ROAD REHABILITATION PROJECT

SIMPLIFIED ENGINEERING DESIGN

INITIAL ENVIRONMENTAL ASSESSMENT

June 1998

JAPAN OVERSEAS CONSULTANTS CO. LTD.
in association with
ORIENTAL CONSULTANTS CO. LTD.
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Executive Summary

The two key outputs of this IEA are the Environmental Management Action Plan (EMAP) and the Resettlement Action Plan (RAP). The EMAP is included in this document as Annex 1, and is a point-by-point description of all measures required in order to avoid and mitigate negative impacts which could arise from the project; relevant documents and contract items, timing of actions, and organizations responsible for actions are specified. The RAP is a full stand-alone document which identifies the resettlement needs of the project, including compensation, entitlement, and cost details, and prescribes the steps required for fair and equitable treatment of all project-affected people (PAPs). The RAP is currently under finalization to meet the Bank's requirement.

This IEA is undertaken in the broader context of building the Royal Cambodian Government's capacity for dealing with environmental issues, particularly those related to infrastructure development. At present, the RCG is poorly equipped institutionally for dealing with such issues, and this project will be the first test case for a new environment cell to be created within the Ministry of Public Works and Transport (MPWT) under ADB TA 2723-CAM. The Environment Cell will be responsible for much of the monitoring of the implementation of environmental measures which will need to be put in place as part of the project.

The project entails the upgrading of 115.2km of roads in Phnom Penh and Sihanoukville Municipalities and Siem Reap Province. 11.8km of the project roads are urban roads, and 103.4km rural. Road improvements will vary from place to place, and will consist of everything from straightforward resurfacing, to widening by several meters, to elevation of the roadbed by over 3m for flood prevention. The improvements will be made in two stages. All project roads will be brought up to a standard width of 8m in the first stage (construction is slated to begin in late 1999), while the end of the second stage, some ten to fifteen years on, will see the standard width increased to 11m.

The main issues of concern in the project are:

- the need to resettle people who are living and doing business within the rights-of-way of the project roads;
- appropriate management of cultural heritage found in the RoW in the face of increasing road widths and traffic; and
- features of the natural environment, particularly waterways and trees, which intersect or are growing within the RoW, and which could suffer negative impacts as a result of the road improvements.

Resettlement

All national highways in Cambodia have a RoW of 50m, and while this is legally recognized, enforcement of the boundary has been such that there is nevertheless considerable activity within the RoW, including permanent habitation, agriculture, and commerce. This level of encroachment has not presented problems in the past, but in order to accommodate the road upgrades and associated increases in traffic volume and speed, management of activity within the RoW is deemed necessary. Nearly 1500 project-affected people and over 1200 structures will have to be relocated and compensated for the first stage of the project to proceed; these are concentrated along NR6 in Siem Reap Province, and to a lesser extent along NR3 in Sihanoukville Municipality. In the vast majority of cases, the effect of the relocation on livelihoods and communities will be minor, as it will involve little more than "shifting back" from the road. The resettlement will be fully compensated under the terms of the Resettlement Action Plan (RAP).
Cultural Heritage

Siem Reap Province, the only part of the study area in which cultural heritage features are a concern, is designated by Royal Decree as a Protected Cultural Zone, which means that all development actions must be evaluated and approved with respect to protection of cultural property. Of particular relevance to this project is the NR6 RoW, which coincides with an ancient Angkor highway dating from the 12th-13th Century, and includes ten Angkor bridges in addition to other possible as-yet-undocumented artifacts. Development of NR6 will require special attention to cultural heritage management, particularly with respect to treatment of the ten bridges. All will be studied to determine the feasibility of keeping them in use by the national highway. The RCG has formed a Steering Committee on Cultural Property (CCP), headed by the Minister of Culture and Planning, to guide the incorporation of cultural heritage management into the project process.

Natural Environment

Natural environmental issues related to this project are for the most part minor, because the project involves no alignment changes, minimal widening, and relatively low projected traffic levels. The project roads do not pass through any sensitive environments; most roadside areas have already been extensively modified. Waterways are of perhaps the greatest concern, because several bridges and culverts will be replaced. However, if the standard mitigative and precautionary measures prescribed in the EMAP are followed, impacts on waterways should be minimal. Tree removal is to be kept to an absolute minimum: only those trees which interfere with safe operation of the road or cannot be accommodated with design modifications will be cut down. All trees removed will be replaced as part of a replanting program.

Two issues of primary importance to all involved in the implementation of this project are timing and cost. These issues are both addressed in the IEA. The implementation timetable, which appears in Section 5.3 as Table 3, specifies the start date and duration of all project components to be implemented in the design, construction and operational phases of the project. Crucial timing issues are the implementation of the RAP, and the upcoming Cambodian elections. Execution of the RAP is critical to the overall project's implementation, since all relocation of project-affected people must take place before the construction phase can begin. The elections are critical because the outcome could make or break the entire project; the decision of whether to proceed with the project as planned may be made on a political basis.

Section 5.5 of the IEA outlines in brief the costs associated with implementing the social, cultural and natural environmental measures as prescribed in the EMAP and RAP. The total estimated cost of implementing the EMAP measures is US$1,255,000, and for the RAP it is US$313,435. The total estimated cost of all recommended social and natural environmental measures to be implemented as part of the project therefore comes to US$1,568,435. A detailed accounting of the costs associated with implementing the RAP can be found in the RAP document.
1 INTRODUCTION

1.1 INITIAL ENVIRONMENTAL ASSESSMENT (IEA) OBJECTIVE

The objective of the IEA is three-fold:

i. to identify the impacts of the proposed project activities on the natural and social environment and thereby establish what further level of environmental study, e.g., a full environmental assessment (EA), the project requires;

ii. to describe and assess the general impacts that could result from the proposed project options, define the most effective mitigation measures, and prepare an environmental management action plan (EMAP) covering both the natural and social environments; and

iii. to prepare a Resettlement Action Plan (RAP), addressing the issue of relocation and compensation of Project Affected Persons (PAPs).

In cases where only IEAs are applied, as with this project, there is an implication that the potential impacts are well understood, predictable with a large degree of certainty, and can be effectively mitigated using standard methods.

1.2 THE PROJECT

The proposed project consists of the rehabilitation and, in a few cases, the reconstruction of roads in three regions of the country, Sihanoukville Municipality, Phnom Penh Municipality, and Siem Reap Province (see Map 1). Of the total 115.2km of roads under consideration, approximately 11.8km pass through urban areas, and 103.4km traverse rural agricultural settings, often passing through small villages. The longest single continuous road section occurs in Siem Reap Province, extending along NR6 from the intersection of the Siem Reap airport access road and NR 6 to the provincial border with Kampong Thom, for a distance of approximately 89km. The types of work proposed for this road improvement project are:

- Resurfacing — calling for treatment of existing pavement, surface patching and restoration, as well as full-width application of thin (≤ 25mm) asphalt surfacing. This is sometimes referred to as preventive maintenance or periodic maintenance and does not involve extending the work area beyond the existing pavement edge, or undertaking any geometric modifications to the road;

- Rehabilitation — calling for full-length and full-width resurfacing and selective strengthening and road surface shape correction, but no geometric changes; also recycling of one or more pavement layers, e.g., scarification and reworking of a pavement layer;

- Betterment — calling for geometric improvements related to road width, curvature or gradient, pavement and road shoulders; and

- Reconstruction — calling for the full-width, full-length reconstruction of roadway pavement and shoulders, mostly on existing alignments, often including the rehabilitation of all drainage structures.

Other than temporary construction-period disruptions, only the latter two road improvement categories are considered as having potentially significant environmental impacts.

Within urban areas no roadwork improvements beyond rehabilitation are proposed, and resurfacing will not extend beyond the existing curbs. Along rural sections of NR3 and NR6 betterment and

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1 Should the IEA suggest the potential for serious impacts, a full EA would have to be undertaken.

2 For the purposes of this report, urban areas occur only within the population centers of Phnom Penh, Siem Reap and Sihanoukville. All other population centers, e.g., towns and villages, are considered to be part of the rural setting, and the roads passing through them are considered rural roads.
reconstruction work is proposed. In the first stage, these roads will be widened to 8m (including two 0.5m shoulders) and resurfaced; this will require the relocation, away from the road (Figure 1), of over 1,200 structures, mostly residences and small commercial wooden structures. The second stage, beginning some 10 to 15 years in the future, will involve a further widening to the 11m national road standard. However, all new bridge and culvert installations will be installed to the full 11m dimension in Stage 1, since having to replace these structures in Stage 2 would be a huge additional cost.

A major part of the work will be the replacement and reconstruction of bridges which were damaged or destroyed during past military actions or have broken down due to lack of maintenance. There are more than 48 waterway and canal crossings along NR6. Ten of the NR6 crossings involve 12th-13th Century Angkor bridges, which are in various states of disrepair due to past military activities and monsoon flooding. At many of these bridges, the ancient laterite blocks lie scattered near the crossings. One exceptional bridge, the Speam Praptos at Kampong Kdai, which is 85m long and 14m wide (Photo1), has been well preserved and stands as a prime example of ancient bridge construction.

Map 1 Project Roads in the Context of the Cambodian National Road Network

The Royal Cambodian Government (RCG) has expressed concern about subjecting this cultural treasure to the increasing traffic volumes of the national highway system. The other nine Angkor bridges, while culturally significant, represent a less ornate construction style and are considered less important culturally than the Speam Praptos. It is planned that all of these nine bridges will be strengthened with the addition of reinforced concrete deck slabs and internal columns together with some reconstruction. They will then continue to perform as bridges on the new improved road as per the recommendation of the archeological expert engaged to study this particular problem.
Along NR3 there are 15 water crossings, generally in better condition than those on NR6. The larger ones are Bailey bridges with sound substructures. For these bridges rehabilitation will consist of improvements to the approaches and replacement of the timber decking with welded steel plates, but no widening. The smaller bridges, mostly concrete-box and open-bottom culverts, will be replaced with new ones having a larger opening and permitting the full 11m national standard road width planned for the future.

Photo 1 The Speam Praptos Bridge on NR6 at Kampong Kdai, 1998
[See hard-copy version for photo]

Aside from two structures on NR3 and the Kampong Kdai bridge, all bridges cross intermittent waterways where no flows exist from December to mid-May. The intermittent waterways are essentially runoff channels during the monsoon period (except the two along NR3, which are tidal channels).

In Annex 3 the cross-sections of the new road surface/dimensions are superimposed on the existing dimensions, providing a measure of how much change can be expected in relation to the type of rehabilitation.

The construction work would be undertaken over a three-year period, with most project roads in operation by 2003.

1.3 STUDY AREA BOUNDARIES
National highways in Cambodia have a 50m RoW in most locations. While no law specifies this width, the Royal Cambodian Government (RCG) assumes 25m from either side of the road centerline to be the RoW boundary. Figure 1 shows the relationship between the RoW and the area to be cleared of encroachers. The 7-9m clearance zone is also the area where most trees are to be removed. It is assumed that tree removal will be kept to a minimum, and in urban areas the road pavement widths may actually be adjusted to accommodate mature trees that add to the aesthetic appearance of the roadside area.

Figure 1 Cross-section of RoW, Clearance Zone and Corridor of Impact on Cambodian National Highways (not to scale)

2 INSTITUTIONAL SETTING, LAWS, POLICIES AND GUIDELINES
The objective of this section is to highlight the institutional strengths and weaknesses of the Ministry of Public Works and Transportation (MPWT) as they relate to the application and management of EAs of infrastructure in general and transportation projects specifically by the MPWT.
2.1 ORGANIZATION OF INSTITUTIONS

As with most line agencies in Cambodia, the MPWT functions under a minister, who reports to the cabinet. The minister usually has a secretary general or director general, with division or department heads reporting directly to the director general. In the case of the MPWT, there are division heads and department directors.

The MPWT has neither an environment department nor a unit with the express task of managing EA requirements flowing from infrastructure development projects such as this one. One mid-level technical person attended the first major Cambodian training program in EA.\(^3\) Given the size of the existing and proposed investment portfolio\(^4\) of this ministry, it would seem highly desirable to create an environmental planning unit to serve the ministry's three project-implementation divisions. There are presently at least ten large infrastructure projects under consideration at the feasibility stage within the MPWT, most with environmental mitigation and monitoring requirements; more are being considered at the early conceptual stage.

There is no formal structure requiring the MPWT to involve the Ministry of Environment (MOE), which is the key EA resource unit, or any other relevant ministry during the planning and execution of a project. The new Law on Environmental Protection and Natural Resources Management (1997) specifies that a completed EA document should be sent to the MOE for review and comment—not necessarily approval.

Developments of roads, bridges, power generation and other infrastructure projects can be approved by Cambodian Investment Board (CIB) within 45 days, without the need to seek environmental approval or even consultation with relevant line agencies. Instead of building environmental management linkages, the present institutional organization tends to minimize them, leaving environmental matters unaddressed. A new institution-building project funded through the ADB\(^5\) has a mandate to design and equip small environmental cells within the MPWT and the Ministry of Industry, Mines and Energy (MIME). This means that greater environmental skills and management capacity will be in place by March 1999.

Technically, the Ministry of Economics and Finance (MEF) is responsible for handling all socio-economic and resettlement issues. In reality however, these issues are managed with input from 'round table' task forces which are assembled, often in an ad-hoc fashion, from representatives of the proponent ministry and other ministries with a significant stake in a project's output(s). The MEF is the only permanent, constant member. These 'round tables' take the completed feasibility studies, which include the EAs, and decide on budget, implementation and compliance. While they do have some technical knowledge through the representatives from the line agencies such as Agriculture, the MOE (the most knowledgeable on EA), is rarely present. Responsibility for implementation rests with a project implementation unit (PIU),\(^6\) which is a specially established group of MPWT staff whose primary function is to implement all aspects of the road project, including environmental measures.

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\(^3\) Miss Phoeum Kanha of the Ministry of Public Works and Transport attended the ADB funded training program conducted in Phnom Penh in 1996.

\(^4\) Based on the international donors' planning meetings convened in mid-1996, development assistance allocations to the MPWT (if one includes investments in aviation) would rank it the No. 1 recipient along with the Min. of Health.

\(^5\) ADB TA No. 2723; Institutional Strengthening and Expanding EA Capacity in Cambodia.

\(^6\) A PIU has been established for this project.
2.2 LEGAL AND POLICY FRAMEWORK, INSTRUMENTS AND PROCESS

2.2.1 Environmental Legislation
In early 1997, the RCG enacted the Law on Environmental Protection and Natural Resources Management. This law is general but nevertheless identifies the MOE as the lead agency with regard to EA. Decrees (policies) and sub-decrees (regulations) dealing with EA, pollution and other related matters must now be developed to fully empower the MOE to do its job. The law stipulates that the MOE should prepare a set of sub-decrees relating to the EA procedure as well as the classification of projects according to the intensity of environmental assessment required. Drafting effective sub-decrees will be an onerous task, given the limited skilled resources within the agency and indeed the country.

Aside from the Law on Environmental Protection and Natural Resources Management, Cambodia is just starting to assemble the regulatory instruments it needs to effectively manage the massive resource extraction, reconstruction and development process sweeping the country. The informal ‘round table’ approach, implemented by the Council of Ministers, is the only known consultative forum which, at least in principle, provides for some assessment of environmental benefits and costs as a project is designed.

2.2.2 Land and Social Legislation
In the area of land and resettlement, three issues with legal implications must be considered. They are: (i) acquisition of land; (ii) fair compensation; and (iii) rehabilitation due to losses. Land acquisition and compensation are controlled by the MEF and are defined in the Cambodian Land Law of 1992. Of primary importance to this project is Article 5 of that law, which states that private user rights of government land are not guaranteed in a number of cases, including the use of “land reserved for road construction and road maintenance”. The law also states that users of the land who have legal title to it, or have ‘permission’ (rented or permit from the rightful owner) to use it, must be fairly compensated for the loss of its use. The law does not specify what fair compensation is or who should monitor the process and assure that fair valuations are established. In practice, market-based replacement values have been used, most recently for the Ho Chi Minh to Phnom Penh Road Feasibility Project (Scott Wilson Kirkpatrick, 1997). Cambodia does not have any specified requirements for rehabilitation, which is therefore technically at the discretion of the PIU. In the absence of Cambodian regulations and guidelines regarding rehabilitation, the common practice is to apply donor specifications.

2.3 CAPACITY TO IMPLEMENT ENVIRONMENTAL MEASURES
During over twenty years of civil war, Cambodia’s technical capacity and critical mass of trained people was severely depleted, with many bright minds fleeing the country and thousands of others purged from the system. In effect, there exists no ‘mentor’ level of professionals in Cambodia. A young and enthusiastic, but basically inexperienced group is now dealing with environmental matters, and it needs help. Aside from the 30-odd students who participated in the 1996 training course, no domestic EA expertise exists, and besides the Environmental Impact Assessment Department, no Cambodian agency has the capacity to complete a coherent and technically acceptable EA. Skills in mitigative measure implementation and compliance monitoring are even more scarce, which is understandable given that only two EAs have been completed in Cambodia to date.

Within the MPWT there is only one person with some applied knowledge of EA. This extreme shortage of skilled staff can be expected to worsen rapidly, as the number of development projects

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7 It was pointed out in the ADB TA report that the best students in the 1996 EA training course were hired away from the government by private sector firms, thus seriously reducing this new public sector talent pool, and again weakening the government’s capacities and depth in EA.
8 Personal communications, Mr. Trac Thai Sieng, Senior Advisor to the Deputy Minister of PWT.
9 The RAP, included as a stand-alone section of the IEA, provides more details on these conditions (see Annex 6).
being proposed has already eclipsed the capacity of the MOE and MPWT to address environmental concerns. Without the establishment of a special unit, such as an environmental cell within the MPWT or project-specific entities, the RCG may not be able to implement and monitor even a limited number of the many projects requiring EA.

In the areas of social impact analysis and the fair and equitable handling of resettlement, there is even less capacity. The Ministry of Economics and Finance (MEF) is just that, the manager of the national budget, collector of taxes, etc., with limited experience in social assistance and implementation of resettlement action plans (RAPs). Any new units, e.g., an environmental cell in the MPWT, must incorporate specific expertise in identifying and mitigating impacts on the social environment.

3 EXISTING CONDITIONS

3.1 OVERVIEW

The study area can be divided into three geographic regions:

i. the alluvial plains of the Mekong River, which includes Phnom Penh;
ii. the Tonle Sap Lake basin in which the Siem Reap study area is located; and
iii. the Gulf of Thailand coastal zone, in which the Sihanoukville study area is located.

With regard to climatic conditions, the three study areas vary considerably in rainfall but minimally in temperature. The country is subject to two major seasons, the monsoon period (May-November) and the dry season (December-April). Greatest annual rainfall occurs in Sihanoukville, where it can reach as high as 4 m per year. Along the coastal hills in some sections of NR3, the annual rainfall can go as high as 5m, while in the Siem Reap area it averages about 2-2.5m per year. The monsoon invariably results in massive flooding; elevations of most of the lands in the study area are only a few meters above the Tonle Sap/Mekong's mean level. From the perspective of road development in areas of such low terrain and high rainfall, water and erosion management are the two environmental conditions requiring the most attention. Wildlife, natural habitats and forests are expected to play a minor role in this project as none of the proposed improvements directly affect or impinge on conservation areas or sensitive habitats.

3.2 PHNOM PENH

In Phnom Penh, the project area consists of 3.3km of 11m-wide roadway (Table 1) running from the Central Market Ring Road south to the Southern Truck Route (Map 2). The road passes through primarily commercial and light industrial land-use areas. This roadway will undergo resurfacing, as well as construction of new local drainage facilities, curbs and gutters, thus no widening beyond the existing edge-of-pavement is planned.

3.2.1 Natural Environment

3.2.1.1 Forests, Wildlife and Habitat

The study area within the Phnom Penh municipality is essentially urban, coinciding with existing streets and devoid of any forest and wildlife, except for several common urban birds such as sparrows, mynah birds, and other songbirds. Bats are common and flying foxes make their homes in the very large trees which grow close to the Tonle Sap and Mekong Rivers. A number of open 'park' areas exist within Phnom Penh, but these are sparsely treed; some barely have grass and are more amusement parks or temporary garbage collection areas than green spaces. Most mature trees in public places in Phnom Penh are in poor condition, due primarily to the lack of funds for urban parks maintenance. Non-native trees such as eucalyptus and casurina pine have been planted in a number of locations to improve the city's appearance. A number of low-lying areas in the city, e.g., 'Lakes' Boeng Kok and Tre Bek, are storm water and sewer discharge catch basins.
Map 2 Phnom Penh Project Road

LEGEND

- Project Road Sections
Table 1 Statistics for Project Roads

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<td><strong>Total for the Project:</strong></td>
<td></td>
<td></td>
<td><strong>115.2</strong></td>
<td><strong>28.103</strong></td>
</tr>
</tbody>
</table>

3.2.1.2 Water Resources

Phnom Penh has the misfortune of having a combined sewer system, designed such that sewage and street runoff mix and end up in the catch basins, which empty into the Mekong River (Sap and Bassac Rivers). The system is virtually plugged, causing severe flooding during the monsoon season when storm water mixed with sewage flows down the streets, flooding businesses, homes and restaurants. In essence the streets act as drainage channels, funneling this contaminated water into the Sap and Bassac Rivers, just at their confluence with the Mekong.

3.2.1.3 Airshed

To date no data on air quality or the extent of road-related emissions have been obtained. The majority of Phnom Penh’s traffic consists of motorcycles. Local airshed contamination does not appear to be a problem; there are no visible signs of air pollution. Due to its location on the shore of the Mekong-Sap confluence, Phnom Penh is subjected to regular winds, which quickly dissipate vehicle emissions.

3.2.1.4 Noise and Vibration

Although no noise data exist for the project streets (based on a complete database search), it is estimated that during the morning and evening rush hours, noise levels easily exceed 70dBA. These levels originate mainly from poorly maintained motorcycle taxis, and to a much lesser degree from cars and trucks. Traffic picks up dramatically at around 0600hrs and then drops off by 1000hrs. By 2100hrs most streets are quiet, with noise levels well below the 45dBA mark. Vibration is not an issue since heavy vehicles are very uncommon in Cambodia.
3.2.2 Socioeconomic Environment

Running from the Central Market Ringroad southward, Boulevard Charles de Gaulle and Boulevard Samdach Monireth, the project roads, pass through a mostly commercial and light industrial area. The existing street is a fully-developed urban thoroughfare, with curbs, gutters, sidewalks (in some places), and some roadside trees. These streets are used not only for vehicular traffic but also as gathering places, sales areas and locations for mobile vendors.

3.3 SIHANOUKVILLE MUNICIPALITY

All the roads in the Sihanoukville study area are within the Gulf of Thailand coastal zone. The rural road sections comprise NR3 along the coast between Veal Rênh and Ban Trapeang Rapou. The 1.1km of urban roads within the town of Sihanoukville pass through a market and commercial area.

The project roads within the town of Sihanoukville are in a state of severe disrepair (see Annex 3), and present safety and sanitary hazards to local businesses.

For the first 6-7km from Veal Rênh, NR3 passes through rice-growing lands mixed with major tidal canals before moving on through marginal grazing lands on the landward side of the road and cut-over mangrove forest on the seaward or southwest side of the road (Photo 3 and Photo 4). For 6km, the railroad parallels the road alignment. There are ten villages located along the road, most presenting minor environmental problems. Between Km 7 and Km 18, the roadbed will be raised to prevent destructive annual flooding of the road; the elevation of the road will be increased by up to 3.3m. The large amount of filling required for such an increase in elevation will create side slope toes as far as 15m from the edge of the existing carriageway (see cross-section details in Annex 3). The new road structure will extend over a 26m-width for at least 10km of NR3. The fill material will come from existing borrow sites as well as a number of new sites located along the road. Trapeang Rapou, where between 25 and 30 residences and business establishments will have to be moved back from the carriageway to permit the road widening to take place, poses a problem in terms of resettlement and compensation (see RAP for details).

Photo 2 Example of Urban Streets Included in the Project in Sihanoukville
[See photos at end of report after Section7-References]

Photo 3 NR3 Roadside Conditions
[See photos at end of report after Section7-References]

Photo 4 Cut-over Mangrove Forest Along NR3
[See photos at end of report after Section7-References]

3.3.1 Natural Environment

3.3.1.1 Forestry Wildlife and Habitat

The natural environment of the urban Sihanoukville area relevant to the road project (1.1km) consists of roadside vegetation and trees which, for 95% of the road’s length, will not be touched.

The habitat along both sides of NR3 has been extensively modified, with draught animal grazing, rice production and mangrove cutting (for charcoal production) taking place. Gully erosion is commonly seen south of Veal Ta Aoog village. Phnom Bokor National Park’s southern boundary parallels the NR3 RoW between Kbal Prek and Trapeang Rapou, but it is more than 6km inland from the road.
3.3.1.2 Airshed

Air quality in the Sihanoukville study area, which is well supplied with winds by the Gulf of Thailand, appears to be excellent. No quantitative data are available, but given the size of Sihanoukville Town and the small towns along NR3, as well as the low present and projected traffic levels (see Table 2), air quality is not an issue in this study area.

3.3.1.3 Water Resources

In Sihanoukville Town water resources issues revolve around the storm water runoff and the present system of directing all runoff into the coastal waters along Sihanoukville’s beach area. Beach users have complained about bad smells and pollution-induced (bacterial) ‘swimmer’s itch’. City officials have noted this problem. The project will not affect this situation, either positively or negatively, and no action related to drainage works is possible within the project TOR.

Along NR3 there is one very large river/tidal canal (Prek Kampong Smach); the bridge which spans it will have a new deck installed. Further on, there are at least 10 small stream crossings. Five of the existing bridges will be used as they are and the rest will have new box culverts installed. These streams are surface drainage channels for the hills to the east. During the dry season they become small tidal canals; conditions vary between fresh water and brackish water. An extreme variation in water volumes exists, and sizing of bridge openings will be crucial to the maintenance of free-flowing systems in order to prevent, or at least minimize, erosion. The final crossing along NR3 at the Trapeang Rapou River/tidal canal requires replacement of a large bridge deck. The river will not be affected by this work.

3.3.1.4 Noise and Vibration

Noise levels throughout this study area are estimated to be well below the 65-70 dBA levels considered to be the maximum acceptable in an outdoor residential setting. Within Sihanoukville, the actual and projected traffic volumes (see Table 2) suggest that noise is not and will not be an issue. The traffic volume forecasts predict 9000 vehicles per 24 hours on NR3 in 2017. This is small for a national highway, on which more than 80% of the traffic is two- and three-wheeled motorized vehicles. At night the existing traffic has been virtually non-existent because of the dangers associated with night travel. It is expected to rise to an estimated 15% of the 24-hour volume over the next twenty years. Vibration is not an issue in this study area as heavy vehicles are rare.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>AADT Traffic Volume Forecasts Along Project Roads (from economic study)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forecast Period/Type</td>
<td>Forecast Year</td>
</tr>
<tr>
<td>Non-motorized Traffic % of total</td>
<td>General</td>
</tr>
<tr>
<td>24hr period (total # of vehicles)</td>
<td>1997</td>
</tr>
<tr>
<td></td>
<td>2007</td>
</tr>
<tr>
<td></td>
<td>2017</td>
</tr>
<tr>
<td>NIGHT: (0-5% of total traffic)</td>
<td>1997</td>
</tr>
<tr>
<td>NIGHT: (15%)</td>
<td>2007</td>
</tr>
<tr>
<td>NIGHT: (15%)</td>
<td>2017</td>
</tr>
</tbody>
</table>

1 AADT—Average Annual Daily Traffic Volume: expressed as vehicles per day passing a point.

10 In fact, the proportion of 2- and 3-wheeled motorized traffic is not expected to decrease substantially over the next 20 years.
3.3.2 Socioeconomic Environment

3.3.2.1 Land, Communities and People
In the urban area of Sihanoukville, encroachment on the RoW was found to be zero. Ten small communities are located along the rural section of NR3, with the largest being Trapeang Rapou. About 30 families live along the NR3 as it approaches the Trapeang Rapou Village bridge from the north. For the most part the villages along NR3 are well back from the road and typically consist of several residences, a store or two, a temple and a few other buildings. Encroachment is minor as most village residences are well off the road; however, some front yards of dwellings extend into the RoW. Stretches of NR3 from Km7 to Km18 are subject to severe annual flooding, resulting in major erosion problems along the road. Houses in the area are flooded regularly.

3.3.3 Cultural Environment
There are no significant cultural heritage features within the RoW in the Sihanoukville study area.

3.4 SIEM REAP PROVINCE
Siem Reap Province is quite diverse topographically. Siem Reap Town, while almost on the shore of Tonle Sap, is within 20 km of the southern extension of the Dangkret sandstone escarpment which stretches across northern Cambodia, reaching elevations of 400-600 meters.

The roads to be rehabilitated in Siem Reap Province fall into three distinct categories: urban roads, semi-urban roads (Main Angkor Wat Access Road), and rural roads (see Table 1).

3.4.1 Natural Environment
Within Siem Reap Town, the roads slated for rehabilitation have no sensitive natural environment features in the RoW other than the mature trees on the town’s main street, which runs past the King's palace and the access road to Angkor Wat. Only resurfacing of the road is planned along the stretches that have large trees, and therefore the trees will not be affected.

Air quality, noise and vibration are not significant issues in the Siem Reap study area, as is indicated by the traffic volume projections (see Table 2).

3.4.1.1 Forests, Wildlife and Habitat
On the rural sections of NR6 (towards the provincial border), roadside forest plantations are of some issue since over 1,500 mature trees will need to be removed from along the RoW to upgrade NR6 to an 8m road standard. Many of the roadside trees bear fruit such as mango, guava, and jackfruit, which are harvested by local people (see RAP for details). Tree removal is of particular concern in villages where trees, often with large canopies, provide shade, shelter and fuel for many residents. They serve as habitat for birds, which in turn control insect pests. Extensive agriculture (principally rice production) along roadsides precludes any ‘natural’ wildlife habitat being negatively affected.

3.4.1.2 Water Resources
With the exception of the Siem Reap River, all waterways crossed by the project roads have an intermittent flow and are dry for 5 to 6 months of the year. These streams act as rain runoff channels and as such do not host fish year-round. During the monsoon season the river flows increase dramatically and fish from the Tonle Sap Lake migrate upstream to use a number of the streams (e.g., the Stoeng Chikreng, flowing through Kampong Kdai), for feeding and spawning. Fish species likely to be found in these streams include cyprinids (minnows, carp) and various catfish. These fish constitute an important seasonal food supply for the local population, and therefore these crossings are considered sensitive (see EMAP, Annex 1).
3.4.1.3 Air
The actual and projected traffic volumes (see Table 2) do not indicate any present or future emissions-derived problems in Siem Reap. However, laterite dust produced by fast-moving traffic is a major problem during the dry season along NR6. Dust was observed coating structures and trees within 100m of both sides of the road, including nearly 100% of the dwellings and food stalls along the roadside. A number of the open-air sheds along this road experience high levels of suspended particulate matter, especially during the dry season when wind conditions tend to be calm and the dust disperses slowly. Mitigative measures for the construction period along NR3 and NR6 as well as on the new quarry haul road off of NR6 (see Map 4) will have to be carefully planned.

3.4.1.4 Noise and Vibration
While somewhat noticeable during heavy traffic periods of the day, noise is not a concern in Siem Reap Town. Noise levels are estimated to be at around 55dBA, with occasional spikes to 65-70dBA as trucks pass by. Dwellings are generally set far back from the road, and thus avoid noise effects. On the rural sections of NR6, road noise is at virtually absent because of the very light vehicular traffic and the fact that existing traffic travels at low speeds. This is the case for all villages in the rural areas.

Vibration is not an issue in Siem Reap Town nor in the villages through which the roads pass since traffic is primarily motorcycles and the occasional 5 to 10-ton truck; not enough to create road-related vibration problems.

3.4.2 Socioeconomic Environment
Along the length of the NR6 RoW under consideration there are at least 12 villages which are very closely linked to the road in terms of transportation, commerce and communication. For the most part they are single or two-tiered villages (having one to two rows of buildings facing the road), with stores and restaurants fronting the main road. Small businesses, houses, stores and mobile vendors are all found within the RoW (Photo 5).

Photo 5 Roadside activity, Kampong Kdai, Siem Reap Province, 1998
[See photos at the end of report after Section 7-References]

3.4.2.1 Land, Community and People
Encroachment in the Siem Reap study area occurs along the urban as well as the rural roads. In the urban sections, namely SRE 2A-2B, more than 25 establishments (mostly businesses) are located in the RoW. In the rural sections of NR6, including the many small villages through which the road passes, the census of PAPs indicated that over 1,300 will be affected. These PAPs are primarily encroachers who have set up small business operations, are cultivating the land, or have ponds within the RoW. As discussed in the RAP, the majority of people using this land are farming small plots for rice, garden vegetables, and fruit tree crops. About 228 (of 1449) PAPs indicated that their operation in the RoW is their only means of support.

3.4.3 Cultural Property
Siem Reap Province was designated a Protected Cultural Zone in 1994 under a Royal Decree (Reachkret). Any development work undertaken anywhere in the province which might disturb the natural environment and cultural property is governed by the Royal Decree, which requires that environmental studies, focusing on the impacts on and protection of cultural property, be undertaken. Under the terms of the Decree, the modification of any feature must be cleared with the provincial APSARA office as well as the Minister of Planning’s office (UNESCO, 1996). Because of the highly sensitive cultural heritage and archeological conditions in Siem Reap, a full program of cultural property management, as pertains to the road rehabilitation project, is defined in this IEA.
NR6 runs through Siem Reap from the airport turnoff and over the Siem Reap River, and forms the gateway to the town and all the tourist attractions found there. The road from the Siem Reap River to the border with Kampong Thom Province is built over an ancient Angkor highway, and a number of important archaeological remains exist in the RoW. In fact the roadway itself is considered to be a culturally significant area because of its long existence.

The most important site along the road is the 85m-long Speam Praptos Bridge, which crosses the Stoeng Chikreng River at Kampong Kdai. The bridge dates back to the 12th or 13th Century and is considered to be an important piece of the national cultural heritage. Partially restored by the French government in 1966-67 [Dumarcay, 1967], this massive, ornate structure has been designated as part of the Angkor World Heritage Site (see Photo I).

In addition to the Speam Praptos, there are nine comparatively small Angkor bridges made of quarried laterite along the road (see Photo 3). Four of these bridges were badly damaged by past military actions, and the rest have been weakened by flooding and the removal of laterite blocks by local people for building material. None are particularly visible from the roadway, yet each one is an integral part of this historic road (Photo 6). A number of the bridges have been buried by the existing road, with more recent bridge structures superimposed upon them. After consultation with the RCG, it was agreed that these nine smaller bridges would be strengthened and reconstructed and appropriate signage and interpretive information provided for tourists and other road users. Prior to the strengthening and restoration work technical specialists will complete a superficial archaeological survey of each site11 and any other area within the construction that may have archaeological remains. It may well be that there is other, previously undiscovered cultural property within the road RoW.

Map 3 Strip Maps of NR6 Showing Location of Laterite Bridges
[See following pages]

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11 Around these sites there may be buried ancient structures, dating back to the 12th and 13th centuries.
Strip Map of NR 6 Showing Locations of Laterite Bridges
4 IMPACTS AND MITIGATIVE MEASURES

Mitigative measures for the project area are summarized in this section and are identified in detail (including costing) in the project EMAP in Annex 1.

4.1 PHNOM PENH MUNICIPALITY

4.1.1 Natural Environment

For the urban roads, impacts on the natural environment will be negligible. Construction-period impacts such as noise, dust, restricted access and traffic congestion are about the same as those associated with regular city road maintenance; these impacts are temporary in nature, and do not call for special mitigation. Proper procedure for management of construction sites and materials, protection of private property, and traffic management will be observed and specified in the Construction Contract, Terms and Conditions, and Specifications.

Given that the roads in question are projected to have relatively low traffic volumes, even in 20 years (see Table 2), the project should not generate air quality problems. Improved road surfaces should aid traffic flow, thus reducing congestion and associated air pollution. In any case, Phnom Phen experiences regular winds originating in the Mekong-Sap confluence which aid in dissipating air pollutants.

4.1.2 Social Environment

Other than temporary inconvenience from the resurfacing and storm drain improvement, no social impact is anticipated.

4.2 SIHANOUKVILLE MUNICIPALITY

4.2.1 Natural Environment

In Sihanoukville Town, impacts resulting from the resurfacing of the 1.3km of urban roads are expected to be negligible. Removal of roadside vegetation will be minimal, the sewer system will be unaltered, and projected increases in traffic levels (see Table 2) are not expected to be great enough to produce any significant air quality or noise-related impacts. Along NR3, roadside residents will experience occasional noise peaks from poorly maintained trucks passing by, but these are expected to be infrequent occurrences.

In the rural areas along NR3, impacts will be greater. The elevation of the road between Km7 and Km18 will greatly increase the portion of the RoW taken up by the fill slopes. Roadside trees which would interfere with the fill slopes will have to be removed. These will be replaced as part of the replanting program, which will have to take place during the construction period so as to avoid erosion of the new fill slopes and increased siltation of local waterways. Care will have to be taken in the design and construction stages to ensure that upgraded water crossings do not cause new erosion or fish migration problems. This can be achieved by ensuring that all culverts have sufficient capacity to carry the runoff flows without constricting channels and increasing flow speeds. New culverts should be placed at slopes no greater than 3% to maintain streambed gradients acceptable for migrating fish, and any downstream plunge pools should have erosion protection, such as large rocks or a concrete lip extending beyond the culvert edge. Borrow site operations, maintenance and closure are described in the EMAP (Annex 1).
4.2.2 Social Environment

Social impacts of the straightforward resurfacing work to be undertaken within Sihanoukville Town are expected to be negligible. No relocation of residents' homes or activities will be required. Disruption of business activities during the construction period is a temporary impact, and is in any case expected to be minor.

The greatest social impacts are expected along the rural stretches of NR3 between Km7 and Km18. Here, the elevation of the road by up to 3.3m and the associated increase in the size of the overall road structure will mean that access for local residents and businesspeople will be made more difficult; new access roads and ramps will have to be provided. A number of dwellings, other structures, and agricultural plots which are presently located within the fill zone will need to be moved. Most of the loss of agricultural land will occur along both sides of the road between Km9 and Km18. Based on a driving survey, it is estimated that 35 to 40 structures will need to be relocated along NR3, of which about 50% are located along the 400-500m approach to the Trapeang Rapou bridge. With the exception of a few structures very close to the bridge, where several layers of structures exist, relocation will involve simply moving the structures back from the existing carriageway as far as is dictated by the projected location of the slope toe. Relocation and compensation issues are addressed in detail in the RAP (Annex 6).

Annual flooding of the communities along NR3 is a fact of life for residents, and currently has little to do with the road. Attention will have to be paid during the design stage to the potential effects of the newly elevated roadbed on dispersal of floodwaters. Where impoundment of floodwaters by the new 3m-high road structure is anticipated, appropriate drainage measures will be incorporated to avoid prolonging the flood season for roadside communities.

In locations where the roadway is customarily used for commerce or congregating or, for that matter, wherever it is used by pedestrians, a potentially significant social impact is reduced safety. The condition of NR3 has always been such that traffic was very light and had to move relatively slowly; local residents are not familiar with the hazards posed by a greater number of faster-moving vehicles. Speed limit signs and other standard road-safety measures will be used in an effort to prevent an increase in serious road-related accidents in and around villages.

4.3 SIEM REAP PROVINCE

4.3.1 Natural Environment

Mature trees lining both sides of NR6 from the airport access road intersection and through town are considered to be an important part of the scenic entrance to the center of Siem Reap; these trees will be left in place. They are far enough from the road's edge that no modifications in road design will have to be made to accommodate them.

Due to a local scarcity of suitable aggregate material, a new quarry may be established northeast of Kampong Kdai along the Praptos River (Map 4). Its construction and operation will need to be carefully monitored.

The design and construction stages must include measures to ensure that upgraded water crossings do not cause fish migration problems. Exposed earth slopes should be revegetated promptly to avoid siltation of channels. Also, all culverts should have sufficient capacity to carry the runoff flows without constricting channels and increasing flow speeds. New culverts should be placed at slopes no greater than 3% to maintain streambed gradients acceptable for migrating fish, and any plunge pools should have erosion protection, such as large rocks or a concrete lip extending beyond the culvert edge.
4.3.2 Social Environment

The overriding environmental issue in Siem Reap is the relatively large number of project-affected people along the rural section of NR6. In the town of Siem Reap only two or three dwellings will have to be relocated; for the most part, impacts within the town will be limited to temporary access restrictions during the construction period. Measures will be put in place to ensure that businesses in the RoW maintain street access throughout the construction period.

Along the NR6 from Siem Reap to the Khampong Thom border road, more than 200 structures will need to be pushed back from their existing locations at the edge of the carriageway (about 3-3.5m from the centerline). Compensation measures proposed in the RAP (Annex 6) include permitting people to continue to use a portion of the RoW, since during Stage 1 of the improvement widening will only be to 8m. The government will provide financial assistance to help people to move their structures back to a safe distance from the carriageway. Those remaining in the 50-m RoW would be asked to sign an agreement stipulating that they will move further back from the RoW when Stage 2 is initiated and the widening to the full 11m width takes place. If possible, agreements will be made to have the PAPs move off the corridor-of-impact during this resettlement. The signed agreement will give occupants ample time to plan their eventual move further back from the RoW within the next 10-15 years if they choose to remain close to the road during this time. More details are presented in the RAP (Annex 6).

As with NR3, local residents, especially those in rural areas, are not accustomed to fast-moving traffic. This poses a safety concern; speed control signs will be placed at the entrances of the towns and villages through which the road passes, with the goal of preventing an increase in serious accidents.

A further safety concern posed by the mixture of slow- and fast-moving vehicles is being addressed by the design of an oxcart path which would parallel the road where space permits.

4.3.3 Cultural Environment

An archeological expert from the Ecole Francaise d'Extreme Orient (EFEO) conducted a study of the ancient bridges on the NR6 between Siem Reap city and the Khampong Thom provincial border. His brief was to recommend a strategy for the Project that would preserve the cultural aspects of these bridges and yet satisfy the Project objective to improve the road. Although the final report of this expert was not available at the time of finalizing this report an interim report was available. This interim report recommended that the ancient bridges not be dismantled or moved from their current positions but rather that engineering solutions should be identified whereby the bridges could remain where they are and with suitable strengthening and reconstruction the new widened and improved road could pass over them. This strategy has been informally accepted by the CCP and adopted by the Project.

The issue of greatest concern in terms of possible cultural heritage impacts is the continued use of the Speam Prapto bridge at Kampong Kda for national highway traffic.

The nine smaller ancient Angkor bridges are to be strengthened with a new reinforced concrete deck slab and internal columns together with reconstruction/restoration as found necessary. This work will be performed under the additional specialist supervision of an archeologist.

One potential negative impact is damage to cultural heritage that may exist in the RoW. A superficial archaeological survey is called for in the EMAP, but it is possible that some sites will be overlooked and permanently buried beneath the road. The EMAP also contains a provision for the training of construction workers in procedures for dealing with cultural heritage features uncovered during the construction period.
In light of the great wealth of cultural heritage features in Siem Reap and the considerable potential for project-related impacts on it, the RCG has decided to form a Steering Committee on Cultural Property (CCP). The CCP's role will be to advise and assist the PIU in all handling of cultural heritage issues related to project actions; it will also develop a protocol to be acted upon in the event of any discovery of previously unknown cultural heritage features in the RoW during construction. See Annex 4 for details on the establishment of the CCP.

4.4 THE ENVIRONMENTAL MANAGEMENT ACTION PLAN

In arriving at the design and scale of this project, many options were examined (see Options Report, IOC, 1998). The options were examined in terms of their engineering, economic and environmental benefits and costs. Some roads were completely removed from consideration due to their high engineering costs and potential environmental losses, primarily in the social environment area. Under the chosen scenario, impacts on the natural environment are, for the most part, expected to be minor and in fact an improvement in the natural environmental conditions is possible in many cases. Consultation with the MOE and Forestry officials, as well as international organizations such as FAO, UNEP and others working in Siem Reap and Kampot provinces, confirmed these findings.

The following construction-period actions were predicted to generate the greatest negative impacts:

**Natural Environment**
- bitumen heating and aggregate crushing;
- borrow pit and quarry access road construction and operation (NR6);
- laterite dust production from construction and other vehicle movement;
- construction noise at late hours;
- clearing the RoW of trees; and
- workforce sewage and garbage disposal.

**Social Environment**
- displacement of people from the road RoW;
- destruction of immovable assets located within the RoW; and
- taking of arable land currently used by occupants of the RoW.

**Cultural Environment**
- loss of cultural property during construction;
- exposure of the Speam Prapot bridge to increasing traffic
- strengthening and restoration of the nine ancient 12th to 13th Century bridges along NR6;
- possible loss of culturally significant assets, which have not been discovered.

During the operation stage, impacts involving road-generated noise and emissions-related air quality deterioration will grow in proportion to traffic volumes. The projected growth in traffic volumes through 2017 may generate air and noise pollution impacts of enough magnitude to warrant mitigative measures in some cases, primarily in the urban areas.

The maintenance of culverts and bridges to prevent obstructions from constricting the runoff flow during the monsoon period will be important erosion control measures.

Since the population living along the project roads is not accustomed to any traffic, the opening of the road will pose a serious safety hazard, particularly through the many towns and villages where the road will be used as a commercial zone and place for congregating.

Ox carts, bicycles, motorcycles and motorcycle taxis will constitute more than 80% of the traffic on the upgraded roads. This slow-moving traffic will share the roads with cars, trucks and buses which will be able to travel the resurfaced roads at greater speeds. The mix of slow- and fast-moving vehicles could pose a safety problem.
The Simplified Engineering Assessment and Design of the Kompong Kdai bridge indicated that the increased live load due to vehicle weight will make little difference on the foundations as 95% of load carried by the foundations is due to dead load (i.e. the bridge's own self weight). The critical stress within the masonry structure of the bridge occurs at the apex of the arches. The scheme proposed for strengthening will, in fact, decrease the stress at this critical point through a wider distribution of the live load. It is recommended that when the detail design is made tests should be done on leatherite masonry blocks or cores taken from material similar to that which is in the bridge. These tests should determine the safe compressive stress in the leatherite masonry. Also, a stress analysis should be carried out to confirm the stresses induced in the apex of the arches.

All details concerning reconstruction and compensation issues, broken down by road and location along each road, are presented in the RAP Annex 6.

A focused summary of the natural, social and cultural environmental impacts and mitigative actions detailed in the EMAP matrix table (Annex 1) is presented in the following subsections. Further details of the summarized information on impacts and mitigative measures can be found in Section 3 of this IEA document.

4.4.1 Phnom Penh Municipality
Aside from the construction-period impacts listed above, all of which are considered temporary and minor, the roadwork in the municipality should present no environmental problems. No mitigative measures are called for.

4.4.2 Sihanoukville Municipality
In Sihanoukville the proposed treatment of the urban roads does not present a problem for either the natural or social environment. Along NR3, no natural environment impacts are serious. Bridges crossing tidal channels will not be altered (aside from deck replacement with welded steel plates); thus there is no possibility that tidal flows could be modified. Existing substandard and crumbling culverts will be replaced with properly sized new ones, reducing the problems with flooding, water damming and erosion. Some trees will need to be removed, but replanting is planned.

Approximately 1218 dwellings will have to be moved back from the existing carriageway to a distance that permits the safe operation of an 8m-wide carriageway. In the flood-prone areas of NR3, high vertical alignments will require careful construction of cross-drainage channels and access roads for local residents who will be faced with climbing up a 3-3.5m embankment from their residences to reach the road. There are no PAPs in these areas.

4.4.3 Siem Reap Province
With the proposed Phase 1 widening to a full 8m carriageway, plus shoulders and ditches, a large number of mature trees will have to be removed along the rural section of the NR6 outside Siem Reap city. Wherever possible, measures will be taken to protect mature shade trees (for details see the EMAP, Annex 1). Within Siem Reap city the construction contract documents specifically prohibit the felling of trees along the access roads to the airport and to Angkor Wat. Also, on the NR6 within Siem Reap city it is stated in the construction contract documents that the intent of the Project is not to fell any trees along the NR6 within the city. In the exceptional case where it is required to fell a tree approval in writing must be obtained from APSARA and also from the Engineer.
Given the scarcity of aggregate material in this area, a new quarry located northeast of Kampong Kdai along the Praptos River may be established (Map 4). Its construction and operation would need to be carefully monitored as it means the transformation of a farm track into a temporary
temporary haul road. The many water crossings along this possible quarry access road would require great sensitivity and careful replacement due to the unusual wet season conditions with large amounts of monsoon rain coupled with extreme water level fluctuations of the Tonle Sap Lake. It is during this season that fish, a local food source, move into a number of these waters to spawn.

The strengthening and restoration/reconstruction of the nine smaller Ankor period bridges will require specialist design and supervision to ensure that the engineering solution chosen for implementation respects the cultural and archeological value of the bridges.

All predicted environmental impacts, the proposed mitigative actions, the timing of their implementation, responsibility for implementation and monitoring of these actions, and costs (where known), are presented in the EMAP (Annex 1). The relocation of PAPs within the RoW will affect social systems, but should not interfere with ecological stability. Details of the resettlement and compensation actions are presented in the RAP (Annex 6).

Map 4 Access Road from Kampong Kdai to Quarry Site at Phnum Khtum [See following page]

4.5 THE RESETTLEMENT ACTION PLAN (RAP)

The RAP is currently under finalization to meet the Bank’s requirements. In summary, the major findings and prescribed mitigative actions are as follows:

The surveys found that there are over 1500 right-of-way users who can be classified as project-affected persons (PAPs). The majority of PAPs using the RoW lands have done so for more than three years. PAPs mainly use the RoW for agriculture and retail activities. They generally do not depend heavily on the RoW for their livelihood; only 228 PAPs declared it to be their sole source of income.

Large numbers of fruit bearing trees are cultivated within the RoW, and the loss of these important assets will mean a prolonged shortfall in the income of the local people who have been tending these trees over the years. Another immovable asset commonly found in the RoW is ‘live’ fencing, consisting of trees and bamboo planted as a barrier (over 14km for both roads in total). The built assets found in the RoW are mostly semi-permanent living quarters and places of business made from thatch or wood, some with plastic or metal roofing. Three permanent buildings and six wells were found along the project road.

The costs of resettlement include compensation payments for lost earnings, compensation for lost assets, and compensation for lost access to previously used land. Vulnerable groups receive additional assistance, both financially and through counseling. At this stage in the project, determination of compensation costs is preliminary but includes all contingencies; exact compensation eligibility and costs will be confirmed in the Verification Survey, which will be undertaken in the pre-construction period. Compensation costs quoted in the RAP do not include estimates of the de-mining activities possibly needed in some areas.

12 Predictions are that if the contractor does choose to upgrade and improve this road for the purpose of extraction of aggregate from the quarry for use on this Project then the road will become a permanent access to the quarry, given that the quarry has a high volume of extractable material and the scarcity of local sources of good rock.
Map 4 Access Road from Kampong Kdai to Quarry Site at Phnum Khtum
5 IMPLEMENTATION PROCESS

5.1 OVERVIEW
The establishment of an environment cell within the MPWT in late 1998 will help significantly in the implementation of the EMAP. Most of the effects from this project will take place during the construction period; the contractors will therefore be responsible for undertaking many of the mitigative actions. The EMAP contains cross-references to Contract Terms and Conditions, and Contract Specification clauses which deal with mitigative measures.

The RAP deals primarily with social and community issues, and will need to be implemented prior to the contractor breaking ground. Specifically, all relocation of people and assets will need to be completed before work begins. Compensation payments and any other entitlements do not need to be fully delivered before the start of construction. The lack of technical expertise within the MPWT in the implementation of RAP requirements will necessitate the use of an experienced consultant or NGO working under the administrative supervision of the PIU.

5.2 IMPLEMENTING THE EMAP
Working closely with the MOE, the PIU will analyze the EMAP included in the IEA report, and prepare a rough schedule of activities. The mitigative measures required during the construction period have been cross-referenced to the Contractors’ Terms and Conditions and the Contract Specification documents and the EMAP has been attached to the contract documentation. This work must be completed and incorporated in the contract documents by the time the construction contracts are tendered.

It is the contractors’ responsibility to undertake the mitigative actions in a timely and competent manner, either through a technical subconsultant or with the assistance of the government (but paid for as part of the contractors’ costs). The PIU will oversee the completion and monitoring of all work (see Annex 2). For tree replacement, the contract bidding documentation will include general location maps and counts of the trees to be removed, as well as replanting specifications prepared by the provincial forestry departments. The contractors bidding on the project will have to include an estimate for the costs of replanting and maintenance of the replanted trees during the construction period. Payment for this work will be made at the end of the construction period, and based on a count of healthy, newly-planted trees. Penalties will be applied if the contractor does not meet the replanting specifications, e.g., replanting a certain number of trees for each one cut down. In Siem Reap, contractors will have to coordinate all tree cutting and replanting with ASPARA, in advance of any cutting.

The contractors or their subconsultants will have to prepare regular mitigation action completion certificates, and submit them to the MPWT and the MOE after each major mitigative action is completed. The Environment Cell of the MPWT, working closely with the PIU and the MOE’s provincial representative, will undertake the necessary compliance monitoring and report any problems to the PIU. The Environment Cell must not communicate directly with the contractor on infractions and compliance issues, but must instead have the PIU take any necessary actions (Figure 2).

The Environment Cell of the MPWT (under direction of the PIU) will be responsible for planning and executing all mitigative measures specified for the roads’ operational period. During the final year of construction, they will be required to prepare the work plan/implementation schedule, based on the EMAP. They will provide monthly and, after the first year, quarterly compliance monitoring completion sheets and annual effects monitoring data to MPWT, with copies to the EIA.

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13 The Environment Cell will be formed, staffed and equipped through the ADB TA Project No. 2723-CAM.
14 In the future the MPWT’s Environment Cell, established as part of the ADB TA, will undertake this task.
15 Hiring a skilled subcontractor is most relevant for the replacement of trees cleared from the road construction area.
16 This will need to be coordinated with a RAP implementation consultant or NGO.
Department of the MOE, for the second construction year and for years 1 and 3 of operation. Compliance monitoring will include a count of the number of living replacement trees planted during the construction period. The draft timetable (Table 3) presents the proposed sequence of actions, as specified in the EMAP, and should form the basis of the contractors' timetable.

5.3 IMPLEMENTING THE RAP

The implementation of the RAP is critical to the project's timetable in that, according to the World Bank's Operational Directive 4.30, all notification and relocation of PAPs must be completed before the civil works can begin (Table 3). People must be relocated and provided with the shifting allowance at a pace four months ahead of the civil works affecting the area. However, compensation payments and any other entitlements do not need to be fully delivered before the start of construction.

Table 3 Proposed Timetable of Tasks for the Implementation of the Project RAP and EMAP

<table>
<thead>
<tr>
<th>Activity NO.</th>
<th>Description</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAP</td>
<td>Appointment of PAP Survey NGO</td>
<td>F</td>
<td>M</td>
<td>A M</td>
</tr>
<tr>
<td>RAP</td>
<td>Census and Socio-Economic Survey of PAPs</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAP</td>
<td>RAP Details Submitted to MPWT</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAP</td>
<td>Establish Unit Prices for RAP compensation</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAP</td>
<td>Circulation of Entitlement Policy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAP</td>
<td>Finalize RAP - Review by WB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAP</td>
<td>Finalize RAP - Review by MPWI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAP</td>
<td>Final Review and Approval of RAP by RCG</td>
<td></td>
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<tr>
<td>RAP</td>
<td>Community Consultation</td>
<td></td>
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<tr>
<td>RAP</td>
<td>Resettlement of People</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>RAP</td>
<td>Compensation for Land and Assets Lost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAP</td>
<td>Compliance and Effects Monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAP</td>
<td>Reporting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RCG &amp; WB</td>
<td>Appraisal (A) and Contract Sign (C), with WB</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMAP</td>
<td>Nat. Env. Survey and Impact Assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMAP</td>
<td>Prep. of EMAP by Consultant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMAP</td>
<td>EMAP mitigative measures included in Contract Terms and Conditions &amp; Specifications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMAP</td>
<td>As part of Bid-proposal, contractor prepares EMAP Execution Plan</td>
<td></td>
<td></td>
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<tr>
<td>EMAP</td>
<td>Contractor Implements EMAP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMAP</td>
<td>Compliance Monitoring by PIU and the EC</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Engineering</td>
<td>Prequalification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering</td>
<td>Request for Bids Starts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering</td>
<td>Contractor Selected</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering</td>
<td>Start of Civil Works</td>
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</tbody>
</table>

Note: Monitoring will continue as specified on the EMAP and in the IEA document, Sections 5.2 & 5.3.

17 The RAP will have received approval by the RCG and the World Bank by the end of June 1998; minor locational and temporal adjustments may be made after approval, but no changes to the entitlement amounts and eligibility criteria will be possible. Such changes would need World Bank concurrence.
Figure 2: Steps Involved in the Implementation of EMAP and RAP Mitigative Measures
Since the MPWT’s experience in resettlement is very limited, an implementation NGO or consultant will be retained by the PIU to coordinate the RAP work. The distribution of compensation payments and the collection of the release letters and follow-up monitoring will be undertaken by the PIU and an independent monitoring or auditing agency working with the governor’s office as well as local (commune) resettlement representatives identified by the governor’s office. RAP monitoring should be undertaken by the PIU, working closely with a monitoring agency, quarterly until all compensation and other forms of assistance are distributed and once at the end of the construction period. Reporting will be to the MPWT, with copies sent to the World Bank. The content of such monitoring reports will be prescribed by the PIU of the MPWT.

5.4 IMPLEMENTATION TIMETABLE

The RAP/EMAP implementation timetable is based on a date of late November 1999 for the start of civil works (Table 4). A summary of the activities for both plans is presented in Table 4 of the RAP. As indicated earlier in this document, the resettlement of people located in the cleared area of the RoW must be completed before the civil works can begin. Compliance monitoring will continue beyond the end of the first year of construction, in accordance with the specifications given in Sections 5.2 and 5.3.

5.5 ESTIMATED COSTS

Table 4 represents a first-order estimate of the cost of implementing the measures called for in the EMAP and RAP, including staff and administrative costs.

Table 4 Estimated Costs of Executing EMAP and RAP Requirements

<table>
<thead>
<tr>
<th>ITEM</th>
<th>TOTAL</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EMAP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Construction period mitigative measures to be costed by contractor as part of competitive bid*</td>
<td>$100,000.00</td>
<td>Included in contract estimate</td>
</tr>
<tr>
<td>2. Tree Replanting program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No. trees removed:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No. Trees replanted: 10,000 seedlings @ $5</td>
<td>$50,000.00</td>
<td></td>
</tr>
<tr>
<td>3. Superficial Archaeological Survey of NR6</td>
<td></td>
<td>Separate Bank fund</td>
</tr>
<tr>
<td>4. Strengthening and reconstruction/restoration of nine small Angkor bridges</td>
<td>$1,100,000.00</td>
<td>Included in contract estimate</td>
</tr>
<tr>
<td>5. One Notebook Pentium II computer incl. software</td>
<td>$5,000.00</td>
<td>Bank to fund</td>
</tr>
<tr>
<td><strong>EMAP Total</strong></td>
<td>$1,255,000.00</td>
<td></td>
</tr>
<tr>
<td><strong>RAP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. National Road 3</td>
<td>$67,747.55</td>
<td>See RAP Table 6</td>
</tr>
<tr>
<td>7. National Road 6</td>
<td>$205,979.60</td>
<td>See RAP Table 6</td>
</tr>
<tr>
<td>8. Administration of RAP</td>
<td>$65,000.00</td>
<td>See RAP Table 7</td>
</tr>
<tr>
<td>9. Contingency (10% of 6+7)</td>
<td>$27,372.72</td>
<td></td>
</tr>
<tr>
<td><strong>RAP Total</strong></td>
<td>$366,099.87</td>
<td>Total: $1,621,099.87</td>
</tr>
</tbody>
</table>

* The $5 includes planting, tending and protecting for 16 months.

6 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are made within the context of the existing work plan and the project TOR:

- This project's benefits will clearly outweigh its costs, and no major natural or social environmental issues are anticipated.

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18 Stating that the PAP will vacate (without compensation) the RoW, before the final widening is to take place.
• Siem Reap’s designation as a special conservation area, under the Royal Decree, called for the establishment of a Cultural Property Advisory Group (CPAC), which would make all final decisions regarding the work in or near cultural properties in the province. The makeup and TOR of the Advisory Panel are presented as (Annex 4) of this EA.

• A full census of PAPs along both NR6 and NR3 was undertaken in March and April 1998. The outcome revealed that 1489 eligible PAPs occupy the area to be cleared within the RoW. All of those PAPs will remain within the RoW and simply shift back (see RAP for details).

• Cost of implementing the EMAP (including construction and other costs) is $272,700.

• Compensation of entitled households and people will involve six categories of PAPs with an estimated total cost of US$266,700 (plus 10% contingency).

• A superficial archaeological survey of the nine Angkor bridge areas as well as the NR6 road RoW is needed, and is now being undertaken through a separately funded study. The final results are expected by mid-June 1998, but action has already been taken to include the interim recommendations into the implementation plan for the Project.

• It is clear that the institutional capacity of the MPWT is insufficient to properly execute and administer a RAP and EMAP. The ADB TA No. 2723-CAM should address this weakness by helping to establish and outfit an environment cell within the MPWT. Should this recommendation not be implemented, a training program on how the key outputs from this EA process must be implemented and managed should be provided to 3 or 4 people from the MPWT. Collaboration with the MOE and MEF may be appropriate. A capable local NGO or consultant may be called on to work together with the PIU to implement the measures while, at the same time, providing on-the-job training.

7 REFERENCES
Asian Development Bank, Ministry of Environment (Cambodia), and Seatec International. 1998. *EIA Sub-Decree.* Preliminary draft of new legislation for Cambodia, proposed as part of ADB T.A. No. 2723-CAM.


PHOTOGRAPHS
Photo 1 The Speam Praptos Bridge on NR6 at Kampong Kdaï, 1998

Photo 2 Example of Urban Streets Included in the Project in Sihanoukville
Photo 3 NR3 Roadside Conditions

Photo 4 Cut-over Mangrove Forest Along NR3
Photo 5 Roadside activity, Kampong Kdai, Siem Reap Province, 1998

Photo 6 Small Laterite Block Bridge in "Good" Condition
ANNEX 1
### Annex 1  Environmental Management Action Plan (EMAP) Cambodian Highways Rehabilitation Project

<table>
<thead>
<tr>
<th>Environmental Impact</th>
<th>Mitigation Measures taken or to be taken</th>
<th>Ref No. 19 (FIDIC Clause)</th>
<th>Ref No. 20 (Contract Specs.)</th>
<th>Location</th>
<th>Timeframe</th>
<th>Implementing Organization / Supervising Organization</th>
<th>Capital Cost in S$ (3,600R/ SUS)</th>
<th>Operational Costs/Unit Cost ($)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Increased visual intrusion from clearance of alignment</td>
<td>1. Trees along the roadside in Siem Reap are under the management of APSARA (since the entire province is a cultural conservation zone). Carriageway widths have been modified to prevent and significantly reduce the need to cut trees. All tree cutting in the urban section of NR6 will be cleared by APSARA and the Provincial Town Planning Department. In rural sections tree removal will be based on a plan in which the trees interfering with safe traffic movement will be marked for removal. This plan will be checked by the PIU and approved prior to the commencement of civil works.</td>
<td></td>
<td></td>
<td>Entire NR6 area</td>
<td>During design phase</td>
<td>PIU, MPWT and APSARA</td>
<td>Included in the Contract Document capital costs</td>
<td>See Contract Estimate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. A design will be prepared for an ox cart track paralleling the road (within the RoW) where space permits, either as a part of the roadway feature or a separate surface located a meter or two from the toe of the roadbed. Special provisions at bridges will also be designed into these cart tracks. Secondly, given that the carriageway is 8m across, i.e., two four-meter-wide lanes, there will be room for slower moving vehicles, e.g., motorcycles, to use the shoulder areas (about 1.5m) of the carriageway.</td>
<td></td>
<td></td>
<td>In rural sections of the road and where space permits—flattened path only</td>
<td>During design phase</td>
<td>PIU, MPWT and APSARA</td>
<td>Included in the Contract Document capital costs</td>
<td>See Contract Estimate</td>
<td></td>
</tr>
<tr>
<td>Danger to non-motorized traffic</td>
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<tr>
<td></td>
<td>3. A rehabilitated road will more than quadruple the traffic within a matter of days of its completion, due to the long-suppressed traffic coming back onto the road. To help reduce the risk of serious accidents, speed control signs and other visual means will be used at the entrance and through the urban zones of towns and villages along the road. Many of the activities of the villages are centered on the road and thus there is a large pedestrian and livestock traffic back and forth across the road. A reduced speed will help both with safety and noise problems, particularly in the evening.</td>
<td></td>
<td></td>
<td></td>
<td>During design phase</td>
<td>PIU, MPWT and APSARA</td>
<td>Included in the Contract Document capital costs</td>
<td>See Contract Estimate</td>
<td></td>
</tr>
</tbody>
</table>

19 Clauses found in contract conditions FIDIC 4  
20 Clauses found in the Specification of the contract packages of MPWT.  
The RAP is currently under finalization to meet the Bank's requirements.
<table>
<thead>
<tr>
<th>Environmental Impact</th>
<th>Mitigation Measures taken or to be taken</th>
<th>Ref. No. 1 (FIDIC Clause)</th>
<th>Ref. No. 2 (Contract Spec.)</th>
<th>Location</th>
<th>Timeframe</th>
<th>Implementing Organization / Supervising Organization</th>
<th>Capital Cost in $S ($3,600R/ SUS)</th>
<th>Operational Cost/Unit Cost (Unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land, assets and right to use land taken away</td>
<td>4. Compensation will be given to entitled PAPs based on a census of all PAPs. This will form the basis of the Resettlement Action Plan (RAP) and its Entitlement Policy.</td>
<td>Refer to Table 6 in RAP</td>
<td>During Design Phase</td>
<td>Contractor working with community leaders</td>
<td>MPWT and NGO(s) recommended as a monitor and the PIU</td>
<td>See RAP for $S values</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. The RAP will be implemented by the provincial Governor’s Office in cooperation with a reputable NGO. The NGO would participate as the advisor to the Governor’s Office. Entitled people must be moved back from the work zone, (as defined during the PAP census), before any civil engineering works can start. This will be done in a sequence such that actual resettlement occurs at least 4 months ahead of the start of civil works in that location. (See RAP)</td>
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<tr>
<td></td>
<td>6. The RAP will contain a section outlining who is entitled to compensation, what the compensation mechanisms will be, how grievances are filed, and how the Government is expected to handle them.</td>
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<td></td>
<td>7. In the approaches to towns and villages and the road through them, mobile vendors who sell items on the ground or from makeshift stands at the edge of the pavement, will be encouraged to conduct their business at new market areas provided by the project. These would be constructed at locations agreed to by the village head and the displaced vendors. These market areas are proposed for Damdek, Kampong Kdai, and Trapeang Rapou. Details are provided in the RAP document.</td>
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</tr>
<tr>
<td>Losses to Cultural Heritage Demolition of buried archaeological sites</td>
<td>8. The Minister of Culture and Planning, Mr. Molyvann, will form a Steering Committee on Cultural Property (CCP) to address and advise on all architectural problems arising with the project.</td>
<td>Based in PP, but operating from Siem Reap</td>
<td>During design phase</td>
<td>PIU and CCP</td>
<td>10,000</td>
<td>10,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9. Visible cultural heritage sites along the alignment have been identified and inventoried. A more detailed surface archaeological survey of the road corridor will be conducted to confirm that there are no special additional sites that need conservation. A protocol and action plan will also be prepared by the CCP, to establish exactly the procedure the contractor(s) must follow should a cultural feature be unearthed (regardless of size). Finally, the CCP will organize a half-day training session, given by an external expert, for contractors and monitors (latter from PIU and Env. Cell) on road construction and archaeological finds and key steps to follow. Attendance by contractors will be mandatory.</td>
<td>Along SR roads</td>
<td>During design phase</td>
<td>Contractor(s) must follow the procedure established by the CCP</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>10. A special study was commissioned by the Bank to confirm the capacity of the Kampong Kdai bridge to continue to carry the current and future traffic load. The study was directed by the PIU and established that with suitable strengthening and reconstruction the bridge could continue to be used.</td>
<td>At Kampong Kdai</td>
<td>During design phase</td>
<td>Contractor with direction from PIU and Env. Cell</td>
<td>180,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11. The nine small Angkor period bridges have been inventoried and photographed. It was agreed with the Government to strengthen and restore these bridges so that they can continued to be used to carry traffic.</td>
<td>At bridge sites</td>
<td>Design phase, prior to the initiation of civil</td>
<td>Contractor with direction from PIU and Env. Cell</td>
<td>122,000 per bridge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Impact</td>
<td>Mitigation Measures taken or to be taken</td>
<td>Ref No. 1° (FIDIC Clause)</td>
<td>Ref. No.2° (Contract Specials)</td>
<td>Location</td>
<td>Timeframe</td>
<td>Implementing Organization / Supervising</td>
<td>Capital Cost in $S (SUS)</td>
<td>Operational Cost/Unit Cost ($unit)</td>
</tr>
<tr>
<td>----------------------</td>
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</tr>
<tr>
<td>Increasing danger of flooding due to inadequate culverts and drainage</td>
<td>12. All culverts will be designed for the purpose of the flood discharge (100-year flood). In areas where extreme fill heights (&gt;3.5m) need to be used to prevent road flooding, e.g., along NR3, cross drainage will be carefully managed to assure that no lands are flooded or conversely washed away by build-up of water followed by flash flooding. No new bridges will be constructed.</td>
<td>19.1 (c)</td>
<td>Special Specification</td>
<td>Throughout corridor during construction</td>
<td>During reconstruction of grade and between asphalt removal and replacement</td>
<td>Contractor/ MPWT and its PIU. At present no intervention envisaged. Capacity It will come from new Environment Cell within MPWT under ADB-TA. Pollution Control Dept. for monitoring Standard Equipment and materials</td>
<td>Covered under normal work Pay Items and item No 103</td>
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</table>

**CONSTRUCTION PHASE**

**Natural Environment**

**Dust, Odor, Air and Noise**

| Dust/Odor | 13. Water should be sprayed during the construction phase in any mixing area where dry materials are handled and/or crushed. Temporary access roads to aggregate sites must be included in the dust suppression program. A spraying schedule will be prepared by the contractor and will serve as the basis of a dust control program. The PIU will monitor this schedule should problems arise. | 19.1 (c) | Special Specification | Throughout corridor during construction | During reconstruction of grade and between asphalt removal and replacement | Contractor/ MPWT and its PIU. At present no intervention envisaged. Capacity It will come from new Environment Cell within MPWT under ADB-TA. Pollution Control Dept. for monitoring Standard Equipment and materials | Covered under normal work Pay Items and item No 103 |
| 14. Vehicles delivering materials to and from the construction sites should be covered to reduce spills. | 19.1 (c) | | | | | |
| 15. Asphalt application will be heated liquid bitumen sprayed onto an aggregate base. Bitumen preparation sites will be noisy, with some odor and a considerable risk of fire. Therefore all bitumen preparation and loading sites must be over 500m down-wind from any communities/residences, and the contractor must have spill and fire protection equipment available to rapidly deal with any accidents. | 19.1 (c) | | | | | |
| 16. Mixing and crushing plants/operations should be equipped with dust suppression devices such as water sprays. Operators should wear dust masks and ear protection. | 19.1 (c) | | | | | |

**Air Pollution**

| Air Pollution | 17. Vehicles and machinery to be regularly maintained so that emissions conform to national standards. Since Cambodia's standards for emissions controls are still being developed, Thailand's standards for construction vehicle and truck emissions will be applied (except from Thailand's regulations are attached as Error! Reference source not found. to the ISA). | 19.1 (c) | Special Specification | Throughout corridor | Beginning with and continuing throughout construction | Contractor/ with monitoring from PCD and PIU or Environment Cell of MPWT | Covered under normal work Pay Items and item No 103 |
| | | Section 1.12 | | | | |

**Noise**

<p>| Noise | 18. Noise standards at aggregate crushing plants and bitumen preparation sites will be strictly enforced to prevent exceedances of acceptable noise standards (Government of Thailand standards for commercial zones, namely Lw, of 70dBA). Maintenance of machinery and vehicles should be enhanced to minimize noise. | 19.1 (c) | Special Specification | Throughout Corridor | Beginning and throughout construction | Contractor/ with monitoring from PCD and PIU or Environment Cell of MPWT | Covered under normal work Pay Items and item No 103 |
| | 19. When construction is taking place at ≤100 m from the many | 19.1 (c) | | | | | |</p>
<table>
<thead>
<tr>
<th>Environmental Impact</th>
<th>Mitigation Measures taken or to be taken</th>
<th>Location</th>
<th>Timeframe</th>
<th>Implementing Organization / Supervising Organization</th>
<th>Capital Cost in $ (3,660R/ SUS)</th>
<th>Operational Costs/Unit Cost ($/unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WATER</strong></td>
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<tr>
<td>Loss of wetlands and ponds</td>
<td>20. Wherever possible, the siting of alignment and filling should avoid ponds and wells. Natural wetlands, such as those found along the NR3 road corridor, should be left undisturbed.</td>
<td>Design Requirement</td>
<td>Special Specification Section 1.12</td>
<td>Whenever encountered during construction</td>
<td>PIU and Contractor// MOE and Environment Cell of MPWT</td>
<td>Covered under normal work Payitems and Item No 103</td>
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<td></td>
<td>21. Where ponds are affected, replacements will be dug. Any wells removed must be replaced with an equivalent or better well (same flow level) prior to the closure of the existing well.</td>
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<td>See RAP (FPN) Reference source not found, of IEA</td>
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<tr>
<td>Alteration of drainage</td>
<td>22. In sections along watercourses, earth and stones will be properly disposed of so that they do not block rivers and streams, resulting in adverse impact on water quality and flow regime.</td>
<td>Refer to Cross Drainage Structure Engineering Report</td>
<td>Whenever encountered during construction</td>
<td>Contractor// PIU and Environment Cell of MPWT</td>
<td>Covered under normal work Payitems and Item No 103</td>
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<tr>
<td>Stagnant water as insect-borne disease vectors</td>
<td>23. The formation of standing waters on construction sites in tropical areas often leads to the spread of insect-borne diseases such as malaria, dengue fever and schistosomiasis. Therefore there must be a vigorous program by the contractor to avoid such standing waters, including the removal of old materials such as used tires and storage drums. In cases where standing waters are managed by their owners (users), e.g., through fish or waterfowl stocking, they will be held responsible for insect control. The owners/users should be given information about the dangers of waterborne diseases in standing water and how to prevent them.</td>
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<td>24. All necessary measures will be taken to prevent earthworks and stone works related to the road from impeding cross drainage at rivers/streams and canals or existing irrigation and drainage systems. 'Side-borrow' sites will be used as drainage ditches and designed such that they drain into the nearest water course—BUT at a slope (e.g., &lt;5%) permitting fine suspended materials to settle out.</td>
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<tr>
<td>Sitiation</td>
<td>25. Construction materials containing fine particles, e.g., limestone or laterite, should be stored in an enclosure such that sediment-laden water does not drain into nearby watercourses, but rather percolates slowly into the soil. See measure for soil erosion.</td>
<td>Refer to construction site plans</td>
<td>Throughout construction period</td>
<td>Contractor// PIU and Env Cell of MPWT, input from MOE</td>
<td>Covered under normal work Payitems and Item No 103</td>
<td></td>
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<tr>
<td>Contamination of water table or surface drainage</td>
<td>26. For this type of road rehabilitation the most severe possible water quality impact could come from spilled bitumen or any petroleum products used to thin the bitumen. Bitumen is stored in drums which may leak or which are often punctured during handling after long periods (&gt;6 months in the elements) of storage. No bitumen must enter either running or dry streambeds and none can be disposed of in ditches or small waste disposal sites prepared by the contractor. Bitumen storage and mixing areas must be protected against spills and all contaminated soil must be properly handled according to MOE or other acceptable (to RCG and World Bank) standards. As a</td>
<td>Refer to construction site plans</td>
<td>Throughout construction period</td>
<td>PIU and Env Cell prepare spill contingency plan Monitoring by PIU and Env Cell, with advice from Pollution</td>
<td>Covered under normal work Payitems and Item No 103</td>
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<tr>
<td>Environmental Impact</td>
<td>Mitigation Measures taken or to be taken</td>
<td>Ref No. 19 (FIDIC Clause)</td>
<td>Ref. No. 20 (Contract Spec.)</td>
<td>Location</td>
<td>Timeframes</td>
<td>Implementing Organization / Supervising Organization</td>
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<td>Contamination from waste water (other than sewage)</td>
<td>Minimum these areas must be contained, such that any spills can be immediately contained and cleaned up. Prior to initiating the work, the contractor will meet with the MOE to determine the proper siting of the mixing areas and the handling and management of such spills. Any petroleum products used in the preparation of the bitumen mixture must also be carefully managed to avoid spills and contamination of the local water table only 3-6 meters below the road surface.</td>
<td>19.1. (c)</td>
<td>Special Specification Section 1.12</td>
<td>Refer to Construction Design Survey document (CDSR)</td>
<td>Throughout construction period</td>
<td>Contractor/ PIU and Env. Cell of MPWT</td>
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<tr>
<td>Contamination from fuel and lubricants</td>
<td>Vehicle maintenance and refueling should be confined to areas in construction camps designed to contain spilled lubricants and fuels. Waste petroleum products must be collected, stored and taken to approved disposal sites, according to MOE requirements.</td>
<td>19.1. (c)</td>
<td>Special Specification Section 1.12</td>
<td>Construction camp lease area</td>
<td>Throughout construction period</td>
<td>Contractor/ PIU and Environment Cell of MPWT</td>
</tr>
<tr>
<td>Sanitation and Waste Disposal in Construction Camps</td>
<td>Sufficient measures will be taken in the construction camps, i.e., provision of garbage bins and sanitation facilities. All sewage sources or toilet facilities should be at least 300m from water sources or existing residences. Prior to initiating work, the contractor will present a simple sewage management plan to the MOE and PIU for approval.</td>
<td>19.1. (c)</td>
<td>Special Specification Section 1.12</td>
<td>Construction camp lease area</td>
<td>Before and during building of construction camps</td>
<td>Contractor/ PIU and Environment Cell of MPWT</td>
</tr>
<tr>
<td>Soil Erosion</td>
<td>On slopes and other potentially erodible places along the roadside, appropriate vegetation that retards erosion should be planted.</td>
<td>Design Requirements</td>
<td>Special Specification Sections 6.6 and 6.20</td>
<td>Primarily at water crossings and sections where fill heights are &gt;3m. Refer to CDSR.</td>
<td>Upon completion of construction activities at these sites</td>
<td>Contractor/ PIU and Environment Cell of MPWT</td>
</tr>
<tr>
<td>Loss of topsoil</td>
<td>Arable lands should not be used as earth borrowing or storage sites whenever possible. If needed, the topsoil (15cm or so) should be kept and refilled after excavation is over to minimize the impact on productive lands.</td>
<td>19.1. (c)</td>
<td>Special Specification Section 1.12</td>
<td>Along corridor</td>
<td>During construction</td>
<td>Contractor/ PIU and Environment Cell of MPWT</td>
</tr>
<tr>
<td>Compaction of Soil</td>
<td>Construction vehicles should operate within the Corridor of Impact, i.e., approx. 9m to either side of the carriageway.</td>
<td>19.1. (c)</td>
<td>Special Specification</td>
<td>Throughout corridor especially in</td>
<td>During construction</td>
<td>Contractor/ PIU and</td>
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<table>
<thead>
<tr>
<th>Environmental Impact</th>
<th>Mitigation Measures taken or to be taken</th>
<th>Ref No. 1&lt;sup&gt;st&lt;/sup&gt; (FIDIC Clause)</th>
<th>Ref No. 2&lt;sup&gt;nd&lt;/sup&gt; (Contract Organization Costs in $/Unit)</th>
<th>Location</th>
<th>Timeframe</th>
<th>Implementing Organization / Supervising Organization</th>
<th>Capital Cost in $5 (@$3,690R/US)</th>
<th>Operational Costs/Unit Costs ($/unit)</th>
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<tr>
<td><strong>FLORA</strong></td>
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<td>Loss of trees</td>
<td>37. A tree-cutting and replanting scheme will be prepared by APSARA, the Provincial Forestry Department, the contractor and the PIU, within the first four months of the start of civil works. Tree clearing within the RoW of NR3 should be avoided beyond what is directly required for construction activities and what should be removed to reduce accidents. A replanting scheme must be developed by the Prov. Forestry Dept., the contractor and the PIU, within the same 4-month time period.</td>
<td>Design Special Specification Section 19.1 (c) Areas of Tree Plantations along roadsides, refer to strip mapping survey. Soon after completion of construction activities in immediate area During clearing operations</td>
<td>Environment Cell of MPWT</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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<td>Compaction of vegetation</td>
<td>38. See soil compaction (No. 36).</td>
<td>Special Specification Section 1.12</td>
<td>Especially in arable areas</td>
<td>Contractor/ PIU and Env. Cell of MPWT</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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<td><strong>FAUNA</strong></td>
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<td>Loss of access</td>
<td>39. Construction workers should be told to protect natural resources and wild animals. Hunting is strictly prohibited. 40. Stream crossings that are dry during the work period should be kept unobstructed at all times and the channels should not be altered, since during the monsoon periods these dry river beds become fishing areas for local residents. Materials are not to be borrowed from these river beds. 41. In the NR3 corridor, the first 5km of roadway are flanked by brackish tidal waters, which mark the end of a large brackish wetland stretching to the coast. During road construction this channel may have to be moved back away from the carriageway, and if so this must be done with great care to make sure that the natural water movement (in terms of flow and volume) is maintained. Prior to civil works beginning there the MOE should be consulted. 42. Many of the streams along NR3, for which culverts will be sized, are tidal influenced and therefore adequate measures to keep such flows unimpeded must be considered in calculating the culvert sizes.</td>
<td>19.1 (c) Special Specification Section 11.12 Vicinity of construction During construction</td>
<td>Contractor/ PIU, MOE, and Env Cell Contractor/ PIU, MOE and Env Cell Contractor/ PIU, MOE and Env Cell Contractor/ PIU and Env Cell</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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<td>Traffic jams and congestion</td>
<td>43. Temporary bypasses should be constructed and maintained (including dust control) during the construction period, particularly at bridge crossings. 44. If there are traffic jams during construction, measures should be taken to relieve the congestion through better coordination between the contractor, the Provincial Transportation</td>
<td>19.1 (c) Special Specification Section 1.9 Wherever necessary During construction</td>
<td>Contractor/ PIU and Env Cell</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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<th>Capital Cost in $S/Unit ($3,600R/Unit)</th>
<th>Operational Costs/Unit Cost ($/unit)</th>
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<td></td>
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<td>Section 1.9</td>
<td>Section 1.9</td>
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<td>authority</td>
<td>Payitems and Item No. 103</td>
<td>Covered under normal work Payitems and Item No. 103</td>
</tr>
<tr>
<td>Road safety, collisions between vehicles, people and livestock</td>
<td>Control speed of construction vehicles through road safety education and fines.</td>
<td>19.1 (c)</td>
<td>Special Specification Section 1.9</td>
<td>Throughout road corridors</td>
<td>During construction</td>
<td>Contractor//PIU</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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<td>Allow for adequate traffic flow around construction areas.</td>
<td>19.1 (c)</td>
<td>Special Specification Section 1.9</td>
<td>Throughout road corridors</td>
<td>During construction</td>
<td>Contractor//PIU</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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<td>Communicate to the public through radio, TV, and newspaper announcements regarding the scope and timeframe of projects, as well as certain construction activities causing disruptions or access restrictions.</td>
<td>19.1 (c)</td>
<td>Special Specification Section 1.9</td>
<td>Throughout road corridors</td>
<td>During construction</td>
<td>Contractor//PIU</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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<td>Support and design during road safety education campaign.</td>
<td>19.1 (c)</td>
<td>Special Specification Section 1.9</td>
<td>Throughout road corridors</td>
<td>During construction</td>
<td>Contractor//PIU</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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<td>Make sure that there is good principal area drainage at all construction areas, to avoid creation of stagnant water bodies, including water in old tires, especially in urban/industrial areas.</td>
<td>19.1 (c)</td>
<td>Special Specification Section 1.9</td>
<td>Construction camps</td>
<td>During construction</td>
<td>Contractor//PIU</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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<td>Provide adequate sanitation and waste disposal at construction camps.</td>
<td>19.1 (c)</td>
<td>Special Specification Section 1.9</td>
<td>Construction camps</td>
<td>During construction</td>
<td>Contractor//PIU</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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<td>Provide adequate health care for workers and locate camps away from sensitive areas.</td>
<td>19.1 (c)</td>
<td>Special Specification Section 1.9</td>
<td>Construction camps</td>
<td>During construction</td>
<td>Contractor//PIU</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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<td>Effective safety and warning measures will be taken to reduce accidents.</td>
<td>19.1 (c)</td>
<td>Special Specification Section 1.9</td>
<td>Construction camps</td>
<td>During construction</td>
<td>Contractor//PIU</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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<td>The management and use of blasting materials will be in strict conformity with the safety requirements for public security.</td>
<td>19.1 (c)</td>
<td>Special Specification Section 1.9</td>
<td>Construction camps</td>
<td>During construction</td>
<td>Contractor//PIU</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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<td>The management and use of blasting materials will be in strict conformity with the safety requirements for public security.</td>
<td>19.1 (c)</td>
<td>Special Specification Section 1.9</td>
<td>Construction camps</td>
<td>During construction</td>
<td>Contractor//PIU</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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<td>If archaeological relics or remains are discovered, the procedure developed by the CCP should be triggered immediately. The primary contact would be APSARA in Siem Reap. The construction should be stopped until APSARA or their designated specialist assesses the find and gives a resume work instruction.</td>
<td>27.1</td>
<td>Special Specification Section 1.12</td>
<td>Throughout road corridors</td>
<td>Throughout construction</td>
<td>Contractor with PIU, APSARA and Env. Cell of MPWT</td>
<td>Covered under normal work Payitems and Item No. 103 and a specific item for Kompong Kdei</td>
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<td>Should any artifacts be uncovered, archaeologists will supervise the excavation to avoid any damage to the relics.</td>
<td>27.1</td>
<td>Special Specification Section 1.12</td>
<td>Throughout road corridors</td>
<td>Throughout construction</td>
<td>Contractor with PIU, APSARA and Env. Cell of MPWT</td>
<td>Covered under normal work Payitems and Item No. 103 and a specific item for Kompong Kdei</td>
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<td></td>
<td>A simplified Engineering Assessment and Design study has determined that with suitable strengthening and reconstruction the Kompong Kdei bridge will be capable of carrying the future projected traffic load.</td>
<td>27.1</td>
<td>Special Specification Section 1.12</td>
<td>Throughout road corridors</td>
<td>Throughout construction</td>
<td>Contractor with PIU, APSARA and Env. Cell of MPWT</td>
<td>Covered under normal work Payitems and Item No. 103 and a specific item for Kompong Kdei</td>
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<td>All construction materials should be reused, recycled or properly disposed of. This will become particularly important at the many small bridge replacement sites, where old reinforced concrete will need to be properly disposed of. All worn out parts, equipment and empty containers must be removed from the site to a proper storage location designated by the provincial government and the MOE.</td>
<td>19.1 (c)</td>
<td>Special Specification Section 1.12</td>
<td>Throughout road corridors</td>
<td>Throughout construction</td>
<td>Contractor with PIU, and Env. Cell of MPWT</td>
<td>Covered under normal work Payitems and Item No. 103</td>
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**OPERATIONAL PHASE**

**Natural Environment**

**AIR**

**Dust**

58. Maintain roads.  

Register intervals based on maint. plan  
Design then build during construction  
MPWT Env Cell of MPWT  
Covered in construction phase under
<table>
<thead>
<tr>
<th>Environmental Impact</th>
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<th>Ref No. (FIDIC Clause)</th>
<th>Ref No. 2(Contract Spec.)</th>
<th>Location</th>
<th>Timeframe</th>
<th>Implementing Organization / Supervising Organization</th>
<th>Capital Cost in SS (US$)</th>
<th>Operational Costs/Unit Cost (Sumit)</th>
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</thead>
<tbody>
<tr>
<td>59. Replace roadside tree plantations lost to construction and encourage new afforestation projects.</td>
<td>Any areas where new plantings took place</td>
<td>Plant immediately after area is no longer disturbed</td>
<td>Environment Department</td>
<td>sub-head of Flora of this EMAP</td>
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<tr>
<td>Pollution</td>
<td>60. The Department of Pollution Control of the MOE should check emissions from diesel trucks, buses and 2-stroke motor bikes semi-annually and require maintenance. 61. By increasing roadside plantations, localized air pollution will be reduced due to the blocking effect of foliage and through photosynthesis.</td>
<td>Particularly in settlement areas</td>
<td>After completion of construction</td>
<td>See Flora</td>
<td>Dept of Pollution Control/ MPWT Forest Department/ Env. Cell of MPWT</td>
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<tr>
<td>Noise</td>
<td>62. According to monitoring results, at places with excessive noise, measures such as soil berms, dense layered plantings of vegetation, line of sight blockages to noise by placement of commercial establishments to block the noise, or other measures should be considered.</td>
<td>After completion of construction</td>
<td>MOE, MPWT, Dept of Pollution Control and Forestry Dept.</td>
<td>Covered in construction phase under sub-head of Flora of this EMAP</td>
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</tr>
<tr>
<td>WATER RESOURCES</td>
<td>Contamination from spills due to traffic movement and accidents</td>
<td>1.12.6.1</td>
<td>Provincial Governor's Office and MPWT</td>
<td>Should be developed</td>
<td>Prov. Public Works Dept., Govt. Office and MOE</td>
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<tr>
<td>Maintenance of Storm Water Drainage System</td>
<td>The drainage system will be periodically cleared so as to ensure adequate storm water flow.</td>
<td>1.12.2.5</td>
<td>Urban areas</td>
<td>Beginning and end of monsoon</td>
<td>MPWT, Municipal Govt.</td>
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<tr>
<td>FAUNA</td>
<td>Tend and maintain tree plantations</td>
<td>Trees planted along the roadsides and in villages to replace the ones lost during construction need to have a tending and maintenance schedule prepared and live-tree counts provided to the MPWT every six months.</td>
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<tr>
<td>Social Environment</td>
<td>Accident involving hazardous materials</td>
<td>1.12.6.2</td>
<td>N/A</td>
<td>Prepare Plan within 6 months of commencement of construction and familiarize contractor with SCP at start of work and implementation measures that are required.</td>
<td>MPWT, working with the MOE and likely an international consultant</td>
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</tbody>
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ANNEX 2
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<thead>
<tr>
<th>Responsibility</th>
<th>Description of actions</th>
<th>Implementation Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Preparing to implement the RAP</td>
<td>The PIU shall ensure that all necessary actions are taken to implement the requirements of the RAP in accordance with the project timetable. This includes ensuring that the verification survey has been planned and that a schedule for the field work has been prepared. Commune heads should be given the opportunity to review and comment on the compensation package, to allow them to make any minor adjustments concerning location and timing issues. As soon as the consultation process is complete, the implementation of the compensation measures specified in the RAP can commence. The PIU should ensure that agreement on the RAP is reached 3-4 months before the scheduled RAP implementation date, which itself should be 4-6 months before the start of construction (presently set for late November 1999).</td>
<td>Pre-construction</td>
</tr>
<tr>
<td>2. Implementation of the RAP</td>
<td>The PIU shall retain a Cambodian NGO which has experience in resettlement to coordinate the RAP work, i.e., distribution of compensation payments, collection of release letters, follow-up monitoring, etc. The PIU will work with the NGO to ensure that the RAP is implemented in a timely and competent manner. The implementation should begin 4-6 months before the November 1999 start-of-construction date to ensure that all relocation of people and assets has been completed before construction begins.</td>
<td>Pre-construction</td>
</tr>
<tr>
<td>3. Monitoring of the RAP</td>
<td>Working closely with the resettlement NGO, the PIU will undertake RAP monitoring and provide reporting annually during the first two construction years and for years 1 and 3 of operation. Reporting should be to the MPWT, with copies to the World Bank. The format of the reports will be prescribed by the PIU.</td>
<td>Construction and Operation</td>
</tr>
<tr>
<td>4. Implementation of the EMAP</td>
<td>Working closely with the MOE, the PIU shall analyze the EMAP document and prepare a schedule of activities to be carried out in implementing the EMAP. The construction period steps laid out in the EMAP have been incorporated in the contract. The PIU will be fully responsible for ensuring that all 68 mitigative actions called for in the EMAP are carried out by the responsible organizations, as named in the EMAP.</td>
<td>Pre-construction</td>
</tr>
<tr>
<td>5. Implementation of mitigative measures</td>
<td>The PIU shall oversee and monitor all construction work, ensuring that all mitigative measures specified in the EMAP and built into the Contract Terms and Conditions and Contract Specification Clauses are carried out to their full extent. Cooperation with the Environment Cell, the Pollution Control Department, and the contractor will be necessary.</td>
<td>Construction</td>
</tr>
<tr>
<td>6. Formation and implementation of a Grievance Committee</td>
<td>The PIU shall be responsible for the establishment of a working Grievance Committee, according to the instructions listed in the RAP document (Section 6). Cooperation with the CCP and APSARA to ensure that the CCP’s recommendations concerning the protection of cultural property are fully acted upon. The PIU will have to maintain consistent contact with the CCP, and be prepared to adapt to changes made by the CCP. The CCP’s role is to provide updates and make changes to the RAP document (Section 6).</td>
<td>Pre-construction and construction</td>
</tr>
<tr>
<td>7. Compliance monitoring</td>
<td>The PIU will act as necessary to address compliance issues and problems revealed in compliance monitoring reports submitted by the Environment Cell.</td>
<td>Construction</td>
</tr>
<tr>
<td>8. Preparation of a spill contingency plan</td>
<td>The PIU shall work with the Environment Cell of the MPWT (or the MOE's EIA Department), should the Environment Cell not be operational, and the Pollution Control Department to develop a spill contingency plan which would be put into action in the event of a construction-period spill of bitumen, fuel, or any other harmful substance.</td>
<td>Pre-construction</td>
</tr>
<tr>
<td>9. Traffic control</td>
<td>The PIU shall cooperate with the provincial transport departments and the police to ensure that construction-period traffic circulation problems are kept to a minimum.</td>
<td>Construction</td>
</tr>
<tr>
<td>10. Adherence to standards</td>
<td>The PIU shall ensure that all standards, including but not limited to those regarding noise, emissions and construction site management (including drainage, waste management and worker behavior), are adhered to throughout the construction period.</td>
<td>Construction</td>
</tr>
<tr>
<td>11. Address cultural heritage impacts</td>
<td>The PIU will coordinate with the CCP and APSARA to ensure that the CCP’s recommendations concerning the protection of cultural property are fully acted upon. The PIU will have to maintain consistent contact with the CCP, and be prepared to adapt to changes made by the CCP. The CCP’s role is to provide updates and make changes to the RAP document (Section 6).</td>
<td>Construction</td>
</tr>
<tr>
<td>12. Operation-phase monitoring</td>
<td>The PIU will direct the Environment Cell in preparing and implementing a plan for monitoring after the end of the construction period.</td>
<td>Construction (final year)</td>
</tr>
</tbody>
</table>
ANNEX 3
Annex 3  cross-section diagrams of all recommended rural and urban road configurations

A) National and Provincial Roads

11.0 (2nd PHASE)  

8.0 DBST (1st PHASE)

0.5 DBST Shoulder

4.8 Existing Road Surface

3%  

0.5 DBST Shoulder

Existing and New Profile Grade to be the same

Note:
Some of the existing base course will be recycle and used in the new base course (See Table 4B(a))

11 m full width DBST will be constructed in urban areas along NR 6.

Typical Cross Section of Pavement for NR6, Siem Reap to Kompong Thom Border (SRE 2C - SRE 2F)

Typical Cross Section of Pavement for NR6, SRE 2A and SRE 2B (Urban)

Typical Cross Section of Pavement of Access Road to Angkor Wat (SRE 4)

Note:
(1) The granular base course is constructed over the existing road surface
(2) 0.16m depth of existing pavement (only Subsection SRE-4b) is recycled, detail see Table 3A-2 of Appendix 3
(3) The area of the widening granular base course (see Table 3A-2 of Appendix 3 and Table 4/E/C-4 of Appendix 4)
AIRPORT ACCESS ROAD
IT HAS BEEN AGREED BY THE WORLD BANK AND THE MPWT THAT NO TREES SHOULD BE CUT DOWN ON THE AIRPORT ACCESS ROAD. THIS MAY HAVE CONSEQUENCES ON THE ROAD LAYOUT THAT WILL BE DECIDED IN THE DESIGN PHASE WHEN MORE SURVEY DATA BECOMES AVAILABLE.

Typical Cross Section of Pavement for Access Road to Siem Reap Airport, SRE 1

Typical Cross Section for NR3 (SVE-1 from Veal Rinh to Provincial Border)

Typical Cross Section for NR3 (SVE-1 from Veal Rinh to Provincial Border), Flood Area
B) Urban Roads

Typical Cross Section of Pavement for PPI5, PP3, PP4 in Phnom Penh

Typical Cross Section of Pavement for SV1, SV2, SV5 in Sihanoukville

Note:
1. The width of the pavement for each section, see Table 4B(b).
   The existing pavement structure is rehabilitated.
Annex 4 Establishment of a Steering Committee on Cultural Property (CCP)
[See hard-copy version for this annex]

Annex 5 Laws and Standards on Pollution Control in Thailand, 3rd ed.
[See hard-copy version for this annex]
ANNEX 4
Annex 4   Establishment of a Steering Committee on Cultural Property (CCP)

ESTABLISHMENT OF A COMMITTEE ON CULTURAL PROPERTY (CCP)

STAFFING

- Who is involved:
  - Lead: Mr Vann Molyvann (or designate), Senior Minister, Council of Ministers
  - Member: Mr/Ms. ?????? Ministry of Public Works and Transportation
  - Member: Mr/Ms????? ASPARA or MOE

GENERAL REQUIREMENT

The following tasks are suggested as the main actions needing to be completed by the CCP in order to address the cultural issues associated with this project.

TASKS OF THE COMMITTEE:

- Decide if an archaeological survey of NR6 is to take place, and if so, identify:
  - a timetable, and
  - a cost estimate
- Decide if one or two bridges are to be rebuilt as cultural heritage/touristic sites
- Establish which bridges are to be rebuilt
- Determine who will undertake the archaeological restoration work on the small bridges to be moved and restored (needs specialised skills and will take time)
- Provide an estimate of cost for the:
  - reconstruction/restoration of the bridge(s)
  - site preparation, and
  - development of interpretative materials and signage
- Establish who is to be involved in the first bridge excavation work: the idea here is to undertake a more detailed excavation work on the first of the 9 bridges to be dismantled, and assume that these results will apply to all remaining bridges.
- Establish the protocol to follow if any cultural artefact is found while construction is going on.
- Determine exactly what is to be done with the ancient laterite stone blocks, which will come from the bridges.
- Provide a timetable for the completion of all 8 tasks listed above

The CCP should also establish the best communication channel among APSARA, the Seam Reap Town Planning Department and the MTCP; particularly in relation to the management of urban roadside trees

TIMETABLE

The CCP needs to finish all these activities before April 15 1998, in step with the project’s reporting process.
Steering Committee on Cultural Property (CCP)
Vice-President of Superior Council of National Culture

Rehabilitation Project of National Road 6 by World Bank
(9 bridges from Kompong Thom to Siem Reap)

Chairman: - H.E. Vann Molyvann, Senior Minister
Vice-Chairman: - Mr. Ang Choulean (Director of Institute of Khmer Study - APSARA Authority)
Members: - The Governor of Siem Reap (or his representative)
- The Minister of Culture and Fine Arts (or his representative)
- The Minister of Tourism (or his representative)
- The Minister of Environment (or his representative)
- The Minister of Public Works (or his representative)
- The provincial District Authorities
Expert-consultants: - Mr. Gaucher (Representative of EFEO - Ecole Francaise d'Extrême-Orient)
- Mr. Gardet (Technical Advisor - APSARA Authority)
Secretary of the Committee: - Ms. Tep Vattho (Director of Urban Affairs - APSARA Authority)
ANNEX 5
Annex 5 Laws and Standards on Pollution Control in Thailand, 3rd ed.

LAW AND STANDARDS ON POLLUTION CONTROL IN THAILAND 3rd ED.

POLLUTION CONTROL DEPARTMENT
MINISTRY OF SCIENCE TECHNOLOGY AND ENVIRONMENT

SEPTEMBER 1994

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ISBN 974-7571-88-9
A. Air Quality Standards

1. National Ambient Air Quality Standards

2. Emission Standards
   a. Industrial Emission Standards
   b. Motor Vehicle Emission Standards
   c. Boat/Ship/Vessel Emission Standards
2. Emission Standards

a. Industrial Emission Standards

In order to avoid industrial nuisance problems, the smoke capacity at the mouth of the stack shall not exceed 40 percent of total blackness by the Ringlemann scale except for the short periods of time during starting of operation, soot blowing, or other malfunctions of the soot control system.

**Penalty:** According to Factory Act No. 2, B.E. 2518 (1975) which rules that violators are subjected up to one month imprisonment or fined not more than 10,000 baht or both.


**Penalty:** According to Factory Act B.E. 2535 (1992) which rules that violators are subjected to fined not more than 200,000 baht.

### Emission Standards

(as shown in the following table)

<table>
<thead>
<tr>
<th>No.</th>
<th>Substances</th>
<th>Sources</th>
<th>Standard Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Particulate</td>
<td>Boiler &amp; Furnace</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Heavy oil as fuel</td>
<td>$300 \text{ mg/Nm}^3$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Coal as fuel</td>
<td>$400 \text{ mg/Nm}^3$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Others fuel</td>
<td>$400 \text{ mg/Nm}^3$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Steel/Aluminium Manufacturing</td>
<td>$300 \text{ mg/Nm}^3$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other source</td>
<td>$400 \text{ mg/Nm}^3$</td>
</tr>
<tr>
<td>2</td>
<td>Antimony</td>
<td>any source</td>
<td>$20 \text{ mg/Nm}^3$</td>
</tr>
<tr>
<td>3</td>
<td>Arenic</td>
<td>any source</td>
<td>$20 \text{ mg/Nm}^3$</td>
</tr>
<tr>
<td>4</td>
<td>Copper</td>
<td>Furnace or smelter</td>
<td>$30 \text{ mg/Nm}^3$</td>
</tr>
<tr>
<td>5</td>
<td>Lead</td>
<td>any source</td>
<td>$30 \text{ mg/Nm}^3$</td>
</tr>
<tr>
<td>6</td>
<td>Chlorine</td>
<td>any source</td>
<td>$30 \text{ mg/Nm}^3$</td>
</tr>
<tr>
<td>7</td>
<td>Hydrogen Chloride</td>
<td>any source</td>
<td>$200 \text{ mg/Nm}^3$</td>
</tr>
<tr>
<td>8</td>
<td>Mercury</td>
<td>any source</td>
<td>$3 \text{ mg/Nm}^3$</td>
</tr>
<tr>
<td>9</td>
<td>Carbonmonoxide</td>
<td>any source</td>
<td>$1000 \text{ mg/Nm}^3$ or 870 ppm</td>
</tr>
<tr>
<td>10</td>
<td>Sulfuric acid</td>
<td>any source</td>
<td>$100 \text{ mg/Nm}^3$ or 25 ppm</td>
</tr>
<tr>
<td>11</td>
<td>Hydrogen Sulphide</td>
<td>any source</td>
<td>$140 \text{ mg/Nm}^3$ or 100 ppm</td>
</tr>
<tr>
<td>12</td>
<td>Sulfurdioxide</td>
<td>$H_2SO_4$ production</td>
<td>$1300 \text{ mg/Nm}^3$ or 500 ppm</td>
</tr>
<tr>
<td>13</td>
<td>Oxides of Nitrogen</td>
<td>Boiler</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Coal as fuel</td>
<td>$940 \text{ mg/Nm}^3$ or 500 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Others fuel</td>
<td>$470 \text{ mg/Nm}^3$ or 250 ppm</td>
</tr>
<tr>
<td>14</td>
<td>Xylene</td>
<td>any source</td>
<td>$870 \text{ mg/Nm}^3$ or 200 ppm</td>
</tr>
</tbody>
</table>
- **Motor Vehicle Emission Standards**

<table>
<thead>
<tr>
<th>Organization</th>
<th>Parameter</th>
<th>Emission standards</th>
<th>Measuring Methods (summary)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Measuring Systems</td>
<td>Maximum Permissible Limit</td>
</tr>
<tr>
<td>(1) Ministry of Science Technology and Environment (MOSTE)</td>
<td>Black Smoke (Diesel Vehicle)</td>
<td>Bosch</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hartridge Bosch</td>
<td>52% 40%</td>
</tr>
<tr>
<td>(CO) (Gasoline Vehicle)</td>
<td>Non-Dispersive Infrared Detection</td>
<td></td>
<td>6%</td>
</tr>
<tr>
<td>(HC) (Motorcycle)</td>
<td>Non-Dispersive Infrared Detection</td>
<td>14,000 PPM 10,000 PPM (start 1995)</td>
<td>1) Idling 2) Average value of the two measurements.</td>
</tr>
<tr>
<td>Organization</td>
<td>Parameter</td>
<td>Emission Standards</td>
<td>Measuring Methods (summary)</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>------------------------------------</td>
<td>--------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measuring Systems</td>
<td>Maximum Permissible Limit</td>
</tr>
<tr>
<td>(2) The Police Department</td>
<td>Black Smoke (Diesel Vehicle)</td>
<td>Bosch (Free Acceleration)</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hartridge Bosch (On Test Bench)</td>
<td>52%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CO (Gasoline Vehicle) Non-Dispersive Infrared</td>
<td>6%</td>
</tr>
<tr>
<td>(3) Department of Land Transport</td>
<td>Black Smoke</td>
<td>Bosch</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hartridge Bosch</td>
<td>52%</td>
</tr>
<tr>
<td></td>
<td>CO</td>
<td>Non-Dispersive Infrared Detection</td>
<td>6%</td>
</tr>
</tbody>
</table>

* Note: The emission standards and measuring methods for black smoke issued by the Police Department will be changed to be the same as MOSTE's.

Source:

1. MOSTE

2. The Police Department:

3. Department of Land Transport:
c. Boat/Ship/Vessel Emission Standards

Black smoke emissions shall not exceed 40% by Bosch or 52% by Hartridge Systems when measuring at 2/3 of maximum rotating speed.

**Penalty:** Two hundred baht for first violation and two thousand baht for second violation.

B. Noise Quality Standards

1. Community Noise Standards

2. Noise Emission Standards
   a. Motor Vehicle Standards
   b. Boat/Ship/Vessel Noise Standards

3. Noise Standards in Workplace
   a. Standards by Ministry of Interior
   b. Standards by Ministry of Industry
B. Noise Standards

1. Community Noise Standards: In draft by Committee.
2. Noise Emission Standards

a. Motor Vehicle Noise Standards

<table>
<thead>
<tr>
<th>Organization</th>
<th>Type of motor vehicle</th>
<th>Standards and methods of measurement</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| (1) PCD Pollution Control Department| All types             | 1) The noise level shall not exceed 85 dBA measured at 7.5 meters from the exhaust pipe or 100 dBA at 0.5 meter from the exhaust pipe.  
2) Use maximum value of the two measurements when different value measurements is not more than 2 dBA  
3) The motor vehicle is stationary and engine conditions during measurement vary according to type of engine as follow:  
a) diesel engine: maximum rotating speed  
b) gasoline engine: no-load acceleration at 3/4 of maximum rotating speed  
c) motorcycle: If maximum rotating speed is more than 5,000 rev./min, the measurement shall be done at 1/2 of maximum rotating speed.  
If the maximum is less than 5,000 rev./min, the measurement shall be done at 3/4 of maximum rotating speed. | Details of tested field, equipment and calibration and others are stated. |
<p>| (2) The Police Department            | All types Road Motor Vehicle | Motor vehicle is stationary and in normal used engine condition. The noise level shall not exceed 85 dBA | Details on tested field, equipment and calibration are stated more or less the same as MOSTE |</p>
<table>
<thead>
<tr>
<th>Organization</th>
<th>Type of motor vehicle</th>
<th>Standards and methods of measurement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>3) Department of Land Transport</td>
<td>Transportation Motor Vehicle (Buses &amp; Truck)</td>
<td>measured at 7.5 meters from the exhaust pipe or 100 dBA measured at 0.5 meter from the exhaust pipe.</td>
<td>Details on tested field equipment and calibration are stated more or less the same as MOSTE's standards and methods of measurement.</td>
</tr>
</tbody>
</table>

**Penalty:**

1. PCD: none
2. The police Department
   - Whoever violates the regulation will be fined one thousand baht for all types.
3. Department of Land Transport
   - The fine will be up to fifty thousand baht.

**Sources:**

1. PCD
2. The Police Department
3. Department of Land Transport

**b. Boat/Ship/Vessel Noise Standards**

The standard is 85 dBA, measuring at 7.5 meters away from the vessel when the vessel is under stationary state with the mode of no-load acceleration at 2/3 the maximum rotating speed or 100 dBA at 0.5 meter with the same condition.

**Penalty:**

- Two hundred baht for first violation and two thousand baht for the second violation.

**Source:**

3. Noise Standards in Workplace
   a. Standards by Ministry of Interior

<table>
<thead>
<tr>
<th>Noise Level (dBA)</th>
<th>Exposure (hours per day)</th>
<th>Time Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>91</td>
<td>less than 7</td>
<td>Ear plugs or ear muffs should be used if needed</td>
</tr>
<tr>
<td>90</td>
<td>7-8</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>more than 8</td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>not allowed</td>
<td></td>
</tr>
</tbody>
</table>

**Penalty:** Any employer and employee who violates of neglects to act in compliance with the prescription of the Ministry of Interior issued under Article 2 of the Announcement of the Revolutionary Party shall be liable to a term of imprisonment not exceeding six months or to a fine of not over twenty thousand baht, or both.


b. Standards by Ministry of Industry

- Ear plugs or ear muffs shall be provided to a worker who works in the factory with noise level exceeded 80 dBA.
- Ear guards shall be provided to a worker who works in the workplace that may be dangerous to pinna and ear canal.
- the factory shall control or eliminate odor, noise, vibration, dust, soot and smoke to the level that do not cause any nuisance, trouble, damage or health problems to the nearby community.

**Penalty:** According to Factory Act No. 2 B.E. 2518 (1975) which rules that violators are subjected up to one month imprisonment or fined not more than ten thousand baht or both.