CHAPTER 4 ENVIRONMENT

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4.1 GENERAL

A regional masterplan on tourism development will not be complete without an analysis on the environmental problems. In the case of Pattaya, which is an ocean resort, the environmental considerations will have to be made both from the land side and from the sea side. The environmental problems on the sea side, (the marine environment), is of particular importance since the marine environmental conditions are more delicate and subject to easy influence by external factors.

The study on environment will have to be made from two directions for the tourism development. The first is considerations of the effect of tourism development on the environment. The other is considerations on the influence of the environment on the tourist resort.

In this chapter, discussion will be made on both aspects first from the land side and subsequently on the marine environment.

4.2 LAND ENVIRONMENT

4.2.1 Effect of tourism development on environment

The rapid change of Pattaya from a fishing village to an ocean resort in the past ten years had undoubtedly very great social impact on the resort. However, the effects on the environment on the land side has not been so great in the physical sense. The two main reasons are that the tourism development has hitherto taken place on the narrow strip of land facing the sea and that the hinterland has also been developed for agricultural use, either as paddy field or as tapioca and coconut plantations.

In the masterplan, large scale development of the hinterland is proposed, but it is not anticipated that the land environment will be affected. In the present agricultural land, no fauna and flora species of any particular interest is existing, and the development activities will not have any ecological effects to the region on the whole. The swampy area to the back of the developed area is proposed to be utilized. Here, care will be taken that the utilization of the swamp will not upset the ecological balance of the area.

With the provision of adequate infrastructure facilities in conjunction with the development, the living environment will be maintained at a satisfactory level for both the tourists and the local community.

In conclusion, it can be said that the development of the tourist resort will not have any adversed effects on the environment of the study area from the land side. On the other hand, through the new provision and improvement of infrastructure facilities and the enforcement of related laws and regulations, the development activities will have very favourable effect on the living and social environment of the area.

4.2.2 Effect of surrounding environment on Pattaya as a tourist resort

The other point on environment which has to taken into consideration is the effect of the surrounding on the resort after the development of the area.

The first consideration will be the effect of traffic on the resort. In this regards, it is fortunate that the Sukhumvit Highway, which is the trunk road connecting the resort with Bangkok to the north and Sattahip to the south, does not run through the study area but only skirts by the eastern boundary. Thus the possibility of disturbance of the resort by through traffic is very small. The proposal for designating the strip of land on both sides of the Sukhumvit Highway as preservation area will also prevent uncontrolled development along the highway.

The planned construction of a railway line along the east of the Sukhumvit Highway with the provision of two stations near the study may have impact on the resort, if uncontrolled development of the surrounding of the stations should take place. Any detrimental effects may be prevented by enforcement of control of the quantity and quality of development activities around the stations and along the railway line.

Little significant industrial developments is found in or around the study area and the main ones are the tapioca factories located to the north and the south out of the study area. The environmental effect on the sea side may be very great through the waste water discharged from the factories. Greater attention will be given on this aspect in the subsequent sections. On the land side the environmental effect is small since the factories do not emit disagreeable smoke or obnoxious gases in the process of production. Some dust may be anticipated but the factories are too far away from the study area to offer any threat to the environment.

The one big factor that requires careful attention is the concept of development of the Laem Chabang region into a large industrial area, since the boundary of the proposed industrial area will come very close to the study area. There are no definite programs on this concept yet and without knowing the types of industries that may be introduced, the effect of the operation of these industries to the environment cannot be correctly assessed.

However, it is strongly recommended that in the event of implementation of the industrial development in Laem Chabang, it is necessary and of great importance that careful deliberation be made regarding the types of industries that should be approved for investment. The main considerations from the point of land environment will be that the industries to operate in the area should not cause any pollution through noise, smoke, gas, dust or solid waste. It is also of utmost importance the regulations on environmental preservation should be strictly imposed.

4.3 MARINE ENVIRONMENT

4.3.1 General

By far the more important environmental aspect for an ocean resort is the marine environment. In Pattaya, particularly, some marine environmental problems are already becoming quite ostensible. In this section, detailed discussion shall therefore be made on all aspects of marine environment.

A beach resort generally consist of sea and marine life. Pattaya beach resort consists of sea, marine life and coral reef. These three resources are under the domination of marine environment. Marine resources need clean sea water just as human being need clean air. Because sea and marine life are very important to bolster the charm of an ocean resort, the survey of the existing sea water condition and the study to resolve sea-water pollution problems should be strongly stressed in the tourism development of Pattaya.

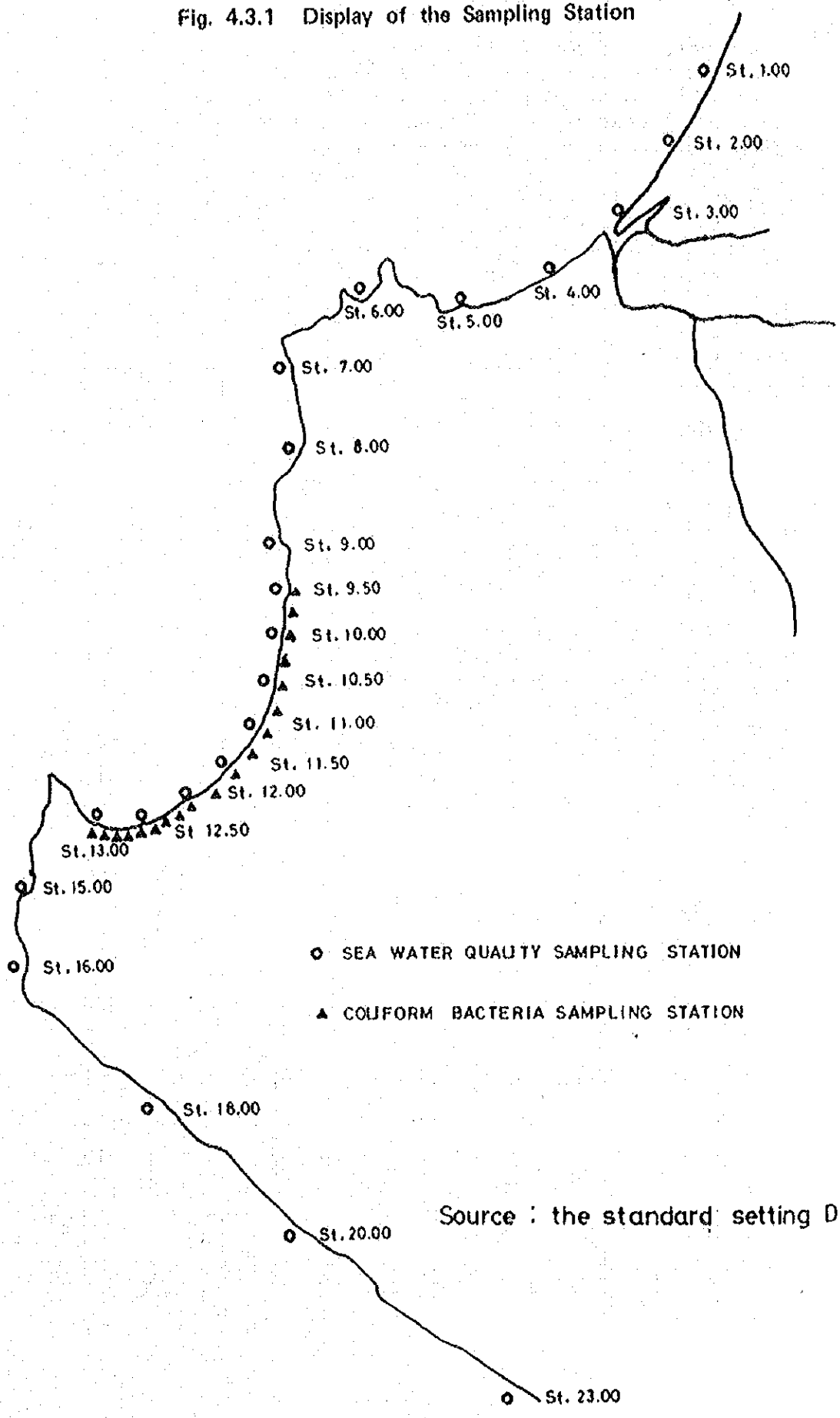
4.3.2 Existing water quality condition

(a) Water quality condition in the upper gulf of Thailand

Several water quality surveys in the upper gulf of Thailand were carried out in the past as follows:

* Marine Fishery Surveys by Fishery Department, 1963-1966
* Survey by Hydrographic Department of Royal Thai Navy, 1967
* Survey Hydrographic Department in collaboration with the Fishery Department, 1973
* Survey by Subcommittee for Pollution Survey in the gulf of Thailand (SPSGT), 1973
* Survey by Marine Fisheries Laboratory (MLF), Department of Fishery, 1974

Fig. 4.3.1 Display of the Sampling Station



Source : the standard setting Div. NEB.

From the results of these surveys, the existing water quality conditions may be summarized as follows:

1) Water Temperature

The distribution of water temperature shows that the temperature is quite high during a year, and gradually increases toward the head of the gulf. The vertical distribution is quite uniform.

2) Transparency

The transparency of the mouth of the gulf is more than 10m average, but is lower than 5 m at the head of the gulf of the Thailand. This phenomenon is due to the effluence of the river discharge including suspended solid.

3) Salinity Variation

Salinity is an useful indicator for the mixing condition between sea water and fresh water. Especially in a shallow bay like the upper gulf of Thailand, it appears that the mixing condition between the fresh water coming from river and the sea water coming from outer bay could be roughly estimated from the salinity.

Regarding the character of annual changing ratio of Pattaya coast, due to the lack of large rivers, the effects of river discharge are not quite strong except in September and October. Especially from December to next April, the salinity distribution is similar to the oceanic sea water character.

(b) Water quality condition along Pattaya coast

Water quality surveys along the shoreline of Pattaya coast have been carried out every month from December 1976 by the Standard Setting Division of National Environment Board. Fig. 4.3.1 shows the sampling points and Table 4.3.1 shows the analyzed consequences of water quality. The Japanese survey team also conducted the water quality survey, including the study of the sea bottom materials and sea current, from 10th, Aug. 1977 to 8th, Sep. 1977 as a part of the study for the tourism development of Pattaya. Fig. 4.3.2 shows the sampling points and Table 4.3.2 shows the results of the survey.

From the above two studies, the water quality of Pattaya coast can be summarized as follows:

1. At present, the sea area along the Pattaya beach may not be said as being in its best condition as an ocean resort.

2. The water quality as a whole is not deteriorated so seriously. However the pollution problems in some areas should not be ignored and the some remedy measures should be taken as soon as possible.

Table 4.3.1-1 The Observation Results of Pattaya Coast

Station	17 Dec. 1976 14:00 Low Tide					18 Dec. 1976 9:00 High Tide				
	TEMP °C Air	TEMP °C Water	PH	DO mg/	SS mg/	TEMP °C Air	TEMP °C Water	PH	DO mg/	SS mg/
1.000	34	28	7.75	3.0	1,596		28	7.9	3.7	150
2.000	30.5	28.5	7.6	4.6	430		28	8.1	5.7	276
3.000	31	29	7.1		226		28	8.0	5.4	192
4.000	30.5	28.5	8.0	5.2	380		27.5	8.1	5.5	266
5.000		27	8.05	5.0	298		27	8.1	5.25	56
6.000			8.1	6.1	90		28	8.3	6.15	54
7.000		27.0	8.35	6.1	96		28	8.4	6.75	106
8.000		27.0	8.25	6.5	94		28	8.2	6.70	100
9.000		28.0	8.35	6.6	68			8.3	6.45	64
9.500										
10.000		28.0	8.30	6.4	66		26.5	8.35	5.5	56
10.500										
11.000	31	27.0	8.30	6.5	78		28.5	8.0	5.1	106
11.500										
12.000	31	27.5	8.40	6.3	19		27	8.0	5.85	156
12.500										
13.000		28	8.20	6.3	39		26.5	8.0	5.65	138
15.000		27	8.30	6.5	28		27	8.15	6.55	106
16.000		27	8.00	6.5	42		27.5		6.5	
18.000		27.5	8.30	6.9	68		28	8.15	6.9	72
20.000		26.5	8.40	6.9	30		26	8.0	7.55	38
23.000		26	8.30	5.7	70		28	8.15	7.20	124

Source: National Environmental Board

Table 4.3.1-2 The Observation Results of Pattaya Coast

Station	8 Jan. 1977 10:00 High Tide				8 Jan. 1977 15:00 Low Tide			
	TEMP °C Air	TEMP °C Water	PH	DO mg/	SS mg/	TEMP °C Air	TEMP °C Water	PH	DO mg/ℓ	SS mg/ℓ
1.000		27	8.35	3.1	37		29	7.45	1.1	235
2.000		27	7.7	3.95	7		28.5	7.1	0	271
3.000		26.5	6.6	2.05	27		29	7.7	2.65	208
4.000		27	7.7	5.10	10		28.5	7.85	6.90	203
5.000		27.5	7.75	5.0	217		29.0	7.95	6.80	214
6.000		27.5	7.8	5.35	48		28.0	7.9	6.55	130
7.000		28	7.8	6.0	72		29.0	8.0	7.0	202
8.000		28	7.75	6.4	40		29.0	8.0	7.3	154
9.000		27	7.65	5.5	36		29.0	7.95	6.9	29
9.500										
10.000		27.5	7.65	5.9	33		29.0	8.0	7.05	31
10.500										
11.000		27.5	7.8	6.2	19		29.0	8.0	6.95	203
11.500										
12.000		26.5	8.2	4.75	43		29.0	7.9	6.8	203
12.500										
13.000		27.5	8.1	6.1	32		27.0	8.0	7.65	203
15.000		28	8.2	6.1	39		29.0	8.05	6.90	217
16.000		28	7.6	6.3	37		29.0	8.0	7.05	220
18.000			7.6	6.2	29		29.0	8.05	6.40	22
20.000		28	7.7	6.6	40		29.0	8.0	6.35	202
23.000		28	7.7	6.25	59		29.0	8.0	6.45	203

Source: National Environmental Board

Table 4.3.1-3 The Observation Results of Pattaya Coast

Station	6 Feb. 1977 9:30 Low Tide						6 Feb. 1977 16:10 High Tide					
	TEMP °C Air	TEMP °C Water	PH	DO mg/l	SS mg/l	BOD_5 mg/l	TEMP °C Air	TEMP °C Water	PH	DO mg/ℓ	SS mg/ℓ	BOD_5 mg/l
1.000	27	26	7.65	4.5	36	26	28	27	7.6	6.45	78	12
2.000	"	"	7.4	1.7	3	20	"	"	7.5	4.70	59	10
3.000	"	"	7.3	0	6	21	"	"	7.6	3.70	54	12.5
4.000	"	"	7.6	1.2	10	16	"	"	7.9	0	124	12
5.000	"	"	8.0	2.9	2	3.5	"	"	7.7	4.80	66	7.5
6.000	"	"	7.7	4.0	13	4.0	"	"	8.0	4.55	116	4.5
7.000	"	"	7.75	6.15	20	2.5	"	"	8.1	7.20	130	1.0
8.000	"	"	8.05	6.6	8	3.2	"	"	8.1	7.20	119	5.0
9.000	"	"	8.25	5.8	29	2.2	"	"	8.3	6.90	89	<1
9.500	"	"	8.3	6.3	17	3.2	"	"	8.1	7.30	49	1.0
10.000	"	"	8.4	6.55	35	3.0	"	"	8.2	7.40	156	<1
10.500	"	"	8.1	6.5	35	2.4	"	"	8.1	7.50	169	9.5
11.000	"	"	8.35	6.45	22	7.2	"	"	8.0	7.20	72	7.0
11.500	"	"	8.25	6.60	24	3.6	"	"	8.1	7.05	55	5.8
12.000	"	"	8.30	6.30	8	28	"	"	7.9	7.00	86	4.0
12.500	"	"	8.1	5.50	66	6.0	"	"	8.2	7.30	115	5.0
13.000	"	"	8.4	6.0	39	1.6	"	"	8.3	7.30	106	4.0
15.000	"	"	8.3	6.7	40	1.6	"	"	8.4	7.10	90	3.2
16.000	"	"	8.4	6.65	99	1.6	"	"	8.4	7.20	176	1.0
18.000	"	"	8.4	6.90	95	<1	"	"	8.2	7.60	84	1.0
20.000	"	"	8.2	7.05	53		"	"	8.0	7.70	20	1.0
23.000	"	"	8.3	6.80	232	<1	"	"	8.2	7.90	273	1.5

Source: National Environmental Board

Table 4.3.1-4 The Observation Results of Pattaya Coast

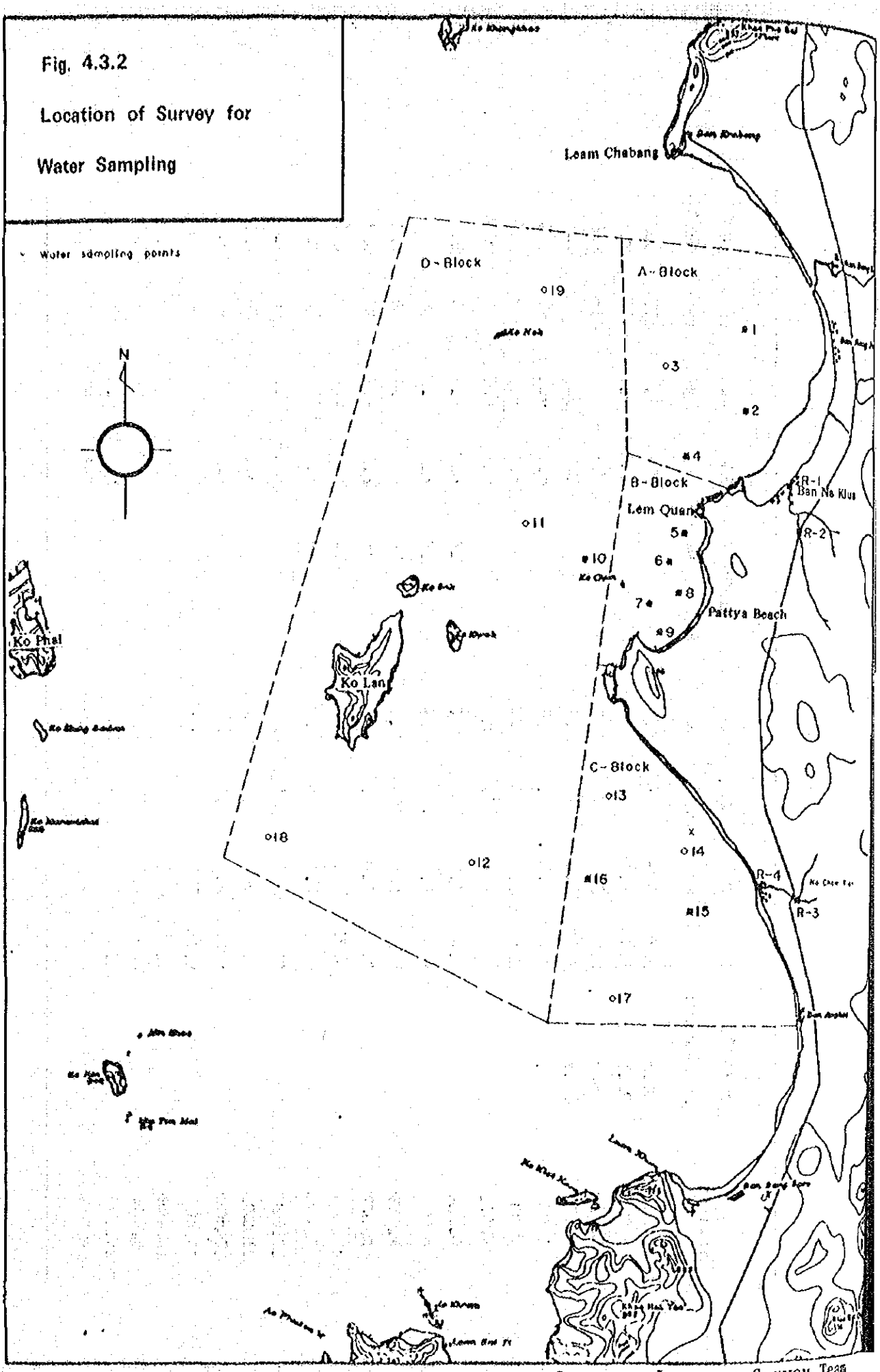
Station	March 1977 High Tide						March 1977 Low Tide					
	TEMP °C		PH	DO	SS	BOD	TEMP °C		PH	DO	SS	BOD
	Air	Water		mg/ℓ	mg/ℓ	mg/ℓ	Air	Water		mg/ℓ	mg/ℓ	mg/ℓ
1.000	30.5		8.55	7.9	6	1.5			8.6	5.2	157	3.2
2.000	30.5		8.4	4.9	56	2.4			8.6	4.9	57	2.0
3.000	29.5		8.5	7.6	140	1.0			7.9	0	89	6.8
4.000	30.5		8.5	7.1	124	0.9			8.2	5.3	4	1.6
5.000			8.4	6.8	152	0.9			8.2	6.1	42	1.6
6.000			8.5	6.9	95	0.4			8.2	6.3	5	0.5
7.000			8.4	7.0	75	0.9			8.2	6.7	34	0.9
8.000			8.4	7.0	160	1.0		29	8.2	6.9	31	0.4
9.000			8.5	6.5	184	0.9		29	8.2	6.3	8	-
9.500			8.5	6.8	112	1.1		29	8.2	6.7	8	0.2
10.000			8.5	7.0	40	0.8		29	8.2	6.5	34	0.1
10.500			8.75	7.1	12	1.1		29	8.2	6.4	23	0.5
11.000			8.45	7.3	5	0.7		29	8.2	7.1	50	0.4
11.500			8.4	7.3	15	0.9		29	8.25	6.5	86	0.6
12.000			8.45	7.4	19	1.0		29	8.2	6.6	76	0.6
12.500			8.5	7.6	73	0.8		29	8.2	6.4	83	0.4
13.000			8.45	7.7	6	0.6		29	8.2	6.5	40	0.6
15.000			8.6	6.6	34	1.0		29	8.3	6.8	53	1.0
16.000			8.6	6.3	95	0.6		29	8.3	7.1	7	0.8
18.000			8.5	7.6	29	1.6		29	8.3	6.8	136	0.8
20.000			8.5	6.5	139	1.5		29	8.2	6.7	59	0.9
23.000			8.5	6.3	68	2.0		29	8.3	6.6	82	0.6

Source: National Environmental Board

Fig. 4.3.2

Location of Survey for

Water Sampling



Source: Japanese Survey Team

Table 4.3.2-1 The Observation Result of Pattaya Sea Area

Station \ Item	Date	Time	Tide	Air Temparature (℃)	Depth (m)	Transparency (m)	Water Temparature (℃)	pH	Cl (‰)	DO (ppm)	DO Sutiation degree (%)	COD (ppm)	SS (ppm)
St. 1.H	8.23	12:57	High	28.0	8.20	3.0	30.1	8.35	15.7	4.77	101.6	1.03	5
1.L		07:05	Low	27.0	6.05	3.0	29.2	8.37	15.2	6.63	96.5	1.46	4
St. 2.H	8.23	13:25	High	27.2	6.60	2.7	30.0	8.37	16.0	6.88	102.8	0.97	5
2.L		07:25	Low	27.0	5.30	1.9	29.6	8.28	15.7	6.51	96.2	1.54	8
St. 3.H.0	8.23	12:37	High	27.5	10.30	6.0	30.0	8.36	16.2	6.86	102.6	0.99	5
3.H.5							30.1	8.32	16.5	6.24	94.0	0.85	5
3.L.0		06:50	Low	27.0	8.80	4.0	29.2	8.33	15.7	6.32	92.6	1.86	4
3.L.5							29.1	8.33	15.8	6.63	97.1	1.54	4
St. 4.H.0	8.23	12:10	High	28.0	11.00	5.0	29.4	8.30	16.6	6.46	96.0	1.05	5
4.H.5							30.0	8.32	16.5	6.26	94.0	1.40	6
4.L.0		06:25	Low	27.0	7.90	4.5	29.4	8.34	15.9	6.59	97.1	1.31	4
4.L.5							29.2	8.32	16.2	6.28	92.5	1.40	4
St. 5.H	8.20	08:12	High	27.5	6.30	4.0	29.1	8.33	15.1	6.26	90.9	2.16	2
5.L		13:25	Low	28.0	5.10	3.5	29.6	8.39	14.9	6.65	97.4	1.68	2
St. 6.H	8.20	08:45	High	27.5	7.00	5.0	29.1	8.32	15.1	6.42	93.2	1.80	2
6.L		13:38	Low	28.0	5.90	4.0	29.6	8.36	15.0	6.84	100.3	1.56	2
St. 7.H	8.20	08:55	High	27.5	6.70	5.5	29.8	8.44	15.1	6.67	98.2	2.18	2
7.L		13:49	Low	27.6	5.90	4.5	29.8	8.47	15.0	6.86	100.8	1.56	2
St. 8.H	8.20	07:50	High	27.5	4.60	4.6	29.0	8.41	15.1	6.21	90.2	2.18	2
8.L		13:10	Low	28.0	3.90	3.5	29.7	8.42	15.1	6.65	97.8	1.74	3
St. 9.H	8.20	07:38	High	27.5	4.80	4.7	29.7	8.40	15.0	6.46	94.8	1.76	2
9.L		13:01	Low	29.7	4.00	3.5	29.7	8.40	15.2	6.59	96.9	1.40	2
St.10.H.0	8.27	14:40	High	27.1	17.30	7.0	30.3	8.32	17.3	6.19	94.4	1.21	2
10.H.5							30.4	8.22	16.2	6.03	90.9	1.80	2
10.H.10							29.9	8.21	17.5	5.55	84.3	1.07	3
10.L.0		08:37	Low	29.0	15.30	10.0	30.1	8.24	16.6	6.19	93.2	1.15	2
10.L.5							30.0	8.32	17.1	6.09	92.1	1.33	1
10.L.10							29.9	8.28	17.4	4.97	75.3	1.37	2

Source: Japanese Survey Team

Table 4.3.2-2 The Observation Result of Pattaya Sea Area

Item / Station	Date	Time	Tide	Air Temperature (℃)	Depth (m)	Transparency (m)	Water Temperature (℃)	pH	Cℓ (‰)	DO (ppm)	DO Satiation degree	COD (ppm)	SS (ppm)
St.11.H.0	8.27	15:10	High	27.0	21.20	8.5	30.1	8.32	17.0	6.32	95.6	0.91	1
11.H.5							30.2	8.24	17.2	6.11	93.0	1.66	2
11.H.10							29.9	8.22	17.5	5.74	87.1	0.91	3
11.L.0							30.0	8.32	16.6	6.38	96.0	1.09	1
11.L.5		09:10	Low	27.3	18.75	13.0	29.8	8.22	16.6	6.19	92.7	1.68	1
11.L.10							29.9	8.22	17.5	5.57	84.5	1.09	2
St.12	8.28	11:05	Low	27.0	17.00	9.0	30.0	8.27	17.4	6.13	93.1	1.70	4
St.13.H.0	8.24	12:41	High	28.0	10.50	8.0	30.0	8.34	17.0	6.44	97.4	1.13	14
13.H.5							30.0	8.38	17.0	6.36	96.1	1.05	5
13.L.0		06:02	Low	27.0	8.85	5.0	29.4	8.29	16.9	5.67	84.6	0.40	10
13.L.5							30.0	8.28	17.2	5.47	82.7	0.40	4
St.14.H.0	8.24	14:27	High	27.8	10.40	7.0	30.0	8.37	16.6	6.63	99.7	0.99	4
14.H.5							29.8	8.39	16.8	6.48	97.5	1.52	4
14.L.0		07:28	Low	27.0	9.65	7.5	29.6	8.32	16.6	5.98	89.3	0.79	4
14.L.5							29.7	8.32	16.2	5.82	86.5	0.87	3
St.15.H.0	8.24	14:05	High	27.8	9.60	7.0	30.0	8.33	16.7	6.50	97.9	1.13	5
15.H.5							29.8	8.38	16.9	6.50	97.7	1.39	3
15.L.0		07:10	Low	27.0	9.35	7.0	29.6	8.33	16.9	6.05	90.7	0.73	4
15.L.5							29.7	8.33	16.9	5.90	88.5	0.61	3
St.16.H.0	8.24	13:10	High	27.8	10.10	8.0	30.0	8.39	16.9	6.59	99.4	1.33	2
16.H.5							29.9	8.39	17.0	6.57	99.1	0.85	2
16.L.0		06:27	Low	27.0	5.60	>5.6	29.7	8.34	17.1	5.92	89.0	0.85	3
16.L.5							29.8	8.25	17.1	5.85	88.3	0.57	2
St.17.H.0	8.24	13:32	High	27.5	12.10	7.0	29.9	8.38	17.2	6.44	97.4	0.89	3
17.H.5							29.7	8.38	17.3	6.26	94.4	1.39	4
17.L.0		06:50	Low	27.0	12.70	8.0	29.7	8.36	17.0	6.05	91.0	0.77	2
17.L.5							29.8	8.35	17.0	6.05	91.2	1.01	4
St.18	8.28	12:00	Low	28.7	23.50	12.5	29.9	8.31	17.4	6.28	95.3	1.33	3
St.19	8.28	10:00	Low	27.2	16.20	13.0	29.9	8.22	16.4	6.26	93.7	1.07	1

Source: Japanese Survey Team

3. The main cause of such pollution problems can be traced to the waste water from the disorderly development without adequate infrastructure and to the waste water from the tapioca factories. The polluted sea water in the whole Upper Gulf is another factor affecting the water quality of Pattaya coast.

4. The river mouth of Na Klua is highly polluted.

(c) Existing sediment condition and coliform

1) Sediments

The characteristics of the bottom sediment are good indicators of pollution occuring in the overlying water column, since the characteristics of the water sediments are relatively stable in relation to the characteristics of the water column over a period of time.

The bottom sediments pollution of most area of the gulf of Thailand does not seem to pose any problems. But it is noted that the Na Klua river area is in the process of pollution especially, and it is feared that further deterioration may cause future ecological problems.

2) Coliform

Coliform from human extrea including other enteric pathogens, is good indicator of effects on marine environment through human activities. In U.S.A. and Japan a standard is set to control the level of coliform in waters for sea bathing.

Coliform surveys have been carried out at Chonburi Coast and Pattaya coast as follows.

* Surveys by Chulalongkorn Univ. and Department of Marine Science 1970 and 1971
* Surveys by Asian Institute of Technology (A.I.T.) 1972, 1973
* Surveys by National Environment Board 1977

Table 4.3.3 and Table 4.3.4 shows analitical data of A.I.T. and National Environment Board Surveys.

The Japanese survey team also conducted Coliform bacteria survey at the sea water around Pattaya beach and Ko Lan island. As the object of this survey was to supplement NEB's data, the sampling points were located at the offshore area of those of NEB's survey. Fig. 4.3.3 shows the sampling points and Table 4.3.5 shows the results of the survey. These survey results show one of the major source of pollutants is living waste water discharged directly into the sea.

Table 4.3.3 Coliform Analysis of Bang Saen and Pattaya Beach Waters

Samples	Bang Saen	Pattaya
15/7/72	%	%
greater than 1,000/100 ml	59	29
less than 1,000/100 ml	29	36
spoiled samples	12	35
14/1/73		
greater than 1,000/100 ml	66	0
less than 1,000/100 ml	33	100
spoiled samples	0	0

Table 4.3.4 Coliform Bacteria Sampling (unit: MPN/100 ml)

Station	Location	8 Jan. 1977				22 Jan. 1977		**6 Feb.1977		**21 Feb. 1977		
		9:00	12:00	15:00	18:00	9:30	15:00	9:30 (L)	16:30 (H)	10:00 (L)	15:00 (H)	
9.250	Orchid Lodge Hotel					20	20	140	0	490	110	
9.500	Weekender Hotel	300	110	40	50	50	110	170	20	330	1,100	
9.750	Pattaya Soi 7					20	330	330	120	20	50	
10.000	Hyatt Pattaya Hotel	1,100	70	130	790	90	80	110	330	80	50	
10.250	Tropicana Hotel					130	50	170	80	490	130	US standard for caliform bacteria
10.500	Holiday Inn Hotel	330	130	230	80	220	50	-	330	130	490	
10.750	Sai-Thong Bungalow					80	130	220	270	490	330	
11.000	Ocean View Hotel	210	80	80	50	20	230	50	110	170	270	less than 1000 MPN/100 ml for Swimmer
11.250	Yatch Club					490	170	330	140	130	1,300	
11.500	Sea Side Hotel	700	170	110	330	490	460	340	1,300	110	1,100	
11.750	Boat House Restaurant					230	3,480	1,700	1,300	1,300	3,500	
12.000	Thai Phanich Bank	≥9,200	16,000	1,700	2,800	490	2,780	2,400	3,500	≥24,000	5,400	
12.125	Habour Market					1,300	≥24,000	16,000	2,800	2,200	2,400	
12.250	Fantasy Club					790	1,720	9,200	5,400	5,400	5,400	
12.375	Marine Restaurant					1,410	16,090	≥24,000	5,400	≥24,000	330	
12.500	Barbos Restaurant*	≥24,000	≥24,000	≥24,000	≥24,000	1,720	2,400	16,000	1,700	1,300	≥24,000	
12.625	Sang Kaew Bungalow					1,300	330	9,200	3,500	5,400	3,500	
12.750	Siam Bayshore Hotel					1,300	110	9,200	16,000	460	330	
12.875	South Pattaya Canal					1,720	20	16,000	1,300	80	230	
13.000	South End of Pattaya Beach	1,700	5,400	490	330	490	20	≥24,000	5,400	50	0	

(H): High Tide (L): Low Tide

* Resulted by discharge from mouth of Pattaya canal (MPN in canal ≥24,000).

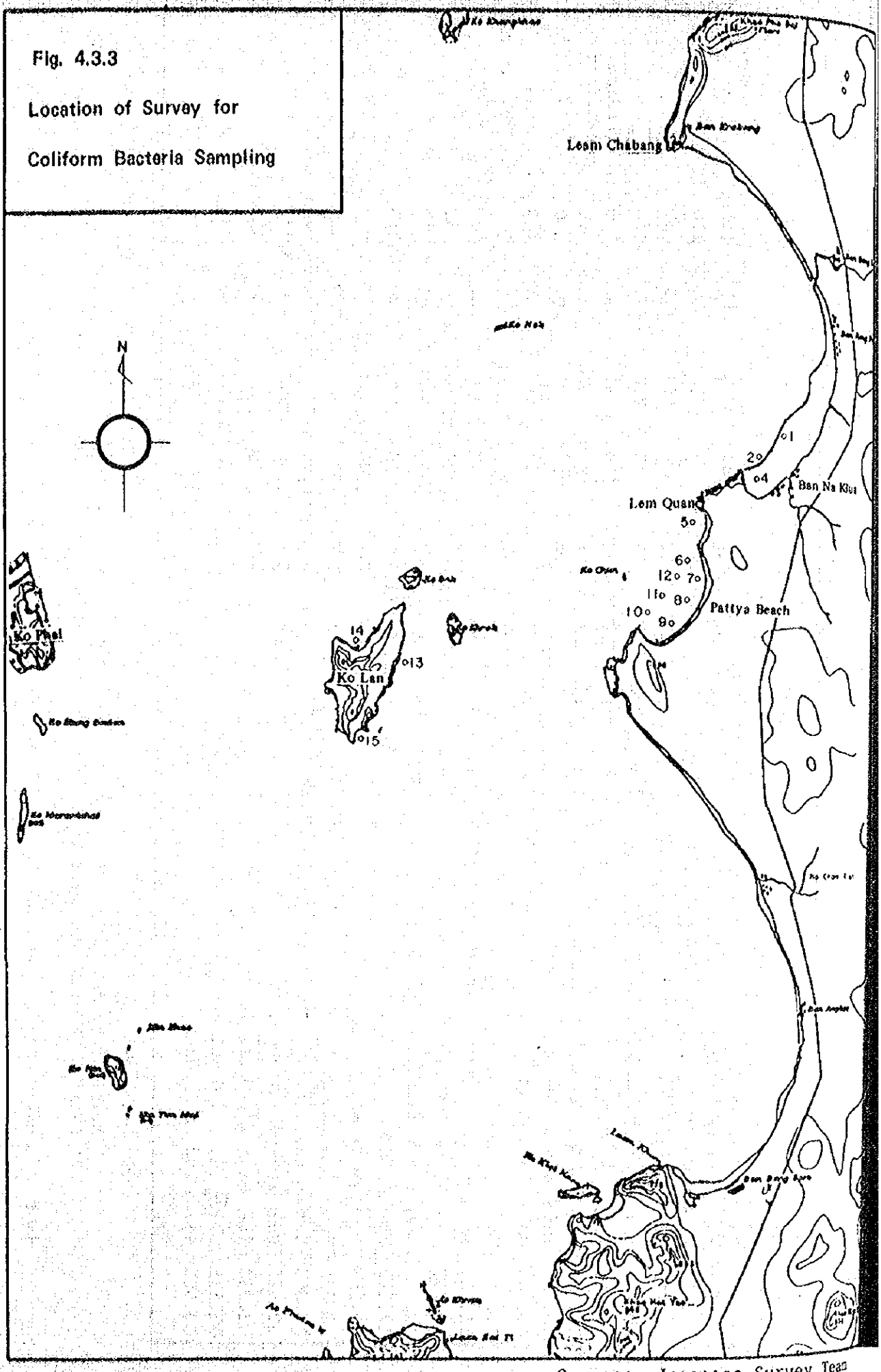
** CHINESE NEW YEAR on 18-19 Feb. 1977, Maximum number of local tourists during a year.

Source: National Environmental Board, Standard Setting Division.

Fig. 4.3.3

Location of Survay for

Coliform Bacteria Sampling



Source: Japanese Survey Team

Table 4.3.5 The Result of Coliform bacteria Survey

Items / Sample No.	Depth (m)	Water Temperature (°C)		Coliform Bacteria (MPN/100m2)	
		First Time	Second Time	First Time	Second Time
St. 1	1.1	30.7	30.8	2	33
2	1.4	30.5	31.0	5	1,600
3	-	-	-	-	-
4	0.9	30.8	31.0	170	540
5	3.6	30.8	30.7	<2	46
6	3.2	30.8	30.2	<2	49
7	1.0	30.2	30.2	22	33
8	0.9	30.9	30.4	14	540
9	0.9	30.4	30.3	<2	>2,400
10	4.7	30.6	30.3	<2	49
11	4.0	30.4	30.2	<2	9
12	4.2	30.3	30.2	<2	33
13	2.9	30.3	30.0	280	33
14	3.0	30.7	30.1	2	11
15	3.5	30.4	30.0	2	2

Sampling Date : First Time 18th Aug.
Second Time 29th Aug.

Source : Japanese Survey Team

4.3.3 Water quality in future

(a) Waste water resources

The discharged waste water along Chonburi coast comes from two sources. The first is the industrial waste water from petroleum refineries, slaughterhouses, sugar refineries and tapioca starch factories etc. The second source is the domestic waste water.

From most of the factories which are located along the coast, the industrial waste water being loaded to the Chonburi's coast is estimated to carry the following matters:

SS	6×10^3 ton/year
BOD	13×10^3 ton/year
N	2×10^3 ton/year
P	$1\ 10^3$ ton/year

Table 4.3.6 ∿ 4.3.8 shows the discharged volume of SS and BOD by the tapioca factories along the Chonburi coast. Past data shows that most (97%) of waste water load from factories are the waste water from tapioca starch mills.

The domestic waste water is directly discharged through the small river and canals. This domestic waste water may caused a public healthy problem from the enteric pathogenes.

Table 4.3.6 Monthly Discharge of Industrial Waste Waters along the Chonburi Coast by Tapioca Factories

Month	Suspended Solids		BOD	
	Tapioca A	Tapioca B	Tapioca A	Tapioca B
Jan	86203	763232	186390	1739328
Feb	64768	381616	140029	869664
Mar	72323	-	156634	-
Apr	27387	-	59211	-
May	12403	-	26825	-
June	52222	457939	112904	1043596
July	28796	457939	62264	1043596
Aug	18847	610585	40757	1391462
Sept	28285	610585	61196	1391462
Oct	50292	763232	105746	1739328
Nov	39272	763232	84978	1739328
Dec	65371	763232	141340	1739328

kg/month

Table 4.3.7 Monthly Industrial Waste Water Discharge along the Coast of Study Area

Item / Month	Suspended Solids	BOD	N	P
January	320	700	110	55
February	190	410	64	35
March	10	20	4	2
April	7	5	2	1
May	3	5	1	0.5
June	210	450	68	34
July	200	430	66	33
August	270	590	90	45
September	250	550	84	42
October	340	750	119	59
November	330	710	112	56
December	350	770	120	60
Total	2,500	5,400	840	420

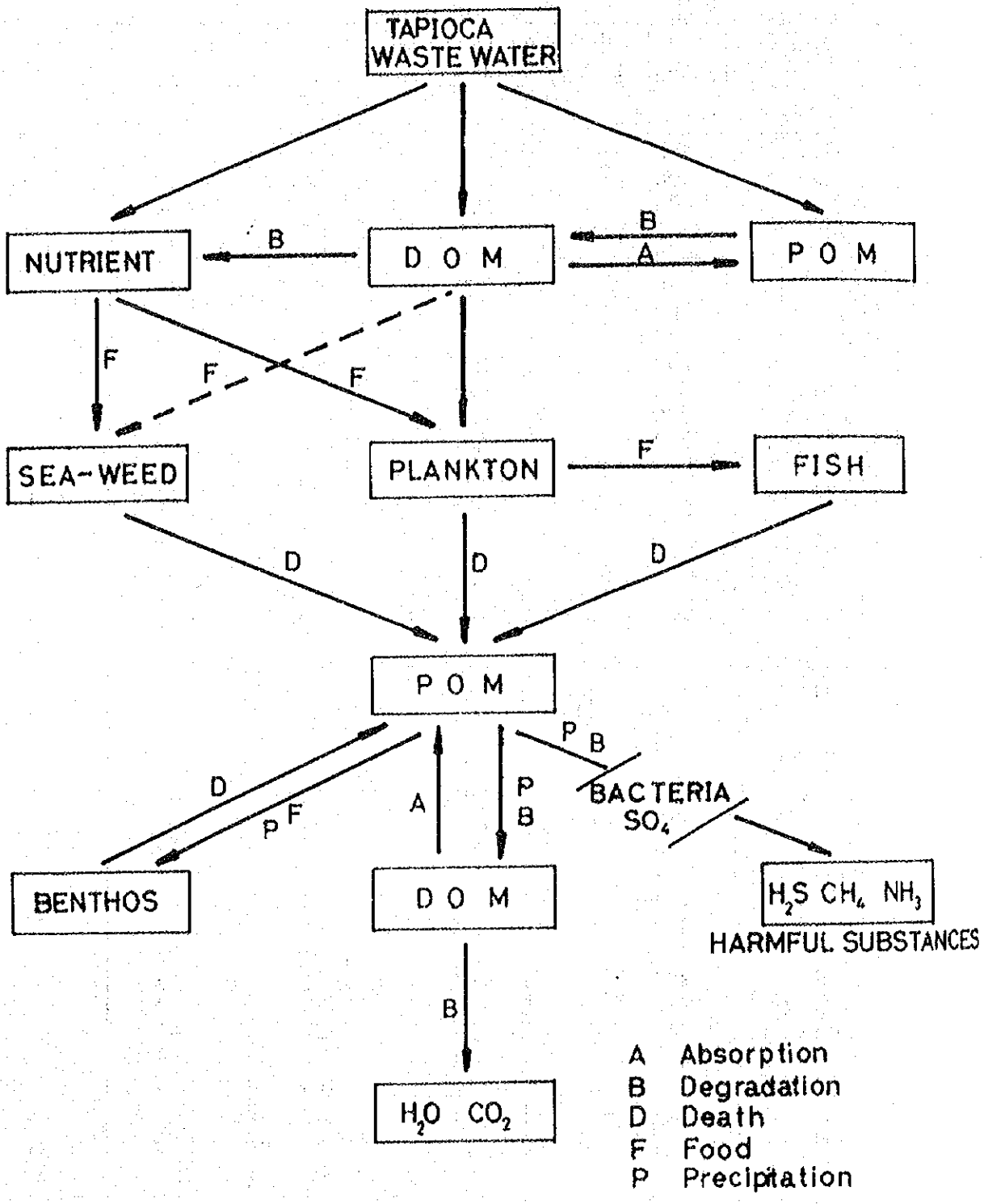
(ton)

Table 4.3.8 Monthly Total Waste Water Discharge along the Coast of Study Area

Item / Month	Suspended Solids	BOD	N	P
January	340	720	110	55
February	210	430	64	32
March	30	53	4	2
April	27	28	2	1
May	23	28	1	1.5
June	230	470	68	34
July	220	450	66	33
August	290	610	90	45
September	270	570	84	42
October	360	770	120	59
November	350	730	110	56
December	370	790	120	60
Total	2,700	5,650	840	470

(ton)

Fig. 4.3.4 Sea Ecology Pattern



(b) The impact of industrial waste water

The waste water of tapioca starch mills is composed of the flume discharge and separator discharge. The flume waste water include the sand and soil, chips of tapioca and other admixtures. But this waste water has a low BOD and include more inorganic matters than organic matters. The separator waste water, on the other hand has a high BOD concentration because of much dissolved organic protein and sugar. The concentration of the non-treated waste water is estimated to be 3,000 ppm in BOD, 2,000 ppm in SS, 140 ppm in N and 60 ppm in P.

With the stabilization system, it is estimated that the removal rates of BOD, SS, N and P are 25∿35% of BOD and 30∿40% of SS, and removal effect of N and P is small. Therefore, the concentration of waste water in the study area may be assumed to be 2,000 ppm of BOD, 1,000 ppm of SS, 140 ppm of N and 60 ppm of P. If the waste water is discharged to the river, the concentration of the waste water will be reduced by dillution and diffusion. But the concentration may remain high enough to have great effect on river ecology.

The waste water will also have strong impact on marine ecology. For example, these waste water include high volume of P.O.M. (Particulated Organic Matter) & D.O.M. (Dissolved Organic Matter). If the waste water is discharged into the sea, some part of organic matters may be degraded into H_2O and CO_2 caused by food chain in marine ecology, or may turn into harmful organic matter such as H_2S, CH_4, NH_3 by bacteria under an aerobic condition. The abnormal chemical compositioned ecosystem sea water may disturb the food chain reaction and marine ecosystem. Sea water under such condition may result in occurrences of harmful phenomena, such as red tide. Fig. 4.3.4 shows a system of possible reaction.

(c) Estimated water quality in future

As stated before, the main source of contaminants in the Pattaya coastal area is the waste water discharged from tapioca starch plants.

The rough estimate of the condition of water quality in 1996 is made in the following paragraphs.

As indicated in the sewerage section of chapter 5, the existing rate of the industrial waste water discharge is estimated to be 5,000 tons/day. As described above, since the waste water from tapioca starch plants accounts for 97% of the total waste water in this area, it may be assumed here that the rate of 5,000 tons/day is the quantity of the waste water from these tapioca starch plants. Further, the quality of waste water from tapioca plants can be classified into two classes depending upon the type of plants, namely those having the concentrations of 4,500 and 1,500 ppm. Assuming that the waste water flow into sea

through rivers as their discharging passages with their assumed intertrap of 0.5, the waste water has the concentrations of 2,250 and 750 ppm, respectively, as it flows into sea. Since the waste water is discharged into the passages in a mixed form, it may be assumed here that the waste waters flow into sea at the concentration of 1,500 ppm. Subjecting these parameters to a calculation using the Joseph-Sendner's formula will bring the point where the waste water having the concentration of 1,500 ppm is diluted to become 1 ppm at the outside of a circular arc with a radius of 1,400km. Therefore, if the waste water is discharged from tapioca starch plants without being treated, a substantial effect will be produced on the water quality in the Pattaya coastal zone.

Joseph-Sendner's formula:

$$S = (S_o - S_1)\left[1 - \exp.\left\{-\frac{Q}{\pi pd}\left(\frac{1}{r} - \frac{1}{r_1}\right)\right\}\right] + S_1$$

where: S_o: Concentration at waste water discharge port (1,500 ppm),

S_1: Concentration at offshore point (assumed that $S_1 = 0$),

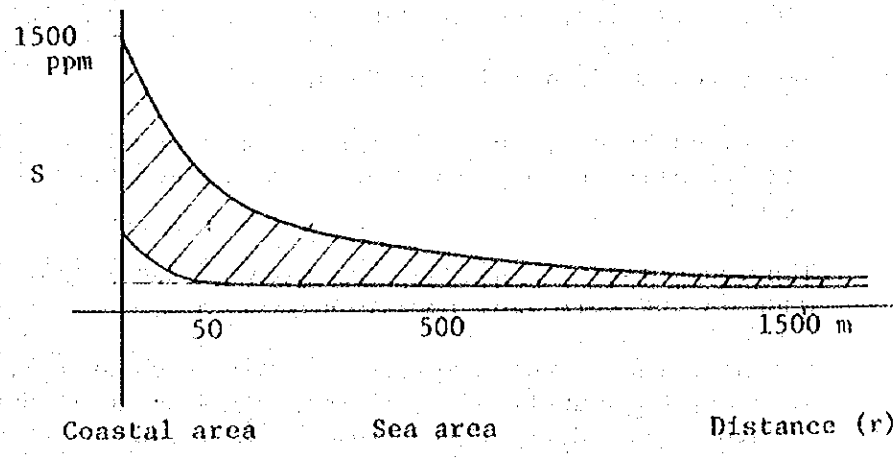
Q : Flow rate (5,000 t/d),

p : Diffusion rate (1 cm^2/sec.)

r : Distance,

r_1: Distance nullifying the effect ($r_1 = \infty$),

d : Mixing depth (d = 2m).



According to the proposed method of waste water treatment in the Master Plan, for an estimate scale of discharge rate of 41,800 tons/day in 1996, the estimated waste water quality becomes about 30 ppm. A calculation through the Joseph-Sendner's

formula using these parameters will determine the effective line as 250m in terms of radius. Therefore, an actual application of waste water treatment will permit the water quality in the Pattaya coastal area to be maintained at a fully allowable level. Further, as assured by the findings of the water quality survey, it is probable that an active self-cleaning capability found in this sea area will improve the water quality above the existing level, provided that the pollution due to the source from the upper Gulf is maintained as it is now.

Since the Joseph-Sendner's formula does not take account of the diffusion in the sea area, it may be suggested that the contribution of waste water to the effect on the sea water quality will be even smaller.

Under these conditions, trying to calculate the effect through the following formula presented by Iwai (Japanese) will give the concentration of 0.14 ppm at a point 50m offshore from the discharge port along the shore.

Iwai's formula:

$$S = \frac{q}{2d\sqrt{\pi \cdot K \cdot U \cdot X}}$$

where: d: Mixing depth (d = 2m)

K: Diffusion coefficient (K = 11.88 $cm^2/sec.$)

U: Flow velocity ($u = \frac{2\ U\ max.}{\pi} = 0.38$ m/sec.)

x: Distance

q: Load

4.3.4 Proposal of waste water treatment

According to the Master Plan, it is planned that waste water treatment facilities will be provided in 1986. These facilities will adopt an oxidizing pool process. As calculated in the following section, this process will have a remarkable effect on the maintenance of the water quality.

However, it should be noted that the process can remove a part of nutritious salts, but the rate of removal is still low. The nutrification by these nutritious salts is estimated to be doubled after 20 years from now as compared with the present level. Since the quantity of waste water itself will be also increased, and the treatment load will be kept almost at the same level as the present level, it is considered that potential of the future nutrification due to nutritious salts will be in the same order as the present potential.

On the basis of the aforementioned discussion, it is essential that a complete provision of waste water treatment facilities should be carried out along the Pattaya coastal zone in order to maintain the water quality.

Also, with waste water treatment facilities provided other toxic materials such as coliform, will cause little pollution problems at Pattaya beach in future.

4.3.5 External effects on the marine environment

The marine environment is more subject to the influence of external factors than land environment and the effect may come even from a distant source.

So far, we have discussed the effect of waste water discharge from within the study and the close vicinity of the study area and it is noted that with adequate provision of a sewerage system, the discharge from the study area can be maintained to such a level as not to cause any problems of environmental pollution to the sea of Pattaya. Here we shall carry one step further to examine the possibility of marine environmental pollution of the sea water of of Pattaya as part of the upper gulf of Thailand.

Generally speaking, being a part of the upper gulf of Thailand, the pollution of the sea of Pattaya is port and a parcel of the overall problem of water pollution of the entire upper gulf of Thailand. Despite a sewerage system being proposed in this report which will ensure that the sea of Pattaya will not be polluted by the activities through tourism development of the Pattaya resort, the possibility of deterioration of the marine environment of Pattaya will remain if the source of pollution is external.

The gulf of Thailand, on the whole is still free of pollution but the coastal waters, particular along the more developed region, is undergoing quite a rapid process of deterioration. The seas off the month of the Chao Phraya River, for instance, is much more advanced in pollution than the over waters due to the discharge of waste water from the metropolitan of Bangkok through the Chao Phraya River to the sea.

It is in fact suspected that even today, the waters of Pattaya may already be influenced by the pollution off Bangkok although to a small extent, because some of the floating matters found along the beach of Pattaya and the islands of Ko Lan and Ko Phai are said to have come from Bangkok.

It is thus a matter of importance that a general policy should be established for the maintenance of the environmental condition of the entire upper gulf of Thailand through controlling the quality of the waste water to be discharged into the gulf directly or indirectly through rivers and other water channels. The National Environmental Board is said to have started in this direction and it is hoped that their effort will result in the prevention of pollution of the marine environment of the entire gulf.

Looking at a closer range, the two concepts that are of concerned as far as regarding the marine environment of Pattaya are the proposal of a deep-sea port at Laem Chabang and the plan of

an industrial estate in the Laem Chabang region. Both will have major effects on the environment of Pattaya as a tourist resort. If a deep-sea port is constructed at Laem Chabang, the water off Pattaya, in the vicinity of Ko Phai Island may inevitably become a thoroughfare on the sea for boats coming into the port from the south. Besides the possibility of interference of ocean activities such as deep-sea fishing, by the sea traffic, the possibility of pollution of the sea surface through oil leakage or discharge of waste-water from the boats can be anticipated. Although this will not be so serious as to render Pattaya unsuitable as an ocean resort, the effect may still be quite great. If the construction of the deep-sea port is decided as a national policy, it is recommended that designation of the route of sea traffic be clearly made and strict enforcement of the designated route be made on the sea-faring boats. Also, strict regulations, accompanied by penalty on offence be established on the prevent of oil leakage and waste water discharge by the boats. Engineering steps may also be taken at the port to physically prevent the flow of oil or polluted water from Laem Chabang to Pattaya.

Industrial development will inevitably be accompanied by discharge of industrial waste water. Since the types, numbers, and scale of industries to be introduced into the planned industrial area is not known, the effect on the marine environment cannot be accurately assessed. However, due to the proximity between Laem Chabang and Pattaya, any pollution of the sea water at Laem Chabang will have a great repercussion effect on the marine environment of Pattaya. It is therefore of utmost importance that very strict criteria be set up for the types of industries that may be allowed in the proposed new industrial area in order to shut out any industries that are accompanied by discharge of detrimental waste both in quantity and in quality. It is also necessary to set up criteria on the quality of waste water that the industries may discharge into the public water channel, and any waste water that exceeds the criteria should be pretreated within the factory compound before discharge. the regulation should be accompanied by necessary penalty measures for offence and routine inspection should be carried out by the authority to ensure proper enforcement.

In the immediate neighbourhood, the existing tapioca factories that operate just outside the boundary of the study area should be given immediate attention. Data have shown that the discharge of waste water from these factories is the main contributing factor towards the deterioration of the marine environment in Pattaya. Although the sewerage system proposed in this report will also cater for the treatment of waste water from these tapioca factories, it will be several years before the facilities will come into full operation, and prevention of pollution by these factories for the next few years is an urgent step.

In the plan for the sewerage system it is proposed that the waste water from these factories should undergo pretreatment before being received by the public sewerage system for treatment. Such pretreatments by some of the existing factories prove to have high effect. It is therefore recommended that immediate steps be

taken to set up criteria for pretreatment and for the enforcement of the pretreatment requirement through appropriate legislative measures.

4.3.6 Necessity of monitoring of water quality

The quality of the sea water changes day by day according to external conditions. To ensure that the water quality is always compatible to a tourist resort, it is necessary that the monitoring of the water quality be made a routine procedure so that any necessary remedial steps or measures may be taken in time in case of any deterioration of the marine environment. The National Environmental Board has been carrying out regular water quality survey along the shoreline for the past months. It is recommended therefore that this routine procedure be maintained at all time and that the surveys be extended to cover also the quality of the water offshore.

It is also of great importance that the criteria for the water gradity of an ocean resort be established to serve as the basis for water quality control. For this purpose, the standard of water quality adopted in Japan is presented in Table 4.3.9 being on which the standard to be adopted in Thailand may be prepared, taking into consideration the local conditions of Thailand.

Table 4.3.9 Standards of Coastal Water Quality

Category	Item / Purpose of Utilization	Standard Values[2]				
		PH	Chemical Oxygen Demand (COD)	Dissolved Oxygen (DO)	Number of Coliform Groups[1]	N-hexane Extracts
A	Fishery, class 1: bathing conservation of natural environment and uses listed in B-C	7.8~8.3	2 ppm or less	7.5 ppm or more	1,000MPN/100 ml or less	Not detectable
B	Fishery, class 2: industrial water and uses listed in C	7.8~8.3	3 ppm or less	5 ppm or more	-	Not detectable
C	Conservation of environment	7.0~8.3	8 ppm or less	2 ppm or more	-	-

* With regard to the quality of fishery, class 1 for planting oysters, the number of coliform groups shall be less than 70 MPN/100 ml.

Notes: 1. Fishery class 1: For aquatic life such as red sea-bream, yellow tail, seaweed and those of fishery.

Fishery class 2: For aquatic life such as gray mullet, laver, etc.

2. Conservation of environment: Up to the limits at which no unpleasantness is caused to people in their daily life (including a walk by the shore, etc.).

Source: Environmental Laws And Regulations in Japan in 1976.

CHAPTER 5 INFRASTRUCTURE PLAN

CHAPTER 5 INFRASTRUCTURE PLAN

5.1 GENERAL

5.1.1 Policy

(a) In this chapter, basic planning, alternative study and rough cost estimation will be made based on the existing situation and the basic demands through the total development of Pattaya beach resort in the next 20 years.

Infrastructure plan includes the following systems and facilities.

(1) Water Supply System
(2) Sewerage System
(3) Storm Water Drainage System
(4) Solid Waste Disposal System
(5) Road and Street System
(6) Electric Power Supply System
(7) Telecommunication System
(8) Marina and Port Facilities

The plan will cover the study area up to 1996 in scope for the public investments, excepting the land owned by the private sector and the area which will have too low population density to warrant provision of public systems.

(b) Location of the project

Location of the project is the mainland which has sandy and rocky beaches of about 22km long and an island which is about 10km from the mainland.

The east boundary is a line 500 meters east of the Sukhumvit Highway which runs about 2 km to the east of the shore line.

The north and south limits extend from the south end of the buddhist college to the river of Na Jom Tiem.

(c) Basic requirements

Basic policy for the study on infrastructures are as follows:

a) To establish the necessary fundamental systems for the development of the resort and serve the local residents and communities.

b) To install the basic facilities necessary for the international beach resort.

Thus in the preparation of infrastructure plan, two major policies are considered. One is to establish the basic facilities for the international beach resort and the other is to define the necessary facilities for the service of the local residents and communities.

Although Pattaya is known as an international tourist resort, the infrastructure facilities are not adequate. There is a population of over 40,000 and about 3,600 hotel rooms to cater for the requirements of the tourist. However, the average occupancy rate of the hotels is generally rather low. One of the reasons may be the lack of infrastructures.

The implementation of all the proposed projects will require a long time and it will take three years before the first projects will come into operation and service. For this reason, in this report some suggestions have been made for the implementation of a small part of some of the projects as urgent programs in order to obtain immediate effect in the improvement of the resort.

5.1.2 Summary of cost estimation

(a) Total costs

Total project costs for all the infrastructure projects including the cost of land acquisition and construction and operating and maintenance costs up to 2006 is estimated to be 3,561.3 million bahts (178.1 million US dollars). The cost in the first ten years will be 1,743.7 in million baths (87.2 million US dollars) or roughly about half the total costs.

The breakdown of this 1,743.7 million baths is 1,214.6 million bahts in local currency and 529.1 million bahts (26.5 million US dollars) in foreign currency. The costs for the first ten years (Phase 1) by items are summarized as follows:

Item	Total	Local Currency portion	Foreign Currency portion	%
1.Water supply	473.3	277.2	196.1	27.0
2.Sewerage	230.4	161.4	69.0	13.0
3.Storm water drainage	145.8	142.7	3.1	8.5
4.Solid waste collection and disposal	56.4	40.5	15.9	3.5
5.Road & street	288.5	258.4	30.1	16.5
6.Electric power supply	252.5	142.4	110.1	14.5
7.Telecommunication	181.2	94.6	86.6	10.5
8.Port and marine facilities	115.6	97.4	18.2	6.5
Total	1,743.7	1,214.6	529.1	100.0
(Total in million US$)	87.2	60.7	26.5	-

(b) Cost estimation items

Cost estimates are made to an accuracy of about ±30% and cover the following items for the various infrastructure systems.

1) Construction cost (excluding tax)
2) Operation & Maintenance cost
3) Tax components
4) Land cost

The major items of the tax components are a 5% business tax and a import duty of about 50% on C.I.F. price for supplies to be imported from abroad. Since the infrastructure projects are investment by the government and exemption on import duty can be expected, the tax components are computed only for reference purpose.

5.2 WATER SUPPLY SYSTEM

5.2.1 General

In this section, suitable solution and planning are carried out to meet basic water demand for the present and the future. Studies are made on such items as water sources, transmission main, water treatment system and distribution system. For selection of the most suitable water sources, possibility of early implementation and completion was one of the major factors in making the final decision.

(a) Basic policies to meet the water shortage area

The east coast of the Gulf of Thailand has few water sources at present and in the future. Water shall be treated as one of the limited natural resources of the region. Under this situation the following basic policies will be taken not only in the construction process but also in the operation and the maintenance.

1) Reasonable charge

The rate of water charge will be decided with careful study in line with the established charging policy in Thailand for local residents and the acceptable level of rate to the tourism industry.

2) Recycling water

Although recycling system is generally considered as one of the ways to solve the problem of lack of water resource, in this study, this sophisticated system is not adopted for Pattaya after careful alternative studies for the reason of the extremely high incremental cost. The following lists the results of the alternative analysis.

a Total cost for the proposed alternative

Water supply	746.1 million baht
Sewage	421.8 million baht
Total	1,167.9 million baht

b Total cost for the alternative adopting recycling system

Water supply	641.6 million baht
Sewage	609.3 million baht
Others	50.0 million baht
Total	1,300.9 million baht

LEGEND

RAW WATER MAIN
PHASE I TRANSMISSION LINE
PHASE I DISTRIBUTION LINE
PHASE II TRANSMISSION LINE
PHASE II DISTRIBUTION LINE
URGENT PROGRAM DISTRIBUTION LINE
TREATMENT PLANT
URGENT PROGRAM SERVICE RESERVOIR
PHASE II SERVICE RESERVOIR
URGENT PROGRAM ELEVATED TANK
PHASE I ELEVATED TANK

N

0 200 500 1000 2000M

FIG 5.2.1 WATER SUPPLY SYSTEM

Note: In alternative (b) it is assuming that 80% of the sewage will be located by secondary treatment and 20% by advanced treatment.

3) Reducing of leakage

This study considers a possible leakage of 15% through the distribution lines. Careful choice of the materials and the workmanships shall be made in design and the construction stages, and appropriate maintenance procedures shall also be adopted to reduce water leakage.

4) Save-all instruments

Many kinds of save-all instruments have been developed recently on such end fittings as the improved taps and flush toilets etc. Encouragement of the use of these instruments will also contribute to water saving.

5) Definite usage of the well water

Well water shall be controlled so as not to disturb natural recycling. The allowable capacity which is generally less than the volume replenished in nature may be ascertained by field investigations.

5.2.2 Existing situation

(a) Water supply system at Na Klua and Pattaya area

1) At the Na Klua area, a public water treatment plant supplied by the Department of Public Works is operating at a capacity of 40 cu.m per hour and is capable of supplying water to about 5,000 residents. The rate of water charge per cu.m of water is 2 Baht.

2) At the Pattaya area, there is no public water supply system at all. Water resources for this area are by shallow and deep wells, direct storage of rain water and supplemented by truckloading of water. The service ratio between well water and truckloading water for hotels and restaurants depend upon the quality and quantity of water from wells and room occupancies or number of guests. Some hotel reports supplying 30% of water from wells and the remaining by truckloading at peak days. Others report that all water demand is met by well water. Only the hotels and restaurants which are located on a rich underground flow may intake sufficient water to meet demand.

In the dry season water from wells become brackish and sometimes has a large iron oxide content which must be removed before being treated by water softeners and other suitable plants. (Softing cost is said to be 1 baht per cu.m.) This situation may be deteriorated by excessive intake beyond safety capacity from wells. This overpumping may also draw salt water and even sanitary waste water too. Using this kind of low quality and unhealthy water is dangerous to the health and sanitation of the consumers in general.

3) This self sustaining pattern in which the water users have to provide themselves with water is causing not only a great loss economically but also a dangerous situation in the health condition.

4) One hotel is said to have a long pipeline laid to water source at their expenses. Another is having the concept to transport water by a water tanker. A manager of the major hotel said his hotel may contact the plant makers which will be able to provide the distillation plants for distilling of sea water.

5) The present average consumption of water in the hotel complex is about 2.1 cu.m. per room per day. The average drinking water consumption is 1.5∿2.0 litres per room per day.

6) Only one hotel denied the need of any public supply system in the study area, of the 9 hotels and 6 restaurants which have been interviewed by the study team during field survey.

(b) Water resources to be developed and to be investigated for the study area.

In this section several possible water resources are described roughly. Alternative study among them are presented in subsequent sections.

1) Concerning this subject, NESDB'S report by Water Resources Planning Subcommittee, the "Feasibility Report on Water Supply for Pattaya-Banglamung", August 1976 is the best reference and includes such useful data as:

a. Existing water consumption pattern in Pattaya

b. Alternative study on the three reservoirs of Bang Phra, Dogkrai and the controversial Mabprachan.

c. Water rate for Pattaya

2) According to the Public Works Department, a plan is in hand to carry out detail design for the water main between Bang Phra reservoir to the study area in 1977 to be completed by mid 1978. At that time, a final decision will be made on whether Mabprachan project will be restarted.

3) By the rough schedule, Pattaya area may be supplied with fresh water in July 1980 if implementation proceeds smoothly or in 1981 if some delay is encountered. But in the case of Mabprachan reservoir, it is not yet known when the implementation of the controversial reservoir will be restarted.

5.2.3 Water demand

The basic water demand in the future are estimated basing on the following assumptions, and summarized in Table 5.2.1.

(a) For households in the service area, the water demand for each key year is calculated based on the unit demand per day per capita, which is 210 liter to 240 liter, taking into consideration the population at each key year and the rate of service to the population. The system will cover all of residents in Na Klua and new residential areas and 70 percent of population of the other areas.

(b) For hotels, the water demand is estimated from the daily unit demand per room which is 2.9 cu meter and the number of rooms in each year.

(c) For low density accommodation areas such as villas and summer houses, the water demand is to be the same as that for hotels.

(d) For day trip visitors, the water demand for each key year is calculated based on the unit demand of 70 liter per day per capita, and the design number of the visitors.

(e) The water demand of restaurants, night-clubs, shops, etc., is assumed to be included in that estimated for household use.

(f) Industrial water is estimated at 5,000 m^3/day.

Basing on the above basic requirements, the maximum daily demand is calculated as shown on table 5.2.2. The annual water demand is computed using the following formula, and the results shown in Table 5.2.3.

$$A.W.D = \text{Mean } D \times 365 = k \times \text{Max. } D \times 365$$

where, A.W.D = Annual water demand (m^3/year)

Max.D : Maximum daily demand (m^3/day)

K : Co-efficient = $\frac{\text{Mean Daily Demand}}{\text{Max Daily Demand}} = 0.70$

Mean D: Mean Daily Demand (m^3/day)

Table 5.2.1 Unit Demand of Water Supply

Year	Resident (l/p.d)	One day visitor (l/p.d)	Hotel & villa (m^3/r.d)
1981	210	70	2.9
1986	220	70	2.9
1991	230	70	2.9
1996	240	70	2.9

* It is assumed that the quantity of escape is the 15% of the Unit Demand.

Table 5.2.2 Water Demand (Max. Daily Demand)

Item / Year	Resident				One Day Tripper				Hotel (Including Bungalow)						Villa (South of Pattaya Hill)			Industry	Total
									Existing			Newly							
	Population (Person)		Unit Demand (l/p.d)	% of Service	Water Demand (m^3/d)	Population (Person)	Unit Demand (l/p.d)	% of Service	Water Demand (m^3/d)	No. of Room	Unit Demand (m^3/R.d)	Water Demand (m^3/d)	No. of Room	Unit Demand (m^3/R.d)	Water Demand (m^3/d)	No. of House	Unit Demand (m^3/R.d)	Water Demand (m^3/d)	(m^3/d)	(m^3/d)
1,981	*1	25,700	210	100	5,400	5,500	70	100	400	3,270	2.9	9,500	-	-	-	-	-	-	5,000	23,100
	*2	19,030	210	70	2,800														
1,986	*1	35,000	220	100	7,700	7,500	70	100	500	3,270	2.9	9,500	530	2.9	1,600	370	2.9	1,100	5,000	28,300
	*2	19,030	220	70	2,900														
1,991	*1	46,460	230	100	10,700	10,000	70	100	700	3,520	2.9	10,200	2,830	2.9	8,200	740	2.9	2,100	5,000	40,600
	*2	22,740	230	70	3,700														
1,996	*1	57,460	240	100	13,800	12,000	70	100	900	3,520	2.9	10,200	4,930	2.9	14,300	1,110	2.9	3,200	5,000	51,200
	*2	22,740	240	70	3,800														

* 1. The population lives in the Town and Hotel area.

* 2. The population lives in other area.

Table 5.2.3 Annual Water Demand

Year	Mean Daily Demand (m^3/day)	Annual Demand (m^3/year)
1981	16,200	5,900,000
1986	19,800	7,200,000
1991	28,400	10,400,000
1996	35,800	13,100,000

5.2.4 Quantity of intake

According to J.W.A.S. (Japan Waterworks Association Standard), the quantity of intake is recommended at 110% of total water demand in the service area. Following the Standard, the total annual quantity of intake is estimated as in the following table.

Table 5.2.4 Total Annual Quantity of Intake

Year	Annual Intake (m^3/year)
1981	6,500,000
1986	7,900,000
1991	11,400,000
1996	14,400,000

5.2.5 Source of raw water

There are no water sources in the study area which will provide raw water in the necessary quantity, so that alternative sources were studied by the study team as follows:

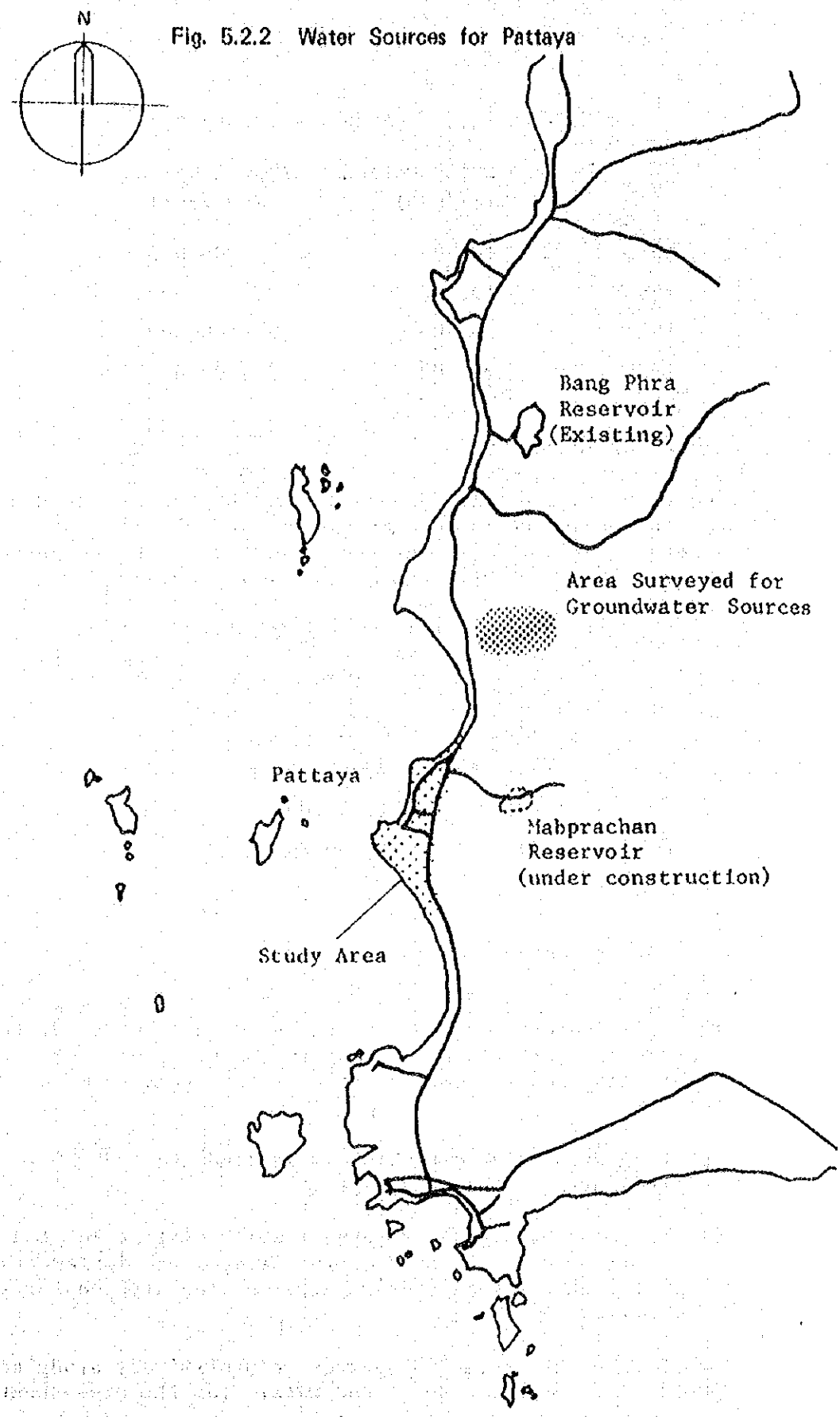
(1) Bang Phra reservoir which is located about 35 km in the north of the study area.

(2) Proposed Mabprachan reservoir which will be located about 6 km in the east of the area, where implementation of which may soon restart after having stopped for some years.

Other than the above two sources, a preliminary study on the possibility of the underground water from the area about 15 Km in the north of Pattaya was also under consideration.

The general location of the alternative water sources are shown in Fig. 5.2.2. and further description is given below.

Fig. 5.2.2 Water Sources for Pattaya



(a) Bang Phra reservoir

Under present condition, the storage capacity of the reservoir is about 110.0 million cu.m and has enough quantity to allow annual intake of 14.4 million cu.m for consumption in Pattaya in the 2nd phase, which is about 13% of the storage capacity of the reservoir.

This reservoir is considered a most feasible one for water supply to the study area, after comparative study.

(b) Mabprachan reservoir

From the information and interview on this controversial reservoir, it was learnt that the dispute over its implementation has not been wholly settled.

According to study by R.I.D for the reservoir construction, the storage capacity is 14.8 million cu.m and its active storage capacity is assumed to be 10 - 12 million cu.m which is about 75 percent of the quantity of the annual intake requirement for 1996 in the study area.

In spite of its smaller storage capacity than Bang Phra, the reservoir is the nearest and a more manageable reservoir to the Pattaya area if its construction will be finished at an early date.

The prospect of Mabprachan reservoir which is the nearest one to the study area is not known yet, and the time of its completion cannot yet be predicted. Considering this complication and the actual water shortage problem in the study area, as a preliminary direction to get water sources, the study team adopted the following fundamental method.

(1) From existing Bang Phra reservoir in both phases 1 and 2.

(2) From Mabprachan reservoir as well in phase 2.

This decision was made considering the complication on implementation and the relatively small capacity of the reservoir in the Mabprachan project, so that new water sources will eventually be required in the future even if intake is from this source in the early stage.

5.2.6 Raw water main

Alternative studies on the main are carried out on the condition that the treatment plant has to be installed at the Na Klua area.

(a) Alternative 1

This line is a direct transmission system to the plant from the Bang Phra through all phases.

Construction cost	188 million bahts
Length of the main	35 km
Facilities	*One intake pump station *Two transfer pump station

(b) Alternative 2

In Phase 1 water will be supplied from Bang Phra reservoir. In Phase 2 same quantity will be continuously served from Bang Phra and supplemented by water from Mabprachan reservoir.

Construction cost	267 million bahts
Length of the main	41 Km (35 Km, 6 Km)
Facilities	*Two intake pump stations *Two transfer pump stations

Bang Phra line will also provided raw water to the residents and industries on the way to Pattaya, in a quantity of 28 million cu.m per year. (From the results of studies on the feasibility analysis report titled "Water Supply for Pattaya - Bang Lamung", August 1976 by Water Resources Planning Subcommittee of National Economic and Social Development Board, the total demand on these users on the way to Pattaya was estimated at 28 million cu.m per year which the study team considered a possible estimation on alternative study in this period.)

(c) Alternative 3

Same procedure but no water will be supplied to the local residents and industries on the way to Pattaya.

Construction cost	133 million bahts

Judging from the alternative studies for the source of raw water and raw water main, the study team recommend alternative 3 as the most adequate system for the raw water main under the following two aspects. The first aspect is that alternative 3 will provide the most economical solution and the other is the solution has to fulfil the future requirement of the demand in the study area, therefore the unknown demands by the users such as local residents and industries along the main pipe route before Na Klua Station should not be reflected on the raw water main design.

5.2.7 Water treatment plant

(a) Location of water treatment plant

In selection of the location of the water treatment plant, the following three alternatives are studied.

1) Alternative 1 In a location close to Bang Phra reservoir

By providing a water treatment plant close to the existing Bang Phra reservoir, treated water will be transmitted to the Pattaya area by a pipeline and on the way to Pattaya area, villagers and other users will also be supplied with clean water. This method will be economically desirable in the case of providing a regional integrated water supply system.

2) Alternative 2 In a location close to Mabprachan reservoir

By constructing a water treatment plant near Mabprachan reservoir, treated water will be sent to the study area by a pipeline, and on the way to the study area if villages will also be supplied with clean water, further benefit in economy is obtained.

3) Alternative 3 In the study area

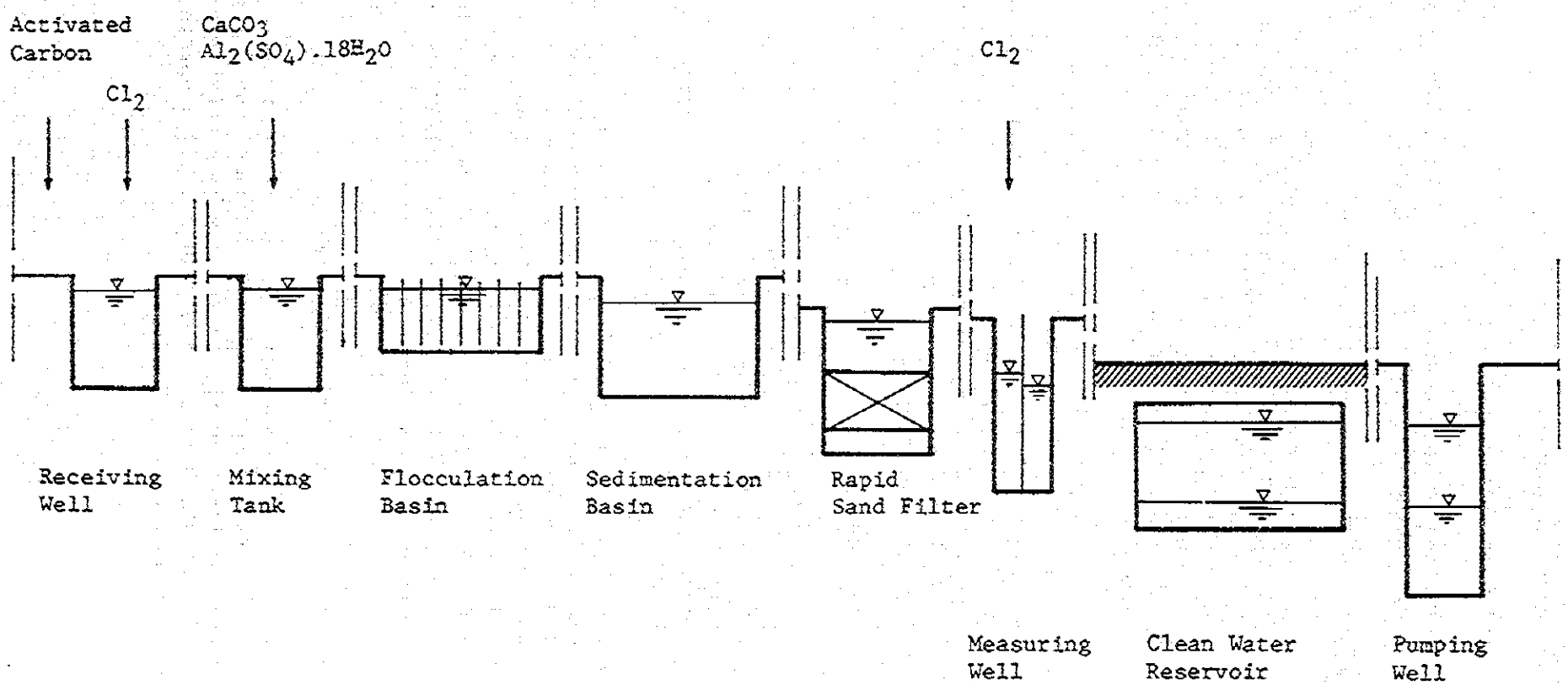
In the case of providing a water treatment plant in the study area or its surrounding, raw water will be sent to the plant to be treated into clean water. This alternative will be most favourable if raw water is to be supplied from plural sources, not only from the economic aspect but also from the engineering point of view.

Of the above alternative locations for plant, the study team recommend the constructing of the treatment facility in Na Klua or its surrounding which is located at the north end of the study area because total demand after 20 years will have to be supplied from both Bang Phra reservoir and Mabprachan reservoir. This method will be most economical and reasonable to provide a sound and realistic solution for the implementation on Pattaya's development at this stage.

(b) Capacity of water treatment plant

Water treatment plant will be planned to treat raw water to meet the requirements by W.H.O. standard and designed to be capable of treating raw water from Bang Phra reservoir, the quality of which is shown on Table 5.2.5 according to the N.E.S.-D.B's report mentioned before.

Fig. 5.2.3 Flow Chart of Water Purification Facility



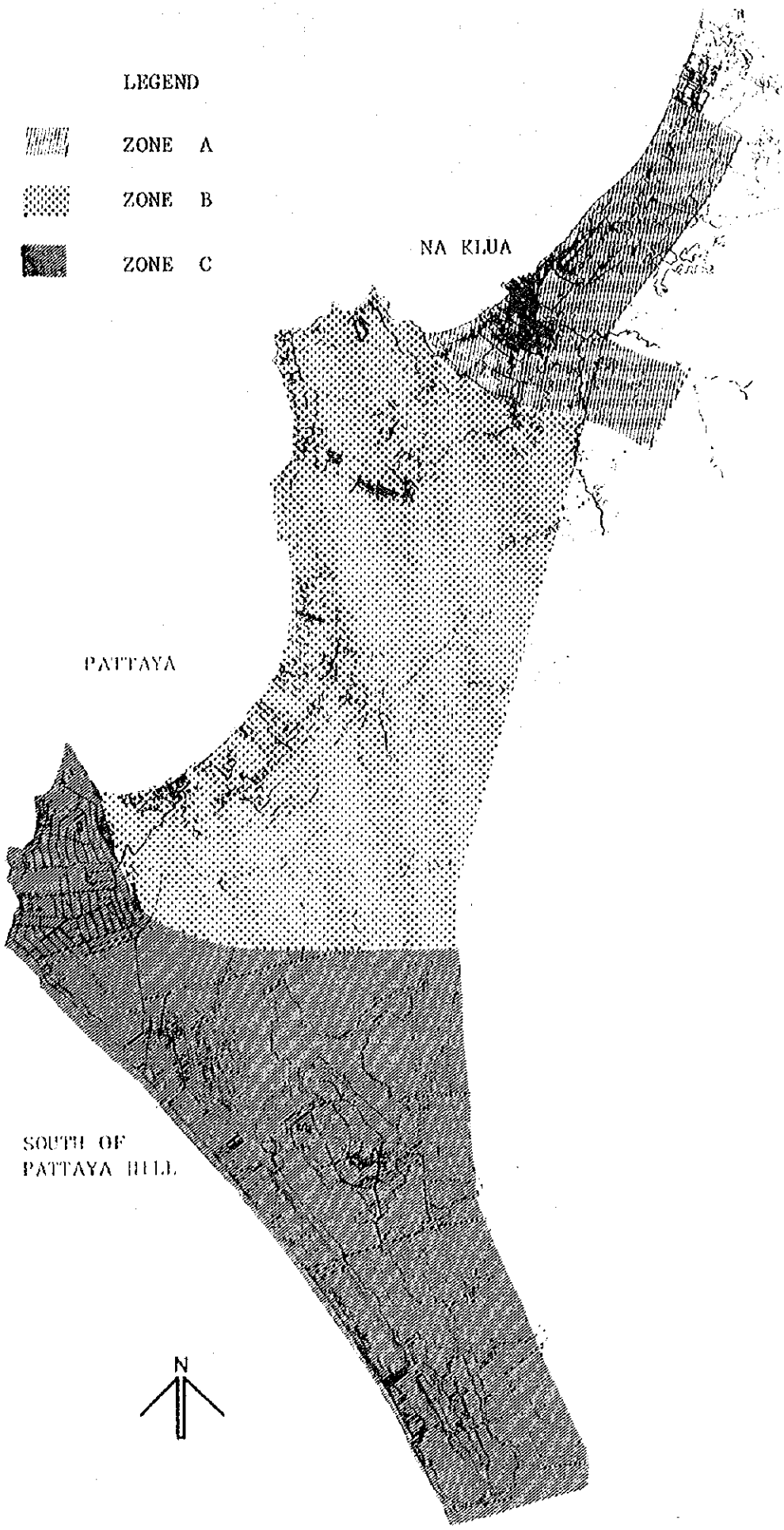
Following the data by the N.E.S.D.B report, it seemed possible to treat raw water by slow sand filtration plant, although high density duckweed is found to form at the flock of the sedimentation basin in the existing Bang Phra treatment plant. The removal of duckweed was thus also taken into consideration in planning the treatment plant at the study area.

A possible method of treatment for consideration is shown in Fig. 5.2.3 which will be a combined system of chemical sedimentation basin and rapid sand filter. Duckweed removal may be by chlorination system with activated carbon or micro strainer. Based on the daily maximum demand method which shown on Table 5.2.2, the treating capacity in Phase 1 will be 23,100 m^3/day for Stage 1 (1976-1981), a further 5,200 m^3/day for Stage 2 (1982-1986) and in Phase 2 (1987-1996) an additional 22,900 m^3/day will be added for a total of 51,200 m^3/day.

Table 5.2.5 Quality of Raw Water from Bang Phra Reservoir

No.	Item	Data
1	P^H	7.53
2	Acidity ($CaCO_3$)	8.40 mg/ℓ
3	Alkalinity ($CaCO_3$)	49.00 mg/ℓ
4	F_e^{++}	0.08 mg/ℓ
5	Hardness ($CaCO_3$)	26.00 mg/ℓ
6	Turbility	14.00

Fig. 5.2.4 Water Supply System Distribution Area



5.2.8 Water distribution system

(a) Basic arrangement

The water distribution system at the study area is divided into three distribution zones which are shown on Fig. 5.2.4.

Zone "A" is for Na Klua area, zone "B" is for Pattaya area where existing hotels, restaurants, shops and others are located, and zone "C" is south of Pattaya hill where at present there is less development but heavy development is planned in the future.

In zone "A" an elevated water tank will be provided for distribution. A service reservoir and an elevated water tank will be planned for both zone "B" and "C" at the locations shown in Fig. 5.2.1.

The capacity of service reservoirs are planned at one third of the design daily maximum demand, or at the service volume in 8 hours service and also to include fire fighting water conforming to requirements of J.W.A.S. (Japan Waterwork's Association Standard) as shown in Table 5.2.6.

The design population in the service area in phase 2 is shown in table 5.2.7 and the capacity of service reservoir will be as follows:

For	zone "A"	3,900 cu.m
	zone "B"	6,100 cu.m
	zone "C"	8,100 cu.m

The capacity of elevated water tanks for the three zones in phase 2 is shown in Table 5.2.8.

(b) Distribution network

The design of distribution network has to base on several engineering requirements and selection of materials.

1) Service pressure shall be so determined as to insure 1.5 Kg/cm^2 throughout the distribution networks.

2) For hotels, public water distribution will be provided to the front of the private land, and hotels shall prepare pond and pumping units if necessary at their own expenses.

Table 5.2.6 Required Capacity of Service Reservoir for Fire Fighting in Addition to Basic Capacity (by population)

Population (persons)	Capacity for Fire Fighting (m^3)
Less than 5,000	50
10,000	100
20,000	200
30,000	300
40,000	350
50,000	400

Note. According to J.W.W.A. Standard.

Table 5.2.7 The Design Population in the Service Area on Phase-II

Zone	A	B	C
House hold	25,680 persons	39,740 persons	14,780 persons
Hotel	-	2,780 Rooms x 1.6 Persons x 0.85 = 3,780 Persons	5,670 Rooms x 1.6 Persons x 0.85 = 7,710 persons
Villa	-	-	1,110x5.0x0.85 =4,720 persons
Sub-total	25,680 persons	43,520 persons	27,210 persons
Capacity for Fire Fighting	300 m^3	400 m^3	300 m^3

Table 5.2.8 Capacity of Elevated Water Tank for the Three Zones

Zone	A	B	C
*Capacity	450 m^3	700 m^3	1,000 m^3

* Max. Hourly Demand x 30 minutes

3) The pipe size and velocity of flow shall conform basically to Hagen-Williams' formula.

4) The basic velocity of flow shall be in the range from 0.7 m/sec to 1.4 m/sec to ensure economy.

5) Pipes of diameter larger than 400 mm may be ductile cast iron pipe (D.C.I.P) with interior mortar lining, and the joints shall be mechanical joints or others

6) Pipes of diameter smaller than 350 mm may be asbestos cement pipe or others to be determined after detail studies.

7) Pipe shall be laid as much as possible in the road way or pedestrian way and other public zones.

Fig. 5.2.5 shows the water balance for the study area.

5.2.9 Urgent program

It is recommended to install some temporary distribution facilities of raw water as an urgent program to serve the developed tourist area at Pattaya. The design daily maximum volume will be 1,400 cu. meter assuming an existing unit daily demand of 2.0 cu. meter per room, and a peak room occupancy rate of 60% and a saving ratio of 50%. Some part of the service reservoir and an elevated tank in the supply zone B will be constructed. Distribution lines will be provided from an elevated tank through the Pattaya hotel area along the beach road to downtown area.

5.2.10 Ko Lan island

In phase 2 the total demand of water supply for Ko Lan island will be 1,700 cu.meter per day.

Alternative studies were made from the following methods.

(a) to transport clean water from the mainland by a pipeline

(b) to transport clean water from the mainland by water barges

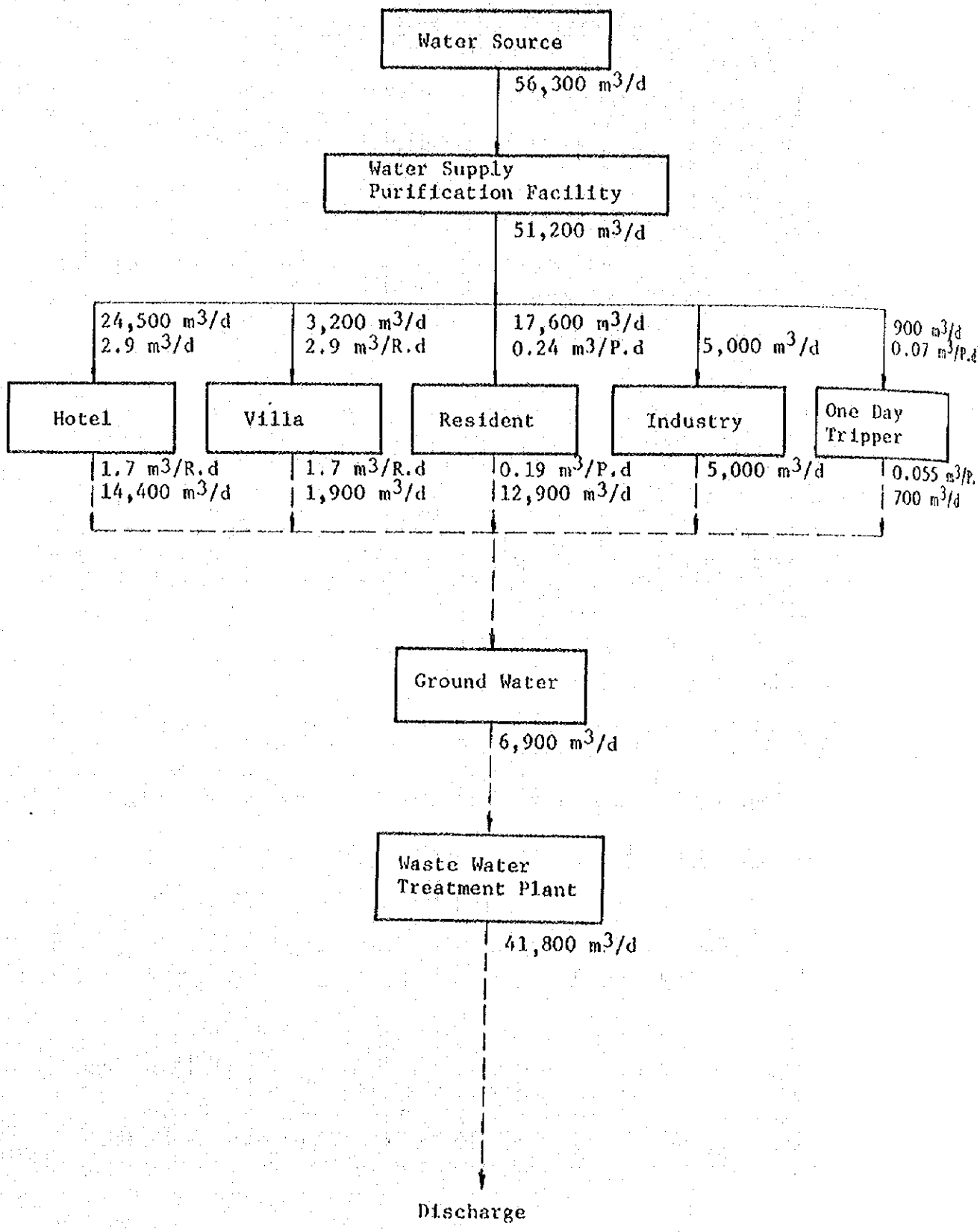
(c) to collect rain water into a reservoir and to treat the water on the island

(d) to distil sea water

The total cost for method (a) is 146 million baht including 133 million baht for the submerged pipe line.

The total cost for method (b) is 26 million baht including 13 million baht for three 400-ton water barges.

Fig. 5.2.5 Water Balance in Study Area

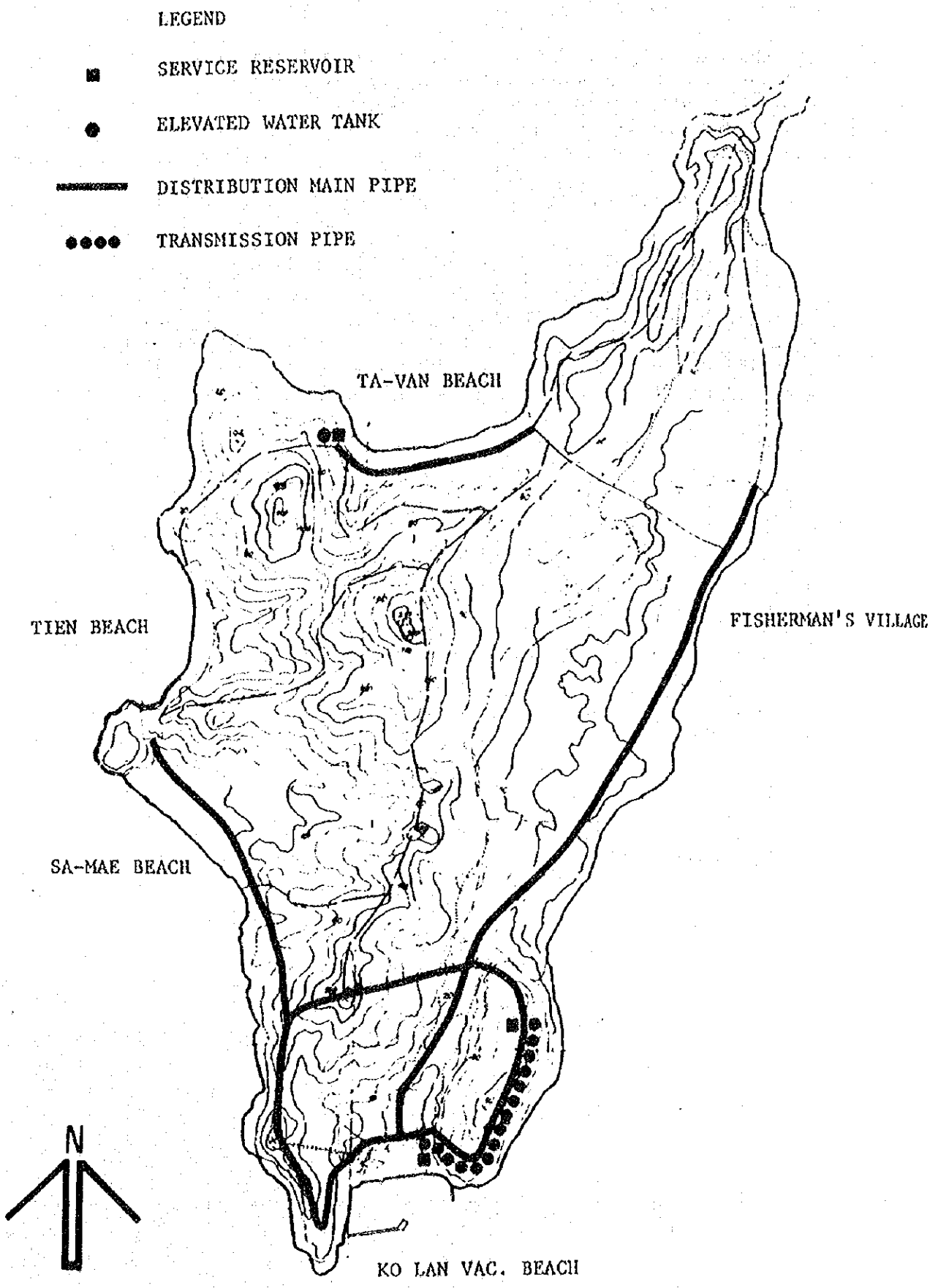


In the case of method (c) it will require installing rain water reservoir of 180,000 cu.meter in capacity, and it will not be so easy to store rain water in the island during the dry seasons. This system will be considered only as a supplementary method.

Item (d) is not justified for the reason of extremely high cost.

In comparing the alternatives, the method of conveying treated water by barges is considered most favorable. Water barges will receive water which will be supplied from the plant through piers at the marine facilities and unloaded at the jetties on the island. The barges will make two trips a day for the peak demand. The water supply distribution network is shown in Fig. 5.2.6.

Fig. 5.2.6 Water Supply System in Ko Lan Island



5.3 SEWERAGE SYSTEM

5.3.1 General

In this section, suitable solution and planning are carried out to meet basic sewerage system requirements for the present and the future. Studies are made on such basic items as forecasting of quantity of sewage, sewerage system, especially for the tapioca factories, methods of discharge and locationing of main facilities.

Waste water by the tapioca factories have influenced severely the existing natural environment and also will greatly affect the size and the grade of the sewerage system. Although there is a possibility that the factories may be removed to some other industrial zones by enforcement of the law, this study is made based on the assumption that the factories will operate at present production capacity within the study period.

5.3.2 Existing situation

The existing situation of sewage and sewerage system in the study area may be itemized as follows:

(a) In Na Klua Sanitary District, a simple public sewerage system is existing at the estuary area of Na Klua River. This system consists of pits and drainage ditches along the road and street without any treatment plant. Sanitary waste water runs to the waterways or to the sea through the ditches. This simple and primitive system is controlled by the Na Klua Sanitary District.

(b) On the Pattaya beach and south of Pattaya Hill there are no public sewerage system at all.

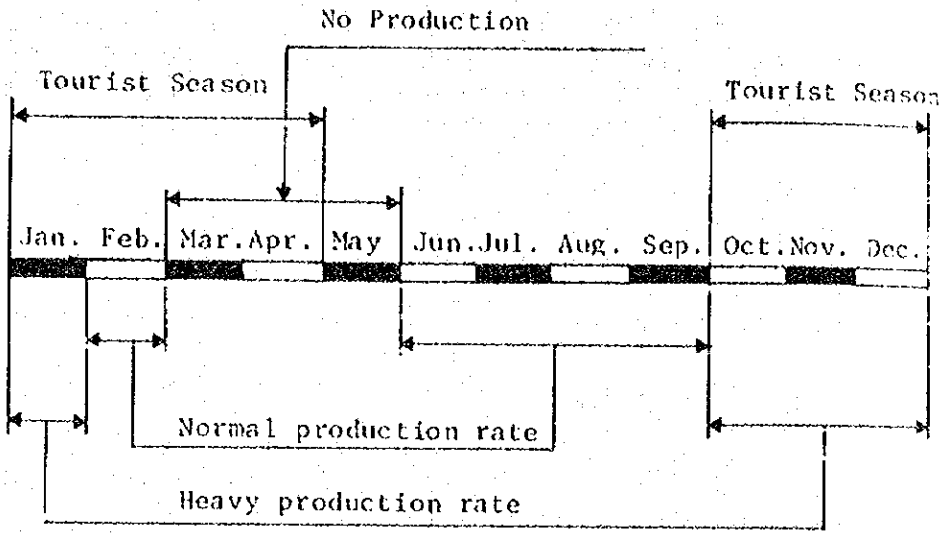
(c) Table 5.3.1 and Fig. 5.3.2 & 5.3.3 show the present and estimated future quantity and quality of waste water in the study area. The sea pollution in Pattaya is mainly from the following two sources.

1) Waste water discharged by Na Klua village and Pattaya resort, mainly from the tapioca factories around the study area.

2) General waste and pollution of the Gulf of Thailand itself, mainly from the rivers of Chao Phraya, Bang Pa Kong, and Tachin. Useful information are presented on the Study Report "Coastal Water Pollution Survey of Chonburi province" by Asian Institute of Technology in 1972.

(d) In Chonburi province 179 tapioca factories were in operation in 1976. 17 factories of these are in the study area,

mainly sited along the Na Klua River. The monthly production of starch of the three major factories are 270 tons, 720 tons and 1,800 tons. There are monthly fluctuations on production as shown below. It is noted that the factories carry heavy production on the dry season accompanied by plenty of waste water. The peak production season of the tapioca industry coincides with the peak tourist season.



The unit waste water per unit ton of production of starch is estimated to be 40-50. cu.m. in quantity in which B.O.D. (biochemical oxygen demand) and the S.S. (suspended solid) loads are about 3,000 to 7,500 mg per litre and 1,500 to 3,500 mg per litre respectively at the first grade factories and 1,200 to 4,200 mg per litre and 1,000 to 2,000 mg per litre respectively at the second grade plants. This extreme intensity of waste is characteristic of the starch production process. The waste water contains also nitrogen and phosphorous.

As a step towards the environment pollution prevention, the government of Thailand has prepared a guideline "Design Guidelines for Treatment of Waste Waters from Tapioca Starch Industry" in August 1976 and "Pollution Control in the Tapioca Starch Industry in Thailand" in Jan. 1977 by the office of National Environmental Board.

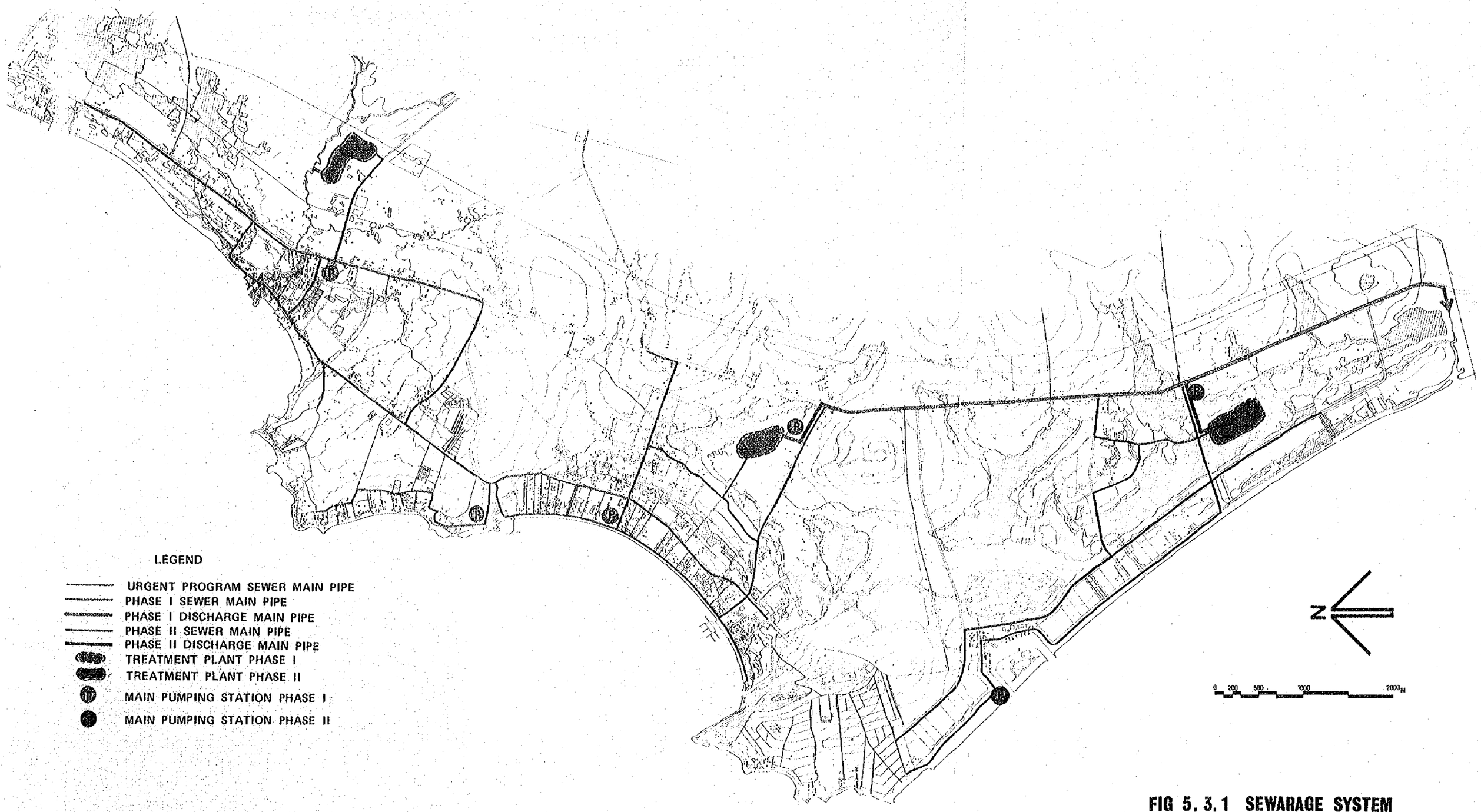


FIG 5.3.1 SEWARAGE SYSTEM

(e) Existing private treatment plant of tapioca factory

One of the major tapioca factories near the study area has constructed a stabilization pond system the data of which are as follows:

- Daily loading	2,400	m^3 per day
- Number of ponds	8	ponds
- Total area	3.3	hectares
- Quality of influent	13,280	ppm in COD
- Quality of effluent	240	ppm in COD
- Daily unit loading	9,658	kg per hectares in COD
- Duration	14.5	days
- Year of construction	1976	

This pond has the efficiency of 85% purification in a week.

(f) On the bottom of waterways and the sea at the Na Klua estuary, plenty of waste material is deposited and emits very strong odour and other pollutants, and is detrimental to the health of the residents. The thickness of sludge on the bottom may be more than 30 cm.

(g) At the Pattaya beach, a lot of waste water such as sanitary waste and fuel oil etc. is discharged directly to the sea by about 150 excursion boats and about 300 small boats and others.

(h) The existing situation near the most developed Pattaya beach are as follows:

1) Only recently built big hotels have their own waste water treatment plants.

2) Others, such as restaurants, shops and households discharge directly to the ground or to the sea.

3) Three large hotels have the machine and the sceptic tank to treat the water for recycling purpose. However, this kind of water is utilized only for garden irrigation.

4) There is no hotel that owns a complete recycling water system to produce clean water for human utilization.

5) Every hotel and restaurant strongly desires the construction and the operation of a public sewerage system as soon as possible.

Table 5.3.1 Quantity and Quality of Sewage

Area	Item / Year	(1) None Sewerage System					(2) Stabilization Pond System							Others		(A)	Ratio of Conversion
		Quantity				Quality	Quantity					Quality		Quantity	Quality		
		Residents & One Day Tripper (m^3/d)	Hotel & Villa (m^3/d)	Industry (m^3/d)	Total (m^3/d)	(a) BOD5 (kg/d)	Residents & One Day Tripper (m^3/d)	Hotel & Villa (m^3/d)	Industry (m^3/d)	Ground Water (m^3/d)	Total (m^3/d)	(b) BOD5 (kg/d)	(c) After Treatment (b)x0.15 (kg/d)	(m^3/d)	(d) BOD5 (kg/d)	(c)+(d) (kg/d)	(1-A/a)x100 (%)
A	1986	1,650	"	-	1,650	330											-
	1976	2,750	150	*1 2,400 *2 2,600	7,900	11,000											-
	1981	3,220	"	"	8,870	11,194	5,240	150	*3 5,000	1,680	10,070	2,178	327	480	96	423	96.8
	1986	4,850	"	"	10,000	13,430	4,150	"	"	1,900	11,400	2,400	360	500	100	461	96.6
	1991	4,650	"	"	10,800	13,580	5,140	"	"	2,060	12,550	2,558	384	510	102	486	96.4
	1996	6,510	"	"	11,660	14,252	5,380	"	"	2,210	13,360	2,726	409	530	106	515	96.3
B	1986	2,010	-		2,010	304	-	-	-	-							-
	1976	3,180	3,850		7,230	1,446	-	-	-	-	-	-					-
	1981	4,130	3,650		7,980	1,596	2,870	3,650	-	1,340	8,060	1,444	205	1,260	252	454	71.6
	1986	5,200	4,580		9,780	1,956	1,590	4,580	-	1,690	10,160	1,694	* 254	1,310	262	516	73.7
	1991	5,790	"		10,360	2,065	1,420	"	-	1,800	10,800	1,800	270	1,340	268	538	77.0
	1996	6,340	"		10,910	2,182	1,960	"	-	1,910	11,450	1,908	286	1,380	276	562	77.2
C	1986	440	-		440	88	-										-
	1976	730	1,990		2,720	544	-										-
	1981	780	1,990		2,770	554	-							2,770	554	554	0
	1986	810	2,790		3,600	774	-							3,620	724	774	0
	1991	1,950	2,130		9,280	1,856	1,590	7,130	-	1,760	10,580	1,764	265	460	92	357	80.8
	1996	3,050	11,530		14,580	2,916	2,590	11,530	-	2,820	16,940	2,874	424	460	92	516	82.3
Total	1986	4,120	-	-	4,120	826	-										
	1976	6,660	5,990	*1 2,400 *2 2,600	17,850	14,990	-										
	1981	8,140	5,990	2,600 2,600	19,620	15,344	9,110	4,000	5,000	3,020	18,130	3,522	529	4,510	902	1,431	90.7
	1986	10,860	7,520	"	24,400	16,100	8,240	4,730	"	3,590	21,560	4,094	614	5,430	1,086	1,701	89.4
	1991	13,360	17,060	"	30,420	17,305	11,050	12,060	"	5,620	33,730	6,122	919	2,310	462	1,381	92.1
	1996	15,900	16,260	"	37,160	18,852	13,510	16,360	"	6,960	41,350	7,458	1,119	2,370	474	1,593	91.5

*1 BOD5 loading is 400 mg/l
*2 BOD5 loading is 6,500 mg/l
*3 BOD5 loading is 300 mg/l
* others's BOD5 loading is 100 mg/l

Fig. 5.3.2 Total Quantity of Sewage (Except Ground Water)

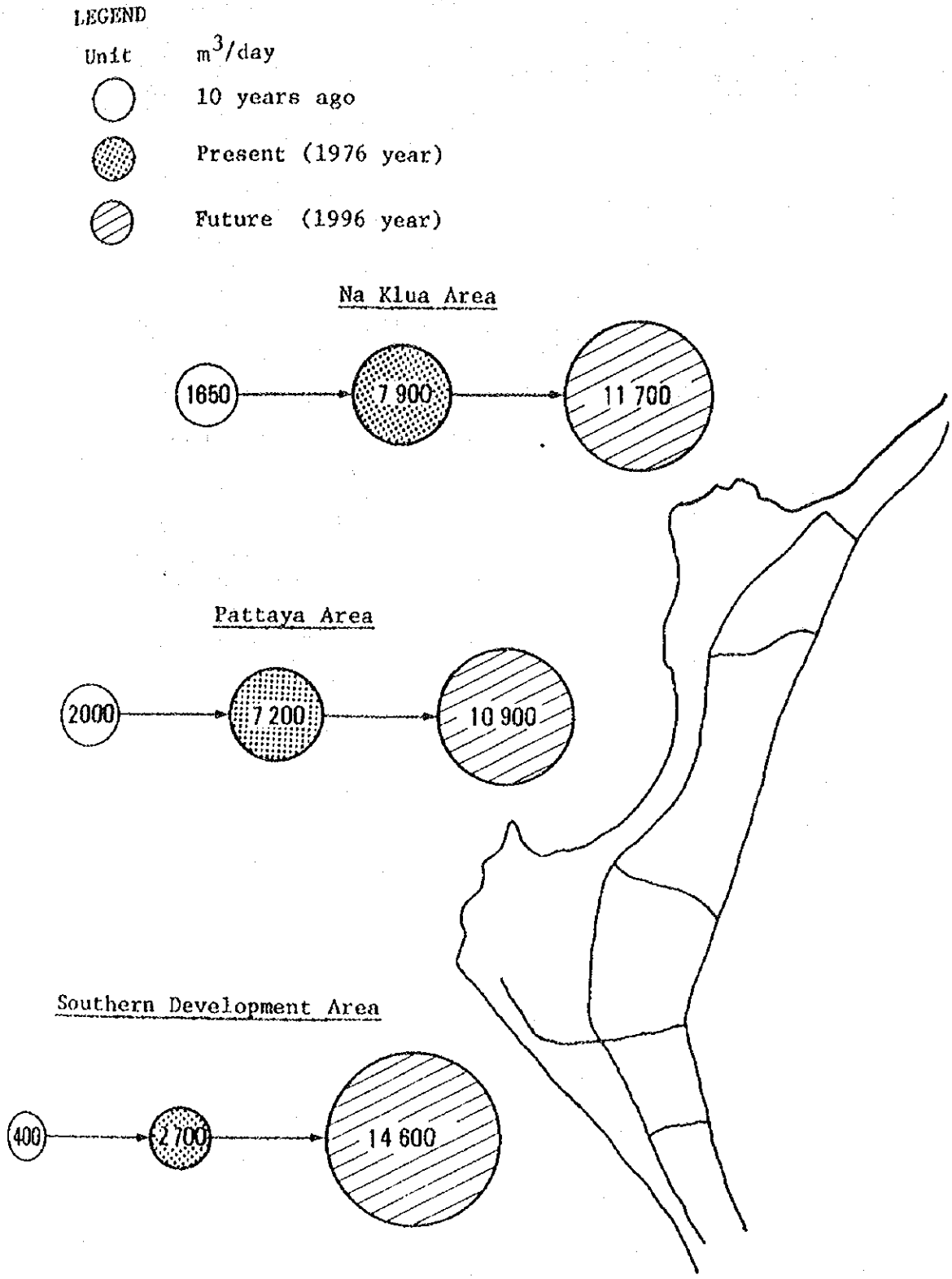
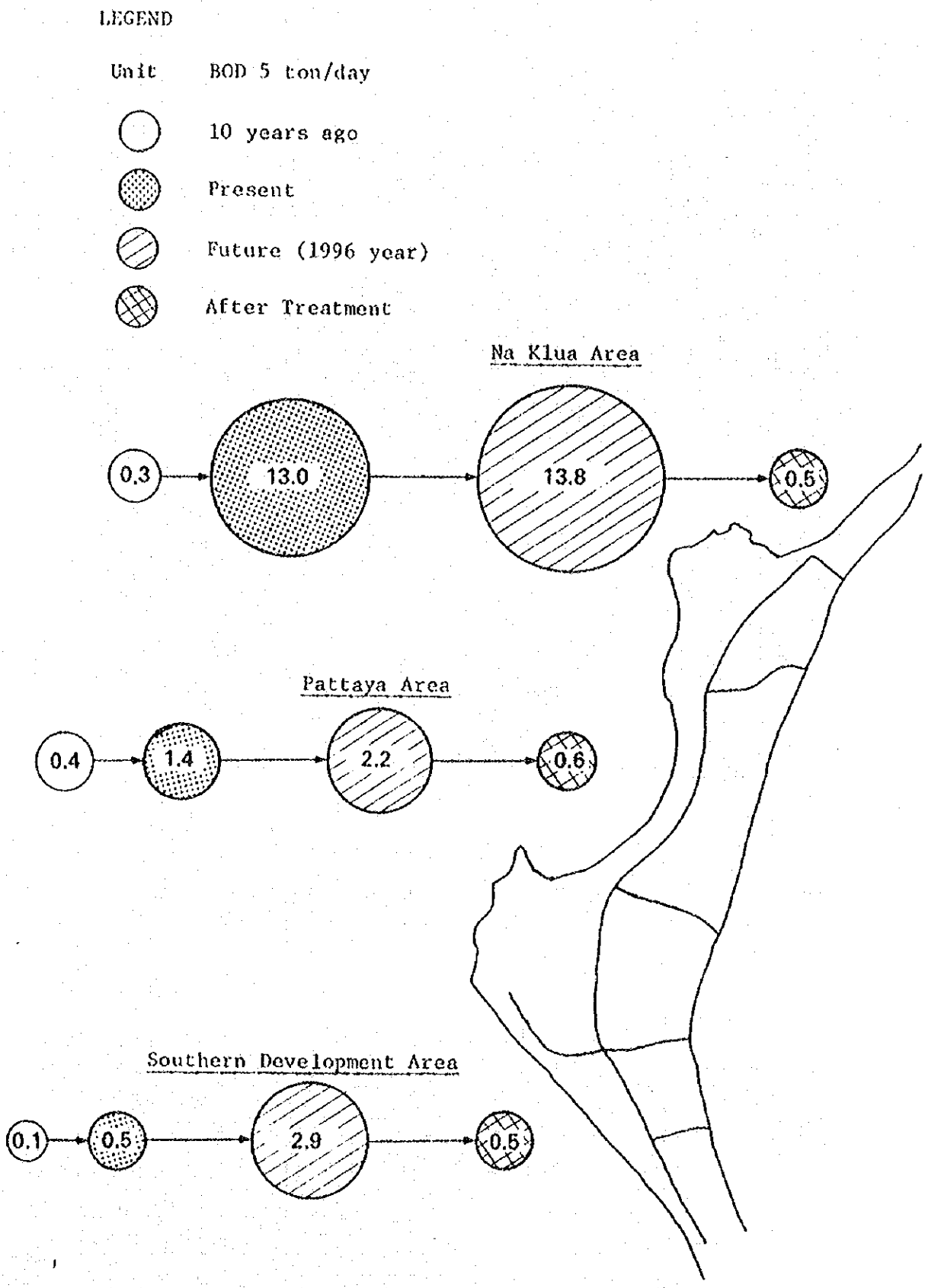


Fig. 5.3.3 Quality of Sewage



5.3.3 Quantity of sewage

The basic quantity of sewage is analysed for the three categories of hotel complex, industry, and residents including restaurants and shops.

(a) Hotel

The unit volume of sewage per room is estimated at 1.7 cu. meter per day which is calculated from the unit volume of water supply, excluding the quantity used for irrigation, swimming pool, air conditioning and lost through leakage of supply lines. The daily maximum volume are estimated from the above unit volume, the forecast total number of hotel rooms for the key year, assuming a service ratio of 100%. The quality of sanitary sewage is estimated to be 200 mg per liter in 5 day BOD and at 200 mg per liter in suspended solid.

(b) Residents

The unit daily volume per capita is estimated to be 95% of water supply volume, excluding leakage through the pipe and is assumed to include the sewage of the restaurants and shops. The daily maximum quantity is calculated from forecast populations and the service ratio which is planned at 100% for Na Klua village and the new residential areas, and 70% for residents along the existing roads. The quality of waste is assumed to be the same as that for hotels. The unit daily volume per day trip visitor is estimated at 55 litre which is calculated from the unit volume of water supply, excluding the quantity lost through leakage of supply lines. The quality of waste is assumed to be the same as for residents. The daily maximum quantity is estimated basing on the volume of peak day trip visitor demand and the service ratio is assumed to be 100%.

(c) Industry

In the study area, waste water by tapioca factories has a greater impact than other sources. From survey data collected in 1976, one ton of raw material will produce about 9 cu.m of waste water, and one ton of end product (starch) will result in waste of 43 cu.m in volume. The daily maximum volume of waste water from the tapioca factories is about 5,000 cu.m. Though there are some fluctuations in discharge rate, an assumption of constant discharge in waste water is made in planning of treatment plant. The quality of waste water by tapioca factories is estimated to be more than 4,500 mg per litre in 5 day BOD and with suspended solid at extremely high intensity. Thus the discharge is not only high in intensity but also large in quantity. But, in this study, the quality of the waste water is assumed to be 300 mg per liter in 5 days BOD with reference of section 5.3.5.

Table 5.3.2 shows the future total waste water in 5 years interval.

Table 5.3.3 lists the unit waste water discharge for the study area.

Table 5.3.2 Sewage Quantity

Item / Year	Resident					One Day Tripper				Hotel (Including Bungalow)						Villa (South of Pattaya Hill)			Industry	Ground Water	Total
		Population (Person)	Unit Demand (ℓ/p.d)	% of Service	Sewage Quantity (m^3/d)	Population (Person)	Unit Demand (ℓ/p.d)	% of Service	Sewage Quantity (m^3/d)	Existing No. of Room	Existing Unit Demand (m^3/R.d)	Existing Sewage Quantity (m^3/d)	Newly No. of Room	Newly Unit Demand (m^3/R.d)	Newly Sewage Quantity (m^3/d)	No. of House	Unit Demand (m^3/d)	Sewage Quantity (m^3/d)	(m^3/d)	(m^3/d)	(m^3/d)
1981	*1	25,170	170	100	4,300	5,500	55	100	300	*3 2,350	1.7	4,000	-	-	-	-	-	-	5,000	3,000	18,100
	*2	12,840	170	70	1,500																
1986	*1	36,470	180	100	6,200	7,500	55	100	400	*3 2,350	1.7	4,000	430	1.7	800	-	-	-	5,000	3,600	21,600
	*2	12,840	180	70	1,600																
1991	*1	46,460	185	100	8,600	10,000	55	100	600	3,520	1.7	6,000	2,830	1.7	4,800	740	1.7	1,300	5,000	5,600	33,700
	*2	14,610	185	70	1,900																
1996	*1	57,460	190	100	10,900	12,000	55	100	700	3,520	1.7	6,000	4,930	1.7	8,400	1,110	1.7	1,900	5,000	6,900	41,800
	*2	14,610	190	70	2,000																

* 1. Population of Town & Hotel area.

* 2. Population along the main street.

* 3. Except Royal Cliff Hotel and Asia Pattaya Hotel.

5.3.4 Decision on the type of sewerage system to be adopted (Separate type or combined type)

In this area, the annual rainfall ranges from 1,200 mm to 1,500 mm and the major part is expected to be precipitated in the rainy season. During dry season there will be little rainfall and the rain water will have no power of flush flow to remove waste materials in a combined system, and solid waste and other materials may remain in pipe. Moreover, cost for the combined system will be more expensive than the separate system. From these considerations, the separate type is considered more suitable than the combined type.

However, the separate system has also the problems that the first flush flow of rainwater will transport some kinds of waste at the beginning of heavy rainfall to the river or the sea. Therefore some countermeasures shall be considered against such dirty first flow in storm water drainage on the separate system.

5.3.5 Waste water treatment

(a) Basic policies

According to the zoning plan and their categories, there are three waste sources on waste water, of the commercial and hotel areas, of the residential areas and of the factories which are considered to need to be controlled by the masterplan although they are located mostly out of the study area.

The characteristics of these sources have to be taken into consideration in the analysis for deciding on whether the centralized plant or the individual system is more suitable.

1) For waste water by the commercial and hotel areas

Considering the concentration and the scale of waste, the centralized type is more suitable than the individual type although it is reported that six major existing hotels have their treatment plants.

2) For the residential areas

The centralized method is proposed as a fundamental policy from the following reasons:

i) It is difficult for each residential family to prepare its individual treatment facility at own expense.

ii) Environmental control can be more efficiently effected with public centralized plants.

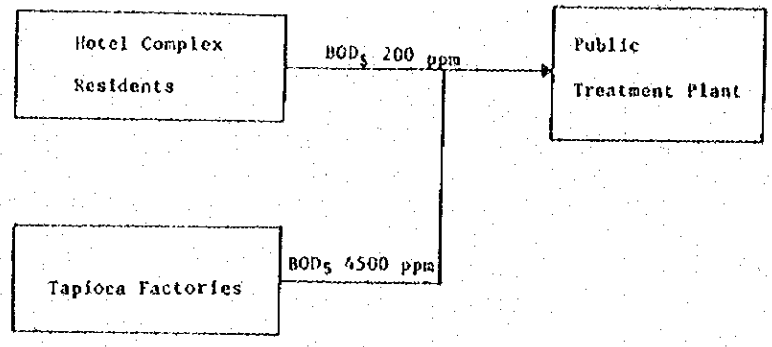
iii) Even after the completions of the public water supply system some consumers will draw water from shallow

Table 5.3.3 Unit Discharge of Sewage

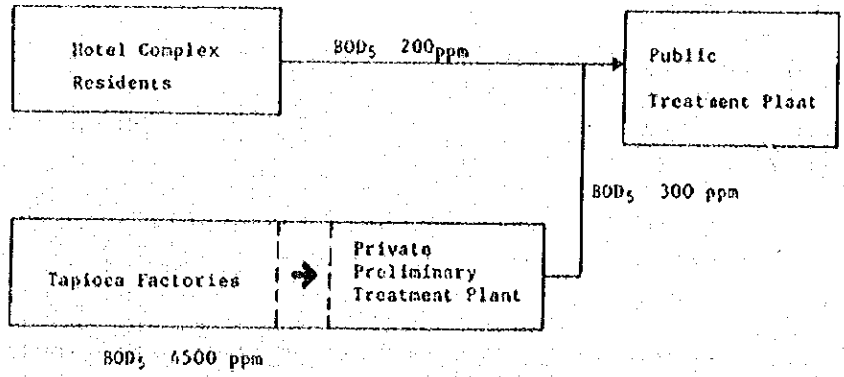
Year	Resident (l/p.d)	One day visitor (l/p.d)	Hotel & villa (m^3/r.d)
1981	170	55	1.7
1986	180	55	1.7
1991	185	55	1.7
1996	190	55	1.7

Fig. 5.3.4 Two Basic Treatment Plan

(1) System A



(2) System B



wells and a centralized system will ensure better sanitary condition for the well water users.

iv) Although from the economical point of view the costs of the individual system will be less expensive than the centralized one, the cost difference is not sufficiently significant to justify the installation of the individual system.

3) For factories

At this stage, sewage from tapioca factories is the main sources to be treated. There are two basic alternatives in planning the treatment plant as shown in Fig. 5.3.4. System A will be advantageous only to tapioca factories, and the residents and hotel complex will have to bear great burden for treatment of waste originated from the factories. In system B, tapioca factories will provide its own private pretreatment facility such as sedimentation pond at factories expenses. This system is reasonable in fact not only from the engineering point of view but also from the point of economy in public infrastructure investment.

Therefore public treatment plant shall be planned on the condition that waste water delivered from the factories shall be treated to some extent before going to the public treatment plant.

For this master plan stage, the public plant will be prepared and equiped to treat waste water of 300 mg per litre in 5 days BOD from tapioca factories with reference made of the report "Pollution Control in the Tapioca Starch Industry in Thailand" Jan. 1977 by Office of National Environmental Board.

From the studies above, the centralized treatment plant system is proposed as the suitable type for the study area.

5.3.6 Treatment plant

(a) Basic method

The centralized treatment plant methods can be classified into two different methods of physico-chemical method and biochemical method. Taking into account the volume of waste it is considered more favorable to adopt the latter which has higher efficiency than the former.

(b) Level of treatment plant

The level of treatment plant shall conform with general requirements and conditions as follows:

* Adequate to treat the quantity and the quality of raw waste water.

*Sufficiently efficient so that the output will not aggravate pollution of the sea waters, and to maintain Pattaya as an international beach resort.

The following two alternatories were studied for the centralized treatment plant.

i) Alternative A

All raw water will be treated by secondary treatment plants by which the quality of waste water will be treated to less than 30 mg per liter in 5 days BOD. The cost for this alternative for Phase 1 is estimated to be 230.4 million bahts.

ii) Alternative B

All raw waste water will go through advanced treatment plants by which the quality of waste water will be treated to less than 10 mg per liter in 5 days BOD. The cost for Phase 1 is estimated to be 511.4 million bahts.

The effects of these alternative measures may be more clearly seen from the figures. It is estimated that by 1986, the total load of waste will reach 16.1 tons per day in 5 days BOD without any countermeasure. The completion of Alternatives A and B will reduce the waste load to respectively 1.7 tons and 0.6 tons per day, reducing the total load to a fraction.

Although the effect will be greater in the case of Alternative B, the enormous extra cost cannot justify its adoption and it is considered that the Alternative A is the adequate and suitable system for the Pattaya resort.

(c) Alternative study on the treatment system

In the biochemical method five major systems are compared briefly from the points of efficiency and cost and the results are summarized as follows:

Method	Efficiency in percentage	Rough cost** estimation in million Baht
1) Activated	90%	460
2) Rotary Aerated	90	420
3) Stabilization Pong	85	80
4) Trickling Filter	70	400
5) Sedimentations*	30	100

* This system is only for pretreatment.

** These costs include land cost.

From the above comparative study, it can be seen that the cost for the stabilization pond method is only a fraction of the other systems, although the efficiency is slightly sacrificed. This system is therefore considered most suitable to be adopted for Pattaya, from the following reasons.

a. The system has a lowest costs in construction, maintenance and operation.

b. The system is easy in operation.

c. Some industry around the study area has already some experience of this system.

From the 1977 survey on the existing stabilization ponds for the largest tapioca factory along the Na Klua River, which has been in service for one year and treated 2,400 cu. meter of waste water a day, the following data were obtained.

i)	Number of ponds	8 ponds
ii)	Total area	33,000 sq. meter
iii)	Influent	13,280 ppm in C.O.D.
iv)	Effluent	240 ppm in C.O.D.
v)	Unit loading	9,658 kg in C.O.D. per hectare
vi)	Duration	14.5 days

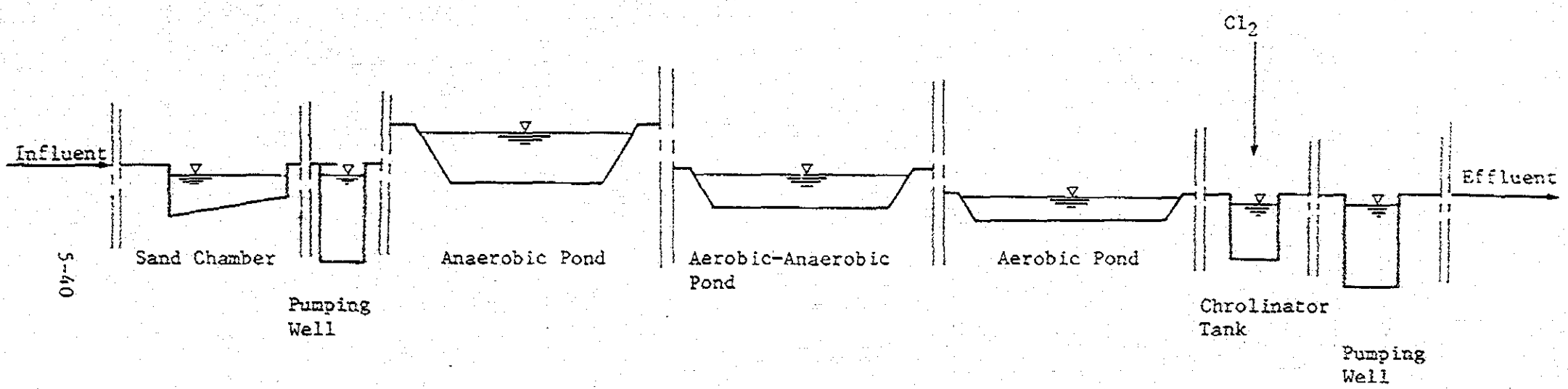
In other words the efficiency of the ponds is about 85% after a week of retention period or 98% for a two week retention period. Although the ponds of this factory come into use only for a year, the climate and other natural conditions seem to be favourable for its effective and efficient operation.

The proposed pond will be kept in a distance of more than 400 meters away from the tourism area and local community, at the low land which is far enough from the roadway and land cost of which is low. If necessary, aeration system may be adopted for the pond for better efficiency in reducing the environmental problems from odor. The surrounding of the pond should be well landscaped with suitable vegetation, etc.

The ponds are planned with criteria as follows:

1)	Detention time	longer than 10 days
2)	Effective depth	0.5m for an aerobic pond 1.2m for an anaerobic pond
3)	Unit loading	200 kg per hectare per day in BOD.

Fig. 5.3.5 Flow Chart of Waste Water Treatment System



4) Planned efficiency 85% in removal volume

Each plant has a series of units which consists of an anaerobic pond, an aerobic-anaerobic pond, an aerobic pond and a chlorinator tank in sequence.

The flow chart of waste water treatment system is shown in Fig. 5.3.5.

(d) Locationing of the treatment facility

The ponds need a large area so that it is better not to concentrate all the ponds at one site. This policy also has the advantage that the Phase 2 investment on the facility which is for the southern region of Pattaya Hill may be deferred until such time that site is developed. As shown in Fig.

5.3.1., three ponds will be constructed at the Na Klua village (A), at the Pattaya tourism and residential area (B) and at the southern region of Pattaya Hill (C), the capacity of each will be more than 11,000 cu. meter per day and it will be adequate in scale for the operation separately.

The required area of the ponds of them at the end of each phase are estimated as follows:

	Phase-1	Phase-2
Site A	14.4 ha	16.3 ha.
Site B	10.2 ha	11.3 ha.
Site C	0	17.6 ha.

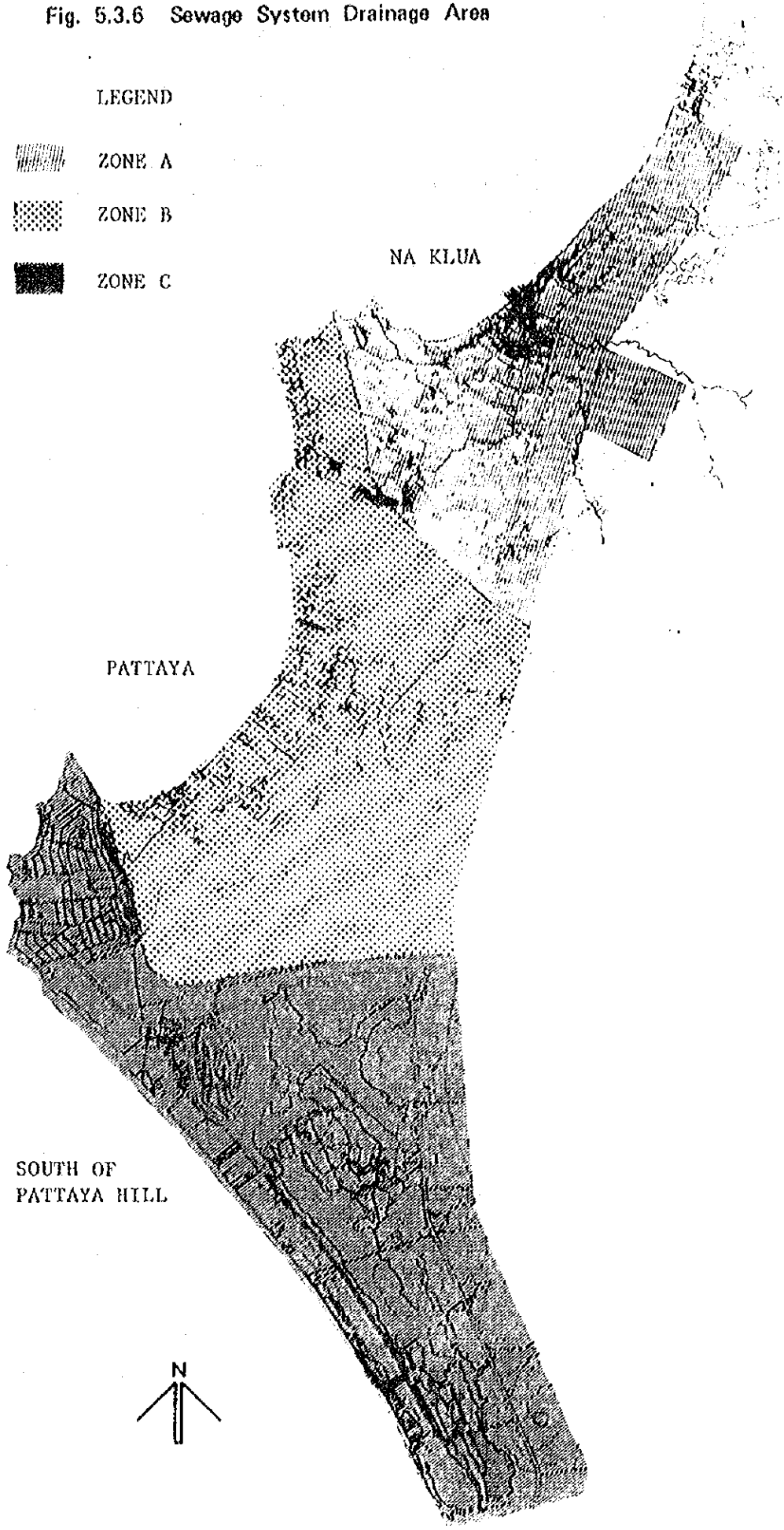
These areas include necessary buffer zone around the ponds and also land for their equipments. The adoption of the aeration systems is not considered at this stage.
Waste water drainage system at the study area is divided into three zones as shown in Fig. 5.3.6.

5.3.7 Collection line and its facility

For the collection of waste water, several gathering and pumping stations will be provided at each of the three collection areas. Gravity flow to the pond is not justified from the economical point of view because with the gravity flow the ponds have to be very deep and since it is necessary to prevent seepage of ground water it will become much more expensive than provision of pump units.

The treated waste water will be also discharged by the aid of pump units through discharge lines to the discharge points. Basically, reinforced concrete pipes may be used with a maximum soil burden of 6.0 meters, and the pipes will be laid in the right-of-way of the road and street system.

Fig. 5.3.6 Sewage System Drainage Area



5.3.8 Discharging method

(a) Basic method

In discharging method, the following four alternative were taken up in comparative study:

1) to the river and the waterway

2) to the sea (inshore)

3) to the sea (off shore)

4) to the ground by permeation

Method 1) is most economical if a river exists near the study area and has sufficient capacity to accept the discharge.

Method 2) is normally not expensive but it is not so easy to maintain the discharging against sand movement and waves that may attack inshore, and such direct diacharge to the sea is more liable to cause pollution of the beautiful coast.

Method 3) will consist of pumping units and a pipeline laid under the sea bottom to offshore at about 2 - 3 km from shore-line. This method is extremely expensive as compared to other methods.

Method 4) is most suitable from the point of keeping rivers and the sea in good condition. But it is not nofirmed if existing soil condition is suitable for permeating all treated waste water of more than 40,000 cu.m per day.

In the selection of discharging point for methods 1), 2) and 3), much precaution has to be paid to prevent pollution, even by treated water, taking particular care on the direction of current and other movements of the sea. Considering the above alternatives, method 1) is considered most suitable for Pattaya not only being economical but also from the engineering point of view.

The lines are planned to satisfy the following criteria:

1) Design hourly maximum flow

The volume shall be more than 200% of the hourly rate of the design daily maximum flow.

2) The average velocity should be 0.8 m per second

3) The capacity of the pipe shall conform with the Manning's formula.

(b) Discharging point

As possible discharging point there are three alternatives as;

1) to Na Klua River

2) to Pattaya River

3) to Na Jom Tiem River which is 7 km south of Pattaya

The basic conditions to consider are the sea current which is noted to be normally north to south, and the topographical shape of beach which shows that Pattaya area is enclosed by two capes.

The alternative 3) of discharging to Na Jom Tiem River, is considered most suitable followed by 1) Na Klua River from the environmental point of view.

5.3.9 Ko Lan Island

In phase 1, the total daily maximum sanitary waste water will come to 1,700 cu.m approximately, or the same quantity as the water supply. Sewerage System will be chosen from the following three alternatives.

1) Construction of septic tanks with necessary equipment and to let treated water to permeate to the ground.

2) To prepare the oxidation pond and to permeate to the ground.

3) To transport the raw waste water to the mainland by barges and to transmit them into the public treatment plant.

Alternative 1) is recommended as a suitable system considering the difficulty of construction of alternative 2) on the rocky island and lower cost than alternative 3). Sewerage zones will consist of five beaches, the South Beach for Ko Lan Vac, the Eastern Fishering Village, the Tavan Beach, the Tien Beach and the Sa-mae Beach. For the fishering village individually installed septic tanks are considered. However, larger septic tanks at a capacity for 50 to 200 persons will be prepared for other beaches. The system on the Tavan, Sa-mae and Tien beaches will be provided and operated by the public while the village and the Ko Lan Vac beach will be by private investment.

5.4 STORM WATER DRAINAGE SYSTEM

5.4.1 General.

There is at present no integrated system for storm water drainage in the study area, so that during the rainy season,damages due to flooding of low laying areas often occur, and as a result it is obstructing the effective use of available land. The survey team studied the means and facilities for restoring the main streams and water channels to normal situation, so that the land may be effectively utilized and the local community may not receive any damage due to inundation.

In the planning of the storm water drainage, considerations were made to the fact that the objectives are not limited to the draining of water from the area, but that the draining of storm water to the sea should not result in pollution of the shore or in ecological changes which may be detrimental to Pattaya as a beach resort.

The storm water drainage planning area covers the area designated for tourism development up to 1996. Considerations are made that the plan will be an integral part of the overall development plan, paying particular attention to the coordination with the future landuse plan and the future road network.

The storm water drainage plan may be roughly classified into the following two categories.

1) Early drainage facilities for existing developed area.

2) Future drainage systems.

In the decision on the discharge outlet, cares are taken that the discharge will not result in sea pollution or future blocking of the estuary due to sedimentation of earth and sand carried by the water discharged.

5.4.2 Existing Situation.

The existing situation of storm water drainage system in the study area may be itemized as follows:

1) From the topographical point of view, the study area has six storm water catchment zones as shown Fig. 5.4.1 and Table 5.4.1.

2) A present, public storm water drainage is provided only at Na Klua which is controlled by the Na Klua Sanitary District.

3) The typical section of the area is shown in Fig. 5.4.2. According to topographic survey map at a scale of 1: 2,000, the average height of the area at 50 m - 500 m from the beach is about 5 m - 6 m above M.L.W.S. (Mean Low Water Spring). The average height

LEGEND

PHASE I OPEN CHANNEL

PHASE II OPEN CHANNEL

= BOX CULVART

PHASE I SEDIMENTATION BASIN

PHASE II SEDIMENTATION BASIN

N

0 200 500 1000 2000 M

FIG 5. 4. 3 STORM WATER DRAINAGE SYSTEM

behind this coastal area is 4.5 m - 5 m above M.L.W.S. Beyond this, it rises gradually to the hill.

4) The tidal range in spring tide is expected to be approx. 2.0 metre between mean high water and mean low water.

5) Under heavy rainfall, most of the storm water drains to the sea through the rivers, but partially stays in the low area and swamp then goes underground and some part evaporates.

6) The dikes along the beach and some artificial earth fills act as natural obstacles to the storm water drainage. But the dikes may also have a ability to store water and keep the underground water level high so that wells which are installed in the area about 50 m to 500 m from the beach may be supplied with water by such natural underground water reservoir.

7) In the swamps behind the dike, there are places where water-plants are growing.

8) The estuaries of existing river mouths show that even in the dry season, waterway may be maintained to allow storm water to go through. No heavy clogging of river mouth by littoral drift and other matters were observed during the investigation period.

9) The existing situation at the hotel and downtown area along the Pattaya beach are as follows:

   (a) There is no storm water drainage system in the hotel area.

   (b) Storm water is mainly discharged directly to the ground.

   (c) Some hotels, restaurants and stores reserve the rain water in tanks.

   (d) No flood problem is existing in the hotel area even during heavy rains.

   (e) There were floods during heavy rains in the area behind the back road which is located at 300 m behind the beach. The causes are due to some buildings (hotels, restaurants and shops) blocking the outlet of storm water to the sea, and private land developers filling the land, closing up water-way to build houses and roads.

10) Present storm water flow pattern at each zone.

   (1) Na Klua zone.

   Rain water collected from the 128 ha out of 920 ha in total, between northwest slope and the back road are discharged directly into the sea. Rain water from the 260 ha enclosed by the back road and Sukhumvit Highway flows into the Na Klua river after staying momentarily in the northern swamp. For

Table 5.4.1 Catchment Area for Storm Water Drainage System in the Study Area

No.	Name	Catchment Area (in ha.)		River	
		Total	In Study Area	Name of River	Width
A	Na Klua	920	580	Na Klua	Approx. 10 m
B	North Pattaya	216	216	-	-
C	Middle Pattaya	1,897	1,299	Pattaya	Approx. 10 m
D	Pattaya Hill	288	288	-	-
E	South Pattaya	1,498	760	-	-
F	Na Jhom Thien	588	350	Na Jhom Thien	Approx. 5 m
	T o t a l	5,407	3,493 ha		

Fig. 6.4.1 STORMWATER CATCHMENT AREA

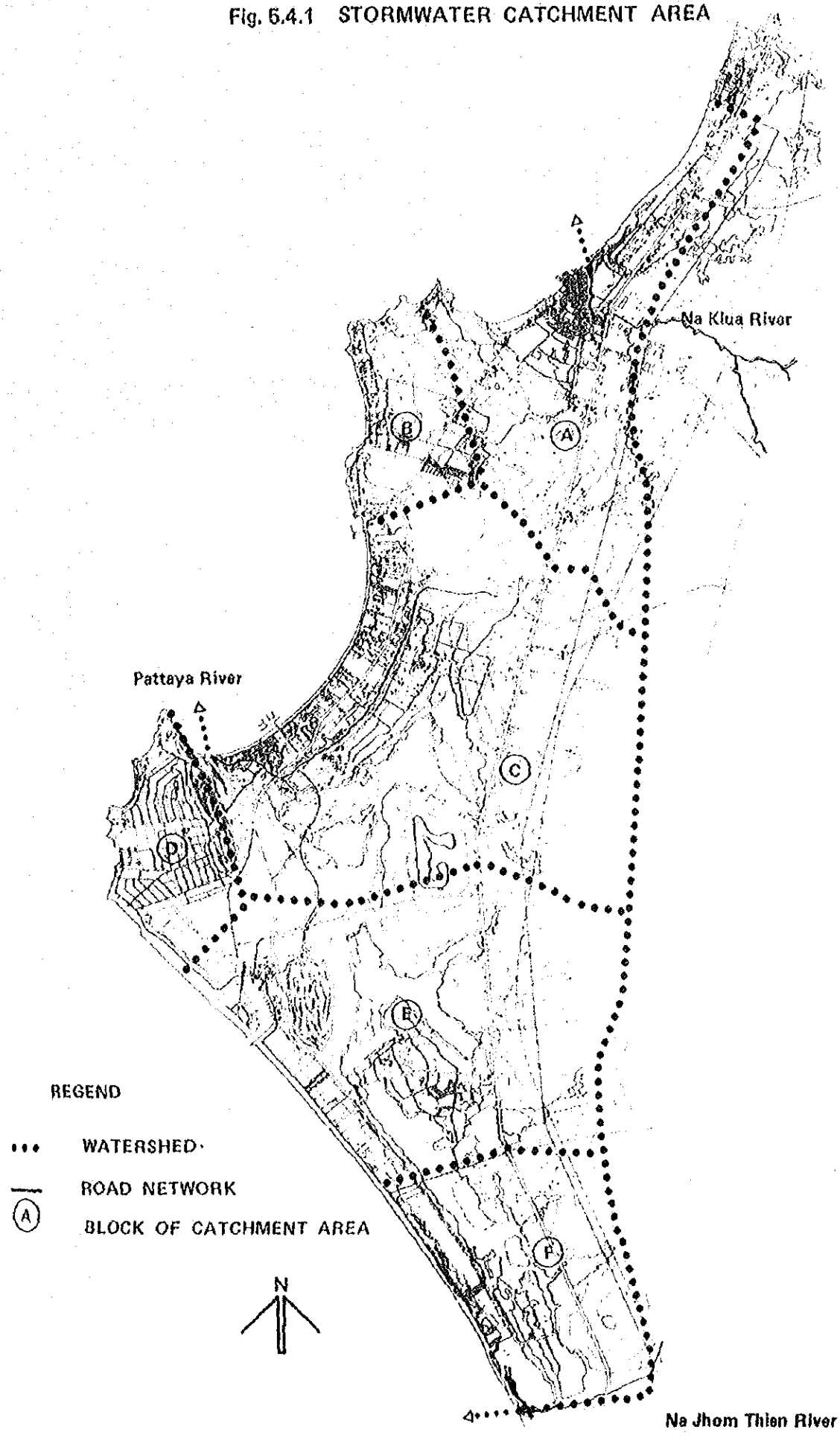
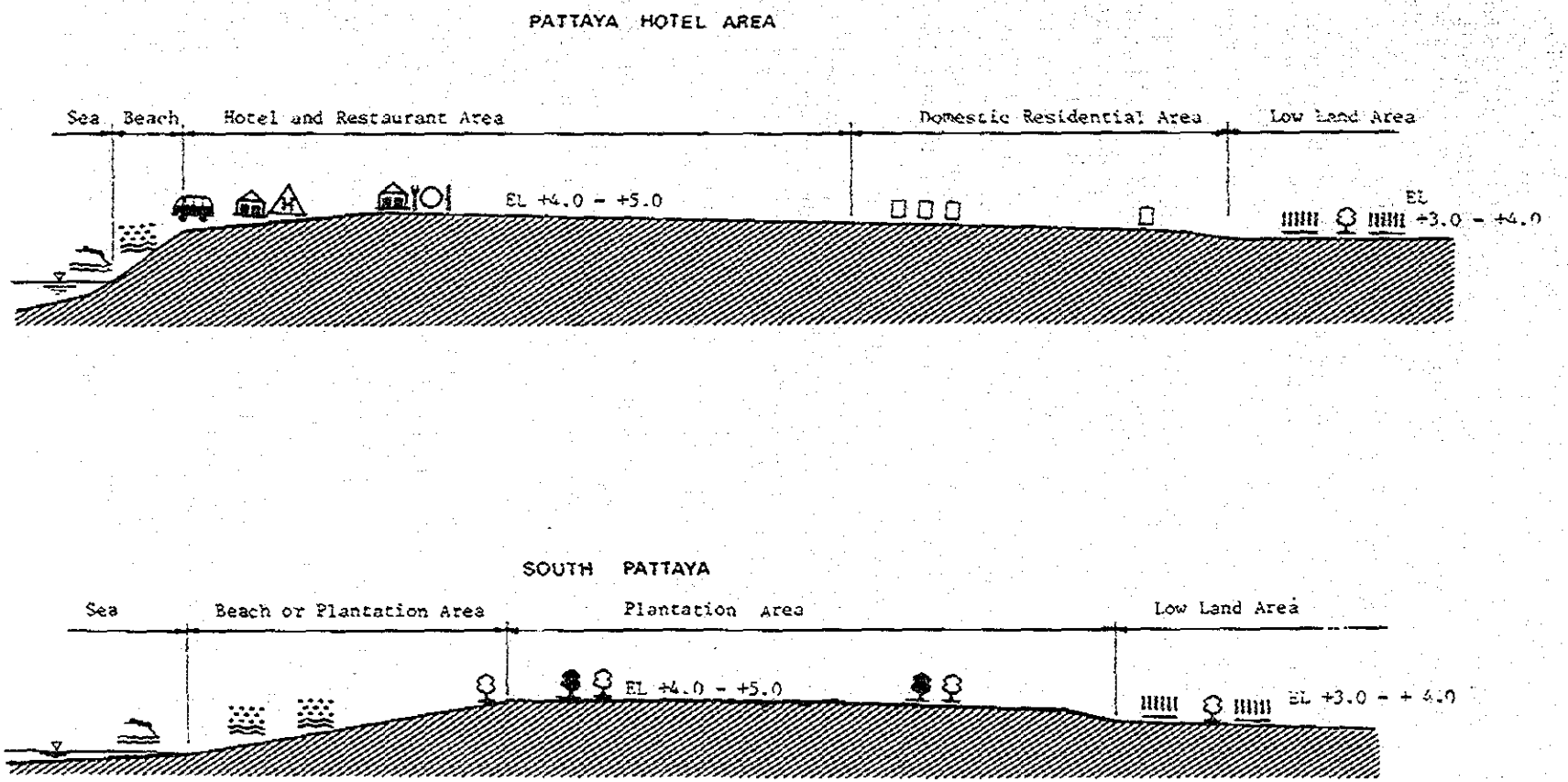


Fig. 5.4.2 General Cross Section of Pattaya Area



an area of 50 ha, about 1.5 Km north of the river mouth, rain water flows directly into the branch channel which is connected to the Na Klua river. Rain water collected at further northern area up to the Buddhist college is discharged directly into the sea.

(2) North Pattaya zone.

Rain water runs along the slope of North Pattaya Hill and is discharged into the sea.

(3) Middle Pattaya zone.

Rain water coming from the 688 ha. which is located east of the Sukhumvit Highway flows through two channels and concrete culvert boxes under the highway and are gathered to the Pattaya river. One of these two channels runs parallel to the back road after passing through the north of the northern new town and is connected to the other channel from the south of the northern new town at the Pattaya downtown area through some kind of water way consisting of natural pond and swamp and finally runs into the Pattaya river mouth.

At the river mouth, existing tourism facilities such as a hotel and restaurants are disturbing the smooth flow of the channel because the effective channel width is narrowed down to less than 10 meter.

(4) Pattaya Hill zone.

Rain water is discharged into the sea through an existing storm water drainage system which was planned and constructed in the development of the resort housing area.

(5) South Pattaya zone.

Rain water from the 738 ha at the east of Sukhumvit Highway flows into the South Pattaya rice field through two channels which are located at the north and the south of the proposed southern new town and are finally discharged into the sea.

(6) Na Jhom Thien Zone.

Most of this zone is rice field or swamps, through which rain water is discharged to the sea.

5.4.3 Basic method of Planning

The basic method and direction of planning of the storm water drainage system is described here and details are shown on Fig. 5.4.3 as a flow diagram. Storm water runoff will be collected at the main drain channel through existing narrow and shallow waterways. Most channels will run into the existing rice field and serve in irrigation purpose. Rain water on paved areas such as roads and parking areas will be connected to the main channel through the branches. Most soil, larger solid waste and other materials which are carried to the main channel during storm will be screened and removed at the sedimentation pond to be constructed on the channel for keeping the beach clean and safe.

Open space type ponds will be provided to serve the function of drains and as a part of park and garden, the typical section of which are shown in Fig. 5.4.4. At the areas and points where channels have to be covered such as at road crossing points and in the downtown area, it is planned to install a single or double spaced concrete box, culverts, the typical section of which are shown in Fig. 5.4.5. At the Pattaya river mouth where the width and bottom slope of which are narrow and flat, a new channel has to be excavated and maintained on the southern land along the existing channel to maintain adequate capacity for maximum flow. The existing channel is not adequate in capacity even after removing such present obstacles as dike and other structures. It is not practical to make the existing channel wider and deeper in the limited private own hotel garden. The new channel will be designed and installed as a point of tourist attraction provided with necessary landscaping. Other than this new Pattaya channel, another will be constructed at the southern beach south of Pattaya.

(a) Estimation of storm water quantity.

The following "rational formula" is adopted in estimating the quantity of storm water.

$$Q = \frac{1}{360} \cdot C \cdot I \cdot A$$

where Q: the peak rate of runoff in cu. meter per second

C: the coefficient of runoff

I: the rainfall intensity in millimeter per hour during the assumed design storm with a rainfall duration

A: the catchment area in hectare.

Rainfall intensity by duration is determined base on the data of Chonburi area and the results are shown in Fig. 5.4.7.

Fig. 5.4.4 Typical Section of Open Space Pond

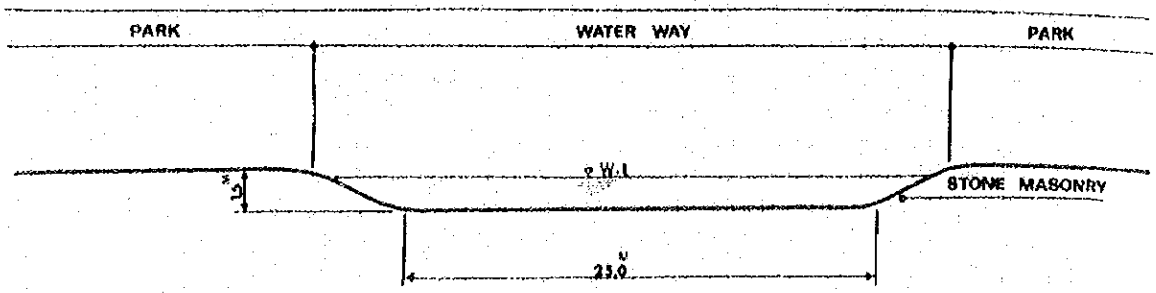
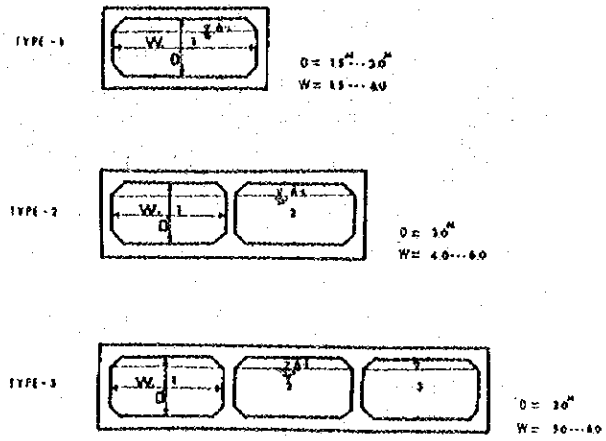


Fig. 5.4.5 Box Culvert Typical Section



Where

D: depth in meter
1.5 m to 2.0 m in range

W: span width in meter
1.5 m to 6.0 m in range

Fig. 5.4.6 Typical Section of Open Channel

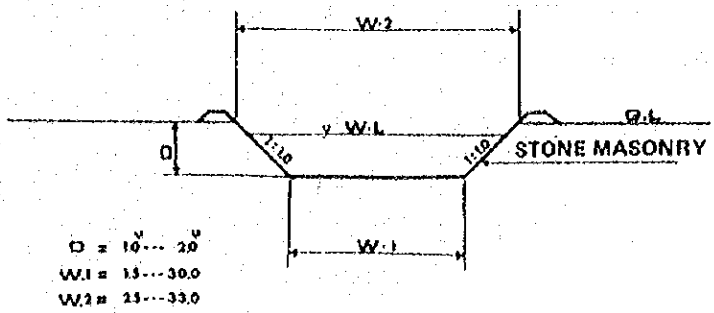
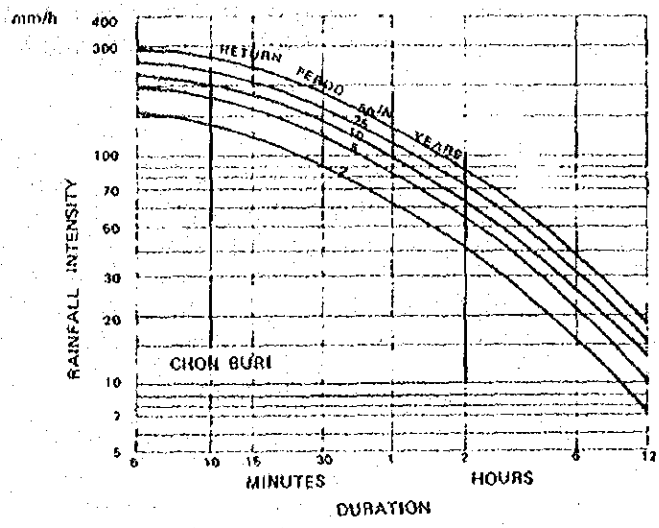


Fig. 5.4.7 Rate of Rainfall at Chonburi Province



(b) Study on dimension of channels.

For this purpose Manning's formula was adopted.

$$V = \frac{1}{n} \cdot I^{1/2} \cdot R^{2/3}$$

where V: average velocity in channels in meter per second

n: coefficient of roughness
n = 0.025 for open channel
n = 0.015 for concrete box culvert

I: bottom gradient of channel

R: hydraulic mean depth

Vmin: allowable minimum velocity
Vmin = 0.6 meter per second

Vmax: allowable maximum velocity
Vmax = 3.5 meter per second

The maximum and allowable volume in flow are decided using the following formulas

$$Q^\circ = A.V$$

where A: Effective sectional area of channel

Q°: Maximum volume in cu. m per second

$$Qa = 0.8Q^\circ$$

where Qa: Allowable volume in cu. m per second

(c) Main structures.

There are three main structures in the storm drainage system, namely open channels, concrete box culverts and sand sedimentation basins. The general ideas of each is explained below.

1) Sand sedimentation basins.

The basins will have such functions that soil running off, larger solid waste and floating materials will be screened out and made sinkable. The capacity of sunk materials and soil are assumed to be about 10 cu. m per hour and it is necessary to excavate or dredge the basins one or two times a year.

As a countermeasure for the dry season, dikes will be installed to reserve water inside, at a capacity of 7,500 cu. m for each basin. In this planning area, seven basins will be constructed so that the total reserving volume will be about 40,000 cu. m. Some of the reserved water will be utilized for irrigation, gardenning and as water supply to the artifical pond.

2) Open channels.

For protecting them from scouring and damages by heavy flow, they are reinforced by stone masonry. The average velocity of flow is estimated to be about 1.5 meter per second in the channel. The general dimensions are as shown in subsequent sketches. (See Fig. 5.4.6)

Wet stone masonry will be partially provided in the place where water will have to be kept in the channel to prevent leakage especially during the dry season. Dikes and low dams will reserved rain water which will maintain the ground water at a high level.

3) Concrete Box culvert.

Box culverts to be provided will be the same characteristics and quality as those which are constructed recently at the Sukhumvit Highway. They will be constructed at the road crossing points and others where open channel will not be suitable and proper. The typical sections of the culverts are shown in Fig. 5.4.5.

5.4.4 Implementation

The storm water drainage system is proposed to be implemented in stages according to the proposed phasing of development of other facilities for the resort. The phasing is shown in Fig. 5.4.3 and the timing of implementation is estimated to be as follows:

i) Phase 1, stage 1 to be completed by 1981

ii) Phase 1, stage 2 to be completed by 1986

iii) Phase 2 to be completed by 1996

It is proposed also that as part of the discharge channel for a temporary sewage system, a portion of the proposed new channel be constructed as an urgent program. Although this portion will mainly play the role of discharge channel for treated sewer, it will be converted eventually into part of the overall storm water drainage system. The rough construction cost of the urgent program, excluding land cost is about 31 million baht.

5.5 SOLID WASTE DISPOSAL SYSTEM

5.5.1 General

This section studies the garbage collection and disposed system to be adopted for the study area.

Waste other than garbage such as solid waste on the public area, on the beach and floating materials on the sea are also important sources of waste to be treated to maintain the total area clean and safe for tourists.

After various surveys in the field, the study team made an estimate of the future volume of solid waste and carried out alternative studies on the method of solid waste collection and disposal, taking into consideration of the sanitary aspect, the cost and the ease in future maintenance and operation.

5.5.2 Existing Situation

The existing situation of solid waste disposal system in the study area may be itemized as follows:

(a) The kind of solid waste disposal system and its origin are shown in Table 5.5.1.

This waste may be grouped into three categories as follows:

1) Garbage

2) Waste on the roads and the beaches dumped mainly by tourists.

3) Floating waste on the sea and sunk waste on the sea bottom.

Some solid waste on the beach and on the surface of the sea are from other regions and sea carried to Pattaya by wave and current movement.

Small and sharp solid waste on the beach are very dangerous to tourists. Table 5.5.2 shows the typical sampling data at the beach in the study area over an area of 25 m^2 collected during field investigation.

(b) Public solid waste collection is carried out daily for all the three catagories of Solid Waste by Na Klua Sanitary District.

(c) Although the total daily discharge of solid waste in the study area is estimated roughly more than 200 cu.m, the present capacity of the public collection system is 90 cu.m per day using collecting trucks as follows:

2 trucks of 6 cu.m in capacity
1 truck of 4 cu.m in capacity

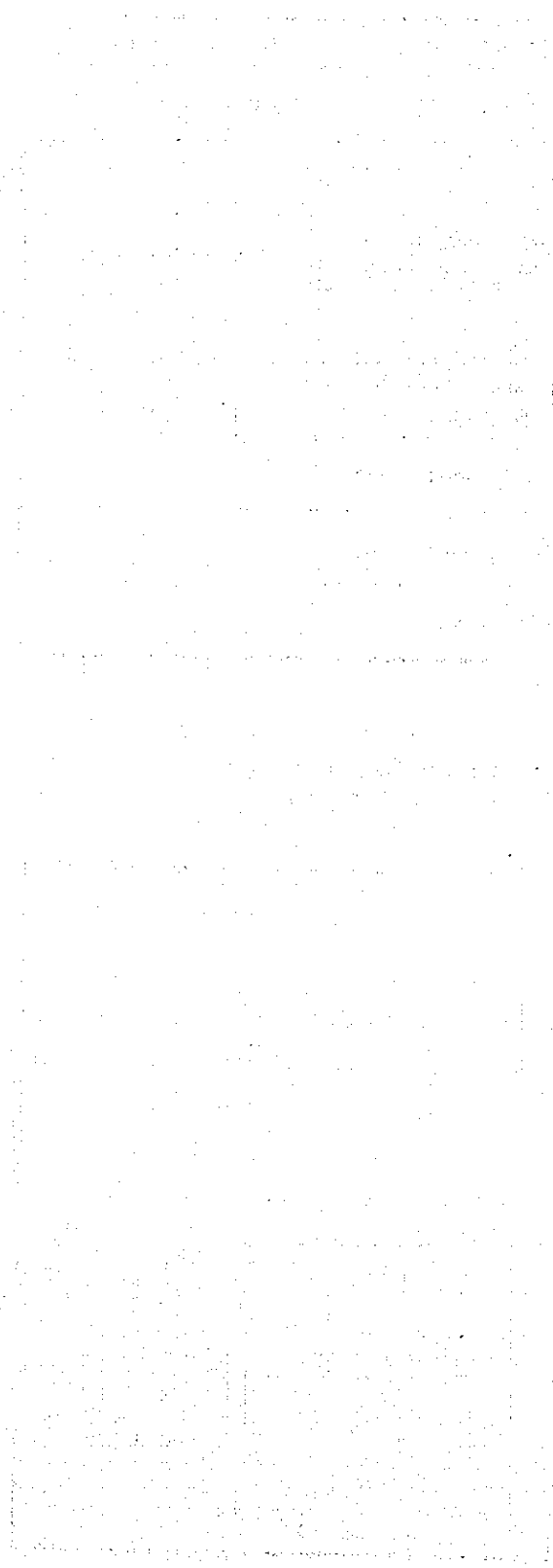
Table 5.5.1 Kind of Waste

	Originate From		Kind of Waste	Disposal System
1	by Hotels, Restaurants, Shops, etc.		Garbage etc.	by Public
2	Households		"	"
3	Public Area	Road and Street	Paper, bottle, can wood, leaf, vinyl	Public and private
4		Beach	"	"
5		River	Garbage, wood leaf, vinyl	None
6	Sea	On shore	Vinyl, wood, leaf	"
7		Off shore	Vinyl, wood, leaf	"
8		Bottom on shore	Can, vinyl	"

Table 5.5.2 Solid Waste on the beach Collecting area is about 25 sq. m on the beach

No.	Kind of Materials	Size in cm	Quantity	Note
1	Vinyl bag & straw	20 x 20 15 long	18	*1
2	Hard plastic material	2 x 5	5	
3	Empty can	3 x 12	1	
4	Sandal	8 x 27	1	
5	Cuttlebone	10 - 15	8	
6	Coral with sea weed	15	1	
7	Soft plastic material	5 x 5	3	
8	Small & green seed	2 - 3	3	
9	Cigarette butt	2 - 3	3	
10	Wooden bar	20 - 50	more than 50	About 90% of Total weight
11	Wooden plate	20	11	
12	Coconut's seed	15	1	
13	Bamboo	4 x 20	7	
	Total		more than 110	

Note: *1 Mostly filled by sand. Most of these vinyl bags and straws are for local peoples to suck dring with ice water.



(d) Collected solid waste is disposed at a dumping site which is located on low and wet land about one km from the Na Klua river estuary. The basic disposal system is a primitive dumping method without any consideration on the sanitary cover-up by suitable materials and technics.

(e) It is planned that within this year, the garbage collection service will be improved by addition of 1 truck of 10 cu.m in capacity and 1 truck of 4 cu.m in capacity.

(f) The total manpower for garbage collection in the Pattaya area is 14 laborers out of a total of 40 for the whole Na Klua Sanitary District.

(g) At the area not covered by the public system, most of the solid waste is treated by primitive incineration system at the road side or even on the shore. This method dirties the road and the seashore with black carbon and cinders and is also dangerous to tourists and residents.

(h) Floating waste such as solid wooden and other hard materials are not only harmful to the beautiful scene but also may be dangerous to swimming, water skiing and small but high speed motor boats.

(i) The existing situation on the downtown and hotel area along the beach is as follows:

1) Solid waste is collected daily by the public system.

2) The average amount of the solid waste from the hotels is about 4.5 kg. per room.

3) Floating suspended solids on the sea are collected mainly by the hotels.

4) The existing dumping site is only 8,000 sq.m and will be filled up in the next three years.

5.5.3 Quantity of Solid Waste

The following method was adopted in estimating the future volume of solid waste.

(a) The solid waste discharge by the residents is estimated from the future forecast population by assuming the unit discharge per resident (kg/person/day).

(b) The volume of solid waste from the hotels is calculated from the number of rooms at a rate of 5 kg/room/day.

(c) The discharge by restaurants, snacks and other tourist facilities are assumed to be included in the unit discharge assumed for the local populations.

Table 5.5.3 Volume of Solid Waste

Year	(1) Residents			(2) Hotel			Total	
	Population (persons)	Unit Discharge (kg/person/day)	Volume (ton/day)	Number of Room (Room)**	Unit Discharge (kg/room/day)	Volume (ton/day)	In ton/day (tons)	in M^3/day* (M^3)
1981	48,800	1.1	53.7	3,600	5	18.0	71.7	239
1986	58,100	1.3	75.5	4,420	5	22.1	97.6	325
1991	69,200	1.6	110.7	7,090	5	35.5	146.2	487
1996	80,200	2.0	160.4	9,560	5	47.8	208.2	694

* Assuming a bulk density of solid waste of 0.3 ton/m^3

* Number of hotel room includes number of second house.

Basing on the above calculation, the future volume of solid waste from the project area is calculated as shown in Table 5.5.3 and Fig. 5.5.2 for each key year.

5.5.4 Comparative Study of Alternative Systems

(a) Collection System

Two possible methods of collection of solid waste, namely that by truck and that by pipeline, are considered for the study area. Although collection by pipeline may be feasible in the long future, the high cost of construction and the technique required in maintenance and operation makes such a proposal doubtful in practicability, and it is considered that collection by truck is most suitable.

(b) Treatment and Disposal System

Three possibilities of treatment and disposal system for the study area were considered and the comparative processes are as shown in Fig. 5.5.3.

The comparative initial costs for Phase 1 (up to 1986) of the project area are estimated as follows:

Alternative	Initial Cost (Million baht)
a. Sanitary land-fill system	27.6
b. Incineration system	102.4
c. High-rate composting system	74.6

As for the cost of maintenance and operation, past data have shown that the running cost is highest for 'incineration system' and the maintenance is most difficult, while the simplest and cheapest method is the 'sanitary land-fill system' if land can be acquired at reasonable price.

From the above analysis, the sanitary land-fill system is here recommended as the most suitable method of solid waste treatment and disposal for the study area.

Fig. 5.5.2 Accumulated Volume of Solid Waste Dumped at Landfill Site

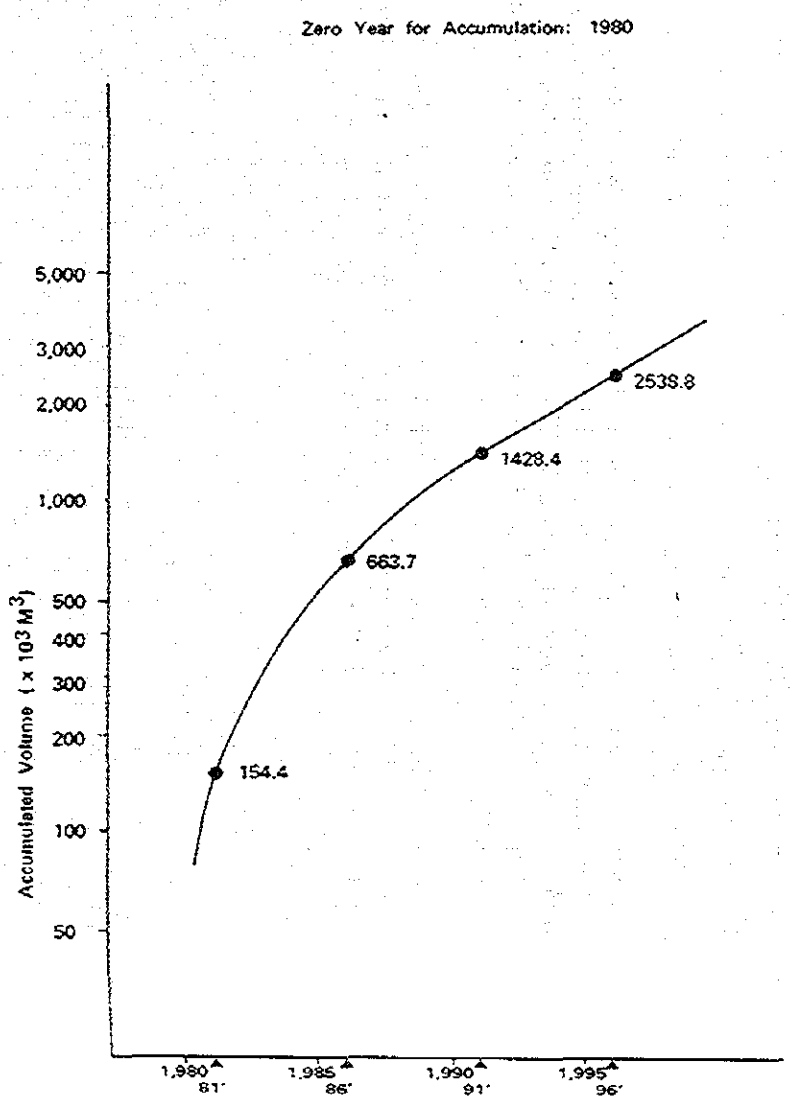
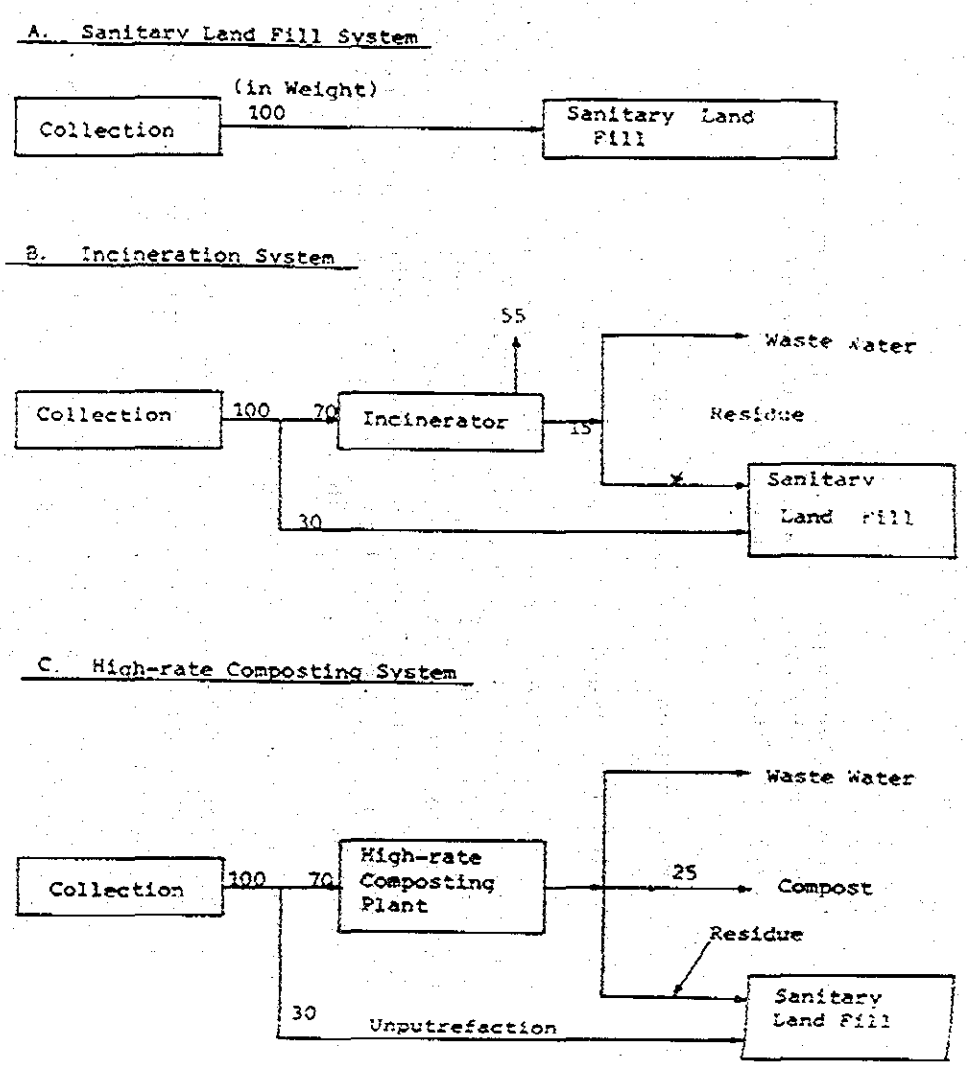


Fig. 5.5.3 Treatment and Disposal System

(ALTERNATIVE STUDY)



5.5.5 Determination of system

The most important aspect of a solid waste collection and disposal system is that the solid waste discharged should be swiftly collected and sanitarily treated to reduce such detrimental effects as odour, noise or dust. For this purpose, a clearly defined system of collection should be established and the operation and maintenance of the disposal system should be performed in an efficient way.

The following sums up the findings of the study team with regard to solid waste collection and disposal.

(a) Collection System

1) Collection vehicles

The study team recommends the adoption of the rearloader with a capacity of $8m^3$ as the collection vehicles for the project area. The number of vehicles required is estimated at 17 vehicles in 1986 and 35 vehicles in 1996.

2) Time of collection

It is recommended that as far as possible, the solid waste collection should be made early in the morning, avoiding the time when the tourists or tourist catering services are at the peak of their activities.

(b) Disposal System

1) Land-fill site

As a result of actual field survey at Pattaya, the site as shown on Fig. 5.5.1 is recommended as a suitable site for land-fill from the points of soil condition, wind direction and environmental conditions.

It is estimated that assuming a land-fill depth of 5m, the land area required up to 1986 will be 17 ha and that up to 1996 will be another 47 ha.

2) Land-fill method

There are various different methods of land-fill, but considering that the proposed site is flat in physical feature, the 'trench method' is recommended. A trench will be excavated for dumping of solid waste, and the excavated earth is re-used for top soil covering thus enabling a rational sanitary land-fill.

(c) Solid waste other than garbages

It is proposed to establish a functional and suitable system for collection and disposal of refuse and litter which will be

thrown away by the human being and will be drifted by wind and wave actions to the study area. At this moment it is reported that most of refuse in front of the beach road and on the beach itself are treated not by public but by private "self-help system". This system is not so bad, but such voluntary operations are however not enough to maintain the tourism area clean and safe, and a public system should be installed on public sites. Cleaning will be carried out generally early in the morning for refuse and floating material along the shore and off-shore by engine-operated cleaning boats with suitable equipments.

Excursion boats are also one of the sources of litter and such litters should be collected at the pier moors where they are allowed to berth.

Maintenance of cleanliness of the sea bottom is the most important considerations in a tourist resort in order that diver and swimmers may enjoy their activities without accounting unsightly litters on the sea bottom. Regular cleaning of the sea bottom by screening should therefore also be performed.

(d) Ko Lan Island

The future quantity of solid waste from the island is estimated as follows:

Year	Quantity (ton/day)
1981	2.7
1986	4.9
1996	7.5

For Ko Lan island, the incenaration system will be more suitable and proper than other methods such as sanitary land-fill. Incinerators will be installed at each of the four beaches. The cinders which are estimated to come to about 30% of original refuse will be sanitarily filled into the land not along the shore but inland. This operation and maintenance shall be done by the public authority.

5.6 ROAD AND STREET SYSTEM

5.6.1 General

For planning a road and street system in the study area, particularly for a tourist resort, the landscaping, landuse zoning, and the proposed development control have to be taken into consideration. Needless to say, the proposed width of the road should have sufficient capacity to provide adequate service to future traffic demand. But great importance has to be put on the environmental effects of the road to the vicinity. As an international tourist resort, the road and street network in the study area is so planned that the detrimental effects of noise, vibration and exhaust gas pollution from motor vehicles are minimized.

Since most of the roads in Thailand are planned according to the criteria of AASHO, in the planning of the road and street network for Pattaya, the AASHO standards are principally adopted while the standards of Highway Structure of the Japan Highway Association are used as reference where necessary.

The roads in Thailand are classified into two types, one under the control of the Highway Department and the other under the local administration. In the case of the study area, the major existing road sections are national highways under the Highway Department, and only the local street network is under the local administration.

5.6.2 Existing Situation

The existing situation of road and street system in the study area may be itemized as follows:

1) Existing network of the roads and streets are shown in Fig. 5.6.2.

2) All road and street pavements are of asphalt pavement. There are plenty of damaged parts to be mended.

3) The Sukhumvit Highway is utilized as the access road from Bangkok to Pattaya, and construction is underway to expand the Highway to 4 lanes. The construction work is expected to be completed by the end of 1978.

4) There are three approach roads for access from the Sukhumvit Highway to the Pattaya beach.

5) Existing hotels, restaurants, and shops etc. are developed mainly along the area between the 2 lane beach road of 10 meters in width and the 2 lane back road of 10 meters in width. These two parallel roads are further connected by interconnecting roads of 6 meters.

6) The curvatures and alignments of the existing roads are not adequate especially at the junctions and the road corners.

7) Generally, pedestrian walks are not provided except for some sections along the beach road.

8) Most of the roads are not provided with any storm water drainage.

9) No effective traffic signals are installed.

10) The Highway Department is planning to improve two access roads in the fiscal year 1977. (Roads 2-2, 2-3 in Fig. 5.6.2).

11) The existing condition around the hotels and downtown area along the beach are as follows;

(a) Noise and speed by vehicles using the beach road effect safety and comfortability of tourists, especially hotels guests to the beach.

(b) Exhaust gas and vibration are of lesser problems.

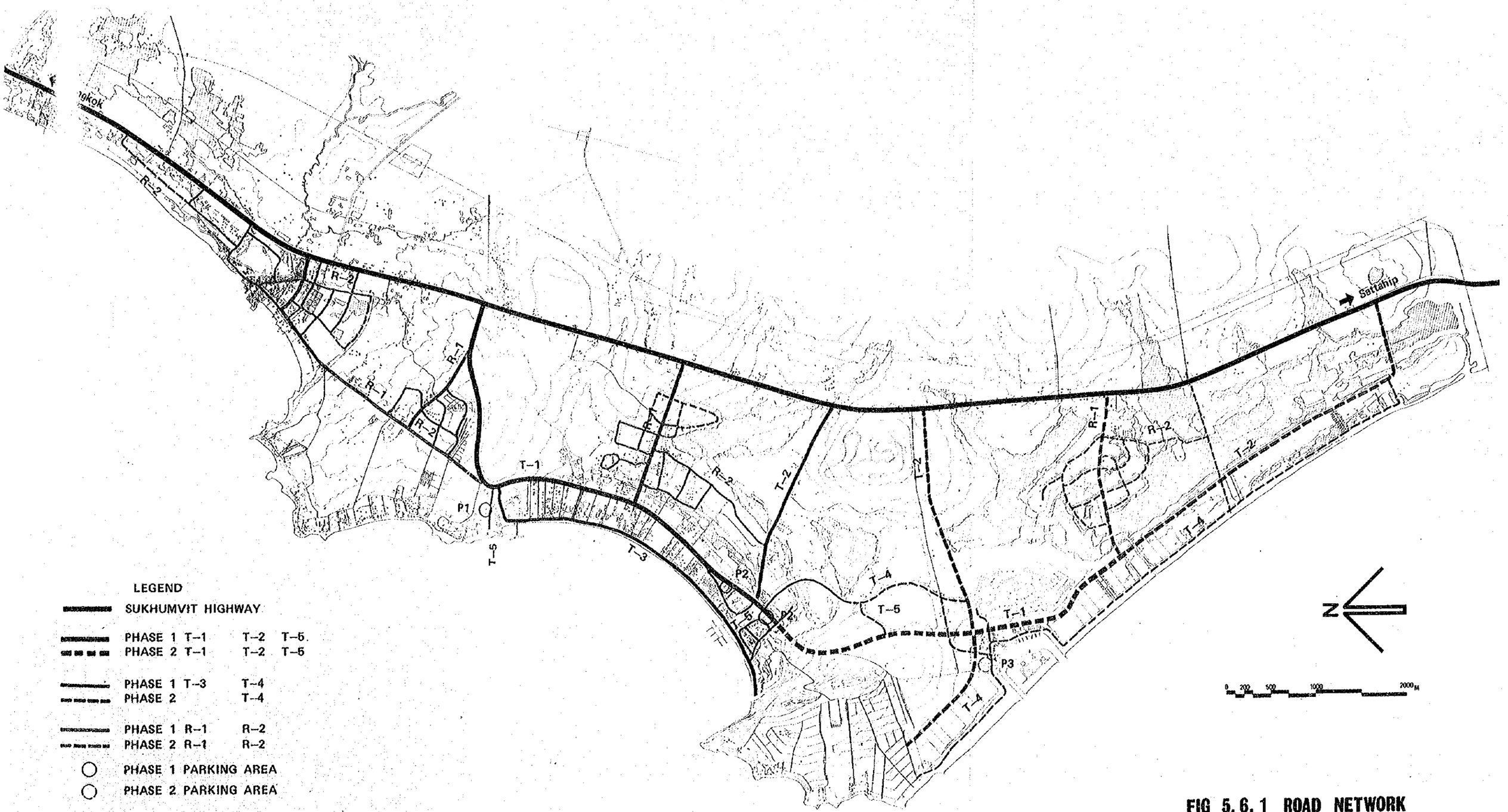
(c) The south access road and middle access road from the Sukhumvit Highway to the Pattaya beach are flooded during rainy season.

(d) Most of the hotels which have access from back road prefer to have the beach road improved or closed completely to vehicle traffic for the sake of the beach users.

(e) Parking space of each hotel is adequate. In average, existing major hotels have one parking space to every three rooms.

(f) Cleaning is performed by the Na Klua Sanitary District, but there is a problem of shortage in man power and machineries.

(g) Lighting on the road and street is not adequate not only in the lighting intensity but also in arrangement of lighting system.

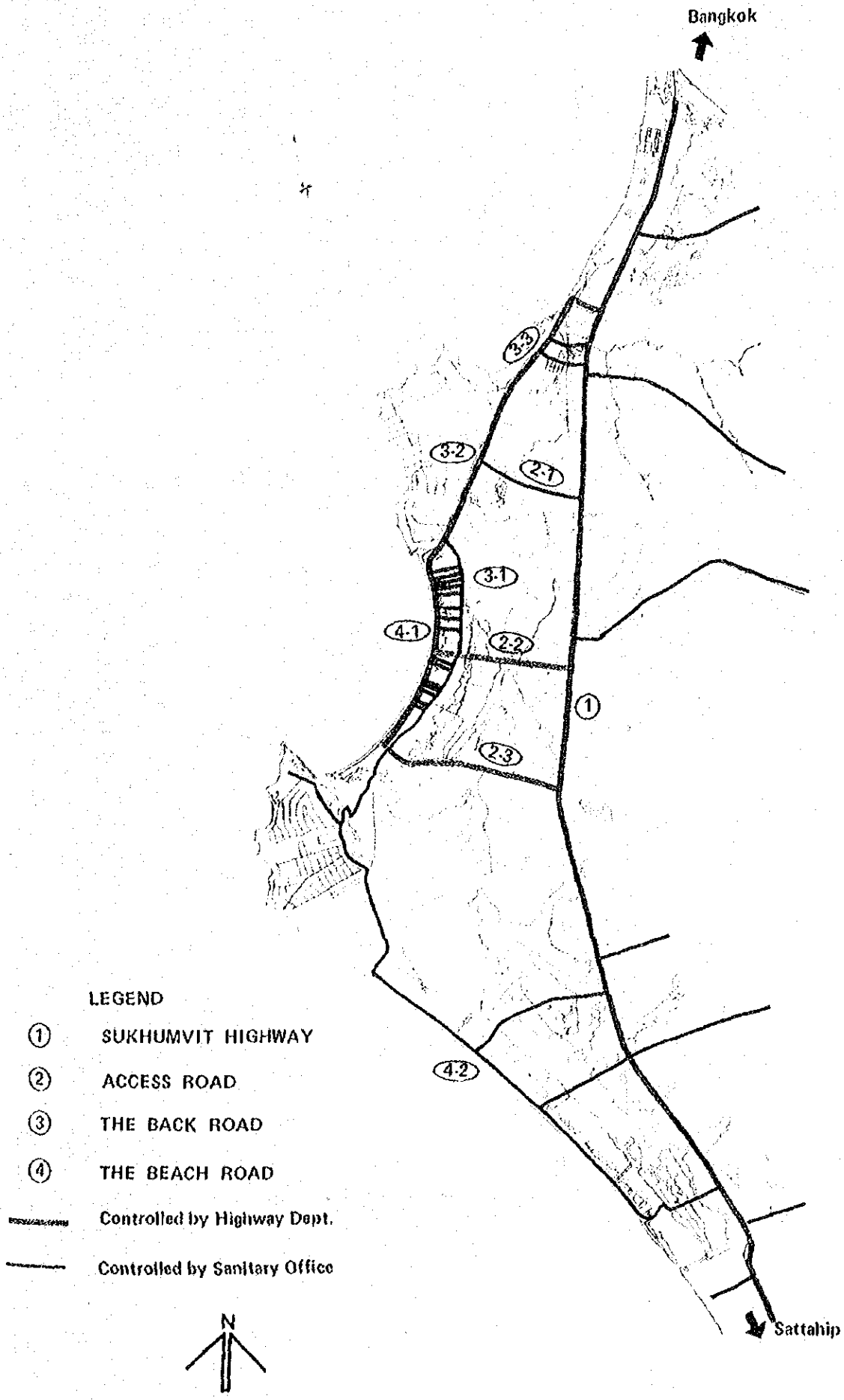


LEGEND

- SUKHUMVIT HIGHWAY
- PHASE 1 T-1 T-2 T-5.
- PHASE 2 T-1 T-2 T-5
- PHASE 1 T-3 T-4
- PHASE 2 T-4
- PHASE 1 R-1 R-2
- PHASE 2 R-1 R-2
- ○ PHASE 1 PARKING AREA
- ○ PHASE 2 PARKING AREA

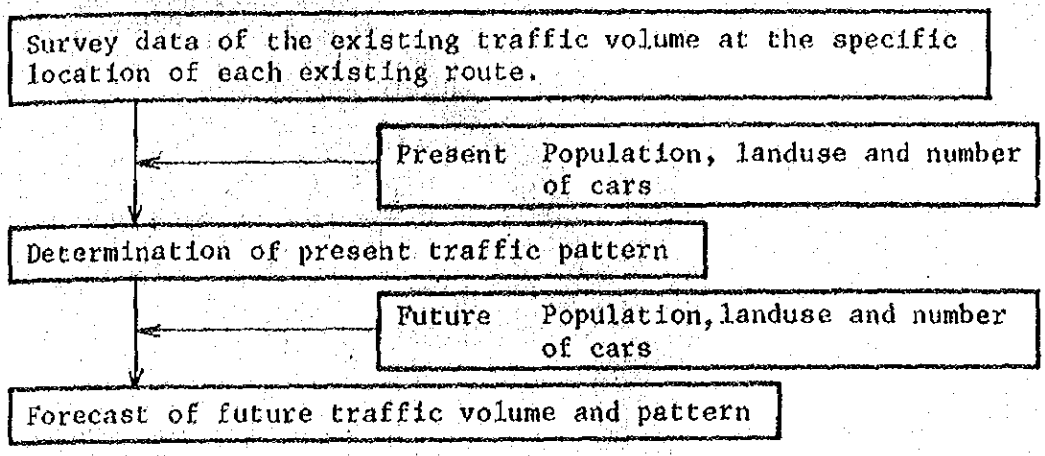
FIG 5.6.1 ROAD NETWORK

Fig. 6.6.2 EXISTING ROAD NETWORK



5.6.3 Traffic analysis

In this section a rough analysis of the present traffic volume and a rough forecast of future traffic demand is made to serve as a basis in the planning of the road and street system. The general process of analysis is shown figuratively as follows:



In the study area, there are two major sources of traffic, one is the tourism related trips and the other is that of local residents. The volume of tourist related trips is normally related to the number of cars which is proportional to the number of tourists to the area. The other trips are proportional to the population of the local community. In this analysis the following formula are used for the forecast of the future traffic demands.

$$Vi = Vl \times Ki + Vi2 + Vi3$$

where:

Vi : estimated future traffic volume at route i,

Vl : estimated number of trips tourist related trip

Vi2 : estimated number of other trips at route i

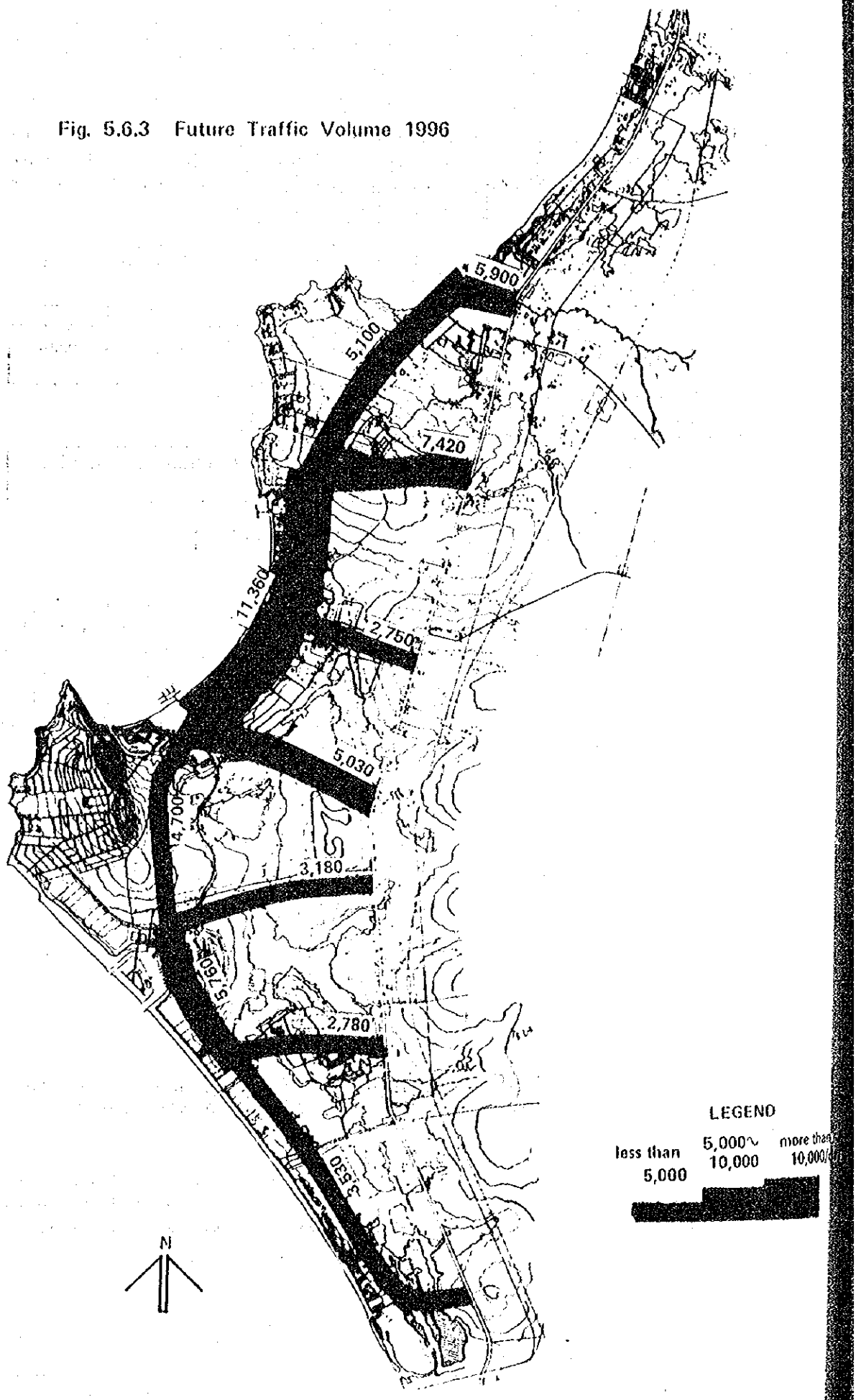
Vi3 : through traffic volume at route i

Ki : diversion ratio of tourist related trip at route i.

The diversion ratio is estimated by analysis of the survey data such as traffic direction analysis, landuse and facilities.

From the above analysis, the future cross section traffic volumes at each route in the area are calculated in terms of daily traffic volume for the peak month and the result is shown in Fig. 5.6.3.

Fig. 5.6.3 Future Traffic Volume 1996



5.6.4 Proposed road and street network

The proposed future road and street network is established in conformity with the landuse plan, the pattern and phase of development and also the future traffic volume, as shown in Fig. 5.6.1. In the figure the major road sections are for the sake of convenience, named T-1, T-2, T-3, T-4, R-1, R-2 and R-3. The proposed timing of implementation of these road sections is shown by lines as follows:

i) Road sections in ——— : in Phase 1
ii) Road sections in – – – : in Phase 2

The roads ratio (the proportion of road area to the total area) of the various new landuse zones as proposed are as shown below:

		Total Area (ha)	Road Ratio (%)	Road Area (ha)
Phase-1	Na Klua Town "A"	123.1	16	20.2
	Na Klua Town "B"	50.0	17	8.4
	Northern New Town	74.0	17	12.5
	Total	247.1		41.1
Phase-2	Na Klua Town "A"	55.9	17	10.4
	Na Klua Town "B"	0	-	0
	Northern New Town	46.0	17	7.8
	Southern New Town	106.0	17	17.9
	Sub Total	207.9		36.1
	Grand Total	455.0		77.2

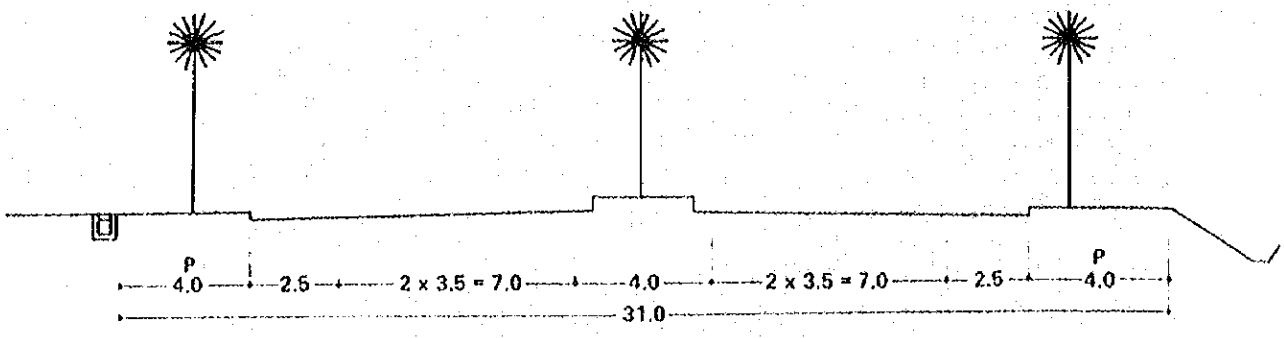
For the northern low density accommodation area and the existing hotel area, it is proposed that the improvement of the existing network be implemented. The existing beach road which is the existing main artery for vehicles will, however, be closed to general vehicle traffic.

For provision of public parking facilities, three public parking areas shall be provided as follows:

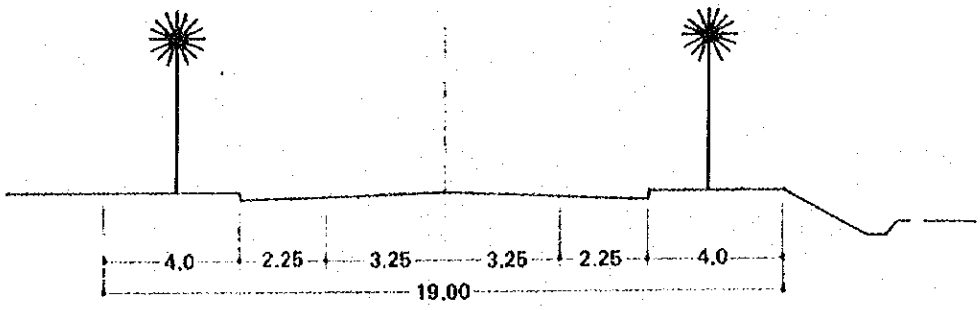
Phase 1	Parking Area P-1	1.0 ha in area
	Parking Area P-2	2.1 ha in area
Phase 2	Parking Area P-3	1.5 ha in area

Fig. 5.6.4 Cross Section

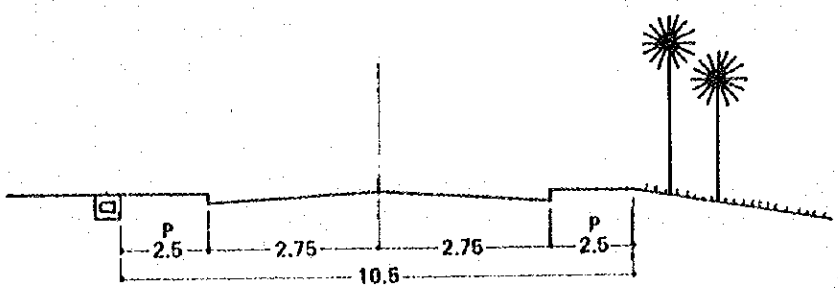
T-1



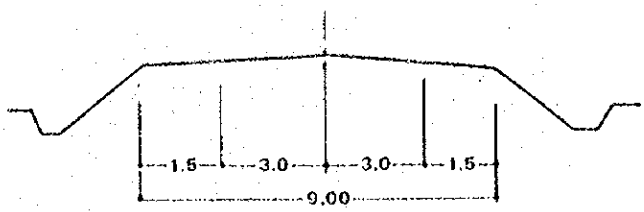
T-2



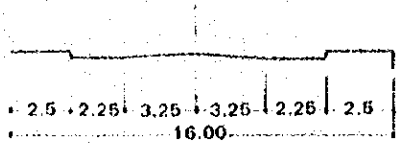
T-3



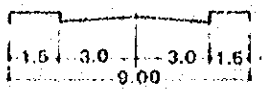
T-4



R-1



R-2



5.6.5 Lighting system

Roadway lighting is proposed along the roads, streets and in the parking area. The design criteria will be based on the policies in "An Informations Guide for Lighting Controlled Access Highways" by AASHO or Design standard on J.I.S.

At each phase, the lighting facilities will be installed and maintained following the schedule as follows.

Phase	Road and Street
Phase 1, Stage 1	T-1, T-2 and T-3
Phase 1, Stage 2	Road and street networks in the Na Klua new town and in the Northern new town for residential areas
Phase 2	Some parts of T-1 and T-2 which will run in the hotel area, and some parts of the Southern new town.

For the public areas other than roads and streets mentioned above, such as area for the activity zone, the amusement tourist facilities zone and the park zone, properly operated automatic lighting will be installed to provide not only the functional needs but also to fulfil the landscape requirements.

Since the light fixture in these areas will be appreciated by pedestrians and will contribute to the projected atmosphere as an ocean resort, special visual considerations have to be made in the adoptation of lighting fixture types and the design of lighting system.

5.6.6 Summary of the proposed road and street system

1) Of all the road sections, it is important that the sections (T-1), (T-2) and (T-3) should be implemented as soon as possible, in order to clearly define the access roads to Pattaya and to provide a new artery in order to divert the traffic from the existing beach road. Since some demolition will also be necessary for the implementation of section (T-3) and some delay through acquisition is anticipated, the early decision on its implementation is necessary. (Fig. 5.6.4)

2) The land price is expected to increase if the masterplan is implemented. It is necessary therefore that for the other road sections, the right-of-way should be acquired as soon as possible in order to reduce the cost in land acquisition. This should include the road sections proposed for Phase 2 implementation since early action will enable land acquisition more easily at a relative low cost. Land acquisition shall be made in consideration with other infrastructure to minimize land cost.

Table 5.6.1 Design Criteria

Road Type	Unit	Sukhumvit hwy	Pattaya Raod Network						
			T-1	T-2	T-3	T-4	R-1	R-2	R-3
Hwy Dept. Class	-	P_D	P_1	S_2	-	-	S_2	-	-
Av. Daily Traffic	Veh/day/lane	above 8,000	4000∿8000	2000∿4000	-	-	2000∿4000	-	-
Design Speed	kph	*	60-80	55-70	-	-	55-70	-	-
Shoulder Width	m	*	2.50	2.25	-	-	2.25	-	-
Cross Slope of Pavement	%	*	2.50	2.50	-	-	2.50	-	-
Cross Slope of Shoulder	%	*	5	5	-	-	5	-	-
Minimum Raidus	m	*	150	110	-	-	110	-	-
Vertical Curve Radii									
Crest	m	*	1400	800	-	-	800	-	-
Sag	m	*	1000	700	-	-	700	-	-
Median Width	m	*	4	-	-	-	-	-	-
Traffic Lane	-	*	(3.5x2)x2	3.25x2	-	-	3.25x2	-	-

* Criteria for existing Sukhumvit Highway are as built.

3) Ample coordination and cooperation with the government agency in charge of environmental control should be sought for the control and regulation of such environmental problems as noise, exhaust gas, pollution etc.

4) The beach road should be closed to general vehicle traffic to make it available to pedestrian and bicycle traffic and a limited number of public vehicle traffic. The general vehicle traffic shall be diverted to the improved road section (T-1).

5) While some tentative design criteria are listed in Table 5.6.1, it is recommended that a more in depth study on any technical problems shall be carried out at a later stage in order to ex expedite implementation.

5.6.7 Phasing

At the T-1 road with four lanes, it is recommended to install only two lanes at the early stage, and to construct the remainder at the time when traffic volume increases to such an extent as to justify expansion of the road. But the land acquisition for the right of way shall be however done at the first stage if possible.

5.6.8 Technical Descriptions

The design criteria follows tentatively the standard for the national highway design and construction by which roads and streets can be classified in eight categorical types.

No.	Name of way	Category on the standard
1	Sukhumvit Highway	Class PD, in Highway department
2	T-1	Class P1, ditto
3	T-2	Class S2, ditto
4	T-3	The beach road,
5	T-4	The sidewalk,
6	R-1	Class S2, in Highway department
7	R-2	Street
8	R-3	Street

Table 5.6.1 list the design criteria tentatively proposed for application to the road and street network of the study area.

5.7 ELECTRIC POWER SUPPLY SYSTEM

5.7.1 General

Electric power supply system in the study area is represented by distribution system and Bang Lamung Substation. On the planning of electric power supply system the following basic requirements are established.

a. High quality ... stable in voltage
b. High reliability . no interruptions

Also it is required for high quality power that the frequency is stable. However as frequency is controlled by balance of supply and consumptions, it is a problem of the power stations. After the completion of the plan, electric power supply to the study area will be stable in voltage and rare in interruption.

5.7.2 Existing Situation

Present conditions of electric power supply system in the study area are as follows.

(a) Power Supply Network

Electric power is now supplied by 115 kV transmission line from Bang Kapi Substation (SS) in Bangkok through Cha Choeng Sao SS, Chonburi SS, Sri Racha SS and Bang Lamung SS which step down voltage into 22 kV to supply Pattaya area. The power transmission line network is shown in Fig. 5.7.3.

In this year, Ao Pai SS will be connected to Bang Kapi SS by 230 kV ultra high tension transmission line. Therefore it will be not only sufficient for southeast area demand such as Pattaya area and Sattahip area but also the reliability of power supply will improve.

In future a proposed nuclear power station may be constructed at Ao Pai Bay 2 km apart form Sri Racha SS from where power will be transmitted to Ao Pai SS.

(b) Bang Lamung SS

All the power demand on Pattaya is supplied form Bang Lamung SS. The old 12.5 MVA transformer had been recently changed up to the capacity of 25 MVA against overloads. The peak demand on Pattaya area is now 11.8 MVA, and the bank capacity of Bang Lamung SS will be enough for a while.

(c) Distribution Lines

115 kV electric power is now stepped down into 22 kV distributed voltage at Bang Lamung SS then is distributed to hotels,

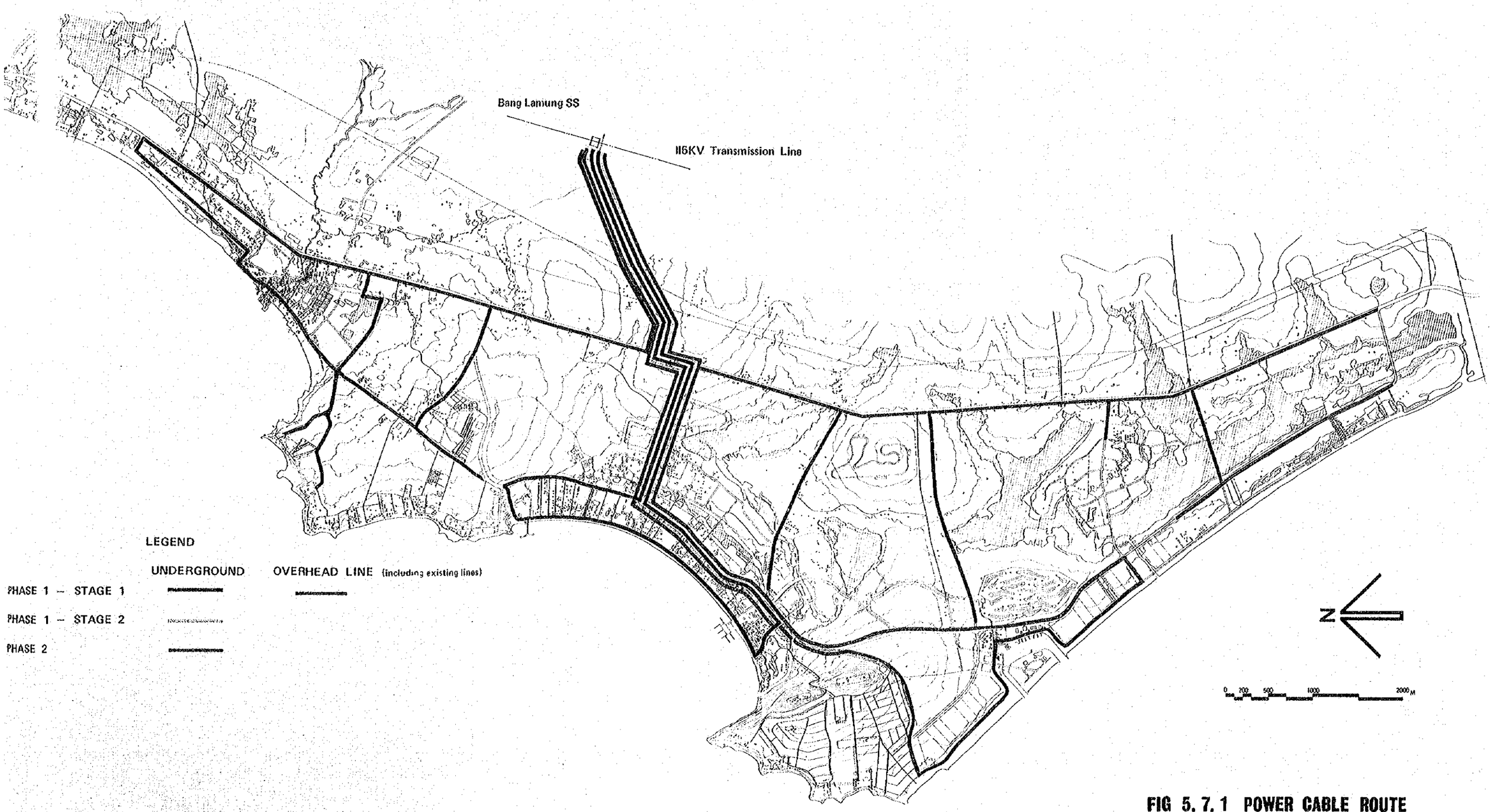


FIG 5.7.1 POWER CABLE ROUTE

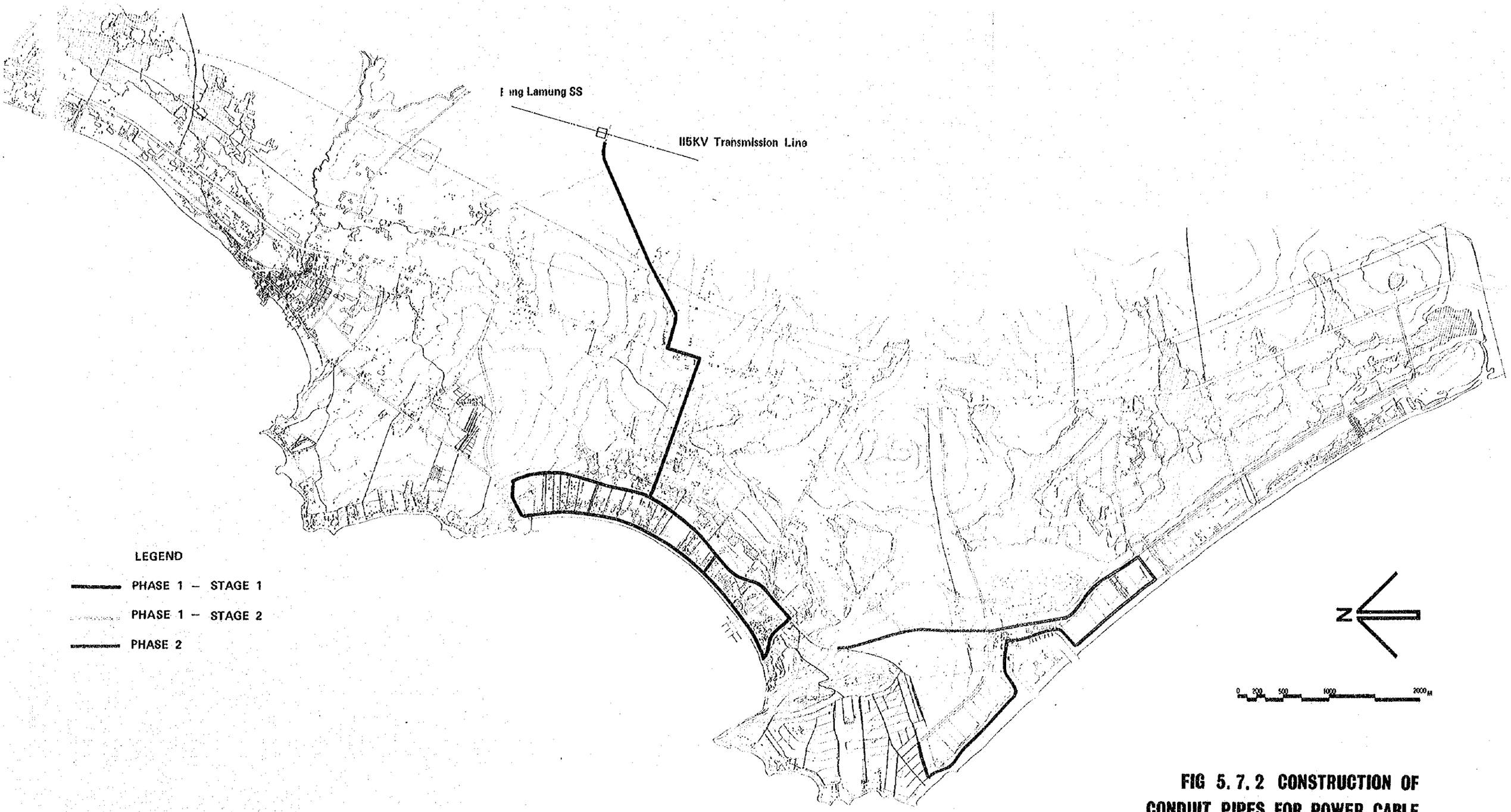


FIG 5.7.2 CONSTRUCTION OF CONDUIT PIPES FOR POWER CABLE

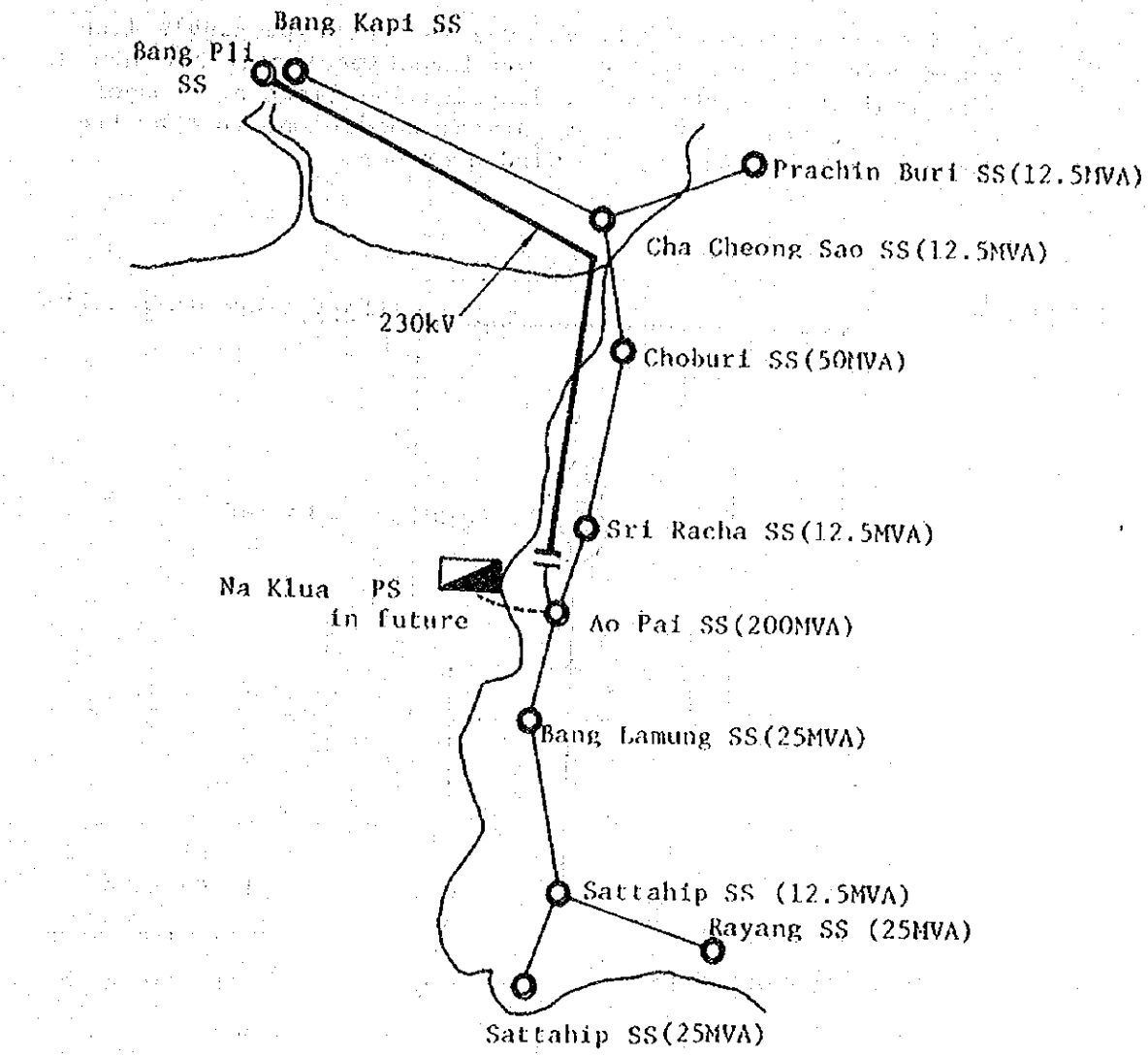


Fig. 5.7.3 Power Transmission Network

restaurants, shops, houses, factories and others by three feeder lines (F1, F2, F3) as shown in Fig. 5.7.4 and Fig. 5.7.5.

Distribution system in Pattaya area is tree type single line system which is simplest with low investiment cost but inferior in reliability. Furthermore, distribution lines are longer and liable to interferance by natural conditions such as tree branches, snakes and salt by wind over sea.

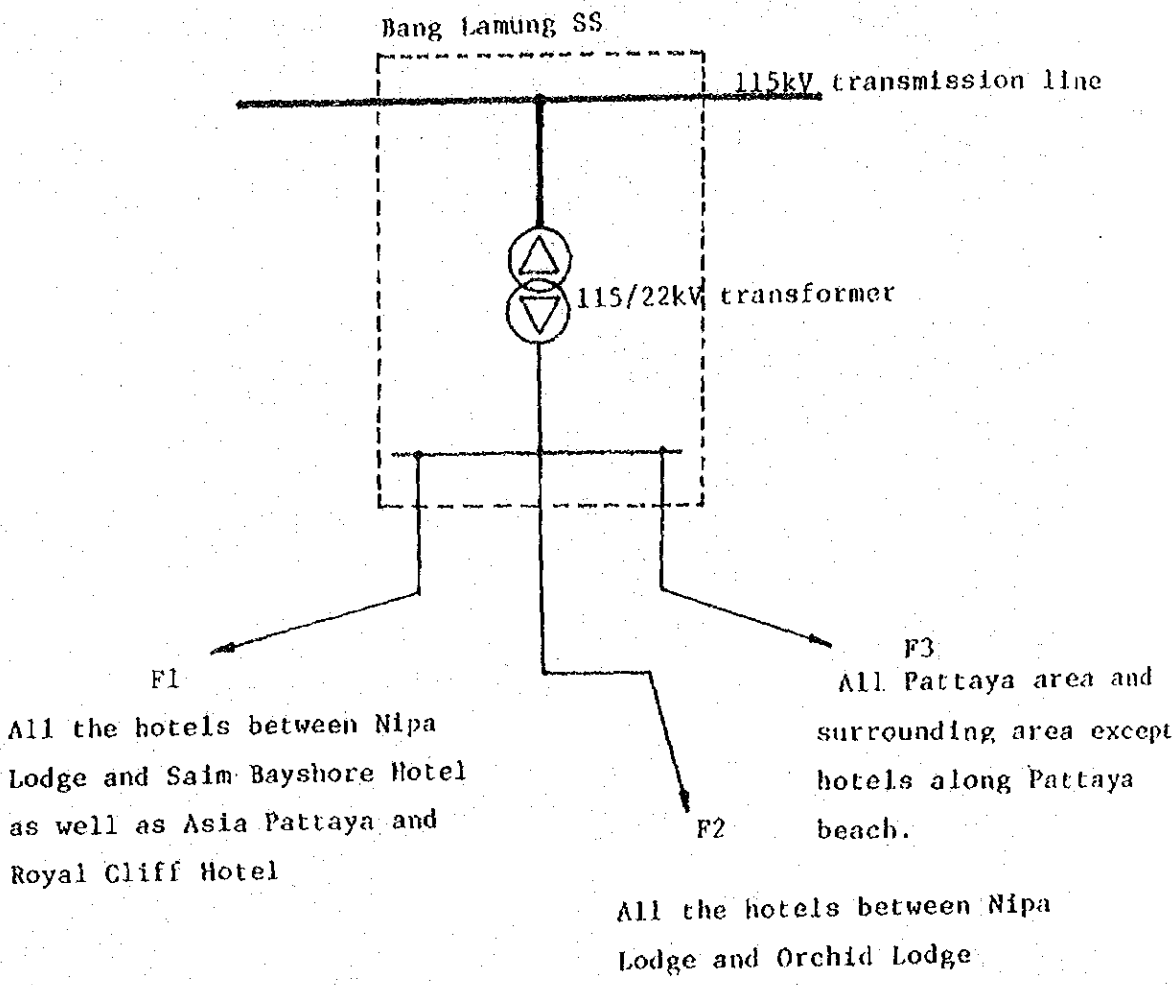
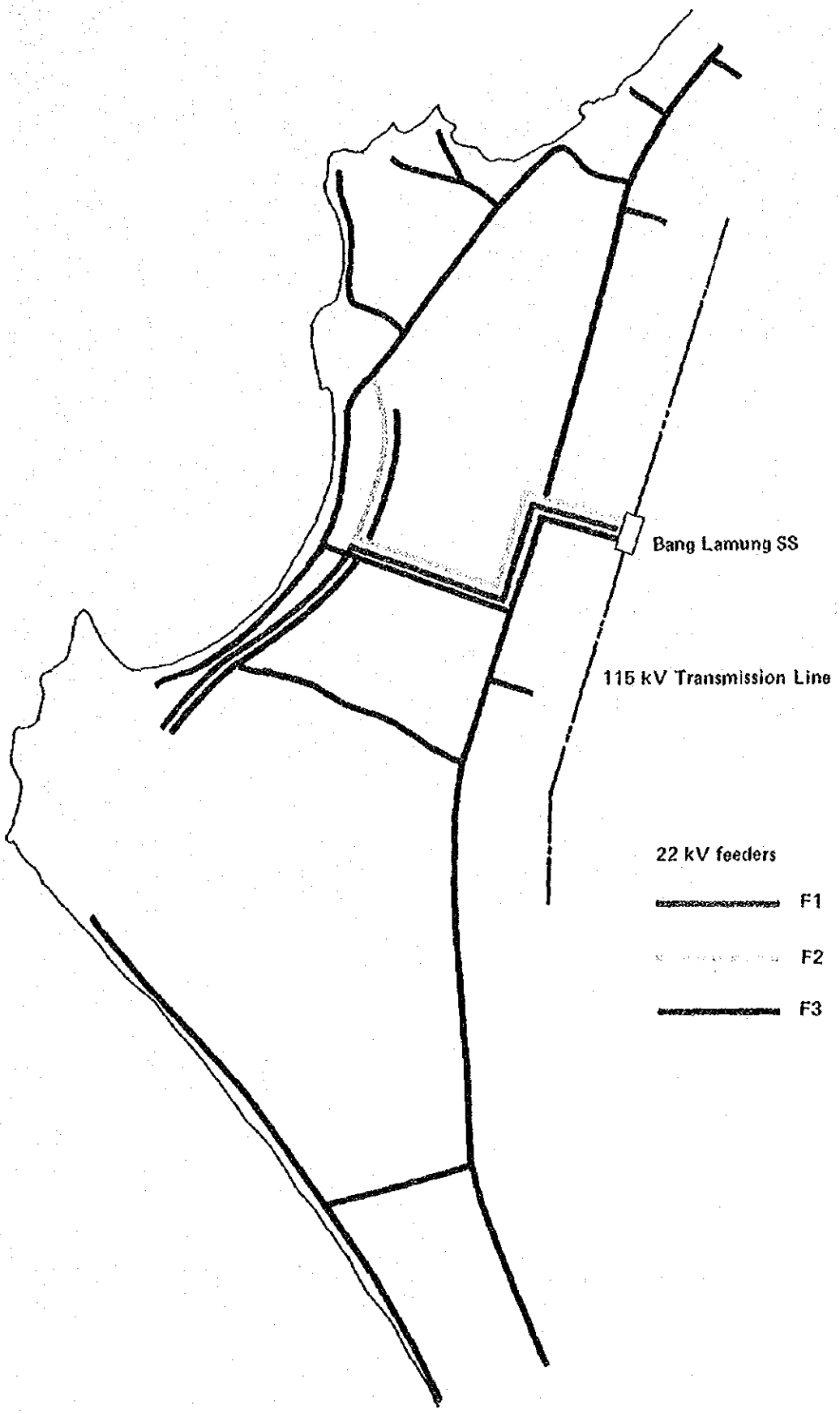


Fig. 5.7.5 Existing Distribution Network

(d) Problems

Existing distribution lines result in many interruptions (about 10 times a month), and once a distribution line failure occurs it takes about 2 hours mean repair time. Such situation forces large consumers such as hotels to have their own large emergency generators with a capacity of 50% of demand, which is extremely high comparing to the normal emergency countermeasure in the world.

Fig. 5.7.4 EXISTING DISTRIBUTION NETWORK



5.7.3 Forecast of Power Demand

Power demand in Pattaya area was forecast for the following items.

a. Power demand by hotels
b. " " by houses, shops, restaurants
c. " " by facilities

The total power demand in each key year in Pattaya area is summarized as follows and shown in Fig. 5.7.6.

Year	1981	1986	1996
Power demand (KW)	14,600	20,150	44,160

The power demand is classified by area and also by consumers in table 5.7.1 and table 5.7.2.

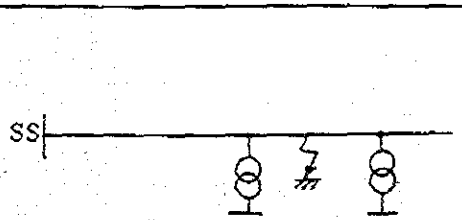
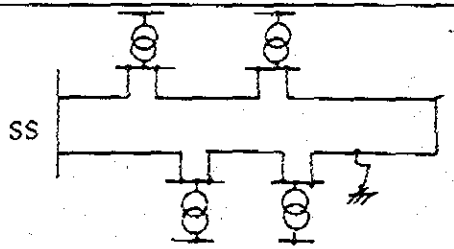
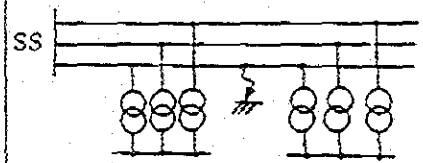
Table 5.7.1 Power demand classified by area

Area		1981	1986	1996
Na Klua	(KW)	3,420	4,110	7,160
Pattaya beach	"	8,810	10,230	13,330
Pattaya Hill	"	1,710	4,860	10,730
New south	"	840	950	12,940
Total	"	14,600	20,150	44,160

Table 5.7.2 Power demand classified by consumers

Area		1981	1986	1996
Hotels	(KW)	7,110	10,250	24,000
Houses, shops, restaurants	"	4,160	6,430	14,320
Facilities	"	1,560	1,700	4,070
Factories	"	1,770	1,770	1,770
Total	"	14,600	20,150	44,160

Table.5.7.3 Alternative distribution system

Item	Single line	Loop line	Spot network
System configuration			
System explanation	° Power is supplied by single feeder. ° When feeder failure (grounding or short circuit), power is completly interrupted until repair is completed.	° Power is supplied by loop feeder. ° When feeder failure (grounding or short circuit), power is continuously supplied without instant interruption.	° Power is supplied by 3 feeders. ° When feeder failure (grounding or short circuit), power is continuously supplied without instant interruption.
Protection	Circuit breaker or power fuse	Circuit breaker with pilot wire relay	Network protector fuse and network circuit breaker/relay
Transformer capacity	100 % of demand	100 % of demand	150 % of demand
Reliability	poor	high	very high
Investment cost	low	fair	very high
Application	low density area (not fit for buildings, hotels public facilities)	high density area (fit for hotels, pulic facilities)	very high density area like Metropolis (not fit for Pattaya in the point of investment cost)

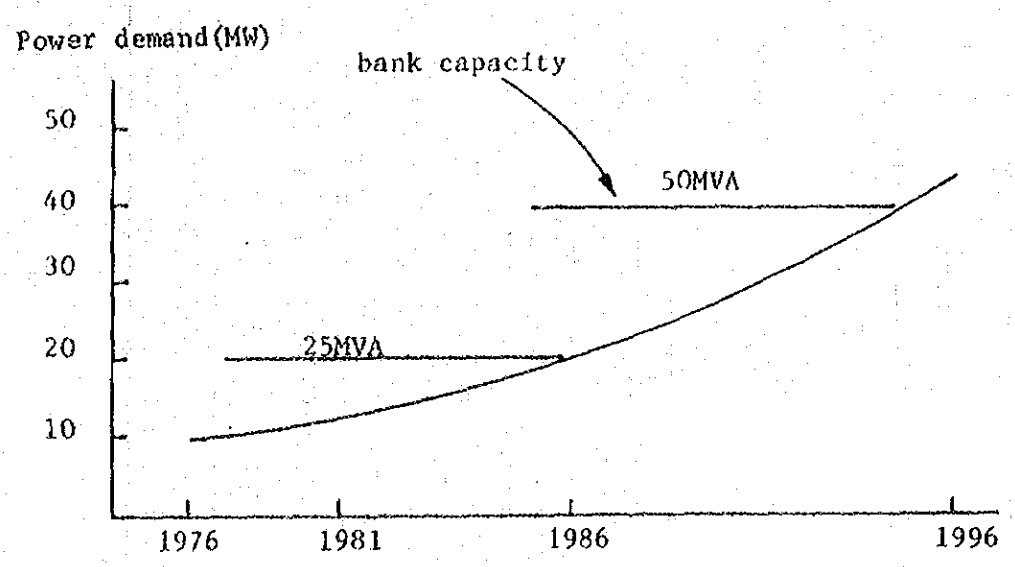


Fig. 5.7.6 Power Demand

5.7.4 Alternative Study

(a) Distribution System

There are three possible alternative distribution systems, namely single line, loop line and spot network systems, and their relative merits are listed in Table 5.7.3.

The loop line connection and single line connection will be applied according to the degree of load. The loop line connection will be applied for big consumers and public consumers in high density area such as Pattaya beach, Pattaya Hill and New South area. The single line connection will be applied for low density residential area.

(b) Wiring Method

There will be 2 alternative wiring for feeder and service lines. (Table 5.7.4).

a. overhead line
b. underground line

Both wiring will be used together because single line is profitable for low density area by overhead and loop line is in harmony with underground from the point of reliability and landscape.

Table 5.7.4 Alternative wiring method

Item	Overhead line	Underground line
Endurance against natural disturbance		
tree branch	Weak	No need to be considered
snakes	"	"
salt	"	"
Conductor	Naked or vinyl sheathed cupper or aluminium wire	Paper insulated cable or cross linked polyethylene cable
Structure	Concrete pole	Walk way duct, or conduit pipe with manholes (handholes)
Repair time	Short	Long
Maintenance	Serious	Easy
Reliability	Low	Very high
Investiment cost	Low	High
Application	Low density area	High density area with loop line connection

5.7.5 Conclusion

(a) Bang Lamung Substation

With the future increase of power demand, the bank capacity of Bang Lamung which had already extended up to 25 MVA in February, 1977 against overloads, will be further extended. The extension schedule by phases will be as follows:

Phase 1 : There will be no needs to extend bank capacity for an estimated demand of 20,150 KW.

Phase 2 : An additional 25 MVA bank with the same facilities as the existing consisting of transformer, line switch, circuit breaker and others will be installed.

(b) 115 KV Transmission Line

115 KV transmission line between Ao Pai SS and Bang Lamung SS has a capacity of 120 MVA and feeds not only Pattaya area but also the southern area such as Sattahip and Rayong. On the assumption that power demand on the southern area will not increase so rapidly as Pattaya area, it will not be necessary to extend the 115 KV transmission line between Ao Pai SS and Bang Lamung SS even with the extension of Bang Lamung bank capacity.

(c) Distribution Lines

1) Basis

The following countermeasure will be considered to maintain disbribution lines in high reliability.

i) Feeder lines will be wired underground to prevent natural disturbance such as broken tree branches, snakes and salt by wind over seas.

ii) Feeder lines will be wired in loop line connection against any chance of line failure.

iii) Where loop line connection is not feasible for technical and economical reasons, the power will be supplied by 2 different feeders.

iv) Different feeders will be tied through circuit switch to cope with failure.

v) Single line feeders will be completely prevented from natural disturbance by cutting trees, adding more insulators and retransmitting after 1 minute interruptions.

2) Disbribution method

Basically power supply to hotels, high density commercial area, amenity core and public facilities will be fed by underground loop line connection. Power supply to low density residential area and Na Klua area will be overhead single line.

The distribution method for the underground loop line is shown in Fig. 5.7.7 and explained below:

i) Power will be fed from Bang Lamung SS by 3 phase, 50 Hz, 22 kV underground loop line.

ii) All consumers will be connected to loop line.

iii) All hotels will have private substation which step down 22 kV into 3 phase, 4 wire, 50 Hz, 380/220V service voltage.

iv) Distribution units for low tension consumers will be installed around high density area.

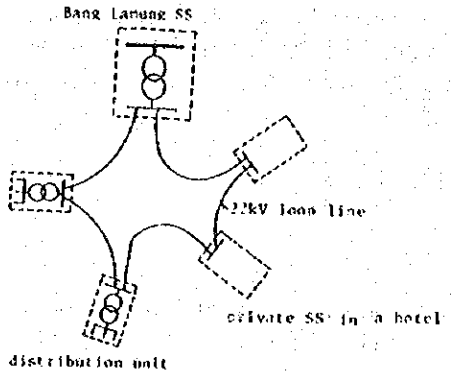


Fig. 5.7.7 Loop Line Connection

3) Underground lines

Underground line will consist of conduit pipes, handholes or manholes and 22 kV, 3 conductors cross linked polyethylene insulated cables. Conduit pipes will be constructed along roads and handholes or manholes will be constructed each 200 meters long for power cable connection or corner. Fig. 5.7.8 shows the configuration of the underground lines.

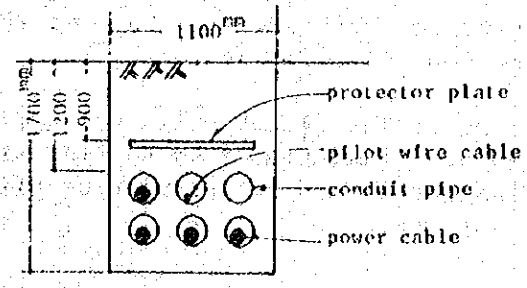


Fig. 5.7.8 Typical Cross Section of Underground Lines

4) Distribution routes

Though single line feeders will be wired step by step in line with increased in demand, loop line feeders shall be wired previously taking into account of future demand because it will be difficult for additional demand to be connected in loop line without any area limitation. As for the route of loop line feeders, they shall be wired theoretically in different routes to prevent interruptions by conduit failure caused by for instance construction pickers. However, actually a part of loop line feeder will be wired in same conduit route for the reason that as investiment cost of underground line is very high, it is profitable to collocate loop line feeder in same conduit route to the extent that it does not reduce reliability. The distribution route is shown in Fig. 5.7.1 for each phase.

Phase 1; Stage 1 — 22 kV loop line will be constructed for Pattaya beach. Additional conduit pipes which will be used for Pattaya hill loop line and Pattaya New South loop line as is shown in Fig. 5.7.2 will be previously constructed to reduce investment.

Phase 1; Stage 2 — 22 kV loop line will be constructed for Pattaya Hill. Since conduit route which is the same with Pattaya beach loop line will have been constructed in stage 1,only cables will be wired.

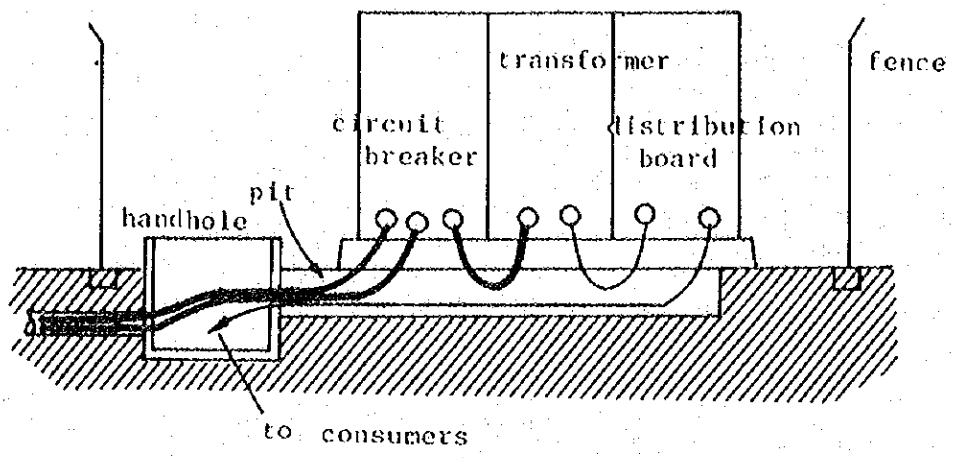
Phase 2: 22 kV loop line will be constructed for New South.

5) Distribution unit

Distribution units will be installed and branched from loop line instead of transformers in single line feeders. Distribution units will intake 22 kV cables then step down into low tension (380 V/220 V) and supply to consumers in high density area such as restaurants, shops, and houses. Distribution unit will consist of line switches, circuit breakers, transformer and distribution board.

22 kV CV cables will be wired through manholes or handholes, as shown in Fig. 5.7.9.

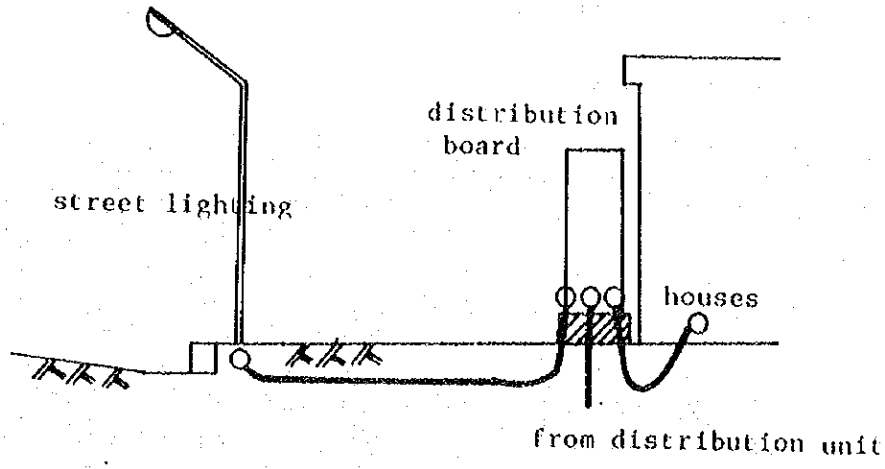
Fig. 5.7.9 Distribution Unit



6) Service lines

Service lines to restaurants, shops and others will be supplied through handholes or manholes from distribution board. Low tension power, which is 380 V by line voltage and 220 V by phase voltage, will be served through distribution switch to houses, shops, restaurants, and street lighting as shown in Fig. 5.7.10.

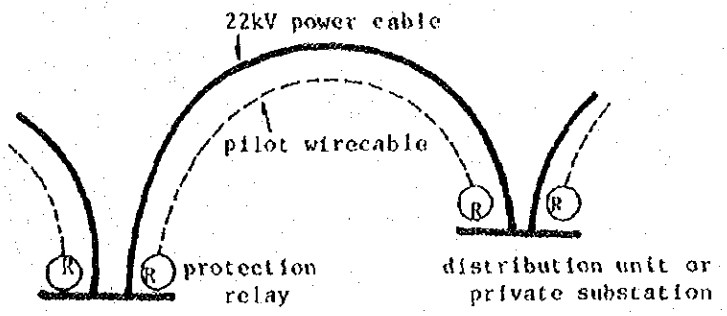
Fig. 5.7.10 Service Lines



7) Loop line protection

Pilot wire protection system will be needed for loop line protection. Pilot wire cable will be constructed along power cables as shown in Fig. 5.7.11.

Fig. 5.7.11 Loop Line Protection



5.7.6 Recommendations.

a) 115 kV Transmission Line.

Though 115 kV transmission line will not need to be extended, it is recommendable that additional 3 phase circuit on existing tower be constructed to maintain high reliability in the tree type network.

b) Installation of Emergency Generator.

Although reliability of power supply will be improved by loop line and underground wiring, emergency generator should be installed at important facilities or public consumers such as hotels, water supply facilities, telecommunication facilities. As for hotels, power supply to the following load shall be maintained by private emergency generators.

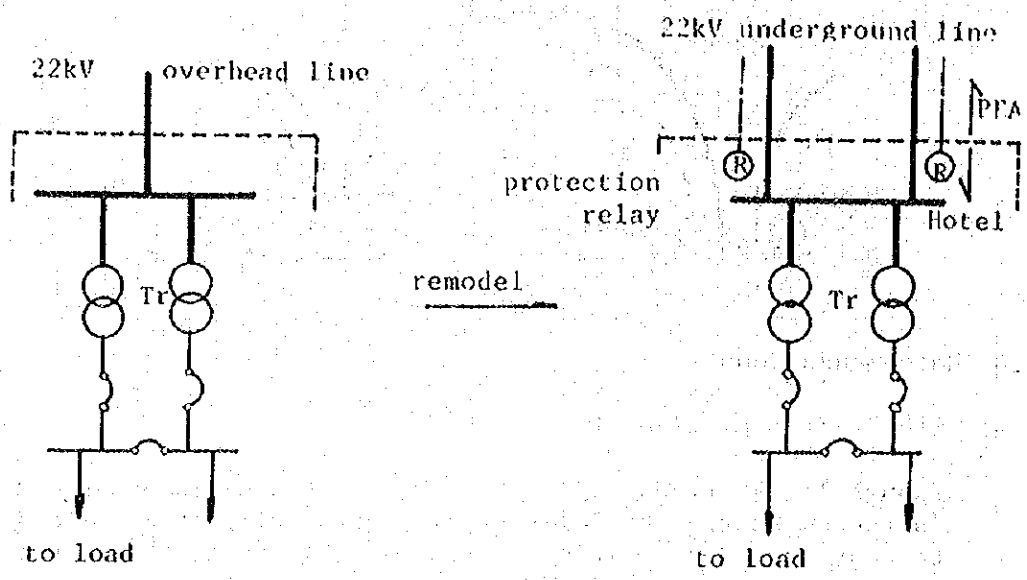
a.	Lighting	:	More than 1/5 of total lighting facilities
b.	Elevator	:	About 1/3 of total elevator
c.	Water supply & sewage pump	:	All
d.	Ventilation fan	:	Required fans
e.	Fire fighting pump	:	All
f.	Fire alarm	:	All
g.	Control power	:	All

Hence, the total demand on emergency generator will be less than 30 % of private substation capacity.

c) Requirement For Hotel Substation.

The existing hotels along Pattaya beach which are supplied by 22 kV overhead lines shall be remodeled to intake 22 kV underground line. Furthermore, as 22 kV loop line is planned one more circuit breaker and protection equipment shall be added in phase 1, as shown in Fig. 5.7.12.

Fig. 5.7.12 Requirement for Hotel Substation



5.7.7 Technical Descriptions.

a) Criteria for forecast.

1. Hotels.

Standard peak power consumption in international resort hotels in the world is 0.03 kW/m2 for lighting loads and 0.05 kW/m2 for air conditioning loads. The standard size of hotel room in Pattaya beach is estimated to be 45 m2 cluding common spaces and ancillary facility area. The peak power demand on a room will thus be 3.6 kW. Multiplying this unit peak demand by the number of rooms, the capacity of private substation in a hotel will be calculated.

However, for the peak demand on Bang Lamung SS, a demand factor must be considered taking into account the occupancy etc., which is 0.5 for international resort hotel. Thus unit demand per hotel room will be 1.8 kW (2.25 kVA).

For instance, a standard hotel (300 rooms) will have the following private substation and power demand.

private substation : 300 rooms x 3.6 kW/room = 1,080 kW

power demand : 300 rooms x 1.8 kW/room = 540 kW

2. Houses, shops, restaurants

Basically power demand by houses, shops, restaurants etc. which are classified as small consumer (under 6 kW and 6 kW - 30 kW) was forecast proportional to the increase of population. According to data by a private company in January 1977, the total demand by these small consumers, which numbers about 6,200 consumers, is 2,820 kW. The average power consumption per person in Pattaya area is calculated to be 0.08 kW. This unit demand will increase in pace with the improvement of living standard as follows.

	1976	1981	1986	1996
increase factor	1.0	1.28	1.63	2.65
unit demand (kW/person)	0.08	0.1	0.13	0.21

5.7.8 Ko Lan Island

a) General.

There is no electric power supply in Ko Lan Island now except for private generators. On the planning of electric power supply system the same basic policy as that for Pattaya area is adopted.

b) Forecast of power demand.

The power demand in the Island was forecast for the following items.

a. power demand by hotels.

b. power demand for residential and commercial use.

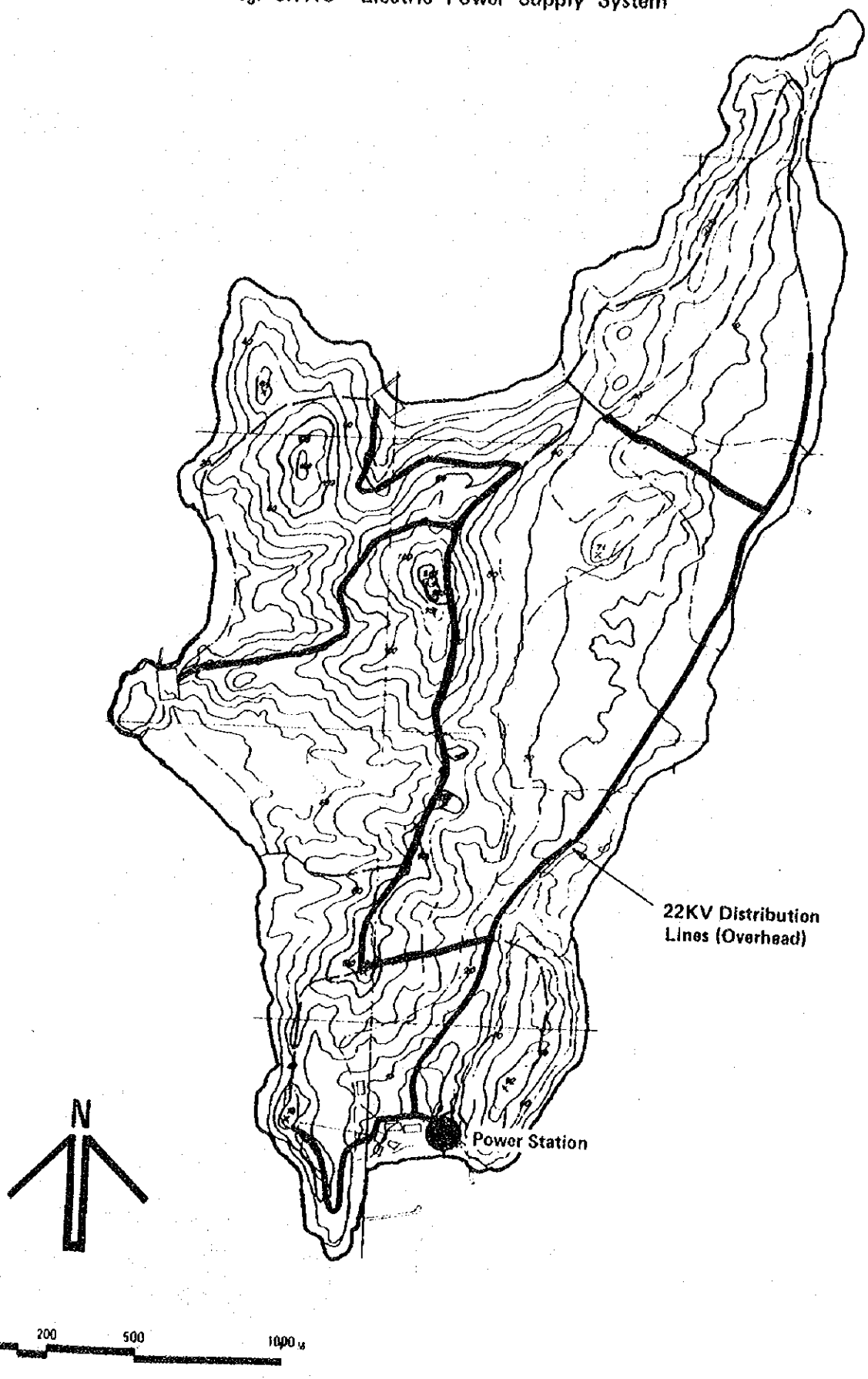
Herein the criteria for forecast is the same as that for Pattaya beach. The estimated power demand in each phase will be as follows:

Year	1981	1986	1996
Power demand (kW)	340	770	1,030
Power demand (kVA)	450	1,000	1,300

The power demand is classified by consumers as follows:

Consumers		1981	1986	1996
Hotel use	(kW)	150	450	450
Commercial use	(kW)	30	60	120
Residential use	(kW)	160	260	460
Total	(kW)	340	770	1,030

Fig. 5.7.13 Electric Power Supply System



c) Conclusion.

i) Power station by diesel generators will be constructed at Ko Lan Vac. Co. on Ko Lan Island for the reason that power supply from Bang Lamung SS by means of submarine cable is not feasible in view of very high investment cost. Furthermore, submarine cable is liable to be exposed to water pressure, corrosion, electrical corrosion, frictional exhaustion and disturbance by fishing boat.

ii) Diesel generators will be installed in the power station. A pair of diesel generators will be needed taking into account the periodical maintenance of diesel engine at an interval of once in six months.

phase 1, stage 1: 2 sets of 750 kVA diesel generators will be installed and operated simultaneously. During periodical maintenance of one, the other generator will supply power demand.

phase 1, stage 2: 1 set of 750 kVA diesel generator will be added to meet increased power demand.

The relationship between power demand and capacity of generators is follows:

		1981	1986	1986
power demand	(kVA)	450	1,000	1,300
true capacity	(kVA)	750	1,500	1,500
spare capacity	(kVA)	750	750	750
Total	(kVA)	1,500	2,250	2,250
		(750×2^{sets})	(750×3^{sets})	(750×3^{sets})

iii) Distribution system in Ko Lan Island will be single line for the reason that distribution line is not so long and there will be no big consumers.

Power in Ko Lan Island will be supplied by 22 kV overhead single line along the road, then stepped down to service voltage by pole transformers. (Fig. 5.7.13)

iv) Hotels in Ko Lan will be served at low tension (380 V) in view of the small consumptions. (A standard hotel having 80 rooms will consume about 140 kW).

v) The following countermeasure will be adopted to prevent failure of distribution lines.

a. Insulators will be installed against interference by salt.

b. Tree branches near distribution lines will be always cut.

5.8 TELECOMMUNICATION SYSTEM

5.8.1 General

The telecommunication system in the masterplan is represented by combined telephone system and radio links. The combined telephone system consists of telephone system for international calls and domestic calls, and Telex system for message transmission. The radio links are used for trunk lines of this combined telephone system.

On the planning of telecommunication system, the following three basic requirements are adopted.

a. Clear .... high quality of transmission.

b. Stable ... high reliability even during specially heavy traffic

c. Speedy ... low link blocking probability and no waiting time.

This will mean that international and domestic calls between Pattaya area including Ko Lan Island and all countries in the world, Bangkok and other provinces will be served speedily, stably and clearly by direct dial system. (Operators will be required for international calls only at International Telephone Exchange Station in Bangkok.)

5.8.2 Present Conditions

The existing conditions of telecommunication system in the study area are as follows:

(a) General

The telecommunication system available at present in Pattaya is a combined telephone system and radio links. The combined telephone system provides services for domestic calls and also international calls and Telex service via Bangkok.

(b) Telephone Network

The telephone network is, as shown in Fig. 5.8.3, a star type network centered on the Bangkok supervisory station and is not a direct dial system but a waiting system handled by attendant operators.

(c) Trunk Lines

The Pattaya Exchange Station has 8 trunk lines to Chonburi Station, which is connected to Bangkok Station by 34 trunk lines, and has 2 direct trunk lines to Bangkok Station through Chonburi Station.

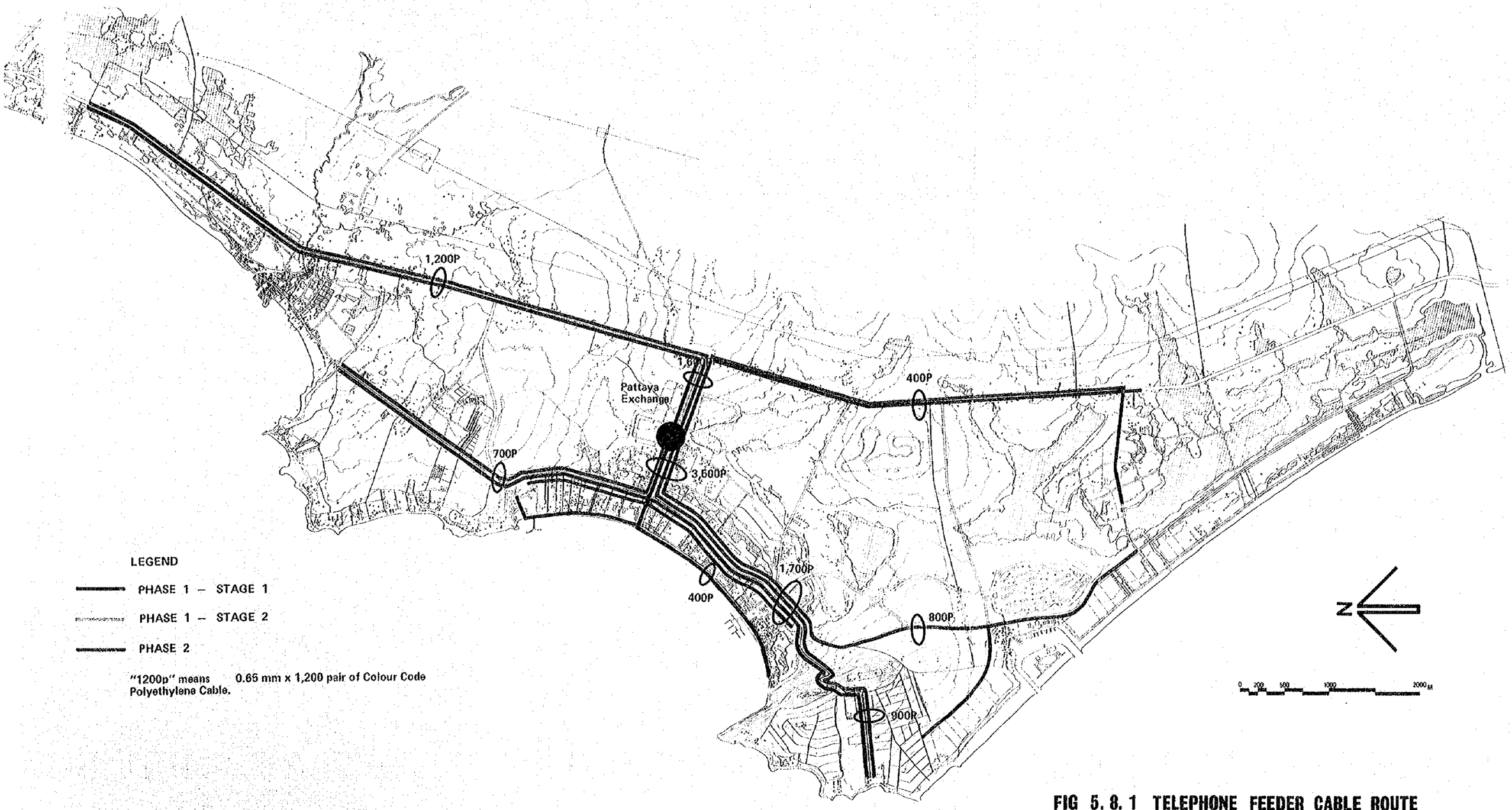


FIG 5.8.1 TELEPHONE FEEDER CABLE ROUTE

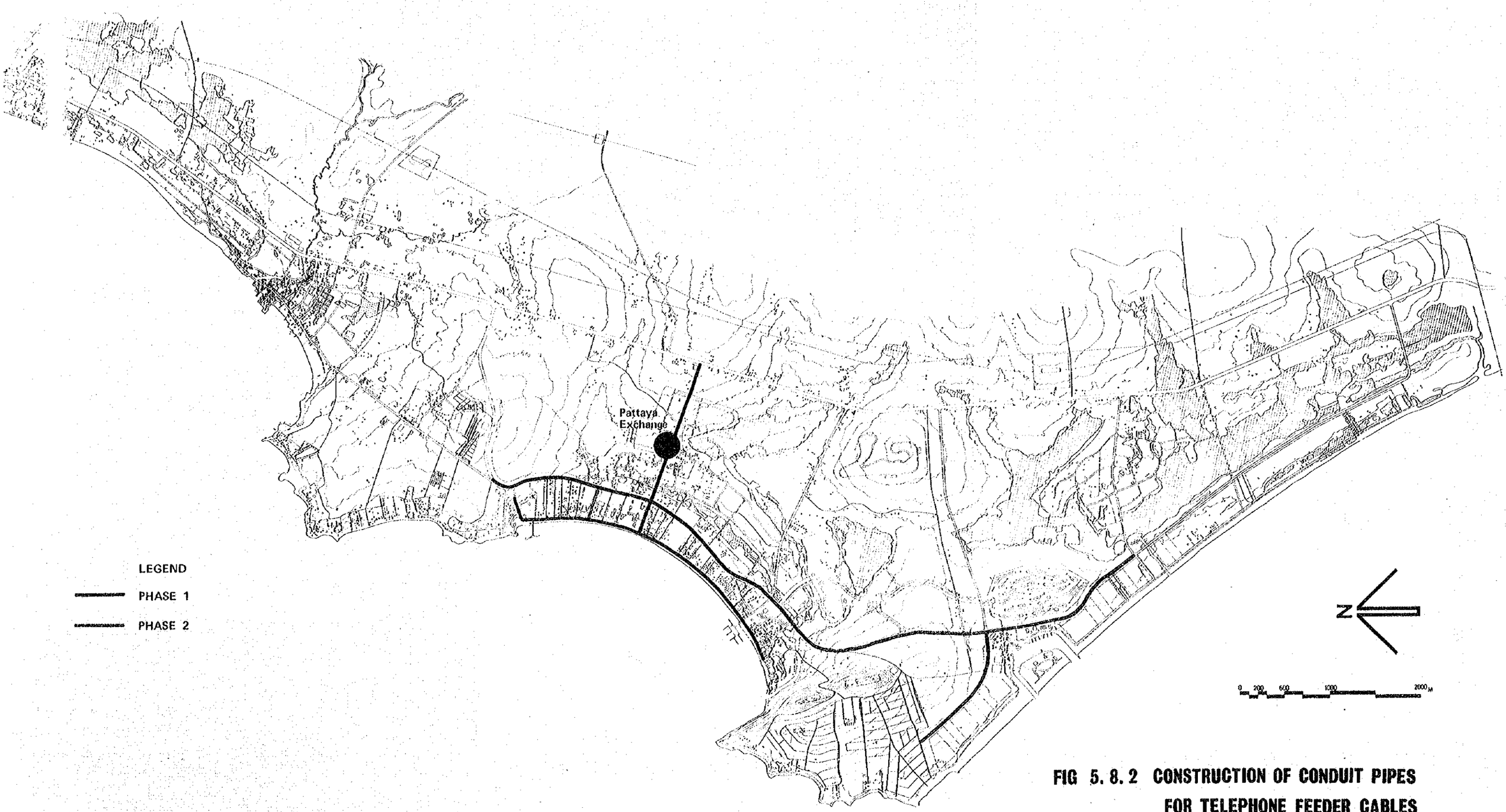


FIG 5.8.2 CONSTRUCTION OF CONDUIT PIPES FOR TELEPHONE FEEDER CABLES

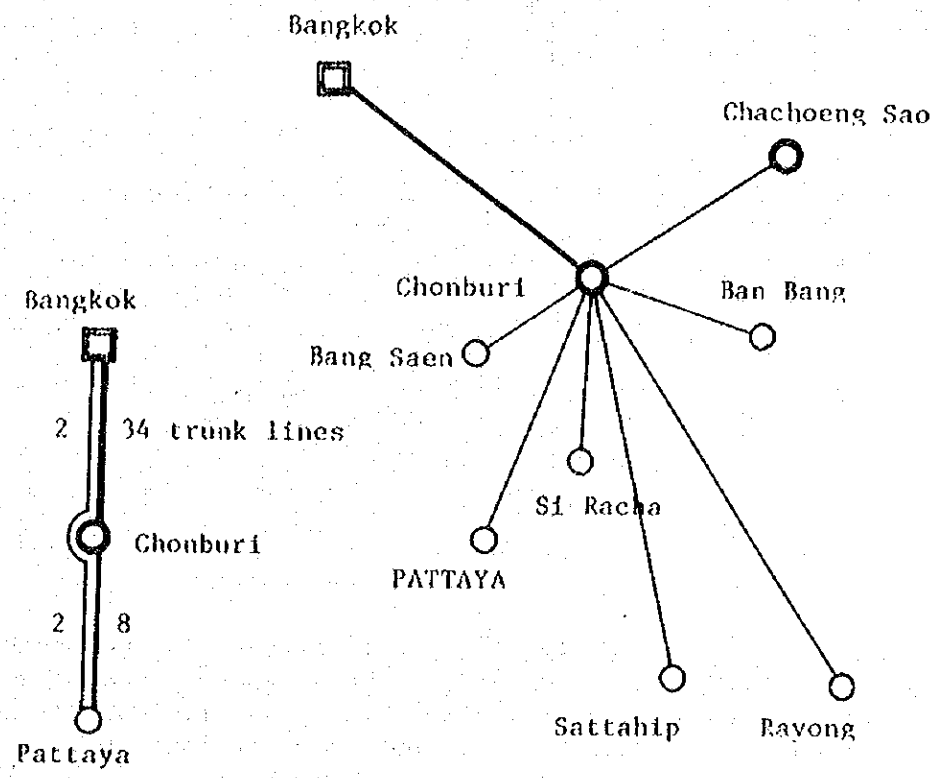
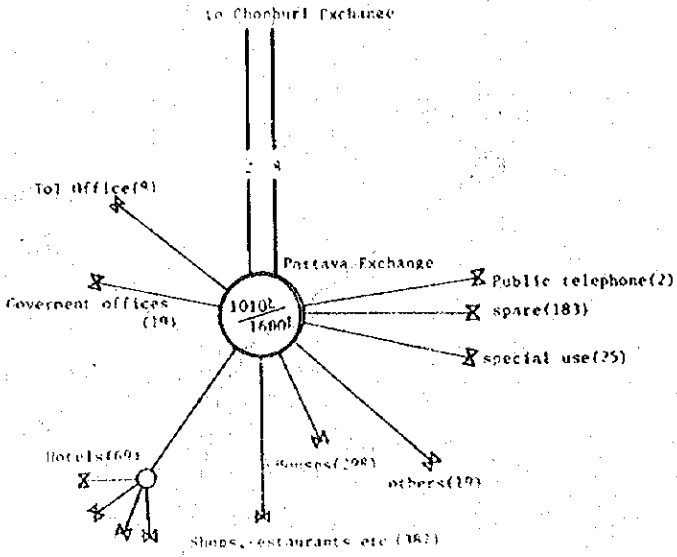


Fig. 5.8.3 Existing Telephone Network

(d) Exchange

The exchange capacity of Pattaya Station is 1,600 lines, of which 802 lines are used for hotels, restaurants, shops, clinics, houses and government offices and 25 lines are for special uses such as for V.I.P. and 183 lines serve as spare. This situation is shown on Fig. 5.8.4.

Fig. 5.8.4 Number of City Lines and Trunk Lines



(e) Problems

With regards to the traffic, local call service in the study area such as from hotels to restaurants, from houses to shops is not complete but is generally satisfactory. However, long distance calls (connected to Bangkok or through Bangkok) are not satisfactory because of 45 minutes of mean waiting time. This unsatisfactory situation is due to the lack of trunk lines between Bangkok Station and Pattaya.

(f) Expansion Plan by Telephone Organization of Thailand (TOT)

ToT has now in hand "The Long Distance Telephone Plant Project (1972 - 1979)" in "The Economic Development Project of the "TOT", in which the trunk lines will be increased in number by the end of 1979 through provision of long distance equipment such as microwave link. The details of the project are as follows.

Link	No. of trunk lines
Bangkok - Chonburi	300 lines
Chonburi - Pattaya	59 lines

To solve the problems of long waiting time for long distance calls an urgent plan is also made to increase the number of trunk lines (12 trunk lines) by provision of radio link.

(g) Telex and International Calls

The Communication Authority of Thailand is responsible for the international telephone service and Telex service other than domestic telephone service. Every hotel and subscriber in Pattaya is able to call overseas via International Telephone Exchange in Bangkok. Beside international calls, Telex service is also available and are installed at major hotels in Pattaya now. However, these hotels are long distance subscribers connected to Bangkok domestic Telex exchange because of no line concentrator at Pattaya Station.

5.8.3 Forecast of Demand

(a) Forecast of City Lines

The number of city lines (subscribers) in Pattaya area was estimated by the following items.

a. telephone demand by hotels
b. telephone demand by lodges
c. telephone demand by commercial facilities
d. telephone demand by residents
e. installation of public telephones

The resultant number of city lines required for each phase at Pattaya Station is estimated as follows, and shown in Fig. 5.8.5.

	1981	1986	1996
No. of city lines (line)	1,800	2,600	5,100

These numbers of city lines are classified by area and subscribers in Table 5.8.1 and 5.8.2.

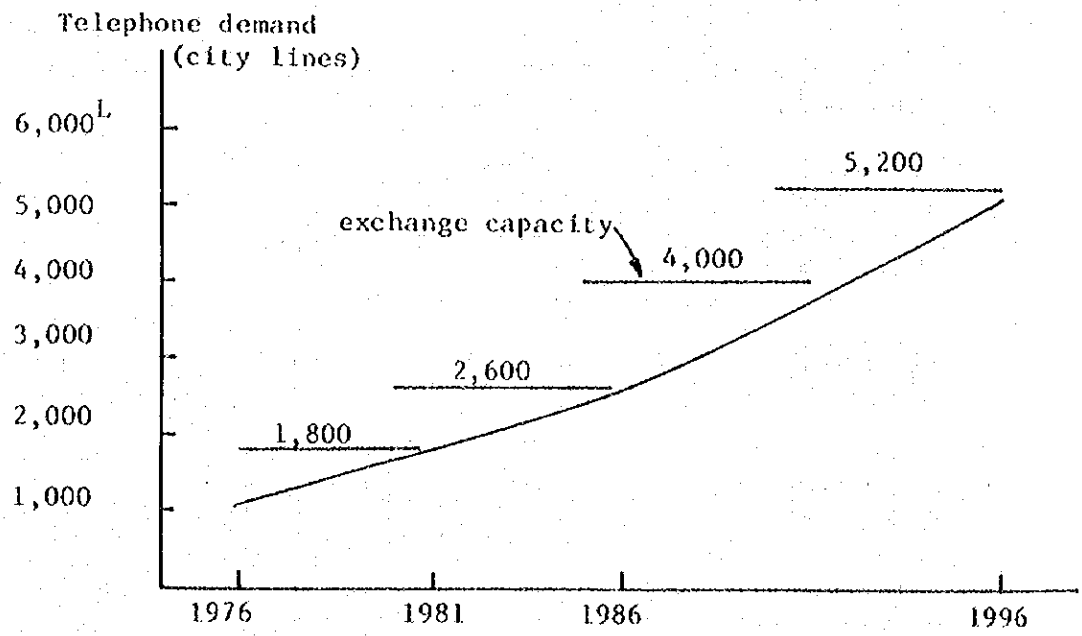
Table 5.8.1 Number of city lines classified by area

	1981	1986	1996
Na Klua	500	650	1,160
Pattaya beach	1,010	1,300	1,790
Pattaya Hill	80	350	870
New South	90	90	910
Government use	110	160	320
Ko Lan	10	10	10
Total (lines)	1,800	2,560	5,060

Table 5.8.2 Number of city lines classified by subscribers

	1981	1986	1996
Hotel use	300	320	670
Lodge use	-	270	790
Commercial use	770	1,010	1,800
Residential use	580	750	1,400
Government use	110	160	320
Public telephone	40	50	80
Total (lines)	1,800	2,560	5,060

Fig. 5.8.5 Telephone Demand



(b) Forecast of Telex

Telex sets will be installed in standard hotels of over 300 rooms in size.

The number of Telex sets were forecast as follows to meet the requirement of increase in hotel rooms.

Number of Telex sets

Area	1981	1986	1996
Pattaya	12	13	28
Ko Lan	1	3	3
Total	13	16	31

(c) Forecast of Trunk Lines

The number of trunk lines between Pattaya Station and Chonburi Station is calculated from the number of city lines and the number of Telex sets.

Assuming that calls traffic unit per subscriber, outgoing or incoming at Pattaya Station is 0.02 Erlang, the number of trunk lines is estimated by multiplying the number of city lines by this calls traffic unit. Using the Erlang B table (probability = 0.01), the number of trunk lines is calculated as follows.

	1981	1986	1996
No. of trunk lines for telephone (lines)	48	66	119

The trunk lines for Telex set is calculated on the condition that automatic line concentrator is installed at Pattaya Station, and the results are as follows:

	1981	1986	1996
No. of trunk lines for Telex (lines)	4	6	10

The total trunk lines between Pattaya and Chonburi Station will therefore be as follows.

	1981	1986	1996
Total No. of trunk lines (lines)	52	72	129

5.8.4 Summary on the Telecommunication System

(a) Telephone Exchange

The telephone exchange at Pattaya Station will be improved in Stage 1, phase 1 and be extended in Stage 2, phase 1 and phase 2 for the following reasons.

a) It will be difficult without interrupting the existing telephone service to remodel the existing system to direct dial system and to add trunks for trunk lines.

b) An exchange room will be newly constructed for future demand so that there will be no interruption of service in extending the exchange.

c) Having 2 exchanges in a station by adding new exchange to the existing is complicated and not a good system technically.

The existing exchange which is too big for Ko Lan requirement will be removed to same province where no direct dial system will be needed.

Phase 1; stage 1 — Exchange room combined with microwave and UHF shelter and tower will be newly constructed. The existing exchange having 1,600 lines capacity will be upgraded to new cross-bar type exchange which will have 5,200 lines capacity and 1,800 lines will be actually installed to serve 1,800 subscribers.

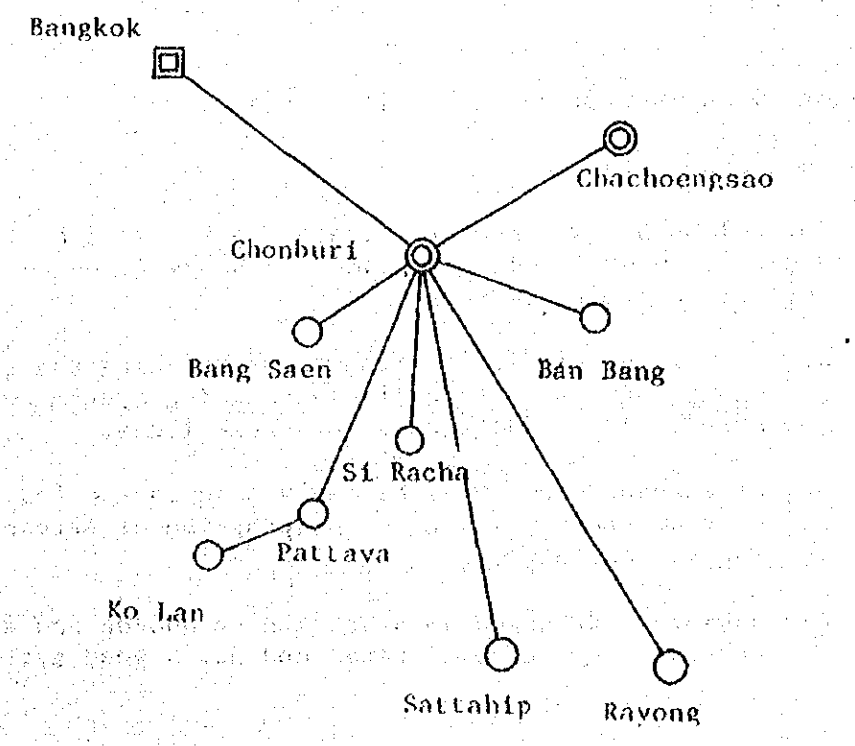
Phase 1; stage 2 — An additional 800 lines will be added to serve 2,600 subscribers.

Phase 2: — Together with the increase of telephone demand, an additional 2,600 lines will be installed up to full capacity (5,200 lines) by steps of 500 lines or 600 lines.

(b) Exchange Network

The telephone exchange network around Pattaya Area will be planned to be the same with the existing except for the addition of a Ko Lan Station subordinated to Pattaya Station, as shown in Fig. 5.8.6.

Fig. 5.8.6 Telephone Exchange Network



The Pattaya Station including Ko Lan Station and Chonburi Station shall be direct dial relay station without any attendant operators.

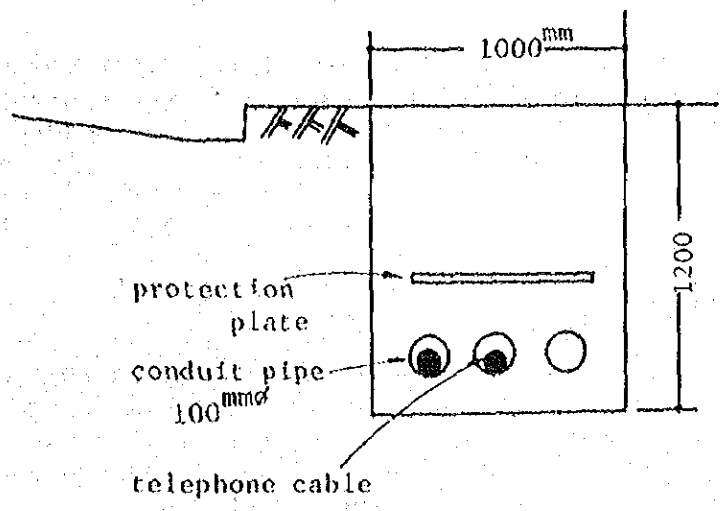
(c) Feeder Lines

Telephone cables are classified to feeder lines and distribution lines. Feeder lines will be wired in bundle from Pattaya Station to where subscribers gather, then wired to distribution line to serve to subscribers. Feeder lines will be divided to 6 feeders from Pattaya Station as shown in Fig. 5.8.1.

a. Feeder Lines for Na Klua
b. " Pattaya north
c. " Pattaya beach
d. " Pattaya Hill
e. " New South hotel area
f. " New South residential area

As for wiring, overhead lines and underground lines will be planned. Overhead lines which are put to electric power distribution pole will be economical where pairs of cable are not so large in number. However, the reliability is lower than underground lines because of the possibility of car-crush to pole or fire of houses nearby. It is also less desirable form the point of aesthetics. On the other hand, underground lines which will require larger investment will be reliable and will be profitable where lines are in bundle.
Therefore, feeder lines will be wired underground along the Pattaya beach, the main access roads where no electric pole will be allowed and near Pattaya Station where feeder lines will be supplied concentrically.
Standard cross section of underground feeder lines are shown in Fig. 5.8.7, with handholes or manholes to be constructed at 500 meters interval.

Fig. 5.8.7 Underground Feeder Line



(d) Telex System

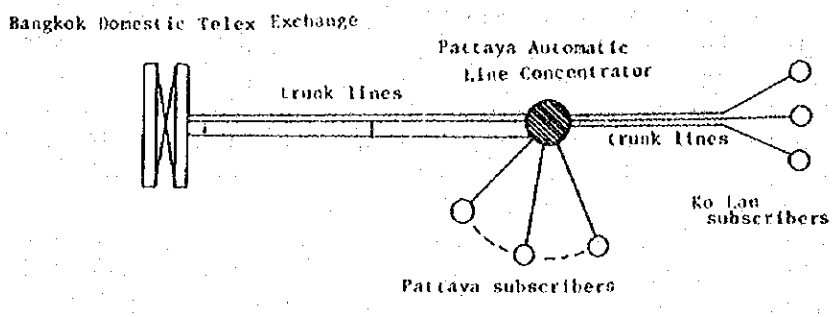
Telex demand will increase with that of hotel rooms. As number of Telex sets is estimated to increase up to 31 by the end of 1996, Telex automatic line concentrator will be installed at Pattaya Station, which will be linked to Bangkok Domestic Telex Exchange, as shown in Fig. 5.8.8.

Phase 1; stage 1: Automatic line concentrator which accommodates 24 Telex subscribers and has 8 trunk lines in capacity will be installed at Pattaya Station.

Phase 1; stage 2: Telex demand will be adequately served by automatic line concentrator installed in stage 1.

Phase 2: The same automatic line concentrator will be added, and subsequently doubled.

Fig. 5.8.8 Telex System



(e) Radio Links

Two radio links will be constructed to serve full telecommunication for Pattaya.
One is the Pattaya - Chonburi microwave link and the other is the Pattaya - Ko Lan UHF link.

a. Pattaya - Chonburi microwave link

Together with the increase of telephone demand and Telex demand, the following trunk lines between Pattaya Station and Chonburi Repeater Station will be needed, as seen in Fig. 5.8.9 and Fig. 5.8.10.

	1981	1986	1996
No. of trunk lines (lines)	52	72	129

Though existing trunk lines are linked to Chonburi and directly to Bangkok by means of cable carrier equipment, it is most reasonable to construct microwave link in such number of trunk lines and long distance other than cable carrier, coaxial carrier and PCM carrier.

Phase 1; stage 1: Microwave link will be constructed between Pattaya Station and Chonburi Repeator Station. At Pattaya Station, a tower and a shelter, which will be used commonly with Pattaya - Ko Lan UHF link, transmitter/receiver, multiplex carrier equipment, non-break power supply equipment and parabolic antenna will be newly constructed. At Chonburi Repeater Station, only transmitter/receiver, multiplex carrier equipment and antenna will be provided, because a tower, shelter and non-break power supply equipment will have been constructed under "The Long Distance Telephone Plant Project (1972 - 1979)" in "The Economic Development Project of the ToT"
In terms of capacity, a 300 channels type mitter/receiver will be enough. As for multiplex carrier equipment, 60 channels of 240 channels capacity will be actually installed.

Phase 1; Stage 2: An additional 12 channels (for a total of 72 channels) will be installed to the multiplex carrier equipment at both stations.

Phase 2: An additional 60 channels (in total 132 channels) will be installed to the multiplex carrier equipment at both stations.

b. Pattaya - Ko Lan UHF Link

As the result of alternative study, it is proposed that subscribers in Ko Lan island will be accommodated in a Ko Lan Station to be provided. The following number of trunk lines between Pattaya Station and Ko Lan Island will be needed.

	1981	1986	1996
No. of trunk lines (line)	10	11	12

For this purpose, UHF link (400 Mhz band) will be most suitable, as seen in Fig. 5.8.9 and Fig. 5.8.10.

Phase 1; Stage 1: At Pattaya Station, transmitter/receiver, multiplex carrier equipment and antenna will be installed. As mentioned before, tower, shelter and non-break power supply equipment will be commonly used with the microwave link.
At Ko Lan Island, shelter and tower will be newly constructed at Ko Lan Vacation Co area in which transmiter/receiver, carrier equipment and non-break power supply equipment will be installed. The capacity of channels will be 24 channels, of which 12 channels will be actually installed.

Fig. 5.8.9 Telecommunication System

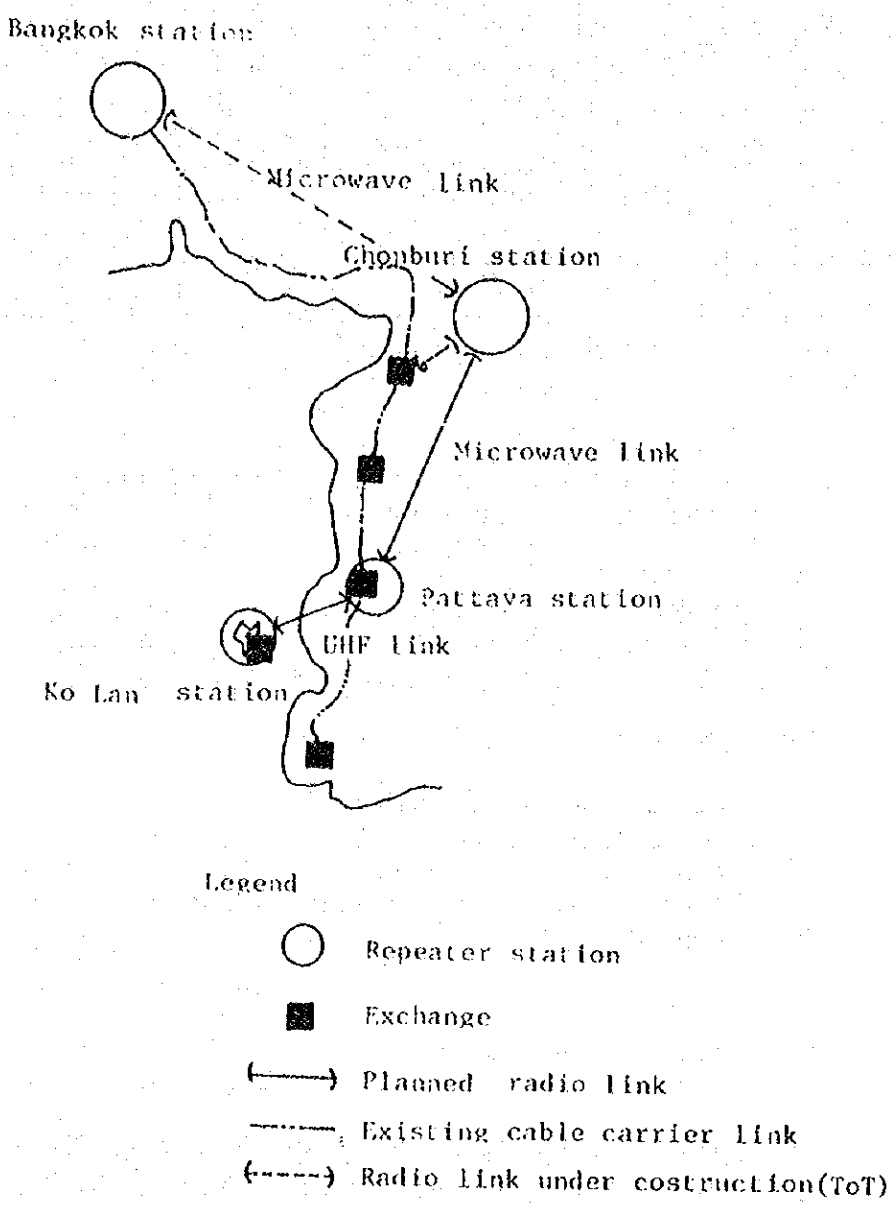
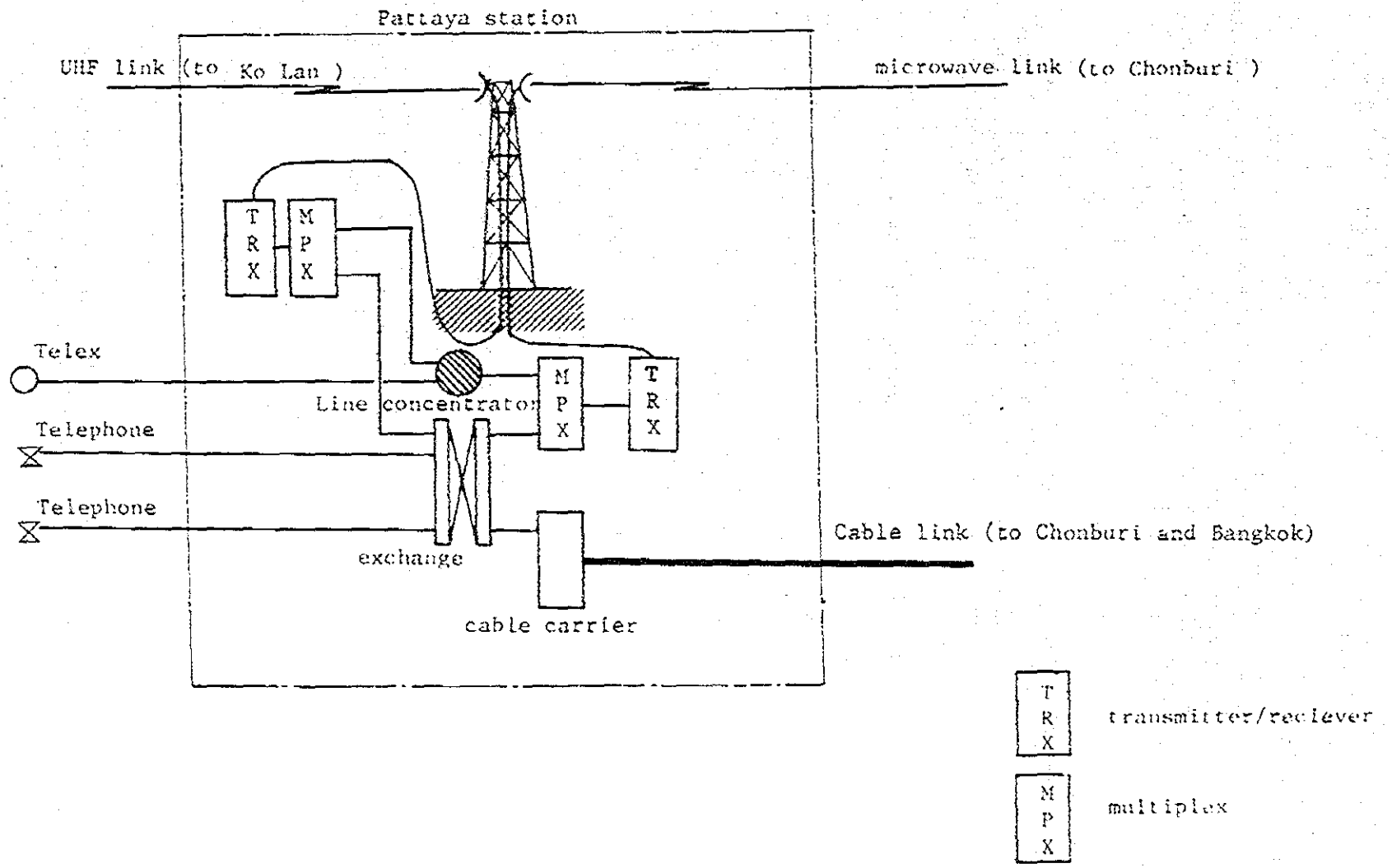


Fig. 5.8.10 Telecommunication System in Pattaya Station



Phase 1, stage 2 and Phase 2: No need for any expansion.

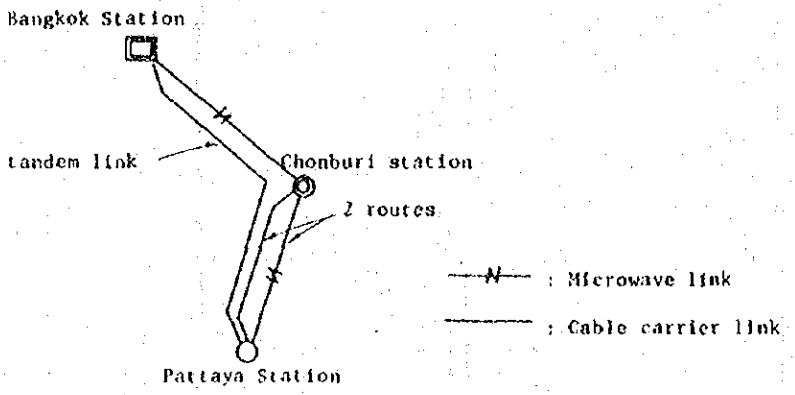
(f) International Telephone

Speedy, clear, stable international calls between Pattaya area and all countries will be made available by means of Pattaya exchange and new trunk lines through International Telephone Exchange in Bangkok.

(g) Recommendations

i) The existing cable carrier link will remain as it is, because it is useful as tandem link between Pattaya Station and Bangkok Station and is useful to maintain high reliability between Pattaya Station and Chonburi Station. (Fig. 5.8.11)

Fig. 5.8.11 Usage of Existing Cable Carrier Link



The cable carrier to Sattahip, Rayong etc. will also be maintained.

ii) More study must be made concerning microwave propagation between Chonburi Station and Pattaya Station with profile map. UHF Link will be feasible concerning UHF radio propagation.

5.8.5 Technical Descriptions

(a) Criteria for Forecast

i) Hotel

A standard hotel with 300 rooms is assumed to have 360 extension lines for tourists and employees.
Study indicates that the standard calls traffic (mean incoming and outgoing calls traffic through city lines) in international hotels in the world is 0.033 Erlang per extension line. Consequently calls traffic at a hotel in Pattaya is estimated to be 12 Erlang in line with an

international hotel. Thus the number of city lines at a hotel totals 24 lines including 3 public telephones and 1 Telex set, applying the Erlang B table. (Probability is 0.01).

ii) Residential and commercial use

The growth factor of telephone in Pattaya is estimated taking into account the planned ToT project, future GNP and increase in population. The unit demand will be calculated by multiplying the growth factor by present unit demand.

	Present	1981	1986	1996
Growth factor	1.00	1.45	1.60	1.98
Commercial use (sets/person)	0.03	0.04	0.05	0.06
Residential use (sets/person)	0.01	0.015	0.016	0.02

iii) Trunk lines

Calls traffic standard is estimated to be 0.02 Erlang per subscriber in Pattaya.

5.8.6 Ko Lan Island

(a) Forecast of City Lines

The number of city lines in Ko Lan Island was forecast in the same way as that for Pattaya area. The criteria is the same except for hotels because a hotel in Ko Lan Island will be smaller in scale. As a result, the number of city lines in each phase will be as follows.

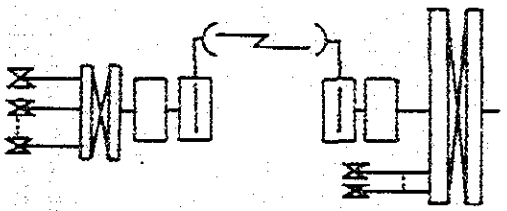
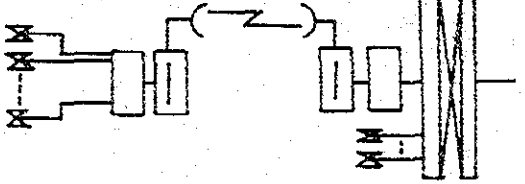
	1981	1986	1996
No. of city lines (line)	70	100	130

(b) Forecast of Trunk Lines

By the same calculation as that for Pattaya Station, the number of trunk lines for telephone is calculated. Adding 4 special use trunk lines such as for police and Telex use, the number of trunk lines in total between Pattaya Station and Ko Lan Station will be as follows.

	1981	1986	1996	
No. of trunk lines (Total)	10	11	12	(lines)
" (Telephone)	6	7	8	
" (Telex & other)	4	4	4	

Table.5.8.3 Alternative telephone system in Ko Lan Island

Item	Alternative :A	Alternative:B	Remarks
System	Ko Lan Pattaya 	Ko Lan Pattaya 	: Transmitter reciever : Multiplex : Exchange : Subscriber
Installation of exchange	150 lines exchange	None	
No. of lines transmitted	12 lines (trunk line)	130 lines (city lines)	
Link	UHF Link (12 CH/24 CH)	Microwave link (130 CH/240 CH)	
Reliability	SAME		
Service	Different trunk number will be given to Ko Lan Station	SAME	
Investment cost	1.0 M฿/Ko Lan Station including exchange	3.6 M฿/Ko Lan Station	Exclude same basis such as land, tower shelter

(c) Alternative Study

There would be 2 possible alternative systems for telephone service to Ko Lan subscribers.

One is to install an exchange in Ko Lan Island, in which all subscribers will be accommodated and will be linked to Pattaya Station by trunk lines. The another is to accommodate all subscribers in the Pattaya exchange where all the city lines will be transmitted and received. (Table 5.8.3).

(d) Conclusion

All the telecommunication system in Ko Lan Island will be completed in Phase 1, Stage 1, and there will be no requirement for expansion up to 1996. (Fig. 5.8.12, 5.8.13)

i) Transmitter/receiver site will consist of a shelter with a tower to be constructed at Ko Lan Vacation Co. area, in which transmitter/receiver, exchange and power supply equipment will be accommodated.

ii) Ko Lan exchange which will have a 150 lines capacity, cross-bar type, will be installed to accommodate 130 subscribers up to the year 1996.

iii) The exchange will be linked to Pattaya Exchange Station by 12 trunk lines.

iv) Feeder lines to subscribers in Ko Lan Island will be connected through electric poles along the road to Tavan beach, Tien beach, Samae beach and residential area.

(e) Technical Descriptions

The criteria for city lines of Ko Lan will differ from that of Pattaya Beach, because the hotel in Ko Lan Island is rather small in size. A hotel having 80 rooms will have 100 extension lines. Therefore calls traffic for the hotel will be 3.3 Erlang. This will need 10 city lines including 1 public-telephone.

(f) Temporary Facilities

There is at present no telecommunication connecting between Pattaya and Ko Lan, but the need for such connection is imminent. It is therefore worth considering the provision of the temporary facility before completion of the UHF link, to the police, clinic and other public facilities by linking Ko Lan Island with Pattaya exchange by VHF radio link, so that these users may be accomodated in Pattaya exchange through VHF radio. (Fig. 5.8.14).

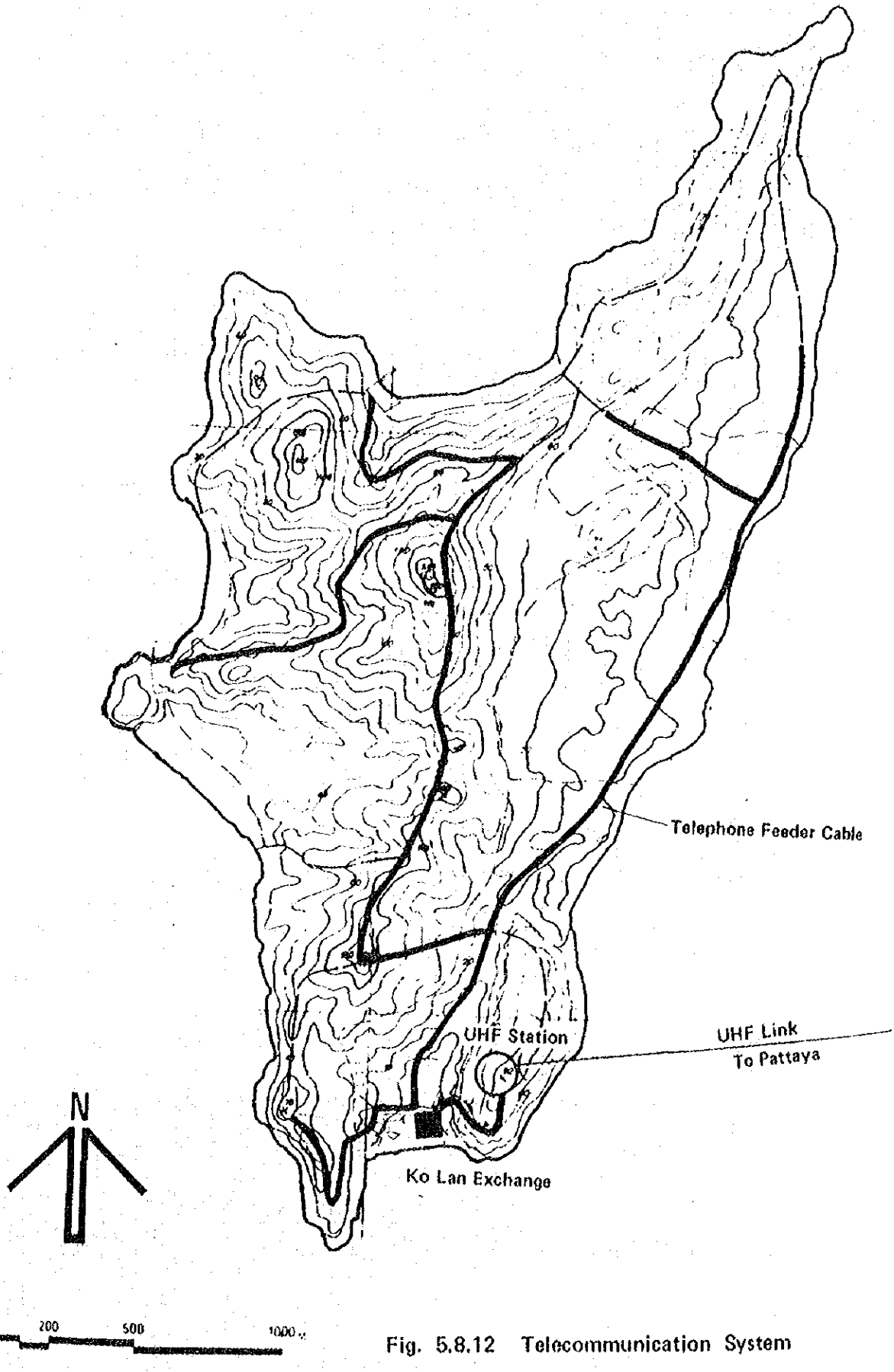


Fig. 5.8.12 Telecommunication System

Fig. 5.8.13 Telecommunication System in Ko Lan Island

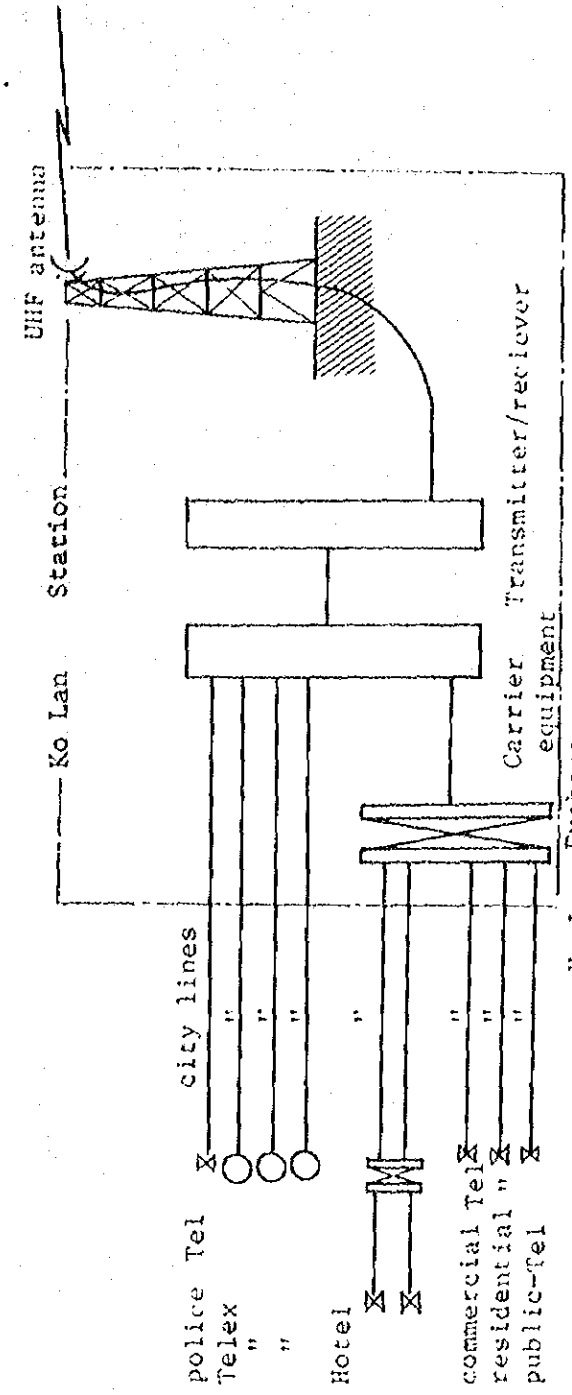
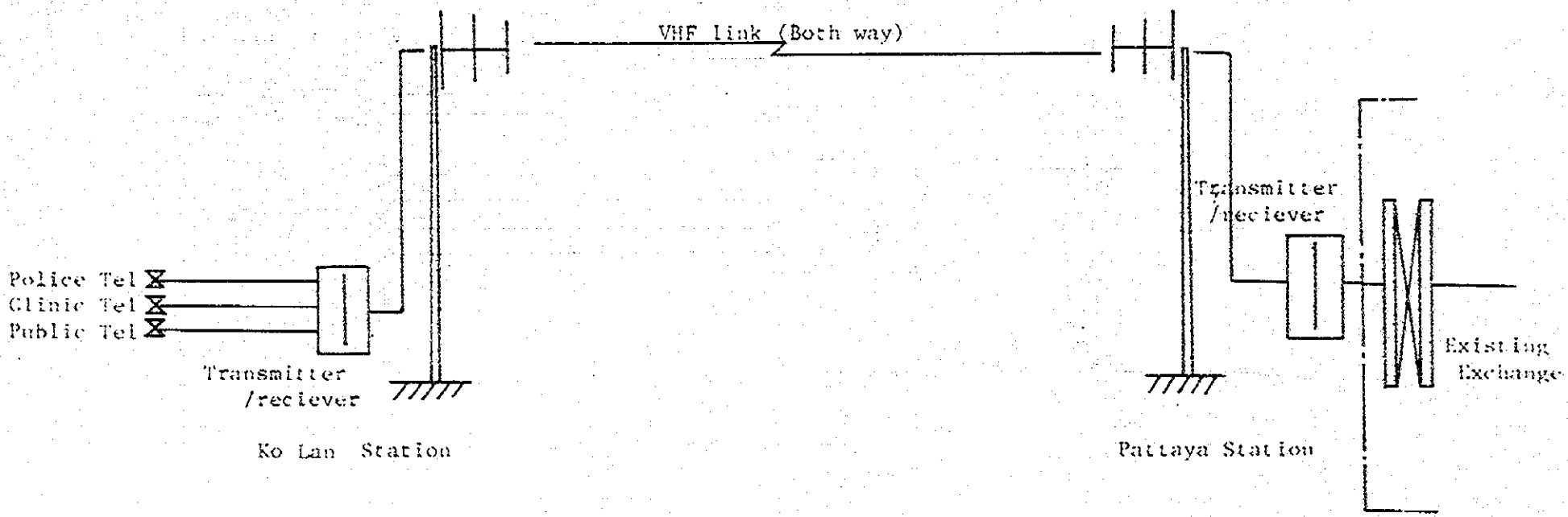


Fig. 5.8.14 Temporary Facilities



5.9 MARINA AND PORT FACILITIES

5.9.1 General

Some fishing villages with piers are located around the project area. They are just piers without break-water because of very calm wave conditions. Fishermen's houses are built above sea water together with piers. The fishermen's village in South Pattaya has developed into the downtown area of the resort following tourism development which has taken place over the past years. Although about 20 fishing boats are still working off-shore for Pattaya and using the piers, most of the fishing boats at Pattaya, Na Klua and Ko Lan have been converted into excursion boats.

Now there are many boats and vessels related to tourist activities in Pattaya, including excursion boats, motor boats, scootor boats and sailing boats. These boats directly are launched from the beach and are moored near the shore. From the point of safety and convenience, it is necessary to provide suitable and adequate facilities for boarding and unboarding passengers and for mooring all boats and vessels as well as to control sea-surface usage.

5.9.2 Planning Concept

The basic planning concept to accomodate all boats is shown as follows:

1) Port facilities should harmonize with natural beauty of Pattaya.

2) Port plan should coordinate with the control plan for water surface usage.

3) It is necessary to limit the number of high speed boats such as motor boats and scooter boats to within the existing number.

4) Excursion boats should be reduced to less than the existing number, and the increased demand in future should be met by scheduled passenger boat service.

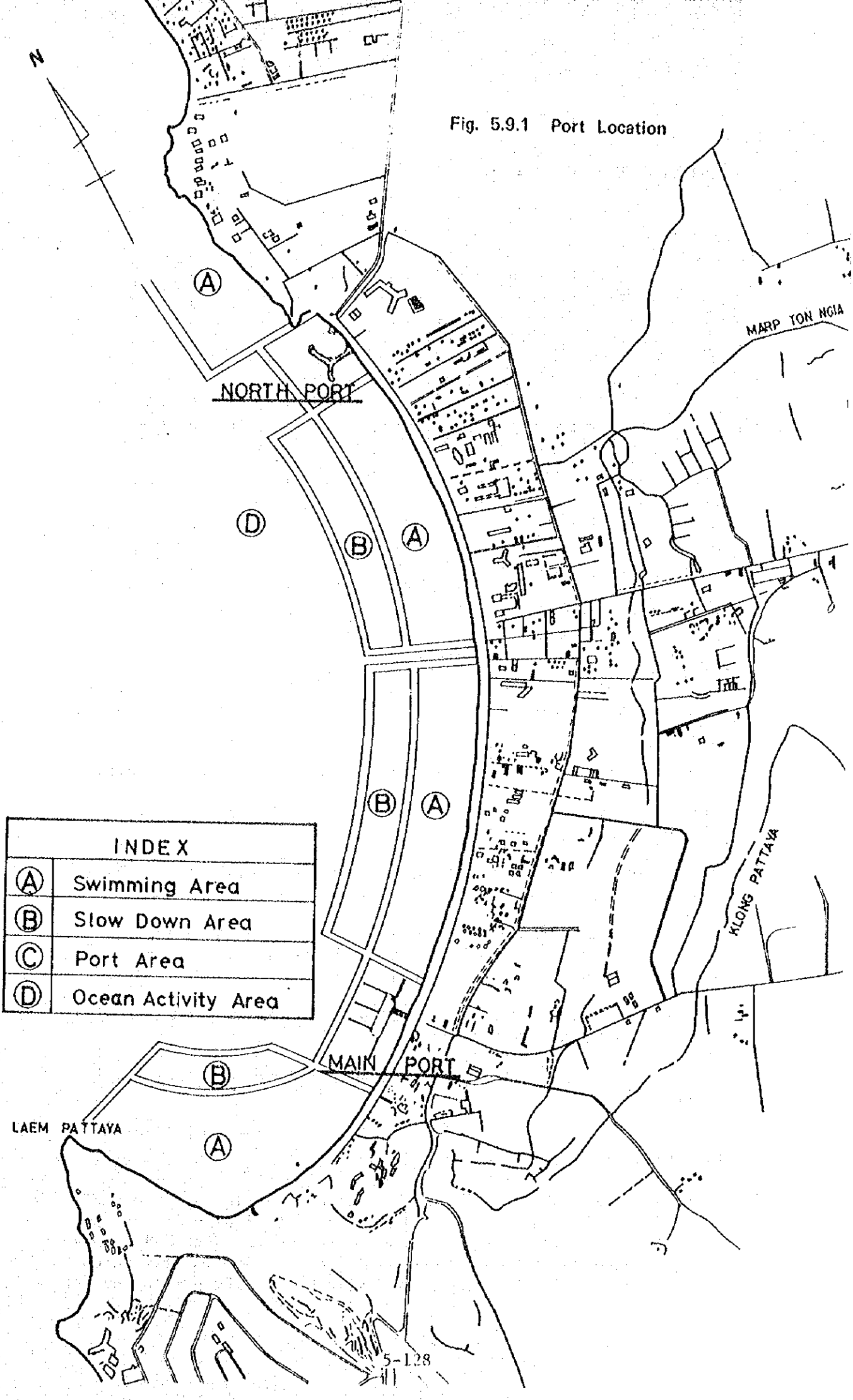
5) All boats should be controlled through a license system to maintain the safe and comfortable use.

6) No boats should be allowed without mooring piers or storage houses.

5.9.3 Port Location and its character

The proposed port locations are as shown in Fig. 5.9.1 which were decided taking into consideration the control plan of sea surface usage and the convenience in access for users. Basically, most of the excursion boats will be accommodated in the main port which is located at the sea side of the downtown area. The present number

Fig. 5.9.1 Port Location



of excursion boats is so large that another mooring facilities named the North port will be provided at the north-end of Pattaya beach. By preparing two port facilities in Pattaya beach, convenient access for tourist will be obtained and excessive facility at one location will be avoided in order to maintain the beautiful setting of Pattaya beach. As for motor boats, scooter boats, launching ramps will be constructed at the main port and North port. A new south port is planned to serve tourist in the new development area which is planned to be implemented in Phase 2.

(a) Main port

The existing downtown area is planned to be improved to become the main amenity core and the existing restaurants and shops on the sea side will be removed for this purpose. The main port being planned in this study will function as the key tourist spot for ocean activities in coordination with the inland amenity core. There now exist some piers serving the fishermen and 20 fishing boats are still in operation. Therefore the main port plan should take into consideration the construction phasing for renewal of existing piers.

(b) North port

Though the North port which is planned to be developed newly at the north end of Pattaya beach has about the same character as the main port, this port will have more important function in relation to ocean activities and serve mainly the internation-al tourists. There is a beautiful hill at the back to this port, and (the port in view) from the hill will become more attractive.

(c) South port

In phase 2, the new hotel area will be developed. In order to make this into a more attractive tourist spot, a artificial lagoon is proposed and it will be utilized also as mooring facilities.

5.9.4 Port capacity

The existing number of boats related to tourism is shown as follows:

	Number	Length of boat	Mooring depth
Excursion boat	150	big 15-20^{m}	2-2.5^{m}
		small 8-10^{m}	1^{m}
Motor boat	50	3- 5^{m}	1^{m}
Scooter boat	60	3^{m}	1^{m}
Sail boat	100	3- 5^{m}	

To estimate the future demand, the following assumptions are made and the results are shown.

(a) The users of excursion boats demand will increase proportionally to the increase in the number of visitors to Pattaya, and most of the excursion boats will be hired for trips to Ko Lan. Therefore, if scheduled passenger boat service to Ko Lan is provided, it is possible to keep or reduce the existing number of excursion boats.

(b) By assuming the participation rate in each activity as calculated in the section on tourism demand, the needs for motor boats, scooter boats and sail boats are estimated. Taking into consideration the needs, the number of boats was determined accordint to planning policy which requires reducing existing number of boats.

Accommodation plan

a. Main Port

Items		1986	1996
Excursion boats		75	75 boats
Fishing boats	Offshore	10	17
	Deap sea	7	13
Power boats		20	33
Scooter boats		20	10
Sail boats		10	18
Ferry boats	Large	1	2
	Small	2	4
Skilled fishing boats		20	20

b. North Port

Items		1986	1996
Excursion boats		35	35
Fishing boats offshore		7	10
Power boats		20	20
Scooter boats		20	10
Sail boats		5	10
Ferry boats	Large	-	1
	Small	1	2

c. South Port

Items		1986	1996
Excursion boats			40
Fishing boats offshore			10
Power boats			10
Sail boats			10
Ferry boats	Small		1

5.9.5 Consideration for design and construction

(a) Main Port

The design for the main port will be influenced to a large extent by the demolition plan of the existing fishermen's facilities, sea side restaurants and shops. In the renewal plan of existing downtown, although removal of all sea side facilities is proposed, the time schedule for the renewal cannot yet be clearly defined. But it is a high priority to provide passengers with piers to board and unboard safely. The main port should be so planned that the influence of the demolition plan is minimized.

In this study, two basic design concepts were studied and these plans are shown in Fig. 5.9.2 and 5.9.3. Plan A in Fig. 5.9.2 permits more diversified use and architect could design more freely to make an attractive tourist spot, but the construction cost is 20% higher than the Plan B. Technically, the proposed artificial island might cause toubolo phenomenon and a careful considerations are necessary to prevent undesirable transformation of the beach alignment.

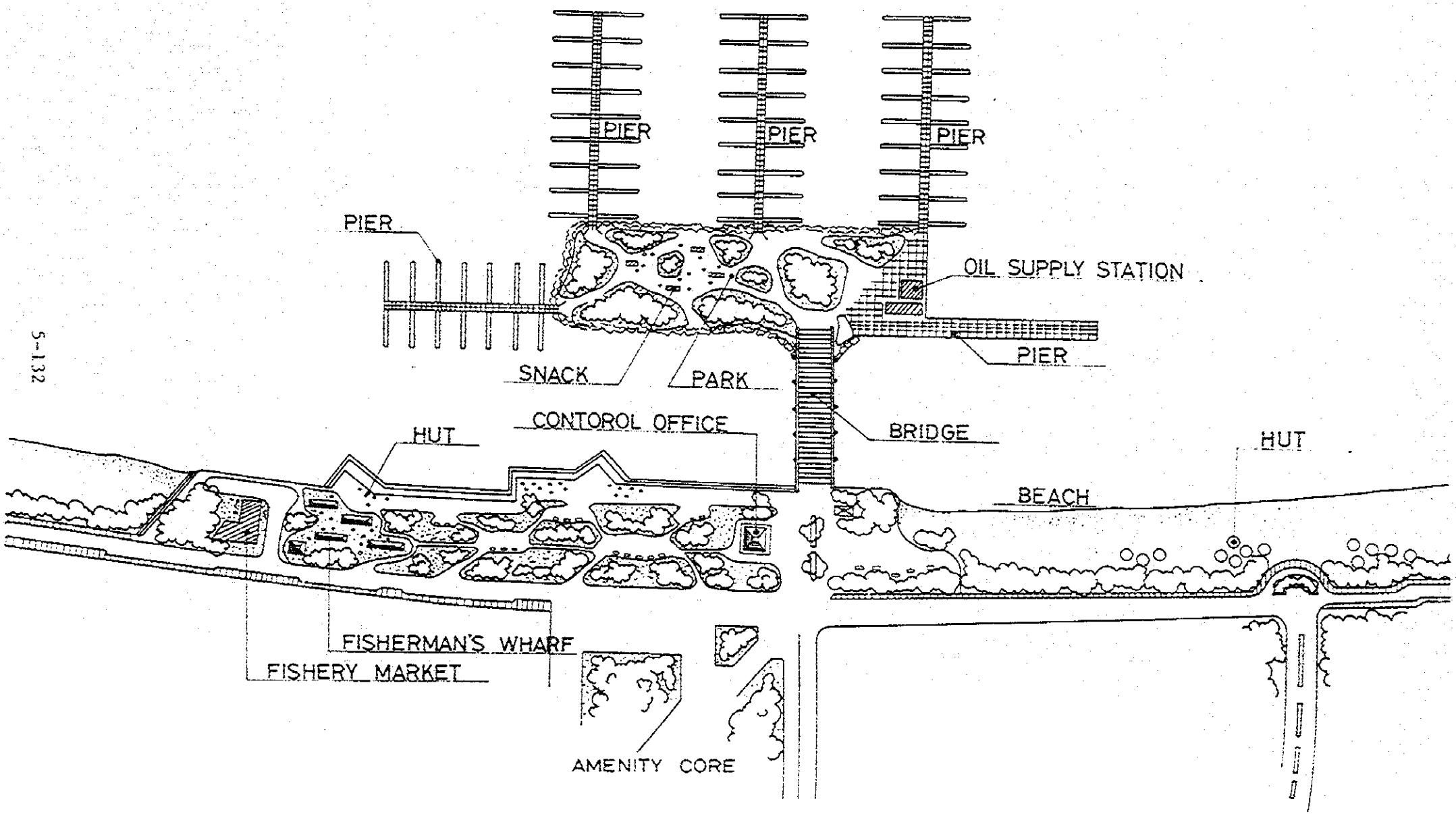
In Plan A, sand may be conveyed behind the artificial island by wave actions and consequently the adjacent beach might be eroded. But the anticipated wave action is not so strong and this problem could be solved through replenishment of sand. The Plan B would be more desirable from the technical point of view. But it is difficult to avoid the feeling of monotony. On condition that sufficient fund is available, the Plan A would be more preferable to provide an attractive tourist spot as part of the main amenity core.

(b) North Port

The new north port is proposed at the north end of Pattaya beach to supplement the function of the main port. The hinterland is utilized by hotels which are mainly for foreign tourists. Unlike the main port where the concentration of day-trip visitors is anticipated, the north port would serve mostly the night staying tourists. Although the north port would have almost the same function as the main port, it will play a more international role with a quiet atmosphere. As there is a headland which continues to the hill at the back, it will provide beautiful scenery when incorporated with port facilities.

As shown in Fig. 5.9.4, rubber mound type mole used for access to mooring facilities is proposed instead of main piers because hard structure like concrete pier does not fit the beautiful scenery of the headland and will be unsightly to swimmers and boat users near north port, especially at low tide. Technically there might be some difficulties in dredging and piling because of the rock bed extending from the headland. Therefore boring survey will be needed in the feasibility study stage. Periodical dredging work may be required to maintain the water depth for access and mooring because of sand movement.

Fig. 5.9.2 Main Port (Plan – A)



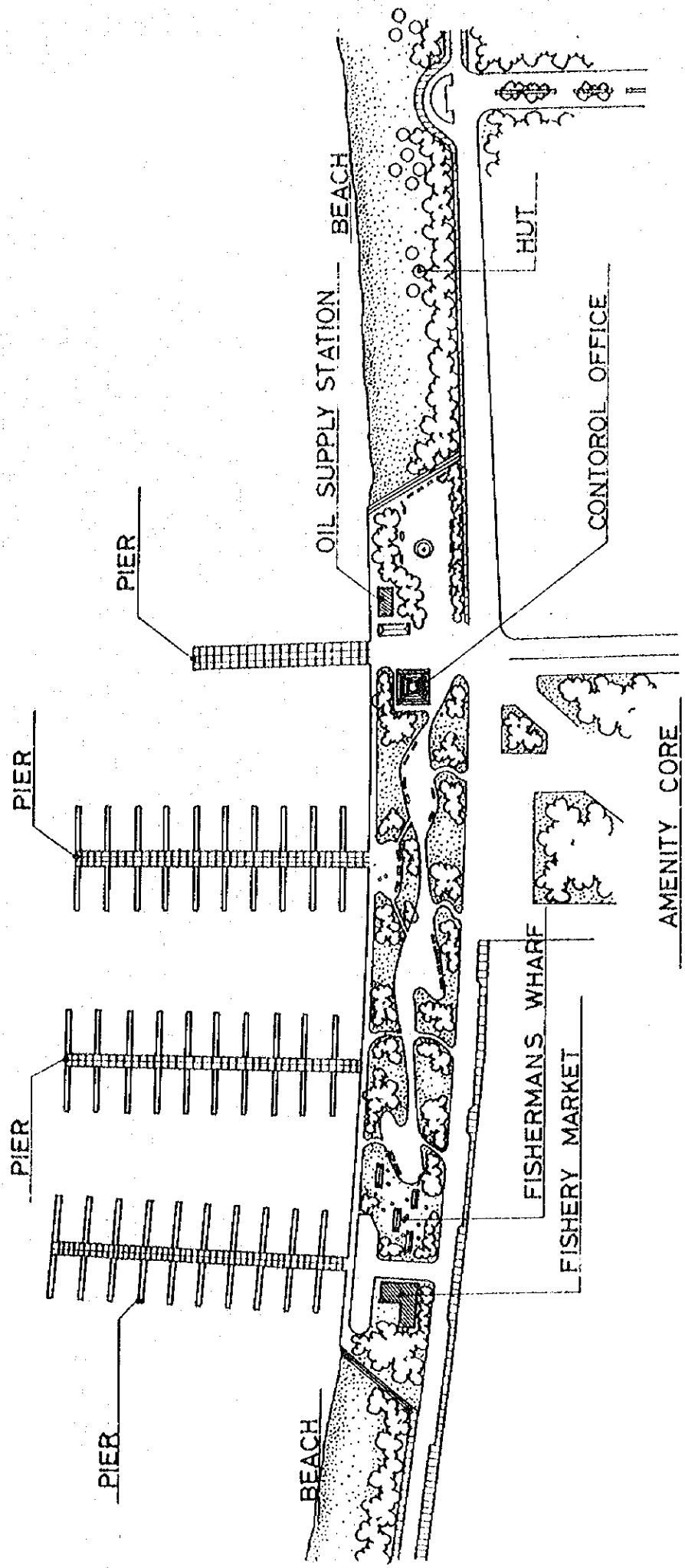
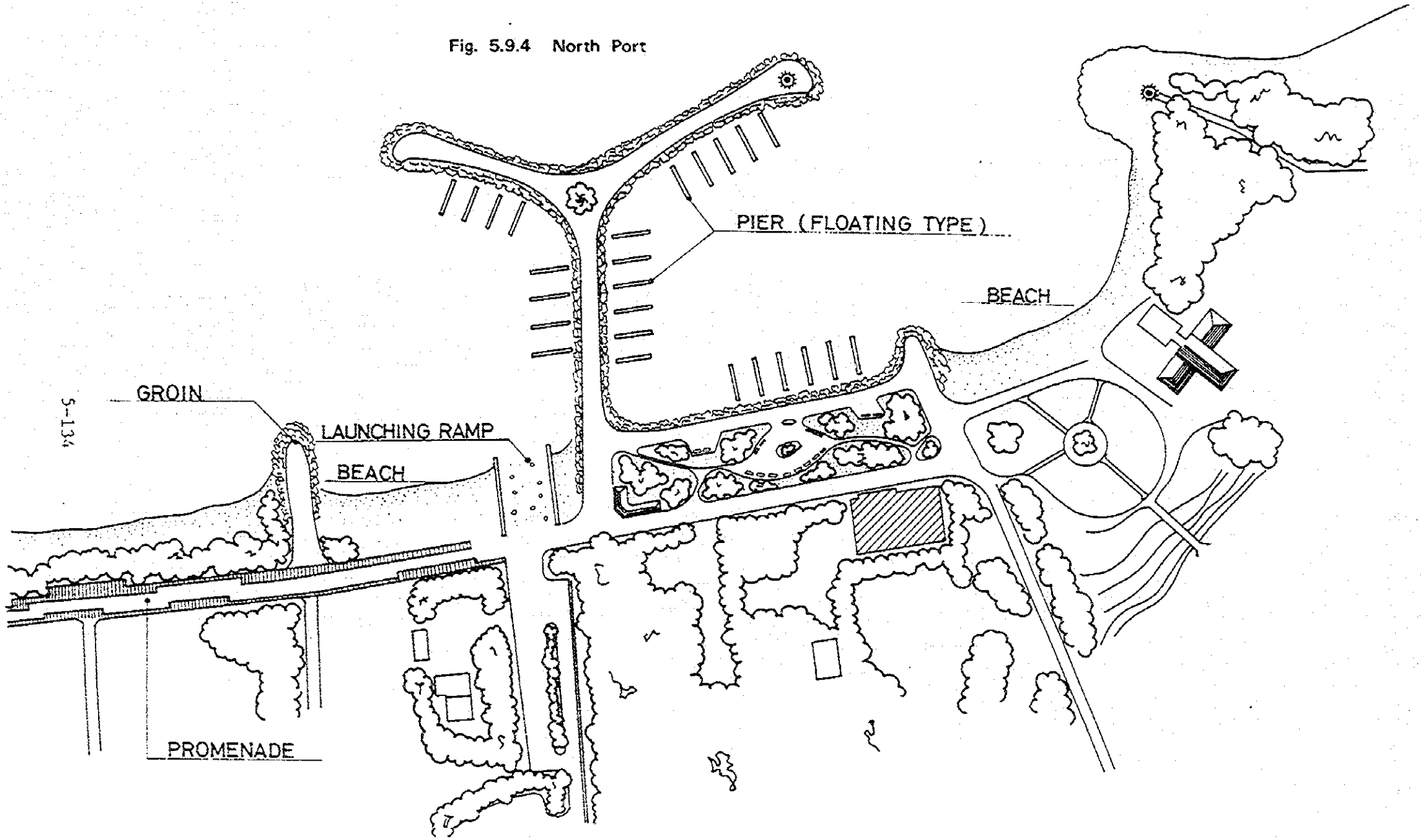


Fig. 5.9.3 Main Port (Plan – B)

Fig. 5.9.4 North Port



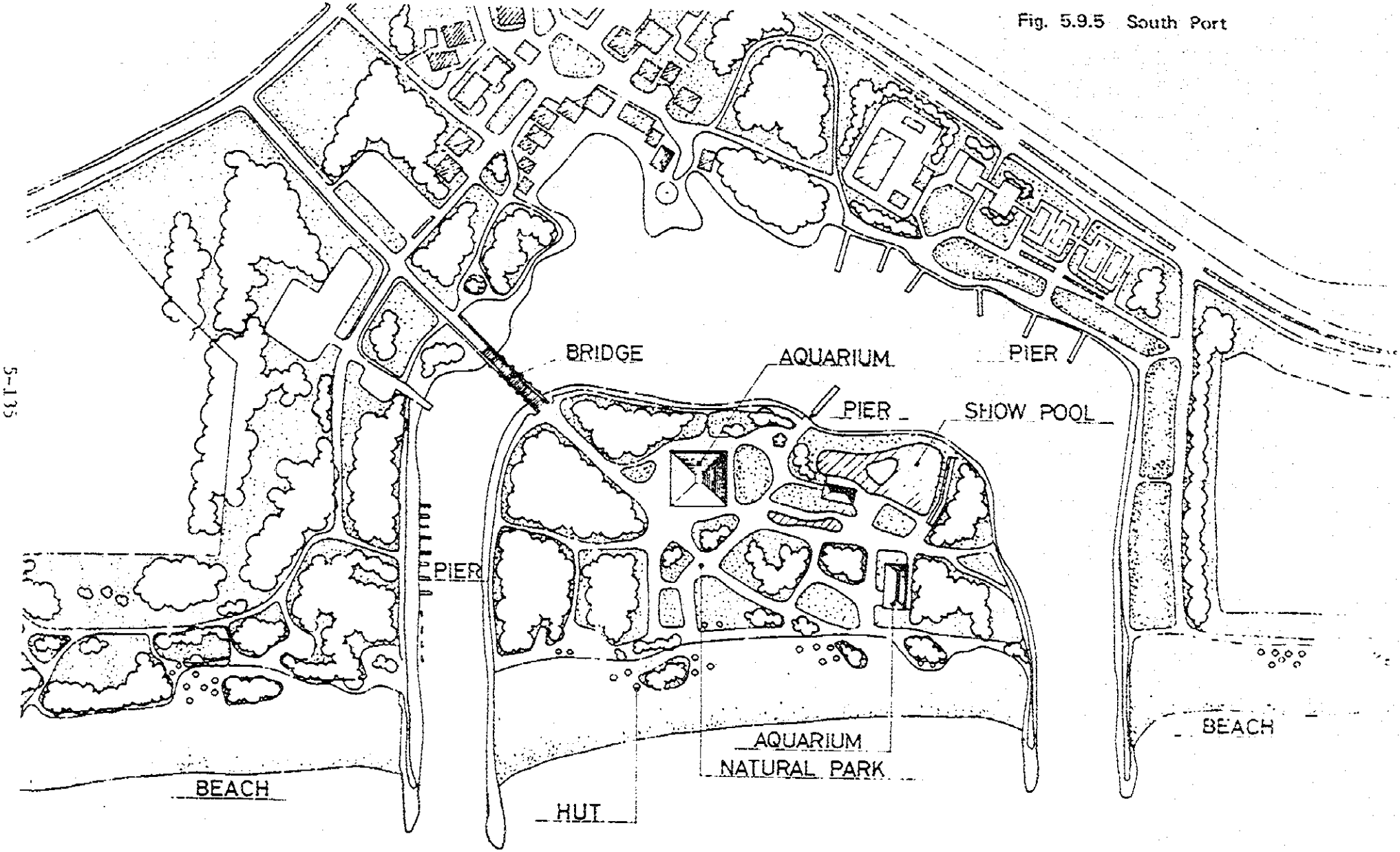


Fig. 5.9.5 South Port

(c) South port

The area immediately south of the Pattaya Hill is proposed as the new hotel area for further development and water facilities as a means of recreation will be necessary. But the coastal waters of this area are not suitable for providing mooring facilties in nature because of relatively rough sea condition in summer caused by strong southwest winds and the scenery of this area shows a lack of variety with plain land and long but monotonous beach. Considering the above factors, artificial intakes and lagoon are proposed as the best solution both from the architectual and engineering point of view as shown in Fig. 5.9.5. In this plan more detailed study about sand movement should be conducted to maintain the depth of access channels to the lagoon and to deal with any possible undesirable changes to the adjacent beach. Basing on the new data from this study, capacity and the type of boats may be reexamined.

5.9.6 Design conditions for protective structures and mooring facilities.

(a) Tide

The records of tides obtained at the tide gauge station of Ko Kichang are given below.

H.H.W.L = +1.80 m
H.W.L = +0.94 m
M.S.L = ±0.00 m
L.W.L = -0.97 m
L.L.W.L = -2.48 m

(b) Wave conditions

Ko Phai and Ko Lan shelters the proposed harbor sites of the main and north port from the incident waves caused by the southwest and west wind. The most severe wave condition is given by the northwest wind. The incident wave may be calculated by the Bredshneider's method as follows:

conditions for the wind wave calculation

Wind direction	northwest
Wind velocity	13m/sec
Fetch	90 Km

The results are H 1/3 = 1.8 m and T 1/3 = 5.0 sec. The incident wave height obtained by Bredsh Bredshneider's method will be modifyed by the refraction effect when approaching the harbor site at a estimated refraction coefficient of about 0.5.

The design wave height = 0.5 x 1.8 = 0.9 m. In this wave height calculation, the maximum wind velocity recorded at Ko Sichang was used even though the data to show the duration were not available. If the changes of the wind velocities with time were given, more accurate calculation would be obtained. Presumably,

the actual duration of the maximum wind velocity would be relatively short comparing with the minimum duration which was assumed in this calculation. Furthermore, the recorded maximum wave height along the Chonburi coast was of the order of 1.5 m. The proposed site of the South port, on the other hand, has no shelter from the wave attack caused by the southwest wind and the longest fetch toward the southwest. The same method was used to forcast the wave height as follows:

Conditions for the wind wave claculation

Wind direction	southwest
Wind velocity	20 m/sec
Fetch	130 km

The results are H 1/3 = 3.3 m and T 1/3 = 7 seconds

5.9.7 Considerations for design criteria

(a) Protective works

There has been no damage by waves to the existing mooring facilities which are without any breakwater. The calculated wave height is also not so high. Therefore, the main port and north port will not need any provision of breakwaters. But the wave condition is so rough at the south port as calculated in the previous section that an artificial lagoon will give the best solution on condition that careful attention will be paid to water quality problems. A long-term observation on sand movement is required for the design of protective structures, especially in sandy beach like the proposed harbor sites. Otherwise, protective structures should be planned so as to allow some modification to cope with undesirable sand movement phenomena.

Considerations concerning sandmovement problems are as follows:

1) North port

After the construction of the main mole and north mole which will extend from the end of the main mole to the north, careful observation should be made concerning the accumulation of sand. If a large amount of sand is trapped by the main mole, the jetty located at the south end will be extended up to the necessary length to prevent the sand movement.

2) Main port

Behind the artificial island, some accumulation of sand may occur and the adjacent beach may be eroded. But the wave action is not so severe that this will not be a serious problem.

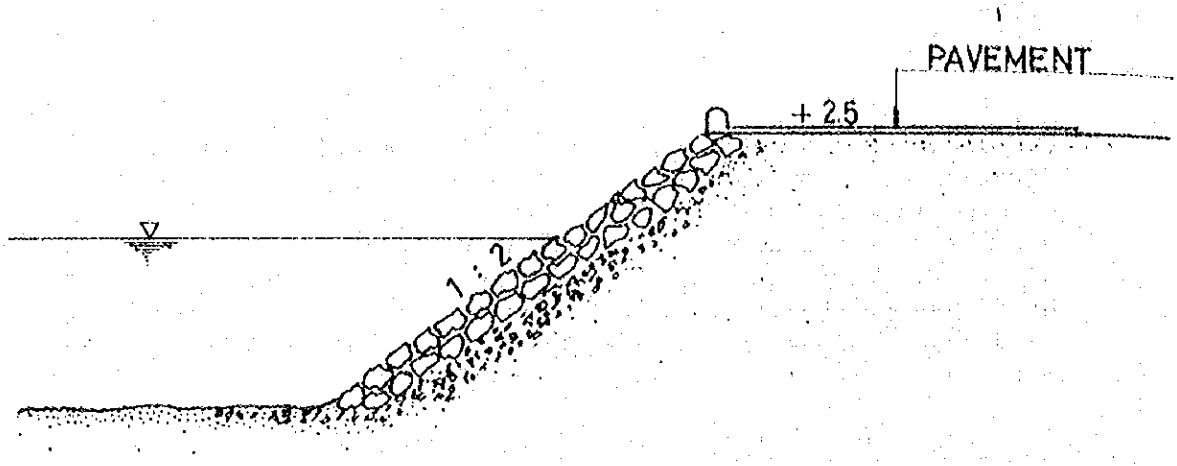


Fig. 5.9.6 Riprap Type Revetment

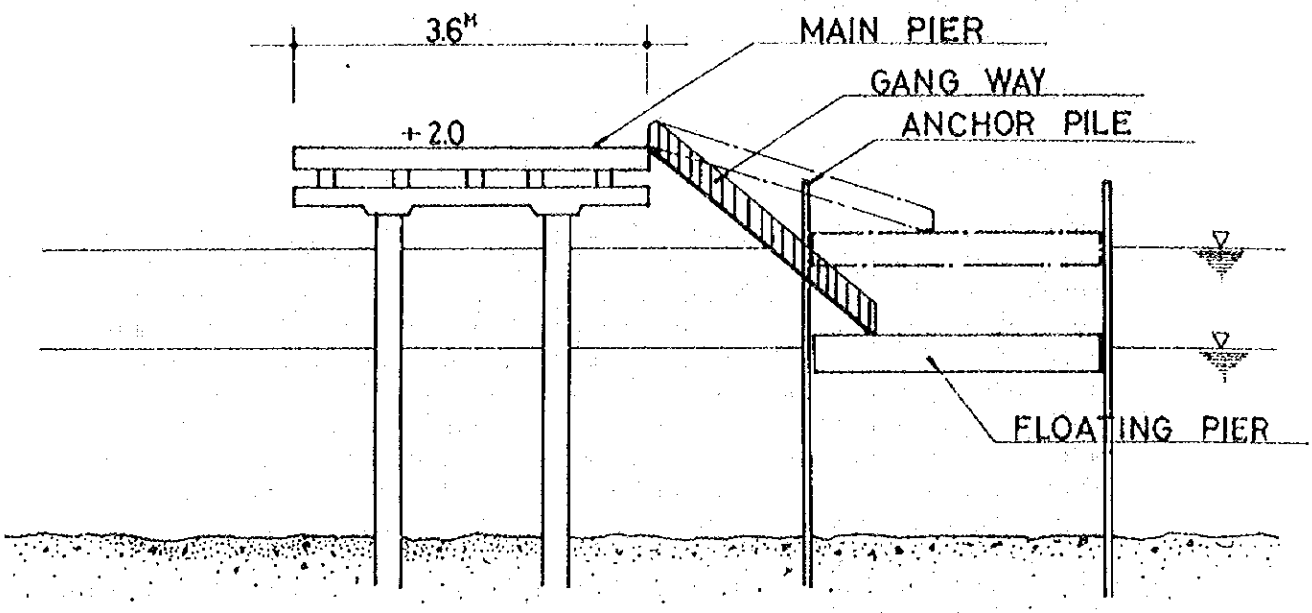


Fig. 5.9.7(1) Berthing System in the Main Port

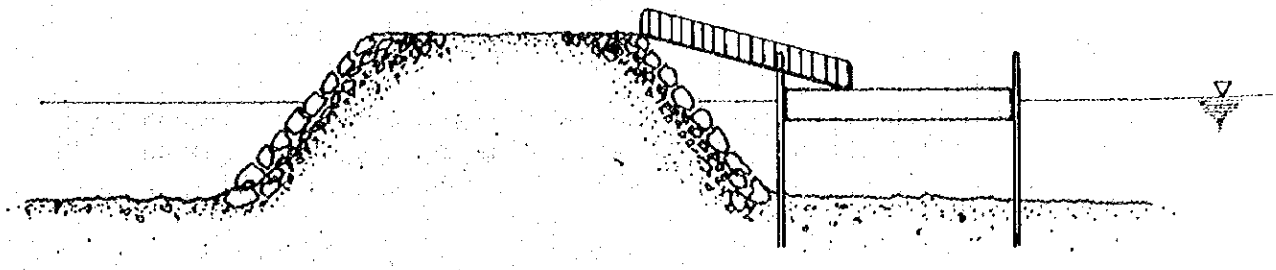


Fig. 5.9.7(2) Berthing System in the North Port

3) South port

Even though jetties to prevent sand movement and maintain the water depth of the access channel will be constructed, periodical dredgings might be required.

Wigh regard to revetments, riprap type as shown in Fig. 5.9.6 would be desirable in looks as the main tourist spot and construction cost is generally cheap compared with other types. In the main port, stairways for tourists to reach the sea water will be provided in some places of the riprap revetment.

The elevations of these structures are given below:

Landfill	+2.5 m above M.S.L
Island at the Main port	"
Mole at the North port	"
Jetties	+1.5 m above M.S.L

(b) Berthing facilities

The typical berthing facilities are shown in Fig. 5.9.7. The proposed berthing system will consist of fixed main piers and floating finger piers held in place by anchor piles. The floating berths will be connected to the main piers by gangways. In the first construction phase, the main pier without finger piers and some floating piers at the end of main piers for boating will be provided.

A transient dock to accommodate boat users and a loading dock with jib crane and electric hoist will be provided.

Dimensions of berthing facilities are shown as follows:

Width of main piers	3.6 m
Width of finger pier	1.5 m
Elevation of main piers	+2.0 m

(c) Navigational considerations

The access channel and mooring area will have a project depth of 5m (from M.S.L datum). This project depth was decided by condidering existing excursion boats and the tidal range. Clear waterways between ends of slips will be a minimum of 1.75 times the length of the longest slip. In this master plan, the distance between main piers was assumed as follows:

Slip length = 15 m
Clear waterway = 30 m

The distance between main piers will be 30 m + 30 m = 60 m

The design and construction of appropriate aids to navigation will be provided by the Harbor Department

(d) Harbor administration

The building for harbor administration will be located at the island of the main port. The building will be a single-level unit, accommodating the harbor administration facilities, a chandlery and a snack bar.

(e) Utilities

1) Waters

It is deriable that water will be supplied to the harbor sufficiently clear and pure for consumption and in enough quantity and pressure for fire fighting. Near the launching ramp a wash area will be installed.

2) Sewerage and Refuse

The sewage of the boat harbor should be collected and disposed of into a sanitary disposal system. In addition, a unit for emptying on-board wastes will be provided.

Collection and disposal of refuse will be provided for by receptacles conveniently located near the berths. These receptacles will help control insects and rodents and should be designed so as to enhance the appearance of the ports.

3) Power and Telephone

Power for the administration building, concessions, area lighting, and berthing slips will be provided, and the slips will be provided with receptacles. But it is not intended that the full capacity of the receptacle be utilized, as the basis for providing power to the slips is for minor repair work.

CHAPTER 6 ECONOMIC AND FINANCIAL EVALUATION

CHAPTER 6 ECONOMIC AND FINANCIAL EVALUATION

6.1 GENERAL

All development plans have to be proved economically viable before the implementation can be justified. In other words, the total costs of the projects should be amply exceeded by the anticipated economic return, whether direct or indirect, from the point of national economy.

For projects where a financial return can be anticipated in the form of revenue, the financial viability of the projects have also to be assessed to ensure that the investment will not result in a financial loss to the operating body.

In this chapter, an economic and financial evaluation of the proposed development plan of Pattaya is made. The economic evaluation will cover all proposed investments for the complete inplementation of the masterplan, including the cost on the infrastructure projects, the public sector investments on other tourist facilities and public facilities, and also the necessary private sector investments either for provision of tourist facilities or for construction of the local community.

As the estimates at this masterplan stage are inevitably rough, it is important that a more refined calculation be made at the Feasibility Study stage based on the estimates of a smaller range of error. For the masterplan, the costs for the infrastructive projects are estimated to an accuracy of ±30%, whereas all other cost estimates for the public and the private sectors are made to an accuracy of ±40%.

6.2 ECONOMIC EVALUATION

6.2.1 Classification of The Project

There are many projects proposed in the masterplan, and they may be classified into the following categories.

(a) Infrastructure projects

These are the project which have to be invested by the government, and include both the projects from which a revenue can be expected, such as water supply and electrical power supply and also project where no revenue is anticipated such as road and street system and storm water drainage.

(b) Public sector investment Group I

This category covers the government investment projects, other than infrastructure, of either public or tourist facilities from which no revenue is expected, such as parks, community center, information center etc.

(c) Public sector investment Group II

This consists of projects which are self-sustaining through revenue receipt, but are grouped under public sector investment from the consideration that public investment in these projects may better ensure the quality and level of service. Such inland activities as aquarium, handicraft center and museum are included in this category. These projects may, if necessary, be invested by the private sector through concession and put under the supervision of the authority.

(d) Private sector investment Group I

This group includes the private investment in projects on a commercial basis for the purpose of gaining a profit, such as hotels, restaurants etc.

(e) Private sector investment Group II

This covers the private sector projects for the community such as housing units, private bungalows etc.

6.2.2 Cost Estimates

The costs to be considered in economic evaluation include the construction cost and operation and maintenance cost.

(a) Construction cost

The total construction costs of all projects in all the above 5 categories are considered. The breakdown by years is made based on the years when the cost will be incurred at each year. The tax components are deducted from the costs.

Table 6.2.1 to 6.2.3 summarize the total construction costs for the implementation of the masterplan.

(b) Operation and maintenance costs

The operation and maintenance costs are estimated only for the infrastructure projects and the public sector investment Group I project. The self-sustaining projects are not included for the reason that these costs are recoverable through revenue receipt.

Tables 6.2.4 to 6.2.6 summarize the operation and maintenance costs.

Table 6.2.1 Estimate of Construction Cost for Projects in Mainland

(Millions Baht)

		Phase 1 (1977 - 86)									Phase 2 (1987 - 96)			Grand Total				
		Stage 1 (1977-81)			Stage 2 (1982-86)			Total										
		Local Currency	Foreign Currency	Sub-Total	Local	Foreign	Sub-Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Land Cost	Total (Including Land Cost)
Infrastructure	Water Supply System	21.9	19.7	41.6	99.3	168.3	267.6	121.2	188.0	309.2	99.5	80.5	180.0	220.7	268.5	489.2	1.5	490.7
	Sewerage System	6.6	2.4	9.0	71.9	63.5	135.4	78.5	65.9	144.4	106.7	29.0	135.7	185.2	94.9	280.1	14.7	294.8
	Storm Water Drainage System	27.5	1.3	28.8	32.6	1.0	33.6	60.1	2.3	62.4	57.7	2.5	60.2	117.8	4.8	122.6	64.6	187.2
	Solid Waste Collection & Disposal System	-	-	-	1.4	1.7	3.1	1.4	1.7	3.1	12.6	4.9	17.5	14.0	6.6	20.6	63.4	84.0
	Road & Street System	55.2	12.1	67.3	35.1	6.1	41.2	90.3	18.2	108.5	179.8	45.6	225.4	270.1	63.8	333.9	126.2	460.1
	Electrical Power Supply System	-	-	-	45.0	58.2	103.2	45.0	58.2	103.2	57.6	97.9	155.5	102.6	156.1	258.7	-	258.7
	Telecommunication System	-	-	-	30.0	63.6	93.6	30.0	63.6	93.6	29.0	64.0	93.0	59.0	127.6	186.6	0.1	186.7
	Port & Marine Facilities	2.0	-	2.0	60.0	15.0	75.0	62.0	15.0	77.0	60.2	14.9	75.1	122.2	29.9	152.1	-	152.1
	Total (A)	113.2	35.5	148.7	375.3	377.4	752.7	488.5	412.9	901.4	603.1	339.3	942.4	1,091.6	752.2	1,843.8	270.5	2,114.3
Other Investments	Public: Park & Open Space	30.9	7.6	38.5	26.1	6.6	32.7	57.0	14.2	71.2	41.4	7.8	49.2	98.4	22.0	120.4	207.2	327.6
	Public: Amenity Core	3.5	0.8	4.3	3.5	0.8	4.3	7.0	1.6	8.6	3.9	1.0	4.9	10.9	2.6	13.5	10.7	24.2
	Public: Local Community	25.5	6.4	31.9	46.9	11.7	58.6	72.4	18.1	90.5	79.1	19.8	98.9	151.5	37.9	189.4	15.6	205.0
	Public: Sub-Total (B)	59.9	14.8	74.7	76.5	19.1	95.6	136.4	33.9	170.3	124.4	28.6	153.0	260.8	62.5	323.3	233.5	556.8
	Private	197.0	51.8	248.8	443.9	197.3	641.2	640.9	249.1	890.0	1,737.7	1,120.8	2,858.5	2,378.6	1,369.9	3,748.5	687.1	4,435.6
	Total	256.9	66.6	323.5	520.4	216.4	736.8	777.3	283.0	1,060.3	1,862.1	1,149.4	3,011.5	2,639.4	1,432.4	4,071.8	920.6	4,992.4
Grand Total	Public (A + B)	173.1	50.3	223.4	451.8	396.5	848.3	624.9	446.8	1,071.7	727.5	367.9	1,095.4	1,352.4	814.7	2,167.1	504.0	2,671.1
	Private	197.0	51.8	248.8	443.9	197.3	641.2	640.9	249.1	890.0	1,737.7	1,120.8	2,858.5	2,378.6	1,369.9	3,748.5	687.1	4,435.6
	Total	370.1	102.1	472.2	895.7	593.8	1,489.5	1,265.8	695.9	1,961.7	2,465.2	1,488.7	3,953.9	3,731.0	2,184.6	5,915.6	1,191.1	7,106.7

Notes: 1 Construction base

2 Currency equivalents US$1.00 = 20.00 Bahts

Table 6.2.2 Estimate of Construction Cost for Projects in Ko Lan Island

(Millions Baht)

		Phase 1 (1977 - 86)									Phase 2 (1987 - 96)			Grand Total				
		Stage 1 (1977-81)			Stage 2 (1982-86)			Total										
		Local Currency	Foreign Currency	Sub-Total	Local	Foreign	Sub-Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Land Cost	Total including Land Cost
Infrastructure	Water Supply System	9.2	0.3	9.5	3.2	0.1	3.3	12.4	0.4	12.8	1.1	0.1	1.2	13.5	0.5	14.0	-	14.0
	Sewerage System	-	5.5	5.5	-	0.9	0.9	-	6.4	6.4	-	0.7	0.7	-	7.1	7.1	-	7.1
	Solid Waste Collection & Disposal System	-	0.7	0.7	-	0.5	0.5	-	1.2	1.2	-	0.3	0.3	-	1.5	1.5	-	1.5
	Road & Street System	2.7	-	2.7	0.7	-	0.7	3.4	-	3.4	0.4	-	0.4	3.8	-	3.8	0.3	4.1
	Electric Power Supply System	2.6	16.5	19.1	0.4	6.2	6.6	3.0	22.7	25.7	0.1	0.1	0.2	3.1	22.8	25.9	0.1	26.0
	Telecommunication System	0.7	2.5	3.2	0.2	0.4	0.6	0.9	2.9	3.8	-	-	-	0.9	2.9	3.8	-	3.8
	Total (A)	15.2	25.5	40.7	4.5	8.1	12.6	19.7	33.6	53.3	1.6	1.2	2.8	21.3	34.8	56.1	0.4	56.5
Other Investments	Public: Park & Open Space	0.8	-	0.8	0.7	-	0.7	1.5	-	1.5	-	-	-	1.5	-	1.5	0.3	1.8
	Public: Beach Facilities	1.4	0.3	1.7	0.3	0.1	0.4	1.7	0.4	2.1	0.7	0.2	0.9	2.4	0.6	3.0	0.5	3.5
	Public: Local Community	8.3	2.7	11.0	3.9	1.0	4.9	12.2	3.7	15.9	2.2	0.8	3.0	14.4	4.5	18.9	0.2	19.1
	Public: Sub-Total (B)	10.5	3.0	13.5	4.9	1.1	6.0	15.4	4.1	19.5	2.9	1.0	3.9	18.3	5.1	23.4	1.0	24.4
	Private	13.7	5.2	18.9	70.2	64.5	134.7	83.9	69.7	153.6	7.9	3.6	11.5	91.8	73.3	165.1	0.7	165.8
	Total	24.2	8.2	32.4	75.1	65.6	140.7	99.3	73.8	173.1	10.8	4.6	15.4	110.1	78.4	188.5	1.7	190.2
Grand Total	Public (A + B)	25.7	28.5	54.2	9.4	9.2	18.6	35.1	37.7	72.8	4.5	2.2	6.7	39.6	39.9	79.5	1.4	80.9
	Private	13.7	5.2	18.9	70.2	64.5	134.7	83.9	69.7	153.6	7.9	3.6	11.5	91.8	73.3	165.1	0.7	165.8
	Total	39.4	33.7	73.1	79.6	73.7	153.3	119.0	107.4	226.4	12.4	5.8	18.2	131.4	113.2	244.6	2.1	246.7

Notes: 1 Construction base

2 Currency equivalents US$ 1.00 = 20.00 Bahts

Table 6.2.3 Estimate of Total Construction Cost of All Project for both Mainland & Ko Lan Island

(Millions Baht)

		Phase 1 (1977-86)									Phase 2 (1987-96)			Grand Total				
		Stage 1 (1977-81)			Stage 2 (1982-86)			Total										
		Local Currency	Foreign Currency	Sub-Total	Local Currency	Foreign Currency	Sub-Total	Local Currency	Foreign Currency	Sub-Total	Local Currency	Foreign Currency	Sub-Total	Local Currency	Foreign Currency	Sub-Total	Land Cost	Total includ-Land Cost
Infrastructure	Water Supply System	31.1	20.0	51.1	102.5	168.4	270.9	133.6	188.4	322.0	100.6	80.6	181.2	234.2	269.0	503.2	1.5	504.7
	Sewerage System	6.6	7.9	14.5	71.9	64.4	136.3	78.5	72.3	150.8	106.7	29.7	136.4	185.2	102.0	287.2	14.7	301.9
	Storm Water Drainage System	27.5	1.3	28.8	32.6	1.0	33.6	60.1	2.3	62.4	57.7	2.5	60.2	117.8	4.8	122.6	64.6	187.2
	Solid Waste Collection & Disposal System	-	0.7	0.7	1.4	2.2	3.6	1.4	2.9	4.3	12.6	5.2	17.8	14.0	8.1	22.1	63.4	85.5
	Road & Street System	57.9	12.1	70.0	35.8	6.1	41.9	93.7	18.2	111.9	180.2	45.6	225.8	273.9	63.8	337.7	126.5	464.2
	Electrical Power Supply System	2.6	16.5	19.1	45.4	64.4	109.8	48.0	80.9	128.9	57.7	98.0	155.7	105.7	178.9	284.6	0.1	284.7
	Telecommunication System	0.7	2.5	3.2	30.2	64.0	94.2	30.9	66.5	97.4	29.0	64.0	93.0	59.9	130.5	190.4	0.1	190.5
	Port & Marine Facilities	2.0	-	2.0	60.0	15.0	75.0	62.0	15.0	77.0	60.2	14.9	75.1	122.2	29.9	152.1	-	152.1
	Total (A)	128.4	61.0	189.4	379.8	385.5	765.3	508.2	446.5	954.7	604.7	340.5	945.2	1,112.9	787.0	1,899.9	270.9	2,170.8
Other Investments	Public: Park & Open Space	31.7	7.6	39.3	26.8	6.6	33.4	58.5	14.2	72.7	41.4	7.8	49.2	99.9	22.0	121.9	207.5	329.4
	Public: Amenity Core	3.5	0.8	4.3	3.5	0.8	4.3	7.0	1.6	8.6	3.9	1.0	4.9	10.9	2.6	13.5	10.7	24.2
	Public: Beach Facilities	1.4	0.3	1.7	0.3	0.1	0.4	1.7	0.4	2.1	0.7	0.2	0.9	2.4	0.6	3.0	0.5	3.5
	Public: Local Community	33.8	9.1	42.9	50.8	12.7	63.5	84.6	21.8	106.4	81.3	20.6	101.9	165.9	42.4	208.3	15.8	224.1
	Public: Sub-Total (B)	70.4	17.8	88.2	81.4	20.2	101.6	151.8	38.0	189.8	127.3	29.6	156.9	279.1	67.6	346.7	234.5	581.2
	Private	210.7	57.0	267.7	514.1	261.8	775.9	724.8	318.8	1,043.6	1,745.6	1,124.4	2,870.0	2,470.4	1,443.2	3,913.6	687.8	4,601.4
	Total	281.1	74.8	355.9	595.5	282.0	877.5	876.6	356.8	1,233.4	1,872.9	1,154.0	3,026.9	2,749.5	1,510.8	4,260.3	922.3	5,182.6
Grand Total	Public (A + B)	198.8	78.8	277.6	461.2	405.7	866.9	660.0	484.5	1,144.5	732.0	370.1	1,102.1	1,392.0	854.6	2,246.6	505.4	2,752.0
	Private	210.7	57.0	267.7	514.1	261.8	775.9	724.8	318.8	1,043.6	1,745.6	1,124.4	2,870.0	2,470.4	1,443.2	3,913.6	687.8	4,601.4
	Total	409.5	135.8	545.3	975.3	667.5	1,642.8	1,384.8	803.3	2,188.1	2,477.6	1,494.5	3,972.1	3,862.4	2,297.8	6,160.2	1,193.2	7,353.4

Note: 1 Construction base

2 Currency equivalents US$ 1.00 = 20 Bahts

Table 6.2.4 Estimate of Operating and Maintenance Cost for Projects in Mainland

(Millions Baht)

		Phase 1 (1977-86)									Phase 2 (1987-2006)						Grand Total (C+D+E)		
		Stage 1 (1977-81)			Stage 2 (1982-86)			Total (C)			(D) Stage 1 (1987-96)			(E) Stage 2 (1997-2006)					
		Local	For-eign	Sub-Total	Local	For-eign	Sub-Total	Local	For-eign	Total	Local	For-eign	Sub-Total	Local	For-eign	Sub-Total	Local	For-eign	Total
Infrastructure	Water Supply System	5.1	-	5.1	25.3	-	25.3	30.4	-	30.4	79.0	-	79.0	102.0	-	102.0	211.4	-	211.4
	Sewerage System	0.9	-	0.9	17.3	-	17.3	18.2	-	18.2	51.5	-	51.5	66.0	-	66.0	135.7	-	135.7
	Storm Water Drainage System	2.8	-	2.8	6.7	-	6.7	9.5	-	9.5	15.4	-	15.4	16.0	-	16.0	40.9	-	40.9
	Solid Waste Disposal System	2.8	3.8	6.6	9.2	10.4	19.6	12.0	14.2	26.2	33.8	30.9	64.7	46.0	28.0	74.0	91.8	73.1	164.9
	Road & Street System	6.5	-	6.5	14.5	-	14.5	21.0	-	21.0	42.6	-	42.6	49.0	-	49.0	112.6	-	112.6
	Electrical Power Supply System	-	-	-	21.3	-	21.3	21.3	-	21.3	65.0	-	65.0	76.0	-	76.0	162.3	-	162.3
	Telecommunication System	-	-	-	13.1	-	13.1	13.1	-	13.1	37.8	-	37.8	45.0	-	45.0	95.9	-	95.9
	Port & Marine Facilities	1.7	-	1.7	7.5	-	7.5	9.2	-	9.2	28.0	-	28.0	30.0	-	30.0	67.2	-	67.2
	Total (A)	19.8	3.8	23.6	114.9	10.4	125.3	134.7	14.2	148.9	353.1	30.9	384.0	430.0	28.0	458.0	917.8	73.1	990.9
Other Investments	Public: Park & Open Space	3.0	0.3	3.3	7.6	0.9	8.5	10.6	1.2	11.8	29.8	2.6	32.4	32.4	3.6	36.0	72.8	7.4	80.2
	Public: Amenity Core	0.5	0.1	0.6	3.4	0.4	3.8	3.9	0.5	4.4	12.3	1.4	13.7	12.6	1.4	14.0	28.8	3.3	32.1
	Public: Local Community	8.1	0.9	9.0	31.0	3.5	34.5	39.1	4.4	43.5	133.2	14.8	148.0	173.7	19.3	193.0	346.0	38.5	384.5
	Public: Sub-Total (B)	11.6	1.3	12.9	42.0	4.8	46.8	53.6	6.1	59.7	175.3	18.8	194.1	218.7	24.3	243.0	447.6	49.2	496.8
	Private	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	11.6	1.3	12.9	42.0	4.8	46.8	53.6	6.1	59.7	175.3	18.8	194.1	218.7	24.3	243.0	447.6	49.2	496.8
Grand Total	Public (A+B)	31.4	5.1	36.5	156.9	15.2	172.1	188.3	20.3	208.6	528.4	49.7	578.1	648.7	52.3	701.0	1365.4	122.3	1487.7
	Private	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	31.4	5.1	36.5	156.9	15.2	172.1	188.3	20.3	208.6	528.4	49.7	578.1	648.7	52.3	701.0	1365.4	122.3	1487.7

Note: 1 Excluding the operating and maintenance cost of private sector projects

2 Payment base

Table 6.2.5 Estimate of Operating and Maintenance Cost for Projects in Ko Lan Island

(Millions of Baht)

		Phase 1 (1977-86)									Phase 2 (1987-2006)						Grand Total (C+D+E)		
		Stage 1 (1977-81)			Stage 2 (1982-86)			Total (C)			Stage 1 (1987-96)(D)			Stage 2 (1997-2006)(E)					
		Local	Foreign	Sub-Total	Local	Foreign	Sub-Total	Local	Foreign	Total	Local	Foreign	Sub-Total	Local	Foreign	Sub-Total	Local	Foreing	Total
Infrastructure	Water Supply System	0.2	3.0	3.2	1.0	6.0	7.0	1.2	9.0	10.2	4.0	-	4.0	4.0	-	4.0	9.2	9.0	18.2
	Sewerage System	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Solid Waste Collection & Disposal System	0.2	-	0.2	1.0	-	1.0	1.2	-	1.2	2.0	-	2.0	2.0	-	2.0	5.2	-	5.2
	Road & Street System	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Electrical Power Supply System	6.7	-	6.7	43.1	-	43.1	49.8	-	49.8	99.6	-	99.6	100.0	-	100.0	249.4	-	249.4
	Telecommunication System	0.8	-	0.8	4.3	-	4.3	5.1	-	5.1	9.0	-	9.0	9.0	-	9.0	23.1	-	23.1
	Total (A)	7.9	3.0	10.9	49.4	6.0	55.4	57.3	9.0	66.3	114.6	-	114.6	115.0	-	115.0	286.9	9.0	295.9
Other Investment	Public: Park & Open Space	0.4	-	0.4	0.5	-	0.5	0.9	-	0.9	1.0	-	1.0	1.0	-	1.0	2.9	-	2.9
	Public: Beach Facilities	0.6	0.1	0.7	1.3	0.1	1.4	1.9	0.2	2.1	2.9	0.3	3.2	3.6	0.4	4.0	8.4	0.9	9.3
	Public: Local Community	2.7	0.3	3.0	5.8	0.7	6.5	8.5	1.0	9.5	15.5	1.7	17.2	17.1	1.9	19.0	41.1	4.6	45.7
	Public: Sub-Total (B)	3.7	0.4	4.1	7.6	0.8	8.4	11.3	1.2	12.5	19.4	2.0	21.4	21.7	2.3	24.0	52.4	5.5	57.9
	Provate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	3.7	0.4	4.1	7.6	0.8	8.4	11.3	1.2	12.5	19.4	2.0	21.4	21.7	2.3	24.0	52.4	5.5	57.9
Grand Total	Public (A+B)	11.6	3.4	15.0	57.0	6.8	63.8	68.6	10.2	78.8	134.0	2.0	136.0	136.7	2.3	139.0	339.3	14.5	353.8
	Private	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	11.6	3.4	15.0	57.0	6.8	63.8	68.6	10.2	78.8	134.0	2.0	136.0	136.7	2.3	139.0	339.3	14.5	353.8

Note: 1 Excluding the operating and maintenance cost of private sector projects

2 Payment base

3 Currency equivalents US$ 1.00 = 20 Bahts

Table 6.2.6 Estimate of Operating and Maintenance Cost for All Projects for Both Mainland & Ko Lan Island

(Millions of Baht)

		Phase 1 (1977-86)									Phase 2 (1987-2006)						Grand Total (C+D+E)		
		Stage 1 (1977-81)			Stage 2 (1982-86)			Total (C)			(D) Stage 1 (1987-96)			(E) Stage 2 (1997-2006)					
		Local	Foreign	Sub-Total	Local	Foreign	Sub-Total	Local	Foreign	Total	Local	Foreign	Sub-Total	Local	Foreign	Sub-Total	Local	Foreign	Total
Infrastructure	Water Supply System	5.3	3.0	8.3	26.3	6.0	32.3	31.6	9.0	40.6	83.0	-	83.0	106.0	-	106.0	220.6	9.0	229.6
	Sewerage System	0.9	-	0.9	17.3	-	17.3	18.2	-	18.2	51.5	-	51.5	66.0	-	66.0	135.7	-	135.7
	Storm Water Drainage System	2.8	-	2.8	6.7	-	6.7	9.5	-	9.5	15.4	-	15.4	16.0	-	16.0	40.9	-	40.9
	Solid Waste Collection & Disposal System	3.0	3.8	6.8	10.2	10.4	20.6	13.2	14.2	27.4	35.8	30.9	66.7	48.0	28.0	76.0	97.0	73.1	170.1
	Road & Street System	6.5	-	6.5	14.5	-	14.5	21.0	-	21.0	42.6	-	42.6	49.0	-	49.0	112.6	-	112.6
	Electrical Power Supply System	6.7	-	6.7	64.4	-	64.4	71.1	-	71.1	146.6	-	146.6	176.0	-	176.0	411.7	-	411.7
	Telecommunication System	0.8	-	0.8	17.4	-	17.4	18.2	-	18.2	46.8	-	46.8	54.0	-	54.0	119.0	-	119.0
	Port & Marine facilities	1.7	-	1.7	7.5	-	7.5	9.2	-	9.2	28.0	-	28.0	30.0	-	30.0	67.2	-	67.2
	Total (A)	27.7	6.8	34.5	164.3	16.4	180.7	192.0	23.2	215.2	467.7	30.9	498.6	545.0	28.0	573.0	1,204.7	82.1	1,286.8
Other Investments	Public: Park & Open Space	3.4	0.3	3.7	8.1	0.9	9.0	11.5	1.2	12.7	30.8	2.6	33.4	33.4	3.6	37.0	75.7	7.4	83.1
	Public: Amenity Core	0.5	0.1	0.6	3.4	0.4	3.8	3.9	0.5	4.4	12.3	1.4	13.7	12.6	1.4	14.0	28.8	3.3	32.1
	Public: Beach Facilities	0.6	0.1	0.7	1.3	0.1	1.4	1.9	0.2	2.1	2.9	0.3	3.2	3.6	0.4	4.0	8.4	0.9	9.3
	Public: Local Community	10.8	1.2	12.0	36.8	4.2	41.0	47.6	5.4	53.0	148.7	16.5	165.2	190.8	21.2	212.0	387.1	43.1	430.2
	Public: Sub-Total (B)	15.3	1.7	17.0	49.6	5.6	55.2	64.9	7.3	72.2	194.7	20.8	215.5	240.4	26.6	267.0	500.0	54.7	554.7
	Private	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	15.3	1.7	17.0	49.6	5.6	55.2	64.9	7.3	72.2	194.7	20.8	215.5	240.4	26.6	267.0	500.0	54.7	554.7
Grand Total	Public (A+B)	43.0	8.5	51.5	213.9	22.0	235.9	256.9	30.5	287.4	662.4	51.7	714.1	785.4	54.6	840.0	1,704.7	136.8	1,841.5
	Private	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	43.0	8.5	51.5	213.9	22.0	235.9	256.9	30.5	287.4	662.4	51.7	714.1	785.4	54.6	840.0	1,704.7	136.8	1,841.5

Note: 1 Excluding the operating and maintenance cost of private sector projects.

2 Payment base

3 Currency equivalents US$ 1.00 = 20.00 Bahts

(c) Total costs

The total costs of all items including both the construction cost and operation and maintenance costs by years are summarized in Table 6.2.7.

6.2.3 Economic Benefits

Whereas in the progress report a preliminary economic analysis was made by estimating the net gain in receipt from tourist income and, in order to obtain a microscopic estimation of the economic benefit, considering the multiplies factor at this stage, the economic benefit is more conservatively computed for the following two items.

(a) The net foreign exchange earning

From the total earning through the receipt from tourists, the net foreign exchange earning is calculated by deducting the foreign exchange loss in the construction of the projects and also the foreign currency portion of the operation and maintenance costs incurred by both the public and the private sectors.

(b) The operating profit of the tourism industry

Of the expenditure of the tourists, only the operating profit portion of the tourism industry is enumerated as the net economic benefit, deducting all costs to be incurred by the industry. It may be noted that of the operating cost components of the tourism industry, a portion for personnel expenses may also be accounted as economic benefits to the economy. However, from the fact that the portion is small and that it is difficult to analyse the costs incurred by the individuals for deriving the income, this portion is neglected to ensure the calculation to be on the safe side.

Table 6.2.8 lists the economic benefit by years.

6.2.4 Other Assumptions in Economic Evaluation

(1) Period of analysis : 30 years (up to the year 2006)

The masterplan is prepared for a target year of 20 years (up to 1996), and many of the projects are scheduled to be completed by 1986 to meet demand up to 1996. Should the same 20 years be adopted as the analysis period, it will mean that some of the projects will be in operation for only 10 years within the analysis period. To make a better coverage of these Phase 2 projects, the analysis period is set at 30 years from now or 10 years after completion of the Phase 2 projects.

Table 6.2.7 Cost Estimate of Total Cost of All Reports in Mainland & Ko Lan Island

(Million Baht)

Year	Mainland			Ko Lan Island			Grand Total		
	Public	Private	Total	Public	Private	Total	Public	Private	Total
1977	30.3	66.3	96.6	3.0	3.9	6.9	33.3	70.2	103.5
78	250.9	66.1	317.0	5.6	3.9	9.5	256.5	70.0	326.5
79	399.9	66.1	466.0	4.8	3.9	8.7	404.7	70.0	474.7
80	408.1	74.6	482.7	58.4	3.8	62.2	466.5	78.4	544.9
81	260.8	74.5	335.3	10.2	3.7	13.9	271.0	78.2	349.2
82	105.4	146.1	251.5	11.2	27.1	38.3	116.6	173.2	289.8
83	95.0	146.0	241.0	13.3	27.1	40.4	108.3	173.1	281.4
84	89.2	154.4	243.6	12.7	26.9	39.6	101.9	181.3	283.2
85	317.0	154.0	471.0	21.9	26.9	48.8	338.9	180.9	519.8
86	200.7	145.1	345.8	14.2	26.9	41.1	214.9	172.0	386.9
87	138.1	331.5	469.6	13.8	3.1	16.9	151.9	334.6	486.5
88	137.9	331.5	469.4	13.8	3.0	16.8	151.7	334.5	486.2
89	137.8	331.4	469.2	13.8	0.7	14.5	151.6	332.1	483.7
90	137.1	348.9	486.0	13.9	0.7	14.6	151.0	349.6	500.6
91	137.0	346.1	483.1	13.9	0.7	14.6	150.9	346.8	497.7
92	119.0	330.9	449.9	14.9	0.7	15.6	133.9	331.6	465.5
93	117.9	330.7	448.6	14.0	0.7	14.7	131.9	331.4	463.3
94	121.4	330.7	452.1	14.0	0.7	14.7	135.4	331.4	466.8
95	127.5	330.4	457.9	14.1	0.7	14.8	141.6	331.1	472.7
96	126.8	330.3	457.1	14.2	0.7	14.9	141.0	331.0	472.0
97	70.1	-	70.1	13.9	-	13.9	84.0	-	84.0
98	70.1	-	70.1	13.9	-	13.9	84.0	-	84.0
99	70.1	-	70.1	13.9	-	13.9	84.0	-	84.0
2000	70.1	-	70.1	13.9	-	13.9	84.0	-	84.0
1	70.1	-	70.1	13.9	-	13.9	84.0	-	84.0
2	70.1	-	70.1	13.9	-	13.9	84.0	-	84.0
3	70.1	-	70.1	13.9	-	13.9	84.0	-	84.0
4	70.1	-	70.1	13.9	-	13.9	84.0	-	84.0
5	70.1	-	70.1	13.9	-	13.9	84.0	-	84.0
6	70.1	-	70.1	13.9	-	13.9	84.0	-	84.0
Total	4,158.8	4,435.6	8,594.4	434.7	165.8	600.5	4,593.5	4,601.4	9,194.9

Notes: 1. Public consists of Infrastructure cost and cost of Public Other Investments.

2. Public includes construction, Land and Operation & Maintenance cost, and Private includes Construction and Land cost.

Table 6.2.8 Estimate of Economic Benefit

(Million Baht)

Year	Operation Profit (before depreciation)			Foreign Exchange Earnings							(A + D) Economic Benefit
			(A)	(B) Gross Increase of Earnings	Foreign Exchange Loss					(D) (B - C) Net Increase of Earning	
	Hotel	Other	Total		Construction Cost	Operation Cost of Public	Operation Cost of Hotel	Operation Cost of Other	Total (C)		
1977	8	4	12	29	14.5	0.1	2	1	17.6	11.4	23.4
78	15	9	24	61	49.8	0.2	5	2	57.0	4.0	28.0
79	30	18	48	118	164.6	0.3	9	5	178.9	(-)60.9	(-)12.9
80	47	28	75	182	218.4	7.3	14	8	247.7	(-)65.7	9.3
81	67	40	107	257	113.6	0.6	20	11	145.2	111.8	218.8
82	86	52	138	351	71.6	1.2	26	14	112.8	238.2	376.2
83	109	66	175	456	68.0	5.1	33	18	124.1	331.9	506.9
84	137	83	220	572	68.5	1.5	41	22	133.0	439.0	659.0
85	164	99	263	702	104.3	8.3	49	26	187.6	514.4	777.4
86	194	118	312	846	101.4	5.9	58	31	196.3	649.7	961.7
87	220	134	354	959	135.3	2.0	66	36	239.3	719.7	1,073.7
88	250	152	402	1,077	134.4	3.3	75	41	253.7	823.3	1,225.3
89	279	170	449	1,202	132.1	6.7	84	45	267.8	934.2	1,383.2
90	310	188	498	1,332	139.4	3.4	93	50	285.8	1,046.2	1,544.2
91	344	209	553	1,476	139.2	4.5	103	56	302.7	1,173.3	1,726.3
92	368	224	592	1,562	129.1	7.8	110	60	306.9	1,255.1	1,847.1
93	390	237	627	1,649	128.6	4.4	117	63	313.0	1,336.0	1,963.0
94	413	251	664	1,740	128.6	5.5	124	67	325.1	1,414.9	2,078.9
95	436	265	701	1,833	128.2	8.7	131	71	338.9	1,494.1	2,195.1
96	467	284	751	1,934	128.2	5.4	140	76	349.6	1,584.4	2,335.4
97	467	284	751	1,934	-	5.4	140	76	221.4	1,712.6	2,463.6
98	467	284	751	1,934	-	5.4	140	76	221.4	1,712.6	2,463.6
99	467	284	751	1,934	-	5.4	140	76	221.4	1,712.6	2,463.6
2000	467	284	751	1,934	-	5.4	140	76	221.4	1,712.6	2,463.6
1	467	284	751	1,934	-	5.5	140	76	221.5	1,712.5	2,463.5
2	467	284	751	1,934	-	5.5	140	76	221.5	1,712.5	2,463.5
3	467	284	751	1,934	-	5.5	140	76	221.5	1,712.5	2,463.5
4	467	284	751	1,934	-	5.5	140	76	221.5	1,712.5	2,463.5
5	467	284	751	1,934	-	5.5	140	76	221.5	1,712.5	2,463.5
6	467	284	751	1,934	-	5.5	140	76	221.5	1,712.5	2,463.5
Total	9,004	5,471	14,475	37,678	2,297.8	136.8	2,700	1,463	6,597.6	31,080.4	45,555.4

Table 6.2.9 Economic rate of return

(Million Baht)

Year	Investment Cost	Benefit	Discount Rate 20%			Discount Rate 30%		
			Discount Factor	Discounted Investment Cost	Discounted Benefit	Discount Factor	Discounted Investment Cost	Discounted Benefit
1977	103.5	23.4	.8333	86.2	19.5	.7692	79.6	18.0
78	326.5	28.0	.6944	226.7	19.4	.5917	193.2	16.6
79	474.7	(-)12.9	.5787	274.7	(-) 7.5	.4552	216.1	(-)5.9
80	544.9	9.3	.4823	262.8	4.5	.3501	190.8	3.3
81	349.2	218.8	.4019	140.3	87.9	.2693	94.0	58.9
82	289.8	376.2	.3349	97.1	126.0	.2072	60.0	77.9
83	281.4	506.9	.2791	78.5	141.5	.1594	44.9	80.8
84	283.2	659.0	.2326	65.9	153.3	.1226	34.7	80.8
85	519.8	777.4	.1938	100.7	150.7	.0943	49.0	73.3
86	386.9	961.7	.1615	62.5	155.3	.0725	28.1	69.7
87	486.5	1,073.7	.1346	65.5	144.5	.0558	27.1	59.9
88	486.2	1,225.3	.1122	54.6	137.5	.0429	20.9	52.6
89	483.7	1,383.2	.0935	45.2	129.3	.0330	16.0	45.6
90	500.6	1,544.2	.0779	39.0	120.3	.0254	12.7	39.2
91	497.7	1,726.3	.0649	32.3	112.0	.0195	9.7	33.7
92	465.5	1,847.1	.0541	25.2	99.9	.0150	7.0	27.7
93	463.3	1,963.0	.0451	20.9	88.5	.0116	5.4	22.8
94	466.8	2,078.9	.0376	17.6	78.2	.0089	4.2	18.5
95	472.7	2,195.1	.0313	14.8	68.7	.0068	3.2	14.9
96	472.0	2,335.4	.0261	12.3	61.0	.0053	2.5	12.4
97	84.0	2,463.6	.0217	1.8	53.5	.0040	0.3	9.9
98	84.0	2,463.6	.0181	1.5	44.6	.0031	0.3	7.6
99	84.0	2,463.6	.0151	1.3	37.2	.0024	0.2	5.9
2000	84.0	2,463.6	.0126	1.1	31.0	.0018	0.2	4.4
1	84.0	2,463.5	.0105	0.9	25.9	.0014	0.1	3.4
2	84.0	2,463.5	.0087	0.7	21.4	.0011	0.1	2.7
3	84.0	2,463.5	.0073	0.6	18.0	.0008	0.1	2.0
4	84.0	2,463.5	.0061	0.5	15.0	.0006	0.1	1.5
5	84.0	2,463.5	.0051	0.4	12.6	.0005	-	1.2
6	84.0	2,463.5	.0042	0.4	10.3	.0004	-	1.0
Total	9,194.9	45,555.4		1,732.0	2,160.0		1,100.5	840.3

Economic Rate of Return: 26%

(ii) Items of analysis

Basically, the internal rate of return is the main item of analysis. However, in the process of analysis the B/C ratio and the net present worth are also obtained as by products of the IRR calculation at different discount rates.

6.2.5 Results of Analysis

The discounted cost stream and benefit stream at discount rates of 20% and 30% by year are listed in Table 6.2.9.

It is seen that at a discount rate of 20%, the present worth of costs comes to 1,732 million baht and the present worth of benefits is 2,160 million baht so that the net present worth is +428 million bahts. The benefit/cost ratio at the 20% discount rate will therefore be 1.25.

The internal rate of return is calculated at 26%.

The high internal rate of return indicates that the implementation of the tourism development of Pattaya is highly feasible from the point of national economy. It is recommended therefore that on condition that the financial viability is also verified, the implementation of the development according to the masterplan should be carried out starting with feasibility studies on the projects of high priority.

6.3 FINANCIAL EVALUATION

6.3.1 Scope of Financial Evaluation

The financial evaluation is necessary to assess the financial viability of the projects. In this respect, the effort will be concentrated on the investment by the public sector. The following three different cases are considered in financial evaluation.

(a) Water supply project

The water supply project is one single project among the infrastructure projects in the group of first priority for which a revenue receipt can be expected and it is important to establish the financial viability of this project by itself.

(b) Water supply and sewerage projects

The other project listed in the first priority group is the sewerage system project. As it is difficult to charge the users of a sewerage system, it is proposed that a financial evaluation be made on the assumption that the cost for the water supply and sewerage projects will be financially recovered together through the revenue of the

Table 6.3.1 Cost Estimate of Water Supply System & Sewerge System in Mainland

(Millions Baht)

Year	Water Supply System				Sewerage System				Grand Total			
	Construction Cost	Land Cost	Operation & Maintenance Cost	Total	Construction Cost	Land Cost	Operation & Maintenance Cost	Total	Construction Cost	Land Cost	Operation & Maintenance Cost	Total
1977	-	-	-	-	-	-	-	-	-	-	-	-
78	41.6	-	-	41.6	9.0	-	-	9.0	50.6	-	-	50.6
79	107.0	1.5	1.7	110.2	54.2	8.9	0.3	63.4	161.2	10.4	2.0	173.6
80	112.3	-	1.7	114.0	58.1	-	0.3	58.4	170.4	-	2.0	172.4
81	58.9	-	1.7	60.6	30.9	-	0.3	31.2	89.8	-	2.0	91.8
82	3.3	-	4.5	7.8	2.4	-	3.2	5.6	5.7	-	7.7	13.4
83	3.3	-	4.7	8.0	2.4	-	3.3	5.7	5.7	-	8.0	13.7
84	3.2	-	5.1	8.3	2.3	-	3.5	5.8	5.5	-	8.6	14.1
85	26.2	-	5.4	31.6	19.8	5.8	3.6	29.2	46.0	5.8	9.0	60.8
86	26.1	-	5.6	31.7	19.7	-	3.7	23.4	45.8	-	9.3	55.1
87	10.8	-	6.0	16.8	8.3	-	4.0	12.3	19.1	-	10.0	29.1
88	10.8	-	6.4	17.2	8.2	-	4.2	12.4	19.0	-	10.6	29.6
89	10.8	-	6.8	17.6	8.1	-	4.4	12.5	18.9	-	11.2	30.1
90	10.8	-	7.2	18.0	8.1	-	4.6	12.7	18.9	-	11.8	30.7
91	10.8	-	7.6	18.4	8.1	-	4.9	13.0	18.9	-	12.5	31.4
92	10.8	-	8.0	18.8	8.1	-	5.2	13.3	18.9	-	13.2	32.1
93	10.7	-	8.4	19.1	8.1	-	5.5	13.6	18.8	-	13.9	32.7
94	10.6	-	8.8	19.4	8.1	-	5.9	14.0	18.7	-	14.7	33.4
95	10.6	-	9.6	20.2	8.1	-	6.2	14.3	18.7	-	15.8	34.5
96	10.6	-	10.2	20.8	8.1	-	6.6	14.7	18.7	-	16.8	35.5
97	-	-	10.2	10.2	-	-	6.6	6.6	-	-	16.8	16.8
98	-	-	10.2	10.2	-	-	6.6	6.6	-	-	16.8	16.8
99	-	-	10.2	10.2	-	-	6.6	6.6	-	-	16.8	16.8
2000	-	-	10.2	10.2	-	-	6.6	6.6	-	-	16.8	16.8
1	-	-	10.2	10.2	-	-	6.6	6.6	-	-	16.8	16.8
2	-	-	10.2	10.2	-	-	6.6	6.6	-	-	16.8	16.8
3	-	-	10.2	10.2	-	-	6.6	6.6	-	-	16.8	16.8
4	-	-	10.2	10.2	-	-	6.6	6.6	-	-	16.8	16.8
5	-	-	10.2	10.2	-	-	6.6	6.6	-	-	16.8	16.8
6	-	-	10.2	10.2	-	-	6.6	6.6	-	-	16.8	16.8
Total	489.2	1.5	211.4	702.1	280.1	14.7	135.7	430.5	769.3	16.2	347.1	1,132.6

water consumption. It is anticipated that in this case due to the increase in cost, it will not be financially viable to recover the cost through only the revenue receipt of water supply, and government subsidy is deemed necessary to make the two projects financially viable.

The extent of the subsidy required will be calculated.

(c) All projects to be undertaken by Pattaya Tourism Development Corporation

In the subsequent chapter, it is proposed that a Pattaya Tourism Development Corporation be established for the implementation of the public sector projects. The financial viability of the development corporation is also evaluated to ascertain that all investments on public sector projects can be financially recovered.

6.3.2 Water supply project

(a) Costs

The cost items include the construction cost, land cost and operation and maintenance costs. The tax component for construction is excluded on the assumption that being an infrastructure project, tax exemption from the Bureau of Investment will be made applicable.

The costs summarized by years are shown on the left hand columns of Table 6.3.1.

(b) Revenue

The revenue will be the receipt from the water consumption which is obtained by assuming the unit rate of water charge on the consumers. To determine the financially feasible rate of water charge, alternative cases were studied for unit rates.

i) In all cases, the unit rate of water charge to residential consumers is fixed at 2 baht/m^3 which is about the average rate in Bangkok and also the existing rate in Bang Lamung.

ii) For consumption by hotels, the four different unit rates of 5 baht, 7 baht, 10 baht and 13 baht/m^3 were adopted for alternative studies.

Tables 6.3.2 and 6.3.3 list the annual water consumption in both the mainland Pattaya and the Ko Lan Island. Table 6.3.4 summarizes the annual revenue for water consumption for the four different cases of unit rates.

(c) Financial evaluation

The calculation on financial return of the water supply project is as shown from Table 6.3.5 to 6.3.8 for the 4 cases and

Table 6.3.3 Estimate of Annual Quantity of Water Consumption in Ko Lan Island

Year	Hotel							Others													(J + O) Total Net Water Demand (10^3 m^3/y)
								Resident						One Day Tripper							
	(A) No. of Rooms	(B) Unit Demand (m^3/r.d)	(AxB) Water Demand (m^3/d)	(C) Annual Water Demand (10^3 m^3/y)	(D) Room Occupancy (%)	(E) Receivable Ratio (%)	(CxDxE) Net Water Demand (10^3 m^3/y)	(F) Population	(G) Unit Demand (ℓ/h.d)	(FxG) Water Demand (m^3/d)	(H) Annual Water Demand (10^3 m^3/y)	(I) Receivable Ratio (%)	(HxI) (J) Net Water Demand (10^3 m^3/y)	(K) No. of Tripper	(L) Unit Demand (ℓ/h.d)	(KxL) Water Demand (m^3/d)	(M) Annual Water Demand (10^3 m^3/y)	(N) Receivable Ratio (%)	(MxN) (O) Net Water Demand (10^3 m^3/y)	
1977	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81	80	2.9	230	84	80	80	54	2,080	210	440	161	80	129	1,600	70	110	40	80	32	161	
82				106	"	"	68				172	"	138				42	"	34	172	
83				133	"	"	85				184	"	147				44	"	35	182	
84				167	"	"	107				197	"	158				46	"	37	195	
85				210	"	"	134				211	"	169				48	"	38	207	
				1981-86 25.6							1981-86 7.0						1981-86 5.0				
86	250	2.9	720	263	"	"	168	2,820	220	620	226	"	181	2,000	70	140	51	"	41	222	
87				"	"	"	"				230	"	184				53	"	42	226	
88				"	"	"	"				234	"	187				55	"	44	231	
89				"	"	"	"				238	"	190				57	"	46	236	
90				"	"	"	"				243	"	194				59	"	47	241	
91				"	"	"	"				248	"	198				61	"	49	247	
92				"	"	"	"				253	"	202				63	"	50	252	
93				"	"	"	"				258	"	206				65	"	52	258	
94				"	"	"	"				263	"	210				67	"	54	264	
95				"	"	"	"				268	"	214				69	"	55	269	
											1986-96 1.9						1986-96 3.7				
96	250	2.9	720	263	"	"	"	3,140	240	750	274	"	219	2,900	70	200	73	"	58	277	
97				"	"	"	"				"	"	"				"	"	"	"	
98				"	"	"	"				"	"	"				"	"	"	"	
99				"	"	"	"				"	"	"				"	"	"	"	
2000				"	"	"	"				"	"	"				"	"	"	"	
1				"	"	"	"				"	"	"				"	"	"	"	
2				"	"	"	"				"	"	"				"	"	"	"	
3				"	"	"	"				"	"	"				"	"	"	"	
4				"	"	"	"				"	"	"				"	"	"	"	
5				"	"	"	"				"	"	"				"	"	"	"	
6				"	"	"	"				"	"	"				"	"	"	"	
Total							3,976						5,116						1,294	6,410	

Notes: 1. Annual Water Demand is calculated on the basis of 365 days in a year.

Table 6.3.2 Estimate of Annual Quantity of Water Consumption in Mainland

Year	Hotel: of which Total Rooms	(A) Target Rooms	(B) Unit Demand (m³/r.d)	(AxB) Water Demand (m³/d)	(C) Annual Water Demand (10³m³/y)	(D) Room Occupancy (%)	(E) Receivable Ratio (%)	(CxDxE) Net Water Demand (10³m³/y)	Others – Resident: of which Total Population	(F) Target Population	(G) Unit Demand (ℓ/h.d)	(FxG) Water Demand (m³/d)	(H) Annual Water Demand (10³m³/y)	(I) Receivable Ratio (%)	(HxI) (J) Net Water Demand (10³m³/y)
1977	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81	3,520	2,089	2.9	6,058	2,211	80	80	1,415	48,440	39,021	210	8,200	2,993	80	2,394
82					2,492	80	80	1,595					3,152	80	2,522
83					2,808	80	80	1,797					3,320	80	2,656
84					3,165	80	80	2,026					3,496	80	2,797
85					3,567	80	80	2,283					3,681	80	2,945
					1981-86 12.7								1981-86 5.3		
86	4,050	3,800	2.9	11,030	4,026	80	80	2,577	58,100	48,321	220	10,630	3,880	80	3,104
87					4,461	80	80	2,855					4,121	80	3,297
88					4,943	80	80	3,164					4,377	80	3,502
89					5,477	80	80	3,505					4,648	80	3,718
90					6,069	80	80	3,884					4,936	80	3,949
					1986-91 10.8								1986-91 6.2		
91	6,350	6,350	2.9	18,420	6,723	80	80	4,303	69,150	62,378	230	14,350	5,238	80	4,190
92					7,120	80	80	4,557					5,458	80	4,366
93					7,540	80	80	4,826					5,687	80	4,550
94					7,985	80	80	5,110					5,926	80	4,741
95					8,456	80	80	5,412					6,175	80	4,940
					1991-96 5.9								1991-96 4.2		
96	8,450	8,450	2.9	24,510	8,946	80	80	5,725	80,200	73,378	240	17,610	6,428	80	5,142
97					"	"	"	"					"	"	"
98					"	"	"	"					"	"	"
99					"	"	"	"					"	"	"
2000					"	"	"	"					"	"	"
1					"	"	"	"					"	"	"
2					"	"	"	"					"	"	"
3					"	"	"	"					"	"	"
4					"	"	"	"					"	"	"
5					"	"	"	"					"	"	"
6					"	"	"	"					"	"	"
Total								112,284							110,233

Year	Others – One day Tripper: (K) No. of Tripper	(L) Unit Demand (ℓ/h.d)	(KxL) Water Demand (m³/d)	(M) Annual Water Demand (10³m³/y)	(N) Receivable ratio (%)	(NxB) (O) Net Water Demand (10³m³/y)	Villa: (P) No. of House	(Q) Unit Demand (m³/h.d)	(PxQ) Water Demand (m³/d)	(R) Annual Water Demand (10³m³/y)	(S) Receivable Ratio (%)	(RxS) (T) Net Water Demand (10³m³/y)	Industry: Water Demand (m³/d)	(U) Annual Water Demand (10³m³/y)	(V) Receivable Ratio (%)	(UxV) (W) Net Water Demand (10³m³/y)	(J+O+T+W) Total Net Water Demand (10³m³/y)
1977	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81	5,500	70	390	142	80	114	-	-	-	-	-	-	5,000	1,825	80	1,460	3,968
82				151	80	121	-	-	-	-	-	-		1,825	80	1,460	4,103
83				161	80	129	-	-	-	-	-	-		1,825	80	1,460	4,245
84				171	80	137	-	-	-	-	-	-		1,825	80	1,460	4,394
85				182	80	146	-	-	-	-	-	-		1,825	80	1,460	4,551
				1981-86 6.3													
86	7,500	70	530	193	80	154	370	2.9	1,080	394	50	197	5,000	1,825	80	1,460	4,915
87				204	80	163				452	50	226		1,825	80	1,460	5,146
88				216	80	173				519	50	260		1,825	80	1,460	5,395
89				229	80	183				596	50	298		1,825	80	1,460	5,659
90				242	80	194				684	50	342		1,825	80	1,460	5,945
				1986-91 5.8													
91	10,000	70	700	256	80	205	740	2.9	2,150	785	50	393	5,000	1,825	80	1,460	6,248
92				265	80	212				851	50	426		1,825	80	1,460	6,464
93				275	80	220				922	50	461		1,825	80	1,460	6,691
94				285	80	228				999	50	500		1,825	80	1,460	6,929
95				296	80	237				1,083	50	542		1,825	80	1,460	7,179
				1991-96 3.7													
96	12,000	70	840	307	80	246	1,110	2.9	3,220	1,175	50	588	5,000	1,825	80	1,460	7,436
97				"	"	"				"	"	"		"	"	"	"
98				"	"	"				"	"	"		"	"	"	"
99				"	"	"				"	"	"		"	"	"	"
2000				"	"	"				"	"	"		"	"	"	"
1				"	"	"				"	"	"		"	"	"	"
2				"	"	"				"	"	"		"	"	"	"
3				"	"	"				"	"	"		"	"	"	"
4				"	"	"				"	"	"		"	"	"	"
5				"	"	"				"	"	"		"	"	"	"
6				"	"	"				"	"	"		"	"	"	"
Total						5,322						10,113				37,960	163,628

Note: 1. Annual Water Demand is calculated on the basis of 365 days in a year.

2. Target rooms of Hotel in 1981 are calculated based on required rooms in 1981, i.e. $2,300 \times \frac{3,270}{3,600} = 2,089$ rooms

3. The added figures in the column of Annual Water Demand show the average annual increase rate (%).

Table 6.3.4 Estimate of Revenue from Water Consumption in Mainland & Ko Lan Island

(Thousands Baht)

Year	Case I (Hotel 5 Baht/m³, Others 2 Baht/m³)							Case II (Hotel 7 Baht/m³, Others 2 Baht/m³)							Case III (Hotel 10 Baht/m³, Others 2 Baht/m³)							Case IV (Hotel 13 Baht/m³, Others 2 Baht/m³)						
	Mainland			Ko Lan Island			(A+B) Total	Mainland			Ko Lan Island			(C+D) Total	Mainland			Ko Lan Island			(E+F) Total	Mainland			Ko Lan Island			(G+H) Total
	Hotel	Others	(A) Sub-Total	Hotel	Others	(B) Sub-Total		Hotel	Others	(C) Sub-Total	Hotel	Others	(D) Sub-Total		Hotel	Others	(E) Sub-Total	Hotel	Others	(F) Sub-Total		Hotel	Others	(G) Sub-Total	Hotel	Others	(H) Sub-Total	
1977	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81	7,075	7,936	15,011	270	805	1,075	16,086	9,905		17,841	378		1,183	19,024	14,150		22,086	340		1,345	23,431	18,395		26,331	702		1,507	27,838
82	7,975	8,206	16,181	340	860	1,200	17,381	11,165		19,371	476		1,336	20,707	15,950		24,156	680		1,540	25,696	20,735		28,941	884		1,744	30,685
83	8,985	8,490	17,475	425	910	1,335	18,810	12,579		21,069	595		1,505	22,574	17,970		26,460	850		1,760	28,220	23,361		31,851	1,105		2,015	33,866
84	10,130	8,788	18,918	535	975	1,510	20,428	14,182		22,970	749		1,724	24,694	20,260		29,048	1,070		2,045	31,093	26,338		35,126	1,391		2,366	37,492
85	11,415	9,102	20,517	670	1,035	1,705	22,222	15,981		25,083	933		1,973	27,056	22,830		31,932	1,340		2,375	34,307	29,679		38,781	1,742		2,777	41,558
86	12,885	9,830	22,715	840	1,110	1,950	24,665	18,039		27,869	1,176		2,286	30,155	25,770		35,600	1,680		2,790	38,390	33,501		43,331	2,184		3,294	46,625
87	14,275	10,292	24,567	840	1,130	1,970	26,537	19,985		30,277	1,176		2,306	32,583	28,550		38,842	1,680		2,810	41,652	37,115		47,407	2,184		3,314	50,721
88	15,820	10,790	26,610	840	1,155	1,995	28,605	22,148		32,938	1,176		2,331	35,269	31,640		42,430	1,680		2,835	45,265	41,132		51,922	2,184		3,339	55,261
89	17,525	11,318	28,843	840	1,180	2,020	30,863	24,535		35,853	1,176		2,356	38,209	35,050		46,368	1,680		2,860	49,228	45,565		56,883	2,184		3,364	60,247
90	19,420	11,890	31,310	840	1,205	2,045	33,355	27,188		39,078	1,176		2,381	41,459	38,840		50,730	1,680		2,885	53,615	50,492		62,382	2,184		3,389	65,771
91	21,515	12,496	34,011	840	1,235	2,075	36,086	30,121		42,617	1,176		2,411	45,028	43,030		55,526	1,680		2,915	58,441	55,939		68,435	2,184		3,419	71,854
92	22,785	12,928	35,713	840	1,260	2,100	37,813	31,899		44,827	1,176		2,436	47,263	45,570		58,498	1,680		2,940	61,438	59,241		72,169	2,184		3,444	75,613
93	24,130	13,382	37,512	840	1,290	2,130	39,642	33,782		47,164	1,176		2,466	49,630	48,260		61,642	1,680		2,970	64,612	62,738		76,120	2,184		3,474	79,594
94	25,550	13,858	39,408	840	1,320	2,160	41,568	35,770		49,628	1,176		2,496	52,124	51,100		64,958	1,680		3,000	67,958	66,430		80,288	2,184		3,504	83,792
95	27,060	14,358	41,418	840	1,345	2,185	43,603	37,884		52,242	1,176		2,521	54,763	54,120		68,478	1,680		3,025	71,503	70,356		84,714	2,184		3,529	88,243
96	28,625	14,872	43,497	840	1,385	2,225	45,722	40,075		54,947	1,176		2,561	57,508	57,250		72,122	1,680		3,065	75,187	74,425		89,297	2,184		3,569	92,866
97	28,625	14,872	43,497	840	1,385	2,225	45,722	40,075		54,947	1,176		2,561	57,508	57,250		72,122	1,680		3,065	75,187	74,425		89,297	2,184		3,569	92,866
98	28,625	14,872	43,497	840	1,385	2,225	45,722	40,075		54,947	1,176		2,561	57,508	57,250		72,122	1,680		3,065	75,187	74,425		89,297	2,184		3,569	92,866
99	28,625	14,872	43,497	840	1,385	2,225	45,722	40,075		54,947	1,176		2,561	57,508	57,250		72,122	1,680		3,065	75,187	74,425		89,297	2,184		3,569	92,866
2000	28,625	14,872	43,497	840	1,385	2,225	45,722	40,075		54,947	1,176		2,561	57,508	57,250		72,122	1,680		3,065	75,187	74,425		89,297	2,184		3,569	92,866
1	28,625	14,872	43,497	840	1,385	2,225	45,722	40,075		54,947	1,176		2,561	57,508	57,250		72,122	1,680		3,065	75,187	74,425		89,297	2,184		3,569	92,866
2	28,625	14,872	43,497	840	1,385	2,225	45,722	40,075		54,947	1,176		2,561	57,508	57,250		72,122	1,680		3,065	75,187	74,425		89,297	2,184		3,569	92,866
3	28,625	14,872	43,497	840	1,385	2,225	45,722	40,075		54,947	1,176		2,561	57,508	57,250		72,122	1,680		3,065	75,187	74,425		89,297	2,184		3,569	92,866
4	28,625	14,872	43,497	840	1,385	2,225	45,722	40,075		54,947	1,176		2,561	57,508	57,250		72,122	1,680		3,065	75,187	74,425		89,297	2,184		3,569	92,866
5	28,625	14,872	43,497	840	1,385	2,225	45,722	40,075		54,947	1,176		2,561	57,508	57,250		72,122	1,680		3,065	75,187	74,425		89,297	2,184		3,569	92,866
6	28,625	14,872	43,497	840	1,385	2,225	45,722	40,075		54,947	1,176		2,561	57,508	57,250		72,122	1,680		3,065	75,187	74,425		89,297	2,184		3,569	92,866
Total	561,420	327,256	888,676	19,880	32,050	51,930	940,606	785,988	327,256	1,113,244	27,832	32,050	59,882	1,173,126	1,122,840	327,256	1,450,096	39,760	32,050	71,810	1,521,906	1,459,692	327,256	1,786,948	51,688	32,050	83,738	1,870,686

(the same as Case I)

Table 6.3.5 Financial Rate of Return of Water Supply System in Mainland

(5 baht/m^3 for hotels) (Millions of Baht)

(Case I)

Year	Investment Cost	Revenue	Discount Rate 1%			Discount Rate 4%		
			Discount Factor	Discounted Investment Cost	Discounted Revenue	Discount Factor	Discounted Investment Cost	Discounted Revenue
1977	-	-	.9901	-	-	.9615	-	-
78	41.6	-	.9803	40.8	-	.9246	38.5	-
79	110.2	-	.9706	107.0	-	.8890	98.0	-
80	114.0	-	.9610	109.6	-	.8548	97.4	-
81	60.6	15.0	.9515	57.7	14.3	.8219	49.8	12.3
82	7.8	16.2	.9420	7.3	15.3	.7903	6.2	12.8
83	8.0	17.5	.9327	7.5	16.3	.7599	6.1	13.3
84	8.3	18.9	.9235	7.7	17.5	.7307	6.1	13.8
85	31.6	20.5	.9143	28.9	18.7	.7026	22.2	14.4
86	31.7	22.7	.9053	28.7	20.6	.6756	21.4	15.3
87	16.8	24.6	.8963	15.1	22.0	.6496	10.9	16.0
88	17.2	26.6	.8874	15.3	23.6	.6246	10.7	16.6
89	17.6	28.8	.8787	15.5	25.3	.6006	10.6	17.3
90	18.0	31.3	.8700	15.7	27.2	.5775	10.4	18.1
91	18.4	34.0	.8613	15.8	29.3	.5553	10.2	18.9
92	18.8	35.7	.8528	16.0	30.4	.5339	10.0	19.1
93	19.1	37.5	.8444	16.1	31.7	.5134	9.8	19.3
94	19.4	39.4	.8360	16.2	32.9	.4936	9.6	19.4
95	20.2	41.4	.8277	16.7	34.3	.4746	9.6	19.6
96	20.8	43.5	.8195	17.0	35.6	.4564	9.5	19.9
97	10.2	43.5	.8114	8.3	35.3	.4388	4.5	19.1
98	10.2	43.5	.8034	8.2	34.9	.4220	4.3	18.4
99	10.2	43.5	.7954	8.1	34.6	.4057	4.1	17.6
2000	10.2	43.5	.7876	8.0	34.3	.3901	4.0	17.0
1	10.2	43.5	.7798	8.0	33.9	.3751	3.8	16.3
2	10.2	43.5	.7720	7.9	33.6	.3607	3.7	15.7
3	10.2	43.5	.7644	7.8	33.3	.3468	3.5	15.1
4	10.2	43.5	.7568	7.7	32.9	.3335	3.4	14.5
5	10.2	43.5	.7493	7.6	32.6	.3206	3.3	13.9
6	10.2	43.5	.7419	7.6	32.3	.3083	3.1	13.4
Total	702.1	888.7		633.8	732.7		484.7	427.1

Financial Rate of Return = 3%

Table 6.3.6 Financial Rate of Return of Water Supply System in Mainland

(7 baht/m^3 for hotels) (Millions of Baht)

(Case II)

Year	Investment Cost	Revenue	Discount Rate 4%			Discount Rate 7%		
			Discount Factor	Discounted Investment Cost	Discounted Revenue	Discount Factor	Discounted Investment Cost	Discounted Revenue
1977	-	-	.9615	-	-	.9346	-	-
78	41.6	-	.9246	38.5	-	.8734	36.3	-
79	110.2	-	.8890	98.0	-	.8163	90.0	-
80	114.0	-	.8548	97.4	-	.7629	87.0	-
81	60.6	17.8	.8219	49.8	14.6	.7130	43.2	12.7
82	7.8	19.4	.7903	6.2	15.3	.6663	5.2	12.9
83	8.0	21.1	.7599	6.1	16.0	.6227	5.0	13.1
84	8.3	23.0	.73o7	6.1	16.8	.5820	4.8	13.4
85	31.6	25.1	.7026	22.2	17.6	.5439	17.2	13.7
86	31.7	27.9	.6756	21.4	18.8	.5083	16.1	14.2
87	16.8	30.3	.6496	10.9	19.7	.4751	8.0	14.4
88	17.2	32.9	.6246	10.7	20.5	.4440	7.6	14.6
89	17.6	35.9	.6006	10.6	21.6	.4150	7.3	14.9
90	18.0	39.1	.5775	10.4	22.6	.3878	7.0	15.2
91	18.4	42.6	.5553	10.2	23.7	.3624	6.7	15.4
92	18.8	44.8	.5339	10.0	23.9	.3387	6.4	15.2
93	19.1	47.2	.5134	9.8	24.2	.3166	6.0	14.9
94	19.4	49.6	.4936	9.6	24.5	.2959	5.7	14.7
95	20.2	52.2	.4746	9.6	24.8	.2765	5.6	14.4
96	20.8	54.9	.4564	9.5	25.1	.2584	5.4	14.2
97	10.2	54.9	.4388	4.5	24.1	.2415	2.5	13.3
98	10.2	54.9	.4220	4.3	23.2	.2257	2.3	12.4
99	10.2	54.9	.4057	4.1	22.3	.2109	2.2	11.6
2000	10.2	54.9	.3901	4.0	21.4	.1971	2.0	10.8
1	10.2	54.9	.3751	3.8	20.6	.1842	1.9	10.1
2	10.2	54.9	.3607	3.7	19.8	.1722	1.8	9.5
3	10.2	54.9	.3468	3.5	19.0	.1609	1.6	8.8
4	10.2	54.9	.3335	3.4	18.3	.1504	1.5	8.3
5	10.2	54.9	.3206	3.3	17.6	.1406	1.4	7.7
6	10.2	54.9	.3083	3.1	16.9	.1314	1.3	7.2
Total	702.1	1,113.2		484.7	532.9		389.0	327.6

Financial Rate of Return = 5%

Table 6.3.7 Financial Rate of Return of Water Supply System in Mainland (Case III)
(10 baht/m^3 for hotels) (Millions Baht)

Year	Investment Cost	Revenue	Discount Rate 7%			Discount Rate 9%		
			Discount Factor	Discounted Investment Cost	Discounted revenue	Discount Factor	Discounted investment Cost	Discounted revenue
1977	-	-	.9346	-	-	.9174	-	-
78	41.6	-	.8734	36.3	-	.8417	35.0	-
79	110.2	-	.8163	90.0	-	.7722	85.1	-
80	114.0	-	.7629	87.0	-	.7084	80.8	-
81	60.6	22.1	.7130	43.2	15.8	.6499	39.4	14.4
82	7.8	24.2	.6663	5.2	16.1	.5963	4.7	14.4
83	8.0	26.5	.6227	5.0	16.5	.5470	4.4	14.5
84	8.3	29.0	.5820	4.8	16.9	.5019	4.2	14.6
85	31.6	31.9	.5439	17.2	17.4	.4604	14.5	14.7
86	31.7	35.6	.5083	16.1	18.1	.4224	13.4	15.0
87	16.8	38.8	.4751	8.0	18.4	.3875	6.5	15.0
88	17.2	42.4	.4440	7.6	18.8	.3555	6.1	15.1
89	17.6	46.4	.4150	7.3	19.3	.3262	5.7	15.1
90	18.0	50.7	.3878	7.0	19.7	.2992	5.4	15.2
91	18.4	55.5	.3624	6.7	20.1	.2745	5.1	15.2
92	18.8	58.5	.3387	6.4	19.8	.2519	4.7	14.7
93	19.1	61.6	.3166	6.0	19.5	.2311	4.4	14.2
94	19.4	65.0	.2959	5.7	19.2	.2120	4.1	13.8
95	20.2	68.5	.2765	5.6	18.9	.1945	3.9	13.3
96	20.8	72.1	.2584	5.4	18.6	.1784	3.7	12.9
97	10.2	72.1	.2415	2.5	17.4	.1637	1.7	11.8
98	10.2	72.1	.2257	2.3	16.3	.1502	1.5	10.8
99	10.2	72.1	.2109	2.2	15.2	.1378	1.4	9.9
2000	10.2	72.1	.1971	2.0	14.2	.1264	1.3	9.1
1	10.2	72.1	.1842	1.9	13.3	.1160	1.2	8.4
2	10.2	72.1	.1722	1.8	12.4	.1064	1.1	7.7
3	10.2	72.1	.1609	1.6	11.6	.0976	1.0	7.0
4	10.2	72.1	.1504	1.5	10.8	.0895	0.9	6.5
5	10.2	72.1	.1406	1.4	10.1	.0822	0.8	5.9
6	10.2	72.1	.1314	1.3	9.5	.0754	0.8	5.4
Total	702.1	1450.1		389.0	423.9		342.8	314.6

Financial Rate of Return = 8%

Table 6.3.8 Financial Rate of Return of Water Supply System in Mainland (Case IV) (13 baht/m^3 for hotels)

(Million Baht)

Year	Investment Cost	Revenue	Discount Rate 9%			Discount Rate 13%		
			Discount Factor	Discounted Investment Cost	Discounted Revenue	Discount Factor	Discounted Investment Cost	Discounted Revenue
1977	-	-	.9174	-	-	.8850	-	-
78	41.6	-	.8417	35.0	-	.7831	32.6	-
79	110.2	-	.7722	85.1	-	.6930	76.4	-
80	114.0	-	.7084	80.8	-	.6133	69.9	-
81	60.6	26.3	.6499	39.4	17.1	.5428	32.9	14.3
82	7.8	28.9	.5963	4.7	17.2	.4803	3.7	13.9
83	8.0	31.9	.5470	4.4	17.4	.4251	3.4	13.6
84	8.3	35.1	.5019	4.2	17.6	.3762	3.1	13.2
85	31.6	38.8	.4604	14.5	17.9	.3329	10.5	12.9
86	31.7	43.3	.4224	13.4	18.3	.2946	9.3	12.8
87	16.8	47.4	.3875	6.5	18.4	.2607	4.4	12.4
88	17.2	51.9	.3555	6.1	18.5	.2307	4.0	12.0
89	17.6	56.9	.3262	5.7	18.6	.2042	3.6	11.6
90	18.0	62.4	.2992	5.4	18.7	.1807	3.3	11.3
91	18.4	68.4	.2745	5.1	18.8	.1599	2.9	10.9
92	18.8	72.2	.2519	4.7	18.2	.1415	2.7	10.2
93	19.1	76.1	.2311	4.4	17.6	.1252	2.4	9.5
94	19.4	80.3	.2120	4.1	17.0	.1108	2.1	8.9
95	20.2	84.7	.1945	3.9	16.5	.0981	2.0	8.3
96	20.8	89.3	.1784	3.7	15.9	.0868	1.8	7.8
97	10.2	89.3	.1637	1.7	14.6	.0768	0.8	6.9
98	10.2	89.3	.1502	1.5	13.4	.0680	0.7	6.1
99	10.2	89.3	.1378	1.4	12.3	.0601	0.6	5.4
2000	10.2	89.3	.1264	1.3	11.3	.0532	0.5	4.8
1	10.2	89.3	.1160	1.2	10.4	.0471	0.5	4.2
2	10.2	89.3	.1064	1.1	9.5	.0417	0.4	3.7
3	10.2	89.3	.0976	1.0	8.7	.0369	0.4	3.3
4	10.2	89.3	.0895	0.9	8.0	.0326	0.3	2.9
5	10.2	89.3	.0822	0.8	7.3	.0289	0.3	2.6
6	10.2	89.3	.0754	0.8	6.7	.0256	0.3	2.3
Total	702.1	1,786.9		342.8	385.9		275.8	225.8

Financial Rate of Return = 11%

summarized as follows:

i) At 5 baht/m^3 for hotel consumption.
Financial Rate of Return = 3%

ii) At 7 baht/m^3 for hotel consumption, FRR = 5%

iii) At 10 baht/m^3 for hotel consumption, FRR = 8%

iv) At 13 baht/m^3 for hotel consumption, FRR = 11%

It is seen that the financial rate of return is very low if the unit rates of water charge are set at 5 baht or 7 baht/m^3 for hotel consumption of the water supply. At a rate of 10 baht/m^3, the financial rate of return is a more comfortable 8%.

From the above analysis, it is concluded that the water supply project is financial viable if the minimum unit charge of water consumption is set at 2 baht/m^3 for residential consumption and more than 10 baht/m^3 for hotel consumption.

It is noted that the consumption for restaurants and other commercial facilities are included in that for residents, so that if, in actual practice, the same rate as that for hotels is made applicable to all commercial facilities, the financial rate of return will greatly improve.

6.3.3 Both water supply and sewerage system

(a) Costs

The cost stream will include the costs for both the water supply project and the sewerage system project. The total costs of these two projects by year are summarized in Table 6.3.1 previously presented.

(b) Revenue

The same revenues for water supply project (Table 6.3.4) is applicable. However, since the cost stream will greatly increase, only the cases of 10 baht and 13 baht/m^3 are calculated.

(c) Financial evaluation

The calculations are shown in Tables 6.3.9 and 6.3.10 and the results are summarized as follows:

i) At an unit rate of 10 baht/m^3 for hotel consumption of water, Financial Rate of Return = 2.8%

ii) At an unit rate of 13 baht/m^3, FRR = 6%

In both cases, the financial rate of returns inevitably become very low, and financial subsidy from the government will be necessary to bring the financial rate of return to an acceptable level.

Table 6.3.9 Financial Rate of Return of Water Supply System & Sewerage System in Mainland (Case III) (Millions Baht)

Year	Investment Cost	Revenue	Discount Rate 2%			Discount Rate 3%		
			Discount Factor	Discounted Investment Cost	Discounted Revenue	Discount Factor	Discounted Investment Cost	Discounted Revenue
1977	-	-	.9804	-	-	.9709	-	-
78	50.6	-	.9612	48.6	-	.9426	47.7	-
79	173.6	-	.9423	163.6	-	.9151	158.9	-
80	172.4	-	.9238	159.3	-	.8885	153.2	-
81	91.8	22.1	.9057	83.1	20.0	.8626	79.2	19.1
82	13.4	24.2	.8880	11.9	21.5	.8375	11.2	20.3
83	13.7	26.5	.8706	11.9	23.1	.8131	11.1	21.5
84	14.1	29.0	.8535	12.0	24.8	.7894	11.1	22.9
85	60.8	31.9	.8368	50.9	26.7	.7664	46.6	24.4
86	55.1	35.6	.8203	45.2	29.2	.7441	41.0	26.5
87	29.1	38.8	.8043	23.4	31.2	.7224	21.0	28.0
88	29.6	42.4	.7885	23.3	33.4	.7014	20.8	29.7
89	30.1	46.4	.7730	23.3	35.9	.6810	20.5	31.6
90	30.7	50.7	.7579	23.3	38.4	.6611	20.3	33.5
91	31.4	55.5	.7430	23.3	41.2	.6419	20.2	35.6
92	32.1	58.5	.7284	23.4	42.6	.6232	20.0	36.5
93	32.7	61.6	.7142	23.4	44.0	.6050	19.8	37.3
94	33.4	65.0	.7002	23.4	45.5	.5874	19.6	38.2
95	34.5	68.5	.6864	23.7	47.0	.5703	19.7	39.1
96	35.5	72.1	.6730	23.9	48.5	.5537	19.7	39.9
97	16.8	72.1	.6598	11.1	47.6	.5375	9.0	38.8
98	16.8	72.1	.6468	10.9	46.6	.5219	8.8	37.6
99	16.8	72.1	.6342	10.7	45.7	.5067	8.5	36.5
2000	16.8	72.1	.6217	10.4	44.8	.4919	8.3	35.5
1	16.8	72.1	.6095	10.2	43.9	.4776	8.0	34.4
2	16.8	72.1	.5976	10.0	43.1	.4637	7.8	33.4
3	16.8	72.1	.5859	9.8	42.2	.4502	7.6	32.5
4	16.8	72.1	.5744	9.6	41.4	.4371	7.3	31.5
5	16.8	72.1	.5631	9.5	40.6	.4243	7.1	30.6
6	16.8	72.1	.5521	9.3	39.8	.4120	6.9	29.7
Total	1,132.6	1,450.1		922.4	988.7		840.9	824.6

Financial Rate of Return = 2.8% (10 baht/m^3 for hotels)

Table 6.3.10 Financial Rate of Return of Water Supply System and Sewerage System in Mainland (Case IV)

(Millions of Baht)

Year	Investment Cost	Revenue	Discount Rate 3%			Discount Rate 7		
			Discount Factor	Discounted Investment Cost	Discounted Revenue	Discount Factor	Discounted Investment Cost	Discounted Revenue
1977	-	-	.9709	-	-	.9346	-	-
78	50.6	-	.9426	47.7	-	.8734	44.2	-
79	173.6	-	.9151	158.9	-	.8163	141.7	-
80	172.4	-	.8885	153.2	-	.7629	131.5	-
81	91.8	26.3	.8626	79.2	22.7	.7130	65.5	18.8
82	13.4	28.9	.8375	11.2	24.2	.6663	8.9	19.3
83	13.7	31.9	.8131	11.1	25.9	.6227	8.5	19.9
84	14.1	35.1	.7894	11.1	27.7	.5820	8.2	20.4
85	60.8	38.8	.7664	46.6	29.7	.5439	33.1	21.1
86	55.1	43.3	.7441	41.0	32.2	.5083	28.0	22.0
87	29.1	47.4	.7224	21.0	34.2	.4751	13.8	22.5
88	29.6	51.9	.7014	20.8	36.4	.4440	13.1	23.0
89	30.1	56.9	.6810	20.5	38.7	.4150	12.5	23.6
90	30.7	62.4	.6611	20.3	41.3	.3878	11.9	24.2
91	31.4	68.4	.6419	20.2	43.9	.3624	11.4	24.8
92	32.1	72.2	.6232	20.0	45.0	.3387	10.9	24.5
93	32.7	76.1	.6050	19.8	46.0	.3166	10.4	24.1
94	33.4	80.3	.5874	19.6	47.2	.2959	9.9	23.8
95	34.5	84.7	.5703	19.7	48.3	.2765	9.5	23.4
96	35.5	89.3	.5537	19.7	49.4	.2584	9.2	23.1
97	16.8	89.3	.5375	9.0	48.0	.2415	4.1	21.6
98	16.8	89.3	.5219	8.8	46.6	.2257	3.8	20.2
99	16.8	89.3	.5067	8.5	45.2	.2109	3.5	18.8
2000	16.8	89.3	.4919	8.3	43.9	.1971	3.3	17.6
1	16.8	89.3	.4776	8.0	42.6	.1842	3.1	16.4
2	16.8	89.3	.4637	7.8	41.4	.1722	2.9	15.4
3	16.8	89.3	.4502	7.6	40.2	.1609	2.7	14.4
4	16.8	89.3	.4371	7.3	39.0	.1504	2.5	13.4
5	16.8	89.3	.4243	7.1	37.9	.1406	2.4	12.6
6	16.8	89.3	.4120	6.9	36.8	.1314	2.2	11.7
Total	1,132.6	1,786.9		840.9	1,014.4		612.7	520.6

(13 baht/m^3 for hotels)

Financial Rate of Return = 6%

It is estimated that if the unit rate for hotels is maintained at 10 baht/m^3, a subsidy by the government to the amount of a about 90% of the annual revenue receipt will be necessary to obtain a financial rate of return of 10%. This subsidy is easily recoverable from the increase in tax receipt through the implementation of the development.

6.3.4 Projects undertaken by Pattaya Tourism Development Corporation

(a) Costs

In this analysis, the projects included for calculation are the infrastructure projects and the public sector investment Group I projects which are non-self-sustaining. The self-sustaining Group II projects are excluded on the understanding that the implementation of these project will be carried out after receiving justification on the financial viability of each individual project.

Table 6.3.11 sums up the total costs for these projects broken down by year.

(b) Financial receipt

Since the projects covered in this category include also all public projects for which a financial return cannot be expected, the financial receipt will include both the revenue receipts of all revenue generating projects and the increase tax receipts either of the national or the local government which are the results of the implementation of the development. The following are the items included.

a. Revenue receipt

i) The revenue receipt for water consumption.

This will be calculated for the case that the unit rate of water charge is 10 baht/m^3 for hotel consumption.

ii) The revenue receipt for electric power consumption.

This is calculated assuming the existing unit rate of charge for power consumption.

iii) The revenue receipt for telecommunication system usage.

Due to the complicated usuage of the telecommunication system, the revenue is calculated based on the following conservative assumptions:

* The rate per city call = 0.5 baht
* The rate per outstation call to any part of Thailand = 10 baht
* International call and Telex usage charge are not enumerated.

Table 6.3.11 Cost Estimate of Infrastructure & Other Public Investments in Mainland & Ko Lan Island

(Millions Baht)

Year	Mainland									Ko Lan Island									Grand Total								
	Infrastructure				Other Public Investments					Infrastructure				Other Public Investments					Infrastructure				Other Public Investments				
	Construction Cost	Land Cost	Operation & Maintenance Cost	Sub-Total	Construction Cost	Land Cost	Operation & Maintenance Cost	Sub-Total	Total	Construction Cost	Land Cost	Operation & Maintenance Cost	Sub-Total	Construction Cost	Land Cost	Operation & Maintenance Cost	Sub-Total	Total	Construction Cost	Land Cost	Operation & Maintenance Cost	Sub-Total	Construction Cost	Land Cost	Opera tion & Maintenance Cost	Sub-Total	Total
1977	-	-	-	-	13.1	16.4	0.8	30.3	30.3	-	-	-	-	2.8	-	0.2	3.0	3.0	-	-	-	-	15.9	16.4	1.0	33.3	33.3
78	148.7	68.8	2.3	219.8	13.1	16.4	1.6	31.1	250.9	-	-	-	-	4.5	0.5	0.6	5.6	5.6	148.7	68.8	2.3	219.8	17.6	16.9	2.2	36.7	256.5
79	301.2	63.4	3.6	368.2	13.0	16.3	2.4	31.7	399.9	-	0.4	-	0.4	3.5	-	0.9	4.4	4.8	301.2	63.8	3.6	368.6	16.5	16.3	3.3	36.1	404.7
80	336.5	16.7	10.0	363.2	17.9	23.5	3.5	44.9	408.1	53.3	-	3.0	56.3	1.0	-	1.1	2.1	58.4	389.8	16.7	13.0	419.5	18.9	23.5	4.6	47.0	466.5
81	207.6	-	7.7	215.3	17.6	23.3	4.6	45.5	260.8	-	-	7.9	7.9	1.0	-	1.3	2.3	10.2	207.6	-	15.6	223.2	18.6	23.3	5.9	47.8	271.0
82	44.5	-	20.5	65.0	19.5	16.4	6.5	40.4	105.4	-	-	8.5	8.5	1.2	0.1	1.4	2.7	11.2	44.5	-	29.0	73.5	20.7	14.5	7.9	43.1	116.6
83	27.8	-	25.6	53.4	19.3	14.3	8.0	41.6	95.0	-	-	9.2	9.2	2.2	0.3	1.6	4.1	13.3	27.8	-	34.8	62.6	21.5	14.6	9.6	45.7	108.3
84	27.5	-	23.5	51.0	17.2	11.7	9.3	38.2	89.2	-	-	9.9	9.9	1.1	-	1.7	2.8	12.7	27.5	-	33.4	60.9	18.3	11.7	11.0	41.0	101.9
85	123.1	121.6	25.5	270.2	19.9	16.1	10.8	46.8	317.0	2.8	-	16.6	19.4	0.7	-	1.8	2.5	21.9	125.9	121.6	42.1	289.6	20.6	16.1	12.6	49.3	338.9
86	122.6	-	30.2	152.8	19.7	16.0	12.2	47.9	200.7	-	-	11.2	11.2	1.1	-	1.9	3.0	14.2	122.6	-	41.4	164.0	20.8	16.0	14.1	50.9	214.9
87	60.1	-	28.7	88.8	22.6	12.8	13.9	49.3	138.1	-	-	11.4	11.4	0.4	-	2.0	2.4	13.8	60.1	-	40.1	100.2	23.0	12.8	15.9	51.7	151.9
88	58.6	-	31.2	89.8	20.5	12.2	15.4	48.1	137.9	-	-	11.4	11.4	0.4	-	2.0	2.4	13.8	58.6	-	42.6	101.2	20.9	12.2	17.4	50.5	151.7
89	54.8	-	36.1	90.9	18.0	12.2	16.7	46.9	137.8	-	-	11.4	11.4	0.4	-	2.0	2.4	13.8	54.8	-	47.5	102.3	18.4	12.2	18.7	49.3	151.6
90	54.8	-	34.2	89.0	18.0	12.2	17.9	48.1	137.1	-	-	11.4	11.4	0.4	-	2.1	2.5	13.9	54.8	-	45.6	100.4	18.4	12.2	20.0	50.6	151.0
91	54.7	-	37.0	91.7	15.5	10.7	19.1	45.3	137.0	-	-	11.5	11.5	0.3	-	2.1	2.4	13.9	54.7	-	48.5	103.2	15.8	10.7	21.2	47.7	150.9
92	44.5	-	41.7	86.2	11.7	1.0	20.1	32.8	119.0	-	-	11.5	11.5	1.2	0.1	2.1	3.4	14.9	44.5	-	53.2	97.7	12.9	1.1	22.2	36.2	133.9
93	44.3	-	39.7	84.0	11.7	1.0	21.2	33.9	117.9	-	-	11.5	11.5	0.3	-	2.2	2.5	14.0	44.3	-	51.2	95.5	12.0	1.0	23.4	36.4	131.9
94	44.2	-	42.3	86.5	11.7	1.0	22.2	34.9	121.4	-	-	11.5	11.5	0.3	-	2.2	2.5	14.0	44.2	-	53.8	98.0	12.0	1.0	24.4	37.4	135.4
95	44.2	-	47.3	91.5	11.7	1.0	23.3	36.0	127.5	-	-	11.5	11.5	0.3	-	2.3	2.6	14.1	44.2	-	58.8	103.0	12.0	1.0	25.6	38.6	141.6
96	44.1	-	45.8	89.9	11.6	1.0	24.3	36.9	126.8	-	-	11.5	11.5	0.3	-	2.4	2.7	14.2	44.1	-	57.3	101.4	11.9	1.0	26.7	39.6	141.0
97	-	-	45.8	45.8	-	-	24.3	24.3	70.1	-	-	11.5	11.5	-	-	2.4	2.4	13.9	-	-	57.3	57.3	-	-	26.7	26.7	84.0
98	-	-	45.8	45.8	-	-	24.3	24.3	70.1	-	-	11.5	11.5	-	-	2.4	2.4	13.9	-	-	57.3	57.3	-	-	26.7	26.7	84.0
99	-	-	45.8	45.8	-	-	24.3	24.3	70.1	-	-	11.5	11.5	-	-	2.4	2.4	13.9	-	-	57.3	57.3	-	-	26.7	26.7	84.0
2000	-	-	45.8	45.8	-	-	24.3	24.3	70.1	-	-	11.5	11.5	-	-	2.4	2.4	13.9	-	-	57.3	57.3	-	-	26.7	26.7	84.0
1	-	-	45.8	45.8	-	-	24.3	24.3	70.1	-	-	11.5	11.5	-	-	2.4	2.4	13.9	-	-	57.3	57.3	-	-	26.7	26.7	84.0
2	-	-	45.8	45.8	-	-	24.3	24.3	70.1	-	-	11.5	11.5	-	-	2.4	2.4	13.9	-	-	57.3	57.3	-	-	26.7	26.7	84.0
3	-	-	45.8	45.8	-	-	24.3	24.3	70.1	-	-	11.5	11.5	-	-	2.4	2.4	13.9	-	-	57.3	57.3	-	-	26.7	26.7	84.0
4	-	-	45.8	45.8	-	-	24.3	24.3	70.1	-	-	11.5	11.5	-	-	2.4	2.4	13.9	-	-	57.3	57.3	-	-	26.7	26.7	84.0
5	-	-	45.8	45.8	-	-	24.3	24.3	70.1	-	-	11.5	11.5	-	-	2.4	2.4	13.9	-	-	57.3	57.3	-	-	26.7	26.7	84.0
6	-	-	45.8	45.8	-	-	24.3	24.3	70.1	-	-	11.5	11.5	-	-	2.4	2.4	13.9	-	-	57.3	57.3	-	-	26.7	26.7	84.0
Total	1,843.8	270.5	990.9	3,105.2	323.3	233.5	496.8	1,053.6	4,158.8	56.1	0.4	295.9	352.4	23.4	1.0	57.9	82.3	434.7	1,899.9	270.9	1,286.8	3,457.6	346.7	234.5	554.7	1,135.9	4,593.5

b. Tax receipts

i) Business tax

The average tax rate for business tax is assumed at 65%.

ii) Corporate income tax

Computed according to the Revenue Code and applicable to hotels and other commercial establishments.

iii) Personnel income tax

Computed according to the Revenue Code and applicable to all personnel in the tourism industry.

iv) Import duty

This is an indirect item which covers the import duty for the foreign currency portion of the consumables and other imported materials and supplies necessary for the operation of all the facilities of the tourism industry.

It is assumed that since the tax receipt listed above are government revenues generated through the implementation of the development, the government may subsidize the development corporation to the extent not exceeding the tax receipt from the above items.

Table 6.3.12 shows the estimated increase in receipt by the tourism industry in Pattaya with the implementation of the masterplan.

Table 6.3.13 shows the structure of financial account assumed for the tourism industry of Pattaya.

From the above two, the tax receipt is calculated and summarized in Table 6.3.14.

The total financial receipts including both revenue receipt and tax receipts are summed up in Table 6.3.15.

(c) Financial analysis

Table 6.3.16 shows the calculation for the financial rate of return of the development corporation and it is seen that the financial rate of return comes to 9.1%.

It can be concluded that the investment in all the projects of the public sector proposed in the masterplan will be recovered from the revenue receipts and tax receipts generated from the development. With such a favorable financial viability, the establishment of the development corporation for the implementation of the tourism development of Pattaya is strongly recommended.

Table 6.3.12 Estimate of Increase in Receipts from Tourist through Development

Year	With Development (A)								Without (B)								Increase in Receipt (A - B)				
	Visitors (persons)			(nights) Average Length of Stay		Receipts (Millions Baht)			Visitors (persons)			(nights) Average Length of Stay		Receipts (Millions Baht)			Increase in Receipts (Millions Baht)				
	Foreign Tourists	Residents	Total	Foreign Tourists	Residents	Foreign Tourists	Residents	Total	Foreign Tourists	Residents	Total	Foreign Tourists	Residents	Foreign Tourists	Residents	Total	Foreign Tourists	Residents	Total	Inside hotel (60%)	Outside hotel (40%)
1977	233,020	200,580	433,600	1.7	1.3	293	136	429	210,000	190,000	400,000	1.7	1.3	264	128	392	29	8	37	23	14
78	258,412	211,610	470,022	1.7	1.3	325	143	468	"	"	"	"	"	"	"	"	61	15	76	46	30
79	286,414	223,090	509,504	1.8	1.4	382	162	544	"	"	"	"	"	"	"	"	118	34	152	92	60
80	317,290	235,012	522,302	1.9	1.5	446	183	629	"	"	"	"	"	"	"	"	182	55	237	143	94
81	352,000	248,000	600,000	2.0	1.6	521	206	727	"	"	"	"	"	"	"	"	257	78	335	202	133
82	377,720	257,680	635,400	2.2	1.6	615	214	829	"	"	"	"	"	"	"	"	351	86	437	263	174
83	405,170	267,719	672,889	2.4	1.6	720	223	943	"	"	"	"	"	"	"	"	456	95	551	331	220
84	434,640	277,949	712,589	2.6	1.7	836	246	1,082	"	"	"	"	"	"	"	"	572	118	690	415	275
85	466,110	288,522	754,632	2.8	1.7	966	255	1,221	"	"	"	"	"	"	"	"	702	127	829	498	331
86	500,000	300,000	800,000	3.0	1.7	1,110	265	1,375	"	"	"	"	"	"	"	"	846	137	983	590	393
87	516,300	320,500	836,800	3.2	1.7	1,223	283	1,506	"	"	"	"	"	"	"	"	959	155	1,114	669	445
88	533,010	342,283	875,293	3.4	1.8	1,341	320	1,661	"	"	"	"	"	"	"	"	1,077	192	1,269	762	507
89	550,120	365,436	915,556	3.6	1.8	1,466	342	1,808	"	"	"	"	"	"	"	"	1,202	214	1,416	850	566
90	567,630	390,042	957,672	3.8	1.8	1,596	365	1,961	"	"	"	"	"	"	"	"	1,332	237	1,569	942	627
91	588,000	412,000	1,000,000	4.0	1.85	1,740	396	2,136	"	"	"	"	"	"	"	"	1,476	268	1,744	1,047	697
92	601,730	435,270	1,037,000	4.1	1.9	1,826	430	2,256	"	"	"	"	"	"	"	"	1,562	302	1,864	1,119	745
93	615,650	459,719	1,075,369	4.2	1.9	1,913	454	2,367	"	"	"	"	"	"	"	"	1,649	326	1,975	1,186	789
94	629,760	485,398	1,115,158	4.3	1.9	2,004	480	2,484	"	"	"	"	"	"	"	"	1,740	352	2,092	1,256	836
95	644,040	512,379	1,156,419	4.4	1.9	2,097	506	2,603	"	"	"	"	"	"	"	"	1,833	378	2,211	1,327	884
96	660,000	540,000	1,200,000	4.5	2.0	2,198	562	2,760	"	"	"	"	"	"	"	"	1,934	434	2,368	1,421	947
97	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
98	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
99	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2000	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1	"	"	"	"	"	"	"	"	—	"	"	"	"	"	"	"	"	"	"	"	"
2	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
3	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
4	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
5	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Total	-	-	-	-	-	45,598	11,791	57,389	-	-	-	-	-	7,920	3,840	11,760	37,678	7,951	45,629	27,392	18,237

Table 6.3.13 Structure of Profit and Loss of Hotel Industry and Other Tourist Industry

Hotel Industry

(%)

Sales		100
of which	Room	45
	Food & beverage	45
	Other	10
Sales Cost (before depreciation)		30
Gross Profit on Sales (")		70
Operating Cost (")		35
of which	Personnel Expenses	20
Operating Profit (")		35
Net Non-Operating Cost (")		10
Net Profit (before depreciation before corporate tax)		25
Depreciation Expense		10
Net Profit (after depreciation before corporate tax)		15
Corporate Income Tax 1/		4
Net Profit (after depreciation after corporate tax)		11
Business Tax		6.5

Other Tourist Industry

(%)

Sales		100
Sales Cost (before depreciation)		30
Gross Profit on Sales (")		70
Operating Cost (")		40
of which	Personnel Expenses	20
Operating Profit (")		30
Net Non-Operating Cost (")		10
Net Profit (before depreciation before corporate tax)		20
Depreciation Expense		5
Net Profit (after depreciation before corporate tax)		15
Corporate Income Tax 2/		3
Net Profit (after depreciation after corporate tax)		12

Notes: 1. Based on the data from the World Bank, the Book club Finance and Securities Co., Ltd., Bangkok and Bang Lamung District Office.

2. 1/ Tax rate 25%
   2/ Tax rate 20%

Table 6.3.14 Analysis of Cash Flow Based on Increase in Receipts

(Millions of Baht)

Year	Hotel Industry										Other Tourist Industry							
	(A) Receipts	of which (B) Business Tax	(A-B) Sales (C)	(Cx35%) 1/ Operating Cost (D)	of which (Dx30%) Foreign	(Cx20%) Personnel Expenses(E)	(Ex10%) Personnel Income Tax	(Cx35%) 2/ Operating Profit	(Cx15%) 3/ Net Profit (F)	(Fx25%) Corporate Income Tax	Sales (G)	(Gx40%) 4/ Operating Cost (H)	of which (Hx20%) Foreign	(Gx20%) Personnel Expenses(I)	(Ix10%) Personnel Income Tax	(Gx40%)5/ Operating Profit	(Gx15%)6/ Net Profit (J)	(Jx20%) Corporate Income Tax
1977	23	1	22	8	2	4	0.4	8	1	-	14	6	1	3	0.3	4	1	0.3
78	44	2	43	15	5	9	0.9	15	6	-	30	12	2	6	0.6	9	5	1
79	92	6	86	30	9	17	2	30	13	-	60	24	5	12	1	18	6	2
80	143	9	134	47	14	27	3	47	20	-	94	38	8	19	2	28	14	4
81	202	12	190	67	20	38	4	67	29	-	133	53	11	27	3	40	20	4
82	263	16	247	86	26	49	5	86	37	9	174	70	14	35	4	52	26	6
83	331	20	311	109	33	62	6	109	47	12	220	88	18	44	4	66	33	7
84	415	25	390	137	41	78	8	137	59	15	275	110	22	55	6	83	41	8
85	498	30	468	164	49	94	9	164	70	18	331	132	26	66	7	99	50	10
86	590	36	554	194	58	111	11	194	83	21	393	157	31	79	8	118	59	12
87	669	41	628	220	66	126	13	220	94	24	445	178	36	89	9	134	67	13
88	762	47	715	250	75	143	14	250	107	27	507	203	41	101	10	152	76	15
89	850	52	798	279	84	160	16	279	120	30	566	226	45	113	11	170	85	17
90	942	57	885	310	93	177	18	310	133	33	627	251	50	125	13	188	94	19
91	1,047	64	983	344	103	197	20	344	147	37	697	279	56	139	14	209	105	21
92	1,219	68	1,051	368	110	210	21	368	158	40	745	298	60	149	15	224	112	22
93	1,186	72	1,114	390	117	223	22	390	167	42	789	316	63	158	16	237	118	24
94	1,256	77	1,179	413	124	236	24	413	177	44	836	334	67	167	17	251	125	25
95	1,327	81	1,246	436	131	249	25	436	187	47	884	354	71	177	18	265	133	27
96	1,421	87	1,334	467	140	267	27	467	200	50	947	379	76	189	19	284	142	28
97	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
98	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
99	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2000	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
3	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
4	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
5	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Total	27,392	1,674	25,718	9,004	2,700	5,147	519	9,004	3,857	949	18,237	7,298	1,463	3,643	368	5,471	2,736	543

Notes: 1/ Before the depreciation expense.
2/ Before the depreciation expense.
3/ After the depreciation expense, and before the corporate income tax.
4/ Before the depreciation expense.
5/ Before the depreciation expense.
6/ After the depreciation expense, and before the corporate income tax.

(Millions Baht)

Year	Revenue Receipts				Tax Receipts							Total Receipt (A)+(B)
	Water	Electricity	Telecom	Total (A)	Business Tax of Hotel	Corporate Income Tax of Hotel	Corporate Income Tax of Others	Personal Income Tax of Hotel	Personal Income Tax of Others	Import Duty	Total (B)	
1977	-	-	-		1	-	0.4	0.4	0.3	1	3	3.0
78	-	-	-		3	-	1	0.9	0.6	2	7	7.0
79	-	-	-		6	-	2	2	1	5	16	16.0
80	-	-	-		9	-	3	3	2	7	24	24.0
81	23.4	16.8	9.7	49.9	12	-	4	4	3	10	33	82.9
82	25.7	21.4	10.6	57.7	16	9	5	5	4	13	52	109.7
83	28.2	25.9	11.5	65.6	20	12	7	6	4	17	66	131.6
84	31.1	30.5	12.3	73.9	25	15	8	8	6	21	83	156.9
85	34.3	35.0	13.2	82.5	30	18	10	9	7	25	99	181.5
86	38.4	39.6	14.1	92.1	36	21	12	11	8	29	117	209.1
87	41.7	49.8	15.5	107.0	41	24	13	13	9	34	134	241.0
88	45.3	58.6	16.8	120.7	47	27	15	14	10	38	151	2 1.7
89	49.2	68.4	18.2	135.8	52	30	17	16	11	43	169	304.8
90	53.6	78.0	19.5	151.1	57	33	19	18	13	47	187	338.1
91	58.4	87.6	20.9	166.9	64	37	21	20	14	52	208	374.9
92	61.4	97.2	22.2	180.8	68	40	22	21	15	56	222	402.8
93	64.6	106.8	23.6	195.0	72	42	24	22	16	59	235	430.0
94	68.0	116.4	24.9	209.3	77	44	25	24	17	63	250	459.3
95	71.5	126.0	26.3	223.8	81	47	27	25	18	67	265	488.8
96	75.2	136.6	27.6	238.4	87	50	28	27	19	71	282	520.4
97	"	"	"	"	"	"	"	"	"	"	"	"
98	"	"	"	"	"	"	"	"	"	"	"	"
99	"	"	"	"	"	"	"	"	"	"	"	"
2000	"	"	"	"	"	"	"	"	"	"	"	"
1	"	"	"	"	"	"	"	"	"	"	"	"
2	"	"	"	"	"	"	"	"	"	"	"	"
3	"	"	"	"	"	"	"	"	"	"	"	"
4	"	"	"	"	"	"	"	"	"	"	"	"
5	"	"	"	"	"	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"	"	"	"	"	"
Total	1,522.0	2,449.6	562.9	4,534.5	1,674	949	543	519	368	1,370	5,423	9,957.5

Table 6.3.16 Financial rate of return of Public Projects by Pattaya Tourism Development Corporation

(Millions Baht)

Year	Investment cost	Revenue	Discount Rate 10%			Discount Rate 8%		
			Discount Factor	Discounted Investment Cost	Discounted Revenue	Discounted Factor	Discounted Investment Cost	Discounted Revenue
1977	33.3	3.0	.9091	30.3	2.7	.9259	30.8	2.8
78	256.5	7.0	.8264	212.0	5.8	.8573	219.9	6.0
79	404.7	16.0	.7513	304.1	12.0	.7938	321.3	12.7
80	466.5	24.0	.6830	318.6	16.4	.7350	342.9	17.6
81	271.0	82.9	.6209	168.3	51.5	.6806	184.4	56.4
82	116.6	109.7	.5645	65.8	61.9	.6302	73.5	69.1
83	108.3	131.6	.5132	55.6	67.5	.5835	63.2	76.8
84	101.9	156.9	.4665	47.5	73.2	.5403	55.1	84.8
85	338.9	181.5	.4241	143.7	77.0	.5002	169.5	90.8
86	214.9	209.1	.3855	215.3	80.6	.4632	99.5	96.8
87	151.9	241.0	.3505	53.2	84.5	.4289	65.1	103.4
88	151.7	271.7	.3186	48.3	86.6	.3971	60.2	107.9
89	151.6	304.8	.2897	43.9	88.3	.3677	55.7	112.1
90	151.0	338.1	.2633	39.8	89.0	.3405	51.4	115.1
91	150.9	374.9	.2394	36.1	90.0	.3152	47.6	118.2
92	133.9	402.8	.2176	29.1	87.6	.2919	39.1	117.6
93	131.9	430.0	.1978	26.1	85.1	.2703	35.7	116.2
94	135.4	459.3	.1799	24.4	82.6	.2502	33.9	114.9
95	141.6	488.8	.1635	23.2	79.9	.2317	32.8	113.3
96	141.0	520.4	.1486	21.0	77.3	.2145	30.2	111.6
97	84.0	520.4	.1351	11.3	70.3	.1987	16.7	103.4
98	84.0	520.4	.1228	10.3	63.9	.1839	15.5	95.7
99	84.0	520.4	.1117	9.4	58.1	.1703	14.3	88.6
2000	84.0	520.4	.1015	8.5	52.8	.1577	13.2	82.1
1	84.0	520.4	.0923	7.8	48.0	.1460	12.3	76.0
2	84.0	520.4	.0839	7.1	43.7	.1352	11.4	70.4
3	84.0	520.4	.0763	6.4	39.7	.1252	10.5	65.2
4	84.0	520.4	.0693	5.8	36.1	.1159	9.7	60.3
5	84.0	520.4	.0630	5.3]	32.8	.1073	9.0	55.9
6	84.0	520.4	.0573	4.8	29.8	.0994	8.3	51.7
Total	4,593.5	9,957.5		1,983.0	1,774.7		2,132.7	2,393.4

Financial rate of return : 9.1%

CHAPTER 7 ORGANIZATION

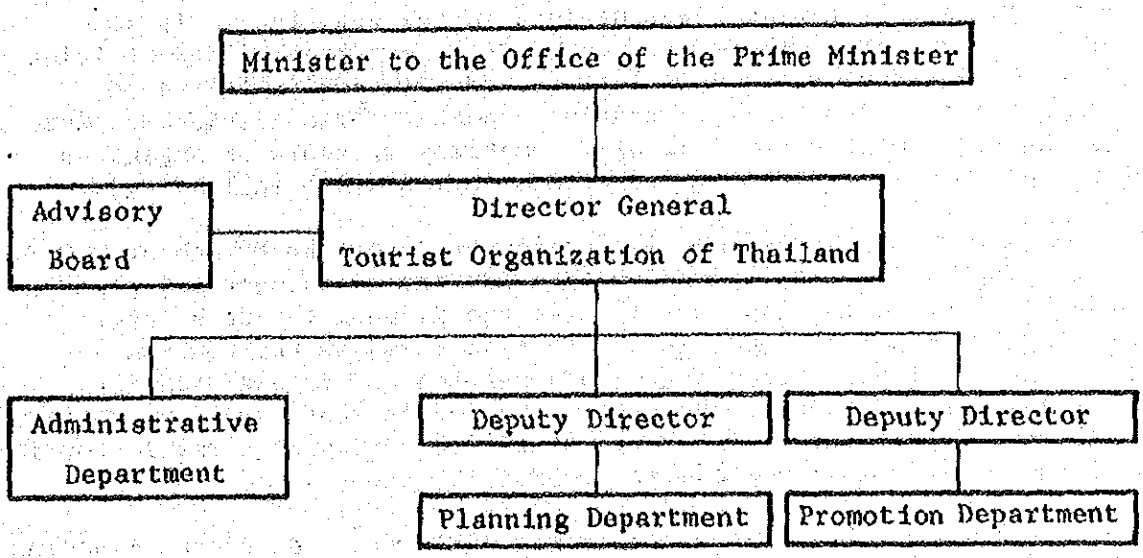
CHAPTER 7 ORGANIZATION

7.1 NATIONAL ORGANIZATION

The efficient implementation of a masterplan requires an implementing organization delegated with the necessary power and authority for control, implementation, operation and maintenance of the development projects.

The existing official organization in charge of tourism is the Tourist Organization of Thailand which is a government sponsored organization under the Minister to the Office of the Prime Minister. It was established in 1969 mainly for the purpose of tourism promotion

The organization may be summarized as follows:



Accounts
General affairs

Tourism Development Planning

Surveys, Statistical Analysis

Tourism Facilities Improvement

Domestic Offices

Overseas Offices

Promotion Films, Printed Materials

External Correspondence

Conventions & Seminars

The T.O.T. is an organization under the Minister to the Office of the Prime Minister. An advisory board, with the Minister to the Office of the Prime Minister as chairman, establishes the policy on activities of the T.O.T. The board member includes the Minister of Interior, the Director General of the Budget Bureau, the Direct General of the NESDB and heads of other relevant ministries and government agencies. The Director General of T.O.T. serves as the secretary of the board.

The T.O.T. with a total staff of slightly less than 300 is basically divided into two branches with distinct functions. A brief description will be given in the subsequent paragraphs.

The first branch is the Promotion Department, which, together with the overseas offices, has been instrumental in the rapid growth of tourism industry in Thailand. The Promotion Department is in charge of the overseas offices in the world. There are now six offices spreading over Europe, North America and Asia, and establishment of new overseas offices in the near future is now under preparation. The department carries out promotion activities through distribution of news letters, posters and pamphlets on tourist attractions in Thailand to persons or organizations related to the tourism industry. It also sometimes sponsors or organizes international conventions, conferences or seminars in Thailand.

The Planning Department is the other important branch of T.O.T. The planning division is responsible for the assessment and planning of tourism development all over the Kingdom for both international and domestic tourists. It also compiles the tourism statistics from data collected and carries out regular tourist surveys for updating of the data. The development division of the Planning Department is in charge of the promotion of domestic tourism and also controls the domestic T.O.T. offices.

Although tourism development plans are prepared by the Planning Department, the T.O.T. has no authority for execution of the plans. These plans are recommended to the relevant government agencies for implementation at the discretion of these agencies. Any restrictive or regulative measures formulated by T.O.T. have also to be referred to other government departments for enforcement.

With the increased importance of tourism industry to Thailand, and an anticipated large scale tourism development necessary to cater for the increased demand, as well as future needs for strong control, regulation and supervision of the tourist industry, it is a prerequisite that the T.O.T. be reorganized into an executing agency with the necessary authority to implement, control, operate, maintain and supervise tourism development and the tourism industry.

The promotion of the T.O.T. to the ministry status is one of the methods, but it is considered more expedient to reorganize the T.O.T. into an Authority with executing authority under an existing ministry. Whatever the form of organization, it is proposed that the authority and responsibility of the new executing agency should included the following:

1) The authority for formation of tourism development plans and for the implementation, control and supervision of these plans.

2) The authority to make direct request for the necessary budget for tourism development.

3) The authority to draft the necessary laws, acts, ordinances and regulations related to tourism development and to enforce or cause to enforce these legal measures.

4) The authority to request for foreign loans necessary for tourism development.

5) The authority to establish "Tourism Development Corporations" under the organization and to engage in investment, approval, regulation, supervision and management of tourism development through these corporations.

Fig. 7.1.1 shows an example of the organization of the executing agency in the case that it is in the form of an Authority. The Authority will have five major departments.

(1) The Promotion and Marketing Department

This department will continue to provide the same services as those under the Promotion Department of the existing T.O.T.

(2) The Planning and Research Department

Besides the duties of the Planning Department of the existing T.O.T. this development will also formulate and seek legislation of necessary legal measures, as well as planning the necessary training programs for both the public and the private sectors.

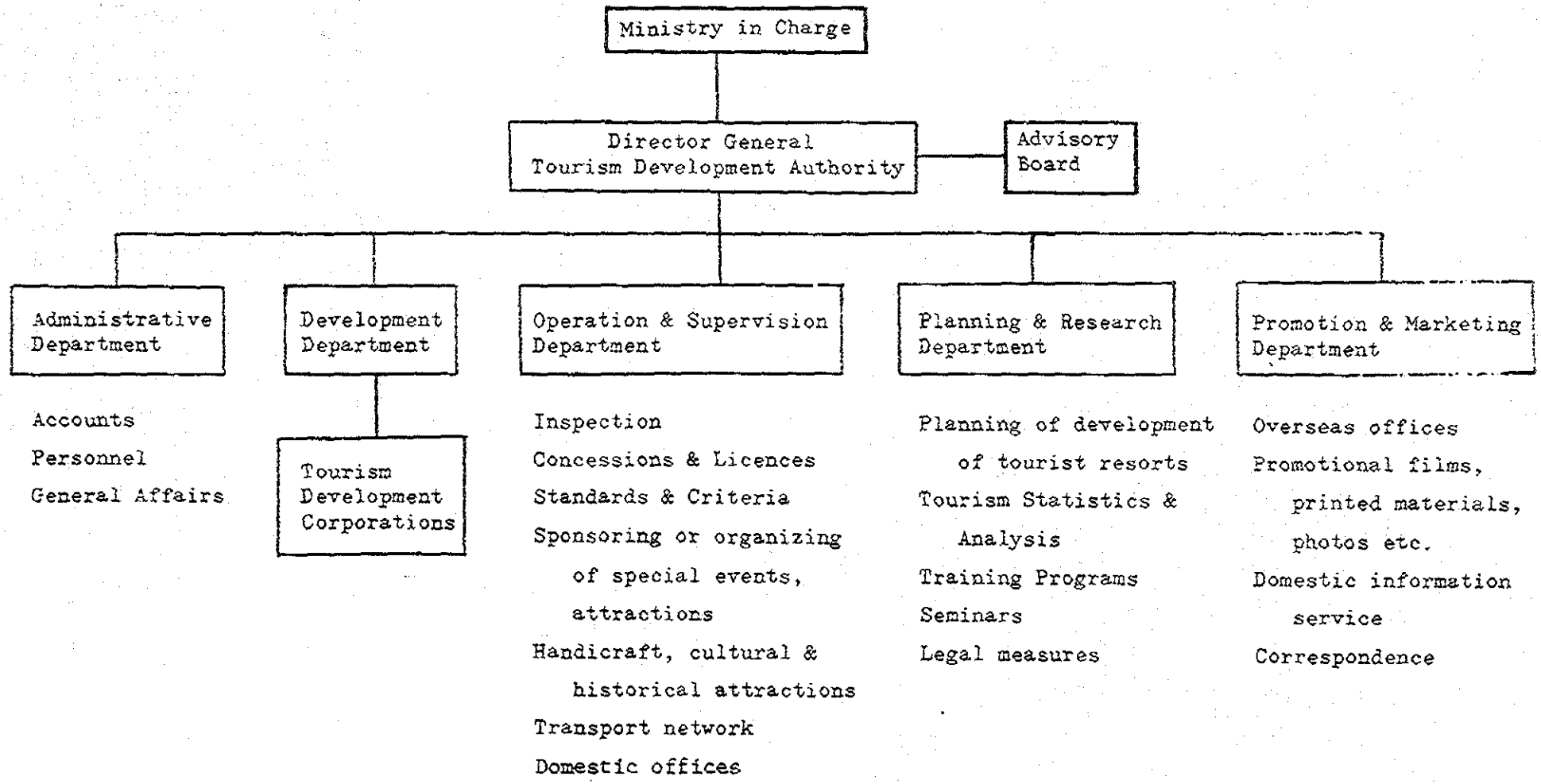
(3) Operation and Supervision Department

This department will be responsible for the control and supervision of the operation of the private sector through inspection, approval of concessions and licences and establishment of standards and criteria. It will also be responsible for the organization or the sponsoring of special events, attractions and for the promotion of handicraft, cultural and historical attractions.

(4) Development Department

This department will carry out the implementation of the tourism development projects either through "Tourism Development Corporations" under its supervision if the development is on a large scale or through direct investment in the projects if the projects involved are small.

Fig. 7.1.1


Ministry in Charge
Director General
Tourism Development Authority
Advisory Board
Administrative Department
Development Department
Operation & Supervision Department
Planning & Research Department
Promotion & Marketing Department
Accounts
Personnel
General Affairs
Tourism Development Corporations
Inspection
Concessions & Licences
Standards & Criteria
Sponsoring or organizing of special events, attractions
Handicraft, cultural & historical attractions
Transport network
Domestic offices
Planning of development of tourist resorts
Tourism Statistics & Analysis
Training Programs
Seminars
Legal measures
Overseas offices
Promotional films, printed materials, photos etc.
Domestic information service
Correspondence

(5) Administrative Department

This department will be in charge of the administrative affairs, including accounting, personnel and general affairs of the executing agency.

7.2 PATTAYA TOURISM DEVELOPMENT CORPORATION

The implementation of tourism development of Pattaya in accordance with the recommendations of the masterplan will be a very large scale development involving investments by the public sectors in infrastructure, public tourist facilities and amenities. For the efficient execution of the implementation, it is recommended that a "Pattaya Tourism Development Corporation" be established under the national executing agency on tourism. Moreover the executing agency may seek the investment participation from, or transfer the executing power of the actual construction of the projects according to the recommendation by the agency to the local government, the other relevant government agencies or any interested private enterprises.

The corporation should have the following authority and responsibility.

1) For the acquisition of land and investment in necessary infrastructure project.

2) For the construction of public tourist facilities and amenities.

3) For the maintenance and improvement of the beach of Pattaya.

4) For the handing out of concessions or operation licences in order to obtain revenue.

5) For regulation, control and supervision of development activities by the private sector.

6) For establishment and operation of tourist information and amenity services.

7) For the operation directly, or giving operating concession to the private sector, on intra-regional public transport.

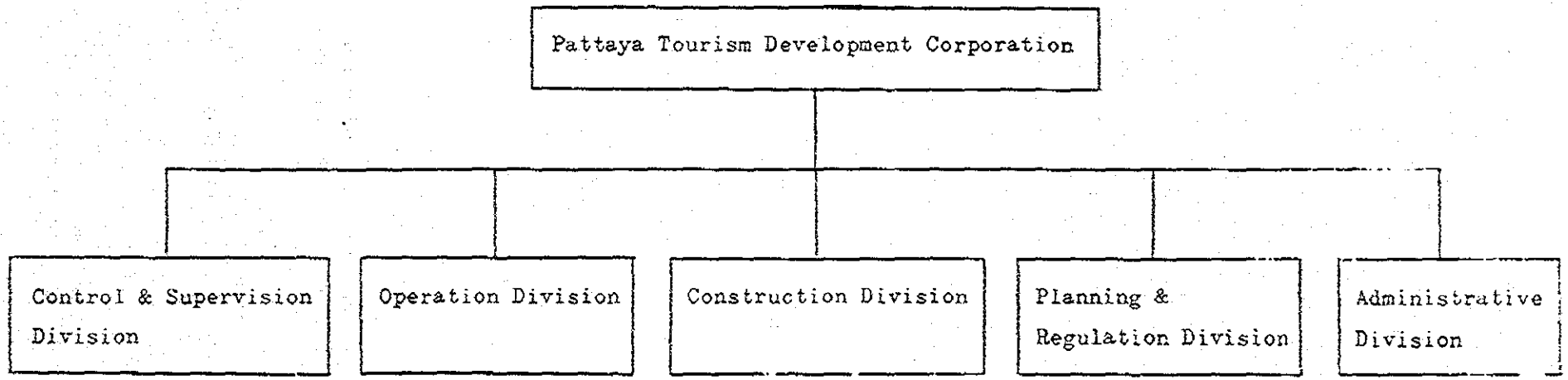
8) For the establishment of appropriate public fare and charge rates in order to maintain self-substenance of the investment on tourism development in Pattaya.

Fig. 7.2.1 shows an example of the organization of the proposed Pattaya Tourism Development Corporation. It is basically divided into 5 divisions.

(1) The Administrative Division

This division will be in charge of the general affairs of the corporation including accounts and personnel management.

Fig. 7.2.1


Pattaya Tourism Development Corporation
Control & Supervision Division
Operation Division
Construction Division
Planning & Regulation Division
Administrative Division
Operation of
Hotels
Guide, Tour & Travel Agencies
Tourist Facilities Operators
Restaurants
Souvenir Shops
Operation of
Local Transport
Inland Activities
Infrastructures
Amenity Centres
Information Services
Construction of
Infrastructures
Public Facilities
Development Planning
Proposal on Landuse & Landscape Regulations
Sea Surface Usage
Outlaying Islands
Permits, Licences and Concessions
Personnel
Accounts

(2) The Planning & Regulation Division

The planning division will formulate the detailed plans of development in Pattaya, propose landuse and landscape regulations, decide the usage of the sea surface and the outlaying island, as well as hand out permits, concessions and licences for the private sector.

(3) The Construction Division

The construction division will be in charge of the construction of the infrastructure projects and public facilities. It will select the consultants and contractors necessary for the engineering and construction services and supervise the performance of these services.

(4) The Operation Division

The operation division will be responsible for the operation, management and maintenance of the infrastructure and public facilities after completion of their construction.

(5) The Control & Supervision Division

This division will be in charge of control of the activities by the private sector in the tourism industry to ensure that they are in accordance with legal requirements and maintain a satisfactory safety, sanitary and service standard. The division will also give guidance on the price level of commodities or services offered to the tourists.

7.3 PATTAYA TOURIST ASSOCIATION

There is at present a Pattaya Resort Association with membership extended to hoteliers and other major operators of the tourist business. The present association does not have authority to make any decision binding to the members.

In view of the fact that self regulation is one of the important steps to ensure satisfactory services to the tourists, it is recommended that the existing Pattaya Resort Association be reinforced so that under the guidance of the Pattaya Tourism Development Corporation, the reinforced private sector organization, tentatively called "Pattaya Tourist Association", may make resolutions binding to all members of the association.

The association should have subcommittees to make deliberation and set standards binding to the members. The following are some of the subcommittees that may be set up.

1) Hoteliers

2) Catering services (restaurants, etc.)

3) Tour and travel agents, guides and interpreters

4) Boat owners

5) Sports facilities

6) Souvenir shops

7) Other facilities and services (car rental, drivers, taxis etc.)

The function of the subcommittee should be to establish the standard on the following items.

1) Sanitary standard

2) Safety standard

3) Security standard

4) Fare and charge level

5) Service level

The Pattaya Tourism Development Corporation may further facilitate the enforcement of these voluntary standards by incorporating the resolutions of the association into appropriate legal measures.

CHAPTER 8 LEGISLATION

CHAPTER 8 LEGISLATION

8.1 GENERAL

Appropriate legislations and legislative measures are necessary to provide legal support in the implementation of the development plan. There is at present no legislation directly concerned with the tourism industry, although there are different acts or ordinances under various ministries which are applicable also to the tourism industry. The following are some of the major existing legislations in Thailand which affect the tourism industry in Thailand.

* T.O.T. Establishment Act
* Environmental Act
* Town Planning Act
* Building Code
* Land Code
* National Park Act
* Wild Life Preservation Act
* Historical and Cultural Preservation Act
* Public Health Law
* Port & Harbour Act
* Industry Act
* Mineral Resource Act
* Fishery Act
* Canal Preservation Act
* Police Law
* Investment Act

It is seen from the above list that other than the act which authorized the establishment of the Tourist Organization of Thailand, all other legislations are measures which generally apply to the whole Kingdom. Basing on these general Acts, the relevant administrative agencies then prepare the detailed by-laws, regulations and/or directives at the administrative level binding to the public. In the case of the regions designated for tourism development, many of these acts will have to be made applicable. Moreover, it is important that legislative measures directly applicable to the tourism industry should be enacted.

In this chapter, a narrative shall be made of the legislations directly concerning the tourism industry which should be enacted as well as those of the general Acts which should be made applicable to Pattaya.

8.2 BASIC TOURISM LAW

The most necessary and important legislation which should be made in Thailand is the establishment of a "Basic Tourism Law". In a country where tourism industry plays an important role in the national economy, it is of utmost importance that the policy, goal and spirit regarding the tourism industry to be adopted by the Government should be clearly defined in the basic law together with a general narration of the steps, means or methods necessary to fulfil or attain such policy, goal and spirit. The actual administrative measures to be adopted may then be more clearly and concretely defined through the enacting of related new laws and legislations and the establishment of by-laws, directives, regulations etc. basing on other existing general laws or acts.

(a) Purpose of the Basic Tourism Law

The purpose of the Basic Tourism Law should be for the definition of the target of tourism development and the determination of the general service level and the necessary facilities required for attracting tourists to Thailand in order to obtain foreign exchange earning through promotion.

(b) Contents of the Basic Tourism Law

The Basic Tourism Law should include, inter alia, the stipulations or regulations on the following items.

(i) On the necessary provision or improvement of tourist resort and tourist facilities for attracting international tourists and for providing convenient and healthy tourist activities.

(ii) On the definition and establishment of integrated tourism routes including the facilities for access transport.

(iii) On improvement of services to international tourists and on ensuring the safety and security of the tourists.

(iv) On development of new tourist resorts to diversify the concentration of tourists into established resorts and to further enhance tourist attraction in Thailand.

(v) On preservation and protection of natural, cultural and historical tourism resources.

(vi) On the coordination of tourism industry with other industries.

(vii) On the establishment of necessary organizations for the execution of the tourism policy and the authority and responsibility of the organizations.

(viii) On the collecting and maintenance of statistical data on tourism.

(ix) On the necessary government financial and fiscal steps and measures.

8.3 ENACTMENT OF OTHER NEW LEGISLATIVE MEASURES

Basing on the spirit and policy stipulated in the Basic Tourism Law, new legislative measures for the regulation of the tourism industry will be necessary at the administrative level. The following are the major necessary legislative measures which may be in the form of new acts, ordinances, by-laws, regulations or directives to be decided case by case.

(a) Legislative measures for the regulation of tour and travel agents and operators.

Since the tour and travel agents and operators are the people who come into direct and constant contact with the tourists, it is necessary to control the quality and standard of services by these agents and operators to ensure the safety, security and convenience of the tourist.

At present, tour and travel agents and operators may operate after commercial registration. However, it is considered necessary to introduce the licencing system of the operators after evaluation of the qualification of the applications before making the necessary approval. The operation of a tour or travel agent should be under a qualified personnel whose qualification is ascertained after some kind of official evaluation or deliberation. The required qualification should include the knowledge on procedures for travelling, quarantine, custom duty, foreign exchange etc. the language proficiency, the knowledge on the political, cultural, geographical aspects of the country and also the capability to provide safe, secure and convenient services for tourists. As the operators will have cash dealing with the tourists, they should also be required to make some cash deposit with the government for permission for operation to prevent any default.

(b) Legislative measures on the regulation of tourist guides and interpreters.

The tourist guides and interpreters are the persons who spend much time together with the tourist. For the protection of the interest of the tourists, it is important therefore that their integrity and reliability be guaranteed by some legislative measures. The professional capability may be established through official examination to be held by the authority testing the language proficiency and knowledge of the places of tourist interest in the country. The examination should also include testing on the knowledge on safety and security measures in case of emergency and also on the ethical, and moral requirements for guides and interpreters. Operating licence shoudl be granted only to those who have proved their qualification through such examinations.

(c) Legislative measures for regulation of tourist hotels

Although the operation of hotels is regulated by many different common laws and acts which govern business operation in general, in view of the closeness of relation between hotels and tourists, it is considered important and necessary to establish legislative measures specifically for the control of hotels which cater for services to the tourists. The legislation should define the sanitary, moral, safety and security standards required of these hotels, the minimum facilities necessary for fulfilment of these requirements, and the method of establishing the rates of fares or charges according to the level of services and facilities available.

8.4 APPLICATION OF GENERAL LAWS TO TOURIST RESORTS

In the first page of this chapter, a list of major legislation which are also applicable to tourist resorts was presented. Some of the laws cannot be strictly enforced undiscriminatedly because they will greatly affect the daily economic or social activities of the public. However, it is considered necessary to make a more affirmative enforcement of many of these existing laws to tourist resorts by providing by-laws, regulations or directives basing on these basic laws. The following are some of the additional legislative measures which may be evolved from the existing laws and made applicable to tourist resorts. They may-be make applicable either to tourist resorts in general or to any specific tourist resorts.

(a) Legislative measures for preservation and protection of tourism resources.

This purpose may be attained through the application of the "Town Planning Act", the "National Park Act", the "Wild Life Act" and "Historical and Cultural Preservation Act" etc.

The legislative measures should define the boundary of the areas designated as tourism development areas, and set up criteria for the scope and range of tourism development activities to be allowed and to be prohibited within the designated area in order to prevent excessively or destructive development activities. The definition of historical or cultural assets to be preserved or protected and steps required for protection and penalty for violation should also be given.

(b) Application of the "Environmental Act" to tourist resorts

The existing "Environmental Act" gives a general outline on environmental preservation. Legislative measures evolving from this existing law to be made applicable to tourist resorts shall be taken including the setting up of limit of air and water pollution level for the industries in the designated tourism development area, and defining the types or categories of industrial activities which may be allowed within the vicinity of the tourist resort. Strict restriction should particularly

be imposed on the pollution of sea water at or near ocean resorts. Regular water quality monitoring survey requirements should also be made mandatory for ocean resorts.

(c) Legislative measures on food sanitation

Food sanitation is one of the most important factor in the protection of the interest of the tourist. Legislative measures basing on the "Public Health Law" should be taken to be made applicable to the catering establishments in tourist resorts. This will include the stipulation of the sanitary standard of food, the establishment and its surrounding and the cares to be taken in the handling of food and utensils. Inspection procedures and penalty measures for defaults should also be included. The disposal of waste and garbage should also be subject to control. Also, it may be necessary to introduce some kind of qualification for the personnel in charge of catering through official evaluation.

8.5 LEGISLATIVE MEASURES FOR GIVING LEGAL SUPPORTS

For tourist resorts where masterplans for tourism development are under implementation, it is necessary to take appropriate legislative measures to ensure that the implementation of the recommendations in the approved masterplans may be enforced with legal authority. These legislative measures will usually be limited in scope and made applicable only to each specific resort under development. Some of the items which require legal authority to ensure implementation according to plan are as follows:

(a) Regulations on the structures to be allowed for the tourist resort. This will include the floor area ratio in relation to land area, the height and type of the structures, the coordination of the structures with the surrounding scenery, the types of materials to be allowed, the required setback of the building from road or shoreline and etc, which are planned in the masterplan.

(b) Regulations on the use and maintenance of water surface and the beach according to the recommendations in the masterplan, in case of an ocean resort.

(c) Regulations on the safety measures to be adopted by the tourist facilities such as transport facilities, sport facilities, entertainment facilities etc.

CHAPTER 9 TRAINING

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9.1 GENERAL

The implementation of the development plan according to the proposed schedule will result in an increase of a large number of tourist and tourism related facilities and a consequent increase in personnel requirement both in the management and operation of the facilities in the private sector as well as in the administration and supervision of the facilities and activities in the public sector. A concerted training program is necessary in order to secure the personnel of required calibre and standard to meet the annual increase in demand.

In this chapter, an analysis of the personnel requirement and the necessary training program shall be made for both sectors.

9.2 PRIVATE SECTOR

(a) Personnel requirement

1) Hotel Personnel

The most important items in the private sector will be the personnel employed in the hotels which cater directly for the tourist demand. There are in Pattaya 2,767 hotels rooms in 11 major hotels with a total of 4,363 employees in 1976 so that the average staff per rooms for Pattaya is about 1.58. An analysis in the "National Plan on Tourism Development" of T.O.T. shows that the existing average hotel personnel for hotels both in and outside Bangkok as follows:

Class of Hotel	Average Staff per Room
In Bangkok	
Luxury Hotels	1.69
First Class Hotels	1.42
Second Class Hotels	0.91
All Hotels in Bangkok	1.46
Outside Bangkok	
Luxury Hotels	0.71
Second Class Hotels	0.55
All Hotels Outside Bangkok	0.63
In Pattaya	
11 Major Hotels	1.58

It is seen that the staffing requirement is much greater in Bangkok, where most of the hotels cater mainly for international tourist, although a large number of local tourists from upcountry also share the hotel facilities. Considering that Pattaya is being planned as an international resort, and that over half the future demand is estimated to be foreign tourist, it is considered that the average for hotels in Bangkok is more applicable than the hotels outside Bangkok which mainly cater for domestic requirements. Taking into consideration that some of the accommodation facilities in Pattaya are planned as the bungalow type which require less personnel and that a future improvement in productivity can be expected through appropriate training, it is assumed that the average staffing requirement for each additional room in Pattaya will be 1.5. At this assumption, the total additional personnel requirement is estimated as follows:

Year	Total rooms (rooms)	Additional rooms (rooms)	Additional personnel (persons)
1977	3,600	0	0
1981	3,600	0	0
1986	4,300	700	1,050
1991	6,600	2,300	3,450
1996	8,700	2,100	3,150
Total		5,100	7,650

Thus it is seen that over 7,600 new employees will be required over the whole planning period to serve in the proposed new hotels.

The said report of T.O.T. also reported an average composition of hotel employees sampled at luxury hotels in Bangkok as follows.

a. Management staff : 3%

b. Upper technical staff : 6%

(Room development manager, food and beverage manager, chief cook, housekeeper, front desk manager, chief engineer, chief accountant, internal auditor, personnel manager etc.)

c. Middle technical staff : 16%

(Bartenders, headwaiters, kitchen supervisors, cashiers, housekeeping supervisors, secretaries, accounting staff)

d. Lower technical staff : 75%

(Porters, waiters, room-cleaners, kitchen helpers, front desk clerks, telephone operaters etc.)

Applying these percentages to Pattaya, the total personnel requirement by level will be as follows:

a.	Management staff :	230
b.	Upper technical staff :	460
c.	Middle technical staff :	1,220
d.	Lower technical staff :	5,740
	Total	7,650

2) Tourist guides and interpreters

The next important item is the tourist guide and the tour and travel agents. There are at present about 100 full time guides serving tourists in Bangkok, supplemented by semi-trained or part-time guides of lower standard. These guides also go with tourists to Pattaya when required, so that there are at present no full-time guides stationed in Pattaya. The number of full-time trained guides is insufficient to serve all tourist demand and it is estimated that 400 - 500 guides is the proper supply to meet present day demand. Since it can be anticipated that in future guiding services for tourists in Pattaya will be continuously supplied from Bangkok, there is no necessity to provide guides specifically for Pattaya. However, it is of importance that sufficient supply of guides in Bangkok should be maintained to ensure adequate guiding service. The number of trained guides required may be assumed to be proportional to the international tourist demand, and is estimated as follows:

Year	International tourist (thousand)	Additional guides required
1976	1,098	400
1981	1,600	250
1986	2,000	200
1991	2,500	250
1996	3,000	250
Total:		1,350

Thus it is estimated that a total of 1,350 more trained guides will be required throughout the whole period.

3) Tour and travel agents

There are about 140 tour and travel agencies in Bangkok which also cater for tourists who extend their trip to Pattaya may being small operators. The number of employees in this respect is not known, due to lack of readily available data. Under the present system the tour and travel agents can begin operation after registration with the Ministry of Commerce, and there is no qualification requirement for the operators or their employees. With the future increases in the volume of tourists, an increase in the number of tour and travel agents can be anticipated.

4) Other services

The other services which are directly related to international tourists are the employees of restaurants, snack-bars, souvenir shops and other tourist facilities. The present employment situation is not known, due to lack of data, and it is difficult to estimate the future personnel demand. However, it can be seen that the training requirement for these personnel will be language proficiency, and no special training will be required.

(b) Training program

At present, there are several schools and institutions which provide courses related to travel industry.

1) The Chulalongkorn University has a travel industry management course in the Commerce Faculty which sends out about 10 - 20 graduates every year.

2) The Bangkok Technical School has a one year training course in travel industry management which provides training for about 100 students every year.

3) There are other vocational schools providing training courses ranging from 3 months to 2 years, at which 200 - 300 students complete the 2 year course and about 200 - 400 students complete the shorter courses every year.

Considering also the personnel requirements in Bangkok, it can be seen that the total supply of personnel will not be sufficient to meet future hotel personnel requirement in Pattaya, Particularly for management staff, the requirement for which after 1990 of about 20 per year is much greater than the supply of 10 - 20 from Chulalongkorn University. It is necessary therefore for the University to expand the course or for other universities to introduce similar courses. It will also require recruitment of expatriate personnel during the initial stage of operation of the hotels before their gradual replacement by local personnel.

The requirements of the upper and middle technical staff has to be filled by students who complete the 2-year course. The requirement after 1990 will be over 150 per year, or more than half the present supply from the vocational schools. Since the supply will have to meet overall national demand, it is doubtful whether all requirement of Pattaya can be met at present capacity of supply and additional 2-year or longer courses is deemed necessary.

The lower technical staff requirement will be over 500 per year, and here again future expansion short term is of importance.

A requirement of 40 - 50 trained guides per year will be necessary and here it is deemed important that special training courses be set up in vocational schools or universities to train the guides who should be well versed in the tourist attractions of Thailand, proficient in foreign languages, and also have a good knowledge of the laws, regulations and rules which ensure the safety, convenience and comfort of tourists.

Since the tour and travel agents are very closely in contact with the tourist, and greatly affect the interest of the tourist, it is desirable that together with the introducing of the "permit system" in place of the existing registration system, the operators should be required to possess adequate qualification in order to carry out their operation. Therefore some kind of training program should be planned for these tour and travel operators to ensure that they are well versed with the legal requirements, the safety measures, sanitary measures and the moral standards necessary for the provision of services to the tourists.

In all the cases above, it may be noted that language proficiency will be the major requirement other than specialty in each particular field of service. Consideration also the language requirement for restaurants, snack-bars, souvenir etc. the total requirement for language training will come to be very high, and comprehensive training program for languages should be set up at an early date. The major language for training will be of course English, but some personnel should be trained also in the French, German and Japanese language.

9.3 PUBLIC SECTOR

The personnel requirement will be both for the infrastructure sector and for the organizations in charge of tourism. In the infrastructure sector, it is anticipated that the required personnel will be provided by each respective government agency. The personnel requirement will be more acute for the organization in charge of tourism. At present, the major effort of T.O.T. is on promotion. Although the Planning Division has recently been strengthened to some extent, the total man-power is even today insufficient to meet present planning demand. With the addition of implementation and

operation to the field of activities of the organization in charge of tourism, the additional requirement for technical and professional staff is expected to be high. It is not possible to estimate the future requirement of technical and professional staff requirement without a final government decision on the final scope and scale of the organization. But it can be said that the personnel requirement may not be easily met from local supply due to the lack in experience in Thailand of such large scale tourism development, implementation and operation by the public sector. Some possible steps for receiving these technical and professional staff are suggested as follows:

1) Recruitment of professional personnel from the private sector or other government departments who are experienced in same or similar projects as the nucleus of the organization.

2) Recruitment of new graduates and despatching them to training courses abroad or in other government agencies in order to obtain practical experience.

3) Employment of experienced foreign consultants to serve as advisors in the organization during the initial stage of implementation and gradual replacement of these expatriates after completion of transfer of technical know-how.

4) Assignment of the implementation, operation and management of specific projects to foreign engineering and management consultants by contract and specifying training of local counterparts as a requirement of the contract.

In ay case, the requirement of technical and professional staff will be quite urgent and a government policy in the method of training to be adopted has to be made at an early date.

CHAPTER 10 IMPLEMENTATION OF THE PROJECT

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10.1 OVERALL SCHEDULE OF IMPLEMENTATION

10.1.1 Phasing of development

In the previous chapters, a masterplan for the tourism development of Pattaya has been prepared with the various infrastructure and other public and private investment projects proposed. An economic and financial evaluation was also made of the public investment projects, including the infrastructure and tourist facilities projects. The plan has been set up in line with the forecast future tourist demand of the resort.

The implementation schedule for the masterplan may be basically divided into two Phases. The Phase 1 Projects are planned to cater for tourist demands for the first 10 years up to the year 1986, and the Phase 2 projects are for meeting tourist requirements up to 1996. The Phase 1 is further subdivided into Stage 1 up to 1981 and Stage 2 for the subsequent 5 years.

Basically, the projects included in Phase 1 are the projects for provision of infrastructure facilities to the existing developed resort area and also the provision of tourist facilities to enhance the atractiveness of the existing resort area. It may be seen from the previous chapters that the existing number of hotel rooms of all categories come to about 3,600 rooms which is more than sufficient to meet the tourist demand for some years to come. By 1986, the number of additional hotel rooms required is about 700 room. Thus during the Phase 1 development period there is no urgent necessity to to develop new areas beyond the existing developed area. The supply of infrastructure and tourist facilities to ensure efficient and effective services to tourists at the existing accommodation facilities, however, is of utmost importance. This is the aspect where the Phase 1 development is concentrated.

Further increase of tourist demand beyond 1986 will warrant provision of additional hotel rooms. It is estimated that the hotel room requirement for 1996 will be almost double that for 1986. The masterplan proposes that the additional hotel rooms for this Phase 2 period will be planned at the area south of Pattaya Hill. The proposed new site for additional development is at present almost undeveloped, so that such supply of additional hotel rooms at the new site will require supply also of new infrastructure and tourist facilities.

Rough about 60% of the total investment cost on infrastructure is estimated to be spent in Phase 1 and the cost for Phase 2 comes to around 40%. As for investment for other quarters, including tourist facilities both in the public and the private sectors, about 30% will be invested in Phase 1 and 70% spent in Phase 2.

10.1.2 Necessity for review of masterplan

The masterplan presents a long term plan for landuse and the necessary projects for the realization of the long term plan, indicating an implementation at a year-by-year basis to meet the future demand for the next twenty years. However, it must be stressed that future changes in world economic situation or world events may cause a deviation of the assumptions for the forecast of tourist demand at a long term basis. In other words, the forecast results for the long future is more liable to have a great error than the forecast for the immediate future. In this sense, while it is recommended that the Phase 1 project be implemented at an early date, it is also proposed that a reassessment of the Phase 2 of the masterplan be made after completion of the implementation of Phase 1, basing on the up-to-date data available by that time, in order to reach a decision on whether the Phase 2 projects should be implemented as scheduled.

10.1.3 Regarding urgent programs

Besides the recommendations on the implementation of the masterplan at two phases, this report also makes recommendations on the implementation of the urgent programs which may be immediately undertaken. These are the steps or measures which may be immediately implemented at relatively low cost but have immediate effect on the improvement of the resort. Some are minor improvement accompanied by introduction and enforcement of new regulations and may be realized without substantial investment. Some are provision of low cost temporary facilities which will be eventually replaced by permanent facilities to be completed through the implementation of the masterplan. Some are immediate construction of a small part of the permanent facilities to meet immediate demand. Although the immediate programs are described in the various respective sections, these programs will be summarized in section 10.3 of this chapter.

10.2 DETERMINATION OF PRIORITY OF PROJECT IMPLEMENTATION

10.2.1 General

The Phase 1 infrastructure projects include the following eight items:

1. Water supply
2. Sewerage
3. Storm water drainage
4. Solid waste collection and disposal
5. Road and Street

6. Electric Power Supply

7. Telecommunication

8. Marine facilities

The total construction cost for these projects including tax and land acquisition for the Phase 1 period is to come to about 1.7 billion bahts (85 million US$) of which the foreign currency portion comes to about 530 million bahts (26.5 million US$) or nearly 30% of total cost. The decision on the investment involving such enormous capital cost cannot be made without careful feasibility study to be carried out for each individual project. Moreover, the simultaneous study and implementation of so many projects may be technically and financially difficult. For this reason, it is necessary to determine the priority of these projects so that should only part of the projects be implemented, the projects of higher priority will be chosen first.

In this section, a study of the priority of the infrastructure projects will be made, taking into consideration various different factors.

10.2.2 Considerations for determination of project priority

(a) From the point of contribution in upgrading the level of service to the tourist.

The water supply project is by far the most important in this respect. At present, water supply to the tourists is the responsibility of the individual establishments, which adopt different methods in securing water resource, treatment and distribution of water. As a result, the sanitary level and the convenience to tourists differ from one establishment to another. During the dry season when less underground water is available, or during the peak tourist season when the demand increases, some of the establishments have to supplement any shortage of water from their own resources through purchase from outside the resort area, conveyed by tank lorries, and at a relative high price. With the daily growth in tourist volume and consequent increase in water demand, it can be expected that the situation will further deteriorate, resulting in a general worsening of service level to the tourists. The provision of a water supply system at a stable sanitary condition is therefore of utmost importance not only in ensuring the level of service to the tourists but also from the point of maintaining the sanitary condition of the tourist.

The lack of a sewerage system is not ostensibly felt by the tourists nor by the establishments despite its very great importance from the point of sanitation and maintenance of the environment. The establishments in Pattaya treat their own waste by the sceptic tank method and let the treated discharge permeate to the ground, where inevitably, some discharge is

mixed into the underground water drawn as resource for water supply. Besides resulting in high cost in treatment for the supply, such situation may also endanger the sanitary condition of the resort. Therefore, although the direct impact of the lack of an adequate sewerage system is not immediately felt, the provision of a sewerage system is a matter of great urgency.

For the same reason, the solid waste collection and disposal system is also of great importance in connection with the maintenance of the sanitary conditions of the resort, since the limited facility that is available at present is not adequate to cope with demand in the near future.

Although the existing road and street system is rather simple and, other than the beach road, the width is generally on the narrow side, due to the low average vehicle volume, adequate service to the tourists is available. However, with the policy of eventually closing the beach road to the general vehicle traffic, it is necessary to rearrange, and improve the entire road and street system in order to provide access of vehicle traffic to the establishments lining along the beach.

Other than the piers along the south Pattaya for the use of fishing boat, there is no port and marine facility at the Pattaya resort now. The boats which cater for the tourists are scattered all along the shoreline, so that it is inconvenient for the tourists who need the use of a boat, not to mention the possible danger to passengers on boarding and unboarding the boats. The policy in the masterplan is for concentrating the boats at several specific locations so that tourists may have easy access to the boats. For this purpose, the provision of port and marine facilities for mooring of boats and for boarding and unboarding of passengers is necessary. Temporary facilities are recommended as urgent program to cater for tourist service until the completion of the permanent facilities.

The purpose of the provision of a storm water drainage system is to eliminate the occasional floods which occur at the hinterland of Pattaya during the wet season. However, the affected area is not at present developed for tourists use and the floods are seldom and unserious so that as far as the existing resort is concerned, this is not a top urgent project. Nevertheless, this is a necessary project following the eventual development of the area behind the existing developed area, in line with the recommendations of the masterplan.

Electric power supply system, and telecommunication system, are the infrastructure facilities which are at present available, although substantial improvement is desirable and future expansion of the systems will be necessary to cope with anticipated future increase in tourist demand. The respective administrative agencies for these facilities already have their individual improvement programs either in the implementation or the planning stage, so that the urgency of these projects is less acute.

(b) From the Point of Environmental Preservation

In this regards, the sewerage system is by far the most important system. It has been described in detailed in the previous chapters that the discharge of waste water to the sea either directly or through public water channels by both the tourist catering establishments and the tapioca factories in the vicinity of Pattaya has been responsible for the pollution of the sea water resulting in rapid deterioration of the water quality of this ocean resort. Unless urgent step is taken to prevent further pollution of the sea water, the resort may eventual be so worsened as to be unsuitable for swimming and ocean activities.

Inadequate solid disposal system will also greatly affect the environmental condition of the resort. The landfill system is at present adopted for waste disposal. However, the area is not adequate for long term use, and the sanitary condition of the filled area is not adequately maintained. From the point of maintenance of sanitary environmental condition and provision of a system for a long term, the solid waste collection and disposal system is also of great importance.

The improvement of the road and street system and the provision of the port and marine facilities will improve the traffic flow both on land and on the sea surface, thus greatly bolstering the image of the resort, and improveing the tourism environment of the resort. These two facilities will therefore be next in importance from the point of environmental preservation.

10.2.3 Determination of priority of the projects

From the above qualitative analysis, the infrastructure projects proposed in the masterplan may be classified into three categories as follows:

(a) First priority group of projects

This group will include the projects without which the future viability of Pattaya as an ocean resort will be affected. In other words, these projects will decide the life and death of Pattaya when the tourist volume is greatly increased in the future. In this group are the following projects:

(i) Water Supply System

(ii) Sewerage System

(iii) Sold Waste Collection and Disposal System

(b) Second priority group of projects

The completion of projects in this group will greatly improve the image and enhance the attraction of Pattaya as a tourist resort. These are the projects necessary to ensure constant

future growth in tourist volume to the resort.

The projects in this group are:

(i) Road and Street System

(ii) Port and Marine Facilities

(iii) Storm Water Drainage System

(c) Third priority group of projects

These projects are for improving the quality of service to the tourist and local community. They include:

(i) Electric Power Supply System

(ii) Telecommunication System

The above priority has been determined purely from the points of technical consideration basing on the analysis of the Section 10.2.2. With regards to the selection of the projects to be taken up in implementation, the above listed priority will of course be first taken into consideration. However, the plans that the various government agencies may have already in hand or in the conceptual stage will also have to be carefully considered. Thus it is possible that some urgent measures or steps may have already been taken by some government agencies or departments on certain high priority projects so that the project may not need to be persued by T.O.T. On the hand, some measures or steps related to certain low priority projects may have been taken so that it require an early implementation of the project in order to ensure full benefit of such measures. In the implementation stage, it is therefore necessary that a list of implementation sequence be prepared taking into consideration not only the priority determined in this study but also the status quo of the projects.

10.2.4 Recommendation

As shown in the previous chapter, the economic feasibility of the implementation of the masterplan was established indicating that the economic return of the investment from the point of national economy will amply cover the costs involved in the implementation of all the projects proposed in the masterplan, both for the public and the private sector. The financial analysis of the investment by the public sector on the infrastructure and tourist facility projects also prove that the financial return of investment in the form of revenues and additional tax receipts will be sufficient to warrant the investment by the government on these public sector projects.

Basing on the results of these economic and financial analyses, the implementation of the infrastructure projects at an early date will be highly desirable for the realization of the masterplan. However, since the cost of investment will be enormous, it will be necessary to make selective investment at the initial stage. Also, further detailed studies will be necessary particularly on the major projects to ascertained the technical aspects of the projects and to reassess the construction cost to better accuracy. It is therefore recommended that feasibility studies on the projects of high priority be carried out at an early date in order that the implementation of these projects may be made.

10.3 RECOMMENDATION ON IMPLEMENTATION OF URGENT PROGRAMS

10.3.1 General

From the implementation schedule previously presented, it is seen that the tourism development plan for Pattaya will be a long term plan with most of the projects requiring many years before even partial completion. On the other hand, many problems are already felt in Pattaya as an existing tourist resort. In this chapter, recommendations are therefore made on the implementation of urgent programs. Basically, the recommendations will include steps, measures or projects which can be easily implemented at a low cost and within a short period, and the effect will be spontaneous. They may come under the following categories.

(a) Projects which can be completed within a year at small investment cost and which can either be converted easily into a part of the future permanent structure as part of the masterplan or are temporary structures to be eventually replaced by permanent structures.

(b) Periodical routine and provision of simple facility which will improve the conditions of the resort.

(c) Legislative or administrative measures which enforcement will contribute towards the improvement of the resort.

The relevant items which are described in their respective sections, and a summary of all the items is presented in subsequent paragraphs.

10.3.2 Urgent Projects

(a) The temporary provision of raw water supply line.

The existing tourist establishments (hotels, restaurants, etc.) procure water supply from their own source and treat the water in the facilities within the establishment.

During dry season or peak tourist season, raw water has to be purchased and conveyed by tank lorries to supplement any deficit. It is proposed that a raw water storage pond with elevated tank be installed at the site proposed as future water treatment plant site for water supply along the road leading from Sukhumvit Road to North Pattaya and a pipeline be laid along the beach road to reach South Pattaya. Raw water will be supplied by tank lorry from outside and stored in the pond to be distributed to the consumers along the beach road by gravity flow from the elevated tank. The establishments will treat this supplied raw water in their own facilities.

This pipeline will be converted into the main distribution pipe of fresh water after eventual completion of the water supply system, and the pond and elevated tank will also be eventually converted into use in the final water supply system.

This temporary measure will ensure stable supply of raw water to the existing establishments even during the peak period. By concentrating the supply of raw water to one location, the quality of the raw water can also be easily controlled. Since the storage capacity will be larger than that of each individual establishment, constant replenishment of raw water can be made during off peak period. This will prevent the sudden increase of traffic of water conveying vehicles into the tourist area during peak period.

The total construction cost excluding tax will be about 40 million bahts (2 million US$) and part of the cost can be recovered through the sale of the raw water to the consumers.

(b) The temporary provision of sewerage system for South Pattaya

The largest quantity of discharge of sewage, other than the tapioca factories, is from the restaurants and other establishments in South Pattaya. Pollution of the sea is progressing at a very high rate. Since the provision of the permanent sewerage system will not be completed within a short period, it is important to make some temporary provision as an urgent measure.

It is proposed that a small scale stabilization pond be provided at the site proposed for the permanent facility at South Pattaya, and a sewage collection pipe be laid from the South Pattaya beach road to the pond. This will ensure that the sewage discharge is thus partially treated at the temporary pond. A storm drainage channel will be also constructed in South Pattaya so that the treated waste may as a temporary measure be discharged into the sea at South Pattaya. The pond and the pipe will eventually be converted into part of the permanent facility.

The total cost is estimated at 9 million bahts (450 thousand US$), for the treatment facility and 28 million bahts (1.4 million US$) for the discharge channel.

LEGEND

WATER SUPPLY SYSTEM

SEWERAGE SYSTEM

STORM WATER DRAINAGE SYSTEM

N

0 200 500 1000 2000M

FIG 10.3.1 URGENT PROGRAMS OF INFRASTRUCTURE PLAN

(c) The provision of temporary marine facilities

It is proposed in the masterplan that the use of the sea water surface be controlled and that the boats which now freely line the shoreline should be concentrated at designated locations. For the convenience of boat users, it is proposed that a temporary wooden quay be constructed at South Pattaya, and all loading and unloading of passengers be concentrated at this temporary quay. This temporary facility will be eventually replaced by the permanent facility. This cost estimated for the temporary facility is about 2 million baht (100 thousand $)

Fig. 10.3.1 shows the outline of these proposed urgent projects.

10.3.3 Periodical routines and simple facility provision

(a) For the maintenance of sanitary condition of the beach

This will be accomplished through the following measures

(i) Regular cleaning of the beach

(ii) Restriction of horse riding on the beach and provision of temporary area for horse riding activity.

(iii) Regular cleaning of the litters in the water along the beach and clearing of sea-weed in the water.

(iv) Carrying out of chlorine injection to the sceptic tanks of existing establishments.

(b) For the maintenance of safety of beach users

(i) Designation of areas for mooring of boats

(ii) Designation of water surface zoning and regulation of water surface usage of the zones

(iii) Establishment of coast guards and first aid units along the beach.

(iv) Provision of necessary traffic signs for control of traffic and enforcement of traffic regulations

(c) For the improvement of service and convenience to tourists

(i) Designation of areas for vendors.

(ii) Provision of benches along the beach

(iii) Promotion of bicycle as a means of transport on the beach road and provision of bicycle parking area

(iv) Periodical monitoring of the water quality through regular surveys.

10.3.4 Legislative and administrative measures

(a) For the maintenance of safety to tourist

(i) Introduction of one-way-street system for beach road from Nipa Lodge Hotel to South Pattaya.

(ii) Closing of beach road to vehicle traffic from Nipa Lodge Hotel to the north.

(iii) Enforcement of registration of boats for tourist use and stipulation of safety requirements for boats.

(iv) Regulation of speed of public transport vehicles.

(b) For the improvement of service and convenience to tourists

(i) Restriction on street soliciting for souvenir vending or other services.

(ii) Establishment of criteria of quality of factory waste water from tapioca factory and strict enforcement of the criteria.

(c) For the prevention of disorderly development before implementation of master plan.

(d) Others

The above are recommendations on steps and measures to be taken immediately which will have rapid effect on the improvement of service level, convenience and safety to the tourist. Besides these measures, it is also recommended that early steps should be taken to make preparation for implementation of the master plan. These will include:

1) Preparation for the necessary feasibility study and design services on the project.

2) Taking steps to establish the necessary legislations mentioned in Chapter 8.

In this Chapter, the implementation schedule of the projects of the masterplan has been presented to meet the requirements based on the estimated future tourist demand. It is noted that in actual practice, the time required for procurement of finance, selection of consultants for the engineering services, the selection of contractors for construction works, and other administrative procedures is apt to take much longer than the original plan, thus resulting in considerable delay in the completion of the project. It is therefore important that the recommended urgent projects, which are measures proposed to meet immediate requirements before completion of the masterplan projects, should be implemented as soon as possible and that preparatory works on the implementation should be started as early as possible in order to reduce any delay in final completion of the projects.