7. Environmental impact assessment (EIA)

7.1 Objective of the environmental impact assessment

The potential EIA items, which need to be examined during the stage of the feasibility study, were identified through Initial Environmental Evaluation (IEE) for the master plan (the Long-term Development Plan) of the port, which is described in Volume 2. This chapter describes the EIA which was conducted on the basis of the result of the field surveys and analysis regarding respective items. The EIA is conducted for both the Short-term Development Plan and the Urgent Improvement Measure prepared for the cargo forecast in accordance with the Middle growth scenario.

The EIA focused on the following items:

a. Survey of resettlement and utilization of existing fishing port in Village No.2 (nearest village to the port, see Fig. - 7.4-1 for the location),
b. Counter measures against the water pollution due to dredging and dispersion of dredged materials,
c. Fishery activities in the vicinity of the project area,
d. Resettlement plan of Sihanoukville City,
e. Sedimentation caused by discharge of river water from land area to the New Port area, and
f. Environmental monitoring.

The following field surveys, laboratory test and analysis with numerical simulation were conducted:

a. Interviews with fishing boat owners and the residents in Village No.2,
b. Hydrobios survey (Coral and water biota),
c. Ocean current survey,
d. Sea water sampling and analysis,
e. Soil sediment sampling and analysis,
f. Simulation of suspended soil dispersion during the disposal of dredged material, and
g. Analysis of sedimentation due to effluent of river water to port area.

7.2 EIA for dredging and disposing of dredged materials to sea area (see Appendix D)

This project is expected to generate a large volume of dredged materials(Total : 1,777,000 m^3, Basin : 1,312,000 m^3, North channel : 465,000 m^3). On the other hand, large volume of soil for reclamation will also be required. Based on the survey, only a small portion of dredged material can be utilized for reclamation because the dredged soil contains a high ratio of silt and sand with small particles which are not suitable for reclamation.

Two alternative disposal sites of disposal in the sea area adjacent to the project area were selected (CO-1 and CO-2 , refer to Fig. - 7.2-1). Analysis and evaluation for EIA were conducted on those two selected sites. The following is a brief description of sites where disposing of dredged materials is expected:

CO-1 : the maximum water depth is -45 m and the water area is about 100 ha. (sea area south west of Dek Koul Island), and

CO-2 : the maximum water depth is -25 m and the water area is about 100 ha. (sea area north east of Dek Koul Island).

Based on the result of sea area survey for dumping site, it was determined that the both locations CO-1 and CO-2 satisfy the conditions necessary to serve as the dumping sites for dredged materials.

When dredged materials are dumped into the sea, the following environmental impacts may occur:

a. Water pollution results from the dredging and disposing of dredged materials.
b. Impact on fauna and flora existing in the sea area adjacent to project area.
c. Impact on fishery activities in the water area adjacent to the project site.
d. Impact of water pollution on coastal area.

To evaluate the environmental impact from various viewpoints and to proceed with the detail study, the following surveys, laboratory test, numerical simulation and analyses were conducted:

a. Hydrobios survey (corals, fishes, seaweeds, benthos, plankton),
b. Ocean current survey,
c. Sea water analysis,
d. Soil sediment analysis,
e. Simulation of diffusion of suspended soil,

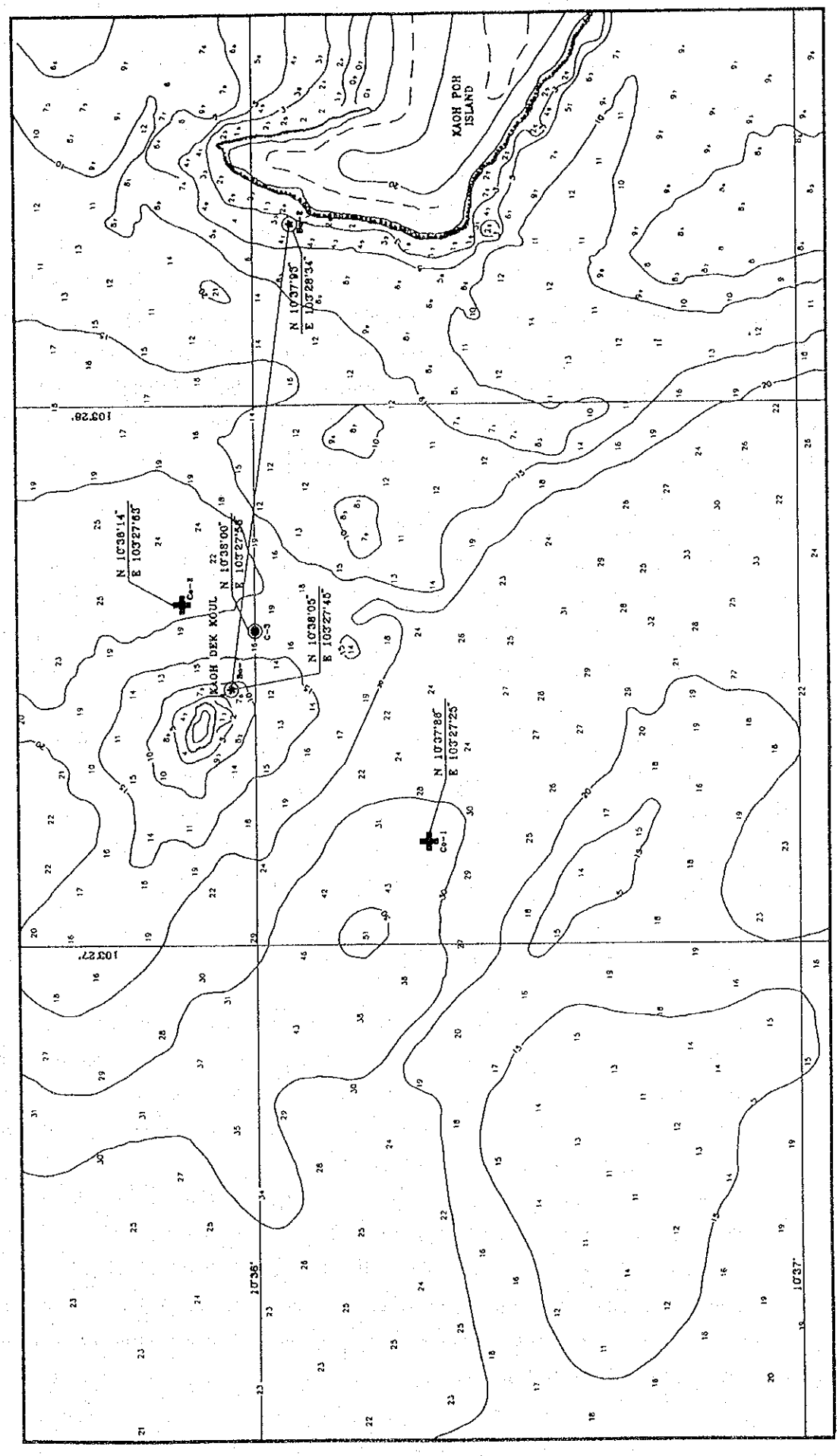

Fig. - 7.2-1 Location map of oceanic survey

f. Analysis of effluent of river water to sea area, and

g. Geographical survey and ecosystem in the sea by divers.

7.2.1 Dispersion of suspended soil during the dredging

It is foreseen that a total volume of 1,777,000 m^3 of dredged materials need to be disposed in the sea areas, namely CO-1 and CO-2. In general, it was observed that, at present, the water at this sea area has a low transparency (transparency test resulted in 3.5 - 4.0m).

The sea water analysis revealed that the sea water contains several chemicals even in the existing stage (Refer to Table - 7.2-1 and 7.2-2). In addition, it was observed that the visibility of sea water in these areas is only 30 cm to 100 cm. The visual observation conducted by professional divers showed that there are many floating materials brought by tidal current. The existing water quality satisfies only the Malaysian national water quality standards, prepared for agricultural irrigation activities, among those standards required by neighboring countries(Refer to Table - 7.2-3, 7.2-4, 7.2-5, 7.2-6, 7.2-7, 7.2-8). As for the quality of seabed soils, it was also observed that seabed soils contain several chemicals and tend to be polluted (Refer to Table - 7.2-9 and 7.2-10). There are no codes or standards on dredging conditions in the neighboring countries, and thus the environmental impact of dredging conditions was examined and evaluated on the basis of Japanese Standards.

It was anticipated that the disposing of the seabed soils would cause some effect on the sea area environment. A numerical simulation was carried out to examine the extent of the dispersion of suspended soil during the dumping of dredged materials. In the numerical simulation the field data such as tidal current and characteristics of seabed materials were used as input information. The results of the numerical simulation are shown in Appendix D.

7.2.2 Impact on fauna and flora existing in the sea area

Large volume of dredging work and disposing of dredged materials for the new North Channel and the basin in the New Port area are included in this project. Two possible locations having depths of 45 m and 25 m respectively were chosen for the dumping of dredged materials according to the survey data. The proposed sites are located in the east and west of the Dek Koul Island and are 4.5 km to 6.0 km away from the New Port area (see Fig.- 7.2-1).

The predominant directions of tidal current in this area are in the southwest and the northeast, and the maximum current speed is approximately 0.5 m/s (at the level 1 m above seabed), which is relatively high. The sea area of Sihanoukville Port has a very low transparency. One of the reasons for the low transparency is assumed to be the large volume of soil erosion which occurs during the rainy season. Soil is carried via rain water from land to the sea through rivers and ponds for the entire duration of the wet season.

(1) Coral

According to the results of hydrobios survey, it was observed that there are some coral reefs around Kaoh Poah Island and Dek Koul Island: the width of the coral reefs is from 20m to 30 m on average. In the Dek Koul Island, the percentage of living coral in the southern part is approximately 70.6 %. This rate implies that the coral is in good condition according to the criteria given below.

(Criteria of living corals).

75 - 100 %	: Excellent
50 - 74.9 %	: Good
25 - 49.9%	: Fair
0 - 24.9 %	: Poor

However, it was observed that around 8.3 % of the coral reefs located in the southern part of this Island are in decay. The dead coral coverage in the northern parts seemed to be less than the southern part, because the living coral coverage in the northern part seemed to be larger than that in the southern part. As for the Kaoh Poah Island, the living coral coverage is fair (47.4 %), while 19.3 % of coral reefs were observed to be dead at the coastal area in the west of Kaoh Poah Island. Due to the existence of the above mentioned water quality, these coral reefs do not include distinct species. The oceanographic investigation showed that there was no remarkable growth of coral reefs or other marine organism. Based on the investigation, it is speculated that one of the reasons of the death of the coral in these areas is the fact that a considerable portion of the surface of coral reefs was covered by sediments brought by the tidal current over many years. However, it was fortunately observed that several coral reefs are still alive in the shallow water area of 20 to 30 m wide along the coastal line of Dek Koul Island. The water depths where these corals are alive were approximately 1 to 3 m, which enable the corals to receive sun light. It should be noted that no coral reefs were observed in either of the proposed dumping areas, where the water depths are too deep for the corals to receive a sufficient amount of sunlight.

In this sea area the following species of corals were observed:

a. Seriatopora hystrix	g. Pavona sp
b. Pocillopora sp	h. Porites sp
c. Lobophyllia sp	i. Favites sp
d. Symphyllia	j. Platygyra sp
e. Acropora hyacinthus	k. Galaxea sp
f. Acropora sp	

(2) Fishes

Due to the low transparency, sunlight cannot reach the sea bottom and the visibility is very low in both the proposed dumping areas. Therefore the divers could not see anything in the water below 20m from the surface. It was thus assumed that there would be only few fishes living in these areas. However, there were many small fragments of mollusc shell flowing with ocean current near the sea bottom, most of which was covered with mud with a little amount of sand and small gravel.

In the coral reefs along the coast line of the two islands, small fishes are observed. In the survey, Chaetodon octofasciatus fish were observed in coral reefs around both islands. In general, this kind of fishes is used as indicator fish of corals. If this species is observed in coral reefs, the corals are either damaged or has been disturbed by man made activities, since this species eats small algae living on dead corals.

It is unlikely, therefore, that there are a large quantity of living fishes in this sea area. Table - 7.2-12 shows the species of fish observed during the survey.

(3) Seaweed

Due to low transparency, sun light can not reach the sea bottom and there is very low visibility in both the proposed dumping areas. No seaweed was observed in this sea area. The only location where seaweed was found is at the shallow coastal area of the islands where coral reefs exist.

In this sea area, the following species of seaweed were observed :

a. Turbinaria sp
b. Coralopsis sp

(4) Benthos

A benthic survey was carried out in accordance with the methodology described in "Survey Manual for Tropical Marine Resources" issued by Australian Institute of Marine Science. All the benthos observed during in the survey area were very common species. It is assumed that the density and population of seaweed living in this area is lower than the level commonly observed in the ocean. Table - 7.2-15 shows the species of fish found in the survey.

(5) Plankton

The survey of plankton in the sea area was based on the methodology of "Survey Manual for Tropical Marine Resources" issued by Australian Institute of Marine Science.

Phytoplankton and zooplankton were observed at all the locations where sampling was done in this survey. The total density of phytoplankton was between 370,208 and 1,247,242 individual/m^3 as shown in Table - 7.2-13. This level falls on in a high level and nutrients of this

sea area are abundant. The nutrients might have been brought from the surrounding sea area by the tidal current or from land by direct run off through the rivers. However, the number of zooplankton species was very few at all the sampling locations (see Table - 7.2-14): between one to three species only. It is not clear why the zooplankton population is small while the phytoplankton is large.

As to plankton living in the sea area, no precious species were observed and the level of density is very low compared with other sea areas.

For species of plankton found in the survey, refer to Table - 7.2-13.

(6) Environmental impact to fauna and flora existing in the coastal area

It is foreseen that one of the outstanding environmental impacts of the implementation of the port development project is caused by dredging and disposal of dredged materials to sea area, since this may result in environmental pollution which has adverse impact on marine biology. It is expected that the dredging work with proper methodology would minimize environmental impact on hydrobios such as coral reefs, fishes, seaweed, benthos, plankton, etc. which presently exist in the project area. According to the survey, the sea areas which were assumed to be prone to impact of the project implementation have very low density of biological organism except for a very limited coastal area near the islands and only very common species were found there.

It is therefore anticipated that the environmental impact to the fauna and flora existing in the coastal areas would not be considerable. Since there are a few coral reefs around the coastal area of the Dek Koul and Kaoh Poah islands, it is necessary to chose the proper method for the dredging work and disposing of dredged materials to minimize the extent of diffusion since there is a fairly strong tidal current.

7.2.3 Impact on fishery

Basically, no fishing either by large sized boats (capacity : 5-6 persons) or small boats (capacity 1-2 persons) is performed in the proposed dredging area and disposing areas for the dredged materials. Shrimp fishing by small boats, however, is conducted from September to November in the sea area in the southern coastal water of the city. Shrimp fishing in this area is generally done using small boats with oil lantern on the bow; shrimp are caught by a fishing net installed around the boat. Fishing is done throughout the year and the period between September and November is high season. Though the scale is small, squid fishing is also conducted throughout the year in this area.

The locations of fishing sites of shrimp and squid for small boats are quite far away from the sea areas for the soil disposal. It is thus anticipated that dredging and disposal of dredged materials would not bring a considerable impact on above fishing activities.

7.2.4 Impact on coastal area

The following coastal areas are identified to be potential areas which could be affected by the dredging work and disposing of dredged materials:

a. Coastal area of Kaoh Poah Island
b. Coastal area of Dek Koul Island
c. Coastal area in the north of the New Port area
d. Coastal area to the west of the downtown

The simulations of diffusion of suspended soil are carried out by personal computer with following software.

Name of software :	Model TAS
Originator of software :	Japan Oceanic Weather Research Co.,Ltd.

The results of the simulation are described in the attached Appendix D. The simulation is conducted by using the field data of tidal current survey and computer software for the analyses of tidal current and diffusion of suspended solid (SS). The results show that the maximum density of the SS due to the disposal at the locations of interest are as follows:

ST-1	North of Dek Koul Island	0.03 ppm after 9 hours
ST-2	South of Dek Koul Island	0.02 ppm after 8 hours
ST-3	Coastal area of Dek Koul Island	Not detected

The results also show that the increase in SS density is practically none. Thus it is anticipated that water pollution from dredging work and disposing of dredged materials affecting the coastal area would have no considerable environmental impact. However, to minimize the influence to the coral in the coastal areas of Kaoh Poah island and Dek Kuol Island, the proposed dumping site, CO - 1 or CO - 2, shall be properly chosen in accordance with the direction of tidal current. In addition to the diffusion of SS by the current, disposed soil would be disturbed by waves. It would be thus recommended to dump soils in massive form: this can be done with the use of such barges that can open the bottom of the hull to dispose the soil.

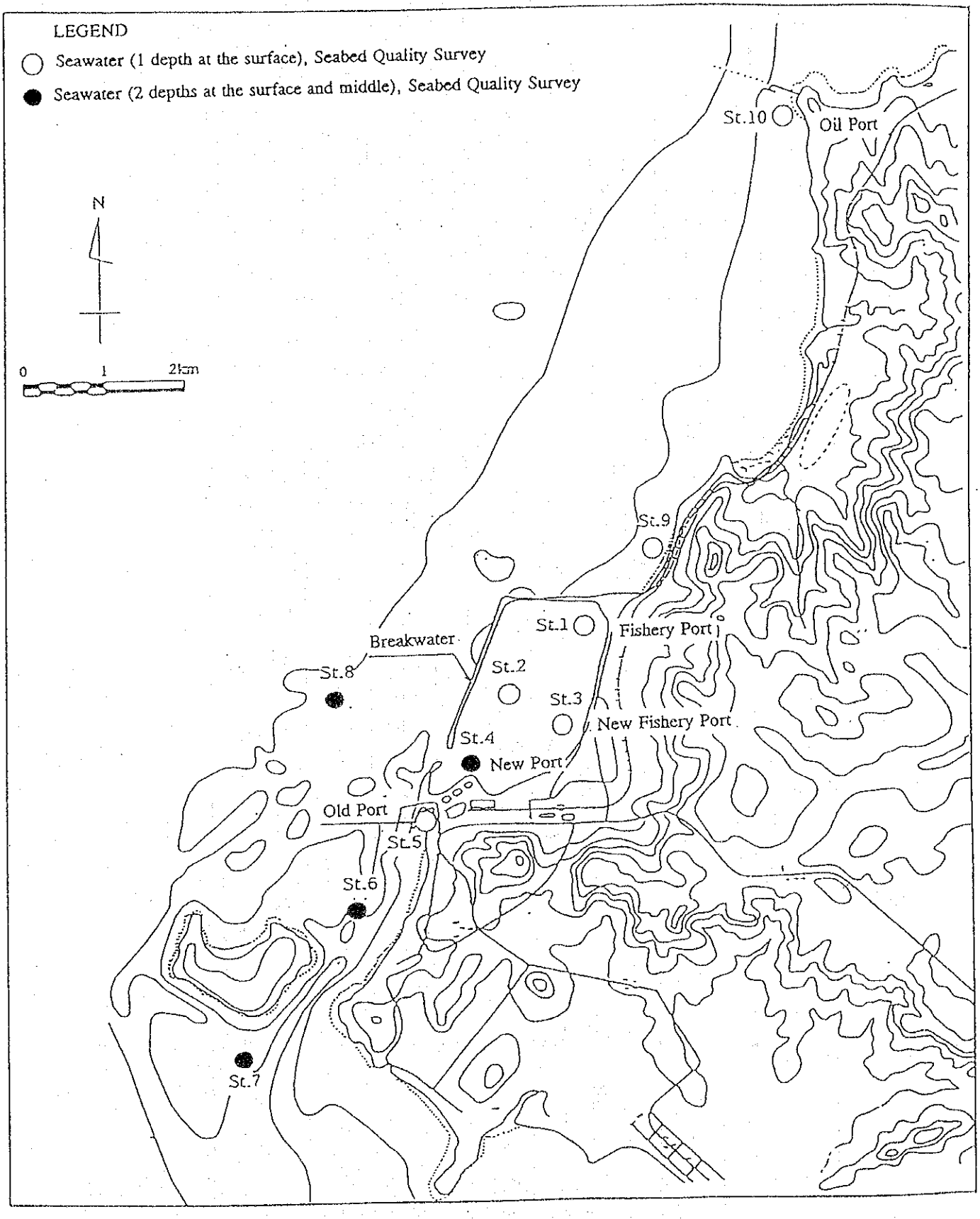

Fig. - 7.2-2 Location map of sewater and seabed quality survey

Table - 7.2-1 Summary of chemical test results of seawater samples (1)

TEST	TEST METHOD	CHEMICAL TEST RESULTS (mg/l)													
		St. 1	St. 2	St. 3	St. 4		St. 5	St. 6		St. 7		St. 8		St. 9	St. 10
		Surface	Surface	Surface	Surface	Middle	Surface	Surface	Middle	Surface	Middle	Surface	Middle	Surface	Surface
pH	-	6.62	6.61	6.60	6.60	6.60	6.56	6.53	6.53	6.13	6.13	6.57	6.57	6.64	6.65
Total Suspended Solids (SS)	APHA 2540 D	40	40	50	40	45	55	45	35	35	35	25	30	40	25
Chemical Oxygen Demand (COD)	(*)	0.5	0.5	0.6	0.2	0.4	0.1	0.2	0.4	0.3	0.2	0.2	0.1	0.1	0.2
Dissolved Oxygen (DO)	APHA 4500-OC	4.7	5.6	5.0	5.8	5.4	5.2	5.9	5.1	5.2	5.4	5.0	5.4	5.1	5.6
Oil & Grease (n-hexane soluble matter)	APHA 5520 B	6	11	10	N.D.	11	N.D.	13	18	N.D.	7	N.D.	8	11	22
Total Conliform at 35°C/ 24hrs (n-hexane solube matter)	APHA 9222 B	40	2	8	6	4	470	28	22	<2	140	410	<2	600	<2
Total Nitrogen (T-N)	APHA 4500	0.66	1.0	0.65	0.68	0.69	0.77	0.73	0.55	0.67	0.52	0.69	0.67	0.52	0.25
Total Phosphorus (T-P)	(*)	0.03	N.D.	N.D.	N.D.	0.02	0.02	0.02	0.01	N.D.	N.D.	N.D.	N.D.	N.D.	<0.01
Total Mercury (T-Hg)	APHA 3500-Hg B	0.004	0.002	0.003	N.D.	0.003	N.D.	0.002	N.D.	0.002	0.002	N.D.	N.D.	N.D.	0.002
R-Hg	APHA 3500-Hg B	0.002	N.D.	0.002	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Cadmium (Cd)	APHA 3500-Cd B	0.002	N.D.	0.002	N.D.	0.002	N.D.	0.002	0.002	0.002	0.002	N.D.	0.002	N.D.	0.002
Cyanide (CN)	APHA 4500-CN F	0.07	0.04	0.09	0.03	0.04	0.04	0.04	0.04	0.03	0.04	0.07	0.09	0.04	0.09
Or-P	(*)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	<0.01
Lead (Pb)	APHA 350-Pb B	0.27	0.19	0.14	0.22	0.21	0.08	0.15	0.29	0.16	0.23	0.21	0.2	N.D.	0.22
Chromium (Cr)	APHA 3500-Cr B	0.03	0.03	N.D.	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.05	0.02
Arsenic (As)	APHA 3500-As B	0.003	0.002	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.002	N.D.	N.D.
Polychlorinated Biphenyls (PCB)	APHA 4500-OC	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

Notes: St.1...St.10 Survey Location
N.D : Not Detected

Table - 7.2-2 Summary of chemical test results of seawater samples (2)

TEST	TEST METHOD	PARAMETER	CHEMICAL TEST RESULTS	
			Co-1	Co-2
			+5m from seabed	+1m from seabed
pH	APHA 4500-H+, B	pH Value @25°C	6.58	6.62
Total Suspended Solids (SS)	APHA 2540 D	mg/l	<5	<5
Chemical Oxygen Demand (COD)	APHA 5220 B	mg/l	0.9	0.7
Dissolved Oxygen (DO)	APHA 4500-O,C	mg/l	8.5	8.1
Oil & Grease (n-hexane soluble matter)	APHA 5520 B	mg/l	3.0	5.0
Total Coliform at 35° C/48hrs	APHA 9222	cfu/10ml	0	0
Total Nitrogen (T-N)	APHA 4500-N,B	mg/l	0.60	0.28
Total Phosphorus (T-P)	APHA 4500-P,C	mg/l	0.015	0.010
Total Mercury (T-Hg)	EPA 7471	mg/l	<0.002	<0.002
Alkyl Mercury (R-Hg)	EPA 7471 MOD	mg/l	<0.002	<0.002
Cadmium (Cd)	EPA 6010	mg/l	<0.02	<0.02
Cyanide (CN)	APHA 4500-CN,C	mg/l	<0.05	<0.05
Organic Phosphorus (Or-P)	APHA 4500-P,B/C	mg/l	<0.005	<0.005
Lead (Pb)	EPA 6010	mg/l	<0.02	<0.02
Chromium (Cr)	EPA 6010	mg/l	<0.02	<0.02
Arsenic (As)	EPA 6010	mg/l	<0.05	<0.05
Polychlorinated Biphenyls (PCB)	EPA 8080/8270	mg/l	N.D.	N.D.

Note : N.D. = Not Detected

Pollychlorinated Biphenyls

	Co-1	Co-2
Monochlorobiphenyl	N.D.	N.D.
Dichlorobiphenyl	N.D.	N.D.
Trichlorobiphenyl	N.D.	N.D.
Tetrachlorobiphenyl	N.D.	N.D.
Pentachlorobiphenyl	N.D.	N.D.
Hexachlorobiphenyl	N.D.	N.D.
Octachlorobiphenyl	N.D.	N.D.
Nonachlorobiphenyl	N.D.	N.D.
Decachlorobiphenyl	N.D.	N.D.

Co-1, Co-2 : Survey Location

Table - 7.2-3 Comparison table of regulations

WATER QUALITY STANDARD

CHEMICAL	DATA SHV PORT	COUNTRIES				
		THAILAND	MALAYSIA	INDONESIA	SINGAPORE	JAPAN
PH	6.53	7.0-8.5	5-9	6-9	6-9	7-8.3
Total Suspended Solids (SS)	35	-	-	-	-	-
Chemical Oxygen Demand (COD)	0.4	-	100	80	100	8
Dissolved Oxygen (DO)	5.1	4	3	4	-	2
Oil & Grease	18	ND	-	5	10	ND
Total Nitrogen (T-N) mg/l	0.55	-	-	-	-	-
Total Phosphorus (T-P) mg/l	0.01	-	-	-	-	-
Total Mercury (T-Hg) mg/l	ND	0.0001	0.002	-	0.05	0.0005
Alkyl Mercury (R-Hg) mg/l	ND	-	-	-	-	ND
Cadmium (Cd) mg/l	0.002	0.005	0.01	0.01	0.1	0.01
Cyanide (Cn) mg/l	0.04	0.01	-	0.2	0.1	ND
Organic phosphorus compound (Or-P) mg/	ND	-	-	-	-	-
Lead (Pb) mg/l	0.29	0.05	5	0.06	0.1	0.01
Chromium (Cr) mg/l	0.03	0.1	0.1	0.05	1	0.05
Arsenic (As) mg/l	ND	-	0.1	0.01	1	0.01
Polychlorinated biphenyls(PCB) mg/l	ND	-	-	0.001	-	ND
NOTES	survey point ST-6	Conservation of natural area	Agricultural irrigation activities	Conservation of marine park	Limit of trade effluent discharge	Environmental water quality standard (coastal water)

THAILAND : COASTAL WATER QUALITY STANDARDS
MALAYSIA : PROPOSED INTERIM NATIONAL WATER QUALITY STANDARDS
INDONESIA : SEAWATER STANDARDS BASED ON ENVIRONMENTAL AND POLLUTION MINISTRY DECREE
SINGAPORE : ALLOWABLE LIMITS FOR TRADE EFFLUENT DISCHARGE TO WATERCOURSE
JAPAN : ENVIRONMENTAL WATER QUALITY STANDARDS

N.D : Not Detected

Table - 7.2-4 Coastal water quality and effluent standards in Thailand

Parameter	Preservation	Conservation of natural area	Conservation of natural area	Agri culture shellfish	Water contact sport	Water proximity sport	Industry
Class	I	2	3	4	5	6	7
Floatable solids	n	NOB*	NOB*	NOB*	NOB*	NOB*	NOB*
Floatable oil/grease	n	NV	NV	NV	NV	NV	NV
Colour/odor	n	–	–	NOB	NOB	NOB	NOB
Temperature(c°)	n	>33.0	>33.0	>33.0	–	–	x >3
pH	n	7.5-8.9	7.0-8.5	7.0-8.5	–	–	**
Salinity (ppt) (per cent)	n	29-35	x >10	x >10	–	–	**
Transparency (m) (per cen)	n	x >10	x >10	x >10	x >10	–	**
DO (mg/l)	n	<4	<4	<4	–	–	**
Total coliform (MPN/100ml)	n	–	–	>1,000	>1,000	–	–
Fecal coliform (MPN/100ml)	n	–	–	–	–	–	–
NO_3 -N(mg/l)	n	n	n	–	–	–	**
PO_4 -P	n	n	n	–	–	–	**
Hg (mg/l)	n	>0.0001	>0.0001	>0.0001	–	–	>0.0001
Cd (mg/l)	n	>0.005	>0.005	>0.005	–	–	>0.005
Cr (mg/l)	n	>0.1	>0.1	>0.1	–	–	**
Cr, hex (mg/l)	n	>0.05	>0.05	>0.05	–	–	>0.1
Pb (mg/l)	n	>0.05	>0.05	>0.05	–	–	**
Cu (mg/l)	n	>0.05	>0.05	>0.05	–	–	**
Mn (mg/l)	n	>0.1	>0.1	>0.1	–	–	**
Zn (mg/l)	n	>0.1	>0.1	>0.1	–	–	**
Fe (mg/l)	n	>0.3	>0.3	>0.3	–	–	**
F (mg/l)	n	>1.5	>1.5	>1.5	–	–	**
Residus Cl_2 (mg/l)	n	>0.01	>0.01	>0.01	–	–	**
Phenols (mg/l)	n	>0.03	>0.03	>0.03	–	–	**
NH_3 -N(mg/l)	n	>0.4	>0.4	>0.4	–	–	**
Sulfide (mg/l)	n	>0.01	>0.01	>0.01	–	–	**
CN^- (mg/l)	n	>0.01	>0.01	>0.01	–	–	**
PCS (mg/l)	n	n	n	n	–	–	**
Total Chlorinated Pesticides (ug/l)	n	>0.05	>0.05	>0.05	–	–	**
Radioactivity							
a -Gross (Becqueral/l)	n	>0.1	>0.1	>0.1	–	–	**
B -Gross (Becqueral/l)***	n	>1.0	>1.0	>1.0	–	–	**

Notes: **NOB** = Not objectionable, NV = not visible, n = natural condition.
x = Change from natural condition

* = Not include natural floatable solids ** = may be established as necessary
*** = Not include natural Potassium 40
> = Not more than < = not less than

Table - 7.2-5 Domestic effluent guidelines in Thailand

Domestic effluent classification for Community Group (persons)

Parameters	Units	A(>2500)	B(501-2500)	C(101-500)	D(<101)
1. B0D*	mg/dm^3	20	30	60	90
2. Solids					
2.1 SS	mg/dm^3	30	40	50	60
2.2 Settleable S.	mg/dm^3	0.5	0.5	0.5	0.5
2.3 TDS**	mg/dm^3	+500	+500	+500	+500
3. Sulfide	mg/dm^3	1.0	1.0	3.0	4.0
4. Free residual chlorine***	mg/dm^3	0.3	0.3	-	-
5. Nitrogen					
5.1 TKN	mg/dm^3	-	-	40	40
5.2 ORG-N	mg/dm^3	10	10	15	15
5.3 NH_3-N	mg/dm^3	-	-	25	25
5.4 NO_3-N	mg/dm^3	-	-	-	-
7. pH	mg/dm^3	5- 9	5- 9	5- 9	5- 9
8. Oil and grease	mg/dm^3	20	20	20	20
9. Fecal coliform	$MPN/100cm^3$	-	-	-	-
10. Phosphate	mg/dm^3	-	-	-	-

Remarks: A, B, C, D, size of community with more than 2500, between 101 - 500 and less than 101 persons respectively.

* Settled BOD (30 min).

** More than TDS of used water.

*** Maximum allowance under epidemic condition only.

Table - 7.2-6 Proposed interim national water quality standards for Malaysia

Parameter	(Units)	Classes I	IIA	IIB	III	IV	V
Ammoniacal Nitrogen	mg/l	0.1	0.3	0.3	0.9	2.7	>2.7
BOD	mg/l	1	3	3	6	12	> 12
COD	mg/l	10	25	25	50	100	>100
DO	mg/l	7	5-7	5-7	3-5	< 3	< 1
pH		6.5-8.5	6-9	6-9	5-9	5-9	-
Colour	TCU	15	150	150	-	-	-
Election condition*	ohms/cm	1,000	1,000	-	-	6,000	-
Floatables		N	N	N	-	-	-
Odor		N	N	N	-	-	-
Salinity*	/00	0.5	1	-	-	2	-
Taste		N	N	N	-	-	-
Total dissemination Solid*	mg/l	500	1,000	-	-	4000	-
Total Suspended Solid*	mg/l	25	50	50	150	300	>300
Temperature	C		Normal	-	Normal	-	-
Turbidity	NTU	5	50	50	-	-	-
Fecal coliform**	counts/100ml	10	100	400	5,000 (20000)	5,000 (20000)	-
Total coliform	counts/100ml	100	5,000	5,000	5,000	5,000	5,000
		I	IIA/IIB		II#	IV	V
Al	mg/l		-		(0.06) 0.5	-	
As	mg/l		0.05		0.4(0.05)	0.1	
Ba	mg/l		1		-	-	
Cd	mg/l		0.01		0.01*(0.001)	0.01	
Cr (VI)	mg/l		0.05		1.4(0.05)	0.1	
Cr (III)	mg/l		-		2.5	-	
Cu	mg/l		1		-	0.2	
Hardness	mg/l		250		-	-	
Ca	mg/l		-		-	-	
Mg	mg/l		-		-	-	
Na	mg/l		-			3 SAR	
K	mg/l		-			-	
Fe	mg/l		0.3		1	1(leaf) 5(others)	
Pb	mg/l	N A T U R A L	0.05		0.02*(0.01)	5	L E V E L S A B O V E
Mn	mg/l		0.1		0.1	0.2	
Hg	mg/l		0.001		0.004(0.0001)	0.002	
Ni	mg/l		0.05		0.9*	0.2	
Se	mg/l		0.01		0.25(0.04)	0.02	
Ag	mg/l		0.05		0.0002	-	
Sn	mg/l		-		0.004	-	
U	mg/l		-		-	-	
Zn	mg/l		5		0.4*	2	
B	mg/l	L E V E L S	1		(3.4)	0.8	IV
Cl	mg/l		200		-	80	
Cl_2	mg/l		-		(0.02)	-	
CN	mg/l		0.02		0.06(0.02)	-	
F	mg/l		1.5		10	1	
NO_2	mg/l		0.4		0.4(0.03)	-	
NO_3	mg/l		7		-	5	
P	mg/l		0.2		0.1	-	
Si	mg/l		50		-	-	
SO_4	mg/l		250		-	-	
S	mg/l		0.05		(0.001)	-	
CO_2	mg/l		-		-	-	
Gross-A	ba/l		0.1		-	-	
Gross-B	ba/l		1		-	-	
Ra-226	ba/l		<0.1		-	-	
Sr-90	ba/l		<1		-	-	

TABLE 7.2-6 (Continued)

	(Units)	I	IIA/IIB	III#	IV	V
CCE	ug/l		500		-	
MRAS? BAS	ug/l	N	500	5,000(200)	-	-
0 and G (mineral)	ug/l	A	40;N	N	-	-
0 and G (emulsified edible)	ug/l	T	7,000;N	N	-	-
PCB	ug/l		0.1	6(0.05)	-	-
Phenol	ug/l	L	10	-	-	-
		E				-
Aldrin/Dieldrin	ug/l	V	0.02	0.2(0.01)	-	
		E				-
BHG	ug/l	L	2	9(.01)	-	
Chlordane	ug/l	S	0.08	2(0.02)	-	-
t-DDT	ug/l		0.1	1(0.01)	-	-
Endosulfan	ug/l	O	10	-	-	-
Heptachlor/Epoxide	ug/l	R	0.05	0.9(0.06)	-	-
						-
Lindane	ug/l	A	2	3(0.4)	-	
		B				-
2,4-D	ug/l	S	70	450	-	
2,4,5-T	ug/l	E	10	160	-	-
2,4,5-TP	ug/l	N	4	840	-	-
Paraquat	ug/l	T	10	1,800	-	-

N = Free from visible film sheen, discoloration and deposits

\# = Maximum (unbracketed) and 24 hours average (bracketed) concentrations.

Source: DOE, Malaysia.

Class I represents water bodies of quality. Standards are for the conservation of natural environment in its undisturbed state. Water bodies such as those the national park areas, fountain-heads, and undisturbed area come under this category Where strictly no discharge of any kind is permitted. Water bodies in this category meets the most requirement for human health and aquatic life protection.

Class II represents water bodies of good quality. Most existing raw water supply sources come under this category . In practice, no body contact activity is allowed in this water for prevention of probable human pathogens. There is a need to introduce another class for water bodies not used for supply but of similar quality which may be referred to as Class IIB. The determination of class IIB standards based on criteria for recreational used and protection of sensitive aquatic species.

Class III is defined with the primary objective of protecting common an moderately tolerant aquatic species of economic value. Water under this classification may be used for water supply with extensive/advanced treatment. This class of water is also defined to suit livestock drinking needs.

Class IV define water quality required for major agricultural irrigation activities which may not cover minor applications to sensitive crops.

Class V represents other water which do not meet above uses.

Table - 7.2-7 Environment quality act. 1974, environmental quality for Malaysia

(sewage and industrial effluents) regulations 1974

regulations 8(1), 8(3) parameter limits of effluent of standards A and B

Parameter	Units	Standard		Parameter	Unit	Standard	
		A	B			A	B
i) Temperature	c°	40	40	xiii) Copper	mg/l	0.20	1.0
ii) pH Value	_	6.0-9.0	5.5-9.0	xiv) Manganese	mg/l	0.20	1.0
iii) BODS5 at 20C	mg/l	20	50	xv) Nickel	mg/l	0.20	1.0
iv) COD	mg/l	50	100	xvi) Tin	mg/l	0.20	1.0
v) Suspended Solids	mg/l	50	100	xvii) Zinc	mg/l	1.0	1.0
vi) Mercury	mg/l	0.005	0.05	xviii) Boron	mg/l	1.0	4.0
vii) Cadmium	mg/l	0.01	0.02	xix) Iron (Fe)	mg/l	1.0	5.0
viii) Chromium, Hexavalen	mg/l	0.05	0.05	xx) Phenol	mg/l	0.001	1.0
ix) Arsenic	mg/l	0.05	0.10	xix) Free Chlorine	mg/l	1.0	2.0
x) Cyanide	mg/l	0.05	0.10	xxii) Sulphide	mg/l	0.50	0.50
xi) Lead	mg/l	0.1	0.5	xxiii) Oil and Grease	mg/l	not	10.0
xii) Chromium, Trivalent	mg/l	0.2	1.0			detectable	

Source: DOE, Malaysia

Standard A: Discharge above any drinking water intake point

Standard B: Discharge below any drinking water intake point

Table - 7.2-8 Allowable limits for trade effluent discharge for Singapore

TO SEWER/WATERCOURSE/CONTROLLED WATERCOURSE

	Items of Analysis	Sewer	Watercourse	Controlled Watercourse
		Units in miligram per liter or otherwise stated		
1	Temperature of discharge	45°C	45°C	45°C
2	Colour	-	7 Lovibond Units	7 Lovibond Units
3	pH Value	6 - 0	6-8	6 - 8
4	BOD (3 days at 20°C)	400	50	20
5	COD	600	100	60
6	Total Suspended Solids	400	50	30
7	Total Suspended Solids	3000	2000	1000
8	Chloride (as Chloride ion)	1000	600	400
9	Sulphate (as SO_4)	1000	600	200
10	Sulphate (as sulphur)	1	0.2	0.2
11	Cyanide (asCN)	2	0.1	0.1
12	Detergents	30	15	5
13	Grease and Oil	60	10	5
14	Arsenic	5	1	0.05
15	Barium	10	5	5
16	Tin	10	10	5
17	Iron (as Fe)	50	20	1
18	Beryllium	5	0.5	0.5
19	Boron	5	5	0.5
20	Manganese	10	5	0.5
21	Phenolic Compounds (Expressed as phenol)	0.5	0.2	Nil
22	Cadmium	1	0.1	0.01
23	Chromium	5	1	0.05
24	Copper	5	0.1	0.1
25	Lead	5	0.1	0.1
26	Mercury	0.5	0.05	0.001
27	Nickel	10	1	0.1
28	Selecium	10	0.5	0.01
29	Silver	5	0.1	0.1
30	Zinc	10	1	0.3
31	Metals in Total	10	1	0.5
32	Chlorine (Frec)	–	1	1
33	Phosphate (PO_4)	–	5	2
34	Calcium (as Ca)	–	200	150
35	Magnesium (as Mg)	–	200	150
36	Nitrate (NO_3)	–		20

Note: The concentration of toxic Metal shall not exceed the limits as shown individually or in total. Controlled Watercourse mean a watercourse from which potable water supplied by PUB under the public Utilities. Act is obtained but does not include a watercourse from which water Is pumped into a main of the PUB.

Table - 7.2-9 Summary of chemical test results of seabed samples (1)

TEST	TEST METHOD	CHEMICAL TEST RESULTS (mg/kg)									
		St. 1	St. 2	St. 3	St. 4	St. 5	St. 6	St. 7	St. 8	St. 9	St. 10
pH value (1:2.5) (Soil:Water Extract)	(**)	7.5	8.0	7.9	7.6	100% of Shell Fragment	8.7	8.1	8.2	8.0	8.2
Ignition Loss at 900°C (% wt.)	(**)	18.0	20.6	5.8	26.3	100% of Shell Fragment	16.6	9.9	17.5	4.6	4.2
Oil & Grease (n-hexane soluble matter)	EPA 9071 A	2.3	6.7	6.5	10	100% of Shell Fragment	4.3	3.5	3.1	2.8	3.5
Chemical Oxygen Demand (COD)	(*)	147.6	34.55	11.35	90.65	100% of Shell Fragment	10.5	24	59.35	1.85	14.45
Total Sulphate (T-S)	BS 1377 Part3:1990	1.03	1.13	0.23	0.80	100% of Shell Fragment	0.37	0.32	0.80	0.11	0.48
Total Nitrogen (T-N)	(**)	3900	3390	1380	4330	100% of Shell Fragment	410	1980	3460	1150	870
Total Phosphorus (T-P)	(*)	4.3	3.1	1.9	20	100% of Shell Fragment	0.3	9.0	5.6	6.8	3.3
Total Mercury (T-Hg)	EPA 3051	0.002	0.001	N.D.	0.002	100% of Shell Fragment	N.D.	0.001	0.001	N.D.	0.001
R-Hg	EPA 3051	N.D.	N.D.	N.D.	N.D.	100% of Shell Fragment	N.D.	N.D.	N.D.	N.D.	N.D.
Cadmium (Cd)	EPA 3051	1.6	1.1	0.7	1.5	100% of Shell Fragment	1.2	0.5	1.1	<0.1	<0.1
Cyanide (CN)	APHA 4500-CN F	1.12	0.6	0.78	0.72	100% of Shell Fragment	0.014	0.17	0.35	0.13	0.18
Or-P	(*)	1.2	0.3	0.6	0.8	100% of Shell Fragment	<0.1	1.6	1.3	2.1	1.2
Lead (Pb)	EPA 3051	16	12	3.6	12	100% of Shell Fragment	0.9	12	16	2.4	16
Chromium (Cr)	EPA 3051	23	22	1.5	18	100% of Shell Fragment	1.7	6.9	25	7.0	7.4
Arsenic (As)	EPA 3051	5.5	5.1	1.9	5.5	100% of Shell Fragment	2.1	2.6	3.2	1.5	1.7
Polychlorinated Biphenyls (PCB)	EPA 8270 (MOD)	N.D.	N.D.	N.D.	N.D.	100% of Shell Fragment	N.D.	N.D.	N.D.	N.D.	N.D.
Copper (Cu)	EPA 3051	49	87	6.3	18	100% of Shell Fragment	0.5	5.9	13	26	4.9
Zinc (Zn)	EPA 3051	92	56	19	70	100% of Shell Fragment	64	23	41	12	15

Notes:

St.1...St.10 : Survey Location

(**) : Manual of laboratory method of soil analysis by rubber research institute of Malaya,1971

(*) : manual on chemical analysis of coastal water and bottom sediment by PRD/FRD Singapore, 1984

Table - 7.2-10 Summary of chemical test results of seabed samples (2)

TEST	TEST METHOD	PARAMETER	CHEMICAL TEST RESULTS	
			Co-1	Co-2
Moisture Content	Oven Drying @75°C	% (w/w)	25.4	38.5
pH value	EPA 9045	pH Value @25°C	8.2	8.0
Ignition Loss at 550°C	Furnace Method	% (w/w)	2.13	2.36
Oil & Grease (n-hexane soluble matter)	EPA 9071	mg/kg	0.01	0.01
Chemical Oxygen Demand (COD)	APHA 5220 B	mg/kg	1.33	0.65
Total Sulphide (T-S)	EPA 9030	mg/kg	3.8	3.8
Total Nitrogen (T-N)	Kjeldahl Method	mg/kg	82	92
Total Phosphorus (T-P)	APHA 4500-P	mg/kg	3.63	2.41
Total Mercury (T-Hg)	EPA 7471	mg/kg	0.012	0.042
Alkyl Mercury (R-Hg)	EPA 7471 MOD	mg/kg	0.010	0.030
Cadmium (Cd)	EPA 6010	mg/kg	<1	<1
Cyanide (CN)	EPA 9010	mg/kg	0.1	<0.1
Organic Phosphorus (Or-P)	APHA 4500-P	mg/kg	0.69	0.38
Lead (Pb)	EPA 6010	mg/kg	<1	<1
Chromium (Cr)	EPA 6010	mg/kg	6.90	4.9
Arsenic (As)	EPA 6010	mg/kg	<1	<1
Polychlorinated Biphenyls (*) (PCB)	EPA 8080/8270	mg/kg	<1	<1
Copper (Cu)	EPA 6010	mg/kg	<1	<1
Zinc (Zn)	EPA 6010	mg/kg	7.60	8.3

Note : Polychlorinated Biphenyls (*) : Results expressed on dry basis

	Co-1	Co-2
Monochlorobiphenyl	<1	<1
Dichlorobiphenyl	<1	<1
Trichlorobiphenyl	<1	<1
Tetrachlorobiphenyl	<1	<1
Pentachlorobiphenyl	<1	<1
Hexachlorobiphenyl	<1	<1
Octachlorobiphenyl	<1	<1
Nonachlorobiphenyl	<1	<1
Decachlorobiphenyl	<1	<1

Co-1, Co-2 : Survey Location

Table - 7.2.11 The reef fishes data on survey location

NO.	SPECIES	NUMBER OF INDIVIDUAL	
		BO_1	BO_2
1.	Chaetodon octofosciantus	4	4
2.	Chelman rostatus	1	-
3.	Cheilinus fasciatus	2	-
4.	Labreidas dimidiatus	1	-
5.	Halichaeres sp	1	-
6.	Pamacentrus braclialus	-	5
7.	Abudefduf lorentzi	4	-
8.	Siganus sp	5	-
9.	Cirritichthys sp	1	-
10.	Myripristis sp	6	-
11.	Scarus sp	2	2
12.	Epinephelus fasciatus	1	-
13.	Chromis ternatensis	-	6

Table - 7.2.12 Coral reef life form data on survey location

NO.	CATEGORIES	% COVER	
		BO_1	BO_2
1.	Acropora sub massive (ACS)	13	2.3
2.	Acropora tabulate (ACT)	3.3	-
3.	Acropora digitate (ACD)	9.3	1.7
4.	Coral sub massive (CS)	17.3	11.7
5.	Coral massive (CM)	27.7	30
6.	Coral encrueting (CE)	-	2
7.	Soft coral (SC)	1.7	-
8.	Sand (S)	16.3	25
9.	Other (OT)	3	-
10.	Dead coral with algae (DCA)	8.3	19.3
11.	Macro algae (MA)	-	8

Note BO_1, BO_2 : Survey location
Refer to Fig. - 7.2-1

Table - 7.2-13 The density of phytoplankton (Individual/m^3) on the survey location

NO.	SPECIES	BO_1 I	BO_2 II	CO-1 I	CO-2 II
	BACILLARIOPHYCEAE				
1.	Chaetoceros sp	518,727	207,488	591,536	253,138
2.	Bacteriastrum sp	350,141	18,624	181,554	236,539
3.	Rhizosolenia sp	116,713	13,192	20,964	99,595
4.	Dithylium sp	1,989	12,968	3,882	12,449
5.	Thalassiothrix sp	3,333	6,984	7,664	45,648
6.	Hemidiscus sp	999	12,968	2,299	4,149
7.	Coscinodiscus sp	999	8,536	2,299	8,299
8.	Climacodium so	-	-	1,553	74,696
9.	Nitzschia sp	64,841	51,872	7,664	41,498
10.	Bellerochea sp	-	-	3,882	66,597
11.	Streptotheca sp	999	-	2,299	8,299
12.	Novicula sp	25,936	25,936	2,299	4,149
13.	Bidulphia sp	2,313	776	2,299	4,149
14.	Gyrosigma sp	1,989	2,328	4,658	-
15.	Lauderia sp	25,936	6,208	-	37,341
16.	Hemiaulus sp	38,904	-	-	-
17.	Fragillaris sp	-	1,552	-	-
18.	Pinnularia sp	12,968	-	-	-
19.	Triceratium sp	333	-	-	-
	DINOPHECEAE				
1.	Ceratium sp	2,313	776	776	4,149
	NYXOPHYCEAE				
1.	Trichodesimium sp	12,968	-	3,882	-
2.	Skleletonema sp	64,841	-	-	-
	Number of Species	19	14	16	15
	Total Density (in/m^3)	1,247,242	370,208	844,510	900,495
	Diversity index (H')	2.421	2.31	1.38	2.91
	Eveness(e)	0.57	0.61	0.34	0.75

Note BO_1, BO_2, CO-1, CO-2 : Survey location
Refer to Fig. - 7.2-1

Table - 7.2-14 The density of zootoplankton (Individual/m^3) on the survey location

NO.	SPECIES	BO_1 I	BO_2 II	CO-1 I	CO-2 II
	CRAUSTACEAE				
1.	Colonus sp	333	766	-	766
2.	Corycaeus sp	-	766	766	766
3.	Oithona sp	-	-	-	8,299
	Number of Species	1	2	1	3
	Total Density (ind/m^3)	333	1,532	766	9,831

Table - 7.2-15 The density of benthos (Individual/m^3) on the survey location

NO.	SPECIES	BO_1 I	BO_2 II	CO-1 I	CO-2 II
	PELECYPODA				
1.	Eusiassatella sp	22	-	89	22
2.	Tellina sp	-	11	11	-
3.	Codralia sp	11	-	-	-
4.	Mediolus sp	-	-	-	11
	POLYCHAETA				
1.	Genus	-	-	11	-
2.	Spharodenidae	-	-	-	33
3.	Onuphis	-	11	-	-
4.	Nories	11	-	-	-
	CRUSTACEA				
1.	Orde nataneae	-	11	-	-
2.	Parthenopidae	-	11	-	-
3.	Pinnixa sp	-	11	33	-
4.	Lagunogammavus	33	11	-	-
	ECHINODERMATA				
1.	Echinodermata	11	-	-	-
	GASTROPODA				
1.	Terebra	-	-	11	-
	Undentified	22	33	-	-
	Number of Species	6	7	5	3
	Diversity Index (H')	2.45	2.64	1.75	1.46
	Eveness(e)	0.96	0.95	0.76	0.92
	Total Density (ind/m^3)	110	99	155	66

Note BO_1, BO_2, CO-1, CO-2 : Survey location
Refer to Fig. - 7.2-1

7.3 EIA for the socioeconomic environment

7.3.1 Impact on the fishery adjacent to project area

According to the statistics prepared by the Municipality of Sihanoukville, there are a total of 2,635 people working in the fishery business in the fishing villages located near the New Port area. The statistics indicate, however, that there used to be neither fishermen nor fishing boats moored in the small basin in Village No.2, because the village did not exist during the construction stage of the New Port. It is said that the fishermen who presently live in the village used to live near Prek Toek Sap Lake, which is located to the south of the port, and their boats were moored on the shore of the lake. With the start of the tourism development projects in the coastal areas conducted by municipality, those who lived in that area were forced to move to the New Port area together with their boats, and this was the start of the formulation of the fishing villages presently observed in the New Port area.

The fishing activities in this area are classified into two groups. One group consists of those who operate low-powered wooden boats in the coastal area and catch mainly shrimps and squids. The other group includes those who operate relatively large size wooden boats in the area 20 km away from Koh Rong Island (see Fig. - 7.3.2-1). That area is officially approved by the government as a commercial fishing site, and those who catch fish in the fishing site are required to pay annual taxes. According to the information of the Fishery Department, the New Port area and the coastal areas of Sihanoukville City are reserved for the preservation of natural resources of fish and no fishing is allowed there. However, the authority allows the small boats with simple fishing gears to catch fish there.

The fish catch amounts to more than 500 kg/day, and some portion of this amount is consumed locally and the rest is transported to the markets in Phnom Penh. The fish sales in Phnom Penh are done by local agents based in Phnom Penh. Recently, a shrimp factory was established between Village No.2 and No.3 by a Hong Kong-based company. Shrimp is processed there and exported to foreign countries in reefer containers. In addition, approximately 20 tons of fish caught by the fishermen of these villages are exported to Thailand. An ice and freezing factory located in the fishing village supplies ice needed for packing of export fish.

It was learned that there are no associations organized by inhabitants of the fishing village in the New Port area. Only two companies were established for the operation of fishery in this area. One is the newly constructed shrimp factory, and the other is fish preserve for export of fish located in Village No.2. It was also observed that there is no water right or common right or fishing right in the sea area where the dredging and disposal of soil will be performed for the port development project. No fishing operations are conducted and it is therefore anticipated that there would be only minor environmental impact occurrence.

According to the result of the interview with the inhabitants of Village No.2 as described

in 7.3.3 (see also Appendix E), it is anticipated that environmental impact to the fishery and fishermen will be relatively small provided that the existing basin and mooring facilities are reserved as they are and the fishermen are allowed to keep using these facilities. The only foreseeable impact is that a conflict between fishing boat traffic and container ship traffic calling on the port could arise unless proper traffic rules are enforced in the port area. In case such a conflict occurs, the situation can be settled by reforming the existing jetty in the village or constructing a new jetty as an alternative facility to moor the fishing boats at an appropriate location in the New Port area.

7.3.2 Resettlement plan conducted by Sihanoukville City

The officials of the Ministry of Public Works and Transport (MPWT) and the Ministry of Agriculture, Forestry and Fisheries acknowledged that the fishermen illegally occupy the state owned lots in the port area of Sihanoukville Port, and that this situation should not be allowed to continue. In 1984, the local government of Sihanoukville city once decided to relocate those fishermen living in the port area in Steng Haw, which is a fishermen's village 23 kilometers away to the north of Sihanoukville, but failed to settle them there. At present, the Municipality of Sihanoukville has another plan to resettle illegal occupants to three locations, namely, Steng Haw, Koh Rong and Koh Tyong (see Fig. - 7.3.2-1 for the locations). These areas have already been approved by the governor.

So far, approximately 2,000 people have been resettled from the mainland to Koh Rong Island which is one of the proposed areas for resettlement and a new local community has already been established there. This island is close to the sea area for commercial fishing which was officially approved by the government, and thus has several advantages for those whose livelihood is fishing. The local government therefore believes that this island is a potential resettlement site for the inhabitants who, at present, illegally stay in Village No. 2.

Even though neither the time schedule of the implementation nor details of further resettlement plan have been announced formally, the relocation of inhabitants of Village No.2 was started in august, 1996. This action was initiated by the resettlement committee organized by Sihanoukville City government and the committee which consists of the governor, representatives of military police, environmental office, planning office, urbanization and construction office, etc.

According to the reconnaissance site survey of the study team in November, 1996, it was observed that approximately 30 houses in Village No. 2 have been already demolished (see Table - 7.3.2-1). However, no detailed resettlement plan had yet been published by the committee and it was not clear how the committee would proceed with the plan in the future. It was said that many of those inhabitants who had moved out from the village and whose houses in Village No. 2 had been demolished owned their permanent homes in the downtown area, and that the committee had borne the cost of moving to the other place.

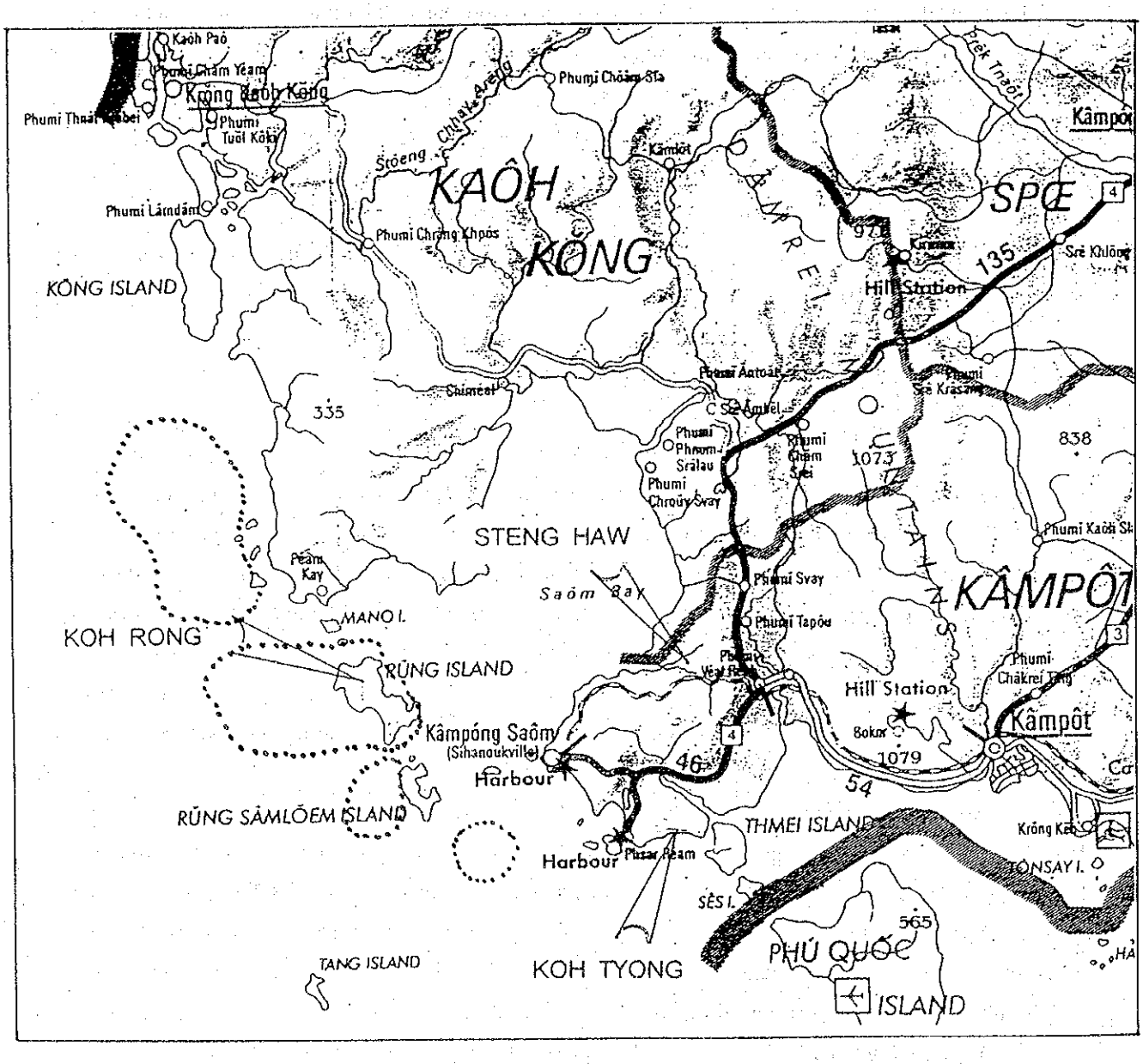

Fig. - 7.3.2-1 Proposed location for resettlement and fishing area

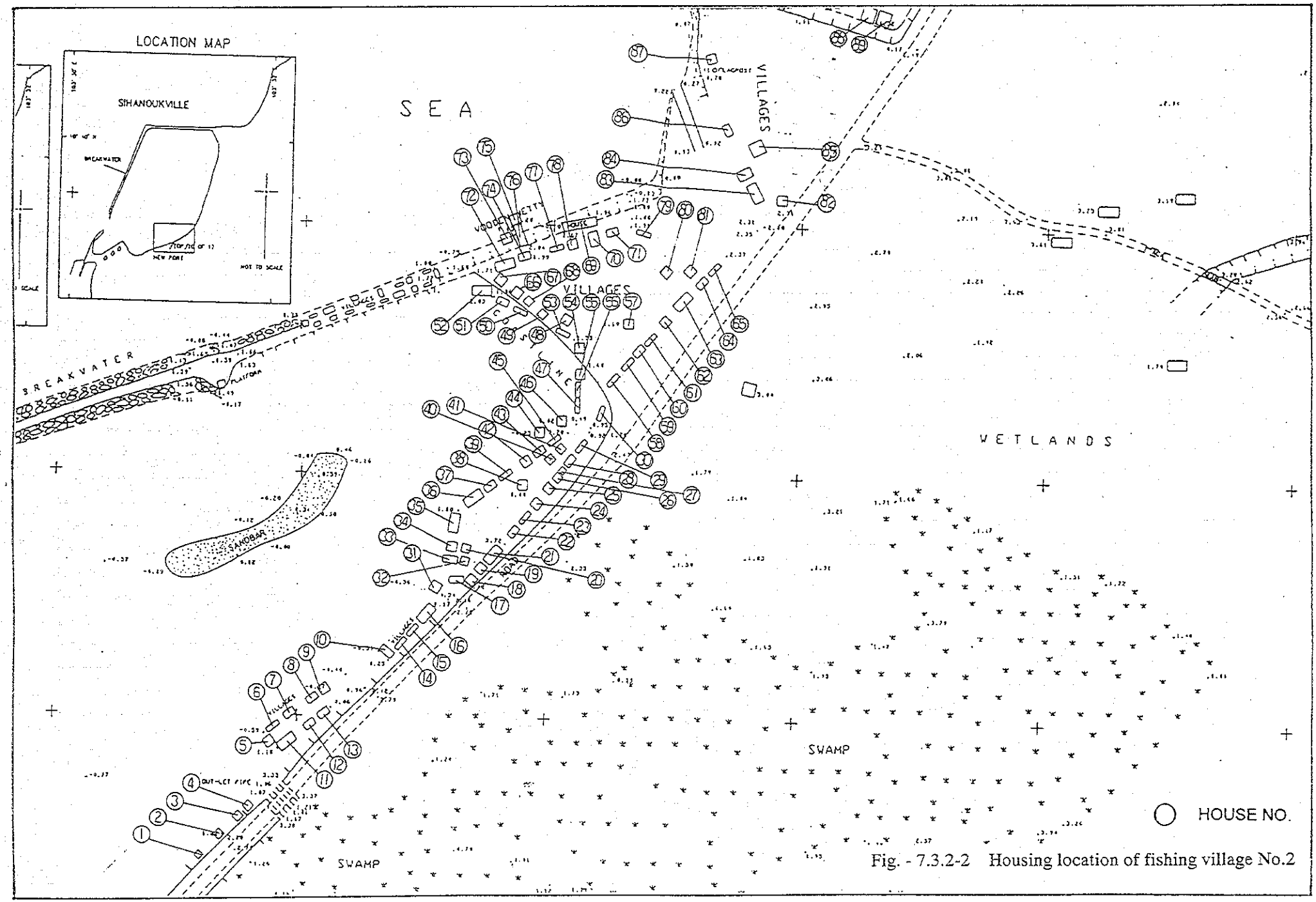

Fig. - 7.3.2-2 Housing location of fishing village No.2

Table - 7.3.2-1 Survey on the existing houses / building at fishing village No.2 (1/2)

SUMMARY OF EXISTING HOUSES/BUILDINGS

KIND OF HOUSE	NUMBERS	DEMOLISHED	NOTES
Living House	73	33	
Cafe	3	0	Numbers : Checked in April 1996
Shop	2	0	Demolished : Checked in November 25,1996
Shop and Snooker Club	1	0	
Boat Running Facility	2	0	
Machine tools Shop	2	0	
Winch House	1	0	
Slipway/Dock Office	1	0	
Oil station	1	0	
Booking Office/Ticket House	1	0	
Fishes Preserve Facility	1	0	
TOTAL	88	33	

Table - 7.3.2-1 Survey on the existing houses / building at fishing village No.2 (2/2)

DATA : As of Nov. 25, 96'

NO.	CHK	KIND OF HOUSE	STRUCTURE	ROOF	ELECT.	NOTES
1	D	Living House	-	-	-	
2	D	Living House	-	-	-	D: Demolished
3	D	Living House	-	-	-	A : Available
4	D	Living House	-	-	-	NA : Not Available
5	A	Living House	Wooden	Palm	NA	
6	D	Living House	-	-	-	
7	A	Living House	Wooden	Galvanized Sheet	NA	
8	A	Living House	Wooden	Palm	NA	
9	A	Living House	Wooden	Palm	NA	
10	A	Living House	Wooden	Palm	NA	
11	A	Living House	Wooden	Palm	NA	
12	D	Living House	-	-	-	
13	D	Living House	-	-	-	
14	A	Living House	Wooden	Palm	NA	
15	A	Living House	Wooden	Palm	NA	
16	A	Living House	Wooden	Palm	NA	
17	A	Living House	Wooden	Palm	NA	
18	A	Living House	Wooden	Palm	NA	
19	A	Living House	Wooden	Palm	NA	
20	A	Living House	Wooden	Palm	NA	
21	A	Living House	Wooden	Palm	NA	
22	A	Living House	Wooden	Galvanized Sheet	A	
23	D	Living House	-	-	-	
24	A	Living House	Wooden	Palm	NA	
25	A	Living House	Wooden	Palm	NA	
26	A	Living House	Wooden	Palm	NA	
27	A	Living House	Wooden	Palm	NA	
28	D	Living House	-	-	-	
29	D	Living House	-	-	-	
30	A	Living House	Wooden	Palm	NA	
31	A	Living House	Wooden	Palm	NA	
32	D	Living House	-	-	-	
33	A	Living House	Wooden	Palm	NA	
34	D	Living House	-	-	-	
35	A	Living House	Wooden	Palm	NA	
36	D	Living House	-	-	-	
37	D	Living House	-	-	-	
38	D	Living House	-	-	-	
39	A	Living House	Wooden	Palm	NA	
40	D	Living House	-	-	-	
41	D	Living House	-	-	-	
42	D	Living House	-	-	-	
43	A	Living House	Wooden	Palm	NA	
44	D	Living House	-	-	-	
45	A	Living House	Wooden	Galvanized Sheet	NA	
46	D	Living House	-	-	-	
47	A	Living House	Wooden	Palm	NA	
48	A	Living House	Wooden	Palm	NA	
49	D	Living House	-	-	-	
50	A	Living House	Wooden	Galvanized Sheet	NA	
51	A	Living House	Wooden	Galvanized Sheet	NA	
52	A	Living House	Wooden	Palm	NA	
53	A	Living House	Wooden	Palm	NA	
54	A	Living House	Wooden	Palm	NA	
55	D	Living House	-	-	-	
56	D	Living House	-	-	-	
57	D	Living House	-	-	-	
58	A	Living House	Wooden	Palm	NA	
59	A	Living House	Wooden	Palm	NA	
60	A	Living House	Wooden	Palm	NA	
61	D	Living House	-	-	-	
62	D	Living House	-	-	-	
63	D	Living House	-	-	-	
64	A	Machine tools Shop	Wooden	Galvanized Sheet	A	
65	A	Winch House	Wooden	Asbest-cement	A	
66	A	Living House	Wooden	Palm	A	
67	A	Living House	Wooden	Galvanized Sheet	A	Under construction
68	D	Living House	-	-	-	
69	D	Living House	-	-	-	
70	D	Living House	-	-	-	
71	D	Living House	-	-	-	
72	A	Shop	Wooden	Palm	NA	
73	A	Boat Running Facility	Wooden	Galvanized Sheet	NA	Under construction
74	A	Shop, Snooker Club	Wooden	Galvanized Sheet	A	
75	A	Boat Running Facility	Wooden	Galvanized Sheet	NA	
77	A	Shop	Wooden	Galvanized Sheet	A	
78	A	Cafe	Wooden	Palm	A	
79	A	Cafe	Wooden	Galvanized Sheet	A	
80	A	Living House	Wooden	Palm	NA	
81	A	Living House	Wooden	Palm	NA	
82	A	Machine tools Shop	Wooden	Plastic Sheet	A	
83	A	Booking Office/Ticket Hous	Wooden	Galvanized Sheet	A	
84	A	Cafe	Wooden	Galvanized Sheet	A	
85	A	Fishes Preserve Facility	Wooden	Galvanized Sheet	A	
86	A	Slipway/Dock Office	Wooden	Galvanized Sheet	A	
87	A	Oil Station	Wooden	Galvanized Sheet	A	
88	D	Living House	-	-	-	
89	D	Living House	-	-	-	

House No. : Refer to FIG. 04 Housing location of fishing village No. 2

To discourage new inhabitants from returning to the village, fences made of concrete posts and barbed wires were constructed by Sihanoukville Port along the coast line between Sihanoukville Port and the entrance of Village No.2. In addition, the local government had started to impose mooring charges of daily base on the boats moored in the basin of the village.

Until August 1996, the local government had never taken any action against the inflow of inhabitants into this area. The study team is still concerned that new interlopers may move in and stay in Village No.2 in the future. In addition to the private properties, there are some various facilities operated by the local government such as shipyards and municipal ports for passenger ships. However, no clear policy is yet established regarding the land and water use of the area after the relocation of the inhabitants.

Regardless of the existing issues described above, it is the study team's understanding that the on-going relocation action carried out by the local government is a project from the viewpoint of the enforcement of local administration of public properties and that it is independent from the current port development study. It should be noted that none of the proposed plans, i.e., the Long-term Plan, the Short-term Plan, and the Urgent Improvement Measure) requires any resettlement of habitants.

7.3.3 Impact on the socioeconomic activities in the village near the Port

(1) Methodology of the socioeconomic survey in the village

The socioeconomic activities in Village No.2 (see Fig. - 7.4-1) were observed in the following manner:

a. Visual observation

The number of houses, other structures and the activities in these facilities were observed by locally hired assistants of the study team. The traffic of the fishing boats across the port entrance and the Village No. 2 was surveyed by the Study Team.

b. Interview with the owners of the fishing boats and the residents of the houses

The impact on the Village is expected to be considerable in the basin behind the groin where the fishing boats were moored and activities related to fishing are performed. Therefore, interviews were conducted with the owners of the fishing boats and the residents of the houses around the basin.

In the Village No.2, there were 110 fishing boats and 41 residential houses. The socioeconomic activities in this village were analyzed on the basis of the results of the interview with the owners of 93 fishing boats and the residents at the 41 houses in the Village. Two separate series of questionnaires were prepared. Ten (10) local people were interviewed under the supervision of the study team.

In the course of the interview, it was recognized that the majority of those who were taking care of the fishing boats and fishing gears were not the owners themselves but employees. Thus, the interviewers had to wait for the arrival of the owners when the fishing boats were ready to leave the Village for fishing. It was also found that most of those who lived in the houses were not the owners but tenants. Therefore, tenants of the houses were interviewed, even though the owners were the original targets.

The fishing boat traffic is shown in Fig. - 7.3.3-1 (at the entrance of the Port) and Fig. - 7.3.3-2 (at the entrance of Village No. 2). It is recognized that, in general, the fishing boats left the Port of Sihanoukville before sunset and returned after sunrise. It should be noted that heavy traffic is observed between 17:00 and 18:00 and between 06:00 and 08:00 at both the port entrance and the entrance of Village No.2.

(2) Results of visual observation

Of the total 110 fishing boats, 103 boats had engines and seven did not. Of the 103 boats with engines, 57 boats were fairly large sized (about 7 to 10 meters) and had a cabin in the middle. Usually four to five people are on board when they leave for fishing. These larger size fishing boats were moored along the jetty of Village No.2. The remaining 46 boats with engine and seven small boats without engine were moored along the shoreline of the basin where residential houses are seen.

(3) Results of the interview

a. Owners of the fishing boats

i) Ownership of the boats (Fig. - 7.3.3-3)

All the boats are owned by individuals .

ii) Major use of the boats (Fig. - 7.3.3-4)

Three-quarters of the boats are used for commercial fishing: shrimp and other kind of fish.

iii) Frequency of boat operation (Fig. - 7.3.3-5)

Majority of the boats are operated almost every day.

iv) Length of mooring in the village (Fig. - 7.3.3-6)

About 90 % of the owners started to mooring their boats since 1993 or later.

v) Activities in the village (Fig. - 7.3.3-7)

The activities include selling the fish they catch, maintenance and repair of the boats and fishing gears and supplying fuel, water, food.

vi) The reason for mooring the boats in the village (Fig. - 7.3.3-8)

The reason is the convenience of above activities.

vii) Place the owners live (Fig. - 7.3.3-9)

One-third of the owners live on their boats, another one third live in the village,

and one fourth live outside of the village. It seems that those who live on the boats have the house somewhere else.

viii) Previous mooring site (Fig. - 7.3.3-10)

More than a half of the owners did not identify where they moored their boats before. Among those who identified their former mooring place, a half are from outside the Sihanoukville Port Area.

ix) Location of fishing site (Fig. - 7.3.3-11)

Fishing sites are located outside of Compong Som Bay. The water area to the west of the Koh Rong Island is the major fishing site. Some fishermen catch fish at the water area to the south of Compong Som Bay

x) Relationship with the Village No. 1 (Fig. - 7.3.3-12)

Forty percent (40%) of the boats owners declined to answer to this question. Twenty percent (29%) of the boats have never called on other village. On the other hand about 10% of owners often called on Village No. 1. Those who visit Village No. 1 seem to be temporary users of the facilities in Village No.1(of the 93 owners interviewed, there were six temporary users).

Those who called on Village No.1 sometimes were 30% of 38 boat owners. The purpose of their calls was to see their relatives and friends, to supply fuel, etc. and to sell fish(see Fig. - 7.3.3-13). This indicate that the activities in Village No. 2 are interrelated with Village No. 1.

xi) Boat Owners who own a house in Village No. 2

Of the 93 owners of the fishing boats, 38 owned a house in Village No. 2.

xii) Selling route of fish

With few exceptions, most of the fish caught by the fishing boats are sold to brokers.

b. Residents of the houses

i) Major use of the houses (Fig. - 7.3.3-14)

Half of the 41 houses are used for accommodation only. One third are used for both accommodation and other purposes: selling fish, maintenance of boats, fishing gears etc. 12 % of the houses are used for restaurants, grocery stores, selling fish, etc.

ii) Occupation of the Chief of households (Fig. - 7.3.3-15)

About half of the residents (the head of each house) are engaged in fishery business, while the other half is engaged in the following activities: soldier, selling groceries, mechanic, motorcycle taxi driver, etc..

iii) Number of adults living in a house (Figs.- 7.3.3-16 and 17)

Number of adults and number of children who live in a house is shown in Fig. - 7.3.3-16 and Fig. - 7.3.3-17, respectively. Figure - 7.3.3-16 shows that about 60% of

the houses are used by two adults and majority of the tenants live together with children (see Fig.- 7.3.3-17). This implies that many of the houses are used by families which consist of parents and their children.

Figures - 7.3.3-17 also shows that 10% of houses are used by one adult only, and about 30 % of the houses are shared by three adults or more. This implies that about 40% of the houses are used as temporary accommodations for those who have jobs related to the commercial activities in the village.

iv) Length of living in the houses (Fig. - 7.3.3-18)

Sixty percent of the households have been living for three years or less(Fig. - 7.3.3-18). Majority of them came from outside the port area(Fig. - 7.3.3-19).

(4) Analysis

Based on the visual observation and the interviews, the following findings are presented:

a. Majority of the boats have been moored in Village No. 2 since three years ago or later. This conforms statements given by the officials of Sihanoukville Port and French people working in the medical program who have been in Sihanoukville since 1991. It is most probable that these boats came from outside of Sihanoukville port area, though a half of the boat owners did not want to identify where they moored the boats before.

b. Most of the houses which presently exist in the village were owned by the boat owners. This fact implies that these houses were constructed by these boat owners when they started mooring their boats and were rent to others. At present, the residents of the houses in the village rent the houses from the boat owners.

Most of the chiefs of households are employees of the boat owners, ship repair yard or other business such as soldiers. Others are self-employed, running grocery stores or operating motorbike taxi. Majority of them live in these houses with their family, while some houses are shared by business colleagues.

c. The major reason why they moor their boats in the village is the convenience of selling fish, maintaining and repairing the boats and fishing gears and supplying fuel, water, food.

d. About one thirds of the boats in Village No. 1 sometimes visit Village No. 2. Thus, there exist some relationship between the two communities exist, though it does not seem to be very close.

(5) Discussions

The community in the village has been formulated over the past three years. Owners of

the fishing boats came to this area from various places outside Sihanoukville Port for shelter of their boats. They constructed houses near the shore. These houses are rent to those who came to this place to get jobs related to the boats.

Most of the residents, at present, are the employees in such businesses as fishing, shipbuilding and repair, transportation business and shops. Some families started running small shops and restaurant for the people living and working in the community.

Thus, the community has been formulated through the fishing and related businesses. The people there seem to prefer to live in the village for the convenience of its proximity to their working place. The tie among the residents is not originated from either kinship or territorial identity.

It is a most important element, therefore, in the development plan of Sihanoukville Port, to avoid impact which may give an adverse effect on the fishing related businesses in the village. This does not necessarily mean that the existing village should be reserved as it is. In such case that some modification of the facilities, structures and topography of the village is required, alternative facilities can be accepted by the people in the community provided that the same functional level and convenience of the existing facilities are provided under the new circumstances .

(6) Road traffic on the municipal road

There is a municipal road just behind the village. The road is the access from National Road No. 4 to Oil Port and the municipal ports in the Sihanoukville port area. However, Sihanoukville Port is directly connected to the National Road No. 4 and no cargo trucks and trailers pass through the above mentioned municipal road. It is thus concluded that no considerable impact on the socioeconomic activities in the village is expected to be generated by the increase of cargo traffic at Sihanoukville Port. The methodology and the results of the traffic survey are described in Appendix F.

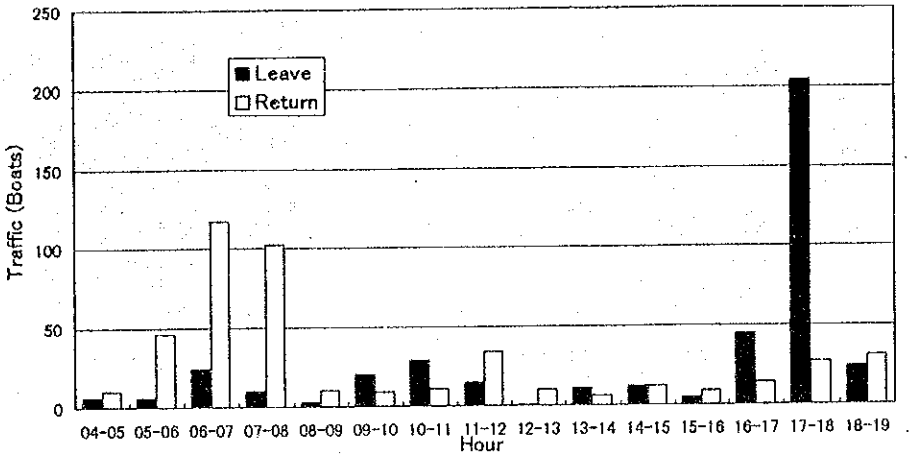

Fig. - 7.3.3-1 Fishing boat traffic at the port entrance

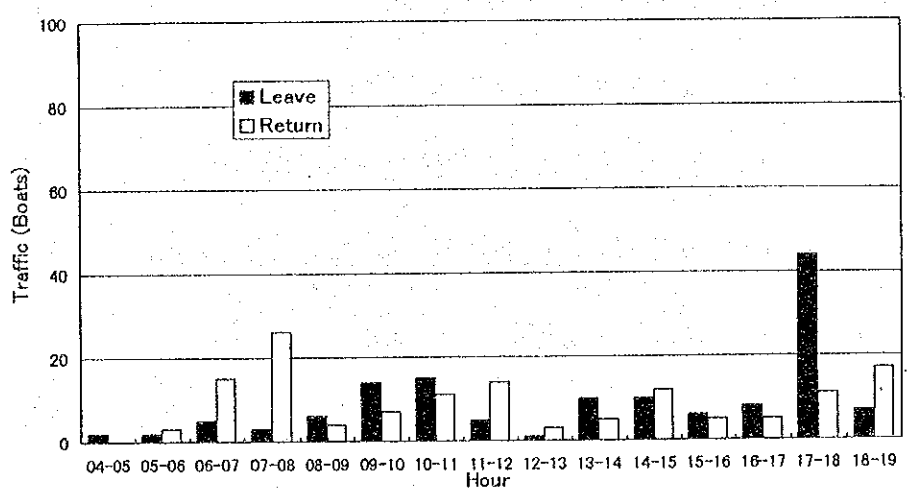

Fig. - 7.3.3-2 Fishing boat traffic at the village

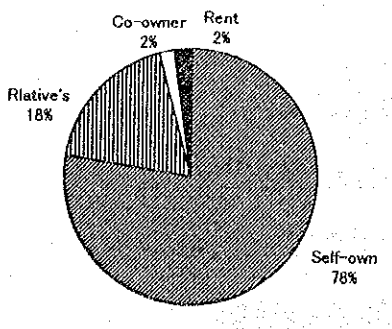

Fig. - 7.3.3-3 Ownership of boats

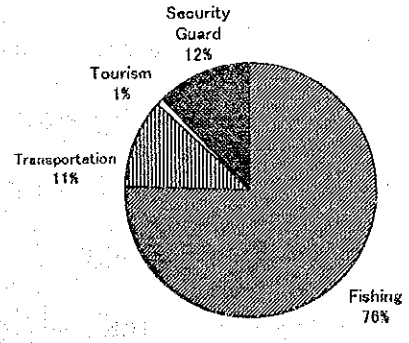

Fig. - 7.3.3-4 Major use of boats

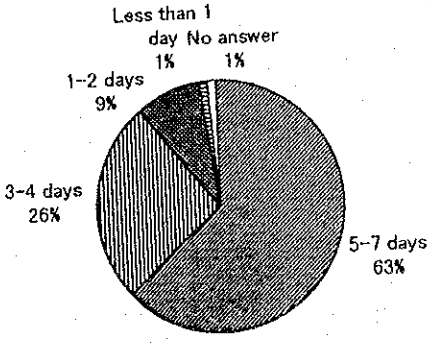

Fig. - 7.3.3-5 Frequency of boats operation per week

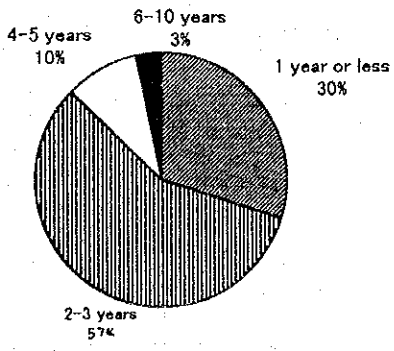

Fig. - 7.3.3-6 How many years have the boats been moored in the village

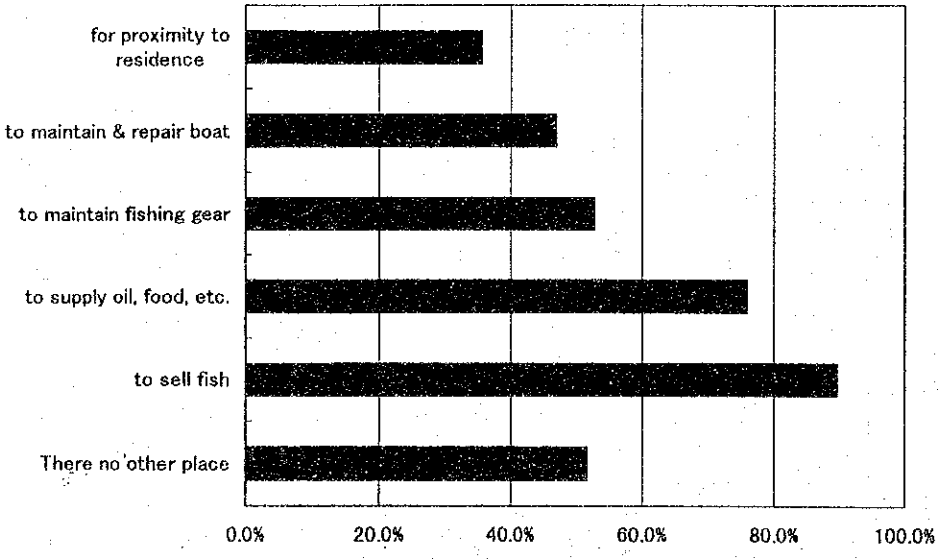

Fig. - 7.3.3-7 Reason to moor boats in the village

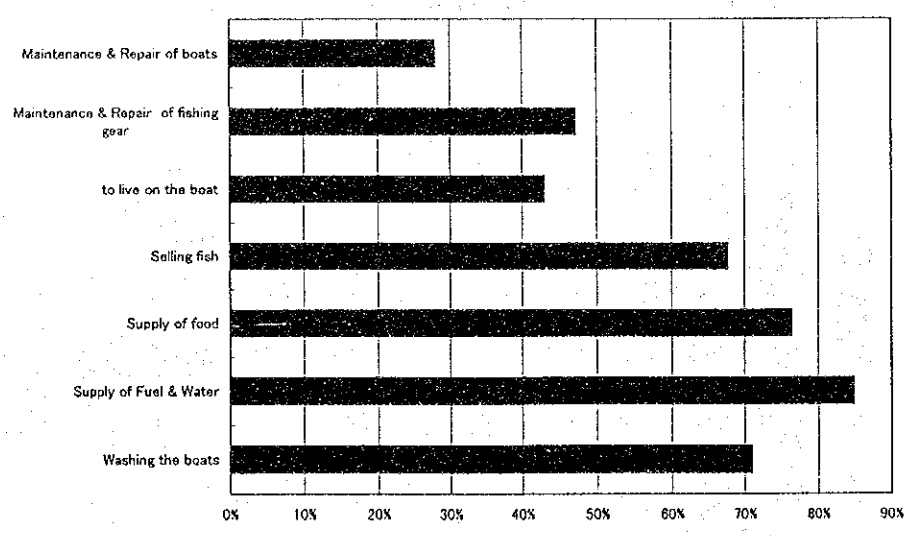

Fig. - 7.3.3-8 Activities in the village

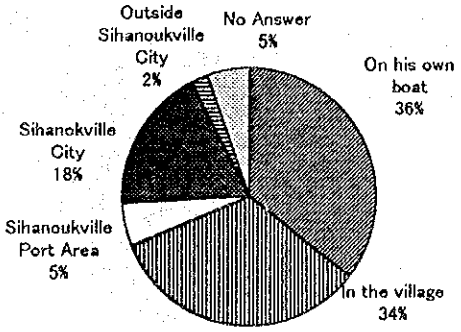

Fig. - 7.3.3-9 Location of the residence of boat owners

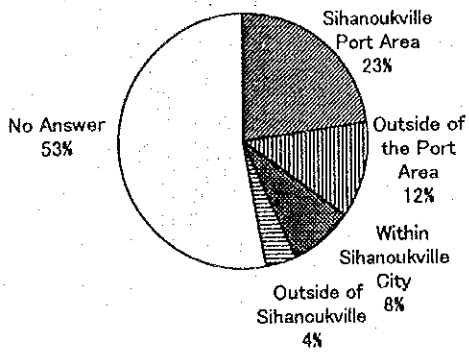

Fig. - 7.3.3-10 Former mooring place

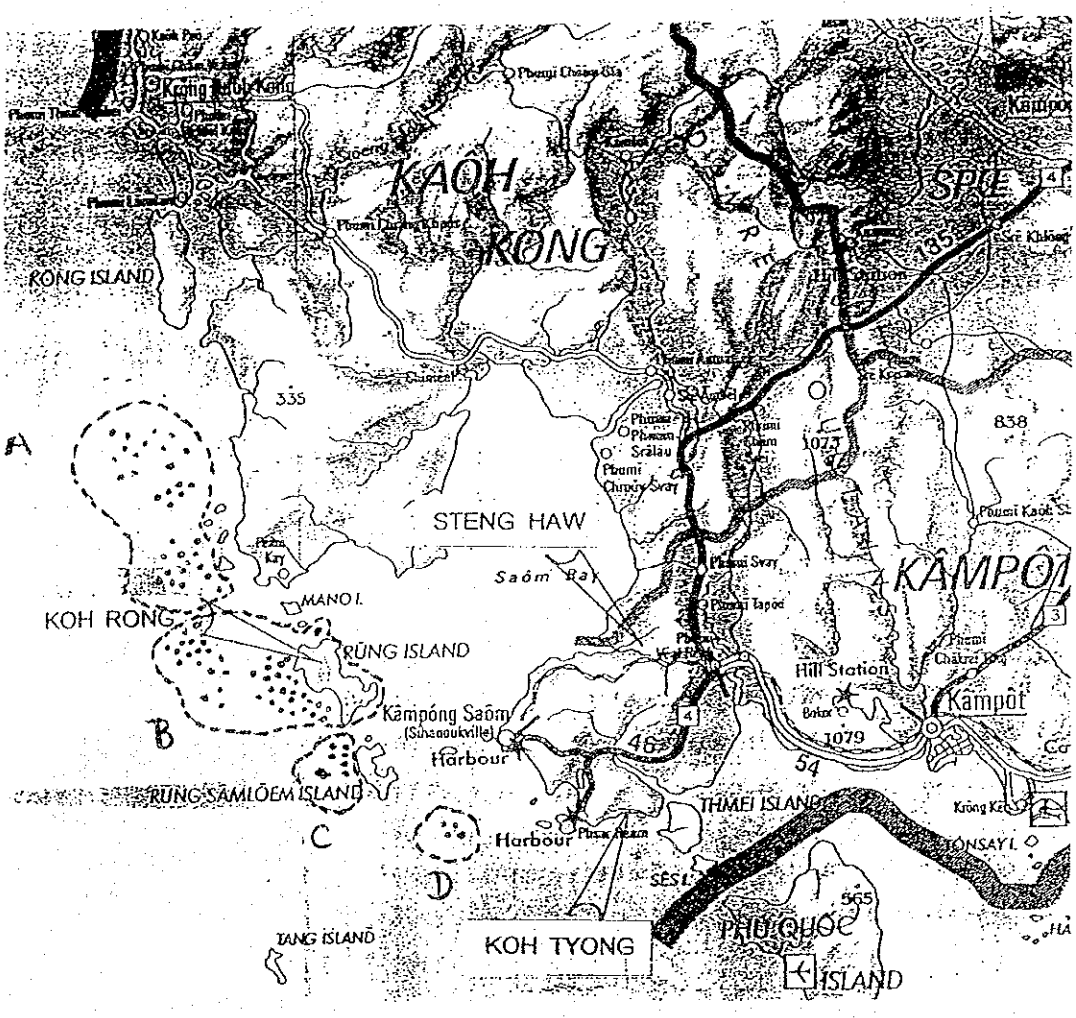

Fig. - 7.3.3-11 Location of fishing site

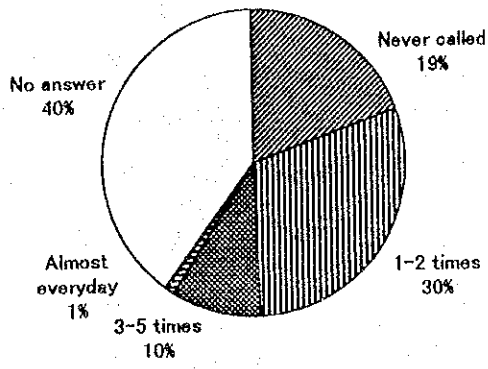

Fig. - 7.3.3-12 Frequency of calls on the other village per week

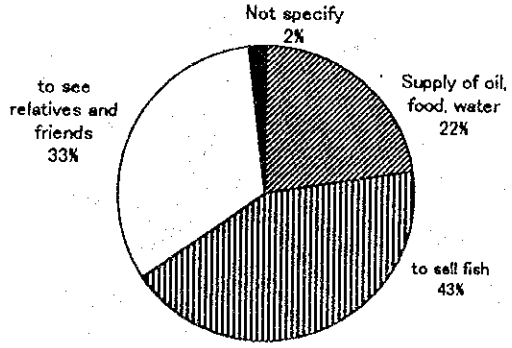

Fig. - 7.3.3-13 Purpose of calls on the other village

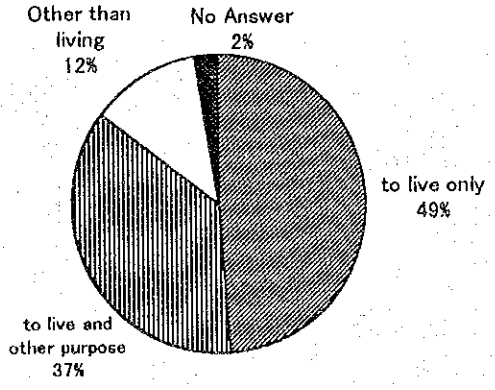

Fig. - 7.3.3-14 Purpose of house use

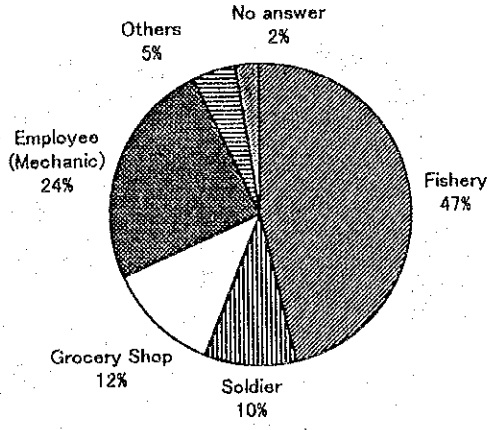

Fig. - 7.3.3-15 Occupation of family chief

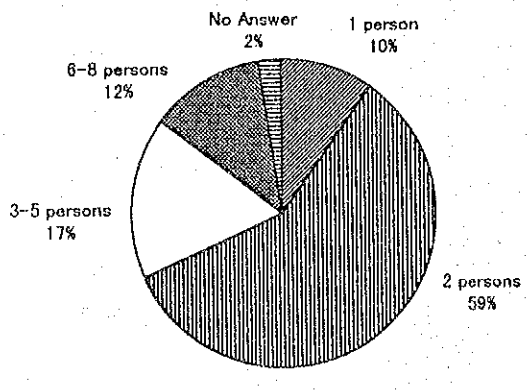

Fig. - 7.3.3-16 Number of adults living in the house

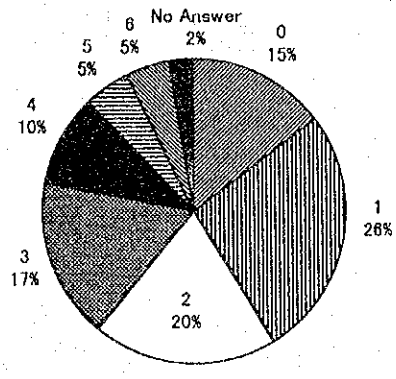

Fig. - 7.3.3-17 Number of children in the house

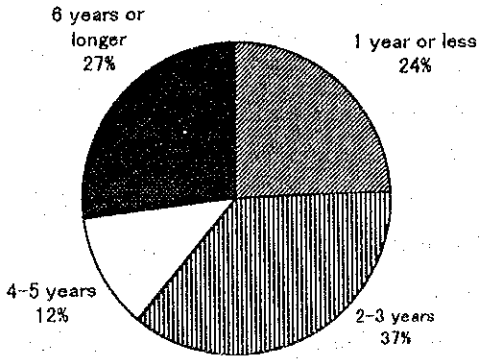

Fig. - 7.3.3-18 How long has the house been used

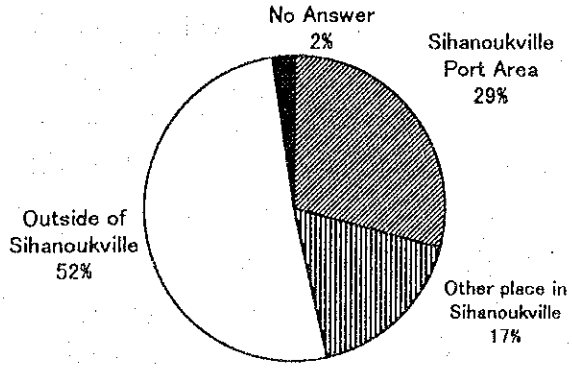

Fig. - 7.3.3-19 Where did you live before moving in

7.4 EIA for the hydrological environment

There are three effluent routes from land area to the basin of Sihanoukville Port. One route is the streams running from the existing pond to the port basin through culverts installed at three locations under the municipal road along the coast (see Fig. - 7.4-1). During the rainy season, the effluent of the streams flowing into the port basin through these culverts contains remarkable suspended soil, of which major constituent is laterite, which is washed away by rain from land area. Another route is the rain water discharged from the land area of the port, and the third route is the domestic sewage from the offices and workshops of the port where approximately 1,020 people are working.

Of these three routes, the first route has the largest discharge water volume into the port basin, and thus would be the main cause of the sedimentation of the basin. The waterfront area of Sihanoukville Port is low and swampy land, and there are several ponds, the sizes of which become larger during the rainy season. Therefore, these ponds serve as buffer of the effluent in the hydrological system in this area and some portion of suspended soil which is brought from the hills nearby would settle in these ponds. This situation would lead to a considerable reduction of the density of suspended soil when the effluent is discharged into the port basin.

According to results of the laboratory test, the density of suspended soil of the effluent water sample which was taken at the outlet of the culvert was 132 ppm. This value of density is considerably high in comparison with the SS density in the middle of the port basin where the SS density was 40 - 45 ppm. This implies that more than half of the suspended soil brought from the land area settles in the port basin and this is the main cause of sedimentation there.

On the other hand, the volumes of water discharged through the other two routes are much smaller than that through the first routes. In addition, the density of suspended soil of the effluent from the port (land) area, which was measured to be 430 ppm after a heavy rain in November 1996, can be reduced considerably when the roads and storage yards are paved in the future. The domestic sewage, which is the third route of the effluent, would not contain much suspended soil. Therefore, from the viewpoint of the suspended soil and the sedimentation, it is concluded that the effluent from the ponds in the waterfront area is the major cause.

According to the numerical simulation of the sedimentation in the port basin near the outlet of the culverts, the construction of a new container terminal (the Short-term Development Plan) will not change the existing hydrological system there and the rate of sedimentation in the area will remain almost unchanged (see Appendix G). However, in order to confirm the results of the numerical simulation, it is also required to monitor the density of the suspended soil and the change of topography of the port basin during the construction stage and after the completion of the project.

In addition, from the viewpoint of preventing water pollution in the port basin, the domestic sewage from the port should be treated by sewage disposal plant before being discharged to the sea.

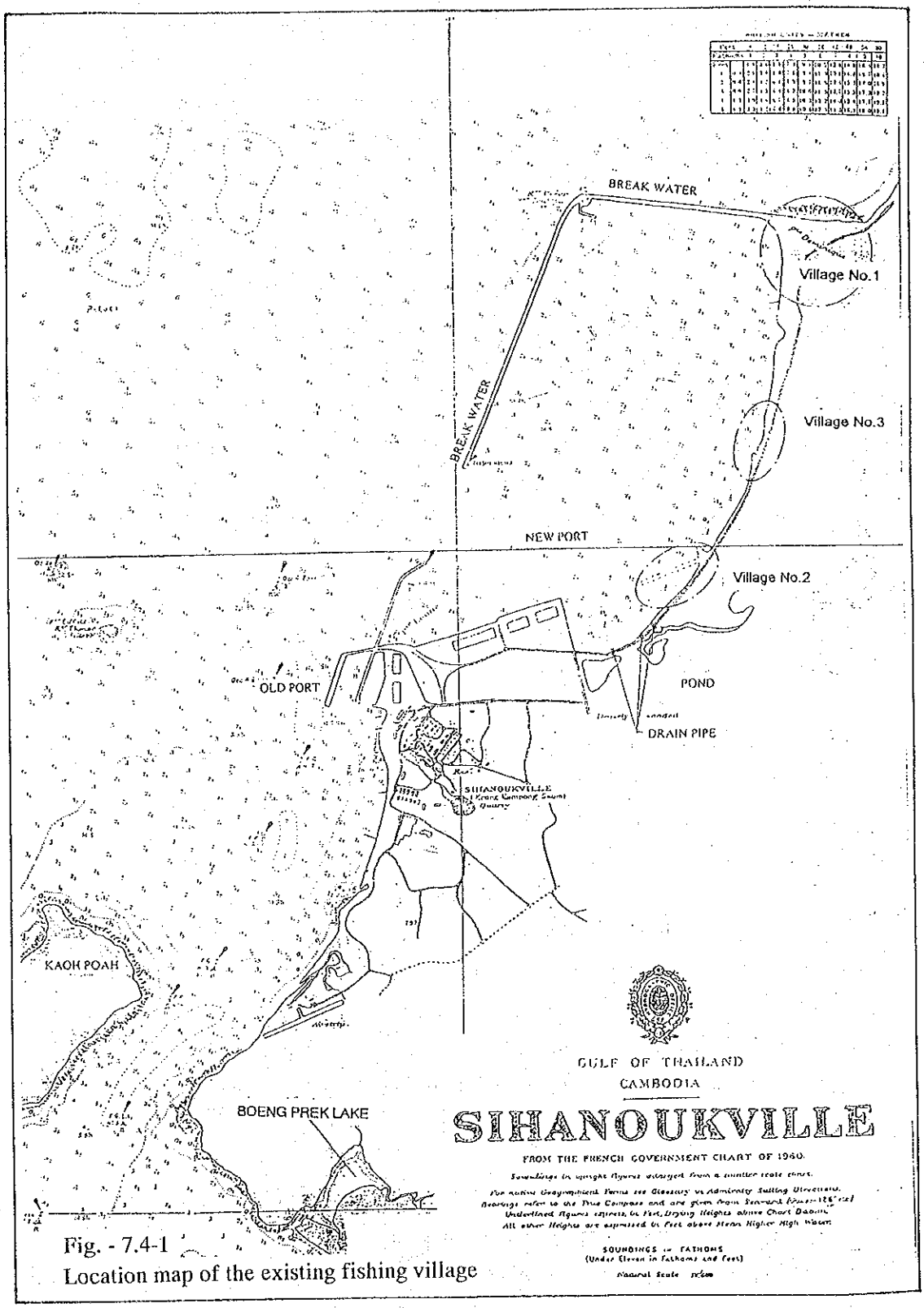

Fig. - 7.4-1
Location map of the existing fishing village

7.5 Environmental monitoring

Though the Low of Environment which is the basic environmental protection law was published in September 1996, the sub-decrees regarding codes, standards and regulations which prescribe the procedure and requirements of EIA were still under preparation by the Ministry of Environment of the Kingdom of Cambodia. Therefore, rules and standards which should have been referred to in this study were not available during the course of the study. However, the proposed port development plans will be implemented, these roles and standards would be enforced, and the implementing agency of the project may be requested by the Ministry of Environment, to observe these roles and standards and to carry out environmental monitoring.

As far as are basic data for port operation is concerned, the port authority, through its own experience, may attain enough data and information needed for the evaluation of the impacts which may occur by the implementation of the project. However, there is still some possibility that environmental impact would occur unexpectedly due to the effect of the reclamation, dredging and disposing of dredged materials, river water flow to port area, resettlement of inhabitants, etc. Regarding these items, it would be required to conduct continuous monitoring to minimize the impact on the environment during and after the construction.

Basically the monitoring work shall be carried out for the following three stages:

a. Environmental survey at pre-construction stage
b. Environmental survey during construction stage
c. Continuos environmental survey at post-construction stage

The survey conducted by the study team is the environmental survey at pre-construction stage, i.e., stage a above. Therefore, it is the responsibility of Sihanoukville Port to conduct monitoring of environmental situation further for the stages b and c in accordance with the list of items which requires monitoring at the respective stages of the project implementation (see Table - 7.5-1)

Regarding the environment monitoring for the construction stage, Sihanoukville Port may request the contractors and consultants involved in the construction to jointly execute the monitoring. After the completion of the construction, Sihanoukville Port is responsible to continue periodical monitoring of environment.

In order to implement environmental monitoring effectively, Sihanoukville Port should proceed with the following steps:

a. Preparation of details of implementation plan for monitoring
b. Execution and maintenance of monitoring plan
c. Analysis of data obtained from monitoring

d. Preparation of proposal for EIA and mitigation

e. Study of evaluation method and execution of environmental survey

It is also foreseen that the oil port may cause serious water pollution once an accident occurs. Taking into account the fact that sea water near the oil port contains considerable amounts of oil and grease (22 mg/l) even at present, which suggests some oil spill might have occurred, the establishment of a monitoring system of water pollution at the oil port is quite urgent, and Sihanoukville Port is the agency to initiate the coordination among the agencies and private companies concerned to establish such a monitoring system. This system can be separated from the environmental monitoring program related to the development project of Sihanoukville Port.

Table - 7.5-1 Required monitoring of environmental conditions

No.	Survey Scope	Initial (Present)	Construction Phase	Operation phase
Social Environment				
1	Resettlement of Inhabitants	Surveyed	Required	Required
2	Economical Activities	Surveyed	Required	Required
3	Traffic and Life Facilities	Surveyed	Required	Required
4	Dividing of Regional Area	Surveyed	Required	Required
5	Historical and Cultural Heritage	Surveyed	Not Required	Not Required
6	Water Right and Common Right	Surveyed	Required	Not Required
7	Hygiene and Health	Surveyed	Required	Required
8	Wastes and Garbage	Surveyed	Required	Required
9	Risks and Hazards	Surveyed	Required	Required
Natural Environment				
10	Topography and Geology	Surveyed	Required	Required
11	Soil Erosion	Surveyed	Required	Required
12	Underground Water	Surveyed	Required	Required
13	Hydrological Regime for River and Lake	Surveyed	Required	Required
14	Coastal zone	Surveyed	Required	Required
15	Ecology, Flora and Fauna	Surveyed	Required	Required
16	Meteorology	Surveyed	Not Required	Not Required
17	Landscape	Surveyed	Not Required	Not Required
Environmental Pollution				
18	Air pollution	Surveyed	Required	Required
19	Water (quality) pollution	Surveyed	Required	Required
20	Soil contamination	Surveyed	Required	Required
21	Noise & Vibration	Surveyed	Required	Required
22	Ground level sinking	Surveyed	Required	Required
23	offensive Odor	Surveyed	Required	Required

7.6 Conclusion of EIA

As the results of the discussion in this chapter, the EIA for the proposed Short-term Plan, including the Urgent Improvement Measures is summarized as shown in Table -7.6-1.

It is concluded that the proposed project involves no potential elements which may cause serious impacts on either the natural or socioeconomic environment. However, in the course of the EIA of this study, the following items were identified to be potential elements which may cause relatively high and medium magnitudes of impacts on the environment.

1)	Water Pollution	B,
2)	Soil Contamination	B,
3)	Ecology, Fauna and Flora	C,
4)	Coastal Zone	C,
5)	Traffics and Life Facilities	C,
6)	Resettlement of Inhabitant	C,

where B and C denote that the magnitude of the impact would be relatively high and medium, respectively.

With regard to the items listed above, the study team has conducted in depth survey, analysis and discussion and has made the best efforts to clarify the mechanism and the magnitude of the impacts. It should be noted, however, that the EIA was conducted on the proposed conditions of which the project involves: facility layout plan, method of construction, construction schedule and etc. Therefore, if any of those conditions is modified in the stage of implementation of the project, the impact in the form of these elements listed above should be re-evaluated in an appropriate manner.

The Law of Environment, the basic environment protection decree, promulgated recently prescribes that, before the implementation of any government project, IEA(Initial Environmental Assessment) and EIA reports should be submitted to the evaluation committee organized by the Ministry of Environment for approval and that the procedure and contents of IEA and EIA should be prepared in accordance with the sub-decrees which the Ministry of Environment is about to publish.

At the time of the completion of this study, the sub-decrees were not yet published. With such an anticipation that the codes, standards and regulations prescribed by the sub-decrees which the government of Cambodia will put in force in the near future may be similar to those which are presently in practice in the countries nearby, the study team made its best efforts to prepare IEE(Initial Environment Evaluation) and EIA reports so that the report would fulfill the codes, standards and regulations presently enforced in Malaysia, Thailand and Indonesia.

Thus, the EIA report presented in this report may need to be reviewed and re-evaluated when the sub-decrees are put in force and the EIA report is inadequate to fulfill the code, standard and regulations of Cambodia.

Table - 7.6-1 Result of EIA for the project

(SHORT TERM PLAN AND URGENT MEASURES)

NO.	ITEMS	RESULT CON. ST	RESULT OPE. ST
	SOCIAL ENVIRONMENT		
1	Resettlement of inhabitants	C	C
2	Economical activities	X	X
3	Traffics and life facilities	C	C
4	Dividing of regional area	X	X
5	Historical and cultural heritage	X	X
6	Water right and common right	X	X
7	Hygiene and health	X	X
8	Waste and garbage	X	X
9	Risks and hazards	X	X
	NATURAL ENVIRONMENT		
10	Topography and geology	X	X
11	Soil erosion	X	X
12	Underground water	X	X
13	Hydrological regime for river and lake	X	X
14	Coastal zone	C	X
15	Ecology, fauna, flora	C	X
16	Meteorology	X	X
17	Landscape	X	X
	POLLUTANT		
18	Air pollution	X	X
19	Water pollution	B	X
20	Soil contamination	B	X
21	Noise and vibration	X	X
22	Land subsidence	X	X
23	Offensive odor	X	X

NOTES:

A : Relatively high magnitude of impact is expected
B : Relatively medium magnitude of impact is expected
C : Relatively low magnitude of impact is expected
X : No effect is expected
CON.ST. : Construction Stage
OPE. ST. : Operation Stage

Explanation of each plan shall be referred to SECTION-3

8. Overall evaluation

The projects proposed in the study has enough capacity to handle the cargo volume in the target years.

The Short-term Development plan is beneficial from the viewpoint of national economy. Provided that the initial project cost for the Urgent Improvement Project is shouldered by other agencies that Sihanoukville Port, the Port is able to implement the project with sound financial status.

Through EIA, No elements were identified as those on which the project give considerable impact. If appropriate attention is paid during the construction period, the impact on natural and socioeconomic environment can be minimized.

On the basis of above discussion and evaluation, it is concluded that the project is feasible.

9. Conclusions and recommendations

Summing up both the Master Planning and the Feasibility Study, the Major conclusions and the recommendations are as follows:

9.1 Basic Concept of the development of Sihanoukville Port

Sihanoukville Port is the principal gateway of Cambodia and as such supports the nation's economic activities. At the same time, the port also plays a role as the leading industry in the Sihanoukville region. Thus, the development plan of the port should be made not only from the viewpoint of the gateway of seaborne trade, but also from the viewpoint of upgrading the national infrastructure and the leading entity of the regional economic activities. The study was carried out on the basis of the following basic concepts for the development of Sihanoukville Port:

(1) Concept of public port

Being the sole deep sea port, Sihanoukville Port has been the principal gateway for all of Cambodia together with Phnom Penh Port. Though situated 240 km away from the Capital, the port is connected to the commercial centre of the country with both an access highway and the railway. The port was originally intended to promote industrial and commercial activities in the port area, and thus spacious water and land areas are reserved in the port area.

The Sihanoukville City, where the port is situated, is the largest city in the Coastal Region, and infrastructures such as city roads, power and water supply have been provided. Located in the middle of a region with such potential, the port is the core of the regional economic activities. Therefore, since Sihanoukville Port, is so important to both the national and regional economy, it should be developed and operated by the public sector.

(2) Scale of the development

Being the largest port of the country, the development of the port in accordance with the growth of the national economy is indispensable. On the other hand, quite large scale investment is required for the timely development of the port, and this ,sometimes, brings the port operating body financial difficulties.

It is quite important for the port to implement the development project in several stages. Flexibility is also required to adjust the development schedule to the growth of the national economy and the cargo volume.

The port should ensure the financing source for the development projects. In addition to the foreign funding agencies such as the World Bank, ADB and other bilateral financing programmes, the port must have its own fund. At present, Sihanoukville Port is financially sound and has the capability to establish its own fund. In the study, thus, it is assumed that the local

portion of the project cost shall be financed by the port's own fund. Invitation of private investment which may lead to hand over the function of port either partially or as a whole should be avoided.

(3) Requirement of the Master Plan of the Port Related Area.

In the existing land use plan of the Sihanoukville City Government, the Port Related Area is defined. However, at present, there is no legal background which prescribes the authority to administrate the area.

In the Port Related Area, where various public and private properties presently exist, the administrative coordination among the central and local government is not well organized for the land use of the area. At the same time, the perspective of the private investment is not clear enough. In this these circumstance, it seems to be impractical to draw a very-long-term plan of the whole Port Related Area from the standpoint of the port only.

Therefore, the study is intended to propose a long-term development plan of Sihanoukville Port up to 2015 and to preserve the maximum flexibility for further development beyond 2015.

Project implementation sometimes faces obstacles such as policy changes of the government, lack of funds, insufficient infrastructure related port activities, the delay of the private investment, etc. It is necessary, therefore, to have the port development plan authorized by the government. To achieve this end, the port development project must be accepted by all the agencies concerned with the land use of the Port Related Area. It is assumed that Sihanoukville Port shall be coordinating with these agencies to formulate consensus development plan of the area.

(3) Review of the plan

The economic and political situation of the country may change in the coming years. It is quite necessary, therefore, that the plan be reviewed and modified, if needed, to adjust to changes related to socioeconomy, maritime service, cargo volume, etc. Especially, whenever regional development plans and private investment plans are published, timely review is indispensable.

It is assumed that Sihanoukville Port monitor the economic and political situation of both the nation and the region. To achieve this end, it is the responsibility of Sihanoukville Port to collect and analyze the statistics of the port activities and production and investment of the private industries.

9.2 Conclusions

(1) Findings of present port

The rehabilitation and development of the national economy is the principal theme of the government of Cambodia. The cargo volume at Sihanoukville Port has been growing over the past five years. Such a high growth of cargoes is attributed to the inflation of the economy during the UNTAC, the cargo shift from Phnom Penh Port to Sihanoukville Port due to the full rehabilitation of the highway and the rapid containerization of general cargo. Thus, it is foreseen that the growth rate of cargo volume will decline to the level in accordance with the growth rate of national economy in the coming years.

The public investment up to 2000 is limited to the rehabilitation of fundamental infrastructure such as major highways and water and power supply in major cities. The public investment plans pledged to start in the coming year are also in the limited fields such as light industries and tourism.

On the other hand, the population pyramid shows that the generation of 14 years old and younger is very large, and it is foreseen that the labor force of the county expands rapidly in the year 2000. This implies that the economic activities of the country will tend to expand rapidly in the first decade of 21st century.

(2) Bottlenecks of the existing port facilities

The structural investigation of the timeworn Old Jetty showed that it would not be usable longer than several years. The construction of some alternative facilities to the Old Jetty is urgent. Also, to cope with the rapid increase of container cargoes, it is necessary to upgrade the container handling facilities at the port.

(3) Natural conditions

The water area where Sihanoukville Port is situated is quite calm throughout the year. Waves and winds are not major causes of the suspension of the port operation, but strong rainfalls occasionally suspend the cargo handling work. The tide is journal and the tidal range is about 100 cm. The north-south tidal current is predominant. The sub-soil condition between seabed and -20m at the project sites is generally silty sand or sandy silt or clay, and there is a rock layer underneath throughout the project sites.

(4) Natural environment

The turbidity of the sea water is considerably high both within and outside of breakwaters. The sea water and the sediments on the sea bed tend to contain some chemicals. There are corals along the shore of the islands nearby. Some of these corals are dead due to the sediments brought by the tidal current. Only very common species of coral or fish are found, and

their populations are fairly small.

The major fishing sites are located at these areas further than 10 km away from the port. Sihanoukville Port is located on the shore of a low and swampy land, and, once it rains, the streams discharge sediment into the basin of the port.

(5) Role of Sihanoukville Port

Phnom Penh Port, located near the economic centre, has the role as a hub of the inland water transportation through the Mekong River system. Thus, the agricultural products, general cargoes, petroleum products and construction materials are the major commodities handled at Phnom Penh Port. Being the sole deep sea port, Sihanoukville Port handles container cargoes, heavy machinery, bulk cargoes and wood products.

(6) Cargo volume forecast

The cargo volume forecast was done for the three scenarios: High, Middle and Low. The results of the cargo volume forecast in 2015 for these High, Middle and Low case scenarios are 7.1mil. (Oil 2.4 mil., others; 4.4 mil.), 6.3 mil.(Oil; 2.1mil., Others; 4.2 mil.) and 4.7 mil.(Oil; 1.6 mil., Others; 3.3 mil.) tons, respectively.

The cargo volume forecast on the basis of the Middle Growth scenario estimated cargo volume in 2005 to be 2.3 million(Oil; 0.6 mil., Others; 1.8 mil.) tons: the Middle Growth Scenario assumes the GDP growth rate to be about 5.5% between 1996 and 1999, and 7.5% in 2000 and after.

(7) Cargo handling capacity of the present port

The capacity of a berth was defined to be the cargo volume handled over a year with the berth occupancy rate of 85%. With this definition, the capacity of the New Quay, with its one general cargo berth and two container berths, has the capacity of 700,000 tons, and the Old Jetty, with its four general cargo berths, has the capacity of about 400, 000 thousand tons.

(8) The Long-term Development Plan

The number of berths required in 2015 is as follows:

High Growth Scenario;

General cargo berth; 5, Container berth; 3, Bulk berth; 2,

Middle Growth Scenario;

General cargo berth; 5, Container berth; 3, Bulk berth; 2,

Low Growth Scenario;

General cargo berth; 4, Container berth; 2, Bulk berth; 2.

To fulfill these requirements, the Long-term Plan proposes to construct the following new facilities:

General cargo wharf; 400m (renovation of existing revetment),
Container terminal; 400m (for High and Middle case), 120m(for Low case),
Bulk Terminal; 300 m.

The new general cargo wharf and the container terminal should be constructed in the same alignment as the existing New Quay.

Two alternative plans were proposed for the location of the bulk terminal. Plan-1 proposes to locate the terminal about 1 km to the north of the proposed container terminal. Plan - 2 proposes to locate it next to the new general cargo wharf (at the back of the South Breakwater).

In addition to the construction of these wharves, four units of container gantry crane should be installed at the container terminal and handling equipment for bulk cargoes, namely, cement and fertilizer should be furnished at the bulk terminal. The north navigation channel should be deepened and widened to accommodate larger ships.

Of the two alternative plans, Plan - 1 is recommended from the viewpoint of the incentives to private investment and the potentiality for the future expansion of the bulk terminal.

(9) The Short-term Development Plan

The major facilities required to be constructed or procured by 2005 are as follows:

General cargo berth; 5 (existing 350m and new construction 400m)
Container berth; 2 (new construction 240m)
Container gantry crane 2 units.

(10) Urgent Improvement Plan

Of the facilities proposed in the Short-term Development plan, the 400 m long general cargo wharf needs to be operational by 2000, when the existing Old Jetty would not be fully operational.

(11) Phased construction plan

It is recommended that the facilities proposed in the Long-term Development Plan be constructed in the following stages:

1998 - 2000; the Urgent Improvement Plan (General cargo wharf 400m)
1999 - 2003; the Short-term Development Plan
(Container terminal 240m, gantry crane 2 units)
2004 - 2006; the Long-term Development Plan (1) (Bulk terminal 150 m),
2008 - 2011; the Long-term Development Plan (2)
(Bulk terminal 150m, additional container gantry crane 1 unit)

2912 - 2914; the Long-term Development Plan (3) (Expansion of the container terminal 160m, additional container gantry crane 1 unit)

(12) Structural design

The concrete block type is recommended for the new general cargo wharf, because the level of the rock layer at this site is too shallow for deck-on-pile type. In order to reduce the reflection of the waves at the wharf, concrete blocks placed near the sea level should be wave absorbing type. At the location of the container terminal, the level of the rock layer is deep enough and deck-on-pile type is recommended because the cost is lower and there is less reflection of wave than by concrete block type.

(13) Construction plan

Working yard for the production of the concrete blocks of the new general cargo wharf is required over the construction period. The land area and the basin at the back of the Old Jetty, which is presently used for the mooring of working vessels of the port, can be used for the working yard.

The dredged materials are not suitable for the fill of the reclamation of the proposed container terminal. Thus, they should be disposed at the dumping sites: the water area either north or south of Dek Koh Island, where the water depths are -20 m or deeper. To avoid the dispersion of the soil during the dredging work, grab type dredger is recommended for the dredging of the basin and cutter suction type is recommended for the dredging of the north navigation channel. Dumping site should be chosen depending on the direction of the tidal current: when the current is northward, dumping should be at the north site and vise versa.

(14) Project cost

The project cost at each stage of development is as follows:

The Long-term Development Plan; $245 million
(including the Short-term and Urgent Plans),
The Short-term Development Plan; $113.5 million,
($85.3 mil. plus the Urgent Improvement Plan $28.2mil.),
The Urgent Improvement Plan; $28.2 million.

(15) Economic Analysis

The EIRR of the Long-term Development Plan fell in the range between 14.0% and 17.8% for various cases. The EIRR for the Short-term Development Plan including the Urgent Improvement Measure results in 15.0%. Even in the worst case, where the project cost is assumed to increase by 10% and the cargo volume reduces by 10%, the EIRR is 11.0%. Since the

project ensures an EIRR of 10%, it can be appraised that the Short-term Development Plan is economically feasible.

(16) Financial analysis

The Short-term Development Plan is concluded to be financially feasible, provided that the initial project cost for the Urgent Improvement Plan is not paid for by Sihanoukville Port. The FIRR for this case is 7.9%. In the case that the initial project cost increases by 10% and revenue decreases by 10%, the FIRR is 2.7%. In the calculation of FIRR, the present tariff system is employed.

(17) Environmental Impact Assessment (EIA)

The Law of Environment was enacted in September, 1996, and all the government projects are requested to prepare EIA reports for submission to the evaluation committee. The standards and guidelines, however, are still being prepared by the Ministry of Environment. Thus, the standard and guidelines of some other countries in Southeast Asia, namely, Malaysia, Singapore, and Indonesia, were used for reference for the EIA in this study.

The results of EIA are summarized as follows:

a. Impact of the disposal of dredged material on the ecology in the dumping sites

It was found that by choosing the dumping site either north or south of Dek Koul Island in accordance with the direction of the tidal current, the impact of the suspended soil on the ecology at these islands can be avoided.

b. Sedimentation in the port

The results of the simulation with a numerical model show that there is no practical change in the magnitude of the sedimentation in the water area within and near the fishing port regardless of the existence of the new container terminal.

c. Impact on socioeconomic activities

Neither the Urgent Improvement nor the Short-term Development Plans requires resettlement of any private properties. The construction of the proposed container terminal will not cause substantial inconvenience for the passage of the fishing boats.

The rerouting of the Municipal Road is very minor, and no considerable impact is foreseen in the traffic in the communities. The route of the heavy cargo trucks to and from the Sihanoukville Port is separated from the municipal road.

The cargo truck traffic on National Road No. 4 becomes heavier as the cargo volume at the port increases. However, it seems that, in 2015, the traffic will not be heavy enough to cause traffic jams. The traffic congestion on National Road No. 4 is expected to be eased as the peace and order situation is improved to allow night driving.

(18) Overall evaluation

The projects proposed in the study for the three stages of development have enough capacity to handle the cargo volume expected to occur in the respective target years. Both the Long-term Development Plan and the Short-term Development Plan are beneficial from the viewpoint of the national economy. Provided that the initial project cost for the Urgent Improvement Project is shouldered by other agencies than Sihanoukville Port, the Port will be able to implement the Short-term Development Plan from a financially sound position.

Through EIA, no elements were identified on which the project would give considerable impact. If appropriate attention is paid during the construction period, the impact on natural and socioeconomic environment can be minimized.

Summing up these evaluations, it is concluded that the Short-term Development Plan is feasible.

9.3 Recommendations

(1) The responsibility of the public port

Since 1993, the government of Cambodia has been making efforts to privatize government corporations. The present status of Sihanoukville Port is a government agency, and it, with its autonomous administration, operates the port fairly efficiently with financial soundness. Thus, privatization of the port as a whole or partially should be avoided. On the contrary, it is the responsibility of Sihanoukville Port as a public corporation to promote and lead the private industries in the region and country. Being a public port, the port should make efforts to reduce the operation cost and to maintain its tariff at a reasonable level

(2) Development of the North Navigation Channel

The proposed project includes the upgrading of the North Navigation Channel. The channel has a bend at the entrance of the port. In addition, permission for the calling ships to leave and enter the port during night time is requested as the number of calling ships is increasing. Thus, the installation and maintenance of the navigation aids are indispensable.

(3) Observation of weather and tide

The observation of tide should be continued to monitor the datum level of Sihanoukville Port and for the navigation safety. Weather observation is also required for the safety of cargo handling and the preparation of future development plans of the port.

(4) Construction

During the construction period, a working yard should be provided within the port. Traffic conflicts between the vehicle and vessel for the construction and those for port operation may occur. It is, thus, necessary to well organize the schedule and arrange routes to avoid such conflicts. The water and land area at the back of the Old Jetty can be used for the working yard. The land area there should be cleared when the construction starts. During the construction stage, the port should inform the local people, especially fishermen, of the schedule of the construction and the routes of the working vessels to avoid accidents.

(5) Improvement of handling productivity

The cargo handling capacity cannot be increased by providing the new berths only. It is as well important to improve the cargo handling productivity. Therefore, all efforts should be made to make much use of available facilities such as the sheds and open storage and to introduce pallets, belt conveyers, etc.

(6) Harbour services

To use the limited number of berths most effectively, it is necessary to start cargo handling as soon as ships dock at the berth and that the ships leave the port as soon as the cargo handling work is over. Thus, it may be necessary to allow ships to leave the port during the night time. In such occasion, due attention should be paid to the traffic of fishing boats.

The unloading facilities of the Oil Port can be owned and operated by the private sector. However, the tug and pilot service and maintenance of navigation channel should be provided by Sihanoukville Port, since the Oil Port is a public facility and Sihanoukville Port is responsible for harbour safety.

(7) Operation and management of the port

It is necessary to establish, within Sihanoukville Port, the Container Terminal Division which is responsible for the entire handling process of container cargoes. Increase of the container cargo volume may require a larger labor force. It is necessary to prepare employment schedule and to establish training programs for both new and existing port workers.

The development of the port should be done in accordance with the cargo volume increase and this requires timely review of the schedule of the development. Thus, the Planning Division has the responsibility to collect information related to the national economy as well as cargoes.

(8) Fund for the development

The financial situation of Sihanoukville Port is evaluated to be sound. It is recommended that the Port save the net income for the future development and establish its own

fund. However, some existing facilities still require maintenance and repair. Thus, it is quite important to schedule properly the investment for the port development so that the cost for the maintenance and repair of the existing facilities is not cut down.

(9) Participation of the private sector in the port operation

At present, it is not necessary to privatize Sihanoukville Port either fully or partially. It is, however, important for the port to introduce the principle of market economy in its management.

There are some elements of the port service which can be privatized. Some of these are: the cargo handling service of specific cargoes for a certain company only, such as bitumen, cement or etc., maintenance and repair of the heavy handling equipment, and services for the welfare of the personnel of the port such as restaurant, garbage and cleaning services.

For the effective use of the port's own fund, cooperation with reliable commercial banks is also needed. To promote local commercial banks may be one of the responsibilities of Sihanoukville Port as the leading industry in the region.

(10) Recommendation of technical matters related to the project implementation

a. Soil survey

The information of the soil conditions at the construction site of the proposed container terminal is not sufficient for detail design of the structure. During the stage of the detail engineering, additional boring should be carried out to ensure the sub-soil conditions, such as the level of the rock layer and the estimation of the settlement of after the reclamation of the container terminal.

b. Structure type of wharves

As the length of the wharf is extended, the reflection of the waves at the wharves become considerable. The type of the structure which reduces the reflection of waves should be chosen.

c. Consideration of the environment

During the dredging work, monitoring of the water quality and the sedimentation is needed. The dredgers employed should be either grab or bucket type to reduce the turbidity in the port. Larger barges are recommendable for the disposal of the dredged material to reduce the extent of the dispersion of the suspended soil. The pond in the port area should be reserved as the source of the water needed for port services.

d. Public relations

When the project is authorized, Sihanoukville Port should inform the contents of the Plan and the construction schedule to the agencies concerned. The port is also responsible to explain

the same to the local people, so that conflicts which may otherwise occur can be avoided.

(11) The responsibility of the Sihanoukville as the port administration entity of the government

a. Authority of the Port to administrate the Port Related Area

The Port Related Area, defined in the Land Use Plan of the Sihanoukville City, has great potential for future development in various fields of economic activities. To achieve the most effective use of the area, it is necessary to prepare a master plan and implementation plan. At the same time, piecewise developments by both public and private sectors which deviate from the master plan should be strictly regulated.

At present, except Sihanoukville Port, there is no agency in the region which possesses enough resources to keep monitoring the process of the development and to coordinate with all the agencies concerned.

It is required to establish a system whereby any project proposal related port activities must be reviewed by Sihanoukville Port before it is implemented.

i) Oil Port

From the view point of harbour safety, and conservation of the natural environment, Sihanoukville Port is responsible to review the expansion plans and monitor the operation of these facilities.

ii) Municipal Ports

From the viewpoint of harbour safety and to achieve the most effective and balanced development of the area, expansion plans of their facilities and the structural design should be reviewed by Sihanoukville Port.

iii) Fishing ports

The same system as to the municipal ports should be applied to the fishing ports. In addition, the disposal and wastes at the fishing ports should be monitored by Sihanoukville Port. The latter also should regulate the traffic of the fishing boats.

b. Responsibilities of Sihanoukville Port as the coordinator of the development of the area

As stated above, it is very necessary to formulate a master plan of the development of the whole Port Related Area. To achieve this end, Sihanoukville Port has the responsibility to take initiative to organize a committee and to discuss and coordinate all the project proposals in the area to formulate an integrated master plan. The constituents of the committee members are the representatives of local agencies such as governor of Sihanoukville City, directors of Fishery Office, Railways, Public Works and Transport. In addition, if necessary, representatives of the local industries should be invited.