailed design stage (*).

FILE NAME : 3-WR-3

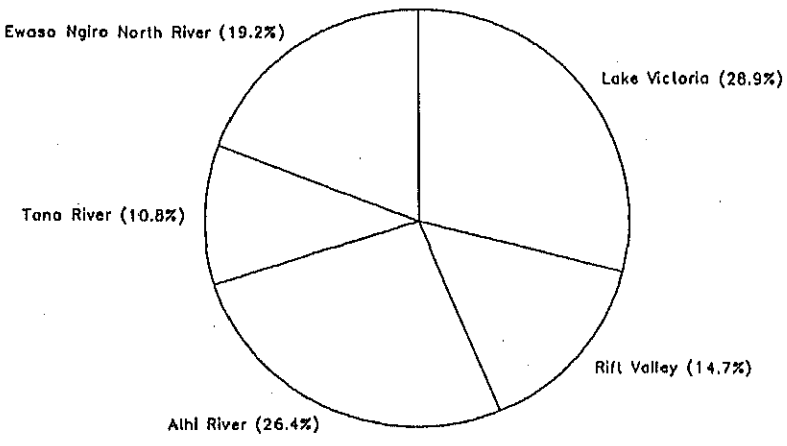
Table H2.2 Number of Existing Small Dams by Basin

Basin	Small Dams		Total
	Dam	Pan	
Lake Victoria Drainage Area			
1A	3	25	28
1B	28	190	218
1C	17	82	99
1D	5	11	16
1E	1	2	3
1F	22	32	54
1G	4	27	31
1H	2	69	71
1J	16	96	112
1K	4	96	100
1L	9	28	37
Rift Valley Drainage Area			
2A	0	0	0
2B	0	21	21
2C	0	12	12
2D	3	19	22
2E	20	118	138
2F	3	47	50
2G	18	87	105
2H	0	18	18
2J	0	0	0
2K	1	25	26
Athi River Drainage Area			
3A	4	100	104
3B	9	75	84
3C	2	14	16
3D	4	76	80
3E	7	253	260
3F	10	90	100
3G	0	4	4
3H	1	0	1
3J	0	0	0
3K	0	0	0
3L	3	9	12
3M	14	24	38
3N	0	4	4
Tana River Drainage Area			
4A	10	25	35
4B	5	25	30
4C	7	42	49
4D	1	10	11
4E	3	26	29
4F	1	5	6
4G	2	44	46
4H	6	74	80
4J	0	0	0
4K	0	0	0
Ewaso Ngiro North River Drainage Area			
5A	28	142	170
5B	34	150	184
5C	20	43	63
5D	79	12	91
5E	0	1	1
5F	0	1	1
5G	0	0	0
5H	0	0	0
5J	0	0	0
			2,660

Source : Topo-Maps Survey of Kenya

Number of Small Dams

Source : Topo-Maps (1: 50,000)



FILE NAME : 2INTERBS

Table H2.3 Inter-Basin Water Transfer Plan with Dam Proposed by Previous Study

Drainage Area	No.	Inter-Basin Water Transfer Plan	Inter-Basin Water Transfer: from	(Sub-Basin)	to	(Sub-Basin)	Purpose	Stage	Remarks
I. Lake Victoria	1	Hemsted's Bridge dam scheme	Nzoia river	1BD	Kerio Valley	2CB	Power/Irri.	M/P	water conveyance tunnel applox.60 km
	2	Mushagumbo dam scheme	Yala river	1FE	Kano Plain	1HA	Irrigation	M/P	
	3	Nandi Forest dam scheme	Yala river	1FD	Kano Plain	1HA	Irrigation	M/P	headrace tunnel 15.2 km, dia.2.5 m
	4	Londiani dam scheme	Nyando river	1GC	Nakuru Town	2FC	Water supply	M/P	
	5	Sondu/Magwagwa dam scheme	Sondu river	1JG	Kano Plain	1GF	Irrigation	F/S	headrace tunnels 7.2 km/4.4 km
	6	Namba Kodero dam scheme	Kuja river (Gogo Falls dam)	1KB	Namba Kodero reservoir	1KC	Power	M/P	open channel 15 km, 4 m wide, headrace tunnel 1.6 km
	7	Moi's Bridge dam scheme	Nzoia river	1BE	Suam/Turkwel	2CC	Power,Irri.	M/P	tunnel 17 km
			Nzoia river	1BE	Kerio Valley	2CB	Water transfer		tunnel 42.5 km
	8	Moiben dam scheme /1	Moiben river	1BA	Eldoret town	1CB	Water supply	D/D	pipeline applox. 40 km
	9	Moiben dam scheme /2	Nzoia river	1BB	Eldoret town/Kerio Valley	2CB	W/S,Power,Irri.	M/P	tunnel 18 km, penstock 4 km
	10	Nyando dam scheme	Nyando river	1GC	Timboroa town/Nakuru town	1GC/2FC	Water supply	Pre-F/S	pipelines about 100 km
	11	Itare dam scheme	Itare river	1LA	Nakuru town/Marigat town	2FC/2EE	Water supply		pipelines 175 km
	12	Amala-Narok diversion	Amala river	1LB1	Ewaso Ngiro North river	2KA	Water transfer	M/P	for Oldorko dam/reservoir
II. Rift Valley	13	Malewa/Trasha dam scheme	Malewa river	2GB/2GC	Turasha dam reservoir	2GC	Water supply	F/S	pipelines 13.6 km(D1000),5.2 km(D900)
					Nakuru/Gilgil/Naivasha towns	2FC/2FA/2GD	Water supply		
	14	Turasha dam scheme	Turasha river	2GC	Nakuru/Gilgil towns	2FC/2FA	Water supply	U/C	pipelines 48.8 km to Nakuru town
	15	Chemususu dam scheme	Chemususu river	2ED	Nakuru town/environs	2FC	Water supply	D/D	pipelines (300 km long) already installed
III. Athi River	16	Baricho dam scheme	Sabaki river	3HB/3HD-1	Mombasa/environs	3MC/3MD	Water supply	M/P	-
	17 *	Sabaki weir/pipeline	Sabaki river	3HD-1	Mombasa/environs	3MC/3MD	Water supply	U/O	pipelines 256 km
	18 *	Mzima pipeline	Mzima spring	3G	Mombasa/environs	3MC/3MD	Water supply	U/O	pipelines 219 km
	19 *	2nd Mzima pipeline	Mzima spring	3G	Mombasa/environs	3MC/3MD	Water supply	F/S	pipelines 219 km
	20 *	Nol Turesh pipelines	Oloitokitok springs	3G	Machakos,Athi River & Kajiado towns/environs	3EA/3EC /3AB/3AC	Water supply	U/O	pipelines 250 km in total
	21 *	Marere pipeline	Marere spring	3MC	Mombasa/Changamwe	3MD1	Water supply	U/O	pipelines 41 km (D300-D250)
IV. Tana River	22 *	Yatta furrow	Thika river	4CC	Mwita Syano/Tiva rivers	4CC	Water transfer	U/O	open channel 55 km
	23	Thika dam scheme	Thika river	4CB	Nairobi/environs	3BA	Water supply	U/C	transmission tunnel 5km, pipelines 20 km
	24	Ndarugu dam scheme (Chania - Komu transfer)	Chania river	4CA/4CC	Ndarugu reservoir	3CB	Water transfer	M/P	tunnel 1.7 km
v. Ewaso Ngiro North River		-	-	-	-	-	-	-	no plan

Source: NWCPC, MOWD, LBDA, KVDA, MOE

Notes: Plans with asterisk have no dam schemes. M/P=Master Plan, F/S=Feasibility Study, D/D (Detailed Design), U/C (Under Construction), U/O (Under Operation)

/1- Scheme by NWCPC

/2- Plan by KVDA, Ref.H.16.

FILE NAME : 5-DAM1

Table H3.1 Summary of Preliminary Screenings (1/5)

I. Lake Victoria Drainage Area

No.	Damsite	Sub-Basin (Dam-site)	Scheme Stage	First Screening: Catchment Area (Dam-site) A1 (km2)	First Screening: Dam Embankment Volume (1000m3)	First Screening: Storage Efficiency (SE)	First Screening: Results	Second Screening: (Yield)/(Dam Embankment Volume) x 1000 (RY)	Second Screening: Results	Third Screening: Water Supply Area	Results of Screenings	Remarks
1	* Kipnai	1BA	-	76	5,588	11		-		-	-	
2	* Chebara	1BA	-	190	568	24	to 2nd Screening	2,931	to 3rd Screening	-	-	
3	Moiben	1BA	(D/D)	188	501	47	to 2nd Screening	290	to 3rd Screening	1CB	selected	
4	* Chebiemit	1BA	-	229	2,975	14		-		-	-	
5	* Makutano	1BA	-	48	1,188	13		-		-	-	
6	* Chebororwa	1BB	-	814	1,010	11		-		-	-	
7	Lower Moiben	1BB	M/P	644	1,658	32	to 2nd Screening	250	to 3rd Screening	-	-	
8	* Losorua	1BB	-	89	1,027	14		-		-	-	
9	* Kiptaberr	1BB	-	60	300	62	to 2nd Screening	292	to 3rd Screening	-	-	
10	* Kapcherop	1BB	-	75	325	39	to 2nd Screening	219		-	-	
11	* Maji Mazuri	1BB	-	1,343	547	5		-		-	-	
12	* Noigameget	1BC	-	546	129	240	to 2nd Screening	-		-	-	
13	* Longleat	1BC	-	191	339	136	to 2nd Screening	554	to 3rd Screening	-	-	
14	Hemsted's Brg.	1BD	Pre-F/S	3,825	5,853	33	to 2nd Screening	-		-	-	
15	Moi's Brg.	1BE	Pre-F/S	858	4,700	464	to 2nd Screening	343	to 3rd Screening	-	-	
16	* Naisabu	1BE	-	739	207	702	to 2nd Screening	2,696	to 3rd Screening	-	-	
17	Rongai	1BG	M/P	4,916	5,791	71	to 2nd Screening	-		-	-	
18	* Kaptama	1BH	-	99	1,227	4		-		-	-	
19	Sergoit (No.1)	1CA	M/P	659	3,557	11		-		-	-	
20	Sergoit (No.2)	1CA	M/P	390	82	(51)		-		-	-	
21	Endoroto	1CB	M/P	58	30	2		-		-	-	
22	* Kibolo	1CB	-	609	1,151	47	to 2nd Screening	250	to 3rd Screening	1CB	selected	
23	Kisongi (No.7)	1CC	M/P	119	172	10		-		-	-	
24	Kerita (No.8)	1CC	M/P	104	27	(1)		-		-	-	
25	* Nureri	1CC	-	493	653	8		-		-	-	
26	* Kormaet	1CD	-	807	105	184	to 2nd Screening	-		-	-	
27	Lugari	1DA	M/P	8,300	9,382	33	to 2nd Screening	-		-	-	
28	Webuye Falls	1DA	M/P	8,420	302	(744)	/1	-		-	-	
29	Teremi	1DB	F/S	138	530	6	/2	-		-	-	
30	* Mukulusi	1EA	-	341	80	354	to 2nd Screening	-		-	-	
31	* Shibei	1EB	-	142	235	39	to 2nd Screening	-		-	-	
32	* Indangalasia	1ED	-	644	77	(197)		-		-	-	
33	Rambula	1EE	M/P	11,849	2,507	65	to 2nd Screening	-		-	-	
34	Ukiru	1FA	M/P	45	1,761	9		-		-	-	
35	* Kositai	1FB	-	346	455	398	to 2nd Screening	2,168	to 3rd Screening	-	-	
36	* Kabongwa	1FC	-	63	79	386	to 2nd Screening	1,698		-	-	
37	Kimondi	1FC	-	692	4,406	176	to 2nd Screening	2,220	to 3rd Screening	-	-	
38	Nandi Forest	1FD	M/P	1,339	6,279	74	to 2nd Screening	431	to 3rd Screening	1HA	selected	
39	* Shikondi	1FE	-	1,693	1,025	119	to 2nd Screening	-		-	-	
40	Mushangumbo	1FE	M/P	1,987	1,852	114	to 2nd Screening	981	to 3rd Screening	-	-	
41	Gongo	1FG	M/P	2,351	6,631	25	to 2nd Screening	-		-	-	
42	* Uranga	1FG	-	2,385	9,087	24	to 2nd Screening	2,574	to 3rd Screening	-	-	
43	* Songhor	1GA	-	50	2,537	14		-		-	-	
44	* Old Sikh	1GA	-	141	772	9		-		-	-	
45	Tinderet F.	1GA	M/P	30	1,505	10		-		-	-	
46	Twin Brg.	1GB	M/P	584	20,623	22	to 2nd Screening	133	to 3rd Screening	-	-	
47	* Tugunon	1GC	-	606	3,424	23	to 2nd Screening	102		-	-	
48	* Kimasian	1GC	-	186	1,154	54	to 2nd Screening	178	to 3rd Screening	-	-	
49	* Kipkoyo	1GC	-	58	9,324	8		-		-	-	
50	Londiani	1GC	Pre-F/S	71	434	187	to 2nd Screening	119	to 3rd Screening	2FC/2EG1	selected	
51	Koru	1GC	M/P	784	4,412	9		-		-	-	

FILE NAME : 5-DAM1

Table H3.1 Summary of Preliminary Screenings (1/5)

I. Lake Victoria Drainage Area

No.	Damsite	Sub-Basin (Dam-site)	Scheme Stage	Catchment Area (Dam-site) A1 (km2)	First Screening: Dam Embankment Volume (1000m3)	First Screening: Storage Efficiency (SE)	First Screening: Results	Second Screening: (Yield)/(Dam Embankment Volume) x 1000 (RY)	Second Screening: Results	Third Screening: Water Supply Area	Results of Screenings	Remarks
52	Nyando	1GD	F/S	1,322	14,272	20	to 2nd Screening	96	to 3rd Screening	1GD/2ED	selected	
53	Awasi	1GD	M/P	1,509	8,956	18	to 2nd Screening	96		-	-	
54	* Fort Ternan	1GG	-	341	536	(4)		-		-	-	
55	* Hamilton	1GG	-	99	1,671	11		-		-	-	
56	* Nasibun	1GG	-	92	531	3		-		-	-	
57	* Siret	1GG	-	113	3,152	6		-		-	-	
58	Kibos	1HA	Pre-F/S	179	415	64	to 2nd Screening	83	to 3rd Screening	-	-	
59	Itare/Chemosit	1JA	Pre-F/S	553	9,700	28	to 2nd Screening	53	to 3rd Screening	-	-	
60	* Kolwa	1JA	-	522	302	71	to 2nd Screening	-		-	-	
61	* Chemelet	1JB	-	767	1,128	10		-		-	-	
62	* Chemosit	1JB	-	19	3,762	11		-		-	-	
63	Mau Forest	1JC	M/P	45	1,345	15	to 2nd Screening	151		1JC	selected	
64	Timbilil	1JC	Pre-F/S	33	1,100	13	to 2nd Screening	209	to 3rd Screening			
65	* Sambret	1JC	-	50	953	6		-		-	-	
66	* Cheymen	1JC	-	71	831	7		-		-	-	
67	* Masabet	1JC	-	138	1,242	13		-		-	-	
68	* Majengo	1JC	-	88	2,472	5		-		-	-	
69	Sisei	1JE	Pre-F/S	557	322	97	to 2nd Screening	-	to 3rd Screening	1JF	selected	
70	Yurith	1JD	M/P	1,358	1,036	2		-		-	-	
71	Orokiet	1JF	M/P	1,081	922	80	to 2nd Screening	-		-	-	
72	* Kapkoros	1JF	-	327	1,797	34	to 2nd Screening	214	to 3rd Screening	-	-	
73	* Satiet	1JF	-	234	3,909	10		-		-	-	
74	* Sotik	1JF	-	1,131	270	14		-		-	-	
75	Magwagwa	1JG	F/S	3,160	9,395	93	to 2nd Screening	667	to 3rd Screening	1GF	selected	
76	* Bunyunyu	1KB	-	120	221	59	to 2nd Screening	423	to 3rd Screening	1KA/1KB	selected	
77	* Macalder	1KB	-	3,080	541	(114)		-		-	-	
78	* Nyakorere	1KB	-	906	1,086	(2)		-		-	-	
79	* Mochengo	1KB	-	1,042	3,776	78	to 2nd Screening	-		-	-	
80	* Katieno	1KB	-	3,002	3,287	427	to 2nd Screening	1,721	to 3rd Screening	1KB	selected	
81	* Nyamagwa	1KB	-	457	1,615	0		-		-	-	
82	* Karapolo	1KB	-	6,032	3,890	34	to 2nd Screening					
83	Namba Kodero	1KC	M/P	2,769	1,578	171	to 2nd Screening	436	to 3rd Screening	1KC	selected	
84	Ol Ngobor	1KC	M/P	1,240	6,129	102	to 2nd Screening	238		1KC	selected	
85	Nyangores	1LA1	M/P	681	11	(262)		-		-	-	
86	Bomet	1LA1	M/P	678	90	16	to 2nd Screening	-		-	-	
87	Tenwek	1LA1	M/P	635	5,543	53	to 2nd Screening	325	to 3rd Screening	-	-	
88	* Merigit	1LA1	-	83	3,617	80	to 2nd Screening	364	to 3rd Screening	-	-	
89	Mara Bridge	1LA2	M/P	2,812	4,319	42	to 2nd Screening	-		-	-	
90	* Ngobor	1LA3	-	731	4,291	183	to 2nd Screening	732	to 3rd Screening	-	-	
91	* Kapkimolwa	1LB1	-	655	149	54	to 2nd Screening	-		-	-	
92	* Sitotwet	1LB1	-	473	2,402	18	to 2nd Screening	-		-	-	
93	Amala	1LB1	Pre-F/S	475	1,853	20	to 2nd Screening	-	to 3rd Screening	1LB1	selected	
94	* Regero	1LB2	-	5	1,558	46	to 2nd Screening	19	to 3rd Screening	-	-	

Source:MOWD,NWCPC,LBDA,KVDA,MOE

Notes : * Damsites newly identified in the Study.
/1 The damsite was recommended as a run-of-river type hydropower scheme in the previous study (Ref.H.5).
/2 The damsite was recommended as a run-of-river type hydropower scheme in the previous study (Ref.H.5).
SE index in the parenthesis above shows negative, i.e., active storage capacity is evaluated to be negative.
For water supply purposes, D=Domestic, I=Irrigation, P=Hydropower, F=Flood control

Table H3.1 Summary of Preliminary Screenings (2/5)

II. Rift Valley Drainage Area

No.	Damsite	River Basin Code (Dam-site)	Scheme Stage	Catch-ment Area (Dam-site) A1 (km2)	First Screening: Dam Embank-ment Volume (1000m3)	First Screening: Storage Effi-ciency (SE)	First Screening: Results	Second Screening: (Yield)/(Dam Embank-ment Volume) x 1000 (RY)	Second Screening: Results	Third Screening: Water Supply Area	Results of Screenings	Remarks
1	* Mbanga	2BA	-	109	4,741	26	to 2nd Screening	81	-	-	-	
2	Moruny	2BA	M/P	388	3,593	27	to 2nd Screening	107	-	-	-	
3	* Marun	2BA	-	564	17,087	43	/1	-	-	-	-	
4	* Kabichich	2BA	-	133	1,842	16	to 2nd Screening	143	to 3rd Screening	-	-	
5	* Ortum	2BA	-	*615*	*894*	*17*	to 2nd Screening	-	-	-	-	
6	Wei Wei	2BB	M/P	200	845	15	to 2nd Screening	183	to 3rd Screening	-	-	
7	* Kipsang	2CB	-	66	900	17	to 2nd Screening	57	to 3rd Screening	-	-	
8	* Tuyobet	2CB	-	674	1,016	15	to 2nd Screening	-	-	-	-	
9	* Kiptunol 1	2CB	-	64	2,883	21	to 2nd Screening	30	-	-	-	
10	* Kiptunol 2	2CB	-	59	1,469	12		-	-	-	-	
11	Kimwarer	2CB	F/S	160	4,425	29	to 2nd Screening	31	to 3rd Screening	-	-	
12	* Kapkalelwa	2CB	-	21	65	(0)		-	-	-	-	
13	Kerio A	2CB/2CC	M/P	2,442	1,328	222	/2	-	-	-	-	
14	* Arror	2CC	-	35	263	30	to 2nd Screening	181	to 3rd Screening	2CC	selected	
15	* Kapsowar	2CC	-	256	2,648	7		-	-	-	-	
16	Sererwa	2CC	F/S	185	8,952	16	to 2nd Screening	29	to 3rd Screening	2CC	selected	
17	* Lokori	2CC	-	6,507	576	31	to 2nd Screening	-	-	-	-	
18	* Embobut	2CC	-	18	3,131	11		-	-	-	-	
19	* Kamukuny	2CC	-	6,024	1,923	311	to 2nd Screening	1,001	to 3rd Screening	2CC	selected	
20	* Tirioko	2D	-	53	2,996	23	to 2nd Screening	31	to 3rd Screening	-	-	
21	Waseges 3	2EB	M/P	321	1,403	45	to 2nd Screening	51	-	-	-	
22	Waseges	2EB	M/P	433	846	16	to 2nd Screening	61	to 3rd Screening	2ED/2EB	selected	
23	* Siracho	2EB	-	473	3,207	9		-	-	-	-	
24	Waseges 4	2EB	M/P	361	7,485	14		-	-	-	-	
25	* Chepkungul	2ED	-	148	2,033	12		-	-	-	-	
26	* Sigoro	*2ED*	-	*419*	*5,965*	*6*		-	-	-	-	
27	* Sabor	2EE	-	81	3,220	10		-	-	-	-	
28	Aram	2EE	M/P	501	7,480	23	to 2nd Screening	72	to 3rd Screening	2EE	selected	
29	* Kibias	2EE	-	496	363	(8)		-	-	-	-	
30	* Marigat	2EE	-	1,352	85	(473)		-	-	-	-	
31	Ratat 2	2EE	M/P	1,001	878	(2)		-	-	-	-	
32	Ratat 1	2EE	M/P	1,068	1,697	37	to 2nd Screening	151	to 3rd Screening	2EE	selected	
33	Molo	2EG1	M/P	395	2,442	7		18	-	-	-	
34	*Mau Stream*	*2EG1*	*Pre-F/S*	*108*	*1,303*	*3*		*19*	to 3rd Screening	-	-	
35	* Lelen	2EG2	-	1,407	1,242	(11)		-	-	-	-	
36	* Kapsonget	2EG2	-	1,444	567	(56)		-	-	-	-	
37	Sitet	2EG2	M/P	1,365	223	(110)		-	-	-	-	
38	Mutaran	2EK	M/P	403	622	29	to 2nd Screening	88	to 3rd Screening	-	-	
39	* Marmanet F.	2EK	-	121	2,130	12		-	-	-	-	
40	* Enderit 1	2FC	-	136	2,078	12		-	-	-	-	
41	* *Enderit 2*	*2FC*	-	50	*1,142*	*22*	to 2nd Screening	*69*	to 3rd Screening	-	-	
42	* Gitanguin	2FC	-	30	7,821	15	to 2nd Screening	-	-	-	-	
43	Malewa	2GB	F/S	635	1,092	56	to 2nd Screening	174	to 3rd Screening	2FA/2FB/2FC	selected	
44	Upper Narok	2KA	Pre-F/S	516	4,306	21	to 2nd Screening	87	to 3rd Screening	2KA	selected	
45	* Lower Narok	2KA	-	633	1,456	25	to 2nd Screening	-	-	-	-	
46	* Olosoisho	2KA	-	329	585	39	to 2nd Screening	-	-	-	-	
47	Leshota	2KB	Pre-F/S	*5,119*	14,190	32	to 2nd Screening	140	to 3rd Screening	-	selected	
48	Oldorko	2KB	Pre-F/S	5,696	5,885	90	to 2nd Screening	368	to 3rd Screening	2KB/2KC	selected	

Source: MOWD, NWCPC, LBDA, KVDA, MOE

Notes : * Damsites newly identified in the Study.
SE index in the parenthesis above shows negative, i.e., active storage capacity is evaluated to be negative.
/1 Limestone dam foundation (refer to Sectoral Report (J)).
/2 Fault problem at the damsite (refer to Sectoral Report (J)).
M/P=Master Plan, Pre-F/S=Prefeasibility Study, F/S=feasibility Study

FILE NAME : 5-DAM3

Table H3.1 Summary of Preliminary Screenings (3/5)

III. Athi River Basin Drainage Area

No.	Damsite	Sub-Basin (Dam-site)	Scheme Stage	Catchment Area (Dam-site) A1 (km2)	First Screening: Dam Embankment Volume (1000m3)	First Screening: Storage Efficiency (SE)	First Screening: Results	Second Screening: (Yield)/(Dam Embankment Volume) x 1000 (RY)	Second Screening: Results	Third Screening: Water Supply Area	Results of Screenings	Remarks
1	Upper Athi	3AA	Pre-F/S	400	171	140	to 2nd Screening	927	to 3rd Screening	3AA	selected	
2 *	Kikuyu	3BA	-	81	250	80	to 2nd Screening	262	to 3rd Screening	3BA	selected	
3	Ruiru A	3BC	M/P	202	1,528	12		-		-	-	
4 *	Kiarie	3BD	-	55	443	23	to 2nd Screening	-		-	-	
5	Nyamangara	3CB	M/P	198	345	30	to 2nd Screening	-		-	-	
6	Ndarugu 1	3CB	M/P	360	1,635	166	to 2nd Screening	579	to 3rd Screening	3BA	selected	
7	Ndarugu 2	3CB	M/P	84	808	23	to 2nd Screening	-		-	-	
8	Munyu	3DA	Pre-F/S	5,590	2,960	192	to 2nd Screening	795	to 3rd Screening	3DA	selected	
9 *	Thwake 1	3DB	-	7,230	2,738	(7)		-		-	-	
10 *	Ikiwe	3EA	-	373	1,207	26	to 2nd Screening	44	to 3rd Screening	3EA	selected	
11 *	Maluva	3EA	-	883	781	(28)		-		-	-	
12 *	Mbuuni	3EA	-	398	235	(4)		-		-	-	
13	Kitata	3EB	F/S	72	438	34	to 2nd Screening	51	to 3rd Screening	3EB	selected	
14 *	Ngwani	3EB	-	1,178	296	(104)		-		-	-	
15	Thwake	3FA	M/P	10,276	8,765	57	to 2nd Screening	168	to 3rd Screening	3FA	selected	
16	Yatta	3FB	M/P	20,000	7,016	57	to 2nd Screening	253	to 3rd Screening	3FA/3FB	selected	
17 *	Yatta 1	3FA	-	10,918	2,006	12		-		-	-	
18	Tsavo	3G	F/S	4,050	274	113	to 2nd Screening	915	to 3rd Screening	3HA	selected	
19	Tsavo I	3G	M/P	5,514	1,023	(36)		-		-	-	
20	Baricho	3HD	M/P	34,240	3,333	245	to 2nd Screening	848	to 3rd Screening	3HD/3HB/3LB	selected	
21	Konjora	3LA	M/P	6,574	367	(833)		-		-	-	
22	Magononi	3LA	M/P	6,554	413	(771)		-		-	-	
23 *	Ndzobuni	3LA	-	604	1,904	30	to 2nd Screening	24	to 3rd Screening	-	-	
24	Rare	3LA	F/S	1,500	337	101	to 2nd Screening	103	to 3rd Screening	3LA/3HD	selected	
25	Mwachi	3MB	M/P	7,141	3,060	27	to 2nd Screening	111	to 3rd Screening	3MB/3MD	selected	
26 *	Kadingo	3MC	-	825	2,333	40	to 2nd Screening	8	to 3rd Screening	-	-	
27	Pemba	3MC	M/P	866	2,368	52	to 2nd Screening	8	to 3rd Screening	3MC	selected	

Source: MOWD, NWCPC, TARDA

Notes : * Damsites newly identified in the Study.

SE index in the parenthesis above shows negative, i.e., active storage capacity is evaluated to be negative.

M/P=Master Plan, Pre-F/S=Prefeasibility Study, F/S=Feasibility Study

Table H3.1 Summary of Preliminary Screenings (4/5)

IV. Tana River Basin Drainage Area

No.	Damsite	Sub-Basin (Dam-site)	Scheme Stage	Catchment Area (Dam-site)	First Screening: Dam Embankment Volume	First Screening: Storage Efficiency	First Screening: Results	Second Screening: (Yield)/(Dam Embankment Volume) x 1000	Second Screening: Results	Third Screening: Water Supply Area	Results of Screening	Remarks
				A1 (km2)	(1000m3)	(SE)		(RY)				
1	* Gitumbi	4AB	-	666	2,980	42	to 2nd Screening	131	to 3rd Screening	-	-	
2	* Nderitu	4AB	-	374	2,606	34	to 2nd Screening	101	-	-	-	
3	* Rutura	4AC	-	195	2,772	5		-	-	-	-	
4	* Kirurumi	4AC	-	177	954	6		-	-	-	-	
5	* Gatitu	4AC	-	231	1,875	28	to 2nd Screening	49	to 3rd Screening	-	-	
6	Kigoini	4AD	M/P	31	225	29	to 2nd Screening	212	to 3rd Screening	-	-	
7	* Gikira	4AD	-	114	2,501	14		-	-	-	-	
8	* S.Mathioya	4BD	-	55	818	10		-	-	-	-	
9	* Muhitu	4BD	-	65	2,650	8		-	-	-	-	
10	* Koimbi	4BD	-	23	4,131	5		-	-	-	-	
11	* Muringaini	4BD	-	141	5,828	7		-	-	-	-	
12	* Kamukabi	4BE	-	77	10,568	10		-	-	-	-	
13	* Kiringa	4BE	-	50	3,211	4		-	-	-	-	
14	Maragua 8	4BE	M/P	210	7,668	18	to 2nd Screening	52	to 3rd Screening	-	-	
15	Maragua 4	4BE	M/P	76	3,595	7		-	-	-	-	
16	* Kiiriangoro	4BE	-	96	3,947	9		-	-	-	-	
17	* Saba Saba	4BF	-	180	2,130	24	to 2nd Screening	-	-	-	-	
18	* Githima	4BF	-	5	1,406	13		-	-	-	-	
19	Chania B	4CA	M/P	338	4,193	13		-	-	-	-	
20	* Sasumua A	4CA	-	130	1,113	9		-	-	-	-	
21	Chania A	4CA	M/P	233	2,764	5		-	-	-	-	
22	Kimakia	4CA	M/P	28	3,040	8		-	-	-	-	
23	Ndiara	4CA	M/P	43	1,500	8		-	-	4CA	selected	
24	* Kigoro	4CB	-	119	8,036	6		-	-	-	-	
25	Thika 3A	4CB	M/P	296	842	23	to 2nd Screening	-	-	-	-	
26	* Ndakaini	4CB	-	27	1,605	9		-	-	-	-	
27	* Mukurue	4CB	-	134	909	11		-	-	-	-	
28	* Kiketani	4CC	-	1,430	4,153	27	to 2nd Screening	-	-	-	-	
29	Thiba	4DA	F/S	173	1,350	12	to 2nd Screening	115	to 3rd Screening	4DA	selected	
30	* Siakago	4EC	-	408	10,262	108	to 2nd Screening	215	to 3rd Screening	-	-	
31	Karura	4ED	M/P	11,802	1,050	(100)		-		-	-	
32	* Kamogo	4ED	-	250	1,866	26	to 2nd Screening	-		-	-	
33	* Karambari	4ED	-	130	2,295	31	to 2nd Screening	83	to 3rd Screening	-	-	
34	Mutonga	4FA	Pre-F/S	15,329	700	90	to 2nd Screening	-	to 3rd Screening	-	selected	
35	Grand Falls (High)	4FB	Pre-F/S	17,459	30,000	170	to 2nd Screening	823	to 3rd Screening	-	selected	
35	Grand Falls (Low)	4FB	Pre-F/S	17,459	8,000	141	to 2nd Screening	-	to 3rd Screening	-	selected	
36	Usueni	4FB	M/P	18,690	10,000	52	to 2nd Screening	-		-	-	
37	Adamson Falls	4GA	M/P	21,462	2,910	209	to 2nd Screening	-		-	selected	
38	Kora	4GB	M/P	24,874	3,600	175	to 2nd Screening	-		-	selected	
39	* Kavgongo	4HA	-	1,644	305	11		-		-	-	

Source : MOWD, NWCPC, MOE, TARDA, NIB, NCC

Notes : * Damsites newly identified in the Study.
SE index in the parenthesis above shows negative, i.e., active storage capacity is evaluated to be negative.
M/P=Master Plan, Pre-F/S=Prefeasibility Study, F/S=Feasibility Study

FILE NAME : 5-DAM5

Table H3.1 Summary of Preliminary Screenings (5/5)

V. Ewaso Ngiro North River Basin Drainage Area

No.	Damsite	River Basin Code (Damsite)	Scheme Stage	First Screening: Catchment Area (Damsite) A1 (km2)	First Screening: Dam Embankment Volume (1000m3)	First Screening: Storage Efficiency (SE)	First Screening: Results	Second Screening: (Yield)/(Dam Embankment Volume) x 1000 (RY)	Second Screening: Results	Third Screening: Water Supply Area	Results of Screenings	Remarks
1	* Ol Bolossat	5AA	-	77	410	14	-	-	-	-	-	
2	Rumuruti	5AA	F/S	680	873	20	to 2nd Screening	319	to 3rd Screening	5AA	selected	
3	Nyahururu	5AA	M/P	29	67	146	to 2nd Screening	215	to 3rd Screening	5AA	selected	
4	* Oraimutia	5AA	-	35	636	33	to 2nd Screening	33	-	-	-	
5	Gage	5AC	M/P	3,290	654	(21)	-	-	-	-	-	
6	Kihoto	5BC	M/P	2,842	6,756	100	to 2nd Screening	212	to 3rd Screening	-	-	
7	* Swari	5CB	-	3,983	3,466	29	to 2nd Screening	-	-	-	-	
8	* Trilo	5CB	-	209	1,196	27	to 2nd Screening	605	to 3rd Screening	-	-	
9	* Barsaloi	5CC	-	2,059	4,640	45	to 2nd Screening	113	-	-	-	
10	* Milgis	5CC	-	7,878	4,209	86	to 2nd Screening	247	to 3rd Screening	-	-	
11	Archers Post	5DA	M/P	15,300	10,620	20	to 2nd Screening	-	-	-	-	
12	* Sinyai	5DB	-	557	6,390	15	-	-	-	-	-	
13	Crocodile Jaws	5DC	M/P	8,583	4,104	5	-	-	-	-	-	
14	Kirimun	5DC	M/P	8,825	19,629	(3)	-	-	-	-	-	
15	Ngadurumuto	5DC/5BC 5BE	M/P	4,230	2,384	31	to 2nd Screening	-	-	-	-	
16	* Tulolong	5DD	-	9,052	4,340	20	to 2nd Screening	-	-	-	-	
17	* Longopito	5DD	-	8,917	1,104	(134)	-	-	-	-	-	
18	* Lokomon	5DD	-	9,511	1,767	(69)	-	-	-	-	-	

Source : MOWD, NWCPC, MOE

Notes : * Damsites newly identified in the Study.

SE index in the parenthesis above shows negative, i.e., active storage capacity is evaluated to be negative.

M/P=Master Plan, Pre-F/S= Prefeasibility Study, F/S= Feasibility Study

Table H3.2 Results of Case Study on Flood Control with Dam and River Improvement Works in Representative Flood Prone Areas

Description		Unit	Rambula dam	Mushagumbo dam	Nyando dam	Magwagwa dam	Katieno dam	Remarks
1. River Name			Nzoia	Yala	Nyando	Sondu	Kuja	
2. Flood Protection Level		year	25	25	25	25	25	refer to Sectoral Rep. G
3. Dam Plan								
(1) Catchment Area	:a	Km2	11,849	1,987	1,322	3,160	3,002	
(2) Topo-max Height	:Hm	m	50	50	70	120	20	
(3) Topo-max Storage	:Sm	mcm	300	250	325	975	1,460	
(4) Dead Storage	:Sd	mcm	136	40	34	101	77	
(5) Features w/o Flood Control								
- Active Storage	:Sa	mcm	-	-	110	452	-	
- Gross Storage	:S1	mcm	-	-	144	553	-	= Sa+Sd
- Dam Height	:H1	m	-	-	58	101	-	
- Embankment Volume	:V1	mcm	-	-	7.3	5.8	-	
(6) Features w/ Flood Control								
- Design Discharge	:Q	m3/s	1,070	290	300	480	440	
- Cut Rate	:r		0.3	0.5	0.5	0.5	0.5	
- Flood Control Storage	:Sf	mcm	139	63	65	104	95	= Q*r*10 days/2
- Gross Storage	:S2	mcm	275	103	209	657	172	= Sd+Sa+Sf, less than Sm
- Dam Height	:H2	m	39	30	65	106	28	
- Embankment Volume	:V2	mcm	2.2	0.9	9.8	6.7	0.6	
(7) Increased Cost								
Case (6) - Case (5)	:IC	mil.$	67.2	26.4	75.0	27.0	18.0	= 30 $/m3 * (V2-V1)
4. River Improvement Plan								
(1) Target Stretch		Km	0 - 18	2 - 16	10 - 30	1 - 8	1 - 11	refer to Sectoral Rep. G
(2) Catchment Area	:A	Km2	11,849	2,864	2,625	3,287	6,600	refer to Sectoral Rep. G
(3) Features w/o Dam Flood Control								
- Design Discharge	:Q1	m3/s	1,070	370	590	500	850	refer to Sectoral Rep. G
- Construction Cost	:C1	mil.$	6.6	11.1	11.8	4.9	5.0	refer to Sectoral Rep. G
(4) Features w/ Dam Flood Control								
- Design Discharge	:Q2	m3/s	750	260	470	265	690	= Q1*(1-(1-(1-r)^2)*a/A)^0.5
- Construction Cost	:C2	mil.$	3.9	6.8	8.2	0.9	3.2	
(5) Decreased Cost								
Case (3) - Case (4)	:DC	mil.$	2.7	4.3	3.6	4.0	1.8	DC = C1-C2
5. IC/DC			24.9	6.1	20.8	6.8	10.0	

FILE NAME : 6-PROSDM

Table H3.3 Selected Prospective Dams

Item No.	Prospective Site proposed in the Study: Damsite	Sub-basin	Purpose	Water Supply: Service Urban Centre	Irrigation: Large Irri. Scheme	Hydropower: Hydropower Scheme	Remarks
L.Victoria Drainage Area							
1 **	(Moiben)	1BA	W	Eldoret/Iten	-	-	detailed design stage
2	Mukulusi	1EA	W	Kakamega	-	-	small dam
3	Londiani	1GC	W	Londiani	-	-	
4	Kibos	1HA	W	Kisumu/Maseno	-	-	
5	Itare	1JA	W	Nakuru/Molo/Njoro /Elburugon/Rongai /Mogotio	-	-	
6 **	(Sondu/Miriu)	1JG	P,I	-	(Kano Plain)	Sondu/Miriu	run-of-river type weir detailed design stage
7	Magwagwa	1JG	P,I	-	Kano Plain	Magwagwa	multipurpose
8	Bunyunyu	1KB	W	Kisii	-	-	
Rift Valley Drainage Area							
9 **	(Chemususu)	2ED	W	Eldama Ravine	-	-	detailed design stage
10 **	(Kirandich)	2EH	W	Kabarnet	-	-	detailed design stage
11	Malewa	2GB	W	Nakuru/Gilgil/ Naivasha	-	-	
12	Upper Narok	2KA	W	Narok	-	-	
13	Oldorko	2KB	P,I,W	Magadi	Lower E.Ngiro	Oldorko	multipurpose
Athi River Drainage Area							
14	Upper Athi	3AA	W	Athi River	-	-	
15 **	(Ruaka (Kiambaa))	3BA	W	rural centres	-	-	centres near damsite
16	Ruiru- A	3BC	W	Nairobi	-	-	
17	Kikuyu	3BA	W	Kikuyu	-	-	
18	Ndarugu	3CB	W,I	Nairobi,Ruiru , Kiambu	Kanzalu	-	multipurpose
19	Yatta	3FB	I	-	Kibwezi Ext.	-	
20	Rare	3LA	W	Malindi	-	-	off-stream reservoir
21	Mwachi	3MB	W	Mombasa	-	-	
22	Pemba	3HC	W	Mombasa	-	-	run-of-river type weir
Tana River Drainage Area							
23	Chania- B	4CA	W,I	Nairobi	(small irri.)	-	multipurpose
24	Thiba	4DA	I	-	Mwea Ext.	-	
25	Mutonga	4FA	P	-	-	Mutonga	
26	Low Grand Falls	4FB	P	-	-	L. Grand Falls	
Ewaso Nigro North River Drainage Area							
27	Rumuruti	5AA	W	Rumuruti	-	-	
28	Nyuhururu	5AA	W	Nyuhururu	-	-	small dam

Note: "**" shows a dam scheme in detailed design stage.

Table H4.1 Prospective and Dam Schemes

Item No.	Prospective Dams	Sub-basin	River (damsite)	Catchment Area (Km2)	Study Stage	Purpose	Reservoir N.W.L. (El.m)	Reservoir L.W.L. (El.m)	Reservoir Dead Storage (MCM)	Reservoir Active Storage (MCM) /1	Reservoir Gross Storage (MCM)	Reservoir Surface Area(FSL) (ha)	Reservoir Yield (m3/s)	Reservoir Yield (m3/day)	Dam Embankment Dam Crest (El.m)	Dam Embankment Dam Height (m) /2	Dam Embankment Embankment Volume (1000 m3)	Remarks
1	Moiben	1BA	Moiben	188	D/D	W	2,361.6	2,337.1	1.22	18.38	19.60	137	0.68	58,666	2,366.6	42	414	under D/D
2 *	Mukulusi	1EA	Mukulusi	341	M/P	W	1,510.1	1,508.5	11.60	5.39	16.99	227	1.10	95,040	1,515.1	8	21	small dam
3	Londiani	1GC	Kipchorian	71	M/P	W	2,325.6	2,297.2	1.60	49.30	50.90	436	0.47	40,608	2,330.6	50	1,720	
4	Kibos	1HA	Kibos	179	M/P	W	1,482.1	1,471.6	2.20	4.93	7.13	68	0.95	82,080	1,487.1	39	700	
5	Itare	1JA	Itare	185	M/P	W	2,400.5	2,379.7	1.11	12.48	13.59	97	1.73	149,472	2,405.5	35	623	
6	Magwagwa	1JG	Sondu	3,160	F/S	P,I	1,665.0	1,603.0	107.00	701.00	808.00	2,349	-	-	1,670.0	** 110	4,388	
7 *	Bunyunyu	1KB	Kuja	120	M/P	W	1,834.3	1,832.7	3.40	1.34	4.74	243	0.61	52,704	1,837.3	16	108	
8	Malewa	2GB	Malewa	635	F/S	W	2,149.0	2,123.5	15.88	55.82	71.70	332	1.37	118,714	2,154.0	80	1,170	
9	Upper Narok	2KA	Ewaso Narok	516	M/P	W	1,985.5	1,975.5	3.10	6.99	10.09	79	1.20	103,680	1,988.5	29	368	
10	Oldorko	2KB	E.Ngiro S.	5,696	Pre-F/S	P,I,W	1,300.0	1,272.0	71.20	885.22	956.42	5,115	-	-	1,305.0	** 55	4,480	
11	Upper Athi	3AA	Athi	400	Pre-F/S	W	1,551.7	1,542.9	3.00	7.30	10.30	112	0.30	25,920	1,554.7	26	171	
12 *	*Ruiru-A*	*3BC*	*Ruiru*	*202*	*M/P*	W	*1,898.9*	*1,855.8*	*1.21*	*17.83*	*19.04*	87	0.35	30,240	1,903.9	69	1,528	
13 *	Kikuyu	3BA	Nairobi	81	M/P	W	2,006.6	1,989.9	0.49	10.50	10.99	106	0.25	21,600	2,009.6	25	221	
14	Ndarugu	3CB	Ndarugu	360	M/P	W,I	1,451.3	1,429.8	9.27	214.95	224.22	1,876	6.10	527,040	1,456.3	36	1,302	
15	Yatta	3FB	Athi	20,000	M/P	I	782.1	764.2	100.00	280.20	380.20	2,561	13.50	1,166,400	787.1	52	4,988	
16	Rare	3LA	Rare	6,246	F/S	W	91.1	82.5	6.00	31.27	37.27	551	0.50	43,200	94.1	21	502	Off-stream reservoir
17	Mwachi	3MB	Mwachi	7,497	M/P	W	85.6	39.5	8.00	105.00	113.00	526	2.75	237,600	90.6	77	3,217	
18	Pemba	3MC	Pemba	866	M/P	W	-	-	-	-	-	-	0.23	19,872	-	weir	-	run-of-river type wei
19	Chania- B	4CA	Chania	338	M/P	W,I	1,790.6	1,720.6	2.03	48.99	51.02	150	1.3	112,320	1,795.6	101	3,816	
20	Thiba	4DA	Thiba	173	F/S	I	1,380.0	1,359.0	1.30	16.73	18.03	122	-	-	1,385.0	** 35	1,200	
21	Mutonga	4FA	Tana	15,329	Pre-F/S	P	550.0	542.0	268.26	87.81	356.07	1,090	-	-	554.0	42	870	
22	Low Grand Falls	4FB	Tana	17,459	Pre-F/S	P	512.0	500.0	742.01	857.78	1,599.79	6,720	-	-	516.0	79	5,820	
23	Rumuruti	5AA	Ewaso Narok	673	Pre-F/S	W	2,012.8	2,010.4	2.00	0.95	2.95	63	0.03	2,592	2,015.8	16	109	
24	Nyahururu	5AA	Nyahururu	29	M/P	W	2,400.0	2,380.9	0.17	10.23	10.40	116	0.26	22,464	2,403.0	20	72	
Committed Dam Schemes																		
25	Sondu/Miriu	1JA	Sondu	3,360	D/D	P,I	-	-	-	-	-	-	-	-	-	weir	-	run-of-river type wei
26	Chemususu	2ED	Perkerra	63	D/D	W	2,336.5	2,315.5	1.51	9.44	10.95	82	0.41	35,000	2,340.0	45	757	/3
27	Kirandich	2EH	Kirandich	28	D/D	W	1,774.4	1,756.5	0.75	3.25	4.52	28	0.13	11,000	1,780.0	50	420	/3
28	Ruaka (Kiambaa)	3BA	Ruaka	100	D/D	W	1,755.7	1,747.7	0.60	2.07	2.67	29	0.12	10,000	1,758.7	18	120	

Notes: Marked "*" shows a damsite newly identified in this Study.
Purpose, W = water supply, I = irrigation, P = hydroelectric power.
Study stage, M/P = mater plan, Pre-F/S = prefeasibility study, F/S = feasibility study
/1 Active storage = (required storage capacity for w/s) + (reservoir evaporation loss)
/2 Dam height above riverbed, while marked "***" shows a dam height from foundation.
/3 Dam features above are based on the detailed design report.

Table H4.2 Estimated Construction Cost of Prospective Dams

Item No.	Prospective Dams	Sub-basin	Estimated Const. Cost (1000 US$)	Annual Water Yield (1000 m3)	Water Cost Const. (US$/m3)	Water Cost O/M (US$/m3)	Water Cost total (US$/m3)	Remarks
1	Moiben	1BA	14,724	21,413	0.069	0.0003	0.070	
2	* Mukulusi	1EA	964	34,690	0.003	0.0000	0.003	
3	Londiani	1GC	54,550	14,822	0.371	0.0019	0.373	
4	Kibos	1HA	23,836	29,959	0.080	0.0004	0.081	
5	Itare	1JA	21,425	54,557	0.040	0.0002	0.040	
6	Magwagwa	1JG	169,702	-	-	-	-	
7	* Bunyunyu	1KB	4,284	19,237	0.022	0.0001	0.023	
8	Malewa	2GB	47,628	43,330	0.111	0.0006	0.111	
9	Upper Narok	2KA	13,192	37,843	0.035	0.0002	0.035	
10	Oldorko	2KB	121,620	-	-	-	-	
11	Upper Athi	3AA	6,519	9,461	0.069	0.0003	0.070	
12	* Ruiru-A	3BC	48,920	11,038	0.447	0.0022	0.449	
13	* Kikuyu	3BA	8,250	7,884	0.106	0.0005	0.106	
14	Ndarugu	3CB	42,227	192,370	0.022	0.0001	0.022	
15	Yatta	3FB	145,235	425,736	0.034	0.0002	0.035	
16	Rare	3LA	35,117	15,768	0.225	0.0011	0.226	/1
17	Mwachi	3MB	97,013	86,724	0.113	0.0006	0.113	
18	Pemba	3MC	1,100	7,253	0.015	0.0001	0.015	
19	Chania- B	4CA	113,527	40,997	0.279	0.0014	0.281	
20	Thiba	4DA	22,208	-	-	-	-	
21	Mutonga	4FA	117,944	-	-	-	-	
22	Low Grand Falls	4FB	242,260	-	-	-	-	
23	Rumuruti	5AA	4,310	946	0.459	0.0023	0.462	
24	Nyahururu	5AA	2,943	8,199	0.036	0.0002	0.036	
	sub-total		1,359,497					
Committed Dam Schemes								
25	Sondu/Miriu	1JA	5,200	-	-	-	-	/2
26	Chemususu	2ED	20,197	12,775	0.159	0.0008	0.160	/3
27	Kirandich	2EH	20,000	4,015	0.502	0.0025	0.505	/3
28	Ruaka (Kiambaa)	3BA	4,708	3,650	0.130	0.0007	0.131	
	sub-total		50,105					
	Total		1,409,602					

Notes: Marked "*" shows a damsite newly identified in this Study.
Unit water cost = (annual cost)/(total yield)
for water supply purpose dams

annual cost = initial cost (project cost)x(i+i/((1+i)^n-1))
where, n : dam design lifetime (50 years)
i : discount rate (10 %)

O/M cost is assumed at 0.5 % of Const. cost.
/1 The cost of Rare dam includes the cost of intake weir and diversion channel.
/2 The above cost of Sondu/Miriu dam shows the cost of intake weir only.
/3 The costs above for Chemususu and Kirandich dams exclude the cost of water supply system

Table H5.1 Future Development Potential Dams (1/2)

Item No.	Prospective Site proposed in the Study: Damsite	Sub-basin	Alternative Site for Future Dev't Potentials: Damsite	Sub-basin	Purpose	Water Supply: Service Urban Centre	Irrigation: Large Irri. Scheme	Hydropower: Hydropower Scheme	Remarks
L.Victoria Drainage Area									
1	** Moiben	1BA			W	Eldoret/Iten	-	-	
2			Moi's Bridge	1BE	P,I,W	-	-	Moi's Bridge	inter-basin w/transfer
3			Hemsted Brg.	1BD	W,I,P	Great Rift W/S	Upper Nzoia	Hemsted Brg.	inter-basin w/transfer
4			Kibolo	1CE	W	-	-	-	
5			Webuye Falls	1DA	P	-	-	Webuye Falls	
6			*Teremi*	1DB	P	-	-	*Teremi*	*rural hydro-electricit*
7	Mukulusi	1EA			W	Kakamega	-	-	small dam
8			Kimondi	1FC	W,I	Great Rift W/S	-	-	inter-basin w/transfer
9			Nandi Forest	1FD	I,P,W	-	Yala Swamp/ Kano Plain	Nandi Forest	multipurpose
10			Mushangumbo	1FE	P	-	-	Mushangumbo	
11	Londiani	1GC			W	Londiani	-	-	
12			Nyando	1GD1	W,I,F	Great Rift W/S	Kano Plain	-	inter-basin w/transfer
13	Kibos	1HA			W	Kisumu/Maseno	-	-	
14	Itare	1JA			W	Nakuru/Molo/Njoro /Elburugon/Rongai /Mogotio	-	-	
15			Timbilil	1JC	W	Kericho	-	-	
16			Sisei	1JF	W	-	-	-	
17	** (Sondu/Miriu)	1JG			P,I	-	(Kano Plain)	Sondu/Miriu	run-of-river type weir detailed design stage
18	Magwagwa	1JG			P,I	-	Kano Plain	Magwagwa	multipurpose
19	Bunyunyu	1KB			W	Kisii	-	-	
20			Katieno	1KB	W	-	-	-	
21			Namba Kodero	1KC	W,P	-	-	Namba Kodero	
22			Amala	1LB1	W	Nakuru	-	-	
Rift Valley Drainage Area									
23			Kimwarer	2CB	W,P,I	-	Kimwarer	Kimwarer	multipurpose
24			Kipsang	2CB	W	-	-	-	
25			Arror	2CC	W	-	-	-	
26			Sererwa	2CC	P,I,W	-	Arror	Arror	multipurpose
27			Waseges	2CC	W	-	-	-	
28			Kamukuny	2CC	W,I	-	-	-	flow augment.
29	** (Chemususu)	2ED			W	Eldama Ravine	-	-	detailed design stage
30			Aram	2EE	W	-	-	-	run-of-river type weir
31			Ratat	2EE	W	-	-	-	
32	** (Kirandich)	2EH			W	Kabarnet	-	-	detailed design stage
33	Malewa	2GB			W	Nakuru/Gilgil/ Naivasha	-	-	
34	Upper Narok	2KA			W	Narok	-	-	
35	Oldorko	2KB			P,I,W	Magadi	Lower E.Ngiro	Oldorko	multipurpose
36			Leshota	2KB	P,W	-	-	Leshota	
Athi River Drainage Area									
37	Upper Athi	3AA			W	Athi River	-	-	
38	** (Ruaka (Kiambaa))	3BA			W	rural centres	-	-	detailed design stage
39	Ruiru- A	3BC			W	Nairobi	-	-	
40	Kikuyu	3BA			W	Kikuyu	-	-	
41	Ndarugu	3CB			W,I	Nairobi/Ruiru /Kiambu	Kanzalu	-	multipurpose
42			Munyu	3DA	W,I,P	Nairobi	-	Munyu	multipurpose
43			Mbuuni	3EA	W	Machakos	-	-	
44			Kiteta	3EB	W	rural	-	-	
45			Thwake	3FA	I,W	-	-	-	
46	Yatta	3FB			I	-	Kibwezi Ext.	-	
47			Tsavo	3G	W	Tsavo	-	-	
48			Baricho	3HD	W	-	-	-	
49	Rare	3LA			W	Malindi	-	-	off-stream reservoir
50	Mwachi	3MB			W	Mombasa	-	-	
51	Pemba	3HC			W	Mombasa	-	-	run-of-river type weir

..... continued

Table H5.1 Future Development Potential Dams (2/2)

Item No.	Prospective Site proposed in the Study: Damsite	Sub-basin	Alternative Site for Future Dev't Potentials: Damsite	Sub-basin	Selected Purpose	Water Supply: Service Urban Centre	Irrigation: Large Irri. Scheme with Dam	Hydropower: Hydropower Scheme	Remarks
Tana River Drainage Area									
52			Maragua 8	4BE	W	-			
53	Chania- B	4CA			W,I	Nairobi	(small irri.)	-	multipurpose
54			Ndiara	4CA	W	-	-	-	
55	Thiba	4DA			I,W	-	Mwea Ext.	-	
56	Mutonga	4FA			P	-	-	Mutonga	
57	Low Grand Falls	4FB			P	-	-	L.Grand Falls	
58			High Grand Falls	4FB	P,W,I	-	-	H.Grand Falls	multipurpose
59			Adamson Falls	4GA	P,W,I	-	-	Adamson Falls	multipurpose
60			Kora	4GB	P,W,I	-	-	Kora	multipurpose
61			Umaa	4HA	W	-	-	-	
62			Mutuni	4HA	W	-	-	-	
63			Kitimui	4HA	W	-	-	-	
Ewaso Nigro North River Drainage Area									
64	Rumuruti	5AA			W	Rumuruti	-	-	
65	Nyuhururu	5AA			W	Nyuhururu	-	-	small dam
66			Archers Post	5DA	W,I,P	-	-	-	flow augment.
67			Crocodile Jaw	5DC	P,W,I	-	-	Crocodile Jaw	flow augment.
68			Kirium	5DC	P	-	-	Kirium	
69			Kihoto	5BC	W,I	-	-	-	flow augment.
70			Nundoto	5CA	W	Maralal	-	-	small dam
71			Lag-Bor	5EA	W	-	-	-	/1
72			Buna	5EA	W	Buna	-	-	/1
73			Habaswein	5EC	W	Habaswein	-	-	/1
74			Meri	5EC	W	Meri	-	-	/1
75			Modogashe	5FA	W	-	-	-	/1
76			Dadab	5FA	W	-	-	-	/1
77			Kutulo-Elwak	5GA	W	-	-	-	/1
78			Takaba	5GA	W	-	-	-	/1
79			Mandera	5GB	W	Mandera	-	-	/1
80			Neboi-Mandera	5GB	W	-	-	-	/1
81			Rham Mandera	5GB	W	-	-	-	/1
82			Arabic	5GB	W	-	-	-	/1
83			Fino	5GB	W	-	-	-	/1
84			Kalatiyo	5H	W	-	-	-	/1
85			Markamari	5H	W	-	-	-	/1

Note: "**" shows a dam scheme in detailed design stage.
/1 potential sites proposed by MOWD. No detailed information available.

FIGURES

Fig. H1.1

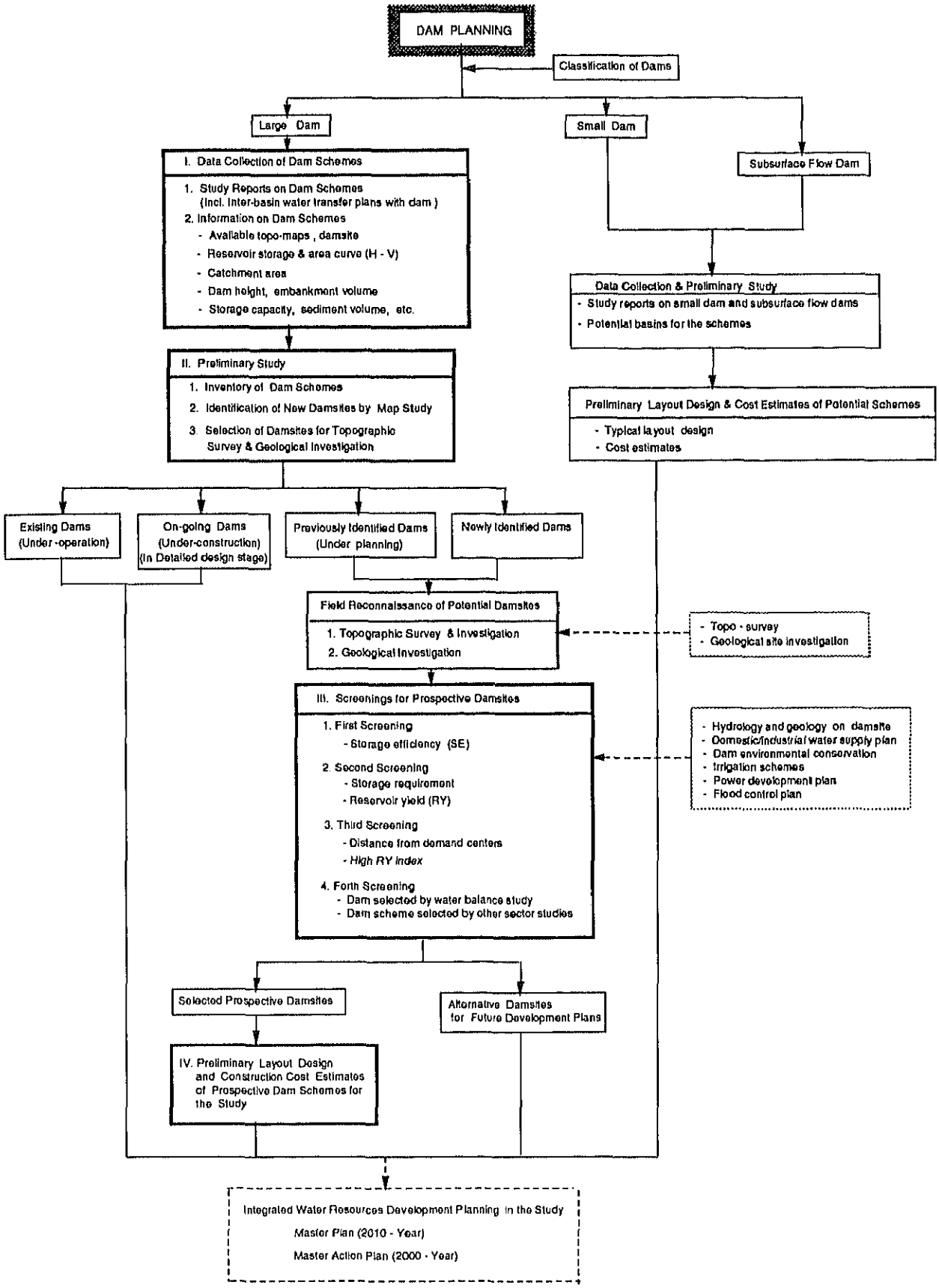


Figure H1.1

Flow Chart of Dam Planning

THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

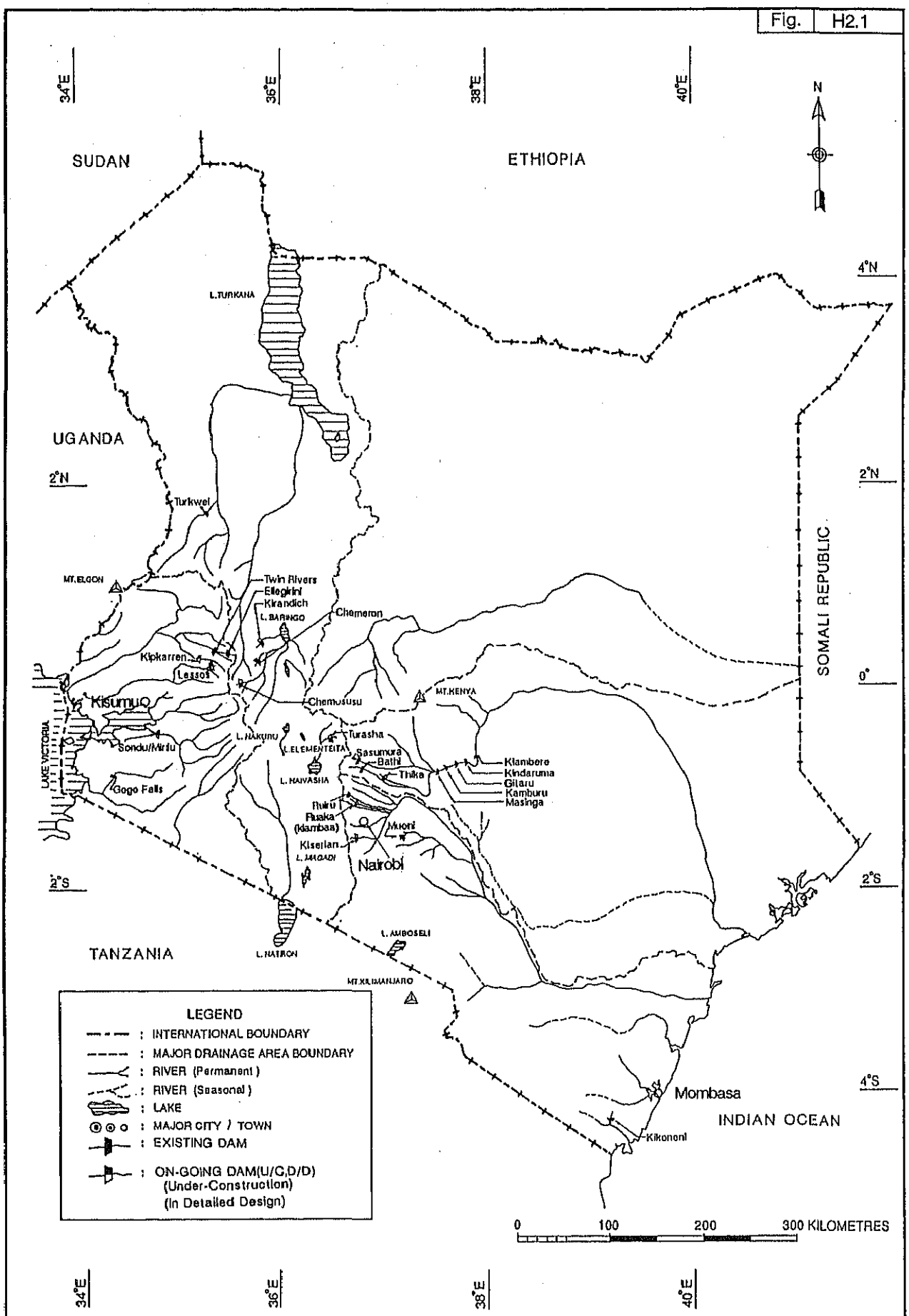


Figure H2.1

Location of Existing and On-going Dams

THE STUDY
ON
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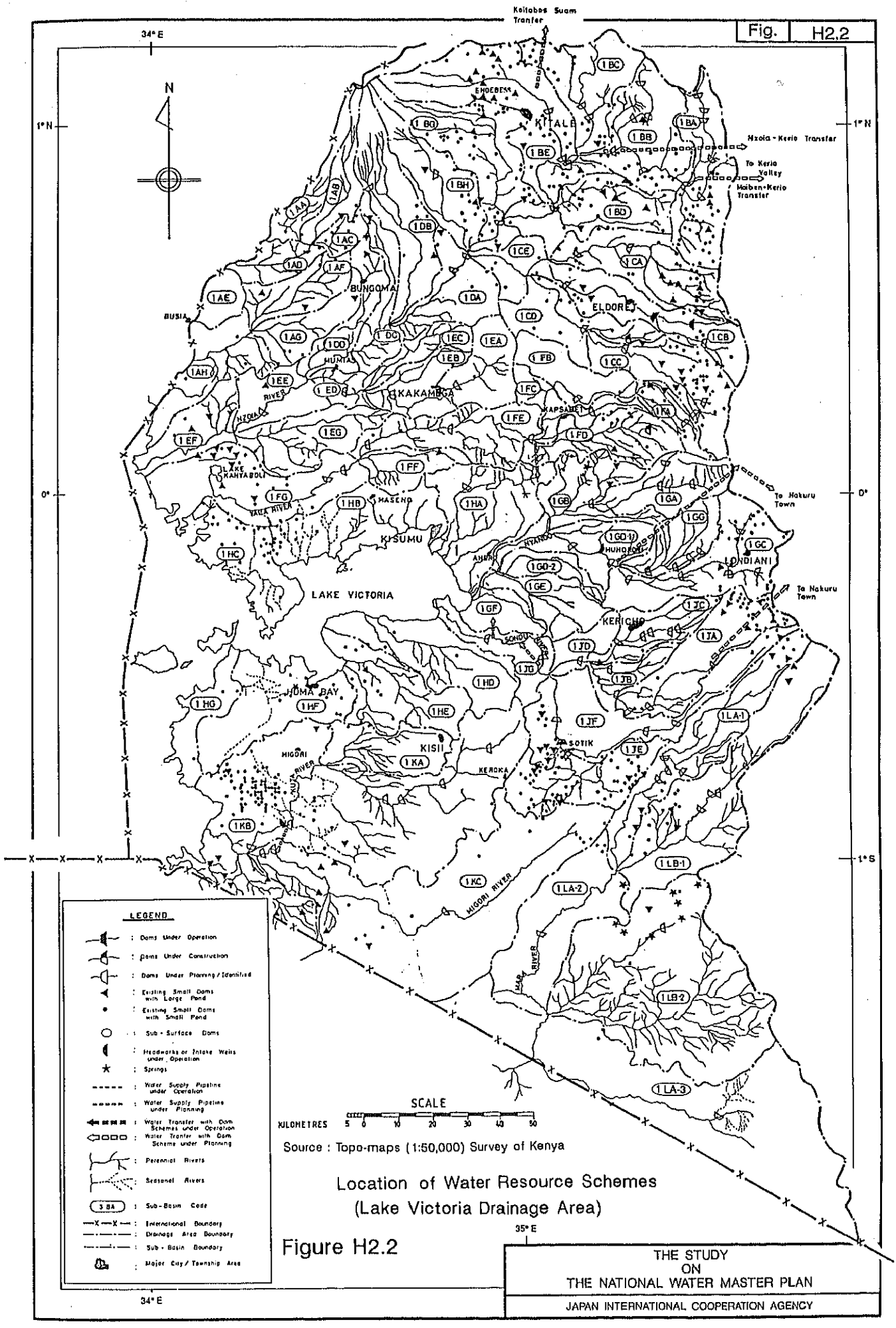

Source : Topo-maps (1:50,000) Survey of Kenya

Location of Water Resource Schemes
(Lake Victoria Drainage Area)

Figure H2.2

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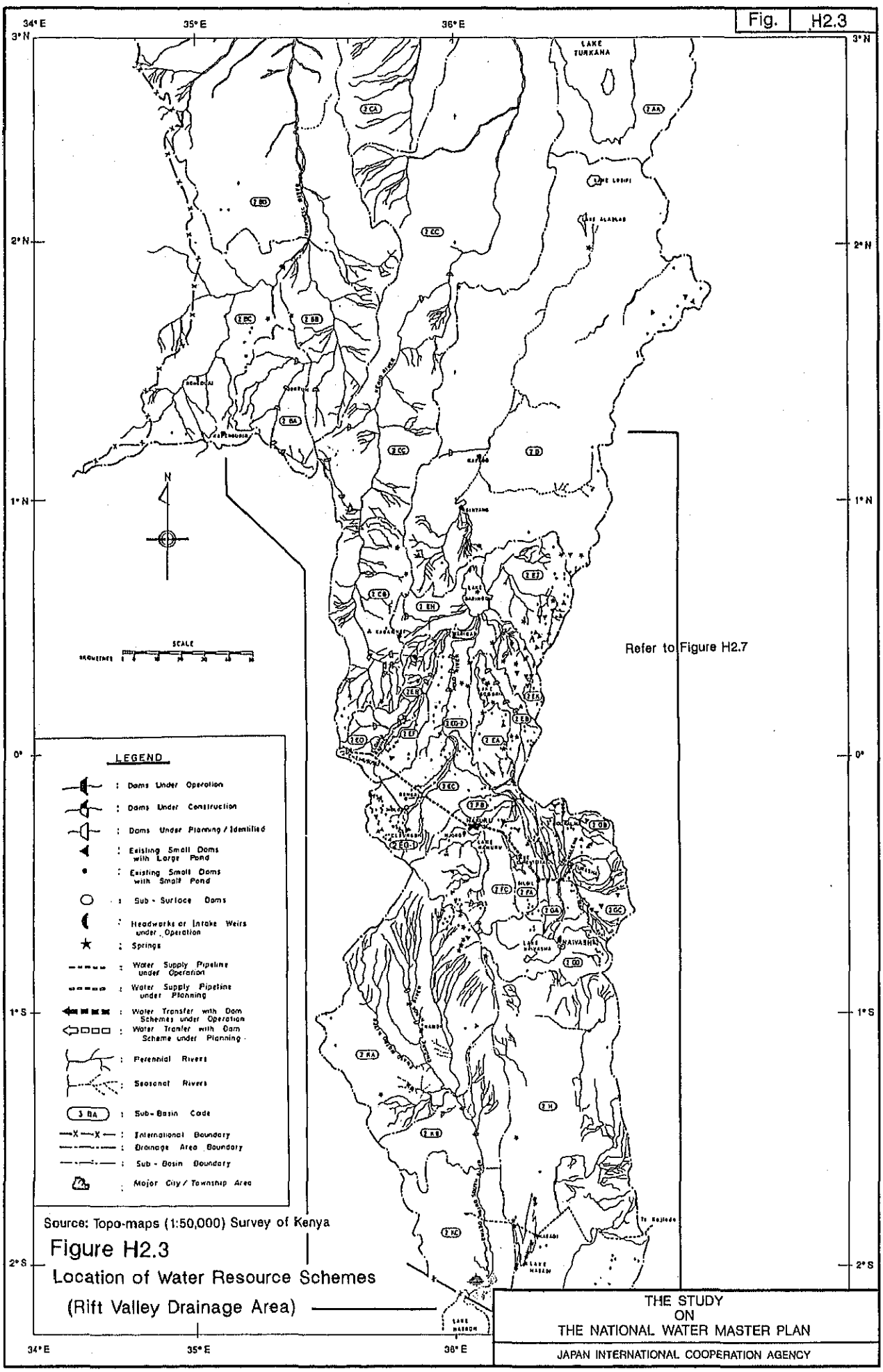
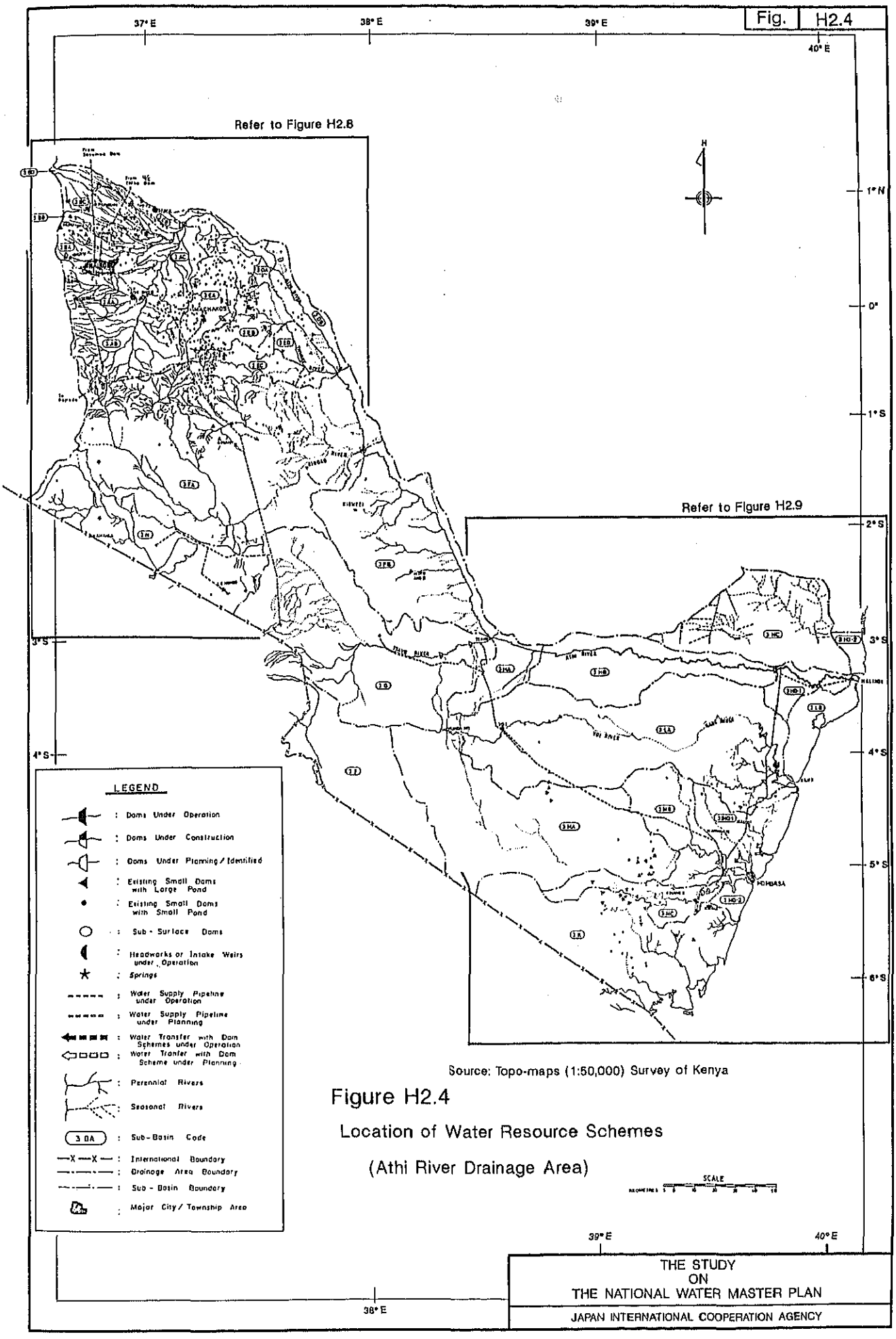


Source: Topo-maps (1:50,000) Survey of Kenya

Figure H2.3
Location of Water Resource Schemes
(Rift Valley Drainage Area)



Source: Topo-maps (1:50,000) Survey of Kenya

Figure H2.4

Location of Water Resource Schemes

(Athi River Drainage Area)

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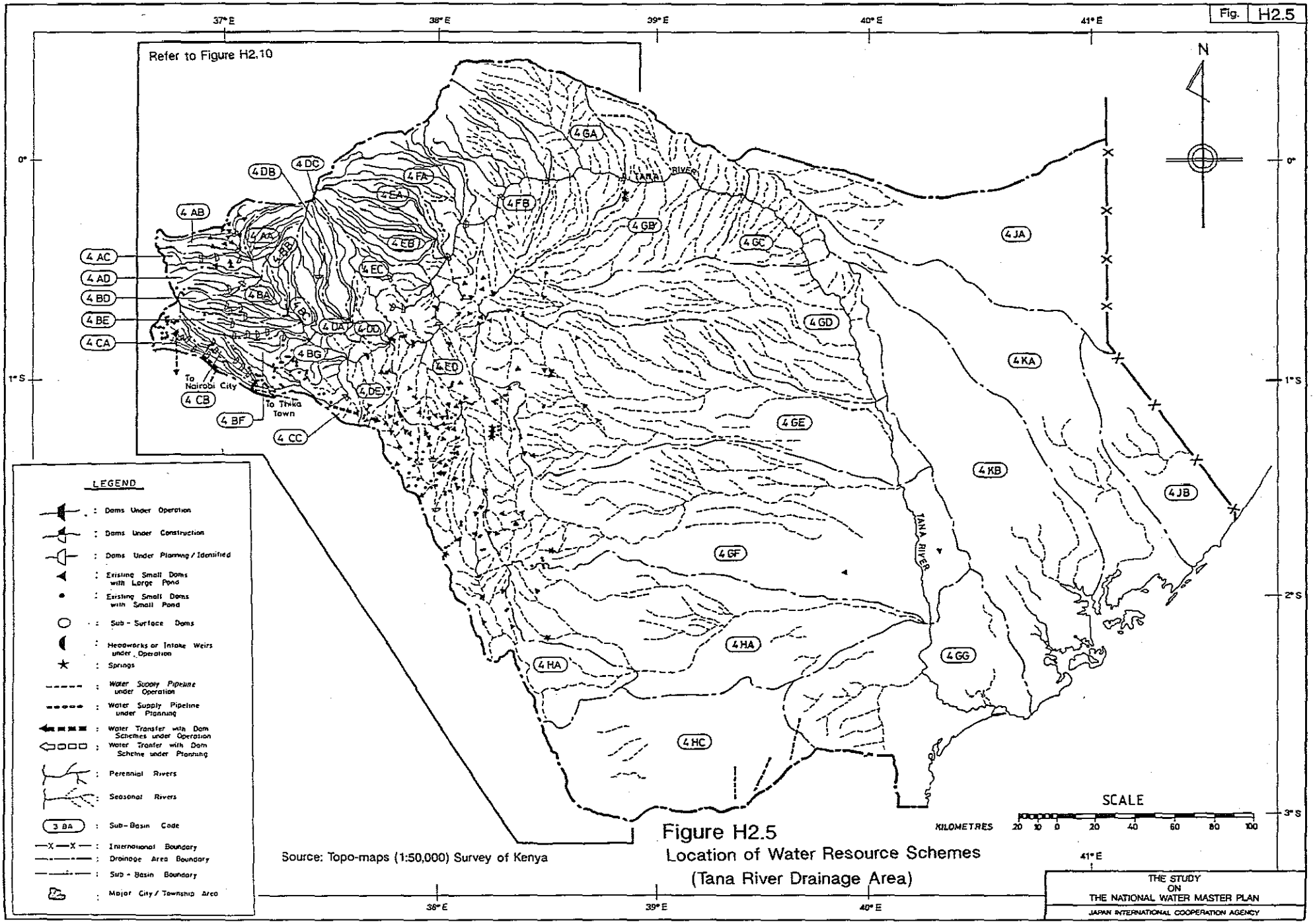
Fig. H2.5



Source: Topo-maps (1:50,000) Survey of Kenya

Figure H2.5
Location of Water Resource Schemes
(Tana River Drainage Area)

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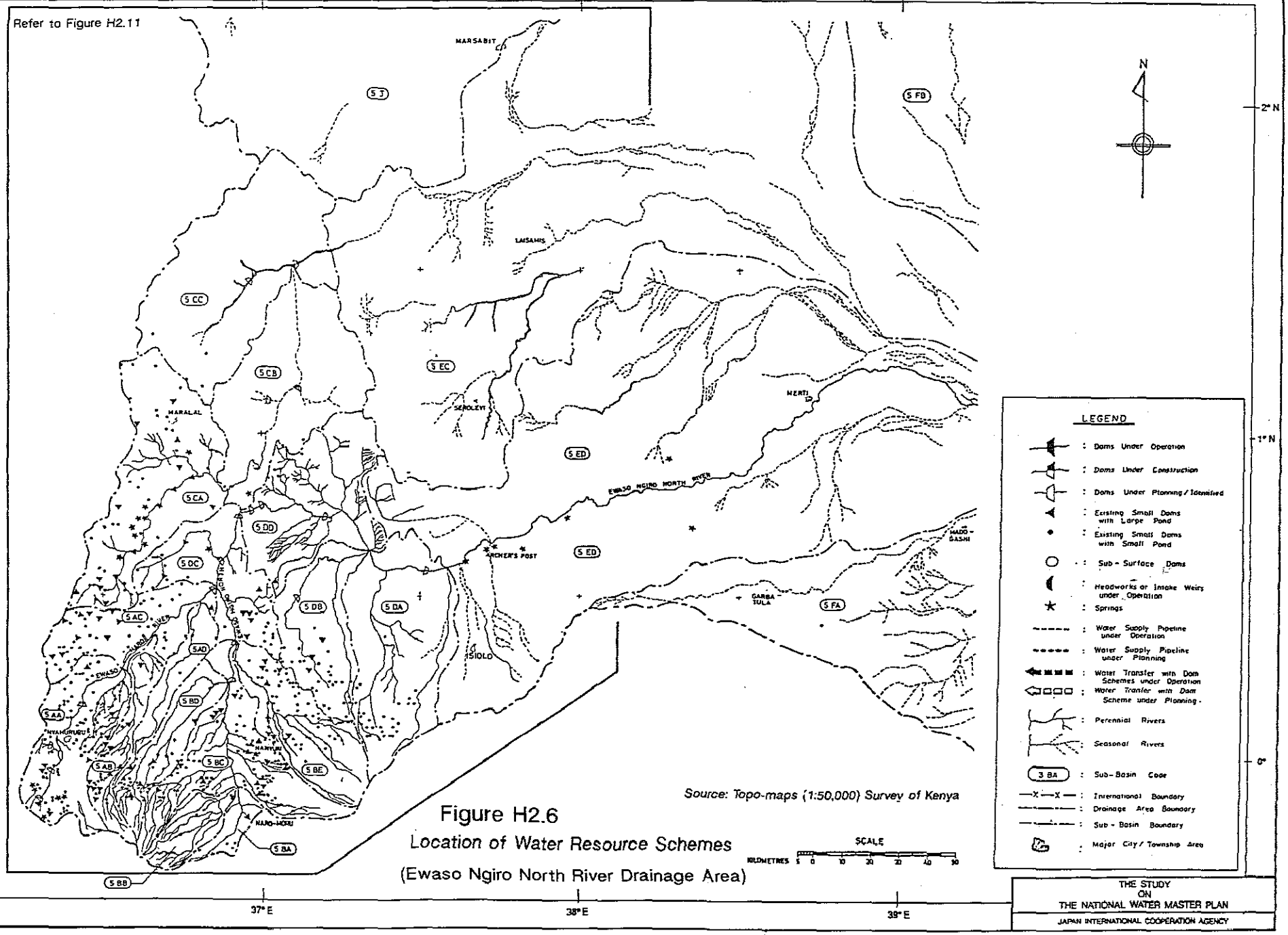
Fig. H2.6



Source: Topo-maps (1:50,000) Survey of Kenya

Figure H2.6

Location of Water Resource Schemes

(Ewaso Ngiro North River Drainage Area)

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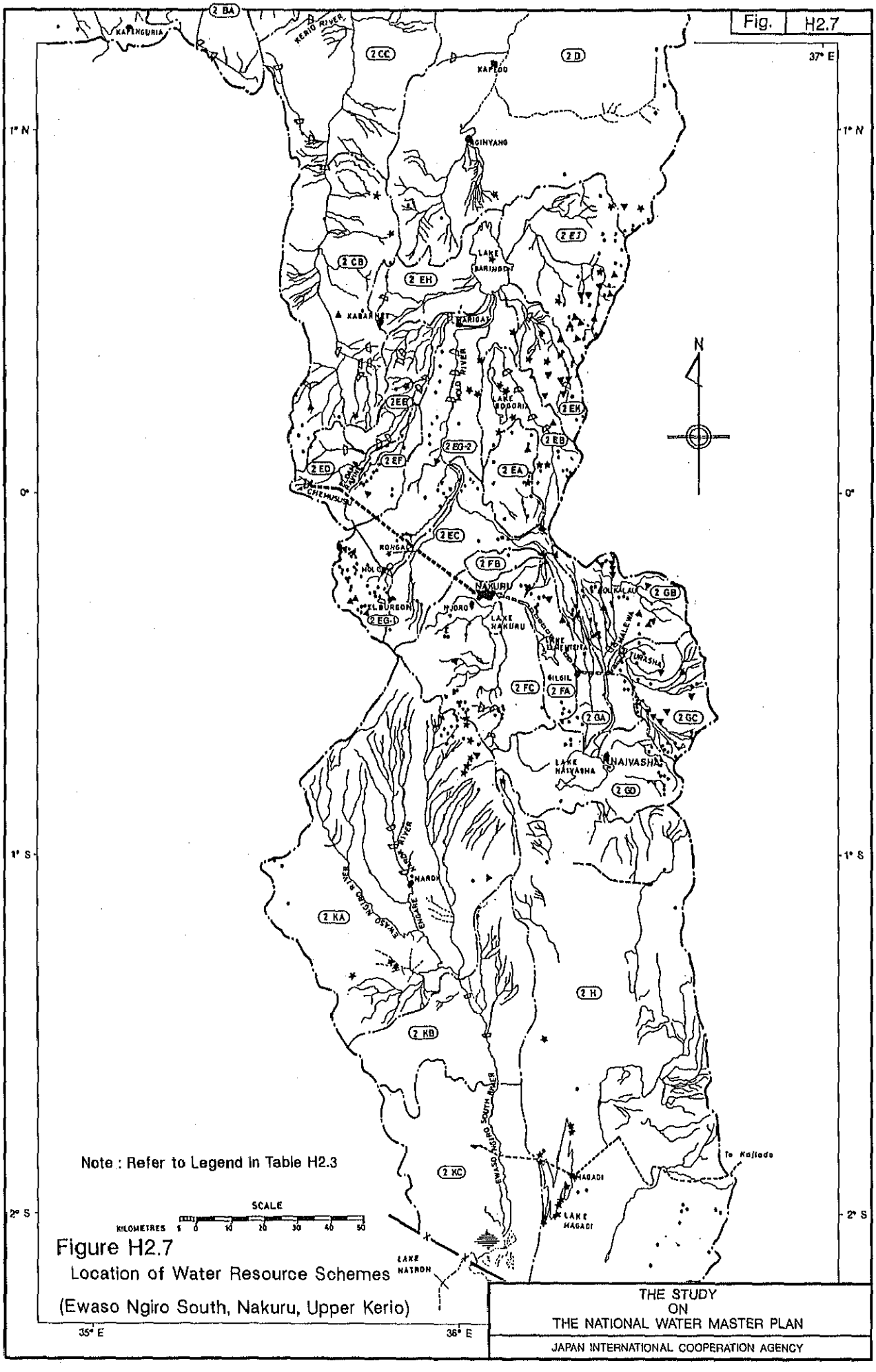

Figure H2.7
Location of Water Resource Schemes
(Ewaso Ngiro South, Nakuru, Upper Kerio)

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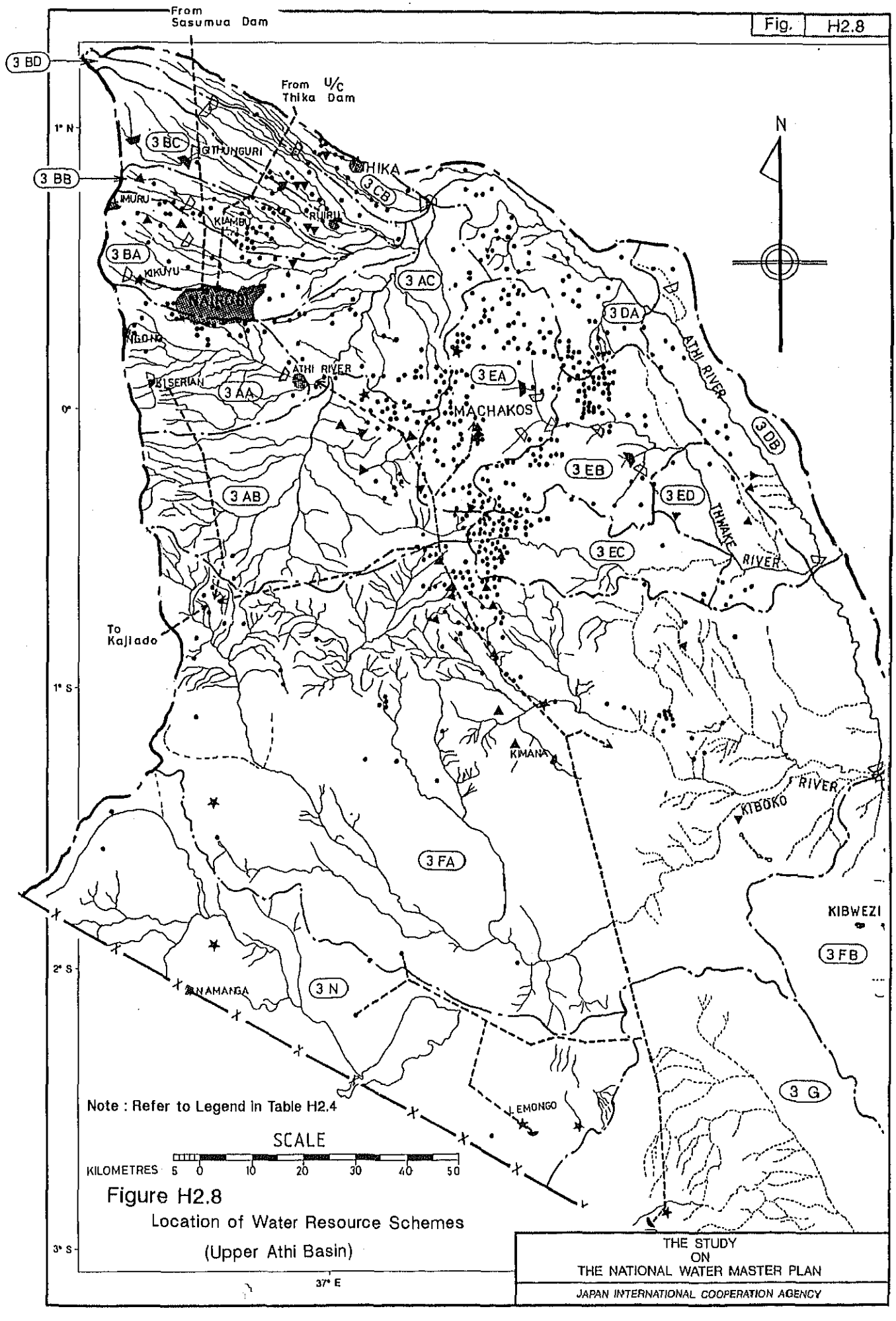
Fig. H2.8
From Sasumua Dam
From U/C Thika Dam
3 BD
3 BB
1° N
0°
1° S
2° S
3° S
37° E
3 BC
3 BA
3 CB
3 AC
3 DA
3 DB
3 EA
3 EB
3 ED
3 EC
3 AB
3 AA
3 FA
3 FB
3 G
3 N
GITHUNGURI
THIKA
IMURU
KIAMBU
RUIRU
KIKUYU
NAIROBI
NGONG
KAJIADO
ATHI RIVER
MACHAKOS
THWAKE RIVER
KIMANA
KIBOKO RIVER
KIBWEZI
NAMANGA
EMONGO
N
Note : Refer to Legend in Table H2.4
SCALE
KILOMETRES 5 0 10 20 30 40 50
Figure H2.8
Location of Water Resource Schemes
(Upper Athi Basin)
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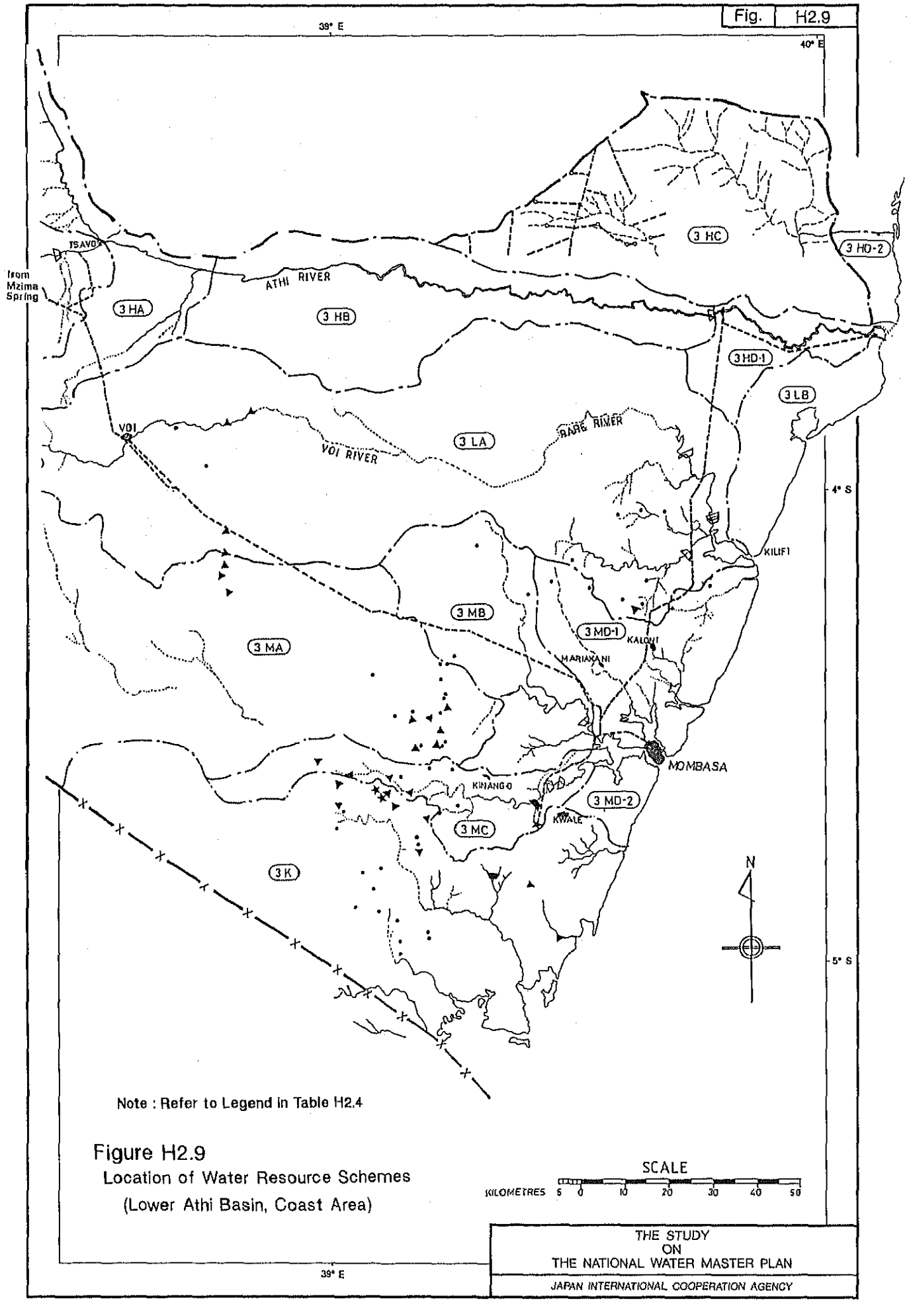

Figure H2.9
Location of Water Resource Schemes
(Lower Athi Basin, Coast Area)

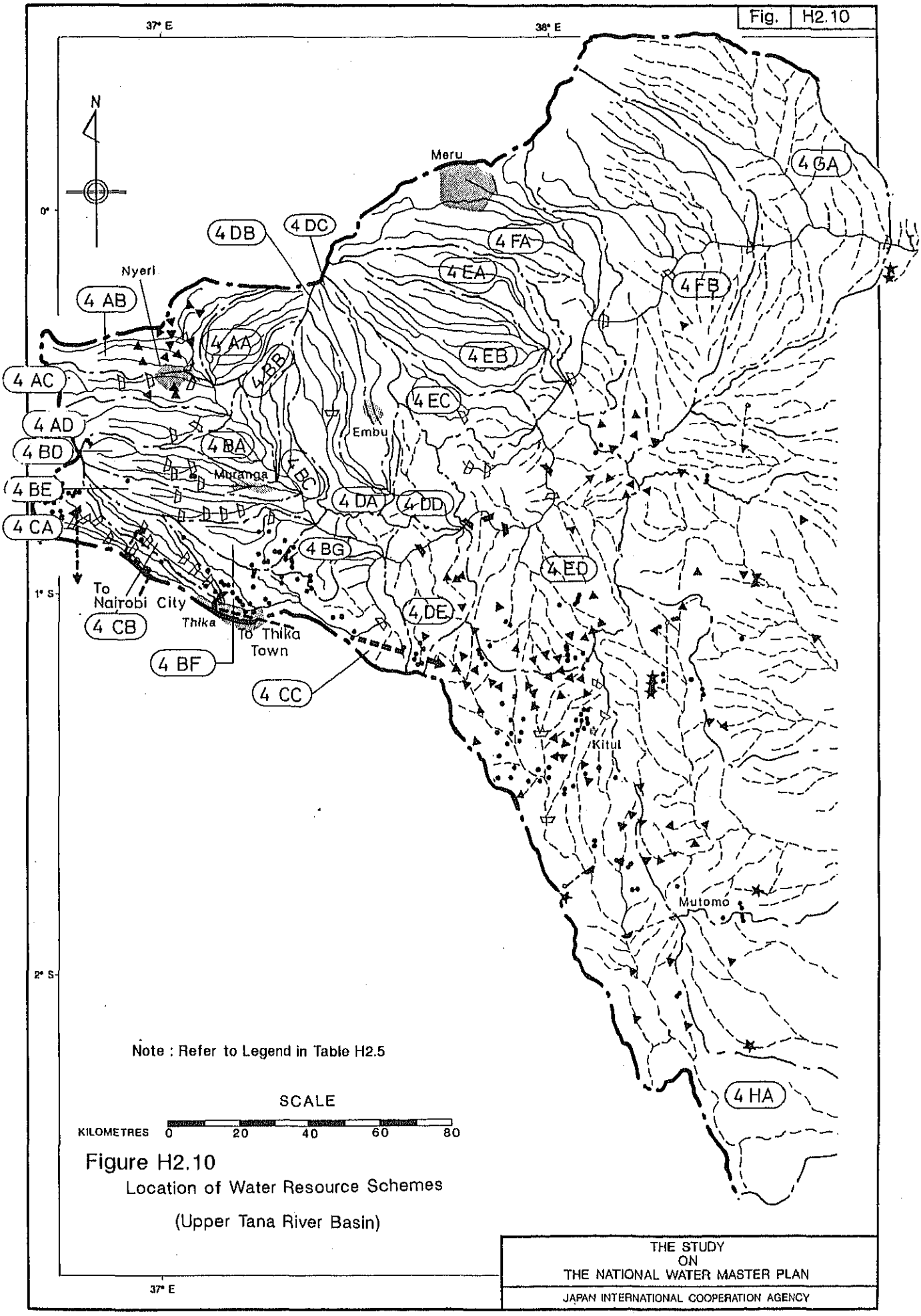

Figure H2.10

Location of Water Resource Schemes

(Upper Tana River Basin)

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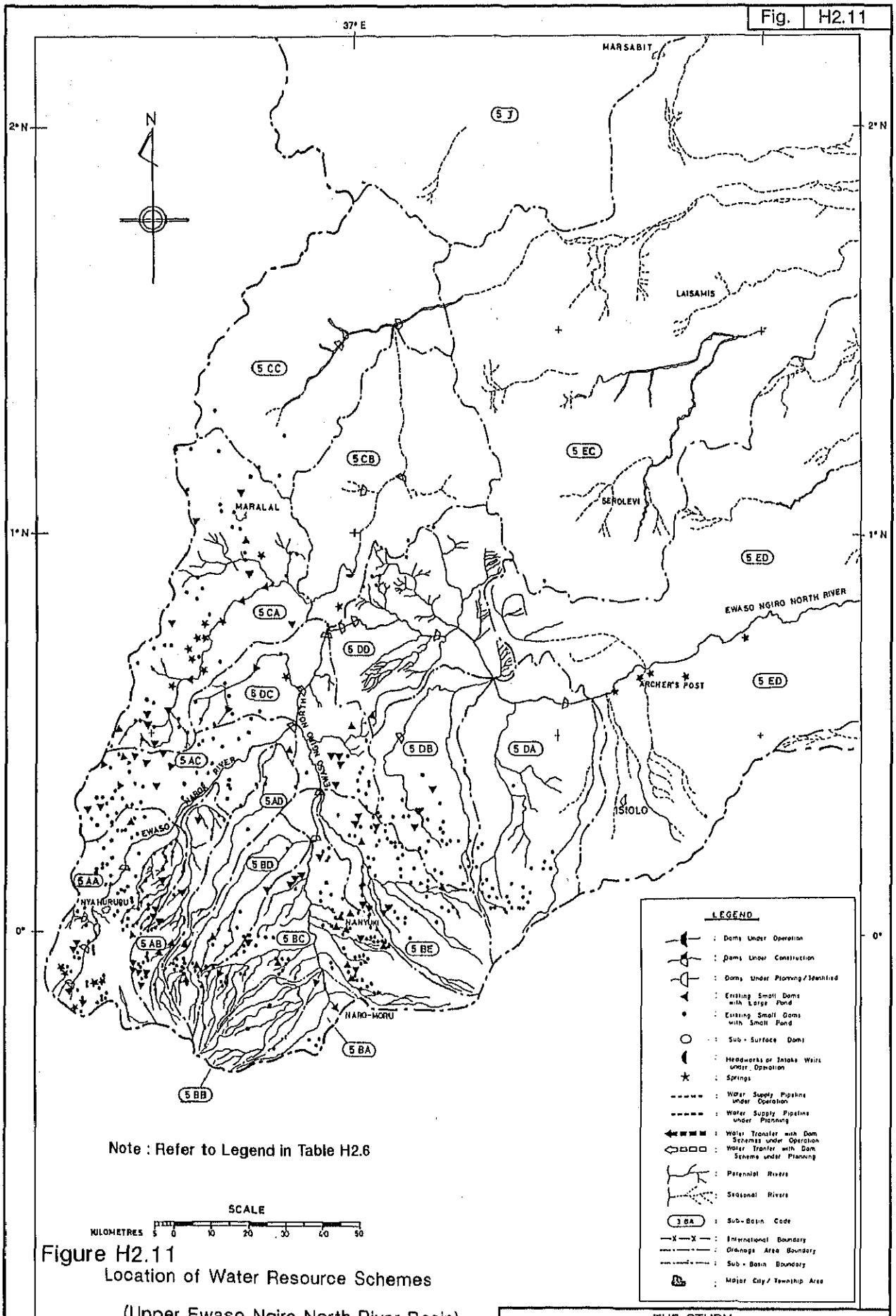
Fig. H2.11



Note : Refer to Legend in Table H2.6

Figure H2.11
Location of Water Resource Schemes
(Upper Ewaso Ngiro North River Basin)

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Fig. H2.12

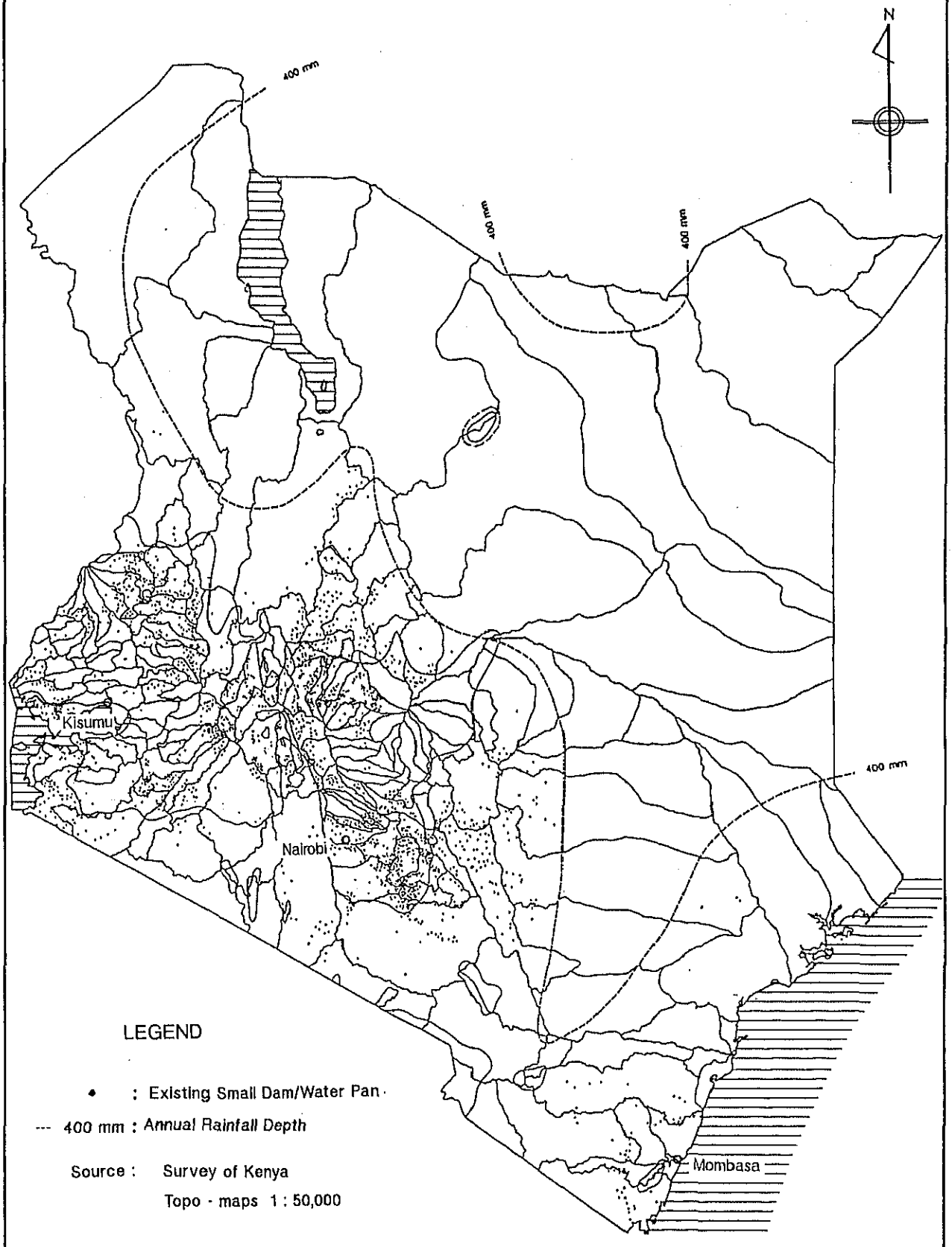

Figure H2.12
Location of Existing Small Dam/Pan

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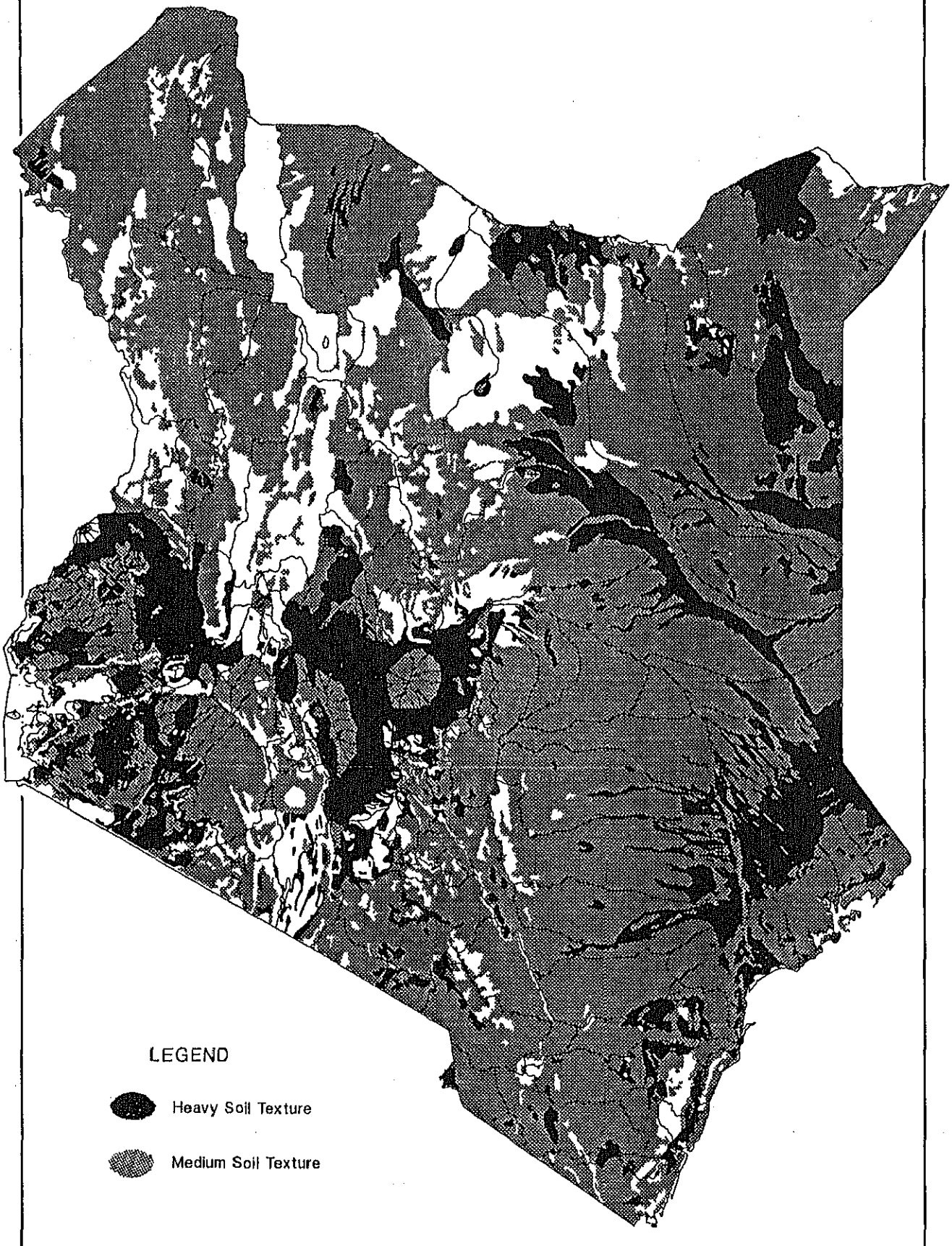

Figure H2.13 Soil Texture Map

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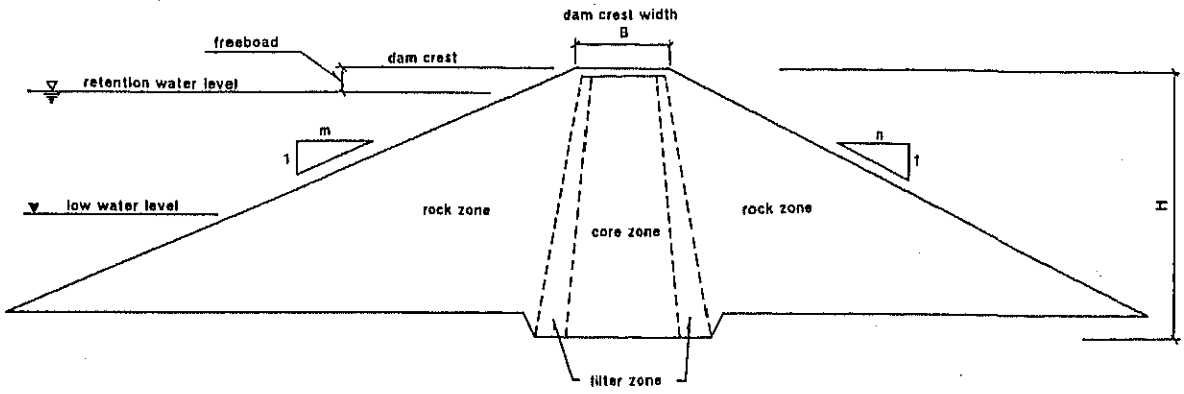

Assumptions for Dam Plan Criteria

Dam embankment volume (V):

A dam embankment volume is estimated by the empirical formula below:

$$V = 1/2 * B * H * (L1 + L2) + 1/6 * (m + n) * H^2 * (L1 + 2 * L2)$$

where,

- B : dam crest width (10 m)
- m : upstream slope of dam embankment (3.0)
- n : downstream slope of dam embankment (2.5)
- H : dam height (m)
- L1 : dam length at crest (m)
- L2 : dam length at bottom (m)

Freeboard (fb):

freeboard = 5 m in case dam height > 30 m
freeboard = 3 m in case dam height < 30 m

Foundation excavation : 5 m deep below ground line

Figure H3.1
Typical Cross Section of Dam Embankment

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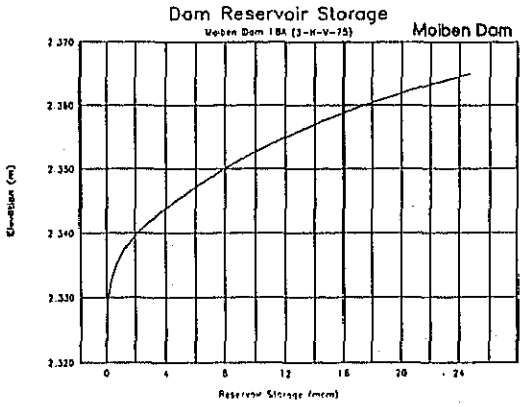

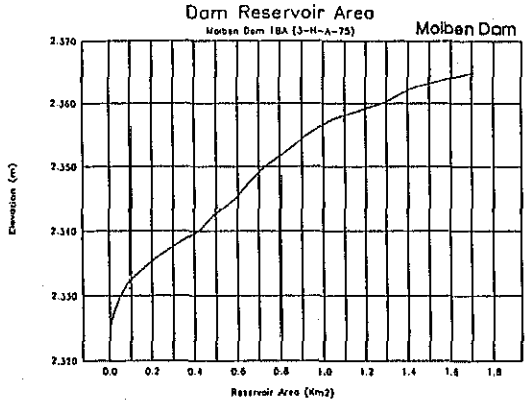

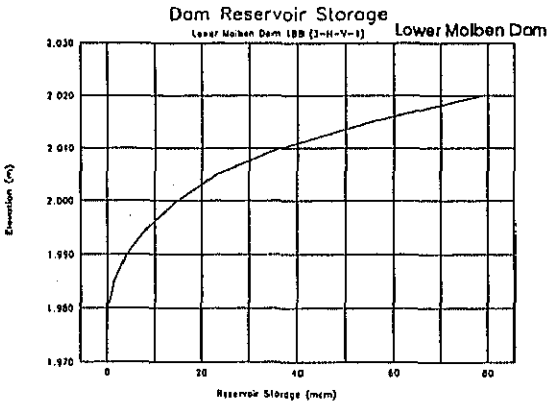

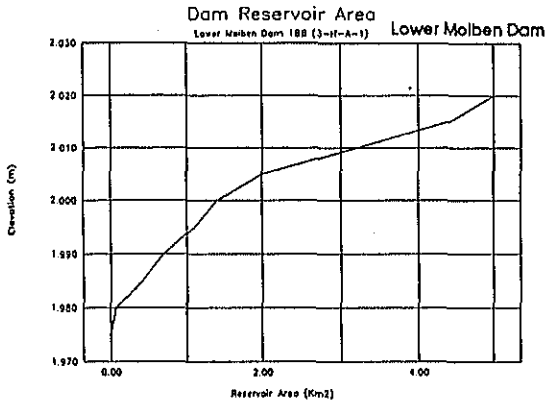

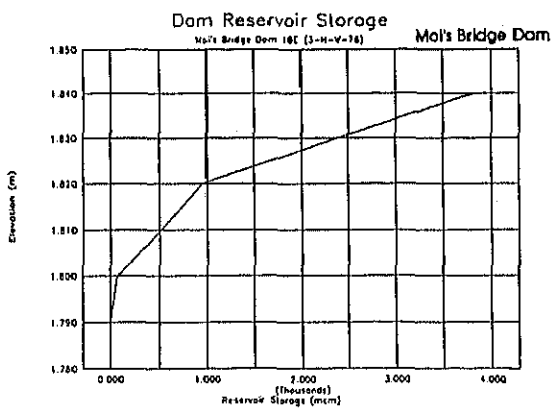

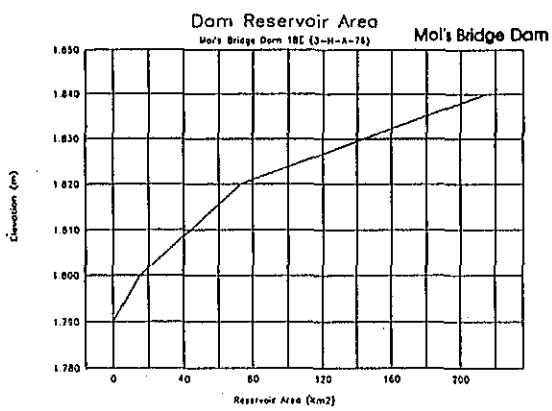

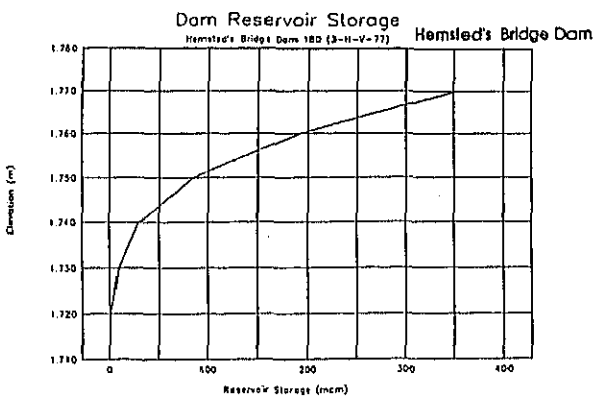

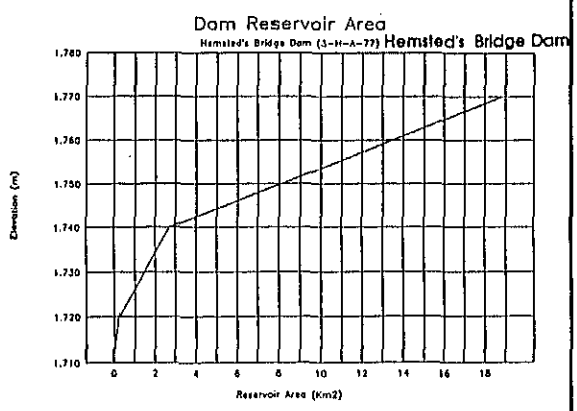

Figure H3.2

Reservoir Storage Capacity and Surface Area by Elevation of Prospective/Potential Dams (1/18)

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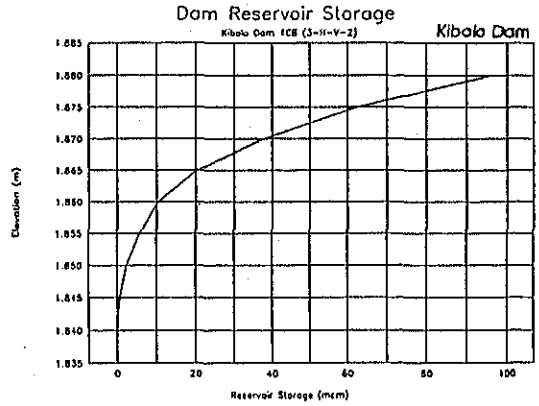

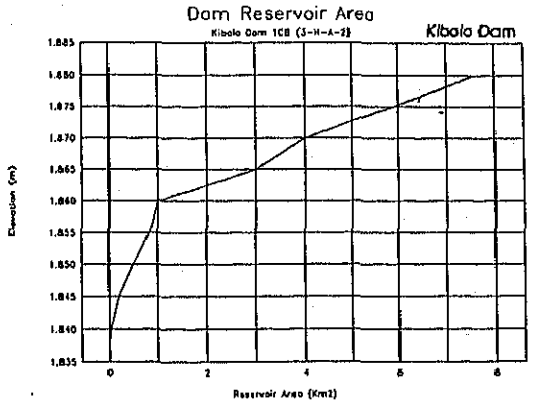

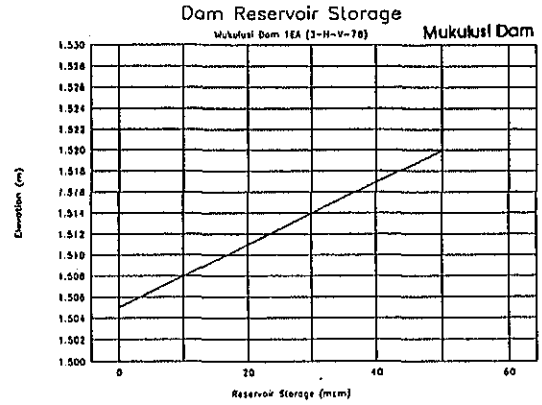

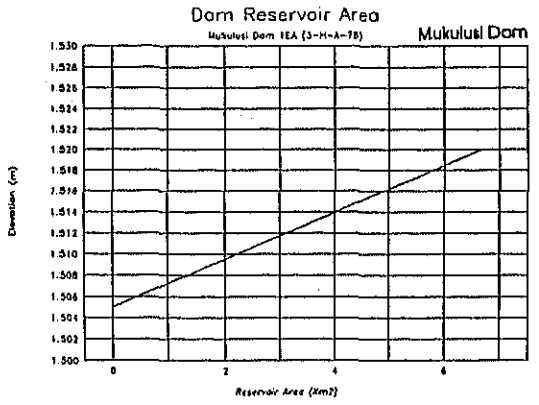

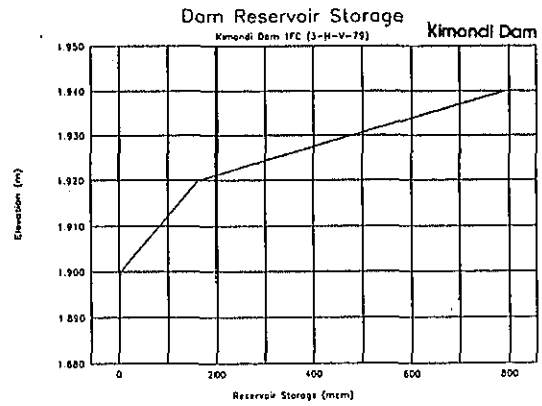

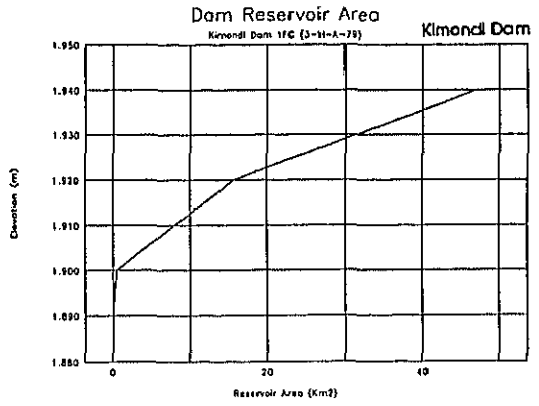

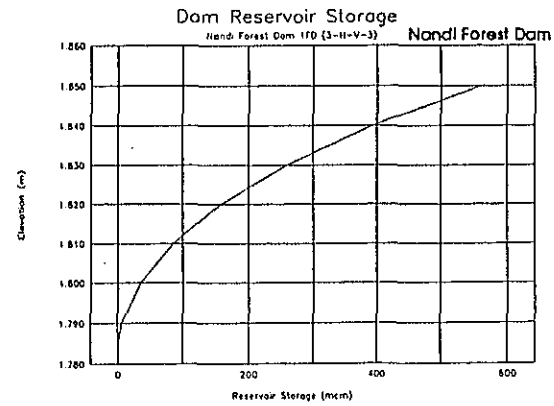

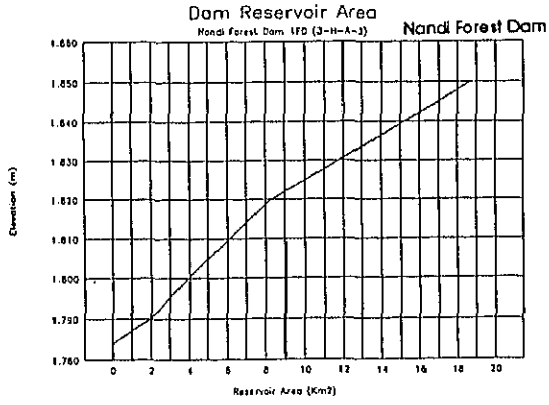

Figure H3.3
Reservoir Storage Capacity and Surface Area by Elevation of Prospective/Potential Dams (2/18)

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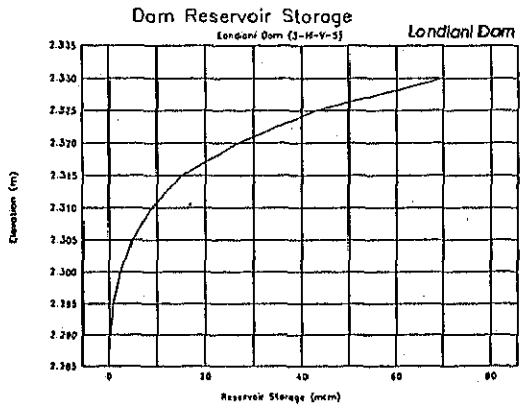
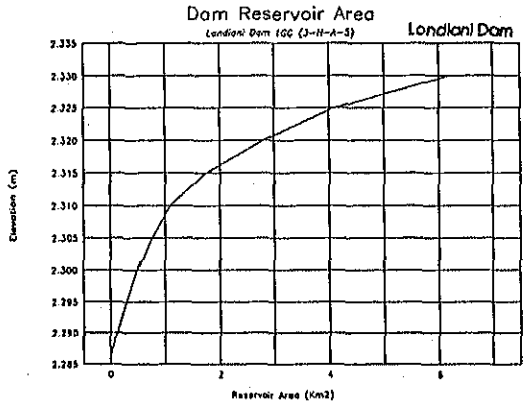
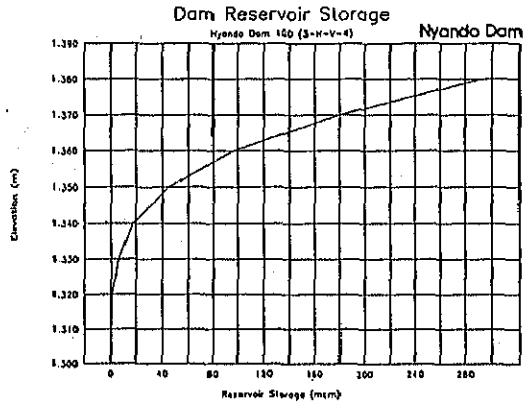
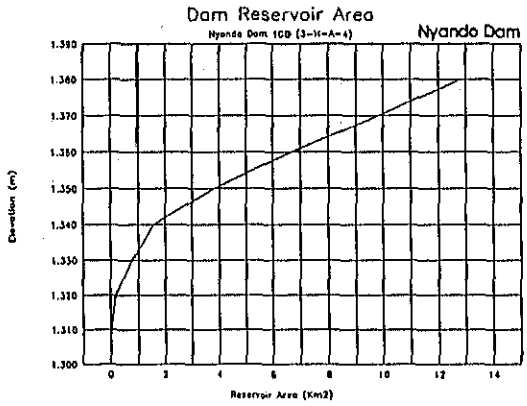
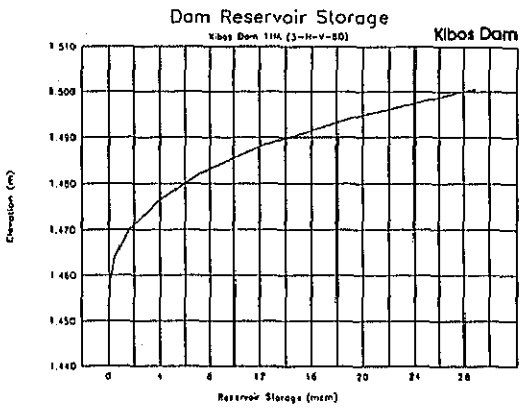
Fig. H3.4

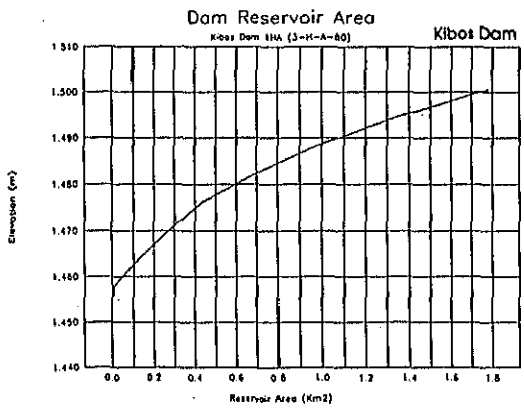


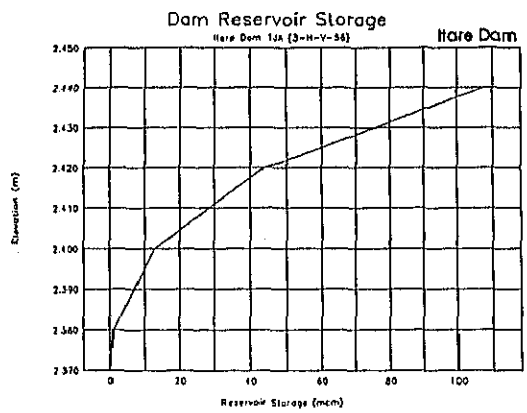












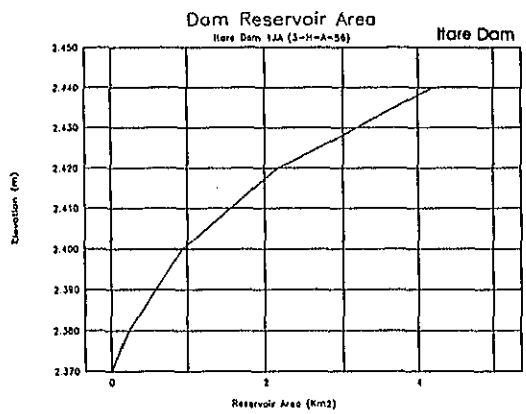


Figure H3.4
Reservoir Storage Capacity and Surface Area by Elevation of Prospective/Potential Dams (3/18)

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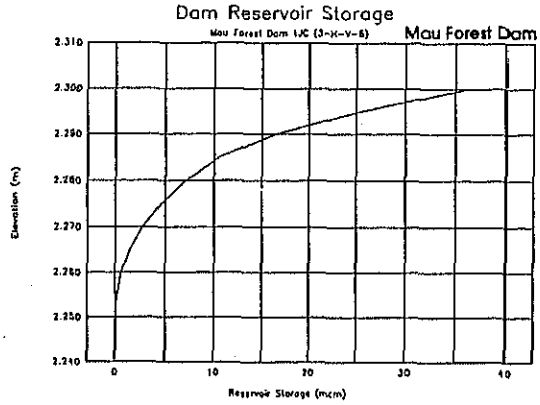

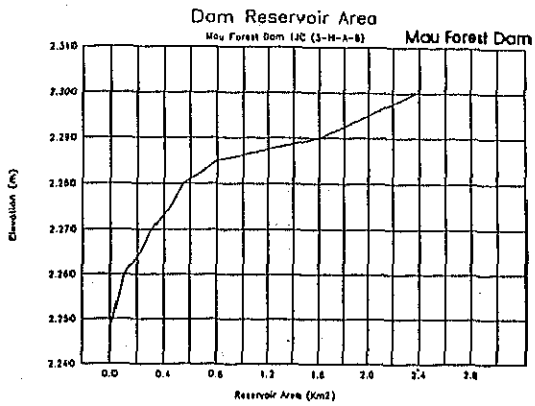

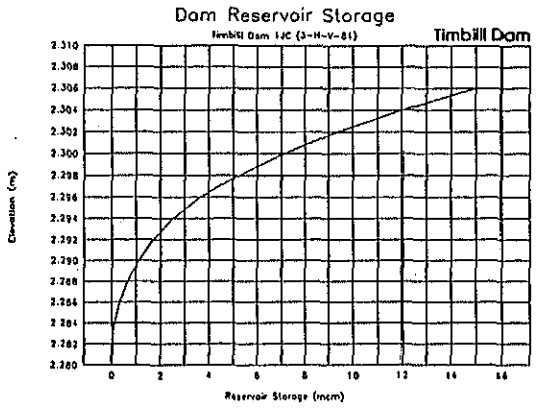

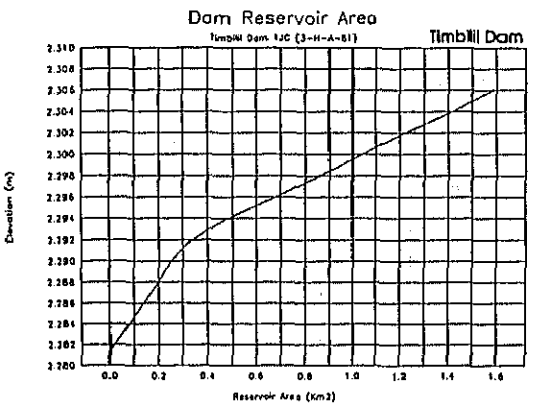

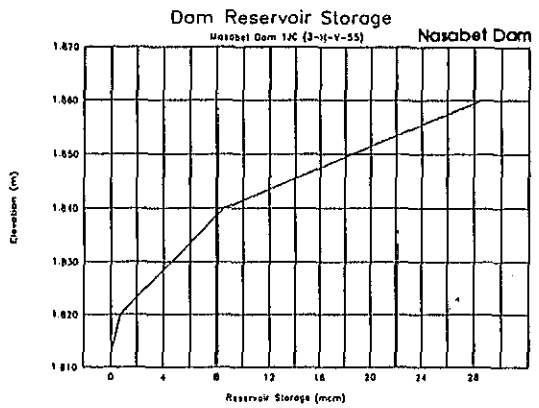

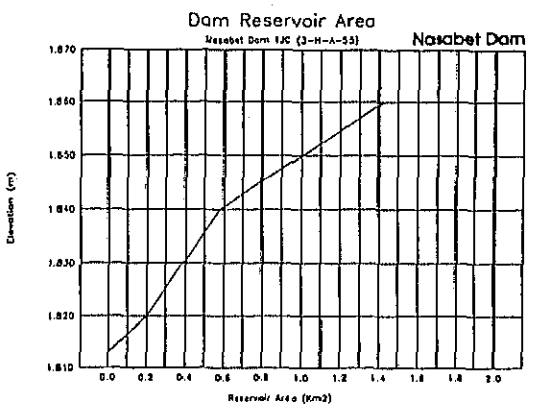

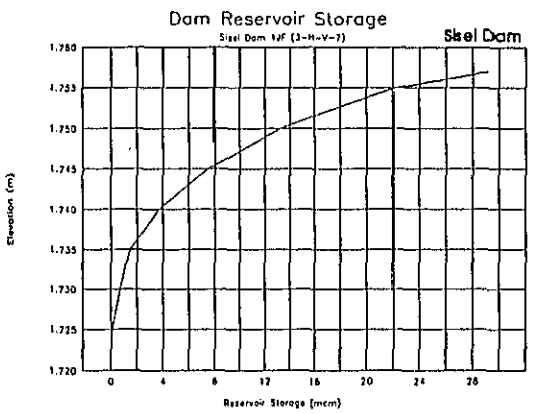

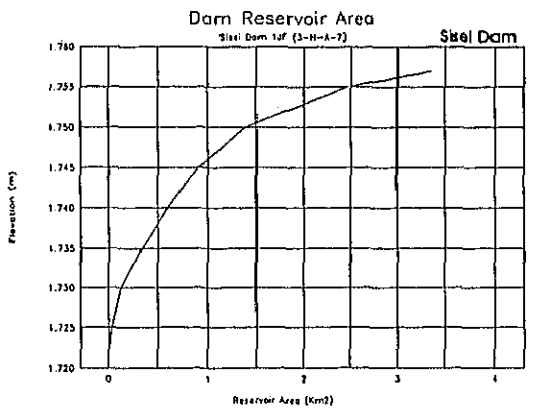

Figure H3.5
Reservoir Storage Capacity and Surface Area by Elevation of Prospective/Potential Dams (4/18)

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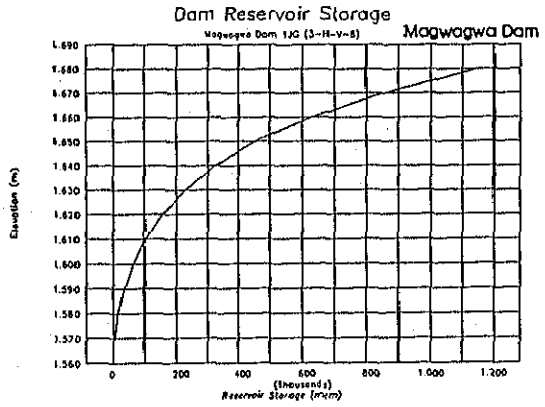

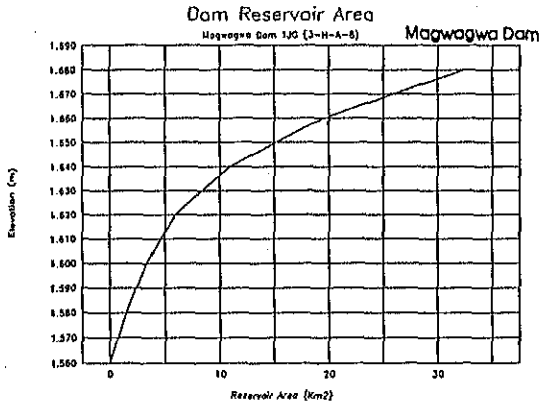

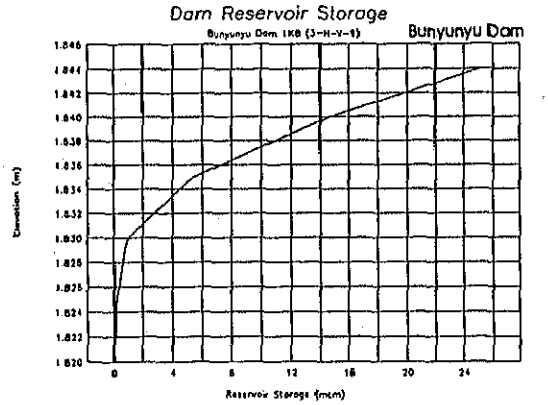

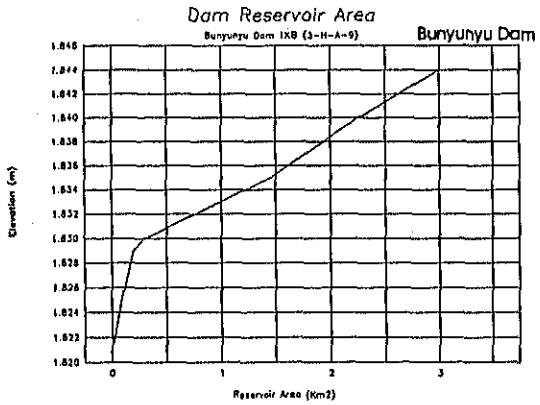

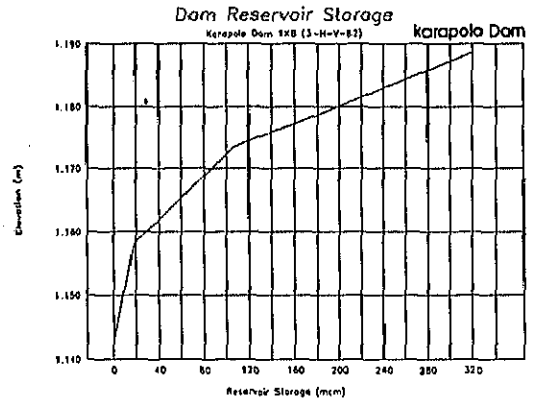

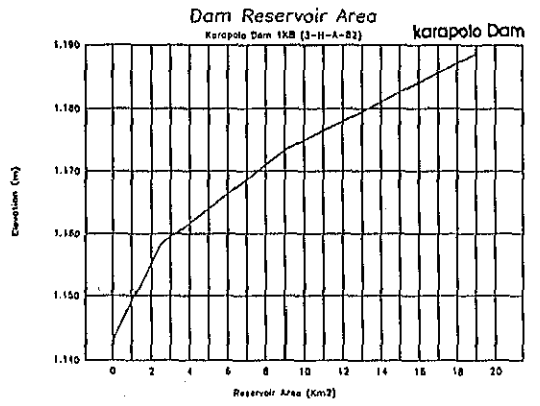

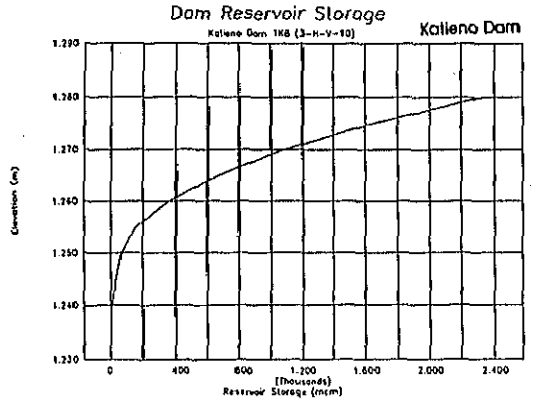

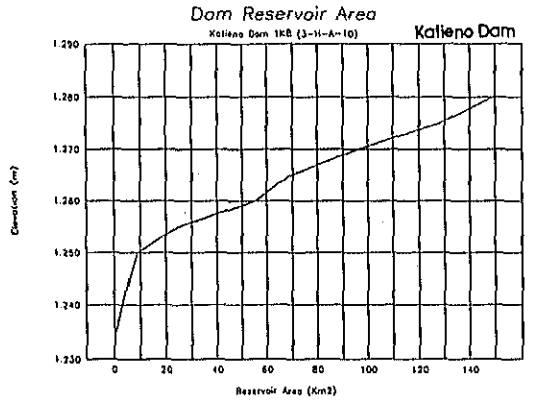

Figure H3.6
Reservoir Storage Capacity and Surface Area by Elevation of Prospective/Potential Dams (5/18)

THE STUDY
ON
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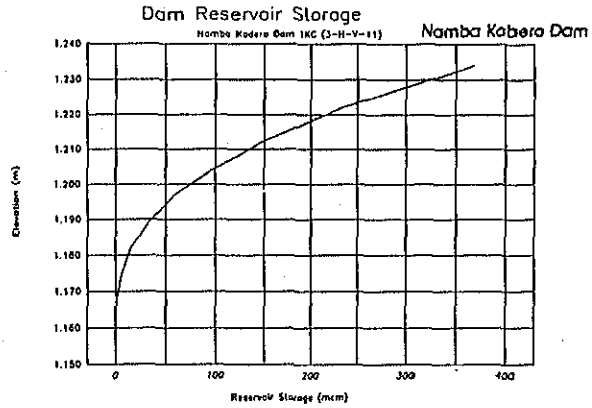

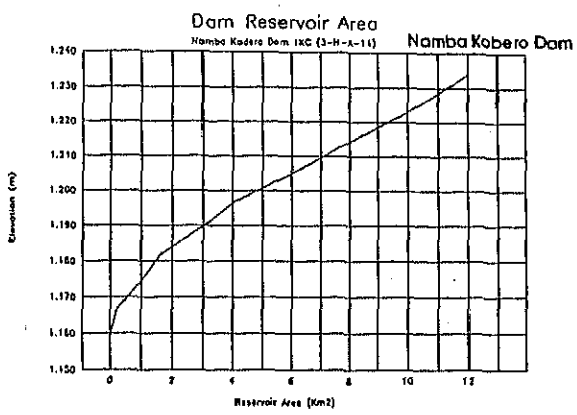

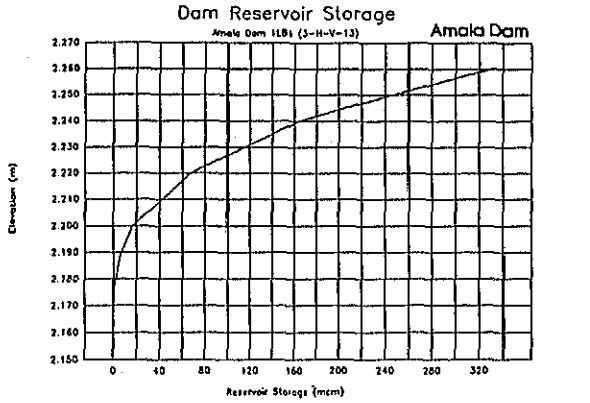

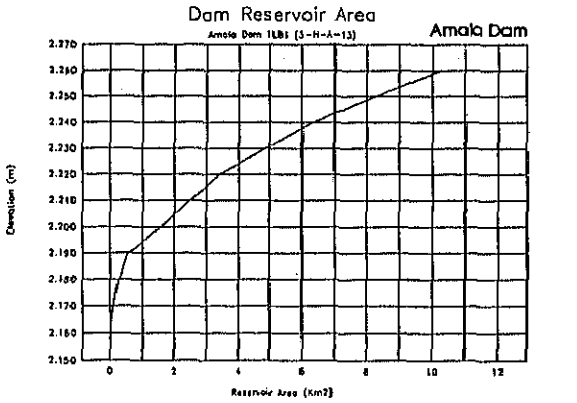

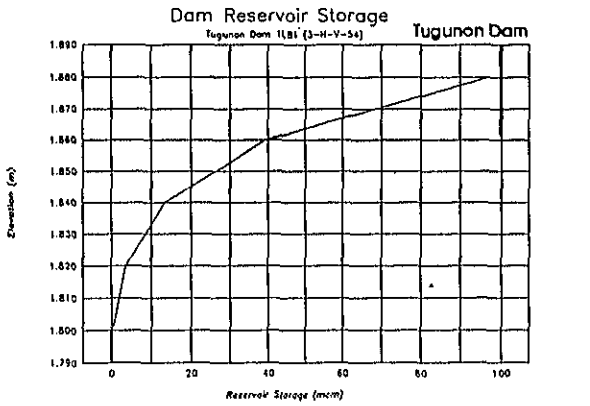

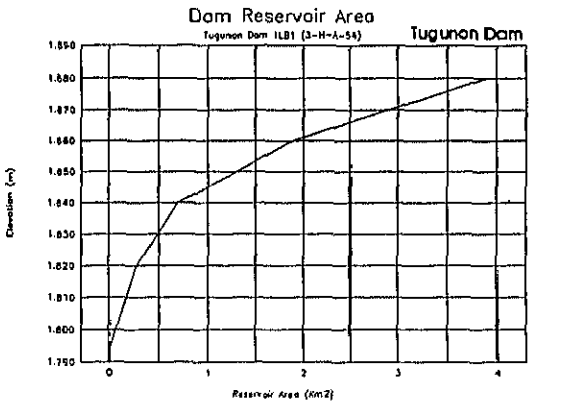

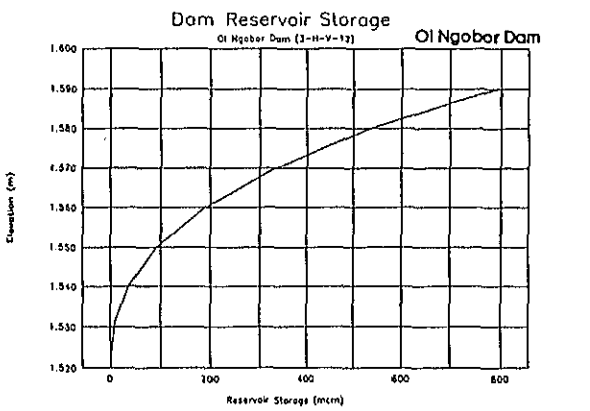

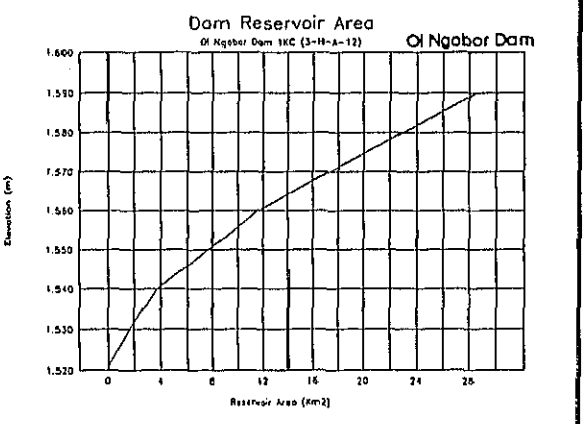

Figure H3.7
Reservoir Storage Capacity and Surface Area by Elevation of Prospective/Potential Dams (6/18)

THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

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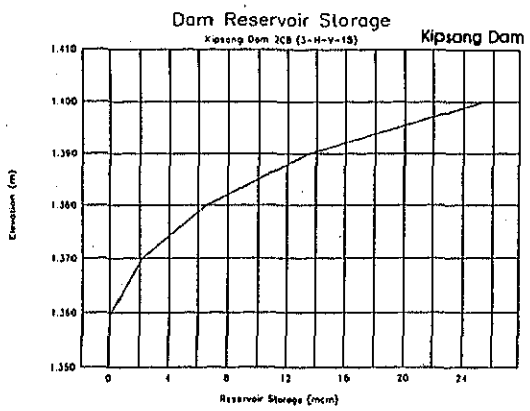

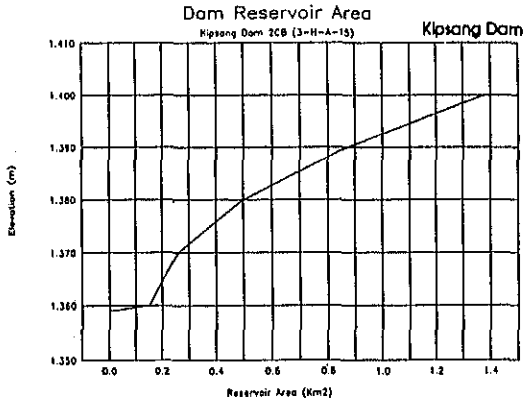

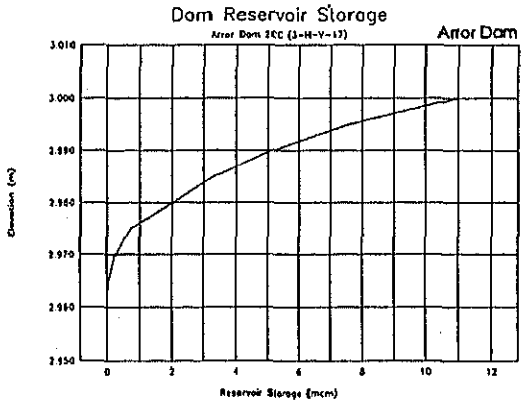

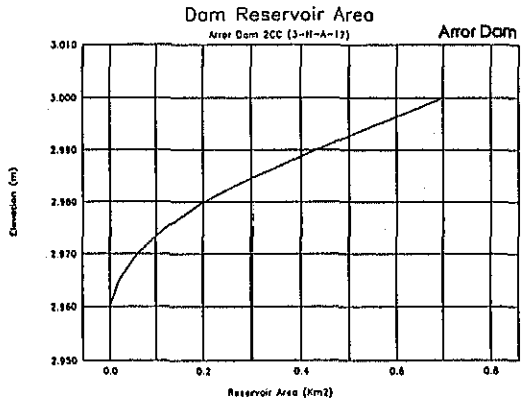

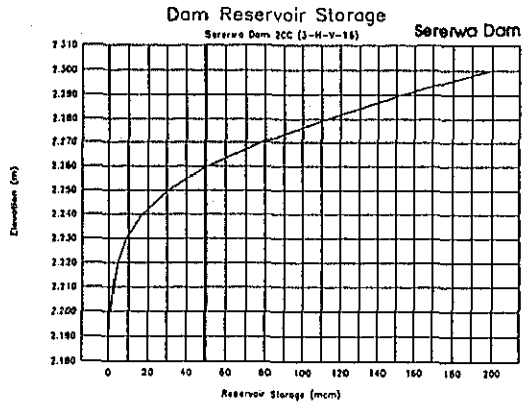

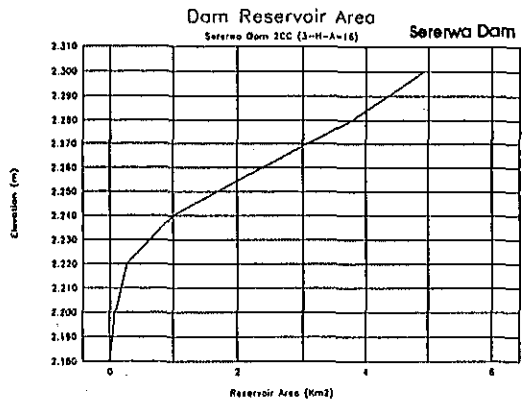

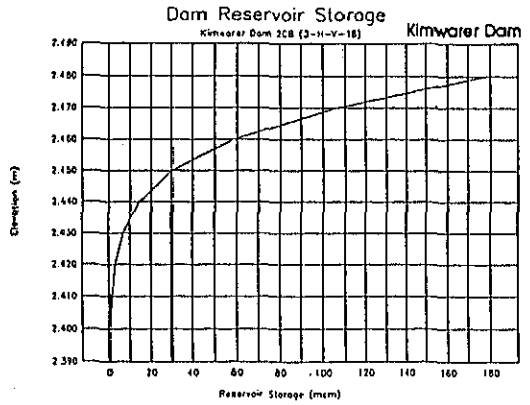

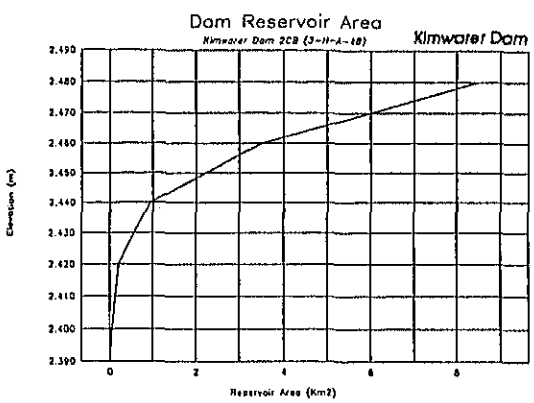

Figure H3.8
Reservoir Storage Capacity and Surface Area by Elevation of Prospective/Potential Dams (7/18)

THE STUDY
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THE NATIONAL WATER MASTER PLAN

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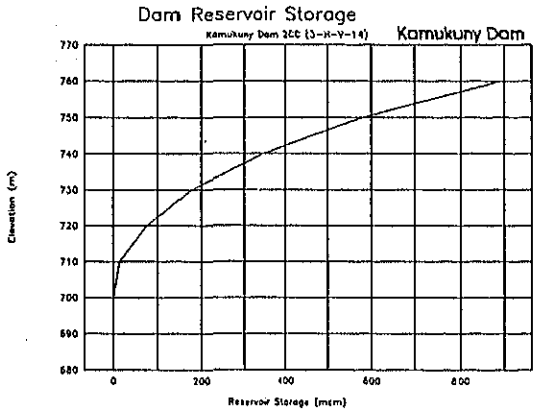
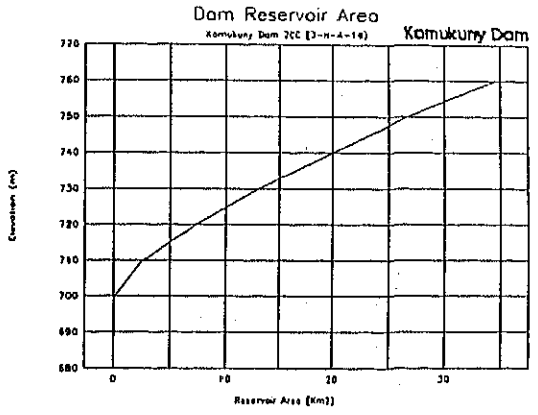
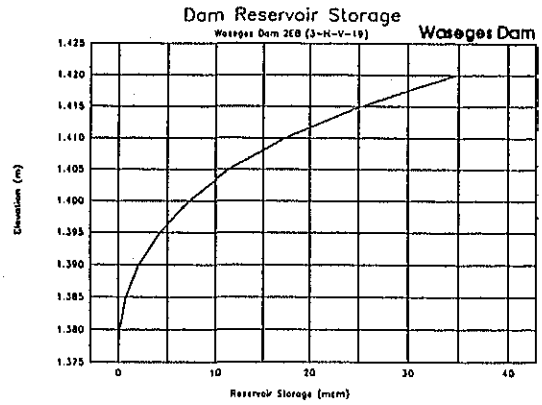
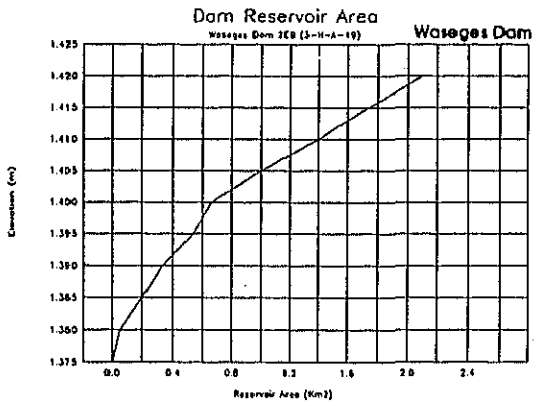
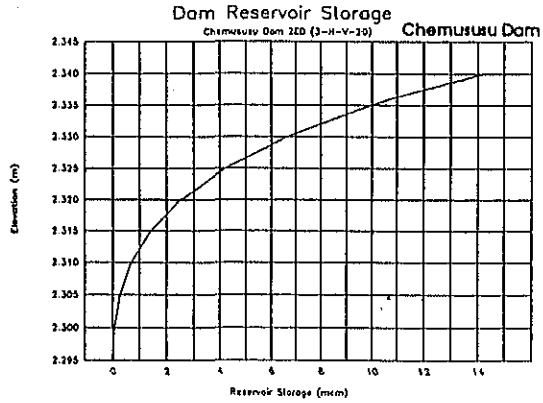
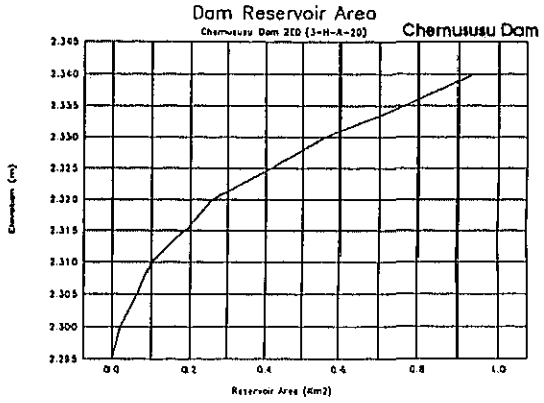


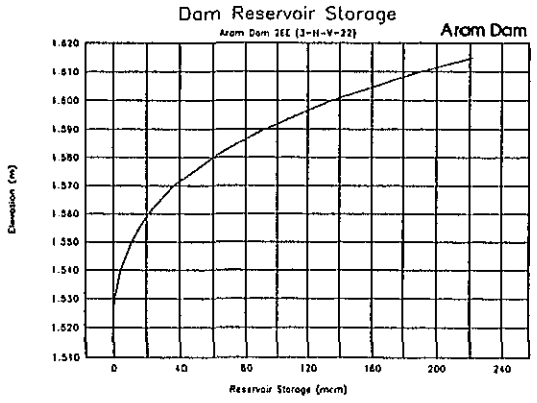












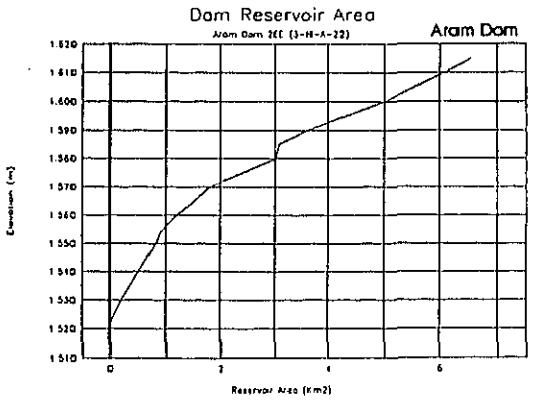
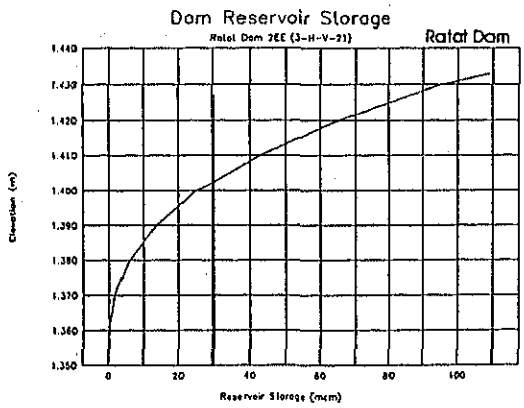
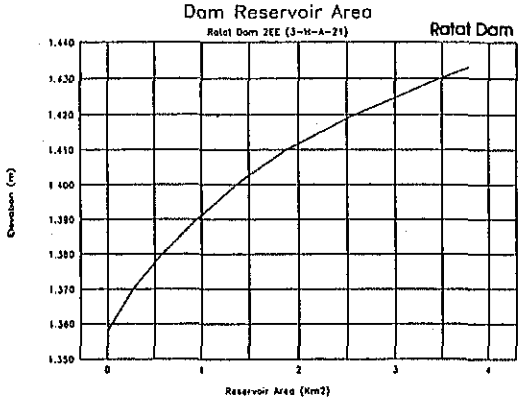
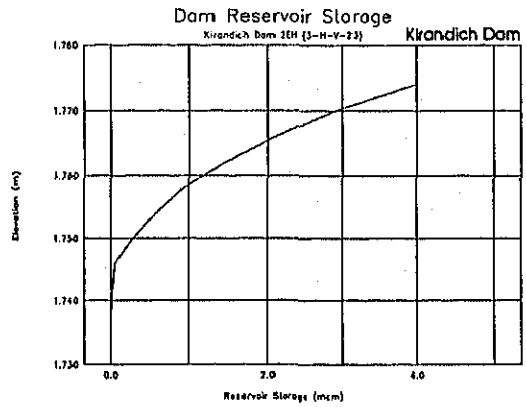


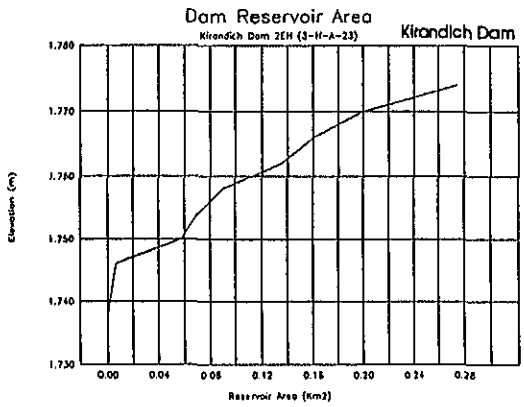
Figure H3.9
Reservoir Storage Capacity and Surface Area
by Elevation of Prospective/Potential Dams (8/18)

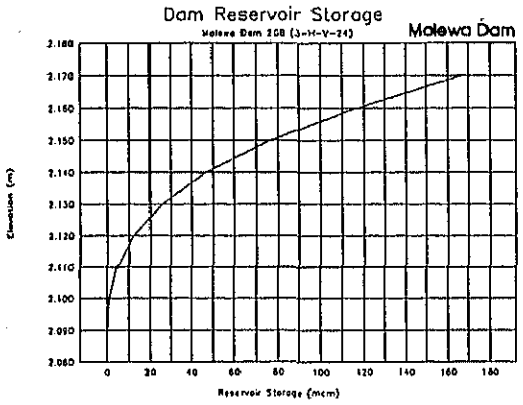
THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

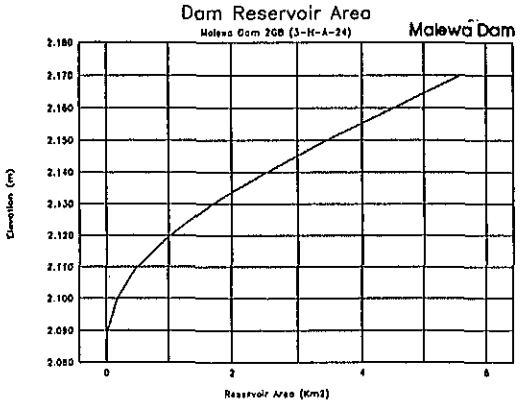


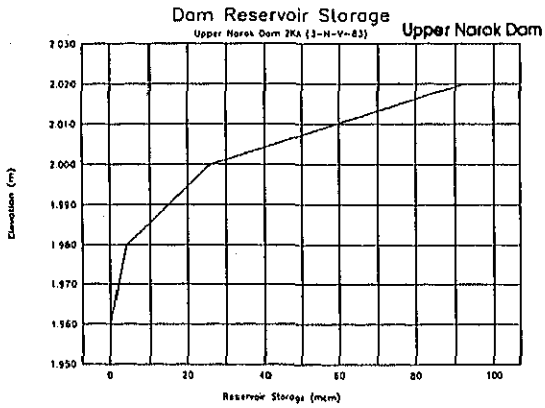












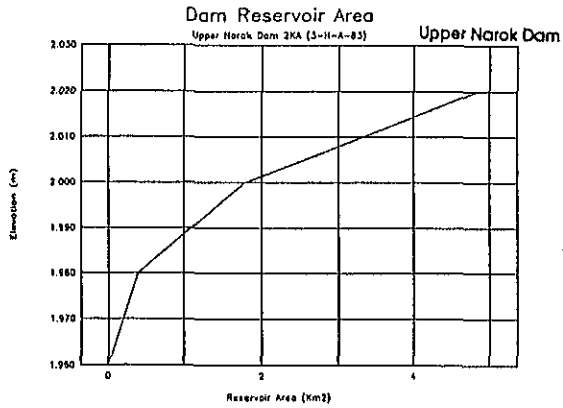


Figure H3.10
Reservoir Storage Capacity and Surface Area by Elevation of Prospective/Potential Dams (9/18)

THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

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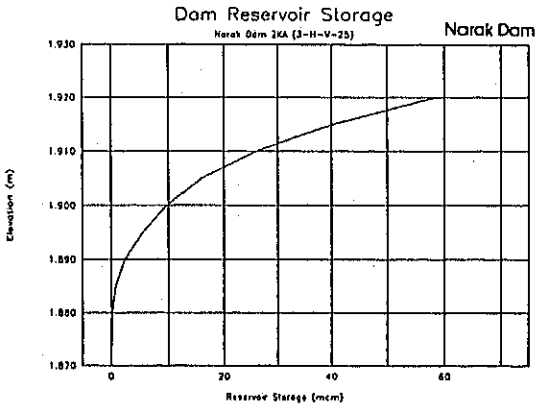
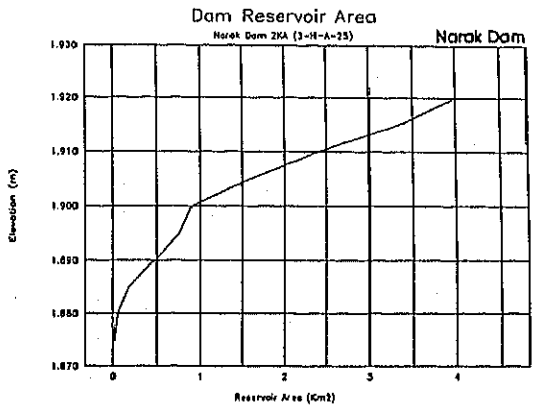
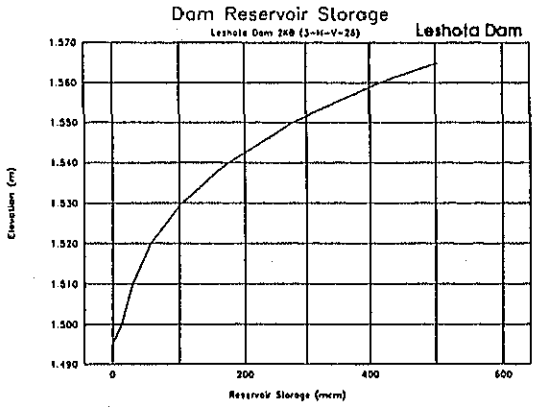
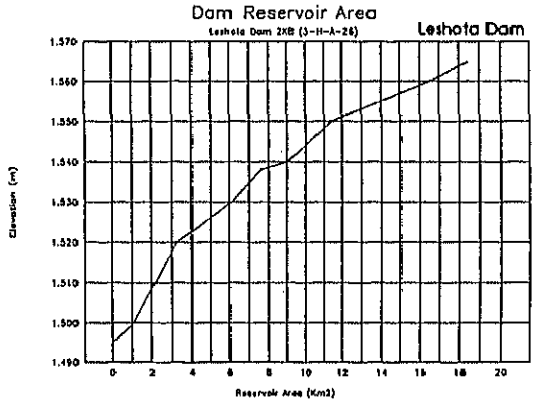
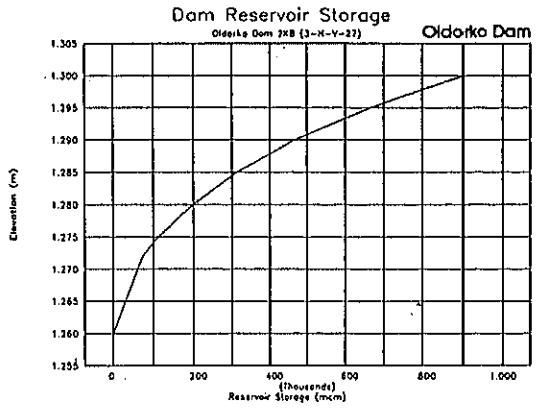
Fig. H3.11

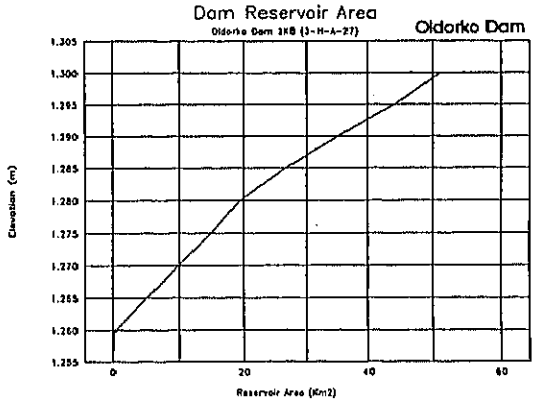


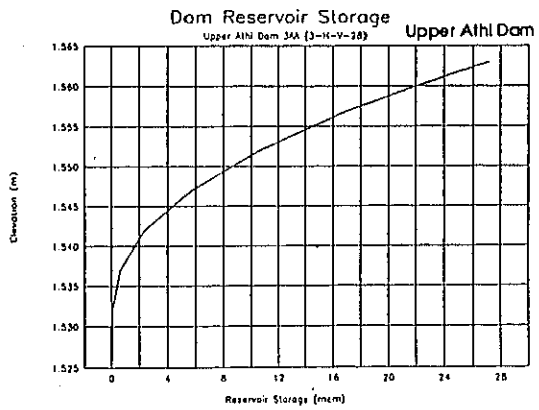












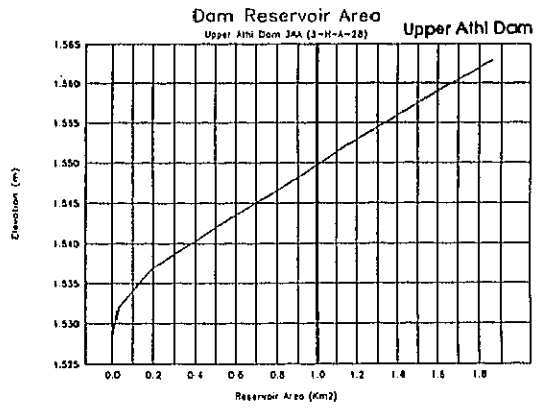


Figure H3.11
Reservoir Storage Capacity and Surface Area
by Elevation of Prospective/Potential Dams (10/18)

THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

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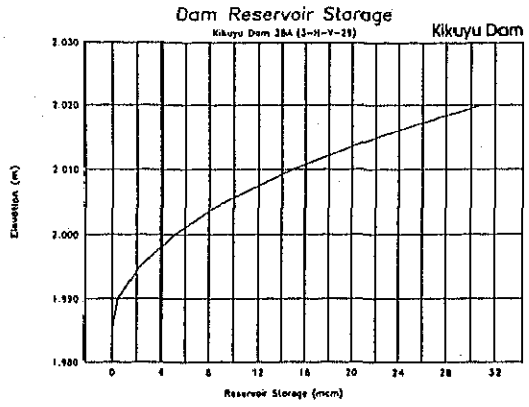

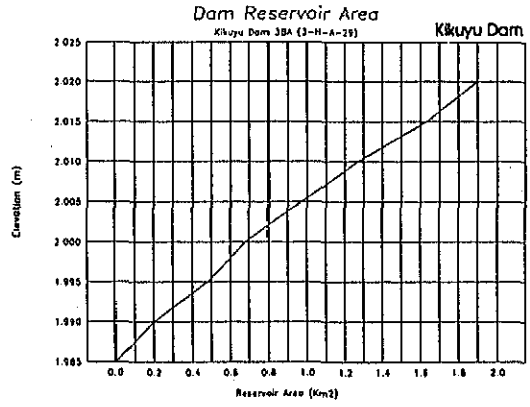

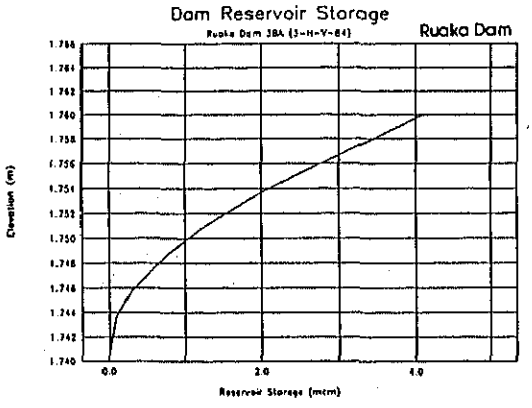

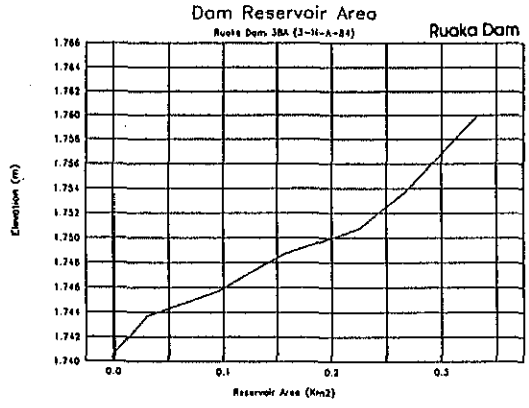

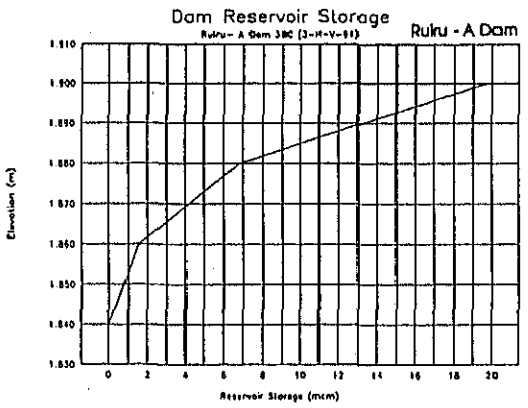

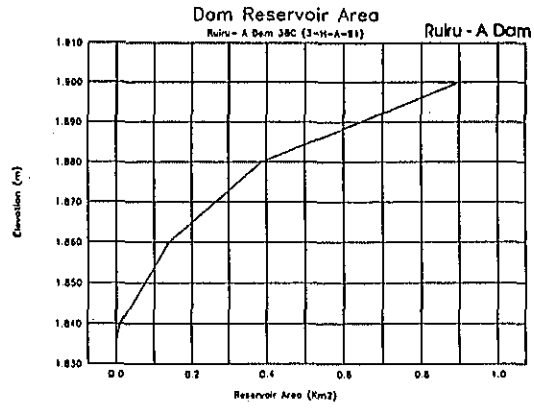

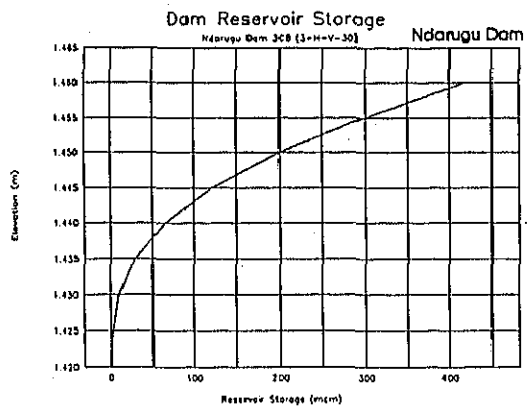

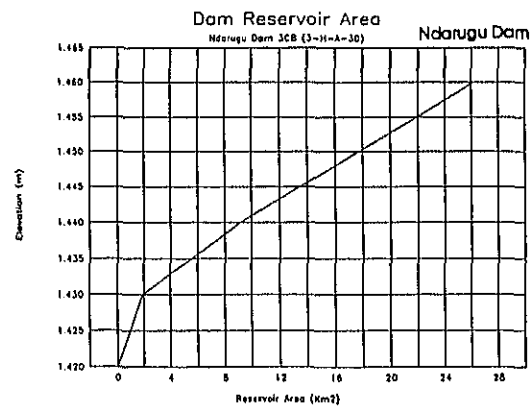

Figure H3.12
Reservoir Storage Capacity and Surface Area by Elevation of Prospective/Potential Dams (11/18)

THE STUDY
ON
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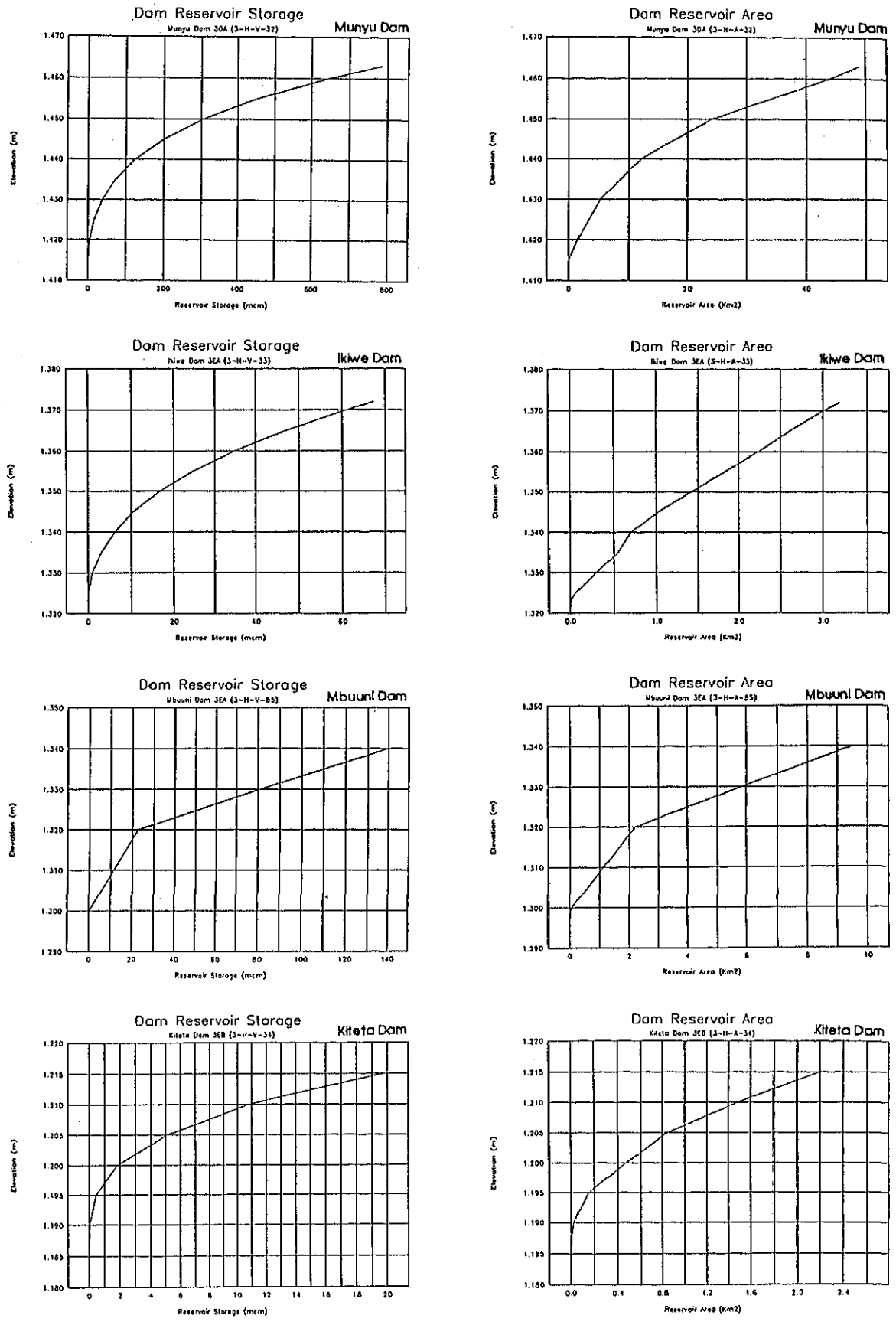
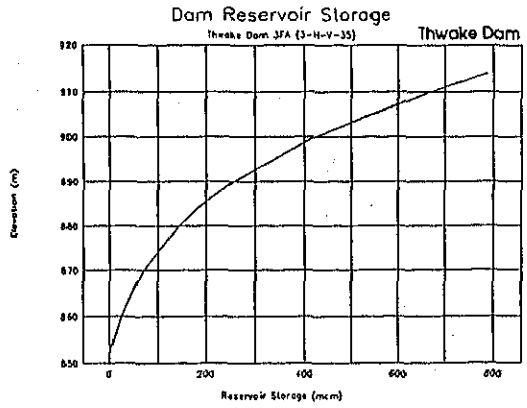
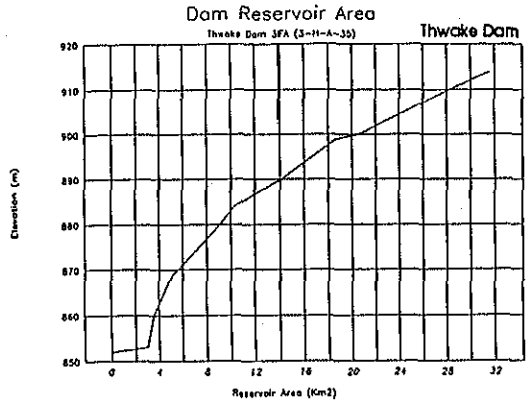


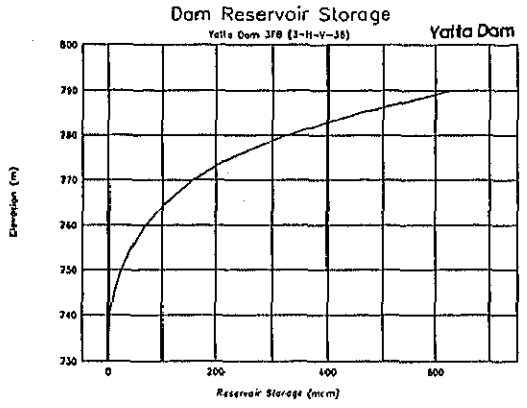
Figure H3.13
Reservoir Storage Capacity and Surface Area
by Elevation of Prospective/Potential Dams (12/18)

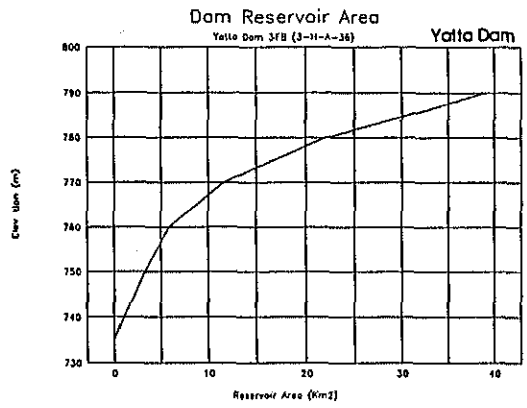
THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

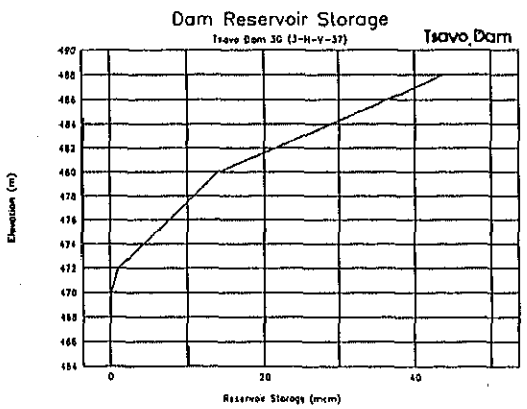
JAPAN INTERNATIONAL COOPERATION AGENCY

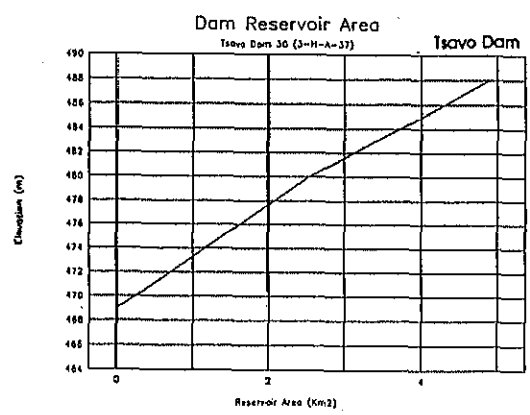


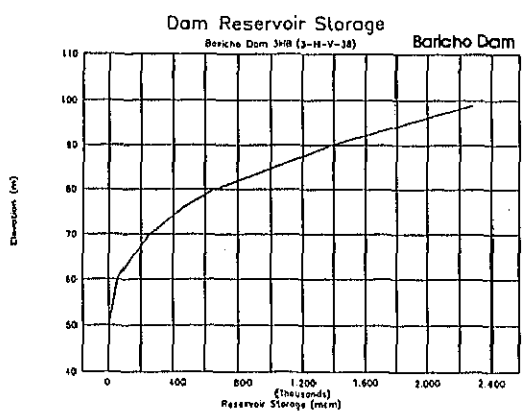












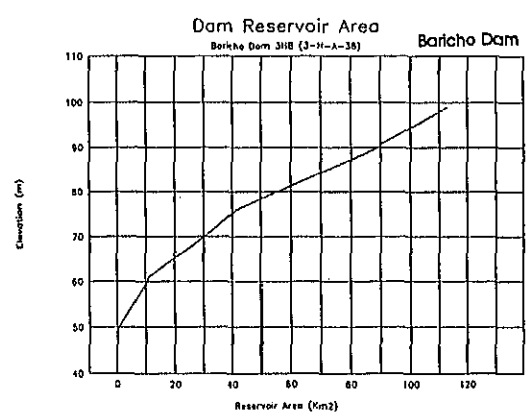


Figure H3.14
Reservoir Storage Capacity and Surface Area by Elevation of Prospective/Potential Dams (13/18)

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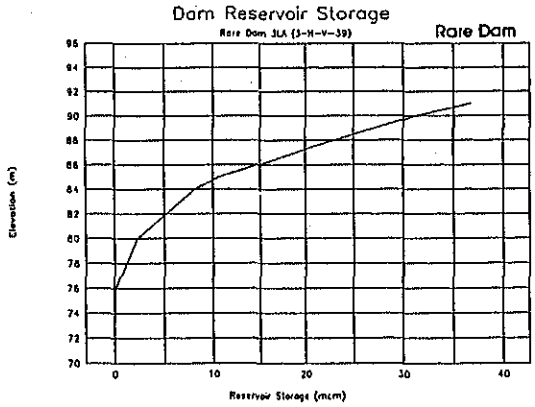

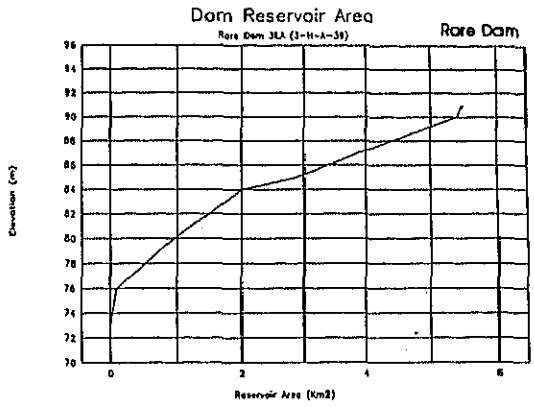

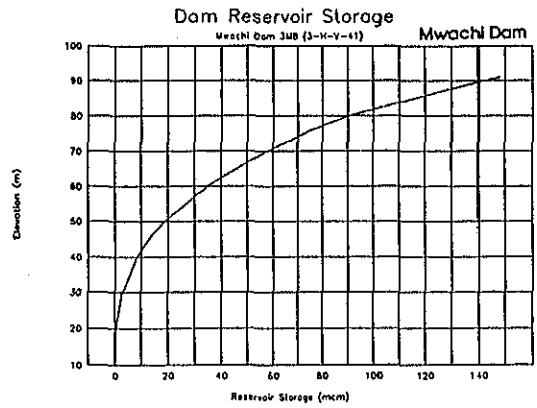

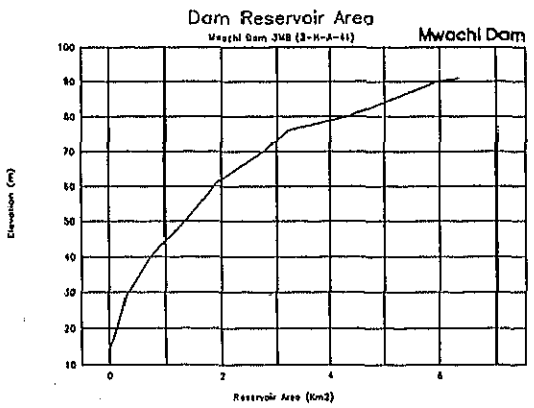

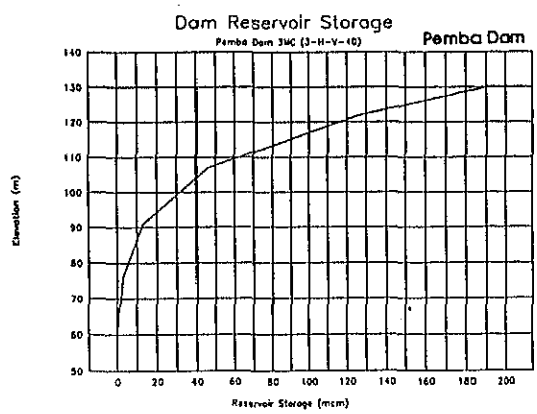

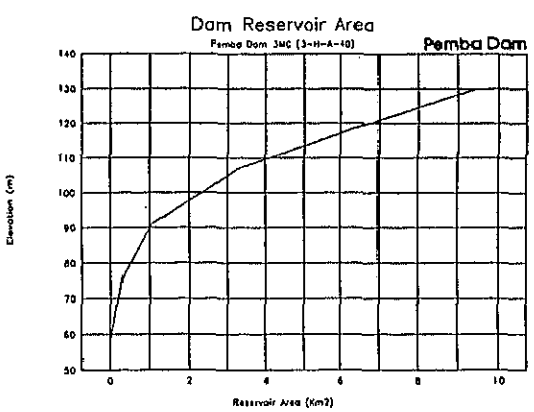

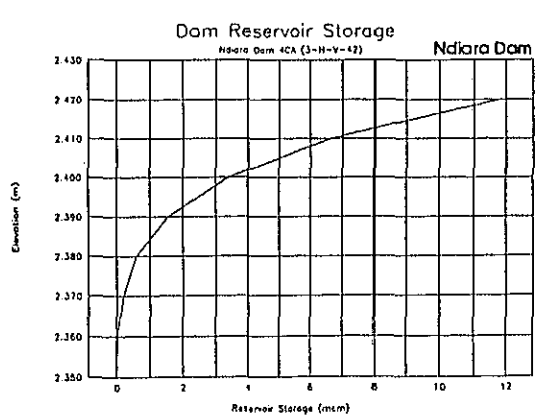

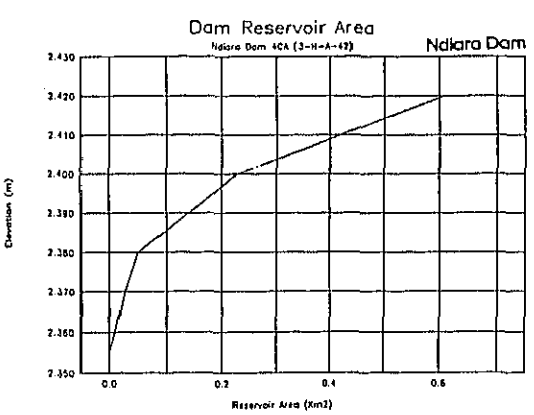

Figure H3.15
Reservoir Storage Capacity and Surface Area
by Elevation of Prospective/Potential Dams (14/18)

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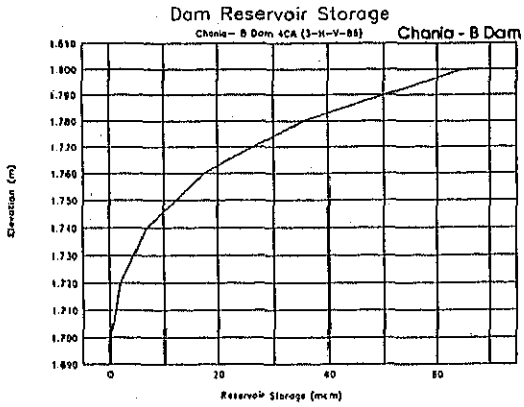

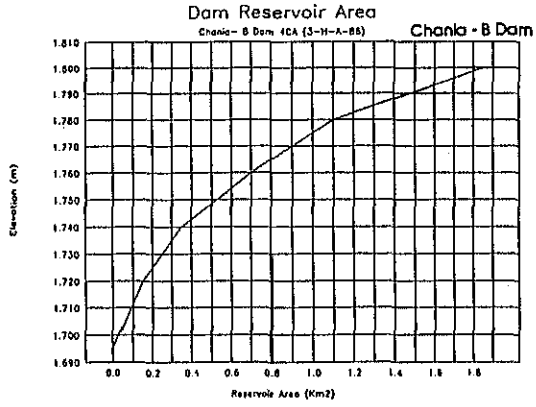

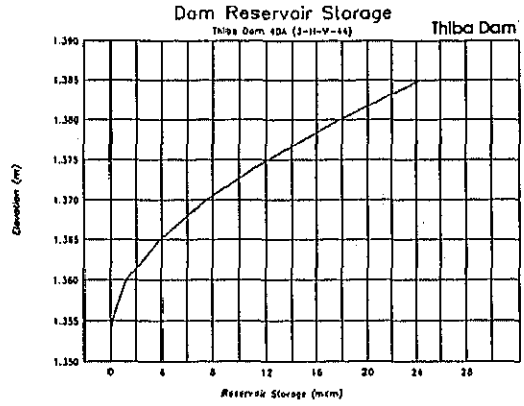

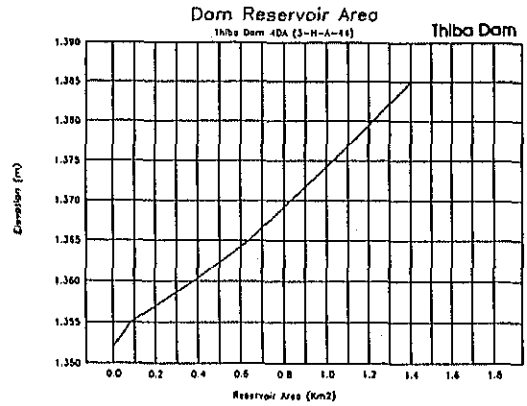

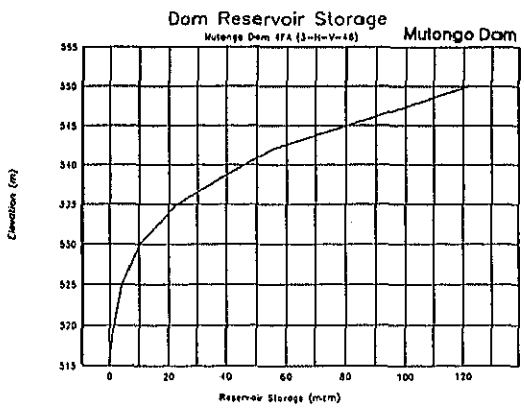

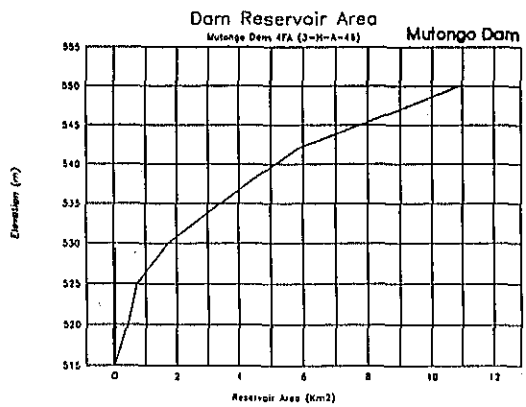

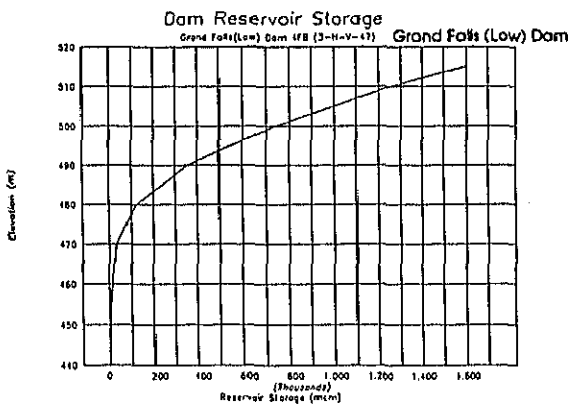

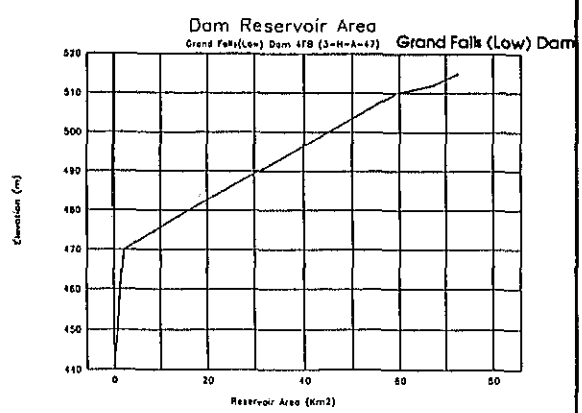

Figure H3.16

Reservoir Storage Capacity and Surface Area by Elevation of Prospective/Potential Dams (15/18)

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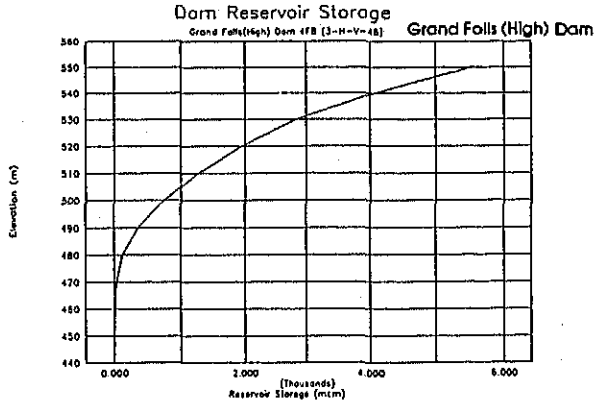
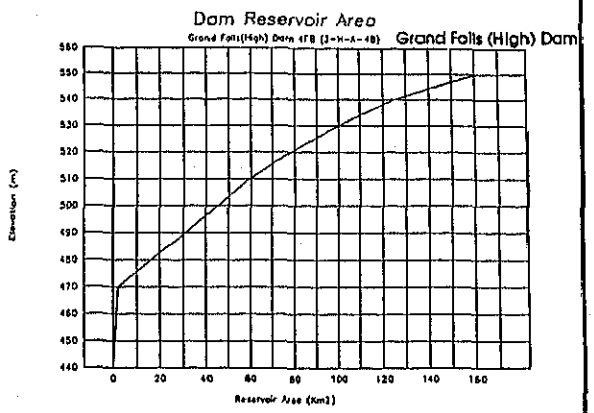
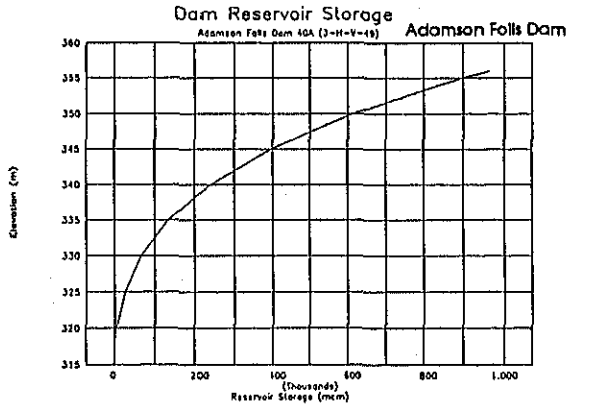
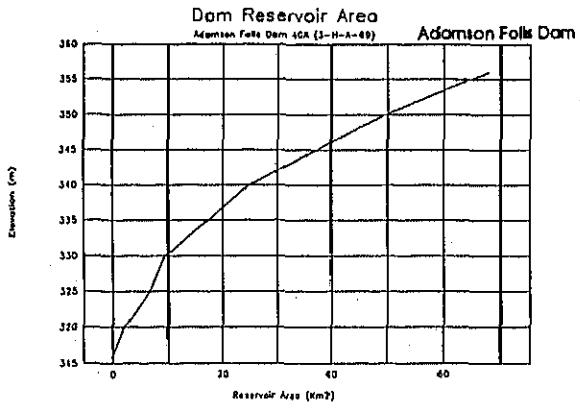
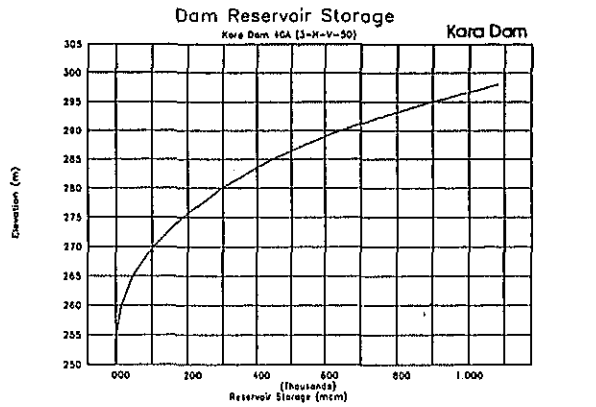
Fig. H3.17

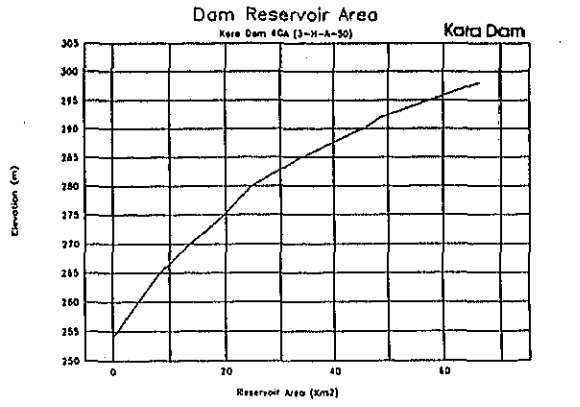


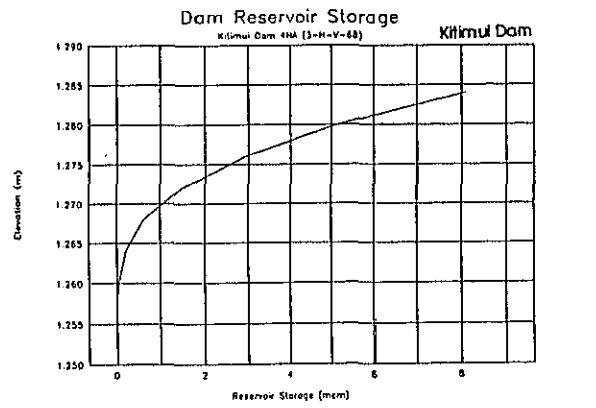












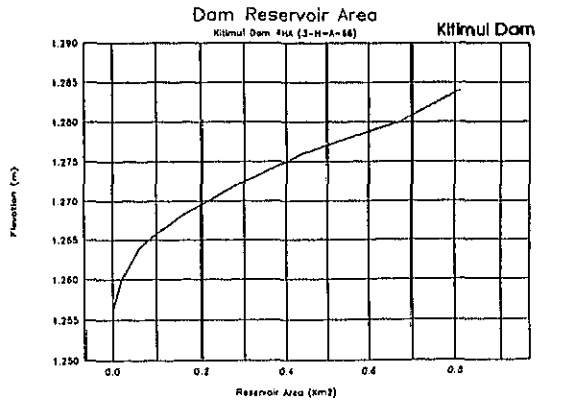


Figure H3.17
Reservoir Storage Capacity and Surface Area
by Elevation of Prospective/Potential Dams (16/18)

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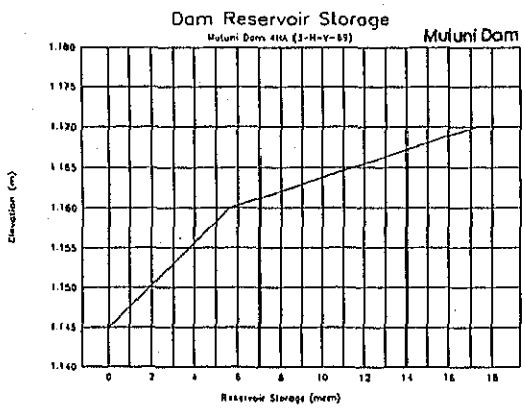

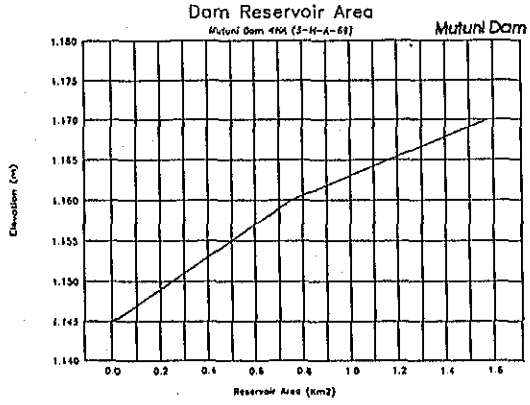

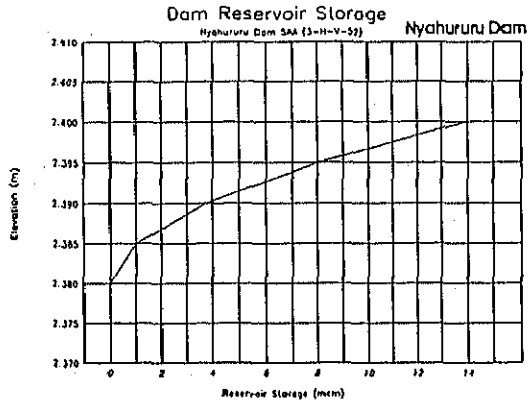

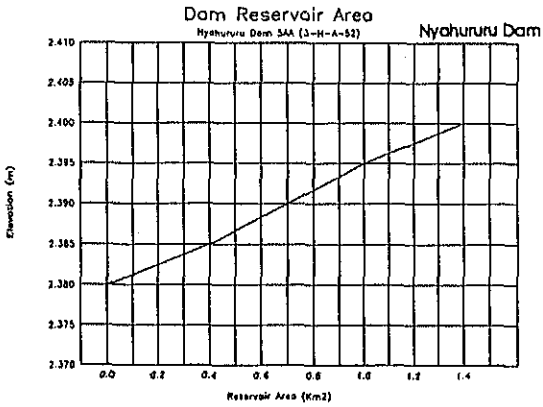

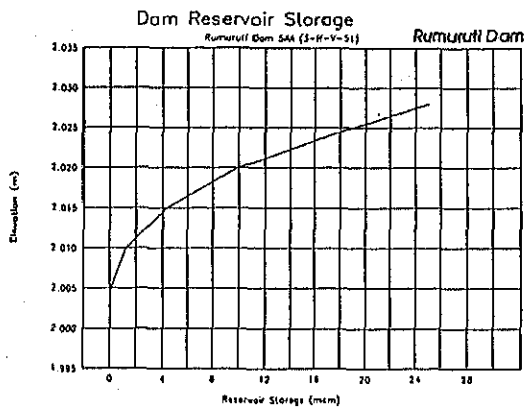

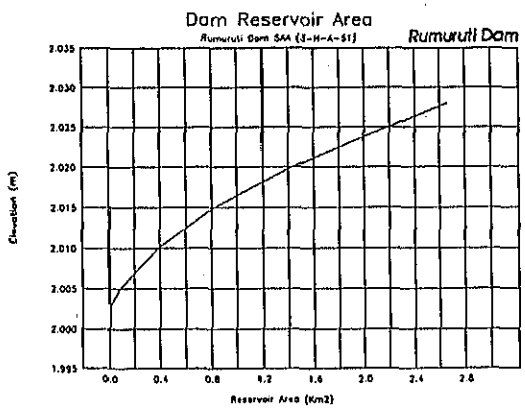

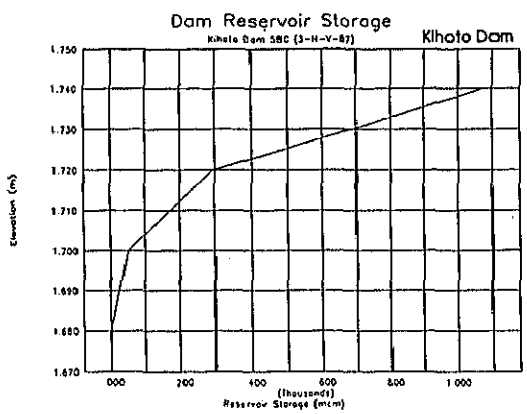

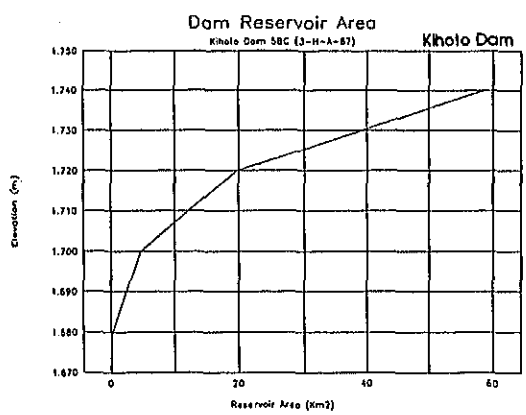

Figure H3.18
Reservoir Storage Capacity and Surface Area
by Elevation of Prospective/Potential Dams (17/18)

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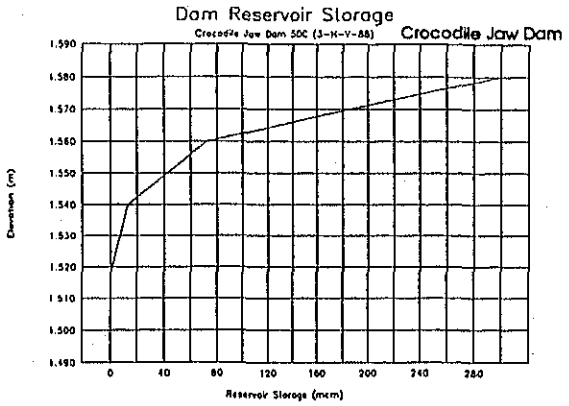

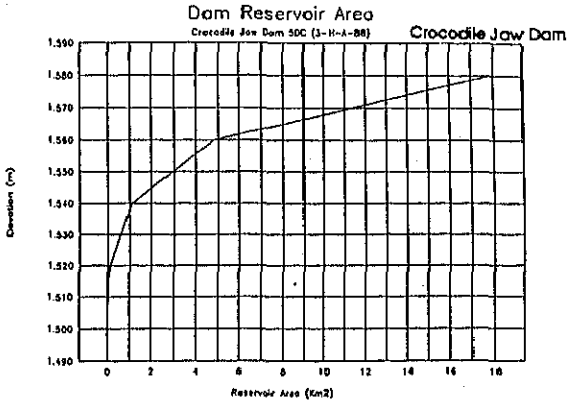

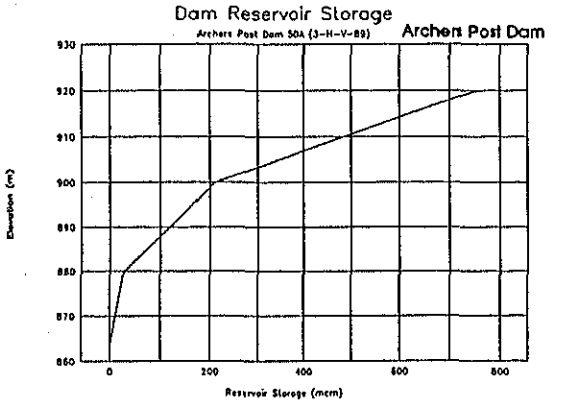

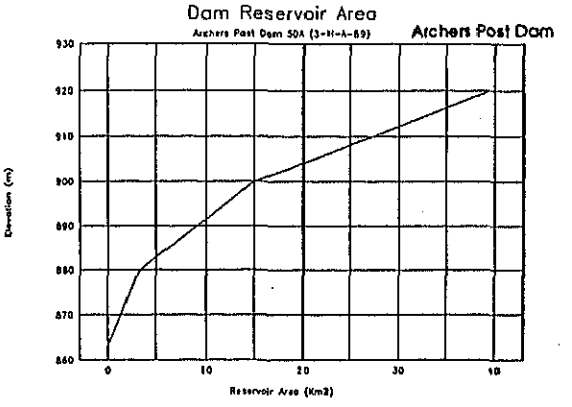

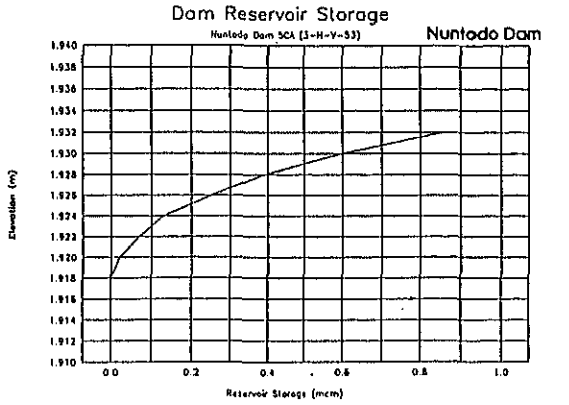

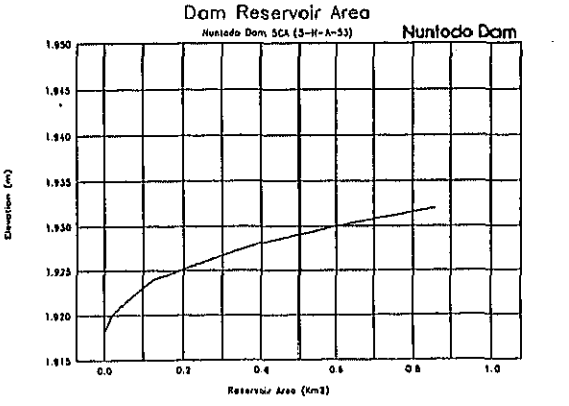

Figure H3.19
Reservoir Storage Capacity and Surface Area by Elevation of Prospective/Potential Dams (18/18)

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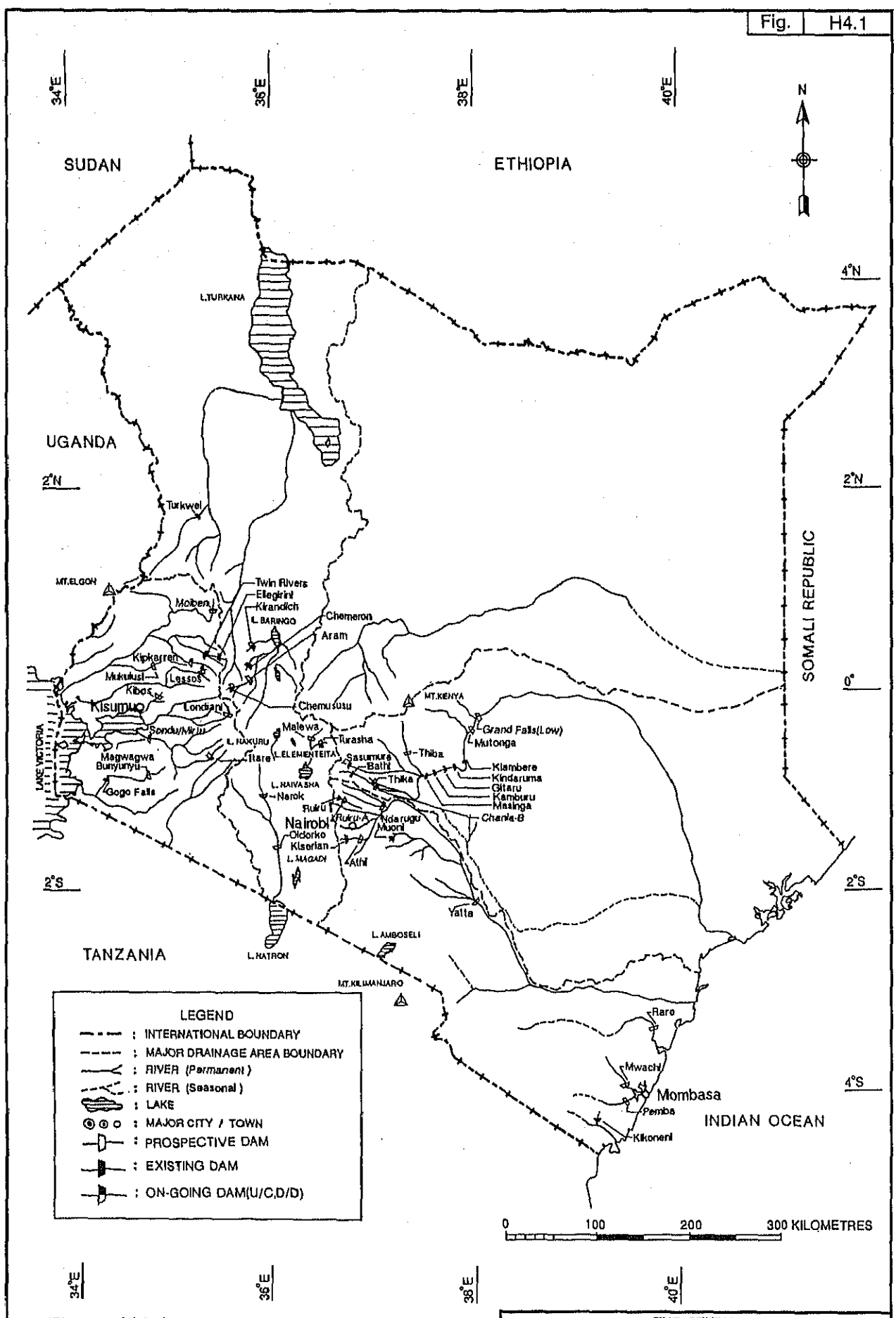

Figure H4.1
Location of Prospective Dams

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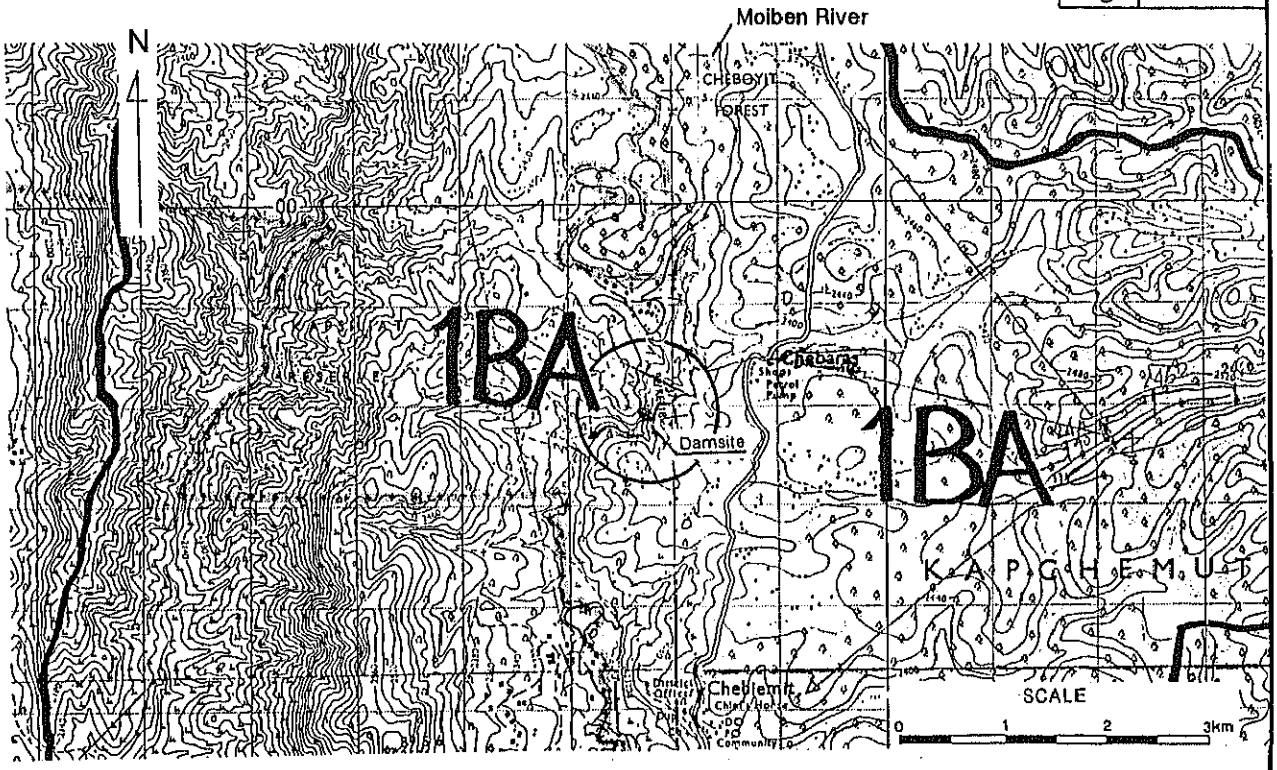
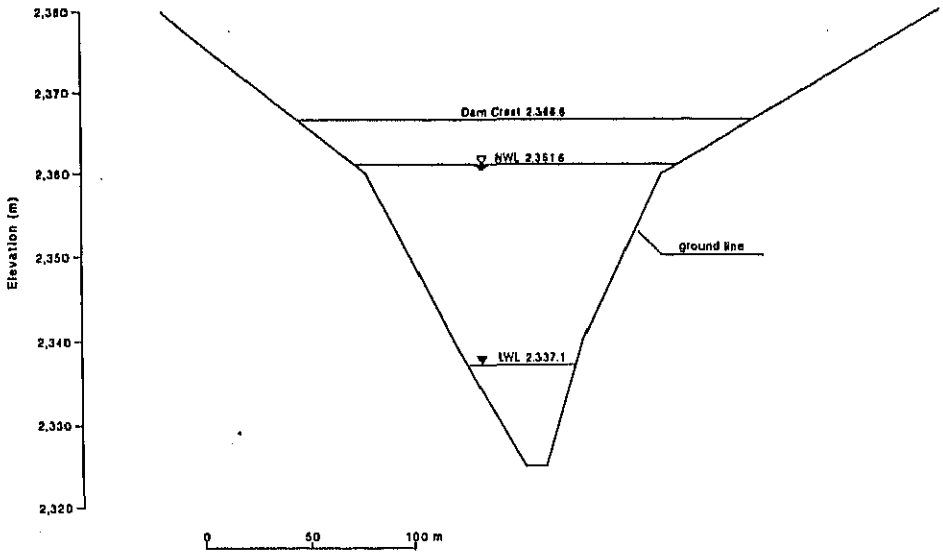
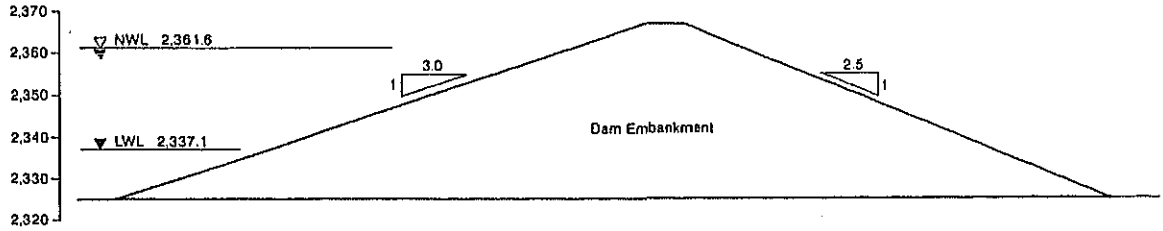
Fig. H4.2







Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

Figure H4.2
Preliminary Layout of Prospective Dam
(Moiben Dam)

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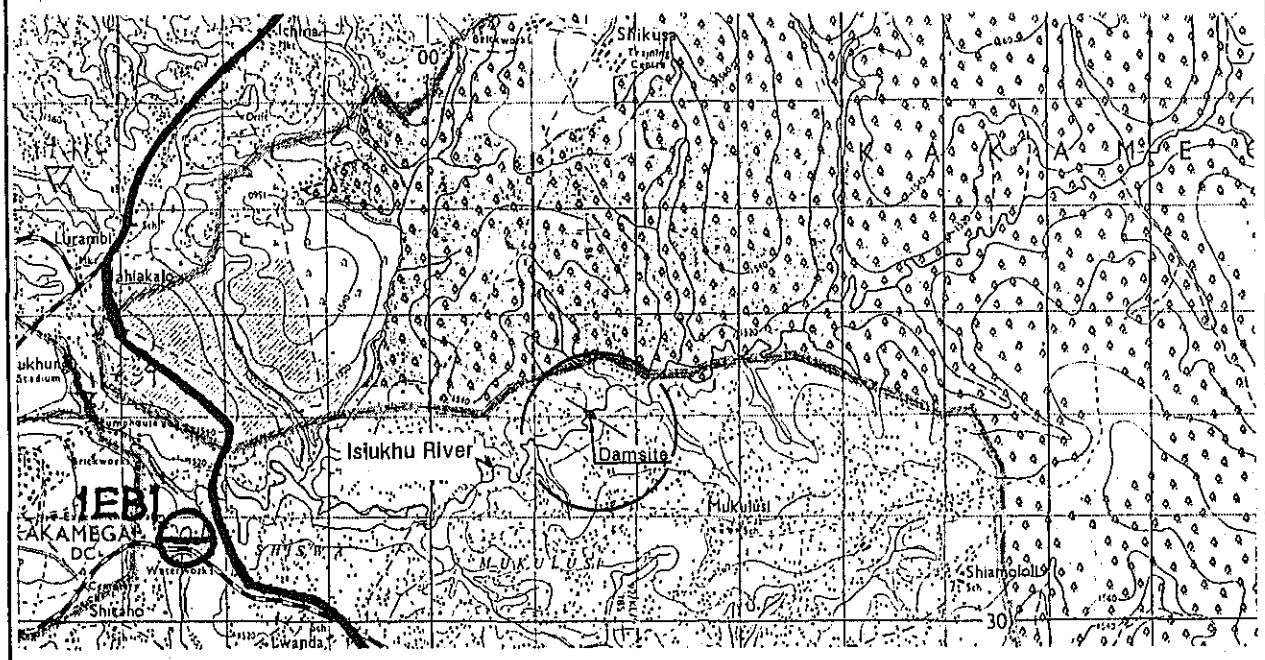
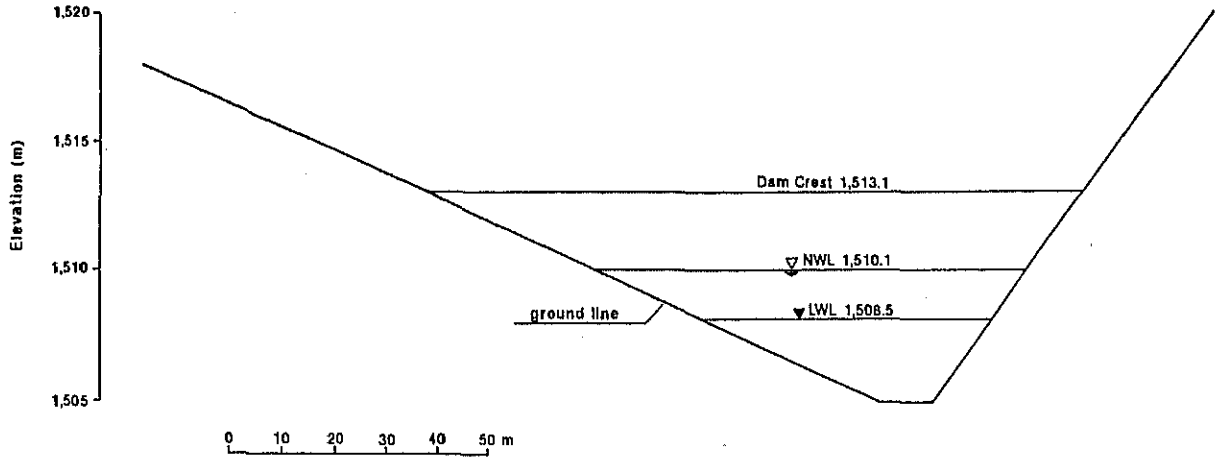
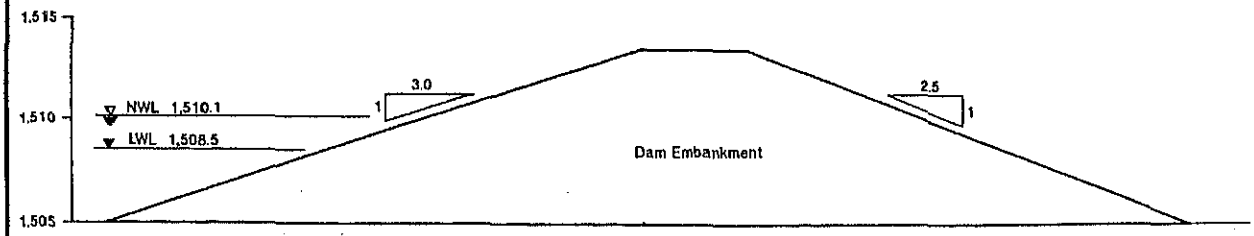
Fig. H4.3







Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

Figure H4.3
Preliminary Layout of Prospective Dam
(Mukulusi Dam)

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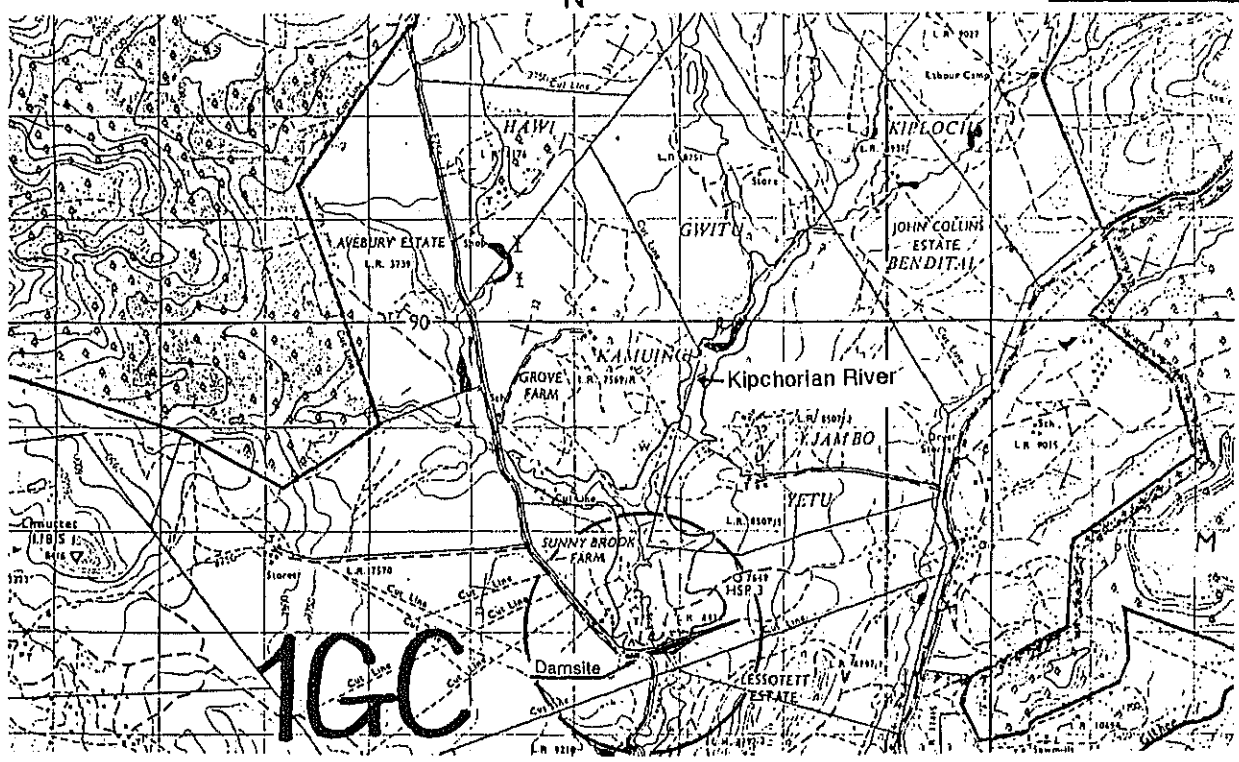
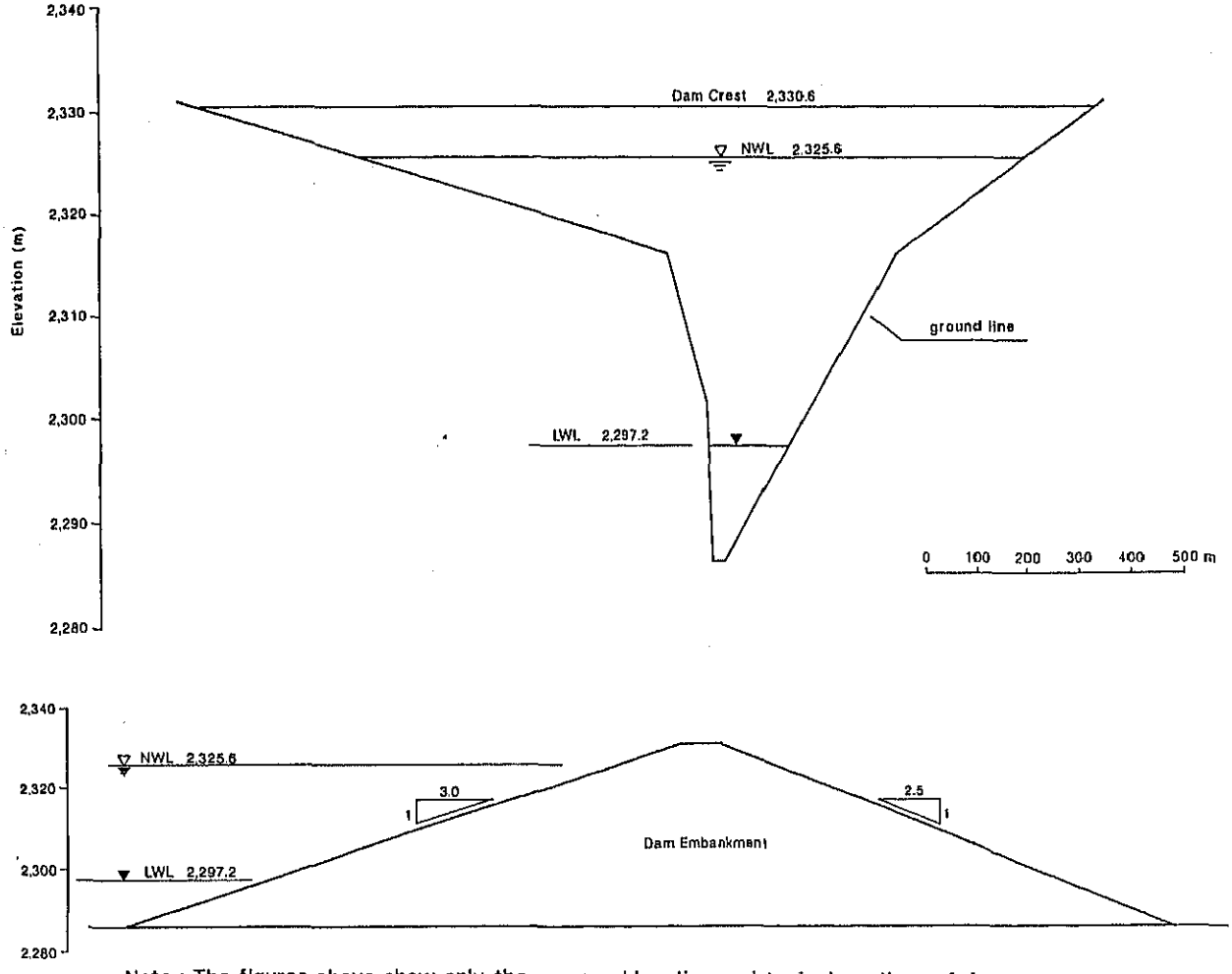
Fig. H4.4





Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

Figure H4.4
Preliminary Layout of Prospective Dam
(Londiani Dam)

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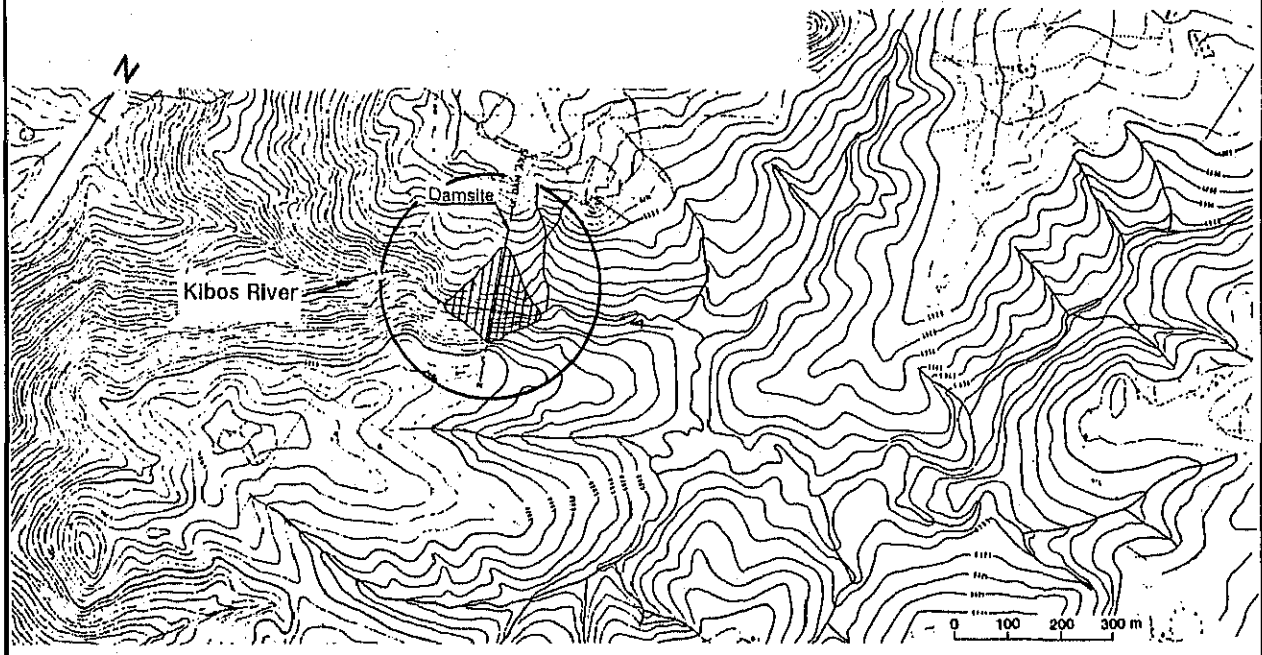
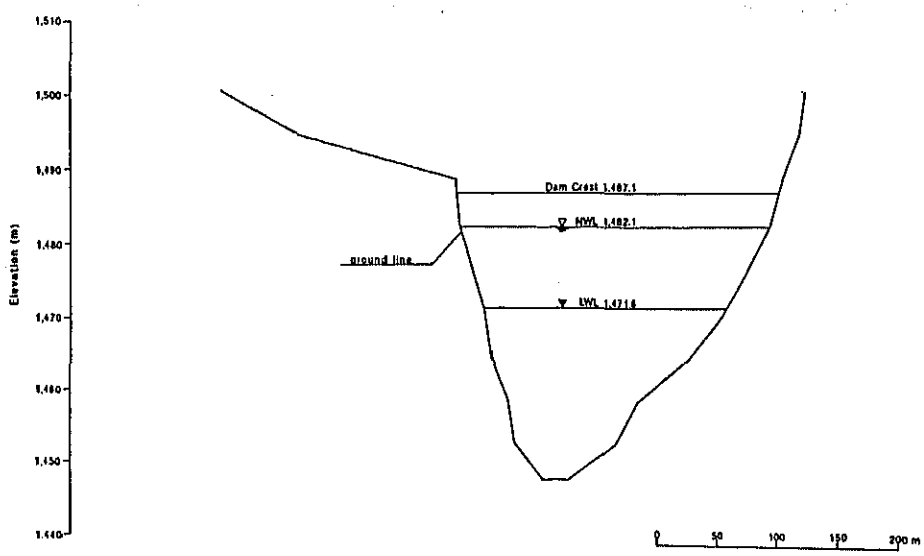
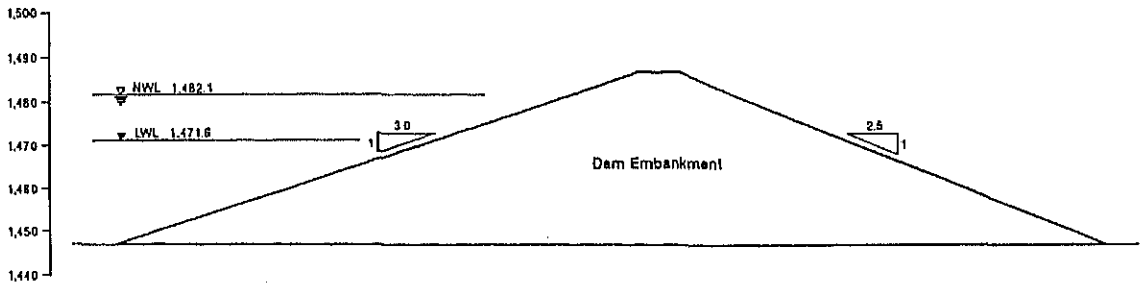
Fig. H4.5







Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

Figure H4.5
Preliminary Layout of Prospective Dam
(Kibos Dam)

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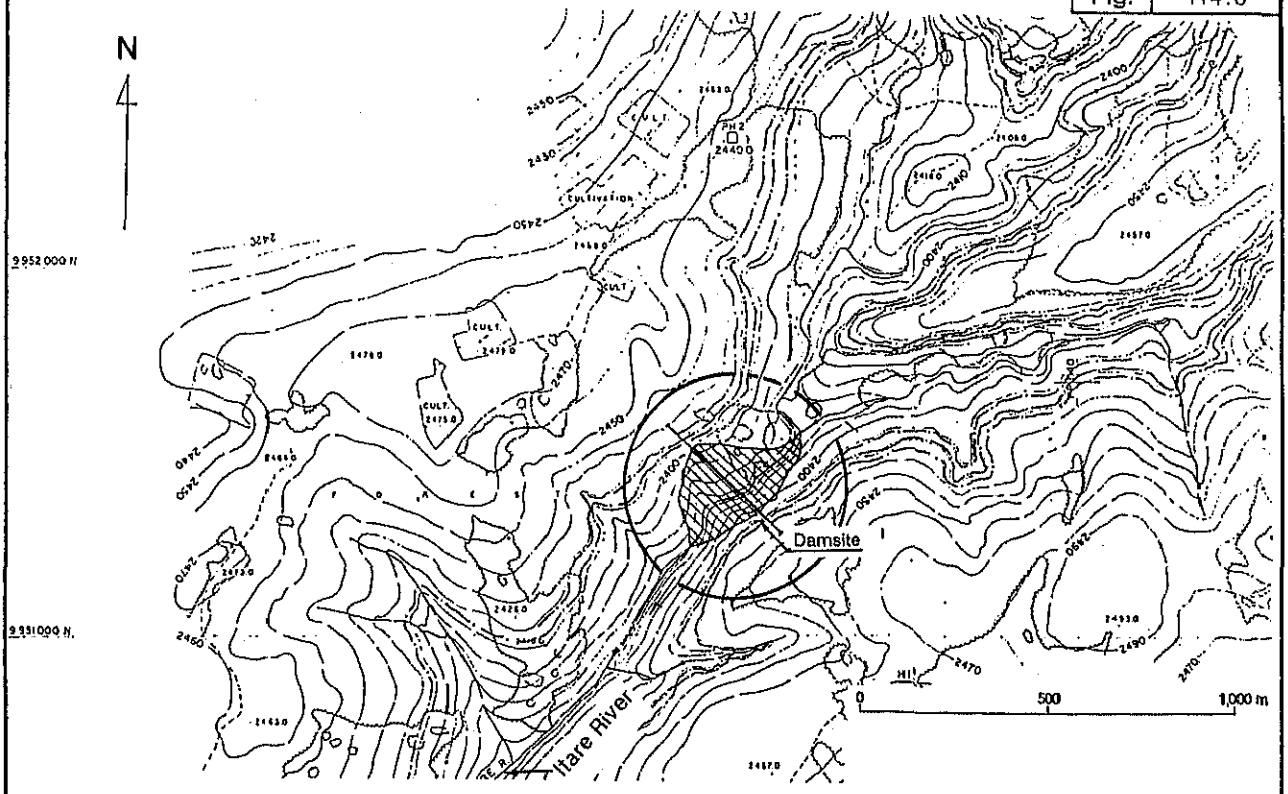
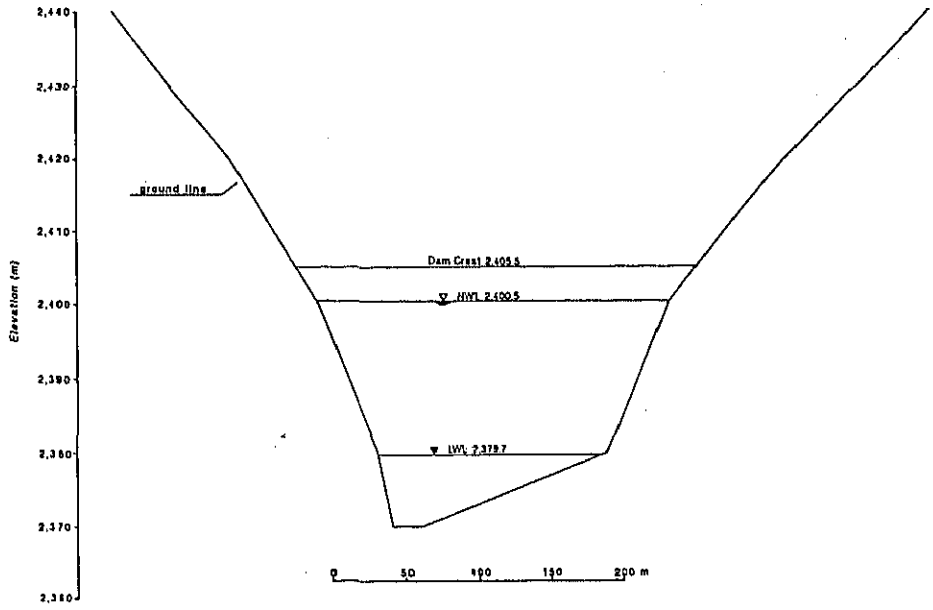
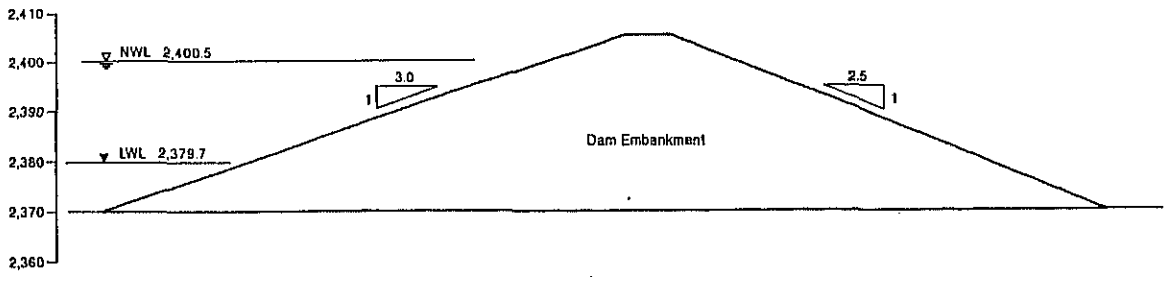
Fig. H4.6







Note : The figures above show only the proposed location and typical sections of dam

Figure H4.6 used for preliminary cost estimate.

Preliminary Layout of Prospective Dam (Itare Dam)

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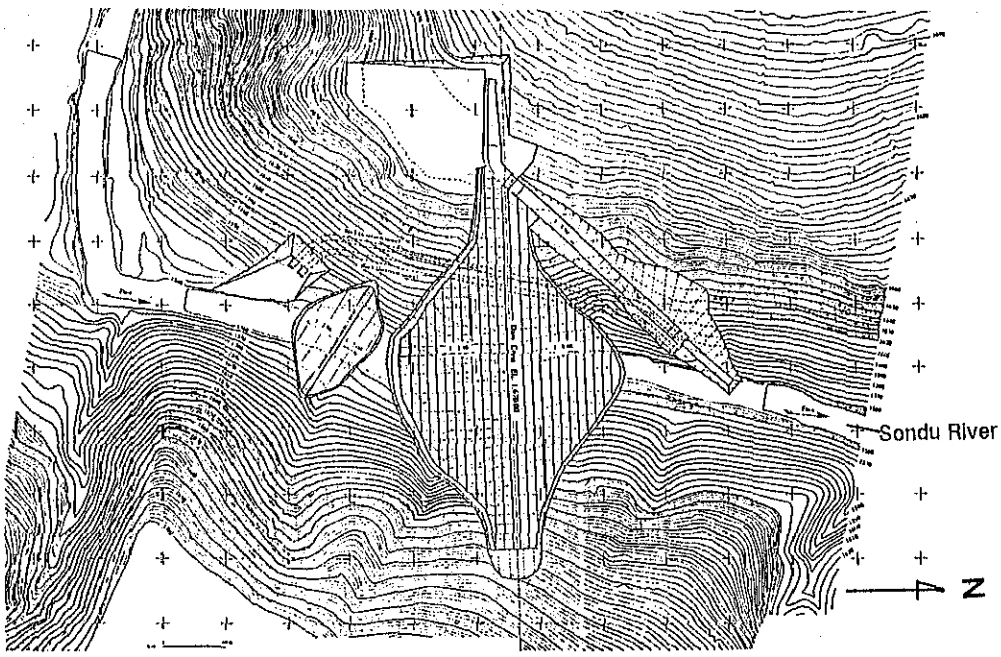
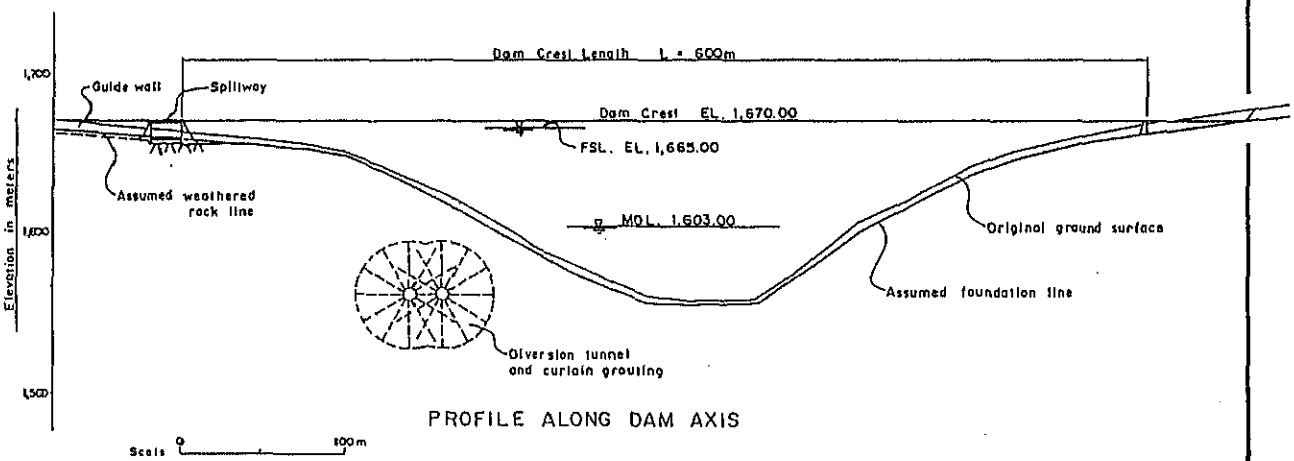
THE NATIONAL WATER MASTER PLAN

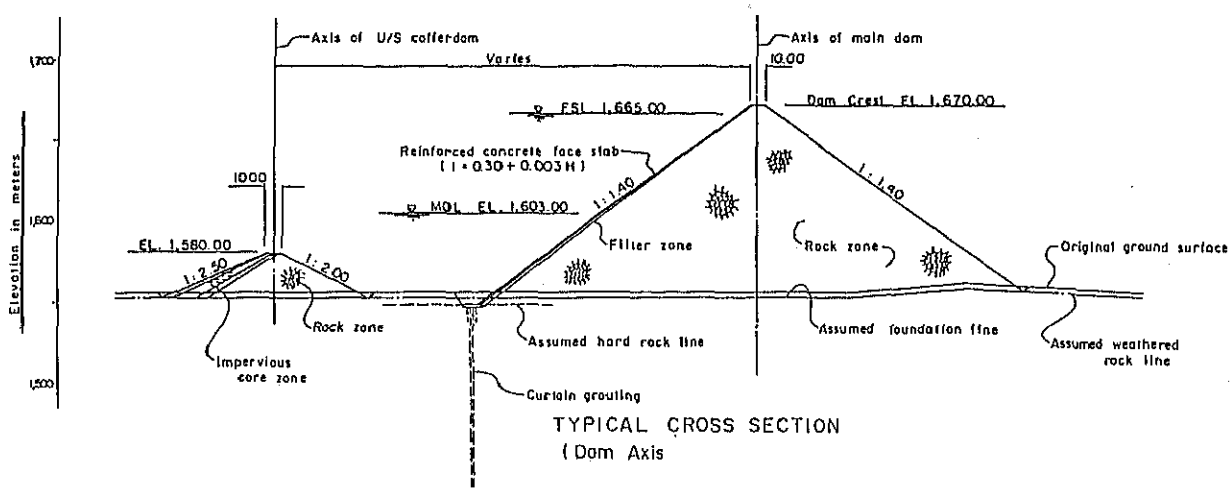
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. H4.7





PROFILE ALONG DAM AXIS

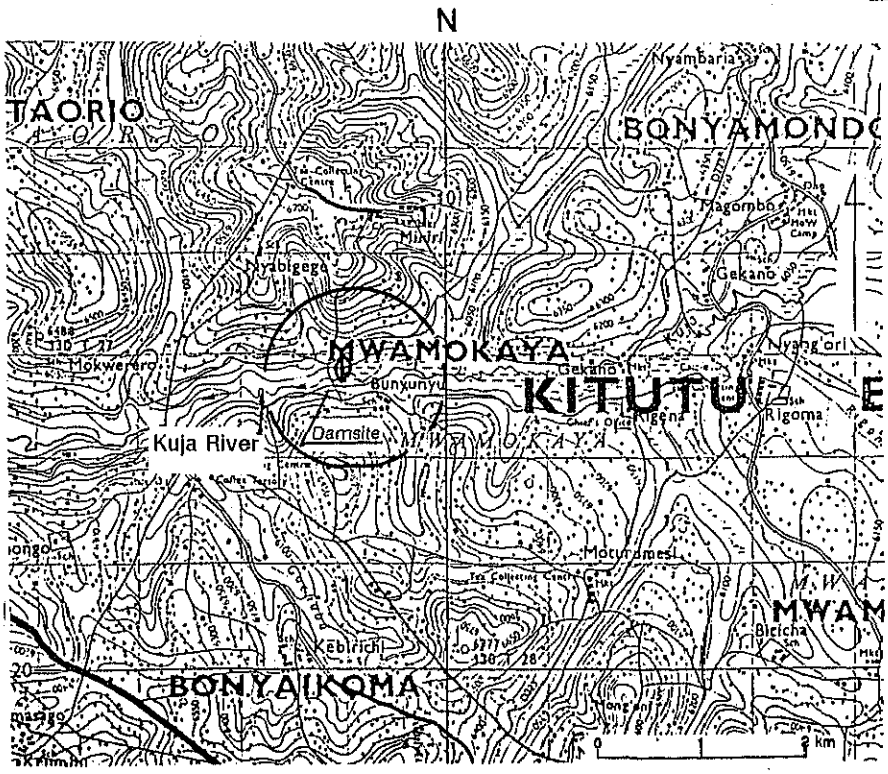


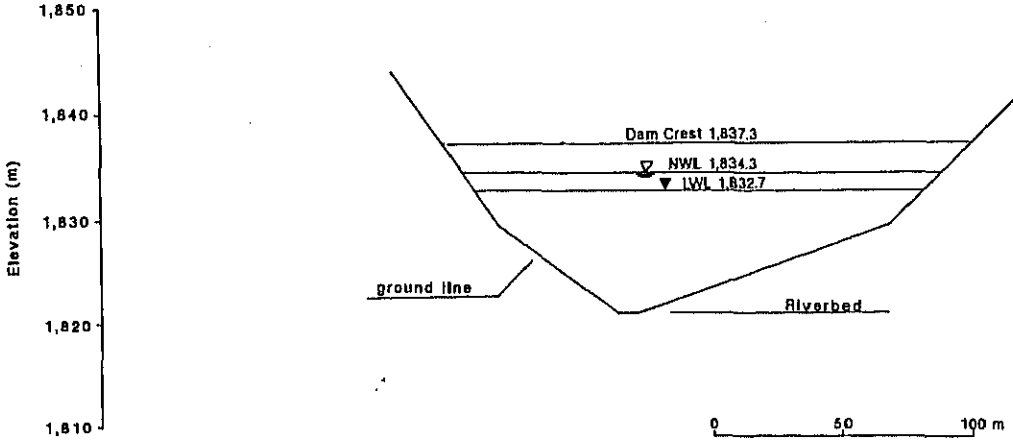
TYPICAL CROSS SECTION
(Dam Axis

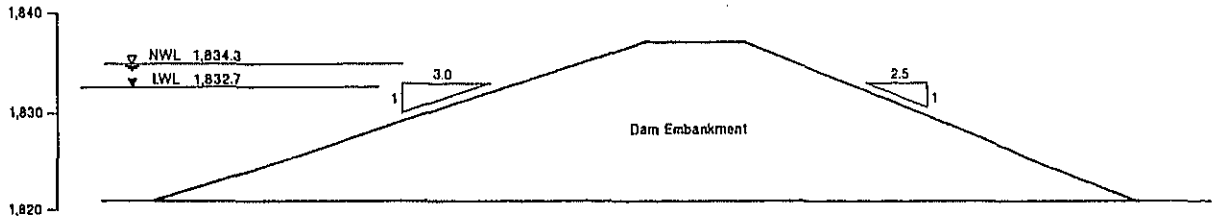
Source : Ref. No.H.11

Figure H4.7
Preliminary Layout of Prospective Dam
(Magwagwa Dam)

THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY







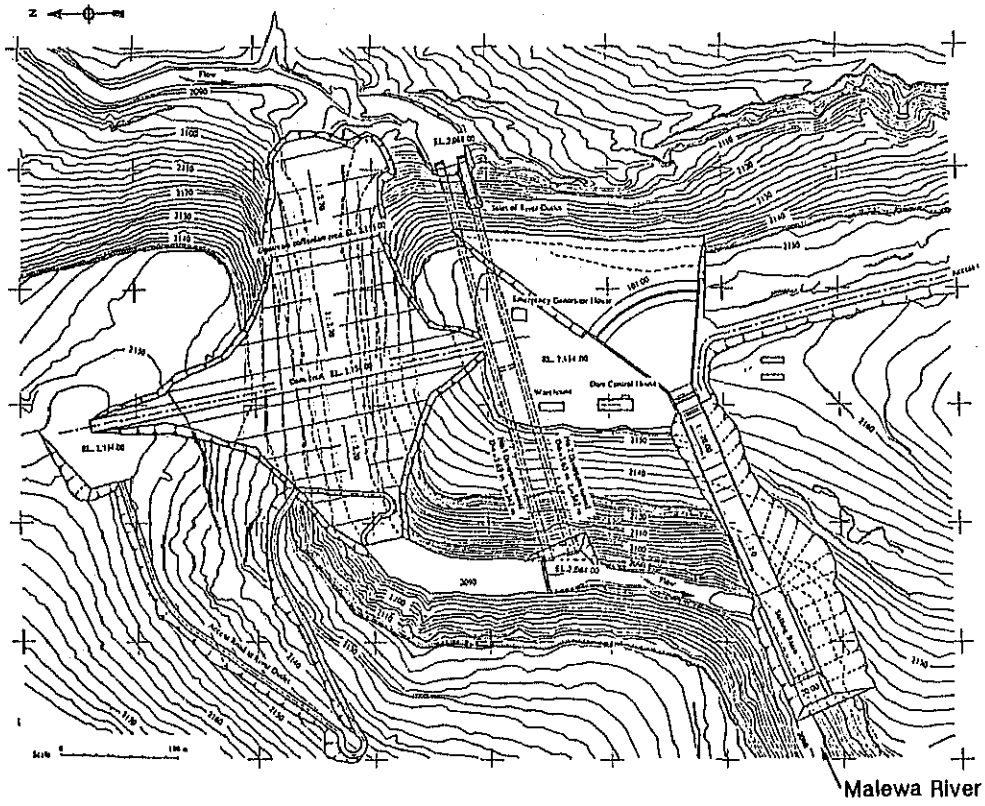
Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

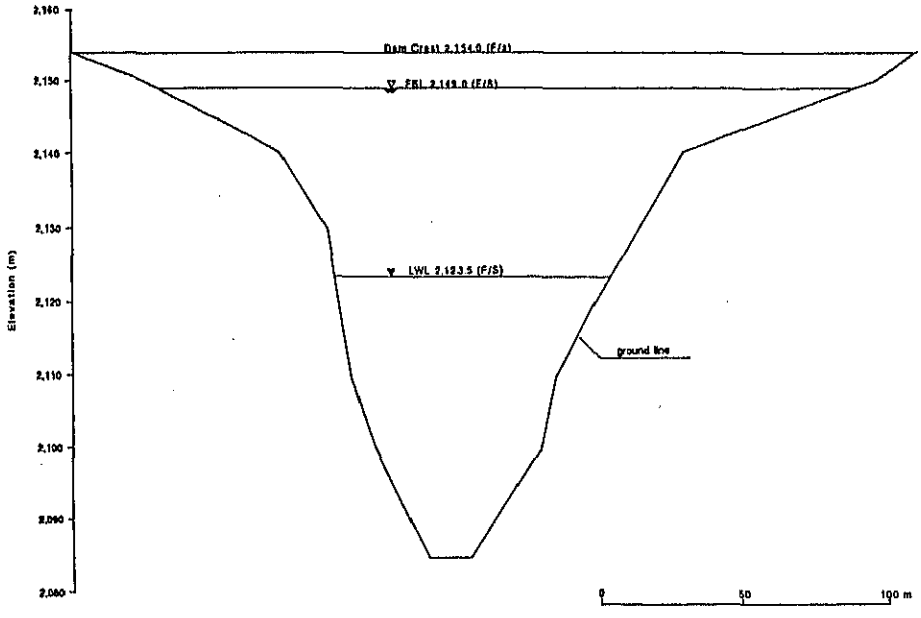
Figure H4.8
Preliminary Layout of Prospective Dam
(Bunyunyu Dam)

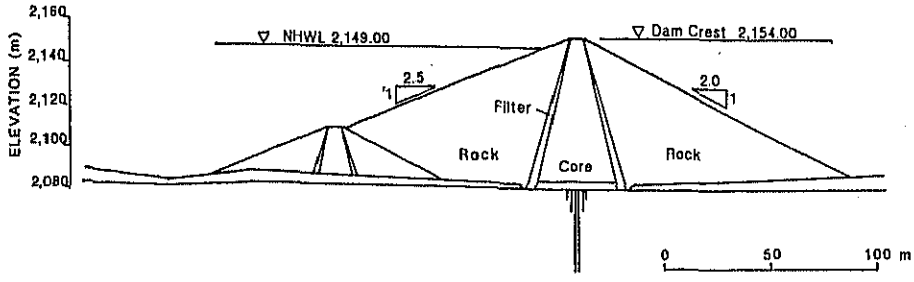
THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. H4.9







Source : Ref. No. H.24

Figure H4.9
Preliminary Layout of Prospective Dam
(Malewa Dam)

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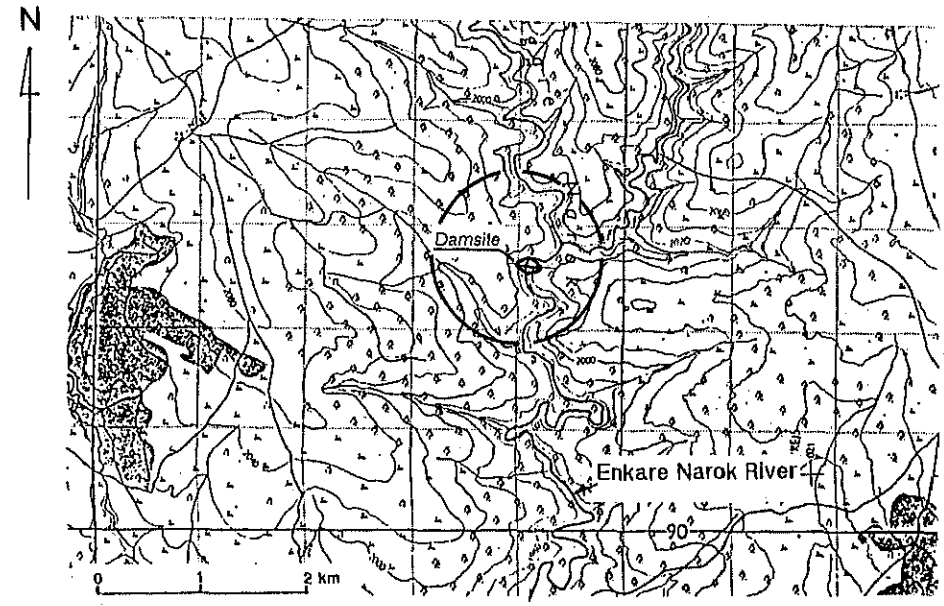
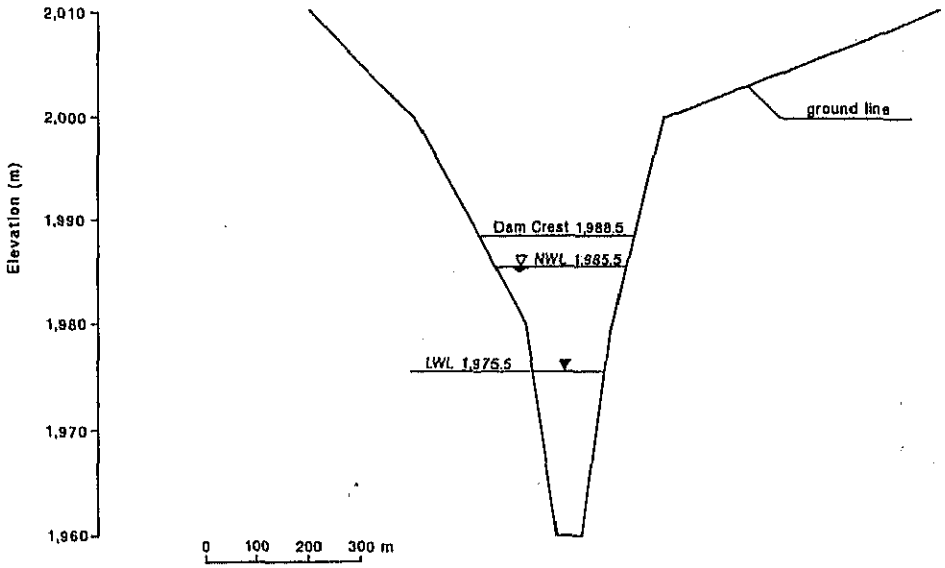
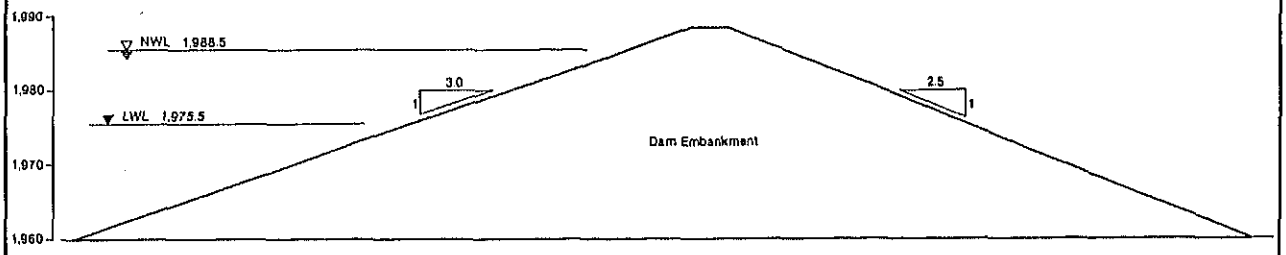
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. H4.10







Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

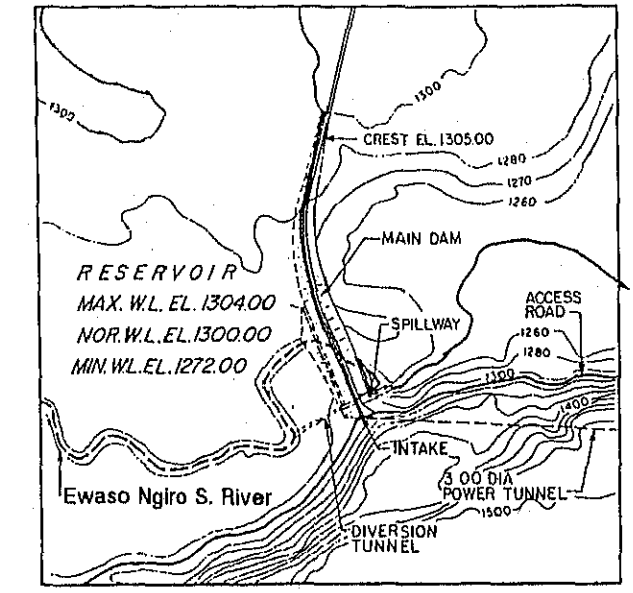
Preliminary Layout of Prospective Dam (Upper Narok Dam)

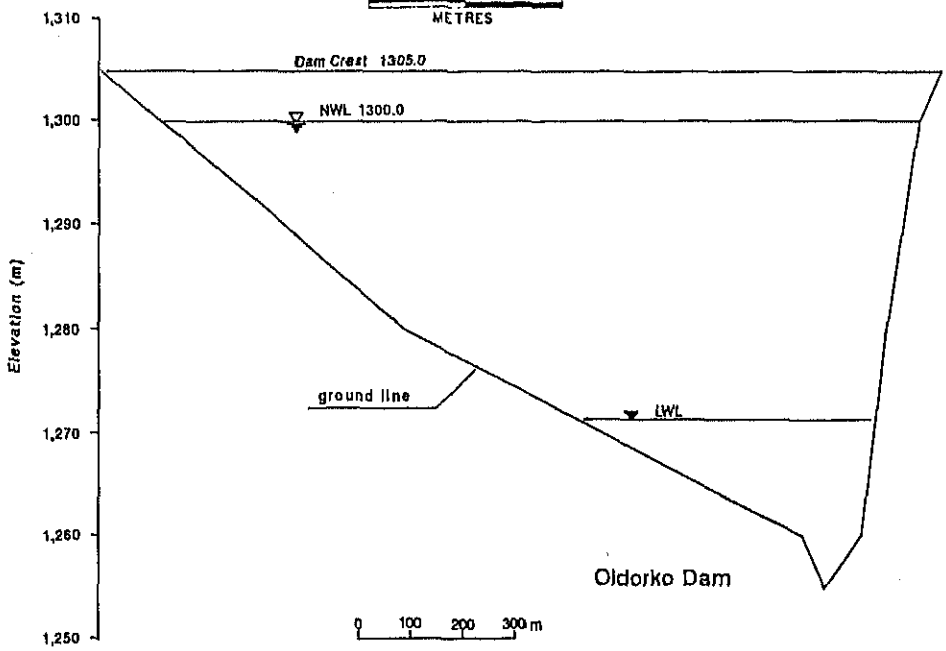
Figure H4.10

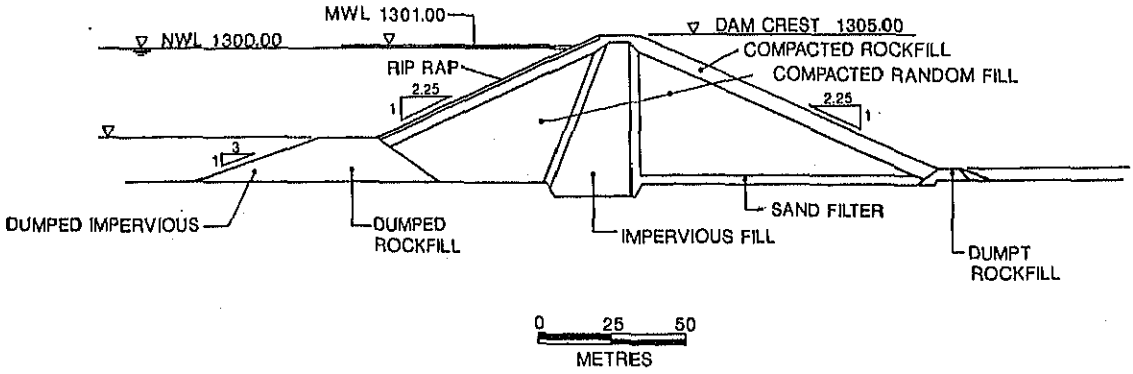
THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. H4.11







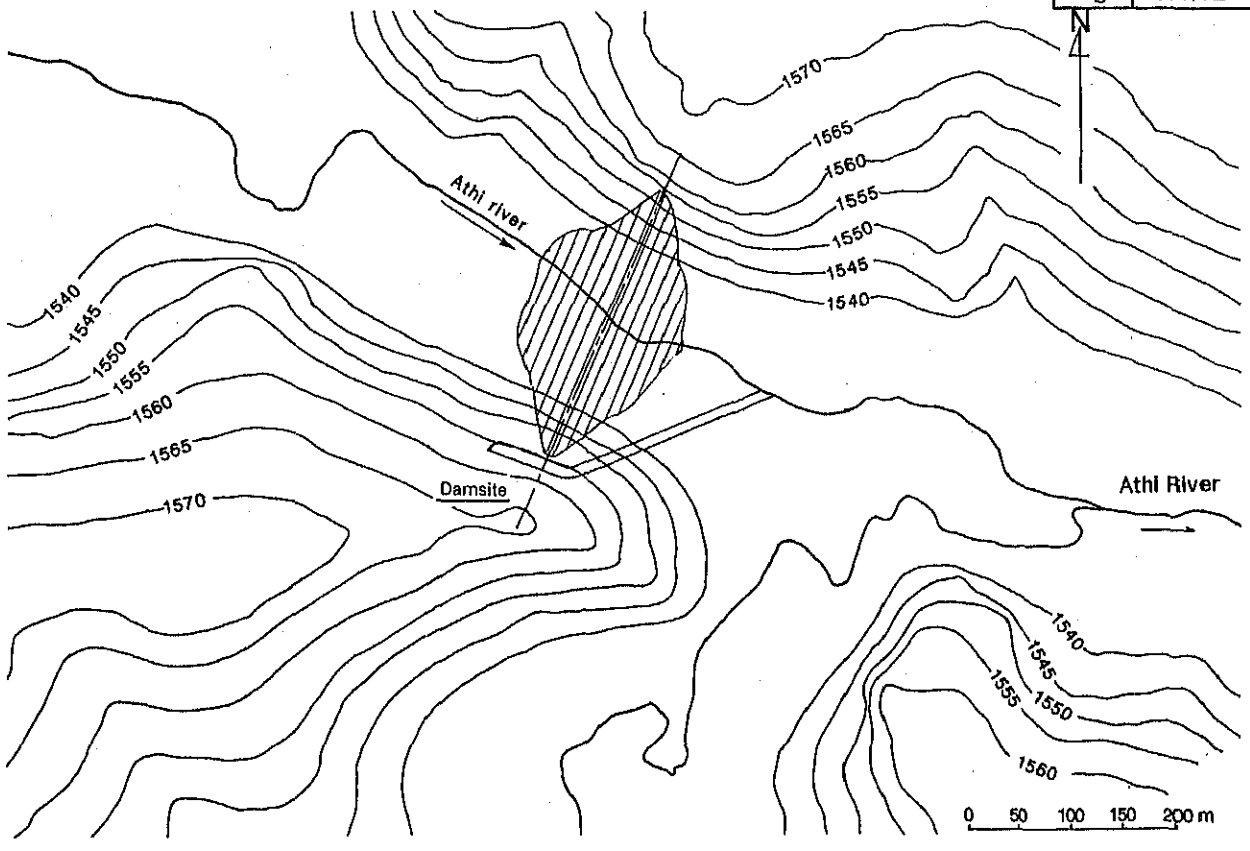
Source : Ref. No. H.2

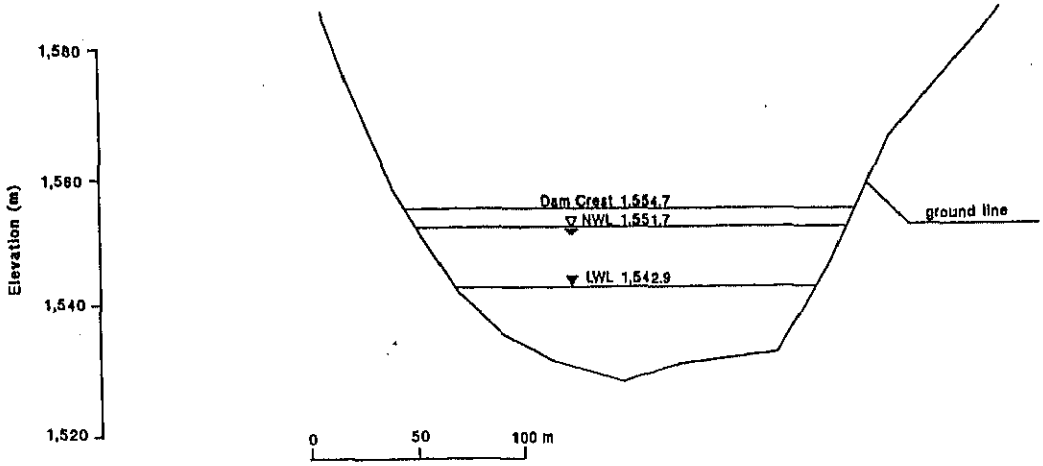
Figure H4.11
Preliminary Layout of Prospective Dam
(Oldorko Dam)

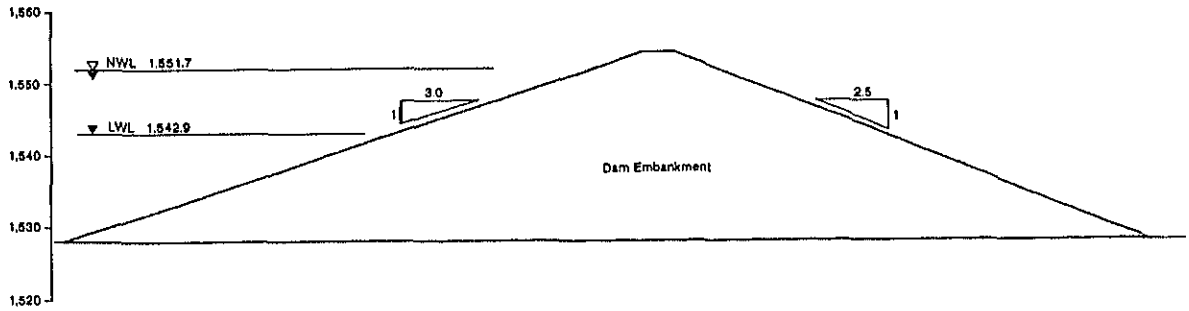
THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. H4.12







Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

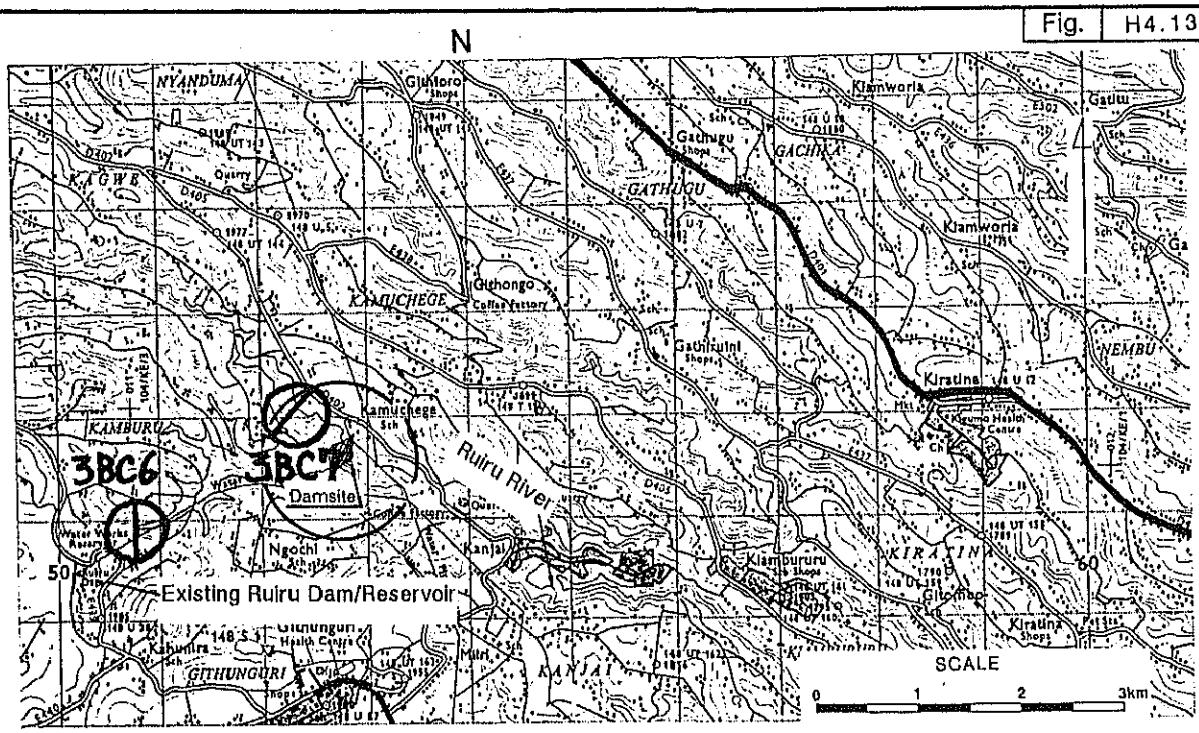
Preliminary Layout of Prosective Dam (Upper Athi Dam)

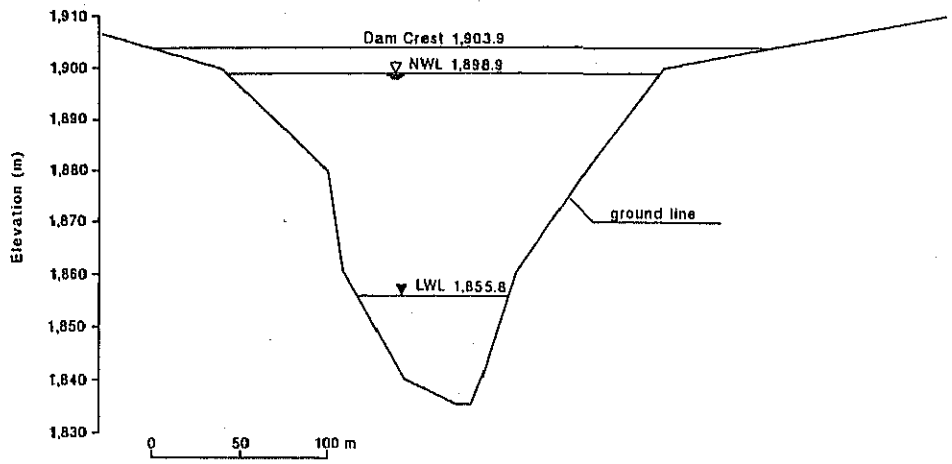
Figure H4.12

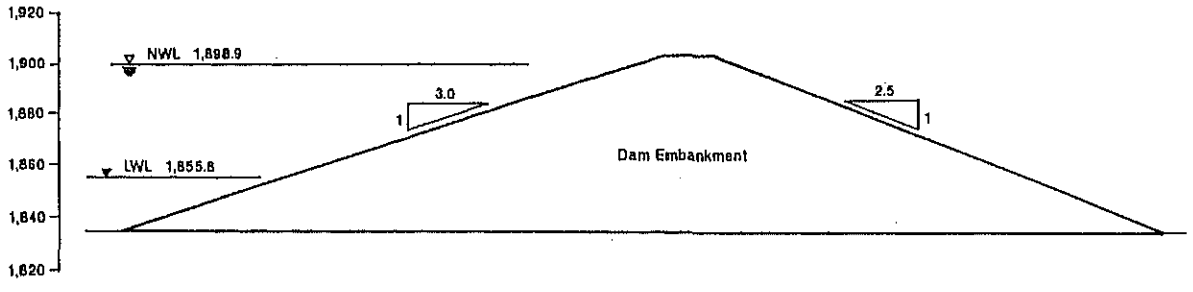
THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. H4.13





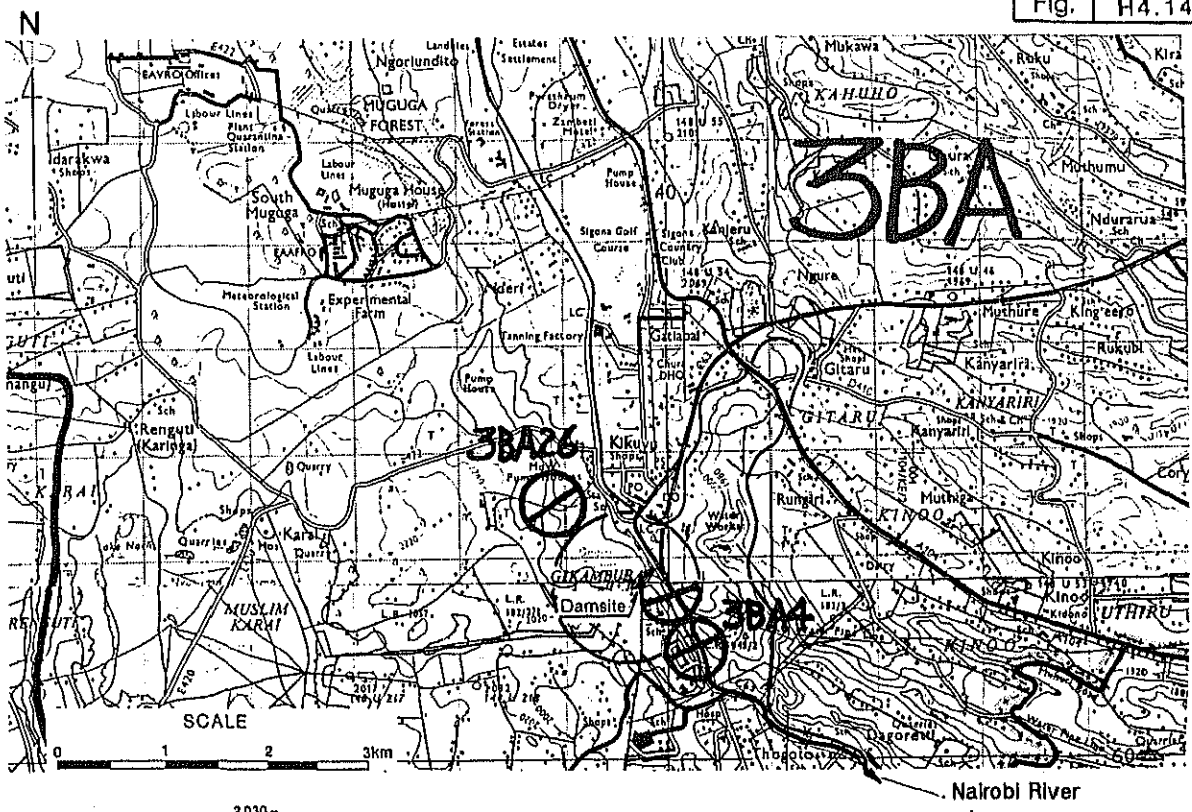


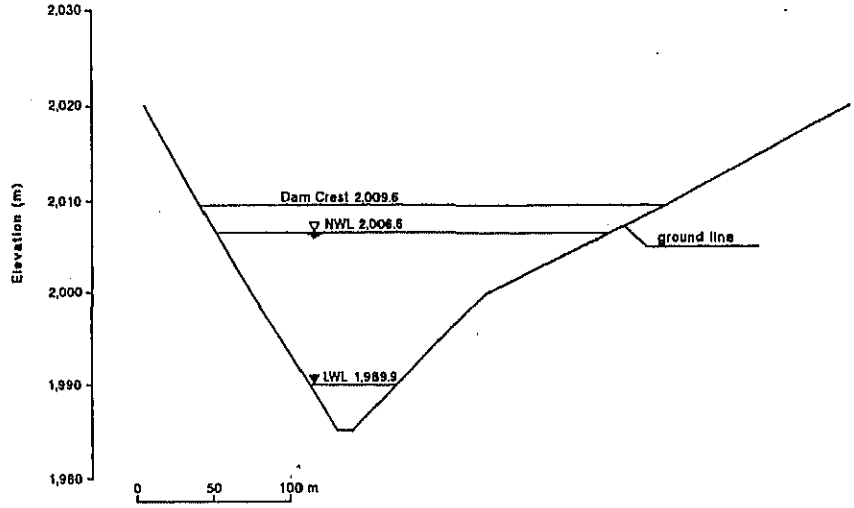
Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

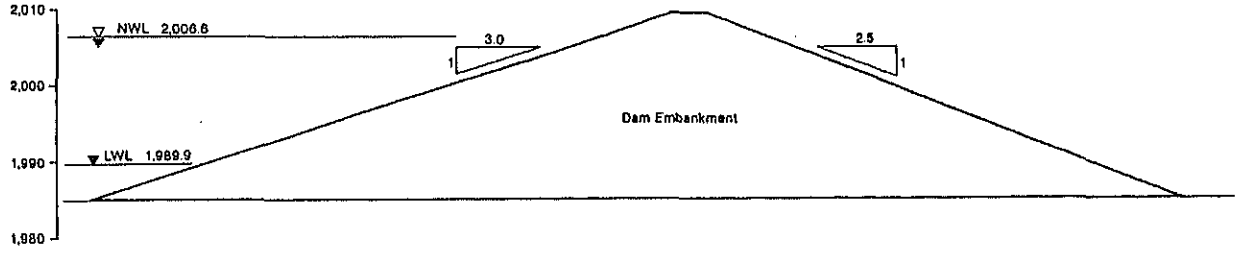
Figure H4.13
Preliminary Layout of Prospective Dam
(Ruiru-A Dam)

THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. H4.14







Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

Figure H4.14
Preliminary Layout of Prospective Dam
(Kikuyu Dam)

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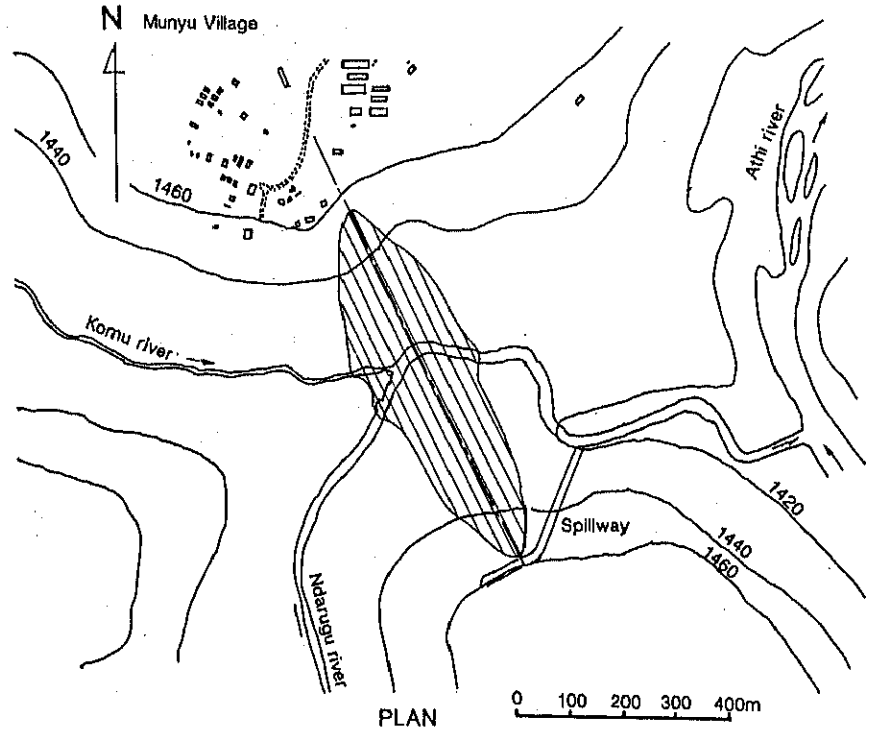
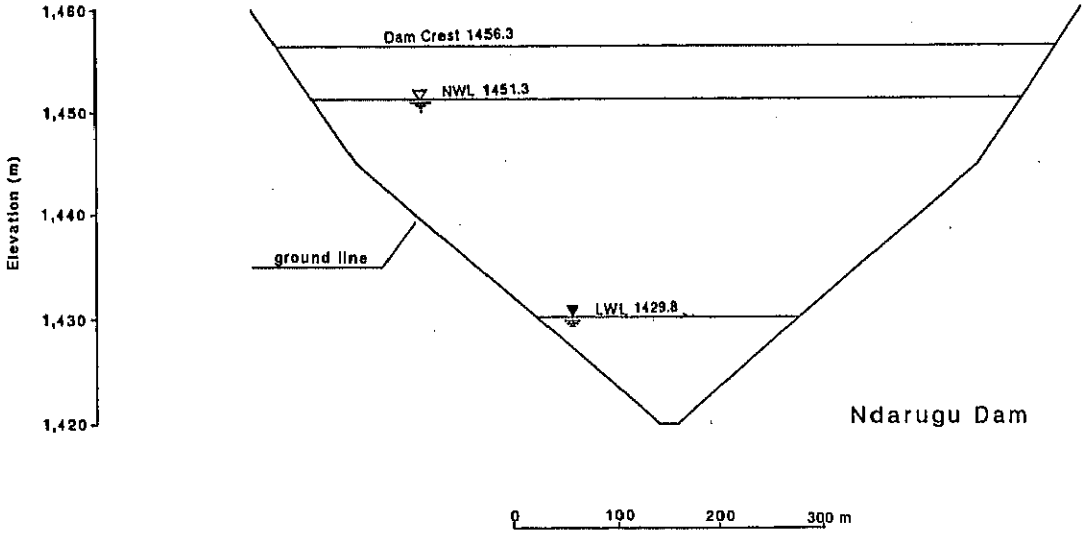
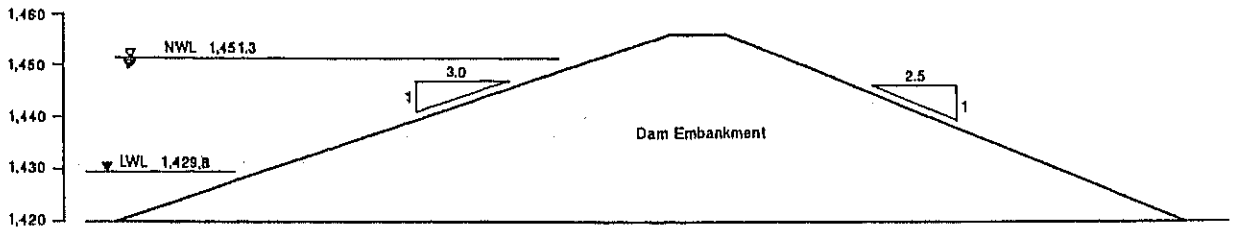
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY



Source : Ref.H.29





Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

Figure H4.15
Preliminary Layout of Prospective Dam
(Ndarugu Dam)

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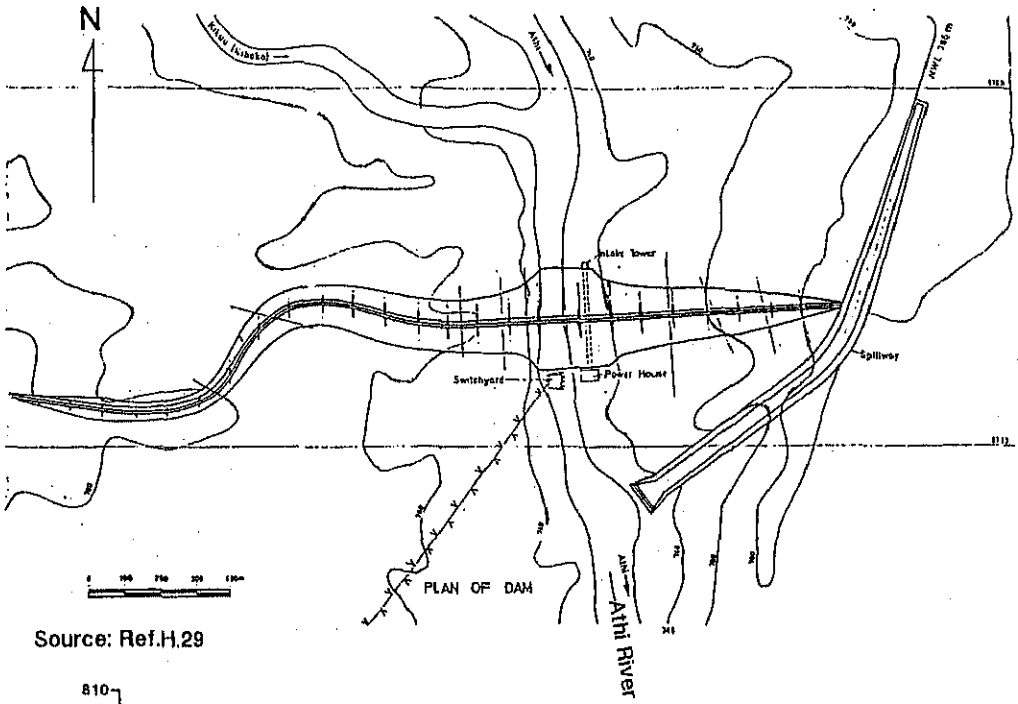
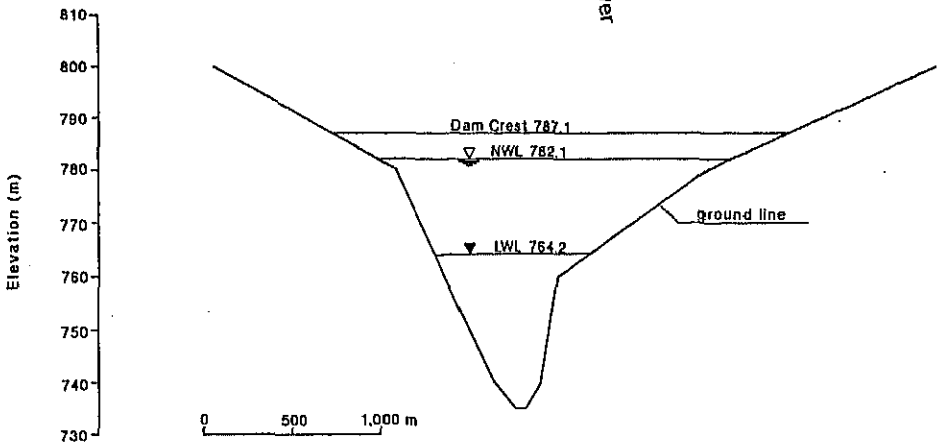
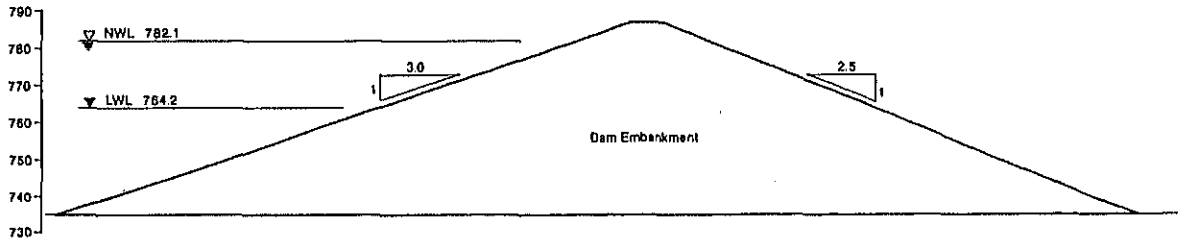
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY



Source: Ref.H.29





Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

Figure H4.16
Preliminary Layout of Prospective Dam
(Yatta Dam)

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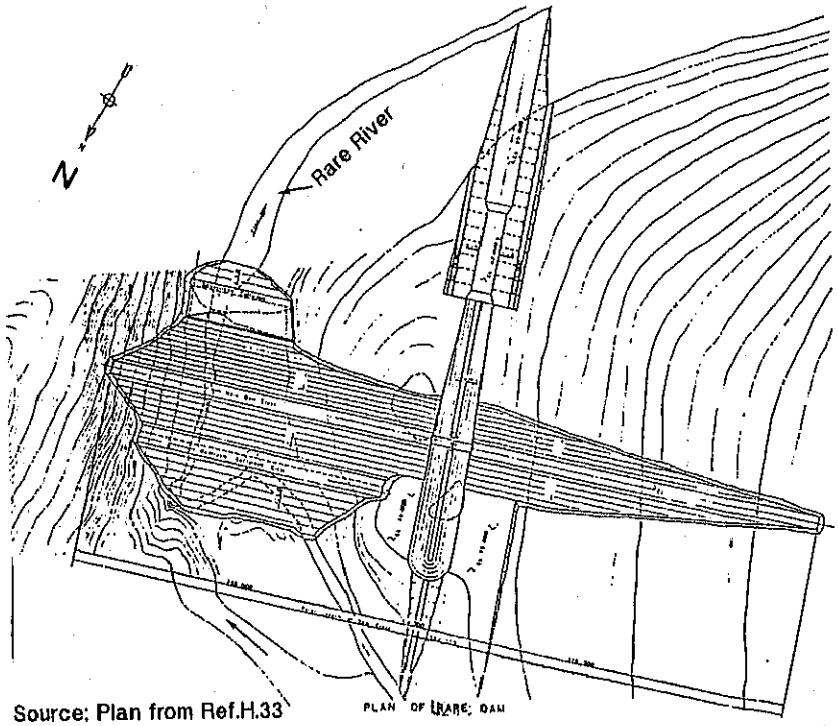
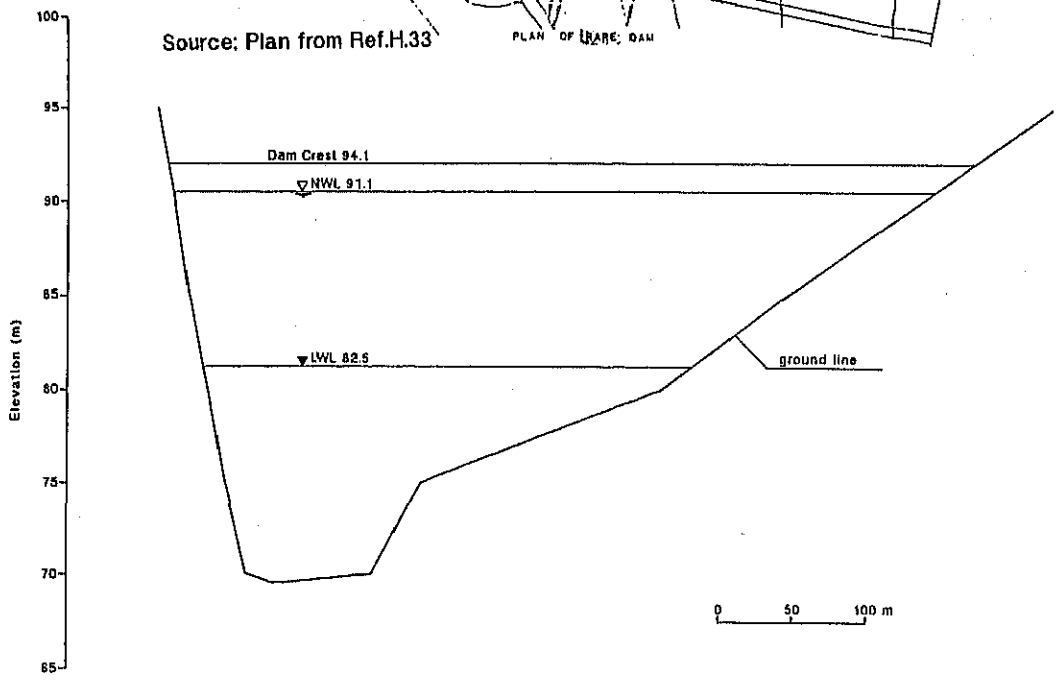
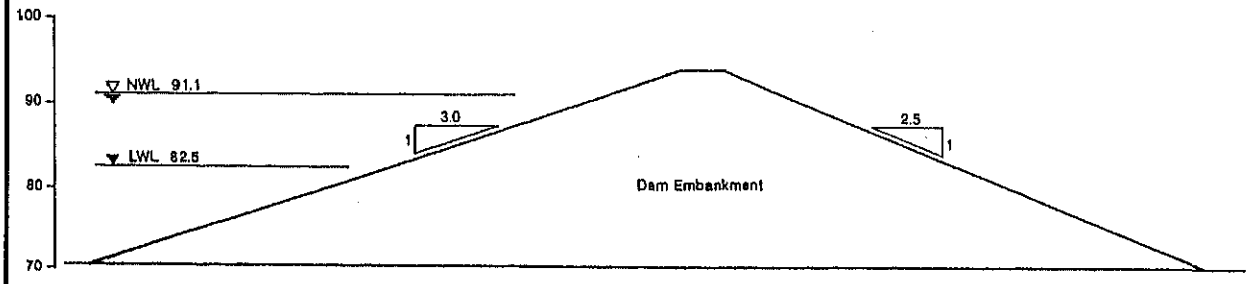
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY



Source: Plan from Ref.H.33





Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

Figure H4.17
Preliminary Layout of Prospective Dam (Rare Dam)

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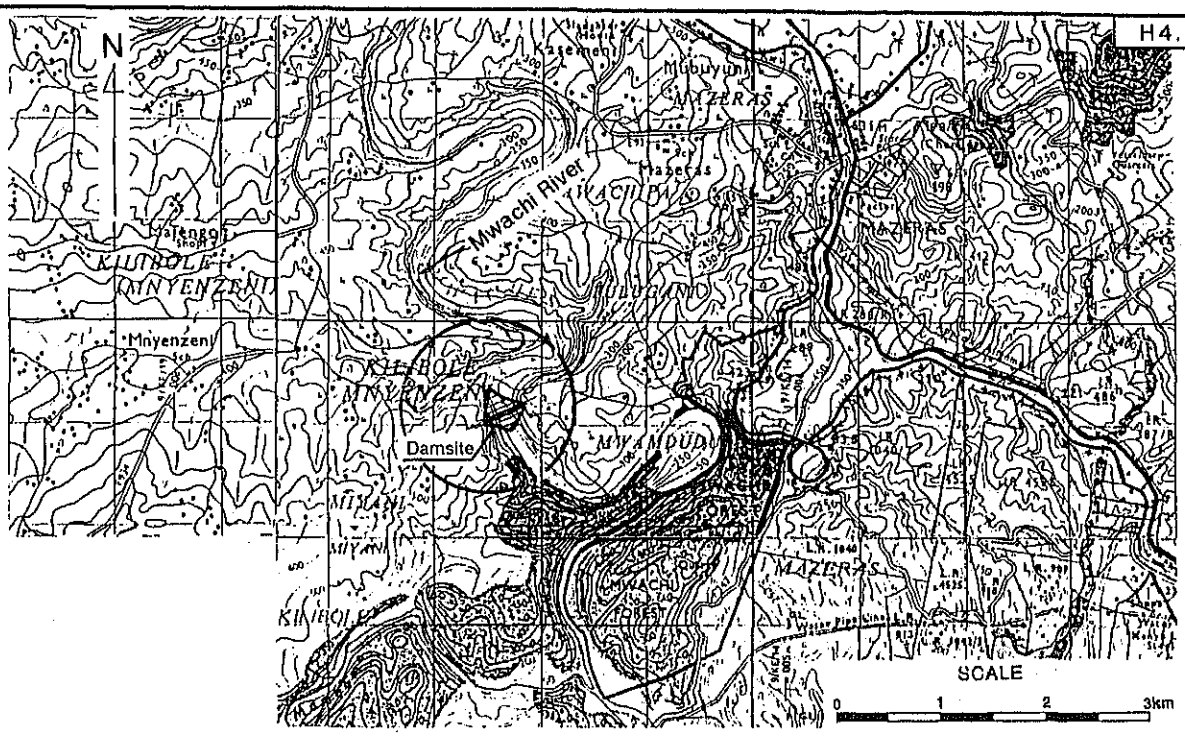
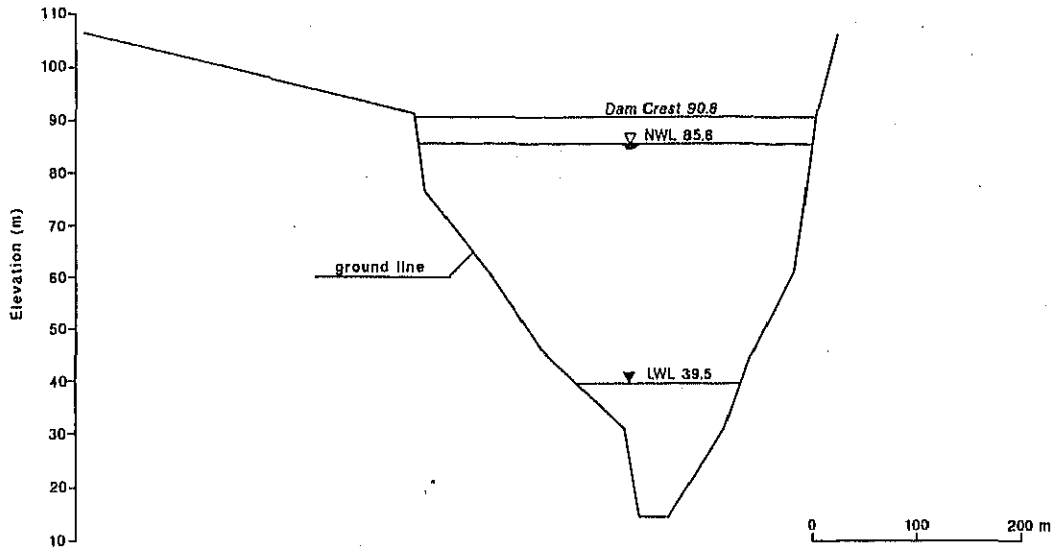
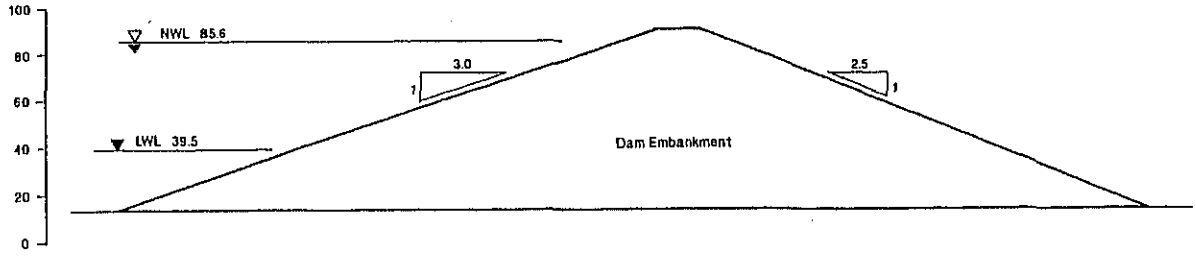
JAPAN INTERNATIONAL COOPERATION AGENCY







Note : The figures above show only the proposed location and typical sections of dam *used for preliminary cost estimate.*

Figure H4.18
Preliminary Layout of Prospective Dam
(Mwachi Dam)

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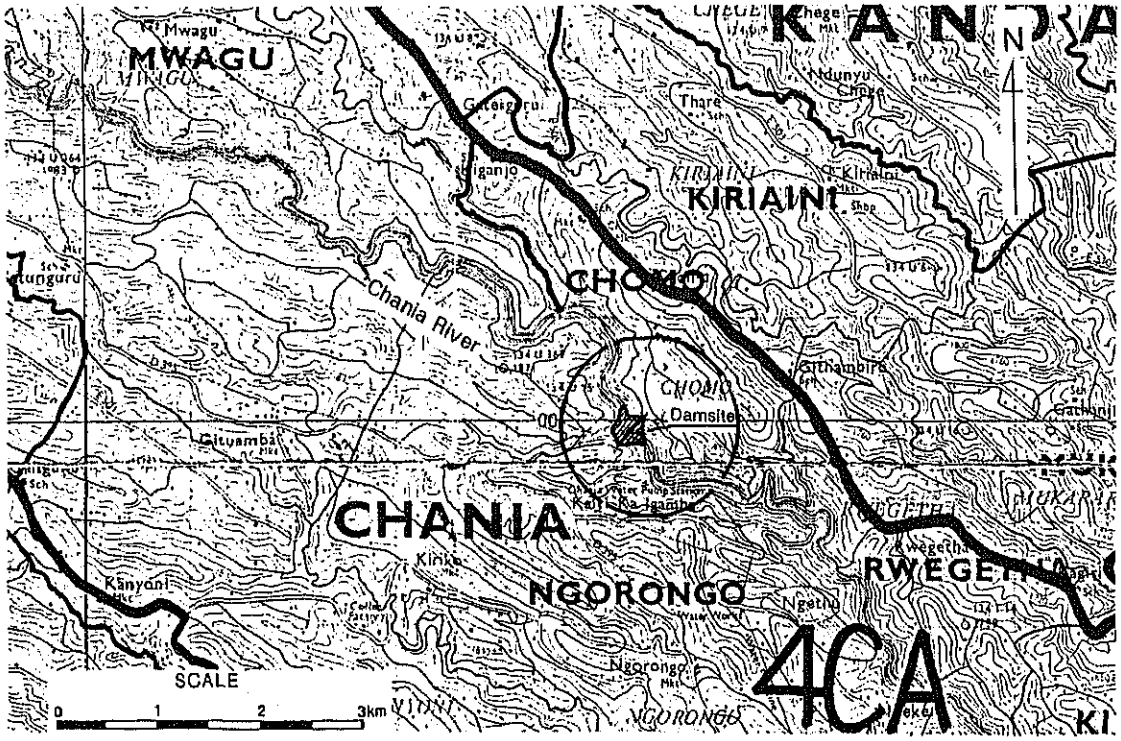
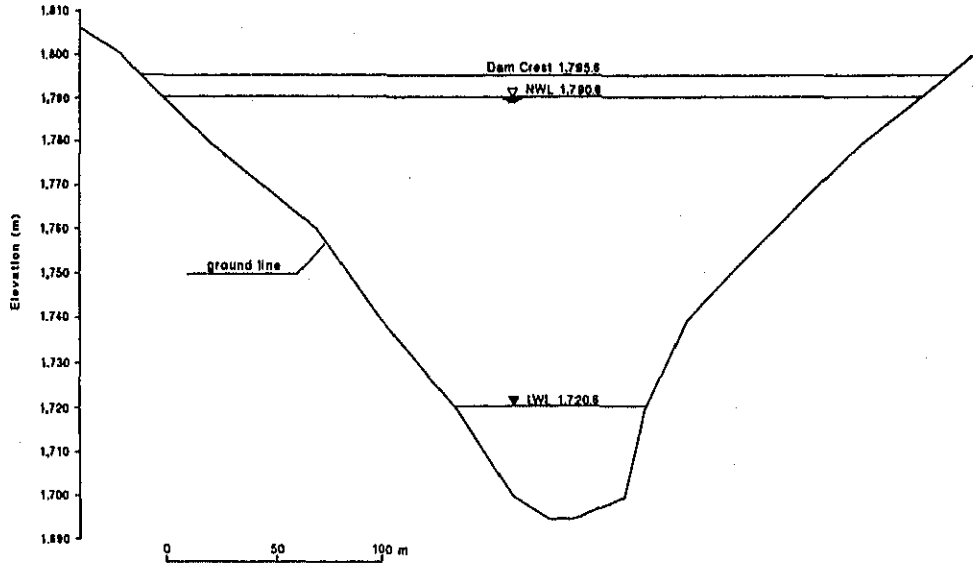
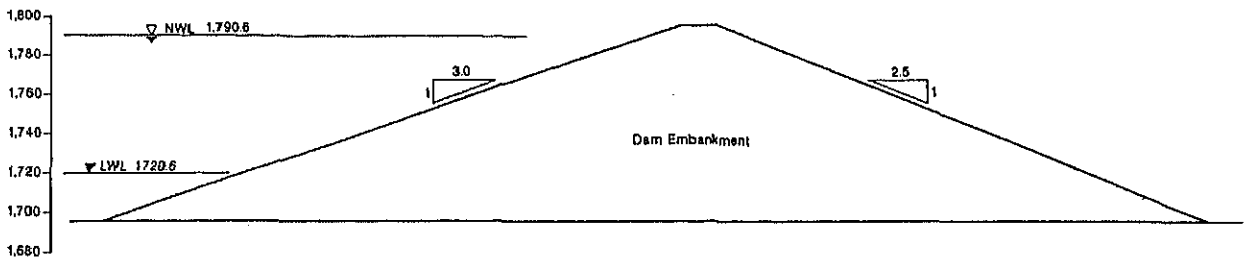
JAPAN INTERNATIONAL COOPERATION AGENCY







Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

Figure H4.19
Preliminary Layout of Prospective Dam
(Chaina-B Dam)

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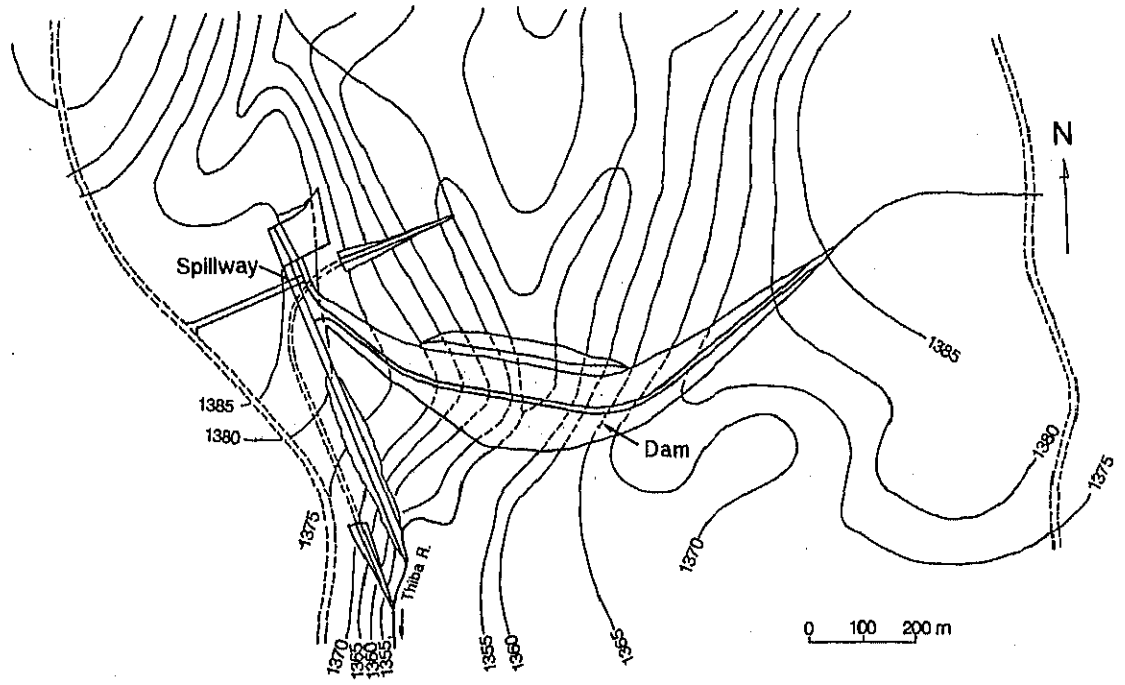
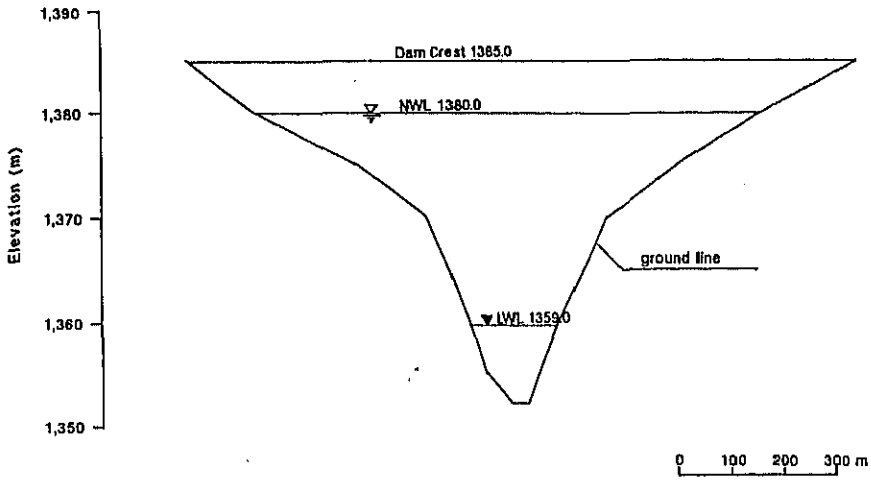
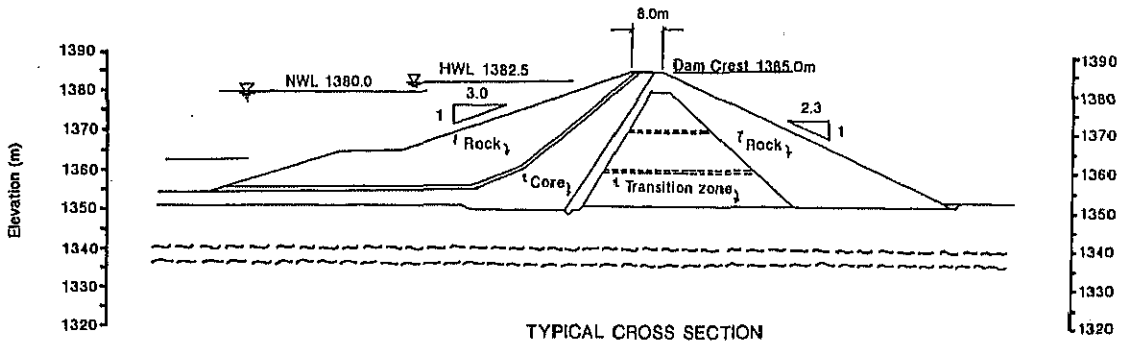
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. H4.20







TYPICAL CROSS SECTION

Source : Ref. No. H.35

Figure H4.20
Preliminary Layout of Prospective Dam
(Thiba Dam)

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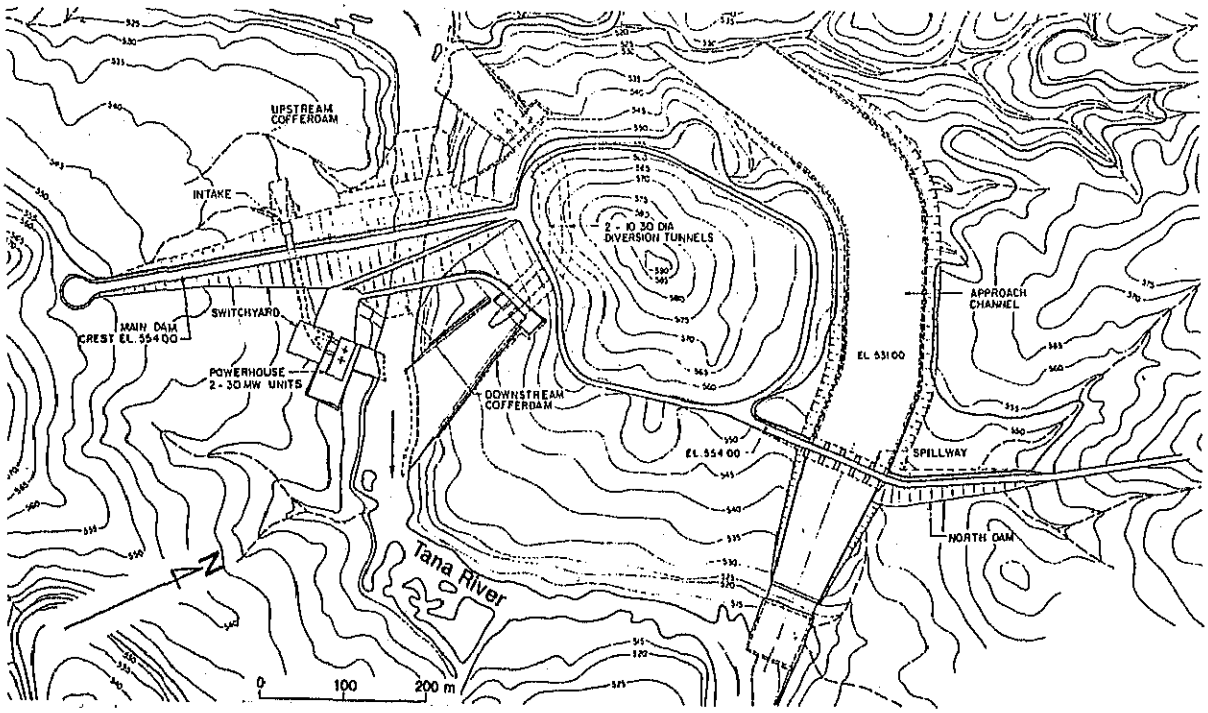
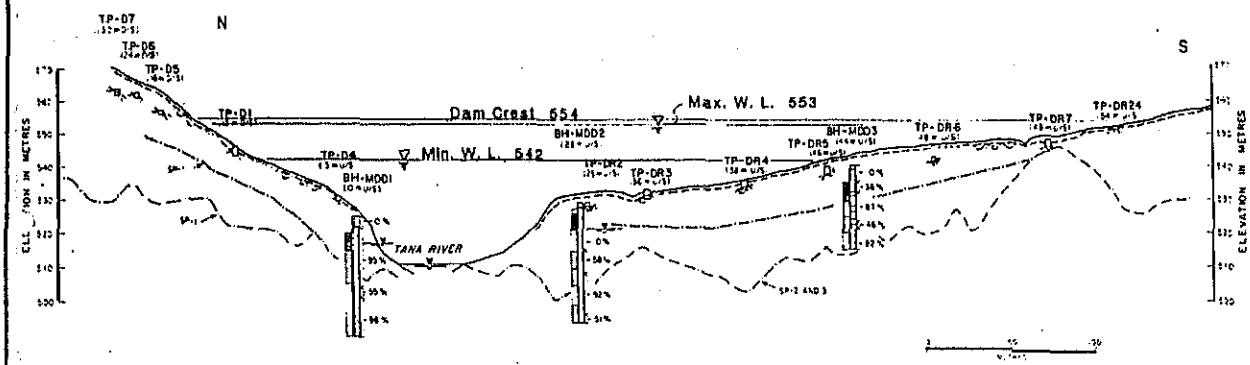
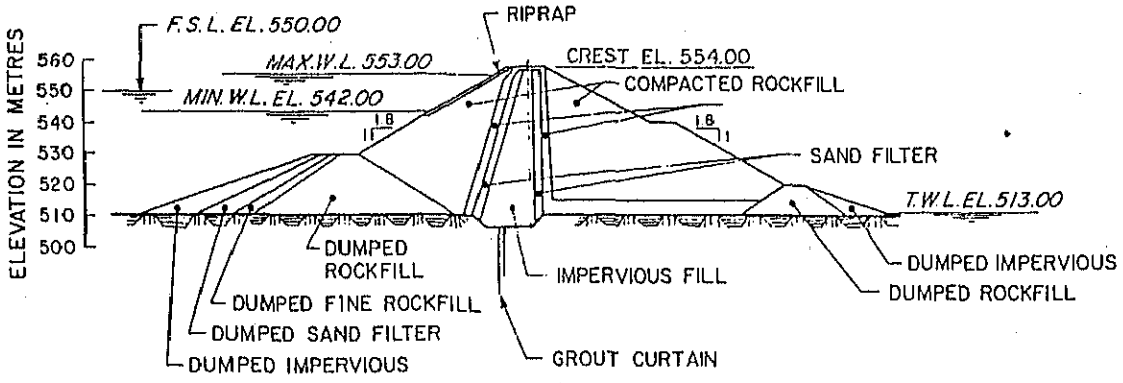
JAPAN INTERNATIONAL COOPERATION AGENCY







Source : Ref. No. H.2

Figure H4.21
Preliminary Layout of Prospective Dam
(Mutonga Dam)

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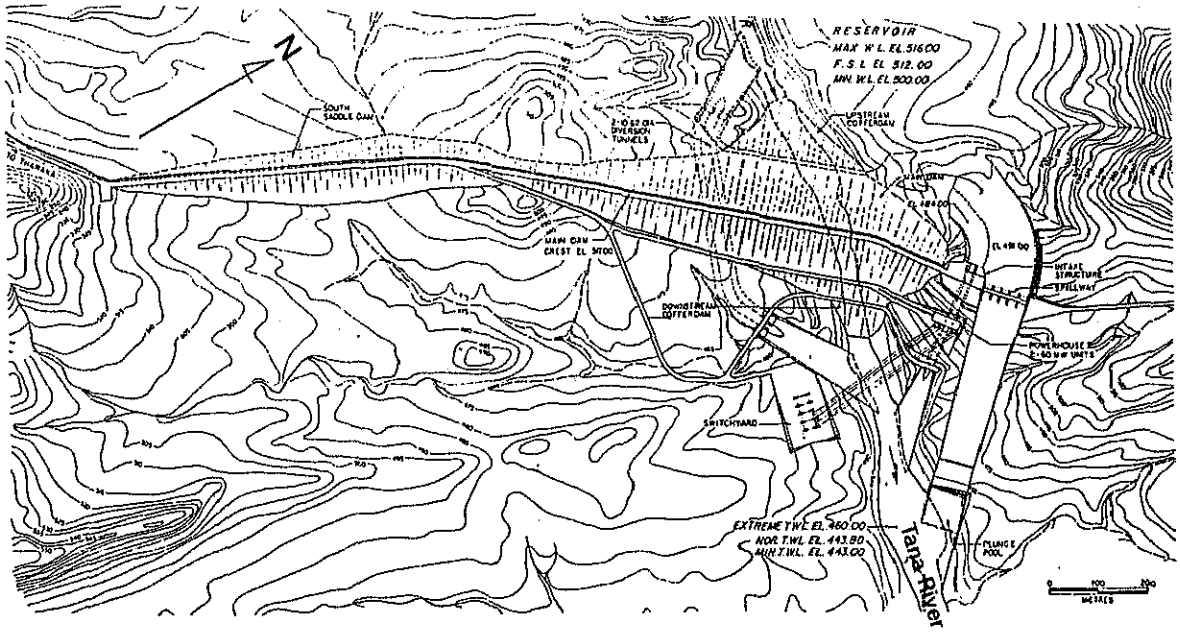
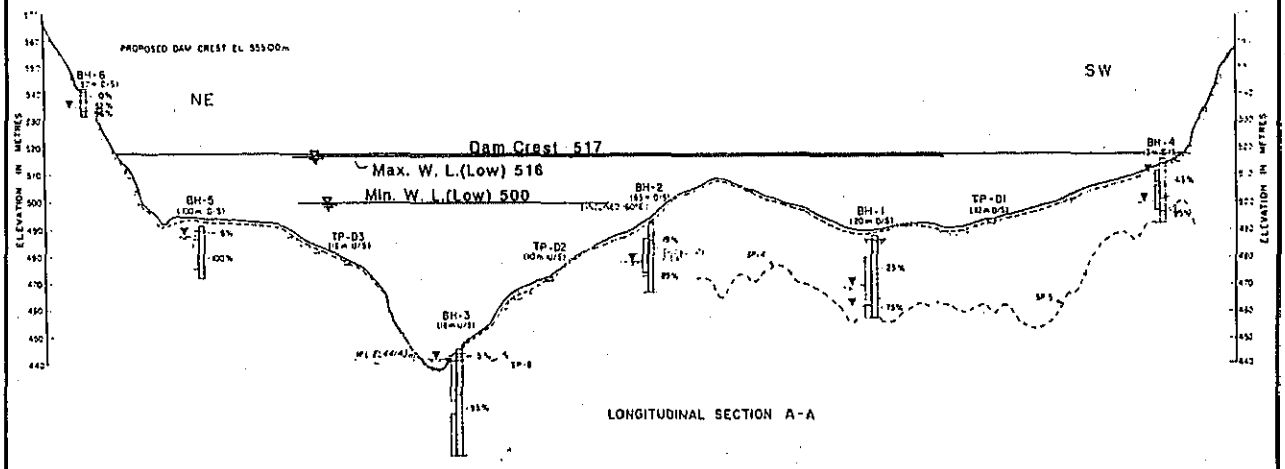
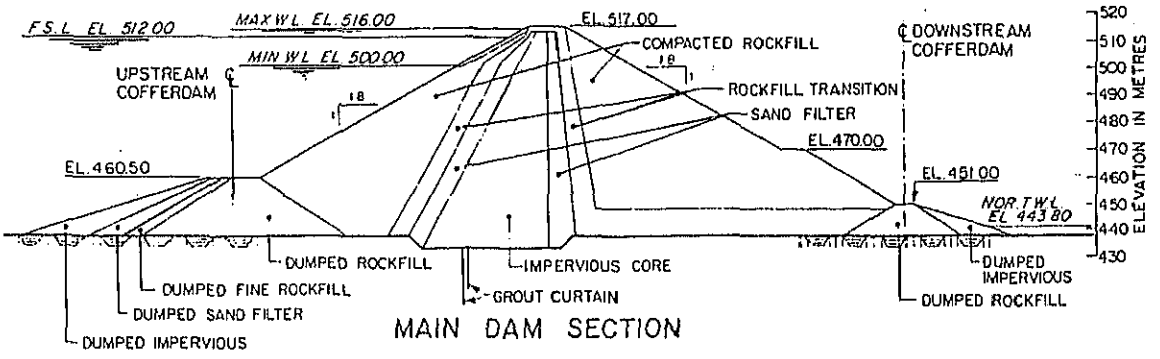
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. H4.22







Source : Ref. No. H.2

Figure H4.22
Preliminary Layout of Prospective Dam
(Low Grand Falls Dam)

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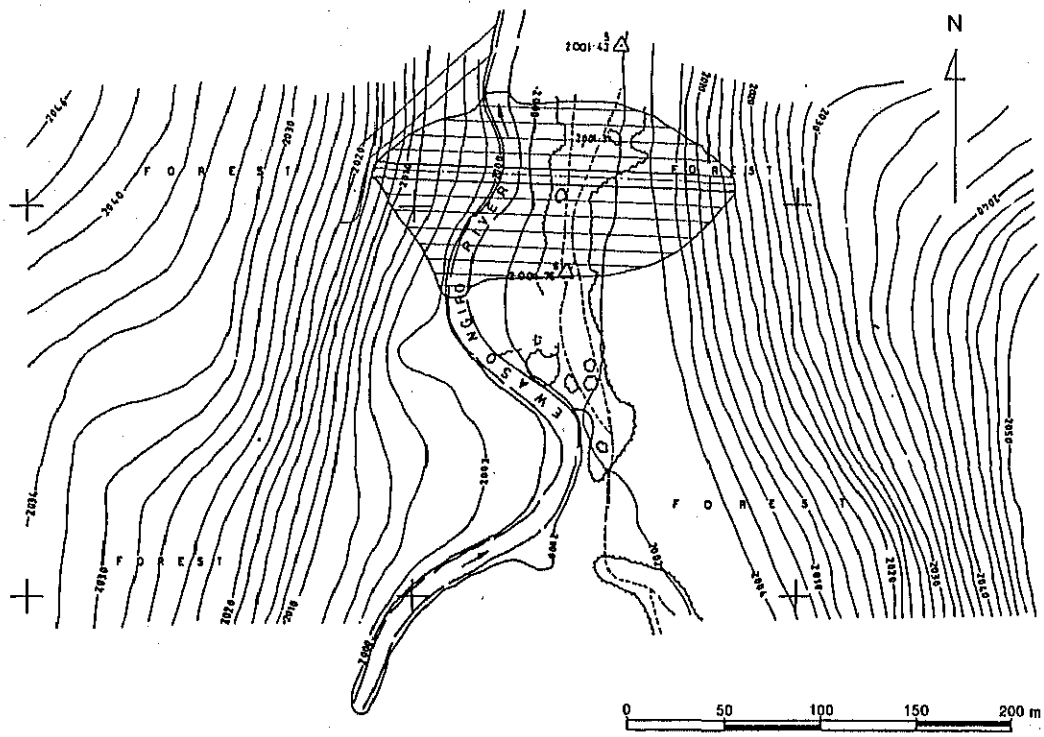
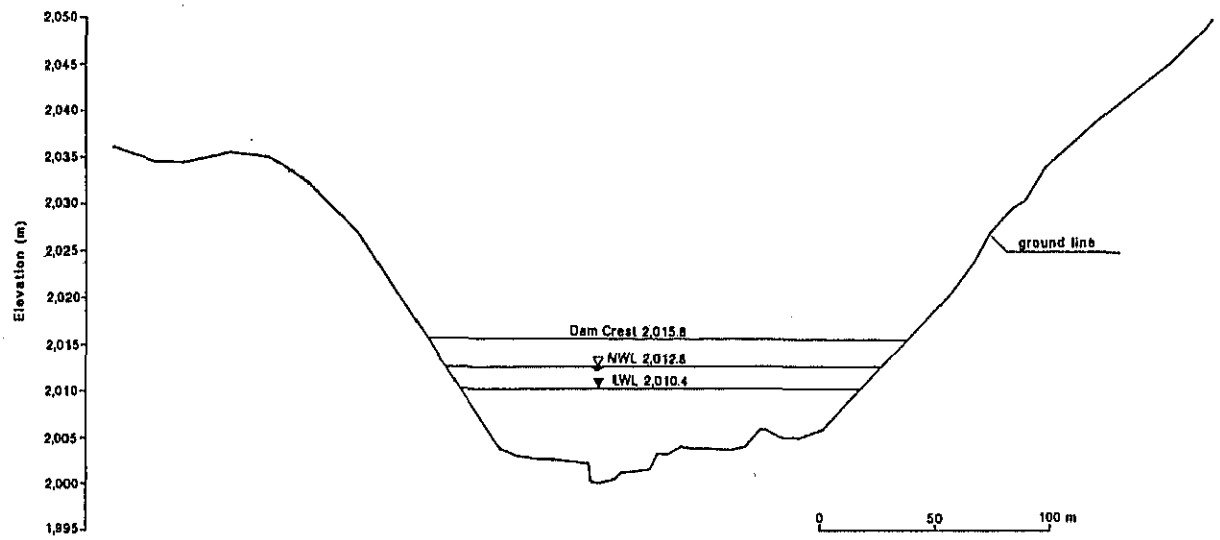
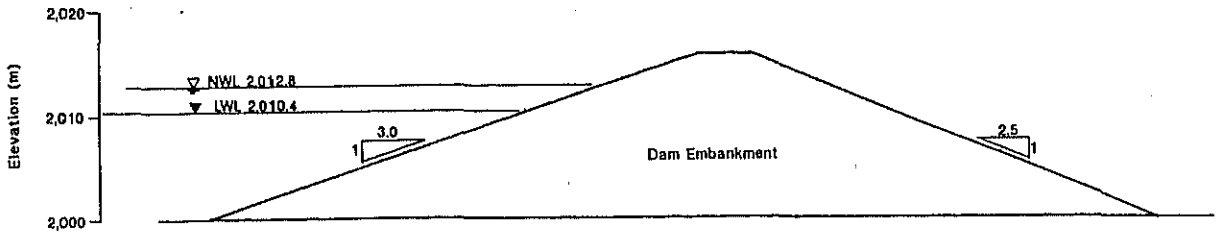
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. H4.23







Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

Figure H4.23
Preliminary Layout of Prospective Dam
(Rumuruti Dam)

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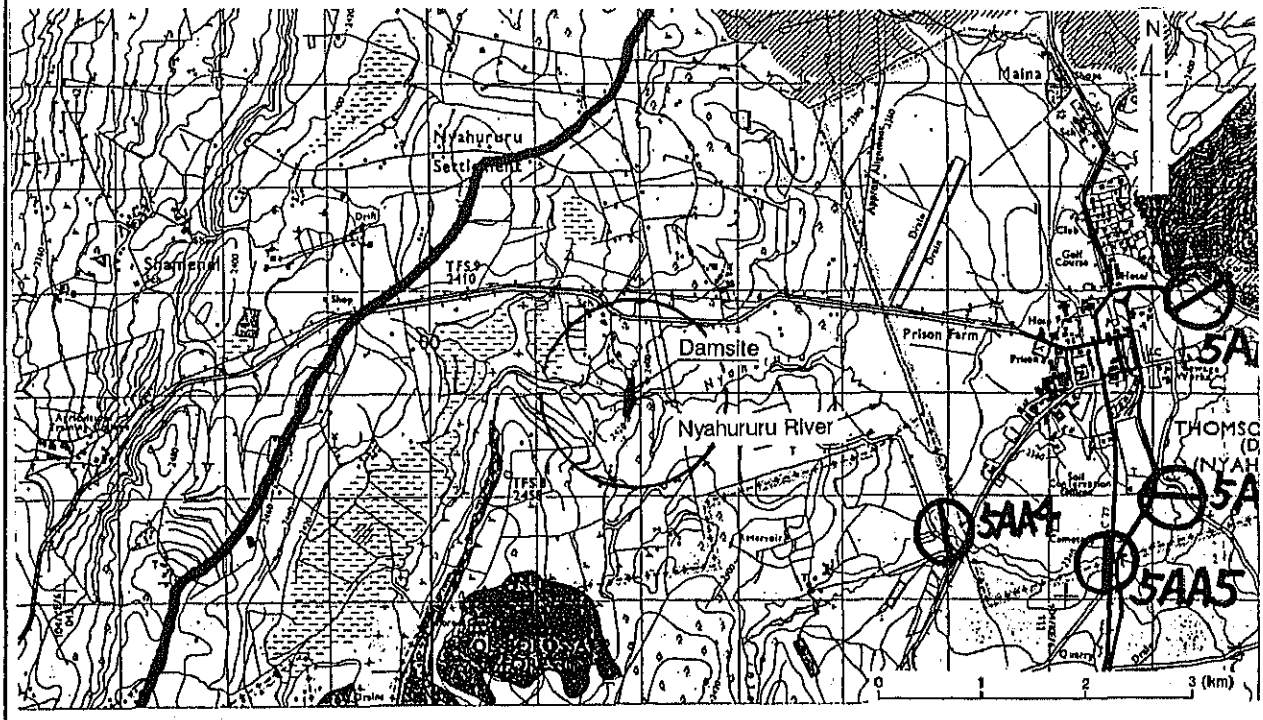
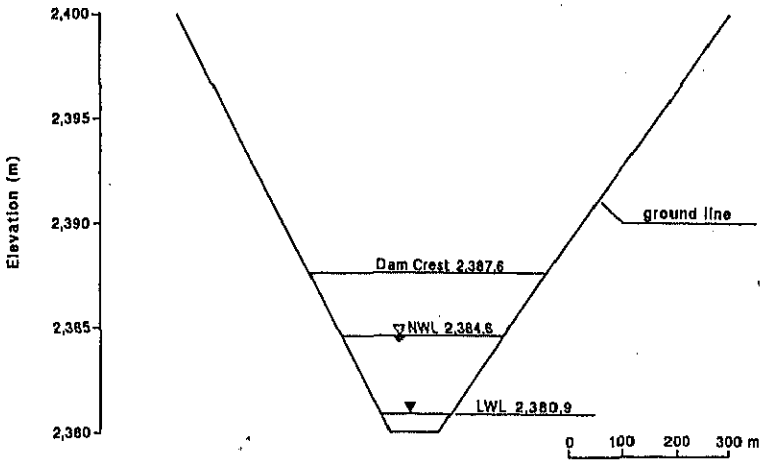
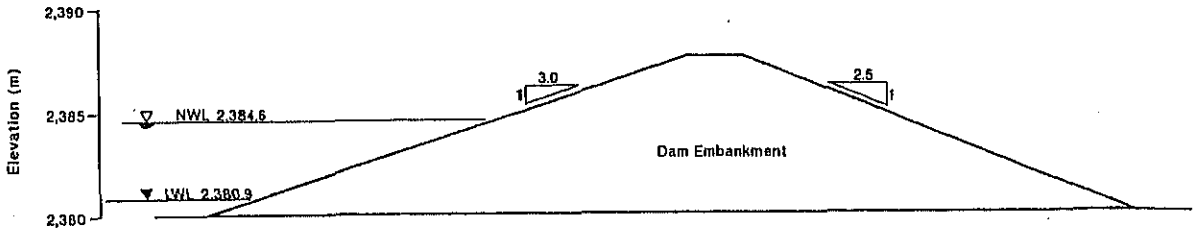
Fig. H4.24







Note : The figures above show only the proposed location and typical sections of dam used for preliminary cost estimate.

Figure H4.24
Preliminary Layout of Prospective Dam (Nyahururu Dam)

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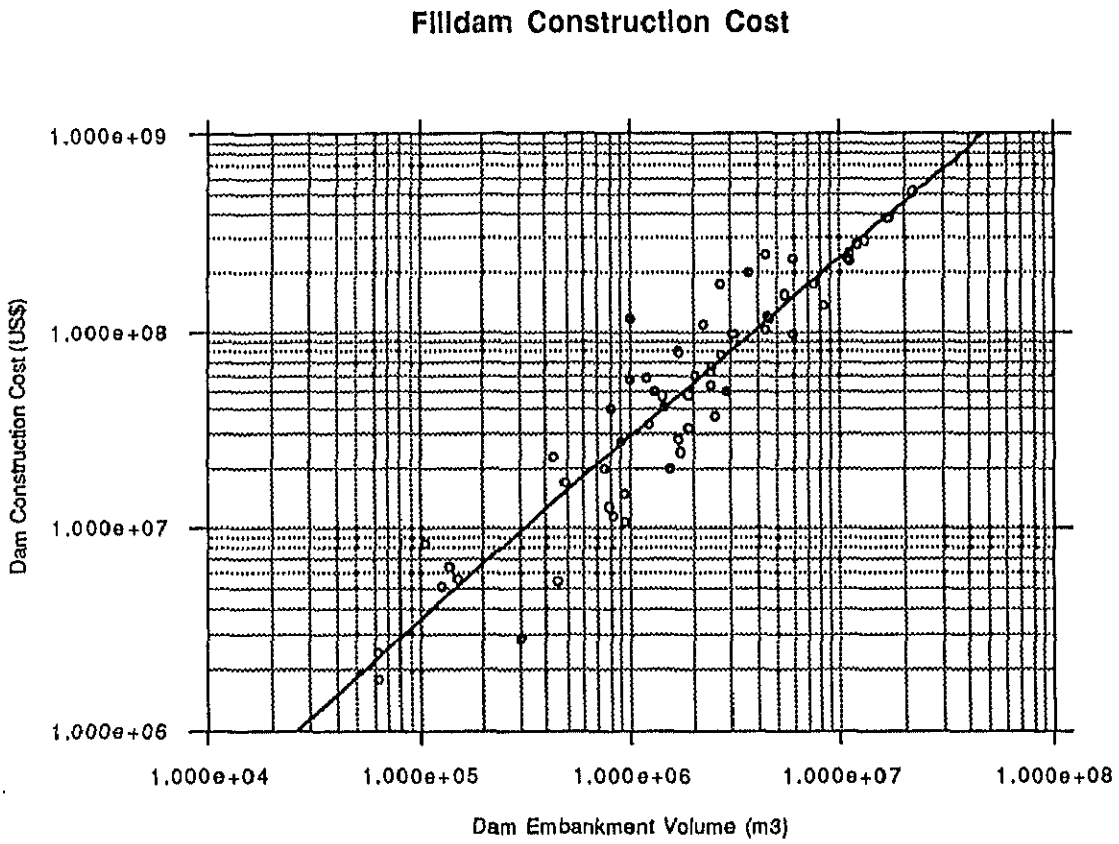

Filldam Construction Cost :

$$C = 100\ V^{0.92}$$

C : Construction Cost (US $)

V : Embankment Volume (m^3)

Figure H4.25

Estimated Dam Construction Cost Curve

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