

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

**DEPARTMENT OF PUBLIC WORKS AND TRANSPORT
MUNICIPALITY OF PHNOM PENH
THE KINGDOM OF CAMBODIA**

**THE STUDY ON
DRAINAGE IMPROVEMENT AND FLOOD CONTROL
IN THE MUNICIPALITY OF PHNOM PENH**

FINAL REPORT

VOLUME 3

SUPPORTING REPORT

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VOLUME 1. SUMMARY

Outline of the Study

- Part I: Master Plan for Drainage Improvement and Flood Control in the Municipality of Phnom Penh
- Part II: Feasibility Studies on Reinforcement of Kop Srov and Tompun Dikes and Tompun Watershed Drainage Improvement

VOLUME 2. MAIN REPORT

- Part I: Master Plan for Drainage Improvement and Flood Control in the Municipality of Phnom Penh
- Part II: Feasibility Studies on Reinforcement of Kop Srov and Tompun Dikes and Tompun Watershed Drainage Improvement

Annexes

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- Sector A: Land Use and City Planning
- Sector B: Meteorology and Hydrology
- Sector C: Topography and Geology
- Sector D: Plan and Design
- Sector E: Organization and Institution
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VOLUME 4. DATA BOOK

ABBREVIATIONS

1. ORGANIZATIONS

ADB	: Asian Development Bank
APUR	: Atelier Parisien d'urbanisme (Town Planning Agency for Paris)
BAU	: Bureau des Affaires Urbaines
CATUC	: Comité de l'Aménagement du Territoire, d'Urbanisme et de Construction (Committee for Planning, Urbanization and Construction)
CDC	: Council for the Development of Cambodia
CNATUC	: Comité National de l'Aménagement du Territoire, d'Urbanisme et de Construction (National Committee for Country Planning, Urbanization and Construction)
COM	: Council of Ministers
CRDB	: Cambodian Rehabilitation and Development Board
CTA	: Cambodian Telecommunications Authority
DPWT	: Department of Public Works and Transport
DSD	: Drainage and Sewerage Division
EdC	: Electricité du Cambodge
EU	: European Union
GDMH	: General Directorate of Irrigation, Meteorology and Hydrology of MAFF
GOJ	: Government of Japan
JICA	: Japan International Cooperation Agency
MAFF	: Ministry of Agriculture, Forestry and Fisheries
MEF	: Ministry of Economy and Finance
MFAIC	: Ministry of Foreign Affairs and International Cooperation
MOE	: Ministry of Environment
MOP	: Ministry of Planning
MPP	: Municipality of Phnom Penh
MPWT	: Ministry of Public Works and Transport
MWRM	: Ministry of Water Resources and Meteorology
NORAD	: Norwegian Agency for Development Cooperation
PMU	: Project Management Unit
PPWSA	: Phnom Penh Water Supply Authority
TdC	: Telecommunication du Cambodge
UNDP	: United Nations Development Program
UNESCO	: United Nations Educational, Scientific, and Cultural Organization
UNICEF	: United Nations Children's Fund
UNTAC	: United Nations Transitional Authority in Cambodia
USAID	: United States Agency for International Development
WB	: World Bank
WHO	: World Health Organization

2. OTHER TERMS

BOD	: Biochemical Oxygen Demand
BOT	: Built, Operation and Transfer
COD	: Chemical Oxygen Demand
CUDSS	: Cambodian Urban Development Strategy Study

CUEIP	: Cambodian Urban Environmental Improvement Project
DO	: Oxygen Demand
GDP	: Gross Domestic Product
GNP	: Gross National Product
GRDP	: Gross Regional Domestic Product
EPNRM	: Law on Environmental Protection and Natural Resources Management
NR	: National Road
PAP	: Project Affected Persons
PIP	: Public Investment Plan
SEDP	: Socio-Economic Development Plan
SS	: Suspended Solid
TA	: Technical Assistance

3. UNITS OF MEASUREMENT

(Length)

mm	: millimeter(s)
cm	: centimeter(s)
m	: meter(s)
km	: kilometer(s)

(Weight)

mg	: milligram(s)
g, gr	: gram(s)
kg	: kilogram(s)
ton	: tonne(s)

(Area)

mm ²	: square millimeter(s)
cm ²	: square centimeter(s)
m ²	: square meter(s)
km ²	: square kilometer(s)
ha	: hectare(s)

(Time)

s, sec	: second(s)
min	: minute(s)
h(hrs)	: hour(s)
d(dys)	: day(s)
y, yr(yrs)	: year(s)

(Volume)

cm ³	: cubic centimeter(s)
m ³	: cubic meter(s)
ℓ	: liter(s)

(Concentration)

mg/ℓ	: milligram per liter
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(Speed/Velocity)

cm/sec, cm/s	: centimeter per second
m/sec, m/s	: meter per second
km/hr, km/h	: kilometer per hour

(Stress)

kg/cm ²	: kilogram per square centimeter
ton/m ²	: ton per square meter

(Flow/Discharge)

ℓ/sec, ℓ/s	: liter per second
m ³ /sec, m ³ /s	: cubic meter per second
m ³ /yr, m ³ /y	: cubic meter per year

(Electrical Units)

W	: watt(s)
kW	: kilowatt(s)
MW	: megawatt(s)
kWh	: kilowatt-hour
MWh	: megawatt-hour
GWh	: gigawatt-hour
V	: volt(s)
kV	: kilovolt(s)

(Note: Other combined units may be constructed similarly as above)

4. MONETARY TERMS

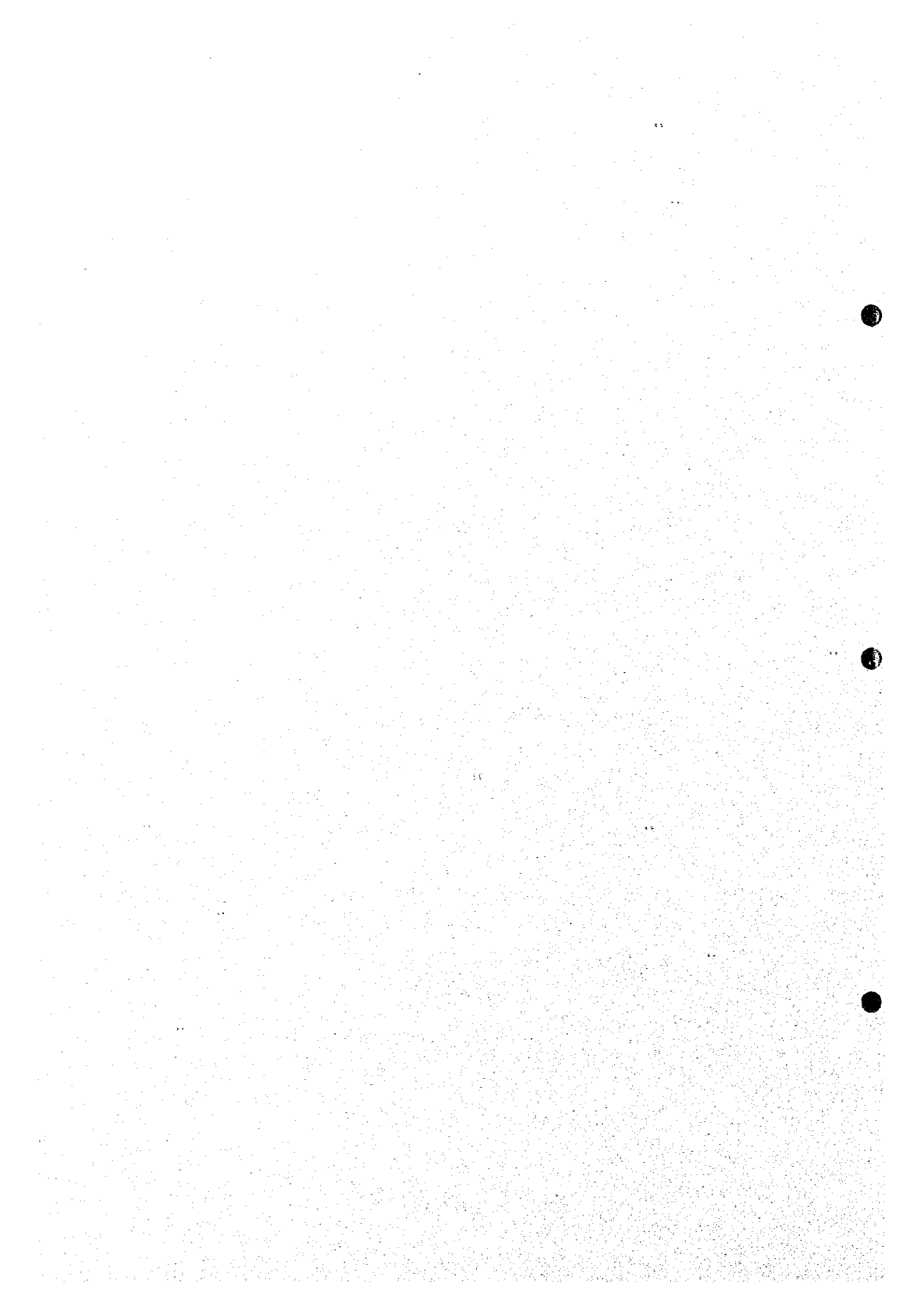
¥	: Japanese Yen
US\$: United States Dollar
Riel	: Cambodian Riels

5. CAMBODIAN TERMS

Boeng	: Lake
Prek	: River/Stream
Stoeng	: River (medium)
Tonle	: River (large)

Sector A

Land Use and City Planning



**THE STUDY ON
DRAINAGE IMPROVEMENT AND FLOOD CONTROL
IN THE MUNICIPALITY OF PHNOM PENH**

SECTOR A: LAND USE AND CITY PLANNING

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A1. Introduction

Evolution possibilities and expectations for Phnom Penh City have to be considered in the context of both its history, which accounts for the present situation, and its geophysical position, which conditions its economical resources.

This city is quite exceptional regarding urbanism. Located on a symbolic and strategic rivers' confluent, it has developed from the natural embankment as a series of concentric folders protected from the river by dike-roads. An appropriate drainage system was developed simultaneously, which relied on the retention capacity of natural basins, the boengs. The story of this development has been described and illustrated in a recent book: "Phnom Penh, développement urbain et patrimoine (MC-APUR, 1997)". The present city covers a surface of about 290 km², with a registered population of 872,000 in 1998 (Department of Planning, MPP). Our main area of study is limited by natural or artificial boundaries such as dikes, roads and the river.

In a paradoxical manner, Phnom Penh City has been largely preserved through the dark times of the past. The takeoff of urban development in the most recent years has been a bit difficult and sometimes chaotic. An important growth actually suffered from a lack of control and squatted areas have spread, as well as suburban areas that are endangered by the risk of flooding.

The necessary institutions have been set up so recently that so far nobody could yet evaluate the possible orientations of development. Only dispersed and selective existing projects could be put together to try and reconstitute a possible global development plan. Its mastering and its application then remained uncertain due to the weakness of institutional structures, while at the same time a persisting instability was still highly preventing investments and development. But today, after the elections and the creation of a new Ministry in charge of Land Use, Urbanism and Construction, all necessary conditions are gathered to lay the foundations of a real development.

Amongst the urban projects identified in this document:

- Some are representative of a method of intervention towards a harmonious urban structure, as is the case for the Boeng Salang integrated Rehabilitation Project;
- Others are leading projects to promote development: this is the case of different projects for a ring road around Phnom Penh, or for an Economic Development Zone.

Many of these projects have been shaped or further developed while this study was being carried on. However they must not lead to neglect the accelerating phenomenon of private initiative building. Scattered operations are multiplying, villas disappear to give place to higher buildings, the loose urban areas tend to spread over the neighboring zones. This evolution is all but neutral regarding hydrology. It carries on land filling and surface impermeabilization. Even in the "loose residential" type of urban areas, it will probably become necessary to limit the trend towards impermeabilization, which in the long term would bring harmful consequences to the drainage situation.

The rapid urban growth that will keep on in the short-term, needs to be mastered to enable Phnom Penh to become the expected pool of human and economic resources for the whole country. In the urban planning for these oncoming years, it is wishful also that much

attention be paid to the traditional building mode. There is a real risk that the urbanization derives through a speculative and disordered process to eventually yield an impersonal, congested and in many regards repulsive city such as Bangkok. On the contrary, it seems that towards a harmonious development, which will indeed attract investors, the city's best asset may be its appealing urban heritage and organization, provided they are carefully preserved.

This Sector consists of the following chapters:

- (1) A1. Introduction: this chapter;
- (2) A2. Study for Master Plan Area: explains present land use and urban development in the whole areas of the Municipality of Phnom Penh, analyze existing reports on urban and rural development plans, and identify existing urban development plans for the future, and finally predict future land use in the target year 2010.
- (3) A3. Study for Priority Projects Area: describe present situation of priority projects area, predict likely evolution by the year 2010 and long-term development, and discuss on impact of priority projects.
- (4) A4. Final Note and Recommendation: describe final note and recommendation from the view point of land use and urban development each for the master plan area and priority projects area.

A2. Study for Master Plan Area

2.1 Present Land Use and Urban Development

2.1.1 Boundaries and Specificity of the Area of Study

The area of study has been determined by JICA in agreement with the Municipality of Phnom Penh. To a large extent it follows natural limits or existing infrastructures. Due to the specific and strong role of the river on its eastern side, much of the city's future geographical development should follow the same principle as in the past, that is in concentric areas resting against the riverbanks. According to this principle the river all along its eastern side borders our area of study.

Since drainage and flood control is a prerequisite of urbanization, it also is natural that already existing dikes play an important role in the future city limits.

The northern limit of the area of study is the Kop Srov dike, going from the Prek Phnov riverside village to the Kop Srov village. From there it bends towards the south to naturally follow the laterite road which joins the National Road No.4 at Tmat Pong village.

It then follows the National Road No.3 down to Sleng village, and from there goes along the existing road towards the east and north, up to Dankouv village. Last, it follows the Boeng Tompun southern dike and the city limit until it meets the river again at the Monivong Bridge.

In this sector report, we discuss also on areas outside of the study area, since the area in the south is close to the city and could have been considered important for several reasons:

- At every rainy season, the wetlands in the south of Boeng Tompun easily get flooded due to their communication with the Tonle Bassac River through the Prek Thnot. This increases the difficulty to evacuate wastewater from the Boeng Trabek catchment towards this area, and even brings a considerable risk of flooding on the city.
- Regarding the city development, this area already has some importance with activities located along the Bassac river, and according to some projects and predictions the area of these activities would spread on the western side of the recently rehabilitated Takhmao road.
- It must also be noted that infrastructures in the surroundings of the Monivong bridge will probably have to be strengthened and/or doubled, for the Asian Highway to properly connect to the city or go round it, and also if building a railway towards Vietnam comes under consideration.

2.1.2 The City and the River

Phnom Penh City location has been chosen, for symbolic reasons as well as for economic reasons, to be on the western embankment of the Tonle Mekong and Tonle Sap rivers conluent, where the Tonle Bassac defluent immediately separates again from the Mekong, towards the South.

At the rainy season, the area beyond the close embankment becomes almost completely flooded via the "preks", natural canals that cross from place to place the close embankment. The preks communicate with the "boengs", kinds of natural basins that also communicate with each other. At dry season, the boengs empty themselves, just like the Tonle Sap Lake, and the remote embankment get dry again. The close natural embankment is the only area never to get flooded.

Phnom Penh City center has developed as a series of folders linked to the river natural embankment, and protected from the river by dike-roads. Due to the very smooth natural relief, inner concentric dikes remaining from successive enlarging of the city, altered this natural relief up to playing a major role in defining the catchment areas borders.

From the very beginning, an appropriate drainage system was developed in Phnom Penh: the water draining is carried out via a highly structured network of sewers towards canals ending in natural depressions or boengs, which serve as retention and purification basins before discharge by pumping beyond the dikes. Now only three of these boengs, which have to be preserved, remain in the inner city; amongst them, the Boeng Salang and the Boeng Trabek play an important role as retention basins.

2.1.3 The Present Development Situation

In its present boundaries, Phnom Penh City covers a surface of about 290 km². Its population grew from 581,000 inhabitants in 1986 (Statistics Book 1995) to about 872,000 in 1998 (Department of Planning, MPP). This makes it by far the first Cambodian city, with about 7 times more inhabitants than in Battambang, the second one. Phnom Penh thus gathers about 75% of the total urban population, which is estimated to be 16% of Cambodians. Projections for the capital city's population in 2015 range from 2,237,000 (UWSSP, 1996) to 3,010,000 (CUDSS, 1996). This latter figure would bring to 24% the urbanization rate of Cambodia.

As the population grew rapidly with an important immigration in the recent years, the city developed with little planning and control, covering at the same time the remaining "free" surfaces inside the city, like the boengs embankments, and some of the most easily accessible surroundings, creating new suburbs along the main road axes. This resulted particularly in:

- An important squatter problem, bringing degradation of the urban center as well as of the drainage system: settling on canals and boengs, squatters often restricted water flow and retention capacity; settling on the protection dikes, they weakened their banks, increasing the danger of flooding while also limiting the intervention possibilities.
- An unplanned urban development outside the present city dikes, thus in areas much more exposed to flood risks, and with no consideration for the natural water flow regulation system that used to participate in the city protection, and which balance is severely threatened.

Along with this process of urbanization came uncontrolled land fill, building and impermeabilization; residential or activities areas developed without service, resulting in "urban" areas that lack much of the necessary facilities, and where safety is uncertain.

2.1.4 Choice of Land Use Categories

Land use categories were determined as follows:

(1) Categories which Definition is Straightforward

The following categories have been applied:

- Lakes and ponds (including rivers and swamps)
- Green spaces and parks (which may include scattered buildings, then covering not more than 5% of the surface).
- Agricultural land
- Fish ponds

This latter category has to be distinguished due to its importance for the rural industry, while it cannot be assimilated to agricultural land nor to mere ponds.

(2) Residential Categories

It is usual to define 2 to 4 urban categories for built urban areas. This often includes an economic city center, and 2 to 3 types of more or less dense residential areas.

While Phnom Penh does have a city center, no place is entirely devoted to economics. For the purpose of drainage issues, there is no difference between the (presently small) economic zones and the dense residential building zones. We hence propose to use the following categories:

- Dense urban center (e.g. big buildings, "Chinese-style" compartments, dense individual/side by side houses) where it can be considered that the land is fully impermeabilized.
- Dense residential (such as city villas, buildings with small gardens in a mainly urbanized and impermeabilized zone) which constitutes a good part of the residential areas of the inner city.
- Loose residential (small villas and buildings surrounded mainly with green spaces or agricultural land) which is the case for the majority of the suburban zones, also including squats.

(3) Industrial/Activities Categories

Three main types of industrial development can usually be considered: heavy industries, light industries, and handicrafts. The latter one, such as clothes making factories, actually are either home-based activities, or are located in small buildings scattered in residential areas. There is no real reason to define a particular land use category for it; for the purpose of drainage it can be assimilated, according to the case, to either dense or loose residential areas.

As for industries, quite no real heavy industries do exist so far in the vicinity of Phnom Penh, neither are they likely to develop in the near future. Thus we suggest to use two categories for what should be called activities rather than industrial zones, which will differ according to the density of buildings and infrastructures:

- Dense activity areas that suppose stronger needs for infrastructure, especially water supply and evacuation, and at the same time a higher degree of building and/or soil impermeabilization.
- Loose activities areas, where “industrial” buildings are more interleaved with residential facilities and green spaces; as for impermeabilization these zones will be comparable to “loose residential”. The un-built, unplanted hardened surfaces, as well as the waste grounds or recently filled-in land, can also be placed into this last category.

We summarize these categories in a table, suggesting for each of them an estimated value of the impermeabilized surface ratio:

Category		Description
A	Dense urban center	Big buildings, Chinese compartments, side by side houses
B	Dense residential	Urban villas, buildings with small gardens
C	Loose residential	Small villas and buildings, important green spaces or agricultural land
D	Large Scale Developments	
D-1	Dense activities	Activities and industries requiring important buildings and infrastructure
D-2	Loose activities	Small-size activities mixed with residential or waste grounds
E	Agricultural land	Rice fields, important vegetable or fruit gardens
F	Fish ponds	Ponds devoted to intensive fish breeding
G	Green spaces and parks	All “urban” green spaces of noticeable size, excluding the gardens surrounding villas in urban residential areas
H	Lakes and ponds	All water-covered surfaces, including rivers and swamps

2.1.5 Present Land Use

Figure A2-1 maps the present land use for the area of study. According to this map, the percentage of the total area that is devoted to each land use category in the present situation is the following:

Category		Description	Area (ha)	Ratio (%)
A	Dense urban center	Big buildings, Chinese compartments, side by side houses	603	3.1
B	Dense residential	Urban villas, buildings with small gardens	1,124	5.7
C	Loose residential	Small villas and buildings, important green spaces or agricultural land	3,012	15.4
D-1	Dense activities	Activities and industries requiring important buildings and infrastructure	287	1.5
D-2	Loose activities	Small-size activities mixed with residential or waste grounds	793	4.1
E	Agricultural land	Rice fields, important vegetable or fruit gardens	11,919	60.9
F	Fish ponds	Ponds devoted to intensive fish breeding	70	0.4
G	Green spaces	Urban green spaces, excluding the gardens surrounding villas in urban residential areas	209	1.1
H	Lakes and ponds	All water-covered surfaces, including rivers and swamps (besides fish ponds)	1,554	7.9
Total Study Area			19,571	100.0

2.2 Existing Data and Reports on Urban and Rural Development Plans for Phnom Penh City and Suburbs

2.2.1 Cambodia Development Strategy

The Cambodia Development Strategy is outlined in the 1997 CG Paper (Draft version 2.0 by CDC/CRDB). According to this document, the following short-term objectives have been set for all economic activities in Cambodia:

- To develop an outward-oriented, competitive industrial and services sector, through the already ongoing structural reform, and
- To support growth and development through rationalizing and improving the public sector, establishing an efficient banking system, and developing the infrastructure and human resources.

Development strategies by sector are summarized as follows:

(1) Industry

Industrial growth will be encouraged in selected zones with the development of infrastructure, industrial zoning, and export processing zones. General orientations for this development will include: export-orientation, labor intensity, natural resource-basis, selective import substitution of consumer goods, careful choice of scale for each industry settlement, rural industry promotion, informal sector growth, promotion of tourism-based industries.

Investments and TA requirements in this industry and manufacturing sector for 1997-1999 were estimated about US\$ 12.8 million.

(2) Tourism

The tourism sector was estimated (prior to the July 1997 events) to be able to grow by about 30% every year to reach one million visitors by 2000. The Tourism Development Management Plan set up in 1996 focused, amongst other goals, on marketing and promotion of urban areas.

(3) Infrastructure

Cambodia is situated as a natural hub in the road networks between Thailand, Laos and Vietnam, and voluminous trade is expected to pass through. Large investments are necessary for infrastructure rehabilitation and development. Effective cost recovery will be the basis for the operation and maintenance cost strategy of the road network. Other means of transportation, namely waterways, railways and airways, also need rehabilitation and improvement. The respective strategies and ongoing actions are detailed below.

(4) Posts and Telecommunications

The mid-term objective in the telecommunication field is to provide complete coverage to the major Cambodian cities. Together with telecommunications, the television and radio networks, as well as the postal delivery service, also are being

improved. While the Telecommunications Master Plan for the rehabilitation, commercialization and restructuring is under way, joint ventures with private sectors allowed the operation of paging and mobile-phone services by private investors.

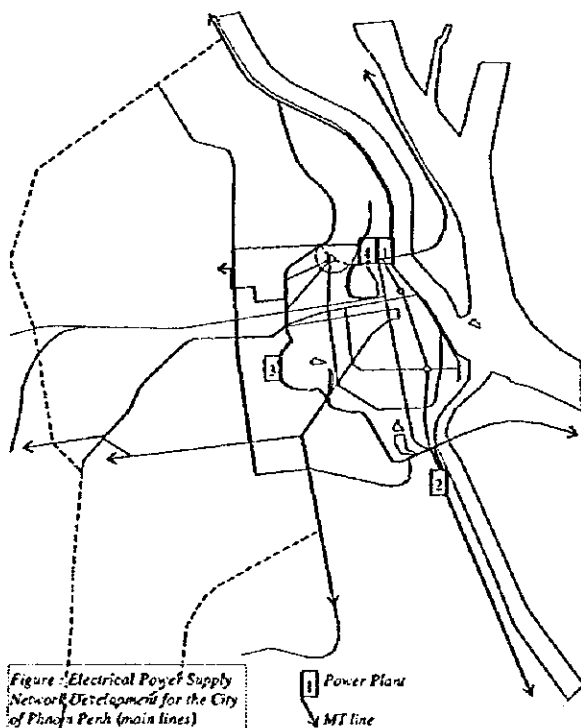
A national operating commercial entity named Telecommunications du Cambodge (TdC) will be set up to operate under control of a separate Cambodian Telecommunications Authority (CTA).

(5) Energy and Electrical Power

Cambodia needs to import all its fuel supplies. Offshore exploration for possible oil and gas reserves is ongoing under agreements designed to protect both the rights of private investors and of the Government.

Electrical power in Cambodia so far has been expensive due to the dependence on small, oil-based generating units. Power generation and distribution is under rehabilitation, with the progressive replacement of obsolete and too small generators, and modernization of the distribution systems. In Phnom Penh, by an independent power producer operating a 60 MW plant facility in a joint venture agreement with Electricité du Cambodge (EdC), the city's anticipated needs for electrical power should be fully covered in the near future. Power production will be provided by four main plants, located North (Plant 1: 60 MW and Plant 4-5-6: 30 MW), South (Plant 2: 35 MW), and West (Plant 3: 10 MW) of the city. The rehabilitation of the distribution network by different international assistance should be completed in the first semester of 1999. It already allowed to decrease the inline losses from a former 74% to only 22% now.

Due to the lack of an urban master plan, EdC's policy for further network growth can only follow the observed progress of urbanization. This lead to a planning for MT network development that is outlined below; this development has started with 50% of the necessary funding being already available:



- East, along the NR 1, from Tchbar Ampouv village to Koki market,
- South, from Kbal Thnol down to the Prek Ho bridge about 6 km further than Takhmao,
- Around the Boeng Tompun lake, along the southern dike,
- From there, South towards Dam Kor and West towards the southern Pochentong

zone,

- From the latter area along the road going North to cross Pochentong Boulevard towards Phnom Penh Thmey,
- West from the Tuol Kork dike up to the Don Bosco school in Phnom Penh Thmey,
- Along Pochentong Boulevard up to Baek Chan village,
- North, along the Battambang road up to Kilometre 6,
- Following the road which departs from the North of Tuol Kork along the Boeng Pongpeay to connect with the Battambang road beyond Russey Keo area,
- On the Chrouy Changvar peninsula, from the bridge up to the Prek Liep agricultural college.

(6) Urban Water Supply

Rehabilitation of water supply systems has been achieved or is under way in all Cambodian towns. As for the capital city, while the Phnom Penh Water Supply Authority (PPWSA) has undergone complete restructuring, the treatment plant has already been renovated and the distribution network is being progressively renewed in the city.

The tariff structure is being revised so as to enable low-income households to afford the connection fees and reduce dependency on unsafe and often more expensive water resources; it is expected that the urban population having access to safe water should rise from 65% in 1997, to 90% in 2000. As for other sectors, PPWSA aims at becoming a self-financing unit.

A list of the different documents gathered and surveyed for the purpose of this study is given in "Bibliography". Most of the relevant information found in these documents has been integrated in the synthesis of current state and projects that is presented below.

However it may be useful to sum up here the key points of two previous studies, considering our objective to predict the forthcoming urban development and future land use.

2.2.2 Cambodia Urban Development Strategy Study (CUDSS), ADB TA No.2281

The city, designed to accommodate about five hundred thousand people, will have to manage with four times that number in about ten years. Hence this report points out the necessity to control development and create the bases of a good economic development of the city, which will likely follow the model of other southern Asia capital cities in playing the role of an economic engine for the whole country. The report insists on the importance of the location of the future developing industries, and the need of a policy to control their development, otherwise it can bring along severe economic and environmental hazards.

The report defines the following objectives for the urban development:

- Urbanization should contribute to a rapid development of the economy, with balance between the urban and rural areas,
- It should be aimed at a sustainable development,

- The city should become a pool of human resources for the benefit of the whole country,
- Urbanization should be planned with care for the nation's poor, who will keep on migrating towards the city, and,
- The city should also become the center of a cultural renaissance.

Towards these objectives the following core strategy statements applied to Phnom Penh:

- The city growth must be anticipated,
- Phnom Penh will be in the vanguard, and a model for the development of other towns,
- While the development will be mainly private and informal, the main role of the government will be to create an enabling environment for efficient and sustainable growth,
- Strategic, selective interventions will have to be made according to the arising opportunities and available capacities.

2.2.3 Cambodia Urban Environmental Improvement Project (CUEIP), ADB TA No.2689

This posterior study carried on a review and assessment of the CUDSS, and outlined what was considered as key development strategy issues, in the following list:

- The development of an environmentally-friendly and economically sustainable urban economy,
- Land development and equitable access to land and housing,
- Institutional development,
- Regulatory, planning and administrative framework development,
- Human resource development, and
- Urban infrastructure development and environmental protection.

Based on these issues a number of actions was recommended; most of them concern the institutional or administrative level and give few indications on the trend of development itself. Concerning urban infrastructure development, quite none gives precise recommendation on the location of future activities. The need for developing a sanitary landfill is outlined.

2.3 Identified Existing Urban Development Plan for the Future

2.3.1 Absence of Master Plan

There does not exist any official document of the Government defining its urban development policy. In the first Socio-Economic Development Plan (1996-2000), a strategy for the development of manufacturing industry has been outlined with the following keywords: modern and competitive, export-oriented, labor-intensive, natural-resources-based, selected import-substitution, small-scale sector, tourism industry.

At the Municipality level also, there currently exists no official master plan for the Phnom Penh City development. Proposals and projects have been developed by the different interested services, with little co-ordination between them; hence choices had to be made

in order to predict what are the directions of development that will most likely be followed in the next ten years. These predictions were made on a triple basis:

- First, the observation of the recent evolution and current development trends, and a projection of their most likely continuation.
- Second, a survey of the existing documents was conducted, and the views of the different actors were collected, in an objective to gather all available information on the current status of projects and proposals.
- Last, the lack of information or sometimes contradictions between different existing projects were alleviated or resolved by a sector-by-sector analysis of environmental constraints; we also took into consideration the observations and recommendations of several recent technical assistance studies.

Hence the resulting predictions are matched with recommendations, which could help to sketch general orientations for the development of the City of Phnom Penh.

2.3.2 Existing Projects

Existing projects include; the city's general development policy, communications, trends or proposals for industrial zones location, agricultural zones, specific projects and proposals as follows:

(I) The City's General Development Policy

The existing legal provisions that can play a role in urban planning and development are:

- The UNTAC land law ruling land ownership since 1992, and
- The CNATUC law for urban planning; this law voted in 1994 created the "Comité National pour l'Aménagement du Territoire, d'Urbanisme et de Construction" and a "Bureau des Affaires Urbaines" in the different main cities. Sub-decrees for different urban projects are being prepared with the help of the BAU of Phnom Penh and submitted to the Government. One has already been adopted, which takes over the full urban planning and restructuring of the Boeng Salang sector. Another one, presently under preparation, aims at the creation of an urban development zone and a partial ring road; it will be exposed below.

While CNATUC and BAU are involved in urban planning, the organization in charge of urban development in Phnom Penh is the Municipal Department of Urbanization and Construction.

The general policy for the development of the city is based on the concern not to overwhelm the present inner city with population. In its present bounds and state the city can properly accept about five hundred thousand inhabitants. Hence there is a need to limit the pressure due to continuous rural exodus. The means to achieve this could reside in developing smaller urban poles - "satellite towns" - at about 20 to 30 kilometers around the capital city. Such urban poles could be located in Oudong, Tonle Bati, Kompong Speu, etc. Efforts are already been encouraged towards this kind of development. If those efforts succeed in giving a vitality to those new cities and surrounding regions, if jobs can be created, then people migrating from the

provinces will likely stop and settle there, where their way of living can remain closer to their rural traditions and uses than in the main city.

Some specific issues, more directly related to the area of study, comprise:

- the settlement of industries of all sizes and type,
- appropriate zones to remain devoted to agriculture,
- the airport displacement or building of a new international airport,
- a possible bigger, international railway station,
- logistical zones,
- the development of a wholesale market.

The question of location or area of settlement of these different elements heavily depends on the one of the best use and development of the communication axes.

(2) Communications

For several years discussions have been going on around the necessity to provide a better road axis from Phnom Penh to Sihanoukville city, which would double the NR 4 and could also connect the city with a possible new international airport.

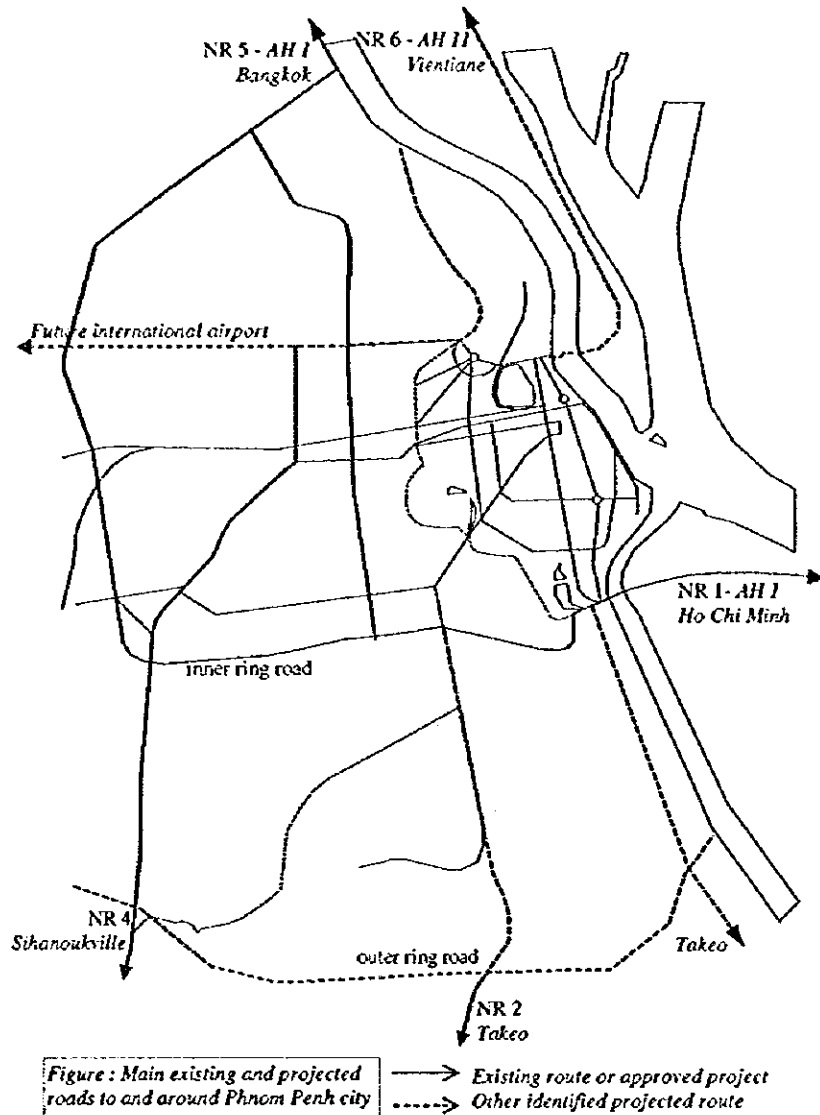
The other main road axis is constituted by the Battambang road (NR 5) to the North, and the Ho Chi Minh road (NR 1) to the South. Both of these, in and beyond the perimeter of study, run close to the rivers (respectively Tonle Sap and Tonle Mekong). Of strategic importance, they are part of the future highway to connect Bangkok, Phnom Penh and Ho Chi Minh.

Ongoing Works

The information provided by the MPWT concerning the current state of Cambodia national roads and ongoing works for their rehabilitation, gives useful indications on the short-term situation of ways of communication across the country, and their connections to Phnom Penh.

By the co-operation mainly from ADB, World Bank, JICA and USAID, within a few years the main road communication axes will be rehabilitated. While most of these roads link the capital city with provincial centers, three of them are of special importance regarding their role in international exchanges:

- The National Road No.5 from Phnom Penh to Sisophon. The 1st ADB loan, currently ongoing, allowed its rehabilitation up to Battambang city. A 2nd ADB loan, to be launched soon, will enable its prolongation up to Sisophon. The commercial exchanges with Thailand through the Poipet border point already are very active, and will highly benefit from this improvement.
- The National Road No.1 links Phnom Penh to Svay Rieng city and then to the border with Vietnam, where it prolonged to Ho Chi Minh city. It already has been improved and enlarged up to Neak Lueng, where it crosses the Mekong River.



These two roads (NR 5 and NR 1) constitute the two Cambodian sections in one of the most strategic axes of international exchanges in Southeast Asia, linking several capital cities: Bangkok, Phnom Penh and Ho Chi Minh, and further Yangon, Kuala Lumpur and Hanoi.

A project of an “Asian Highway” along this axis is under development. This project will be considered below.

- The National Road No.4, going from Phnom Penh to Sihanoukville, already has been rehabilitated by USAID. This road is important for all seaport exchanges, and to a lesser extent for tourism; seaside tourism also benefits from the National Road No.3 to Kampot that is currently under rehabilitation.

Highways

The key project concerning transportation for the future of the Cambodian capital city, as for the whole country, is the Asian Highway. Around this mid-term project several issues arise which are important for the city development.

According to the map issued after the Expert Group Meeting on the development of the Asian Highway network, two highway routes will cross the Cambodian capital: the International Route No.1 towards Bangkok and towards Ho Chi Minh, and the Sub-regional route No.11 towards Vientiane.

- The Highway No.1 is the most strategic and has been planned to be realized first. Since its route goes along the National Roads No.5 and No.1, which already have been partially rehabilitated, according to the most urgent needs and cost limitations the southern section from Neak Lueng to the Vietnamese border will be realized first. The design is completed and the works were to start in June, 1998, with ADB assistance. The following part that could start in about two years should then be the Phnom Penh - Neak Lueng section. The total length of this highway to Vietnam will be about 168 km.
- The Sub-regional Highway No.11 towards Vientiane has not been planned yet. Its realization will require all the more mobilization and investment since no major road so far follows its proposed route, from Kratie to Stung Treng and Kompong Sralay along the Mekong River.

Highways, especially Highway No.1, and to a lesser extent national roads, will enable and generate an important traffic to and from the capital city. Thus their penetration points in the suburbs and in the city are of major importance. While no particular project seems to have been made to handle this traffic, we must consider at this stage that their routes to the city will follow National Roads No.5 and No.1.

Ring Road(s)

All issues about the traffic to and from Phnom Penh and its area, are related to the possible ring road or roads that would run around the city.

The Direction of Plan has already asked JICA for a participation in the design of a ring road to limit traffic in the city's immediate surroundings. The suggested route for this road runs about 15 to 30 km from Phnom Penh: from Oudong on NR 5 in the North, through Kompong Speu province along NR 58 and NR 59, then down to NR 4 and back to the river (Tonle Bassac) at or beyond Takhmao.

This large ring does not preclude the possibility and interest of a smaller ring, closer to the city that could follow for example some of the «natural» routes bounding our area of study. One such project already exists, as a part of a sub-decree proposal for creating an urban development zone:

- According to the sub-decree project, the roads network would be enriched with a local network which main axis, following a dike to be constructed, would connect the Boeng Tumpun dike to the NR 4 after going round the airport. This also corresponds to a route proposed by CUEIP.

Some additional projects have been proposed for expressways with the following routes:

- In the South, from the Monivong bridge to and along the Boeng Tumpun dike, and then along the existing road westwards to Pochentong, then making a large buckle before going on towards the North. This project suffers several severe

drawbacks, including over-concentrating traffic in the southern end of the city, and following an bending route which would go across rather than around a probable future developing area.

- One proposal considers doubling the Pochentong Boulevard with a highway that would be located north of the railroad, coming straight from the west and the possible future international airport. A branch would go round the extended Pochentong airport to connect with the Sihanoukville road. The connection to the city center could need a long bridge over a part of the Tuol Kork district and it would arrive close to the railway station; these two points would probably raise many problems. In the medium term it would anyway be more efficient to enlarge the existing National Road No.4. This less ambitious action by itself would require important funding.
- Another proposed segment of a «ring road» would go from the far northern point of Tuol Kork area, westwards across the Boeng Pongpeay lake and bending South to join the NR 4 (or the projected western highway) at the Northern corner of the Pochentong airport. The western half of this road already has been completed. This new axis has the objective to relieve congestion of the inner city by important road trucks connecting the north (NR 5) to the west and south (NRs 4 and 3). In the north this projected road connects to an area where some activities have started to develop yet without planning; appropriate infrastructure would need to be developed. In the south, the projected road leads to a zone where urban development is likely to be high. A bend closer to the city, along the Phnom Penh Thmey road, would be wishful so as to allow the road to continue its route towards the South.

Airport

The Civil Aviation Development Framework for 1996-2000 focused first on immediate meeting international standards for flight operation and security, and on the development of air navigation services, national airports, and strengthening institutional capacities.

In the capital city, the rehabilitation of the Pochentong international airport is under way. Passenger facilities already have been improved. Track rehabilitation and new installations increased security and made night landing possible. By a BOT with a private consortium, further improvements should allow large aircraft to land. These works have been delayed; their completion could be rapid but even so the Pochentong airport will probably not meet the long-term needs of the developing city. A new, larger international airport already is under study; it could be located about 30 km west of the city, and close to the projected ring road.

In the meantime it has been underlined that the Kompong Chnang airport had a track long enough for cargo airplanes and could be used for freight to and from Phnom Penh, in spite of the important distance.

Railways

The railway network in Cambodia has been much damaged. Together with its rehabilitation, a Railways Act is being prepared, in order to improve efficiency standards, technical operation and cost-recovery management.

At present two main railway lines exist and are in use in Cambodia, respectively towards Sisophon (via Pursat and Battambang) and Sihanoukville (via Kampot) cities. Another one departs west towards Kompong Speu; its current state does not allow using it. Locomotives, rolling stock and wagon workshops are being progressively repaired and renovated. The rehabilitation of railway tracks in order to make them a competitive alternative to road transportation, would need important investments. At this stage it seems that such investments could only be private. No existing project has been identified to this regard.

- **The Sihanoukville railway**

The railway to Sihanoukville has been rehabilitated in 1996 by funding from ADB. It is used for the transportation of different goods; trains can travel at about 30 km/h, and there is about one every day. The railway would be of special interest to the petroleum and other industries located in the north of Phnom Penh (Russey Keo area), provided the "6 km railroad" which goes there from the central station, running round the Boeng Kak, is also rehabilitated. However we argue below about the opportunity to develop heavy industries in this area, which does not seem to be wishful.

- **The Sisophon railway**

As for the one to Sihanoukville, this railway is currently used at a low rate of about one train per day. Since the train speed also is very low, the trip to Battambang or Sisophon usually takes two days, with a stop in Pursat. This railway goes up to cross the Thai border at Poipet and then continues towards Bangkok, which makes it a possible competitor to the Asian Highway for international people and goods transportation.

- **About railways towards Vietnam and Laos**

While one already exists towards Thailand, railways to Vietnam and Laos would have to be created. The one to Vietnam would probably follow a route parallel to the Asian Highway. Its connection to Phnom Penh would be quite a difficult problem; added to the necessity to develop a more important logistical platform for railway transportation, this problem suggests that a new station would be absolutely necessary.

- **About a possible new railway station**

On their way out of Phnom Penh, the two current railways separate from each other about the place where they cross the study area boundary, after running west quite straight from the city station. This separation point could be the best place to choose to install a bigger railway station to various national and international destinations. This location would probably benefit from the proximity of the Pochentong airport.

River Port

The Phnom Penh inland water port has been improved by the Japanese Government so that it can now handle more and bigger cargo vessels, thus improving the cost-effectiveness of this mode of transportation; riverboat services are offered to different riverside cities in the country.

The focus has been given to the necessity of dredging the major waterways. Further upgrading of the port and promotion of waterways is planned for the coming years, with plans to establish self-financing entities to manage the facilities, which will rely on the private sector.

However the present location of the port remains too close to the city center, along a riverbanks which should more logically and wishfully be developed as a quiet residential area. The water port, as far as heavy activities are concerned, should therefore be displaced. An appropriate location could be downstream on the Mekong river, in an area that also seems to be the most appropriate for the development of industrial zones.

(3) Trends or Proposals for Industrial Zones Location

While in 1997, the national GDP was estimated accounted for 41.3% by agriculture, 17.2% by industry and 41.5% by services, the expected growth of these sectors in the coming years were 5.3%, 12% and 7.6% (source: CDC/CRDB, 1997). The important growth of industry would be accounted for essentially by construction and manufacturing, much above mines and quarrying, or electricity and water.

In Phnom Penh as in other cities, this industrial growth will need to be planned and fostered in appropriate areas, if it is to become efficient and competitive in a free market economy, without becoming a threat to the urban environment.

There have been suggestions to encourage the development of industrial zones at different locations. Heavy industries are the ones that bring the more constraints and rise the more issues.

Proposed locations for industries include:

- West zone, along the Kop Srov dike, about where it intersects with the railway. For communications this sector is interesting. But as regards industry, the main issue in considering this zone is the lack of water resource and possibilities for evacuation of wastewater, which almost demands the proximity of a big river. This region should more probably stay devoted to agriculture.
- Northeast zone, on the Chrouy Changvar peninsula. This is quite nonrealistic and un-wishful, since the development of this area is well engaged in other directions, especially residential and leisure activities. This site is about to be protected by UNESCO; and besides being harmful to the city scenery. Heavy industries here would bring a high risk of pollution for the downstream city. It must also be noticed that PPWSA main water intake is located in this area.
- The Russey Keo embankments, which already have received some of the first industrial settlements of the Cambodian capital city. The opportunity to further encourage this trend is discussed below.
- South zone, in one of two possible locations:
On the strip joining the South of Phnom Penh to Takhmao village, west of the existing road, along the Bassac River. The main trouble there is that the Bassac water level stays very low for several months during the dry season. The river becomes not only unsuitable for navigation, but also unable to dilute

important industrial outlets; these outlets would bring a high risk of pollution to the downstream waters and, through the Prek Thnot, to the whole southern area of the city.

Near the northern end of the Tchbar Ampouv peninsula between the Bassac and the Mekong rivers. This place is probably much too close to the city. It would seem much more promising to consider an industrial zone along the Mekong River, further towards the South. This is the natural place dictated by the interest of developing the industries along the river, and as much as possible downstream from the city. The possibilities of connection to the highways and railways network are a further asset to this area. A principle map based on such orientations is under preparation at the BAU of Phnom Penh Municipality.

(4) Agricultural Zones

Agriculture is the first occupation of Cambodian people; it naturally fills most available land, including the close town surroundings. All around Phnom Penh, disseminated villages group people living on this agricultural activity. Considering their present situation and development, two particular zones would seemingly better remain agricultural, which does not preclude some handicrafts and residential development. Close enough to the growing city, these zones would help maintaining its relation with the traditionally rural way of life. They are located:

- North, from the Russey Keo river banks (east) to the Kop Srov village and road limiting the area of study (west), excluding maybe the eastern area, where different kind of activities have started to develop and could be encouraged under a careful control. In 1973 the Mekong Committee already had planned the development of fisheries and intensive agricultural fields on a 2 km-large area along the northern section of the Kop Srov dike.
- South, in that corner of the study area that would be left after development of a possible activity zone between the airport and the Boeng Tompun lake. Useful irrigation resources are available for this area.

(5) Specific Projects and Proposals

The Urban Development Zone Sub-Decree Project

This project currently under revision proposes the creation of an urban development zone towards the southwest of the city. This zone would stretch from the Boeng Tompun lake to the southern corner of the airport; it would be bounded north by the existing road and south by the already mentioned expressway to be created, that is part of the sub-decree project. The zone would be declared of public utility, with the following objectives:

- to complement the roads network so as to ease transportation in the South and West sectors of Phnom Penh,
- to improve the water drainage network and to control the flooding,
- to create public equipment and urban services,
- to develop housing and particularly social housing,
- to favor the development of economic activities.

The Future International Airport

Considering the interest given to this place by road and railway communication possibilities, the distance to the city and the available space, there has been some suggestions that a bigger international airport could be built about 30 km west of the city, where it could also be close to the projected outer ring road.

The Wholesale Market Location

A large wholesale market will become necessary in the suburban area to cover the growing needs of the city population for consumable goods. Although some suggestions have already been expressed (e.g. west of the Stoeng Meanchey area), its location has not yet been determined. This wholesale market should be close enough with an easy access to the city core, as well as to the main (existing, forecast or proposed) communication and transportation axes.

Notion of a Technical Platform at the Highways Cross-roads

The crossroads between the planned North-South highway to Thailand and Vietnam (that is, the ring road connecting both sections) and the important National Road No.4 (and 3) to Sihanoukville (and Kampot) appears to be a strategic location for the economical exchanges. It is interesting to consider the possibility that a "technical platform" would develop there, that is an area where industrial and transport companies could hold warehouses, for the easy switching and stocking of merchandises. This area would also benefit from proximity to the possible future railway station, and to the Pochentong airport, as far as train and aircraft will play a role in the economical exchanges.

Figure A2-2 sums up the main identified development projects in our area of study.

2.3.3 Constraints

The main orientations for the development of Phnom Penh City must be determined through examination of constraints, in a main objective of preserving the environment as well as the urban heritage.

One can classify the different zones in the area of study along the following categories:

- already developed urban zones,
- zones of potential urban development,
- zones of potential urban development - provided appropriate infrastructures are developed (water supply, energy supply, waste collection, wastewater drainage, etc.),
- zones with no possible urban development.

Particular attention has to be paid to the risk of over-densification of the population in some of the already existing urban areas.

We first consider two kinds of constraints that are specific to Phnom Penh City location and present situation: the risk of flooding, and the poor condition of institutional infrastructure.

(1) The Risk of Flooding in Phnom Penh Area

There are four main possible causes of flooding for the City of Phnom Penh. Being a major hazard for its inhabitants, they will constitute the first constraint to take into consideration while the city development will be planned and orientated.

The Mekong River Floods

During the rainy season the Mekong water level can rise up to about 8 meters above its dry-season lowest level. The water then threatens the riverbanks, all along the eastern side of the city, from the Russey Keo area along the Tonle Sap in the north, down to the Bassac riverbanks, in the south. Downstream from Monivong bridge the danger remains, down to the Takhmao village where the high waters rush into the Prek Thnot natural canal, and from there flow back to the north through preks and lakes; they are a threat to the whole southern area of the city.

The Streaming from the North-western Hills

The Oudong area topography, about 30 km in the northwest of Phnom Penh, presents several small hills which contrast with the global flatness of the region. All the rainwater that falls on the southern side of these hills is trapped and runs off towards the city, where the Kop Srov dike stops it. Together with water from the Tonle Sap, a considerable volume of water hence accumulates beyond this dike, which at present is in a hazardous state of weakness.

The Rains on the Kompong Speu Mountains

The rains falling on the mountains located south of the Kompong Speu province, constitute a particularly big threat to the city. The rainwater runs off eastwards, flooding the Takeo road, and comes to strike the southern city dikes. There, it also meets with the waters coming up from the Prek Thnot. Hence, the causes adding to each other, the flooding can be very rapid and dangerous; there has been an unprecedented example in year 1991, with a terrible accident where dikes were forced down, and several hundreds of human lives were lost. The crossing part of NR 3 and Prek Thnot river has been improved by MAFF.

The Rainfall on Phnom Penh City

The last and most obvious cause of flooding of Phnom Penh City is the one from inside, that is the rains falling inside the area of the present inner city limits. The particular situation of Phnom Penh, the long lack of maintenance of the drainage network, retention basins and evacuation pumping stations, together with an over-pressure of urbanization, explain the regular flooding during the rainy season. This problem has already been addressed in several studies and emergency actions have been undertaken to limit and then control this flooding. The task is made more difficult since the rainy season also corresponds to the river floods, and the water must be evacuated to an «outside» area where its level is already high.

(2) Poor Condition of Institutional Infrastructure

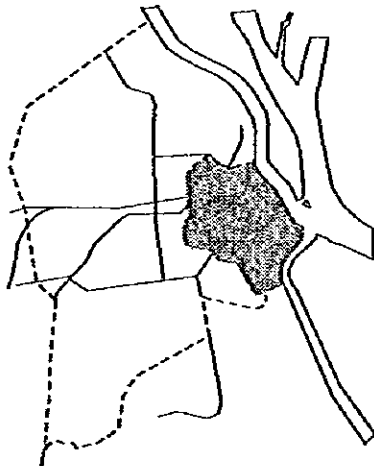
As outlined in the CUEIP report, the urban sector development and environmental improvement of Phnom Penh City is affected by a lack of:

- adequate urban planning and development controls,
- adequate knowledge about causes and effects of environmental degradation,
- appropriate local Government legislation and power,
- educated and skilled personnel,
- resources for operation and investments,
- institutional structure,
- management, operation and maintenance systems,
- sufficient cost recovery systems,
- ability to work with community organizations and mobilize local support.

(3) Analysis of Trends and Constraints by Sector

The natural and environmental constraints can be listed for each area, and together with the constraints dictated by existing projects and realizations, they enlighten the main possible orientations of development. For each sector it can then be assessed if densification or industrialization is possible, and desirable.

The Inner City



The inner Phnom Penh presently counts about 650,000 inhabitants. Yet it can not be considered as over-densified; however, many problems arise from the lack of structures. The development of some neighborhoods has been frozen with the presence of squatters blocking public equipment. Drainage and sanitation problems bring along the raising of individual protections, which worsen the overall problem severity.

The city hence needs a global restructuring; this has already been planned in Boeng Salang area, and in Boeng Trabek catchment a first project is going on with ADB assistance to improve the main drainage canal.

The City of Phnom Penh benefits from a very rich urban heritage that needs to be valorized. The appropriate law already exists, and it is imperative that it be carefully enforced.

All infrastructures (for communications, drainage, power supply and water supply) are considerably damaged and will need much work for their rehabilitation in the next 20 years. This rehabilitation will positively influence the possibility to manage development. Then a moderate and controlled densification of some areas could arise; the city population could rise by about 30% to 40%, without neither spoiling its structure nor changing the overall city scenery. It is imperious for drainage that some strategic sectors be valorized and preserved, especially the major boengs (Boeng Salang and Boeng Trabek).

Moreover, improving the living environment needs a renewed understanding on the majestic city scenery, and the progressive starting up of rehabilitation projects. As a particular example, the Tonle Sap and Tonle Bassac riverbanks should probably be rehabilitated on the same model as the Sisowat gardens.

As a prerequisite to this rehabilitation policy, a careful social management policy has to be developed to manage the delicate problem of squatters. Projects are under study, to fit out pilot sectors and enable re-housing of some communities (UNDP project in Phum Russey area).

By 2010, it is likely that part of these large needed restructuring programs will have been set up and will be going on, and the city may already be able to accommodate about 20% more people. The development of tertiary activities will lead to a daily traffic much increased compared to the present one, by an improvement of the road network. Then car parking will become an issue since quite no car parks exist so far. Roads round the city will be imperative, or the traffic entering Phnom Penh through the different leading axes will most certainly choke the city.

The Tonle Bassac River Front



This “new” emerged area has a very appealing urbanization potential. Here also the numerous squatters constitute a first constraint. A global land use planning would be needed; a preliminary project has been prepared by the BAU of Phnom Penh in 1996. Given the situation of this area, infrastructure development would not bring major issues. A mixed development of residential and tertiary activities could be considered here.

The Chaktomuk Site and the Chrouy Changvar Peninsula

This majestic and symbolic site has a sacred status for the Cambodian capital city. Its possible registration by UNESCO as part of the world heritage, will emphasize the need for a development which pay respect to the environment.

The peninsula can be accessed from the western banks only by the Japanese bridge, which strongly limits its relation with the city. Its development has already started in the north, towards leisure activities, and this orientation could logically be maintained in the future. In the mid-term, it does not seem that the development of important infrastructures can be considered there. Moreover, after



the ongoing construction with the World Bank assistance of a new drinking water station on the Mekong riverbanks, the installation of any polluting activities in this area would be very harmful.

The Tonle Sap Riverbanks and the Russey Keo Area

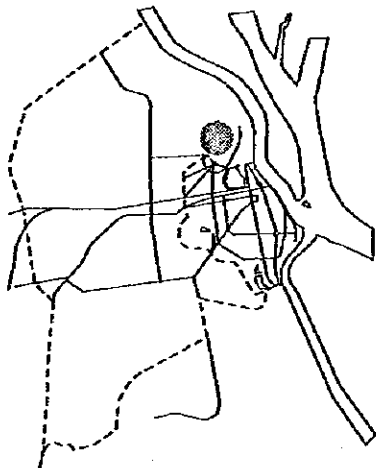


The Tonle Sap waterway is a strong link between the Capital City and the heart of the country, which favors the development of activities in connection both with the big lake's natural resources, and the rest of the world. Hence small industries have developed in the Russey Keo area. But the Tonle Sap water system is a closed circuit for several months every year, and the lake's unique natural reserve would be much endangered if polluting industries were to develop on its banks. It therefore appears recommendable to absolutely forbid such a development, which would in some way be a condemnation of the Tonle Sap system. It is wishful that the banks be fit out again as what could be a residential

area, and the remains of former industrial development could be the base for the development of handicrafts and other non-harmful activities, as a natural extension to the CUEIP proposal for this area.

In the recent years, fish raising has notably developed on the remote embankment, as a complement to the Tonle Sap fisheries. This area could also be a natural place for the development of a wholesale fish market.

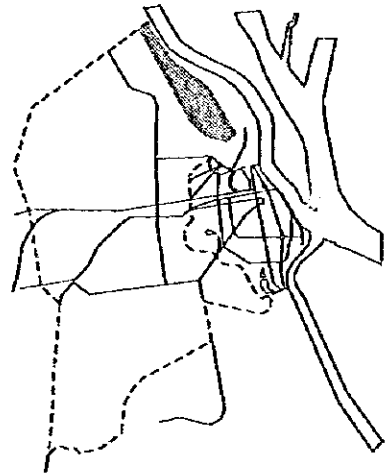
The Northern Tuol Kork Area



In the far southern part of the previous sector, north of the Tuol Kork antenna, for about two years urbanization has been going on through filling in some important areas, and some activities started to develop. This development presently is not controlled. Some former water drainage canals have been filled in, and the northern city area will be endangered if no attention is paid to this matter.

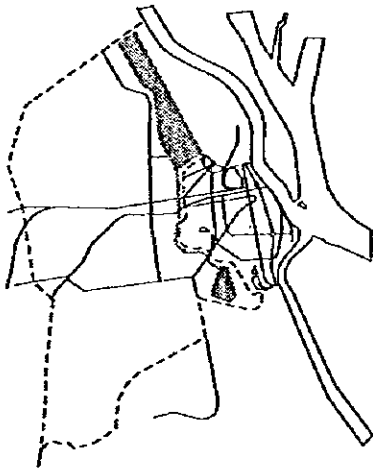
The Boeng Pongpeay Residential Strip

West from the Russey Keo riverbanks, along the Boeng Pongpeay lake, a loose residential area is already developing. The rise in interest for this area could be linked to the announcement of a future direct road from there towards the Pochentong airport zone, which already has been partly achieved. The Municipality should be aware that since this operation will create a new folder in the North of the city, much attention should be paid to the drainage issues, particularly for the water coming from the eastern Tuol Kork catchment area.



This sector's environmental quality is appropriate for a residential development; however, the drainage and sewerage issue brings along a high risk of a rapid environmental deterioration. It is wishful to manage the development of this area so as to limit its urbanization to a "loose residential" type.

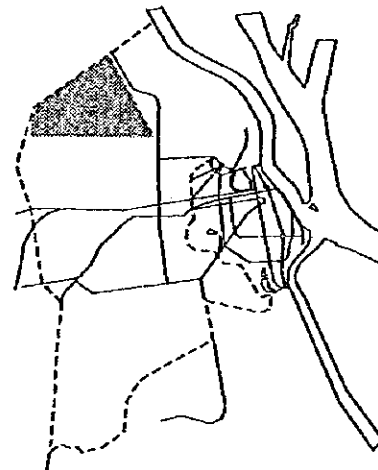
The Northwest Blue Belt



A long sector subject to flooding stretches from the previously described area to the Northwest road that connects the Kop Srouv dike to the "Phnom Penh Thmey" new developing zone. This damp area is essential for rainwater retention. It plays the role of a water reserve for irrigation and wetland agriculture, and must absolutely be preserved. The possible development of this area hence could include traditional farming, together with seasonal leisure activities, prohibiting any massive land filling.

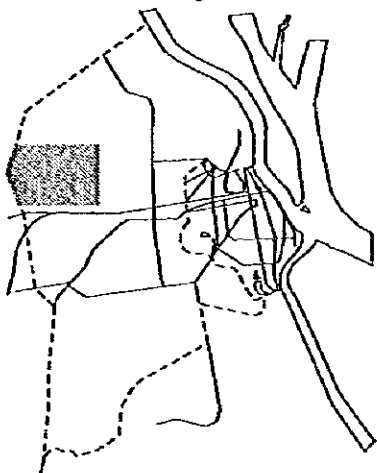
The Northern Green Belt

Further to the west, is a still rural area where the most logical future development should remain agricultural. Water reserves will be available from beyond the Kop Srouv dike. Some experimental irrigated plots are already under exploitation. Water flows in the area will require a careful management, while appropriate irrigation structures will have to be developed.



The Far Western Zone

Going further westwards up to the Kop Srov dike and road limit, the land rises slightly; many villages are settled there, living on local agriculture. Their development could be hold up with some handicraft activities.



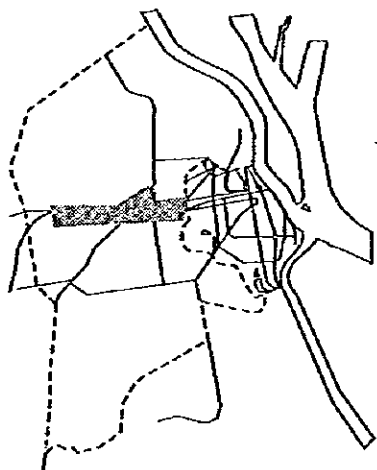
The Kop Srov Dike

This dike is quite weak, which endangers an important area of the developing city, actually all previously described sectors situated north from the railway.



Indeed the water level outside the dike is about EL 9.4 m at floods season, which is higher than any part of the inner area. This dike hence is of major importance, and it also has a role to play in the city development since the road on it makes a strong connection between the NR 5 and the NRs 3 and 4, and already receives an important traffic. In its western part, it crosses the railways towards Battambang and Sihanoukville. In the long term, it could become a major axis round the city, to avoid urban traffic congestion. Its prolongation towards the south and back to the east seems to be wishful, as a logical complement to the existing axes. Projects and proposals for this prolongation have already been considered above.

The East-West Strip along the Pochentong Road



All along the strip that stretches between the Pochentong road and the railway, from the city to the airport, much development has been taking place in the recent years, apparently with little control.

Besides the development of the Pochentong International Airport, which is going on and will enlarge the area devoted to air transportation and related activities, the sector has been under a high pressure for urbanization. Some housing, but mainly warehouses and manufacture buildings, have been settling along the main road axes. A few kilometers away from the city, an important area has also become dedicated to education, with the

International School, the Socio-Economic School, language schools, students' homes, etc.

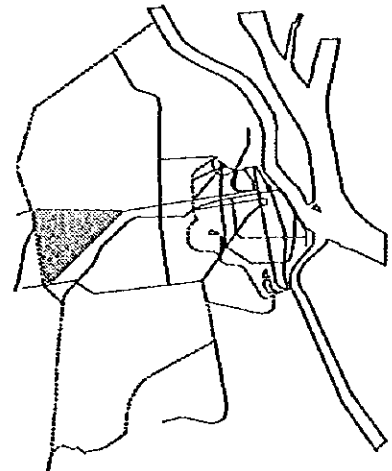
Following the existing drainage difficulties, land filling is generalized, and it keeps on bringing along the same drawbacks: individual attempts to solve local problems

globally result in under-sized infrastructures, more complex water paths, and eventually increased risks of flooding.

It is most likely however that by 2010 all this area will be fully urbanized.

The Railway-Dike-Airport Triangle

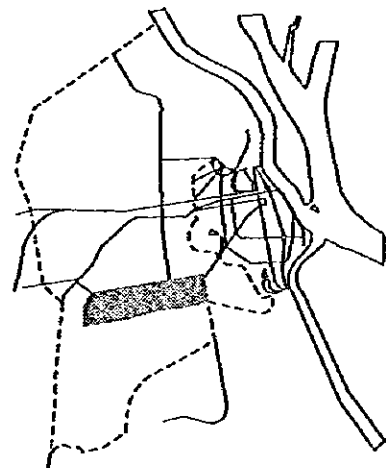
This area located between the railways in the north, the Kop Srov dike in the west and the airport boundaries in the Southeast, is still little developed. Towards the southeast, the development of the airport will bring the settlement of all kind of activities related to air transportation: car parks, hotels, freight facilities, warehouses, etc. In the future, due to its situation close to several of the main communication axes and poles, this triangle is a privileged place for the development of all kinds of activities related to transportation. As we already suggested, it could thus become a “technical platform” devoted to the switching and stocking of merchandises. In the long term it could further develop towards the service sector.



Nevertheless the environmental constraints of this area are strong, and they quite forbid any industrial or even urban development: water will hardly be available, and the disposal of wastewater will be difficult.

Southern Part of the Pochentong Catchment

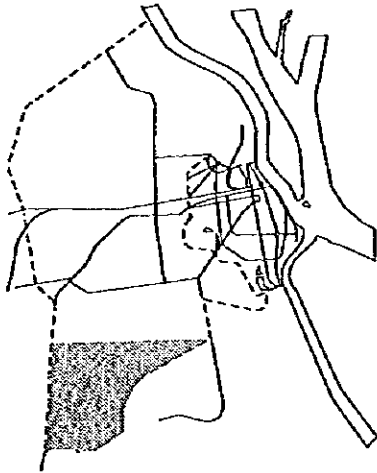
In this area, which surrounds the road connecting the Stoeng Meanchey sector to the southern end of the airport, there is a large zone subject to flooding, which cannot currently be used for any other purpose than agriculture, except after massive filling in. The water regulation however is very difficult, and while a large area remains unusable in the flooding period, during the dry season it lacks resources for irrigation.



The project of an Urban Development Zone that is currently under study, would allow to:

- protect the infrastructures and solve the drainage problems of the sector through the rising of a dike which would support a ring road,
- develop of a large new urban zone, and
- enhance the water management for the irrigation of the agricultural land located in the South.

Far Southern Sector

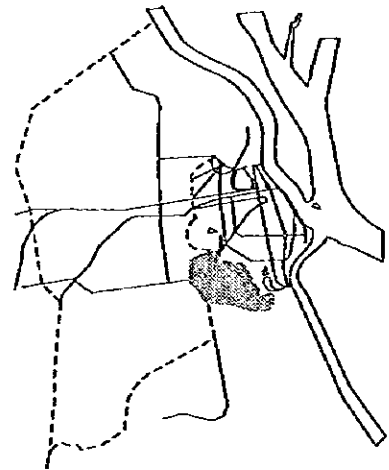


In the most southern sector of the area of study, topography shows a slight rising of the ground level. As for the northwest zone, this sector is still used by a loose concentration of rural villages, where people live on agriculture. Its development will most likely remain rural, though it could be helped by some handicrafts or small manufacture activities.

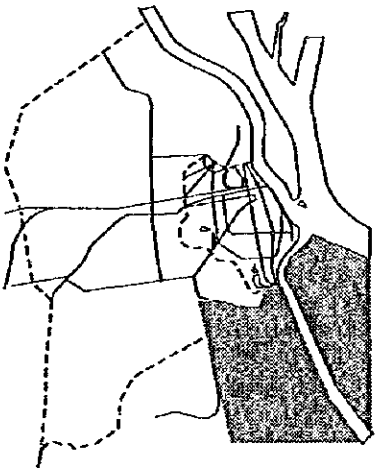
The Boeng Tompun and Stoeng Meanchey Sector

This last sector is one where an important development has taken place in the recent years.

For most of it this development has taken the form of residential villages. Along the inner side of the Boeng Tompun dike, the land occupation remains loose and progressively covers an increasing area. Along the Stoeng Meanchey road, it has risen up to a dense residential type, which already appears to have a real urban structure.



The Southeast Zone



Though it does not belong to our area of study, this zone stretching south of the Boeng Tompun lake, along and beyond the Bassac River, has some importance that already has been partly commented out. While considering its possible and likely future development, the following points should be kept in mind:

- The large wetlands south of the Boeng Tompun presently are the main outlet of the city drainage and sewerage system, in which they play an essential role of natural water treatment (oxidation) before the purified waters go back to the river.
- A notable development already has started on the riverbanks along both the Takhmao road to the south and the Koki road to the east. A new road axis continuing the Monivong Boulevard towards Takhmao could help marking off a privileged area for this development.
- It is most likely that this development will accentuate on the Tchbar Ampouv peninsula, together with the improvement of communications and transportation media to and from this area. This still rises the issue of crossing the river, for the possible railway to Vietnam as well as for an expressway to connect the projected ring road to the Ho Chi Minh Highway. The importance

of this latter road could lead to consider building a new bridge over the Bassac River, close to Takhmao.

- As we pointed out already, this area along the downstream branch of the Mekong is the best if not the only appropriate place to promote the development of an important water port, together with heavy industries.

2.4 Predicted Land Use for Year 2010

According to UWSSP, the increase in the Phnom Penh population by 2010 would be about 25% for the city core, and as much as 75% for the suburbs.

There is a high variability in the density of land occupation but nevertheless it is interesting to note the average land occupation for each urban category of land use (considering the total land area, which includes all infrastructures, gardens, etc.):

Urban land use category	Average surface per person
dense urban center	15 m ²
dense residential	45 m ²
loose residential	55 m ²

The estimated 25% increase of the inner urban population by 2010, will probably not mean an important densification of the urban core. It should be accounted for by a little spread of the dense urban center, a restructuring of the dense residential areas, and a progressive evolution of loose residential sectors towards the dense residential type.

Inside the larger city boundaries, one should expect a development of residential zones along the main communication axes, as well as the growth of housing zones close to the developing activities. Most of this evolution will follow the currently observed trends.

While there is no clear policy for land management so far, the areas covered by this development will probably considerably spread, mainly with a «loose residential» structure.

From these observations we can estimate the surface of each land use category in 2010, in the boundaries of our area of study:

Category	Area in 1998 (ha)	Areal growth (%)	Area in 2010 (ha)	Ratio to total (%)
A Dense urban center	603	10	663	3.4
B Dense residential	1,124	20	1,349	6.9
C Loose residential	3,012	85	5,572	28.5
D-1 Dense activities	287	50	431	2.2
D-2 Loose activities	793	100	1,586	8.1
E Agricultural land	11,919	-32	8,130	41.5
F Fish ponds	70	10	77	0.4
G Green spaces	209	0	209	1.1
H Lakes and ponds	1,554	0	1,554	7.9
Total of Study Area	19,571	-	19,571	100

However the directions of this development and the location of settlement for all kind of activities, can shape the future of the city in many different ways. This future will be function of how the authorities will be able to allow, and to control this development. Considering the two “extreme” possibilities, we propose here two scenarios for the land use in 2010:

(1) Scenario 1: Development Managed with Appropriate Control and Infrastructure

This first and most wishful scenario assumes that the Municipality of Phnom Penh, with the help of appropriate technical assistance, will be able to:

- Set up, operate and maintain the needed infrastructures in the developing zones, especially regarding drainage and flood control.
- Exert when necessary a control on the land occupation, to ensure that this development remains harmonious, safe and sustainable.

(2) Scenario 2: Spontaneous Development with Little Management

In opposition with the precedent one, this scenario tries to sketch the future of the city in case the necessary infrastructure and control tools would not be set up and operated. The city development would then be mostly spontaneous, and follow basically individual interests, such as low costs, self-protection, maximum benefit, etc. This trend has been leading the development of many areas during the recent years, and its observed results have been commented out along this study: lack of safety, comfort and efficiency in new (and some old) “urban” zones, and eventually threat of flooding on large populated sectors.

Figures A2-3 and A2-4 show maps of what could be the land use in our area of study in year 2010, according to each of these two scenarios.

A3. Study for Priority Projects Area

3.1 Present Situation

3.1.1 Kop Srov Dike

The Kop Srov Dike limits the whole area of study towards the north; it goes from the Prek Phnov riverside village to the Kop Srov village, and then towards the South down to the National Road No. 4 at Tmat Pong village. The section of interest to this part of the study is only the northern section, that is 7.65 kilometers long, from the National Road No. 5 up to the Kop Srov village.

This dike was built under the Lon Nol regime, in the early 1970s, in a hurry and without appropriate technique, mostly for military reasons, excluding urbanism considerations. The average width of the dike at its top is around 10 to 12 meters.

We have already pointed out its importance regarding the risk of flooding: the streaming from the northwestern hills leads a considerable volume of water to accumulate beyond this dike. The water level outside the dike is about 10.4 m at floods season, which is higher than any part of the inner area. The hydraulic model actually shows that a very large area is threatened by the risk of flooding if this dike would break. This area represents more than one quarter of the northern city, where urbanization has been growing rapidly during the last years.

The dike happens to be in a hazardous state of weakness, especially between kilometer 2 and kilometer 6. It is porous, probably since it never was appropriately compacted. During the rainy season, it is subject to a high water pressure and it actually suffers from infiltration in many places. Moreover, the laterite road covering it deteriorates quickly and must be repaired every year.

Human occupation on the dike is continuously growing. It is mostly a precarious, squatter-like kind of habitations, following the usual rural village development scheme, eventually blocking the possible area's urbanization; the dike road hence turns to be a servicing way more than a transit way as it should rather be. There nonetheless exists a small traffic activity along this road already.

The most important concentration of population along the dike is a village stretching along its southern side from km 2 to km 4. This place was chosen as a relocation site for displaced people about 1990. A second dike parallel to the main one, and a pumping station, were built for flood protection. A total of 520 wooden houses were originally built for relocated people, who were supposed to gain ownership of the land after 5 years of occupation. Actually, the lack of infrastructure and the remoteness of the area discouraged most of them and only about 20% of this original population remained after 5 years. Due to lack of maintenance and concern the inner dike broke and was not repaired.

A word must be said about the Syay Pak drainage sluiceway. This sluiceway meets severe leakage and working problems, though it ensures protection and regulation of water flows in the whole space included between the Kop Srov dike and the city core, up to Boeng Reachsey, Boeng Pongpeay and Boeng Prayap in the west.

3.1.2 Tompun Dike and Outer Surroundings

The Tompun dike also materializes the limit of our main area of study, towards the south from Dankouv village up to the southern end point of the city core, close to Kbal Thnol and to the Monivong Bridge. It also provides a natural route to get round the city. This dike was built at about the same time and the same way as the Kop Srov one. It is wider, from 15 to 20 meters wide. Built much closer to the city, in the objective of developing a new suburb, this dike has indeed favored a much more important development than the Kop Srov one has. For about four years, the occupation of the direct surroundings of the dike has developed, with yet an increased speed in the last two years. It is now almost continuous, with dwellings on the east side and, towards the west, activity buildings which settlement required important land-filling.

Though enclosing a smaller area, and being probably in a slightly better condition than the Kop Srov dike. To a large extent the same remarks apply concerning its importance since the risk of flooding in case this dike would break concerns at least 40,000 people who have settled around the Boeng Tompun, in the catchment of about 500 hectares limited by the dike.

During the rainy season, it often happens that the floodwaters outside the dike, linked to the Tonle Bassac through the Prek Thnot, rise up to a higher level than the one inside and close to the top of the dike. Besides, the Tompun pumping station is in a serious dysfunction state, and its remaining pumping capacity is fairly insufficient. This eventually results in a considerable risk of flooding for the city.

All along its length both sides of the dike itself are occupied by illicit habitations. The dike is weak, and needs consolidation to protect the Boeng Tompun area from the waters going up through the Prek Thnot at the flooding season.

3.1.3 Tompun-Salang Watershed

This area groups into two parts which have a different history, structure and level of urbanization.

The Boeng Salang area (in which we include two minor basins: Tumnop Tek and Tek Laak basins) is a part of the core city. It represents its second big catchment area after Boeng Trabek, with a surface of 631 ha and a population of maybe 200 thousand people in 1998. The road network and urbanization is almost complete in this area, with mainly a dense residential urban type of occupation, except for the far southwestern zone that is still little structured.

One of the three boengs left in the inner city, the Boeng Salang plays an important role as a retention basin from where the waters either naturally flow through a sluiceway or are pumped out, to the Stoeng Meanchey and Boeng Tompun area. As for other parts of the city, the deterioration of the network, the over-densification of population and buildings in some places, the reduction of the basin and the malfunction of the pumping station have resulted into severe inundation at rainy season during the recent years, especially in 1995 and 1996. The present situation of this area is described in details in a BAU study supporting the sub-decree on the rehabilitation and setting of the Boeng Salang area

“Réhabilitation du Quartier de Boeng Salang. Guy Lemarchands - BAU of PPM, CEE - APUR, 1996”.

On the contrary, the Boeng Tompun area is a very newly urbanized one. It could start to develop thanks to the dike built in the 1970s but actually important occupation of this zone really started only 4 or 5 years ago. It has risen rapidly to a population of more than 40,000 people. It has been developing first along and around the laterite roads, as scattered villages that progressively densify and take, in some places, an urban-like organization. However no coherent planning has been used to guide this development, which results in a very different organization than the fully planned one observed in the city core.

The map in Figure A3-1 illustrates the present state of urbanization of the Boeng Salang and Boeng Tompun areas.

3.2 Likely Evolution by 2010

3.2.1 Natural Trends

Kop Srov Dike

We have pointed out the Kop Srov dike's natural situation as a part of a ring road to connect the major road axis toward the North (mainly Battambang, Siemreap and Kampong Cham provinces, Thailand and Laos) to those towards the south (Takeo, Prey Veng, Kampong Som provinces, and Vietnam). This ring road would avoid the transit through the city and instead favor the development of a “technical platform” and other activities in the vicinity of the airport. This role as a transit road is very important for this axis, while its distance of more than 10 km to the town center leaves a sufficient capacity for the city to develop in the long term.

However, the main present use of the dike, reinforced by its natural evolution, is to be a servicing road for the housings encroached on the dike. If no control was undertaken this trend would lead to a short-term destruction of the dike.

Concerning the area close to this dike, we have noted two main trends for development: small industrial or craftsmanship activities, and agriculture. Most of this region should stay devoted to agriculture, as it has been so far.

It must be noted that in the eastern part of the area enclosed by the dike, an important urban growth already exists, which would be accelerated with the building of an east-west road across the Boeng Reachsey, as it has been projected by the BAU. Some light industries such as brick factories, relying on river transportation, already have started to enrich this region.

Tompun Dike

On its east end, the Tompun dike makes a large bend towards the North, to join the Trabek dike limiting the city core; due to the width, state and disposition of both roads, the Boeng Tompun dike is not, as such, appropriate for an important transit round the city. Actually its eastern part at present is in such a state that absolutely no transit is possible. It is

hardly practicable and used only for local servicing. In particular, the Tompun pumping station is hardly accessible, and its provisioning with fuel has become an issue.

Unlike for the Kop Srov Dike, in the case of the Tompun dike a double issue needs to be considered and mastered. The stake is the closing of a new urban area, and together with its possible role as a transit road, the dike road already plays a major role for the servicing of this newly developing zone.

The wetlands that stretch to the south are quite not exploited nor occupied so far, except for market gardener cultivation. The regular and important flooding restrains development in this area.

Tompun-Salang Watershed

In the Boeng Salang catchment area, the natural foreseeable evolution is the completion of the urbanization process, mainly in the southwestern zone that was not yet fully urbanized in the most recent years. At the same time, the density of population could be still increasing in many places, often with illicit and precarious habitations that lead to an over-density of population considering the current state of urban infrastructure.

As regards the Boeng Tompun area, its natural evolution in the near future is likely to carry on the present one, that is a fast, unregulated urban development. This trend can only be stimulated by the increased security and sanitary conditions that will result first from the rehabilitation of the dike, and then from the drainage improvement project.

Already many small roads go down from the surrounding dikes into the Boeng Tompun catchment. Land filling and building are actively going on along these roads and will probably naturally carry on, with or without regulation and infrastructure, towards a dense urban type of occupation.

The already rapid development of this area will obviously be enhanced and accelerated with the possible development of an activities zone to the west, between the project area and the southern corner of the airport.

The Figure A3-2 illustrates the foreseeable future state of urbanization of the Boeng Salang and Boeng Tompun areas, under the hypotheses that:

- the Boeng Salang rehabilitation program could be funded and achieved, and
- the Boeng Tompun urban development could be monitored in a similar manner, as is mostly recommendable.

3.2.2 Existing Projects

Kop Srov Dike

The Municipality of Phnom Penh already is studying a project of setting up a toll for trucks that will take this Second Ring Road (eastern part is Kop Srov Dike). More importantly, transiting through the city core could become completely forbidden during daytime, and submitted to a toll during the night.

Another project, developed at the MPP, needs to be mentioned here: it would extend the existing road running straight north from the Wat Phnom, to join the NR 5 above the right bend of the river, enclosing the Russey Keo waterfront. This road would hence create a new catchment area and alter the present conditions of drainage, which should be carefully studied. Regarding traffic, this road would ease circulation to and from the city and would be likely to receive an important traffic between the northern road and the close western suburbs, since it would provide another, straighter way to get round the city core than through the Kop Srov Dike.

Boeng Tompun Dike

As well as the Kop Srov Dike in the north, the Tompun Dike is part of a privileged route for a ring road around the city of Phnom Penh; however it will likely more quickly play the role of an urban boulevard.

The interest of this dike to this regard has been pointed out in precedent studies and reports; in particular:

- The study "Diagnostic du Réseau d'Assainissement de la Ville de Phnom Penh" realized in 1996 (Agence DESAIX, APUR - ADITEM - Ville de Paris) suggested that the dike could be prolonged eastwards up to the NR 2, thus enclosing a new area little urbanized so far, and where a retention basin could possibly be created.
- The first recommended action of the CUEIP report is "PP-01: Southwest Levee Construction" which route follows the existing Tompun dike before running further towards the east.
- The sub-decree project for the creation of an urban development zone, includes in its local road network plan a main axis, which would connect the Tompun dike to the NR 4 after going round the airport. The existing dike would hence obviously become of primary importance. This sub-decree project could be presented to the government in the short term.
- Proposals for a ring road close to the city quite always include a part running along the existing Tompun dike and from there westwards towards Pochentong following variant possible routes; the most elaborated project to this regards is the sub-decree project evoked above.

In all these projects, as well as in the master plan project under development, it appears that the dike road should naturally be extended eastwards, up to the NR 2 towards Takhmao and Takeo.

Besides the road, we must notice that the rehabilitation of the electrical power distribution network, following the observed progress of urbanization, includes in its planning a MT line around the Boeng Tompun Lake and the dike. From there, the network extends towards the different quickly developing zones in the south and in the west.

Tompun-Salang Watershed

The Boeng Salang area is especially the zone surrounding the retention basin and stretching westwards into the most external and least urbanized area in this part of the city. The area has focused attention and benefited from one of the most achieved integrated urban planning and rehabilitation project in the recent years.

- One of the recommended actions of the CUEIP report, “PP-06: Boeng Salang Drainage”, is concerned with the rehabilitation of the drainage facilities in the Boeng Salang area.
- Following the CNATUC law for urban planning, a sub-decree, prepared and submitted with the help of the BAU of Phnom Penh and already adopted by the government in 1997, takes over the full urban planning and restructuring of the Boeng Salang sector. This action is a first but a major step towards a global restructuring that would be necessary to an important part of the whole city. Its aim is to rehabilitate the urban infrastructure, especially the urban drainage facilities. The project components, as described in the report “Réhabilitation du Quartier de Boeng Salang”, are grouped under 4 main objectives:
 - Rehabilitation of the Boeng Salang retention basin, and of the associated structures upstream and downstream,
 - Conversion of the physical setting,
 - Adjustment, possibly creation of the operating and management structures, and
 - Improvement of the living conditions of the local populations.

3.3 Likely Long-term Development

3.3.1 General Development Rules of the Cambodian City

Phnom Penh City is located at a unique crossing of waterways, which played a major role in its development. The successive stages of this development, by diking and land-filling, are well described and illustrated in the book “Phnom Penh, développement urbain et patrimoine (Ministère de la Culture, département des affaires internationales, APUR, 1997)”. Due to the almost flat topography the mastering of the annual flooding is an absolute necessity to social and economic life. Human works have been skillfully combined to natural conditions to enable the appropriate water management. Today, as well as from the very beginning, three kinds of structure need special attention and the issue of their preservation and evolution directly influences the definition of management or rehabilitation projects. These are the dikes, the canals and the boengs.

Whenever they have to be rehabilitated, in designing their profile one must take into account their likely natural evolution, that can be foreseen if one observes the history of these sites and of the human settlements. The design given to these structures will direct the evolution of the urban tissue, either towards a situation difficult to master, or towards a harmonious development. The human experience of this evolution has long since been integrated in the traditional building techniques that provide useful examples.

For instance, the road entering the Siemreap City has the following profile:

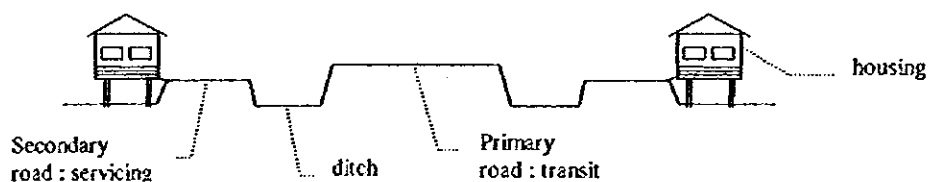


Figure: typical dike / road profile, initial state (P1)

This profile at the same time allows for the double vocation of this road, as a transit road as well as a servicing road for the neighboring houses. It then provides the possibility of an evolution towards a larger, unique road, while it almost excludes the risk of a progressive narrowing of the public space under the pressure of private building.

In an urban context, the long-term evolution of such a profile will most likely see the banking up of most ditches and depressions, and can lead to one of the two following possibilities:

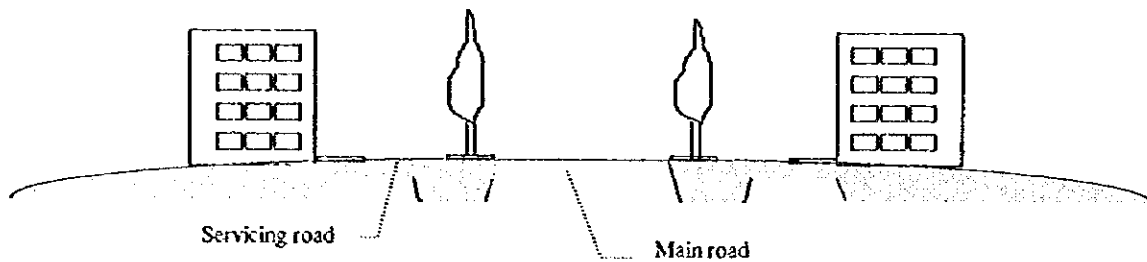


Figure: possible evolution of profile P1: alternative E1.

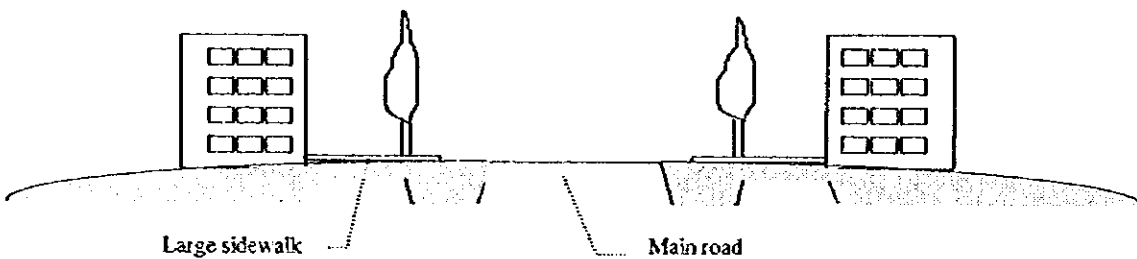


Figure: possible evolution of profile P1: alternative E'1.

The second alternative E'1 corresponds to what we can observe on the Norodom Boulevard in Phnom Penh: a large avenue and sidewalks, with a total width of about 30 meters.

On the contrary, the profile of the present Kop Srov Dike, as well as the Tompun one, is the following:

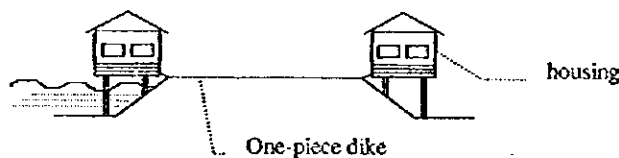


Figure: present profile of dikes under study, initial state (P2)

This situation restricts the public space to the mere surface of the very top of the dike. This allows only for a narrow street, which is only appropriate to be used as a village-like

servicing road. It risks preventing any rapid intervention for the structure maintenance or management. In the context of urban densification, this one-piece profile gives not much opportunity for any other kind of development than the following one:

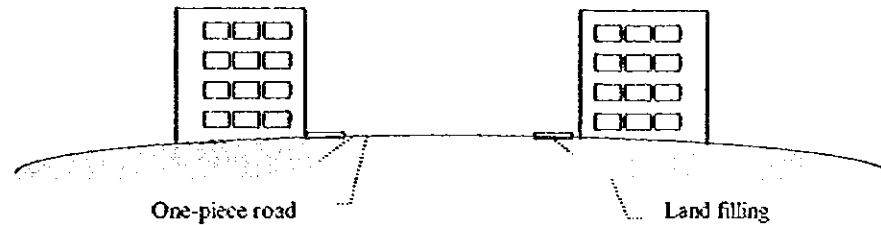


Figure: likely evolution of profile P2: alternative E2.

The total width of such a road would likely be limited to 15 meters, with very compromised possibilities of further evolution. Moreover, in the mid-term period when this dike will still have its role in water retention, the uncontrolled land filling and building will not increase the solidity and efficiency, but on the contrary it will bring irregularities in its charge and the risk of a progressive deterioration of the structure.

3.3.2 Consideration for Future Urban Planning

Dikes

Both dikes that are considered in this feasibility study will mark the limit between a rural landscape that can be valorized, and the inner side of the city (even though in the mid-term the Kop Srov area will keep a mostly agricultural vocation). We have underlined the importance of taking into account from now on the role of these dikes as transit roads. This role will certainly be compromised if the ongoing natural development continues, leaving a maximum road width of 10 to 15 meters at the top of the dike.

To avoid this and enable for the expected important role of these dikes in the mid-term, their necessary renovation should be taken as the occasion to transform their profile with the following principle. If the construction of the secondary road in the land-side is not realistic for urgent implementation in view of necessary cost, it is recommended to be considered in the mid-term urban planning of the city.

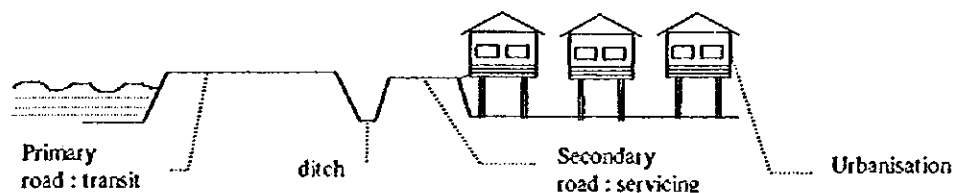


Figure: suggested schematic profile for dikes under study (P3)

This profile enables a natural evolution that should accompany the urbanization of the inner, and then the outer area, with the following possible stages:

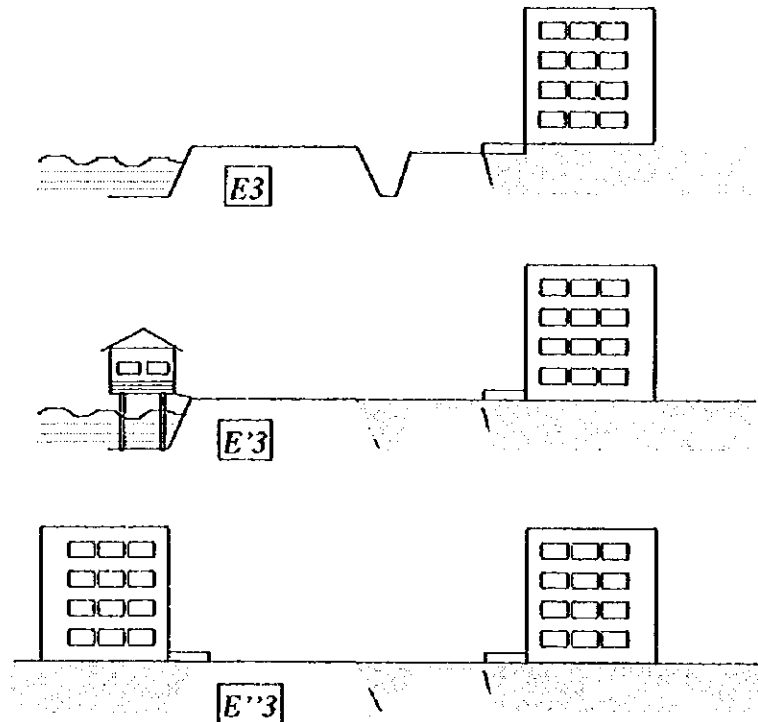


Figure: possible evolution of profile P3: successive stages E3, E'3 and E''3.

If appropriate dimensions are given to the initial structure, the final road can keep a width of about 30 meters, which is compatible with being used as an urban boulevard.

The issue of a possible use as a transit road is determinant in the short term for the Kop Srov Dike, and only to a lesser extent to the Tompun one; considering the city proximity and the area's rapid densification the Tompun Dike road should quickly become an urban boulevard. Due to a more dense present occupation, its widening can be seen as more delicate to operate.

Urban Drains and Retention Basins

Considering the setting of all spaces where the presence of water plays a determinant role for drainage, preservation and then valorization of these water surfaces should be the leading idea of structure design.

Around the Boeng Tompun retention basin, for aesthetic, social, maintenance as well as management reasons, the area occupation plan should first of all make provision for a road around the boeng, as for the project already designed for Boeng Salang basin. The boeng waterfront setting should be organized, including this road, in order to control - that is, mostly, to prevent - human occupation in a close perimeter.

Two alternative possible profiles for these waterfront settings are schematically suggested here:

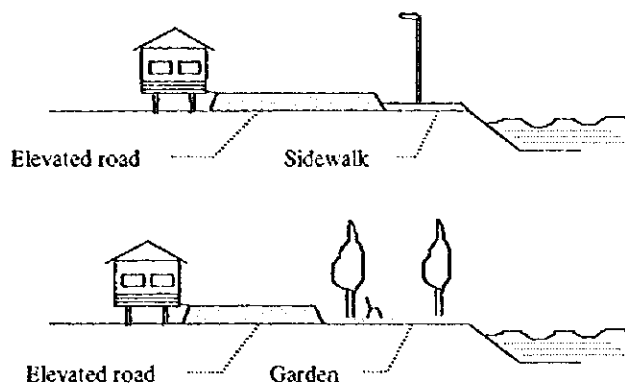


Figure: suggested schematic profiles for boeng / canal waterfront (P4, P'4)

For the same reasons, the exact same remarks apply to the close surroundings of open main drains, that is, in our case, the Stoeng Meanchey Canal. As much as possible, a fitting similar to the one described above should be realized on both sides of the canal.

These profiles only aim at suggesting possible settings for the waterfront, whereas the appropriate section and profile for the canal itself are considered elsewhere. One reason for the slight topographic relief proposed, is the experience that people more willingly settle their dwellings on the downer edge of a small depression. The road elevation can also slightly increase the retention capacity in exceptional situations.

In any case, as far as possible it is wishful to reserve a stretch of at least 10 meters along the waterfront, for the needs of structure management, local servicing, etc. It is wise also to foresee the future will to develop a separate sewerage network, which would naturally need a main sewer along the open drain, and to already make provision for the necessary place.

3.4 Impact of Priority Projects

3.4.1 Possible Emerging Projects

Kop Srov Dike

When this dike is rehabilitated, it will naturally become a major way of transit, bringing along all the kinds of activities that are usually attached to this type of road.

Some people already have considered the possible development of industry along the Kop Srov Dike. Already a few isolated actions can be observed, where massive land filling is followed by the installation of small industries or craftsmanship, like textile workshops. It would certainly benefit from the proximity of an important road axis, and the availability of water during the rainy season.

Different surrounding areas also are concerned with the likely evolution of the dike and its usage. These are mainly:

- The loose residential strip which is developing west from the Russey Keo riverbanks and along the Boeng Pongpeay lake. Besides the future direct road towards the Pochentong zone, this area all will be the better situated regarding communications with the Kop Srov Dike rehabilitation. The drainage of this area, including the Syay Pak sluiceway may become an important issue.
- The Northwest blue belt, stretching west of the above-described sector. As for the latter, this sector will most probably gain interest with the improved communications. Its necessary preservation will then become an issue for the Municipality of Phnom Penh.
- The Northern green belt, a still rural area stretching further towards the West and along the most important part of the dike. A trend towards urbanization will probably emerge and spread from along the dike, with the increased ease of communications, transportation as well as the improved security.

Tompun Dike

It is likely that the rehabilitation of the dike will accelerate the ongoing development of industrial activities in its western area. The prolongation of the dike with a possible ring road westwards will obviously favor the existing project of creating a new urban zone with a high density of economic activities between this area and the airport.

Considering this situation, it seems recommendable that the possibility of prolonging the road eastwards towards the Takhmao Road, be studied in the mid-term.

Besides that, it is also most wishful to plan the necessary rehabilitation of the Boeng Tompun pumping station, considering its primary importance and its present state of deterioration.

Tompun-Salang Watershed

Concerning the inner-city part of this area that is the Boeng Salang catchment, the trunk structures for drainage should urgently be constructed. We, then, must consider that the implementation of the ambitious urban rehabilitation project adopted by the government will bring the most appropriate structures together with a final level of urban development.

In contrary to the city core, problems were due to a lack of management of well-planned and structured urban zones. The Boeng Tompun area development has not been guided by any planning or preliminary works such as systematic land-filling; in this area different long-term development scenarios can be considered, that are not all mutually exclusive:

- After a period of almost uncontrolled development up to a quasi-urban state, problems similar to those presently met in the inner city could arise, all the stronger since here no infrastructure at all exists, except the main drain and natural retention basin. The Municipality of Phnom Penh could then be confronted with an emergency to set up an urban rehabilitation project, with all the complications due to squatters, over-density of population in some areas, etc.
- Before this situation arises, it could as well happen that the improved drainage conditions and access roads raise interest towards this area, for private investors who would then consider developing here different kinds of economic activities, or

maybe large real estate operations. If not carefully controlled many could be harmful to the environment and sustainable development of this area.

- In a more wishful manner, the Municipality could take the opportunity of the current Drainage Improvement Project, to develop in the short term an urban Master Plan for this area. Taking into account the needs for a preserved retention capacity of the Boeng, the Master Plan would ensure that land filling and building would not jeopardize this capacity. On the contrary, as for Boeng Salang, it could include setting the Boeng and its immediate surroundings so as to valorize the presence of water in the social and economical life of the city.

3.4.2 Local Development Constraints

Kop Srov Dike

It is wishful to take as an objective the mid-term vocation of this dike as an important transit road. This objective should lead the design and the works for the rehabilitation of the dike. Care should be taken to favor from the beginning a development around it, that is coherent with its future main usage.

In any case, during the dike rehabilitation works the present occupants will have to move away. The choice will then have to be made, whether they will be enabled to settle in the same anarchical way, or whether the occasion is seized to allow and encourage a more sustainable development. This orientation would deserve a careful project, which would probably consider:

- If the limit of the construction cost allow, including in the design of the dike, the appropriate place and structure for a parallel secondary road, to be used as a servicing way,
- Forbidding whatever could lead to an alteration of the dike; this would primarily mean to regulate the occupation of the surroundings, keeping the necessary areas for servicing, management, etc.

Besides, the settlement of polluting industrial activities should be forbidden in this area. However they would benefit from the proximity of raw water resource, they would drastically suffer from the lack of infrastructure for evacuation of wastewater, and would hence bring on a high risk of environmental damage. Through the Prek Phnov, the Tonle Sap would quickly become polluted upstream from the main city water intake, endangering the whole city as well as the Tonle Sap lake during the 6 months per year when the stream is reversed.

All development of activities should be strongly encouraged to move towards the projected economical development zone if appropriate, or further downstream the Tonle Mekong river for heavy industries. The different master plan works already existing clearly show the possible places that could be reserved to this kind of development. The area surrounding the Kop Srov Dike should mainly remain devoted to agriculture; some specific agricultural projects (intensive fields, experimental farms, fish ponds, etc.) could be encouraged.

Amongst the different parts of the main area of study which are related to the dike, special attention should be paid to the eastern zone, since an improvement of the dike will add

itself to different projected roads to affect its socioeconomic development. We have pointed out the interest of this area for a residential development, but also the likely necessity to limit its urbanization to a "loose residential" type.

The Municipality should be aware that the ongoing creation of a new road towards Phnom Penh Thmey area and the airport, as well as the projected road behind the Russey Keo water banks, will result in creating a new folder and raise new drainage and sewerage issues. These issues are directly related to the state and use of Syay Pak drainage sluiceway. The rehabilitation of this sluiceway is recommended for urgent implementation under the present study.

Just west from this area, is what we have called the Northwest Blue Belt, a damp area which is essential for rainwater retention; for agricultural purposes it must absolutely be preserved. The foreseeable rise in interest will bring the danger of massive land filling, which should be prohibited.

Tompun Dike

Though the present situation and the mid-term vocation of the Boeng Tompun Dike are quite different, considering its development the same basic remarks apply, that has been done above for Kop Srov. Actually, it is likely that this road be first used as transit road but eventually become integrated in a more urban sector. This long-term vocation can be foreseen in the importance already taken by this road, nonetheless its very bad surface state, as an access to the many smaller roads servicing the area enclosed by the dike.

Altogether, the same reasons as for the Kop Srov Dike, lead to recommend that provisions be made in the mid-term in urban planning, to provide the appropriate place and structure for a parallel servicing road, and later to carefully regulate the occupation of the surroundings.

Tompun-Salang Watershed

Concerning the core Boeng Salang area, due to its role in the drainage of an important part of the city core the Boeng Salang retention basin has to be preserved. We can consider the plans proposed by a global rehabilitation plan for this area adopted by the government.

While this example shows that rehabilitation can be undertaken with appropriate care given to the local population and squatters issues, for the Boeng Tompun area which is not yet as much developed, it will be wiser to monitor from now on the ongoing development. This monitoring should take as an objective a harmonious integration of the basin into its urban environment, with benefit to the quality of life as well as to the water management.

Nevertheless, already occupied land will have to be made available for the projected works; many property problems are to be expected at this stage, especially around the Stoeng Meanchey Canal where human occupation already is dense, and where many people consider themselves as legal owners of their land.

Some of the necessary land use management laws and regulations presently are under study; as long as they do not yet exist, the effective reservation or acquisition of these spaces will remain a very delicate problem that has to be treated on a case-by-case basis.

3.4.3 Land Use Management

The above considerations lead to recommend, in order to favor a secure, harmonious and sustainable development, that sufficient areas surrounding the main drainage structures be reserved as public property. The immediate settings may vary, but by any means it seems appropriate to reserve:

- About 30 meters width for the dikes, that is the emerged area, and possibly more for the whole structure, especially during the works period.
- About 10 meters width around the boeng, which contour will have to be clearly outlined, as well as on both sides of the Stoeng Meanchey canal.

Hence a preliminary work to be carried on as early as possible, would be to determine the exact area of realization of the projects, including the structure surroundings, and register them in the Master Plan as being "reserved areas" for the projects.

3.4.4 Implementation Considerations

Two main issues must be taken into account when planning the realization of the priority projects:

- The emergency of protecting the populations against flooding, and
- The untimely occupation of the project sites.

Short-term Flooding Risks

It is absolutely necessary to work on an emergency plan to protect the populations living in the areas enclosed by both Kop Srov and Tompun dikes. It is especially necessary to anticipate that the announcement of a possible rehabilitation in the coming years, can lead to a total release of interest and care for the existing structures, while they are still in a very precarious state.

Recommendations are given here to prevent or at least limit the social and economic aftermath of a possible important flooding:

- The Municipality should be fully aware of the danger and appropriately strengthen the already existing crisis committee, which concretely should be in charge of:
 - Setting up an action plan for all possible situations; for example, an evacuation plan for all the zones where the vulnerability to risk of flooding remains high; an awareness program may be wishful for the concerned population.
 - Preparing and executing flood alert exercises to train themselves as well as the most concerned population.
 - Distributing the necessary materials - sand sacks, plastic awnings, etc. - along the weakened structures, to prepare some emergency measures that could be needed to strengthen the dikes.
 - Keeping teams ready to intervene in case of a crisis.
- The weakest part of the dikes, especially the northern part of the Kop Srov Dike, should be temporarily strengthened through minor works so as to ensure their solidity for the critical oncoming 2-3 years.

- The major sluice gates and pumping stations should likewise be reinforced; a planning of openings and closings of the spillways and working periods of the pumping stations, according to the Tonle Mekong level, should be set up in order to optimize their use.

In the particular case of the Boeng Tompun catchment, in order to set up an evacuation plan the Municipality should address the important areas that already have been rendered secure by land filling. The Municipality should obtain from their private owners the possibility for populations stricken by flooding, to temporarily seek refuge on these areas. If not, people would concentrate on the dike itself, which besides being a highly precarious situation would moreover prevent any efficient intervention.

Project Sites Occupation

Housings or activities buildings more or less untimely occupy the realization area of all projects under study.

This applies to:

- The dikes which are occupied by squatters, in an especially dense manner for the Tompun Dike, and
- The Stoeng Meanchey Canal surroundings, which are densely occupied with many actions already altering its necessary drainage capacity: important land filling, canal narrowing, and even in some place building of concrete structures. This situation will raise delicate issues at the stage of project implementation; orientations towards appropriate solutions should be taken in the mid-term.

Squatters and even certainly also legal land owners, will have to be relocated. This relocation will be at least temporary, often definitive. This constraint is taken into account in the global urban restructuring projects such as the Boeng Salang one; often people can be relocated on or close to their former location, since the restructuring enables to increase the settlement possibilities. Experience shows that the relocation success acutely depends on the attention given to efficiently help these people in their new settlement. Following are some basic observations to this regard:

- Land and/or appropriate financial compensation for evicted or expropriated people must be given, but this alone is not sufficient and may even turn out to be useless:
- It is inefficient to encourage people to settle in a remote place where no infrastructure is present regarding water, drainage, electricity, roads, schools, etc. especially when those people have been used to living in an urban area, and often rely on this urban proximity to earn there living.
- An important symbolic action in settlement for Khmer people traditionally is the building of one's house. Hence it may not be relevant to offer pre-built houses that people may never consider as their own, but rather to help them building it themselves, through financial or material assistance.

The necessary population displacement should comprise several successive stages that are similar to those suggested in the BAU/APUR report on the Boeng Salang rehabilitation project. It includes land use and land ownership inquiries in the needed areas, research and reservation of possible relocation zones, preparation of the zones, delimitation of lots, development of most necessary infrastructure, and then displacement of people.

The experience gained in these earlier works should benefit to further projects, provided one relies on the specialists that are already at work. Amongst the organisms that are most likely to help with those population relocation problems, besides several NGOs one can cite the following:

- the Urban Survey Group (USG), created in 1993, which has developed different activities to help communities threatened of eviction, especially:
 - A savings program to anticipate for an uncertain future,
 - A health structure to provide essential medicine, and
 - An emergency committee to cope with different possible disaster situations.
- The Asian Call for Housing Rights (ACHR), which also has initiated many actions in squatters community organization and training,
- The UNHCS which has been working on an Urban Development Programme (Cmb/94/009) co-funded by UNDP and ODA, with the following objectives:
 - To promote a mechanism of participative decision at the municipality scale, the "Community Development Councils",
 - To reinforce the community development process,
 - To run pilot projects to improve living conditions of squatter communities, and
 - To set up a constructive partnership between the key actors of housing and urbanization.

A4. Final Note and Recommendations

4.1 Recommendations for Master Plan Area

The present report does not claim to define any rules for the Phnom Penh City development. It just aims at being a synthesis of the different ongoing studies that are concerned with the future of the city. These studies propose different views which all are supported by excellent arguments; we hence applied ourselves at finding out the common denominator to all these views, which mainly resides in the present city state and environmental constraints, especially those regarding drainage and risks of flooding. Enlightened by these constraints, we tried to outline the most probable scenarios.

However, if appropriate legal provisions are not set on and strictly enforced, no advanced development prospects can be considered. Hence it is urgent to develop the regulatory tools to enable the control of land use and occupation. Particular measures towards this goal could be:

- Developing the notion of servitude, for preservation of the environment and of existing structures that are essential to drainage, and
- Setting up a control of the percentage of land occupation. A "Land Use Plan" (LUP) would be useful provided its recommendations are carefully enforced.

The City of Phnom Penh owns a unique architectural and urban heritage. Due to a lack of consideration for the constraints that we have tried to underline, the urban core has started to deteriorate, the possibilities to intervene have been reduced, and issues are becoming more and more delicate. It has become urgent that all concerned institutions and authorities be fully aware of this state of fact, and start acting to enable a development that preserve this precious heritage.

4.2 Recommendations for Priority Projects Area

Two considerations should lead the project design and implementation, one for the long-term and one for the short-term.

For the long-term, taking into account from now on the likely development of the city and the natural evolution and role of the projected structures, will multiply the cost-effectiveness of the work done by avoiding the arousal of already foreseeable social and economic issues.

In the short-term, the success of the project will be assessed as much from the view point of social management, as on the technical one. Since the issues that will be met are very similar to those already met in earlier projects, solutions should benefit from the existing institutional and community management structures, as well as from the experience gained in previous situations.

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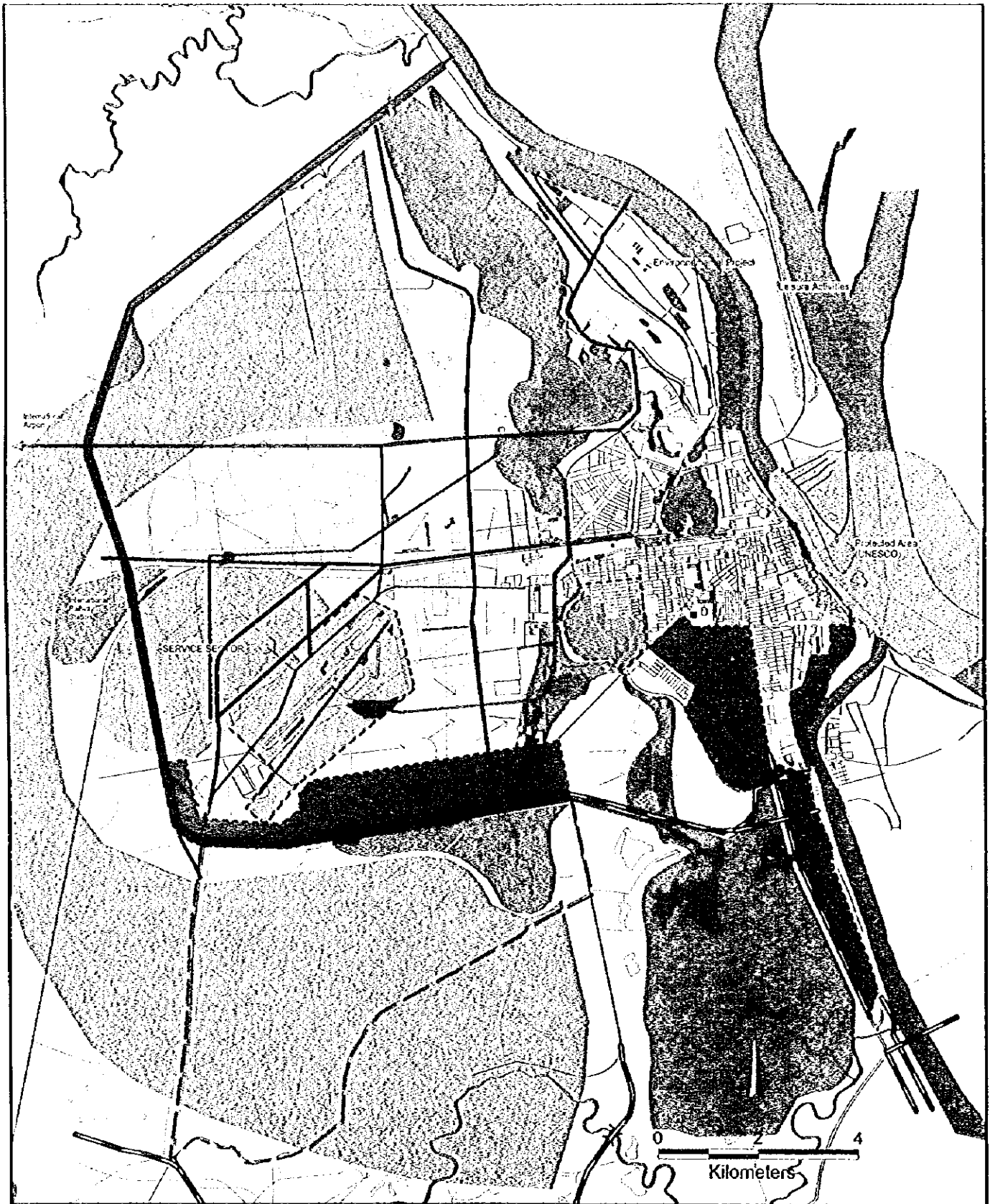
Base map: APUR BAU

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Figure A2-1
Present Land Use

A-47



Base map: APUR/BAU

Areas where urban land management project has been developed

- | | | | |
|--|------------------------------|--|--|
| | Project approved by RGC | | Green Belt |
| | Not yet approved Project | | Blue Belt: area subject to flooding, suitable for agricultural or leisure activities |
| | Projects of private interest | | |

Key roads under study or under realisation










- | | |
|--|-------------------------|
| | Primary road |
| | Secondary road |
| | Ring road and dike |
| | Canals & water surfaces |
| | Perimeter of study |

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Figure A2-2
Identified Projects












Base map: APUR B1U

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|---|---|---|---|---|---|
|  | Dense activities (activities and industries requiring important buildings and infrastructure) |  | Loose residential (small villas and buildings, much green spaces and agricultural land) |  | Green spaces and ponds (all urban green spaces of noticeable size, excluding villa gardens) |
|  | Dense urban centre (important buildings, chinese compartments, side by side houses) |  | Loose activities (small-size activities mixed with residential or waste grounds) |  | Fish Ponds |
|  | Dense residential (urban villas, buildings with small gardens) |  | Agricultural land (rice fields, unused land, important vegetable or fruit gardens) |  | Lakes and ponds (all water-covered surfaces, including rivers and swamps) |

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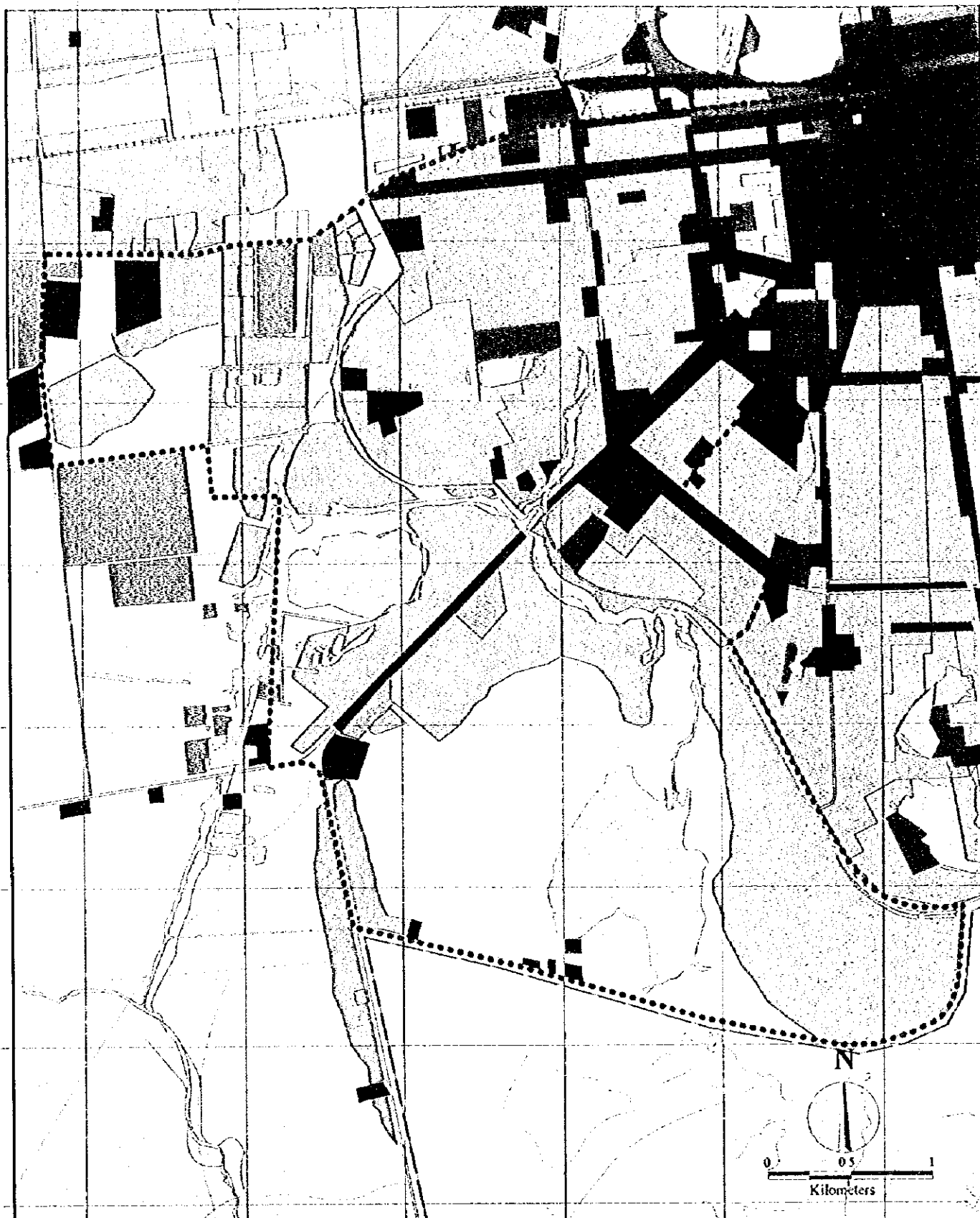
Figure A2-3
Future Land Use: Scenario 1



- | | | | | | |
|---|---|---|---|---|---|
|  | Dense activities (activities and industries requiring important buildings and infrastructure) |  | Loose residential (small villas and buildings, much green spaces and agricultural land) |  | Green spaces and parks (all urban green spaces of noticeable size, excluding villa gardens) |
|  | Dense urban centre (important buildings, chinese compartments, side by side houses) |  | Loose activities (small-size activities mixed with residential or waste grounds) |  | Fish Ponds |
|  | Dense residential (urban villas, buildings with small gardens) |  | Agricultural land (rice fields, unused land, important vegetable or fruit gardens) |  | Lakes and ponds (all water-covered surfaces, including rivers and swamps) |

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Figure A2-4
Future Land Use: Scenario 2

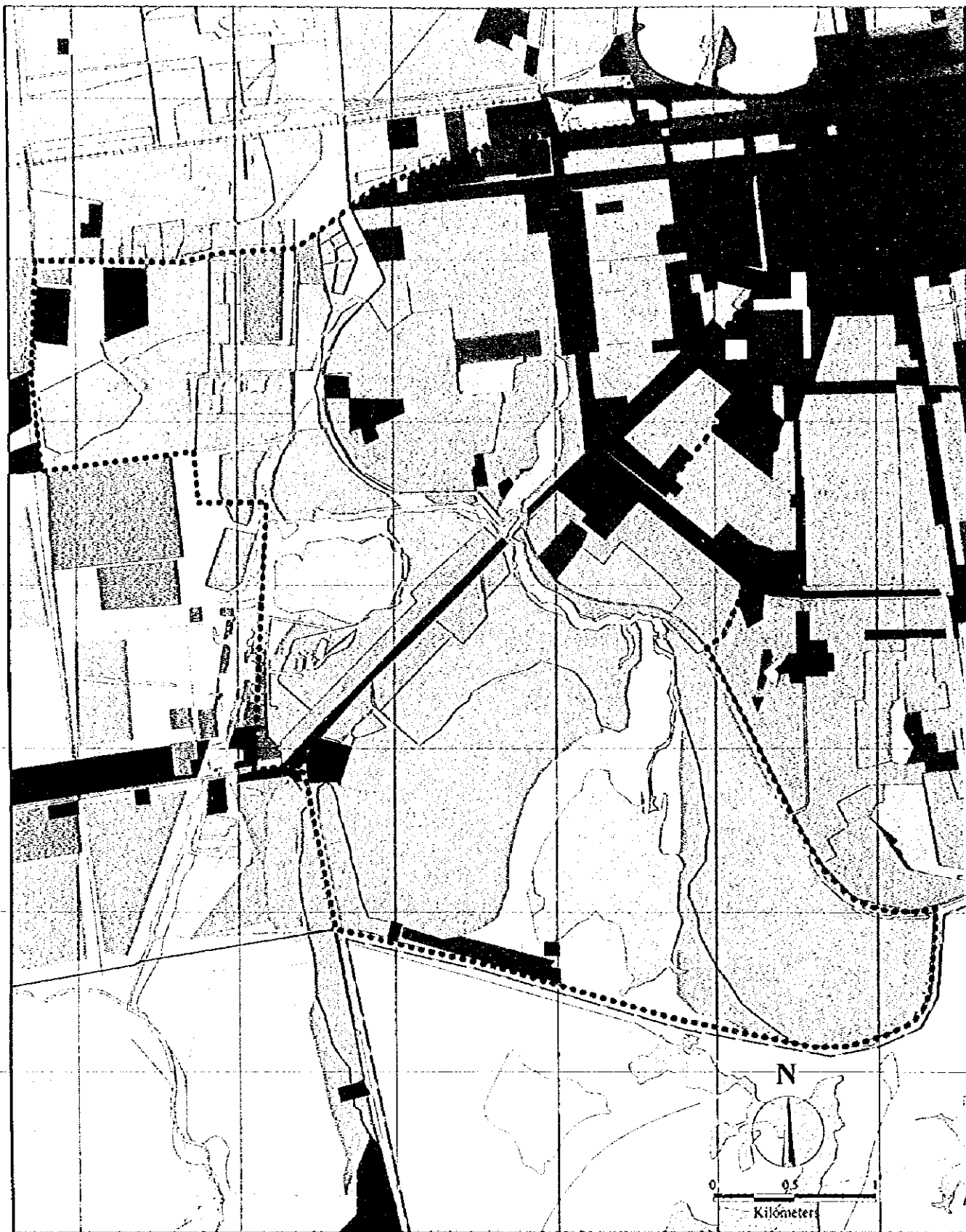


Base map: APUR BAU











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| <ul style="list-style-type: none"> Dense activities (activities and industries requiring important buildings and infrastructure) Dense urban centre (important buildings, chinese compartments, side by side houses) Dense residential (urban villas, buildings with small gardens) | <ul style="list-style-type: none"> Loose residential (small villas and buildings, much green spaces and agricultural land) Loose activities (small-size activities mixed with residential or waste grounds) Agricultural land (rice fields, unused land, important vegetable or fruit gardens) | <ul style="list-style-type: none"> Green spaces and parks (all urban green spaces of noticeable size, excluding villa gardens) Lakes and ponds (all other water-covered surfaces, including rivers and swamps) Catchment of study Perimeter of study |
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Figure A3-1
Present Land Use of Boeng Salang and
Boeng Tompun Areas



Base map: APUR BAU

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|--|---|--|
|  Dense activities (activities and industries requiring important buildings and infrastructure) |  Loose residential (small villas and buildings, much green spaces and agricultural land) |  Green spaces and parks (all urban green spaces of noticeable size, excluding villa gardens) |
|  Dense urban centre (important buildings, chinese compartments, side by side houses) |  Loose activities (small-size activities mixed with residential or waste grounds) |  Lakes and ponds (all water-covered surfaces, including rivers and swamps) |
|  Dense residential (urban villas, buildings with small gardens) |  Agricultural land (rice fields, unused land, important vegetable or fruit gardens) |  Boeng Tompun catchment area |
| | |  Perimeter of study |

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Figure A3-2
Future Land Use of Boeng Salang and
Boeng Tompun Areas