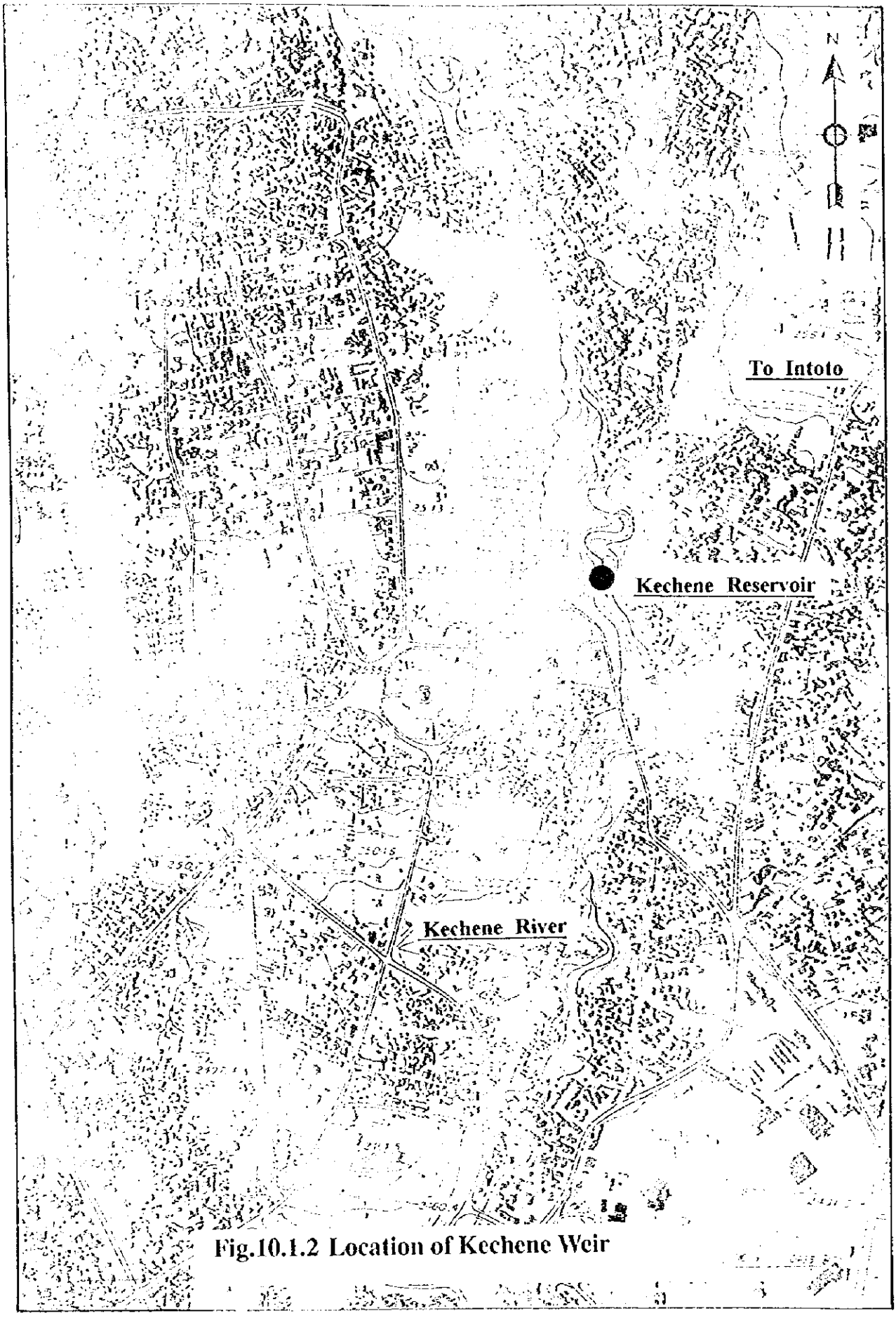


Fig.10.1.2 Location of Kechene Weir

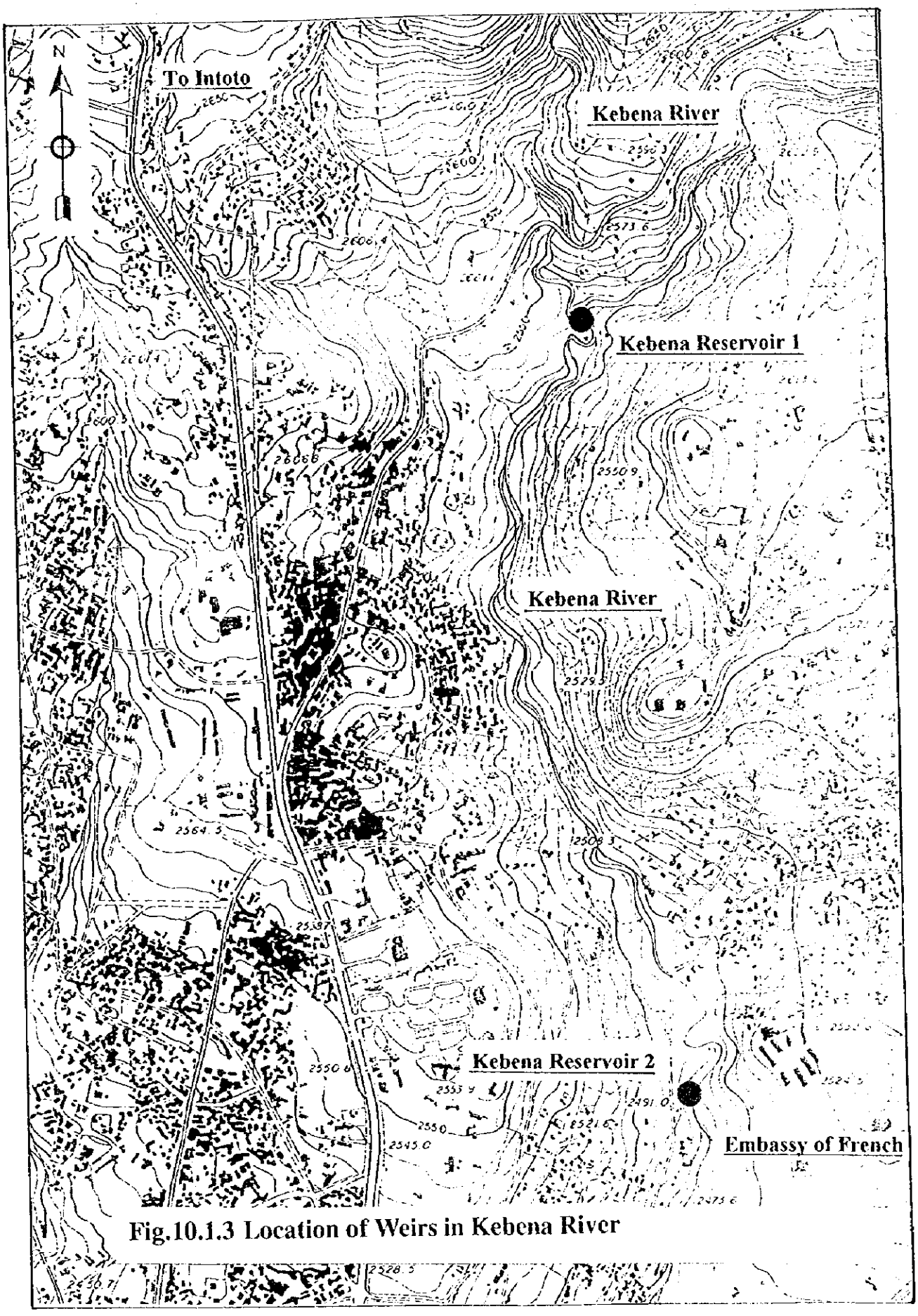


Fig.10.1.3 Location of Weirs in Kebena River

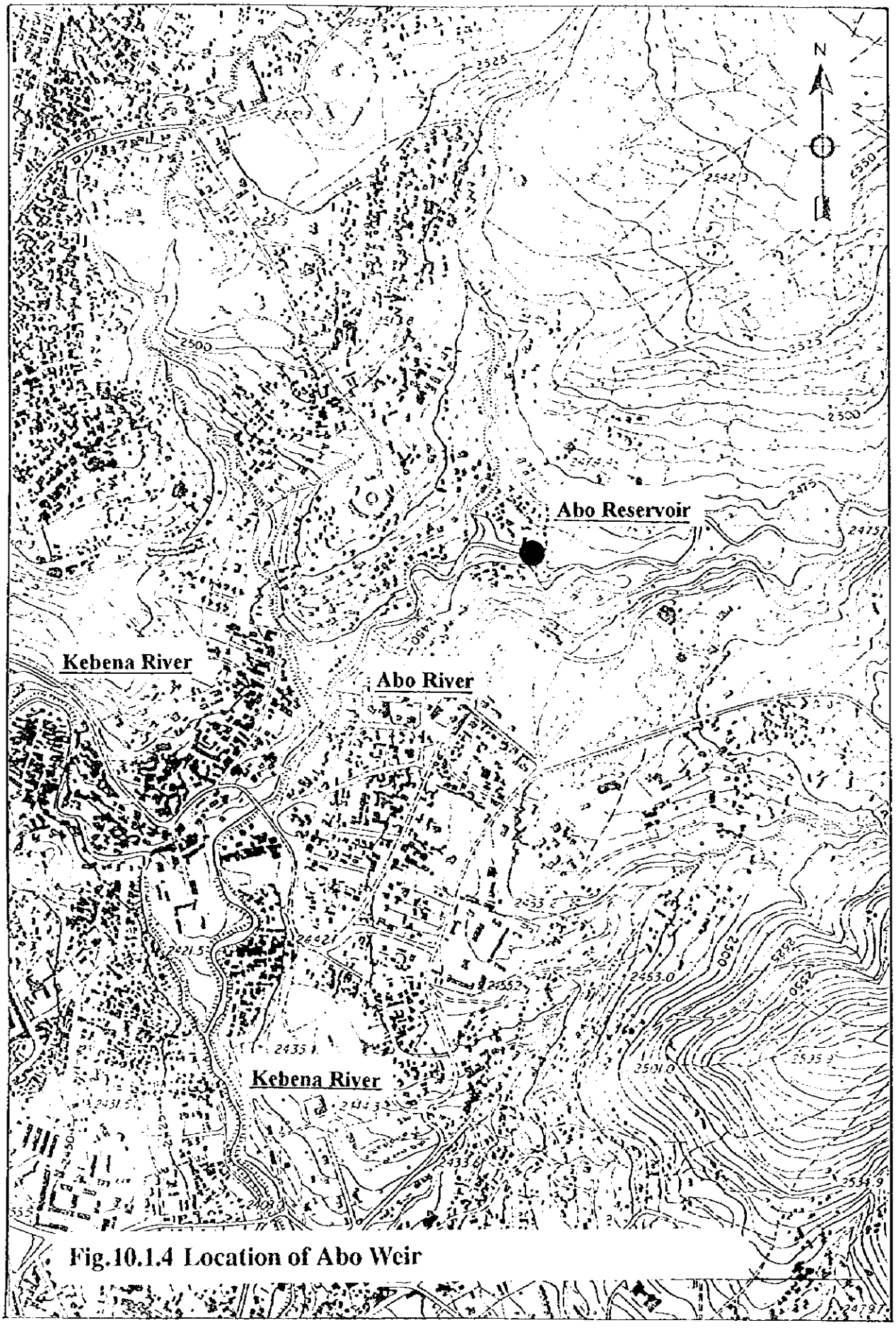
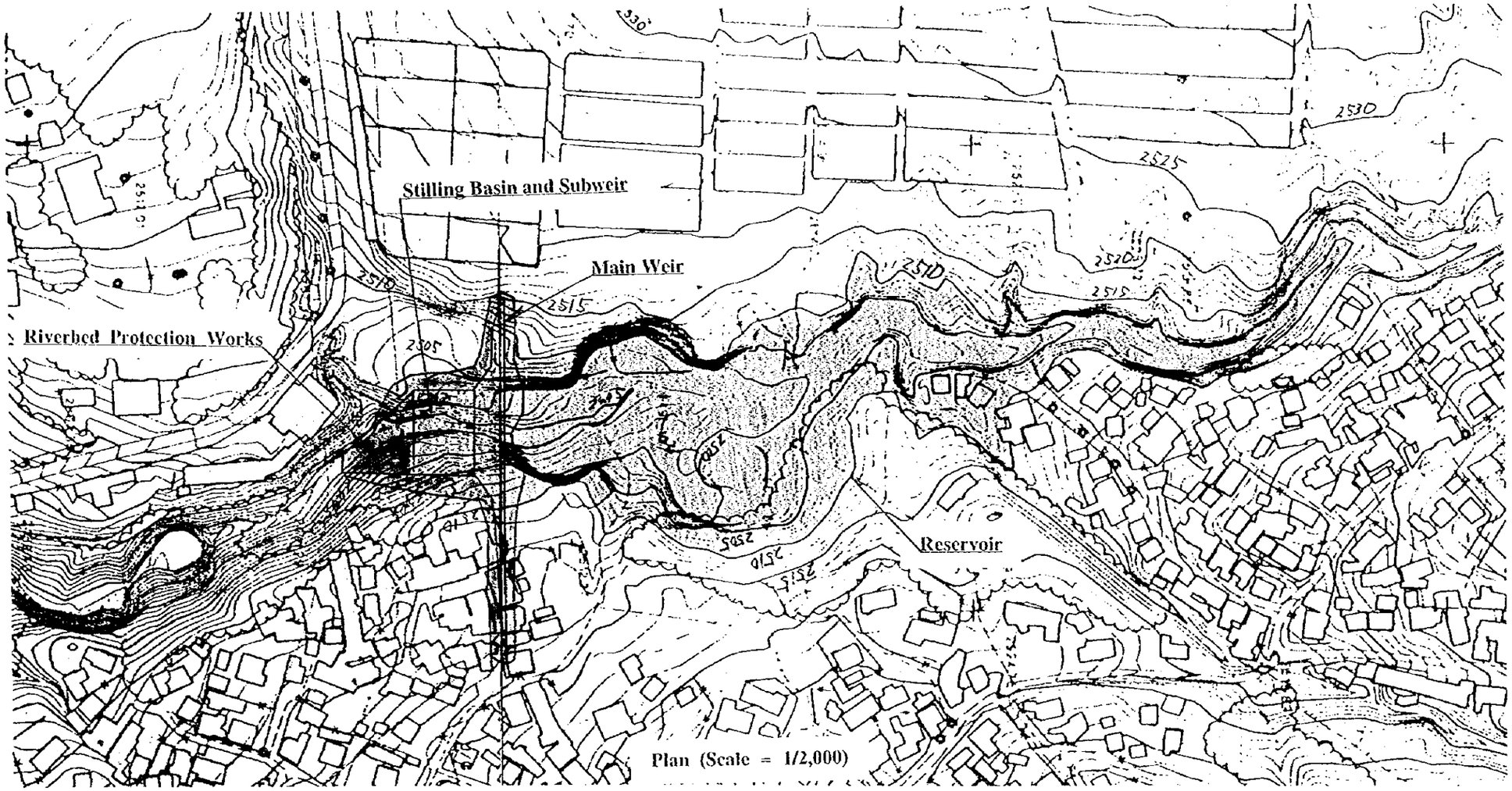
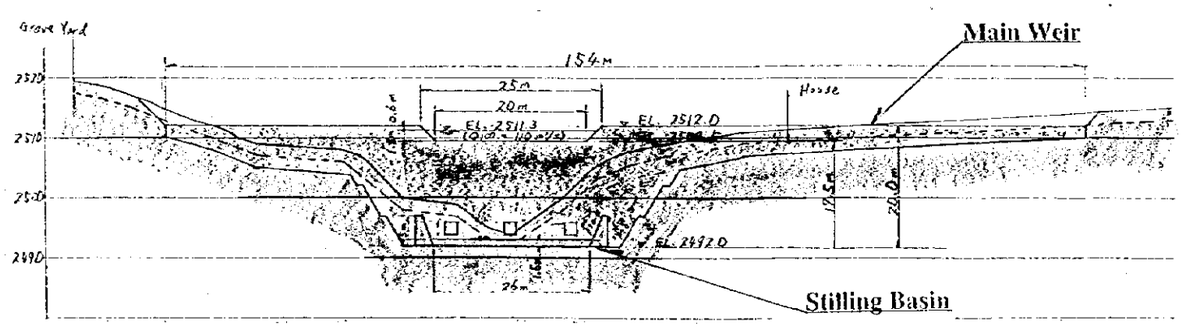


Fig.10.1.4 Location of Abo Weir



Plan (Scale = 1/2,000)

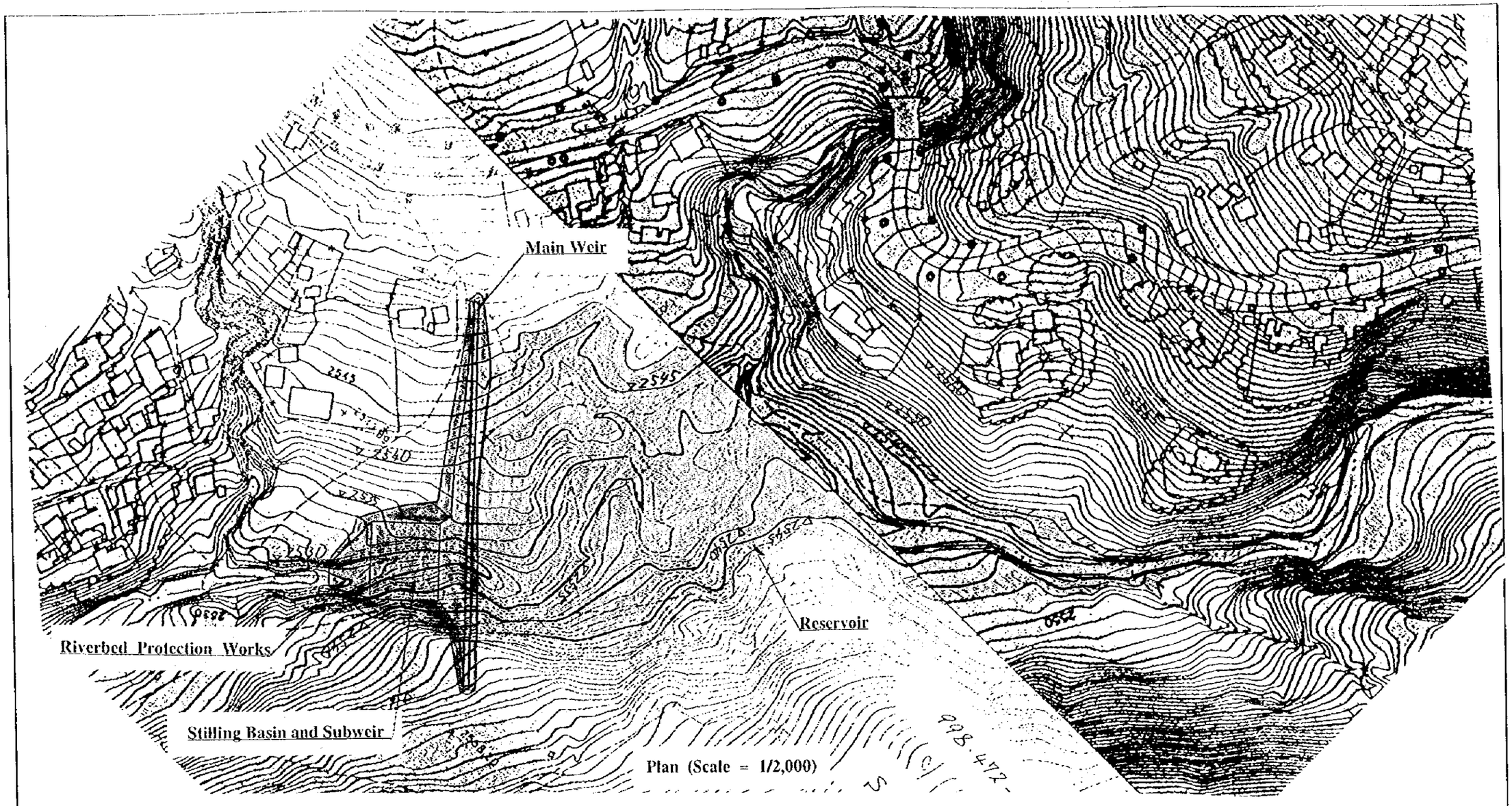


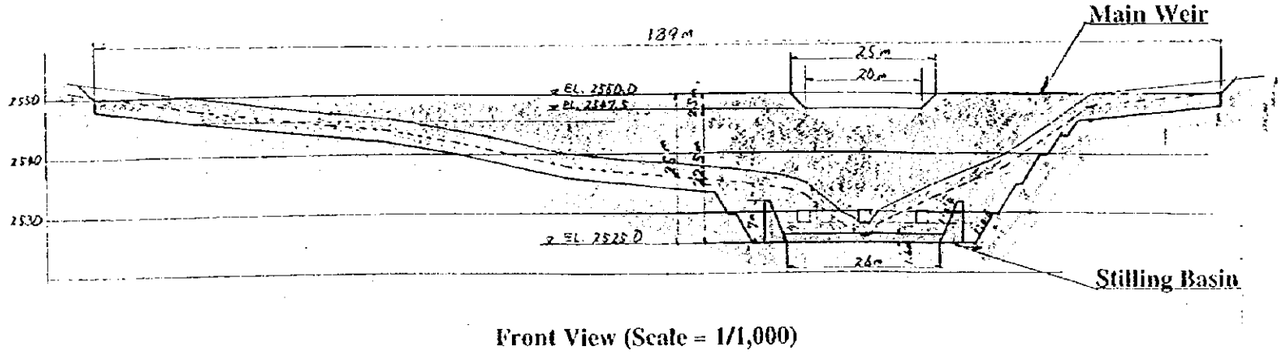
Front View (Scale = 1/1,000)

Major Features

- Type : Concrete Gravity
- Reservoir Storage Volume : 115,000 m^3
- Weir Height : 20 m
- Crest Length of Dam : 154m

Fig.10.1.5 Plan and Front View of Kechene Weir



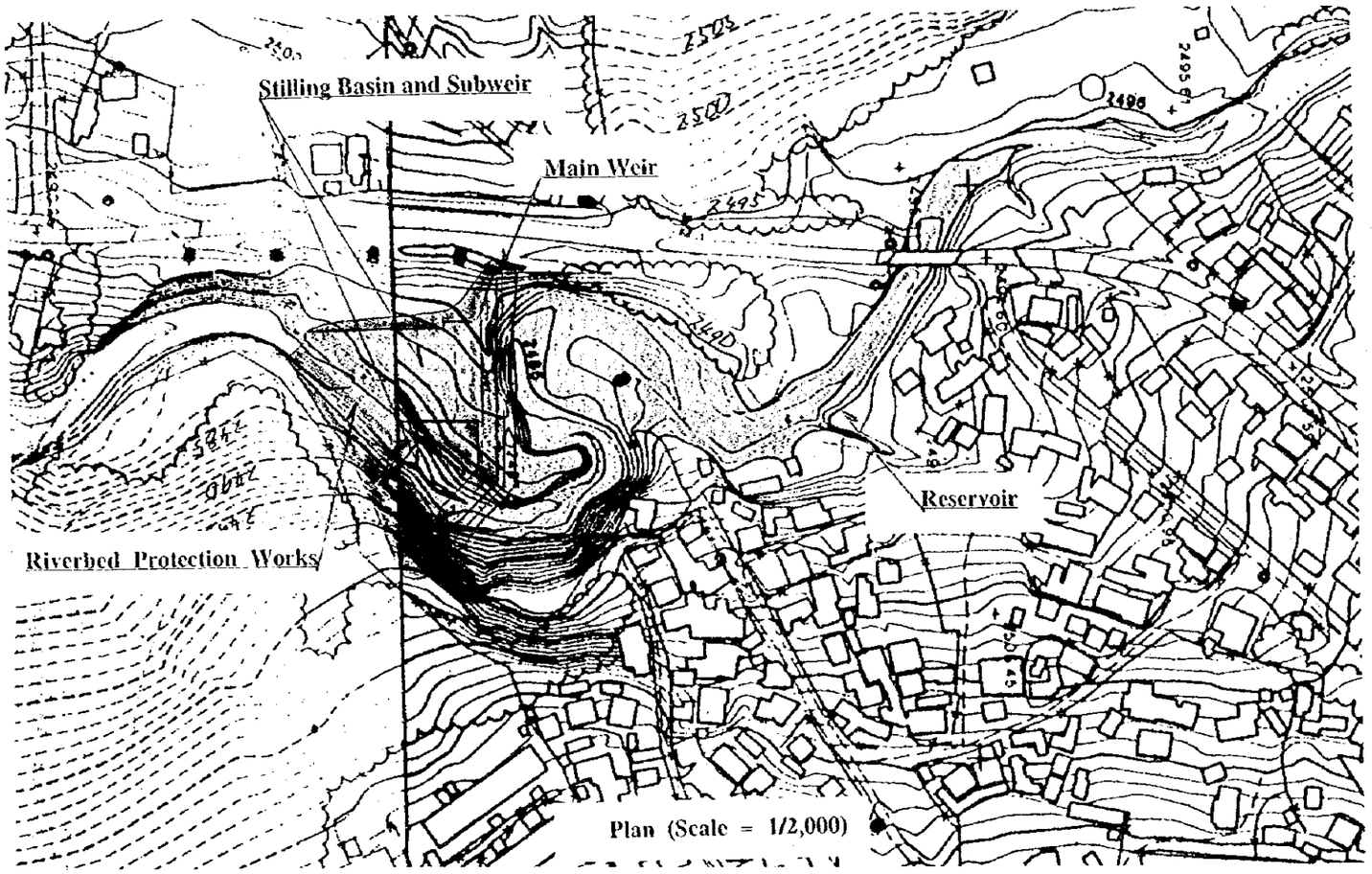


Front View (Scale = 1/1,000)

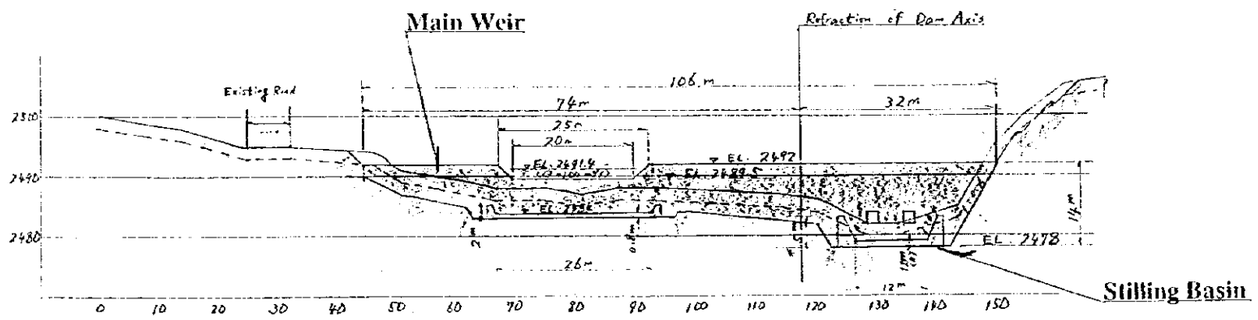
Major Features

- Type : Concrete Gravity
- Reservoir Storage Volume : 212,000 m^3
- Weir Height : 25 m
- Crest Length of Dam : 189m

Fig.10.1.6 Plan and Front View of Kebena No.1 Weir



Plan (Scale = 1/2,000)

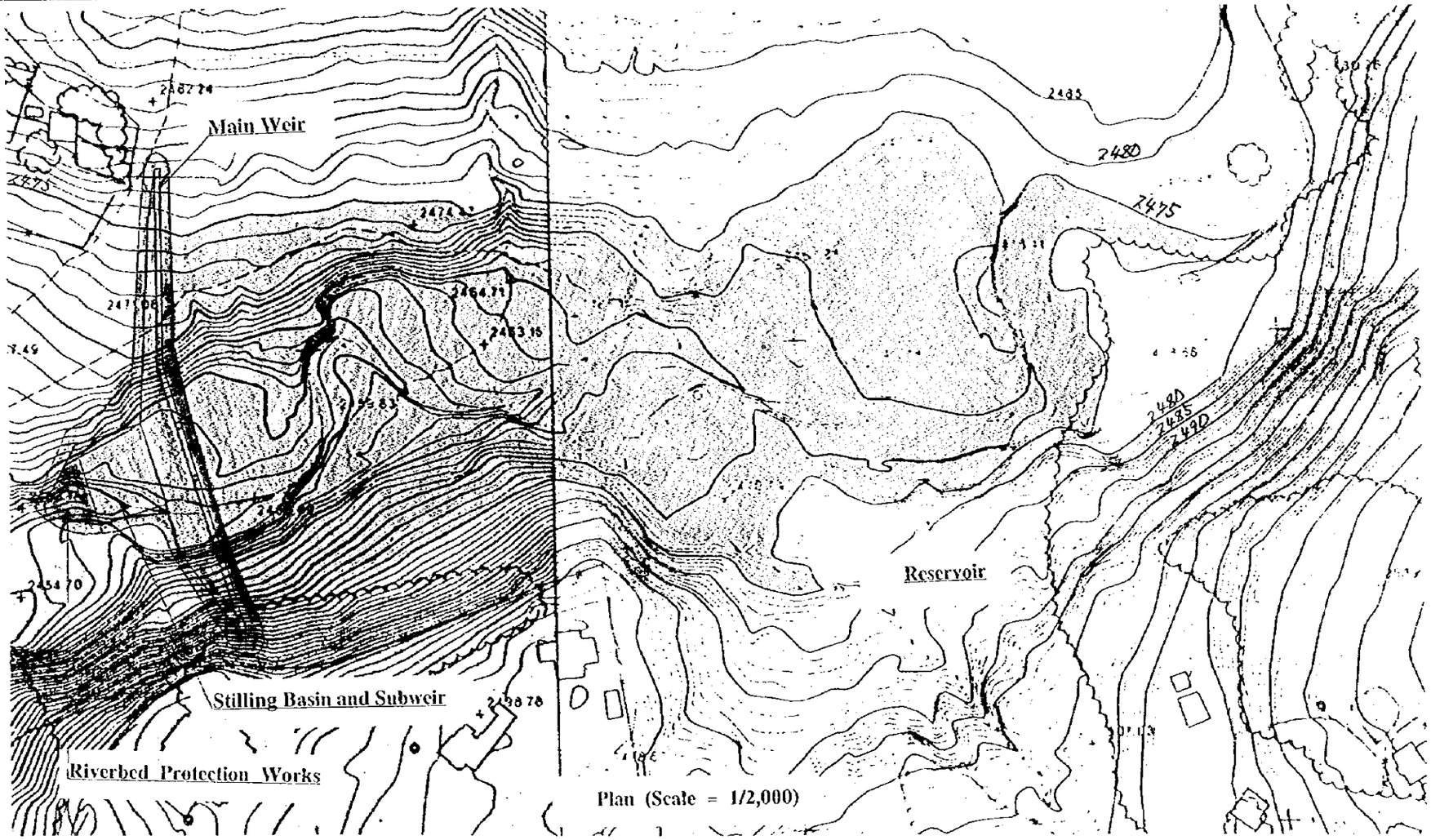


Front View (Scale = 1/1,000)

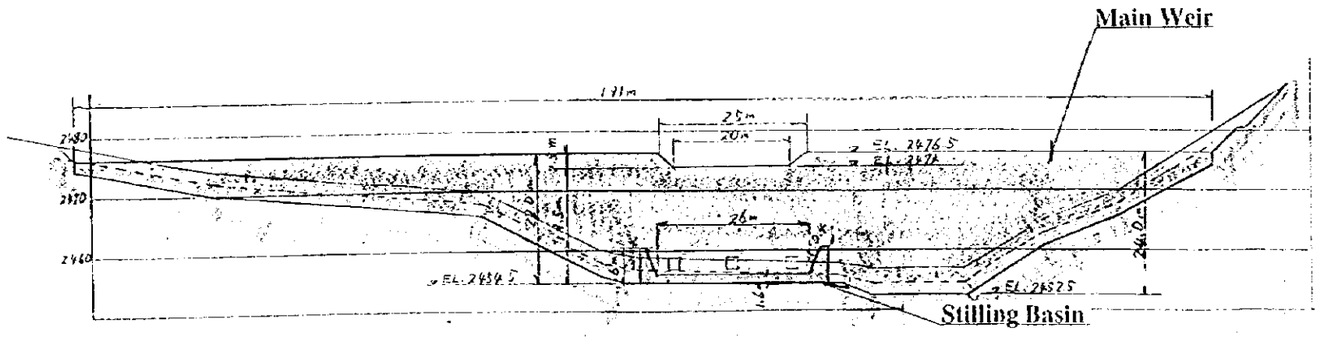
Major Features

- Type : Concrete Gravity
- Reservoir Storage Volume : 22,000 m^3
- Weir Height : 14 m
- Crest Length of Dam : 106m

Fig.10.1.7 Plan and Front View of Kebena No.2 Weir



Plan (Scale = 1/2,000)



Front View (Scale = 1/1,000)

Major Features

- Reservoir Storage Volume : 332,000 m^3
- Weir Height : 24 m
- Crest Length of Dam : 191m

Fig.10.1.8 Plan and Front View of Abo Weir

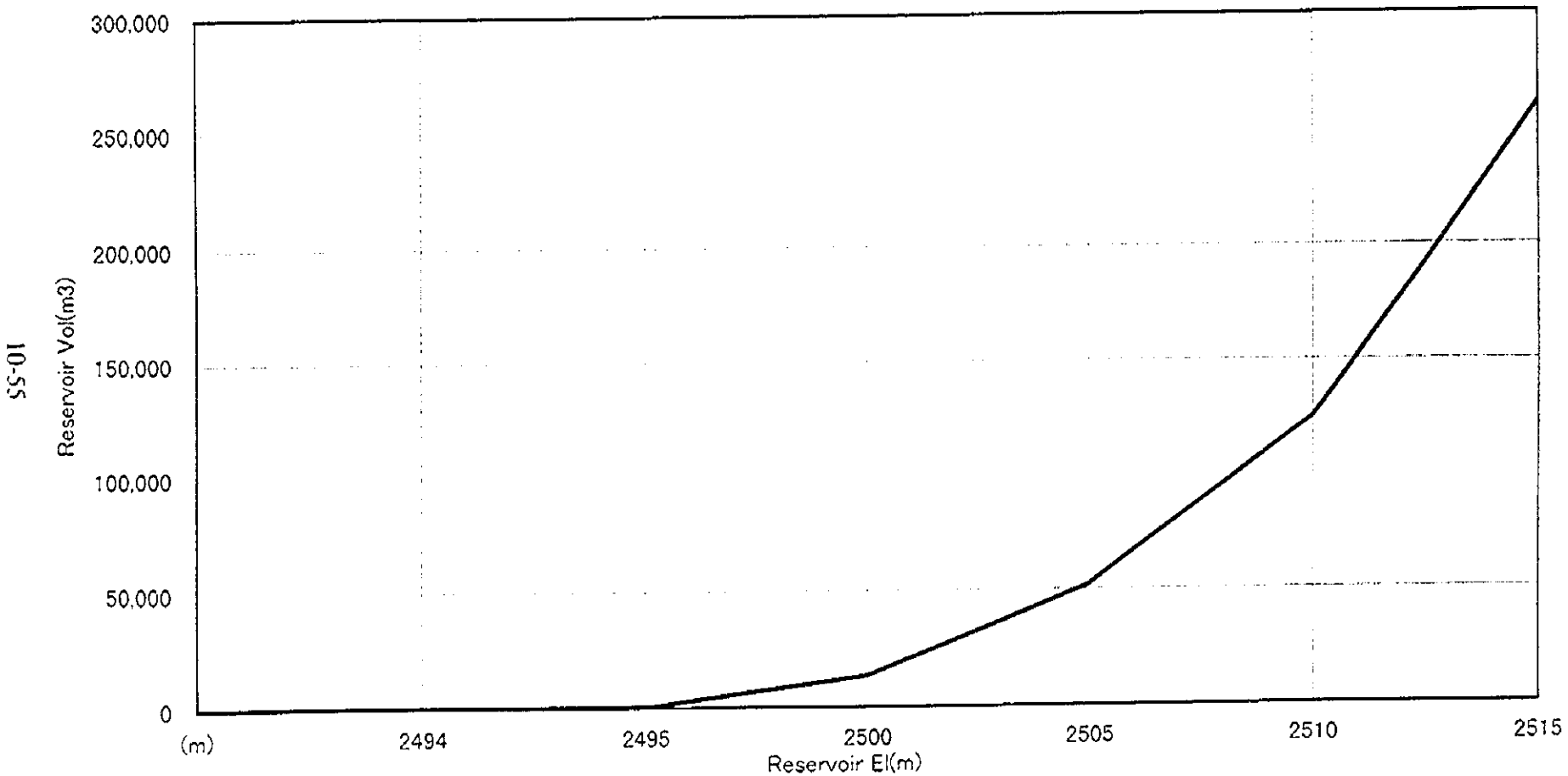


Fig.10.1.9 Reservoir Storage Volume of Kechene Weir

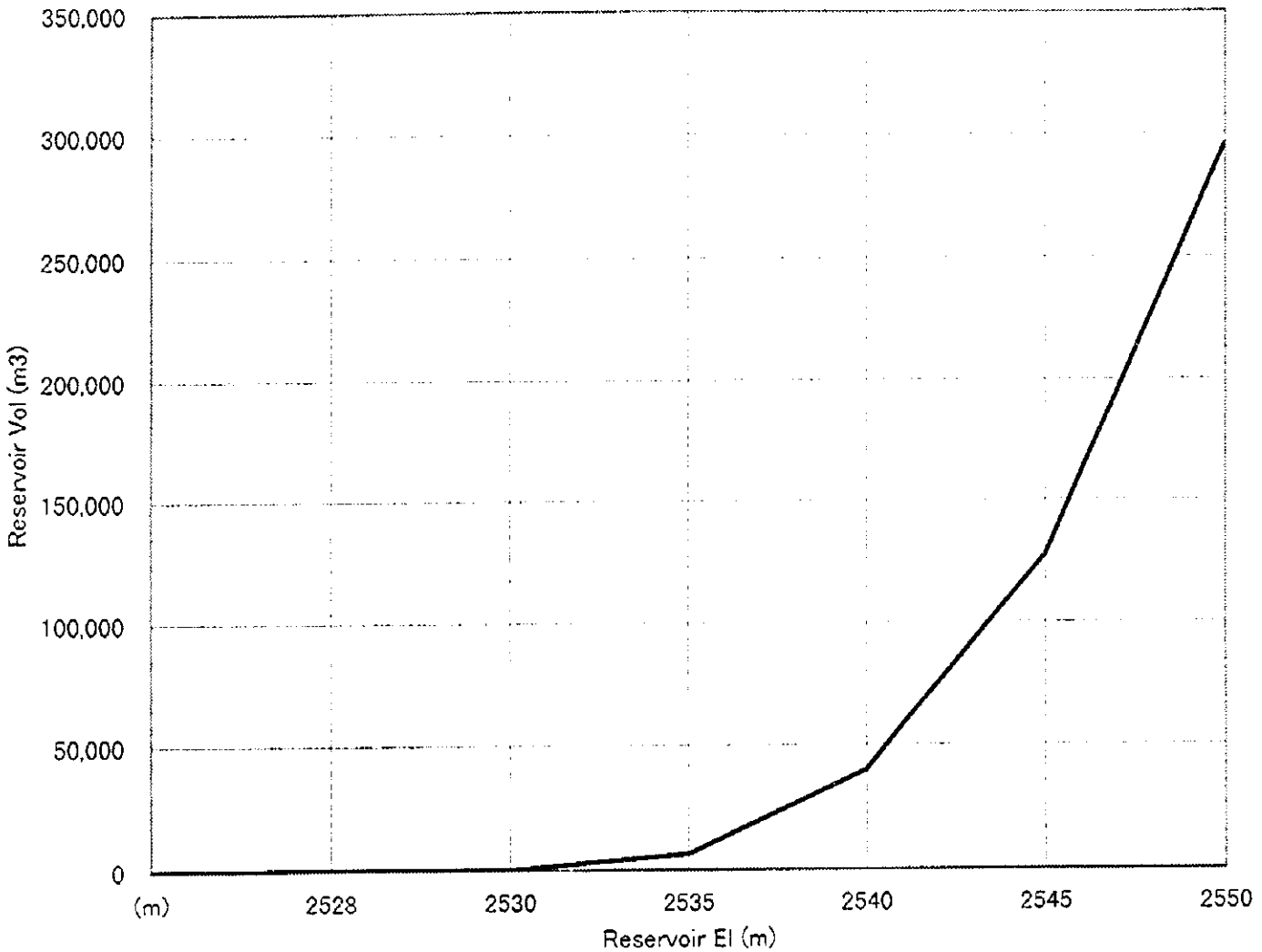


Fig.10.1.10 Reservoir Storage Volume of Kebena No.1 Weir

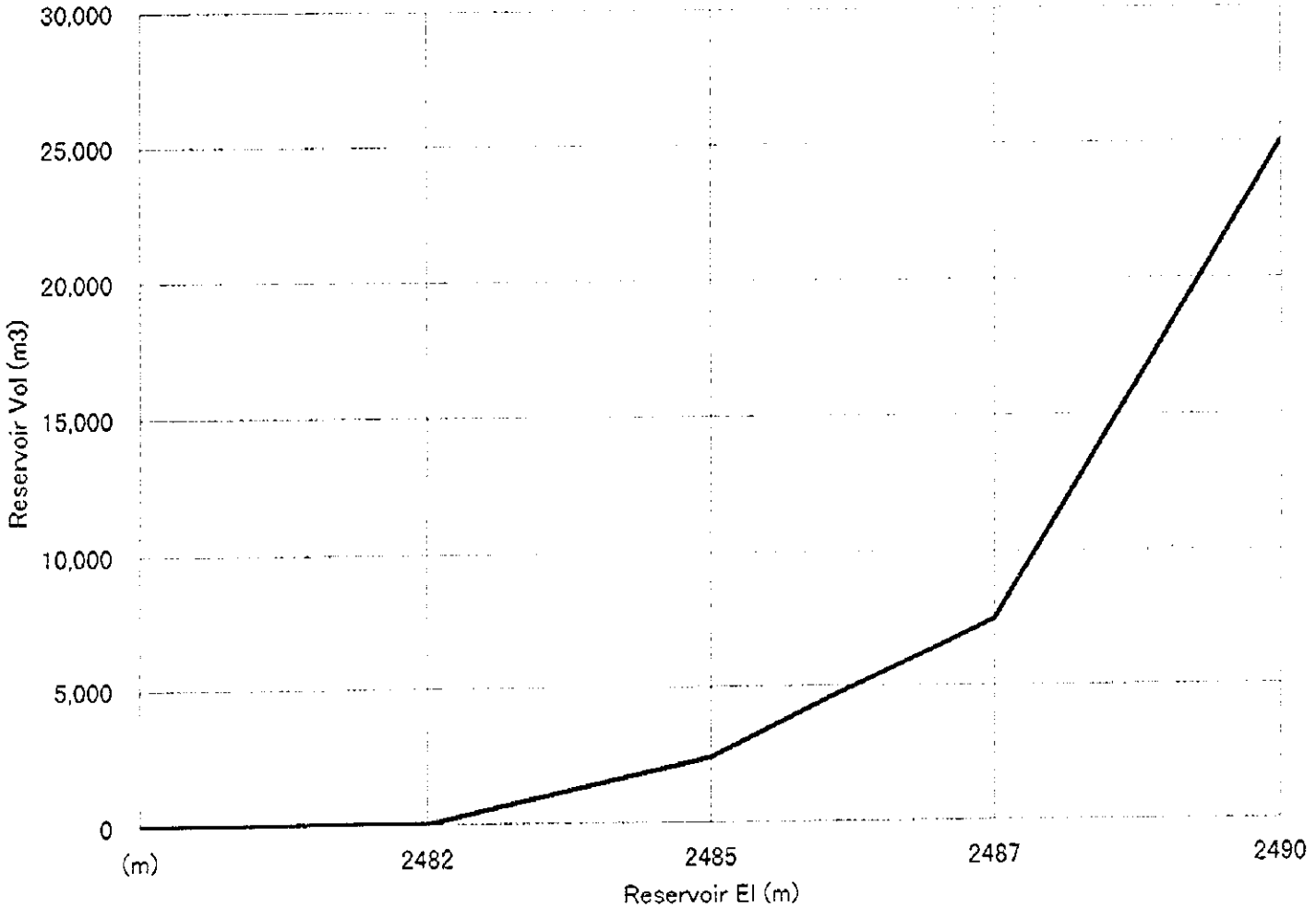


Fig.10.1.11 Reservoir Storage Volume of Kebena No.2 Weir

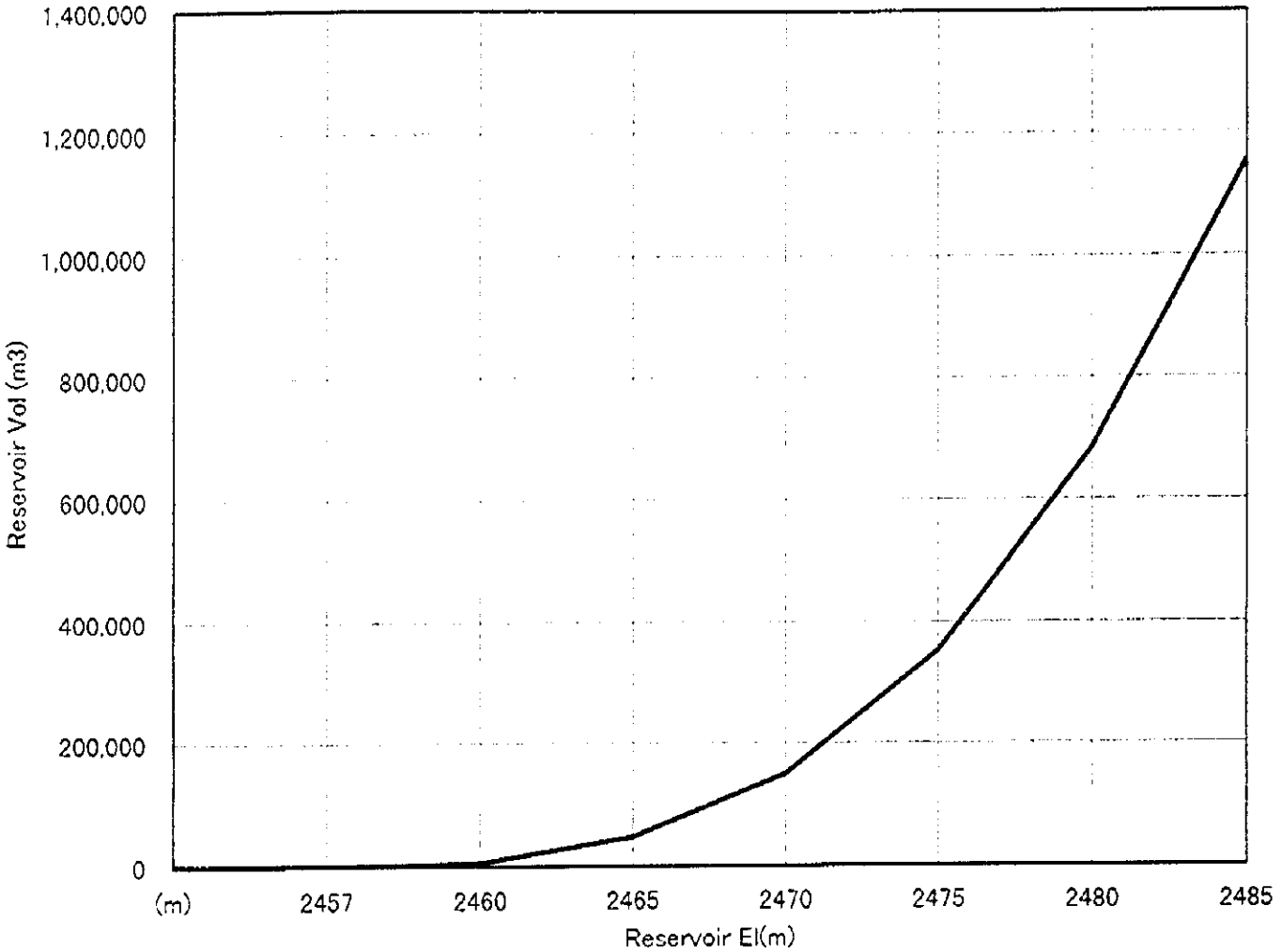


Fig.10.1.12 Reservoir Storage Volume of Abo Weir

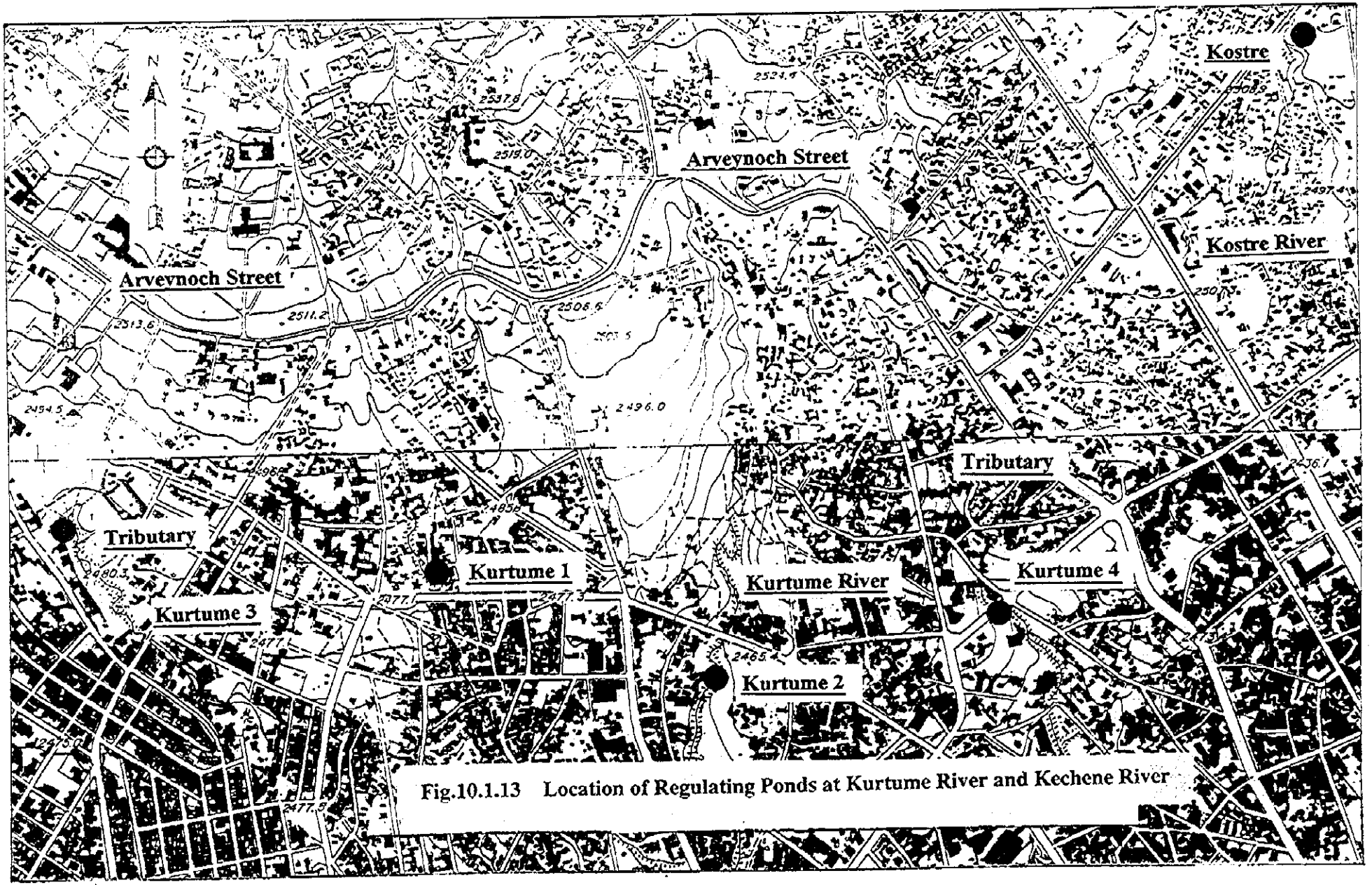


Fig.10.1.13 Location of Regulating Ponds at Kurtume River and Kechene River

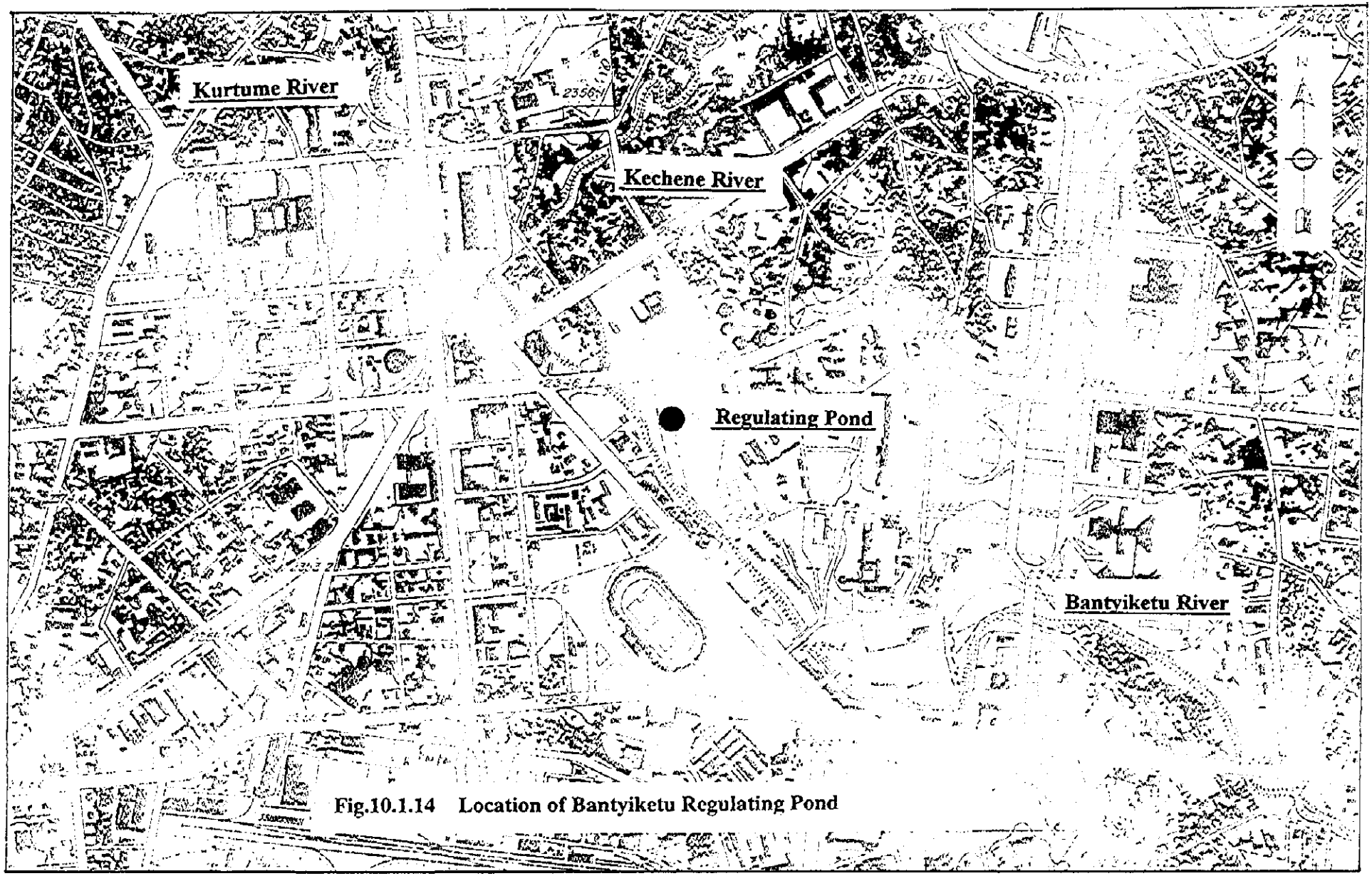


Fig.10.1.14 Location of Bantyiketu Regulating Pond

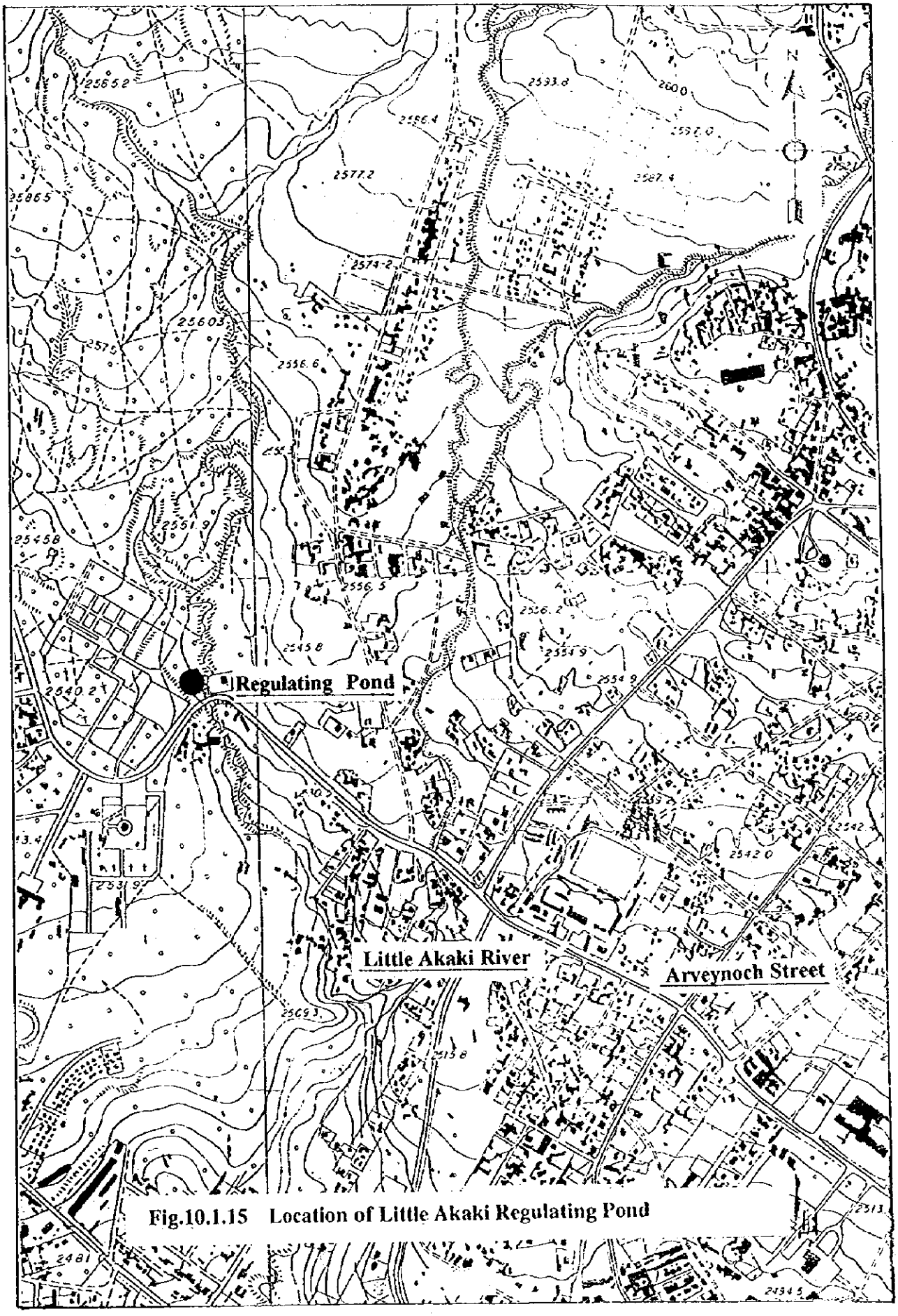


Fig.10.1.15 Location of Little Akaki Regulating Pond

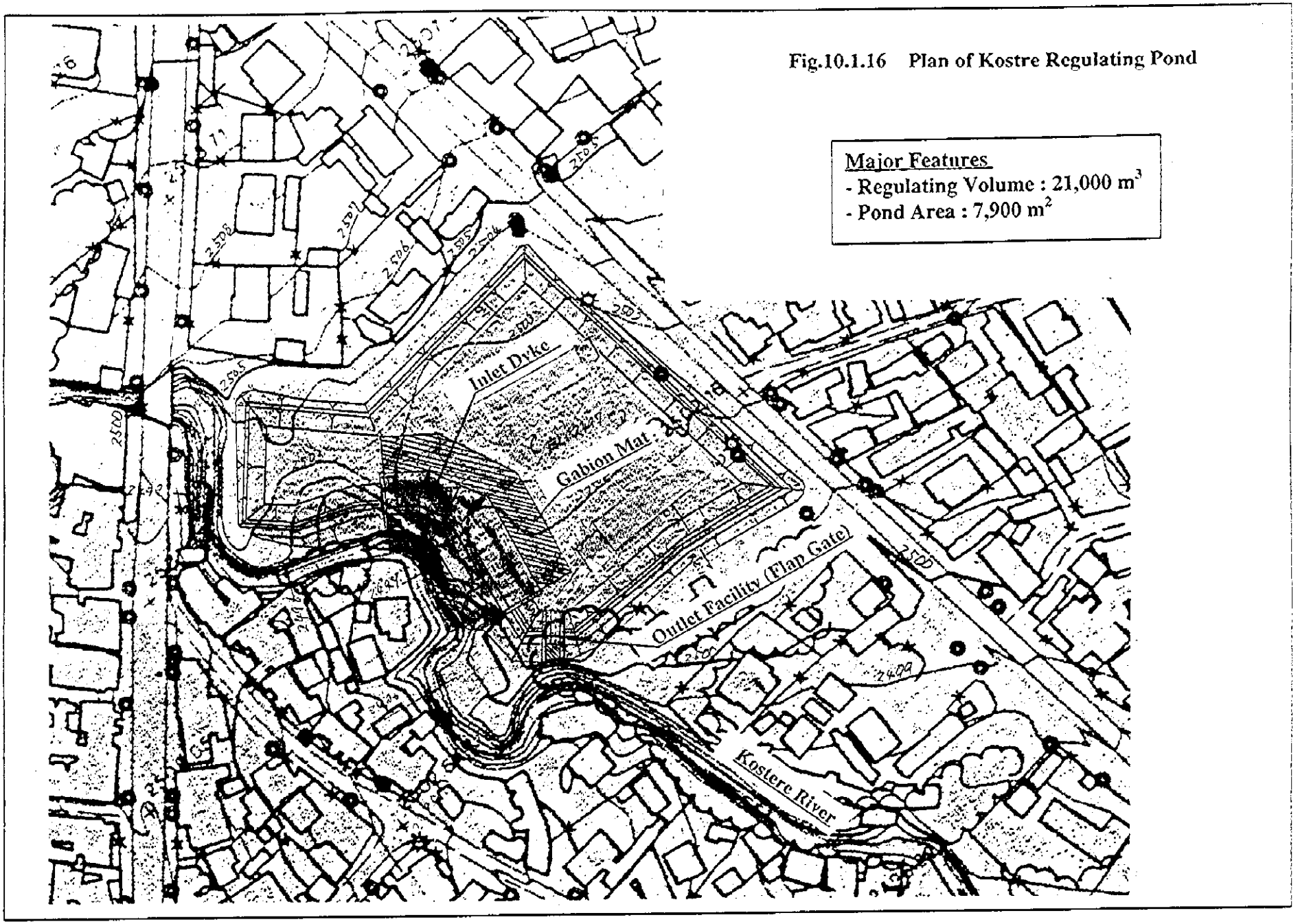


Fig.10.1.16 Plan of Kostre Regulating Pond

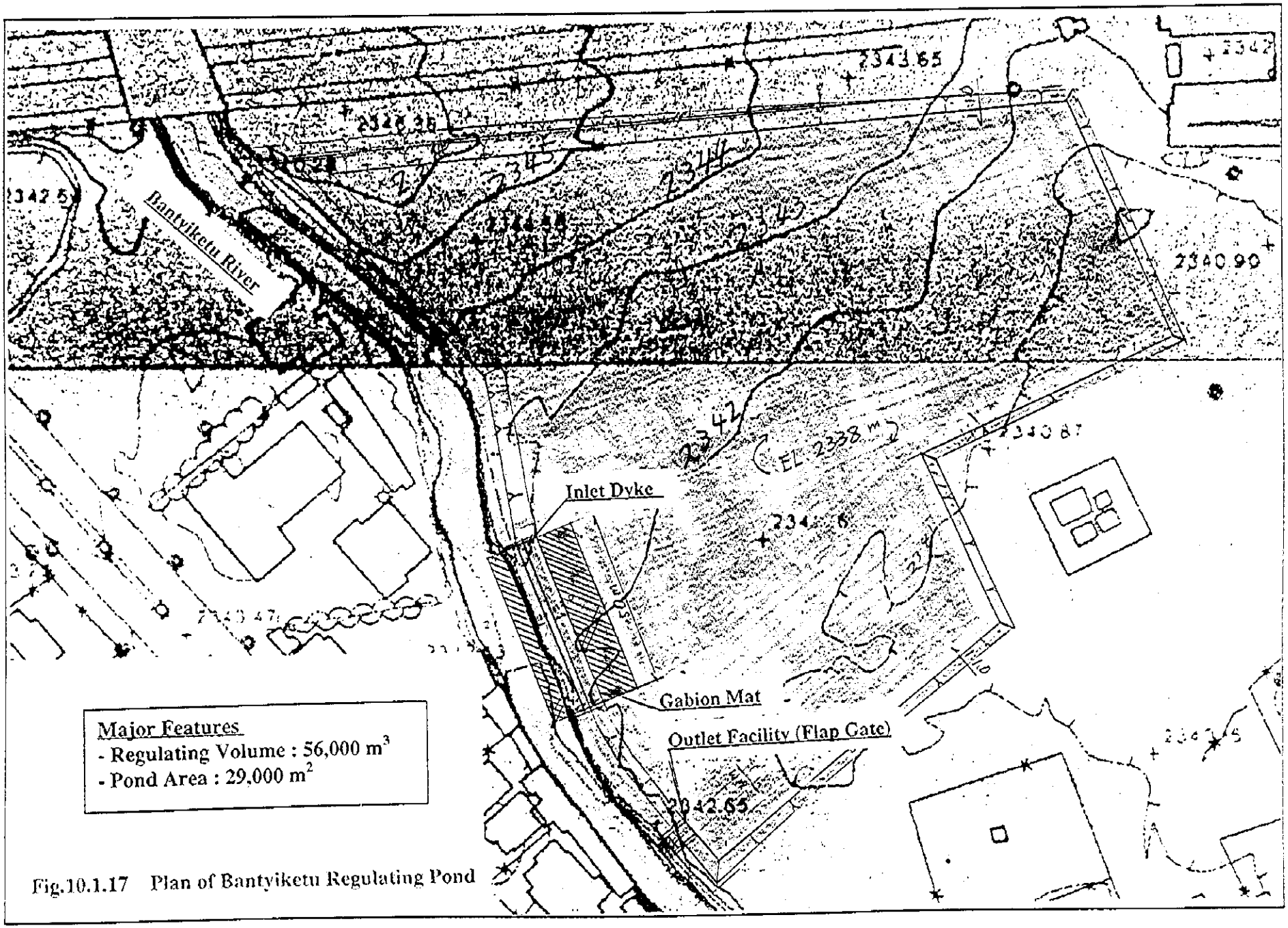


Fig.10.1.17 Plan of Bantyiketu Regulating Pond

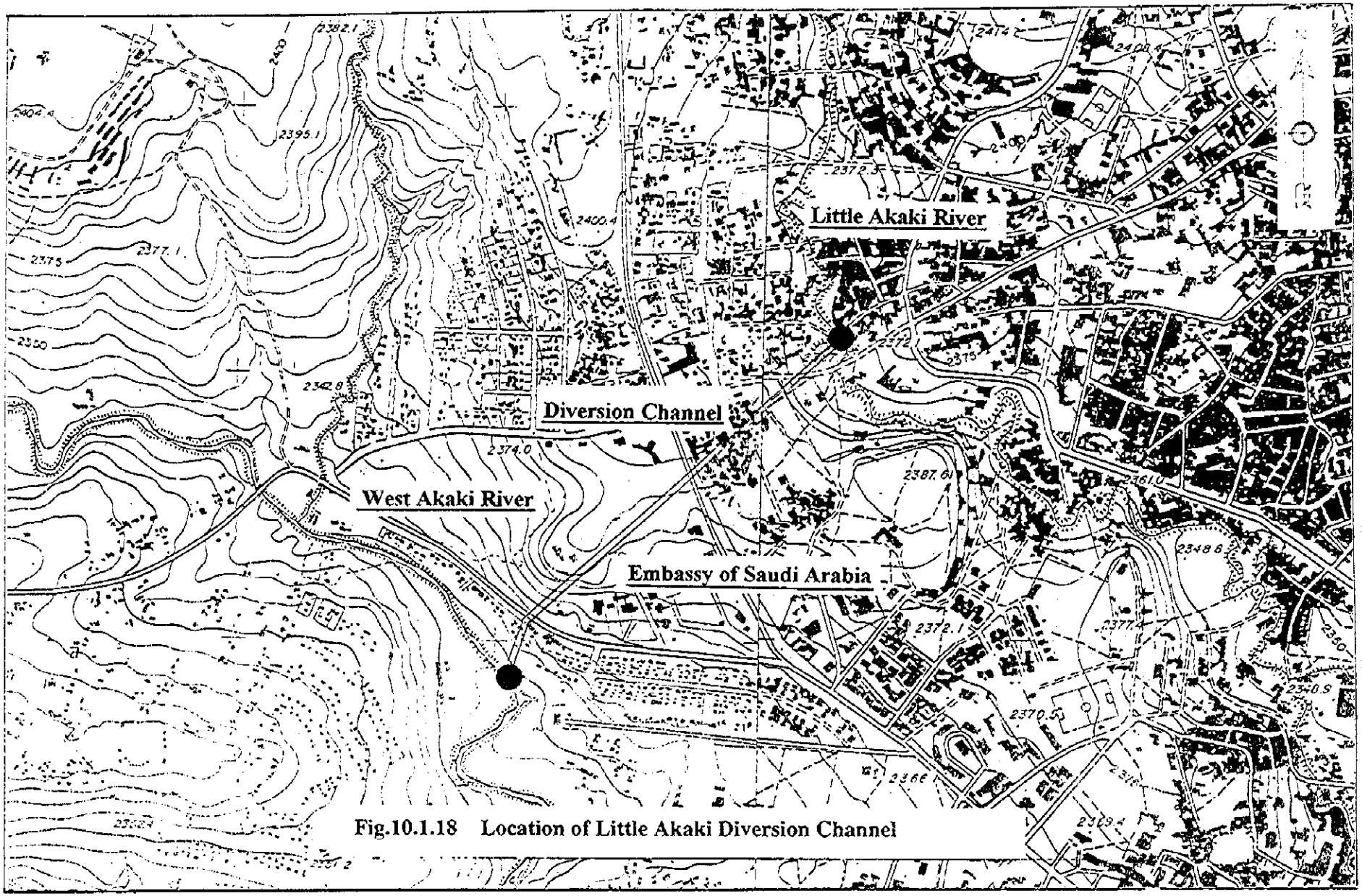
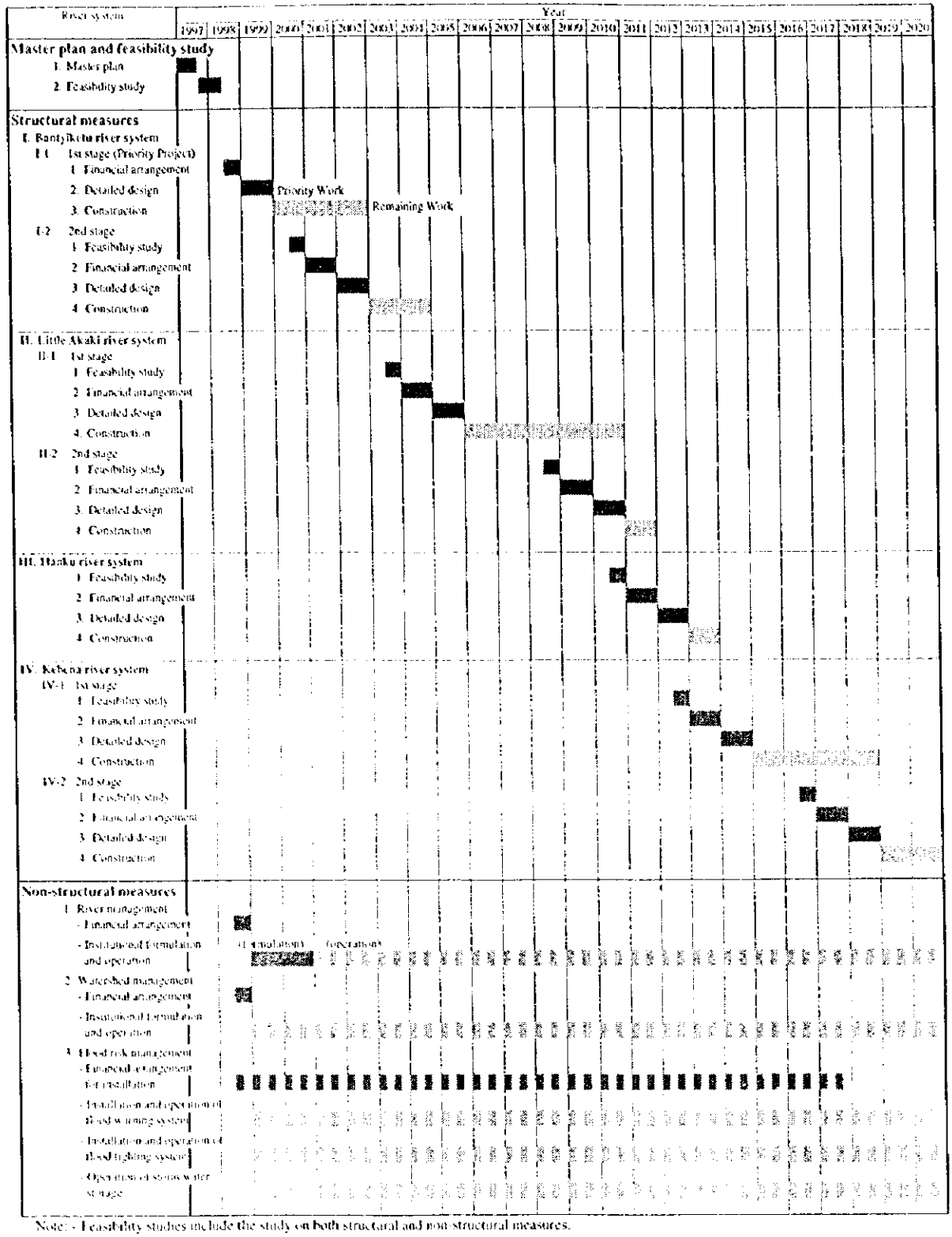


Fig.10.1.18 Location of Little Akaki Diversion Channel



Note: - Feasibility studies include the study on both structural and non-structural measures.
- All the master plan projects will be implemented river by river in order of priority. Each river system will be implemented being divided into two stages, except for the Hanku river system, i.e. 1st stage and 2nd stage.
- 1st stage is high priority projects in the river system.
- 2nd stage is low priority projects in the river system.
- Construction of 1st stage in the Bantyiketu river system (Priority Project) is divided into Priority Work and Remaining Work on the basis of a feasibility study scheduled in 1997/98. The size of facilities chosen as Priority Work may be less than the size of Priority Project contemplated in Master Plan Study. By the completion of Priority Work and Remaining Work, all facilities finish their construction as contemplated in Master Plan Study.
- Construction period of each stage is scheduled so that the yearly disbursement amount of construction cost should not exceed 500 million Japanese yen (equivalent 30 million Birr).

Figure 10.2.1 Proposed Implementation Plan of Master Plan Projects

CHAPTER 11

ENVIRONMENT

THE STUDY
ON
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IN
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

CHAPTER 11 ENVIRONMENT

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11. ENVIRONMENT

11.1 General

Environmental study is carried out to clarify environmental issues related to the flood control master plan by conducting an Initial Environmental Examination (IEE).

11.2 Institutional Conditions on the Environment in Ethiopia

As mentioned in the section of the legal situation on environment in Ethiopia, the basic policy on protection of environment was just issued in April 1997 by Secretariat for the Conservation Strategy of Ethiopia, Environmental Protection Authority in collaboration with the Ministry of Economic Development and Cooperation.

Accordingly the related regulations will be formulated based on this established national policy on environment.

11.3 Initial Environmental Examination

(1) Objectives

The main objectives of the Initial Environmental Examination (IEE) of the Addis Ababa Flood Control Master Plan are to clarify environmental issues related to the flood control master plan, and to provide information to guide Environmental Impact Assessment (EIA) in the feasibility study.

(2) Environmental Items

The flood control master plan includes; 1) construction of flood wall as dyke system, 2) river channel excavation for widening, 3) construction of flood control weir, 4) construction of flood diversion channel, 5) construction of flood regulation pond.

The environmental items for IEE are selected from common items related to these plans based on the Guidelines of the EIA for River and Sand Control Projects of JICA (1994). Consequently, the following items are selected for the IEE:

Social Environmental Issues	Nature Environmental Issues	Environmental Pollution Issues
- Resettlement	- Topography and geology	- Air pollution and noise
- Impairment of the transportation system	- Ground water	- Water quality deterioration
- Communities	- River flow regime	- Noise and vibration
- Encroachment on historical Assets	- Flora and fauna	
- water rights	- Aesthetics & landscapes	
- Solid waste		

(3) Initial Environmental Examination (IEE)

The objective rivers of the flood control master plan are; the West Akaki, Little Akaki, Bantyiketu, Kechene, Kurtume, Kebena, and Hanku rivers.

Among these, the master plan on the West Akaki river is limited to only non-structural measures since the present river channel carrying capacities are sufficient to the basic design discharge. Accordingly IEE here does not touch on the West Akaki river.

Significance for proceeding to Environmental Impact Analysis (EIA) among the IEE items has been classified in the respective schemes by the following classes; (A) mostly significant, (B) significant, (C) significant but relatively minor, (D) No effect is expected. The discussions are presented here and the results are shown in Table 11.3.1

1) Social Environment

a) Resettlement

Resettlement is required for the flood control master plan of the Bantyiketu, Kebena, Little Akaki river systems. The work components of these river systems related to resettlement are mainly widening of the river channel and construction of flood diversion channel. Resettlement needed for construction of low weir in the upstream reaches of the Kebena and Kechene rivers are very limited since the location is outside of the urban area.

The basic concept of the flood control master plan is to minimize the river channel improvement by construction of low weir and regulating pond to avoid resettlement as much as possible. Accordingly the resettlement needed for river channel improvement is limited to certain extent. Resettlement needed for construction of flood diversion channel is also limited to certain extent since the main portion is under a hill as a tunnel.

Therefore the resettlement item is evaluated as significant for channel improvement and construction of flood diversion channel, and as significant but relatively minor or not significant for other work components.

b) Impairment of the transportation system and Communities

Low weir is planned in the rather deep valley without any bridges. Accordingly the impairment of the transportation is not expected. Flood diversion channel is, as mentioned above, planned mainly under a hill as a tunnel. Open channel portion is planned to cross a present foot path, but facilities across the channel are planned not to impair the transportation system. Accordingly the this item is evaluated as significant but minor for diversion channel and not significant for other items.

c) Encroachment on historical Assets

As mentioned in the section of the background of the study area, no historical assets are expected to be existing in the planned area of flood control master plan. Accordingly this item is evaluated as not significant.

d) Violation of Water Right

Surface flow of the Kebena and the Little Akaki rivers are presently utilized during dry season for farmer's association for growing vegetables along the river reaches. The work components of the flood control master plan are to change the flood flow during the rainy season. Accordingly this item is evaluated as not significant.

e) Production of Waste

Waste to be produced by the implementation of the construction works such as the surplus of soil as the result of excavation and demolished houses should be disposed to a spoil bank properly not to impair the environment of the region. This depends on the construction plan and construction management during the construction works. Accordingly this item is evaluated as significant or significant but relatively minor depending on the construction scheme.

2) Nature Environment

a) Topography and Geology

The planned weir is a kind of check dam with low height. The planned flood diversion channel is mainly a tunnel as mentioned above. River channel improvement is planned to be minimum by construction of low weir and regulation pond. Accordingly no substantial change of topography and geology is included in the flood control master plan. Therefore this item is evaluated as significant but minor or not significant.

b) Ground Water

Low weirs are planned in the upstream reaches of the Kebena and Kechene rivers. But different from the conventional dam of large scale for storing water for a long duration, planned weir is a kind of check dam for peak cut of flood of which the duration is within one day. The stored flood water is planned to be discharged soon after the flood. Accordingly the influence to the ground water will be very marginal. Flood diversion tunnel is planned under the hill where the land use is woodland. The influence to the ground water might occur only during construction works. But in consideration of general geology of the area and the land use, the influence to the ground water is also estimated to be very marginal. Accordingly this item is also estimated to be significant but minor or not significant.

c) River Flow Regime

Weir and flood diversion channel will function only during large scale floods. No water transport and fishery are existing in the downstream reaches of the objective rivers. The West Akaki river that receives the diverted flood from the Little Akaki river has enough carrying capacities. Deposition of sediment is not found in the objective river reaches since the river slope is so steep and the river bed is mainly exposed rock. In consideration of these, this item is evaluated as significant but minor or not significant.

d) Flora and Fauna

As discussed in the section on the background of the study area, any flora and fauna are not available in the river reaches of the objective rivers. Accordingly this item is evaluated as not significant.

c) Aesthetics and Landscape

Regulating pond and low weir are planned to store flood water only for a short duration and accordingly water plant will not grow. Low weirs are planned in deep valleys and direct change of landscape will not be created. Accordingly this item is evaluated as significant but minor.

3) Pollution

a) Water Pollution

Generally river channel improvement works may create some turbidity in river flow in the downstream reaches during the construction works and may cause some trouble to the downstream water users. But the turbidity of the river flow in the objective reaches is presently very much and the influence to the irrigation water to vegetable growing in the downstream reaches is estimated to be rather marginal though some measures may be needed during the implementation of the works depending on the availability of water users in the downstream reaches.

Negative impact to the downstream reaches by construction of flood diversion channel is estimated to be not significant because in the downstream reaches of the West Akaki river where the flood of the Little Akaki is to be diverted, there exist no flora and fauna to be influenced by the flood diversion.

The influence to the water users and riverine people along the downstream reaches of the flood diversion channel due to the deterioration of water quality by the decrease of the river flow by construction of flood diversion channel will be also marginal because the flood diversion will take place only during rainy season.

b) Noise and Vibration

Use of heavy equipment and vehicles for implementation of the construction works will create noise and vibration and cause troubles to people around the construction site.

Accordingly some measures to minimize these troubles will be needed during the construction works. The measures against these troubles should be taken up in the detailed design. Monitoring of the situation will be needed during the construction works.

Table 11.3.1 RESULT OF INITIAL ENVIRONMENTAL EXAMINATION

Master Plan	Enrironmental Item													
	Social Environment						Nature Environment					Pollution		
	Resettlement	Transportation system	Communities	Historical assets	Water rights	Solid waste	Topography and geology	Ground water	River flow regime	Flaura and fauna	Aethetics and landscape	Air pollution	Water quality deteriorati	Noise and vibration
Bantyiketu River System														
- Weir	C	D	D	D	D	D	C	C	C	D	C	C	D	B
- Regulationg pond	D	D	D	D	D	D	D	D	D	D	C	D	D	C
- Channel improvement	C	D	C	D	D	D	D	D	D	D	C	C	C	C
Kebena River System														
- Weir	C	D	D	D	D	D	C	C	C	D	C	C	D	B
- Channel improvement	C	D	C	D	D	D	D	D	D	D	C	C	C	C
Little Akaki River System														
- Diversion tunnel	C	C	C	D	D	D	C	C	C	D	C	C	D	C
- Regulating pond	D	D	D	D	D	D	D	D	D	D	C	D	D	C
- Channel improvement	C	D	C	D	D	D	D	D	D	D	C	C	C	C
Hanku River System														
- Culvert	D	D	C	D	D	D	D	D	D	D	C	C	C	C

A : very significant B : significant C : sinnificant but relatively minor D : not significant

CHAPTER 12

ECONOMIC EVALUATION

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12. ECONOMIC EVALUATION

12.1 Methodology

Evaluation of the project is made at the price level of June 1997 and applied foreign exchange rate is one U.S. dollar equivalent to 6.80 Birr and one Birr equivalent to 0.0593 Japanese Yen.

Benefits of flood control projects are estimated from difference of flood damages between those with and without project. In other words, they are flood damage reduction benefits.

Flood damages are estimated as the direct damage, indirect damage, and other damage.

Direct flood damages are estimated as the damages to properties on the following items.

1) General assets
   a) Residence and other buildings for commercial, manufacturing, and public services
   b) Household effects and properties in the buildings specified above
2) Agricultural properties: Various kinds of crops on farmland
3) Infrastructure such as roads, channel, canal and public utilities related to water and electricity supply

Indirect damages are estimated as the damages to economic activities due to their activities stagnation.

Other damage includes the following:

- Paralysis of function as the capital city in social, economical, political and diplomatic aspects,
- Cost of emergency measures made by central and/or rural government,
- Termination of public services such as transportation, communication, electricity, and water supply,
- Loss due to interruption of traffic,
- Inconvenience of citizens' life,

- Loss of memorabilia,
- Stress,
- Insanitary and danger of infectious diseases, and
- Risk to life

Distribution of the properties in the Study Area is based on the statistical data and projection made in this study. In order to estimate the flood damages, unit values of damageable properties per hectare are calculated by the Kebeles in the flood prone area.

Flood damages are estimated, in principle, from properties in flooding area multiplying damage rates depending on the flood condition. Annual mean flood damages are estimated from the flood damages of various magnitude of flood and probability of occurrence and they are the very flood reduction benefits.

Cost-benefit analysis has been made by using accounting price (world price equivalent). It has been made by a cash flow analysis using three types of indicators, i.e. economic internal rate of return (EIRR), benefit cost ratio (B/C), and net present value (NPV). By using a discounting procedure, benefits and costs of the project occurring at different points in time can be compared in terms of present values.

EIRR is the rate that meets the total of the discounted benefits and the total of the discounted costs. B/C is the ratio of the total of the discounted benefits and the total of the discounted costs. NPV is the difference between the total of the discounted benefits and the total of the discounted costs. Applied discount rate for calculation of B/C and NPV is 10 %, the rate used to be applied for economic evaluation of development projects in Ethiopia. All these indicators are commonly used for economic evaluation of the same types of projects.

12.2 Damageable Properties

12.2.1 General Assets

(1) Residence

1) Houses

Types of residence are classified into four types, i.e. house made by wood and mud plaster locally called "Chika" type, concrete block type (including hollow type and solid type), brick masonry type and stone masonry type. Unit value of residence is estimated as follows:

Type of residence	Average floor area (a)	Unit construction cost (b)	Depreciation rate of house (c)	Unit value of residence (a) x (b) x (c)
Chika	44 m^2	580 Birr/m^2	0.5	12,760 Birr
Concrete block	44 m^2	960 Birr/m^2	0.5	21,120 Birr
Brick masonry	67 m^2	1,350 Birr/m^2	0.5	45,225 Birr
Stone masonry	67 m^2	1,750 Birr/m^2	0.5	58,625 Birr

The average floor area is estimated based on interview survey in the Study Area. The unit construction cost is estimated based on information obtained from Works and Urban Development Bureau in Addis Ababa Administration. Depreciation rate of residence is assumed to be 0.5 considering the average lifetime of the residence and period of use.

Table 12.2.1 shows projected population by Kebele in the flood prone area in 1997 and in 2020. Based on the population projection, the number of houses in the Study Area has been estimated on the assumption that family size until the year 2020 continues to be the same as that in 1994. The estimated number of houses in the flood prone area is shown in Table 12.2.2.

In the result report of 1994 Population and Housing Census, the number of houses is available by Kebeles and the number of houses by types is also available by Weredas. Composition of houses by type both in 1984 and in 1994 is summarized below.

Zone	Censuses	Composition of house by type					
		Chika	Concrete block	Brick	Stone	Other	Total
Zone 1	1984 census	85%	2%	2%	5%	6%	100%
	1994 census	87%	2%	1%	3%	7%	100%
Zone 2	1984 census	81%	2%	3%	7%	8%	100%
	1994 census	81%	6%	2%	3%	8%	100%
Zone 3	1984 census	75%	4%	7%	6%	8%	100%
	1994 census	66%	19%	6%	2%	7%	100%
Zone 4	1984 census	83%	1%	2%	7%	7%	100%
	1994 census	88%	2%	2%	3%	6%	100%
Zone 5	1984 census	86%	0%	2%	6%	6%	100%
	1994 census	87%	3%	2%	3%	5%	100%

The Chika type house is a large majority in any zones in both the censuses. However, construction of new houses with concrete blocks and cement instead of wood and mud is increasing in recent years, according to Works and Urban Development Bureau. Almost all new apartment houses planned by the Bureau are made of concrete blocks and cement. The Chika type houses are assumed to be replaced gradually by houses made of concrete block and cement, and the number of both types is assumed to become same in 2020 for estimation of the future value of housing assets.

2) Household Effects

Most households who live in riverine area hold only limited kinds of household effects such as bedding, table and chairs, cooking stove, clothes, and foods. Value of the household effects has been estimated as mentioned below based on the information during site reconnaissance. The household effects were estimated from the market price depreciating by the assumed average lifetime and period of use.

Type of residence	Unit value of household effects
Chika	4,100 Birr
Concrete block	8,300 Birr
Brick masonry	13,300 Birr
Stone masonry	14,900 Birr

(2) Commercial Sector

1) Buildings for Commercial Sector

Unit value of buildings in commercial sector such as retailer, service sector and wholesaler is estimated. Size of shops in Addis Ababa is relatively small. It is assumed that average size of retailers is almost same size of average size of residence. Average size of buildings for service sector is based on site reconnaissance at several locations in

the city. Average floor area of wholesaler is estimated based on information obtained from several state wholesalers in Addis Ababa. The unit value of the buildings in commercial sector is estimated as shown below.

Type of Commercial Sector	Average floor area (a)	Unit construction cost (b)	Depreciation rate of building (c)	Unit value of building (a) x (b) x (c)
Retail	40 m^2	960 Birr/m^2	0.5	19,200 Birr
Service	76 m^2	1,350 Birr/m^2	0.5	51,300 Birr
Wholesale	661 m^2	1,500 Birr/m^2	0.5	495,800 Birr

The number of retailer, service sector and wholesaler is based on registration at Trade, Industry and Tourism Bureau of Addis Ababa Administration. Table 12.2.3 shows numbers of the buildings in commercial sector in Addis Ababa in the Study Area. It should be noted that more than 120,000 of informal sector are doing their economic activities without license or registration in the urban center of Addis Ababa according to a CSA survey on Urban Informal Sector. These urban informal sectors are not included in the table.

The number of the buildings in commercial sector in the year 2020 has been estimated based on an assumption that the number of establishments in commercial sector will increase in proportion to population growth.

2) Facilities in the Buildings for Commercial Sector

Buildings in commercial sector generally have such facilities as show cases, display racks, tables, chairs or cooking facilities inside. Value of such facilities is assumed as shown below based on site reconnaissance.

Type of Commercial sector	Unit value of facilities for commercial sector
Retail	1,700 Birr
Service	9,000 Birr
Wholesale	Negligible small

The value of the facilities for retailer is estimated using sample of several common size general stores in the Study Area. Facilities used for service sector are so much different from one to another. Therefore, unit value of standard furniture for an office is estimated as unit value of facilities for service sector.

3) Merchandise

Value of merchandise in a building for commercial sector is estimated as follows:

Type of Commercial sector	Unit value of merchandise
Retail	16,000 Birr
Service	None
Wholesale	1,618,000 Birr

Unit value of stocked merchandise of retailer is estimated based on interview survey for common size general store in the city. Unit value of stock of wholesaler is estimated based on data on average stock value of a state grain wholesaler in Addis Ababa.

(3) Factory

1) Buildings for Manufacturing

Factories in Ethiopia are generally classified into three categories, i.e. 1) medium and large scale manufacturing establishments engaging 10 or more persons and using power-driven machines, 2) small scale manufacturing establishments engaging less than 10 persons and use power-driven machines, and 3) cottage/handicraft manufacturing establishments performing their activities by hand (using non-power-driven machine).

Average floor area of factory building is assumed based on average number of employees and necessary area for them based on field reconnaissance. Unit value of buildings for factory is estimated as follows.

Type of factory	Average floor area (a)	Unit construction cost (b)	Depreciation rate of building (c)	Unit value of building (a) x (b) x (c)
Medium/Large scale	1,014 m^2	1,500 Birr/m^2	0.5	760,500 Birr
Small scale	36 m^2	960 Birr/m^2	0.5	17,280 Birr
Cottage/Handicraft	36 m^2	960 Birr/m^2	0.5	17,280 Birr

Nationwide surveys on medium and large scale industries and small scale industries were carried out in 1995 and 1997 respectively by CSA. A survey on the Identification and Solution on the Problems facing the Service Giving Organizations and the Society was carried out by Region 14 Administration in 1996. Total number of factories or total value of production is available from the above mentioned survey result. However, the

number of factory by Kebeles is not available from the result. Most of medium and large scale factories are concentrated in the southern part of Addis Ababa and their numbers are limited in the Study Area. Small scale and Cottage/Handicraft factories are not concentrated in specific places and they seem spread all over Addis Ababa. Thus it is assumed that number of the small scale and cottage/handicraft factories is in proportion to the number of population.

2) Property in Factory Building

Property in factory building includes finished or part-finished goods, raw materials, and plant and machinery. Value of properties in factory buildings are estimated as follows:

Type of factory	Unit value of properties in factory building
Medium and Large scale	4,364,623 Birr
Small scale	40,679 Birr
Cottage/Handicraft	555 Birr

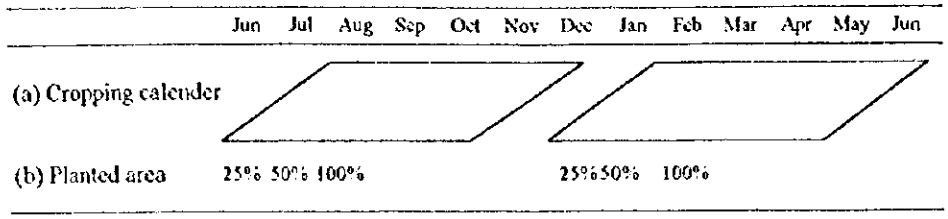
The stock value of finished or part-finished goods, raw materials, and plant and machinery are estimated as presented in Table 12.2.4.

12.2.2 Agricultural Crops

According to Agricultural Bureau of Addis Ababa, about 90 % of consumption of vegetables in Addis Ababa are produced in the city. As discussed in Section 4.1.4, several types of vegetables such as potato, carrot, Swiss chard, and cabbage are produced along the riversides of the Kebena, Bulbula, Shankla and Akaki in an area of about 223 ha as shown in Figure 4.1.8.

Damage to vegetables is decrease in yield due to submergence. According to past record, flood occurs in August most frequently and lasts one to two days.

On the other hand, cropping pattern of vegetables in Addis Ababa is generally as shown below according to information obtained from Agricultural Bureau of Addis Ababa Administration.



The figure indicates that planting of vegetables is completed in almost all fields in August when flood occurs most frequently.

The farm gate price of vegetables is estimated at 33,518 Birr/ha based on planting area, composition of vegetables planted and market price of vegetables in Addis Ababa.

12.2.3 Indirect Damages

The indirect flood damages is the net economic losses of goods and services to the nation due to interruption of economic activities in the Study Area. The indirect damage is estimated from a decrease in income of the flood affected population on assumption that working population in the flood affected area has to stop productive work for two days due to flood. As a result of calculation, 14 % of the flood damage to the general assets are assumed to be the indirect flood damages.

12.2.4 Infrastructure Damages

As a result of site reconnaissance, channels including retaining walls and bridges have been damaged by floods at several places. Such kind of flood damages to infrastructure is assumed at 10 % of the damages to the general assets and the agricultural crops.

12.2.5 Other Damages

Ten (10) percent of total damage to general assets, agricultural crops, indirect damage and infrastructure is assumed as other damages which may include the followings:

- Paralysis of function as the capital city in social, economical, political and diplomatic aspects,
- Cost of emergency measures made by central and/or rural government,
- Termination of public services such as transportation, communication, electricity, and water supply,

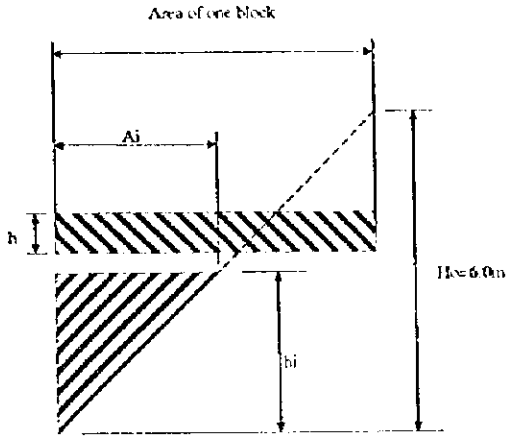
- Loss due to interruption of traffic,
- Inconvenience of citizens' life,
- Loss of memorabilia,
- Stress,
- Insanitary and danger of infectious diseases, and
- Risk to life

12.3 Flood Condition and Damage Rate

12.3.1 Flood Condition

The flood simulation analysis has basically been made by dividing the flood prone area into blocks of about one hectare (ha). As a result of the analysis, average inundation depth and area have been obtained for each river basin. The depth, however, is an average over the inundated area and actual inundated depth is supposed to be different from the calculated average depth depending on the topography of the area.

With the following equations, the inundated depth and area are estimated from the calculated average inundation depth for each block by the following relations:



$hi \leq Ho$ or $h \leq Ho / 2$

$hi = (2h \times Ho)^{0.5}$

$Ai = (2h / Ho)^{0.5}$

where, hi : maximum inundation depth in a block

Ai : percentage of area inundated in a block

h : calculated average inundation depth of a block
Ho : maximum height of land undulation (6.0 m)

The above relations are derived based on the assumption of inclined flat block area (one hectare wide) with the maximum height of six (6) meter. The height was assumed based on a topographic map of 1/2,000.

As to the duration of inundation, flooding is assumed to occur in August and lasts one day based on past record of flood occurrence in the Study Area.

12.3.2 Damage Rate

With respect to house/building, household effects, movable items and agricultural crops, basically standard flood damage rate developed by Ministry of Construction, Japan is applied as shown below since no such data is available in Ethiopia. Damage rate by inundation depth is estimated based on inundation area and depth calculated from the average inundation depth considering the land undulation as discussed above.

Damage Rate

Kind of Assets		Inundation Depth				
		-49cm	50-99cm	100-199cm	200-299cm	300cm-
House		12.4%	21.0%	30.8%	43.9%	57.2%
Household effects		8.6%	19.1%	33.1%	49.9%	69.0%
Business organization	Facilities	18.0%	31.4%	41.9%	53.9%	63.2%
	Stock	12.7%	27.6%	37.9%	47.9%	56.2%
Vegetables (Inundation duration is supposed to be for 1-2days)		27%	35%	51%	51%	51%

Source: Ministry of Construction, Japan

12.4 Flood Reduction Benefit

Probable flood damage is estimated from the damageable property in inundated area multiplied by the flood damage rate corresponding to inundation condition under various magnitude of flood events. The probable flood damage against both present assets and projected assets in the year 2020 has been estimated based on the damageable properties discussed in Section 12.2.

Annual mean flood damage is estimated as accumulation of flood damage segments derived from various magnitude of probable flood damage multiplied by the corresponding probability of occurrence, from non-damageable flood up to design probable flood. The annual mean flood damage against both present assets and projected assets in the year 2020 has been calculated based on the probable flood damage discussed above. Difference of the annual mean flood damage between those with and without project is counted as annual flood reduction benefit.

Even after implementation of flood control works planned in this project, isolated flood may occur until small drainage canals will have been improved. The flood damage is presumed to remain about five percent of total flood damage. In other words, 95 % of the annual mean flood damage have been considered as annual flood reduction benefit of the project.

The assets to be protected by the project are supposed to increase both in volume and value year after year. Therefore, it is assumed that the annual flood reduction benefit will also increase from 1997 to 2020 in this economic evaluation as shown in Figure 12.4.1.

12.5 Economic Project Cost

12.5.1 Project Cost

Accounting price (world price equivalent) has been used for the economic evaluation of the project. Standard Conversion Factor (SCF) has been applied to calculate the accounting price of the nontraded project cost (local currency portion). SCF is calculated by comparing the world price and the domestic price of a representative selection of commodities and it has been obtained by the process shown below.

	Total Import Value			Total Import Tax	Total Export Value		Total Export
	Value (c.i.f.) (Million US$)	Exchange rate	Equivalent (Million Birr)	(duties + sales/excise taxes on imports) (Million Birr)	Value (f.o.b.) (Million US$)	Equivalent (Million Birr)	Taxes (Million Birr)
1993/94	915	5.80	5,305	1,210.3	280	1,621	53.7
(1996/97 price)	1,015		5,888	1,343	310	1,800	59.6
1994/95	1,063	6.25	6,644	1,555.8	454	2,835	126.5
(1996/97 price)	1,137		7,109	1,665	485	3,033	135.4
1995/96	1,413	6.31	8,915	1,694.0	410	2,588	209.2
(1996/97 price)	1,469		9,272	1,761.8	427	2,692	217.6
1996/97	1,403	6.52	9,148	2,084.0	580	3,782	82
Average of 4 years (1996/97 price)	1,256		7,854	1,713	451	2,827	124

$$SCF = \frac{7,854 + 2,827}{(7,854 + 1,713) + (2,827 - 124)} = 0.87$$

Note: Data on import and export value are based on data obtained from Economic Reserch and Planning Department, National Bank of Ethiopia.
Data on import and export taxes are obtained from Ministry of Finance.

As a result of calculation, SCF of 0.87 has been obtained.

Regarding the cost for traded goods and services (foreign currency portion), 10 % of the cost have been deducted for adjustment of import duties.

12.5.2 Annual Operation and Maintenance Cost

Annual operation and maintenance costs for flood control facilities are assumed to be 0.5 % of the direct construction cost.

12.5.3 Replacement Cost

Average lifetime of the metal and mechanical works related to the project is assumed to be 25 years after installation. The replacement cost covers cost for replacement of such metal and mechanical facilities after the lifetime during project life. Annual reserve for the replacement cost has been included in the annual operation and maintenance cost.

12.6 Economic Evaluation

12.6.1 Selection of Optimum Design Scale

As discussed in Section 9.3, economic evaluation has been made for selection of the optimum design scale of main rivers and tributaries. The following three cases have been examined.

A. Bantyiketu River (main, 20-year)+Kechene and Kurtume Rivers (tributary, 10-year)
B. Bantyiketu River (main, 30-year)+Kechene and Kurtume Rivers (tributary, 20-year)
C. Bantyiketu River (main, 40-year)+Kechene and Kurtume Rivers (tributary, 30-year)

Annual flood reduction benefit of each case is as shown in Table 12.6.1 and summarized below.

Design Scale	Annual Flood Reduction Benefit (1,000 Birr)	
	1997	2020
Bantyiketu (20-yr) + Kechene and Kurtume (10-yr)	9,402	15,181
Bantyiketu (30-yr) + Kechene and Kurtume (20-yr)	9,968	16,058
Bantyiketu (40-yr) + Kechene and Kurtume (30-yr)	10,280	16,535

The financial and economic project costs are shown in Table 12.6.2 and the annual economic costs are shown in Table 12.6.3.

Result of the cost-benefit analysis is shown in Table 12.6.4 and summarized below.

Design Scale	EIRR	B/C	NPV (1,000 Birr)
Bantyiketu (20-yr) + Kechene and Kurtume (10-yr)	11.2 %	1.13	10,287
Bantyiketu (30-yr) + Kechene and Kurtume (20-yr)	11.4 %	1.15	12,789
Bantyiketu (40-yr) + Kechene and Kurtume (30-yr)	9.9 %	0.99	-589

Note: B/C and NPV at discount rate of 10 %

Optimum design scales of the main rivers and tributaries are 30-year and 20-year respectively from the result of the economic evaluation.

12.6.2 Flood Control Master Plan

Outline of the proposed master plan including both structural measures and non-structural measures is described in Section 9.6.

The probable flood damage for each river system by different magnitude of flood is shown in Table 12.6.5. Based on the probable flood damage, the annual mean flood damage and the annual flood reduction benefit have been calculated as shown in Table 12.6.6 and Table 12.6.7 respectively.

River System	Design Scale	Annual Flood Reduction Benefit (1,000 Birr) 1997	2020
Bantyiketu River System	30-year	9,968	16,058
Kebena River System	30-year	3,499	6,649
Little Akaki River System	30-year	8,926	18,923
Hanku River System	20-year	55	140

The financial and economic project costs of the structural and non-structural measures are shown in Table 12.6.8 and 12.6.9 respectively. The operation and maintenance costs of both structural and non-structural measures are presented in Table 12.6.10 and annual economic costs are shown in Table 12.6.11.

Result of the cost-benefit analysis for the flood control master plan is shown in Table 12.6.12 and 12.6.13, and summarized below.

River System	EIRR	B/C	NPV (1,000 Birr)
Bantyiketu River System	11.7 %	1.17	11,406
Kebena River System	3.5 %	0.42	-38,852
Little Akaki River System	10.6 %	1.07	4,754
Hanku River System	7.2 %	0.72	-264
Whole Master Plan	10.8 %	1.08	9,315

Note: B/C and NPV at discount rate of 10 %

The flood control plan for the Bantyiketu River system including the Keehene and Kurtume Rivers has had the highest EIRR, B/C, and the largest NPV. Then those of the Little Akaki River system, the Hanku River system, and the Kebena River system follow it. Especially the Bantyiketu River and the Little Akaki River systems have had EIRRs at more than 10 %. EIRR of Whole flood control master plan according to implementation schedule is also high at 10.8 %.

12.6.3 Selection of Priority Projects

The following alternatives have been examined for the selection of the priority projects from the Bantyiketu River system.

Alternative	Major Work Items
Case-1	**(same as master plan)** - Kurtume River (4 regulating ponds & channel improvement) - Kechene River (Kechene dam, Kostre regulating pond, and channel improvement) - Bantyiketu River (Bantyiketu regulating pond, channel improvement, and road side-ditch) - Non-structural measures (River management, watershed management, and flood risk management)
Case-2	- Kechene River (Kechene dam, Kostre regulating pond, and channel improvement) - Bantyiketu River (Bantyiketu regulating pond, channel improvement, and road side-ditch) - Non-structural measures (River management, watershed management, and flood risk management)
Case-3	- Kurtume River (4 regulating ponds & channel improvement) - Bantyiketu River (Bantyiketu regulating pond, channel improvement, and road side-ditch) - Non-structural measures (River management, watershed management, and flood risk management)
Case-4	- Kechene River (Kechene dam and Kostre regulating pond) - Bantyiketu River (Bantyiketu regulating pond, channel improvement, and road side-ditch) - Non-structural measures (River management, watershed management, and flood risk management)
Case-5	- Kechene River (Kechene dam and Kostre regulating pond) - Bantyiketu River (Bantyiketu regulating pond and road side-ditch) - Non-structural measures (River management, watershed management, and flood risk management)

The annual flood reduction benefit has been calculated as shown in Table 12.6.14 and summarized below.

Alternatives	Annual Flood Reduction Benefit (1,000 Birr)	
	1997	2020
Case-1	9,968	16,058
Case-2	8,458	13,625
Case-3	7,006	11,266
Case-4	8,434	13,576
Case-5	6,433	10,368

The financial and economic project costs for the structural and non-structural measures are shown in Table 12.6.15 and the annual economic costs are shown in Table 12.6.16.

Result of the cost-benefit analysis for selection of the priority projects is shown in Table 12.6.15 and summarized below.

Alternatives	EIRR	B/C	NPV (1,000 Birr)
Case-1	11.7 %	1.17	11,406
Case-2	12.6 %	1.27	15,625
Case-3	12.1 %	1.22	11,039
Case-4	13.3 %	1.35	18,910
Case-5	11.9 %	1.20	9,254

Note: B/C and NPV at discount rate of 10 %

As a result of economic evaluation, EIRR of Case-4 is the highest at 13.3 % and B/C and NPV are also highest among five alternatives.

Table 12.2.1 Projected Population of Addis Ababa by Kebele
(Kebeles in the Study Area only)

Zone	Wereda	Kebele	Area in Study Area (ha)	Population Projection			
				1997		2020	
				Population	Average annual growth rate	Population	Average annual growth rate
01	03	30	16.9	10,138	2.5%	17,691	2.5%
		31	17.7	7,812	1.2%	10,369	1.2%
		32	13.9	7,002	0.4%	7,722	0.4%
		33	12.3	5,615	1.7%	8,194	1.7%
		34	12.2	5,079	1.3%	6,913	1.3%
		41	6.9	5,257	1.9%	8,113	1.9%
		42	10.5	8,334	1.4%	11,536	1.4%
		43	9.6	7,836	1.4%	10,894	1.4%
		44	17.7	9,168	0.6%	10,462	0.6%
		45	9.5	3,396	1.0%	4,296	1.0%
		47	15.0	5,064	1.7%	7,540	1.7%
		51	24.8	2,702	1.2%	3,592	1.2%
		52	11.2	2,121	1.3%	2,858	1.3%
		53	54.8	6,519	1.7%	9,565	1.7%
	Sub-total		233.0	86,043	1.4%	119,744	1.4%
01	04	26	24.0	15,297	1.8%	23,295	1.8%
		27	14.3	5,160	1.3%	7,020	1.3%
		28	13.3	5,955	0.0%	5,975	0.0%
		29	10.2	6,159	1.0%	7,797	1.0%
		35	15.2	3,601	1.2%	4,750	1.2%
		36	18.3	11,453	-0.1%	11,214	-0.1%
		37	26.8	6,208	1.3%	8,345	1.3%
		38	11.2	3,459	0.8%	4,194	0.8%
		39	14.7	4,849	0.9%	5,987	0.9%
		40	13.3	5,139	1.6%	7,485	1.6%
		49	13.8	3,130	0.8%	3,737	0.8%
		50	25.6	6,090	2.3%	10,196	2.3%
	Sub-total		200.7	76,499	1.1%	99,995	1.2%
01	05	5	9.7	3,840	1.5%	5,392	1.5%
		6	22.3	4,906	0.3%	5,211	0.3%
		7	15.9	10,688	0.4%	11,606	0.4%
		12	12.6	4,271	-1.3%	3,159	-1.3%
		15	9.2	8,754	1.3%	11,908	1.3%
		16	8.7	7,066	1.4%	9,758	1.4%
		17	9.3	5,093	1.4%	7,048	1.4%
		18	10.1	4,845	1.2%	6,346	1.2%
		19	20.0	7,020	-0.4%	6,470	-0.4%
		20	9.4	8,136	1.7%	11,963	1.7%
		21	9.7	8,277	1.2%	10,788	1.2%
		22	11.1	7,989	1.2%	10,490	1.2%
		23	9.1	6,665	1.6%	9,694	1.6%
	Sub-total		157.1	87,551	0.9%	109,834	1.0%
01	06	1	18.6	7,888	1.2%	10,434	1.2%
		2	13.0	3,903	0.8%	4,644	0.8%
		3	10.3	5,670	1.5%	8,060	1.5%
		4	7.9	3,827	0.7%	4,452	0.7%
		8	18.9	8,055	2.1%	13,138	2.1%
		9	8.9	5,260	1.4%	7,306	1.4%
		10	10.3	6,350	0.6%	7,246	0.6%
		11	7.5	4,029	1.2%	5,319	1.2%
		13	38.0	12,334	2.3%	20,673	2.3%
		14	29.2	7,311	1.6%	10,421	1.6%
		24	12.3	4,579	2.4%	7,881	2.4%
		25	11.8	7,006	1.3%	9,351	1.3%
	Sub-total		186.7	76,212	1.5%	108,927	1.6%
Total of Zone 01			777.5	326,305	1.2%	438,500	1.3%
02	20	28	20.4	2,666	1.1%	3,421	1.1%
		29	22.5	3,503	1.3%	4,665	1.3%
		38	22.1	5,731	2.5%	10,221	2.5%
		39	22.0	2,681	0.8%	3,222	0.8%
		40	51.5	5,479	1.5%	7,780	1.5%

Table 12.2.1 Projected Population of Addis Ababa by Kebele
(Kebeles in the Study Area only)

Zone	Wereda	Kebele	Area in Study Area (ha)	Population Projection			
				1997		2020	
				Population	Average annual growth rate	Population	Average annual growth rate
		42	62.8	12,504	4.8%	36,989	4.8%
		43	36.6	8,863	3.8%	20,878	3.8%
		44	23.5	4,006	2.0%	6,367	2.0%
		45	42.1	8,038	2.5%	14,319	2.5%
		46	39.7	7,741	2.9%	14,844	2.9%
		51	52.9	6,541	7.2%	32,135	7.2%
		52	0.0	0	-	0	-
		53	71.8	8,607	9.5%	69,794	9.5%
	Sub-total		467.9	76,362	3.9%	224,633	4.7%
02	21	1	92.2	6,012	0.1%	6,117	0.1%
		4	53.5	4,452	0.6%	5,120	0.6%
		9	15.3	5,518	0.7%	6,445	0.7%
		10	10.3	2,703	0.3%	2,896	0.3%
		11	5.9	4,257	0.5%	4,800	0.5%
		12	11.9	2,923	2.3%	4,885	2.3%
		13	6.1	4,366	2.8%	8,173	2.8%
		14	16.4	3,470	0.8%	4,179	0.8%
		19	54.4	9,212	8.4%	58,572	8.4%
		20	8.7	4,494	1.4%	6,206	1.4%
		21	8.2	3,114	1.1%	4,022	1.1%
		22	11.5	4,568	-0.2%	4,399	-0.2%
		23	11.4	5,245	-0.9%	4,296	-0.9%
		24	15.4	7,632	0.4%	8,307	0.4%
		25	11.3	3,754	-1.5%	2,651	-1.5%
		30	14.2	3,988	-0.2%	3,828	-0.2%
		31	14.0	6,195	0.0%	6,246	0.0%
		32	9.7	3,600	0.1%	3,644	0.1%
	Sub-total		370.4	85,501	1.2%	144,784	2.2%
02	22	1	221.9	10,513	1.3%	14,098	1.3%
		2	20.1	5,751	0.8%	6,970	0.8%
		3	16.0	5,348	0.1%	5,508	0.1%
		4	19.1	5,218	1.2%	6,788	1.2%
		6	22.9	5,267	1.9%	8,038	1.9%
		7	58.3	5,891	1.4%	8,189	1.4%
	Sub-total		358.3	37,986	1.1%	49,593	1.2%
02	23	8	37.7	7,742	2.7%	14,337	2.7%
		9	17.9	5,606	1.5%	7,972	1.5%
		10	108.4	14,625	3.8%	34,364	3.8%
		11	33.6	7,503	0.0%	7,468	0.0%
		12	165.9	11,315	4.5%	31,214	4.5%
		13	148.3	17,843	6.8%	81,864	6.8%
		14	133.8	4,835	12.9%	78,729	12.9%
		15	147.9	11,100	4.0%	27,298	4.0%
		16	63.8	5,742	10.7%	59,154	10.7%
	Sub-total		857.3	86,310	4.7%	342,401	6.0%
02	24	9	165.9	14,388	2.8%	27,142	2.8%
		10	29.7	8,955	4.4%	23,923	4.4%
		11	89.7	18,285	4.3%	48,334	4.3%
		12	80.5	7,359	1.3%	9,837	1.3%
		13	212.4	18,364	2.7%	34,271	2.7%
		14	253.8	10,130	5.8%	36,683	5.8%
		15	449.8	20,802	10.7%	215,710	10.7%
		16	329.3	2,428	0.0%	2,428	0.0%
		17	1,190.3	20,099	10.2%	187,591	10.2%
		18	0.0	0	-	0	-
	Sub-total		2,801.4	120,812	5.6%	585,918	6.9%
Total of Zone 2			4,855.2	406,971	3.7%	1,347,329	5.2%
03	17	13	40.8	8,180	3.4%	17,564	3.4%
		14	33.2	4,153	2.5%	7,379	2.5%
		15	32.6	5,154	3.1%	10,516	3.1%
		16	41.1	5,691	4.2%	14,665	4.2%

Table 12.2.1 Projected Population of Addis Ababa by Kebele
(Kebeles in the Study Area only)

Zone	Wereda	Kebele	Area in Study Area (ha)	Population Projection			
				1997		2020	
				Population	Average annual growth rate	Population	Average annual growth rate
		17	64.1	8,687	5.5%	30,086	5.5%
		18	79.7	5,984	5.2%	19,021	5.2%
		19	69.3	4,571	1.2%	6,029	1.2%
		20	224.6	6,723	7.8%	38,127	7.8%
		21	91.7	7,118	10.8%	75,769	10.8%
		23	85.0	2,026	4.9%	6,127	4.9%
		24	172.3	20,101	7.4%	103,506	7.4%
		25	88.7	5,158	0.0%	5,158	0.0%
	Sub-total		1,023.1	83,546	5.2%	333,945	6.1%
03	18	6	43.3	6,743	2.8%	12,818	2.8%
		7	23.3	3,176	0.8%	3,810	0.8%
		15	20.0	7,222	2.6%	13,130	2.6%
		16	18.1	2,657	2.0%	4,151	2.0%
		17	23.3	7,694	2.2%	12,565	2.2%
		18	29.5	4,543	3.0%	8,996	3.0%
		26	32.0	3,278	4.2%	8,382	4.2%
		27	64.6	7,374	2.0%	11,652	2.0%
		33	24.2	2,847	2.2%	4,672	2.2%
		34	23.8	3,475	1.9%	5,307	1.9%
		35	34.8	6,635	3.6%	14,999	3.6%
		36	42.3	7,077	4.0%	17,288	4.0%
		41	38.0	4,342	2.4%	7,505	2.4%
	Sub-total		417.2	67,062	2.7%	125,274	2.7%
03	19	47	122.7	3,867	4.2%	9,952	4.2%
		49	31.2	4,282	1.5%	5,991	1.5%
		50	102.3	9,451	3.2%	19,703	3.2%
		54	52.1	7,618	3.2%	15,662	3.2%
		55	0.0	0	-	0	-
		56	55.2	6,674	3.7%	15,425	3.7%
		57	0.0	0	-	0	-
		58	0.0	0	-	0	-
		59	0.0	0	-	0	-
		60	0.0	0	-	0	-
	Sub-total		363.5	31,891	3.2%	66,733	3.3%
03	28	1	0.0	0	-	0	-
		2	0.0	0	-	0	-
		3	0.0	0	-	0	-
		4	0.0	0	-	0	-
		5	0.0	0	-	0	-
	Sub-total		0.0	-	-	0	-
Total of Zone 03			1,803.8	182,499	3.9%	525,952	4.6%
04	01	1	19.8	7,588	1.3%	10,234	1.3%
		3	25.1	6,488	2.1%	10,449	2.1%
		4	32.1	9,389	1.8%	14,302	1.8%
		5	14.0	4,853	1.6%	7,069	1.6%
		6	15.6	6,415	1.4%	8,771	1.4%
		7	23.0	11,591	1.0%	14,689	1.0%
		8	24.2	9,066	1.7%	13,270	1.7%
	Sub-total		153.8	55,391	1.5%	78,785	1.5%
04	09	6	24.1	4,654	2.4%	8,088	2.4%
		7	43.6	9,216	1.5%	13,125	1.5%
		8	21.3	5,318	1.3%	7,205	1.3%
		9	17.3	4,874	3.9%	11,735	3.9%
		10	22.7	3,819	0.8%	4,572	0.8%
		11	18.8	7,248	1.5%	10,300	1.5%
		12	28.3	6,492	2.1%	10,457	2.1%
		20	43.4	8,219	2.6%	14,815	2.6%
		21	30.7	6,644	3.2%	13,797	3.2%
	Sub-total		250.2	56,484	2.1%	94,094	2.2%
04	11	1	75.1	6,533	3.6%	14,585	3.6%
		2	551.7	10,324	3.6%	23,421	3.6%

Table 12.2.1 Projected Population of Addis Ababa by Kebele
(Kebeles in the Study Area only)

Zone	Wereda	Kebele	Area in Study Area (ha)	Population Projection			
				1997		2020	
				Population	Average annual growth rate	Population	Average annual growth rate
		3	7.2	3,134	2.1%	5,052	2.1%
		4	148.1	6,246	2.6%	11,296	2.6%
		5	22.8	4,665	2.8%	8,803	2.8%
		8	13.7	4,282	1.9%	6,567	1.9%
		9	14.0	3,499	1.8%	5,261	1.8%
		10	47.0	4,643	2.6%	8,365	2.6%
		13	12.9	3,501	3.1%	7,031	3.1%
		14	15.3	5,640	2.2%	9,307	2.2%
		15	7.7	3,125	3.0%	6,124	3.0%
		16	18.9	3,601	1.7%	5,355	1.7%
		17	121.2	13,177	0.1%	13,639	0.1%
		19	13.7	6,663	3.3%	14,020	3.3%
		23	320.7	18,907	5.7%	68,294	5.7%
	Sub-total		1,390.0	97,940	2.9%	207,120	3.3%
04	12	6	62.9	4,269	2.6%	7,705	2.6%
		7	263.3	14,013	3.8%	33,088	3.8%
		11	46.1	10,622	3.0%	21,041	3.0%
		12	560.7	13,407	5.4%	44,886	5.4%
		18	37.9	5,685	1.4%	7,745	1.4%
		19	263.1	3,428	2.4%	5,868	2.4%
		20	23.2	3,064	1.3%	4,154	1.3%
		21	86.7	6,942	2.0%	10,886	2.0%
		22	66.7	4,484	4.4%	11,986	4.4%
	Sub-total		1,410.6	65,914	3.3%	147,359	3.5%
04	13	1	28.9	4,816	1.7%	7,078	1.7%
		2	28.9	5,922	2.3%	9,946	2.3%
		3	98.0	13,447	2.4%	23,378	2.4%
		5	11.3	6,577	0.4%	7,160	0.4%
		6	27.9	7,289	1.4%	9,923	1.4%
		8	41.0	7,743	1.2%	10,239	1.2%
		9	25.0	4,343	2.3%	7,406	2.3%
		10	20.5	3,976	1.5%	5,650	1.5%
		11	24.0	4,493	2.4%	7,680	2.4%
		15	28.8	5,472	1.6%	7,871	1.6%
		16	23.7	4,279	2.3%	7,197	2.3%
	Sub-total		358.0	68,357	1.8%	103,528	1.8%
04	15	19	28.4	8,131	2.1%	13,018	2.1%
		20	26.5	4,624	0.7%	5,441	0.7%
		23	22.1	7,794	1.6%	11,148	1.6%
		26	29.8	6,946	2.5%	12,335	2.5%
		27	25.6	5,803	2.2%	9,561	2.2%
		28	23.0	4,644	2.7%	8,646	2.7%
		29	27.9	3,651	1.7%	5,361	1.7%
		30	41.4	3,261	-0.5%	2,893	-0.5%
		31	24.5	4,289	1.3%	5,815	1.3%
		32	23.5	4,362	2.7%	7,986	2.7%
		33	20.5	5,355	1.5%	7,603	1.5%
		34	20.4	3,364	1.8%	5,066	1.8%
		35	9.7	2,700	2.4%	4,665	2.4%
		36	36.7	5,300	2.9%	10,154	2.9%
	Sub-total		360.0	70,223	1.9%	109,690	1.9%
04	16	1	92.6	4,437	1.6%	6,409	1.6%
		2	34.3	5,298	3.3%	11,201	3.3%
		3	40.0	3,594	2.1%	5,788	2.1%
		4	41.8	8,819	3.9%	21,490	3.9%
		5	19.6	3,619	3.6%	8,186	3.6%
		6	282.4	6,447	4.0%	15,885	4.0%
		7	142.2	5,018	4.7%	14,364	4.7%
		8	32.9	6,513	2.5%	11,460	2.5%
		9	36.3	5,284	2.6%	9,457	2.6%
		10	22.1	4,232	3.2%	8,828	3.2%
		11	48.8	7,551	3.0%	15,057	3.0%

Table 12.2.1 Projected Population of Addis Ababa by Kebele
(Kebeles in the Study Area only)

Zone	Wereda	Kebele	Area in Study Area (ha)	Population Projection			
				1997		2020	
				Population	Average annual growth rate	Population	Average annual growth rate
		12	36.6	5,540	3.0%	10,908	3.0%
		22	0.0	0	-	0	-
	Sub-total		829.6	66,352	3.2%	139,032	3.3%
Total of Zone 04			4,752.2	480,661	2.4%	879,607	2.6%
05	02	9	16.8	4,641	-0.4%	4,257	-0.4%
		10	11.9	4,937	1.6%	7,109	1.6%
		11	34.8	5,302	2.3%	8,932	2.3%
		12	24.6	3,255	1.0%	4,058	1.0%
		13	11.1	6,149	2.0%	9,646	2.0%
		14	29.1	5,798	4.1%	14,568	4.1%
		15	21.6	5,622	0.6%	6,420	0.6%
		16	16.4	4,100	1.3%	5,537	1.3%
		17	24.7	3,680	1.6%	5,331	1.6%
	Sub-total		191.0	43,483	1.6%	65,858	1.8%
05	07	17	30.1	6,202	2.2%	10,143	2.2%
		18	15.3	3,286	2.6%	5,900	2.6%
		19	14.9	6,866	2.3%	11,514	2.3%
		20	10.8	5,864	2.2%	9,753	2.2%
		21	10.0	5,588	1.0%	6,986	1.0%
		26	21.7	5,447	3.4%	11,672	3.4%
		27	16.7	6,097	1.5%	8,572	1.5%
		28	10.0	5,192	0.0%	5,150	0.0%
		29	11.3	5,443	1.4%	7,492	1.4%
		30	14.0	6,676	1.5%	9,323	1.5%
		31	14.8	9,792	1.8%	14,711	1.8%
		32	14.6	9,912	0.4%	10,801	0.4%
		33	14.6	8,450	0.9%	10,296	0.9%
		34	10.0	4,740	-2.2%	2,820	-2.2%
	Sub-total		209.0	89,555	1.3%	125,133	1.4%
05	08	1	30.6	6,022	5.5%	20,671	5.5%
		2	490.5	16,386	6.7%	72,214	6.7%
		3	24.0	4,693	4.6%	13,298	4.6%
		5	36.6	6,407	3.1%	13,015	3.1%
		6	43.9	6,572	2.9%	12,579	2.9%
		10	56.2	5,429	2.8%	10,165	2.8%
		11	24.2	6,001	2.2%	9,875	2.2%
		13	35.5	5,824	0.9%	7,233	0.9%
		14	37.1	5,716	3.2%	11,667	3.2%
		15	25.1	4,302	2.9%	8,227	2.9%
		22	9.2	2,592	2.3%	4,416	2.3%
		23	9.8	3,318	1.9%	5,077	1.9%
		24	8.0	4,392	2.1%	7,135	2.1%
		25	14.6	3,753	2.9%	7,247	2.9%
		35	531.0	18,729	8.4%	119,105	8.4%
	Sub-total		1,376.3	100,137	4.4%	321,923	5.1%
05	10	1	213.5	12,248	5.7%	44,057	5.7%
		2	35.3	6,543	3.3%	13,919	3.3%
		3	30.3	4,390	2.0%	6,876	2.0%
		4	36.9	5,968	2.7%	11,123	2.7%
		5	35.6	5,851	2.3%	9,970	2.3%
		13	35.4	7,839	2.7%	14,583	2.7%
		14	26.2	5,355	3.3%	11,185	3.3%
		15	15.1	6,159	1.3%	8,348	1.3%
		16	32.2	8,422	2.1%	13,491	2.1%
		17	51.7	4,772	2.5%	8,362	2.5%
		18	38.6	5,765	1.9%	8,841	1.9%
		22	378.8	14,943	4.2%	38,893	4.2%
	Sub-total		929.6	88,253	3.2%	189,649	3.4%
05	14	7	32.0	7,237	1.5%	10,174	1.5%
		12	10.7	7,168	-0.1%	7,068	-0.1%
		13	27.3	4,714	0.7%	5,550	0.7%

Table 12.2.1 Projected Population of Addis Ababa by Kebele
(Kebeles in the Study Area only)

Zone	Wereda	Kebele	Area in Study Area (ha)	Population Projection			
				1997		2020	
				Population	Average annual growth rate	Population	Average annual growth rate
		14	20.3	5,197	1.6%	7,447	1.6%
		17	12.0	5,685	0.7%	6,653	0.7%
		18	62.3	7,455	0.2%	7,842	0.2%
		21	18.9	8,237	1.9%	12,793	1.9%
		22	13.2	7,943	1.2%	10,393	1.2%
		24	21.4	1,546	0.0%	1,546	0.0%
		25	56.2	4,157	-0.7%	3,563	-0.7%
	Sub-total		274.3	59,338	0.8%	73,028	0.9%
05	25	1	125.5	13,191	5.7%	46,701	5.7%
		2	60.6	4,987	5.7%	17,868	5.7%
		3	107.8	16,073	9.1%	119,083	9.1%
		4	441.5	19,180	5.8%	69,908	5.8%
		5	33.7	5,128	3.9%	12,453	3.9%
		6	24.6	8,428	2.6%	15,263	2.6%
		7	31.4	9,724	3.5%	21,617	3.5%
		8	31.4	5,762	3.1%	11,580	3.1%
		16	315.5	12,333	5.5%	42,230	5.5%
	Sub-total		1,172.0	94,808	5.4%	356,704	5.9%
Total of Zone 05			4,152.2	475,574	3.0%	1,132,296	3.8%
06	26	1	0.0	0	-	0	-
		2	0.0	0	-	0	-
		4	0.0	0	-	0	-
		5	0.0	0	-	0	-
		6	0.0	0	-	0	-
		7	0.0	0	-	0	-
	Sub-total		0.0	-	-	0	-
06	27	3	0.0	0	-	0	-
		8	0.0	0	-	0	-
		9	0.0	0	-	0	-
		10	0.0	0	-	0	-
		11	0.0	0	-	0	-
	Sub-total		0.0	-	-	0	-
Total of Zone 06			0.0	-	-	0	-
Total Urban Area			16,340.9	1,872,010	2.8%	4,323,684	3.6%
Farmers Association							
	17		0.0	0	-	0	-
	19		0.0	0	-	0	-
	28		468.2	516	3.9%	1,244	3.9%
	26		0.0	0	-	0	-
	27		0.0	0	-	0	-
Total Rural Area			468.2	516		1,244	
Total of Addis Ababa			16,809.0	1,872,526	2.8%	4,324,928	3.6%

Note: - For areas of Kebeles, Water Supply - Stage III A by AAWSA was referred.
- Projected Population in 1997 and 2020 has been made referring the result of the population censuses in 1984 and 1994

Table 12.2.2 Projected Number of Houses in Flood Prone Area
(Kebeles in the Study Area only)

Zone	Woreda	Kebele	Area in Study Area (ha)	Projected Number of Houses									
				1997					2020				
				Type of Houses					Type of Houses				
				Total	Chika	Concrete Block	Brick	Stone	Total	Chika	Concrete Block	Brick	Stone
01	03	30	16.9	1,710	1,544	63	22	80	2,984	1,402	1,402	39	140
		31	17.7	1,388	1,254	51	18	65	1,843	866	866	24	87
		32	13.9	1,328	1,199	49	17	62	1,464	688	688	19	69
		33	12.3	1,027	928	38	13	48	1,499	705	705	19	70
		34	12.2	953	860	35	12	45	1,296	609	609	17	61
		41	6.9	938	847	35	12	44	1,447	680	680	19	68
		42	10.5	1,448	1,308	54	19	68	2,005	942	942	26	94
		43	9.6	1,467	1,324	54	19	69	2,039	958	958	27	96
		44	17.7	1,631	1,473	60	21	77	1,861	875	875	24	87
		45	9.5	711	642	26	9	33	900	423	423	12	42
		47	15.0	965	871	36	13	45	1,436	675	675	19	68
		51	24.8	530	479	20	7	25	705	331	331	9	33
		52	11.2	427	386	16	6	20	576	271	271	7	27
		53	54.8	1,303	1,176	48	17	61	1,911	898	898	25	90
	Sub-total		233.0	15,826	14,291	586	206	744	21,966	10,324	10,324	286	1,032
01	04	26	24.0	2,171	2,078	46	17	30	3,306	1,617	1,617	26	46
		27	14.3	870	833	18	7	12	1,184	579	579	9	17
		28	13.3	984	942	21	8	14	988	483	483	8	14
		29	10.2	957	916	20	8	13	1,212	592	592	10	17
		35	15.2	637	609	13	5	9	840	411	411	7	12
		36	18.3	1,906	1,824	40	15	27	1,866	912	912	15	26
		37	26.8	1,062	1,017	22	8	15	1,428	698	698	11	20
		38	11.2	673	644	14	5	9	816	399	399	7	11
		39	14.7	885	847	19	7	12	1,093	534	534	9	15
		40	13.3	950	910	20	8	13	1,384	677	677	11	19
		49	13.8	585	560	12	5	8	699	342	342	6	10
		50	25.6	1,178	1,127	25	9	16	1,971	964	964	16	28
	Sub-total		200.7	12,858	12,305	270	103	180	16,786	8,208	8,208	134	235
01	05	5	9.7	822	770	13	7	31	1,154	550	549	10	44
		6	22.3	754	706	12	7	29	801	382	381	7	30
		7	15.9	1,886	1,767	30	17	72	2,048	977	975	18	78
		12	12.6	851	797	14	8	32	629	300	300	6	24
		15	9.2	1,331	1,247	21	12	51	1,811	864	862	16	69
		16	8.7	1,022	958	16	9	39	1,411	673	672	13	54
		17	9.3	798	748	13	7	30	1,104	527	526	10	42
		18	10.1	789	740	13	7	30	1,034	493	492	9	39
		19	20.0	1,213	1,137	19	11	46	1,118	533	532	10	42
		20	9.4	1,263	1,183	20	11	48	1,857	886	884	17	71
		21	9.7	1,429	1,339	23	13	54	1,862	888	886	17	71
		22	11.1	1,317	1,234	21	12	50	1,729	825	823	16	66
		23	9.1	1,033	968	17	9	39	1,503	717	715	14	57
	Sub-total		157.1	14,508	13,594	232	131	551	18,062	8,615	8,597	163	686
01	06	1	18.6	1,175	1,121	18	13	22	1,554	754	754	17	30
		2	13.0	645	616	10	7	12	768	373	373	8	15
		3	10.3	923	881	14	10	18	1,313	637	637	14	25
		4	7.9	770	735	12	8	15	896	435	435	10	17
		8	18.9	1,243	1,186	19	14	24	2,027	983	983	22	39
		9	8.9	867	827	13	10	16	1,205	584	584	13	23
		10	10.3	957	913	14	11	18	1,092	530	530	12	21
		11	7.5	676	645	10	7	13	892	433	433	10	17
		13	38.0	1,948	1,858	29	21	37	3,265	1,583	1,583	36	62
		14	29.2	953	909	14	10	18	1,358	659	659	15	26
		24	12.3	774	738	12	9	15	1,332	646	646	15	25
		25	11.8	1,215	1,159	18	13	23	1,622	786	786	18	31
	Sub-total		186.7	12,147	11,589	182	134	231	17,325	8,403	8,403	191	329
Total of Zone 01			777.5	55,339	51,779	1,270	573	1,706	74,139	35,551	35,532	773	2,283
02	20	28	20.4	517	447	43	11	15	663	315	315	14	19
		29	22.5	592	512	50	12	17	788	374	374	17	23
		38	22.1	1,084	939	91	23	31	1,933	918	918	41	56
		39	22.0	501	434	42	11	15	602	286	286	13	17
		40	51.5	1,036	897	87	22	30	1,471	699	699	31	43
		42	62.8	2,215	1,918	186	47	64	6,553	3,113	3,113	138	190
		43	36.6	1,634	1,415	137	34	47	3,848	1,828	1,828	81	112
		44	23.5	730	632	61	15	21	1,160	551	551	24	34
		45	42.1	1,484	1,285	125	31	43	2,643	1,255	1,255	55	77

Table 12.2.2 Projected Number of Houses in Flood Prone Area
(Kebeles in the Study Area only)

Zone	Wereda	Kebele	Area in Study Area (ha)	Projected Number of Houses									
				1997					2020				
				Type of Houses					Type of Houses				
				Total	Chika	Concrete Block	Brick	Stone	Total	Chika	Concrete Block	Brick	Stone
		46	39.7	1,398	1,210	117	29	41	2,680	1,273	1,273	56	78
		51	52.9	1,134	982	95	24	33	5,572	2,647	2,647	117	162
		52	0.0	0	0	0	0	0	0	0	0	0	0
		53	71.8	1,543	1,336	130	32	45	12,508	5,941	5,941	263	363
	Sub-total		467.9	13,866	12,008	1,165	291	402	40,421	19,200	19,200	849	1,172
02	21	1	92.2	1,242	1,087	67	19	70	1,263	588	586	19	71
		4	53.5	922	806	50	14	52	1,060	493	492	16	59
		9	15.3	1,117	978	60	17	63	1,305	607	606	20	73
		10	10.3	552	483	30	8	31	591	275	[illegible]	9	33
		11	5.9	862	755	[illegible]	13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		12	11.9	591	517	32	9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	6.4	896	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		14	16.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	47
		19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	54	6,143	2,856	2,850	92	343
		20	8.7	[illegible]	725	45	17	46	1,143	532	531	17	64
		21	8.2	626	547	34	[illegible]	35	808	376	375	12	45
		22	11.5	831	727	45	12	47	800	372	371	12	45
		23	11.4	991	867	54	15	55	812	377	377	12	45
		24	15.4	1,436	1,256	78	22	80	1,563	727	725	23	88
		25	11.3	751	657	41	11	42	531	247	246	8	30
		30	14.2	679	594	37	10	38	652	303	303	10	37
		31	14.0	1,168	1,022	63	18	65	1,178	548	547	18	66
		32	9.7	730	639	39	11	41	739	344	343	11	41
	Sub-total		370.4	15,891	13,905	858	238	890	23,072	10,728	10,705	346	1,292
02	22	1	221.9	2,080	1,957	54	10	58	2,790	1,350	1,347	14	78
		2	20.1	1,071	1,007	28	5	30	1,298	628	627	6	36
		3	16.0	1,066	1,003	28	5	30	1,098	531	530	5	31
		4	19.1	1,014	954	26	5	28	1,319	639	637	7	37
		6	22.9	1,014	955	26	5	28	1,548	749	748	8	43
		7	58.3	1,105	1,040	29	6	31	1,537	744	742	8	43
	Sub-total		358.3	7,351	6,917	191	37	206	9,590	4,641	4,632	48	269
02	23	8	37.7	1,553	1,281	148	82	43	2,876	1,323	1,320	152	81
		9	17.9	937	773	89	50	26	1,333	613	612	71	37
		10	108.4	2,674	2,206	254	142	75	6,283	2,890	2,884	333	176
		11	33.6	1,420	1,172	135	75	40	1,414	650	649	75	40
		12	165.9	1,797	1,482	171	95	50	4,957	2,280	2,275	263	139
		13	148.3	2,961	2,442	281	157	83	13,583	6,248	6,235	720	380
		14	133.8	931	768	88	49	26	15,154	6,971	6,956	803	424
		15	147.9	1,970	1,625	187	104	55	4,845	2,229	2,224	257	136
		16	63.8	1,073	885	102	57	30	11,053	5,084	5,073	586	309
	Sub-total		857.3	15,315	12,635	1,455	812	429	61,496	28,288	28,227	3,259	1,722
02	24	9	165.9	2,447	2,203	140	49	56	4,617	2,212	2,207	92	106
		10	29.7	1,308	1,178	75	26	30	3,495	1,674	1,671	70	80
		11	89.7	2,721	2,449	155	54	63	7,192	3,445	3,438	144	165
		12	80.5	1,311	1,180	75	26	30	1,752	839	837	35	40
		13	212.4	3,111	2,800	177	62	72	5,806	2,781	2,775	116	134
		14	253.8	1,918	1,727	109	38	44	6,947	3,328	3,321	139	160
		15	449.8	3,744	3,369	213	75	86	38,821	18,595	18,556	776	893
		16	329.3	447	403	26	9	10	447	214	214	9	10
		17	1,190.3	3,651	3,286	208	73	84	34,073	16,321	16,287	681	784
		18	0.0	0	0	0	0	0	0	0	0	0	0
	Sub-total		2,801.4	20,659	18,593	1,178	413	475	103,151	49,409	49,306	2,063	2,372
Total of Zone 2			4,855.2	73,082	64,058	4,846	1,791	2,402	237,730	112,267	112,070	6,565	6,827
03	17	13	40.8	1,511	890	384	204	33	3,245	1,369	1,366	438	71
		14	33.2	730	430	185	99	16	1,297	547	546	175	29
		15	32.6	958	564	243	129	21	1,955	825	823	264	43
		16	41.1	1,066	628	271	144	23	2,746	1,159	1,156	371	60
		17	64.1	1,511	890	384	204	33	5,233	2,208	2,203	706	115
		18	79.7	1,121	660	285	151	25	3,563	1,504	1,500	481	78
		19	69.3	878	517	223	119	19	1,158	489	488	156	25
		20	224.6	1,288	758	327	174	28	7,301	3,081	3,074	986	161
		21	91.7	1,343	791	341	181	30	14,298	6,034	6,020	1,930	315
		23	85.0	382	225	97	52	8	1,154	487	486	156	25
		24	172.3	3,316	1,971	850	452	74	17,230	7,271	7,254	2,326	379
		25	88.7	1,036	610	263	140	23	1,036	437	436	140	23

Table 12.2.2 Projected Number of Houses to Be of Private Area (Kebeles in the Study Area only)

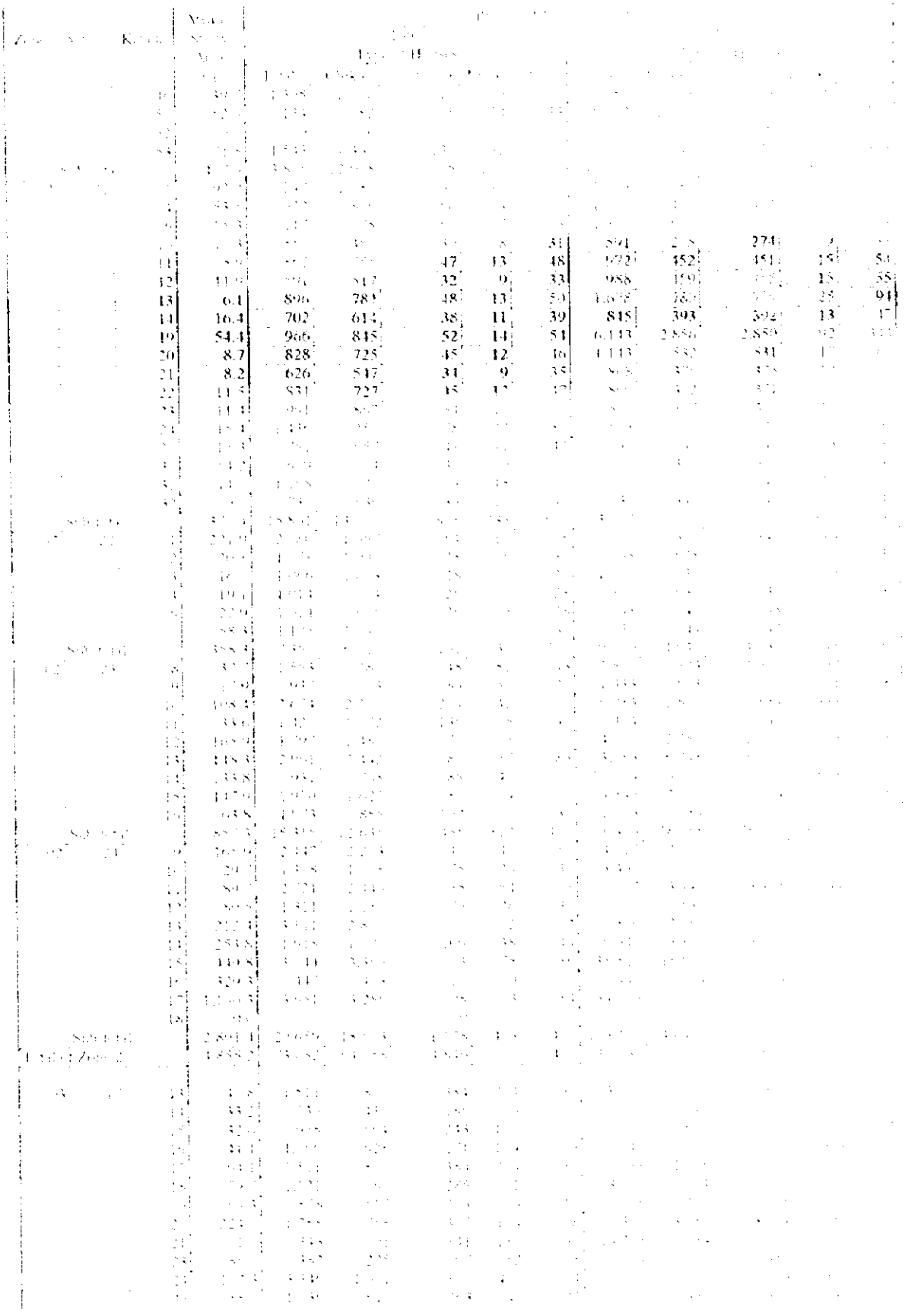


Table 12.2.2 Projected Number of Houses in Flood Prone Area
(Kebeles in the Study Area only)

Zone	Wereda	Kebele	Area in Study Area (ha)	Projected Number of Houses									
				1997					2020				
				Type of Houses					Type of Houses				
				Total	Chika	Concrete Block	Brick	Stone	Total	Chika	Concrete Block	Brick	Stone
	Sub-total		1,023.1	15,169	8,935	3,853	2,048	334	60,216	25,411	25,351	8,129	1,325
03	18	6	43.3	1,440	1,185	85	119	50	2,737	1,207	1,207	227	96
		7	23.3	655	539	39	54	23	786	347	347	65	28
		15	20.0	1,377	1,134	81	114	48	2,504	1,104	1,104	208	88
		16	18.1	460	379	27	38	16	719	317	317	60	25
		17	23.3	1,492	1,228	88	124	52	2,437	1,075	1,075	202	85
		18	29.5	860	708	51	71	30	1,704	751	751	141	60
		26	32.0	661	544	39	55	23	1,691	746	746	140	59
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,264	999	999	188	79
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	814	359	359	68	28
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	943	416	416	78	33
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,849	1,256	1,256	236	100
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,731	1,464	1,464	276	116
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	573	108	45
		[illegible]	417.2	12,85[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	35,614	1,998	842
03		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	894	33	32
		[illegible]	31.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	564	21	20
		50	102.3	1,674	1,145	470	30	28	3,490	1,686	1,682	63	59
		54	52.1	1,372	939	386	25	23	2,821	1,363	1,360	51	48
		55	0.0	0	0	0	0	0	0	0	0	0	0
		56	55.2	1,108	758	311	20	19	2,561	1,237	1,235	46	44
		57	0.0	0	0	0	0	0	0	0	0	0	0
		58	0.0	0	0	0	0	0	0	0	0	0	0
		59	0.0	0	0	0	0	0	0	0	0	0	0
		60	0.0	0	0	0	0	0	0	0	0	0	0
	Sub-total		363.5	5,712	3,907	1,605	103	97	11,898	5,747	5,735	214	202
03	28	1	0.0	0	0	0	0	0	0	0	0	0	0
		2	0.0	0	0	0	0	0	0	0	0	0	0
		3	0.0	0	0	0	0	0	0	0	0	0	0
		4	0.0	0	0	0	0	0	0	0	0	0	0
		5	0.0	0	0	0	0	0	0	0	0	0	0
	Sub-total		0.0	-	-	-	-	-	-	-	-	-	-
Total of Zone 03			1,803.8	33,745	23,429	6,217	3,218	881	96,182	41,772	41,700	10,341	2,369
04	01	1	19.8	1,310	1,186	34	24	67	1,767	823	822	32	90
		3	25.1	1,302	1,179	34	23	66	2,098	978	975	38	107
		4	32.1	1,765	1,598	46	32	90	2,689	1,253	1,250	48	137
		5	14.0	968	876	25	17	49	1,410	657	656	25	72
		6	15.6	1,093	989	28	20	56	1,494	696	695	27	76
		7	23.0	2,096	1,897	54	38	107	2,656	1,238	1,235	48	135
		8	24.2	1,796	1,625	47	32	92	2,629	1,225	1,223	47	134
	Sub-total		153.8	10,331	9,349	269	186	527	14,743	6,870	6,855	265	752
04	09	6	24.1	823	759	16	18	30	1,431	674	674	31	52
		7	43.6	1,574	1,451	31	35	57	2,241	1,056	1,056	49	81
		8	21.3	959	884	19	21	35	1,299	612	612	29	47
		9	17.3	925	853	19	20	33	2,228	1,049	1,049	49	80
		10	22.7	734	677	15	16	26	879	414	414	19	32
		11	18.8	1,355	1,249	27	30	49	1,925	907	907	42	69
		12	28.3	1,089	1,004	22	24	39	1,753	826	826	39	63
		20	43.4	1,452	1,339	29	32	52	2,618	1,233	1,233	58	94
		21	30.7	1,198	1,104	24	26	43	2,488	1,172	1,172	55	90
	Sub-total		250.2	10,109	9,321	202	222	364	16,863	7,942	7,942	371	607
04	11	1	75.1	1,166	1,123	17	6	19	2,603	1,276	1,273	13	42
		2	551.7	1,825	1,757	27	9	29	4,140	2,029	2,024	21	66
		3	7.2	520	501	8	3	8	839	411	410	4	13
		4	148.1	1,088	1,048	16	5	17	1,968	964	962	10	31
		5	22.8	858	826	13	4	14	1,620	794	792	8	26
		8	13.7	794	765	12	4	13	1,218	597	595	6	19
		9	14.0	621	598	9	3	10	934	458	457	5	15
		10	47.0	892	859	13	4	14	1,607	787	786	8	26
		13	12.9	647	623	10	3	10	1,300	637	636	6	21
		14	15.3	1,156	1,113	17	6	18	1,908	935	933	10	31
		15	7.7	663	638	10	3	11	1,299	636	635	6	21
		16	18.9	673	648	10	3	11	1,001	490	489	5	16
		17	121.2	2,173	2,092	33	11	35	2,249	1,102	1,100	11	36
		19	13.7	1,131	1,089	17	6	18	2,379	1,166	1,163	12	38

Table 12.2.2 Projected Number of Houses in Flood Prone Area
(Kebeles in the Study Area only)

Woreda	Kebele	Area	Projected Number of Houses									
			2007					2025				
			Type of Houses					Type of Houses				
			Tukul	Chika	[illegible]	Brick	Stone	Tukul	Chika	[illegible]	Brick	Stone
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	27	64.6	1,433	1,179	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	188	[illegible]
	33	21.2	496	408	29	11	17	[illegible]	359	359	68	[illegible]
	34	23.8	612	503	36	51	[illegible]	[illegible]	416	416	78	33
	35	34.8	1,260	1,037	74	105	44	2,849	1,256	1,256	236	100
	36	42.3	1,359	1,119	80	113	48	3,321	1,464	1,464	276	116
	11	28.0	752	619	41	62	26	1,299	573	573	108	45
Sub total		417.2	12,864	10,587	759	1,068	450	24,068	10,614	10,614	1,998	842
[illegible]	37	122.7	724	493	202	13	12	1,855	896	894	33	32
	40	31.2	837	[illegible]	235	15	14	1,171	566	564	21	20
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 12.2.2 Projected Number of Houses in Flood Prone Area
(Kebeles in the Study Area only)

Zone	Wereda	Kebele	Area in Study Area (ha)	Projected Number of Houses									
				1997					2020				
				Type of Houses					Type of Houses				
				Total	Chika	Concrete Block	Brick	Stone	Total	Chika	Concrete Block	Brick	Stone
		23	320.7	2,537	2,443	38	13	41	9,165	4,491	4,482	46	147
	Sub-total		1,390.0	16,744	16,125	251	84	268	34,228	16,772	16,737	171	548
04	12	6	62.9	832	807	12	4	9	1,501	738	738	8	17
		7	263.3	2,625	2,547	37	13	29	6,199	3,050	3,050	31	68
		11	46.1	2,131	2,067	30	11	23	4,221	2,077	2,077	21	46
		12	560.7	2,467	2,393	35	12	27	8,258	4,063	4,063	41	91
		18	37.9	1,118	1,085	16	6	12	1,524	750	750	8	17
		19	263.1	685	665	10	3	8	1,173	577	577	6	13
		20	23.2	611	592	9	3	7	828	407	407	4	9
		21	86.7	1,296	1,257	18	6	14	2,032	1,000	1,000	10	22
		22	66.7	879	852	12	4	10	2,349	1,156	1,156	12	26
	Sub-total		1,410.6	12,643	12,264	177	63	139	28,085	13,818	13,818	140	309
04	13	1	28.9	997	938	13	12	35	1,465	699	697	18	51
		2	28.9	1,043	982	14	13	37	1,752	836	834	21	61
		3	98.0	2,615	2,461	34	31	92	4,546	2,169	2,164	55	159
		5	11.3	1,328	1,249	17	16	46	1,445	689	688	17	51
		6	27.9	1,358	1,277	18	16	48	1,848	882	880	22	65
		8	41.0	1,343	1,264	17	16	47	1,776	847	845	21	62
		9	25.0	821	773	11	10	29	1,400	668	667	17	49
		10	20.5	777	731	10	9	27	1,101	527	525	13	39
		11	24.0	855	804	11	10	30	1,461	697	695	18	51
		15	28.8	1,086	1,022	14	13	38	1,563	745	744	19	55
		16	23.7	814	766	11	10	29	1,370	653	652	16	48
	Sub-total		358.0	13,037	12,268	169	156	456	19,730	9,411	9,392	237	691
04	15	19	28.4	1,517	1,349	49	56	64	2,429	1,120	1,117	90	102
		20	26.5	810	720	26	30	34	953	439	438	35	40
		23	22.1	1,532	1,362	49	57	64	2,191	1,010	1,008	81	92
		26	29.8	1,419	1,262	45	53	60	2,521	1,162	1,159	93	106
		27	25.6	1,152	1,024	37	43	48	1,897	875	873	70	80
		28	23.0	956	850	31	35	40	1,781	821	819	66	75
		29	27.9	687	610	22	25	29	1,008	465	461	37	42
		30	41.4	625	556	20	23	26	555	256	255	21	23
		31	24.5	841	747	27	31	35	1,140	525	524	42	48
		32	23.5	818	727	26	30	34	1,498	690	689	55	63
		33	20.5	991	881	32	37	42	1,407	649	647	52	59
		34	20.4	611	543	20	23	26	920	424	423	34	39
		35	9.7	571	508	18	21	24	987	455	454	37	41
		36	36.7	1,005	893	32	37	42	1,925	887	885	71	81
	Sub-total		360.0	13,535	12,033	433	501	568	21,212	9,779	9,757	785	891
04	16	1	92.6	844	777	33	18	16	1,219	585	585	26	23
		2	34.3	1,039	957	41	22	20	2,196	1,054	1,054	46	42
		3	40.0	719	663	28	15	14	1,159	556	556	24	22
		4	41.8	1,674	1,541	65	35	32	4,078	1,957	1,957	86	77
		5	19.6	674	621	26	14	13	1,525	732	732	32	29
		6	282.4	1,317	1,213	51	28	25	3,245	1,558	1,558	68	62
		7	142.2	1,001	922	39	21	19	2,865	1,375	1,375	60	54
		8	32.9	1,301	1,199	51	27	25	2,290	1,099	1,099	48	44
		9	36.3	986	908	38	21	19	1,765	847	847	37	34
		10	22.1	779	718	30	16	15	1,625	780	780	34	31
		11	48.8	1,363	1,256	53	29	26	2,719	1,305	1,305	57	52
		12	36.6	917	844	36	19	17	1,805	866	866	38	34
		22	0.0	0	0	0	0	0	0	0	0	0	0
	Sub-total		829.6	12,614	11,617	492	265	240	26,489	12,715	12,715	556	503
Total of Zone 04			4,752.2	89,014	82,977	1,994	1,477	2,562	161,349	77,307	77,217	2,526	4,300
05	02	9	16.8	1,055	813	43	42	155	968	394	393	39	142
		10	11.9	929	716	38	37	137	1,338	544	543	54	197
		11	34.8	924	712	38	37	136	1,556	633	632	62	229
		12	24.6	624	481	26	25	92	777	316	316	31	114
		13	11.1	1,198	924	49	48	176	1,880	765	763	75	276
		14	29.1	1,085	836	44	43	159	2,726	1,110	1,107	109	401
		15	21.6	1,190	918	49	48	175	1,360	553	552	54	200
		16	16.4	859	662	35	34	126	1,160	472	471	46	171
		17	24.7	775	597	32	31	114	1,122	457	456	45	165
	Sub-total		191.0	8,639	6,661	354	346	1,270	12,887	5,245	5,232	515	1,894
05	07	17	30.1	874	827	14	13	20	1,430	688	688	21	33

Table 12.2.2 Projected Number of Houses in Flood Prone Area
(Kebeles in the Study Area only)

Zone	Wereda	Kebele	Area in Study Area (ha)	Projected Number of Houses									
				1997					2020				
				Type of Houses					Type of Houses				
				Total	Chika	Concrete Block	Brick	Stone	Total	Chika	Concrete Block	Brick	Stone
		18	15.3	539	510	9	8	12	967	465	465	15	22
		19	14.9	1,181	1,117	19	18	27	1,981	953	953	30	46
		20	10.8	1,032	977	17	15	24	1,717	826	826	26	39
		21	10.0	895	846	14	13	21	1,118	538	538	17	26
		26	21.7	871	824	14	13	20	1,867	898	898	28	43
		27	16.7	961	909	15	14	22	1,351	650	650	20	31
		28	10.0	942	891	15	14	22	935	450	450	14	21
		29	11.3	945	894	15	14	22	1,300	625	625	20	30
		30	14.0	1,090	1,032	17	16	25	1,523	733	733	23	35
		31	14.8	1,577	1,491	25	24	36	2,368	1,139	1,139	36	54
		32	14.6	1,470	1,391	24	22	34	1,602	771	771	24	37
		33	14.6	1,387	1,312	22	21	32	1,690	813	813	25	39
		34	10.0	775	733	12	12	18	461	222	222	7	11
	Sub-total		209.0	14,539	13,754	233	218	334	20,310	9,769	9,769	305	467
35	08	1	30.6	998	901	37	26	35	3,427	1,611	1,607	89	120
		2	490.5	2,691	2,428	100	70	94	11,861	5,575	5,563	308	415
		3	24.0	713	643	26	19	25	2,019	949	947	52	71
		5	36.6	1,022	922	38	27	36	2,077	976	974	54	73
		6	43.9	1,076	971	40	28	38	2,060	968	966	54	72
		10	56.2	857	773	32	22	30	1,605	754	753	42	56
		11	24.2	1,031	930	38	27	36	1,696	797	796	44	59
		13	35.5	785	708	29	20	27	975	458	457	25	34
		14	37.1	914	825	34	24	32	1,866	877	875	49	65
		15	25.1	761	686	28	20	27	1,455	684	682	38	51
		22	9.2	375	338	14	10	13	639	300	300	17	22
		23	9.8	537	484	20	14	19	822	386	385	21	29
		24	8.0	733	661	27	19	26	1,191	560	558	31	42
		25	14.6	652	588	24	17	23	1,258	591	590	33	44
		35	531.0	2,994	2,700	111	78	105	19,039	8,948	8,929	495	666
	Sub-total		1,376.3	16,139	14,558	597	420	565	51,989	24,435	24,383	1,352	1,820
05	10	1	213.5	2,050	1,979	27	18	29	7,375	3,606	3,599	66	103
		2	35.3	1,045	1,008	14	9	15	2,223	1,087	1,085	20	31
		3	30.3	721	696	9	6	10	1,129	552	551	10	16
		4	36.9	1,039	1,003	14	9	15	1,937	947	945	17	27
		5	35.6	1,010	974	13	9	14	1,721	841	840	15	24
		13	35.4	1,333	1,286	17	12	19	2,479	1,212	1,210	22	35
		14	26.2	891	859	12	8	12	1,860	910	908	17	26
		15	15.1	1,051	1,014	14	9	15	1,424	696	695	13	20
		16	32.2	1,330	1,284	17	12	19	2,131	1,042	1,040	19	30
		17	51.7	799	771	10	7	11	1,401	685	684	13	20
		18	38.6	980	946	13	9	14	1,503	735	734	14	21
		22	378.8	2,456	2,370	32	22	34	6,393	3,126	3,120	58	89
	Sub-total		929.6	14,705	14,191	191	132	206	31,577	15,441	15,409	284	442
05	14	7	32.0	1,498	1,423	18	9	46	2,106	1,015	1,013	13	65
		12	10.7	1,432	1,361	17	9	44	1,412	681	679	8	44
		13	27.3	1,029	977	12	6	32	1,211	584	582	7	38
		14	20.3	986	937	12	6	31	1,413	681	680	8	44
		17	12.0	1,235	1,173	15	7	38	1,445	697	695	9	45
		18	62.3	1,472	1,398	18	9	46	1,548	746	745	9	48
		21	18.9	1,629	1,547	20	10	50	2,530	1,219	1,217	15	78
		22	13.2	1,610	1,530	19	10	50	2,107	1,016	1,014	13	65
		24	21.4	299	284	4	2	9	299	144	144	2	9
		25	56.2	861	817	10	5	27	738	356	355	4	23
	Sub-total		274.3	12,051	11,448	145	72	374	14,810	7,138	7,124	89	459
05	25	1	125.5	2,120	1,946	106	38	30	7,507	3,633	3,633	135	105
		2	60.6	900	826	45	16	13	3,225	1,561	1,561	58	45
		3	107.8	2,343	2,150	117	42	33	17,355	8,400	8,400	312	243
		4	441.5	2,990	2,745	150	54	42	10,899	5,275	5,275	196	153
		5	33.7	669	614	33	12	9	1,625	786	786	29	23
		6	24.6	1,351	1,240	68	24	19	2,446	1,184	1,184	44	34
		7	31.4	1,751	1,608	88	32	25	3,893	1,884	1,884	70	55
		8	31.4	988	907	49	18	14	1,985	961	961	36	28
		16	315.5	2,248	2,064	112	40	31	7,699	3,726	3,726	139	108
	Sub-total		1,172.0	15,361	14,101	768	276	215	56,634	27,411	27,411	1,019	793
Total of Zone 05			4,152.2	81,434	74,712	2,288	1,464	2,964	188,207	89,439	89,328	3,564	5,875

Table 12.2.2 Projected Number of Houses in Flood Prone Area
(Kebeles in the Study Area only)

Zone	Wereda	Kebele	Area in Study Area (ha)	Projected Number of Houses									
				1997					2020				
				Type of Houses					Type of Houses				
				Total	Chika	Concrete Block	Brick	Stone	Total	Chika	Concrete Block	Brick	Stone
06	26	1	0.0	0	0	0	0	0	0	0	0	0	0
		2	0.0	0	0	0	0	0	0	0	0	0	0
		4	0.0	0	0	0	0	0	0	0	0	0	0
		5	0.0	0	0	0	0	0	0	0	0	0	0
		6	0.0	0	0	0	0	0	0	0	0	0	0
		7	0.0	0	0	0	0	0	0	0	0	0	0
	Sub-total		0.0	-	-	-	-	-	-	-	-	-	-
06	27	3	0.0	0	0	0	0	0	0	0	0	0	0
		8	0.0	0	0	0	0	0	0	0	0	0	0
		9	0.0	0	0	0	0	0	0	0	0	0	0
		10	0.0	0	0	0	0	0	0	0	0	0	0
		11	0.0	0	0	0	0	0	0	0	0	0	0
	Sub-total		0.0	-	-	-	-	-	-	-	-	-	-
Total of Zone 06			0.0	-	-	-	-	-	-	-	-	-	-
Total Urban Area			16,340.9	332,614	296,954	16,615	8,524	10,515	757,607	356,336	355,847	23,769	21,655
Farmers Association													
	17		0.0	0	0	0	0	0	0	0	0	0	0
	19		0.0	0	0	0	0	0	0	0	0	0	0
	28		468.2	108	107	0	0	1	261	130	130	0	1
	26		0.0	0	0	0	0	0	0	0	0	0	0
	27		0.0	0	0	0	0	0	0	0	0	0	0
Total Rural Area			468.2	108	107	0	0	1	261	130	130	0	1
Total of Addis Ababa			16,809.0	332,723	297,062	16,615	8,524	10,515	757,868	356,466	355,977	23,769	21,656