whole including dilution water introduction and aerated lagoon treatment will infact reduce the BOD load to the Chao Phraya River by 670 kg/day from the existing discharge amount.

Hence, the BOD level in the downstream reaches of the Chao Phraya River is expected to be slightly less than the existing level of 3 mg/l. As a result, the proposed project will have no adverse effect to the Chao Phraya River, and will have a beneficial effect of improvement in the river water quality.

10.4 Necessity of Sewerage Development in Future

10.4.1 Estimation of Project Effects in the Year 2000

For estimating the effective life span of the klong water purification project, which consists of dilution water introduction from the Chao Phraya River, dredging the klongs to facilitate the dilution water introduction and aerated lagoon treatment of klong water, a simulation analysis of future klong water quality in dry season in the year 2000 was carried out under the following two (2) alternative conditions.

(1) Case 1

Pollution Load Run-off

Pollution load run-off in the Study Area in the year 2000 is estimated in APPENDIX C.

Population of Study Area in the year 2000 will increase to 3.94 million from 2.92 million in 1986. The unit pollution load generation in the year 2000 will be 408 lcd in average from 298 lcd in 1986.

Accordingly, the total volume of wastewater generation in the year 2000 is estimated at 1.61 million m^3/day, which corresponds

to a pollution load generation of 218,000 kg BOD/day. Of this future pollution load generation, 53 % or 116,600 kg BOD/day is estimated to be discharged into the klongs of the Study Area.

Ground Elevation

The ground elevation of the Study Area is assumed to be lowered by 0.5 m from the existing condition by the year 2000 due to the progressing land subsidence

All other conditions are assumed to be the same as those used in the simulation of existing condition of klong water quality as mentioned in Chapter 7.

These condition include :

- Water stage and quality of the Chao Phraya River
- Inflow from the eastern outer areas and its water quality
- Gate and pump operating conditions
- Rainfall in the Study Area
- Manning's roughness coefficient of the Klongs
- Purification rate of klong water
- Sedimentation and dissolution of pollution load

(2) Case 2

Klong Sections

It is assumed that all klong improvement works proposed by the projects: "Flood Control and Drainage Project in the City Core Area, NEDECO, 1984", and "Flood Protection and Drainage Project in Eastern Suburban Bangkok, JICA 1986" will be fully completed before the year 2000.

All other conditions of simulation including that of ground elevation are the same as those of Case 1.

10.4.2 Effects of Klong Water Dilution in Dry Season

(1) Case 1

As a result of the land subsidence of 0.5 m, the amount of dilution water introduction from the Chao Phraya River could be increased to 3.02 million m^3/day from the existing introduced dilution water of 2.91 million m^3/day under the proposed project.

The projected water quality of major target klongs is summarized in Table 10.1, in comparison to the results of the simulation analysis under the existing condition.

Similarly the projected daily average and maximum water quality in each target klong in the year 2000 (dry season) is shown in Table 10.2. and Fig. 10.2.

As evident from Fig. 10.2 the projected klong water quality in the Ratanakosin area is better than that of the klongs in surrounding areas. In the Ratanakosin area, a BOD level of less than 15 mg/l could be maintained due to the dilution effects from the Chao Phraya River and not a very significant increase of pollution load generation in the area.

However, the water quality of klongs in the surrounding areas, including some klongs in the eastern suburban area, would deteriorate to a BOD level more than 25 mg/l due to a significant increase in pollution load generation and difficulty of dilution water introduction.

(2) Case 2

A large amount of dilution water of 4.1 million m^3/day can be introduced from the Chao Phraya River, consistently by gravity. This is due to the land subsidence of the Study Area and the increased discharge capacity of the improved klongs. Moreover,

all the introduced dilution water could be drained by the continuous operation of the Phra Khanong and Krung Kasem pump stations.

As a result of this increased dilution water introduction the water quality of both the klongs in Ratanakosin area and the surrounding area would become better than that of Case 1. Even then the BOD of the klongs in surrournding area including the eastern suburban area could be improved to a level of 19 mg/l only, which is worser than the target water quality of the project; 15 mg/l as BOD (ref. Table 10.1, Table 10.2 and Fig.10.3).

10.4.3 Effects on the Chao Phraya River Water Quality

BOD load balance of the Study Area in dry season was studied for the above mentioned two (2) cases based on the results of the klong water simulation analysis. The calculated BOD load balance is illustrated below in comparison to that of the existing conditions (see Fig. 10.4).

BOD Load Balance in Dry Season

(Unit : kg/day)

	1986		2000	
	Existing Condition	With Urgent Project	Case 1	Case 2
From Chao Phraya River	6,900	8,700	9,100	12,300
From Study Area	61,900	61,900	116,600	116,600
From Eastern Outer Area	4,300	4,300	4,300	4,300
Settlement & Dissolution	23,400	19,600	20,300	19,900
Removal by Aerated Lagoons	-	4,470	6,870	4,280
To Chao Phraya River	49,700	50,830	102,830	109,020

From the above Table, the net BOD load discharged from the Study Area to the Chao Phraya River is as follows :

Existing Condition	:	42,800 kg/day
With Urgent Project	:	42,130
Case 1 (2000)	:	93,730
Case 2 (2000)	:	96,720

The water quality of the Chao Phraya River in dry season in the year 2000 is estimated as follows for the proposed klong water purification project of Case 1 and Case 2, assuming that the average flow of the Chao Phraya River in dry season is 174 m^3/s and the existing water quality of the Chao Phraya River in dry season is 3 mg/l as stream BOD.

Existing Condition (1986)	:	BOD 3.0 mg/l
With Urgent Project (1986)	:	BOD 3.0 mg/l
Case 1 (2000)	:	BOD 6.4 mg/l
Case 2 (2000)	:	BOD 6.6 mg/l

The water quality of the Chao Phraya River at its downstream reaches of the Study Area would deteriorate to 6.4 mg/l and 6.6 mg/l as stream BOD, respectively under Case 1 and Case 2 conditions. This is due to the increase in pollution load generation in the Study Area by the year 2000.

It is to be noted that the proposed klong water purification project does not lead to net pollution load reduction except the fractional BOD removal in the aerated lagoon treatment, hence has only a slight beneficial effects on the Chao Phraya River water quality, though it will improve the klong water quality mainly by dilution.

10.4.4 Conclusion

Sewerage development for the Study Area is essentially required even with the implementation of this project, which is only an urgent measure, in the near future preferably within the next five (5) to six (6) years due to the following reasons.

(1) The existing klong water quality of 20 mg/l as BOD in dry season in the surrounding area will be improved to an acceptable level of 12 mg/l as BOD, immediately, by the proposed project. However, in future (year 2000) under the conditions of Case 1 and Case 2 it would deteriorate respectively to 24 mg/l and 15 mg/l in dry season (ref. Table 10.1).

Fig. 10.5 illustrates the domain of the klong water quality of the surrounding areas bounded by the Case 1 and Case 2 alternatives. Hence the future dry season water quality of this surrounding area until the year 2000 would probably vary within this domain, by the implementation of the proposed project.

Accordingly, as shown in Fig.10.5, the target water quality of 15 mg/l as BOD would probably be breached in five(5) to six(6) years.

(2) The water quality of the Chao Phraya River will continue to deteriorate to about 6.5 mg/l as stream BOD by the year 2000 from the existing level of 3 mg/l, due to increase in pollution load generation in the Study Area. The introduction of dilution water, except the small improvement by aerated lagoon treatment, does not result in any reduction in generated pollution load and virtually has no beneficial effects on the Chao Phraya River water quality.

(3) The introduction of dilution water by this project is limited to dry season only. Hence the water quality of all the klongs in the Study Area in rainy season would continue to deteriorate with increasing pollution load generation in future as evident from Table 10.3 and Table 10.4 (ref. also Fig. 10.6 and Fig. 10.7). The water quality in rainy season in the year 2000 is anticipated to deteriorate to 20-50 mg/l as BOD in most klongs in central Bangkok.

Table 10.1 Water Quality of Target Klongs in Dry Season

Unit: mg/l

			Present (1986)		Future (2000)	
			Existing Condition	With Urgent Project	Case 1	Case 2
Improved Water Quality in Dry Season (BOD: mg/l)	Ratanakosin Area	K. Wat Tep Tida & K. Wat Rajabopit	17 (56)	12 (24)	12 (25)	8 (18)
		Other Klongs /1	12 (22)	10 (18)	12 (23)	9 (15)
	Klongs in Surrounding Area /2		20 (33)	12 (16)	24 (45)	15 (27)
	K. Toey		23 (30)	25 (31)	30 (35)	30 (35)
	K. Sathorn & K. Chong Non Sri		47 (52)	12 (15)	17 (22)	17 (22)
Dilution Water Introduction ($10^6 m^3$ /day)			2.3	2.91	4.10	3.02

Note: 1) /1 ; Lod, Bang Lum Phu, Ong Ang, Phadung Krung Kasem, Mahanak

2) /2 ; Bang Sue, Sam Sen, Prem Prachakorn, Saen Saep, Bang Kapi, Huai Khwang, Tan, Phra Khanong

3) Figure within parenthesis is maximum water quality.

4) Figure with no parenthesis is average water quality.

Table 10.2 Daily Average and Maximum Water Quality in Each Target Klong in Dry Season

Unit: mg/l

	Present (1986)		Future (2000)	
	Existing Condition	With Urgent Project	Case 1	Case 2
K. Bang Sue	11-13 (16-18)	8-10 (9-11)	21-24 (32-35)	13-14 (20-27)
K. Sam Sen	16-25 (26-28)	6-15 (7-16)	12-30 (28-35)	7-18 (16-22)
K. Prem Prachakorn	24-25 (29-32)	9-13 (11-15)	18-23 (33-35)	14-16 (25)
K. Huai Khwang	31 (33)	15 (15)	39 (45)	18 (23)
K. Mahanak - K. Saen Saep	14-25 (21-28)	11-14 (13-15)	11-23 (16-26)	8-17 (11-19)
K. Bang Kapi	24 (26)	14 (15)	28 (33)	16 (21)
K. Phadung Krungkasem	14-16 (20-22)	9-13 (10-13)	16-17 (21-23)	12 (14-15)
K. Bang Lamphu	8 (18)	11 (18)	11 (19)	8 (13)
K. Ong Ang	9 (15)	9 (13)	9 (15)	6 (10)
K. Lod	8-10 (17-19)	8 (12-13)	7-8 (13)	5-6 (8-9)
K. Wat Teptida	18 (56)	10 (16)	10 (16)	7 (12)
K. Wat Rajabopit	15 (30)	14 (24)	13 (25)	9 (18)
K. Tan	16 (17)	14 (14)	26 (28)	18 (19)
K. Phra Khanong	12 (13)	12 (13)	23 (24)	18 (19)
K. Toey	23 (30)	25 (31)	30 (35)	30 (35)
K. Sathorn	44 (45)	9 (13)	13 (19)	12 (17)
K. Chong Non Sri	50 (52)	14 (15)	20 (22)	19 (20)

Note: Figure in parenthesis indicates maximum BOD

Table 10.3 Water Quality of Target Klongs in Rainy Season

Unit: mg/l

			Present (1986)		Future (2000)	
			Existing Condition	With Urgent Project	Case 1	Case 2
Improved Water Quality in Dry Season (BOD: mg/l)	Ratanakosin Area	K. Wat Tep Tida & K. Wat Rajabopit	36 (55)	49 (50)	53 (54)	53 (54)
		Other Klongs /1	24 (38)	40 (49)	50 (57)	51 (58)
	Klongs in Surrounding Area /2		17 (39)	15 (41)	28 (70)	26 (63)
	K. Toey		19 (26)	18 (23)	21 (27)	21 (27)
	K. Sathorn & K. Chong Non Sri		35 (37)	33 (35)	39 (41)	43 (45)

Note: 1) /1 ; Lod, Bang Lum Phu, Ong Ang, Phadung Krung Kasem, Mahanak

2) /2 ; Bang Sue, Sam Sen, Prem Prachakorn, Saen Saep, Bang Kapi, Huai Khwang, Tan, Phra Khanong

3) Figure within parenthesis is maximum water quality.

4) Figure with no parenthesis is average water quality.

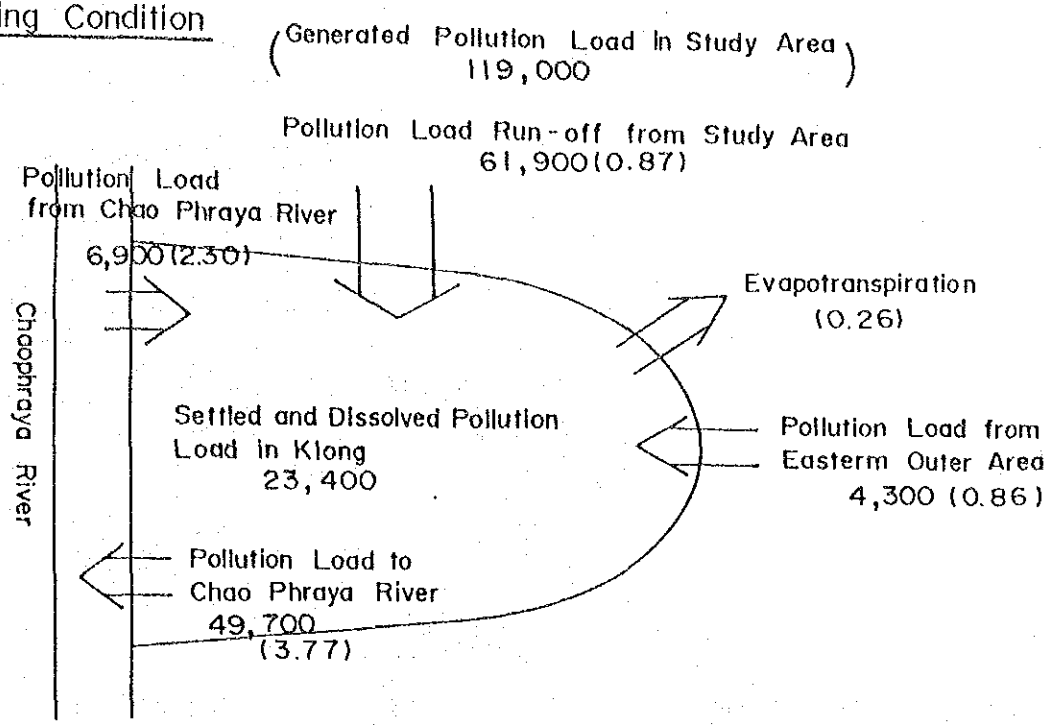
Table 10.4 Daily Average and Maximum Water Quality in Each Target Klong in Rainy Season

Unit: mg/l

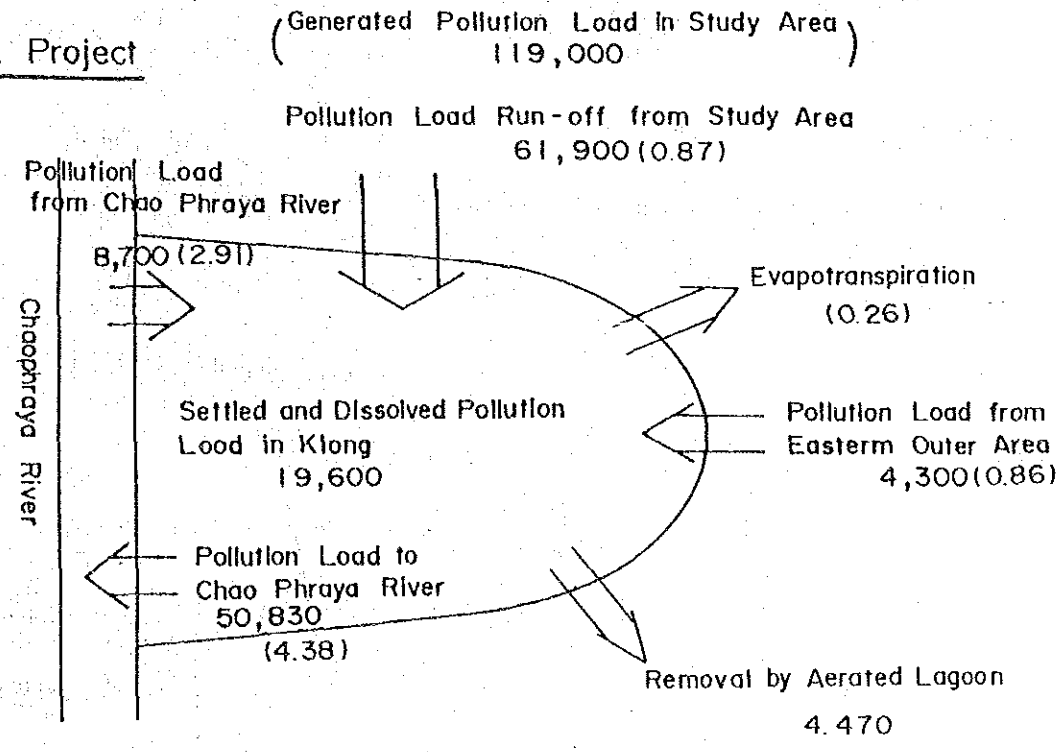
	Present (1986)		Future (2000)	
	Existing Condition	With Urgent Project	Case 1	Case 2
K. Bang Sue	8-14 (9-15)	8-17 (8-17)	22-30 (22-31)	19-27 (19-27)
K. Sam Sen	11-29 (15-30)	8-22 (8-23)	17-41 (17-41)	17-39 (17-39)
K. Prem Prachakorn	26-35 (27-39)	28-39 (28-41)	48-67 (48-70)	46-63 (46-63)
K. Huai Khwang	11 (11)	9 (9)	23 (23)	22 (22)
K. Mahanak - K. Saen Saep	20-22 (22-24)	15-45 (15-47)	25-55 (25-55)	25-56 (25-56)
K. Bang Kapi	16 (20)	8 (9)	18 (18)	18 (18)
K. Phadung Krungkasem	30-37 (30-38)	30-33 (31-34)	43-55 (44-57)	44-58 (44-58)
K. Bang Lamphu	18 (23)	48 (49)	57 (57)	58 (58)
K. Ong Ang	16 (22)	45 (46)	50 (51)	50 (50)
K. Lod	14-22 (18-24)	44-45 (45-46)	50 (50)	50 (50)
K. Wat Teptida	44 (55)	47 (47)	51 (52)	51 (51)
K. Wat Rajabopit	28 (33)	50 (50)	54 (54)	54 (54)
K. Tan	5 (5)	5 (5)	13 (14)	12 (12)
K. Phra Khanong	5 (6)	5 (5)	9 (9)	9 (9)
K. Toey	19 (26)	18 (23)	21 (27)	21 (27)
K. Sathorn	37 (37)	35 (35)	41 (41)	45 (45)
K. Chong Non Sri	32 (33)	30 (30)	36 (37)	41 (41)

Note: Figure in parenthesis indicates maximum BOD

Existing Condition



With Project



Note : Figures within parentheses mean water volume in million m^3/day
Figures with no parentheses mean pollution load in kg BOD/day

FIG. 10.1 EXISTING POLLUTION LOAD BALANCE IN DRY SEASON (BOD)

THE FEASIBILITY STUDY ON PURIFICATION OF KLONG WATER IN BANGKOK

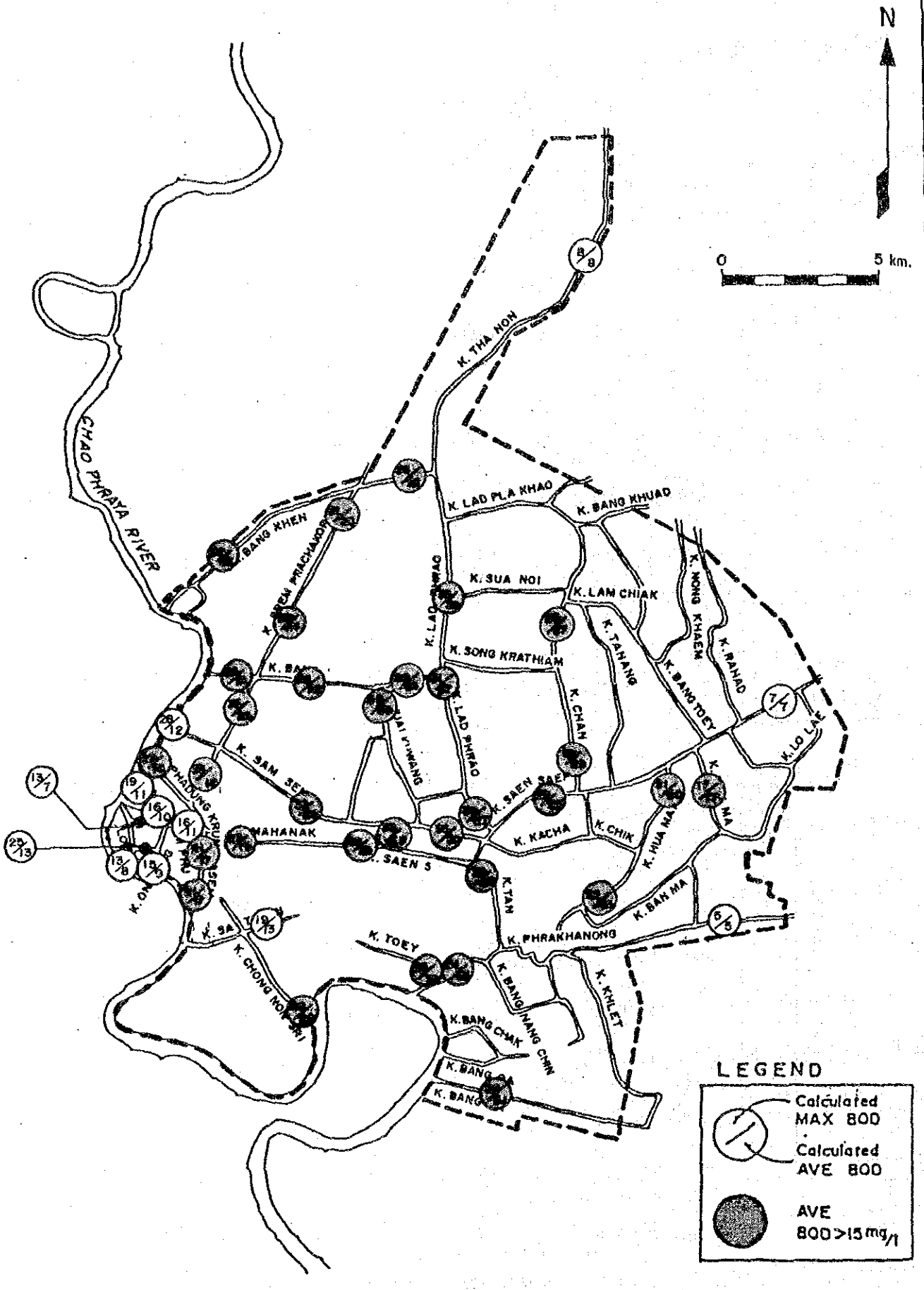


FIG. 10.2 REGIONAL DISTRIBUTION OF KLONG WATER QUALITY IN 2000 FOR CASE I (DRY SEASON)

THE FEASIBILITY STUDY ON PURIFICATION OF KLONG WATER IN BANGKOK

JICA 2532B.E. 1989A.D.

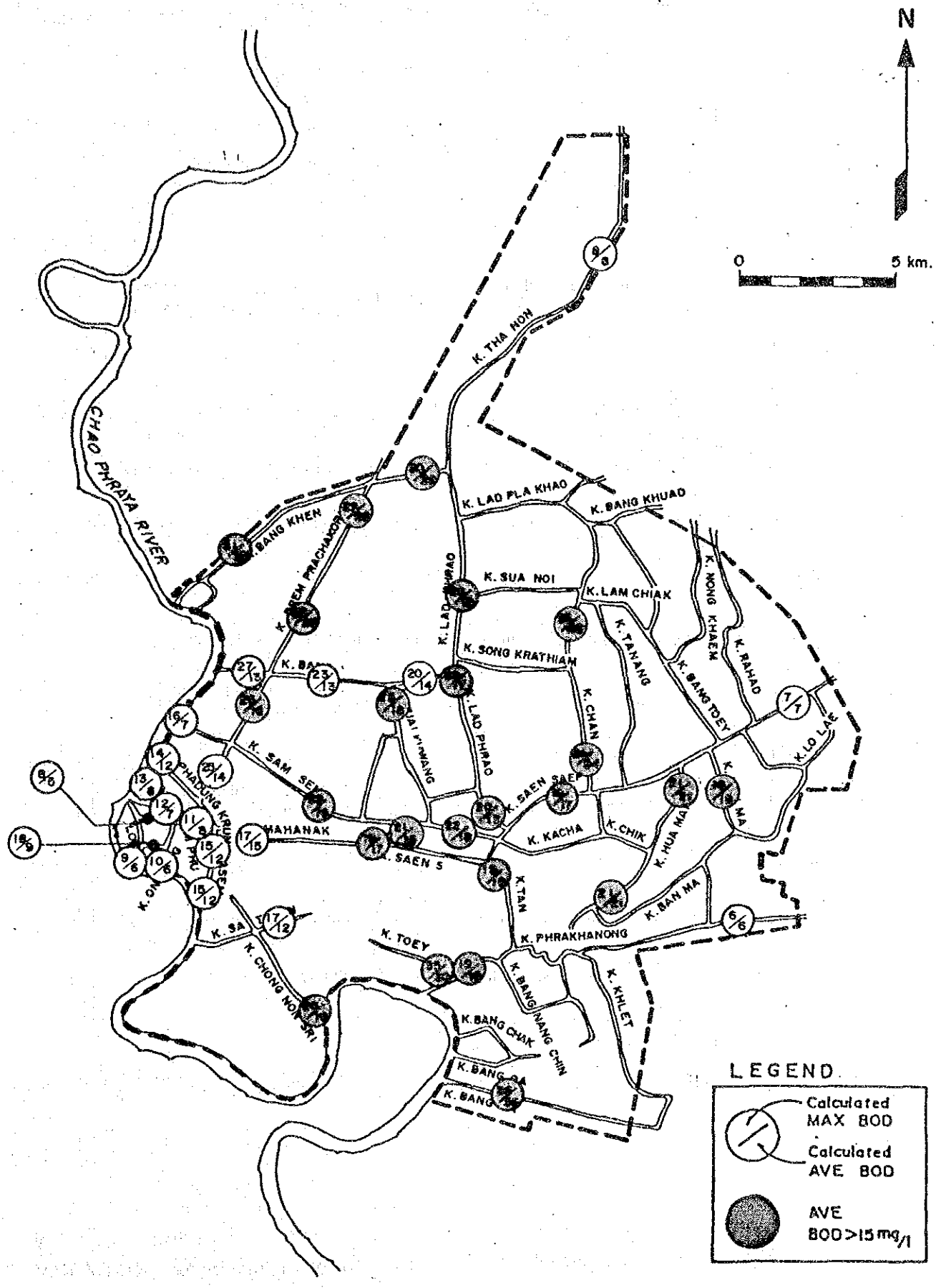
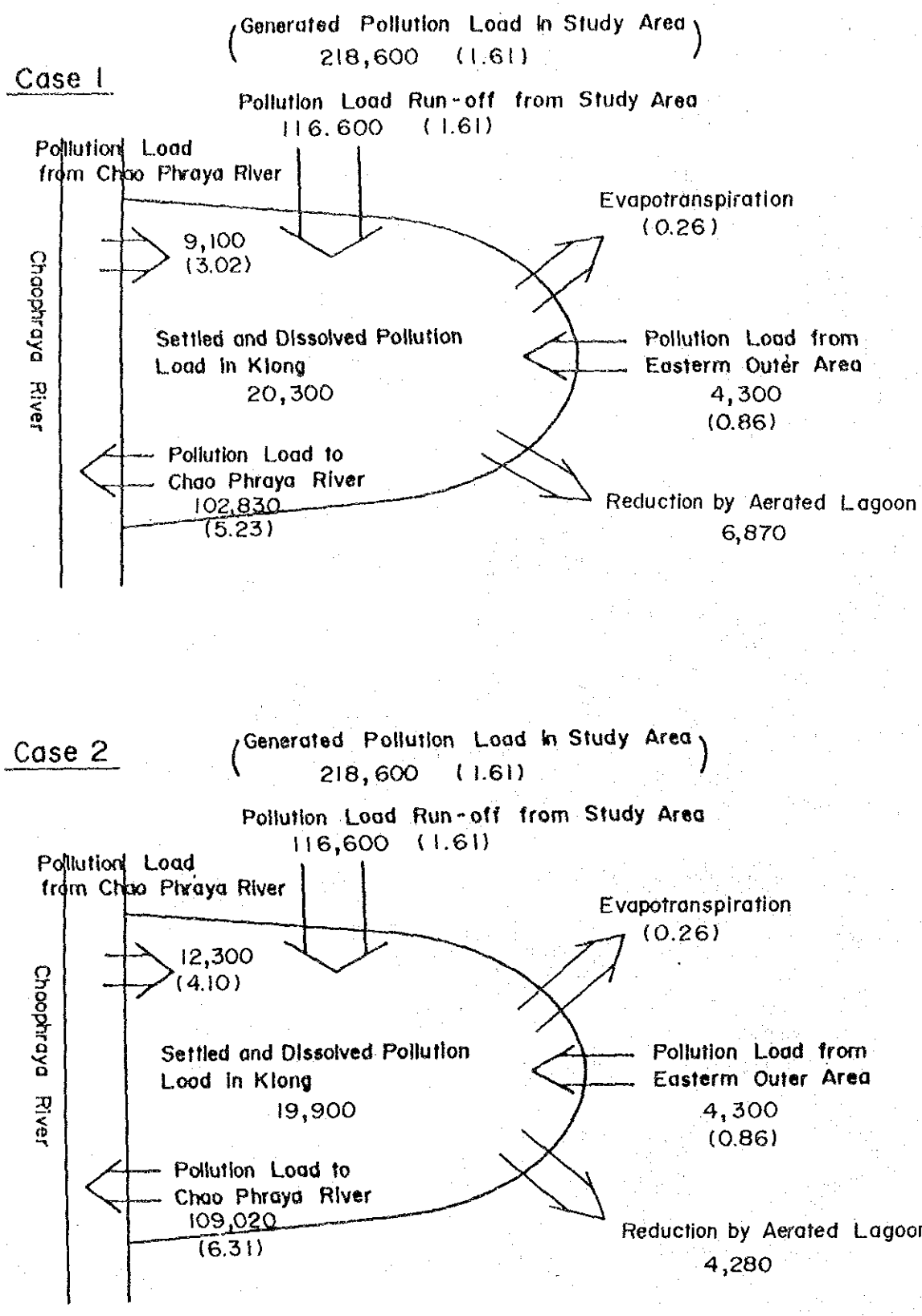


FIG. 10.3 REGIONAL DISTRIBUTION OF KLONG WATER QUALITY IN 2000 FOR CASE 2 (DRY SEASON)

THE FEASIBILITY STUDY ON PURIFICATION OF KLONG WATER IN BANGKOK

JICA 2532R.E. 1989A.D.



Note : Figures within parentheses mean water volume in million m^3/day
Figures with no parentheses mean pollution load in kg BOD/ day

FIG. 10.4 POLLUTION LOAD BALANCE IN DRY SEASON IN 2000

THE FEASIBILITY STUDY ON PURIFICATION OF KLONG WATER IN BANGKOK

JICA 2532B.E. 1989A.D.

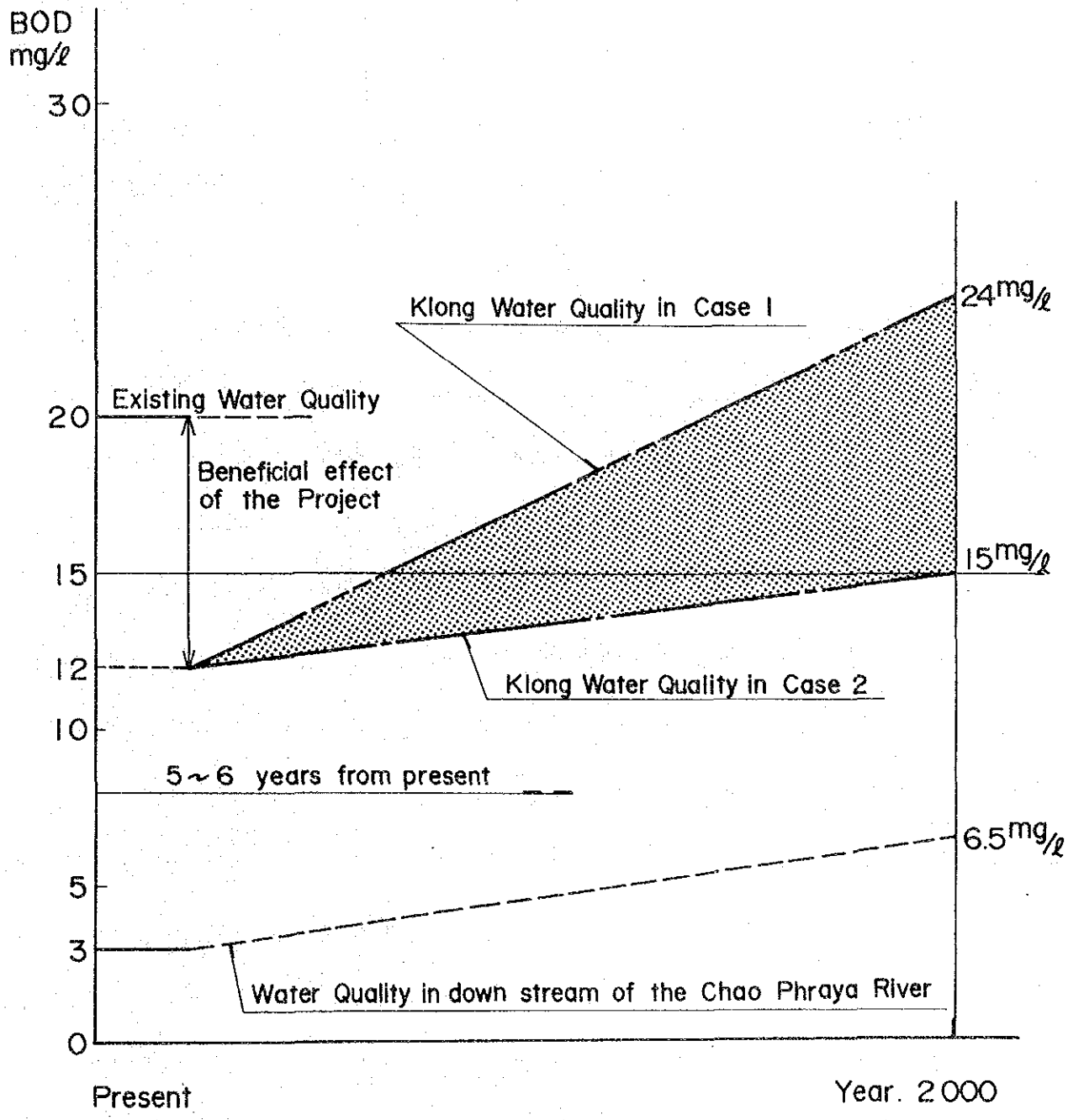


FIG. 10.5 ESTIMATED AVERAGE WATER QUALITY IN BOD OF KLONGS IN SURROUNDING AREA AND CHAO PHRAYA RIVER

THE FEASIBILITY STUDY ON PURIFICATION OF KLONG WATER IN BANGKOK

JICA 2532B.E. 1989A.D.

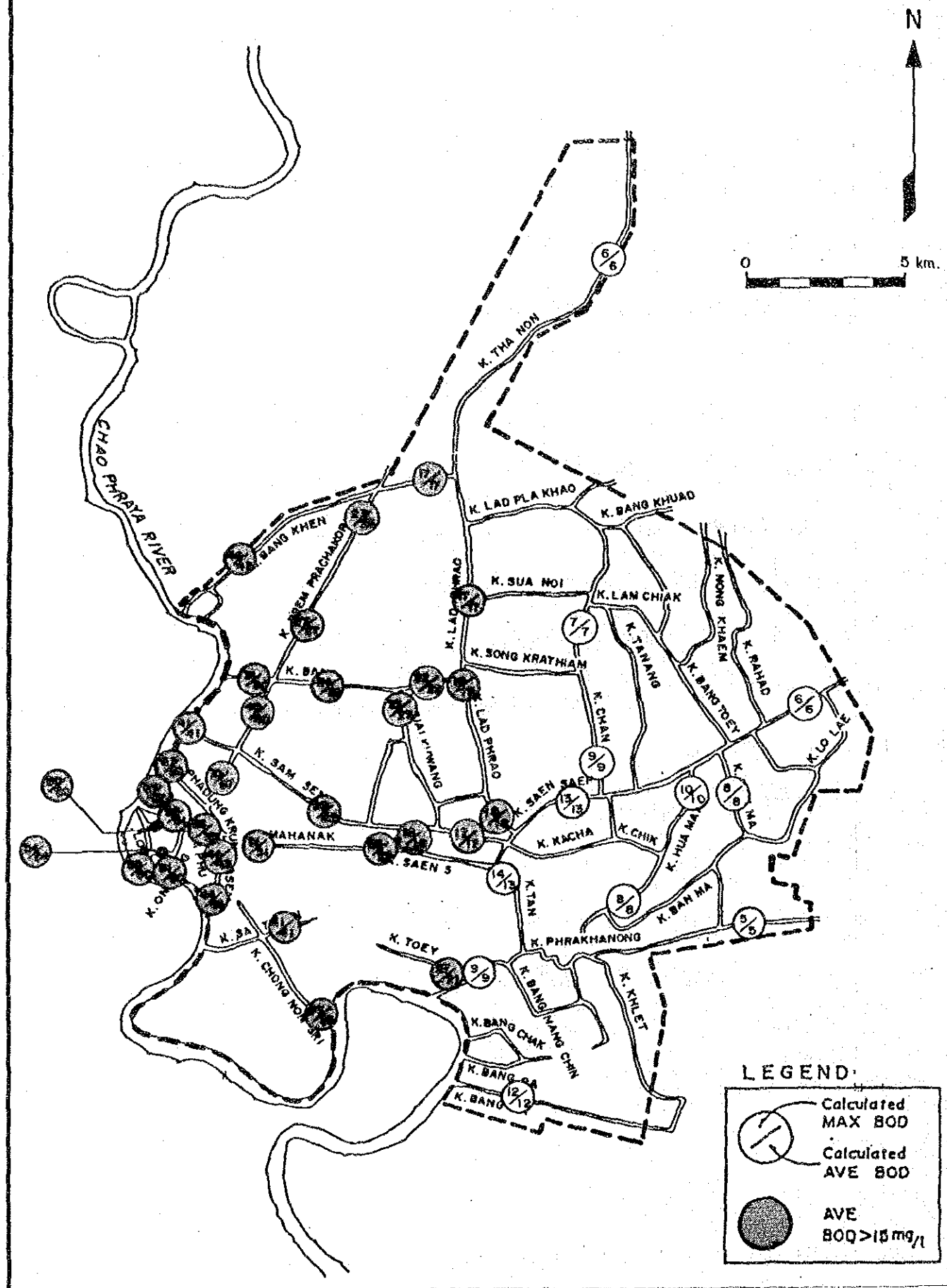


FIG. 10.6 REGIONAL DISTRIBUTION OF KLONG WATER QUALITY IN 2000 FOR CASE I (RAINY SEASON)

THE FEASIBILITY STUDY ON PURIFICATION OF KLONG WATER IN BANGKOK

JICA 2532B.E. 1989A.D.

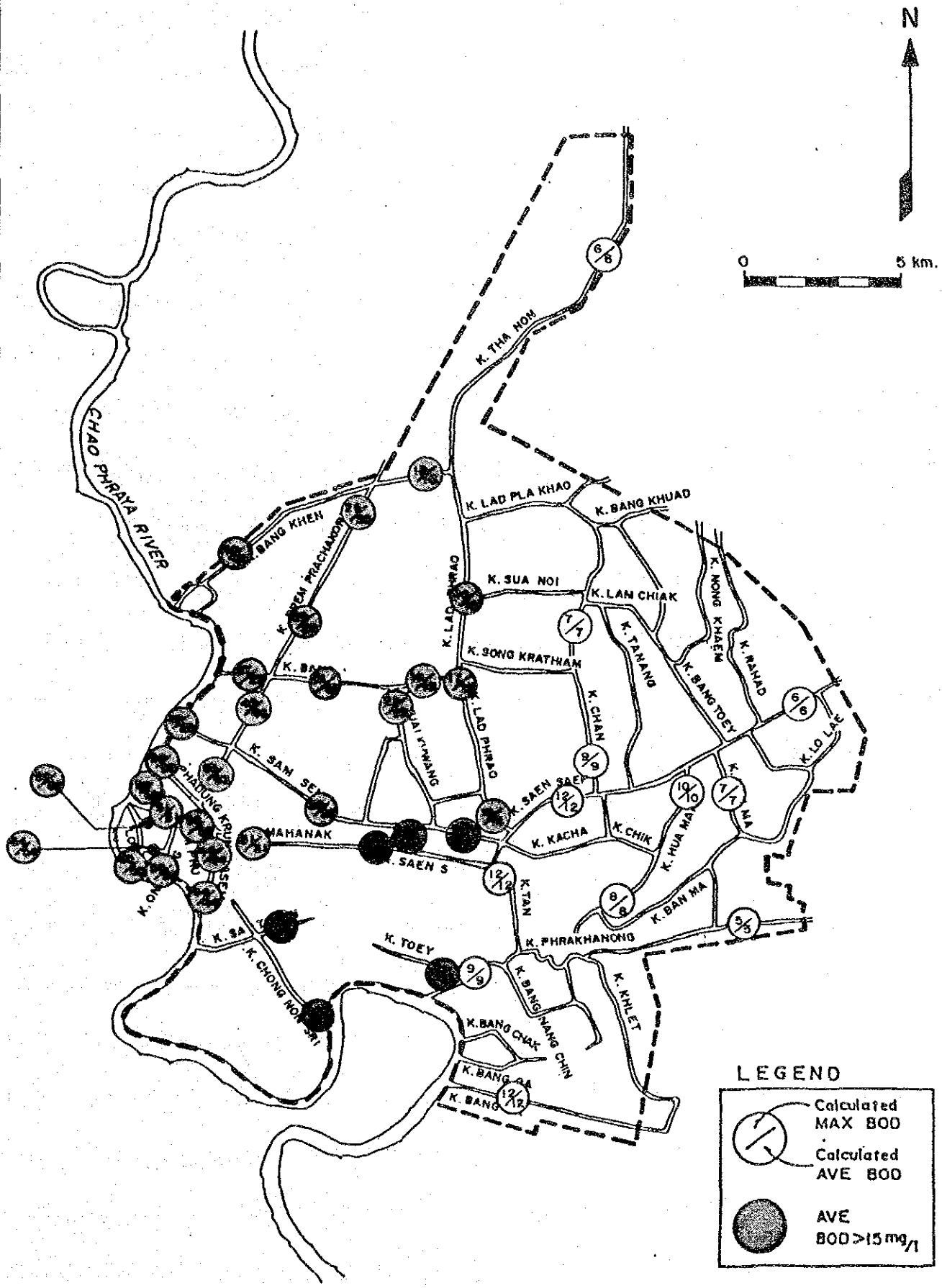


FIG. 10.7 REGIONAL DISTRIBUTION OF KLONG WATER QUALITY IN 2000 FOR CASE 2 (RAINY SEASON)

THE FEASIBILITY STUDY ON PURIFICATION OF KLONG WATER IN BANGKOK

JICA 2532B.E. 1989A.D.

Chapter 11.

SUPPLEMENTARY STUDY

CHAPTER 11. SUPPLEMENTARY STUDY

A reconnaissance survey on the requirement of klong water quality improvement in the Thonburi area was conducted as a supplementary study.

11.1 Reconnaissance Survey of Klongs in Thonburi Area

11.1.1 General Conditions

The Study Area of klong water quality improvement, known as the Bangkok area, lies towards to the left bank of the Chao Phraya River. However, there are many klongs in the Thonburi area, that lies towards the opposite (right) bank of the Chao Phraya River as well, which may also require water quality improvement measures.

The major klongs in the Thonburi area are shown in Fig. 11.1. The available water quality data for the klongs in Thonburi area, obtained by DDS, were reviewed in this Study. Color and odor investigations were also conducted to assess the existing water quality of the klongs, qualitatively, and hence to identify the klongs with serious water quality deterioration.

11.1.2 Present Water Quality

The present average klong water quality during the period of 1981-1986 in the Thonburi area with respect to the water quality parameters DO and BOD, based on the data obtained by DDS, is shown respectively in Fig. 11.2 and Fig. 11.3. Accordingly the klong water quality could be summarized as follows:

(1) The variation of DO is in the range of 0-3.8 mg/l and values over 1 mg/l were obtained in the klongs of suburban areas and in klongs that have exchange of water with the Chao Phraya River, such as K. Bang Sai, K. Maha Sawat, K. Banam Chai, K. Bangkok Noi and K. Bang Pakase. However, the gates of the klongs connecting the K. Bangkok Yai and the Chao Phraya River, such as K. Sam Rae and K. Bang Nam Chon and other small klongs

along the Chao Phraya River, such as K. San and K. Bang Prakok, were mostly closed all the time and hence there was no water exchange with the River. Due to this reason the DO values in these klongs were very low, in the range of 0-0.1 mg/l, indicating severe deterioration in water quality.

(2) The overall variation of BOD is in the range of 4-68 mg/l. In K. Sam Rae and K. Bang Nam Chon, where the DO level was very low, it was high around 68 mg/l and 48 mg/l, respectively. Also in some small klongs, such as K. Sam and K. Bang Prakok, similarly high BOD values, of 66 mg/l and 36 mg/l, were observed. However in most other klongs the BOD was low and less than 10 mg/l. Especially the BOD in K. Maha Sawat in the suburbs was only 4 mg/l, which is similar to the Chao Phraya River.

11.1.3 Color and Odor of Klong Water

The results of the color and odor tests conducted in the klongs of Thonburi area during August 1988 (rainy season) and January 1989 (dry season), by the Study Team, are shown respectively in Fig. 11.4 and Fig. 11.5. The klongs with black or grayish black color emitted strong H_2S odor, indicating anaerobic condition and severe deterioration in klong water quality.

11.1.4 Necessity of Klong Water Quality Improvement Measure

Based on existing data on water quality and the color and odor test results, the following klongs were identified as severely polluted: K. Sam Rae, K. Bang Nam Chon, K. Bang Sakae, K. Bang Saikai, K. Sam and K. Bang Prakok. The deterioration in water quality is due to the gates being kept closed, preventing exchange between of inner and outer water.

Other than the opening of the gates to allow exchange of water, no other measures are considered to be conceivable at present for the improvement of the water quality.

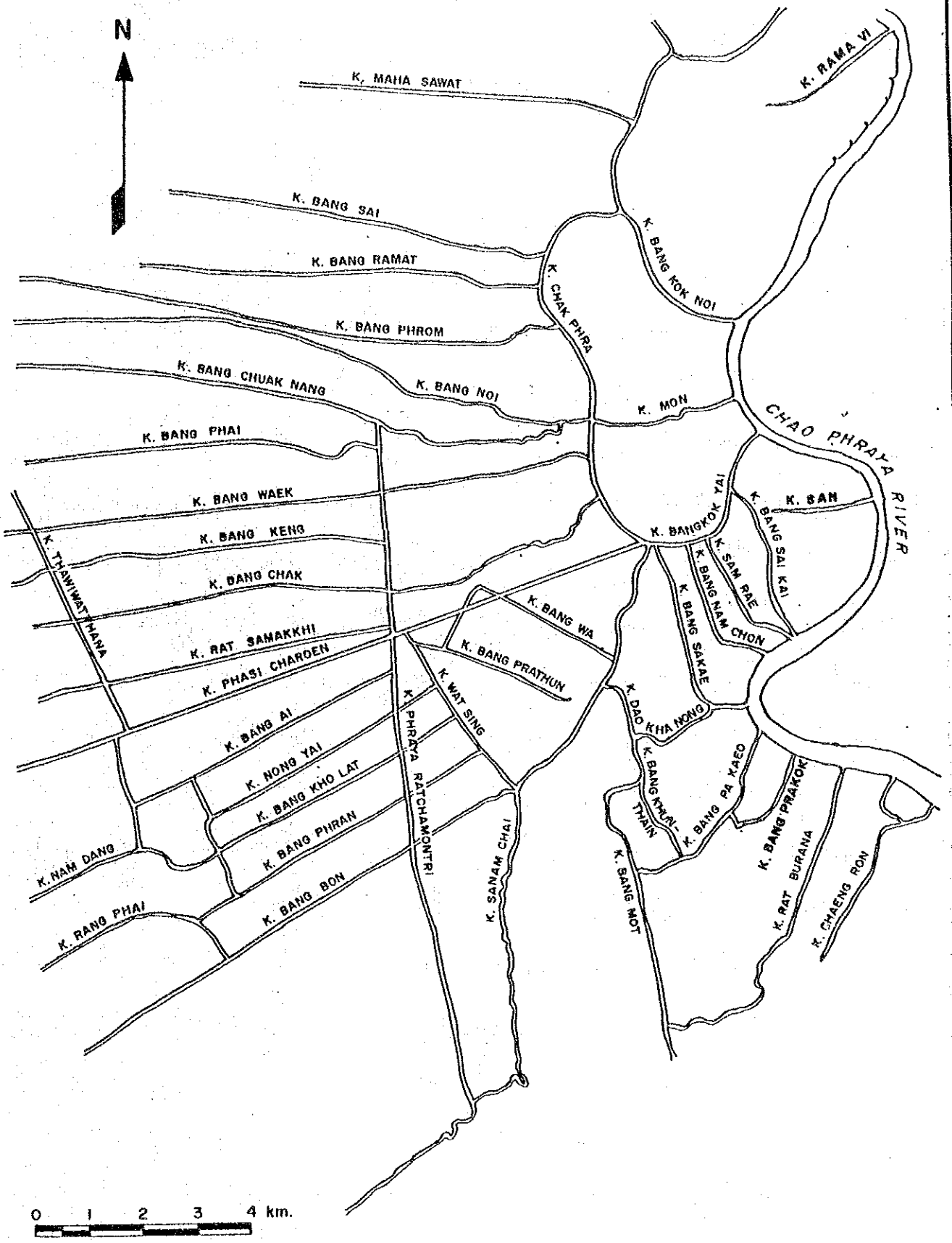


FIG. II. 1 MAJOR KLONG NETWORK IN THONBURI AREA

THE FEASIBILITY STUDY ON PURIFICATION OF KLONG WATER IN BANGKOK

JICA 2532B.E. 1989A.D.

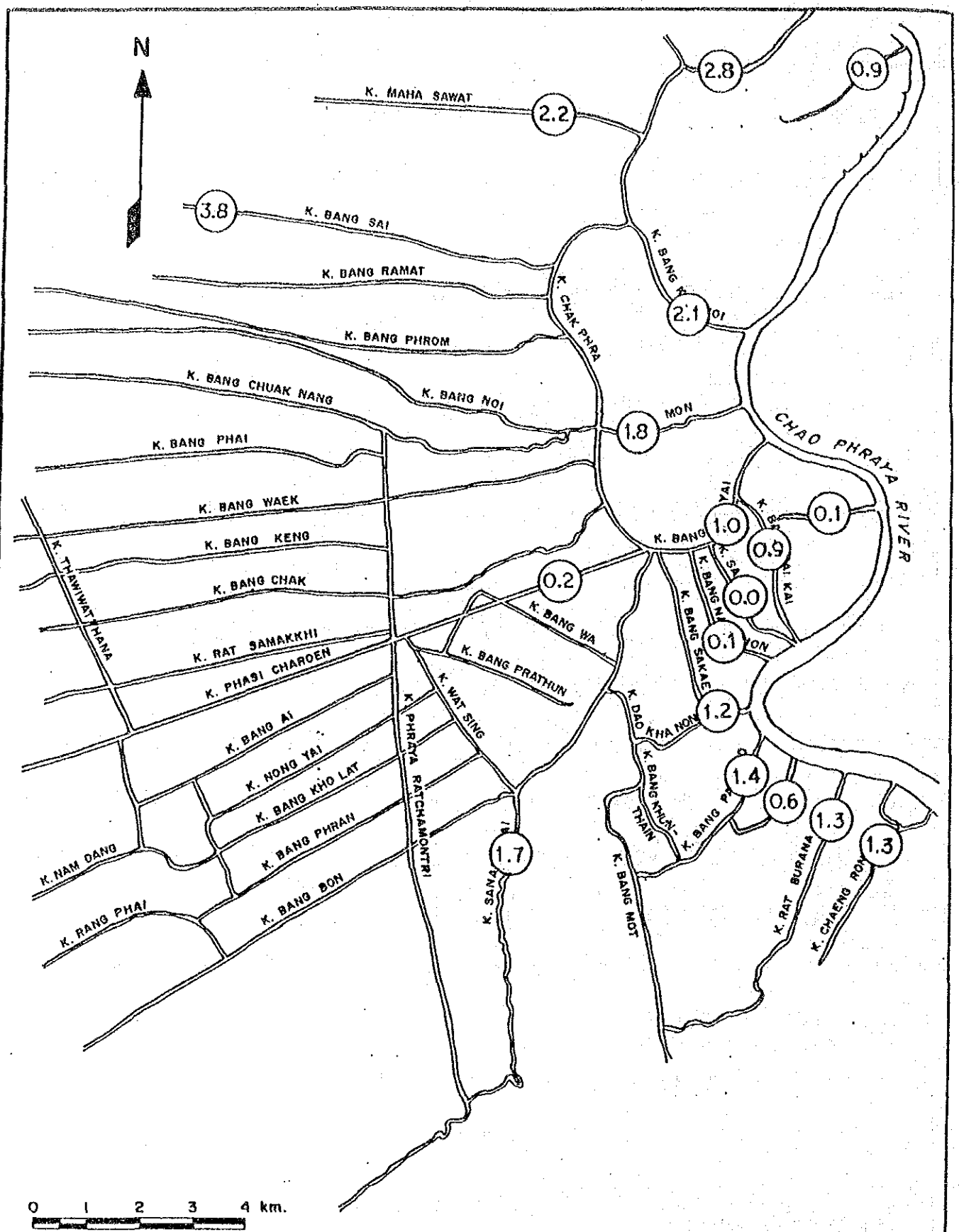


FIG. 11.2 AREAL DISTRIBUTION OF WATER QUALITY (DO)

THE FEASIBILITY STUDY ON PURIFICATION OF KLONG WATER IN BANGKOK

JICA 2532B.E. 1989A.D.

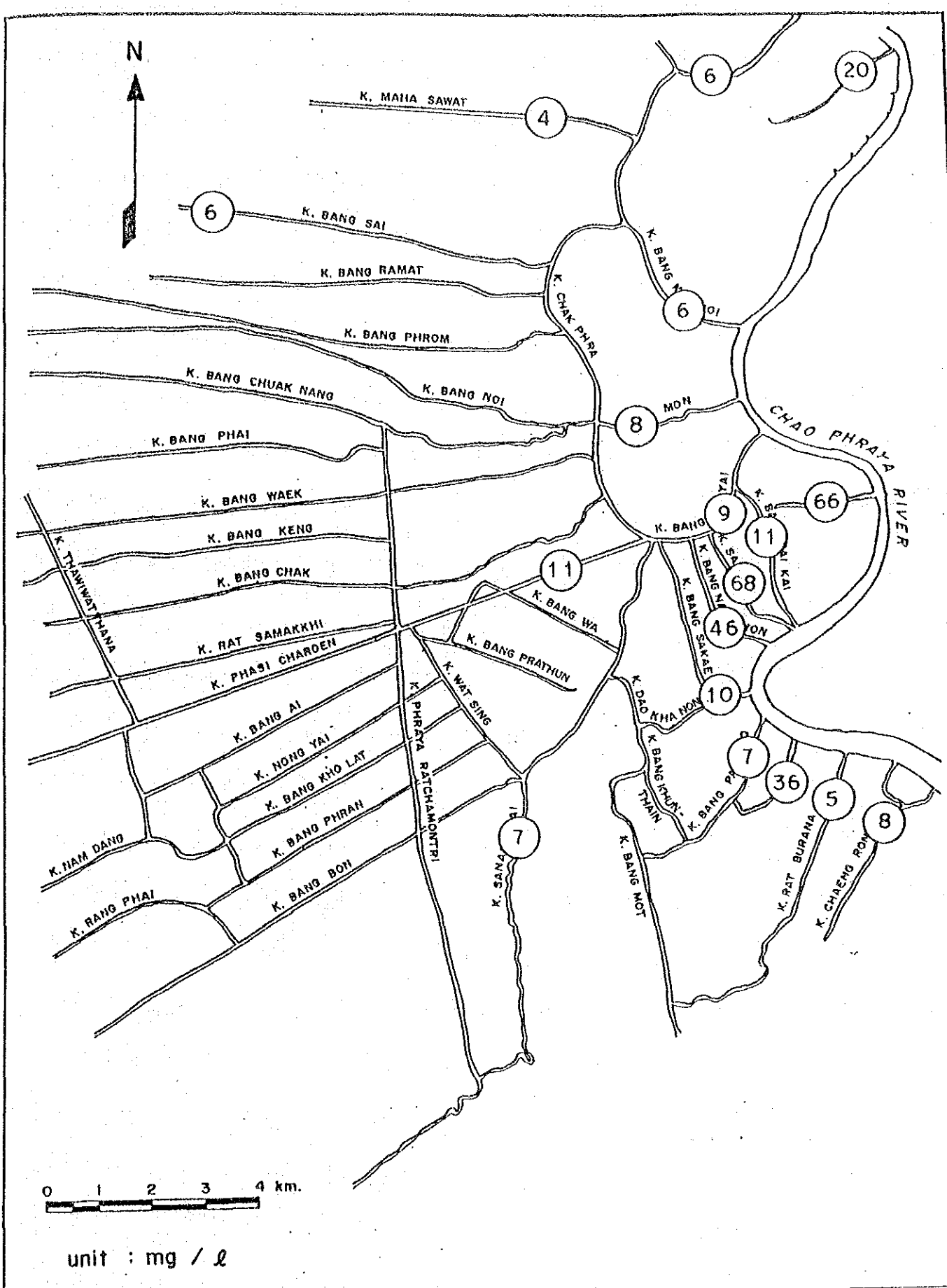


FIG. II. 3 AREAL DISTRIBUTION OF WATER QUALITY (BOD)

THE FEASIBILITY STUDY ON PURIFICATION OF KLONG WATER IN BANGKOK

JICA 2532 B.E. 1989 A.D.

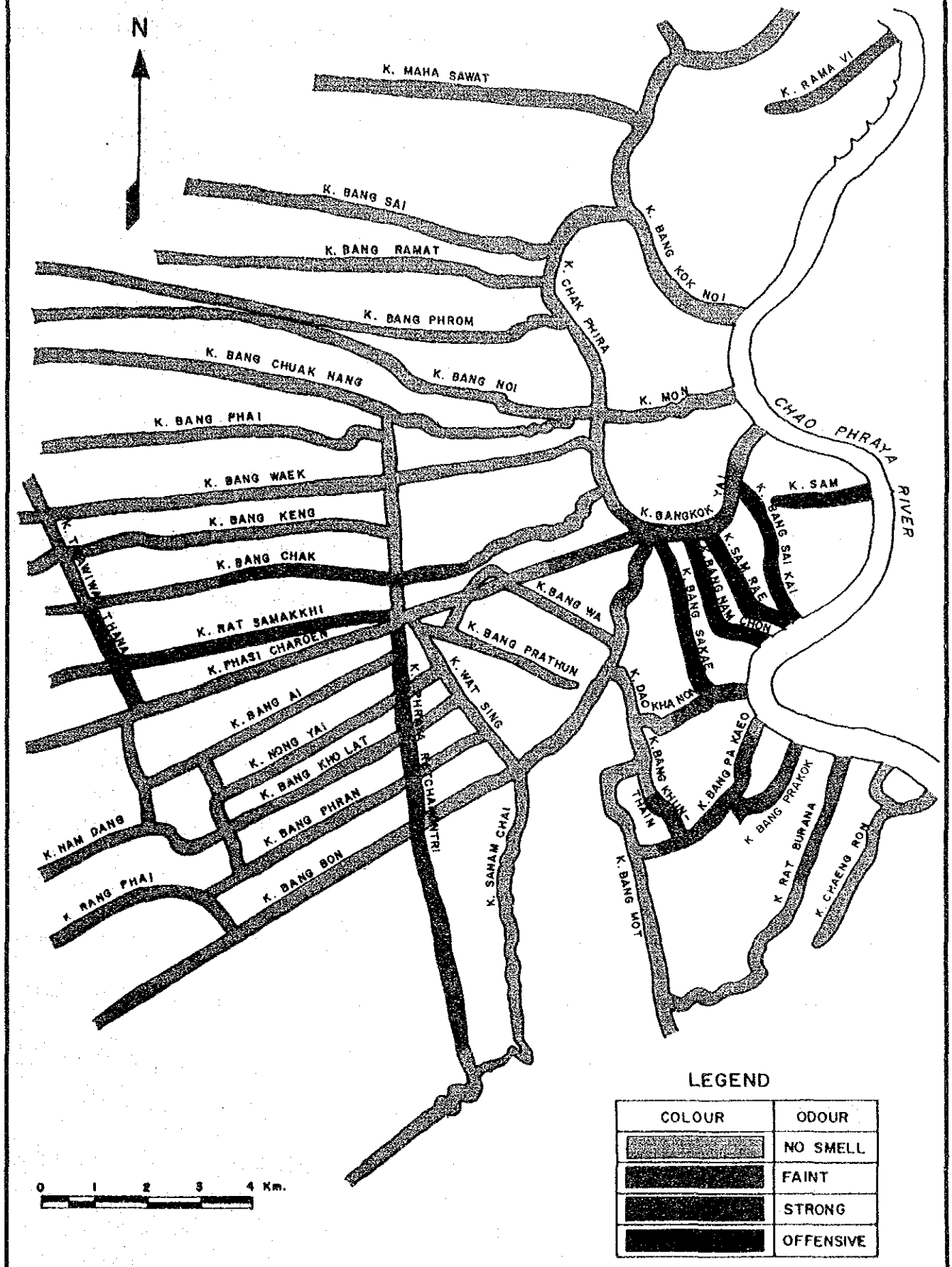


FIG. 11.4 OBSERVED COLOUR AND ODOUR DURING RAINY SEASON IN THONBURI AREA

THE FEASIBILITY STUDY ON PURIFICATION OF KLONG WATER IN BANGKOK

JICA 2532B.E. 1989A.D.

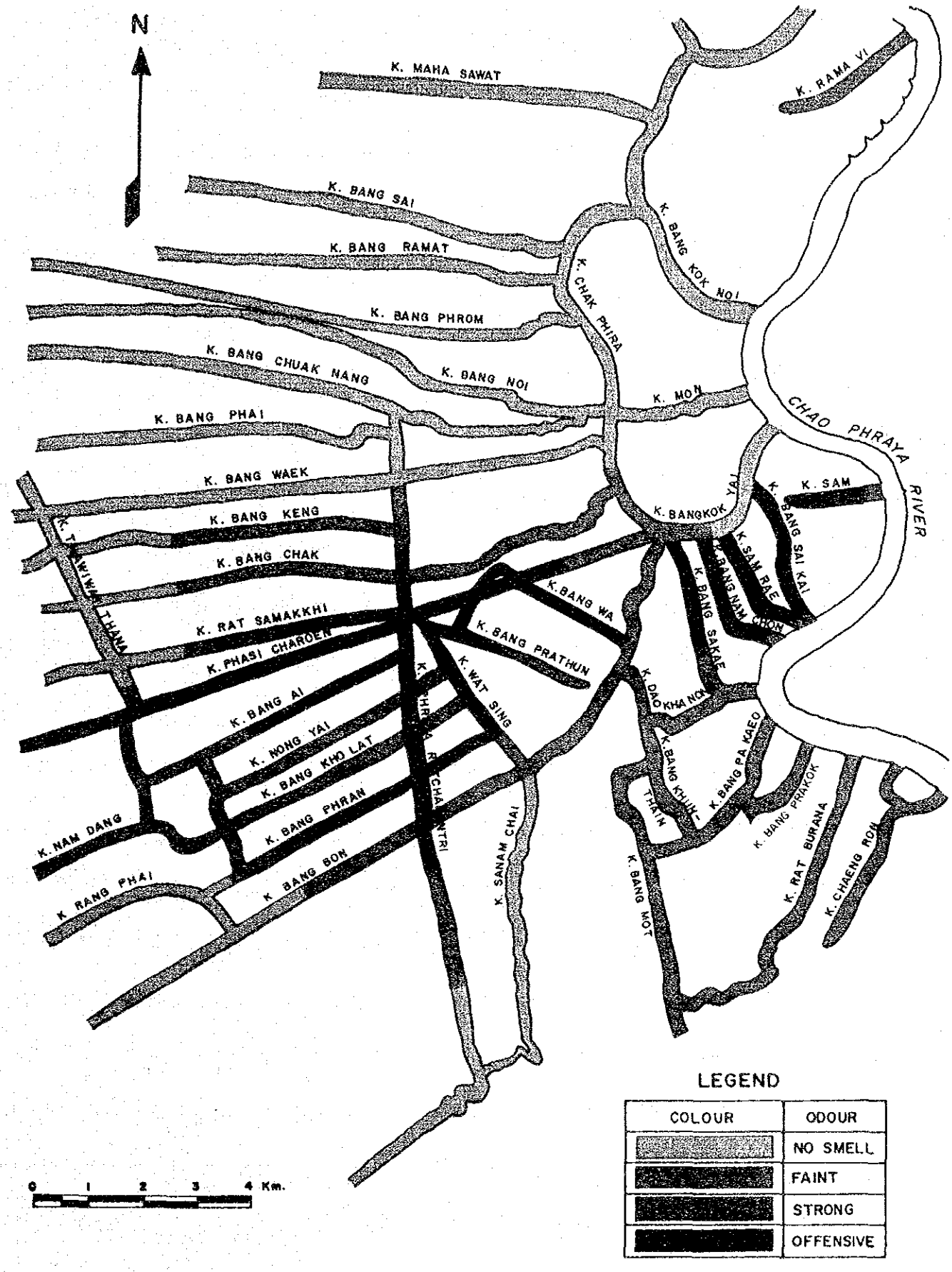


FIG. 11.5 OBSERVED COLOUR AND ODOUR DURING DRY SEASON IN THONBURI AREA

THE FEASIBILITY STUDY ON PURIFICATION OF KLONG WATER IN BANGKOK

JICA 2532B.E. 1989A.D.

Chapter 12.

RECOMMENDATIONS AND FURTHER STUDIES

CHAPTER 12. RECOMMENDATIONS AND FURTHER STUDIES

12.1 The Proposed Project

The proposed project of klong water purification consists of two (2) project components:

(i) Introduction of dilution water from the Chao Phraya River by remodeling the existing pumps and gates to reversible mode of operation and auxiliary dredging of klongs.

(ii) Aerated lagoon treatment of klong water from the klongs, K. Sam Sen and K. Lad Phrao respectively in Makkasan Pond and Rama IX Pond.

The project will produce fruitful effects at a low investment cost with simple operation and maintenance requirement.

The dilution water introduction will improve the klong water quality in the Study Area to a stream BOD level of 15 mg/l resulting in a very significant improvement of color and odor. The existing gray or black color of the klong water will be improved to green or brown. The strong and offensive odor of the klong water will also be improved to a level of no odor or faint odor. These would contribute very much towards the enhancement of aesthetics of klong environment.

On the other hand, the aerated lagoons will contribute to a net pollution load reduction which will more than offset the anticipated increase in pollution load discharge to the Chao Phraya River due to the introduction of dilution water to the klongs.

Hence, the aerated lagoon treatment will marginally contribute to the water quality improvement of the Chao Phraya River.
An early implementation of the Project is recommended.

As another means of klong water quality improvement, feasibility on direct aeration of the klong water itself to enhance the assimilative capacity of the klongs is recommended for further studies.

12.2 Reconstruction of Phra Khanong Pump Station

The dilution water of the klongs introduced from the Chao Phraya River is again discharged back into the Chao Phraya River by the Phra Khanong and Krung Kasem pump stations. The dilution water introduction is limited to the period of eight (8) months of dry season (November - June), in principle. The total yearly pump operation time required for discharging the introduced dilution water by Phra Khanong and Krung Kasem pump stations is estimated to be 48,480 hour·unit and 7,832 hour·unit respectively.

In the year 2000, the ground elevation of the Study Area is expected to become lower than the low water level of the Chao Phraya River due to the progressing land subsidence affecting Bangkok. By that time, a 24-hour pump drainage will be required by the Phra Khanong and Krung Kasem pump stations to discharge the introduced dilution water. The total yearly pump operation time of Phra Khanong and Krung Kasem pump stations is estimated to be 106,000 hour·unit and 21,200 hour·unit.

The existing Krung Kasem pump station is of permanent type, while the Phra Khanong is of temporary type. The existing Phra Khanong pump station shall be remodelled into a permanent type as early as possible to meet the requirement of long-time continuous operation.

12.3 Sewerage Development

The klong water quality in dry season is expected to exceed the target level of 15 mg/l as BOD in five (5) to six (6) years due to the rapidly increasing pollution load generation in Bangkok, even with the proposed klong water purification project which will have significant contribution towards the improvement of the klong water quality. Further more the klong water quality in the year 2000 is projected to deteriorate to 15-24 mg/l as BOD even with the sound functioning of the proposed project. Under such a future conditions in the year 2000, the stream BOD of the Chao Phraya River is forecasted to increase to 6.5 mg/l from the present level of 3 mg/l.

Moreover, in rainy season, the klong water quality will be much deteriorated due to lack of dilution water introduction from the Chao Phraya River. The klong water quality during rainy season in the year 2000 is estimated to be of BOD 20-50 mg/l in central Bangkok.

To cope with these future water pollution problems, sewerage development is essentially required. The sewerage development shall initially cover the central Bangkok Area of 110 km^2 with a high population density (See Fig. 12.1). The pollution load from the areas is discharged into the following klongs.

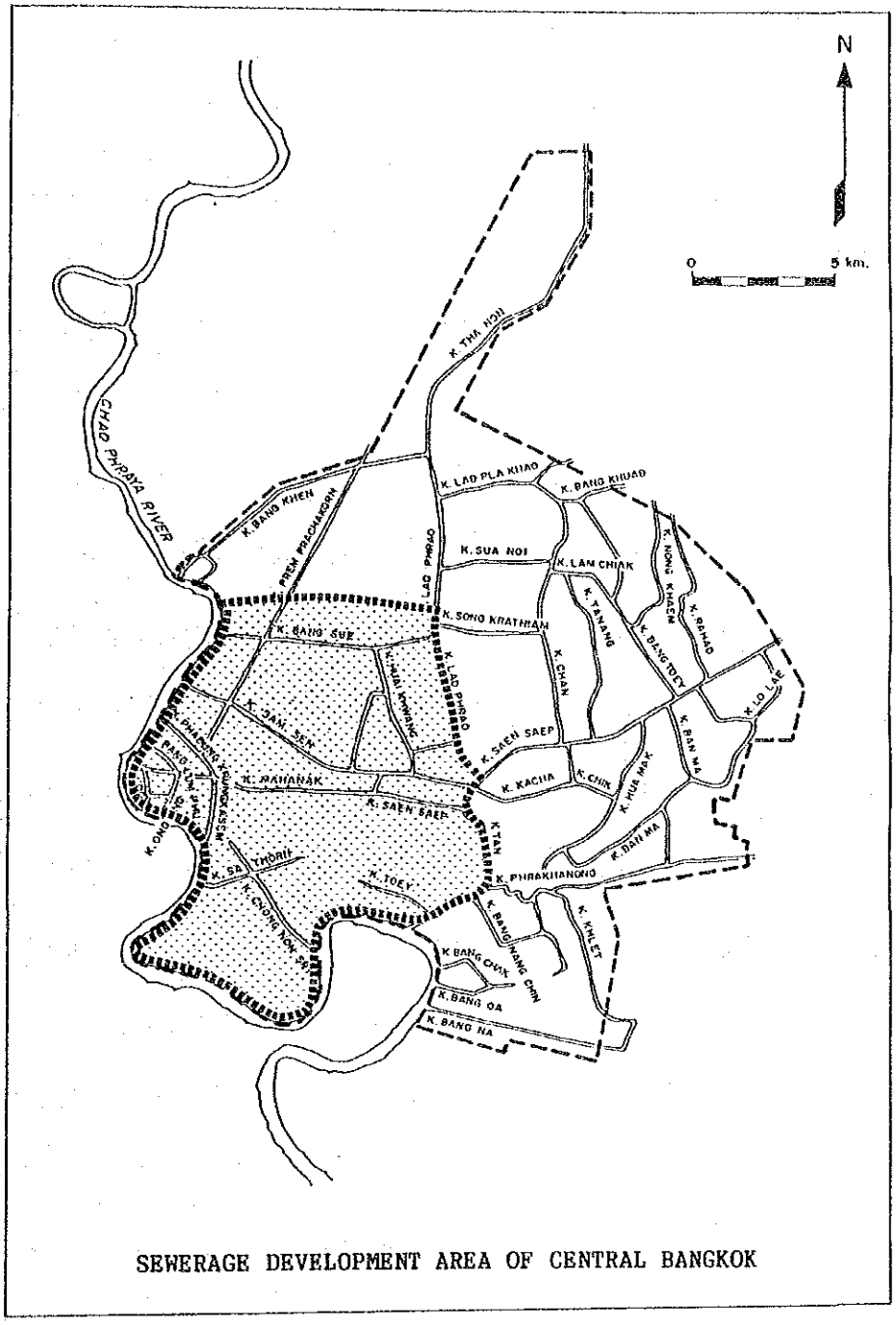
- Bang Sue, Sam Sen, Huai Kwang, Prem Prachakorn, Mahanak, Saen Saep, Padung Krung Kasem, Bang Lum Phu, Ong Ang, Lod, Wat Tep Tida, Wat Rajabopit, Sathorn, Chong Non Sri, Toey

The existing major pollution sources in the central Bangkok are domestic wastes, wastes of toilet origin and commercial wastes. The domestic and commercial wastes are collected through the storm water drains consisting of road side ditches and main pipes and discharged into the klongs with no treatment. Toilet wastes are intended to be treated by septic tanks. However, overflow from septic tank is also discharged into the klongs through the storm water drains.

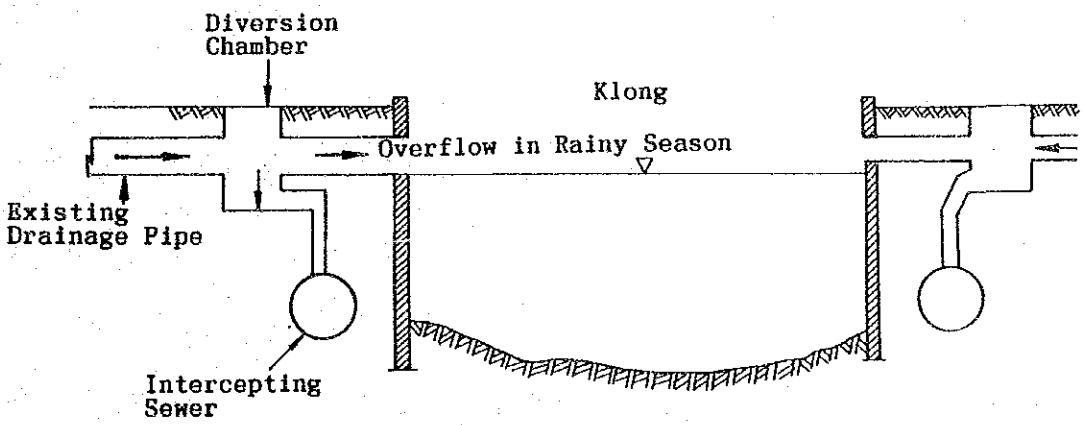
Since a full-scale conventional sewerage development in central Bangkok would require a high cost, a stage-wise implementation program shall be devised. A sewerage development focussing on abatement of water pollution of the klongs and the Chao Phraya River is recommended as the first step.

Construction of wastewater interceptors along the klongs is considered one of the cost-effective methods for abatement of the water pollution (ref. Fig. 12.1). A preliminary study on such a project was conducted by Thailand Development Research Institute in 1988 (Refer to Development of a Framework for Water Quality Management of Chao Phraya and Thachin Rivers). The construction cost of the interceptors with treatment facilities for the above mentioned klongs in central Bangkok is roughly estimated to be 8,000 million Baht. The annual operation and maintenance cost is also roughly estimated to be 250 million Baht.

An early execution of the feasibility study on sewerage development is strongly recommended.



SEWERAGE DEVELOPMENT AREA OF CENTRAL BANGKOK

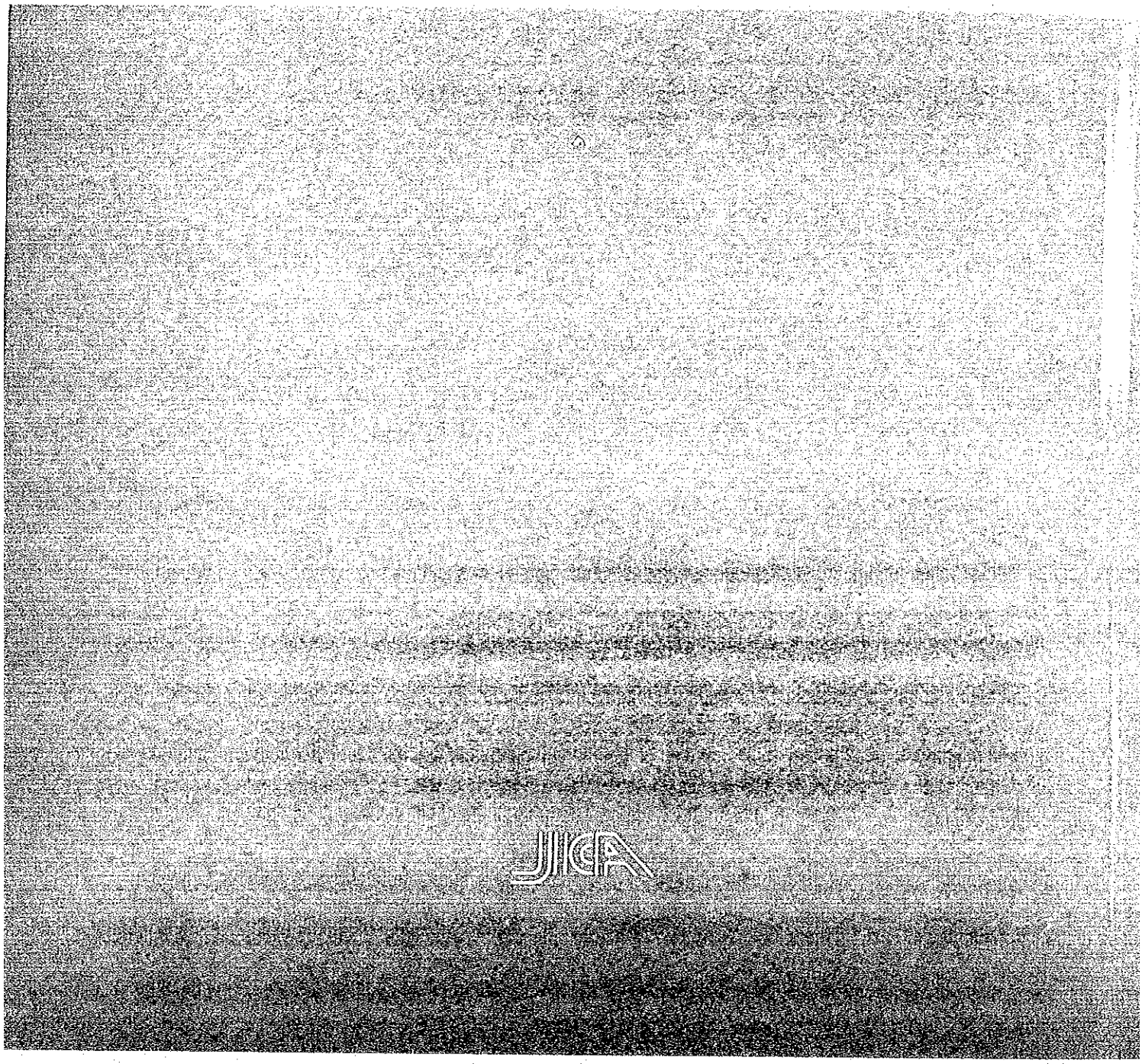


TYPICAL SEWER INTERCEPTOR

FIG. 12.1 PRIORITY SEWERAGE DEVELOPMENT AREA AND TYPICAL INTERCEPTOR

THE FEASIBILITY STUDY ON PURIFICATION OF KLONG WATER IN BANGKOK

JICA 2532B.E. 1989A.D.


JICA