CHAPTER 3: MASTER PLAN FOR PREAH SIHANOUK

Firstly development orientation and strategy of Preah Sihanouk province was proposed in accordance with the Integrated Development Strategy for Coastal area (Section 3.1 – 3.4), in this Chapter. Subsequently, urban planning, environmental management plan, and infrastructure development strategies were proposed in the Target area of Master Plan (M/P) for Preah Sihanouk (Section 3.5 - 3.8). Finally, a detailed land use planning was proposed for the designated urban area in the Target area in Section 3.6.

3.1 Development Goals for Preah Sihanouk

3.1.1 Development Directions for Growth Centers

As mentioned earlier, the City of Preah Sihanouk holds great growth potentials as the unique international sea-gateway for exports and imports. The ocean-going commercial port is not a regional facility but a nationally strategic facility whose function shall determine the Cambodian economic position in the world market and her national security in the world-wide goods distribution. It is predictive that this regional growth center will be growing in parallel with the Cambodian national economy, simply because cargo transport volumes for exports and imports can closely be represented by the entire economic situation. Therefore, the Preah Sihanouk shall be developed as a strategic city leading to the national development. The following directions are proposed:

- The Sihanoukville Port shall be one of the Asian ports, that has to be competitive in the region strategically. Needless to say, the competitiveness means not only its physical capacity, but also, more importantly, modernized port operation and management systems, including establishment of a transparent and rational custom system.

- Such a vital gateway may be strengthened in association with development of: 1) **industrial parks** in its hinterland; 2) a **comprehensive logistic center** directly adjacent to the port for storage and transshipment and the railway to be rehabilitated; 3) a **trading center** linked with the ASEAN market as well as the Siam Bay market, and 4) other relevant facilities.

- As for the tourism industry, Preah Sihanouk will be ale to a reputable international tourist destination, if a proper guidance and land use control is given to private investments in this sector. The long beach strips with white sands are a valuable asset for the beach resort. In particular, ***Ochheuteal Beach*** with 3.0 km long and ***Otres Beach*** with 3.5 km long should be developed in strict consideration of environmental conservation under the thoughtful guidelines to be regulated by the local government. Rich mangrove forests are another attractive tourism asset to be integrated with the beaches. A long-tem master plan is necessary to be formulated for this purpose.

- Basic infrastructures such as the water supply system with a sufficient capacity must be secured. The water supply condition for Preah Sihanouk is unclear due to the lack of reliable future water source, and this issue has to be addressed urgently. Also, the solid waste management system, the storm water drainage system, the sewerage system and the power supply system are all needed to be improved and/or expanded in capacity. The existing sewerage system, however, has been underutilized, due to less subscribers' connections to the treatment facility. Its management and operation system needs to be improved so as to formulate the feasible network covering service areas where the sewage treatment is actually necessary.

- Housing and commercial areas shall be expanded along with the increasing urban population. Based on a preliminary projection by JICA Study Team, the City of Preah Sihanouk will have an increase of about 150,000 persons from 2008 up to 2030, and this population increase will require new land use for residential areas of about 3,000 hectares, and commercial area of 500 hectares. In order to properly manage such urbanization process, a comprehensive land use plan should be urgently formulated, including a functional road network system.

3.1.2 Development Goals for Preah Sihanouk

As discussed in Chapter 4 of Book I, the main provincial features of Preah Sihanouk are summarized as follows:

- International Port;
- International Airport;
- Industrial Estates/ SEZs to accommodate "New Investment";
- Variety of Urban Services and Amenities;
- Key Node of Asian highway No.11;
- Variety of Marketable Agricultural Products;
- Invaluable Beach, Maine and Ecological Resources; and
- Reputation of Coastal Tourism.

Considering the foregoing discussions as well as the Visions for Coastal Area, mentioned in Chapter 5 of Book I, goals on the Preah Sihanouk development were envisaged first by the Study Team, and refined through a series of workshops both on the provincial level and the national level. It has been commonly agreeable that five (5) Goals are appropriate for the Preah Sihanouk development, that is, Preah Sihanouk shall:

Goal 1: Function as the **National Gateway** of international trade, economies, human resource and technologies.

Strengthening of the gateway function of Preah Sihanouk is the most practical and feasible vision, taking into account of the existence of the Sihanoukville Port which fully supports foreign trade and the Sihanoukville Airport which shall be soon capable of hosting regular international flights. It is

expected that the gateway function shall facilitate not only trade activities but also international transactions in many business opportunities, human resource and new technologies.

Goal 2: Be a **National Growth Center** with diversified economic activities and urban services.

Preah Sihanouk must be one of the strategic growth centers which shall lead the growth of the Cambodian economy as a whole. A variety of urban services will be accumulated to support the expanding industrial and economic activities as well as tourism development. In such an accumulating process of a wide variety of urban services, new job opportunities and business opportunities will be created, thereby making Preah Sihanouk a strategic core to be a national growth center.

Goal 3: Be the **National Logistic Center** linked with World Markets.

Linked with the gateway function, a massive volume of cargo traffic shall be attracted and generated to/from the Sihanoukville Port. A current freight distribution and management system shall be modernized and integrated at the national level, and more functional inter-modal transport systems shall be structured with the seaport, railway and road transportations. Should a "**Truck Terminal**" and/or an "**Inland Container Dept**", be provided by the public sector, based on a vision of "National Logistic Center", a number of trucking and shipping companies will start running more sophisticated and diversified operations by using these facilities. Also, smooth connection between the railway under renovation at present and the port facility at Preah Sihanouk needs to be provided. This movement shall gradually innovate the entire intermodal freight transport system at the national level. This must be a crucial supporting factor to induce foreign direct investment.

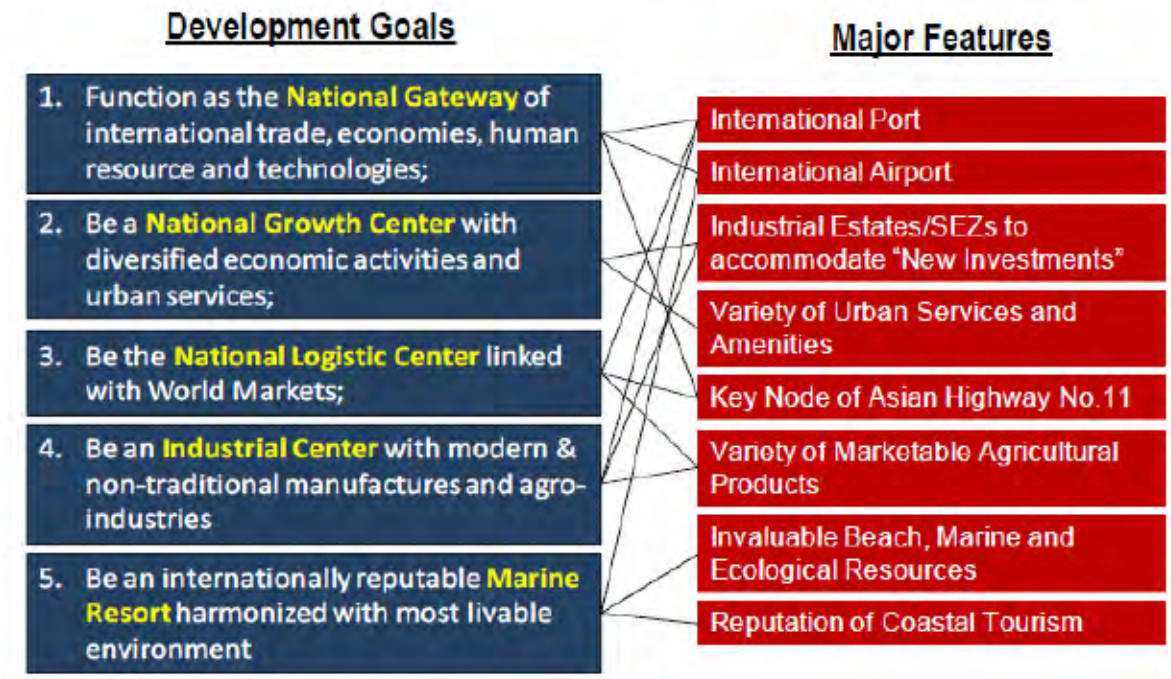
Goal 4: Be an **Industrial Center** with modern & non-traditional manufactures and agro-industries.

By achieving the visions 1 through 3 above, the trading environment and transport conditions will be all well-functioning efficient in the Preah Sihanouk City, which must become the most promising location for new manufacturing and business investment opportunities in various sectors, as will be depicted in Section 4.2 hereafter. This will makes difference non-traditional modern industries, instead of garment and foot-ware products, and facilitate the value-adding process of local resources through agro- processing industries.

Goal 5: Be an internationally reputable **Marine Resort**, harmonized with most **livable environment**.

Tourism would be the effective economic stimulus to boost the local economy in terms of creation of job opportunities and provision of local services of restaurants, transportation and a variety of commercial business activities, given a proper guidance for tourism investment which shall be harmonized with local economy and society. This is the case in the living environment improvement. The livable condition with hygienic, neat and clean environment is essential for local people as well as tourism.

These development goals and the major features of Preah Sihanouk interrelate between them. This concept is illustrated on Figure 3.1.3.



Source: JICA Study Team

Figure 3.1.1 Interrelations between Development Goals and Major Features

3.2 Socio-economic Framework of Preah Sihanouk

3.2.1 Population Projection for Preah Sihanouk Province

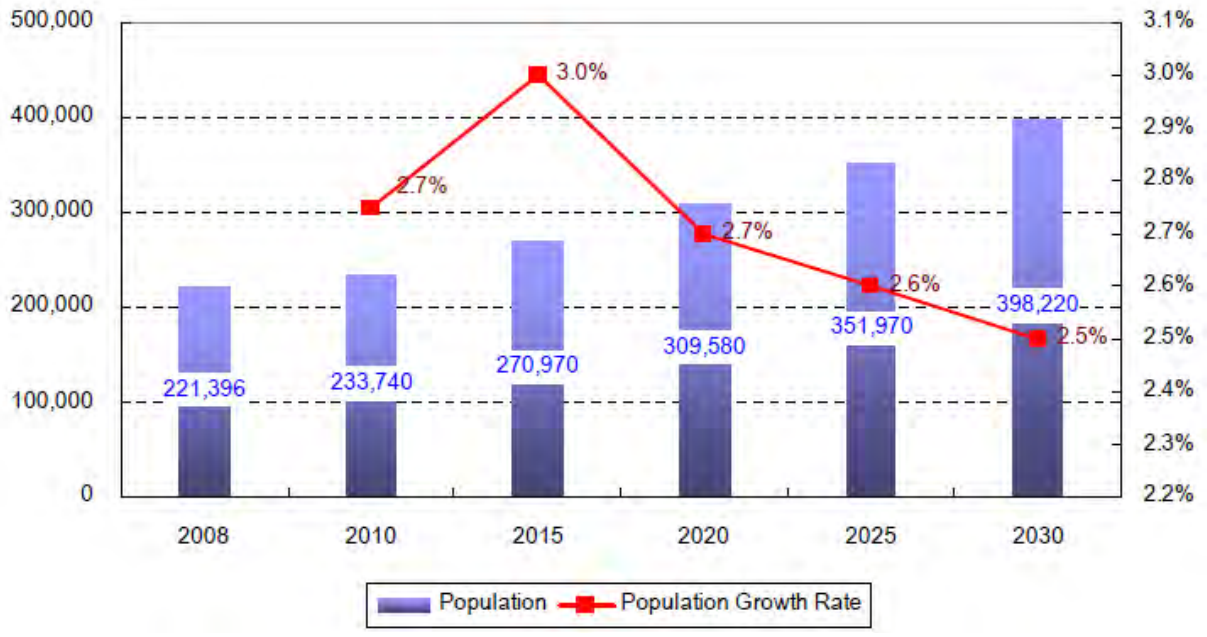
The population projection for Preah Sihanouk province was prepared as shown in Table 3.2.1 and Figure 3.2.1, based upon the current demographic analysis as well as in reference to the NIS 2004 population projection (for detail, see the Section 5.2.1 of Book I.).

As mentioned in the previous chapter, the annual average population growth in Preah Sihanouk province for the last decade, which was 2.6% per annum, exceeds highly that of national average. In addition to the past demographic tendency, the on-going housing and commercial building construction and tourism development projects as well as the commencement of the operation of Sihanoukville Port SEZ will generate additional population inflow in the urban area of Preah Sihanouk around the year 2015. Subsequently, thanks to the implementation of the proposed infrastructure development projects in the following sections, comparatively high population growth rate will last until the target year of 2030 especially by industrial development in Stueng Hav district.

Table 3.2.1 Population Projection and Growth Rate for Preah Sihanouk Province

	2008*	2010	2015	2020	2025	2030
Population	221,396	233,740	270,970	309,580	351,970	398,220
Urban	89,846	100,510	127,360	170,270	204,140	238,930
Rural	131,550	133,230	143,610	139,310	147,830	159,290
Population Growth (%)	--	2.7%	3.0%	2.7%	2.6%	2.5%

Note: *Final results for Census 2008.
Source: JICA Study Team



Source: JICA Study Team

Figure 3.2.1 Population Projection and Growth Rate for Preah Sihanouk Province

3.2.2 Employment

Based on the population above age 15, as well as the abovementioned figures regarding labor force participation rate and proportion of labor force by industrial sector, the labor force projection has been acquired (please refer to the Table 3.2.4, and the Figure 3.2.4)

According to the Team's projection, the total labor force of Preah Sihanouk province will increase from 102,283 in 2008, 142,870 in 2020, and 195,670 in 2030. Labor force in Preah Sihanouk province is projected to grow 3.0% during from 2008 to 2030 (4.7% per annum in urban area, and 1.4% in rural area).

Table 3.2.2 Forecasted Number of Labor Force in Preah Sihanouk Province

	2008 (actual)			2020 (forecasted)			2030 (forecasted)		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Agriculture, hunting and forestry	867	40,959	41,826	650	35,610	36,260	570	36,370	36,940
Fishing	2,083	4,299	6,382	1,560	3,520	5,080	1,380	3,390	4,770
Manufacturing	6,867	2,264	9,131	18,060	6,150	24,210	32,060	11,170	43,230
Construction	4,016	1,521	5,537	9,950	3,890	13,840	16,650	6,660	23,310
Other Secondary Industry	349	197	546	850	500	1,350	1,400	860	2,260
Wholesale and retail trade, repair goods	9,243	5,697	14,940	13,950	8,880	22,830	18,100	11,790	29,890
Hotel and restaurants	2,956	496	3,452	4,460	770	5,230	6,920	1,030	7,950
Transport, storage and communication	5,497	2,251	7,748	11,140	3,510	14,650	17,270	4,660	21,930
Other Services	8,524	4,197	12,721	12,870	6,540	19,410	16,700	8,680	25,380
Total	40,402	61,881	102,283	73,490	69,380	142,870	111,060	84,610	195,670

Source: JICA Study Team

Compared with other provinces in the coastal area, Preah Sihanouk province's dependence on agricultural sector is relatively low. According to the 2008 CENSUS, percentage of agricultural labor force to the total labor force in the province was 40.9% (only 2.1% in urban area).

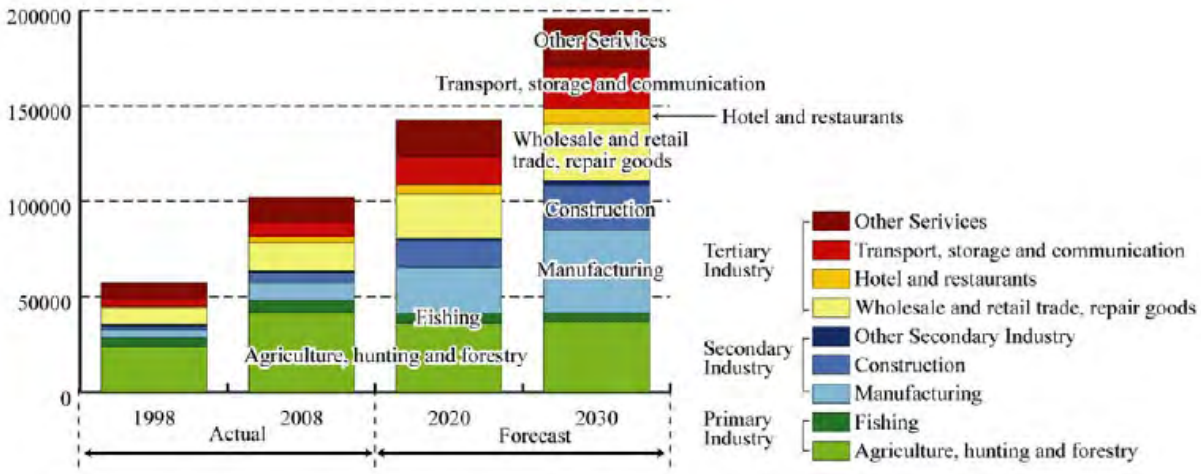
As a result of accelerated industrial development in Preah Sihanouk province, labor force in the province is assumed to be shifted partially from primary industries to secondary and tertiary industries. Percentage distribution of labor force engaged in agricultural sector is forecasted to decline sharply from 45.8% in 2008 to 18.9% in 2030.

In Preah Sihanouk, secondary and tertiary sector is expected to play an important roll in driving the regional economy. Preah Sihanouk City is expected to be "international logistic center", "regional market", as well as "international tourist destination".

Labor force of secondary industry in the province is forecasted to grow at 7.2% per annum, and will account for 35.9% of total labor force in 2030. Labor force engaged in manufacturing sector is expected to grow 7.3% per annum, and will absorb 43,230 or 22.1% of total labor forces in 2030.

The population growth and urbanization in Preah Sihanouk city and an expanding economy as well as promotion of tourism are expected to boost the demand for tertiary industries, contributing to job

growth. Labor force of the tertiary industries in the province is projected to grow at 3.63% per annum. New tourism related jobs in the province will be created as hotels and restaurants expand their capacity to meet increasing tourists. Number of labor force engaged in hotel and restaurant sector in the Preah Sihanouk province is expected increase from about 3,452 in 2008 to about 8,000 in 2030. Transport sector is projected to grow more rapidly from 7,748 in 2008 to 22,000 with 4.8% of annual increase.



Source: JICA Study Team and CENSUS 1998, 2008

Figure 3.2.2 Forecasted Number of Labor Force by Industrial Activities in Preah Sihanouk Province

3.3 Industrial Promotion Plan

In this section, an industrial promotion plan for Preah Sihanouk Province is proposed based on the current industrial development circumstances in the province.

First, although there is no specific industrial promotion strategy prepared by the RGC, the Study on Economic Policy Support in the Kingdom of Cambodia conducted by JICA in 2007 proposed the Cambodia's industrial strategy to develop especially manufacturing sector to contribute its economic growth. The strategy mentioned that the following four industrial policies are to be implemented: i) acquisition of capital and technology through attraction of FDI, ii) conditioning of the industrial infrastructure needed to attract FDI, iii) human resource development (HRD), and iv) specific measures for promotion of promising industries. Also, the strategy selected five manufacturing fields as promising industries for development in Cambodia, which are i) garment, ii) food processing, iii) footwear, and iv) simple assembly electric/electronic components and v) simple machining, and proposed the action plans for applying the abovementioned industrial policies for these five promising industries.

Second, based on the above discussions on industrial strategy for whole Cambodia, baseline surveys for industrial sector for Coastal area were conducted by the Study Team (see Chapter 4 of Book I). Following the survey results, the Industrial Promotion Strategy for the Coastal Area (see the section 5.3 of Book I) was proposed. Then, considering the major features as well as the five development goals of Preah Sihanouk, which were mentioned in the foregoing section of this Chapter, the priority industrial fields to be promoted in Preah Sihanouk shall be: i) export industries and SEZ, ii) resource-based industries, and iii) tourism sector.

In this context, for preparing industrial promotion plan for each priority industrial sector of Preah Sihanouk, it is inevitable to examine the current situation, to clarify the issues, and also to propose action plans to be taken.

In Preah Sihanouk, the total number of Investment Projects (under the 1994 Law on Investment) and Qualified Investment Projects (QIPs: under the 2003 Amended Law on Investment) approved by the Cambodian Investment Board (CIB) of the Council for Development of Cambodia (CDC) in a period between 1994 and 2008 remained at 77, and their fixed assets planned to be invested counted to UD$4,039 at the end of 2008 (See the Table 3.3.1). Its number of approved investment projects stood merely at 5% among total number of investment approved by CIB in all Cambodia.

Table 3.3.1 Number of Approved Investment Projects and Approved Amount (1994-2008)
Million US$

	a) Cambodia Total	b) Preah Sihanouk	c) Ratio (b/a)
Active	17,476 (935)	3,637 (45)	20.8% (4.8%)
Former Active	930 (204)	20 (9)	2.1% (4.4%)
Non Active	7,305 (398)	382 (23)	5.2% (5.8%)
Total	25,711 (1,537)	4,039 (77)	15.7% (5.0%)

Source: CDC/CIB
Note: Number in bracket is the number of projects.

For the trend of each industry sector, tourism sector investment projects dominate overall investment projects in Preah Sihanouk and its share is about 70% in fixed assets and 25% in number. The

investment on Garment and textile industries follows the tourism sector at 22% share in number, whereas oil-related industry investment follows at 16% share in fixed assets.

Table 3.3.2 Private Investment in Preah Sihanouk by Sector: At-a-glance

Million USD

Industry	Non-active		Former Active		Active		Total	
	Asset Value	No.	Asset Value	No.	Asset Value	No.	Asset Value	No.
Agriculture	1.4	3	4.1	1	7.9	3	13.4 (0.3%)	7 (9%)
Garments/ Textile/ Footwear	4.9	2	4.1	3	47.4	12	56.4 (1.4%)	**17 (22%)**
Food processing	2.1	3	10.7	3	57.0	5	69.8 (1.7%)	11 (14.3%)
Other Manufacturing	90.2	6	0.8	2	13.3	3	104.3 (2.6%)	11 (14.3%)
Oil terminal/ Refinery/ Oil Exploitation	0	0	0	0	645.2	5	**645.2 (16%)**	5 (6.5%)
Tourism	14	2	0	0	2,828.2	16	**2,842.2 (70.3%)**	**18 (23.4%)**
Others*	269.4	7	0	0	44	1	313.4 (7.8%)	8 (10.5%)
Total	**382 (100%)**	**23 (100%)**	**20 (100%)**	**9 (100%)**	**3,637 (100%)**	**45 (100%)**	**4,039 (100%)**	**77 (100%)**

Note: *Others are mainly SEZ projects, urban development, and electricity supplier.
() is the percentage share of total.
Source: CDC

3.3.1 Promotion of Export Industries and SEZ

(1) Current Situation of Export Industries and SEZ

Preah Sihanouk has long been expected to be “Dragon Head” for Cambodia’s economic development but, in reality, it has so far been unsuccessful in promoting sizable investment into manufacturing sector.

As Table 3.3.3 reveals, the amounts of approved investment in same period in Preah Sihanouk accounted for 15.7% among all approved investment projects in Cambodia. However, if these in tourism field in recent years (US$2,835.2 million) had been deducted, the remaining investment approved amount remained only at US$1,203.8 million or 4.7% among all Cambodia.

Table 3.3.3 Investment Projects in Tourism in Preah Sihanouk Province (2004-2008)

Thousand US$

	2004	2006	2007	2008	Total
Island Resort	1,955 (1)	371,687 (3)	286,195 (5)	40,900 (2)	707,737 (11)
Ream Development			115,669 (1)	1,844,546 (1)	1,960,215 (2)
Beach Development			109,998 (2)		109,998 (2)
Golf Course			57,275 (1)		57,275 (1)
Total	1,955 (1)	371,687 (3)	569,137 (9)	1,885,446 (3)	2,835,225 (16)

Note: Number in bracket is the number of projects.

Source: CDC/CIB

Among the approved investment projects in Preah Sihanouk, the industrial projects take 32.5% by the number of project and 18.9% by the approved amounts. Thus, the private sector investment in Preah Sihanouk heavily depends on the tourism and the industries have been slow to be developed.

Table 3.3.4 Approved Investment Projects in Preah Sihanouk by Sector

Million USD

Investment Field	Approved Investment Amounts	Ratio in Total
Tourism	2,842 (18)	70.5% (23.4%)
Industries	763 (25)	18.9% (32.5%)
Others	427 (34)	10.6% (44.1%)
Total Approved Investment	4,039 (77)	100.0% (100.0%)

Note: Number in bracket is the number of approved projects.
Source: CDC/CIB

At the end of 2008, 20 approved investment projects were in operation in manufacturing sector, of which 11 were in garment and textiles, 6 in foods and seafood processing, 1 in footwear, and 2 in others. Except the ambulance assembling and cigarette making companies, other 18 companies seemed to be export-oriented projects. “New Star Shoes”, a footwear manufacturing company from Taiwan, was the largest employer in the area, by hiring some 3,500 workers.

As of October 2009, there are six approved SEZs in Preah Sihanouk Province as shown in Table 3.4.5. Although the SEZ scheme had been adopted in December 2009 to boost the export-oriented industries, it has not brought the meaningful result yet in the Sihanouk area. Only 4 Chinese companies were said to have made contracts to locate in the “Sihanoukville SEZ 2” by October 2009, of which 3 companies seemed to be in export-oriented garment and plastics manufacturing.

Table 3.3.5 SEZ in Preah Sihanouk Area (as of October 2009)

1. S.N.C SEZ (Non Active)	
1) Location	Sangkat Bet Trang, Khan Prey Nob , Sihanoukville
2) Land area	150 Ha.
3) License from CDC	No. 3388 November 26, 2002
4) Sub-Decree	Not yet
5) Project Implementation	Infrastructure Developing
6) Zone Investor	None
2. Stung Hav SEZ	
1) Location	Sangkat O Tres, Stung Hav District, Sihanoukville
2) Land area	192 Ha.
3) License from CDC	No. 544 dated February 18, 2005
4) Sub-Decree	No. 50 dated March 25, 2005
5) Project Implementation	Infrastructure Developing: Gate construction, Land filling
6) Zone Investor	None
3- Sihanoukville SEZ 1	
1) Location	Stung Hav District, Sihanoukville City
2) Land area	178 Ha.
3) License from CDC	No. 1966 dated 04 September1998
4) Sub-Decree	No. 113 dated 25 October 2006
5) Project Implementation	Infrastructure Developing
6) Zone Investor	None
4- Sihanoukville SEZ 2	
1) Location	Pou Thoung Village, Betrang Commune and Smach deang Village, Ream Commune, Prey Nop District, Sihanouk Ville
2) Land area	1688 Ha.
3) License from CDC	No. 2162 Dated 29 June 2007
4) Sub-Decree	No.24 Dated 17 March 2008
5) Project Implementation	Infrastructure Developing: Gate and road construction, land filling, factory construction
6) Zone Investor	Nang Guo Garment Co., Ltd (Garment) Hong Dou International Garment Co., Ltd (Garment) Qianlima Vehicle Co., Ltd (Motor Bicycle Assembly) Taihua Plastic Products Co., Ltd (Plastic Production)
5- Sihanoukville Port SEZ	
1) Location	Tomnop Rolok Area, Sangkat Lek1 and Lek3, Khan Meattapheap, Sihanoukville
2) Land area	67.5 Ha.
3) License from CDC	No. 415 Date 31-January-2008
4) Sub-Decree	No.147 Date 02 September 2009
5) Project Implementation	Infrastructure Developing: Landfilling
6) Zone Investor	None
6- Kampong Saom SEZ	
1) Location	Village 4, Sangkat Ortres, Khan Stung Hav, Sihanoukville City
2) Land area	255 Ha.
3) License from CDC	No. 21/09 Date 06-January-2009
4) Sub-Decree	Not Yet
5) Project Implementation	Infrastructure Developing
6) Zone Investor	None

Source: CDC/CSEZB

(2) Issues for Promotion of Export-oriented Industries in Preah Sihanouk

As the Port of Sihanoukville, the only deepwater international seaport in Cambodia, is locates in Preah Sihanouk, it seems to be ideal location for the export-oriented industries. By locating in Preah Sihanouk, the lead time and cost for transportation of production inputs and finished products could be minimized and it would considerably strengthen the competitiveness of the products. While the transportation cost for 40-feet container between Sihanoukville Port and Phnom Penh area is said to be more than $2,000 for round trip, it would be negligibly small if the factory locate in Preah Sihanouk. Nevertheless only 18 companies engage in export-oriented manufacturing in Preah Sihanouk, while most of the exporting companies locate at around Phnom Penh area. The following issues might have been as obstacles for export-oriented companies to locate in the area.

1) Inconvenience to Receive Administrative Services

Under 2003 Amended Law on Investment, most of the export-oriented companies are provided QIP status and entitled to enjoy duty-exempt import of production equipments, production inputs and factory construction materials. In order to enjoy such privileges, QIPs have to submit annual import plan in a form of Master List and amend it whenever the import plans are modified. The whole procedures are taken care by the CIB in case of QIPs located outside of the SEZ and by the CSEZB (Cambodian SEZ Board) or SEZ Administration in case of QIPs located inside of SEZ. In industries such as garment or footwear manufacturing, the import plan (schedule and contents) tends to be adjusted and amended frequently according to the changes in fashion and seasonal order volume. Consequently, the Master List has to be amended often. For this, it may be more convenient for export-oriented QIPs to locate in or around Phnom Penh, as the CIB or CSEZB office locate in Phnom Penh. Although the SEZ Administration is required to be set up at premise of each SEZ so that the QIPs inside of SEZ can submit the Master List to and get the approval for duty-exempt import from the SEZ Administration, only two SEZ Administration have been so far established and are in operation: one at Manhattan SEZ and the other at Phnom Penh SEZ. There is no such service available in Sihanoukville SEZ 2, which is said to be ready to accept the investors.

Although customs services are available in Sihanouk area by the customs office stationed in the Port, some other administrative procedures have to go through time-lengthy process, starting from local government department office to the central government office.

2) Insufficient Development of the SEZ

As shown in Table 3.3.5, “SEZ in Preah Sihanouk Area”, prior to the official introduction of

the SEZ scheme into Cambodia by the Sub-Decree #148 on December 29, 2005, “Sihanoukville SEZ 1”, “S.N.C. SEZ” and “Stung Hav SEZ” had been approved by the CIB in 1998, 2002 and 2005 respectively, as Investment Projects for developing the industrial zones. Thus, an idea of developing industrial zones in Preah Sihanouk has a long history. These 3 Industrial Zones were approved to turn to be the SEZs after the Sub-Decree #148 was issued.

When “Sub-Decree #148 on the Establishment and Management of the SEZ” was issued, it was stipulated that the SEZ developers had to implement at least 30% of the total investment of SEZ construction within 365 days after approval. However, in fact, the implementation of construction work has been slow or delayed in all the SEZs. “S.N.C SEZ” has already been judged as “Non Active Project” by the Project Monitoring Department of the CIB. Nothing has begun in “Sihanoukville SEZ 1“and “*Kampong Saom* SEZ” yet. Although “Sihanoukville SEZ

2"seems to have been rapidly developed, there are only factory buildings and no meaningful infrastructure facilities have been developed. The land filling work and gate construction have started from middle of 2009 in "*Stung Hav* SEZ" but the construction speed has been rather slow till now. Though an international seaport is said to be developed next to "*Stung Hav* SEZ", the developer has not been succeeded in raising enough capital for construction. Such slow and incomplete development of the SEZs may undermine the investors credibility for the SEZ scheme of Cambodia.

3) Lack of Sufficient Manpower Supply

According to the hearing study made to New Star Shoes, they could hire only 30% of total 3,500 workers from the nearby areas, including Sihanouk and Kampot, and the remaining 70% had to be hired from distant areas such as Battambang, Banteay Mean Chey and Preah Vihear.

On the other hand, when the company opened up their second factory near Phnom Penh in early 2010, they could hire 500 workers in two days. They pointed out the necessity that the government should establish the job introduction network for effective worker mobilization from other area to Preah Sihanouk. As the reason for the difficulty in hiring young generation in Preah Sihanouk area, they pointed out the tendency that, although there was a plenty of younger population in the area, they preferred to work in service sector rather than in manufacturing.

4) Lack of Stable Supply of Electricity

Although the electricity is supplied by EDC and also by Colben (IPP) in most part of urban area of Preah Sihanouk, the supply is not enough and still unstable. Frequent power cuts happen even nowadays. In non-urban areas, factories have to be equipped with their own electricity generators as power source, which pushes up the production cost considerably.

5) Lack of Supporting Services

Although the export-oriented industries in Cambodia, mainly garment and footwear, are almost self-sufficient in obtaining the production inputs and auxiliaries by import, they may require purchasing certain supplies and services from outside. For example, certain fabrics may have to be washed out before sewing. Such washing services are usually provided by specialized factories outside. A part of sewing works may sometimes have to be outsourced according to the order volume or delivery terms. Packing material may be purchased locally from outside traders. Since such supply chain does not exist in Preah Sihanouk, there is a limit for the type of operation of the export-oriented industries or kinds of products to be manufactured.

6) Uncertainty of Land Ownership

Current Land Law was promulgated in 2001, by amending 1992 Land Law, aiming to set up modern system of the land ownership and recover the land registration system, which were totally destroyed during the civil war in the latter half of 1970s. Since then, various development partners, including World Bank, have kept assisting the RGC in creating Cadastral maps as a base for establishing the land ownership. Although the land ownership registration has proceeded in most urban areas, the ownership registration has not been completed in some non-urban areas. In such case, there is no certified land title issued and the ownership remains ambiguous on some land. Comparing to Phnom Penh area, there are more possibilities that the ambiguous ownership may create the land disputes in Preah Sihanouk.

7) Lack of Effective Investment Promotion Activities

The most of the investment promotional materials have been initiated and completed by the various development partners or the private sector, not by the CIB. The investment-related information on Cambodia has been distributed through development partners from time to time but they did not include the provincial information. The Investment Sub-committee of Provinces-Municipalities (PMIS) has been established in February 2005 for dealing with the investment under US$2 million. The PMIS of Preah Sihanouk, however, has not been active in investment promotion activities. After it has approved to register four investment projects as QIP, the office of Preah Sihanouk PMIS in Sihanouk City was closed and moved back to the provincial office.

(3) Policies for Promotion of Export-oriented Industries

1) Improving and Strengthening the SEZ scheme

The SEZ could be an effective and efficient tool to tackle and overcome above issues, if it is properly implemented and the scheme is improved. It could certainly serve to promote the export-oriented industries and, moreover, diversify the industries into non-traditional sectors.

Since current Cambodian SEZ scheme has a number of vulnerabilities, the RGC, especially CSEZB, must employ utmost efforts to improve the situation in the following manners.

i) Enactment of SEZ Law

The Cambodian SEZ scheme was introduced by the Sub-Decree #148 of December 29, 2005, not by the Law. Sub-Decree of Cambodia could be issued after the Council of Ministers adopts the draft and is signed by the Prime Minister. There is no need to be examined by the National Assembly, ratified by the Senate, and signed by the King. In other word, its legal base is weaker than the Law and may be amended in easier manner. To strengthen its legal base and enforcement power, the SEZ scheme is recommended to be provided in a form of Law. Upon its enactment, the consistency with the Law on Investment has to be secured. For example, although the RGC approved the exemption of VAT on the production equipment and materials to be imported by investors into the SEZ, Article 14.9 of 2003 LOI prescribes that a QIP which is located in a designated SPZ or EPZ listed in a development priority list issued by the Council (CDC) shall be entitled to the same incentives and privileges as other QIPs stipulated in this law. Such *ad hoc* provision of additional investment incentives would not necessarily enhance the investment climate of the SEZ. Any legal scheme concerning the investment is expected to be transparent, non-discretional, predictable and accountable.

In this regards, the Law on SEZ has to be enacted at earliest occasion to provide the SEZ investors with the stable and reinforced legal base.

ii) Enforcement of the Requirement and Duties of the SEZ Developers

The CSEZB has to prove fully the capital source and volume of the developers to ensure the implementation of development work of SEZ as planned and approved. The CSEZB has also to implement the thorough monitoring works over the progress of construction work and enforce the developers to keep the planned and approved construction schedule. Although Sub-Decree No.148 stipulates that the SEZ developers have following duties, the developers, in practice, do not always observe this provisions and the CSEZB does not seem to control the situation after it approved the SEZ development project. The CSEZB is expected to try to enforce such developers' duties.

- to have sufficient capital and means to develop the infrastructures in the zone, including the human resources to manage the activities of the zone
- to have the legal rights to possess the land in order to establish the zone
- to construct infrastructures in the zone, including electricity, water, road, and telecommunication networks, environment protection and management network, build warehouses, fire-fighting station and other necessary facilities

iii) Strict License Withdrawal

The CSEZB has to reserve and exercise the right to withdraw the SEZ license if the developer does not perform the obligation of minimum investment requirement within 365 working days. It has to define if the 30% requirement includes the land cost as well. Even in case of "S.N.C SEZ", which has been judged as a Non-Active Project by CIB, the name still appears in a list of SEZ prepared by the CSEZB. The development progress has to be observed and checked repeatedly by the CSEZB and, if it is found not to comply with the approved conditions, the development license has to be cancelled.

iv) Clearer Definition of EPZ

The concept of "Export Processing Zone (EPZ)", which is described in the Sub-Decree #148, has to be given clearer explanation by defining: Who would designate "EPZ", what kind of institutional differences exist between the EPZ and non-EPZ areas in the SEZ, and what sort of advantage/incentives would be provided for investors locating in EPZ.

v) Application of Concept of "Different Customs Territory"

The General Department of Customs and Excise (GDCE) of MEF have to make clear if the concept of "different customs territory" would be thoroughly applied to "EPZ" for the purpose of providing the simplified and transparent customs procedures, basing on risk management system, to the investors locating in the SEZs.

vi) Adoption of "Free Zone" Concept

The RGC is recommended to examine if the "Free Zone" concept, as the ultimate form of "different customs territory", could be applicable to the SEZ or at least to the EPZ/Free Trade Area part of the SEZ. In Revised Kyoto Convention, "Free Zone" is defined as "a part of the territory where any goods introduced are generally regarded, insofar as import duties and taxes are concerned, as being outside the Customs Territory. Once the concept of Free Zone is adopted, according to this definition, the investors locating in the SEZ shall be free to import and export into/from the SEZ without considering the import duties. Therefore, they will not be required to obtain duty-free import licenses from the CSEZB. VAT and other taxes shall not be levied on the imported goods either. Customs control shall also be minimized except the case the products go out to the domestic market. Adoption of the concept of "Free Zone" shall give broader free hand to the investors in their operation and, for sure, add much more attraction to the Cambodian SEZ scheme. It is important and meaningful to admit free import-export to the Zone Investors, in view of providing them with better environment to meet in timely manner the rapidly changing market requirement in export-oriented industries.

vii) Admittance of Non-QIPs to Locate in the SEZ

The Sub-Decree #148 requires the investors to obtain the investment registration as QIP to locate in the SEZ. In order to create cross-sector business and establish wider production base, it

is desirable that any legal manufacturing-related sector, including logistics sector, can locate in the SEZ without being registered as QIPs. It is important to take note that only diversified production environment may lead to the establishment of backward linkage with the local enterprises.

Even in case non-QIPs locate in the SEZ, they shall be automatically entitled to the duty and tax exempted import and export unless they export their products to the domestic market, the SEZ shall be designated as "Free Zone".

viii) Area-wise SEZ

The best way to develop economy by utilizing the SEZ scheme may be to adopt an area-wise SEZ concept, as proposed in the JICA Study on "Regional Development of the Phnom Penh – Sihanoukville Growth Corridor" in 2003. The whole village, town or even municipality could be designated as a SEZ and various types of zones and activities shall locate in such area-wise SEZ. It is recommendable that a new SEZ Law clearly states to allow such wide area-wise SEZ to be established. Upon the establishment of area-wise SEZ, the various incentives have to be examined to be provided from viewpoint of accelerating industrial accumulation, especially these of SMEs, and promoting regional development.

ix) Enhanced Investment Promotion into the SEZs

"Investment Promotion and Public Relation Department" of the CIB is currently in charge of investment promotion but their activities do not cover the investment projects in the SEZ and the investment which do not seek for incentives. To improve and strengthen the investment promotion activities of the RGC, the JICA Study on "The Institutional Strengthening of Investment Promotion in the Kingdom of Cambodia" is currently being implemented. One of the issues in the Study is how to reorganize the organization of the CDC to enhance its investment promotional activities. As being proposed in the Study, to establish the integrated and independent investment promotion organization may be the effective and efficient measures to realize the investment promotional activities for "ALL Cambodia", including forthe SEZ.

2) Utilizing the National Agency for Occupations and Labor for Mobilizing Labor

As pointed out by an investor in Preah Sihanouk, it has difficulty in providing enough number of factory workers and, to overcome such vulnerability, the workers have to be mobilized from distant areas in other parts of Cambodia. One of the effective and efficient measures to achieve such goal could be the utilization of "The National Agency for Occupations and Labor (NAOL)" established by the Ministry of Labor and Vocational Training (MLVT).

To increase the effectiveness of public services, "Royal Decree NS/RD/0308/346 on Joint Principles on the Establishment and Introduction of Special Operation Agency" of March 28, 2008 was issued to admit the establishment of Special Operation Agency, which belongs to the line ministries but can provide various services for fees within the contracted missions. Basing on this Royal Decree, MLVT established "The National Agency for Occupations and Labor (NAOL)" by the Sub-Decree #67 (RGC) on Aril 27, 2009. The NAOL has the duties including the followings:

- to facilitate and develop information services for occupations, labor and training education in skills, techniques and vocations;

- to provide information services to job seekers, employees, employers, trainers and the public that they may effectively receive mutual information in an open manner, and to enable relevant parties to communicate with each other through publications and programs made by the National Agency for Occupations and Labor;
- to research and develop the labor markets information system in line with present and future economic and social development;
- to promote information on labor, occupations, technical skills and vocations through the website of the National Committee for Training, and by other means;
- to provide specific data on labor to be used as a base for assisting the Royal Government in making plans for human resources and labor markets development

The NAOL already established its local offices in various parts of Cambodia and started the job introduction work. The integrated and close job introduction network is recommended to be set up among the NAOL, CSEZB and Preah Sihanouk provincial government for timely mobilization of workers required by the investors.

3) Electricity

In December 2009, the Kamchay Hydroelectricity plant in Kampot was inaugurated by Sinohydro Corporation and in four years time it is expected to produce 193.2 megawatts of electric power. In addition, on February 11, 2010, the groundbreaking ceremony was taken place in Preah Sihanouk Province for constructing 100-megawatt coal power plant. The construction is expected to complete within 3 years. Of this undertaking, 80% is owned by Malaysia's Universal Holding's Cambodian subsidiary and 20% by Cambodian International Investment Development Group. Additional 100-megawatt plant is supposed to be approved in 2010 as well. If these projects are implemented as scheduled, the electricity supply in Preah Sihanouk would be improved considerably. The Ministry of Industry, Mines and Energy (MIME) is expected to closely watch the progress and secure the thorough implementation of all projects on time. The MIME and EDC are also required to try to reduce the electricity tariffs, which are currently much higher than in the neighboring countries.

4) Type of Export-oriented Industries to be Promoted

In Preah Sihanouk province, due to the short distance to the Sihanoukville Port, any export-processing industry may enjoy the advantage of the minimum lead time and cost for inland transportation to and from the port. Especially when the export supply chain is much more time-conscious than ever before and cost competition is harder, this advantage should contribute to improve the investors' competitiveness in the export markets. In this regards, the following industries may be counted as preferential industries for the region.

- Any kind of assembling: modular and/or components of electric and/or electronic appliance, machinery, auto parts, etc.
- Plastic processing products: Products of blow molding and injection molding (packing and packaging material, shopping bags, tapes, ropes, plastic basket, cages, containers, key holders, etc.), dolls, toys, furniture, office equipments, stationary, etc.
- Mechanical processing products: Screws, bolts, nails, washer, building instrument and materials such as L-frame metal fitting and tools, machinery parts and component, rig equipment, etc.

- Rubber processing: Tire for replacement market, semi-products for any kind of tire and other rubber-related industry
- Toys: Staffed and plastic toys
- Logistics: International logistic activities, fixed or low temperature warehousing, packaging, reshipment, light processing, etc.
- Processing precious stones and jewelries
- High-end apparel for internationally or regionally established brand-holder
- Footwear for internationally or regionally established brand-holder
- Food processing: Organic fruits and vegetables, and marine products

Finally, the interrelations between each industrial promotion policy and the executing entities are summarized as follows.

Table 3.3.6 Industrial Promotion Plans and Executing Entities: Export-oriented Industries and SEZ

Industrial Promotion Policies	Main Actor	Sub-Actor
1. Improving and Strengthening the SEZ Scheme	CSEZB	CIB
i) Enactment of SEZ Law	CSEZB	CIB
ii) Enforcement of the Requirement and Duties of the SEZ Developer	CSEZB	Private Sector (SEZ developers)
iii) Strict License Withdrawal	CSEZB	
iv) Clearer Definition of EPZ	MEF (GDCF)	CSEZB, MLMUPC
v) Application of Concept of "Different Customs Territory"	MEF (GDCF)	CSEZB, MLMUPC
vi) Adoption of "Free Zone" Concept	MEF (GDCF)	CSEZB, MLMUPC
vii) Admittance of Non-QIP to Locate in the SEZ	CSEZB	CIB MEF (GDCF)
viii) Area-wise SEZ	CSEZB	Provincial Govt. MEF (GDCF)
ix) Enhanced Investment Promotion into the SEZ	CDC (CIB/ CSEZB)	Private Sector (SEZ developer)
2) Utilizing the National Agency for Occupations and Labor for Mobilizing Labor	MLVT (NAOL)	Provincial Govt. NGO Donor Private Sector (SEZ developer, Association of each industry)
3) Electricity	MIME	EDC
4) Type of Export-oriented Industries to be Promoted	MIME	CSEZB Provincial Govt. Private Sector (SEZ developer)

Source: JICA Study Team

3.3.2 Promotion of Resource-based Industries

(1) Current Situation of Resource-based Industries

The agricultural activity within Preah Sihanouk Province remains somewhat detached from the regions markets and the Ministry of Agriculture, Forestry and Fisheries (MAFF) involvement. Except palm oil

and sugarcane plantations and livestock industry operated by a Cambodian conglomerate company, no sizable agricultural activity seems to be taking place in Preah Sihanouk City and its surrounding suburbs due largely to high land prices and the availability of alternative income sources in the area.

On the other hand, fishing industry of Preah Sihanouk Province is the most highly developed in the Coastal Area with well developed capital investment in both open sea fishing and aquaculture. For open sea fishing, the vast majority of excursions are done by deep-sea boats capable of operating for 1 week at sea, when provisioned, and utilizing well developed nets and bait fishing methods. The number of fisherman in the region has been increasing over the past 5 years, and according to the information from a MAFF officer of Preah Sihanouk, about 1,500 households are currently engaged in the fishery industry. Aquaculture in the region has similarly been expanding with both off-shore and inland enterprises.

Although the provincial government proposed paper, boiled fish, dried shrimp, palm oil, and sugarcane as the priority industries for OVOP products, any specific promoting activities have not yet been taken at this moment.

In Preah Sihanouk Province, total amount (in fixed assets) of the investment on oil-related industry ranks second, at 16% (USD645.2 million) of the whole amount of investment in Preah Sihanouk after the tourism industry. Since a large Cambodian conglomerate enterprise has commenced oil supply business at the oil terminal, located 18km north of the Sihanoukville Port, the oil storage and/or supply business has been developed and promoted by the foreign investment. Also, oil and gas fields in Block A, a 6,278 km^2 block about 140km southwest of the Sihanoukville Port, was discovered by an US major oil company in 2004. The expected capacity of each natural gas and condensate in the Block A is 3-5 tef and 400-700 $MMbbl^2$. Although a Chinese investment on oil exploitation with fixed asset of USD400 million was registered and approved in 2006, the oil and gas extracting project seems to be proceeding difficulty[3]. Since then the vigorous movement on this project has not been reported in public.

The Port Authority of Sihanoukville (PAS) will construct a multipurpose terminal including the oil supply base under the loan assistance of Japanese Government.

(2) Issues for Promotion of Resource-based Industries in Preah Sihanouk

1) Fisheries

i) Depletion of marine resources

As mentioned in the section 4.1.4, statistics on fish catch indicate an upward trend in the Coastal Area, due to the rapid growth of consumers' demand as well as improvement of the transportation infrastructure. However, there is concern about depletion of marine resources along the Coastal Area because of intensive trawl fishing in the area. According to the investigation of marine fishery resources executed by the former Soviet Union during 1992-1993, the maximum sustainable yield in Cambodia was between 50,000 and 60,000 tons/year. Marine fish catch in 2007 of 65,300 tons already exceeded this level.

2) Agriculture

i) No linkage between producers and purchasers

All significant agricultural activity appears to occur in proximity to Kampot Province (present *Prey Nob* District) in order that such farmers may have access to the Kampot market and take

advantage of spillover effects from Kampot agricultural activities. The farmers there rely on the Kampot market for both inputs (agri-chemicals, seed, etc.) and to sell their outputs.

Therefore, even there is some potential and substantial demand on fresh and safe vegetables, fruits and meats by Hotels, restaurants and tourists (especially foreigners) in the City of Preah Sihanouk, the linkage between the farmers of *Prey Nob* District and those purchasers in Preah Sihanouk City is quite limited.

ii) Improper use of agri-chemicals

As indicated in Chapter 4 of Book I, vast majority of agri-chemicals supplied over the Study Area are imported from China, Vietnam, or Thailand with labels for the products written in one of those three languages and/or English. As neither the farmers nor suppliers have the ability to read any of these instructions, methods of use are often derived from speculation, visual comparison of other past used chemicals in order to mimic their use, and/or experimentation. The vast majority of farmers interviewed by the Study Team indicated that, should they be provided with information on the recommended/actual use of their agri-chemicals, they would actively change their current practices in light of such information.

(3) Policies for promotion of resource-based industries

As studied in the foregoing sections, the most prospective resource-based industries in Preah Sihanouk Province shall be marine fishery industry. As the number of people engaged in the aquaculture has been growing and the requisite skills and techniques have accordingly been accumulated among them, Preah Sihanouk can be the centre of aquaculture development in the Coastal Area of Cambodia.

On the other hand, the agricultural activities over the Coastal Area are likely to be led by Kampot farmers and extension staff of MAFF Kampot. But several strategies regarding agricultural industry can be jointly carried out with the cooperation and coordination of Kampot MAFF staff.

The following activities are to be considered for promoting resource-based industries:

1) Expansion of Marine Aquaculture

Although the Fishery Sector for the most part appears to be sufficiently capitalized and developing independently, the development potential of marine fishing is limited due to the decreasing fish stock in the Coastal Area. In light of this, marine aquaculture is identified as a priority area. Though its promotion has not been sufficiently supported since the transfer of aquaculture techniques, which is currently taking place under the individual initiatives of fishermen, it is slow with aquaculture seeds still being obtained from the wild or imported from neighboring countries. There are also the risks of infectious fish disease outbreaks if proper disease control measures are not introduced. Although JICA is currently engaged in the construction of Marine Aquaculture Development Center (MADeC) in Preah Sihanouk, which will be used to conduct training in aquaculture and infectious diseases control techniques, there are seemingly insufficient number of technical staff in the overseeing ministry, MAFF, who have practical knowledge in the production of fingerlings and disease control. There is an urgent need for technical assistance in the capacity building of relevant staff in MAFF, which will enable the acceleration of technology transfers in marine aquaculture in the Coastal Area as well as the promotion of the domestic production of fingerlings through MADeC activities.

Regarding this, MAFF staff of Preah Sihanouk Province, who have been trained through MADeC activities shall be dispatched to the other three provinces, where also have the potential for the improvement and expansion of marine aquaculture.

2) Establishment of a Direct Linkage between Producers and Purchasers

Major hotels in Phnom Penh, Preah Sihanouk and Koh Kong tend to buy vegetables from abroad because of local products' inconsistency in quality and unreliability in delivery. The gap between demand and supply is mostly attributable to the lack of market information on the farmers' side. In other words, vegetables have been sold rather in an *ad-hoc* manner, with farmers not knowing what quality and timing their products are demanded by customers.

Since filling this information gap is an important but time-consuming task, it needs to be supported by the MAFF in cooperation with donor agencies. Government extension officers or staff of not-for-profit organizations should facilitate organization of farmers, identify customers who wish to have a long-term relationship with local producers, and establish a linkage (a contract) between these two parties in which correct information about customers' preferences is delivered to farmers with proper price indications, while making sure that all transactions go smoothly according to the contract. Once both parties in a pilot area have established confidence in the market, the system will not need any further support from outside, and the system is expected to grow or be replicated in other areas relatively easily.

As tourism seems to be promised to grow steadily in the City of Preah Sihanouk, establishment of such the linkage between farmers (mainly in Kampot Province) and purchasers brings in the substantial benefits on both parties.

3) Long-term Expansion of High Value Added Chemical Farming

The market demand for high value added crops with introduction of organic and reduced chemical farming is substantial but limited by the inability of the market system to provide means to identify and verify organic and reduced chemical produce. Although more and more Cambodian consumers as well as customer-satisfaction oriented hotels and restaurants are interested in purchasing "safe products", there is currently no means in guaranteeing that the products they are purchasing are in fact organic or reduced chemical.

Pilot projects such as those currently being run by *Centre d'Etude et de Developpement Agricole Cambodgien* (CEDAC) provide a means by which market participants can identify specific farmers in the projects who produce authentic organic or reduced chemical produce.

These initiatives should be reproduced and/or expanded through long-term programs. While perfect adherence to organic standards appears to be largely unnecessary in this market, the involvement of a trusted institution or body that directly links producers and purchasers of the reduced chemical produce would be effective. In the longer term, there should be an effort to establish an institution or body that can verify the compliance of organic standards, although it will be quite difficult in the Cambodian context due to its limited technical and financial capacity and market size.

4) Creation of a Farmer's Handbook to Disseminate Agri-Chemical Information

As farmers in the Coastal Area use a limited range of agri-chemical products (fertilizers and insecticides), instructions for which are usually made in a foreign language, it would be

beneficial for farmers to have a kind of Farmer's Handbook with necessary information in the Khmer language. Based on the information sharing networks already existing in the agricultural community, the handbook could be disseminated to one farmer within each farming community group. Once the benefit of the Handbook is realized from the receiving farmer, the information would naturally be spread within the information network as occurring with most other methods and techniques.

The likely benefits from the creation of such a hand book would be: (1) a reduction in chemical use as most chemicals are currently being overused and farmers will find input cost savings by using less chemicals with at least an equal yield effect; and (2) increased yields per hectare.

5) Complying with Environmental guideline

Although, it is still unknown at present whether the offshore oil and gas would be commercially exploitable or not, once the oil and gas were successfully developed, the additional investment on oil refinery and/ or supply business will be concentrated in Preah Sihanouk. As the area is also containing environment preservation areas and cultivates precious marine resources, it is recommended that formulating monitoring system and training MOE staff of Preah Sihanouk to develop the monitoring capacity.

Finally, the interrelations between each industrial promotion policy and the executing entities are summarized as follows.

Table 3.3.7 Industrial Promotion Plans and Executing Entities: Resource-based Industries

Industrial Promotion Policies	Main Actor	Sub-Actor
1. Expansion of Marine Aquaculture	MAFF	Provincial Govt. Donors NGO Private Sector
2. Establishment of a Direct Linkage between Producers and Purchasers	MAFF	Provincial Govt. Private Sector (Farmers, Consumers (esp. Hotels and restaurants)) NGO
3. Long-term Expansion of Organic and Reduced Chemical Farming	MAFF	Provincial Govt. Donors NGO Private Sector (Farmers, Consumers (esp. Hotels and restaurants))
4. Creation of a Farmer's Handbook to Disseminate Agri-Chaical Information	MAFF	Provincial Govt. Donors NGO Private Sector (Farmers)
5. Complying with Environmental Guideline	MOE	Provincial Govt. MIME Cambodia National Petroleum Authority Private Sector (Developper)

Source: JICA Study Team

3.3.3 Promotion of Tourism

(1) Current Situation of Tourism Sector in Preah Sihanouk Province

Preah Sihanouk Province is one of the three major tourist locations in Cambodia, third to Siem Reap and Phnom Penh in terms of tourist flow as well as sector development. As Table 3.3.3 reveals, the last 5 years in the region have witnessed great expansion of the tourist sector with the expanding of most large hotels and guesthouses in the region as well as the continuing construction of new hotels and facilities. The share of the total amount of the approved tourism investment projects achieves 70% of the total investment amount in Preah Sihanouk Province.

In the long run the region may be approaching saturation due to the level of new hotel construction. This seems even more likely with the closure of several hotels during the recent economic downturn though most construction has continued despite these developments. The majority of tourists in the region are foreign, though the amount of domestic tourists is sizable. The majority of foreign tourists arrive either from Koh Kong or Phnom Penh in transit from Thailand to Vietnam or visa versa. No active hotel or tourism association could be found in the region, and none of the respondents reported knowing of any such organizations.

There area three major beaches in the town; i) *Ochheuteal* Beach, the most popular beach in the city, ii) Independence Beach, and iii) Victory Beach which features plenty of budget accommodation. Various opportunities for marine sport such as scuba diving and snorkeling are available in the beaches.There are a number of restaurants serving fresh seafood in the town.

Koh Pos (Snake island) is also an attractive tourist destination, which is located 800 m away from the Victory Beach. In 2007, the Cambodian government granted a Russian company (Koh Pos Investment Co. Ltd.) with a concession to develop the island into a tourist resort with an initial investment of up to USD 300 million. The concession agreement allows the company to develop and operate the island for 99 years. The company is currently constructing a bridge linking the island with landside.

Beside the abovementioned beach and island resort spots, there are two major ecotourism sites in Preah Sihanouk Province. One is *Kbal Chhay* Waterfalls, located roughly 7km from the City of Preah Sihanouk, which is well known throughout the region as well as most visitors. The waterfall has been damaged by the dam constructed nearby for water supply, and the water has become turbulent. The other is Ream National Park, which is located nearby the Pre Sihanouk international airport that is 18km east of the City of Sihanouk.

(2) Issues for Promotion of Resource Based Industries in Preah Sihanouk

1) Advertising and Sector Coordination

As mentioned in the section 4.1.4 of Book I, although most hotels within the Coastal Area participate in some type of advertising either through guidebooks, newspapers, free journals or websites, these media sources are very much limited to advertising the hotel's facilities and often give little information concerning the surrounding region. The exception to this occurrence is the advertising approaches of the four and five star resorts within the Preah Sihanouk Province, which promote regional attractions in the course of advertising their own hotels. Only these facilities participated in any type of packaged tours with the routes coming out of Phnom Penh and returning the same way after the stay.

Though some efforts have been made towards cooperating in advertising in the Kep region through the Kep Revival Guidebook, a guidebook for the region produced by one hotel owner at

his own expense and compensated for by advertising paid for by other hotel owners, overall there is little communication between hotels in the regions thus leaving regional promotion for tourism purposes to the Ministry of Tourism and its websites.

2) Hotel Associations and Cooperation

As noted earlier, there currently exist no operating hotel associations or significant hotel group cooperation in Coastal Area though one attempt was made at such an association in the past.

One of the primary reasons for this is a general lack of mutual trust by most participants in other participants, and, especially, a distrust of government entities in the region. As such, no substantial efforts or progress have been made towards the creation of any types of hotel associations.

Despite these facts, interest and expectation in the creation of and participation in regional hotel associations founded by a third party is high in the Coastal area. Currently, many hotels are attempting regionally beneficial activities alone such as street garbage removal, creation of nature maps of national parks, bargaining with *tuk-tuk* drivers, and other such activities that would benefit the tourists in general from a collective action. Moreover, hotels have individually, besides the four and five star hotels mentioned earlier, been unable to negotiate out package tours with other hotels or tour agencies in the region due to coordination and cost issues which may be resolved through collective action.

3) Transportation Infrastructure

At present, car transportation is the only way to reach Preah Sihanouk Province and the other three provinces of Coastal area, as well with the exception of daily speed boat connection from Koh Kong.

Although the Cambodian national airline, Cambodia Angkor Air (CAA), a joint venture between the RGC and Vietnam Air. was established in July 2009 and the rehabilitation of Preah Sihanouk International Airport has been completed, there still has no regular flight connecting Preah Sihanouk with other regional airports such as Phnom Penh and/or Siem Reap. As several large-scaled tourism development projects are currently “on-going”, development of air transportation is prerequisite to lure a large number of tourists.

(3) Policies for promotion of tourism

1) Creation of Hotel Associations in Three Provincial Regions

The creation of individual hotel associations in Preah Sihanouk, Kep, and Koh Kong regions, respectively, would likely provide benefit to all sector participants in the region while making possible coordination at the regional level to address the growing tourism sector needs.

While Koh Kong and Preah Sihanouk Provinces would likely involve only the larger sized hotels in the region, it would be important for smaller sized hotels and guesthouses to be included at some level in Kep Province as much of the current sector development activities are spearheaded by smaller hotels and guesthouses. All hotels in the regions expressed interest in the formation of associations as long as such associations are created outside of any one private hotel or government entity, the Ministry of Tourism (MOT).

i) Regional Advertising

Each association should be encouraged, with support, to participate in the creation of a regional website advertising local attractions and facilities in addition to possibly promoting local products. If a prominent, regional website can be achieved, it would help dispel misinformation and outdated information regarding such issues as border crossings and procedures while providing a platform for movie, image, and written tourism media for the region to be provided.

ii) Training and Collective Action

Each association should be given the latitude to select the issues relevant to its region, and receive support in addressing those issues. Two of the provincial regions have expressed interest in staff training, which could be collectively coordinated using the association structure. Moreover, the association could be used as a platform to address other obstacles in the regions such as city cleaning, local transportation arrangements, training of guides, and the creation of local maps. These issues were expressed as serious obstacles to local tourism by participants in the regions.

iii) Tour Packages

The creation of associations in the regions should make it possible for tour agencies and airlines to more easily negotiate and coordinate with each region in order to negotiate and create packaged tours for the region especially with the reopening of the Preah Sihanouk International Airport. As most tourists travel through Cambodia en-route between Thailand and Vietnam, promotion of an alternative route from Koh Kong at the Thai border through Preah Sihanouk, Kep and through to Vietnam in Kampot border crossing could be packaged and encouraged as a tour route. This level of coordination and promotion would likely require substantial support for media promotion as well as organizing and coordinating association activities.

2) Improvement in Transport Infrastructure

Improvement in transport infrastructure is expected to boost tourism in the Study area. Tourism in Preah Sihanouk will be activated by the reopening of the Preah Sihanouk International Airport, which had been suspended after a fatal crash in June 2007. The airport is expected to lure visitors from Cambodia's other destinations, such as Siem Reap and Phnom Penh, to the beaches in Preah Sihanouk. As mentioned in the previous section, CAA was established in July 2009. It is announced that CAA's first services route will be opened between Phnom Penh and Bangkok and Ho Chi Minh and the company is also said to have a plan to start an operation between Preah Sihanouk and Siem Reap soon. In the future, the airport may also facilitate direct flights from neighboring countries.

Also, National Road No. 48 running from the Thai boarder in Koh Kong to Preah Sihanouk Province along the coastal line that has recently been improved, will lure tourists from Thai, Phnom Penh and Preah Sihanouk to Koh Kong.

The connection between Preah Sihanouk and Kep is rather weak even by car transport, and improvement has to be considered by introducing direct bus service between the two resort towns, and/or extending speed boat connection.

3) Facilitation of Movement of Tourists

Cambodia, Vietnam and Thailand have recently signed a visa exemption agreement of passport holders of their citizens. In addition, in 2007, Cambodia signed an agreement with Thailand and Vietnam under which foreign tourists will be able to visit both countries on a single visa. This agreement will contribute to the tourism development in the Study area.

4) Promotion of Touristic Attractions through Media

MOT has recently created several promotion videos that present Cambodia's major attractions including Siem Reap, Phnom Penh and Preah Sihanouk. MOT has also contracted with BBC to publicize these attractions over the air. The Department of Tourism in each of the four provinces has published a leaflet to introduce their major touristic spots, although these leaflets are only distributed within respective provinces. Apart from the beaches of Preah Sihanouk, few initiatives to promote attractions for foreign tourists have so far been taken.

Information about these attractions is only known through individual websites or booklets prepared by private companies which earn commissions through advertisements or hotel reservations.

Finally, the interrelations between each industrial promotion policy and the executing entities are summarized as follows.

Table 3.3.8 Industrial Promotion Plans and Executing Entities: Tourism Sector

Industrial Promotion Policies	Main Actor	Sub-Actor
1. Creation of Hotel Associations in Three Provincial Regions	MOT	Provincial Govt. Private Sector (Hotels, tourist agents and media), MLVT, NGO
i) Regional Advertising	MOT	Provincial Govt. Private Sector (Hotels, tourist agents and media)
ii) Training and Collective Action	MOT	Provincial Govt. MLVT Private Sector (Hotels) NGO
iii) Tour Packages	MOT	Private Sector (Hotels, tourist agents and Airport operator)
2. Improvement in Transport Infrastructure	MPWT	Provincial Govt. Private Sector (tourist agents and Airport, bus, boat operators)
3. Facilitation of Movement of Tourists	Immigration Dept. (MOFA)	MOT
4. Promotion of Touristic Attractions through Media	MOT	Provincial Govt. Private Sector (Hotels, tourist agents and media)

Source: JICA Study Team

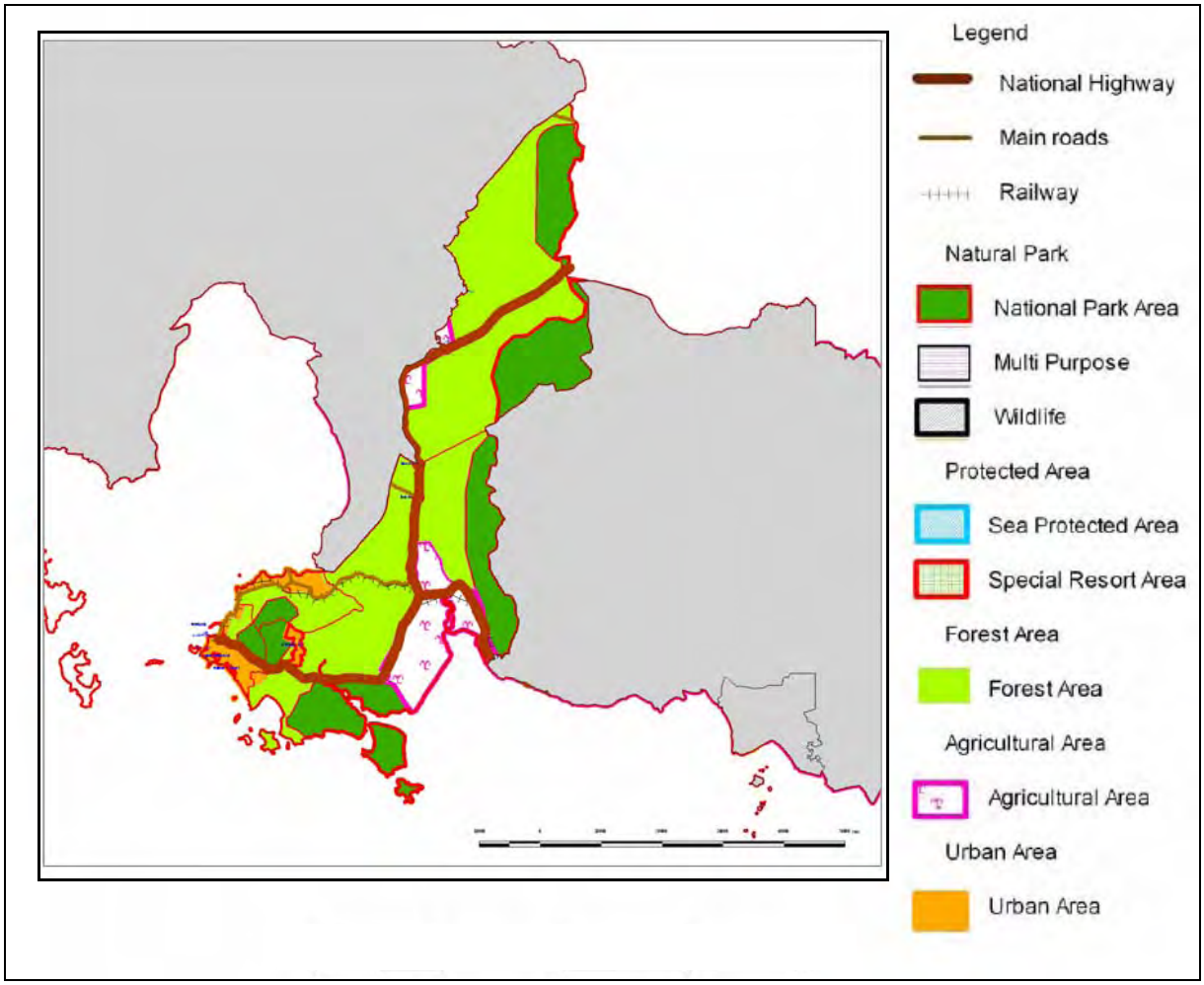
3.4 Spatial Structure Plan

In Section 5.4.5 of Book1, the basic concept and spatial structure plan for Coastal area was discussed. For the Preah Sihanouk Province, the province is designated as "Preah Sihanouk Regional Growth Center", the general land use plan was proposed as in the figure below.

Most of the part of the province is covered by Forest Area and National Park Area Land Use.

Agricultural Area is located along NR4 in Prey Nob District. Islands and seashore of southeast part of the peninsula are designated as Sea Protected Area.

Urban Areas are located in Preah Sihanouk City and Stueng Hav District. Seashore of southwest part of peninsula is specified as Special Resort Area.



Source: JICA Study Team

Figure 3.4.1 General land Use Plan for Preah Sihanouk Province

3.5 Target Area of Master Plan for Preah Sihanouk

3.5.1 Criteria of Selecting Target Area of Master Plan (M/P) for Preah Sihanouk

Based on the development goals to produce the best effect of the role of City of Preah Sihanouk for sustainable development compatible with environmental preservation, the spatial target of M/P should be set with due regard to the prospective urban expansion area consisting of residential and commercial land use expansion and industrial land use expansion, and the main access network area for Preah Sihanouk, a city of the tip of cape.

Criteria 1: Main Access Network

Due to the location of the Preah Sihanouk, the junction of Route NR 3 and 4 is the main gate to Phnom Penh and other regions and access networks. Therefore, the junction of NR3 and 4 shall be included in the target area of M/P for Preah Sihanouk.

Criteria 2: Industrial Land Use Expansion

Approximate area of industrial land use was estimated based upon the labor force forecast in 2030 and population density for manufacturing industry. In accordance with the Forecasted Number of Labor Force in Preah Sihanouk Province in section 3.2.2, estimated total number of labor force of manufacturing in 2030 is 43,230. If 80 person per ha[1] can be used for labor force of manufacturing, rough industrial use area is calculated at 540ha. Considering the land use analysis results and its hilly geographic situation, Stueng Hav district will be an appropriate area for absorbing the future expansion of the industrial use area. Therefore, in terms of the industrial land use expansion, the target area of M/P should cover Stueng Hav district.

Criteria 3: Urban Expansion

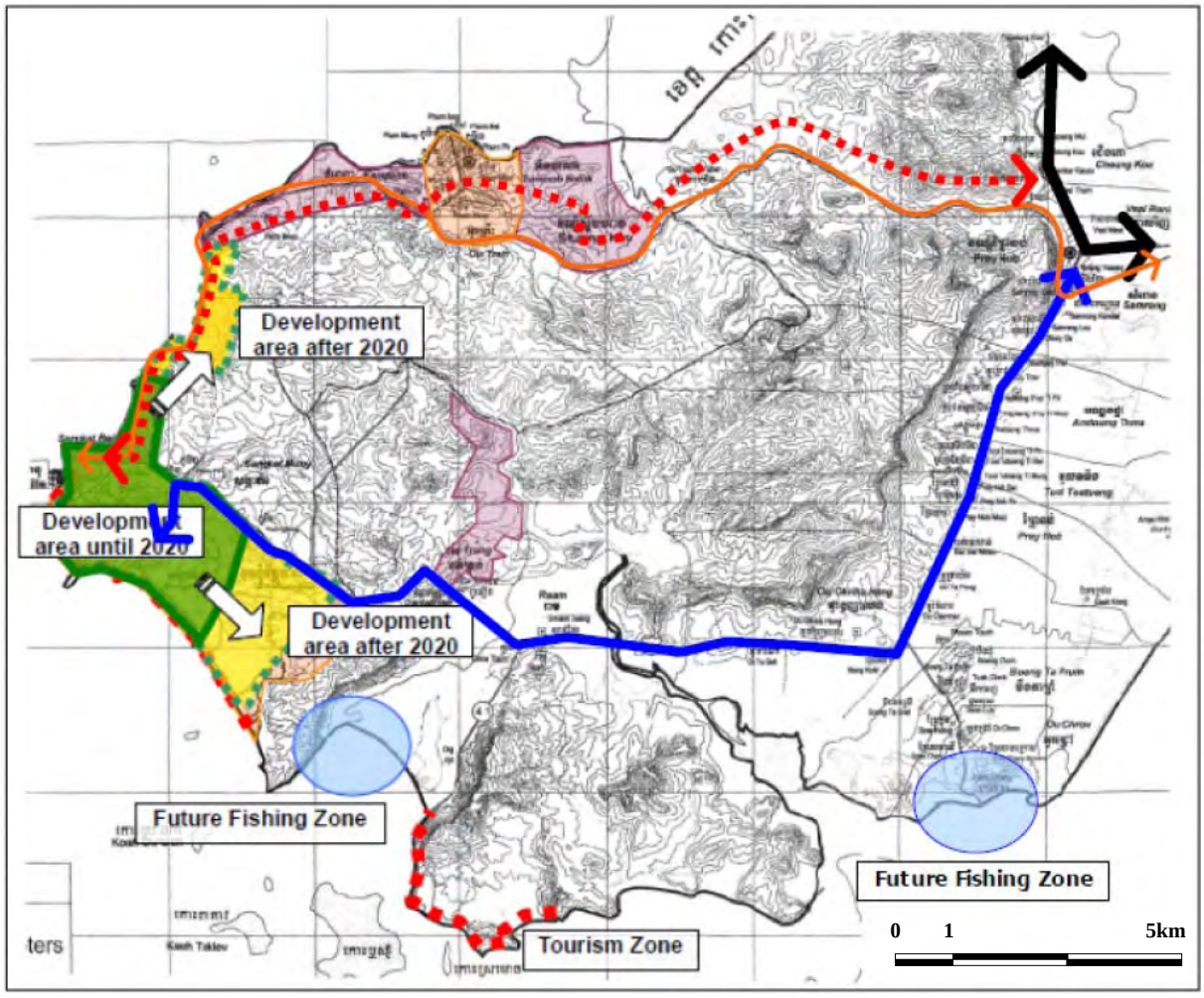
Although it is expected that the current urban area can absorb the future population growth at the target year of 2030, the active urbanization is expected to be occurred in and around the industrial development area in Stueng Hav district. Also, the urban expansion in the junction area of NR.3 and 4 is supposed to be occurred in the future as the as the town center of agricultural villages, although it takes a certain years. Therefore in terms of urban expansion, both Stueng Hav district and the junction of NR3 and 4 in Prey Nob district shall be covered in the target area of M/P.

Target Area of M/P

Based on the abovementioned analysis of urban expansion and the main access network, the target area of M/P for Preah Sihanouk was set at the area, which covers the junction of NR3 and 4 to the western boundary, and Stueng Hav district where the future industrial development is expected, to the northern boundary, as shown Figure 3.5.1.

In addition, the population frame of the target area has been roughly estimated as Table 3.5.1. The current population of the area is estimated at 179 thousand, and will reach 340 thousand in 2030, the target year of this M/P.

[1] The Study Team set 80 people per ha for calculating residential land use area, considering the current population density of "urban area" in Preah Sihanouk.



Source: JICA Study Team

Figure 3.5.1 Target Area of Master Plan

Table 3.5.1 Population Projection in Target Area

Target Area*	2008*	2010		2020		2030	
		No.	G/R* (%)	No.	G/R (%)	No.	G/R (%)
	178,600	188,700	2.8%	262,300	3.4%	339,900	2.6%

Note: *Target Area covers two (2) districts; Preah Sihanouk and Stueng Hav districts and ten (10) communes in Prey Nob district.
*Final results for Census 2008
*G/R stands for Growth Rate.

Source: JICA Study Team

3.5.2 Land Use Zoning for Environmental Protection

In this section, a land use zoning for environmental protection of target area has been prepared.

Sihanouk city is a southern part of Preah Sihanouk Province, and needs to carry out development activities taking environmental protection into account, so that the coastal area achieve to take balance between development and environmental protection and to ensure ecosystem services. In this part,

environmental condition in the target area[2] was evaluated on maps with land use data and field reconnaissance information, and zoning maps were delineated. Zoning is a device of land use regulation, and useful to manage the area in order to take a balance between development and protection. It must be introduced in the land use plan that is proposed subsequent to this section.

Land Use Map Analysis

Land use map is only one existing objective data to evaluate natural condition in and surrounding Sihanouk city. Land-use classification was interpreted from satellite images and several land uses were sorted out on a map. Among the land uses, following land uses are important to maintain ecosystem services.

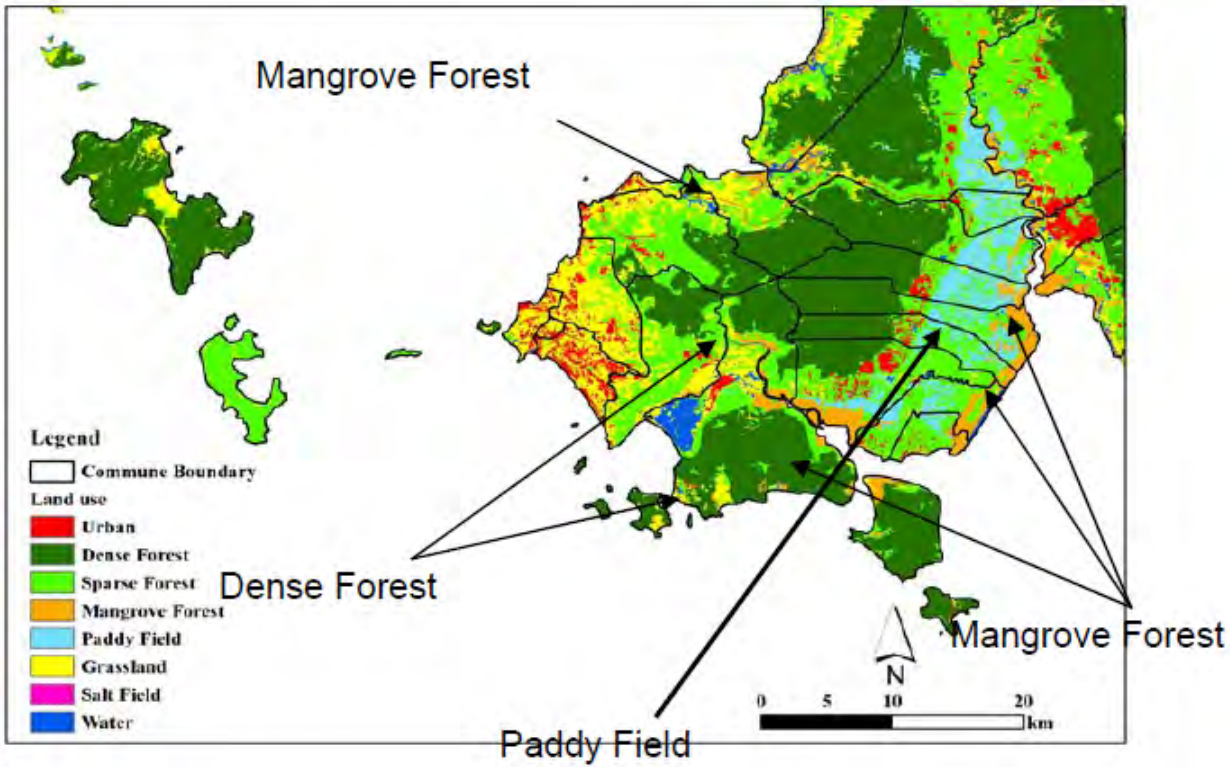
Table.3.5.2 Land Use and Important Function

Land Use	Important Function
Dense forest	- Biodiversity preservation - Water resources preservation - Natural landscape preservation - Land stabilization
Mangrove forest	- Aquatic life preservation - Disaster prevention - Sediment and nutrient filtering
Paddy Field	- Biodiversity preservation - Water retention and disaster prevention - Maintaining food production

Source: JICA Study Team

The important land uses are located as shown in Figure 3.5.2. Dense forest is located at the center of the peninsula, southern part (Ream national park) and islands. Mangrove forest is located along the coast mainly southern part. Agriculture land is located at the east area from north to south between dense forest and mangrove forest.

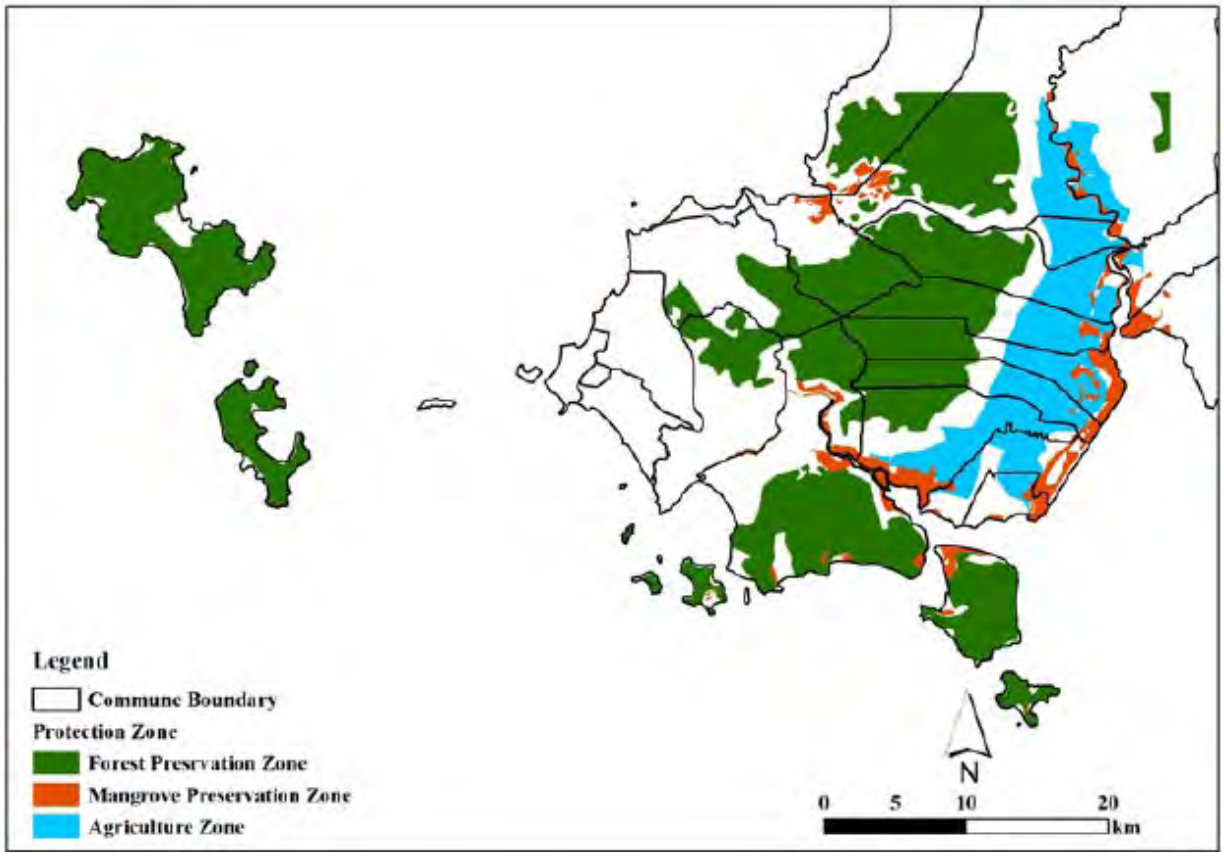
[2] Islands are also included to the target area, as the environmental conservation is most required for the island and coastal zone for biodiversity and tourism development as well.



Source: JICA Study Team

Figure 3.5.2 Location of Important Land Use

From above observation, a zoning map to conserve the natural condition in this area was shown in Figure 3.5.3. Dense forest is defined as forest preservation zone, mangrove forest is mangrove preservation zone, and paddy field is agriculture zone respectively.



Source: JICA Study Team

Figure 3.5.3 Zoning Map with Land Use Analysis

Field Reconnaissance Analysis

As there are few existing natural environmental data, complementary field reconnaissance was carried out in October 2009 and March 2010 so that comprehensive analysis was provided for environmental protection. The reconnaissance comprised field observation and hearing to officials and local people. It was conducted from the viewpoint of biodiversity, natural landscape, eco-tourism, and disaster management that provide ecosystem services listed in the land use map analysis. The idea to establish the protected areas described in Article 8 Chapter III of Protected Areas law[3] was also applied to select the view points.

Environmental condition in and surrounding Sihanouk city is evaluated on the land use map. Figures from 3.5.4 to 3.5.7 show the important areas in and surrounding of Sihanouk city. The importance was divided into significantly high, very high and high[4]. The importance was converted to value shown in Table 3.5.3.

[3] A description of significance of the area(s) proposed for establishment or modification in terms of biological, topographical, geological, historical, cultural, and conservation values.

[4] The criteria were established as follows. Significantly high: If it is lost, ecosystem services in the area will be destructed catastrophically. Very high: If it is lost, ecosystem services in the area will be degraded and restoration will be very difficult. High: If it is lost, a part of ecosystem services in the area will be degraded.

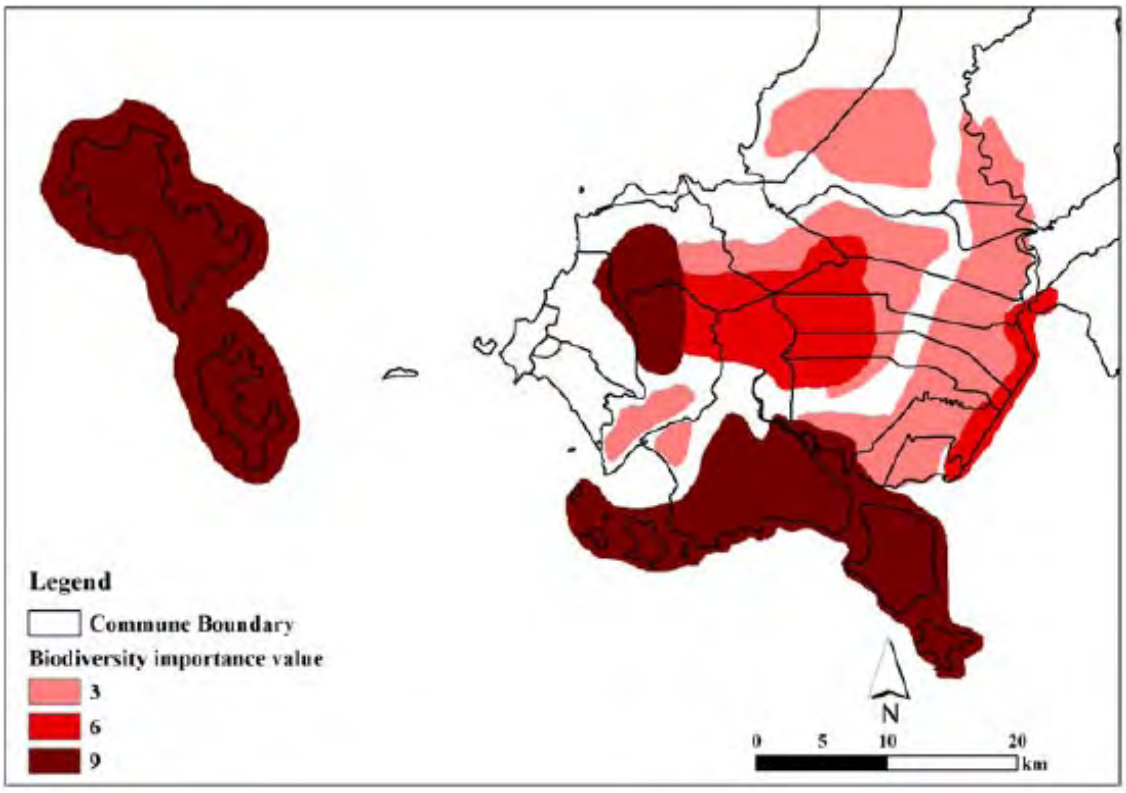
Table.3.5.3 Value of Importance

Importance	Value
Significantly High	9
Very High	6
High	3

Source: JICA Study Team

(1) Biodiversity

The importance was evaluated with abundance of species, diversity of habitats, and vulnerability and specificity of ecosystem, and shown in Figure 3.5.4. Islands and Ream national park are significantly important in terms of biodiversity as these areas include rich natural resources in particular threatened species such as Malayan sun bear, smooth-coated otter, and Irrawaddy dolphin. These areas must be protected from any large scale development that makes serious negative impacts. Kbal Chhay is also significantly important because it still maintains rich wildlife (FoAC pers. com.). It is also important to retain water both surface and underground. The forest stretched continuously up over Preaek Tuek Sab River basin. The forest in the river basin is of very high importance. Other dense forests are of high importance, though those have suffered from human impacts and biodiversity at present is relatively low. Mangrove forest on the east coast has been degraded but still has potential to revive and function to nurture marine organisms. Broad paddy field is the habitat of several species and important from the view point of biodiversity.

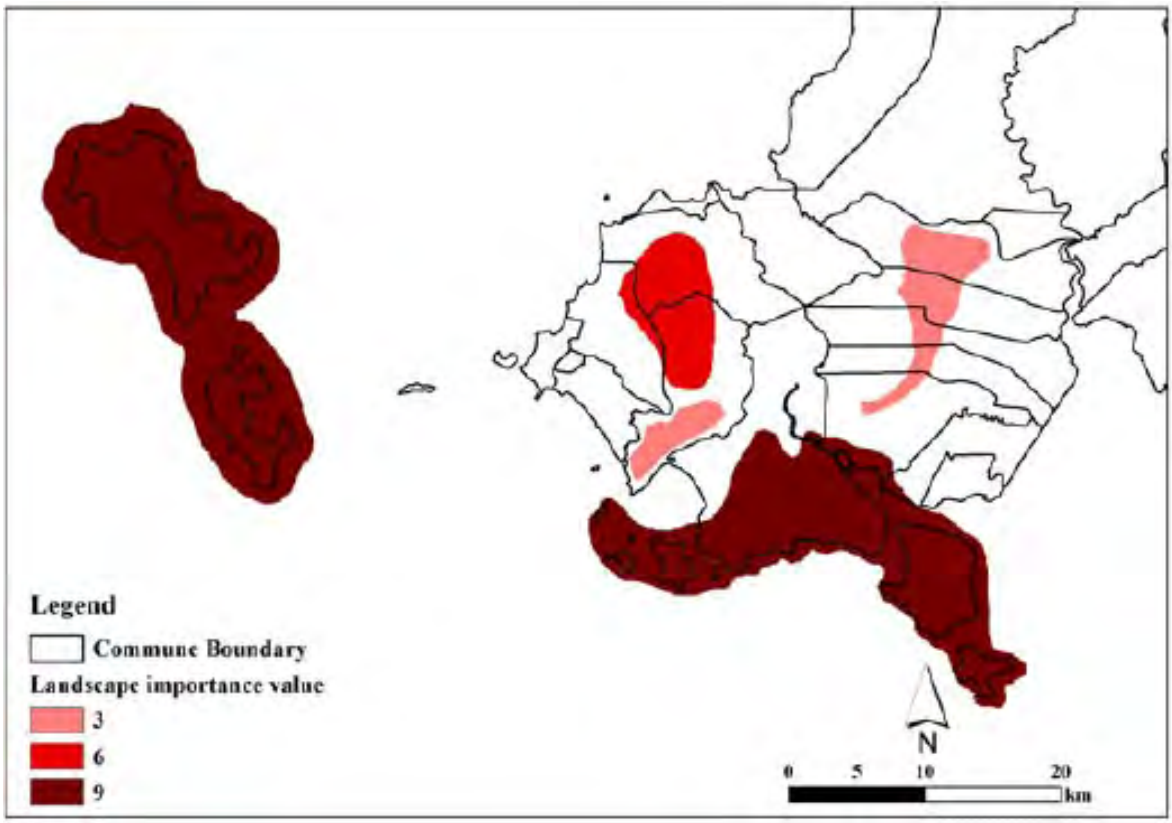


Source: JICA Study Team

Figure 3.5.4 Importance of Land for Biodiversity

(2) Landscape

The importance was evaluated with ratio of green coverage, diversity of habitats, and visibility from urban areas, and shown in Figure 3.5.5. Landscape is the most important natural resource for tourists, and the centerpiece for tourism in Sihanouk is natural landscape. The natural landscape at islands, Ream national park and mountain that tourists can access are significantly important with beautiful scenery. Kbal Chhay is very important as it is tourists destination with a water fall and forest. A sparse forest at the top of the hill from city and beach in Sihanouk city is also important.

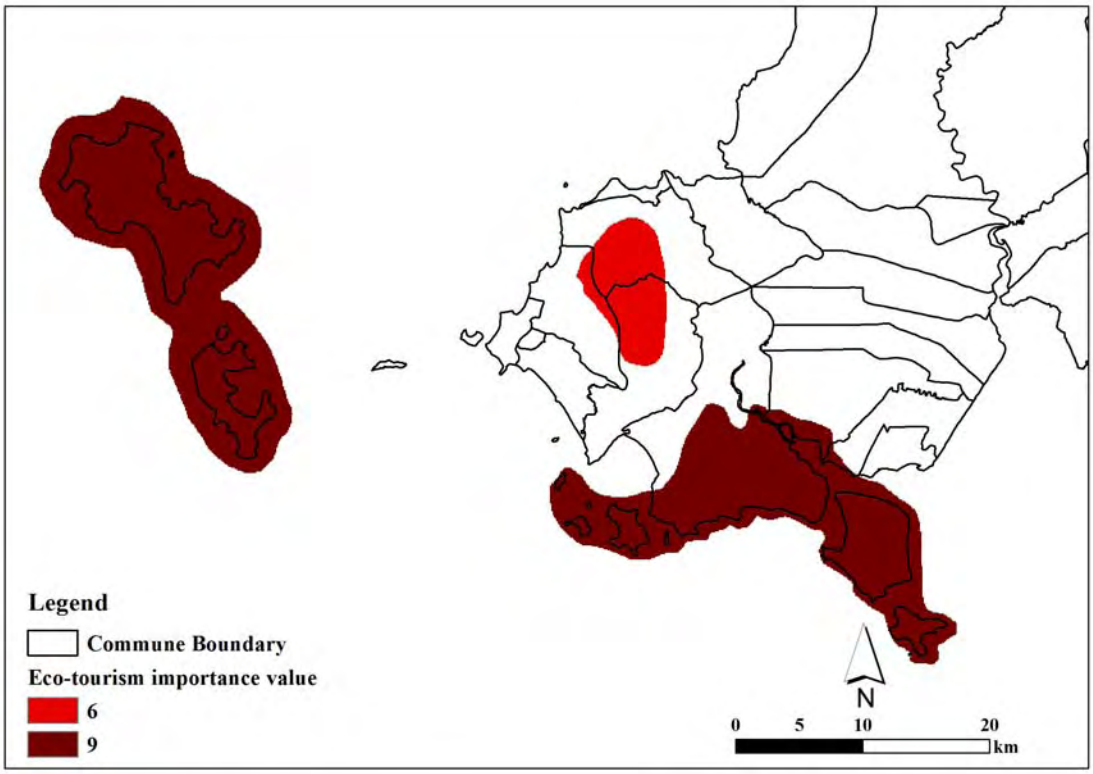


Source: JICA Study Team

Figure 3.5.5 Importance of Land for Landscape

(3) Eco-tourism[5]

The importance was evaluated with specificity of nature, survival ratio of intact and attractive nature, accessibility, and shown in Figure 3.5.6. JICA Study Team made interview to tourism related people (hotels, tour agencies, etc.), and most of them insisted the necessity to maintain the natural resources that are high quality for tourism. They think they can not survive only with beaches. The selling point in Sihanouk is intact nature in combination with beach and sea foods. Therefore eco-tourism (nature tourism) areas are essential. Ream national park and islands are surviving eco-tourism resources and significantly important. The eco-tourism development must preserve present nature condition. Development guideline proposed in the subsequent section must be applied to preserve the significantly important areas not to destruct with mass tourism that sometimes pretends to eco-tourism.



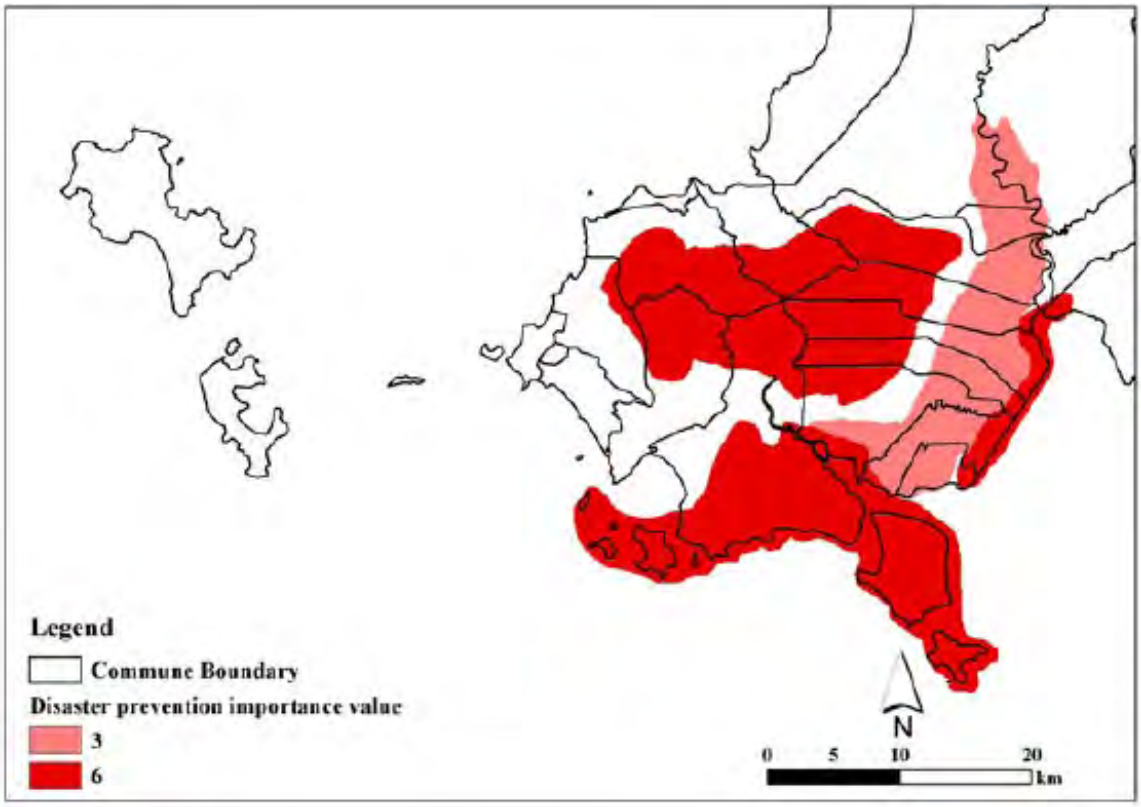
Source: JICA Study Team

Figure 3.5.6 Importance of Land for Eco-tourism

[5] Ecotourism' (also known as ecological tourism) is responsible travel to fragile, pristine, and usually protected areas that strives to be low impact and (often) small scale. (Honey, Martha (2008). Ecotourism and Sustainable Development)

(4) Disaster Prevention

The importance was evaluated with residual ratio of natural environment that has disaster prevention effect (area and density adjacent to urban area), and shown in Figure 3.5.7. Natural environment such as forests, mangrove forests, and paddy fields function to prevent natural disaster such as flood, land slide and heavy wave. So far Sihanouk city has not suffered from Tsunami disaster, but recent climate change causes historic disasters in the world. Forest and mangrove forest are very important to alleviate such disaster.



Source: JICA Study Team

Figure 3.5.7 Importance of Land for Disaster Prevention

The locations, importance and issues of four viewpoints are summarized and listed in Table 3.5.4[6].

[6] There are some small important areas outside of the designated important areas in figures from 3.5.2 to 3.5.7, and if the map scale is large, some additional areas are designated as important areas on the maps. The small and isolated important areas should be preserved individually with the regulation for urban development.

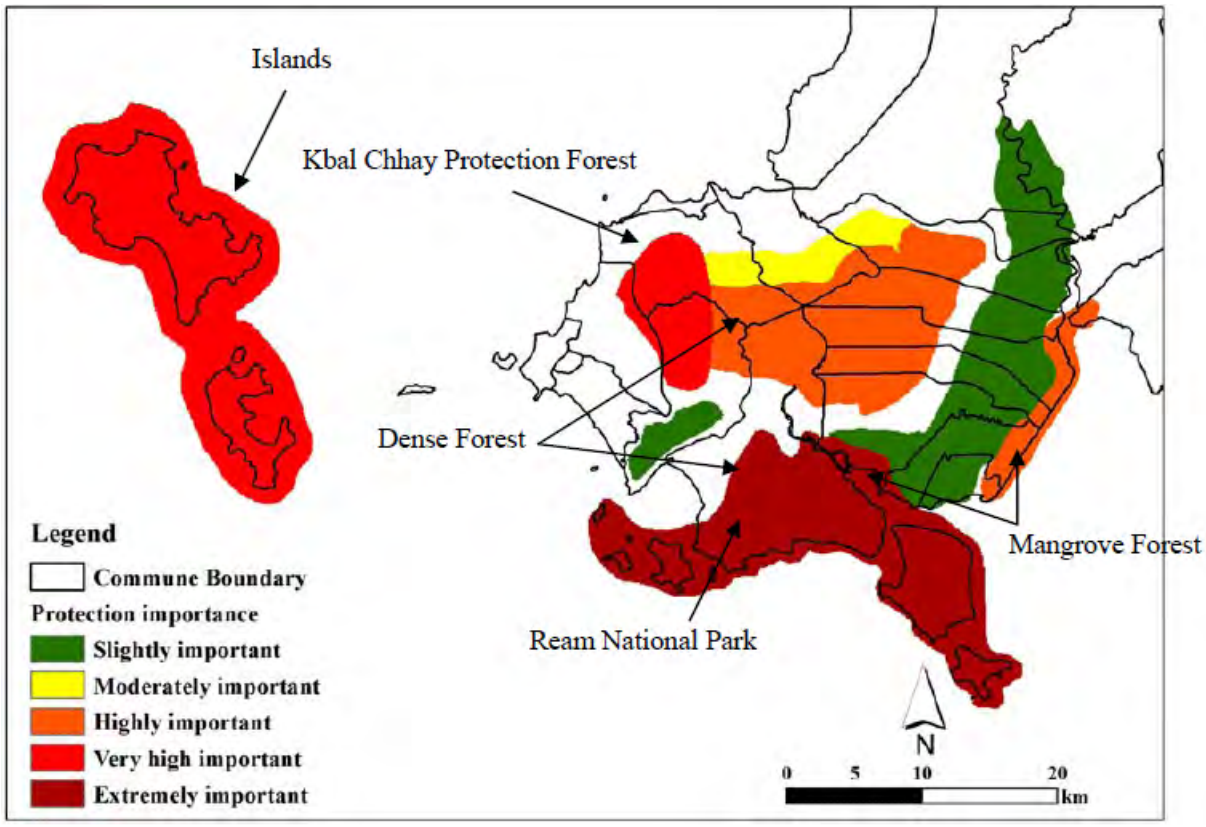
Table.3.5.4 Importance and Issue from Overlaid Map

Viewpoint	Location	Importance	Issue
Biodiversity	Ream National Park Islands Preaek Tuek Sab river basin Mangrove forest Paddy field	Terrestrial flora & fauna Water resource Mangrove forest as the nursery of marine organism Coral reef and fish	Disorderly land development in Ream national park and at islands
Landscape	Ream National Park Islands Preaek Tuek Sab river basin (Kbal Chhay protection forest) Forests visible from route No.4 and city	Ecosystem services Peace and harmony with natural landscape	Disorderly land development in Ream national park and at islands
Ecotourism	Ream National Park Islands Preaek Tuek Sab river basin (Kbal Chhay protection forest)	Intact nature Sea food Income generation	Mass tourism, not ecotourism Destruction and no sustainability
Disaster Prevention	Ream National Park Preaek Tuek Sab river basin Mangrove forest Paddy field	Protection of urban area Water supply	Disorderly land development in Ream national park Illegal logging of mangrove

Source: JICA Study Team

(5) Overall Evaluation

The maps with four viewpoints were overlaid and the overlaid map was shown in Figure 3.5.8. Overall importance from the environmental protection is indicated. Ream national park is extremely important, islands and Kbal Chhay protection forest are very highly important, mangrove forest and dense forest are highly important. This result is basically similar to the zoning map prepared with land use map analysis. The overlaid map is a revised zoning map by integrated information (from land use map, field reconnaissance and scattered existing literature), and it is recommended to use as the zoning map for environmental protection.



Source: JICA Study Team

Figure 3.5.8 Overlaid Map

Necessary measures in order to protect the important areas are presented below.

Ream national park and islands

These areas must be basically protected from development activities. Adequate scale of sustainable use such as ecotourism could be introduced. Although several investors have got QIP by the name of ecotourism, the ecotourism is almost mass tourism that destructs the forest, habitat of wildlife and natural landscape. Their plans must be reviewed by the process of EIA, and the destructions should be restricted. Present condition of islands and encompassing sea is still good, and population of local people is very small. Special treatment is not necessary, and it is only necessary to avoid large scale development.

Mangrove forest

Basic conservation policy is same as that of above zone. Furthermore this area is deemed to prevent Sihanouk city from natural disaster. As there are some inhabitants in this zone, environmental education and livelihood improvement with ecosystem services should be proceeded. Mangrove forest is still remained around the river mouth of Preaek Tuek Sab. This mangrove forest must be strictly protected.

Kbal Chhay protection forest and dense forest

Compared with the expansion of industry and population, water resources are limited. This zone comprises a watershed and it is only one large scale water source for Sihanouk city. As it is close to the residential areas and small scale industries that use wood for energy, illegal logging is common. In order to protect the forest in the watershed, control by FoA, environmental education, and reforestation are necessary.

3.5.3 Land Use Vision of Urban Planning in Preah Sihanouk

Following the concept of the land use zoning in terms of environmental protection, the land use plan of the target area in terms of urban planning is prepared. Firstly, constraints for urban development and transportation are studied for preparing the appropriate land use plan of the target area.

(1) Constraints for Urban Development

Existing problems and issues to be addressed in urban planning in the peninsula area of Preah Sihanouk Province are described below. These issues can be summarized in three point; 1) urban structure, 2) traffic problem and 3) environment on both natural and living condition.

Sparse urban structure: The urban area of Preah Sihanouk Province is sparse and scattered, and the center of the urban area is unclear. In future there should be a clear urban center which should be strengthened to provide the residents with various urban and administrative services and access to market.	
Sprawling of Urban Area: Urban area of Sihanouk is spreading at the fringes of the existing urban areas. This development pressure at the fringe area may continue in future. However, from urban management point of view, urbanized area should be compact to reduce investment on infrastructure such as road, water supply and sewage networks.	
Mixed traffic and inconvenient road network: The road network in Preah Sihanouk is basically dependent on NR No.4 alone, where all types of traffic, including the heavy tracks/trailers for industries, buses and cars for residents and tourists, are all mixed. Where there are settlements along NR No.4, the potential danger of traffic accident is not low. Also, the routes to the beaches are not convenient, with a substantive detour from NR No.4.	

Environmental Protection: In Preah Sihanouk, sustainable water supply is a crucial issue. Conservation of two water reservoirs is an important concern on urban land use planning. The catchment areas should be protected from development activities and existing living activities to maintain the water quality of the reservoirs.	
Uncontrolled Concessions: Existing development activities are often in a disordered manner. Urbanization promotion area and urbanized control area should be divided clearly to conserve the environment. And also industrial area should be separated from residential, commercial and tourism development areas.	
Informal settlements: There are a few informal settlements in Preah Sihanouk scattered in and around the urban area. In particular, an informal settlement within the port area of PAS, where many people engage in fishery for their livelihood, is causing a potential risk for port operation due to the mixing of large ocean-going vessels and small fishery boats. Growth of such communities has to be controlled.	

(2) Road Network

As the present road network is mixed for industrial, and touristic/residential all on NR 4, causing danger for traffic accident, the road network to/from Sihanouk should be divided into two routes; namely passenger and logistics, to improve road safety. The routes are described as below:

As the present road network is mixed for industrial, and touristic/residential all on NR 4, causing danger for traffic accident. From the result of the cordon line survey which was executed on NR4 in this study, it could be found that a present traffic condition is consisted of several kinds of vehicle as follows.

Table 3.5.5 Result of the Cordon Line Survey on NR4

Hours	Mortorcycle		Light Vehicle			Heavy Vehicle		
	Motorbike/ Motor Tricycle	Motorbike Trailer	Sedan/Jeeps / light truck (<3.5 t)	Pick-up (Van & Pick up)	Mini bus (van and Pick-up)	Short & long body bus	Short & long body truck (> 3.5 t)	Semi & Full trailer truck
6:30-7:30	406	5	95	30	23	4	6	21
7:30-8:30	288	9	148	37	23	12	11	42
8:30-9:30	220	10	130	41	25	10	13	37
9:30-10:30	211	6	122	37	25	2	17	22
10:30-11:30	258	8	130	37	30	8	18	22
11:30-12:30	240	7	112	31	37	12	14	25
12:30-13:30	225	8	98	34	31	12	16	15
13:30-14:30	285	9	121	43	30	13	18	20
14:30-15:30	243	8	112	41	22	3	17	35
15:30-16:30	318	7	111	30	28	4	13	45
16:30-17:30	327	6	113	37	21	6	13	38
17:30-18:30	372	5	95	35	21	8	7	44
Total	**3,393**	**88**	**1,384**	**433**	**316**	**92**	**162**	**365**

Source: JICA Study Team

In order to consider a characteristic of NR4 based on the result of the cordon line survey, two categories, which are a large-scale vehicle like a truck, trailer and bus and small-scale vehicle like a motorbike, motorbike trailer, sedan and pick-up, could be provided as shown below.

Table 3.5.6 Ratio of Small-scale Vehicle and Large-scale Vehicle

Category	Vehicle Type	Number	Ratio
Small-scale Vehicle	Motorbike / Motor Tricycle	3,393	0.9
	Motorbike Trailer	88	
	Sedan / Jeeps / Light Truck (< 3.5 t)	1,384	
	Pick-up (Van & Pick-up Truck)	433	
Large-scale Vehicle	Mini Bus (Van and Pick-up Truck)	316	0.1
	Short & Long Body Bus	92	
	Short & Long Body Truck (> 3.5 t)	162	
	Semi & Full Trailer Truck	365	
Total		6,231	1.0

Source: JICA Study Team

It is found that the ratio of small-scale vehicle is 0.9 and large-scale's is 0.1. A ratio of small-scale vehicle is usually considered to be from 0.6 to 0.8. When the ratio is more than 0.8, a road characteristic is considered as a passenger road, on the other hand, when the ratio is less than 0.6, it is considered as an industrial road. It is found that the present condition of NR4 is categorized as a passenger road and small-scale vehicles use NR4 together with large-scale vehicles.

In the future, the number of both small-scale vehicles and large-scales' is estimated to increase in accordance with a growth of an industry of Preah Sihanouk. According to the result of traffic demand forecast which was executed in the Study on the Road Network Development in the Kingdom of Cambodia, the number of vehicles in 2020 was shown as follows.

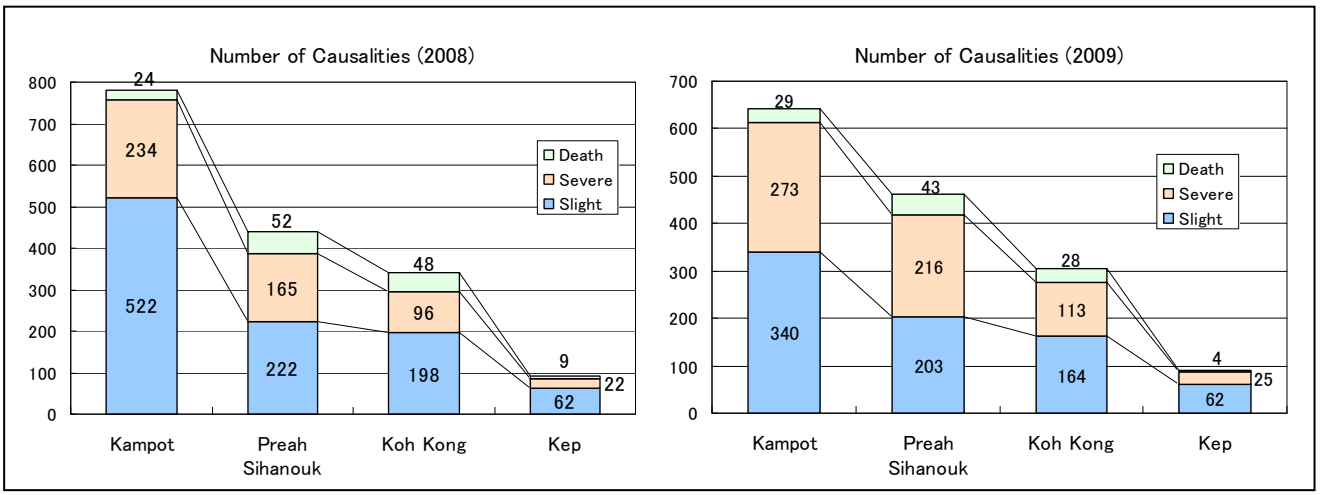
Table 3.5.7 Ratio of Small-scale Vehicle and Large-scale Vehicle

Unit: Vehicle/Day

Location	Assignment Result (2020)			
Preah Sihanouk (NR 4)	Motorcycle	Light Vehicle	Heavy Vehicle	Total
	12,848	6,982	2,145	21,975

Source: The Study on the Road Network Development in the Kingdom of Cambodia (2006)

At the same time, the number of traffic accidents also is estimated to increase. According to "Cambodia Road Crash and Victim Information System", the number of causalities of traffic accidents which was happened in 2008 and 2009 is as follows.



Source: JICA Study Team

Figure 3.5.9 Causalities on Traffic Accidents in the Study Area

Considering the traffic demand forecast executed in the Study on the Road Network Development in the Kingdom of Cambodia, the number of causalities, especially fatalities, is estimated to increase due to congestion and collisions between small-scale vehicles and large-scale vehicles in accordance with the traffic volume.

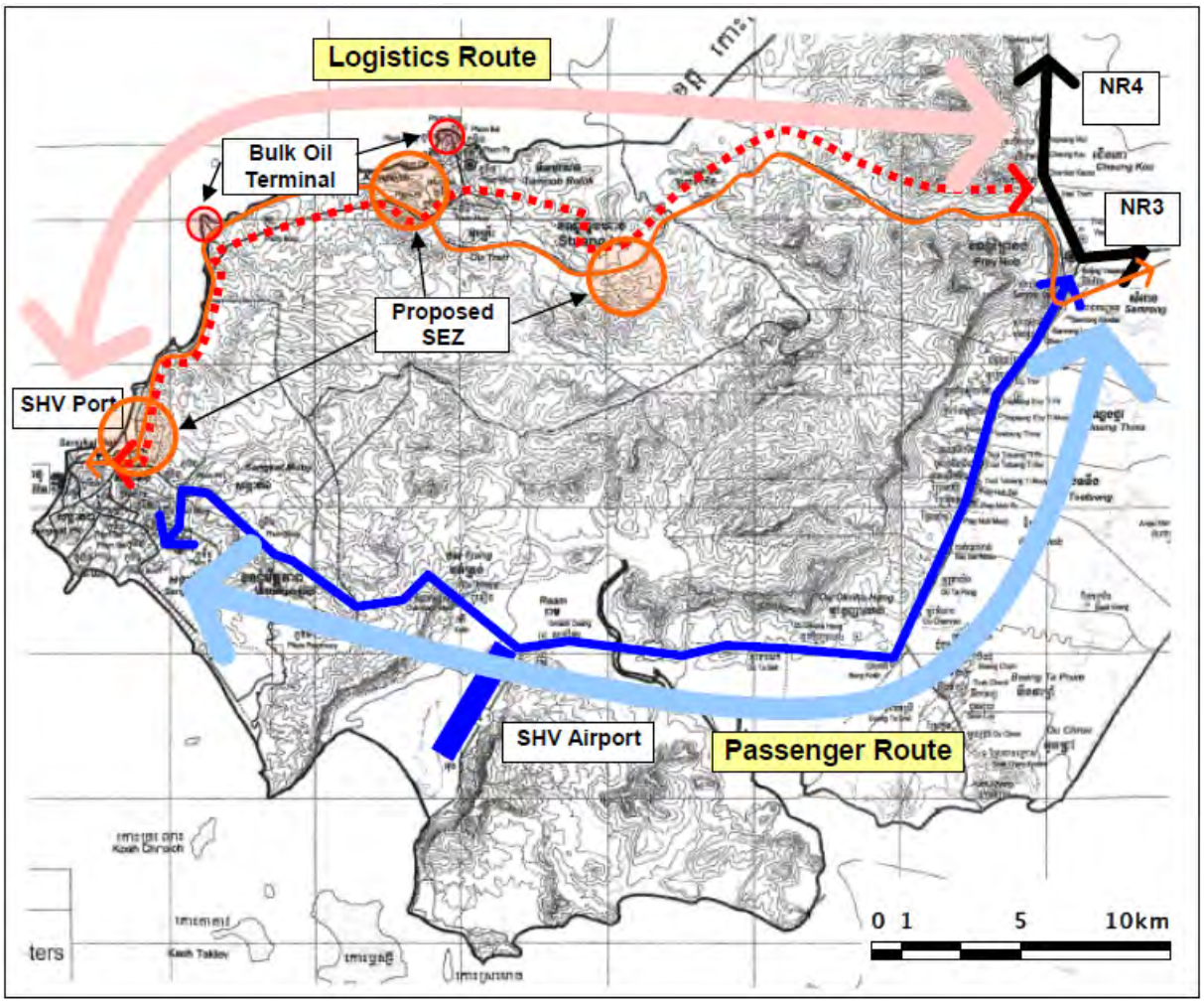
To prevent an increase of traffic accidents and prepare a safe traffic condition, the road network to/from Sihanouk should be divided into two routes; namely passenger and logistics, to improve road safety. The routes are described as below:

1) Passenger route: Existing NR4

This route on the existing NR4 connects the beaches and the administrative area with the downtown, Sihanouk Airport and NR3 & NR4. At present this route accommodates the mixed traffic flow of passengers and cargoes, it is recommended that this route should be prioritized for passenger transportation in order to safeguard the local people living alongside and for tourists.

2) Freight route: Northern detour route

This route connects Sihanoukville Port, Sihanoukville Railway Station, Port SEZ, two Bulk Oil Terminals, Stung Hav Industrial area and NR3 & 4. This route is not quite built at a necessary grade for heavy traffic yet, this route should serves the above mentioned industrial and logistics traffic, and should thus be improved as a cargo transportation route apart from the passenger traffic.



Source: JICA Study Team

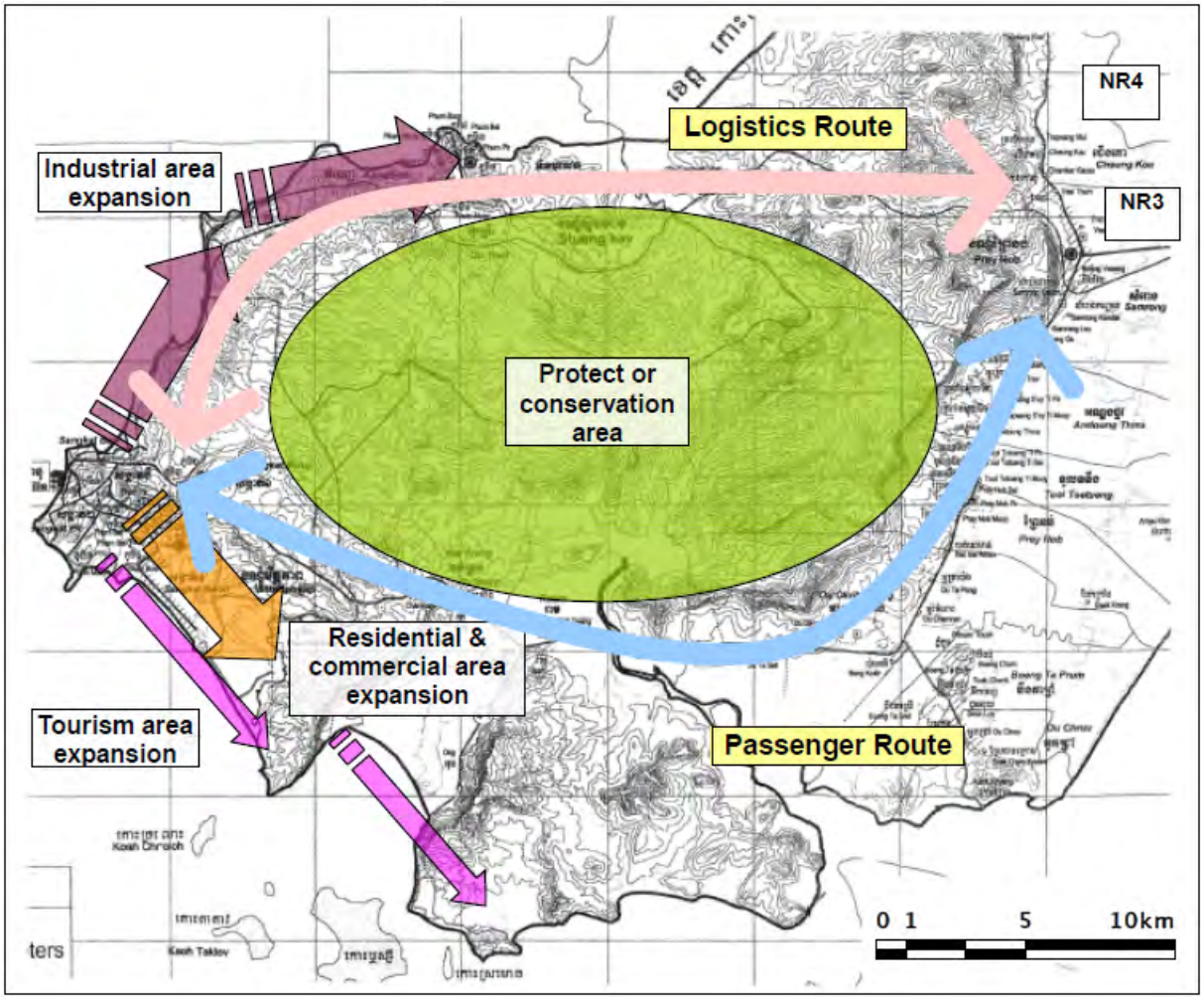
Figure 3.5.10 Road Network

(3) Basic Land Use Structure

Based on the above transportation structure characteristics, a basic land use structure is shown in Figure 3.5.11 below.

Residential and commercial land use should be limited to the south of NR4 and expand to southeast direction in future. This area should include residential land use which accommodates labor force working in this area. Industrial land use should be developed along “Logistics Route” toward north, and not in the south of NR4. The area in the center of the peninsula bounded by NR4 and northern

route is the water source for Preah Sihanouk City, and thus should basically be an environmental protection area or water resource conservation area.



Source: JICA Study Team

Figure 3.5.11 Schematic image of Basic Land Use Vision

(4) Urbanization Promotion Area

Urbanization Promotion Area should be developed in a well planned manner and should be reserved for the future generation of its natural environment. Detailed land use plan will be described in the later part.

1) Tourism Area

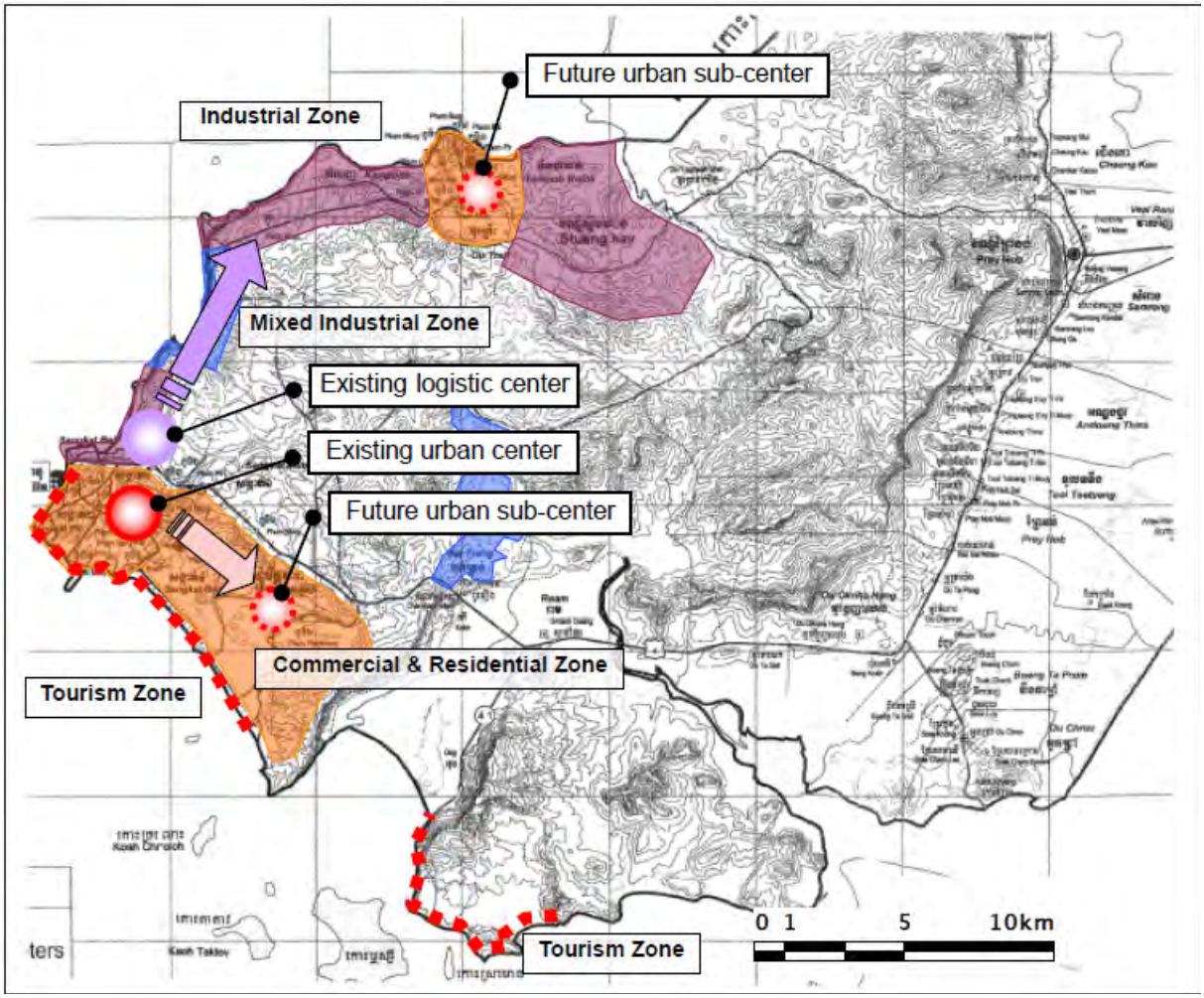
Tourism Area includes islands in Praeh Sihanouk Province. The Areais to be secured for tourism development purpose such as hotels, restaurants, tourist services, and so forth. And beaches in this Area should be open to the public.

2) Commercial and Residential Area

This Area will accommodate commercial activity and increasing urban population in Preah Sihanouk Province. Detailed Land Use Zoning will be defined along with time frame and population forecast in Preah Sihanouk City.

3) Industrial Area

This Industrial Area accommodates the industrial investment, such as Industrial Parks and Special Economic Zones and Inland Container Depots (Logistic Centers)[7] in this region.



Source: JICA Study Team

Figure 3.5.12 Urbanization Promotion Area

[7] Currently container terminal station of railway is planned to be constructed adjacent to the Sihanoukville Port SEZ and Sihanoukville Port. Although there is no specific plan to establish new inland container depots (ICD) around the area, the commencement of the operation of the Sihanoukville Port SEZ and the industrial development in Stueng Hav district are expected to induce the establishment of ICD in the future.

(5) Urbanization Control Area

The urbanization control area is the area where the urbanization will not allowed in principle.

1) Ream National Park Area

National Parks provide important habitats to wildlife include threatened species and to be protected properly with scientific research and strict law enforcement. Ream National Park has well reserved riverine mangrove forests, partially utilized for nature trips.

2) Kbal Chhay protection forest Area (Water catchment area)

This area, about 6,000 ha in all, is the catchment of Kbal Chay river providing water supply to Sihanouk City. It is strictly protected from pollution and contamination as a reserve forest. FOA is doing patrol and reforestation to keep condition of the area.

3) Conservation Area for Mangrove Forest Fostering Area

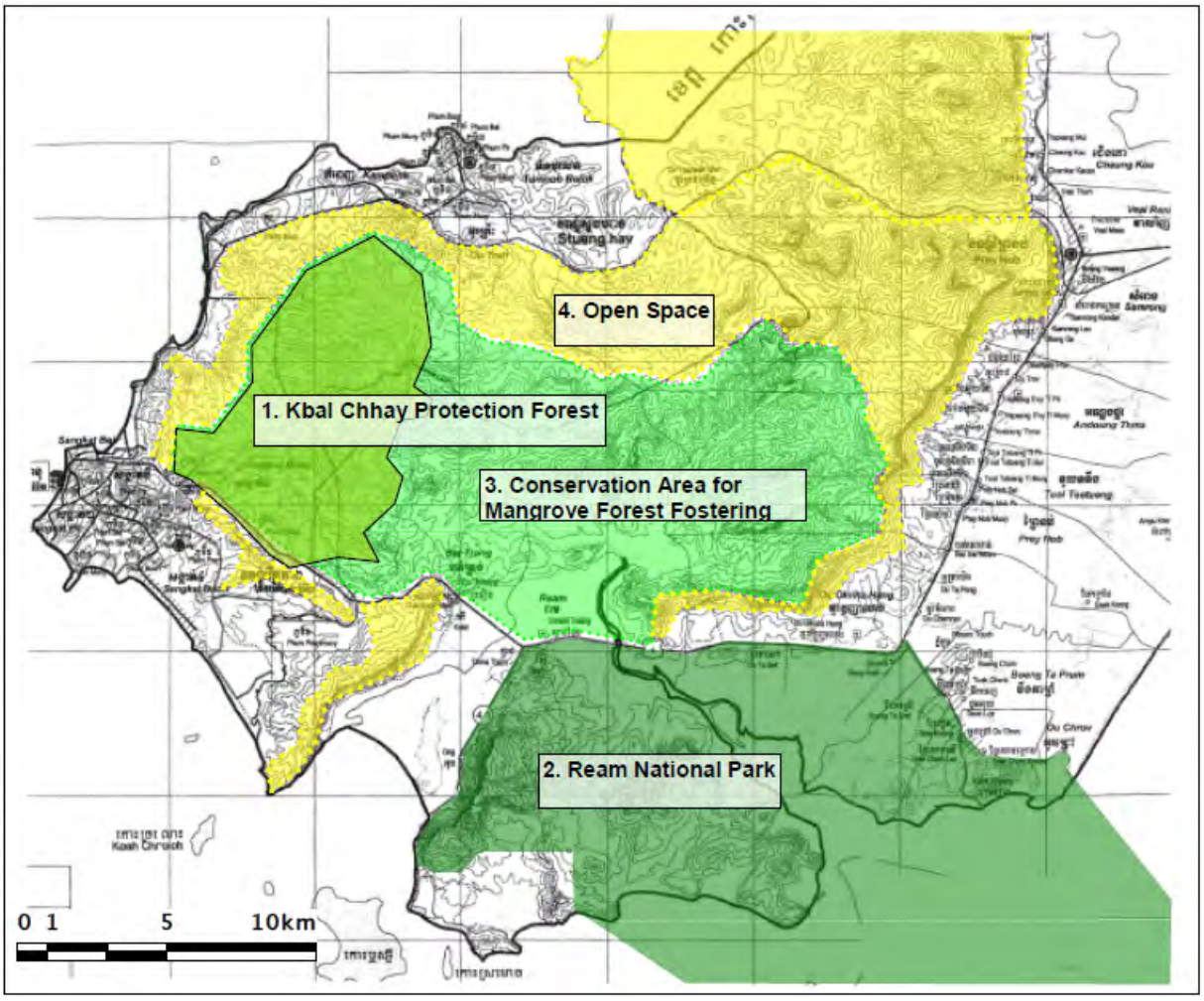
The forest in the watershed of Preaek Tuek Sab river should be protected and reforested for the mangrove forest fostering. On-going development projects should be regulated so as not to harm the mangrove forest with wastewater.

4) Scenic Green Area

Forest of steep slope should be protected from development activities for natural landscape.

5) Open Space Area

Open space are to be conserved the environment for keeping the landscape. Development activities in this area should adopt the development guideline.



Source: JICA Study Team

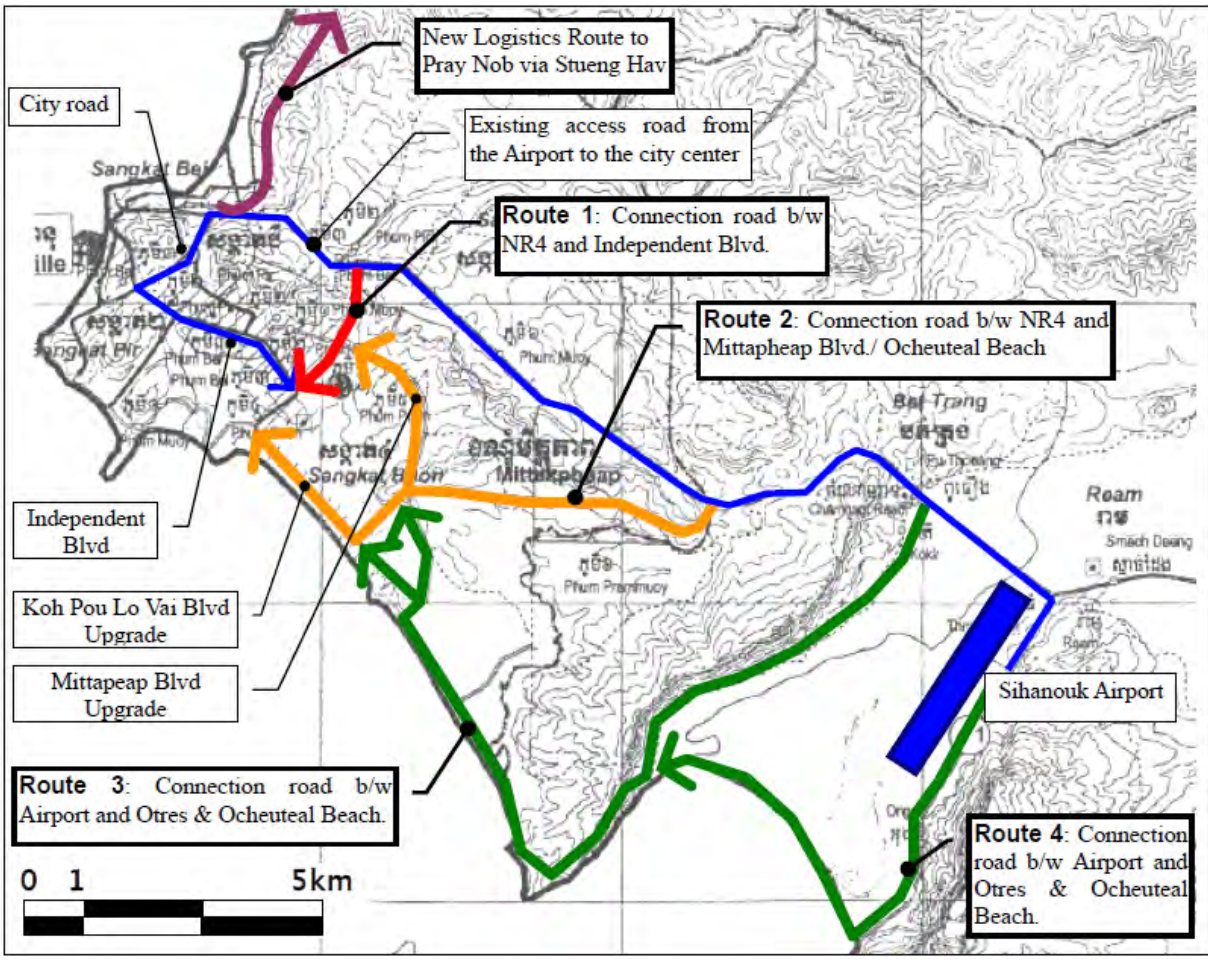
Figure 3.5.13 Urbanization Control Area

(6) Accessibility improvement from NR4 and Sihanoukville Airport

In view of the expected reopening of operation of the Sihanoukville Airport, accessibility between the city center and the Airport through the beach resort area will be important.

The existing road access to the city center of Preah Sihanouk is heavily dependent on NR4, City road and Independent blvd, and involves a substantial detour. To improve the access between the city center and Sihanoukville Airport, the Team proposes three alternative routes to the city center.

Route 1 connects NR4 and the corner of Independent Blvd., the main street of the city center, with wide width of the road. Route 2 connects a saddle portion of NR4 and the junction of Mittapheap Blvd and Otres Road. And Route 3&4 connects the Airport to Ocheuteal Beach via seashore. These options will be studied further in the next step.



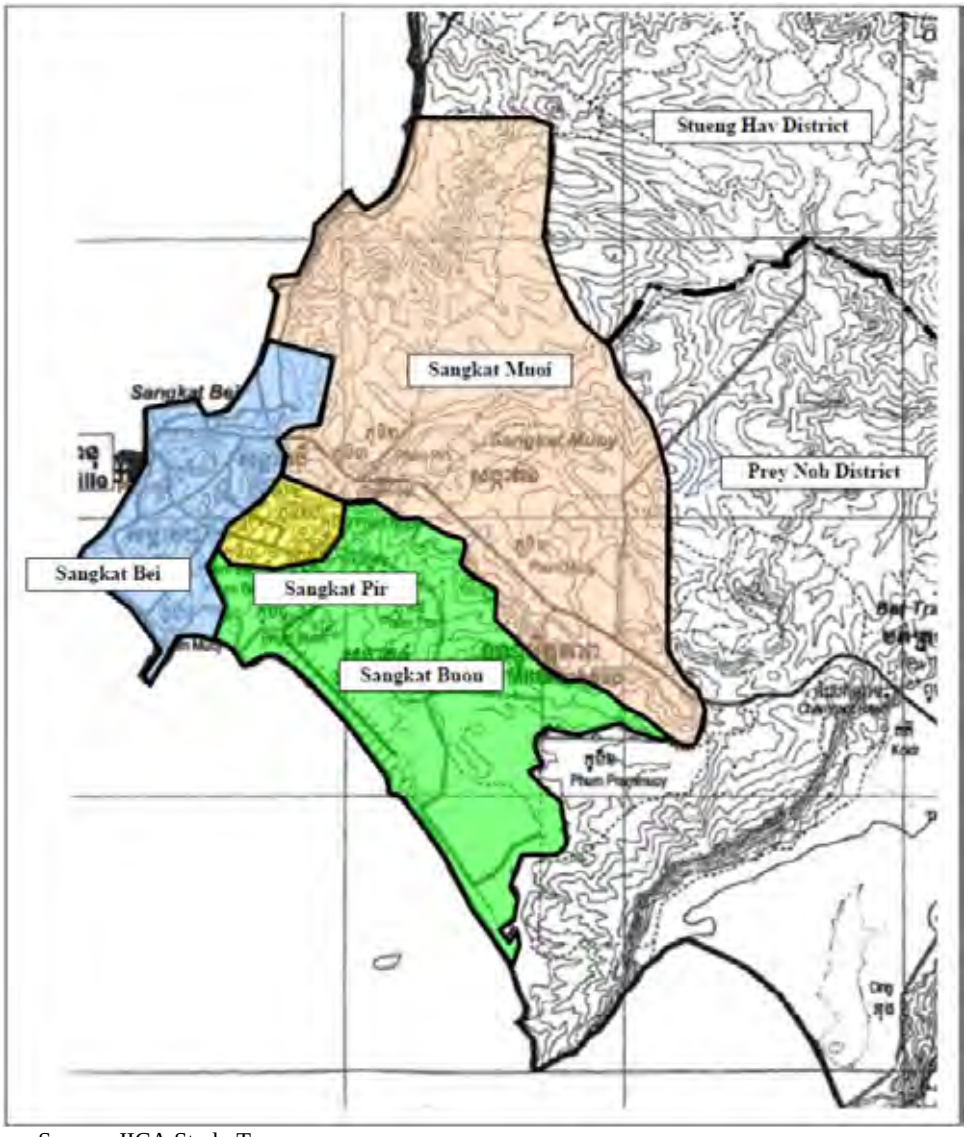
Source: JICA Study Team

Figure 3.5.14 Access Road from NR4 and Sihanoukville Airport

3.6 Land Use Plan for Urban Area

3.6.1 Selection of Urban Area for Preparation of Land Use Planning

Based on the aforementioned land use plan for urbanization promotion area, the detailed land use plan of urban area of Preah Sihanouk, which covers four (4) communes; i.e. *Sangkat Muoy*, *Sangkat Pir*, *Sangkat Bei*, and *Sangkat Buon* has been preparead[1]



Source: JICA Study Team

Figure 3.6.1 Designated Urban Area in the Target Area of M/P

[1] The detailed land use plan of Stueng Hav district where is expected to be the future urban area has already been prepared by MLMUPC. So, in this Study, the existing urban center where the appropriate land use planning is urgently required have been selected for preparation of detailed land use plan.

In the urban area, several large scaled housing, commercial and industrial development projects, including the Sihanoukville Port Special Economic Zone Development Project, have been or scheduled to be implemented. PAS (Port Authority of Sihanoukville) also plans to develop the new multipurpose container terminal under the finance of Japan's ODA.

Considering these development projects, the future population growth of Study area will see concentration of population in the urban area, and thus the population growth rate for the urban area shall be higher than that of the provincial level. Based upon this scenario, the estimated long term population of each commune within the Preah Sihanouk City is shown as following Table 3.6.1.

Table 3.6.1 Population Projection and Annual Growth Rate for each Commune in the Urban Area: Natural Growth Base

	2008*	2010		2020		2030	
		No.	G/R(%)	No.	G/R(%)	No.	G/R(%)
Sangkat Muoy	20,492	21,700	2.9	33,800	4.5	44,300	2.7
Sangkat Pir	13,041	13,800	2.9	18,700	3.1	24,500	2.7
Sangkat Bei	24,276	25,750	3.0	35,900	3.4	47,100	2.8
Sangkat Buon	31,638	33,550	3.0	45,450	3.1	59,650	2.8
Urban Area	89,447	94,800	3.0	133,850	3.5	175,550	2.7

Note: *Final results for Census 2008.
Source: JICA Study Team

On the other hand, the current land use condition must be considered for estimating the commune leveled population distributions.

In this regard, the latest land use was analyzed by the Study Team with Quick Bird Satellite images with remote-sensing analysis. The available land for development, which is basically the expandable area defined as the sum of the development area and vacant land, of the three communes[2] is estimated to be about 392 ha in Sangkat Bei, 1,162 ha in Sangkat Buon and 74 ha in Sangkat Pir communes, respectively, as shown in the following Table 3.6.2 .

Table 3.6.2 Existing Habitable Land Use Area of Urban Communes

	Sangkat Bei		Sangkat Buon		Sangkat Pir	
Land Use	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
Development Area	72.2	6.6	155.8	6.5	21.5	9.1
Vacant Land	319.9	29.4	1005.8	41.9	52.0	22.0
Available Land for Development	392.1	36.0	1,161.6	48.4	73.5	31.1

Source: JICA Study Team

Subsequently the land demand by the future population growth in each commune is calculated as following Table 3.6.3[3]. The expansion areas calculated are 268 ha in Sangkat Bei, 354 ha and 143 ha in Sangkat Pir communes, respectively. From the result of rough estimate, Sangkat Bei and Sangkat Buon can accommodate the urban expansion within the available land area, but Sangkat Pir has not enough available land area. This means that the population density of Sangkat Pir commune, where

[2] Population density of Sangkat Muoy commune is by far lower than that of the other three communes and it is obvious the commune can absorb the future population expansion. Therefore, Sangkat Muoy commune was excluded from this analysis.

[3] The Study Team set 80 people per ha for calculating residential land use area, considering the current population density of "urban area" in Preah Sihanouk.

there is the so-called Downtown of Preah Sihanouk City, should be reconsidered to be a little higher than present, which would be suitable for the city center function it carries.

Table 3.6.3 Provisional Residential Land Use Area Expansion of Urban Communes

Commune	Population 2008	Population 2030	Incremental Population	Residential Land Use Expansion Area (ha)	Available Land for Development (ha)
Sangkat Bei	24,276	47,100	22,824	285	392.1
Sangkat Buon	31,638	59,650	28,012	350	1,161.6
Sangkat Pir	13,041	24,500	11,459	143	73.5
Total	68,955	131,250	62,295	778	1,627.2

Source: JICA Study Team

Considering the abovementioned land use survey results, it can be presumed that a large number of people accommodated in *Sangkat Pir* commune slow will down, while the pace of population growth for *Sangkat Buon* commune will surpass, as the development space in *Sangkat Pir* commune is relatively slow to absorb most of the expected population growth, for the mid and long term.

Finally, the revised population projection of each commune by following the land use survey results was prepared and summarized in Table 3.6.4.

Table 3.6.4 Population Projection and Annual Growth Rate for each Commune in the Urban Area: Revised based o n Land Use Conditions

	2008*	2010		2020		2030	
		No.	G/R(%)	No.	G/R(%)	No.	G/R(%)
Sangkat Muoy	20,492	21,700	2.9	33,800	4.5	44,300	2.7
Sangkat Pir	13,041	13,800	2.9	15,000	0.8	16,500	1.0
Sangkat Bei	24,276	25,750	3.0	35,900	3.4	47,100	2.8
Sangkat Buon	31,638	33,550	3.0	49,150	3.9	67,650	3.2
Urban Area	89,447	94,800	3.0	133,850	3.5	175,550	2.7

Note: *Final results for Census 2008.
Source: JICA Study Team

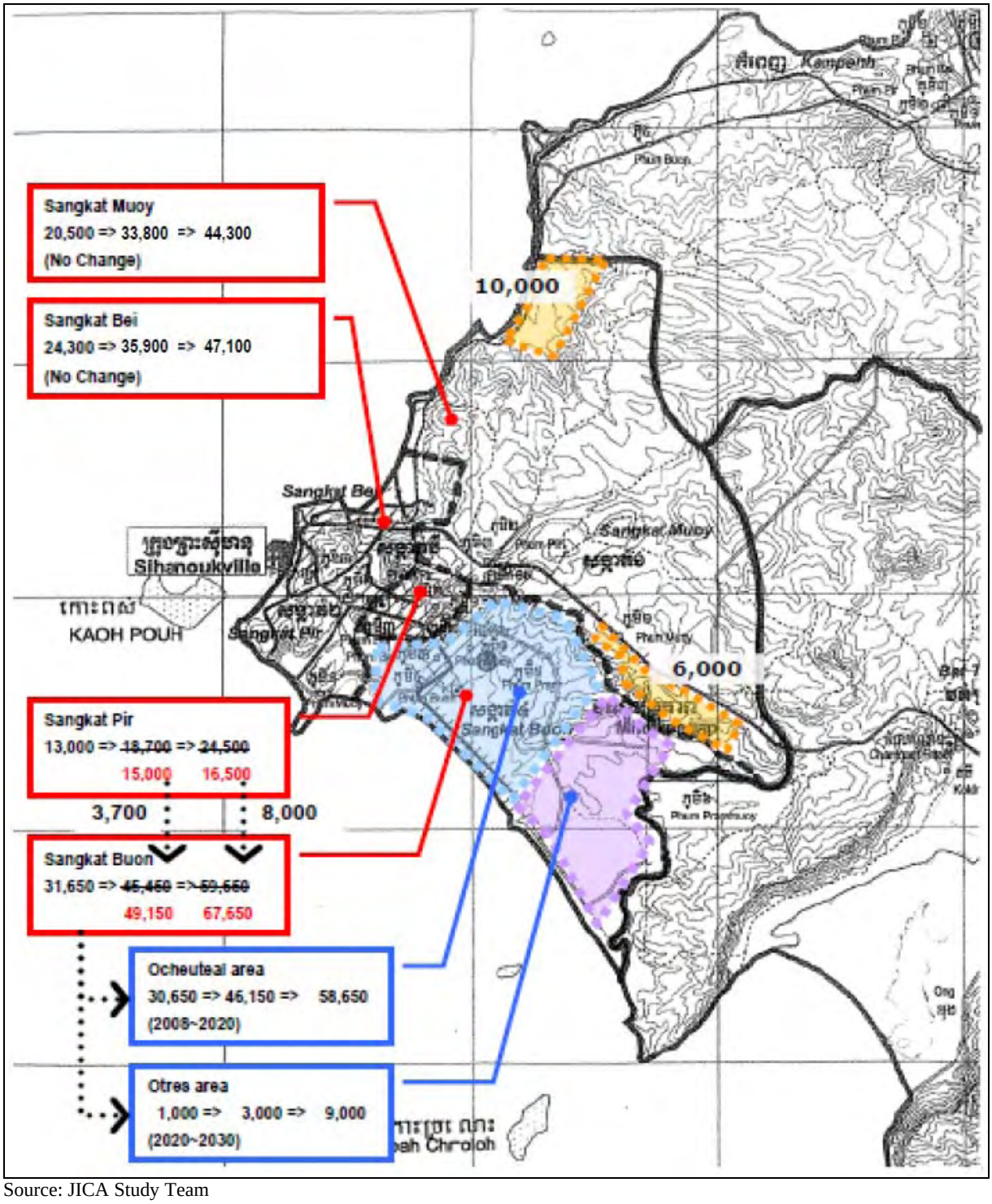
The Figure 3.6.2 displays the future demographic movement among the above mentioned communes.

Based on this population projection, urbanization promotion area should be established and controlled step by step. Development activities until 2020 should be controlled within the development area until 2020 (green colored area on the map) showing below.

The hinterland of Otres beach should be reserved for development after 2020. The main land use of this area should be tourism, commercial and residential use.

Northern area along logistics route will be mainly categorized in industrial land use mainly located in Stueng Hav district. These industrial areas are designated in detail in the Stueng Hav district land use M/P drawn by MLMUPC.

Land use of northern urban expansion area from Sihanoukville Port SEZ to oil jetties should be commercial and residential land use to accommodate labor population for these industrial areas. Because the area has beautiful white sand beach which is good for recreational purpose and the alignment of proposed logistic route is going to shift from existing beach side road to the eastern hill.



Source: JICA Study Team

Figure 3.6.2 Shift of the Population among the Four Communes

3.6.2 Land Use Zoning

In this section, proposed land use zoning and its category, development guideline and building code for Preah Sihanouk City are described[4].

(1) Land Use Zoning Rules

The land use zoning categories are shown in Table 3.6.5. Circle symbol shows adapted use of building. Triangle symbol building use is express necessity of special consultation with governmental organization.

Table 3.6.5 Proposed Land Use Zoning Rules

Index			Hotel	Resort Mansion & Apartment	Guest House	Mansion & Apartment	Detached Residence	Commercial	Small Shop (ex. Mini Mart)	Other Service Business	Restaurant and cafe	Bar & karaoke	Business Office	Car & Bike Maintenance	Small Scale Industry	Light Industry	Heavy Industry	Recreational facility	
1		Tourism	○	○	○			○	○		○	○						○	
2		Commercial	○		○	○		○	○	○	○	○	○	○					
3		Residential				○	○		○									○	
4		Complex			○	○		○	○	○	○	○	○	○	○	○		○	
5		Industrial							○	○	○		○			○	△	○	
6		Administration																	
7		Public Facility																	
8		Religious																	
9		Special purpose																	
10		Open Space					△				○							○	
11		Preservation																○	

*△: with condition.
Source: JICA Study Team

1) Tourism

This zone should be concentrated for promotion of tourism and resort development.

[4] Zoning, Building Code and other codes in this section refer to the Japanese regulations and guidelines such as; *"Guideline for Visual Evaluation by Quantity of Green for Industrial Location", "Evaluation Guideline for Activity in National Parks", "Standard ofGreen Space Ratio for Promotion Area for Industrial Location" , "Standard for District of Green Space Ratio".*

2) Commercial

This zone support city commercial activities (shops, offices, and so on) and middle to low range of tourist accommodation such as guest house and serviced apartment. This zone located along major road with higher population density which is about 120 people/ha.

3) Residential

Basically, Residential zone should be kept in quiet and safe environment. However Preah Sihanouk City should be developed as a tourism and resort city of Cambodia. So that residential zone in the city could include some commercial activities such as restaurant & café, small shops for tourist.

4) Complex

Complex zone is mainly located along NR4 and north of Sihanoukville Port. These zones are already developed mixed with industry land use.

5) Industrial

Industrial zone is mainly defined for SEZ areas. Greening and environment protection guideline for industrial will be discussed in later stage.

6) Administrative

Administrative zone is for governmental institution such as ministry's departments, provincial office and city hall.

7) Public Facility

Public facility zone is defined for school, hospital, transportation facility and so forth.

8) Religious

Religious zone contains pagoda, church, cemetery and so forth.

9) Special purpose

Special purpose zone include security area, sewage treatment, dump site, and port.

10) Open Space

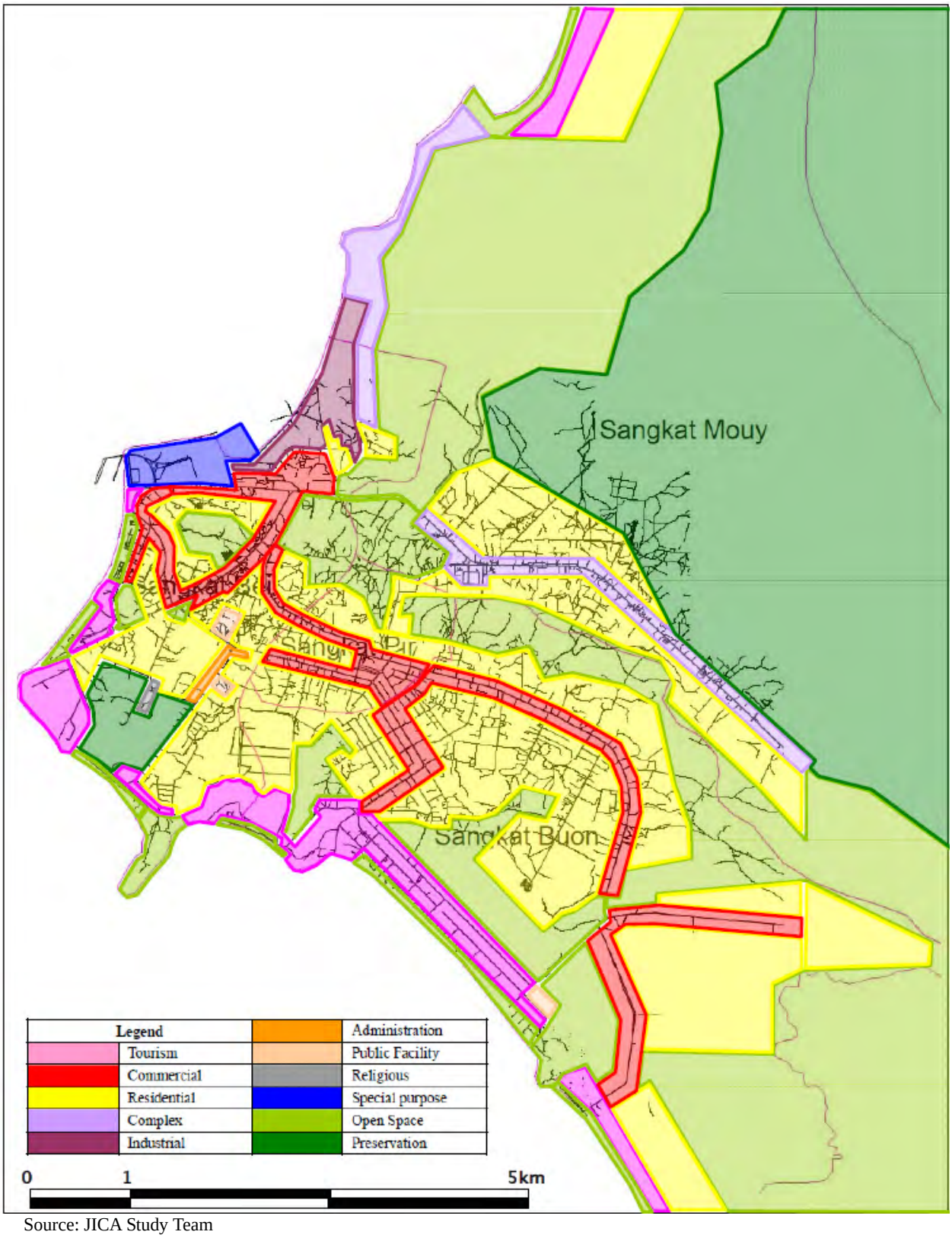
Open Space zone is defined for conservation of existing woodland, beach and for promotion of recreational activities for tourism development such as golf course or outdoor activities. In this zone, spatial and lush greenery detached house can be allowed to build.

11) Preservation

Conservation zone is defined for the purpose of protection for the water catchment area of the water reservoirs in the city. Existing land use activities are allowed to continue to use, but new development activity or any change of land use is prohibited to keep the environment of the catchments.

(2) Proposed Land Use Master Plan

The proposed land use master plan for the designated urban area is shown below.



Source: JICA Study Team

Figure 3.6.3 Proposed Draft Land Use Plan of Preah Sihanouk City

(3) Development Guideline for large scale development project

As described in Section 6.1.2 of Book I, "Development Guidelines" should be provided to guide a development project to avoid the fatal environmental resources.

Following proposed development guidelines pertain to development projects with concession. Concession is a agreement for right to use certain area of land, but it is not a freehand for any development activities. The proposed guideline shows and regulates an appropriate manner for the development.

1) Development Guideline for development projects in the National Park and islands

This proposed guideline pertains to beach and tourism development projects in the National Park and islands, which converted its land use from national park or other natural land use, to fit its construction to the existing environment.

Main objective of this guideline is to conserve its valuable natural environment as much as possible.

Table 3.6.6 Proposed Development Guideline for development projects in the National Park and islands

	Items	Regulation
Building code	Maximum Building Height	10m (or lower than coconut palm trees) Maximum 3 stories
	Maximum Building Coverage Ratio (BCR)	20%
	Maximum Floor Area Ratio (FAR)	40%
	Minimum Green Coverage[5] Ratio (GCR)	60% (40% of existing green should be protected)
	Setback of buildings[6]	20m from main road 50m from sea shore (high tide line) 5m from site boundary
	Color	Use Earth Tone[7]
	Building shape and design	Respect Cambodian traditional building shape and design vocabulary
Environmental Guideline	Protection of water resources	No contamination of surface and underground water resources
	Sewage water treatment	Must be connected to public sewage system where applicable or to have appropriate septic tank system
	Strict protection from erosion especially during construction work	Protect downstream environment to protect fishery condition and mangrove forest
	Special attention to the existing ecosystems (flora and fauna)	Developer should conduct scientific research to check the existing ecosystem of the site

Source: JICA Study Team

[5] Guideline for calculation of green coverage shall be determined in further discussion.
[6] Setback is the distance which a building or other structure is set back from a street or road, a river or other stream, a shore or flood plain, or any other place which needs protection.
[7] Earth tone is a color scheme that draws from a color palette of browns, tans, grays, greens, oranges, whites, blues and some reds. The colors in an earth tone scheme are muted and flat in an emulation of the natural colors found in soil, moss, trees and rocks. Many earth tones originate from clay earth pigments, such as umber, ochre, and sienna.

2) Development Guideline for SEZ

SEZ projects usually develop wide area with a broad scale of earth work. These construction works cause serious environmental problem such as deforestation, land erosion and waste water treatment. To prevent such deterioration of environment, the study team proposes the development guideline for SEZ describe below.

Minimum green coverage ratio is one of important development guidelines for SEZ project. Re-planting certain volume of trees is necessary to recover its environment.

Table 3.6.7 Proposed Development Guideline for SEZ

	Items	Regulation
Building code	Maximum Building Height	10 - 15m (Should be defined in its M/P)
	Maximum Building Coverage Ratio (BCR)	30 - 60% (Should be defined in its M/P)
	Maximum Floor Area Ratio (FAR)	40 - 150% (Should be defined in its M/P)
	Minimum Green Coverage Ratio (GCR)	20% (Especially along main road should be greened properly)
	Minimum Environmental Facility[8] Coverage Ratio (GCR)	25% (Including green coverage area)
	Setback of buildings	20m from arterial road such as National Road 10m from area main road 5m from site boundary
	Color	Use Earth Tone
Environmental Guideline	Protection of water resources	No contamination of surface and underground water resources
	Sewage water treatment	Must be connected to public sewage system or to have appropriate septic tank system. All toxic waste mut be treated on site.
	Strict protection from erosion especially during construction work	Protect downstream environment to protect fishery condition and mangrove forest
	Special attention to the existing ecosystems (flora and fauna)	Developer should conduct scientific research to check the existing ecosystem of the site

Source: JICA Study Team

3) Development Guideline for Residential development

As there can be seen several residential development projects around Sihanouk City, it is also necessary to lay down development guideline for residential development. For residential land use require large volume of tapped water supply and sewage water treatment measure. Sold waste management also focal issue for environmental point of view.

[8] Environmental Facility includes park & garden, recreation facility, landscape facility, athletic ground, indoor athletic facility, cultural facility, rainfall infiltration facility, balancing reservoir,

Table 3.6.8 Proposed Development Guideline for residential development projects

	Items	Regulation
Building code	Maximum Building Height	10 or 12m (Low density area) 20 - 30m (High density area)
	Maximum Building Coverage Ratio (BCR)	30 - 60% (Should be defined in its M/P)
	Maximum Floor Area Ratio (FAR)	40 - 150% (Should be defined in its M/P)
	Minimum Green Coverage Ratio (GCR)	20% (Especially along main road should be greened properly)
	Minimum Environmental Facility[9] Coverage Ratio (GCR)	25% (Including green coverage area)
	Setback (not applicable to each plot)	20m from arterial road such as National Road 10m from area main road 5m from site boundary
	Color	Use Earth Tone
	Building shape and design	Respect Cambodian traditional building shape and design vocabulary
	Children's park	0.25ha per 250m radius
Environmental Guideline	Protection of water resources	No contamination of surface and underground water resources
	Sewage water treatment	Must be connected to public sewage system or have appropriate septic tank
	Solid waste management system	Must have SWM service.
	Strict protection from erosion especially during construction work	Protect downstream environment to protect fishery condition and mangrove forest
	Special attention to the existing ecosystems (flora and fauna)	Developer should conduct scientific research to check the existing ecosystem of the site

Source: JICA Study Team

[9] Environmental Facility includes park & garden, recreation facility, landscape facility, athletic ground, indoor athletic facility, cultural facility, rainfall infiltration facility, balancing reservoir,

(4) Building code for land use zoning

Table 3.6.9 shows proposed building code for each land use zoning. This building code aims to provide guidelines for appropriate allocations and rational density of residential, commercial, industrial and other uses in accordance with the future vision of the entire city and thus ensure efficiency in urban activities.

Detailed code should be discussed and determined among the relevant ministries and departments at provincial level.

Table 3.6.9 Proposed Building Code

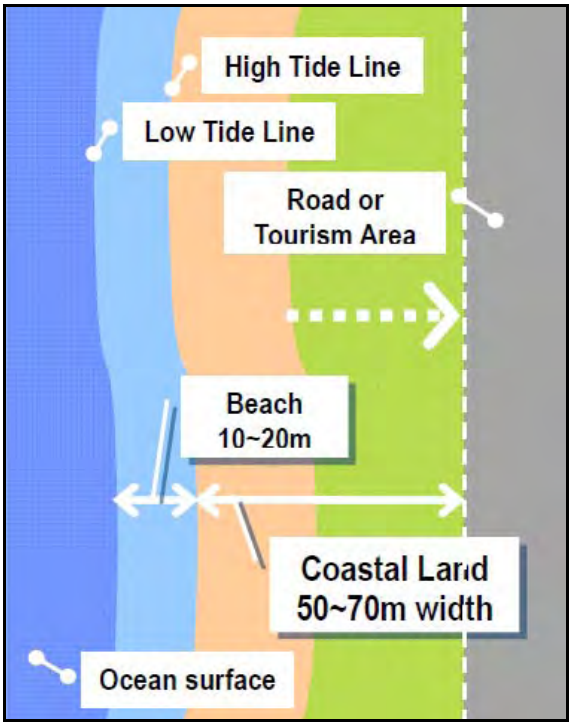
Index			Minimum building height	Maximum Building Coverage Ratio (BCR)	Maximum Floor Area Ratio (FAR)	Minimum Green Coverage Ratio (GCR)	Setback of building from main road	
1		Tourism	13m	20%	40%	40%	5m	
2		Commercial	20m	–	–	–	–	
3		Residential	10m	40%	80%	10%	2m	
4		Complex	15m	–	–	–	–	
5		Industrial	10 ~ 15m	30 ~ 60%	40 ~ 150%	20%	2m	
6		Administration	10m	40%	80%	10%	5m	
7		Public Facility	10m	40%	80%	10%	5m	
8		Religious	–	–	–	–	–	
9		Special purpose	–	–	–	–	–	
10		Open Space	10m	20%	40%	–	–	
11		Preservation	–	–	–	–	–	

Source: JICA Study Team

(5) Coastal Land Area conservation

Coastal Land Area is defined as an area between high hide level line and road or other land use zone with certain width of 50 to 70m. Coastal Land Area is public property (public state land) and should be open for public use in principle.

Coastal Land Area should be designated in Land Use Master Plan to keep the area for public purpose.



Note: The above mentioned standards are tentatively set in discussion with DLMUPCC Sihanouk.
Source: JICA Study Team

Figure 3.6.4 Coastal Land Area delimitation

Source: JICA Study Team

Figure 3.6.5 Plan of Coastal Land Area delimitation in Preah Sihanouk City

3.7 Infrastructure Development Plan

3.7.1 Road and Railway

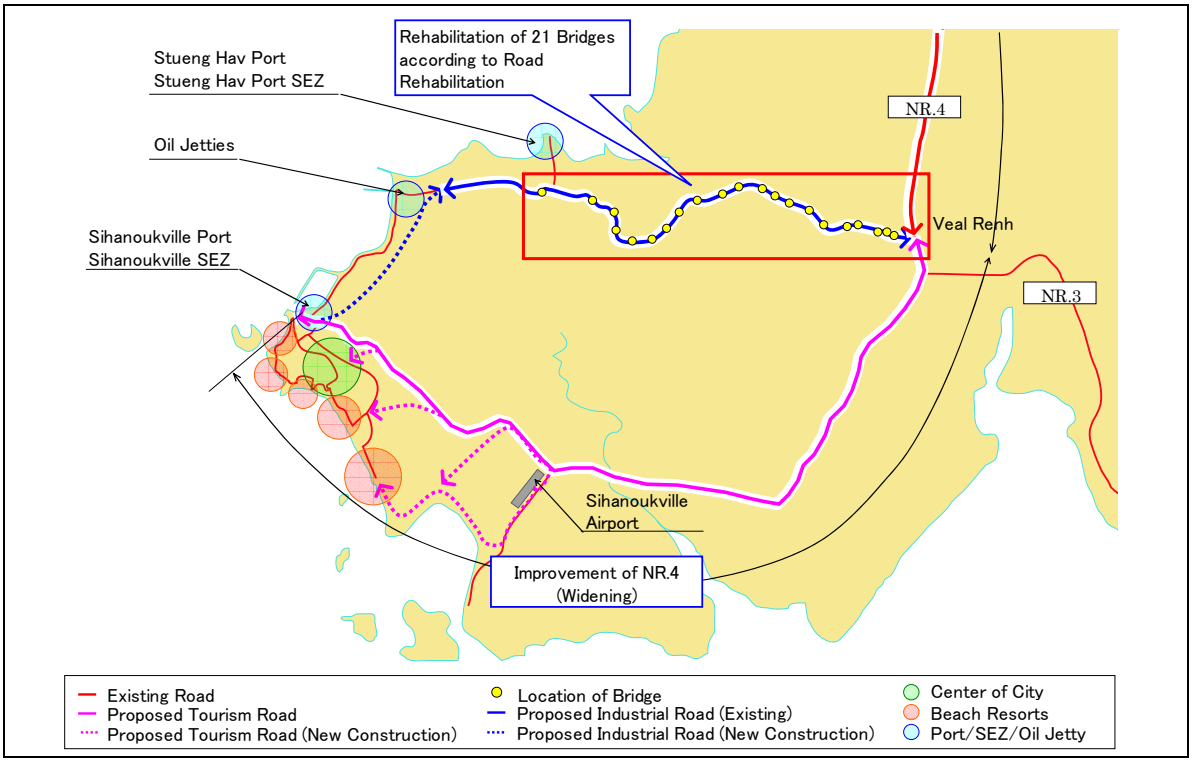
(1) Road Network

As mentioned in Section 4.2.4 of Book II, the present access route to Preah Sihanouk City is only NR4 and residents and tourists have to use NR4 to and from Preah Sihanouk. The present road network condition is not suitable and favorable for the growth of Preah Sihanouk. To provide an efficient road network for Preah Sihanouk, what should be considered is as follows.

- Population growth of Preah Sihanouk,
- Growth of industry and tourism in Preah Sihanouk,
- Situation of traffic congestion, and
- Increase of the number of traffic accidents.

Considering the factors above, the development plan of the road network is proposed as follows.

- Provision of an access road from NR4/Sihanoukville Airport to the beach / city center area,
- Development of an industrial road from Sihanoukville Port via Stueng Hav to Veal Renh,
- Rehabilitation of the 21 bridges located along the existing road from Stueng Hav to Veal Renh, and
- Widening of NR4 or development of an alternative route along with NR.4.



Source: JICA Study Team

Figure 3.7.1 Proposed Development Plan of Road Network

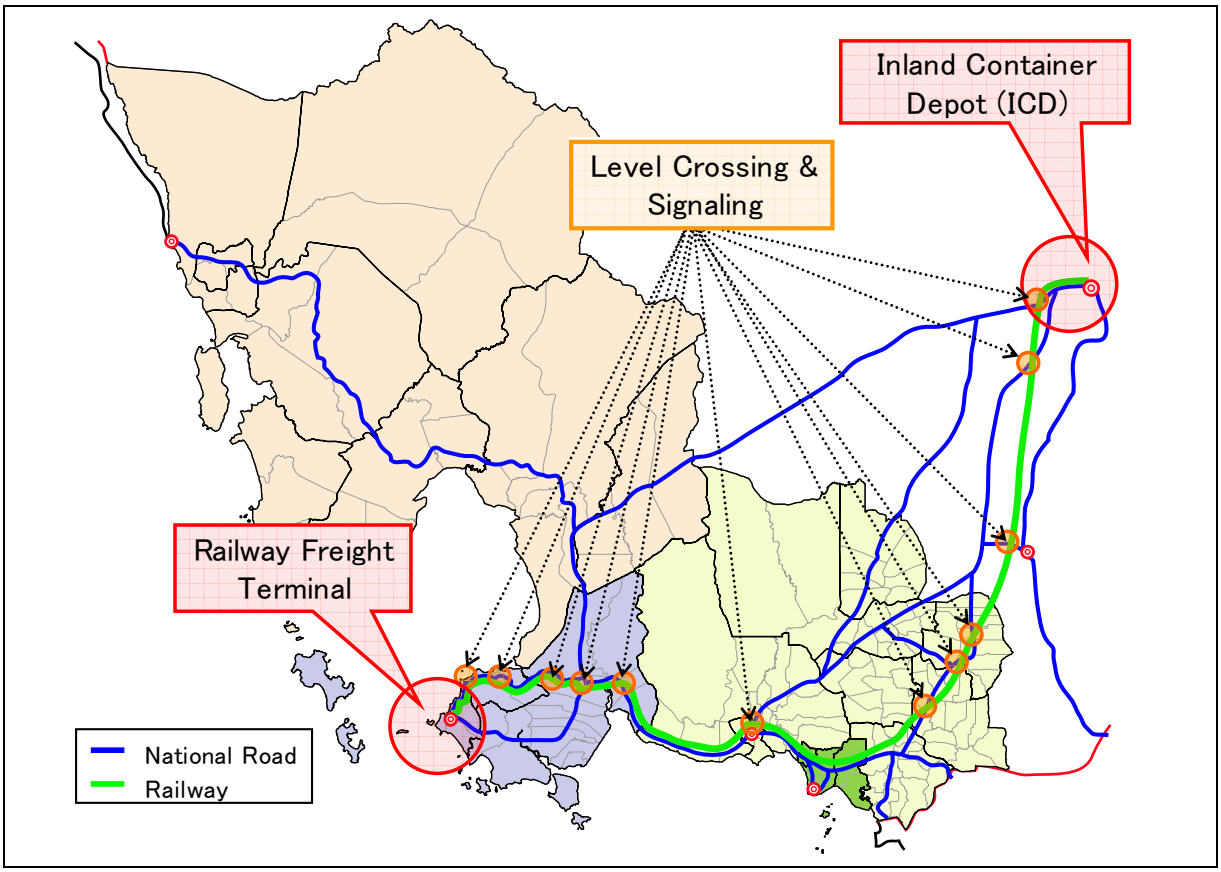
(2) Railway

As mentioned in Section 2.3.1 of Book II, the development plan of the railway freight terminal has not been prepared yet while the track work which covers the length of 500m will be implemented in the rehabilitation of railway funded by ADB. Toll company, which is the concessionaire to operate the railway system, is thought to operate the railway freight terminal, too.

However, Toll company and PAS have not discussed the development and the operation of the railway freight terminal. Considering the railway freight terminal as a series of railway system in addition of the ICD at Phnom Penh, the development plan of the railway freight terminal should be provided. Moreover, a signaling system and a level crossing are important facility to establish safe and reliable railway system. But their facilities are not included in the rehabilitation project of railway. Even if the rehabilitation project is completed, the issues of lack of safety facilities will remain in the railway system.

Considering the mentioned above, the development plan of the railway facilities in Preah Sihanouk is proposed as follows.

- Development of the railway freight terminal based on the mutual understanding between PAS and Toll company,
- Provision of signaling system and level crossing, and
- Exchange of deteriorated rail.



Source: JICA Study Team
* The development of the ICD already has planned and will be implemented by ADB.

Figure 3.7.2 Proposed Development Plan related to Railway

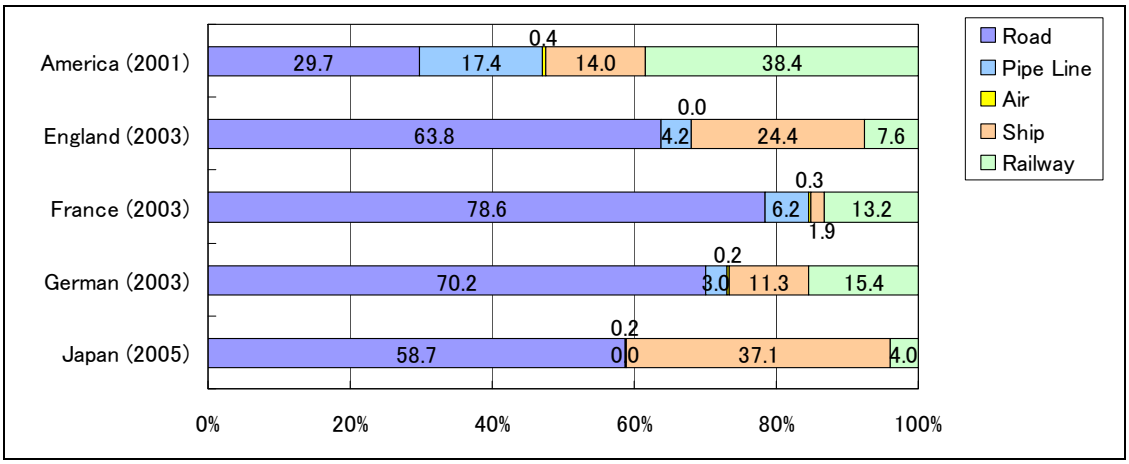
(3) Modal Share between Truck Transportation and Railway Transportation

It is expected that an efficient transportation of freights is provided due to the rehabilitation of railway in Cambodia. It is estimated inevitably that modal share is changed between truck transportation and railway. It is considered apparently that railway transportation is more advantageous than truck transportation because the railway is connected between Phnom Penh which is mass consumption area and Sihanoukville Port which is gateway of freights in Cambodia directly.

However, it is difficult to think that share of truck transportation is decreased by railway in consideration of the following points.

- Railway is not able to provide door-to-door service in a freight transportation,
- It takes about one hour to load freight on/off truck at both ends of railway,
- Railway is unable to be operated during a maintenance work of rail track,
- There is no an alternative way to transport when an accident happens during railway operation, and
- There is no flexibility in accordance with increase and decrease of a number of freight (Railway is unable to transport freights if there is no a load capacity.).

Comparing to foreign countries including Japan, modal share of freight transport is as follows.



Source: JICA Study Team prepared based on "Overseas Transport Statistics 2006 (Ministry of Land, Infrastructure, Transport and Tourism, Japan".

Figure 3.7.3 Modal Share of Freight Transportation (ton-km base)

It is found that modal share of railway transportation is high in America. Freight transportation depends on railway in America because most of the traveling distance is more than 1,000km. It is competitive at a transportation cost.

Though railway will contribute to provide an efficient transportation service of freights, modal share between railway transportation and truck will not be changed dramatically in Cambodia.

Therefore, NR4 and NR3 should be functioned as an important transportation route even if railway is rehabilitated and operated stably. In Addition, a road network to provide an efficient transportation and should be developed.

(4) Logistics

In Master Plan of Sihanouk Development, five (5) goals are suggested and "National Logistics Center linked with World" is included in them as a goal related to logistics. It is observed that an international production network has been developed in East Asia. Cambodia is located between Thailand and Vietnam where an industrial development and a public/private investment are made actively in East Asia. In consideration of geographic condition of Cambodia and the economic development, it is expected that Cambodia join in the international production network due to functioning Sihanoukville Port as a national gateway and preparing an efficient logistics network.

A preparation of transport infrastructures and an improvement of a transport services are indispensable for a region to be included in the international production network. The transport infrastructures and the transport services are generally evaluated cost of money, cost of time and reliability. Especially, reliability is the most important factor. Reliability is composed of three (3) factors, which are quickness, preciseness' and safety. In case of logistics, reliability is accomplished by flexible and efficient transport means that truck transport and railway transport are combined.

In Cambodia, a development and enlargement of Sihanoukville Port was already studied and is prepared for an implementation. On the other hand, railway rehabilitation project has been started by aid of ADB and it is expected that railway transportation is prepared as logistics means between Sihanoukville Port and Phnom Penh. In the Master Plan, moreover, it is suggested to prepare a road network around Preah Sihanouk and expand a width of NR4 which is track road for logistics between Sihanoukville Port and Phnom Penh or develop new road along existing NR4 in order to achieve more efficient logistics.

As the result of developing Sihanoukville Port and preparing transportation infrastructures, it is expected to attract an investment due to increasing a value of Preah Sihanouk as a logistics center. Moreover, it is expected to develop not only logistics infrastructure but a power plant, a telecommunication infrastructure, a water supply infrastructure, waster water and solid waste treatment infrastructure. The preparation of the infrastructures enables Preah Sihanouk to join in the international production network and contributes to a development of a hinterland.

The development of Sihanoukville Port and preparation of transport infrastructures are first step to increase a value of Preah Sihanouk.

3.7.2 Water Supply

This section describes the development plan for water supply in Sihanoukville, following the findings and the evaluation of the water supply system as discussed in Section .2.3.3 of Book II of this report. Comparative assessment of future water sources are given there.

Water supply areas proposed in the master plan cover the urban area that has been defined by the study. The urban area typically has higher population densities (in the order of 70-80 persons per hectare). Peri-urban areas outside the proposed service areas have lower population densities and tend to be more rural in nature. Extending piped water into these sparsely populated peri-urban areas is generally not cost effective or financially viable because the small customer base makes it difficult to recover investment and operating costs.

Peri-urban areas will continue to obtain water from groundwater sources. Supply is typically from individually owned wells or community based small scale schemes. Well yields are typically low but sufficient for small scale schemes with low water demands. Rural areas

typically use surface water sources supplemented with rainwater collection.

Special economic zones and industrial estates located outside the Sihanoukville urban area have developed their own groundwater schemes. There is no information to indicate how sustainable this approach will be. The supply of water to the industrial estates and special economic zones are presumed to be handled by the developers of the estates/zones themselves, and are not integrated to the public water supply system.

(1) Evaluation of Present System

1) Supply Capacity

Criteria

The water source should have the ability to:

(i) meet the maximum day demand, and

(ii) provide one year's supply of water.

These criteria are used to evaluate the adequacy of Preah Sihanouk's water supply.

Existing and Future Conditions

Tables 3.5.1 and 2 summarize the evaluation of Preah Sihanouk's water supply for existing and future conditions under the criteria described above.

Table 3.7.1 Summary of Maximum Day Water Supply Evaluation

m^3/day	2008	2020	2030
Maximum Day Demand [1]	7,151	24,423	41,801
Boeng Prek Tup	3,500	3,500	3,500
Wells	2,000	2,000	2,000
Kbal Chay	10,000	10,000	10,000
Total Current Supply	15,500	15,500	15,500
Surplus (+) / Shortage (-)	8,350	(8,923)	(26,301)

[1] maximum day demand + 5% for treatment plant losses

Table 3.7.2 Summary of Annual Water Supply Evaluation

Million cubic meters	2008	2020	2030
Annual Demand	1.8	7.1	12.2
Boeng Prek Tup	1.8	1.8	1.8
Wells no.1, 2 and 3	0.7	0.7	0.7
Kbal Chay	21.9	21.9	21.9
Total Current Supply	24.4	24.4	24.4
Surplus (+) / Shortage (-)	22.5	17.2	12.2

Boeng Prek Tup

Boeng Prek Tup does not have sufficient capacity

SWSA has been unable to adopt the necessary measures to protect the catchment area of the lake from increased encroachment from public and private buildings, whose construction is often authorized by the central or provincial authorities. This is all the more regrettable since according to past records, the lake and its surrounding area were property of SWSA before the Khmer Rouge era (World Bank). This situation has deteriorated rapidly over the recent past and poses a serious threat to water quality and the long-term viability of using the lake for water supply. SWSA estimates that over half the catchment (upper reaches) is now subject to residential development.

Kbal Chay

A large part of the catchment is within a National Conservation Reserve but a look at satellite images indicates a significant amount of development in the land area comprising the catchment which will affect the way in which the catchment would have been managed to preserve water quality.

Trees and vegetation were not removed from the reservoir and the resulting organic decay is contributing to color, taste and odor problems. Iron and manganese levels in the raw water exceed WHO standards.

Alternative water resources

In 1994, potential long-term sources of water to supply Preah Sihanouk were investigated by Fraser Thomas (UNDP/World Bank Project). These had been identified from other reports and from word of mouth reference from local persons.

The alternative water sources considered were:

i) Lake Boeng Prek Tup

ii) Groundwater - Preah Sihanouk Area

iii) Phnum Riem - Lake Boeng Thom Angkep

iv) Lake at Sokha

v) Groundwater further a field

vi) Prek Tuek Sap - upper reaches

vii) Prek Tuek Sap - lower reaches

(viii) Lower Prek Tuek Sap and tributaries (Prek Ta Am and Prek Ta Dong)

(ix) Other Rivers

The location of potential sources is shown in Figure 3.5.4 and Table 3.5.3 provides a summary of the major factors considered earlier in evaluating each of the potential sources of supply. Particular emphasis was placed on the ability to supply the planned long-term growth and development of Preah Sihanouk.

Table 3.7.3 Alternative Long-term Water Sources for Preah Sihanouk

	Potential Water Sources	Considerations Made
1	Lake Boeng Prek Tup	• Present supply lake • Capacity inadequate for long-term demand • Water source becoming polluted
2	Groundwater - Preah Sihanouk Area	• Groundwater reserves can alleviate short-term demand • 3 new wells provide 2000m^3/day • additional groundwater wells on northern side of groundwater divide could provide upwards of a further 2000m^3/day • groundwater supplies lack capacity for long-term demand • abstraction is more costly than purchasing bulk treated water from Kbal Chhay
3	Phnum Riem - Lake Boeng Thom Angkep	• poor quality water • inadequate capacity for future long-term demand • draw off could impact on adjacent agriculture
4	Lake at Sokha	• water quality is poor and affected by wastewater drains • lake is currently being filled in by land development • lacks capacity for long-term demand
5	Groundwater further a field	• inadequate capacity to meet future demand • draw off could have a negative impact on other public/private wells • high costs to develop and transmit (relative to quantity of resource)
6	Prek Tuek Sap - upper reaches	• Present supply reservoir upstream of Kbal Chhay falls • recently developed by private sector • adequate capacity for long-term supply • undeveloped catchment area and clean resource • relatively close (10 km) to Preah Sihanouk
7	Prek Tuek Sap - lower reaches	• water is brackish; • draw off of fresh water could have a negative impact on river/estuary ecosystem • considerable distance to Preah Sihanouk (20 km) therefore high cost to transmit
8	Lower Prek Tuek Sap and tributaries (Prek Ta Am and Prek Ta Dong)	• water in Prek Tuek reported to be brackish, would require salinity barrier (weir) • Tributaries have small capacity but could be added to water from lower Prek Tuek • draw off of fresh water could have a negative impact on river/estuary ecosystem • potential industrial pollution upstream from SEZ • high cost to transmit
9	Other Rivers	• none with sufficient capacity other than Prek Tuek Sap in close proximity of Preah Sihanouk • alternative sources 30 to 100 km or more from Preah Sihanouk

Source: JICA Study Team

Conditions affecting selection of alternatives have changed little since 1994 except that the preferred source Kbal Chay has already been developed.

The next potential resource is the lower Prek Tuek river. The drainage basin for the lower Prek Tuek and its tributaries is at least as large (if not larger) as the upper catchment (Kbal Chhay) and could potentially yield a significant amount of fresh water.

Development would involve building a salinity barrier (weir) on the lower Prek Tuek River, a raw water intake and a new treatment plant. The construction of a dam with impounding reservoir has not been ruled out but an initial review of topographic contours indicates that extent of flooding would be quite widespread and would require an extensive amount of earthworks.

Pipeline and transmission costs would be high because of the distance and large change in elevation (100 m). Development costs would be difficult to justify in the short term since

there is enough water available from Kbal Chhay at a much lower cost. Nevertheless there may be sufficient water resources in the lower Prek Tuek to support a larger regional water supply system that could be used to supply the development of Special Economic Zones and other smaller urban centers in the area.

Conclusions and Recommendations

a. Source of water supply

The demand forecast indicates an annual water resources requirement of 12.2 MCM by the year 2030. This is around half the estimated reliable dry season yield of Kbal Chay and this is considered adequate.

Hydrological study including flow measurements and rainfall monitoring is required to determine the reliability and yield potential of the Kbal Chay and the lower Prek Tuek resources.

Water quality in Boeng Prek Tuk is threatened by urban development in the catchment area. Building restrictions and control are required to limit residential and commercial development. If development continues the lake will no longer be a viable potable water source.

The Kbal Chay reservoir has been constructed without adequate engineering design and the quality of construction is substandard for a structure that serves such an important function.

The following structural measures are recommended to make sure that the reservoir can provide a reliable and secure long-term supply of water for the city:

i) Provide a controlled outlet structure to release maintenance flows and emergency spillway with sufficient capacity to handle peak discharge and prevent overtopping the earth dam

(ii) Correct leakage which has been observed on the slope and foot of the earth embankment (there is no clay core or impervious blanket on the upstream side to prevent seepage which could lead to a breach in the dam)

(iii) Provide slope protection on the upstream side of the dam (rock fill) to prevent erosion

(iv) Correct subsidence along the crest of the dam to raise low spots that can potentially be overtopped.

b. Treatment Capacity

Preah Sihanouk's current treatment capacity will meet the maximum day demand until about the year 2014 (see Figure 3.5.4). Preah Sihanouk will need an additional 10,000 m^3/day to meet the maximum day demand for 2020 however this assumes that the wells are contributing during the dry season. It is recommended that 15,000 m^3/day of additional treatment capacity be provided in a stage one expansion.

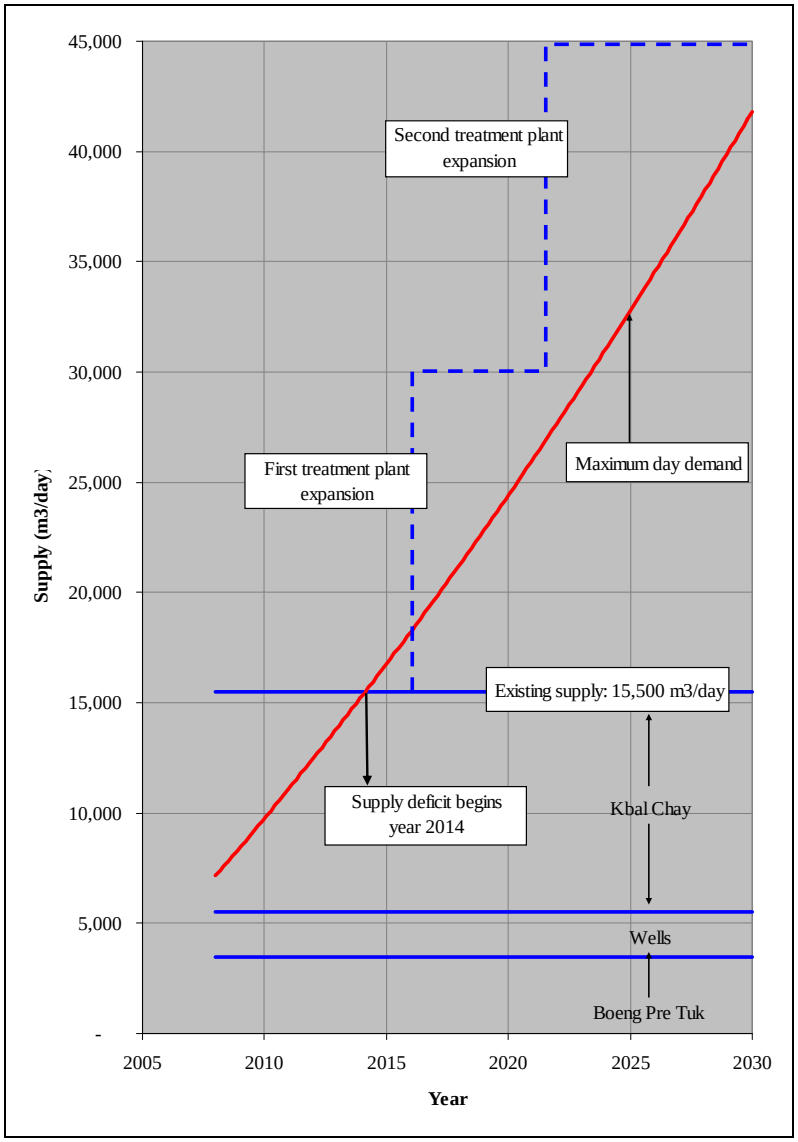
Preah Sihanouk should begin now to identify and evaluate options to increase its daily water supply capacity. In general, Preah Sihanouk could increase its water supply by one or more of the following:

- Increasing treatment capacity at Kbal Chay and augmenting conveyance capacity for treated water.

- Conveying raw water from the Kbal Chay reservoir to the existing public treatment plant
- Conveying raw water from the Kbal Chay reservoir to a new public treatment plant strategically located near the urban area

For planning purposes, it is assumed that Preah Sihanouk will increase its water supply by augmenting the treatment capacity at Kbal Chay because land is available there and the treatment plant facility can easily be expanded. It is assumed that the expansion of treatment capacity will be carried out by the private sector under the present concessionary arrangement therefore the costs of providing treatment facilities are not identified in the development plan.

The operation of the public treatment plant may no longer be viable after 2020 because the water source will become too polluted by urban runoff. Additional treatment capacity would be required to offset this loss.



Source: JICA Study Team

Figure 3.7.4 Maximum Day Demand vs. Supply

2) Treatment

Public Treatment Plant

The evaluation of the City's public water treatment plant is based on information provided by the water supply authority in Preah Sihanouk. The plant was rehabilitated in 2003-04, is generally in good condition and has historically operated as designed. There are three problems that exist:

- The dry season capacity of the raw water source is less than the treatment capacity
- The clear water storage tank is too small to meet peak demands and does not provide an emergency reserve in case of breakdown.

Private Treatment Plant

The private treatment facility is new but there are already several problems that require immediate attention to improve reliability and security of water supply:

i. There is no emergency power facility at the treatment plant
ii. The reservoir is poorly constructed and the embankment is unprotected
iii. Raw water intake facilities and flood spillways are non-existent
iv. Trees and vegetation were not removed from the reservoir and the resulting organic decay is contributing to color, taste and odor problems of this water source.
v. The water supply authority reports that iron and manganese levels in the raw water exceed WHO standards. It is not known if these are being removed to acceptable levels.

Public treatment plant

The electro-mechanical equipment at the public water treatment plant is relatively new and in good condition and should not need to be replaced until the year 2020. The plant can probably continue to operate beyond 2020 with a suitable program of preventive maintenance, annual repairs and eventual replacement of electro-mechanical equipment however the feasibility of continuing operations will depend on the quality of the water source.

Kbal Chay Water Supply

The poor quality of construction of the reservoir at Kbal Chay is a serious concern and could jeopardize the long term sustainability of water supply for Preah Sihanouk. As there is no detail engineering design document available for review, apparently the earth dam lacks in a spillway so that an unexpected inflow to the reservoir may cause overtopping of the reservoir, which could result in the collapse of the dam.

Given the importance of this water resource it is recommended that MIME complete an evaluation of the plant and the reservoir to determine what improvements are required to guarantee long-term sustainability of the scheme. If necessary the contractual arrangements

for this water supply concession should be revised to give DIME more control over performance.

3) Treated Water Transmission

Criteria

The gravity transmission pipeline should be sized to supply the maximum day demand over a 24 hour period. The required capacity of a gravity main for conveying treated water from Kbal Chay is shown in Table 3.5.4

Table 3.7.4 Summary of Transmission Pipeline Evaluation

	2008	2020	2030
Demand (m^3/hr)	248	969	1659
Amount provided by the public treatment plant	146	146	146
Amount required from Kbal Chay Source 1	102	823	1513
Capacity of treated water transmission pipeline	208	208	208
Surplus (+) / Deficit (-)	106	(-615)	(-1305)

Note: (1) average hourly flow assumes adequate end of pipe storage
Source: JICA Study Team

Conclusions and recommendations

The existing 350 mm diameter gravity transmission main is too small to meet future requirements. It is noted that at present the pipeline is actually required to convey peak hourly flows of 300 m^3/hour because there is not enough storage at the terminal end of the pipeline.

The amount of water that can be transferred from Kbal Chay scheme into the distribution system is severely limited by the way the transmission pipeline has been connected into the system. The pipeline joins the outlet of the public treatment plant at a point approximately 22 m lower than the clear water well. This means that treated water from Kbal Chay can only enter the system when the pressure in the distribution system is low enough to allow water to flow into the system by gravity. The water supply authority is attempting to balance flows by closing and throttling a combination of valves to physically separate the two systems however only a small amount of water from the Kbal Chay scheme is currently entering the system.

It is recommended that the distribution system be separated into two supply districts to improve system performance. The public treatment plant would supply a smaller service area and would receive treated water transferred in from Kbal Chay system to meet demands during peak periods and during the dry weather season. The Kbal Chay scheme would supply the largest part of the distribution system and future growth areas.

4) Storage

Criteria

The water supply system should have storage facilities sufficient to provide:

i. Operational storage,

ii. Fire suppression storage and

iii. Emergency storage.

Operational Storage.

Operational storage is the volume of water needed to supply the system for periods when demands exceed the supply. Storage is usually sized on the basis of a 24 demand fluctuation curve which in most systems works out to be 5-6 hours of supply at maximum day. In the absence of demand curve data the rule of thumb is to provide 20-30% of the maximum day demand for gravity supplied scheme and 15% for a pump supplied scheme.

Fire Suppression Storage.

Fire suppression storage is the volume of water needed to provide a required fire flow for specified period of time. There is currently no standard or regulatory requirement for fire suppression storage in Cambodia. The guideline in Vietnam is to provide a minimum of 250 m^3 at each storage reservoir for fire fighting. JICA's design standards for water supply facilities requires a minimum amount of water based on population as indicated in Table 3.5.5.

Table 3.7.5 Fire-fighting Storage Requirements

Population (10,000 persons)	Amount of water for firefighting (m^3)
1	100
2	200
3	300
4	350
5	400

Note: Fire suppression storage for planning purposes will be based on JICA's standard.

Emergency Storage

Emergency storage is the volume of water required to meet water demand during an emergency situation.

An emergency storage volume of at least 1 day at the maximum demand is desirable for gravity schemes.

Pumped schemes require emergency storage that reflects the risk of pump failure (or broken pipeline). In general the greater the number of pumps the lower the risk of failure. The transmission pipelines are quite vulnerable to external damage therefore this study assumes that the worst case scenario will occur when a pipeline is broken. It is assumed that a broken pressure main can be repaired within 8 hours therefore an emergency storage equivalent to 8 consecutive peak periods (max day) will be considered for planning purposes.

Existing and Future Conditions

The evaluation of the City water storage facilities for existing and future conditions is summarized in Table 3.5.6.

Table 3.7.6 Summary of Storage Evaluation

Storage Evaluation	2008	2020	2030
Population	22,303	66,030	113,388
Equalization [1]	1,495	5,364	9,492
Fire Suppression	250 [2]	450 [3]	800 [3]
Emergency [4]	3,224	11,569	20,471
Total Required	4,969	17,383	30,763
Total Existing	1,150	1,150	1,150
Surplus (+) / Shortage (-)	-3,819	-16,233	-29,613

(1) Based on estimated demand pattern. Equivalent to 6 hour at maximum day.
(2) per Vietnamese MOP.
(3) 400 m^3 for first 50,000 persons plus 50 m^3 per every 10,000 thereafter per JICA standards
(4) 1 assuming loss of transmission main for 8 consecutive hours during peak flow periods at max day

Conclusions and Recommendations

The City currently has a severe shortage of water storage facilities. The current deficit is around 4,000m^3. As the population and the water demand in Preah Sihanouk continue to grow, it is projected that in the year 2020 the City will have a storage requirement nearing 16,000 m^3.

It is recommended that the City construct additional reservoir storage as soon as possible. Planning, site acquisition, design and construction could take 24 to 36 months, so the City should start the process immediately.

5) Distribution

Operating Criteria

This study evaluates the performance of the existing water distribution system and proposes improvements to meet future design flow rates. There are no guidelines for water supply in Cambodia therefore evaluation is based on supplying design flows while simultaneously meeting the following criteria which have been taken from Vietnamese manual of practice for water supply:

i. The system should have sufficient capacity to refill all reservoirs from empty to full within 5 days of continuous operation at average day demand

ii. The system should be capable of continuous operation under maximum day demands and each reservoir in the system should have a positive net inflow at this demand

iii. During 3 consecutive days of maximum day demand, reservoirs within the system should not empty

iv. During peak hour demands, all sections of the system should receive a pressure of at least 12 meters. Where an elevated storage serves an area of reticulation, this pressure should be maintained at the lowest operating level of the reservoir. The total system should be capable of supplying water for 6 consecutive maximum hours

v. Pressures in the distribution system should not exceed 80 meters to limit leakage from the mains and minimize problems with consumer plumbing fixtures.

vi. Flow velocity should not exceed 2 m/s anywhere in the system.

Distribution System Model

When planning the expansion of an existing scheme it is necessary to evaluate the operation of the system as a whole. The modeling program known as EPANET is used for this study to simulate operating conditions and evaluate proposed alternatives for improvement. The model is also used to determine the required size trunk mains to meet future demands.

The data used to create the model were obtained from the Preah Sihanouk water supply authority. The data compiled and used to construct the hydraulic model included:

i. Pipeline locations and diameters

ii. Land use maps developed by this study on the basis of satellite images

iii. Elevation contour data from topographic maps developed in 2002

iv. Water demand data

v. Pipe roughness coefficients

vi. Node elevations

vii. Pumps, valve settings, wells and reservoirs.

viii. An EPANET model developed in 2004 to design the water supply improvements implemented by the World Bank project

Head loss

Head losses in the system as calculated using the Hazen Williams C values identified in Table 3.5.7.

Table 3.7.7 Hazen Williams C values for distribution

Material	Maximum C value
Existing Ductile iron	100
Existing Asbestos cement	115
Existing HDPE	130
New pipe	110

Source: JICA Study Team

These values make allowance for the effect of ageing, losses in fittings such as bends, tees and valves. New pipe is assumed to be cement lined ductile iron because it represents the worse case in terms of system head losses.

Design Flow and Distribution System Capacity

Design flows used in this study are indicated in Table 3.5.8.

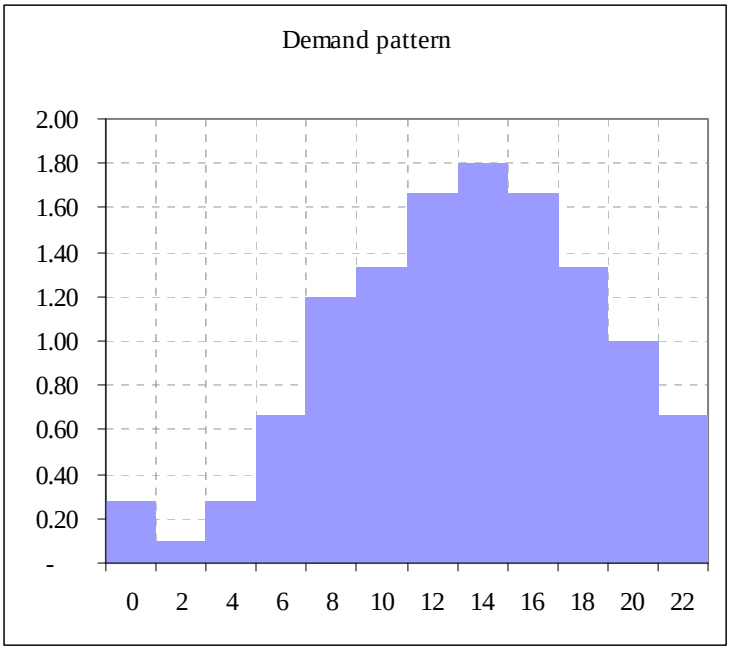
Table 3.7.8 Distribution Capacity

Scheme element	Capacity criteria
Trunk mains gravity supply	MDD over 24 hours
Trunk mains pumped supply	MDD over 20 hours
Distribution	Peak hourly flow = 1.8 x MDD

Source: JICA Study Team

The average day demand was distributed to various nodes in the distribution network according to information provided by the water supply authority and population estimates of new areas to be served.

Simulation of system performance was carried out over an extended 72 hour period. A demand multiplier of 1.25 was applied to obtain maximum day demands at each node. Demands were subjected to a 24 hour fluctuation pattern including peak hourly demand factor of 1.8.The demand pattern is presented in Figure 3.5.5.



Source: JICA Study Team

Figure 3.7.5 Water Demand Hourly Fluctuation Pattern

Existing Conditions

The distribution system model was used to simulate existing conditions with maximum hour demand. Water demand rates for each of these scenarios are described in Section 2.

The modeling results for this scenario indicate the following problems:

i. High pressures in all zones with ground elevations less than 40 m

ii. Low pressures in areas along NR4

iii. Negligible flow from service reservoir R2 into the system because the supply of water from reservoir SR1 is at a higher elevation.

iv. Lack of storage resulting in the potential loss of supply during peak demands.

Other Problems and Needs

The City's water distribution system includes approximately 9,500 meters of ductile iron (DI) pipe. This pipe was installed when the system was constructed in 1958 and is beginning to show signs of distress. The water supply authority has prepared a priority list of distribution mains that it would like replaced. The mains identified for replacement are shown in Figure 3.5.6 in blue and a summary of the length for each existing diameter is provided in Table 3.5.9.

Table 3.7.9 Ductile Iron Pipe Identified for Replacement

Existing Diameter (mm)	Length (m)
100	280
125	1240
150	1700
200	2110
250	4200
Total	9530

Conclusions and Recommendations

a. High Pressures

High pressures at lower elevations can be controlled by installing pressure reducing valves at strategic locations in the systems and by supplying part of the system from new storage located at lower elevation.

b. Low Pressures

Low pressures along NR4 will persist because the feeder main is too small and the static head is only 20 m. The problem will get worse as the system expands along NR4 away from the point of supply. This problem can be solved by implementing a separate pressure district supplied from the Kbal Chay system either from a booster pump station or an elevated tank.

c. Negligible Flow from Kbal Chay Scheme

This problem can be addressed by separating the distribution system supplied from the Kbal Chay scheme.

d. Ductile Iron Pipes

Most of the ductile iron pipes are feeder mains that should be replaced with larger diameters to handle increased flow in the future. Proposed pipe sizes based on preliminary modeling of future demand are identified in section 5.

(2) Overview of Improvement Scheme

Proposed modifications to the transmission and storage of treated water are presented schematically in Figure 3.5.6.

The distribution system is physically separated into three (3) districts as shown in Figure 3.5.7:

District 1 serving areas at higher elevations as well as areas to the west of Boeng Preh Tuk, the port authority and existing service areas along Victory beach. Distribution in district 1 to be supplied from new 1700 m3 storage reservoir S1 located at the existing public water treatment plant. The demand for district no.1 exceeds the capacity of the treatment plant therefore treated water must be transferred into the system from the Kbal Chay source.

District 2 serving areas of the City at lower elevations including the well established central core and future growth areas to the East. Pressure in District 2 to be maintained by a new 9,000 m3 ground storage reservoir S2 located at elevation 88 m. Reservoir S2 is supplied by a new gravity transmission main from the Kbal Chay balancing tank. Reservori S2 can also be supplied from elevated tank S-3 if the gravity transmission pipeline is out of service.

District 3 serving areas at higher elevations along NR4 using one of the existing 350 mm dia gravity mains as a feeder main for distribution. Pressure in the feeder main will be maintained by 1500 m3 elevated tank S3 to reduce the long-term operating costs and difficulties associated with booster pumps.

Cambrew will be supplied directly from the balancing tank by the existing 350 mm diameter gravity main.

(3) Demand by district

The maximum daily water demand for each supply district is provided in Table 3.5.10.

Table 3.7.10 Future Water Demand by Distribution District

	2020		2030	
District	Pop	Domestic	Pop	m3/day
		m3/day		
1	23,069	7,886	32,748	12,506
2	39,037	11,478	69,165	20,926
3	6,792	2,096	15,104	4,581
Total	68,897	21,460	117,016	38,014

Note: Demand for district 3 excluding Cambrew which is supplied by a dedicated transmission pipeline from the balancing tank.
Source: JICA Study Team

(4) Storage

Proposed new storage facilities are identified in Table 3.5.11. In addition a new tank is required to receive flows from the Kbal Chay treatment plant and balance flows transmitted to each supply district. The location of proposed storage is shown in Figure 3.5.8.

Table 3.7.11 Proposed Storage Facilities

ID No.	Type	Initial Volume 2020 (m3)	Incremental Volume 2030 (m3)	Ground Elevation (m)	Top Water level (m)	Bottom Water Level (m)
S1	Ground	1,700	9,000	120	125.5	122
S2	Ground	9,000	9,000	88	89.5	86
S3	Elevated	1,500	0	107	130	127
Balancing Tank	Ground	5,000	5,000	110	112.5	109

Source: JICA Study Team

Outlet of each storage reservoir will be equipped with a magnetic flow meter.

1) District 1:

The existing treatment plant site has limited space and can only accommodate a new ground storage reservoir of about 1700 m3 (22 x 21 x 3.7m). This volume is insufficient to balance the fluctuation in demand therefore variable speed pumping will be required. An evaluation of the required storage volume for district no.1 is provided in Table 3.5.12

Table 3.7.12 Storage requirements district no.1

Ground storage S1	2020	2030
Population	34,049	50,494
Equalization [1]	1,482	2,397
Fire Suppression [2]	250	450
Emergency [3]	400	7,493
Total Required	2,136	10,340
Total Existing	450	1,700
Surplus (+) / Shortage (-)	-1,682	-8,640
Proposed	1700	9,000

[1] Based on demand pattern, and assumed variable speed pumping operations
[2] 250 m3 per Vietnamese MOP. 400 m3 for first 50,000 persons plus 50 m3 per 10,000 thereafter
[3] 8 consecutive hours at peak period during max day.

Emergency storage reflects the risk of pump failure or damage to the pipeline. The construction of a 9000 m3 ground reservoir by 2030 assumes that space will be available because the treatment plant will no longer be operational because the water source will be degraded by urban runoff.

2) District 2:

The site identified for the proposed ground storage reservoir is 22 m lower than the balancing tank therefore gravity supply is feasible. The storage volume requirements provided in Table 3.5.13 are based on a constant 24 hour supply.

Table 3.7.13 Storage requirements district no.2

Ground Storage S2	2020	2030
Population	28,665	52,183
Equalization [1]	2,866	5,220
Fire Suppression [2]	250	450
Emergency [3]	6,181	11,258
Total Required	9,296	16,927
Total Existing	0	9,000
Surplus (+) / Shortage (-)	-9,296	-7,927
Proposed	9,000	9,000

(1) Based on demand pattern, and constant gravity supply.
(2) 250 m3 per Vietnamese MOP. 400 m3 for first 50,000 persons plus 50 m3 per 10,000 thereafter
(3) 8 consecutive hours during peak flow periods at max day.

It is desirable for gravity schemes to provide an emergency storage of at least 1 day at maximum demand however the potential site cannot accommodate such a large facility. The most likely cause of failure is a broken supply main which can normally be repaired within 8 hours therefore the emergency storage is reduced to 8 consecutive peak hourly flow periods.

It is proposed to construct a ground reservoir with two cells. The first 9,000 m3 cell would be provided in stage 1 with provision for a duplicate cell after 2020.

3) District 3:

Elevated storage is proposed to simplify operation however variable speed pumping may be used as a substitute or to reduce the size of the elevated storage tank. Elevated storage is usually sized on the basis of balancing fluctuations in hourly demand but the storage should be sufficient to supply 3 to preferably 6 consecutive hours during peak periods. A fire fighting reserve of 150 m3 is desirable. Emergency storage is normally not provided in elevated tanks because of the costs. An evaluation of the required storage volume is provided in Table 3.7.14

Table 3.7.14 Storage requirements district no.3

Elevated Storage S3	2020	2030
Population	6,228	14,296
Equalization [1]	831	1,863
Fire Suppression [2]	150	150
Total Required	981	2,013
Total Existing	0	1500
Surplus (+) / Shortage (-)	-981	-513
Proposed	1500	0

Source: JICA Study Team

It is proposed to construct a 1500 m3 tank supplied by constant speed pumps operating 20 hours per day. Variable speed pumping would be provided at a later date in lieu of equalization storage to balance demands between 2020 and 2030.

4) Main balancing tank:

The main balancing tank S4 receives flow pumped from the treated water reservoirs at the Kbal Chay treatment plant.

Normally balancing tanks are sized at 0.5 to 2 hours at the maximum pump output rate. In this case a larger tank is recommended to provide additional emergency storage in the system in likely event that the supply from Kbal Chay is interrupted (pump failure or main break). For planning purposes it is assumed that a disruption in service would last for 8 consecutive hours during peak hourly flows periods. The storage requirements for the balancing tank are provided in Table 3.7.15

Table 3.7.15 Storage requirements for balancing tank

Balancing tank S4	2020	2030
Balancing volume for 2 hours at maximum output	2,145	4,291
Demand for 8 consecutive hours at peak flow period	11,569	24,679
Total Required	13,714	28,969
Emergency storage (proposed service reservoirs S1 & S2)	6,681	18,751
Existing		5,000
Surplus (+) / Shortage (-)	-7,034	-5,218
Proposed	5,000	5,000

Source: JICA Study Team

It is proposed to construct a new ground storage reservoir near the junction of Kbal Chay access road and NR4. The site should be large enough to accommodate the construction of a 5,000 m3 tank now followed by a second 5,000 m3 tank between 2020 and 2030.

(5) Transmission Pipelines and Pumps

1) District 1.

Treated water will be pumped to the proposed ground storage reservoir S1 at the existing public water treatment plant. The proposed reservoir cannot be made large enough to balance hourly fluctuations in demand therefore a variable speed pumping scheme will be required. The required peak hourly pumping flow rate is 910m3 /hour, which is approximately 1.6 times the average peak hourly demand.

The existing 350 mm diameter gravity main cannot be used as a pressure main because there would be too much friction loss at the required peak flow. A new 600 mm diameter transmission main is proposed. The size is based on the comparison of head loss for different pipe diameters shown in Table 3.7.16.

Table 3.7.16 Selection of pipeline diameter for transmission to S1

Dia. of transmission main	Peak flow 2030	Head loss in pressure main L=7000m	Velocity	Minor losses 10%	Static head	Total head
mm	m3/hr	m	m/s	m	m	m
350 HDPE [1]	910	119.9	2.6	12.0	14.0	145.9
400 DIP	910	85.2	2.0	8.5	14.0	107.7
600 DIP	910	11.8	0.9	1.2	14.0	27.0
800 DIP	910	2.9	0.5	0.3	14.0	17.2

(1) existing transmission pipeline
Source: JICA Study Team

Variable speed pumps should be arranged in multiple units of equal capacity to provide operational flexibility. Preliminary requirements are identified in Table 3.7.17. The size of the pumps and the relative times of pumping will be very dependant on the actual hourly demands and the amount of storage that can actually be provided at the treatment plant.

Table 3.7.17 Pump requirements for transmission to S1

Parameter	Units		2020	2030
No of pumps		duty	3	5
		standby	1	1
Flow	(lps)	max	60	55
		min	50	40
Operating Head	(m)	max	20	30
		min	15	15
Motor power	(kw)	max	14	18
		min	10	8
Power consumption	(kwH)	per day	551	1114
Energy cost[1]	USD	Per day	138	279

Note: (1) unit cost of electricity $0.25 / kwH,
Source: JICA Study Team

2) District 2

Treated water will flow by gravity from the balancing tank to the proposed ground storage reservoir S2. The pipeline must be able to convey the average hourly maximum day flow for the year 2030.

The existing 350 mm diameter gravity main cannot be used because it does not have sufficient capacity. A new 600 mm diameter transmission main is proposed. The size is selected based on achieving a positive residual head. A comparison of residual heads for different pipe diameters is shown in Table 3.7.18.

Table 3.7.18 Selection of pipeline diameter for transmission to S2

Dia. of transmission main	Average flow 2030	Head loss in gravity main L=5300m	Velocity	Minor losses 10%	Total head loss	Residual head
mm	m3/hr	m	m/s	m	m	m
350 HDPE[1]	870	94.64	2.51	9.46	104	-84.10
400 DIP	870	67.27	1.92	6.73	74	-54.00
600 DIP	870	9.34	0.85	0.93	10	9.73

Note: (1) existing transmission pipeline
Source: JICA Study Team

3) District 3

Treated water will be pumped to the proposed elevated storage reservoir S3 located at higher elevations along NR4. The proposed tank is large enough to balance hourly fluctuations in demand assuming constant speed pumps operating 20 hours per day.

The volume of the tank will not be sufficient to balance peak hourly flows by 2030 therefore variable speed pumps will be required at some time beyond the year 2020. The required

peak hourly pumping flow rate is 153 m3/hour for 2020 and 308 m3/hour for 2030 (approximately 1.6 times the average peak hourly demand).

A comparison of head loss for different pipe diameters is shown in Table 3.7.19.

Table 3.7.19 Selection of pipeline diameter for transmission to S3

Dia. of transmission main	Peak flow	Head loss in rising main L=5500m	Velocity	Minor losses 10%	Static head	Total head
mm	m3/hr	m	m/s	m²	M	m
350 HDPE	153 [2]	3.48	0.89	0.35	12.00	15.83
350 HDPE	308 [1]	12.67	0.89	1.27	12.00	25.94
2x 350 HDPE	308	3.51	0.44	0.35	12.00	15.87
600 DIP	308	1.25	0.30	0.13	7.00	8.38

(1) The flow rate is based on constant pumping for 20 hours per day
(2) Flow rate for 2020
Source: JICA Study Team

The existing 350 diameter HDPE gravity main from the balancing tank has sufficient capacity to be used as a pressure pipeline to the proposed elevated water tank. It will be necessary to install a second 350 mm diameter pipeline as flows increase after the year 2020 in order to reduce energy costs associated with high friction losses. It is considered more economical to install a twin pipeline at a later date than it is to install a larger 600 mm diameter pipeline now.

Pumps should be arranged in multiples to provide operational flexibility. Preliminary requirements are identified in Table 3.7.20.

Table 3.7.20 Pump requirements for transmission to S3

Parameter	Units		2020	2030
No of pumps		duty	1	2
		standby	1	1
Flow	(lps)	Constant [2]	51	43
Operating Head	(m)		23	33
Motor power	(kw)		13	19
Power consumption	(kwH)	per day	255	740
Energy cost [1]	USD	Per day	64	185

(1) unit cost of electricity $0.25 / kwH, assuming a single 350 mm dia. pipeline
(2) The flow rate is based on constant pumping for 20 hours per day
Source: JICA Study Team

Energy costs for 2030 would be reduced to $64 per day by installing a second 350 mm diameter pipeline.

4) Pumping station

The transmission pumps should be located in a building structure that is integrated with the proposed balancing tanks to facilitate the arrangement of suction piping. The pumping station must large enough to accommodate future pumps and should include a reliable emergency power supply.

(6) Distribution Piping

New feeder mains are required to meet increased demand and distribute flow from the proposed storage facilities. Proposed feeder mains are shown in Figure 3.7.6. Sizes are based on preliminary modeling of demands for 2030 using EPAnet. A summary of pipe diameters used for preliminary costing is presented in Table 3.7.21.

Table 3.7.21 Proposed Feeder Mains

Diameter (mm)	150	200	250	300	350	400	600	Total
Feeder ID	Length (m)							
S1-A	-	-	2,963	1,740	-	1,067	-	5,770
S1-B	-	-	2,121	-	-	-	-	2,121
S1-C	-	1,005	879	-	-	-	-	1,884
S2-A1	-	-	-	-	-	3,249	796	4,045
S2-A2	-	-	-	-	920	-	-	920
S2-B	-	465	3,261	705	-	-	-	4,431
S2-C	200	382	494	3,126	1,798	-	-	6,000
S2-D	-	-	1,318	1,653	-	-	-	2,972
S3 in/out	-	-	-	-	450	-	-	450
Total	200	1,852	11,036	7,225	3,168	4,316	796	28,592

Source: JICA Study Team

Proposed feeder mains will replace all of the existing ductile iron mains and some of the newer HDPE mains. Some of the existing water mains may be kept in service for secondary distribution if they are found to be in reasonably good condition in subsequent studies.

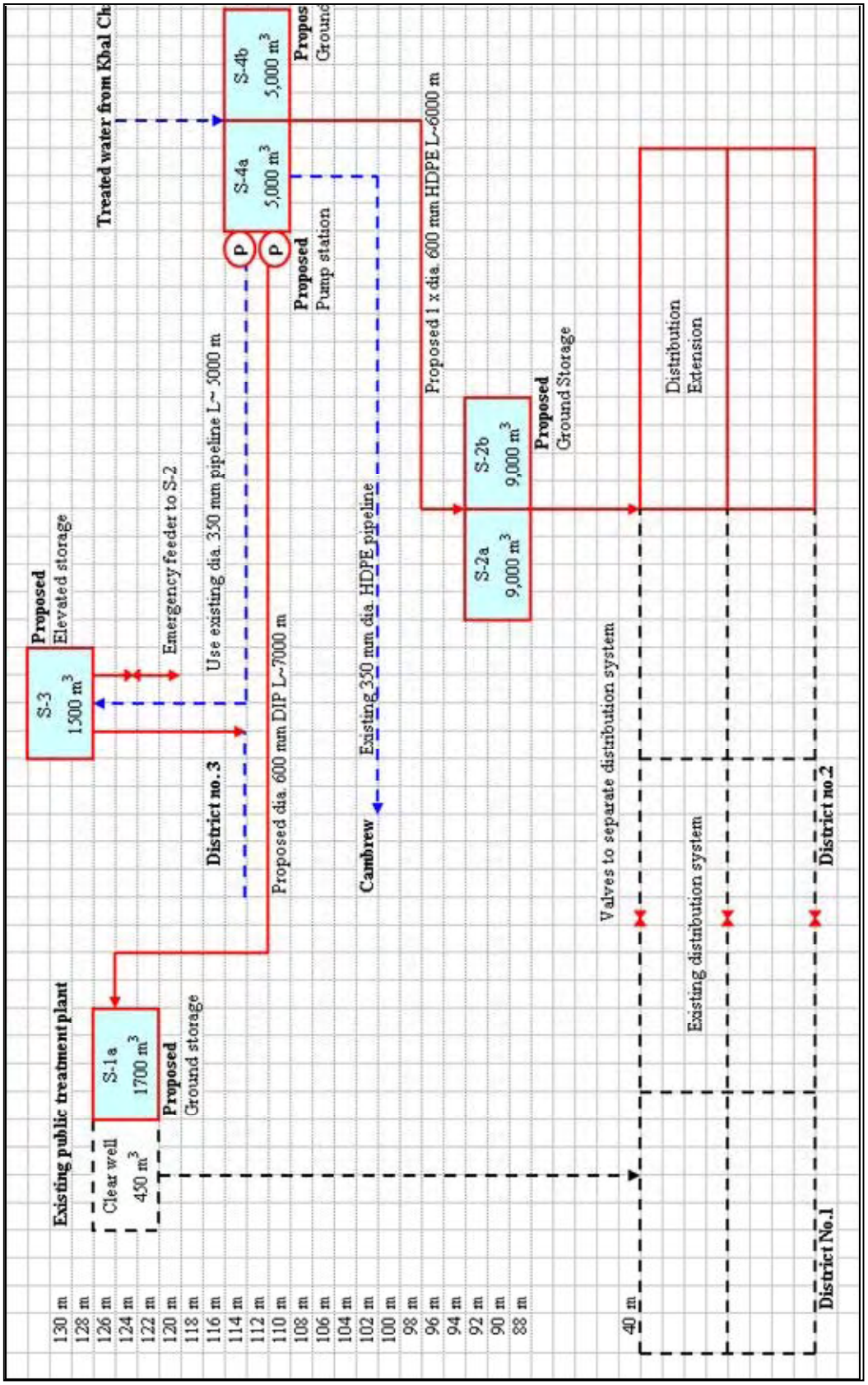
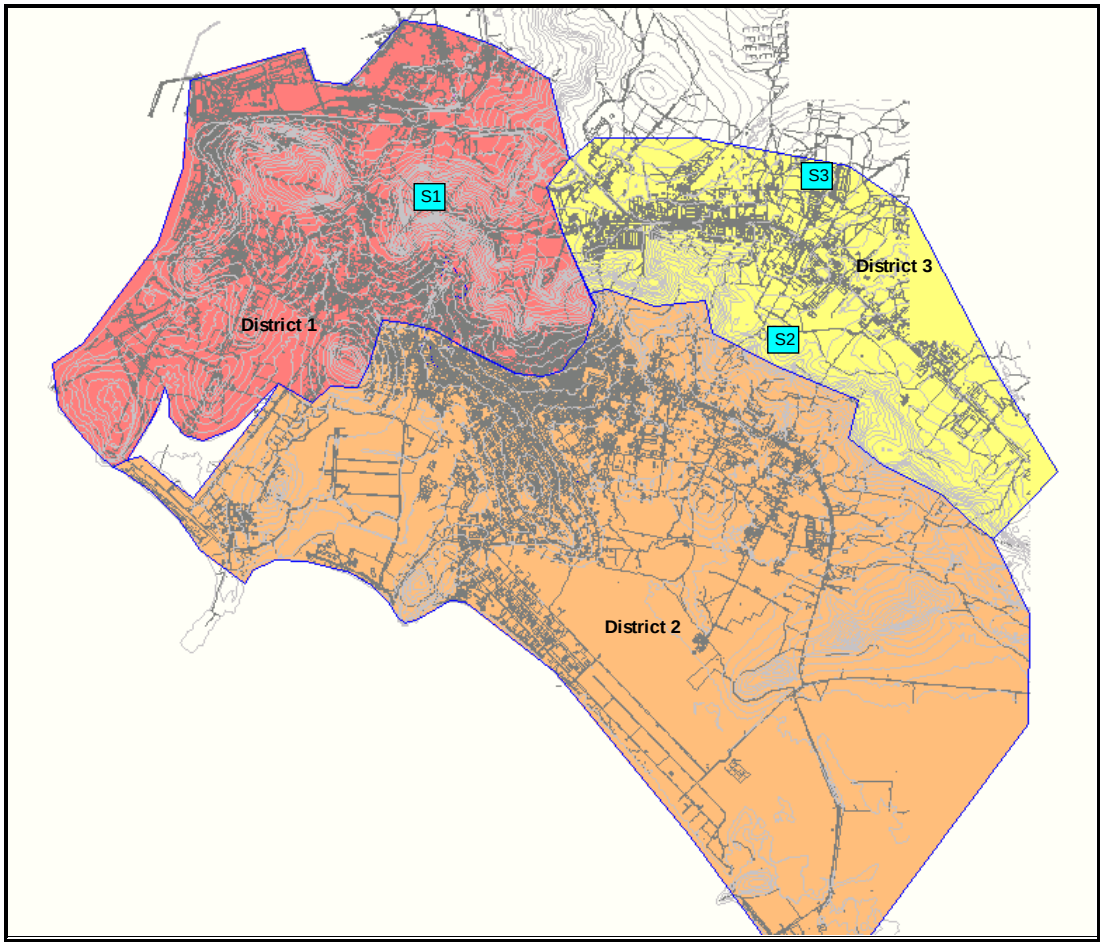
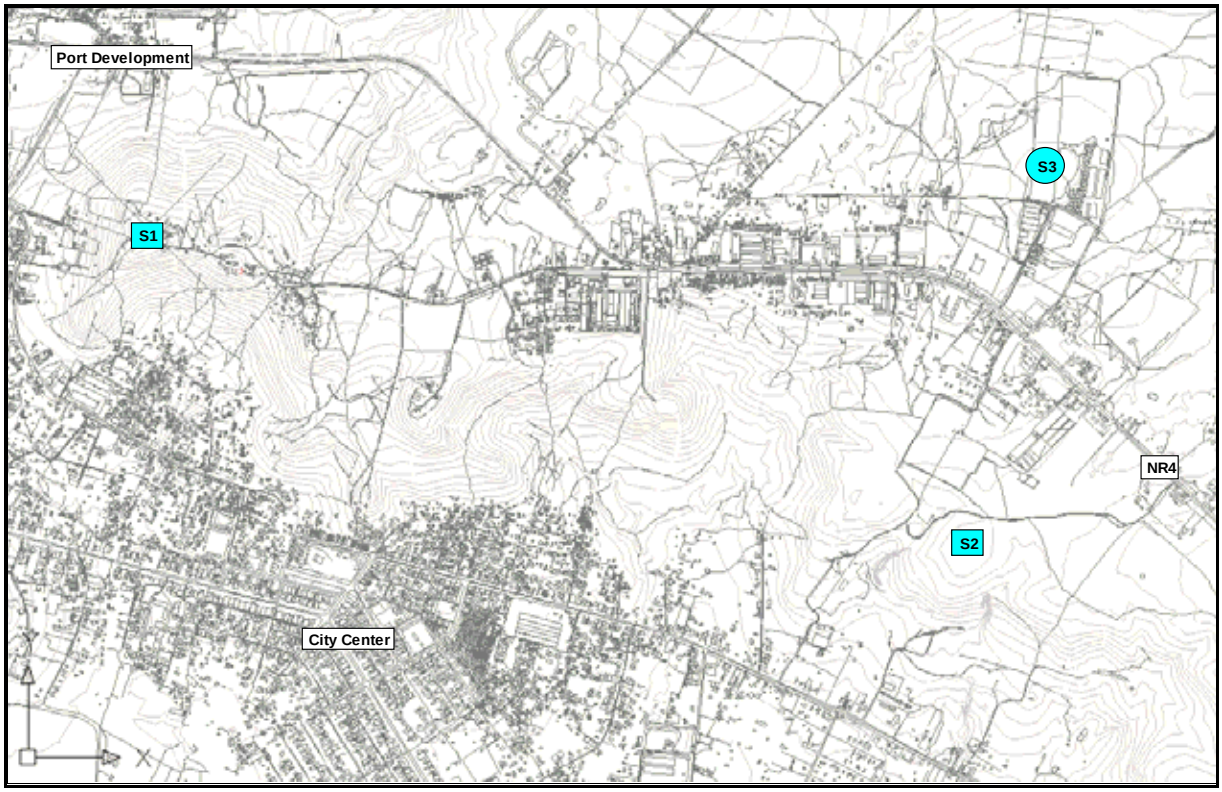


Figure 3.7.6 Proposed Water Supply Storage and Transmission Scheme



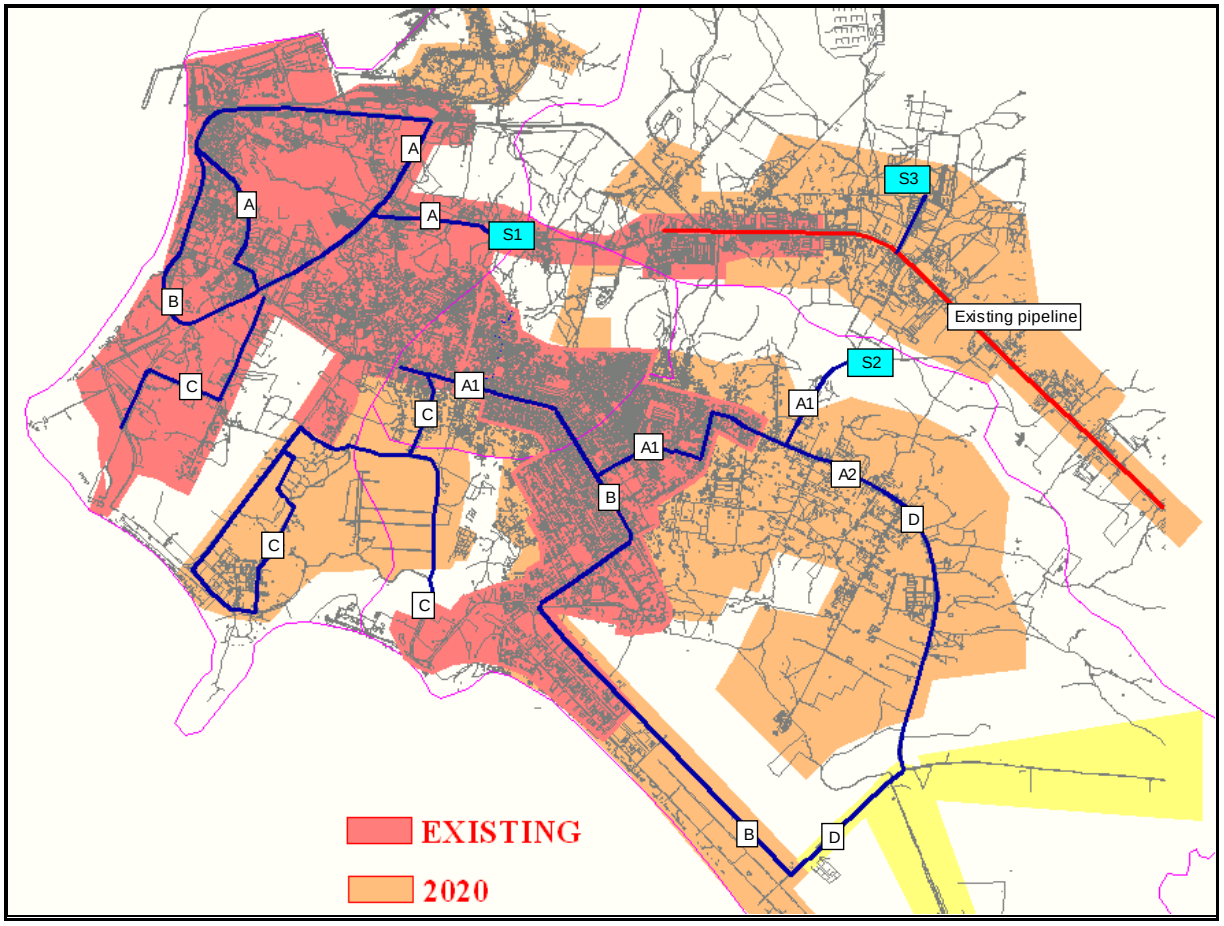
Source: JICA Study Team

Figure 3.7.7 Proposed Water Supply Districts



Source: JICA Study Team

Figure 3.7.8 Location of Proposed Storage



Source: JICA Study Team

Figure 3.7.9 Proposed feeder main

3.7.3 Wastewater Disposal

Sewerage service areas proposed in the master plan cover the urban area that has been defined by the study. The urban area typically has higher population densities (in the order of 70-80 persons per hectare). Peri-urban areas outside the proposed service areas have lower population densities and tend to be more rural in nature. Extending conventional water borne sewer services into these sparsely populated peri-urban areas is generally not cost effective or financially viable because the small customer base makes it difficult to recover investment and operating costs.

The existing sewage lagoon was conceived to service the central core of the City only. The master plan recommends expanding the system as originally planned into the adjacent catchment area thereby doubling treatment capacity at the same site. There is no space at the treatment site for further expansion beyond what was originally planned.

The topography in Sihanoukville is hilly and makes collection to a centralized wastewater treatment plant expensive to operate (and unreliable) because it involves pumping. The master plan recommends a decentralized approach in other urban areas to improve the chance of success whereby individual drainage catchments will have their own small scale treatment plant. In some cases it might be feasible to group 2 or more small drainage catchments to a single decentralized treatment facility.

(1) Evaluation of existing and future conditions

Table 3.7.22 summarizes the evaluation of Preah Sihanouk's existing wastewater system for existing and future conditions.

Table 3.7.22 Summary of Wastewater Flows from Initial Service Area

m^3/day	2008	2020	2030
Flow from existing service area	1,561	3,859	5,047
Total Treatment	6,900	6,900	6,900
Surplus (+) / Shortage (-)	5,339	3,041	1,853

Table 3.7.23 summarizes the flow to the existing treatment plant if wastewater is collected from catchment areas A and B as originally intended when the project was designed.

Table 3.7.23 Summary of Wastewater Flows from Catchment A and B

m^3/day	2008	2020	2030
Flow from Catchment area A	2,044	5,762	9,723
Flow from Catchment area "B"	841	1,781	2,550
Total Flow A+B	2,885	7,544	12,272
Total Treatment	6,900	6900	6900
Surplus (+) / Shortage (-)	4,015	(644)	(5,372)

Tables 3.7.22- 23 are presented graphically in Figure 3.7.10.

(2) Conclusions and Recommendations

1) Initial service area

If the existing collection system does not expand into new growth areas there is a surplus of treatment capacity even at year 2030.

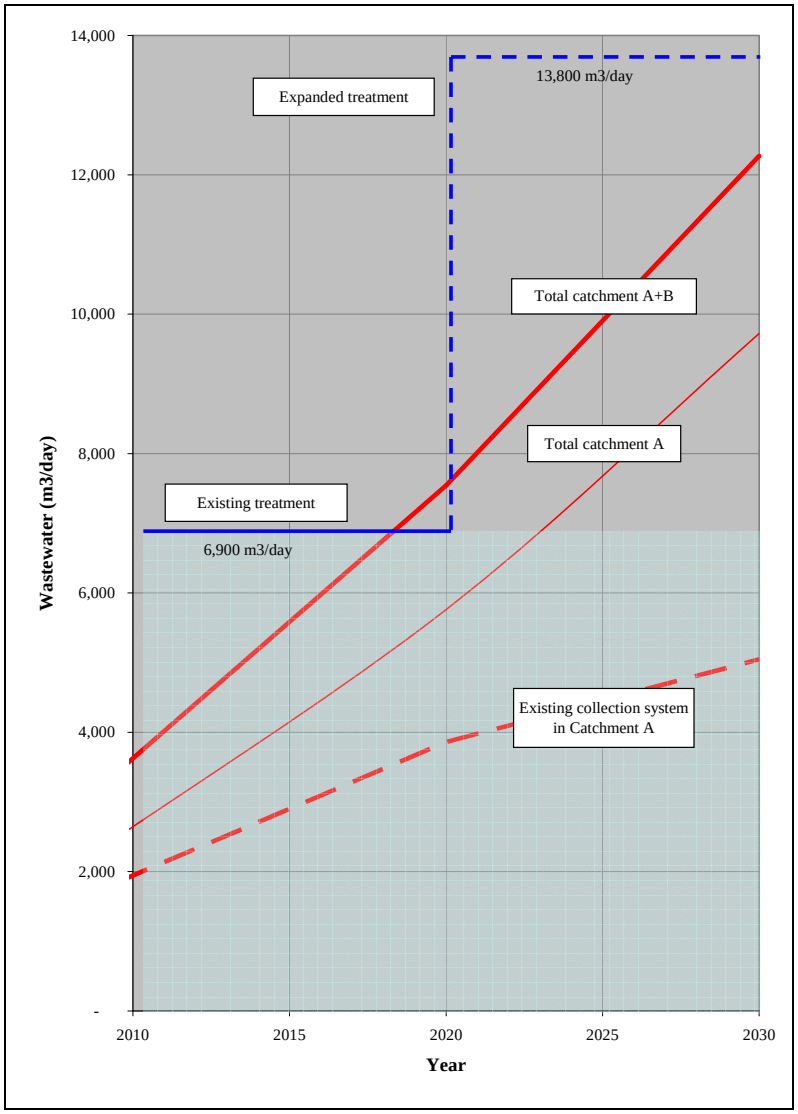
2) Expansion of collection system into Catchment A and B

Additional treatment would be required before 2020 if the system is extended to service growth areas in catchment A and B as originally planned (see Figure 3.7.10).

The treatment plant can be doubled in size to approximately 13,800 m3/day by constructing two more parallel streams. This provides enough capacity beyond 2030 and to full urban development inside the catchment

Wastewater generated in the upper parts of Catchment A can be collected by gravity into the existing system. A new gravity trunk sewer will be required to service other growth areas in the lower parts of the catchment.

Wastewater generated in drainage catchment B can be collected at a low point near the existing drain and pumped over to the existing south trunk sewer.



Source: JICA Study Team

Figure 3.7.10 Average Daily Wastewater Flow Vs. Treatment Capacity

3) Development of Sewerage in Other Drainage Catchments

The hilly topography makes it impossible to convey sewage by gravity to one centralized treatment plant. A decentralized approach is recommended for other catchments because it will minimize the costs and difficulties associated with pumping i.e. each drainage catchment should have it's own collection system and treatment plant. Some drainage catchments might be combined together if pumping is more economical than building a separate treatment facility. A decentralized approach will also allow a more gradual implementation of sewerage on a priority area basis.

4) Priorities for Sewerage Development

The first priority should be to implement a program of mandatory connection of all buildings located within the existing sewerage collection area. This is necessary to achieve the benefits of the project that has already been implemented.

The strip along Ochheutal beach should be serviced as soon as possible to preserve water quality along the beach. The area is lower than the existing south trunk sewer therefore wastewater will have to be collected by gravity to a central point and pumped up to the trunk sewer at the treatment plant.

The collection system should then be expanded into new growth areas located in catchment A. This can be achieved by implementing gravity sewers connected to existing trunk collectors.

Sewerage schemes in other catchments should not be implemented until the existing system can be successfully managed. Sewerage should then be implemented in the following order of priority:

i. Catchment B: stage 2 of the existing sewerage scheme with expansion of the treatment plant by 2020.

ii. Catchment C: to protect Boeng Prek Tup (water supply)

iii. Catchment D, E and F: to protect Hawaii, and Victory Beach

Sewerage in catchment G is not recommended at this time because the area will be resettled when the port expands.

Sewerage in the Otres beach area (Catchment H) can be implemented at later stages depending on how quickly development proceeds. Population densities in the catchment upstream of Notres beach are projected to remain low therefore wastewater in this area should disposed to on site septic tank systems.

It is recommended that water quality along the beaches be monitored regularly for fecal coliform. At the moment there is no data to establish if the discharge of wastewater is having a negative impact in terms of health risks to swimmers and fisheries. Water quality data is necessary to establish trends and support decision making for the implementation of future sewerage projects.

3.7.4 Solid Waste

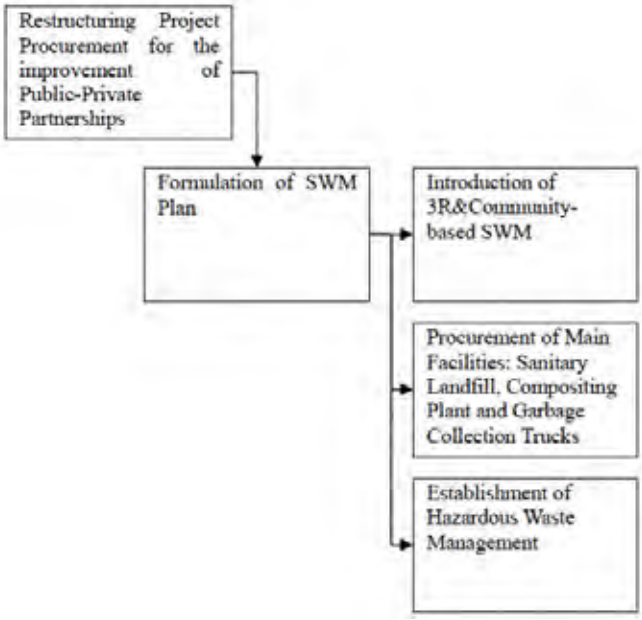
The infrastructure development Plan would be designed in consideration of the common strategies of SWM in the Coastal Area and specific issues of SWM in Preah Sihanouk Province.

The following activities are necessary in order to efficiently establish and utilize infrastructures of SWM.

(1) Present Conditions of Solid Waste Management in Preah Sihanouk Province

Framework and components of infrastructural plan of SWM in Sihanouk follow from the key issues of SWM in Sihanouk, as shown in the following figure. The project procurement structure of SWM should be reconsidered prior to other activities in order to make the private sector and public sector function more actively for SWM from waste reduction at the source to collection, transportation and

management of landfill, and this process has to be done in consideration of marketability of SWM and affordability and willingness to pay of waste generators. Formulation of a SWM plan should be followed by introduction of 3R and Community-based SWM and procurement of main facilities and establishment of hazardous waste management.



Source: JICA Study Team

Figure 3.7.11 Framework and Components of Infrastructural Development Plan in Sihanouk

Description of activities of each component is shown below.

(2) Restructuring Project Procurement

To restructure the project procurement structure of SWM, the question who should be the owner, operator and financer should be studied and reconsidered in full. Risks and responsibilities of SWM shared between private sector and public sector should be clear. The following studies and surveys are necessary.

- Affordability and Willingness to Pay Surveys: Affordability of waste generators and Willingness to Pay (WTP) of waste generators
- Financial Analysis Surveys: Affordability of Province and Districts, including central towns
- Cost estimation by type of technology and project: Type of garbage collection truck, composting plant and sanitary landfill site
- Marketability and Feasibility Study
- Study on Type of Project: BOT, DBFO, BOO, including types shown in the Law on Concessions
- Study on monitoring system of performance of private sector and performance-based payment
- Main conditions that should be mentioned in contract with private company

These studies should be done in collaboration with MOE because it is difficult for the province alone to conduct it.

(3) Formulation of SWM Plan

SWM plan should be made in accordance with the sub-decree on Solid Waste Management. At present there are no guidelines on the formulation of a SWM plan given by the Royal Government, however, the following components should be described in the SWM plan at least.

- Purposes and targets, including numerical target of waste reduction
- Policies of countermeasures, including policy on project procurement
- Main countermeasures to realize purposes and targets
- System of monitoring and evaluation on progress and achievements of the plan

In addition, an action plan showing the schedule and financial sources should be made.

To make SWM plan, surveys on the following actual conditions are necessary.

- Waste quantity survey
- Waste composition survey
- Time and motion survey on collection of waste
- Public awareness survey

(4) Introduction of 3R and Community-based SWM

Based on the results of the studies on project procurement, the roles of province, districts, communes and villages should be clear, and 3R and Community-based SWM should be implemented. Especially the following points should be clarified.

- How and who shall collect and manage garbage collection fee
- How and who shall decide unit price of garbage collection fee
- How to share the garbage collection fee between communities and private company who provide secondary collection service
- How and who shall monitor secondary collection service after primary service by communities
- How and who shall assist communities in implementing 3R and Community-based SWM

(5) Procurement of Main Facilities

The following are considered as the main facilities of SWM.

- Sanitary landfill with leachette and gas control system
- Composting plant
- Garbage collection truck

The above facilities should be prepared for Preah Sihanouk central town and Prey Nob district prior to the other areas because they are urban areas where amount of waste would sharply increase, and the province has already have a proposed site for a new landfill for the areas. However, the proposed site should be carefully decided in consideration of future zoning plans in the province, and environmental and social sustainability. Site surveys are necessary for establishment of landfill and composting plant.

Examples of surveys are as follows:

- Topographic Survey
- Geological Survey
- Environmental Survey
- Desk Study, including Conceptual Design

(6) Establishment of Hazardous Waste Management

Primarily, it should be clear that how much and what type hazardous waste is produced by factories and other sources. At present there are almost no data and information of hazardous waste in Sihanouk. In consideration of the future possibility of environmental impact by hazardous waste, countermeasures should be taken before the producers and amount of hazardous waste increase in accordance with economic development. The following activities are required. To address this issue, the province should collaborate with MOE, which is responsible for hazardous waste according to the sub-decree on solid waste management.

- Establishment of data base: type of waste, amount of produced waste by type of waste, methodology of disposal of waste by type of waste
- Implementation of model projects: reporting, monitoring and instruction system
- Establishment of new regulations: regulations at national level and provincial level should be studied and discussed based on the model project and data base, and required regulations should be finally drafted and established.
- Introduction of new monitoring and management system of hazardous waste

3.8 Considerations for Strategic Environmental Assessment

3.8.1 Strategic Environmental Assessment (SEA)

(1) Concept of SEA in Japanese Official Development Assistance (ODA)

An increasing emphasis in development assistance is placed on strategic interventions in project preparation and implementation. The concept of Strategic Environmental Assessment (SEA) in Japanese ODA projects aimed at facilitating an interactive process in the environmental aspects, and making the aid more effective. SEA urges to ensure environmental considerations be taken into account in this new aid context. Applying SEA to development co-operation projects would make environmental considerations and support more informed decision making, and identify new opportunities by encouraging a systematic and thorough examination of development options.

Though the directive of SEA may vary, the public consultation is one of the most important processes in any SEA, by involving relevant planners, implementer, and all the people/entities which will be affected positively and negatively (called as "stakeholders"). Thus the planning of any development interventions must be planned based on the above stakeholders' participatory discussion.

(2) SEA in JICA Environmental and Social Consideration and Cambodian Policy

1) SEA in JICA Environmental and Social Guideline

The structure of SEA under the JICA guideline for Master Plan Study is based on the following phases[10]:

i) Phase I: Preliminary Study

- "Screening"; investigation of whether the plan or programme falls under the SEA legislation including Stakeholder Meeting,

ii) Scope of Work (S/W) agreement

- Preparation of agreement on enviroment and social impact of the project between JICA and the recipient country,

iii) Master Plan Study (This process will be applied in this Project)

- "Scoping"; defining the boundaries of investigation, assessment and assumptions required,
- "Documentation of the state of the environment" a baseline on which to make effective judgments,
- "Identification of the likely (non-marginal) environmental and social impacts"; usually in terms of direction of change (qualitative) rather than firm figures (quantitative),
- Informing and consulting the public,
- Influencing "Decision making" based on the assessment and,

[10] JICA Environmental and Social Guidelines (revised version), JICA, 2003. This year, April, 2010, JICA revised the guideline. SEA for this Master Plan has been conducted based on the 2003 version.

- Preparing of alternative plans as well as mitigation plans for each component of Master Plan.

Thus, in the JICA Study for Sihanouk-Ville City, the Study Team will follow this guideline for a Master Plan.

In general, SEA only applies to plans and programs, but not policies, although policies imbedded within plans are likely to be assessed and SEA can be applied to policies if needed.

Under the JICA Guideline, as shown below, SEA is supposed to apply to both policy and planning levels.

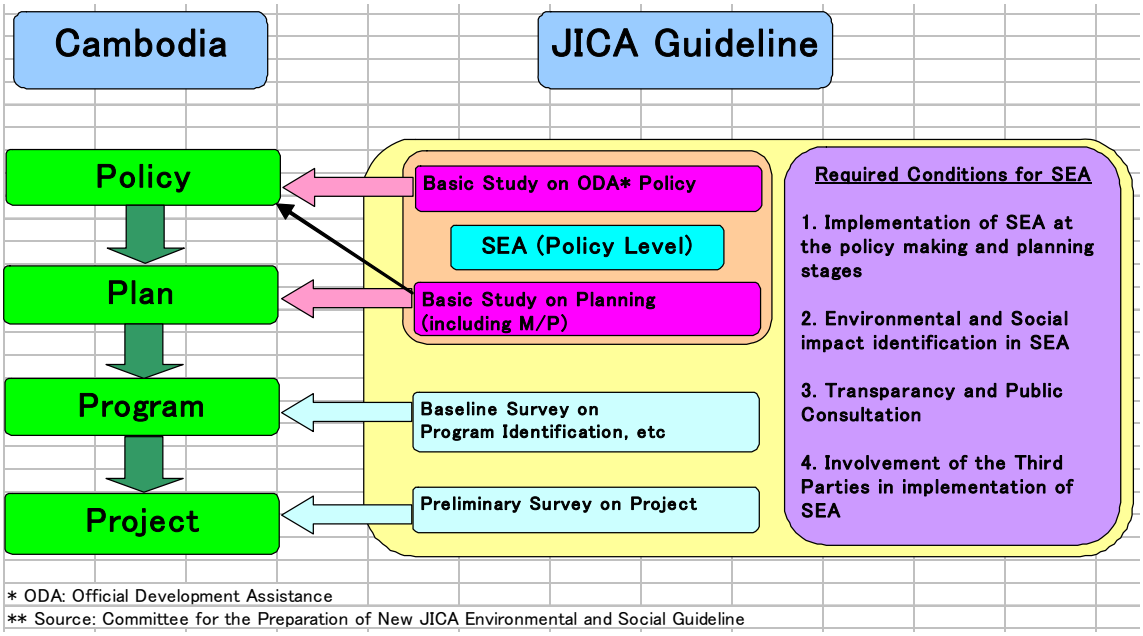


Figure 3.8.1 SEA Implementation Status in JICA Environmental and Social Guideline

SEA ensures that plans and programs to take into consideration the environmental and social effects, which are not limited to impact on natural and social environment but also to overall impacts including impact on national and regional economy and people's livelihood, etc.

The concept of SEA is incorporated to this Study. Specifically preliminary evaluations including comparisons with zero option, consideration of alternative plans and consensus building among stakeholders are carried out for basic plans.

3.8.2 Basic Plans and Preliminary Environmental Impacts Evaluations

There are three basic plans that are industrial development plan, land use plan and infrastructure development plan. These basic plans were preliminarily evaluated from the view point of environmental and social impacts. The results, which were roughly and qualitatively identified impacts and preliminary evaluation, are shown in Table 3.7.1.

Table 3.8.1 Development Plans and Expected Environmental and Social Impacts

Basic Plan	Project*	Expected Environmental and Social Impacts	Evaluation
Industrial Promotion Plan	Promotion of Export Industries and SEZ	Positive Impact: Local economy becomes activated. Negative Impact: Industrial zone may have slight impact in water write, groundwater, flora, fauna and biodiversity, global warming, air, surface water, and coastal zone. Zero Option: It may cause staging economy, and misdistribution of benefit may happen.	C-
	Promotion of Resource Based Industries	Positive Impact: Local economy becomes activated. Social institutions improve. Negative Impact: Surface water and coastal zone are slightly deteriorated. Soil contamination may cause. Zero Option: Marine resources are depleted, and producers and purchaser continue to no linkage.	C-
	Promotion of Tourism	Positive Impact: Local economy becomes activated. Social institutions improve. Negative Impact: Promotion of Tourism may have slight impact in sanitation, soil erosion, surface water, and waste. Some negative impacts are expected at Ream national park and islands in coastal zone, flora, fauna and biodiversity, and landscape. Zero Option: Substantial tourism development is ongoing, and without promotion, the development sites may be ghost town.	B-
Land Use Plan	Zoning Regulations	Positive Impact: Local economy may be activated, and living environment improves. Negative Impact: Land acquisition and involuntary resettlement arise. Environmental burden increases with population grows. Zero Option: Disorderly development continues and local economy is degraded. Ecological habitat and water resources decrease.	C+
	Building Construction Guidelines	Positive Impact: Increase of Environmental burden is inhibited. Living environment improves. Negative Impact: Local conflict may happen. Zero Option: Environmental burden increases. Living environment degraded.	C+
Infrastructure Development Plan	Development of Road and Railway	Positive Impact: Local economy becomes activated. Negative Impact: The area (in particular new construction part) may have slight impact in soil erosion, flora, fauna and biodiversity, global warming, and noise and vibration. Zero Option: Negative environmental impacts are prevented, but the impacts are minimal.	C-
	Extension of Water Supply	Positive Impact: Local people are temporary employed. Sanitation is improved. Negative Impact: The area may have slight impact in hydrological situation, flora, fauna and biodiversity, surface water pollution, and solid waste. Zero Option: Population is increasing, and water supply and sanitation become problem.	C+
	Extension of Wastewater Disposal	Positive Impact: Existing wastewater treatment plant is used effectively. Coastal zone and wildlife habitat restore. Negative Impact: Solid waste is generated, and offensive odor may come up. Zero Option: Wastewater is discharged into river and coast, and degrades wildlife habitat, fishery and tourism.	C+
	Improvement of Solid Waste Treatment	Positive Impact: Solid waste is adequately disposed, and sanitation is improved. Local economy becomes sustainable with 3R. Negative Impact: Around landfill site may have slight impact in groundwater, flora, fauna and biodiversity, surface water, soil contamination and offensive odor. Zero Option: Payment system does not function, and solid waste may not be adequately disposed. Sanitation and aquatic environment become worse.	C+

*: Contents of the projects are referred to section 3.4 – section 3.7.
Evaluation:
A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected to some extent
C+/-: Extent of positive/negative impact is unknown.
Source JICA Study Team

3.8.3 Discussion with Stakeholders and Suggestions of Alternatives

After the draft basic plans were prepared, JICA Study Team presented the basic plans at Sihanouk city on 24th March 2010 (Extra SHM for preliminary SEA). 40 stakeholders gathered and discussed in order to consider the alternatives of basic plans if necessary (alternatives had already examined by JICA Study Team with relevant organizations, and public comments were considered this time). The comments of stakeholders are listed in Table 3.7.2. Referring to the comments and the result of preliminary evaluation, alternatives were suggested in Table 3.7.3.

Table 3.8.2 Comments at the Extra Stakeholder Meeting at Sihanouk on 24th March 2010

Position	Comments
Director of DLMUPC	• If the master plan is totally prepared by JICA Study Team and agreed in province, it will be sent to the council of minister for approval.
Coordination Officer in Provincial Hall	• Master plan has not studied marine boundary. • JICA Study Team should focus on the Islands issues. • Coastal area should be specifically determined.
Chief Office of DLMUPC	• JICA Study Team should identify the width of coastal area. • JICA Study Team should clarify the number of population • JICA Study Team should determine the place of hospital, school, pagoda and cemetery.
Coordinator of ADHOC (NGO)	• If JICA Study Team drew up any reserved place for the increasing population. • If JICA Study Team planed any alternative water resource for future. • If JICA Study Team had any measurement for environmental pollution by the coal-fired power plant.

Source: JICA Study Team

Table 3.8.3 Suggestions of Alternatives

Basic Plan	Alternative
Industrial Promotion Plan	Introduction of mass tourism with destruction of forest was allowed in the basic plan because most of them have got licenses and some have already started. However the mass tourism must be restricted in particular at islands. Most of them have not implemented EIA study, and mass tourism (and all industrial activities) is suggested to be checked by EIA in the basic plan.
Land Use Plan	Land use plan has already involved the examination of coastal area and residential zone. Water resource zone has also delineated on a map (Preaek Tuek Sab river basin). The boundary of islands will be confirmed and incorporated in the basic plan. Furthermore, as cadastral map has just prepared and provided to JICA Study Team, land use plan is revised.
Infrastructure Development Plan	Alternatives of road network have already examined, but access road plan from route No. 4 to city center will be reconsidered taking account of present land titles and progress of constructions on the expected alignment.

Source: JICA Study Team

3.8.4 Consensus Building at 3rd SHM

Third Stakeholder Meeting was held in May. One of the purposes of the meeting is to build consensus about the revised basic plans among stakeholders. The meeting results were briefly written in Chapter 5 of this Report.