

Chapter 3 Implementation Plan

Chapter 3 Implementation Plan

3.1 Implementation Plan

3.1.1 Implementation Concept

The objective of this project is to replace the neighboring three bridges located at about 40.5km from Phnom Penh on NHR 6A. The implementation concept of this project under the grant aid is as follows:

- This project will be implemented over two fiscal years due to the scale of this project. With respect to the degree of replacement urgency, Br.26 in the first fiscal year, Br.24 and Br.25 in the second fiscal year will be the objective for implementation.
- Taking into account of the construction constraints and construction costs, the construction period (including two dry-seasons) for each phase is determined as 16 months and 18 months respectively, with an overlap period between the two fiscal years.
- In order to reduce / minimize the construction costs, construction equipment and temporary construction materials shall be reused during each project. Furthermore, as far as possible, materials and equipment shall be procured from the domestic market, given that the quality and quantity is acceptable.
- Considering the lack of civil engineers with sufficient experience in bridge construction, supervisors to work under the Japanese engineers will be procured from third countries.
- As the PC girder and panel requires high quality products, for the production of these with minimum number of equipment, the training supervisors shall be brought in from Japan. Similarly, training supervisors for the installation of a concrete plant, which also requires high quality supervision, shall also be brought in from Japan.
- There are few past records on construction of bridges having a PC girder superstructure and foundation pile constructed by reverse circulation drill method. Therefore, the hands-on workmen engaged in these works shall be procured from Japan and third countries.
- The removal works of the existing bridges and the construction / removal works of a detour bridge are part of this project because of the following reasons:
 - As the existing Br.24 obstructs the river cross-section of the new bridge and the new river protection works, this bridge will be removed after the new bridge is opened for the traffic.

- As the existing Br.25 stands on the same location as the proposed one, it is necessary to construct a detour bridge (road) for the present traffic before the existing bridge be demolished.
- As the existing Br.26 is planned to possess embankment, the debris of this bridge shall be removed. And the existing temporary bridge shall also be demolished, because this bridge will become an obstacle to the river channel after the completion of the new bridge.

3.1.2 Implementation Conditions

The main work of this project is the construction of bridges. As the result of comparative study on construction conditions, maintenance and operation works, and construction cost, PC girder & panel and concrete deck for the superstructure, reverse circulation drill method for the pile foundation, reversed T-type abutment and wall type pier for the substructure are adopted. Important materials and equipment, construction supervisors and special skilled workmen are expected to be procured from Japan and third countries. For the above reason, this project could be expected to be less difficult to be implemented. However, as the construction site is inundated in the rainy season and water flow is 2 to 3 m/s at the location of bridges due to high water level difference, sufficient countermeasure for floods shall be considered.

Furthermore, countermeasures for the preservation of peace and land mines are very important even though the preservation of peace is remarkably improved after the civil wars.

Overloaded vehicles for this project shall be controlled due to less loading capacity of existing bridges.

Considering the above conditions, the following points need to be observed during the construction works.

- The schedule, quality, materials & equipment, and labour planning & control by the contractor and the supervision by the consultant are important to complete the project within the construction period (including the rainy season).
- Though there is no working safety regulations as followed in Japan, the safety education and safety measures generally practiced in Japan would be performed to the workers for preventing accidents during work.

- The safety measures against general traffic vehicles and regional people shall also be taken.
- As a regulation load of the temporary bridge for Br.26 is 20 ton, the construction yard for the production of PC girder should be planned at Phnom Penh side of this bridge, and heavy equipment should be restricted from passing the construction yard.
- As the foundation of Br.24 is heavily damaged, heavy vehicles for construction works and transportation of construction materials shall be controlled.
- Although removal of land mines and blind shells were confirmed in the Kingdom of Cambodia, further countermeasures for them shall be conducted in the construction site.

3.1.3 Scope of Works

The implementation of the project under the grant aid of the Japanese government will require the share of the works between the Japanese and Cambodian government as described hereafter.

(1) The Share to be borne by the Japanese Government

- Construction of bridge
- Construction of approach road
- Construction of revetment and gabion
- Removal of existing bridge (road) and existing temporary bridge (road)
- Installation and removal of detour bridge (road) and landing stage (road) required for the project works
- Installation and removal of camp yard and construction yard for the project works
- Procurement of the materials, equipment and labour required for the above construction works
- Field management costs for the above construction works
- The necessary consultant's services to implement the works

(2) The Share to be borne by the Government of Cambodia

- Acquisition of the construction sites, and supply of the land necessary to perform the temporary works
- Free offer of the borrow pit owned by the Cambodian government

3.1.4 Consultant Supervision

(1) Basic Policy of Detailed Design and Consultant Supervision

1) Basic Policy of Detailed Design

The basic policy of detailed design is as follows:

- Field studies will be to collect data necessary for the detailed design and will be based on the field work, operations, cost estimates obtained through the confirmation of requirement of Cambodia side against the field investigations, additional topographic / soil surveys, and detailed design.
- After the completion of the design, the context of the detailed design will be explained to the Cambodian authorities, and discussions will be held. Additionally, as this project will be implemented over two fiscal years, the tender documents for each fiscal year will be prepared.

2) Basic Policy of Consultant Supervision

The basic policy of the construction supervision is as follows:

- The construction supervision engineers will be in accordance with the requirements of paragraph 3.1.4.(2) and endeavor to perform the construction supervision operations as smoothly as possible. Furthermore, it is necessary to adopt a backup system for this project in Japan.
- The superstructure by PC girder and foundation pile by reverse circulation drill method is assumed to be not so familiar to the Cambodian engineers. Therefore, the Japanese supervisors will carry out technical transfer related to the bridge works to the Cambodian engineers in cooperation with the contractor

(2) Consultant Supervision

A supervisor will be required to perform the following construction supervision works.

- Approval of the Construction Schedule and Construction Drawings :
Supervisors inspect and approve the construction schedule and shop drawing submitted by the contractor, according to the contract document, contract drawings, specifications, and other design parameters.

- **Schedule Control :**
Supervisors receive the progress report from the contractor, and give adequate and essential instructions required for the completion of the project.
- **Quality Control :**
Supervisors examine and approve the quality of construction materials and construction methods, as according to the contract drawings and specifications.
- **Inspection of Completed Construction Works :**
Through the inspection of the final sections, plane figures, and others, supervisors check the completed construction works according to the criteria and also certifies the quantity.
- **Issuance of Certification Requested by the Contractor :**
Supervisors issue the necessary certificates for payment of contractor, the completion of construction and the expiration of warranty term.
- **Submission of Reports :**
Supervisors inspect the monthly report, final drawings and final pictures prepared by the contractor and submit them to the Cambodian authorities, JICA and others. Furthermore, the supervisors prepare the final report after the completion of the construction.

(3) Consultant Supervision System

Considering the construction contents and time schedule, the number and the term of Japanese engineers to be engaged in the construction supervision services will be as follows :

- **Overall Supervisor, 1 Person :**
The overall supervisor will make spot checks at times of starting and completion of each fiscal year work.
- **Resident Bridge Engineer, 1 Person**
The resident bridge engineer will be assigned permanently for the duration of construction period.

Additionally, some of the local civil engineers who will be taking technical transfer from the resident bridge engineer, will be engaged for the purpose of assisting him in his supervision.

3.1.5 Procurement Plan

(1) Materials

1) Basic Policy

As a general rule, local materials that could be procured for the construction will be procured from local sources. Imported materials that can be procured easily in Cambodia will be considered as local materials. However, when the quality of the material is uncertain, or the volume in circulation will not permit the procurement in sufficient time, then the material will be obtained from Japan or third country (Thailand).

2) Present Procurement Conditions of Materials

The present procurement conditions of the major construction materials required for this project are shown as below:

① Cement

In Cambodia, cement is produced at private plants located about 130 km from Phnom Penh along NHR 3. However, the capacity is still small and poor in quality. On the other hand, the domestic demand for cement has been increasing with the recent economic rehabilitation. Therefore, most of the domestic demands are supplied from overseas. The main import are from Thailand, Indonesia, China and Korea. Most of the imported cement is 'Elephant Cement' from Thailand whose quality is relatively high.

② Aggregates

The natural sand in and near Phnom Penh city is collected during dry-season from Kandal area of the Mekong River (35km upstream from the city) and from the Kompong Spoe River. On the other hand, aggregates, though the volume is limited, are collected during dry season from Kracheh area of the Mekong River (200km upstream from the city).

Boulders are collected from Traeung (18km west side from Kampong Cham along NHR 7), but the volume is little. Therefore, boulders to be used in large quantity at rip-rap and gabion will be compensated by quarry sites near Br.26 suitable in quantity and quality.

As for base course materials and aggregates for concrete, weathered rock can be collected from the quarry sites near Br.26 suitable in quantity and quality. Base course materials can be manufactured at three crushing plants operated by private firms in the suburbs of Phnom Penh city.

As for aggregates for asphalt concrete, fine aggregates shall be procured in Phnom Penh and sand shall be collected from the Mekong River. These materials are applied in other trunk roads and are suitable in quality. There are enough in volume for construction use in the project.

③ Reinforcing Steel Bar, Structural Steel, PC Wire

As no reinforcement or steel bar is produced in Cambodia, the domestic demand of bar depends on import. The main import are from Thailand, China, Russia, Indonesia, and Korea. The size and quality of imported bar are similar to those of Japanese-made, and poses no particular problem.

Except the special structural steel such as steel sheet pile and H-shaped steel, the other steels could be procured in local market.

On the contrary, the steel products concerning PC girder and panel are unavailable in local markets, as there is no domestic demand for these materials.

④ Materials for Concrete Forms

Timber for temporary works is available from dealers or sawmills in Phnom Penh city. However, plywood for general concrete works is procured from overseas. In considering shifting of materials from project to project and high accuracy of products, the steel imported from overseas (Japan) will be used for PC girders and panels.

⑤ Banking Materials

The original NHR 6A, 6, 7 and 61 were built by means of side-borrow from the roadsides, as the region including this project is flat area held between the Mekong River and the Sap River. However, presently, it is not easy to adopt the side-borrow method, because the present neighboring land of NHR 6A has changed into cultivated land and residential area. As a result, the mining right shall be paid to landowners when these lands will be used as borrow pits. In addition, there is a borrow pit that belongs to the Cambodian government near the construction site and the materials are suitable in quantity and quality.

⑥ Ready Mixed Concrete

There are four ready-mixed concrete plants in and near Phnom Penh City. As understand from worker's advice at these plants, the nearest transportation distance for concrete is 25km (within one hour) on account of the traffic congestion inside Phnom Penh city. Therefore, a temporary ready-mixed concrete plant should be installed at the construction site, since the quality deteriorates if the concrete is brought from the existing plants.

⑦ Asphalt Concrete

There are three asphalt plants in the suburbs of Phnom Penh City of which one is located near the site. It is advisable to procure asphalt concrete from these plants for the following reasons.

- In the case of carrying asphalt concrete from Phnom Penh to the site, the time for transportation is within two hours and the temperature, which affects the quality of asphalt concrete does not abate owing to the high atmospheric temperature.
- As the main works of this project are bridges, it is not necessary to install an asphalt plant for the accompanying approach road works.

⑧ RC Concrete Pile

RC piles, mainly used for foundation piles of buildings, are produced at factories in and near Phnom Penh City by using the purchased ready-mixed concrete.

As to this project, judging from costs, the RC piles for foundation piles of the river protection will be produced at the site.

3) Procurement Plan of Materials

Considering the present procurement conditions mentioned above, the procurement plan of major construction materials is shown in Table 3.1.1.

Table 3.1.1 Procurement Plan for Major Construction Materials

Name of Material	Specification	Supply Source			Remarks
		Cambodia	Japan	Third Country	
Banking materials		○			
Asphalt concrete		○			Existing plant
Asphalt emulsions		○			Imports
Base course material	Crushed stone	○			Existing quarry Site
Subbase material	Crusher-run	○			Existing quarry Site
Road marking paint			○		
Traffic sign		○			
Portland cement		○			Imports
Admixtures		○			Imports
Fine aggregate	Sand	○			
Coarse aggregate	Crushed stone	○			Existing quarry Site
Reinforcing steel	Deformed bar	○			Imports
PC wire	12.7mm 19.3mm		○		
PC wire sheath	φ 50mm φ 38mm		○		
PC tendon anchors	7T13M130 1T17.8		○		
Shoe	Rubber		○		With accessories
Expansion joints			○		
PVC pipe		○			Imports
Quarry stone	25~30cm	○			Existing quarry Site
Wire-mesh gabion		○			Imports
Steel form			○		For PC girder, Panel
Plywood		○			Imports
Staging materials				○	
Steel sheet pile	III -type			○	Second hand
Steel sheet pile	for water stop		○		
Steel covering Plate	1*2*0.2m			○	Second hand
Shaped steel	H-shape		○		
Shaped steel	The others	○			Imports
Fuel		○			Imports

(2) Construction Equipment

1) Basic Policy

The procurement policy for construction equipment is similar to the construction materials. Considering the present conditions mentioned below, the construction equipment for common use will be procured locally. On the other hand, large-scaled or special equipment will basically be imported from Japan in order to avoid breakdowns or malfunctions that may affect greatly the schedule and progress of the work.

2) Present Procurement Conditions of Construction Equipment

① General Conditions of Construction Equipment

As both the official and the private firms have the construction equipment to some extent, leasing is available, if the leasing charge and using time of equipment are mutually agreed upon between the owner and the user. MPWT has new equipment procured under foreign aid plans and used equipment operated at aid projects. On the other hand, private firms (contractor and leasing companies) have the equipment purchased or brought in for performing the aid projects. These equipment are mainly for earth works and road works (macadam pavement works), as the aid projects up to date are mostly concerned to construction of roads. Equipment for bridge work however is limited to its kinds and numbers. Small-sized equipment such as water pump is available in local markets and can be easily procured.

② Construction Equipment of Heavy Equipment Center

There are two authorities in Heavy Equipment Center under MPWT; Road Construction Center Intervention and Unit (Former Name : ODEM Workshop) which possess the construction equipment. The outline of equipment belonged to each authority are as follows:

a) Road Construction Center (RCC)

The construction equipment owned by RCC consists of earth works and road works equipment granted by the Japanese Grand Aid Project, and heavy equipment used under AusAID. The former is composed of about 35 kinds and

115 vehicles / sets, and the latter 3 kinds and 3 vehicles. Though the main portion of this project is bridge works, initially, the equipment for approach roads and earth works at camp and construction yards are to be procured from RCC. However, these equipment have been utilized in this project according to the following reasons:

- This project and Siemreap Road Rehabilitation Project by the Japanese Grant Aid are planned to be implemented simultaneously.
- The Siemreap project has the priority to utilize the equipment of RCC, because it precedes this project.

Although utility of the equipment of RCC is regarded to be impossible at the basic study stage, the possibility of their utility shall be confirmed and considered in the construction stage.

b) Intervention Unit

About 100 vehicles belonging to this Unit consists of the equipment purchased on its own, and used or presented one by the aid project up to the present. As most of these equipment were procured from USSR, there are many old ones. Additionally, it is difficult to maintain these equipment for financial reasons. At present, approximately 60 heavy vehicles such as excavator, bulldozer, scraper, dump-truck are in operation for NHR 5 rehabilitation project in which RCC is engaged. As this project lays importance on the construction period, it is unthinkable to procure the equipment from this center because of the above conditions.

3) Procurement Plan of Construction Equipment

The procurement plan of major construction equipment is shown in Table 3.1.2. The plan is based on the present procurement conditions mentioned as above.

Table 3.1.2 Procurement Plan for Major Construction Equipment

Description	Specification	Supply Source			Remarks
		Cambodia	Japan	Third Country	
Bulldozer	15 ton	○			Earth work
Excavator	0.6 m ³	○			
Big breaker	600 kg		○		Removal of existing structures
Motor grader	3.8 m	○			Earth work, Pavement work
Tandem roller	12 ton	○			
Tire roller	8-20t on	○			
Asphalt finisher	2.4-3.6 m	○			Pavement work
Asphalt engine sprayer	2,000 l	○			
Dump truck	10ton	○			Earth work
Concrete plant	30 m ³ /hr		○		Concrete work
Agitator truck	4.4 m ³		○		
Concrete pump truck	30 m ³ /hr		○		
Wheel loader	2.5 m ³		○		Concrete plant
Fork lift					
Self-propelled portal crane	20 t		○		PC girder fabrication
Stationary portal crane	20 t				
Grout pump, mixer	600-800 l		○		PC girder fabri. Transverse work
Tension jack			○		
Erection girder			○		Girder erection work
Crawler crane	60 t		○		Pile, Temporary bridge and pier
Truck crane	25 ton		○		Pile, Temporary bridge and pier, Common work
Vibro-pile driver	60 kw		○		Pile, Temporary bridge and pier
Reverse circulation drill			○		Pile
Air compressor	5 m ³		○		
Water supply truck	10 ton		○		Common mechanics
Truck with crane	4 t /2.9 t		○		
Trailer	Poll tractor		○		Transport of PC girder
Trailer Tractor		○			

(3) Transport Plan of Materials and Construction Equipment

1) Transport Routes

Most of the construction materials and equipment will be carried in or out from Phnom Penh to the site through NHR 6A. In general, the materials and construction equipment procured from overseas are transported to Phnom Penh by the following three routes. For this project, the B and C routes will be adopted.

A. Phnom Penh Port

Phnom Penh Port is a river port facing the Sap River, and there is limited numbers of ships that could enter the berths because of the specific characteristic of this river. Namely, the 1,500 ton ship during dry season and 2,000ton ship during rainy-season. Additionally, there is approximately 350km between the mouths of the Mekong River in Vietnam to this port. As a result, the main unloading and loading products are general consumer goods and agricultural and forestry products respectively.

B. Sihanoukville Port~(NHR 4)~Phnom Penh

Sihanoukville Port is an outer port facing the Thailand Bay. Even big-sized ships can come alongside the berths. The transport route from this port to Phnom Penh (230km) is the NHR 4, which is a section of the Asian Highway A-11 and was reconstructed under the American Aid in 1996. Because of the favorable conditions mentioned above, the volume of transportation on this route shows a steady increase in parallel with the national economic development. This port at present is under rehabilitation.

C. Poipet~(NHR 4)~Phnom Penh

This route is used for transporting cement, steel bars etc. from Thailand. Being a 410 km long transportation route and a NHR 5, one of the Asian Highway A-1, even at present some stretches are still under rehabilitation.

2) Problem of Transportation Route and its Countermeasures

The materials and equipment procured for this project must pass over the existing bridges as it bisects the national roads. The load limit on the bridge is 20 ton.

Therefore, the concrete plant and heavy equipment whose overall weight exceeds the limits will be transported in partition.

3) Transportation Period for Materials and Equipment to be procured from Japan

The materials and equipment from Japan will be transported using the following route and time.

Transport Route		Time
Delivery, Ship Loading	Factory→Port in Japan	0.25 months
Ocean transport	Japan→Sihanoukville Port	0.50 months
Unloading, Custom Clearance	Sihanoukville Port	0.25 months
Inland transport	Sihanoukville Port→Site	0.20 months
		Total delivery time : 1.20 months

3.1.6 Implementation Schedule

This project will be carried out in two phases, and it will be implemented in accordance with the detailed design, tendering, construction / construction supervision schedule. Table 3.1.3 is the Implementation Schedule.

(1) Detailed Design

The detailed design for each phase will be performed as follows by the consultant who has signed the design contract with the Cambodian government.

— Phase 1

- Detailed design including bill of quantities for three bridges.
- Construction cost estimate, tender documents including technical specification of Br.26 .

— Phase 2

- Construction cost estimate, tender documents including technical specification of Br.24 and Br.25 .

(2) Tendering

The tendering for the project will be performed by the consultant for the Cambodian government in Japan in accordance with the phases, and will consist of the following:

Table3.1.3 Implementation Schedule

Item	Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Phase 1	Detailed Design																		
	Tendering																		
	Construction																		
Phase 2	Detailed Design																		
	Tendering																		
	Construction																		

- Receipt of the contractors requesting pre-qualification
- Evaluation of the contractor and preparation of Short List of Tenderers
- Holding of meeting with Tenderers for Question / Answer Session
- Receipt, opening of tenders, and evaluation of tenderers
- Evaluation meeting , and award of contract, and notifying the successful tenderer

(3) Construction / Consultant Supervision

After signing the contract, the approval of the Japanese government will be obtained, and the works will be commenced. The construction operations will consist of; preparation of the construction site, temporary works, bridge substructure works including pile foundation, bridge superstructure works, approach road works, river protection works, and removal works. The construction at first phase will be Br.26, and the construction at second phase will consist of Br.24 and Br.25. Each phase will require 16 months and 18 months respectively.

The above construction operation will require the construction supervision works to be performed by the consultant.

3.1.7 Obligations of recipient country

The obligations of recipient country in this project are as follows:

- Countermeasures for safety (land mines, preservation of peace) : As for land mines, it is confirmed that land mines have already been removed in the project site by the recipient government.
- Control of overloading vehicles
- Acquisition of the construction sites, and supply of the land necessary to perform the temporary works
- Compensation for houses removed and cash trees in the construction sites
- Free offer of the borrow pit owned by the Cambodian government
- The exemption of tax on the materials and equipment imported for the project, and the expeditions processing of the custom procedures
- The exemption of custom fees for the Japanese and the third party nationals entering Cambodia to work on the project, and exemption of other financial obligations

The procedures of land acquisition and tax exemption in Cambodia are as follows

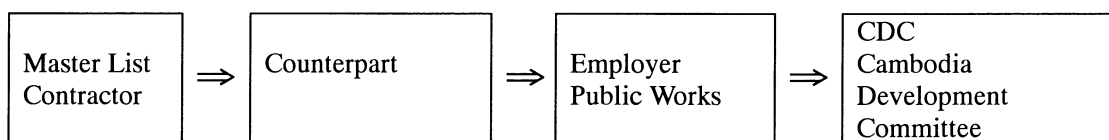
Procedure for Land Acquisition

1. Ministry of Public Works and Transport (MPWT) will confirm land and houses by the drawings and land ledgers.
2. Compensation cost will be estimated by MPWT and public officers in the project area.
3. Negotiation will be conducted with landholders and house owners and the results will be reported to the Ministry of Finance.
4. After the investigation and approval by the Ministry of Finance, the bilateral agreement will be made.
5. Removal of houses and acquisition of land.

The commencement of the first and the second phase of construction stage is November 2000 and September 2001 respectively. The government of Cambodia shall carry out the land acquisition before the commencement of construction stage.

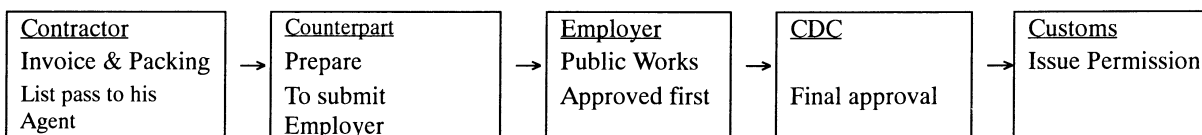
Procedure for Tax Exemption

- First Step (Prior Preparation)



- 1-1. The contractor makes master list and submits it to the agent.
- 1-2. The agent submits it to the counterpart of contractor. After the agreement of counterpart, the agent submit the approval sheet to CDC.
- 1-3. Publish the approval sheet after the approval by the CDC.

- Second Step (in case of import)



- 2-1. The contractor submits the invoice and packing list to the agent.
- 2-2. The agent submits them to CDC.
- 2-3. CDC conducts the approval meeting once a week.

- 2-4. After the approval of CDC, the agent submits the approval certificate to the Customs for customs clearance.
- 2-5. After the approval of the Customs, the agent makes all the required procedures.

3.2 Project Cost Estimation

The expenditure to be borne by the Cambodian government in connection with the implementation of the project is estimated as shown below.

① Land Acquisition	:US\$ 48,088
② Construction Yards Leasing	:US\$ 94,642
③ Prosperity (House Moving) Compensation	:US\$ 3,336
④ Prosperity (Cash Trees) Compensation	:US\$ 315
Total	:US\$ 146,381

The existing Br.24 is seriously damaged and unstable in the structural viewpoint. However, Br.24 is to be replaced 3 years later and will be opened to the traffic till then. More unfavorable impact to the existing Br.24 will be expected in the implementation of the project. The Cambodian government shall make the repair of Br.24 before the commencement of the project.

3.3 Operation and Maintenance Costs

3.3.1 Operation and Maintenance System

Large-scale repair works will not be necessary within 20 to 30 years after the completion of bridges by following the operation and maintenance method mentioned in 3.3.2. Similarly, large-scale repair works are not required regarding the approach roads, as its design life is 5 to 10 years. Therefore, the operation and maintenance after the completion of this project will be carried out by the present system ; Department of Road under Department of Public Works.

3.3.2 Operation and Maintenance Method

Though the main objective of this project is the constructions of bridges, the approach roads are taken as the objectives of the operation and maintenance. The other maintenance and repair works after the completion of the bridges must be performed in line with Table 3.3.1.

Table 3.3.1 Maintenance and Operation Schedule

	Item	Maintenance and Repairing Works	Period
Bridge	①Drain Pipe	Clearing of sediments	3 months
	②Expansion Joint	Repairing of shrieked metal and seal rubber	3 months
	③Handrail	Repairing damages by traffic accidents	3 months
	④Shoe	Removal of earth deposits	6 months
	⑤Superstructure	Repairing of cracks	1 year
	⑥Substructure	Repairing of cracks	1 year
	⑦River Protection	Repairing of scours	1 year
Road	①Road Surface	Patching, smoothing	1 month
	②Shoulder/Slope	Planting (turf), reinforcement of earth, repairing masonry	1 month

4.0 mans / month is sufficient for periodical checking and minor maintenance of the items mentioned in the above table. It is important to keep records of the results of periodical checking on the road resister and grasp the condition of damage in order to establish the repair schedule and its scale. Therefore, the periodical checking system must be established at the early hands.

3.3.3 Operation and Maintenance Cost

The operation and maintenance cost per year is estimated as shown below:

Personal expenses (engineer)	:US\$20 /man × 2 men / month × 12 months =US\$480
Personal expenses (worker)	:US\$5 / man × 2 men / month × 12 months =US\$120
Miscellaneous materials cost	:Lump-sum =US\$480
Vehicle hire charge	: <u>US\$60 / day × 1 day / month × 12 months =US\$720</u>
	Total US\$1,800

Therefore, as the estimated total cost is only 0.02 % of the budget of MPWT, there should be no problems both in terms of the budgets and manpower concerning with the operation and maintenance.

Chapter 4 Project Evaluation and Recommendation

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4.1 Project Effect

NHR 6A is ranked as a part of main trunk road which connects the capital city Phnom Penh with Kampong Cham and a part of Asian Highway route.

NHR 6A was damaged due to hurricane occurred on September, 1996 and some bridges and road sections need urgent repair. Besides, NHR 6A is inundated during the flood and loses its function. It would cause serious socioeconomic impacts.

This project is to conduct urgent repair of these damaged bridges and road sections and to keep traffic functions all through the year. The effects of the Project are as follows.

(1) Direct Effect

- After completion of the project, it will be possible to ensure the traffic function of the key trunk road all through the year.
- Keeping adequate flood capacity in each bridge location will ensure the safety of road and bridges against floods and will enable safety traffic during flood time. Replacement of abutments and piers and installment of gabions and revetments will ensure the safety against scouring and will avoid adverse effects to the upstream area of NHR 6A.

(2) Indirect Effect

- Implementation of the project will contribute to the activation of regional economy around Phnom Penh.
- After completion of the project, it will ensure the place of refuge for inhabitants and livestock during flood time.
- After completion of the project, it will ensure the safety of downstream area of NHR 6A and will ensure the stability of land use.

4.2 Recommendation

This project will be expected to contribute to the regional socioeconomic development by repairing and replacing the road network damaged by floods and civil wars. Therefore, it would be judged to be appropriate to carry out this project as a grant aid development activity.

It will be recommended to conduct regular inspections of road facilities and urgent repair when some damages and defects are seen.

It will be recommended to establish regular inspection system as early as possible and to collect data for assuming future repair time and scale.