

### 2.2.5 Implementation Plan

The issues to be clarified and taken into consideration so as to implement the Project under the Japan's Grant Aid Program are as presented below.

#### 2.2.5.1 Implementation Policy

The implementing agency of the Project is the Department of Public Works and Transport (DPWT) in the Municipality of Phnom Penh and, practically, the Public Works Office will assume the responsibility on project management during the construction period. With regard to the operation and maintenance of facilities, the Drainage and Sewerage Division and the Flood Control Division will be in charge after construction and equipment installation.

The construction period is estimated to be 30 months. Therefore, if the project is implemented under Japan's Grant Aid in fiscal year 2007, it should be completed by March 2010. To comply with the above schedule, it is important to note that the detailed design work should be accomplished before the end of May 2007 and a competent contractor needs to be selected through a fair and legal tendering process by the end of August of the same year. The construction work can be started, provided, that the proper application for occupation of the construction site has been filed by the implementing agency to get the approval of the agency concerned.

The Project includes the construction of revetment, construction of underground reservoirs and pumping stations, improvement of drainage, construction of interceptor and so on. No special technique is required for such civil works; hence, it seems to be not necessary to employ skilled workers from Thailand or other neighboring countries, because foremen, machine operators and other workmen to be engaged in the concreting work may be locally available.

In Phnom Penh, there are over 15 local construction firms, which may be eligible to participate in the Japan's Grant Aid Project as subcontractor of the Japanese general contractor. However, in this Project, the construction of new drainage will be executed at a built-up area. Therefore, the Pressure Injection Method for driving temporary steel sheet piles for retaining wall will be adopted to avoid negative impacts to houses and other buildings, and these firms are not familiar with equipment operation due to their lack of experience. Moreover, they are not also familiar with equipment installation and adjustment of gate pumps and electrical devices. Therefore, it will be necessary to dispatch Japanese experts/engineers to the Project to ensure that the works are properly performed in accordance with plan and design.

### 2.2.5.2 Implementation Conditions

Based on the implementation concept presented above, the following conditions should be fully considered for the smooth implementation of the Project.

#### (1) Environmental Considerations

To proceed with the implementation of the Project, the following two (2) items should be considered from the environmental point of view.

##### (a) Drainage Works

The drainage construction work is to be carried out within the city area. Therefore, the following environmental and safety countermeasures should be considered:

- Security of the present traffic and safety conditions by the setting of detour road and installation of panel deck;
- Carrying out of night work to ensure the commercial activity of the surrounding markets, shops and restaurants;
- Noise and vibration countermeasures with the use low-noise and low-vibration type of equipment (such as the Silent Piler); and
- Safety countermeasures for zone residents with the construction of fence around the work areas to avoid accidents to third parties.

Considering the matters mentioned above, the selection of construction method for excavation work would depend upon the difference of implementation at each construction section. There are four (4) types of construction methods, as shown in Figure 2.2.14.

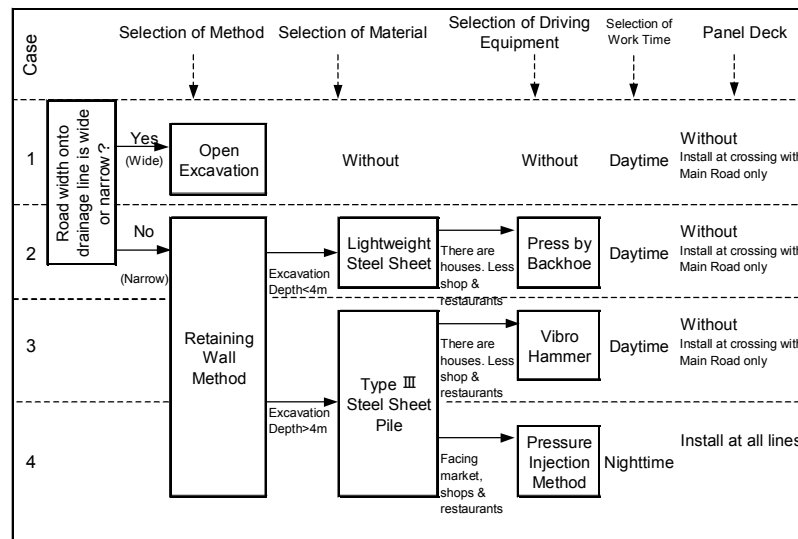


Figure 2.2.14 Selection of Temporary Construction Method

The exact location of underground objects such as water pipes, gas pipes, electrical cables, telephone lines and so on could not be determined without test excavation at the point or line in the proposed drainage area. Therefore, this test excavation work should be carried out before driving the steel sheet piles for retaining wall.

In the drainage works of drainpipes, manholes and inlet pipes, temporary drainage equipment should be provided to divert the drained sewage during the construction period. Therefore, the drainage works should be constructed, basically, from the downstream to the upstream drainage route and, as much as possible, the drainage works at all drainage mains should be completed before the onset of the rainy season (around August). Basically, the drainage works should be executed in blocks (L=20 m), taking account of the width of road, importance of road, occupied area for the work and traffic.

Prior to the start of construction work, it is necessary that the scope of work, purpose of the Project, construction period, etc., have to be explained to the local people with the coordination of the DPWT to obtain the people's understanding and cooperation on project implementation.

**(b) Temporary Stockyard and Disposal Ground for Excavated Materials**

The excavation for revetment works, underground reservoir/pumping station works and drainage works will cause the production of excavated soil materials. Soil materials suitable for backfilling works should be stockpiled temporarily at the playground of

Boeng Trabek High School located at the southern end of Monivong Boulevard and, as the occasion demands, these stockpiled materials should be transported and used for the backfilling works.

On the other hand, soil materials unsuitable for backfilling works should be transported and dumped directly into the designated dumping ground at the Stung Mean Chey area along the Built, Operation and Transfer (BOT) Road about 7 km away to the southwest from the city center through Road No. 217 or Samdach Monireth Boulevard.

However, the area of the playground is limited, so that all excess materials, whether suitable or unsuitable for backfilling, should be transported to the designated dumping area. After the completion of backfilling works, the remaining materials stockpiled in the playground should be graded to make more high-elevated ground.

A fence should be installed around the stockpile area considering the environmental aspect and safety of the playground of the Boeng Trabek High School. Gateways with traffic control men for the separate access of dump trucks and students should be constructed as a further safety measure.

## **(2) Temporary Works**

Since temporary works will play a key role in the overall construction planning, careful attention should be given to traffic conditions, natural and social conditions and environment in the planning and designing stages to facilitate construction work. From the above considerations, it is desirable to take the following measures as temporary works.

### **(a) Revetment Works**

The Old Market East revetment works shall be executed after the completion of the works on Underground Reservoir/Pumping Station No. 5 located just behind this revetment. All work should be carried out from the landside without the construction of a temporary cofferdam based on the construction schedule planned to utilize the variation of water level (over 9 meters) throughout the year at Tonle Sap River.

The works shall be executed based on each construction stage adapted to the water level at Tonle Sap River. Especially, foundation works are to be carried out within a definite period between the end of January and the beginning of May when the water level is always below the level of the concrete top (EL+2.0 m).

The damage at the existing revetment was due to circle slip, which occurred because there was no quality control on backfilling materials. Therefore, backfilling works using adequate backfill materials and satisfactory quality control are needed.

As for the Chakto Mukh National Theater revetment works, the execution plan should consider that the existing bank slope below the water surface is eroding every year. Therefore, the placing and leveling of stone blocks shall be executed, first of all, at the bank slope below the water surface, and then, concrete blocks fabricated at the fabrication yard shall be installed on the design bank slope to prevent further erosion. This work of placing and leveling of stone blocks and the installation of concrete blocks below the water surface is to be carried out using a crawler crane barge at the riverside. After forming a stable bank slope, the driving of steel sheet piles for slope foundation shall be executed from the landside.

From the above explanations, the protection of bank slope below the water surface shall be executed, subsequently, in the first dry season. Steel sheet piling and other revetment works above the water surface shall be executed in the second dry season.

**(b) Construction of Underground Reservoir and Pumping Station**

The construction sites of Underground Reservoir No. 2, 4 and 5 are located in a well-maintained park surrounded by the Tonle Sap River and Preah Sisowath Boulevard, which is lined on one side with restaurants, souvenir shops, hotel, etc. Besides, the Royal Palace and the National Museum are also nearby. Therefore, the excavation for reservoirs shall be executed by the open excavation method. Since many tourists visit this park area in Phnom Penh City, a fence around the construction site should be built prior to the start of construction work in consideration of safety during the construction period and, at the same time, maintain the scenery.

The construction site of Underground Reservoir No. 1 is located in the compound of Chakto Mukh National Theater, which is managed by the Ministry of Culture & Fine Arts, and the area is limited. The retaining wall using steel sheet piles should be adopted at this site to minimize the adverse impact of the excavation work for the reservoir itself.

The revetment works should be constructed carefully paying attention to the time of construction and the joining area, because the works will be done just in front of Pumping Station No. 5 and No. 1.

The foundation pile of the underground reservoir is designed as the PC pile. In the selection of driving method for PC piles, the hydraulic hammer shall be adopted considering the prevention of noise and the problem of oil or soot against the commercial facilities ranged along the opposite side of the park.

**(c) Project Office and Yard**

Due to traffic congestion and the difficulty in acquiring a suitable office space in the Project area, the Project Office and Yard is planned to be located at one block of the park, extending from Underground Reservoir/Pumping Station No. 5 up to the Phnom Penh Railway Station. The proposed site is the greenbelt of the existing park, and the land will be levelled to provide 4,500 m<sup>2</sup> space for a temporary office for the Contractor as well as working yards for iron bar bending and carpentry. In this regard, a space for the Consultant's Office should also be provided, together with the Contractor's Office.

**(d) Fabrication and Stockyard for Concrete Block**

In the Chakto Mukh National Theater revetment works and the Old Market East revetment works, concrete blocks (2 tons/Number and 1 ton/Number) shall be installed for the purpose of stabilizing the revetment slope and prevention of erosion on the foundation. The fabrication and stockpile areas for the aforesaid concrete blocks (approx. 1 ha) shall be planned at the park, just south of the Royal Palace.

### 2.2.5.3 Scope of Works

The scope of work for both Japanese and Cambodian sides needs to be clarified before the implementation of the Project. Each side shall assume responsibility for the work set forth in accordance with the principle of Japanese Grant Aid. The undertakings or responsibilities of both sides are as enumerated below.

**(1) Undertaking of the Government of Japan**

- Engineering services, including the preparation of tender documents, tendering and supervision of construction work;
- Construction and/or improvement of facilities (revetment, underground reservoir and pumping station, drainage and interceptor);
- Procurement of equipment and materials (including sea and inland transportation);
- Equipment installation and test run; and

- Guideline services on operation and maintenance of the equipment procured under the Project.

## (2) Undertaking of the Government of Cambodia

- Acquisition of land for the proposed construction site and temporary construction area, including the filing of proper application to get approval of land use from the agency concerned;
- Installation of service electric power lines to the Compact Transformer Substation (CTS) constructed near the existing Pumping Station No. 3;
- Removal of unexploded bombs or mines, if found before and during the construction work;
- Tax exemption and smooth Customs clearance on imported equipment and materials supplied under the Project; and
- Smooth procedures for immigration, tax exemption and safety assurance for Japanese experts assigned to the Project.

### 2.2.5.4 Consultant Supervision

Since the construction sites are dispersed in an extensive area, it is hardly expected that one Japanese engineer could provide supervision services satisfactory to the Client. Therefore, a supervising system needs to be enforced by employing some local civil engineers to ensure that progress and quality control of the work can be achieved effectively. With regard to procurement and installation of the equipment (Gate Pump and Gate), experts who are specialized in the field of mechanical and electrical engineering need to be dispatched to Cambodia according to the implementation schedule.

#### (1) Main Issues Considered

It should be noted that construction supervisors play an important role in project management. Therefore, the supervisors assigned to the Project should be competent enough to cope with their specialized fields of engineering and technical judgment. In addition, since there are various tasks involved in supervisory work, consulting engineers of the Project are expected to make proper coordination by maintaining close contact with the Implementing Agency concerned. Moreover, in case of emergency related construction work, these engineers should also be able to promptly communicate information to the Japanese Embassy in Cambodia and to JICA (Head Office in Tokyo, Cambodia Office).

The major tasks of the supervisors shall be as follows:

**(a) Meeting and Discussion with Officials Concerned in the Municipality of Phnom Penh and DPWT**

Before the commencement of construction work, the progress of work pertaining to the responsibilities of the Cambodian side should be confirmed through a meeting between both the Japanese and the Cambodian side.

**(b) Inspection for Facility Construction**

Field inspection and confirmation shall be carried out as required at each construction stage for the control of work schedule, quality, progress and safety.

**(c) Inspection of Equipment and Quality Control Test**

Based on the test data provided by the manufacturer, mechanical inspection and quality control tests on equipment shall be conducted according to the manual provided, to certify and confirm the quality of supplied equipment.

**(d) Presence on Work Inspection**

Inspection is required to confirm work achievement for the approval of interim payment. Before the completion of the work, inspection shall be carried out in the presence of the Contractor to verify that the work was done by the Contractor according to plan and specification and on whether or not parts of the work need to be rectified as the result of inspection. Furthermore, the supervisor is required to make procedures for the approval of completion of the work.

**(e) Issuance of Certificate**

A Certificate of Performance shall be issued to the Contractor for the completion of work according to the payment schedule.

**(f) Submission of Reports and Documents**

Monthly reports and as-built drawings shall be prepared and timely submitted to the Client.

**(2) Engineers for the Supervision Services**

Qualified engineers shall be engaged in construction supervision to provide better engineering services for as long as 30 months of construction period. The dispatch of engineers is planned in



such a way that one (1) Japanese engineer will be assigned for a long-term stay as supervisor to maintain consistent services during the whole construction period and three (3) local civil engineers will be employed as support staff of the Japanese engineer. In addition, experts shall be dispatched to the project site from time to time according to the schedule of spot engineering services. The proposed engineers for the supervision services are as follows:

**(a) Construction Management Engineer (Overall Supervisor)**

The Construction Management Engineer shall attend meetings and negotiations with the Client and/or the Contractor at the commencement and completion of the works. If any problem is encountered, he shall take every possible measure to solve it in collaboration with the parties concerned. He shall also be present at the project site to provide spot engineering services at the key period in the schedule.

**(b) Civil Engineer (1)**

An engineer specialized in revetment works needs to be assigned to the Project from time to time according to the schedule.

**(c) Civil Engineer (2)**

The major task is to supervise the structural works for the construction of the four (4) underground reservoirs and pumping stations from time to time according to the schedule. Furthermore, after one (1) year from the completion of the works, he will be dispatched to inspect all facilities and equipment.

**(d) Civil Engineer (3)**

An engineer specialized in drainage works needs to be assigned to the Project from time to time according to the schedule.

**(e) Mechanical/Electrical Engineer**

The Mechanical/Electrical Engineer will be dispatched to the project site at the time of installation of pumps and will give instructions to the Contractor on how to install equipment in a proper way. He will also inspect test runs and approval if the test results are satisfactory.

**(f) Resident Engineer**

The Resident Engineer will be assigned for a long-term stay as supervisor, and is expected to dedicate himself to the quality control and management of the schedule and other necessary works under the responsibility of the Consultant.

**2.2.5.5 Quality Control Plan****(1) Quality Control Plan**

The quality of main construction materials and construction works shall be controlled under the following conditions. The test shall be decided based on the “Civil Work Quality Control Standard” of the Ministry of Land, Infrastructure and Transport, Japan.

**Table 2.2.40 Quality Control Tests**

Work Item	Test Item	Standard	Test Frequency
Concrete	Compressive strength test	JIS A 1108	It shall be implemented twice a day: in the morning and in the afternoon.
	Slump test	JIS A 1101	Once every agitator for site mixed and ready mixed
	Salt content test	JIS A 5308	Once a week
	Air content	JIS A 1116	It shall be implement twice a day: in the morning and in the afternoon.
	Cement material	JIS R 5210	Before construction work and material change
Aggregate	Sieve analysis	JIS A 1102	Once a day
Embankment	Compaction test	JIS A 1210	Before construction work and material change
	Grain size analysis	JIS A 1204	
	Field density test	JIS A 1214	It is implemented once in every 3,000 m <sup>3</sup> .
Subbase Course	Modified CBR Test	AASHTO T193	Before construction work and material change
	Sieve analysis	JIS A 1102	
	Field density test	AASHTO T99	It is implemented once in every 1,000 m <sup>2</sup> .
Base Course	Revised CBR Test	AASHTO T193	Before construction work and material change
	Sieve analysis	JIS A 1102	
	Field density test	AASHTO T180	It is implemented once in every 1,000 m <sup>2</sup> .
Asphalt Pavement	Sieve analysis	JIS A 1102	
	Density and water absorption test	JIS A 1109, 1110	Before construction work and material change
	Filler moisture test	JIS A 5008	
	Marshall stability test	ASTM D 1559	
	Asphalt extraction test	AASHTO T194	Once a day
	Field density test	JIS K 2207	It is implemented once in every 1,000 m <sup>2</sup> .

Construction materials and construction works shall be controlled under the following conditions.

**(a) Concrete**

Concrete shall have the specified strength, durability and watertightness, and dispersion of quality of concrete shall be small. The standard strength of concrete shall be based on

28-day Compressive Strength. The method of compressive strength test shall satisfy JIS A1108 and 1132. A sample of mixed concrete shall be picked up twice a day, and the strength tests of 7 days and 28 days shall be carried out for every sample. At the time of concrete-placing, slump test shall be carried out in site and the slump value shall be confirmed with the specified value. Since the concrete placing work is performed in the tropics, temperature control of concrete shall be performed adequately and temperature of pouring concrete at the time of placing shall be lower than the provided temperature (35°C).

**(b) Placing and Curing of Concrete**

Concrete shall be placed using the method that can possibly avoid the separation of materials, and adequately compacted with a vibrator at placing and immediately after placing. After the placing of concrete, the surface of concrete shall be kept wet for at least five (5) days.

**(c) Cement**

Portland cement shall be used for the construction and its quality shall conform to JIS R5210.

**(d) Aggregates**

Aggregates shall be clean, strong and durable, and shall have adequate grain sizes. Aggregates shall be confirmed not to include contaminations such as dust, sludge, organic substance, salinity and so on. Especially, fine aggregates shall not include thin or slender pieces of stone. Unit weight of oven dried aggregate shall be not less than 2.5 g/cm<sup>3</sup>.

**(e) Reinforcing Bar**

Reinforcing bar shall have the specified strength. Deformed bar may be used as reinforcing bar in case of not specified. The material test of reinforcing bar shall be carried out according to instructions of the Consultant of the Engineer before use.

**(f) Storage of Reinforced Concrete Material**

In case of storing the materials of reinforced concrete, the storage method shall follow the Japanese Concrete Standard Specification.

**(g) Embankment**

Dike or embankment shall be safe for not only stability but also against filtration flow during floods. Therefore, the material of dike or embankment shall be compacted until the specified hardness by the specified method.

**(2) Quality Control Plan of Items Exported from Foreign Country**

The Consultant and the Contractor shall implement factory inspection, pre-delivery inspection and packaging of pump-related machinery and materials of the Project. Moreover, it shall implement inspection by a third party before shipment to confirm that all components are promptly shipped and delivered.

**2.2.5.6 Procurement Plan**

**(1) Procurement of Materials in Cambodia**

**(a) Cement**

Cement products of Thailand circulate freely in the local market. The cement has a good reputation on both quality and quantity to satisfy the demands in Phnom Penh.

**(b) Concrete**

There are four (4) ready-mixed concrete suppliers in the capital city (CPAC, GCM, CHZENG YI, UY HENG), all of which were established with foreign investment. Under these circumstances, the ready-mixed concrete will be used commonly in the construction site in Phnom Penh. Among the concrete suppliers mentioned above, the CPAC which has been established with Thai capital, is considered to be the most reliable company covering nearly 70% of the local market.

**(c) Steel Materials**

With regard to reinforcing bars and other steel materials, products of Thai origin are widely used in the country. Vietnamese iron bars are also available but used to be not guaranteed products for their quality. However, the quality has been improved in recent years since the Japan-Vietnam Joint Corporation was established. Despite these facts, Thai-made products are still predominant over the country.

**(d) Soil Pit**

The soil pit is 10 km away to the south-west from the Phnom Penh city.

(e) **Stone Pit**

The Stone Pit, which can be most trusted as to quantity and quality of aggregate, is 64 km away on the National Road No.4 from the Phnom Penh city.

(f) **Construction Equipment**

The construction equipments, which are available in the recipient country, are Backhoe, Dump truck and Rough Terrain Crane.

(2) **Import Items**

It is impossible to procure materials and equipment at the site, and even if they can be procured locally they cannot be trusted as to quality like the materials and equipment procurable from Thailand, Singapore and Japan. When the import of materials is an option, the MPP shall arrange for a duty-free procedure and Customs clearance on imported materials and equipment.

(a) **Procurement in Japan**

Since gate pumps for the project shall be of the special kind not manufactured in Cambodia or in a neighboring country, procurement from Japan or a Japanese manufacturer with an agent in a neighboring country such as Thailand shall be considered especially in terms of installation and after-sales service such as maintenance and repair, as well as the availability of spare parts.

Low noise and low frequency force-fit type of pile hammer for steel sheet pile works of construction of drainage pipes in dense urban area shall be procured from Japan.

(b) **Procurement in Eligible Country**

Hydraulic pile hammer and its pile driver for construction of foundation piles of underground reservoirs and pumping stations shall be procured from Thailand.

Vibro-hammer and crawler crane with 50 ton capacity for construction of revetment and drainage pipes shall be procured from Singapore.

The 22 kV/400 V type Compact type of Transformer Substation (CTS) used as the standard outdoor type transformer substation by EDC is not produced in Japan. Therefore, the CTS and cables shall be procured from an eligible country.



## 2.3 Obligations of Recipient Country

### 2.3.1 General Undertakings to be taken by Cambodia

The undertakings required of the Cambodian side for the smooth implementation of the project are as follows:

- (1) To provide all data and information necessary for the Project;
- (2) To ensure prompt unloading and Customs clearance at the port/terminal of disembarkation in Cambodia and internal transportation of the equipment procured under Japan's Grant Aid;
- (3) To exempt Japanese nationals from Customs duties, internal taxes and other fiscal levies which may be imposed in Cambodia with respect to the procurement of products and services under the Project;
- (4) To arrange the acquisition of visa and other formalities that may be necessary for the entry of Japanese nationals into Cambodia and stay therein for the performance of the work;
- (5) To maintain and use the equipment properly and effectively with a suitable number of staff assigned for the operation and maintenance and to bear all expenses other than those covered under the Grant Aid;
- (6) To secure and clear the land of the Project site before the start of construction; and
- (7) To bear the advising commission of the Authorization to Pay (A/P) and payment commission to the Japanese bank for banking services based upon the Banking Arrangement (B/A).

### 2.3.2 Specific Undertakings of the Project to be taken by Cambodia

The specific undertakings required of the Cambodian side for the smooth implementation of the project are as described below.

#### (1) Land Acquisition

The Cambodian side is required to secure the necessary site for implementation of the Project such as construction site, stockyard, temporary working yard, disposal area and land for site office. Most of the proposed sites are public areas under the control of the Municipality of Phnom Penh (MPP), so that there would be no problem on land acquisition.

As an exception, Chakto Mukh National Theater is under the control of the Ministry of Culture and Fine Arts hence the MPP is required to get an official approval/permission to enter the site and to execute the construction work in the site from the Ministry of Culture and Fine Arts. In addition, the MPP is required to get an official approval/permission to enter and to use the Trabek High School as the temporary stockyard for excavated soil.

There is no private land to be secured for project implementation.

## **(2) Wiring Work to Transformer Substation**

Power supply to No. 1 Pumping Station and No. 5 Pumping Station will utilize the existing Electricite Du Cambodge (EDC) Substation. A new Compact Transformer Substation (CTS) will be installed to supply electricity to No. 2 Pumping Station and No. 4 Pumping Station. Hence, the MPP shall make the proper arrangements with the EDC for the smooth implementation of the Project. The costs to be borne by the recipient country are as follows:

- (a) The secondary terminals of the existing transformers in EDC's Substation; and
- (b) The distribution line of mid-voltage 22 kV underground cables branched from those at the Sisowath Boulevard up to the primary terminal of the newly-purchased CTS near the existing No. 3 Pumping Station, including connection works.

Procurement and installation cost of CTS and all works and costs after the terminal points of the existing EDC's Substation, such as distribution line and connection works, will be covered under the Japan's Grant Aid Scheme.

## **(3) Application for Electricity**

The pumping station installed by the Project will, basically, be operated with commercial electric power. The Cambodian side is required to make an application to EDC for the utilization of electricity and the installation of the wattmeter at all pumping stations before the pump installation work. All commissions regarding the application and the installation cost of the wattmeter shall be borne by the Cambodian side.

## **(4) Application for Water Supply**

The Cambodian side is required to make an application to the Phnom Penh Water Supply Authority (PPWSA) for the utilization of water supply services and the installation of the flow meter at all pumping stations. All commissions regarding the application and the installation cost of the flow meter shall be borne by the Cambodian side.



All expenses explained in this section are summarized together with the Project Cost in Section 2.5.

## 2.4 Project Operation Plan

### 2.4.1 Operation and Maintenance Plan for Drainage Facilities

#### (1) Pumping Station and Underground Reservoir

The Drainage and Sewage Division (DSD) of Department Public Works and transport (DPWT) is the organization in charge of operation and maintenance work of drainage facilities, such as pumping station, underground reservoir and drainage pipe.

DSD owes an important role on the operation and maintenance work. DSD has 261 staffs (Regular staff: 60; Engineer: 8; Temporary contracted staff: 193), and 133 staffs (Regular staff: 21; Temporary contracted staff: 112) are involved in the operation and maintenance work.

The operation and maintenance work for new pumping stations require the assignment of 3 staff for each pumping station (4 places  $\times$  3 staff = 12 staff).

It is necessary to attempt technology transfer to pump operating staff through the initial operation guidance carried out by the supplier/manufacturer of equipment and machineries newly introduced.

It is preferable to execute the cleaning work on underground reservoirs once a year. DSD has to designate a cleaning work team composed of about 10 members. In consideration of the number of staff of DSD, it is very possible to assign staffs for the operation and maintenance work described above.

#### (2) Drainage and Interceptor System

Pipes are the backbone of drainage and interceptor facilities. Being mostly underground structures, their abnormalities are more difficult to predict and detect than those at pumping station or underground reservoir. On the other hand, any abnormality in conduits causes accidents directly affecting city activities and civil life, such as inundation of sanitary wastewater, road collapse, etc. The objectives of operation and maintenance of pipes are as follows:

- Securing of flow capacity,
- Prevention of accident caused by damage to facilities,

- Prevention of infiltration/inflow (I/I),
- Extension of practical service life, and
- Prevention of damage to the facilities due to other work.

Positive promotion of operation and maintenance of pipes contributes to reduction of the damage caused by accidents and asset utilization effects through extension of the practical service life of pipes. From the long-term viewpoint, this is advantageous economically. Efforts to prevent cross connections and I/I of unknown origin will also contribute to adequate operation of underground reservoir and pumping station.

As described previously, operation and maintenance (O&M) of drainage facilities has been undertaken by the DSD of the DPWT of the Municipality. As of the end of December 2005, the number of personal belonging to the DSD is as given in Table 2.4.1. It is clear that staff required for cleaning is fully secured.

**Table 2.4.1 DSD Personnel**

Description		Full-time worker	Contract worker
Driver	Cesspit Cleaner car (3 cars)	2	4
	Crane Truck	0	2
	Water Wagon	1	1
	Dump Truck (5 cars)	1	8
	Excavator (wheel type)	0	2
	Excavator (crawler type)	0	2
	Back Hoe (2 cars)	1	3
	Water - Back Hoe	1	0
Sub-total		6	22
Operator	For Cesspit Cleaner car	0	25
Worker	For cleaning of pipe & manhole	15	65

Source : DPWT as of December 31, 2005

Operation and maintenance of pipes involves adequate implementation of maintenance inspections, cleaning, dredging, renewal, and repair along a flow series.

**(a) Maintenance and Inspection**

The frequency of drainage facilities inspection should be determined by taking into account the age and burying condition (overburden, ground condition, traffic volume) of facilities, regional importance, and history of problem occurrence. In the “Tentative Guidelines for Optimization of Operation and Maintenance of Sewage Works in Developing Countries (Infrastructure Development Institute-JAPAN, October 2001)”, the inspection frequency is about once in every five years for pipes without any particular

problem. However, it has been confirmed in the site investigations that the drainage system in many parts is clogged with debris and sediment. Therefore, the frequency of inspection should be once in every three years.

**(i) Inspection Items**

Principal inspection items are as follows:

Pipes

- Flow condition and sediment build-up condition
- Settlement of the ground surface: Cracking in pavement due to differential settlement of the ground, etc.
- Damage situation: Damage, crack, penetration of root of a tree
- Groundwater infiltration condition
- Illegal connection

Manhole

- Manhole cover condition
- Internal condition

**(ii) Pipe Inspection Method**

In addition to visual inspection inside the manhole with the cover removed, the inspection shall be made by viewing the inside part of manhole through pipes. Most abnormalities can be detected through visual manhole inspection.

**(iii) Record of Inspection Result**

Inspection results shall be recorded in proper recording sheets, which shall be maintained for use in future cleaning plans.

**(b) Cleaning and Dredging**

Sludge deposits in pipes reduce flow capacity. It also causes wastewater, and hydrogen disulfide and organic acids to accelerate corrosion of pipes. Therefore, it is essential to carry out regular inspections and remove deposits when observed.

**(i) Guidelines for Pipe Cleaning and Dredging**

Generally, the clogging ratio (clogged sectional area  $\div$  bore or inside sectional area  $\times 100$ ) requiring cleaning is approximately 20% for drainage mains and 60%

for house connections. Basically, cleaning need not to be more frequent than the inspection frequency. However, in commercial areas where eating and drinking establishments are concentrated, there is a concern that excessive deposits may accumulate rapidly.

**(ii) Pipe Cleaning and Dredging Method**

Cleaning and dredging shall be executed with water-jetting and sludge suction machine.

**(c) Renewal and Repair of Drainage System**

Deterioration of pipes proceeds over the surface as a whole, and renewal and repair takes considerable time. Therefore, it is necessary to implement renewal and repair according to the plan on the basis of the results of inspections and surveys. This practice will prevent accidents beforehand, thereby avoiding unnecessary social effects.

In Phase I of this project, the "Maintenance Rule for Drainage Channels" was made as the operation and maintenance manual of a drainage canal. The constructed drainage facility is being managed by DPWT based on this manual. Also in this project, it is required to decide upon the management rule in connection with any drainage pipe modeled after the above, and to carry out maintenance based on the rule.

#### **2.4.2 Maintenance Plan for Revetment**

The Riverbank Protection Division of DPWT has control over the maintenance of revetment. The division has 11 personnel (Regular staff: 8; Engineer: 3).

The Riverbank Protection Division is doing the cleaning work of revetment along Tonle Sap River regularly, and when damage of revetment or dike is detected, emergency measures and restoration work are executed by the DPWT. Regular inspection of revetment or river structures is not carried out.

Since a revetment needs neither frequent inspection nor repair work, there is no problem with the present number of personnel assigned to maintenance work after the completion of the Project. However, it is necessary to establish the maintenance rule for revetment, to execute regular inspection and repair, and to carry out patrol in emergency cases.

## 2.5 Project Cost Estimation

### 2.5.1 Initial Cost Estimation

The total project cost is estimated to be **2,668 million Japanese Yen**. The contents of cost based on the scopes of work for Japan and Cambodia are allocated, as follows.

#### (1) Cost Borne by Japan's Grant Aid

This cost to be borne by Japan's Grant Aid is as follows.

**Table 2.5.1 Project Cost Borne by Japan's Grant Aid**

Total Project Cost Borne by Japan's Grant Aid 2,664 million Japanese Yen (US\$ 22.7 million)

Revetment Improvement: Total Length=0.33 km, Drainage Pipe and Interceptor: Total Length =6.20 km,  
Pumping Station and Underground Reservoir: 4 locations

Item		Cost (million Japanese Yen)	
Facility	Wat Phnom Area	Drainage Pipe Drainage Ditch	226
	Central Market Area	Drainage Pipe	1,073
		No. 4 Pumping Station	
		No. 4 Underground Reservoir	
		No. 5 Pumping Station No. 5 Underground Reservoir	
	Royal Palace / National Museum Area	Drainage Pipe	662
No. 1 Pumping Station			
No. 1 Underground Reservoir			
No. 2 Pumping Station No. 2 Underground Reservoir			
Revetment Improvement	Old Market East Revetment	417	
	Chakto Mukh National Theater Revetment		
Interceptor	-	110	
Detailed Design and Construction Supervision		176 (US\$ 1.5 million)	

Exchange Rate: 1 US\$ = 117.11 Japanese yen, and 1 Baht = 2.95 Japanese yen (as of February 2006)

This cost estimate is provisional and would be further examined by the Government of Japan for the approval of the Grant.

#### (2) Cost Borne by the Recipient Country

The cost to be borne by the Government of Cambodia is estimated to be about US\$ 32,400 (3.8 million Japanese Yen). The breakdown is presented in the following table.

Table 2.5.2 Project Cost Borne by Cambodian Government

Item	Cost (US\$)	Cost (million Japanese Yen)
Commission Fees for Banking Arrangement (B/A) and Authorization to Pay (A/P) (Assumed 0.05% of Grant Aid amount)	11,400	1.3
Distribution Line to Transformer Substation	8,000	1.0
Application Fee for Electricity (US\$ 4,000 x 3 locations)	12,000	1.4
Application Fee for Water Supply (US\$ 250 x 4 locations)	1,000	0.1
Total	32,400	3.8

Exchange Rate: 1 US\$ = 117.11 Japanese yen, and 1 Baht = 2.95 Japanese yen (as of February 2006)

## 2.5.2 Operation and Maintenance Cost

The increased amount of operation and maintenance cost of the Project is estimated to be US\$ 59,500 in total.

It is estimated that the total operation and maintenance cost for related facilities become US\$ 938,500 after completion of the Project. The breakdown of operation and maintenance cost before construction and after the completion of the Project is summarized in the table below.

Table 2.5.3 Operation and Maintenance Cost before and after the Project

Item	Before the Project (Actual Expense in 2005) (US\$)	After the Project (US\$)		Ref.: Budget Allocation in 2006 (US\$)
		Increased Amount	Total	
Pump Operation (Electricity, Fuel)	660,000	12,000	672,000	712,500
Maintenance of Pumping Station	24,000	20,000	44,000	162,500
Maintenance of Underground Reservoir	-	12,500	12,500	-
Maintenance of Drainage Pipe and Interceptor	195,000	11,000	206,000	150,000
Maintenance of Revetment	-	4,000	4,000	-
Total	879,000	59,500	938,500	1,025,000

Source: Actual expense of DSD in 2005, DPWT budget allocation in 2006

US\$ 1.0 = 4,000 Riel

### (1) Operation and Maintenance Cost of Pumping Station

#### (a) Pump Operation Cost (Electric Fee)

The electric fee occupies the majority as a operation cost of the newly established pumping station.

Annual pump operation time is calculated based on record of precipitation and river water level in last four years (from 2001 to 2004), and annual operation cost is calculated based on this annual operation time.

The annual operation cost of new pumping stations is about US\$ 12,000.

**Table2.5.4 Annual Operation Cost of New Pumping Stations**

Item	Unit	Pumping Station				Total
		No.1	No.2	No.4	No.5	
Drainage Capacity	m <sup>3</sup> /s	1.4	0.7	1.4	1.4	-
Average Electric Power	kW	98	42	78	64	-
Annual Pump Operation Day	day	82	74	72	66	
Annual Pump Operation Hour	h	200	270	280	230	-
Annual Electric Consumption	kWh	19,600	11,340	21,840	14,720	67,500
Unit Electric Fee	US\$/kWh	0.18	0.18	0.18	0.18	-
Annual Operation Cost	US\$	3,528	2,042	3,932	2,650	12,152

Note : Pump shall be operated during the period that river water level is lower than bottom elevation of outlet.  
“Unit Electric Fee” is US\$ 0.18/kWh, based on EDC rate applied for governmental facilities in 2005.

**(b) Maintenance Cost of Pumping Station**

Maintenance cost of new pumping stations consist of maintenance cost of the machinery, electric equipment and the trash removal work etc..

Maintenance cost is assumed about US\$ 20,000 to be an equivalent value for the maintenance cost in existing Tumpun pumping station.

**(2) Maintenance Cost of Underground Reservoir**

Four underground reservoirs shall be constructed along the Tonle Sap River. Major work of maintenance of underground reservoir shall be the cleaning work of inside of reservoir during the dry season. Cleaning work is basically done with the water jet and the brush by manpower. Cleaning work shall be done every year because sludge, soil, trash and garbage will sediment in reservoir.

The annual maintenance cost of underground reservoir is estimated to be about US\$ 12,500, since unit price of cleaning work is assumed as US\$ 2.5/m<sup>2</sup> and a total floor area of reservoir is about 5,000 m<sup>2</sup>.



**(3) Maintenance Cost of Drainage Pipe and Interceptor**

Sludge deposits in pipes reduce flow capacity. It also causes wastewater, and hydrogen disulfide and organic acids to accelerate corrosion of pipes. Therefore, it is essential to carry out regular inspections and remove deposit when observed. In Phnom Penh City, it has been confirmed in the site investigations that the drainage system in many parts are clogged with debris and sediment. Therefore, the frequency of inspection should be once in every three years. According to the capital-outlay plan in a DPWT budget, unit cost of drainage pipe cleaning is US\$ 5/m, and unit cost of manhole cleaning is US\$ 50/piece. The total operation and maintenance cost is estimated at approximately US\$ 11,000 with the unit price.

**(4) Maintenance Cost of Revetment**

It is considered that maintenance cost of revetment shall be the repair cost of the revetment because there is a possibility that the revetment partially receives damage with the river flow.

The annual repair cost as maintenance cost of revetment is estimated to be about US\$ 4,000 ( $8,000 \text{ m}^2 \times 1\% \times \text{US\$ } 50 = \text{US\$ } 4,000$ ) assuming the repairing unit cost is US\$ 50/m<sup>2</sup>, and expecting the repair volume is about 1% of total surface areas, about 8,000 m<sup>2</sup>, of the revetment.

**2.6 Other Relevant Issues**

**(1) Safety Control**

Since construction area of the Project is located in dense populated area, such as dense urban area and tourist area, safety shall be especially severely controlled so that the accident, that involves the third party, by the vehicle related to construction and the construction machine shall not occur.

The traffic control staffs, the watch men and guards are appropriately arranged to keep the third party out of the construction area, and so as not to interfere the movement of the residents and the tourists.

**(2) Environmental Consideration**

The noise and the vibration, etc. generated by construction work shall be minimized as much as possible in the urban area so as not to influence living environment harmfully. Especially, the construction work around the shopping area may be executed in nighttime so as not to interfere with their business.

During transportation of excavated soil between construction area and stock yard or disposal area, necessary measure shall be taken so as not to daub the road by the drop of soil from the dump track carrier or the scattering of soil adhered to tire. Moreover, cleaning work shall be done whenever the contractor daub the road.

**(3) Wiring Work to be borne by Cambodian Side**

Main power source of the pump equipments of the Project is commercial electric power and each pump equipment receives electric power from the existing EDC's substation or compact type transformer substation which will be newly established by the Project.

It is needed to execute necessary wiring work, which is described in "Obligation of Recipient Country", on time by Cambodian side according to the progress of construction work.

## CHAPTER 3

### PROJECT EVALUATION AND RECOMMENDATIONS

#### 3.1 Project Effect

The direct and indirect effects of the Project, which involve flood control, urban drainage improvement and dike crown road improvement, are as summarized below.

##### 3.1.1 Direct Effect

###### (1) Effect of Flood Protection

Revetments along the Tonle Sap River protect Phnom Penh City from floods. Once floodwaters overtop the dike along the Tonle Sap River, the dike may collapse resulting in enormous flood damage to facilities including about 120,000 units of households, 460,000 residents, 7,600 units of factories, shops and offices and 100 units of schools and hospitals. To minimize the damage, improvement of the Old Market East Revetment and the Chakto Mukh Theater Revetment should be implemented. With the improvement, safety against flooding of a 30-year probability can be assured.

###### (2) Effect of Drainage Improvement

In the Wat Phnom Area, Central Market Area, and the Royal Palace and National Museum Area, which are all situated within the project area, the following direct benefits are expected:

- With the improvement of drainage facilities with a planning scale of 2-year flood probability, drainage of storm water with inundation depths of 20 cm will be possible within 1 to 2 hours;
- The frequency of flooding will be reduced; and
- Flood damage by more than a 2-year flood probability will be mitigated.

The implementation of the Project will also reduce the number of damage by inland water inundation to 34,000 units of residential houses, 40,000 units of households, 120,000 citizens, 3,000 units of factories, shops and offices, and 50 units of school and hospitals.

**(3) Effect of Interceptor**

At present, wastewater flows from the project area directly into the Tonle Sap River and the river is much polluted with untreated wastewater. After implementation and completion of the Project, wastewater of about 9,000 tons/day will not flow directly into the Tonle Sap River. In this Project, the influence with respect to water quality is converted into BOD concentration. BOD<sub>5</sub> of the sewage discharged in the present condition is 100 mg/L. Therefore, the discharge of 900 kg of BOD<sub>5</sub> is controlled per day, and the pollution situation of Tonle Sap River improves greatly.

**3.1.2 Indirect Effect**

**(1) Economic Effect**

The Project will contribute to avoid the occurrence of economic damage because the project area encompasses commercial, tourist and public office areas.

**(2) Hygienic Effect**

As the indirect effect of the improvement of urban drainage facilities in the Project, the prevention of occurrence and spread of epidemics due to long duration of inundation is expected.

**(3) Improvement of Travel Condition**

Frequent inundations block traffic in many places of Phnom Penh City in the rainy season, and then detours to non-inundated roads always cause traffic jams. There are many shops and government offices in the project area, and many residents commute in the morning and evening. Hence, when inundation occurs during this time zone, traffic jams become serious and the situation interferes with not only commercial operation but also administrative activities.

After implementation of the Project, inundation periods will become shorter and inundation depths will become shallower, making it easier for ordinary vehicles to pass the roads.

## 3.2 Recommendations

### 3.2.1 Before the Commencement of Construction Work

#### (1) Explanation Meeting with Local Residents

Most construction works of the Project will be executed in the urban area of Phnom Penh City. Since some portions of the drainage pipe and underground reservoir are adjacent to houses, shops and restaurants, the Cambodian side is required to hold meetings with the local residents to explain the Project before the commencement of construction work. These explanation meetings shall be held for each “Khan” or “Sangkat” concerned.

The resident’s opinion shall be taken into consideration, and it is necessary to facilitate the understanding and cooperation of the inhabitants on project implementation.

#### (2) Land Acquisition

Land acquisition for the construction area, stock-yard, work yard, warehouse, site office, workshop and disposal area shall be given first priority. It is therefore required for the Municipality of Phnom Penh to get an official permission or approval of construction at the location of the Chakto Mukh National Theater from the Ministry of Culture and Fine Arts before commencement of the work to prevent unnecessary conflict.

### 3.2.2 During Construction Work

#### (1) Environmental Countermeasures

According to the result of Initial Environmental Examination (IEE), “Environmental Mitigation Plan” and “Environmental Monitoring Plan”, that are shown in the IEE, shall be executed.

Since the construction works are to be conducted in dense residential areas, noise, vibration or traffic accident by construction equipment during the construction period shall be prevented. To prevent spilling out during transportation to spoil banks, excavated materials loaded on dump trucks should be covered adequately with tarpaulin sheets. It is also necessary to take measures to prevent dropping of excavated materials from carriers and the dispersal of soil adhering to the tires of transport vehicles during transportation.

**(2) Water Control Countermeasures**

The construction work on drainage pipes is to be conducted in the dry season. However, inundation of the work area might take place even in the dry season and wastewaters flow into the construction area. Therefore, temporary facilities and measures for dewatering shall be planned and enforced.

**(3) Construction Work on Revetment**

Since the construction work on revetment will be affected greatly by the water level of the Tonle Sap River, the construction plan shall consider the seasonal variation of water level, and it will be necessary to observe changes in the water level to prevent accidents and disaster occurrence.

**3.2.3 After Construction Work**

**(1) Environmental Monitoring Program**

According to the result of Initial Environmental Examination (IEE), “Environmental Monitoring Plan”, that is shown in the IEE, shall be executed.

Erosion of dike, riverbed scouring of Tonle Sap River, sedimentation of silt and weeding on revetment shall be monitored. Especially, dike erosion and riverbed scouring shall be monitored carefully. If those transformations of river shape are observed, necessary counter measures shall be taken promptly.

**(2) Operation, Maintenance and Management of Facilities**

Appropriate operation, maintenance and management of the planned, designed and completed flood protection and drainage facilities are indispensable to bring them fully functional. Enough number of staff and budget are thus important for the purpose.

The facilities to be constructed in the project are to be managed by the Department of Public Works and Transport (DPWT) of the Phnom Penh City Government, and DPWT has the appropriate organization with enough experience for the operation and maintenance of such facilities. Enough funds shall thus be allocated and made available for disbursement for the operation, maintenance and management by DPWT.

### (3) Rehabilitation of Maintenance Equipment of Drainage System

Even if excellent maintenance of the existing equipment is continued, interference in the maintenance work on the drainage network should be expected in the next five years, because the existing equipment are very old and some of them have already exceeded their service life. The Municipality of Phnom Penh (MPP) is thus required to allocate the necessary budget and disburse it for the rehabilitation or overhauling of maintenance equipment.

### (4) Future Flood Protection Plan along Tonle Sap River

The hydraulic characteristic of the Tonle Sap River is extremely complex at the confluence point with the Mekong River, and it is desirable to protect the riverbanks of the Tonle Sap River with constant improvement after the Project. However, the investigation concerning the present situation of the river and dike at the confluence point has not been conducted yet, and the present status is still unknown. Therefore, investigations and analyses are needed to establish the flood protection plan to secure a long-term safety against flood in the future.

For the portion concerned, the following investigations and analyses are strongly recommended:

- Topographic survey of river shape, alignment and cross-sections at the confluence of the Tonle Sap River and Mekong River, and hydraulic analysis;
- Hydrological investigation of flow volume, flow velocity and flooding duration at the confluence of the Tonle Sap River and the Mekong River under flooding condition, and hydraulic analysis;
- Study on the flood protection plan and suitable facility, such as modeling and riverbed change analysis by the numerical model; and
- Environmental impact assessment.

#### 3.2.4 Gradual Improvement of Drainage System

A large amount of expense and time is required to implement the fundamental measures for solving a drainage problem, and realizing these measures immediately in a developing country is accompanied by difficulty from various restrictions. On the other hand, although the urgency and importance of solving the drainage problem in a city on a long-term target are increasing, the implementation of an effective project even if it is set on a short term becomes very important.

The drainage network consists of the drainage main and drainage laterals, and all of the proposed drainage pipes in this Project correspond to the drainage main. The fundamental measure for solving a drainage problem is to carry out all of the drainage plans including drainage mains and laterals, and an effective drainage plan is not realized in a partial plan.

The drainage problem could be solved only after the installation or improvement of drainage laterals, and all drainage laterals are connected to the drainage main. Although the target of the project can be attained in the circumference where new drainage mains are to be installed, the target could not be attained throughout the city as a whole. Therefore, to be able to attain an impressive target in the whole city area, a suitable operation and maintenance plan and drainage lateral plan are required to be carried out gradually and intentionally.

It should be noted that the drainage system in the area north of Wat Phnom and the area west of the Royal Palace differs from the drainage system in this Project, so that these areas will not receive the effect of this Project so easily. Therefore, it seems that it is necessary to venture on a more comprehensive improvement as soon as possible.

The project for the Trabek Basin and the adjacent area will not be undertaken at the same time as the Project. Since there is a possibility that flood damage in these areas will expand under the present condition, a drainage improvement project for the area should be undertaken immediately.

### **3.2.5 Technology Transfer (Counterpart Training)**

It is recommended that the DPWT staff shall attend the counterpart training conducted by JICA relative to the drainage, sewage, flood protection, and operation and maintenance of drainage facilities/revetment during this project, and it is expected that the trained personnel will stand out in other staff' education and training initiatives.



## APPENDICES

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## 1. Member List of the Study Team

### 1.1 Field Survey in Cambodia (January 10 to February 22, 2006)

No.	Name	Designation	Affiliation
1	Mr. ARAI Kazuhisa	Leader	Team Leader ICT (Information and Communication Technology) and Governance Team, Project Management Group I Grant Aid Management Department, JICA
2	Mr. KAYUMI Shigetada	Technical Advisor (Resident officer in JICA Cambodia Office)	JICA Institute for International Cooperation (IFIC) Senior Advisor
3	Ms. KOMAZAKI Mariko	Project Coordinator	Staff ICT and Governance Team, Project Management Group I Grant Aid Management Department, JICA
4	Mr. MAEDA Masakazu	Project Manager / Flood Protection Planning / Environmental and Social Consideration	CTI Engineering International Co., Ltd.
5	Mr. MATSUSHITA Tsuyoshi	Drainage Facilities Design 1 (Drainage Pipes)	CTI Engineering International Co., Ltd.
6	Mr. FUJIMOTO Kazuyoshi	Drainage Facilities Design 2 (Pumping Station / Reservoir)	CTI Engineering International Co., Ltd.
7	Mr. SEKI Shigeji	Drainage Equipment Design (Pumps)	Nippon Koei Co., Ltd.
8	Mr. YAMASHITA Naoki	River Facilities Design (Revetment Work)	Nippon Koei Co., Ltd.
9	Mr. SHIMOKOCHI Hitoshi	Natural Environment Survey / Foundation Improvement (Topography / Geology / River)	CTI Engineering International Co., Ltd.
10	Mr. MAEDA Hideo	Construction Planning	CTI Engineering International Co., Ltd.
11	Mr. ONUMA Takashi	Cost Estimate	CTI Engineering International Co., Ltd.

### 1.2 Explanation of Draft Final Report in Cambodia (October 8 to October 13, 2006)

No.	Name	Designation	Affiliation
1	Mr. UKAI Hikoyuki	Leader	Deputy Resident Representative JICA Cambodia Office
2	Ms. YAMASHITA Akira	Project Coordinator	Assistant Resident Representative JICA Cambodia Office
3	Mr. MAEDA Masakazu	Project Manager / Flood Protection Planning / Environmental and Social Consideration	CTI Engineering International Co., Ltd.
4	Mr. MATSUSHITA Tsuyoshi	Drainage Facilities Design 1	CTI Engineering International Co., Ltd.
5	Mr. MAEDA Hideo	Construction Planning	CTI Engineering International Co., Ltd.

## 2. Study Schedule

### 2.1 Field Survey in Cambodia (January 10 to February 22, 2006)

No.	Date		JICA Officials		Consultant		
			Mr. ARAI Kazuhisa, Ms. KOMAZAKI Mariko	Mr. KAYUMI Shigetada	Mr. MAEDA Masakazu	Mr. MATSUSHITA Tsuyoshi	Mr. FUJIMOTO, Mr. SEKI, Mr. YAMASHITA, Mr. SHIMOKOCHI, Mr. MAEDA, Mr. ONUMA
1	10-Jan	tue	Leave Tokyo to PHN via BKK				
2	11-Jan	wed	Leave Tokyo to PHN via BKK	Discussion with DPWT			
3	12-Jan	thu	Courtesy call on MPP, JICA Cambodia Office and DPWT and Discussion on I/C				
4	13-Jan	fri	Briefing Session (Explanation on I/C on MPP), Courtesy call on Embassy of Japan in Cambodia, Discussion with French consultant implementing French Government assistance project				
5	14-Jan	sat	Site survey				
6	15-Jan	sun	Holiday				
7	16-Jan	mon	Discussion with DPWT, EDC, and JICA Cambodia Office				
8	17-Jan	tue	Discussion with DPWT			Discussion with EDC and DPWT	
9	18-Jan	wed	Courtesy call on CDC, Signing on M/D, Report to JICA Cambodia Office, and Embassy of Japan in Cambodia				
10	19-Jan	thu	Leave PHN to Tokyo via BKK	Bid for topographic and geological survey			
11	20-Jan	fri	Site survey				
12	21-Jan	sat	Discussion on environmental and social considerations survey				
13	22-Jan	sun	Site survey, Discussion with DPWT, Bid Evaluation				
14	23-Jan	mon	Meeting of topographic and geological survey, and environmental and social considerations survey				
15	24-Jan	tue	Arrangement of Document				
16	25-Jan	wed	Discussion with DPWT			Commencement of Topographic Survey	
17	26-Jan	thu	Site survey				
18	27-Jan	fri	Site survey, Discussion with related organization			Leave PHN to BKK	
19	28-Jan	sat	Arrive at PHN(Second Group), Team Meeting(Confirmation of Schedule and TOR)				
20	29-Jan	sun	Discussion with DPWT (All members), Site survey, Data collection, Preparation for Inundation condition survey				
21	30-Jan	mon	Site survey, Arrangement of Document, Supervision of topographic and geological survey				
22	31-Jan	tue	Arrangement of document				
23	1-Feb	wed	Site survey, Data collection, Supervision of topographic and geological survey, Preparation for Inundation condition survey				
24	2-Feb	thu	Site survey, Data collection, Supervision of topographic and geological survey				
25	3-Feb	fri	Site survey, Data collection, Supervision of topographic and geological survey, Commencement of Inundation condition survey				
26	4-Feb	sat	Site survey, Data collection, Supervision of topographic and geological survey, Discussion with related organization				
27	5-Feb	sun	Site survey, Data collection, Supervision of topographic and geological survey, Discussion with related organization				
28	6-Feb	mon	Arrangement of document, Supervision of topographic and geological survey				
29	7-Feb	tue	Arrangement of document				
30	8-Feb	wed	Site survey, Data collection, Supervision of topographic and geological survey, Discussion with related organization				
31	9-Feb	thu	Site survey, Data collection, Supervision of topographic and geological survey, Discussion with related organization				
32	10-Feb	fri	Site survey of cleaning manhole, Data collection, Supervision of topographic and geological survey				
33	11-Feb	sat	Team Meeting(Confirmation of progress), Site survey, Data collection, Supervision of topographic and geological survey				
34	12-Feb	sun	Site survey, Data collection, Supervision of topographic and geological survey				
35	13-Feb	mon	Arrangement of Inundation condition survey, Arrangement of document, Site survey				
36	14-Feb	tue	Arrangement of Document, Team Meeting				
37	15-Feb	wed	Preparation of T/N, Data collection, Supervision of topographic and geological survey,				
38	16-Feb	thu	Site survey, Data collection, Supervision of topographic and geological survey, Preparation of T/N				
39	17-Feb	fri	Site survey, Data collection, Supervision of topographic and geological survey, Preparation of T/N				
40	18-Feb	sat	Site survey, Data collection, Supervision of topographic and geological survey, Preparation of T/N				
41	19-Feb	sun	Preparation of T/N, Supervision of topographic and geological survey				
42	20-Feb	mon	Preparation of T/N				
43	21-Feb	tue	Team Meeting				
44	22-Feb	wed	Report to MPP and DPWT (Submission of T/N)				
45	23-Feb	thu	Report to JICA Cambodia Office, and Embassy of Japan in Cambodia				
			Leave PHN to BKK				
			Arrive at Tokyo				

PNH : Phnom Penh  
BKK : Bangkok  
T/N : Technical Note  
CDC : Council for the Development of Cambodia

MPP : Municipality of Phnom Penh  
M/D : Minutes of Discussions  
TOR : Terms of Reference  
EDC : Electricité du Cambodge

I/C : Inception Report  
JICA : Japan International Cooperation Agency  
DPWT : Department of Public Works and Transport

## 2.2 Explanation of Draft Final Report in Cambodia (October 8 to October 13, 2006)

No.	Date		JICA Officials	Consultant
1	8-Oct	sun		Leave Tokyo to Phnom Penh via Bangkok
2	9-Oct	mon		<ul style="list-style-type: none"> <li>- Courtesy call on JICA Cambodia Office</li> <li>- Courtesy call on Embassy of Japan in Cambodia</li> <li>- Courtesy call on MPP and explanation of Draft Final Report to MPP</li> </ul>
3	10-Oct	tue		<ul style="list-style-type: none"> <li>- Courtesy call on DPWT, explanation of Draft Final Report to DPWT, and discussion with DPWT</li> </ul>
4	11-Oct	wed		<ul style="list-style-type: none"> <li>- Supervision of the Environmental and Social Considerations Survey</li> <li>- Site survey</li> </ul>
5	12-Oct	thu		<ul style="list-style-type: none"> <li>- Signing on Minutes of Discussion</li> <li>- Report to JICA Cambodia Office</li> </ul>
				<ul style="list-style-type: none"> <li>- Meeting with the consultant of French assistance project</li> </ul>
6	13-Oct	fri		<ul style="list-style-type: none"> <li>- Arrangement of result of the Environmental and Social Considerations Survey</li> <li>- Site survey</li> </ul> <p style="text-align: center;">Leave Phnom Penh to Bangkok</p>
7	14-Oct	sat		Arrive at Tokyo

MPP : Municipality of Phnom Penh

DPWT : Department of Public Works and Transport

### 3. List of Parties Concerned in the Recipient Country

Name	Designation	Organization
<b><u>Municipality of Phnom Penh : MPP</u></b>		
H.E. Kep Chuk Tema	Governor	MPP
H.E. Chhun Sirun	Deputy Governor	MPP
Prince Sisowath Pheanuroth	Deputy Governor	MPP
H.E. Trac Thai Sieng	Deputy Governor	MPP
H.E. Chrieng Sophan	Deputy Governor	MPP
Nuon Someth	Chief of Cabinet	MPP
Nak Tanavuth	Director	International Relations Department
<b><u>Department of Public Works &amp; Transport : DPWT</u></b>		
Nhem Saran	Director	DPWT
Ean Narin	Deputy Director	DPWT
Moeung Sophan	Deputy Manager	Project Management Unit
Chou Kimtry	Deputy Chief	Public Works Office
Chea Vantha	Deputy Chief	Public Works Office
Top Sovannarith	Staff	Public Works Office
Meas Chantha	Chief	Riverbank Protection Division
Doung Chansarath	Deputy Chief	Drainage and Sewerage Division
<b><u>Department of Environment : DOE</u></b>		
Chiek Ang	Deputy Director	Department of Environment
<b><u>Electricite du Cambodge : EDC</u></b>		
Yim Nolson	Deputy Managing Director	EDC
Iv Visal	Deputy Director	Distribution & Transmission Department
Junya Shinohara	JICA Expert	EDC
Ou Chanrith	Chief	Network Unit
Mak Thorn	Staff	EDC
<b><u>Phnom Penh Water Supply Authority : PPWSA</u></b>		
Ek Sonn Chan	General Director	PPWSA
Long Naro	Deputy General Director	PPWSA
<b><u>Ministry of Public Works and Transport : MPWT</u></b>		
Dr. Yit Bunna	Director	MPWT
Ph.D. Khun Sokha	Deputy Director	MPWT
<b><u>Council for the Development of Cambodia (CDC)</u></b>		
Heng Sokun	Director	Bilateral Aid Coordination Dept.
Sachiko Nishioka	Expert	CDC
<b><u>Private Company</u></b>		
Thierry Dalimier	Managing Director	Kosan Engineering
Nol Bunna	Engineer	Kosan Engineering
<b><u>Embassy of Japan in Cambodia</u></b>		
Kazumi Jigami	Counselor	Embassy of Japan in Cambodia
Tomoaki Korezumi	Second Secretary	Embassy of Japan in Cambodia
Jun-ichi Hoshikura	Second Secretary	Embassy of Japan in Cambodia
<b><u>JICA Cambodia Office</u></b>		
Juro Chikaraishi	Resident Representative	JICA Cambodia Office
Kazuhiro Yoneda	Resident Representative	JICA Cambodia Office
Hikoyuki Ukai	Deputy Resident Representative	JICA Cambodia Office
Tomohiro Ono	Assistant Resident Representative	JICA Cambodia Office
Shigetada Kayumi	Senior Advisor	JICA Cambodia Office
Keisuke Nakashima	Assistant Resident Representative	JICA Cambodia Office
Akira Yamashita	Assistant Resident Representative	JICA Cambodia Office
Meng Chan Vibol	Program Officer	Infrastructure Division

## 4. Minutes of Discussions

### 4.1 Field Survey in Cambodia (January 10 to February 22, 2006)

**Minutes of Discussions on the Basic Design Study  
on the Project for Flood Protection and Drainage Improvement  
in the Municipality of Phnom Penh (Phase II)  
in the Kingdom of Cambodia**

In response to a request from the Government of the Kingdom of Cambodia (hereinafter referred to as “Cambodia”), the Government of Japan decided to conduct a Basic Design Study on the Flood Protection and Drainage Improvement in the Municipality of Phnom Penh (Phase II) (hereinafter referred to as “the Project”) and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as “JICA”).

JICA sent to Cambodia the Basic Design Study Team (hereinafter referred to as “the Team”), which is headed by Mr. Kazuhisa ARAI, Team Director of the Information and Communication Technology and Governance Team, Grant Aid Management Department, JICA, and is scheduled to stay in the country from 11<sup>th</sup> of January to 22<sup>nd</sup> of February, 2006.

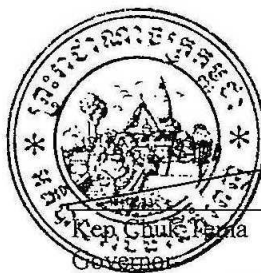
The Team held discussions with the officials concerned of the Government of Cambodia and conducted a field survey at the study area.

As a result of discussions and field survey, both parties confirmed the main items described in the attached sheets. The Team will proceed to further works and prepare the Basic Design Study Report.

Phnom Penh, January 18, 2006

新井 和久

Kazuhisa Arai  
Leader  
Basic Design Study Team  
Japan International Cooperation Agency



Municipality of Phnom Penh  
Kingdom of Cambodia

## ATTACHMENT

### 1. Objective of the Project

The objective of the Project is to provide the Municipality of Phnom Penh with high safety against the flooding from the Mekong River system and to minimize the flood damage by repairing the revetment, and also to minimize the inundation and its damage caused by local rainfall by improving the drainage system.

The Project is a part of the implementation of the “Master Plan of Drainage Improvement and Flood Control in the Municipality of Phnom Penh” which was conducted by JICA, and follows the first implementation ‘the Project for Flood Protection and Drainage Improvement in the Municipality of Phnom Penh’.

### 2. Project sites

The Project site is shown in Annex-1.

### 3. Responsible Organization and Implementing Agency

3-1. The responsible organization is the Municipality of Phnom Penh (hereinafter referred to as “MPP”). The organization chart is shown in Annex-2-a.

3-2. The implementing agency is the Department of Public Works and Transport (hereinafter referred to as “DPWT”). The organization chart is shown in Annex-2-b.

### 4. Items requested by the Government of Cambodia

After discussions with the Team, the components described in Annex-3 were finally requested by the Cambodia side. JICA will assess the appropriateness of the request and will recommend to the Government of Japan for approval.

### 5. Japan’s Grant Aid Scheme

5-1. The Cambodian side understands the Japan’s Grant Aid Scheme explained by the Team, as described in Annex-4.

5-2. The Cambodian side will take the necessary measures, as described in Annex-5, for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented.

### 6. Schedule of the Study

6-1. The Team will proceed to further study in Cambodia until February 22, 2006.

6-2. JICA will prepare the draft report in English and dispatch a mission to Cambodia in order

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to explain its contents in around August, 2006.

- 6-3. In case that the content of the report is accepted in principle by the Government of Cambodia, JICA will complete the final report and send it to Cambodia by October, 2006.

## 7. Other relevant issues

### 7-1. Environmental and Social Considerations

- 7-1-1. Both sides confirmed that the Project is categorized as Category B in the 'JICA Guidelines for Environmental and Social Considerations', and therefore necessary procedures should be properly taken by both sides.
- 7-1-2. The Cambodian side will conduct Initial Environmental Examination (hereinafter referred to as "IEE") in accordance with the concerning laws and regulations of Cambodia, and report the result to the Team by 15<sup>th</sup> of February, 2006.
- 7-1-3. The Cambodian side will take any necessary actions required by the result of IEE or any other research/survey concerning the environmental and social considerations for the Project. The Japanese side will also properly reflect the results to the Basic Design of the Project.

### 7-2. Scale of the Project

- 7-2-1. The Cambodian side understands that the scale of the Project might have to be diminished from the request, in consideration of cost and effectiveness.
- 7-2-2. In that case, the Cambodian side requested that even if the amount or some items of each component be cut down, all the five areas described in Annex-3 shall be covered, and not eliminate any area wholly from the Project.
- 7-2-3. The Japanese side will assess the request in addition to the result of the field survey analysis, and draw out the basic design of the Project.

### 7-3. Operation and Maintenance

- 7-3-1. The Cambodian side shall allocate enough budget and qualified staff to properly and effectively operate/maintain the facilities and equipments supplied by the Project.
- 7-3-2. To do this, the Cambodian side additionally requested equipments for maintenance of the drainage. This additional request is also described in Annex-3.
- 7-3-3. The Cambodian side requested a counterpart training in Japan to be carried out as a technical cooperation by JICA. The Cambodian side understands that another official request will be necessary to be submitted by the Cambodian side to the Embassy of Japan and/or the JICA office.

### 7-4. For the Smooth Implementation of the Project

- 7-4-1. The Cambodian side shall ensure prompt tax exemption and customs clearance of the products at the terminal of disembarkation.

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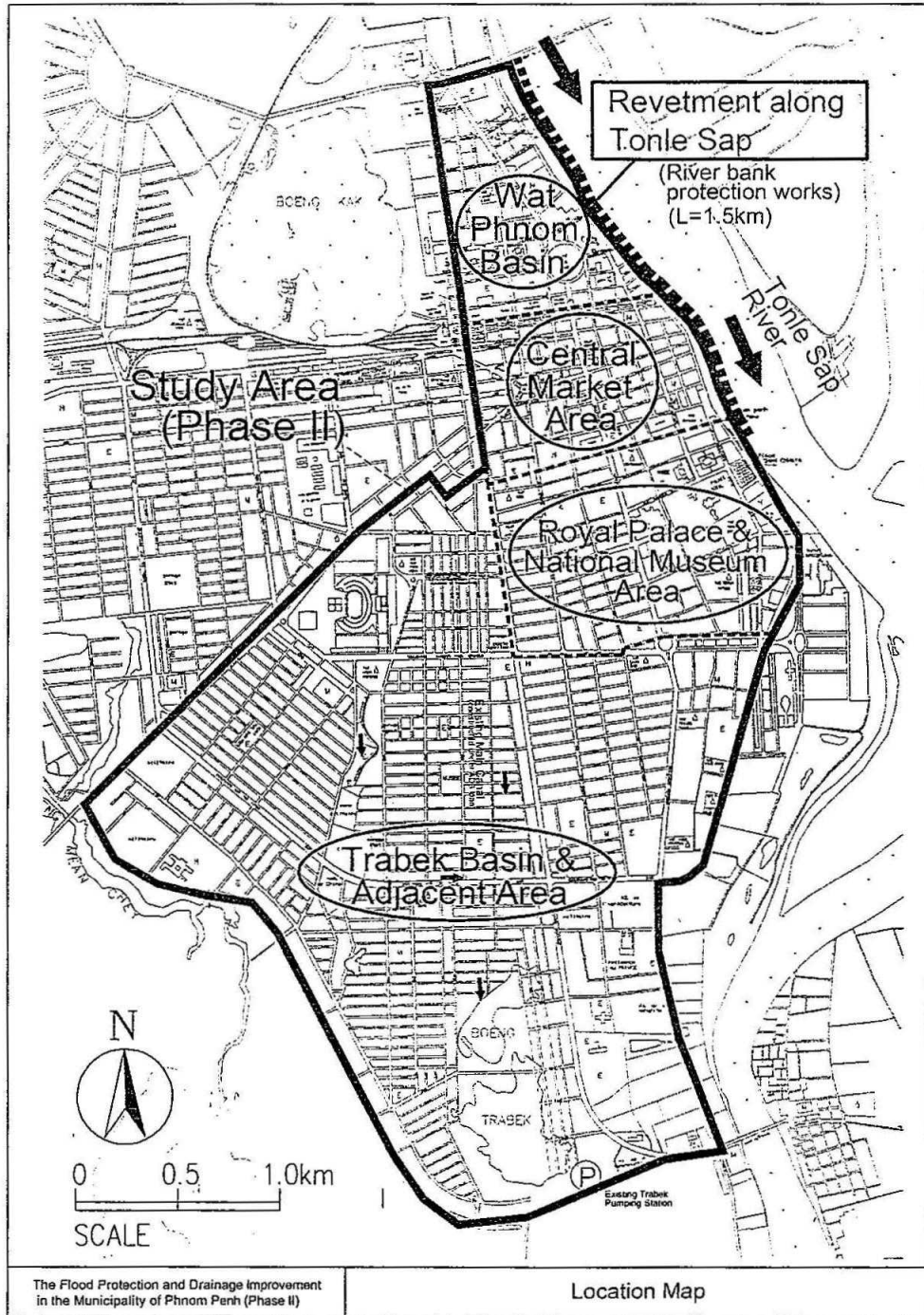
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- 7-4-2. The Cambodian side agrees to secure and clear the land of the Project site before the beginning of the construction.
- 7-4-3. For the objects which must be relocated for the construction of the Project (utility poles, cables and lines buried underground, etc.), the Cambodian side requested to bear the relocation fee by the Japanese side. However, the fee is supposed to be a considerably large amount and bearing it in the Project will possibly lead to the diminishment of the Project scale. Therefore, the Japanese side will prepare the basic design in consideration with the cost, efficiency, and schedule of the construction.
- 7-4-4. DPWT shall make coordination with the organizations concerned, especially with Electricite Du Cambodge, for the smooth implementation of the Project. This includes the minimization of the relocation work mentioned above, and also the usage of electricity during the construction and after the completion of the Project.

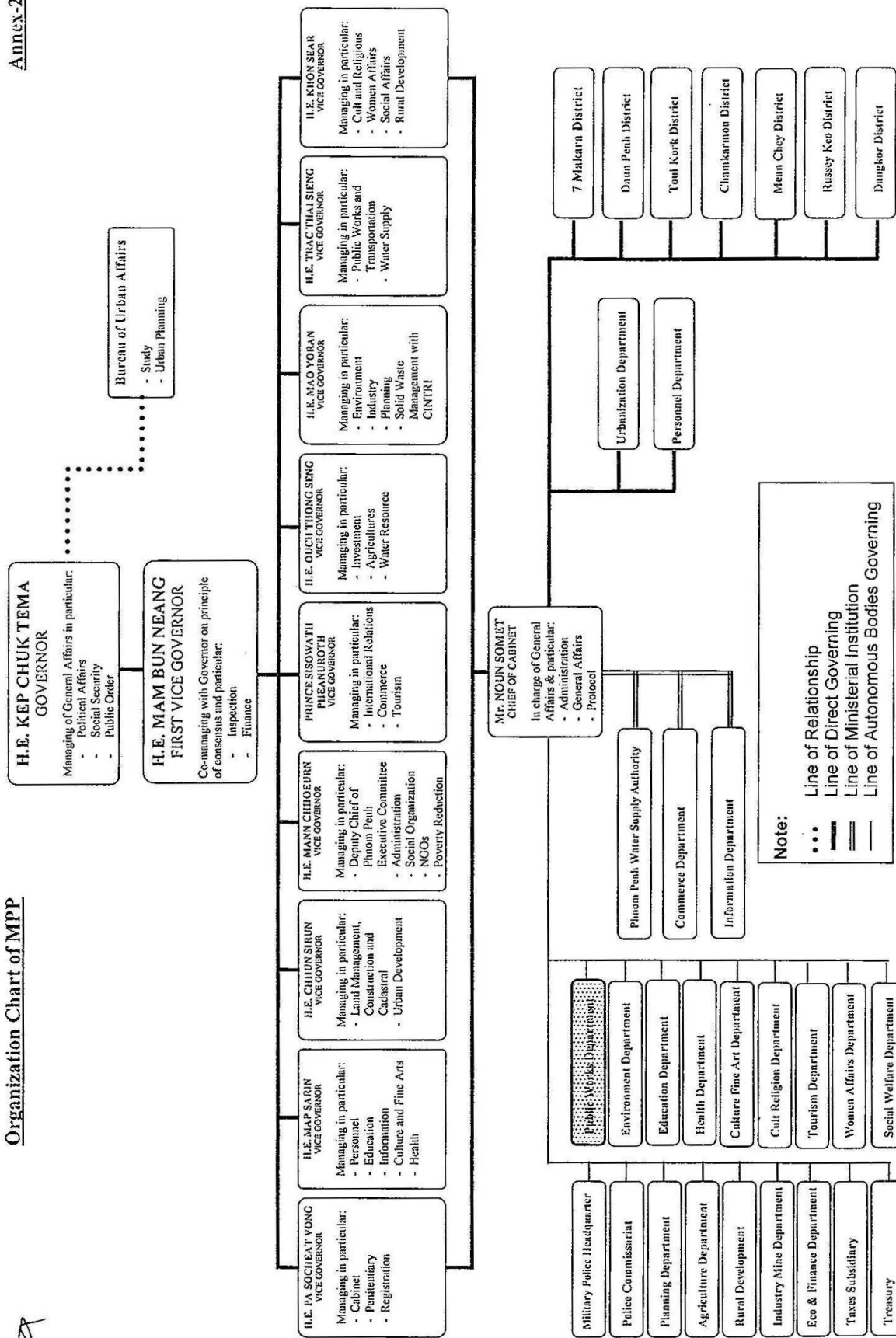
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Location of the Project Site



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Organization Chart of DPWT

