Provincial and Peri-Urban Water Supply and Sanitation Project, Royal Kingdom of Cambodia

Initial Environmental Impact Assessment Report

Bavet (M07)

District of Chantrea
Svay Rieng Province

DRAFT, December 2002
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>BOD</td>
<td>Biochemical Oxygen Demand</td>
</tr>
<tr>
<td>COD</td>
<td>Chemical Oxygen Demand</td>
</tr>
<tr>
<td>DBL</td>
<td>Design/Build/Lease</td>
</tr>
<tr>
<td>DD</td>
<td>Detailed Design</td>
</tr>
<tr>
<td>DPWS</td>
<td>Department of Potable Water Supply</td>
</tr>
<tr>
<td>DPWT</td>
<td>Department of Public Works and Transport (Municipality)</td>
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<tr>
<td>EA</td>
<td>Environmental Assessment</td>
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<tr>
<td>EEA</td>
<td>Environmental Examination Application</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EMiP</td>
<td>Environmental Mitigations Plan (part of an EMP)</td>
</tr>
<tr>
<td>EMoP</td>
<td>Environmental Monitoring Plan (part of an EMP)</td>
</tr>
<tr>
<td>EMP</td>
<td>Environmental Management Plan</td>
</tr>
<tr>
<td>FS</td>
<td>Feasibility Study</td>
</tr>
<tr>
<td>FT</td>
<td>Fraser Tomas (Engineering Consultants)</td>
</tr>
<tr>
<td>GHD</td>
<td>Gutteridge, Haskins &amp; Davey (Engineering Consultants)</td>
</tr>
<tr>
<td>IEIA</td>
<td>Initial Environmental Impact Assessment</td>
</tr>
<tr>
<td>JICA</td>
<td>Japan International Cooperation Agency</td>
</tr>
<tr>
<td>LCPSS</td>
<td>Low Cost Pilot Sewerage System</td>
</tr>
<tr>
<td>Lpcd</td>
<td>Liters per capita per day</td>
</tr>
<tr>
<td>Mg/l</td>
<td>Milligrams per liter</td>
</tr>
<tr>
<td>MIME</td>
<td>Ministry of Industry, Mines, and Energy</td>
</tr>
<tr>
<td>MoA</td>
<td>Ministry of Agriculture</td>
</tr>
<tr>
<td>MoE</td>
<td>Ministry of Environment</td>
</tr>
<tr>
<td>MPP</td>
<td>Municipality of Phnom Penh</td>
</tr>
<tr>
<td>MWRM</td>
<td>Ministry of Water Resources and Meteorology</td>
</tr>
<tr>
<td>MPWT</td>
<td>Ministry of Public Works and Transport</td>
</tr>
<tr>
<td>NGO</td>
<td>Non Governmental Organization</td>
</tr>
<tr>
<td>PCD</td>
<td>Pollution Control Department (Ministry of Environment)</td>
</tr>
<tr>
<td>PG</td>
<td>Provincial Government</td>
</tr>
<tr>
<td>PMU</td>
<td>Project Management Unit</td>
</tr>
<tr>
<td>PO</td>
<td>Project Owner</td>
</tr>
<tr>
<td>PPWSA</td>
<td>Phnom Penh Water Supply Authority</td>
</tr>
<tr>
<td>PPUWSSP</td>
<td>Provincial and Peri-Urban Water Supply and Sanitation Project</td>
</tr>
<tr>
<td>RGC</td>
<td>Royal Government of Cambodia</td>
</tr>
<tr>
<td>ToR</td>
<td>Terms of Reference</td>
</tr>
<tr>
<td>TSS</td>
<td>Total Suspended Solids</td>
</tr>
<tr>
<td>WB</td>
<td>World Bank</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>WSS</td>
<td>Water Supply and Sanitation</td>
</tr>
<tr>
<td>WTC</td>
<td>Willingness to Connect</td>
</tr>
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</table>
PROJECT SUMMARY

General
The purpose of the Environmental Assessment is to identify and evaluate the significance of any potential environmental impacts on the proposed construction and development program for a new water supply system for Bavet (District of Chantrea, Svay Rieng Province) and to recommend avoidance, preventive and mitigation measures to ensure that residual environmental impacts are acceptable and are within the applicable limitation standards prescribed by the Ministry of Environment and the World Bank.

The Local Government of Bavet has initiated the current project, with support of the Provincial Government of Svay Rieng and the Department of Potable Water Supply (DPWS) of MIME. The actual ‘Project Owner’ is the Ministry of Industry, Mines and Energy.

Project description
Based upon the evaluation of the various options for a possible water supply scheme, MIME, with support of the Engineering Consultants GHD/FT, has prepared a viable project proposal. The project will provide piped water supply for an estimated population of 6,337 persons, with service initially to some 51 to 60 percent of the population within the service area at 40 l/cd, increasing to 60 l/cd and serving 90 percent of the population in the service area. Preliminary calculations indicate a required water demand (ADP) of 535 m3/day. Coverage comprises a service area encompassing the central town and the development along NR1 to, and including the international border market.

The water source will be groundwater, to be abstracted via deep bores. The necessary treatment will be applied to comply with Cambodian drinking water quality standards. A treatment plant will be established on the land identified by the Commune, behind the existing Commune office. Treatment will comprise aeration, disinfection and pH correction with lime dosing. Pumping from a Clearwater tank through a booster pump into the system. A single metered connection will be provided to each house, where it is assumed that household “water jar” storage will continue to be used.

No resettlement will be required.

Land Acquisition
The scheme is based on two boreholes sited in open rice fields to the north-west of the town with a raw water pipeline to the treatment plant on land identified as being available behind the Commune Office. The treatment plant will also be located on the land to be made available immediately behind the Commune Office.

It is not anticipated that land has to be purchased. The land for the proposed wells and pumping stations will be made available by the Commune with official documentation as soon as the locations of wells are confirmed by the private operator. The acquisition of land will be facilitated by MIME as part of their responsibility to the project. If possible, the PMU representative will facilitate the issuance of “Deed of Donation” or statements on the willingness to sell prior to the construction to avoid any conflict with the lot owner.
Consultations
After series of meetings/consultations with concerned Provincial Government Officials of the Svay Rieng Province and the local officials and residents of Bavet, the Project was approved and endorsed. Overall, the project is perceived to be of great help to the community since it will significantly improve the quality of the drinking water supply and public health conditions by reducing common cases of water borne diseases (diarrhea, gastroenteritis and parasitism). The project will further stimulate socio-economic growth through increase in the number of commercial and economic activities thus adding revenue to the community.

The Willingness to Connect (WTC) indicated that 62.6% of the 1088 households within the service area of Bavet approved a tariff of 1830 Riel/m³.

Environmental Management Plan
To mitigate possible general adverse environmental impacts (e.g. drainage, sanitation, damage to soils and water and economic losses), discussions are held with all major stakeholders. The findings and conclusions on the actions to be taken have been summarized in an Environmental Management Plan (EMP), including:

- An Environmental Mitigation Plan (EMiP), outlining the measures to be taken to mitigate adverse environmental impacts;
- An Environmental Monitoring Plan (EMoP), defining the environmental parameters to be observed and reported;
- Overview if the implementation arrangements, defining the responsibilities and timing.

Monitoring arrangements
MIME will have the overall responsibility for the proper implementation of the Environmental Management Plan (EMP). Upon the signing of the DBL contract, the Project Management Unit (PMU) will proceed with the necessary steps for the environmentally sound construction and operation of the water supply system, as defined in the EMP. During the construction phase, PMU will be responsible for securing that proper measures are taken by the different contractors. The PMU will inform DPWS/MIME if violations occur, and appropriate actions will be taken. Moreover, DPWS/MIME staff will carry out control inspection during their regular visits to the Provinces.

During operation of the water supply system, the Contractor and the PMU will have the main responsibility for the proper implementation of the monitoring plan. The monitoring data will be well documented and be available with the Contractor and PMU for consultation and inspection.

Brief quarterly monitoring reports will be submitted to DPWS/MIME and the Ministry of Environment, including: Presentation of the collected data; Discussion of the compliance and non-compliance to the EMP; and Conclusion and Recommendation.

Regular annual monitoring reports will be submitted to the World Bank during the operation phase. The environmental data will be available with the DPWS/MIME and the Contractor for consultation and inspection.
### Environmental Mitigation Plan (EMiP) for Bavet, Svay Rieng

<table>
<thead>
<tr>
<th>Phase</th>
<th>Mitigation measures</th>
<th>Responsibility</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-construction</td>
<td>Lack of control of water source. Acquire land directly around the facilities (or secure a possible purchase), Reduction in flow. Locate the well in an area where other water users are not affected. Disturbance of land use and economic activities. Usage of public areas. Provision for proper compensation.</td>
<td>MIME, World Bank</td>
<td>Prior to DBL contracts</td>
</tr>
<tr>
<td>Abandoning phase</td>
<td>Water availability. Keep traditional water sources available.</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
# Environmental Monitoring Plan (EMoP) for Bavet, Svay Rieng

<table>
<thead>
<tr>
<th>Phase</th>
<th>Monitoring activities</th>
<th>Responsibility</th>
<th>Implementation</th>
</tr>
</thead>
</table>
| Pre-construction | • Land acquisition Check if the required land has been acquired properly, or that a proper "Deed of Sale/Donation" has been prepared  
• Resettlement and Compensation If applicable, check if proper arrangements are made and documented | MIME, World Bank        | Prior to DBL Contract        |
| Construction     | • Hindrance to local population Noise, air pollution (odor, TSP, fume emissions), land damage, traffic  
• EMP compliance of the contractors Erosion control, vegetation protection, soil and water contamination  
• Safety precautions of contractors Conform professional standards  
• Sanitary control Proper construction of on-site facilities, Proper construction of sullage drainage system | Operator, with supervision of MIME consultant | Continuous, through regular construction supervision |
| Operation        | • Quality of distributed water conform official standard procedures (microbiology, standard parameters, Arsenic, heavy metals),  
• Groundwater resources water level (2 X per month (after pumping recovery period), operation of pumps (abstraction)) | Operator, with supervision of MIME | Regular, according to professional standards |
| Abandoning phase | • None                                                                                 | -                       | -                            |
1 INTRODUCTION

1.1 Background of the Project

The 'Provincial and Peri-Urban Water Supply and Sanitation' project (PPUWSSP) is being prepared and implemented by the Department of Potable Water Supply (DPWS) of the Ministry of Industry, Mining and Energy (MIME), and the Phnom Penh Water Supply Authority (PPWSA), Kingdom of Cambodia. The PPUWSSP is financed through a loan from the World Bank.

The MIME component aims at financing water supply and sanitation projects targeting provincial towns and district towns that express demand for improved services and low-income communities in urban centers. It finances investments that (i) respond to what consumers want and are willing to pay, (ii) facilitate and develop private sector participation in financing, operating and maintaining constructed facilities, while designing specific instruments that ensure inclusion of low income communities residing in the service areas.

Upon the request of the local governments, the town of Bavet, Province of Svay Rieng (Figure 1-1), has been included in the first batch of the project. Bavet has expressed its interest in the project as it is a larger town at the border with Vietnam, but it has no proper water supply system yet. It has the potential to increase its commercial activities now that the National Road #1 is being upgraded.

Figure 1-1 – Location map of the project area

The purpose of the present Initial Environmental Impact Assessment (IEIA) is to identify possible environmental and social impacts arising from the proposed construction and development of a piped water supply system for Bavet, Province of Svay Rieng (M07).
As described below, many sections of the current report have been obtained from the Feasibility Study reports, prepared by the Engineering Consultant GHD/FT.

### 1.2 Environmental Assessment

The EA has been prepared in accordance with the guidelines of the Ministry of Environment (MoE, see also section 1.3), combined with World Bank guidelines on Environmental Assessment. Both within the Cambodian and the World Bank regulatory framework an environmental clearance is required before the project implementation can start. Environmentally sound practices have been incorporated in the project planning and design, and possible negative impacts have been identified to be mitigated to acceptable levels.

The EA was carried out by a technical team, comprising of engineers and environment specialists (See Annex I - List of EA preparers) Multiple consultations with the staff of MIME, Provincial Government, Commune chiefs, and the local beneficiaries were conducted in order to solicit their comments, reactions and finally seek their proper approval and endorsement of the proposed project (see Annex II – WTC Process documentation and Annex III - Proof of social acceptability).

Desk research was carried out through obtaining available data about the physical, socio-economic, environmental characterization, political profiles from the Engineering Consultants GHD/FT. Data were also gathered and reviewed from the national line agencies/offices such as Ministry of Rural Development (MRD), Ministry of Agriculture (MoA), and Ministry of Environment (MoE). These available reports/literatures and other materials relevant to the conduct of the Environmental Assessment report were compiled and reviewed.

Aside from data gathering activities, actual interview and constant coordination with the members of the Provincial Management Unit (PMU) at the Provincial and Municipal/City levels were carried out to gather first hand information/data.

### 1.3 Institutional and legal framework

Overall management of the environment lies with the Ministry of Environment (MoE), which was created in 1993. The MoE has wide responsibilities, which are spelled out in the Law on Environmental Protection and Natural Resources Management. At the provincial and city levels, there are corresponding Provincial/City Environment Departments. These local departments have the responsibility of enforcing the environmental legislation coming under the competence of the MoE. However, the daily operational functions of these departments would normally come under the direct control of the provincial/city authorities.

The objectives of the framework Law are to protect environmental quality through the prevention, reduction and control of pollution, to establish an Environmental Impact Assessment (EIA) system, to ensure sustainable use of natural resources, to encourage public participation and to suppress acts which are harmful to the environment.
The framework Law calls for an EA to be conducted for every private or public project, to be reviewed by the Ministry of Environment before submission to the Government for a final decision. All proposed and existing activities are to be covered under this requirement. Sub-decrees are anticipated to provide for the finer details of the system.

The Sub-degree on Environmental Impact Assessment Process, which was issued in December 1999, details specific procedures to be followed and the nature and size of projects which are required to submit EIAs. The Cambodian EIA requirements for water supply projects start with 10,000 users.

Based on the above mentioned documents, the MoE have drafted flowcharts showing the EIA procedure to be applied. For the present project, with MIME being the Project owner, the applied process is shown in Figure 1-2.

**Figure 1-2 – Applied EA Process**

The first step in the EA process is the preparation of an Initial Environmental Impact Assessment (IEIA), to be submitted by the Project Owner to the MoE, supplemented with an Environmental Examination Application (EEA). Based on the review of the IEIA, the Project will either be approved, additional changes to the IEIA will have to be made, or a full scale EIA report will have to be prepared.

Furthermore, the MoE has prepared draft guidelines for the set-up and contents of the EIA reports. Although still in draft form, they have been applied as the basis for the IEIA reports.
2 PURPOSE OF THE PROJECT

2.1 Objectives

The objective of the project is to supply safe drinking water through a piped water supply system to the town of Bavet, Svay Rieng Province. The project is anchored on the principals that:

- Water can be managed as an economic good;
- The project must be "demand-driven" oriented meaning, that the prospective end users must be willing and capable to pay for services;
- The system will be operated and managed by a private operator.

The project design is consistent with the water supply and sanitation policy framework of Cambodia, and finance investments that (i) respond to what consumers want and are willing to pay, (ii) facilitate and develop private sector participation in financing, operating and maintaining constructed facilities, while designing specific instruments that ensure inclusion of low income communities residing in the service areas.

2.2 Public participation

Public participation and consultations of the PPUWSSP focused on two main objectives:

1. To assist national and local governments in arriving at a decision to finance the development of their water supply system based on their financial capacity and to select the most feasible management and operation system of the water utility;
2. To encourage user's participation in the selection of a technically feasible water supply system, that is based on their demand/wants and their capacity and willingness-to-pay for that desired service.

Bearing these principles in mind GHD/FT designed strategies that would promote these principles during the conduct of the Rapid Feasibility Study. Among these strategies are the series of presentation and consultation activities with the different stakeholders at the local level. The areas for consultation and negotiations were focused on the following:

- Technical options for the water supply system, the project investment cost, and the required equity contribution;
- Cost recovery options and water tariff structure;
- Operation and management scheme for the system; and
- Project implementation arrangement (Design/Build/Lease) of the water utility.

There were two levels of consultations during the feasibility study. The first level was with the local governments (see section 5.1). The second level of consultation focused on for the prospective users in the service areas (see section 5.2).

For a Project Town to proceed to full preliminary design, at least 51% of the heads of households living within the Service Area(s) must indicate their support for the new scheme (see section 5.3).
3 PROJECT DESCRIPTION

3.1 Service area

The proposed service area or the project is shown in Figure 3-1. It consists of the town center, market and central road network. Development along roads intersecting with NR11 until development drops off at start of rice fields. Also development along NR11 through the town for a distance of three kilometres.

The project will provide piped water supply for an estimated population of 6,337 persons, with service initially to some 51 to 60 percent of the population within the service area at 40 l/cd, increasing to 60 l/cd and serving 90 percent of the population in the service area.

3.2 Summary of Infrastructure

The proposed infrastructure to be constructed for the project is summarized in Table 3-1. The listing is based on the feasibility study, as prepared by GHD/FT. Figure 3-1 shows the layout of the proposed infrastructure.

Table 3-1 – Summary of proposed infrastructural works

- Groundwater abstraction via deep bores and the establishment of a treatment plant on the land identified by the Commune, behind the existing Commune office.
- Treatment comprising aeration, disinfection and pH correction with lime dosing.
- Pumping from a Clearwater tank through a booster pump into the system.
- Distribution network along the main roads, comprising a service area encompassing the central town and the development along NR11 to, and including the international border market.
- A single metered connection provided to each house, where it is assumed that household “water jar” storage will continue to be used.
Figure 3-1 – Proposed service area and infrastructure (DRAFT)

Source GHD/FT, 2002
3.3 Water quality standards

There are currently not yet official water quality standards of Cambodia. In general, the World Health Organization (WHO) guidelines are being applied.

Official standards are however under preparation by an Inter-ministerial Committee, with support from WHO. The proposed water quality standards are included in Annex IV, and will be applied for the proposed water supply system.

The recommendations are especially important for the Arsenic level. As it seems that the WHO guideline of 10μg/l is unrealistic to apply currently, a (temporary) value of 50μg/l will be proposed for Cambodia.

3.4 Project planning and implementation

Bavet is part of a first batch of the PPUWSSP, to be implemented under World Bank financing, through the joint effort of MIME, the PPWSA, and Ministry of Finance (MoF). MIME has the implementation responsibility for the provincial town program. A Project Management Office (PMO) has been established by the MIME in Phnom Penh for directing, supervising and coordinating all day-to-day implementation activities. The Provincial Government of Svay Rieng has established a Project Management Unit (PMU) for actual implementation of the water system.

The adopted strategy for implementing the water supply systems in the towns is to bid a Design/Build/Lease (DBL) scheme to private operators. Under the DBL scheme, MIME will enter into a contract with a private operator who will be responsible for the design, construction and operation of a cluster of systems. The lease contract is expected to cover a period of fifteen (15) years and will establish the conditions and provisions under which the operator must operate and maintain the water system. After the 15 years contract period, the private operator should turn over the water system in operating conditions to MIME or may enter into a new agreement with MIME to renew the lease contract for a similar period of time.

The project construction is expected to commence, after approval of the proposed water charges by the respective beneficiaries, beginning of 2003, with the bidding for the DBL contract and to be implemented over a period of 18 months. The confirmation of the water sources recommended in the feasibility study, particularly the drilling and construction of exploratory/production well, is considered a critical activity. In fact only when capacity and quality of the water sources are confirmed and detailed design can be prepared including any necessary revision in the scheme outlines in the feasibility study.
4 DESCRIPTION OF ENVIRONMENTAL RESOURCES

4.1 Physical resources

Topography
Bavet is a larger town with several markets, including an international border market and casinos. It lies within the Chantrea District of Svay Rieng Province. The town contains the Commune Office, a large primary and junior high school, an ice factory, government departments and a health center. The town development has a defined street network around the central town area, and from this linear development extends along NR1 towards the international border with Vietnam some 10 km to the east. Development also extends along NR1 and through the town for a distance of around three kilometers. There is one large Wat located in the middle of the town.

In geographic terms Bavet is situated on NR1 east of Svay Rieng and 167.5 km by road from Phnom Penh. Bavet like many of the project towns lies in the middle of extensive, cultivated rice fields. It has a developed area of some 85 hectares, comprising the central town with its network of roads and ribbon development along NR1. The topography is flat with little variation in level.

Geology
Cambodia can be divided by 'geological provinces', as shown in Figure 4-1 (ESCAP, 1993). Bavet is located in the Southern portion of the "Tongle Sap-Mekong plains". This area, including the great Lake Basin of Tongle Sap and the central valley of Cambodia, were formed by the slight subsidence of the broad central area along northwest-southeast axes in the Quaternary, leading to broad areas of a Mid- to Late-Quaternary cover with a thin to moderate thickness.
Quaternary deposits are widespread in Cambodia, especially in the broad central plains of the Mekong and Tongle Sap River systems and across the northern uplands, generally occupying levels from 0 to 40m above sea-level. The Quaternary occupies 'grabens' and depressions in the broad area, build up of intercalations of continental and marine rocks revealing a history of periods of transgression and regression of the sea. In general the following units are distinguished:

- The Holocene (Q₄) sediment cover is represented on the coastal and interior plains, and in small upland valleys, by recent deposits of fluvial, lacustrine (lakes), and shallow-sea origin.
- The Middle-Upper Quaternary (Q₂₋₃), a principal sedimentary aquifer, is widespread in the north, southeastern and northwestern sectors of Cambodia, where it is known as the Battambang formation. On the Mekong Plain the upper Quaternary (Q₃) is recognized as the Mochoa formation, occupying the 10-15m terraces in the areas southeast of Phnom Penh. It is composed of grits, sands and clays outcropping on higher relief levels on the outer parts of the central plains.
- Quaternary plateau basalts (QB) of Middle-Upper Pleistocene age and Neogene-Quaternary platform basaltic rocks
- The Lower Quaternary (Q₁) consists of sands, silts and clay-stones of both fluvial and marine origin. It is here combined with the Pleistocene deposits (unit N₂₋₋Q). The Middle Quaternary (Q₂) of the plains comprises red sandy sediments occupying terraces above 15 metres.
The whole of the Tertiary is represented by Pliocene sedimentation. The Neogene-Early Pleistocene (N2-Q) is seen in large basins in eastern Cambodia. These are represented by the Bamieu formation, comprising of clay-stones and siltstones usually laid upon well-developed conglomerate horizons. Large volumes of this material fill the broad lowland grabens of the Mekong valley and the Tongle Sap Region, overlain by younger alluvial materials. The deposits of this age are often referred to as the "alluvions anciens", the "older alluvium". These sediments generally form terrains and plains in the levels 25-150m above sea level. The upper levels are strongly laterized and this has been used as building materials (for example at Angkor Wat).

Mesozoic and Paleozoic sedimentary units and intrusive rocks are generally referred to basement rocks.

**Climate**

The climatic conditions for Bavet are monsoonal. Table 4-1 shows the main climatic parameters recorded in Cambodia.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Wet Season</th>
<th>Dry Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Months</td>
<td>May - November</td>
<td>December - April</td>
</tr>
<tr>
<td>Wind Direction</td>
<td>Southwest</td>
<td>Northeast</td>
</tr>
<tr>
<td>Cool Months</td>
<td>November</td>
<td>December - February</td>
</tr>
<tr>
<td>Hot Months</td>
<td>May</td>
<td>March - April</td>
</tr>
<tr>
<td>Cambodian Average Rainfall</td>
<td>1300 to 3600 mm per annum</td>
<td></td>
</tr>
<tr>
<td>Phnom Penh Average Rainfall</td>
<td>1300 mm per annum</td>
<td></td>
</tr>
<tr>
<td>Mean Rainfall</td>
<td>200 mm per month</td>
<td>3 - 15 mm per month</td>
</tr>
<tr>
<td>Evaporation</td>
<td>September - October</td>
<td>December - March</td>
</tr>
<tr>
<td>Average Temperatures</td>
<td>69 - 105 mm per month</td>
<td>170 mm per month</td>
</tr>
<tr>
<td>Humidity</td>
<td>30 Degree Celsius</td>
<td>April 35 Deg C peak</td>
</tr>
<tr>
<td></td>
<td>Sept-Oct 85% average</td>
<td>Jan-April 75% average</td>
</tr>
</tbody>
</table>

Source: GHD/FT, 2002

**Surface Water**

There are no significant and/or reliable surface water resources in the vicinity of the town.

**Hydrogeology**

Bavet is located in the center of the Mekong Basin, a large alluvial area with in general a high groundwater potential. The principal aquifers are the Pliocene/Pleistocene sediments, and to a lesser extent the fissure zone or weathered zone of the basement rocks. The Pliocene/Pleistocene sediments are overlying the basement rocks. The depth of the basement is estimated at a depth more then 150m.

Recharge of the Quaternary aquifers takes place from rainfall and river water infiltration (during the high river levels during July-December). Reported yields (JICA, 1999) from the Pliocene/Pleistocene sedimentary deposits in the 'Mekong groundwater basin', are high with values of up to 1000 m3/day (> 40 m3/hr), which indicated the good groundwater potential of the area.
General water quality concerns in the area are higher Iron, Manganese and Arsenic concentrations, all occurring naturally. The highest values are generally reported along the Mekong and Tongle Sap rivers.

The water testing results indicate that the tested ground water wells have low iron levels and no detectable arsenic. However, water quality concerns (especially Arsenic) will have to be tested after drilling. The pH is marginally lower than desired and should be adjusted through lime dosing. Otherwise, aeration and disinfection is all the treatment required.

4.2 Ecological resources

Bavet is located in a flat agricultural area, mainly used for cultivating rice. The area has no other specific ecological resources and/or protected nature areas in its surroundings.

4.3 Socio-economical resources

Population
A count of houses and institutions was conducted within the identified service areas during the rapid appraisal phase and again confirmed in later town visits and surveys. Major discrepancies in the information provided by commune officials were identified requiring reconciliation with the circumstances identified in the individual towns. All information and statistics on population and household size were rigorously reviewed due to the impact of these on the design and sizing of the scheme. The population to benefit from a reticulated water supply system was derived from the discussions with the communes and their expression of the area they would wish to see reticulated. This was followed by a review of the town development, population densities and the extent to which a viable system could be sustained on technical and operating grounds.

The total population of the service area for Bavet was estimated by GHD/FT at 6,337 (1,148 houses). The count of commercial establishments and institutions is 12 and 8, respectively.

Population forecasts in Cambodia are hampered by an absence of reliable data and information on population trends. The population forecasts from the 1998 national census indicate an average annual population increase for Cambodia of 2.5 percent. This latter figure has been used for the current project.

Standard of living and Income

In Cambodia, a number of the population live in well-built houses (up to 60% in some towns), although the majority, 62% overall, live in poor quality or makeshift homes. The immediate environment of the homes differs sharply between those located in the core of each town, usually along the main roads, and those on the periphery or in nearby satellite villages, which remain largely rural in character. While development is occurring in the central core of the towns, with new commercial buildings and houses now evident, the immediate surroundings are often squalid, with prominent deposits of solid waste blocked, stagnant drains. In contrast, the areas around many homes outside the core areas are decidedly well kept, even in the case of some of the poorest quality houses.
With regard to the economic status of the beneficiary group, the survey indicates high levels of poverty, with average incomes equating to some USD 0.54 per person per day (as low as USD 0.48 in Svay Rieng).

As a comparative indicator for the living conditions in Bavet, the town has 24hrs electricity supply, supplying 69% of the households. Furthermore it is estimated that around 60% of the households own a TV.

**Public Health**

Reviews of the health sector in Cambodia show that life expectancy and infant mortality, both principal indicators of the state of health of the population, have declined in recent years. However, they remain high by international and regional standards, with some 56 years life expectancy and 89 infant deaths per 1000 live births. Health issues that feature prominently in the project towns include parasite infestations, nutritional deficiencies, sexually transmitted diseases and waterborne diseases (e.g. diarrhea).

Diarrhea alone inhibit economic activity, is a potentially life threatening hazard, and is a continual nuisance among the population of the project towns. The socio-economic survey carried out for this project found that at least 5 percent of households had suffered cases of diarrhea among its members within the previous two weeks. In the worst cases, up to 12 percent of households had suffered diarrhea among its adult members during this period. While the source of infection of diarrhea diseases vary, most can be attributed to polluted water supplies inadequate supplies for drinking, food preparation and hygiene and inadequate sanitation.

**Water Supply**

No appropriate piped water supply system exists in Bavet. The population uses shallow wells and rainwater collection as their current water supplies.

**Sanitation**

With regard to sanitation in general in Cambodia, many people (at least 49%) use field or bush around their homes for defecation. This arrangement is often considered more or less satisfactory, though many town dwellers (40 %) have latrines and of those that do not, the majority (57%) would like to install one and meet the cost of doing this, suggesting a high level of awareness of sanitation issues and their role in improved living conditions.

In Bavet it is estimated that the use of the field, latrines and other facilities is 42.6%, 14.8%, and 42.6%, respectively.

The flat area results in poor natural drainage conditions.
5 PUBLIC PARTICIPATION

5.1 General

The only way of ensuring that proposed water supply and sanitation investments lead to sustainable services in the long run is to foster interaction between DPWS/MIME and the Provincial Governments, District and Commune-level institutions, consultants, operators and contractors, and the main beneficiaries, i.e. the users who will benefit directly from the project. Creating ownership and responsibility at the various levels is the final objective of the participative process.

During the meetings with District Governors and Bavet Commune Chiefs a measure of the community’s interest in receiving a piped water supply and to participate in a sanitation program was gained.

Earlier in the project a sample of households in each Commune in the Project Towns was interviewed, according to a questionnaire that gathered basic demographic and socio-economic information, information on existing water supply and sanitation costs and arrangements, and basic hopes and aspirations for future improvements in these two services. The survey team took care to ensure that sampling was done evenly through each Commune, gaining a sample that was representative in terms of different income groups and that included any minority groups in each Commune.

Formal discussions also occurred with the Provincial, District and Commune administrations to familiarize the team with the areas and communities and to build up confidence of the administrations and residents in the team members. From these discussions, it became clear that the Commune Chiefs, their committees and the communities want, and would demand, information on a number of issues, primarily:

1. Cost (tariff and connection cost)
2. Scheduling and likely implementation
3. Providers (information about the possible companies, namely the owners)
4. Protection of consumers
5. Roles of Government and authorities

The earlier meetings with the Bavet Commune Councils and representatives of the Chantrea District and Svay Rieng Province attempted to gauge overall interest in obtaining piped water supplies from a private sector operator and views held regarding the nature of any technical and management options. Items which were seen to require elaboration and answers at the Willingness to Connect stage included:

1. Connection cost and repayment scheme
2. How will the operator be controlled and who will be responsible?
3. If a breakdown occurs who will be responsible for the cost, especially for water meters?
4. Where would the water meter be located for households (and what distance would the free connection be)?
5. How long will it take to implement the project if it goes ahead?
5.2 Consultations with the Prospective Users

The participation of end users (the community) in the design and operation of water supply and sanitation systems is, along with engineering, resource and environmental considerations, key to the sustainability of the services to be established in the Project Towns. Effective participation ensures that, to the extent practicable, the services provided will be acceptable to the users, appropriate to their conditions, and affordable to them. In order for participation to be effective, representative views from members of different age groups, gender, income categories, religious and minority groups need to be heard and understood.

The project comes at a time when fundamental steps have been taken by the Royal Government of Cambodia to put community representation structures into place, and to develop participatory methods for development at Commune and village level in the country, but also at a time when processes for developing such structures are still at an early stage. The communication and information strategy for the PPUWSSP has worked with the structures that have been, or are being set up, so as to help strengthen them and avoid the conflicts and confusion that would arise from establishing new structures or processes. The communication and information strategy has also been arranged to ensure regular and feedback to the Commune Councils, the village representatives and their communities.

5.3 Willingness-to Connect (WTC)

The WTC area meetings are instruments for the dissemination of key information on the proposed water supply and sanitation improvements, by means of facilitated presentation and discussion, hand-out leaflets and, information sheets and follow-up discussion. The team has prepared a simple text for information brochures designed to introduce the purpose of the project, (with reference to Government policy on water and sanitation), the basic principles behind the private sector involvement, and an outline of what is planned in terms of further project preparation and the construction of facilities. These documents are contained in the Volume of Appendices.

The strategy has therefore focused on a communication process reinforcing the beneficiaries (Commune, village and households) understanding of the project, its rules and thereby increasing ownership. The process has also highlighted the benefits of safe and reliable water supply and sanitation and the means of achieving sustainable and affordable town water supply systems. This underpins the foundations of the WTC process and has worked to establish an environment for a knowledgeable response from the community.
The communications strategy involved the following initiatives in the period leading up to, and during the WTC activities:

- **Information**: Meetings organized with the Commune Chief and Commune Council to reaffirm their understanding of the project rules and the process of project preparation and implementation, especially for the newly-elected Commune Chiefs and Commune Councils.

- **Dissemination**: After the above consultation meetings, the organization of a meeting at village level with the village chief and representatives of the village development committee, where these existed, with the participation of the Commune Chief, Commune Council and MIME / Consultants for preliminary discussion about the project rules, proposed options and service.

- **Decision**: Thereafter a series of focused group discussions with beneficiaries (communities) on the selected options by MIME and Council to discuss the Willingness-To-Connect (WTC). These meetings were arranged with the Commune and Village representatives to determine the most suitable time, venue and structure to ensure strong attendance and participation. With the assistance of the Commune and Village representatives the WTC forms were distributed to the proposed beneficiaries after the meeting, and a date was agreed with the beneficiaries for the return of the "signed WTC agreement forms" to the Commune Chief / MIME, and verification by the Commune Chief.

The Willingness to Connect (WTC) indicated that 62.6% of the 1088 households within the proposed service area for Bavet approved a tariff of 1830 Riel/m³.
6 ENVIRONMENTAL IMPACT ANALYSIS

6.1 Methodology

General environmental checklists were used as the basis for developing the project checklist that would suit the assessment intended for the proposed waterworks supply project. Project impacts are classified into the four stages: 1) Pre-construction; 2) Construction, and 3) Operation.

A rapid comparison of the "no project" and "with project" scenarios have been carried out in the form of a Summary Matrix of Environmental Issues/Impacts (Table 6-1). This analysis briefly presents the main environmental issues and possible positive and negative impacts. Impacts are classified as being significant negative environmental impact (--), moderate negative environmental impact (-), none or insignificant environmental impact (o) and beneficial environmental impact (+).

Table 6-1 - Summary matrix of Environmental Issues/Impacts

<table>
<thead>
<tr>
<th>Phase</th>
<th>Environmental Parameter</th>
<th>'No Project'</th>
<th>'With Project'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Construction</td>
<td>Reliability of water availability</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Reliability of water quality</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Land acquisition and resettlement</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Disturbance of land use and economic activities</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Construction</td>
<td>Disturbance of the land use</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Loss of natural vegetation</td>
<td>O</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Disturbance of stream channels, aquatic plant and animal</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>habitats</td>
<td>O</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Soil and water contamination</td>
<td>O</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Hindrance (noise, air pollution, traffic, etc) due to</td>
<td>O</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>construction activities</td>
<td>O</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Soil erosion and compaction</td>
<td>O</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Employment</td>
<td>O</td>
<td>+</td>
</tr>
<tr>
<td>Operation</td>
<td>Public Health</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Contamination of stream channels</td>
<td>O</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Water logging and salinization</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Soil erosion</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Land subsidence</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Increase Land Value</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Enhance Economic Activity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend

-- Significant negative environmental impact
- Moderate negative environmental impact
O None or insignificant environmental impact
+ Beneficial environmental impact

The possible environmental impacts are elaborated in the sections below. If available, quantitative/numerical data are further elaboration in the mitigation and monitoring plans (see Chapters 8).
6.2 Pre-Construction Considerations

Water source selection
Selection of the water source has been done on the basis of security of supply and possibilities for protection of the source. Firstly, the water source should be sufficient to provide enough water during the dry season, and during dryer years. Accordingly, smaller creeks and ponds were considered not acceptable. Moreover, a water source, for which the Local Government may not be able to provide proper protection against pollution, has been rejected for the present water supply system.

Of the options considered for Bavet the only viable water resource is groundwater abstraction. The recommended location is for a small array of two bores to be located within the open fields to the north-west of the town, away from development and likely contamination, with a raw water pipeline connecting to the treatment plant located on the site indicated by the Commune, at the rear of the Commune office. The bores, being located clear from the town development, should not impact on existing bores and supplies.

Land acquisition
Land acquisition will be minimal. The scheme is based on two boreholes sited in open rice fields to the north-west of the town with a raw water pipeline to the treatment plant on land identified as being available behind the Commune Office. The treatment plant will also be located on the land to be made available immediately behind the Commune Office.

It is not anticipated that land has to be purchased. The land for the proposed wells and pumping stations will be made available by the Commune with official documentation as soon as the locations of wells are confirmed by the private operator. The acquisition of land will be facilitated by MIME as part of their responsibility to the project. If possible, the PMU representative will facilitate the issuance of “Deed of Donation” or statements on the willingness to sell prior to the construction to avoid any conflict with the lot owner.

The laying of distribution pipes will mainly be located in public property along the roads. Only minor parts of the distribution system will have to be excavated into private property. During the public consultations, the local residents expressed their cooperation to allow the laying of the pipes in their property as “right of way”.

Involuntary resettlement
No involuntary resettlement will be required.

6.3 Environmental impacts during project construction

General
Negative environmental impacts due to the construction of the proposed water works system are limited. Impacts will be mainly on the terrestrial (land), air environment and on affected persons due to noise and possibly relocation. The impacts could be temporary or permanent, significant or not significant depending on the nature and existing quality of sensitive receptors.
Major activities for the construction will be site-clearing, excavations, pipe-laying, and material hauling. Potential environmental impacts observed in similar construction activities include interference with existing utilities, damage to properties (e.g. displacements, cracks, etc.), and conflicts with existing transportation infrastructure. All damages can be mitigated by applying proper professional construction methods and supervision of compliance with international standards.

Common other impacts from construction activities like dust, noise, limited erosion, and traffic effects can not be fully mitigated, but can be kept within acceptable limits by applying professional standards and construction methods.

The construction of the water supply is not expected to have significant impacts on drainage characteristics of the region. However, it will be important to avoid local flooding or the blocking any natural drainage channel during construction. If applicable, appropriate temporary drainage infrastructure will have to be constructed.

**Site specific impacts**
Located in the Mekong delta, a flat area with limited natural drainage, the increase of wastewater flows may create stagnant water in the residential areas. During the wet season, the areas is flushed by the large amount of rain, possibly even flooding.

The total workforce to be employed by the DBL Operator during construction is estimated at approximately of 25 persons until completion of the project.

**Economic Losses**
The construction of the system may have some negative impacts on the income of selected people. Agricultural activities are disturbed, and some damage to the soil can be expected due to the construction activities and the increased traffic.

Compensation to affected persons will be applied according to general project rules (using market values) as set out in the Operations Manual, prepared in accordance with standards and regulations of the Government of Cambodia.

**6.4 Environmental impact during project operation**

As the proposed project will improve the existing water supply and sanitary conditions in the town, considerable benefits will be achieved for improving public health situation during the operation of the project. Also, the installation of water meters and appropriate pricing of water will reduce leakage and thus result in water conservation.

The construction and improvement of the water supply conditions will increase the amount of toilet waste and wastewater. Especially a possible change from pour flush to flush type toilets and the direct disposal of the effluent of septic tanks into the surface water or drainage system are concerns.

The main environmental risk regarding (temporary) disruption of the water supply service (e.g. through mal-performance of the operator) is that currently used water sources may not be available anymore to fall back to. It is therefore necessary to continue protecting the traditional ponds and water sources from pollution and depletion.
There are no environmental harmful materials to be disposed of in case of a failure of the project.

6.5 Summary of significant environmental impact

Depending on the implementation and precautions taken by the contractor, the construction activities may have various adverse environmental impacts. Although most of them are temporary, they should be mitigated in the best possible manner.

In summary, the most significant adverse environmental impacts are:

- Damage to soil and natural habitat (temporary);
- Contamination of soil and water (temporary);
- Hindrance to local population, e.g. noise, air pollution, and traffic (temporary);
- Increase of wastewater flow (continuous).

A higher concentration of Arsenic is a potential risk for all water supply systems. Extensive water quality testing will be carried out for the water source during development and operation. If necessary, new water sources will be developed.
7 ECONOMICAL ANALYSIS AND ENVIRONMENTAL VALUE

7.1 General

The project is considered economically feasible and sustainable. The water supply system will operate on a commercial basis, and all operating and maintenance costs are in principle paid through the water fee. By securing a reliable water source, sufficient pressure in the network, a minimum number of connections during the preparation stage, and by creating sufficient incentives and obligations for the operator to provide good services, it is not foreseen that the water supply will be disrupted once initiated.

7.2 Financial Data

The following summarizes the principal financial data, as prepared in the feasibility study by GHD/FT.

**Capital Cost**
Construction cost of USD 259,423. Total Project Capital Cost after contingencies etc. of USD 330,346

**Tariff and Financial returns**
The financial model indicates the following tariffs for the different levels of capital recovery and the required return to the investor.

<table>
<thead>
<tr>
<th>FIRR to Operator</th>
<th>MIME Capital Recovery</th>
<th>TARIFFS Riel / m³</th>
<th>Net Present Value - USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>90%</td>
<td>2,065</td>
<td>-199,647 MIME: 75,136</td>
</tr>
<tr>
<td>20%</td>
<td>50%</td>
<td>1,839</td>
<td>-240,183 MIME: 34,013</td>
</tr>
<tr>
<td>20%</td>
<td>0%</td>
<td>1,535</td>
<td>-291,106 -17,609 MIME</td>
</tr>
<tr>
<td>0%</td>
<td>100%</td>
<td>2,030</td>
<td>-</td>
</tr>
</tbody>
</table>

**Sensitivity Analysis**
The sensitivity analysis shows the impact on the investor's return for any reduction in sales (revenue) for a 10, 15, and 20 percent reduction. The sensitivity analysis has adopted the option with a 90% Capital recovery by MIME (RGC).

<table>
<thead>
<tr>
<th>Reduction in demand (revenue)</th>
<th>Reduction in households</th>
<th>Residual households connected</th>
<th>Return to Investor</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% reduction</td>
<td>115 houses</td>
<td>1,033 houses</td>
<td>12.7%</td>
</tr>
<tr>
<td>15% reduction</td>
<td>172 houses</td>
<td>976 houses</td>
<td>Negative</td>
</tr>
<tr>
<td>20% reduction</td>
<td>230 houses</td>
<td>918 houses</td>
<td>Negative</td>
</tr>
</tbody>
</table>
8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 Introduction

Based on the findings of the environmental assessment and the discussions held with the concerned local residents, the Local and National Governments, an Environmental Management Plan has been drafted, including an Environmental Mitigation Plan (EMiP) and an Environmental Monitoring Plan (EMoP).

By submitting the present IEIA, the Ministry of Industry, Mines and Energy certifies that to their knowledge all the information in the enclosed IEIA for Bavet (M07) is true, accurate, and complete (see Annex V), and is committed to its proper implementation.

8.2 Environmental Mitigation Plan

Table 8-1 summarizes the main environmental concerns, the necessary actions and mitigation measures to protect the environment, and the responsibilities of the different parties.

8.3 Environmental Monitoring Plan

In Table 8-2 the required Environmental Monitoring Plan is presented. It is considered necessary that selected data will be collected on a regular basis for the proper implementation and monitoring of environmental mitigation measures, as described in Table 8-1.

8.4 Responsibilities

MIME will have the overall responsibility for the proper compliance monitoring of the Environmental Management Plan (EMP). Upon the signing of the DBL contract, the Contractor will proceed with the necessary steps for the environmentally sound construction and operation of the water supply system, as defined in the EMP. During the construction phase, PMU will be responsible for securing that proper measures are taken by the Contractor. The PMU will inform DPWS/MIME if violations occur, and appropriate actions will be taken. Moreover, DPWS/MIME staff will carry out control inspections during their regular visits to the Provinces.

During operation of the water supply system, the Contractor will have the main responsibility for the proper implementation of the monitoring plan. The monitoring data will be well documented and be available with the Contractor and PMU for consultation and inspection. Environmental compliance chapter will be included in the agreed Project monitoring reports to be submitted to DPWS/MIME and the Ministry of Environment, including Presentation of the collected data; Discussion of the compliance and non-compliance to the EMP; and Conclusion and Recommendation.

Regular Project monitoring reports will be submitted to the World Bank during the operation phase. The environmental data will be available with the DPWS/MIME and the Contractor for consultation and inspection.
Table 8-1 - Environmental Mitigation Plan

<table>
<thead>
<tr>
<th>Phase</th>
<th>Mitigation measures</th>
<th>Responsibility</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-construction</td>
<td>Lack of control of water source. Acquire land directly around the facilities (or secure a possible purchase).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduction in flow. Locate the well in an area where other water users are not affected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Disturbance of land use and economic activities. Usage of public areas. Provision for proper compensation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Lack of control of water source. Acquire land directly around the facilities (or secure a possible purchase).</strong></td>
<td>MIME, World Bank</td>
<td>Prior to DBL</td>
</tr>
<tr>
<td></td>
<td>Reduction in flow. Locate the well in an area where other water users are not affected.</td>
<td></td>
<td>Contracts</td>
</tr>
<tr>
<td></td>
<td>Disturbance of land use and economic activities. Usage of public areas. Provision for proper compensation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>Disturbance of land use due to drilling/construction. Minimize impacts, Restore damages.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Loss of natural vegetation. Replanting of affected areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Disturbance of stream channels, aquatic plant and animal habitats. Erosion and sedimentation control.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil and water contamination (e.g., spilling of oil products and other construction materials). Control (collection, disposal) of waste water.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hindrance (noise, air pollution, traffic, etc) due to drilling/construction activities. Minimize hindrance, Usage of main roads when possible.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil erosion and compaction. Proper runoff and erosion control measures; Heavy traffic restrictions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Safety hazards. Proper safety and warning measures. Provision of temporary crossings/bridges; Public information campaign.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>Public health hazards due to increase of wastewater. Support the construction of proper on-site sanitary facilities (if lacking). Improve storm drainage system for sullage.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contamination of the groundwater. Acquire and fence a protection zone directly around the well. Regulate potential polluting activities in recharge zone. Monitor water level and groundwater abstraction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lowered groundwater table: Space wells at larger distances. Avoid over-abstraction and consequent lowering of groundwater table. Calculate safe yield (abstraction). Assure/proof that other water users are not affected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abandoning phase</td>
<td>Water availability keep traditional water sources available.</td>
<td>Operator, with supervision of MIME</td>
<td>To be determined during feasibility study.</td>
</tr>
</tbody>
</table>

Main text (DRAFT) 8-2 December 2002
Table 8-2 - Environmental Monitoring Plan

<table>
<thead>
<tr>
<th>Phase</th>
<th>Monitoring activities</th>
<th>Responsibility</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-construction</td>
<td>- Land acquisition Check if the required land has been acquired properly, or that a proper “Deed of Sale/Donation” has been prepared</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Resettlement and Compensation. If applicable, check if proper arrangements are made and documented</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>- Hindrance to local population Noise, air pollution (odor, TSP, fume emissions), land damage, traffic</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- EMP compliance of the contractors Erosion control, vegetation protection, soil and water contamination</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Safety precautions of contractors Conform professional standards</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Sanitary control Proper construction of on-site facilities, Proper construction of sullage drainage system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>- Quality of distributed water, conform official standard procedures (microbiology, standard parameters, Arsenic, heavy metals)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Groundwater resources water level (2 X per month (after pumping recovery period), operation of pumps (abstraction)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abandoning phase</td>
<td>- None</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9 INSTITUTIONAL CAPACITY

Organization structure
The Department of Potable Water Supply (DPWS) of MIME has the overall responsibility for the implementation of the project. A Project Management Office (PMO) will be established at MIME as part of the project loan. At the local level, Project Management Units (PMU) have been established already at Provincial level. The PMU will be responsible for the daily supervision of the project activities in the respective provinces.

Budget / Schedule
A special budget will be allocated for overall Project supervision and monitoring, including compliance monitoring of the EMP. Monitoring will be carried out by MIME and World Bank staff.

Staff skills
The capacity of MIME to properly monitor the project is admittedly limited. Although MIME has skilled and motivated staff, current financial, institutional and logistical constraints will obviously be a major factor in the successful implementation.

To reduce the amount of compliance monitoring, many of the responsibilities have been included in the Operators contract. Regular monitoring reports will be provided, which will include a Chapter on environmental compliance monitoring.

Methodological tools and equipment.
The principal equipment required as part of the compliance monitoring is for water quality testing. Most of the field equipment is already available and applied by MIME as part of their ongoing activities. Additional field equipment will be purchased during the project. More specialized water quality testing for the compliance monitoring (e.g. Arsenic) will be carried out by certified laboratories.

Daily water quality testing during the operation of the water supply system is part of the operators contract obligations.

Training
Environmental Management training will be provided 'on-the-Job', as part of the overall monitoring activities to be carried out. Support will be provided by World Bank staff if required.
10 CONCLUSIONS AND SUGGESTIONS

General
The Project, endorsed and approved by the and the beneficiaries of Bavet (Svay Rieng Province) and the Ministry of Industry, Mines and Energy is not expected to create adverse potential environmental impacts. The impacts can be prevented and mitigated to an acceptable level using proven engineering practice and other measures. The proposed development of a water supply system would be beneficial to the entire municipality. It will bring significant health improvements through improvement of water supply and sanitary conditions. It will also increase economic development of the area, resulting in increased land values and employment.

List of Resolved Issues
The provision of clean and safe water will bring a significant improvement in the public health conditions of the participating households. It is expected that a decrease in the number of cases of water-borne diseases (diarrhea, gastroenteritis and parasitism) will occur.

The environmental monitoring program will provide the necessary data for improved environmental management of the water supply facilities. This will enable Ministry of Industry, Mines and Energy to identify and present solutions to possible environmental risks and concerns.

Proper sanitation and wastewater disposal mechanisms will be encouraged through public education and awareness programs to mitigate the adverse effect of an increase in the production of wastewater. Accordingly, the gained benefits in public health will not be negatively influenced. Also, appropriate measures (cleaning, maintenance of the current drainage system) will be addressed to prevent water logging and drainage problems arising from an increase in wastewater.

List of Partially Resolved Issues
All possible precautions will be taken to minimize negative impacts during the construction phase. Damage to soil and water will be restored and properly compensated. Other limited negative impacts that can not be fully mitigated (noise, traffic) will only be temporary.

Economic losses due to construction activities will be compensated according to standards developed and agreed upon with the Royal Government of Cambodia.

New issues arising from the IEIA that have been resolved
The IEIA emphasized on proper water source selection and protection, as currently incorporated in the feasibility study and final designs.
11 PRINCIPAL REFERENCES.

PPUWSS Project
GHD/Fraser Thomas, 2002 – Bavet Feasibility Study report (M07, Svay Rieng).
GHD/Fraser Thomas, 2002 – Bavet Willingness to Connect Report (M07, Svay Rieng).
Parsons – DRAFT technical specifications for the ‘Provincial and Peri-Urban water supply project’.

Kingdom of Cambodia
MOE - List of the Projects Require an IEIA or EIA; Annex of Sub-Decree No 72 ANRK. BK. Date 11 August, 1999.
MRD/JICA, 2001 – The study on Groundwater Development in Central Cambodia. Interim Report, prepared by Kokusai Kogyo Co., Ltd
Royal Government of Cambodia (1996) - Law on Environmental Protection and Natural Resource Management
Royal Government of Cambodia (1997) - Sub-decree of Construction License (No. 86)
Royal Government of Cambodia (1999) - Sub-decree on Water Pollution (No: 27.ANRK.BK)

World Bank Guidelines
Annex I - List of EA preparers

MIME staff
Mr. Peng Navuth, Director, Public Water Supply Department
Mr. Sin Vaidia, Deputy Director DPWS, PPUWSSP Project Manager
Mr. Cheav Channy, Deputy Chief of Technical Office, DPWS

Local Government Representatives

World Bank supervision
Mr. P. Illangovan, Senior Environmental Specialist
Mr. Vijay Jagannathan, Task Team Leader
Mr. Luiz Tavares, Senior Sanitary Engineer

Consultant
Frank Radstake, Environmental and Water Resources Management Advisor
Annex II – WTC Process documentation

General
The meetings and discussions in each town conformed to a set pattern, varied only by the individual requests for change on the part of the Communes:

1. The first day in each Province was devoted to the PMU training and familiarization workshop.

2. On entering a District the teams paid a short courtesy visit to the District Governor and the senior advisors to reinforce the project objectives and rules, and to seek his/her advice on matters they should take into account in their subsequent meetings.

3. The teams would then meet with the Commune Chief(s) and Commune Council members with an established agenda providing for:
   - Introduction of participants and the facilitator
   - Briefing on the meeting – why (project information sheet), objectives and action plan
   - The project – background, rules, roles and responsibilities, structure and implementation, and benefits
   - Feasibility Study – outline of work, technical options, management options, financial options and costs, tariffs
   - Open forum – questions and answers
   - Action planning – arrangements for area-wide meetings of villagers, schedule for meetings, program for area-wide meetings
   - Additional roles and responsibilities – Commune support and attendance at area-wide meetings, roles of Commune Chiefs and Commune before, during and after the village meetings
   - Willingness-To-Connect – how to distribute the agreement forms and generate the 51% positive return required, The involvement of the Commune Chiefs in collecting the returns and validating the responses, and confirmation and synthesis of agreement.

4. The teams also met with the Village Chiefs and members of the Village Development Council, if one existed. More often than not the Commune preferred the two meetings to occur together to ensure the same information was related to all parties and that a uniform interpretation of this was resolved. Where separate meetings occurred, these followed the same agenda as the meetings with the Communes.

5. On reaching agreement for the program and timing of the village meetings the team then departed for another town and meetings there with the Commune and Village Chiefs. After a space of several days the team returned to conduct the area-wide meetings, thus allowing time for local organization and arrangements for the meetings.
6. The area-wide meetings occurred in each village in a location suitable to the villagers. The pictorial displays and samples of fittings, meters and materials were used to support the presentation. The meetings were participatory and encouraged viewpoints and questions. In general the presentation followed the following structure:
   - Explanation of the purpose of the meeting – indication of the participatory nature and indication that views were welcome and invited
   - The project – background and description, socio-economic benefits
   - Presentation of options – summary of Feasibility Study, technical options, financial options, tariffs
   - Open forum – questions and answers
   - Summation and closure

7. Prepared information kits of all relevant information in the Khmer language were left with the Commune Chief and Commune members, the Village Chiefs and Development Committee members, and key/influential persons within each village – to ensure that advice could be provided to villagers seeking elaboration concerning the project.

8. Following work in each group of towns the teams were debriefed in the Consultants’ office in Phnom Penh to embody the lessons learned and to refine the process.

At the conclusion of the above meetings the teams left WTC forms with the Commune Chiefs with instructions for their completion by the villagers. These instructions requested that:

1. The issue and collection of the forms should be controlled to allow these to be reconciled later for the calculation of the WTC ratio.
2. The forms should be distributed and collected by each Village chief.
3. The forms should be verified by the Commune to confirm:
   - The signatory was a bona fide head of household, or so authorized
   - The location of the property was correctly identified
   - There was only one form from each household
   - That the signatory was in fact the identified person (most signatures are in the form of a thumbprint).
4. The forms were collected around a week later and brought to the Consultants’ office and subjected to a further audit and recount.
5. The forms have been collated, bundled and boxed for future reference, and will be handed over to MIME for safekeeping.
6. During the in-house audit a number of incomplete forms were observed and separated from the correctly-completed returns. MIME will need to follow-up on these returns to establish the intent of the signatory, to avoid later dispute regarding the provision of a free connection, or otherwise.
Bavet (M07) WTC Summary
The following summarizes the findings of the WTC survey in Bavet, as provided by GHD/FT. More details can be found in the Willingness-to-Connect report.

1. Service Area
The initial Service Area comprised the town center, international market and central road network, and development along roads intersecting with National Route #1 (NR1) until development drops off at start of rice fields. Also development along NR1 through the town for a distance of 3 kilometres.

As a result of feedback during WTC meetings, the Service Area has been extended to include two small, isolated pockets of housing. However a third, more substantial, proposal does not appear to be within the scope of the project (see below).

2. Number of Households in Service Area
The initial Service Area contains 1088 households, based on audited WTC returns. This number correlates closely with the direct count previously undertaken by the Consultants.

3. Consultation Process
The feasibility design, and related options, and the tariffs have been presented to, and discussed with the District and Commune governments at Bavet. Similarly the feasibility designs and related tariffs have been conveyed to area-wide meetings of villagers residing within the proposed supply areas. The presentation and meetings have conformed to the communication strategy displayed to, and agreed with MIME.

4. Options
The initial options considered for Bavet and discussed with MIME before finalising the Feasibility Study related to 1) the supply of the core town area only, and 2) alternatively, extension of the system to pick up the development around the International Border Market.

The International Market is 2 kilometers to the east of the main town along NR1. The consideration of these options showed that the costs of the scheme were not sensitive to the additional reticulation required for the extension to the border market. In fact the Tariff for the extended scheme proved to be cheaper than the tariff for a scheme focusing on the core area only.

In the course of the consultation the community identified other options. Two of these options would require minor extension to the piped reticulation, which can be accommodated with negligible impact on the overall scheme.

One further request entails a significant extension to the east with the impost of far higher costs for the town residents. The driver for this extension is the desire for service to a new casino at the border with Vietnam, some 1.8 km beyond the end of the present Service Area. However the impacts of this on the scheme on the scheme would be far higher pressures than the project Operations Manual permits and significantly higher tariffs. A supply to this casino would service little or no additional housing and is therefore unlikely to assist the project objective of poverty alleviation.
It is considered that the casino venture would be better placed organising on-site groundwater supplies, like the adjacent, existing casino. Alternatively it would be open to the new venture to enter into a fully-commercial arrangement with the water supply scheme operator.

5. WTC Response
The WTC returns have been audited, recounted and reconciled against the forms issued, the number of returns received, the unused forms and those unaccounted for through non-return from the village households that have refrained from indicating an opinion one way or the other. Similarly the number of households has been reconciled for the calculation of the WTC ratio.

The WTC indicate that 62.6% of 1088 households within the service Area of Bavet approved a tariff of 1830 Riel /m3.
Annex III - Proof of social acceptability

<table>
<thead>
<tr>
<th>VILLAGE</th>
<th>YES</th>
<th>NO</th>
<th>SPOILT</th>
<th>TOTAL ISSUED</th>
<th>FS COUNT *</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Ta Pov</td>
<td>158</td>
<td>45</td>
<td>0</td>
<td>203</td>
<td></td>
</tr>
<tr>
<td>2  Ta Boeub</td>
<td>78</td>
<td>73</td>
<td>11</td>
<td>162</td>
<td></td>
</tr>
<tr>
<td>3  Bavet Leu</td>
<td>77</td>
<td>154</td>
<td>1</td>
<td>232</td>
<td></td>
</tr>
<tr>
<td>4  Chrork Leav</td>
<td>136</td>
<td>55</td>
<td>0</td>
<td>191</td>
<td></td>
</tr>
<tr>
<td>5  Bavet Kandal</td>
<td>232</td>
<td>68</td>
<td>0</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>681</td>
<td>395</td>
<td>12</td>
<td>1088</td>
<td>1148</td>
</tr>
</tbody>
</table>

WTC Percentage: 62.6%

* indicates house count by Consultants in Rapid Appraisal stage
Annex IV – Applied Water Quality Standards

The following water quality standards are proposed at a seminar workshop on the development of national drinking water quality standards for Cambodia, Phnom Penh, June 24-25, 2002

Table 1. Standard Values for Bacteriological Quality

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Standard value (number/100ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>E. coli or thermotolerant (fecal) coliform bacteria</td>
</tr>
<tr>
<td>II</td>
<td>Treated water entering the distribution system</td>
</tr>
<tr>
<td>III</td>
<td>Treated water in the distribution system</td>
</tr>
</tbody>
</table>

* In case of large quantities where sufficient samples are examples, it must not be present in 95% of samples taken throughout any 12-months period

Table 2. Standard Values for Chemical Quality: Health significance

A. Inorganic constituents

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Maximum level (mg/liter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>antimony</td>
<td>0.005</td>
</tr>
<tr>
<td>arsenic</td>
<td>0.01*</td>
</tr>
<tr>
<td>barium</td>
<td>1</td>
</tr>
<tr>
<td>boron</td>
<td>0.5</td>
</tr>
<tr>
<td>cadmium</td>
<td>0.01</td>
</tr>
<tr>
<td>chromium</td>
<td>0.05</td>
</tr>
<tr>
<td>cyanide</td>
<td>0.07</td>
</tr>
<tr>
<td>fluoride</td>
<td>1.5</td>
</tr>
<tr>
<td>lead</td>
<td>0.01</td>
</tr>
<tr>
<td>mercury (total)</td>
<td>0.001</td>
</tr>
<tr>
<td>molybdenum</td>
<td>0.1</td>
</tr>
<tr>
<td>nickel</td>
<td>0.02</td>
</tr>
<tr>
<td>nitrate (as NO₃⁻)</td>
<td>50</td>
</tr>
<tr>
<td>nitrite (as NO₂⁻)</td>
<td>3</td>
</tr>
<tr>
<td>selenium</td>
<td>0.01</td>
</tr>
</tbody>
</table>

* Proposed interim Maximum Allowable Concentration until June 2007
Arsenic 0.01-0.05
B. Organic constituents

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Maximum level (µg/liter)*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pesticides</strong></td>
<td></td>
</tr>
<tr>
<td>Aldrin/Dieldrin</td>
<td>0.03</td>
</tr>
<tr>
<td>Altrazine</td>
<td>2</td>
</tr>
<tr>
<td>Chlordane</td>
<td>0.2</td>
</tr>
<tr>
<td>DDT</td>
<td>2</td>
</tr>
<tr>
<td>Endrin</td>
<td>0.2</td>
</tr>
<tr>
<td>Heptachlor and Heptachlor epoxide</td>
<td>0.03</td>
</tr>
<tr>
<td>Lindane</td>
<td>2</td>
</tr>
<tr>
<td><strong>Aromatic hydrocarbons</strong></td>
<td></td>
</tr>
<tr>
<td>Petroleum oils &amp; grease</td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td>10</td>
</tr>
<tr>
<td>Toluene</td>
<td>700</td>
</tr>
<tr>
<td>Xylene</td>
<td>500</td>
</tr>
<tr>
<td>Ethylenzene</td>
<td>300</td>
</tr>
<tr>
<td>Benzo[a]pyrene</td>
<td>0.7</td>
</tr>
<tr>
<td><strong>Cyanobacteriational toxins</strong></td>
<td></td>
</tr>
<tr>
<td>Microcystin-LR***</td>
<td>1</td>
</tr>
</tbody>
</table>

*Note: The unit used in this table is µg/L = mg/L/1000.

**Constituents can be added or deleted depending on the pesticides use in Cambodia.

***Microcystin-LR is an emerging concern in Cambodia in both urban and rural areas using surface water for drinking.

Table 3. Standard Values for Physical and Chemical Quality: Aesthetic Quality

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Level (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taste</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Odor</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Color</td>
<td>10 TCU</td>
</tr>
<tr>
<td>Turbidity</td>
<td>5 NTU</td>
</tr>
<tr>
<td>Aluminum</td>
<td>0.2</td>
</tr>
<tr>
<td>Ammonia</td>
<td>1.5</td>
</tr>
<tr>
<td>Chloride</td>
<td>300</td>
</tr>
<tr>
<td>Copper</td>
<td>2</td>
</tr>
<tr>
<td>Hardness (as CaCO₃)</td>
<td>300</td>
</tr>
<tr>
<td>Hydrogen Sulfide</td>
<td>0.05</td>
</tr>
<tr>
<td>Iron</td>
<td>0.5</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.5</td>
</tr>
<tr>
<td>pH</td>
<td>6.5 – 8.5 (no unit)</td>
</tr>
<tr>
<td>Silver</td>
<td>0.1</td>
</tr>
<tr>
<td>Sodium</td>
<td>200</td>
</tr>
<tr>
<td>Sulfate</td>
<td>500</td>
</tr>
<tr>
<td>Total Dissolved Solids (TDS)</td>
<td>10000b</td>
</tr>
<tr>
<td>Zinc</td>
<td>5b</td>
</tr>
</tbody>
</table>

TCU – true color unit, NTU – nephelometric turbidity unit

a Secondary standards, compliance with the standard and analysis are not obligatory

b TDS consist of calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulphates
### Table 4. Standard Values for Disinfectant and Disinfection By-Products

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Maximum Level (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a Disinfectant</strong></td>
<td></td>
</tr>
<tr>
<td>Chlorine (residual)</td>
<td>0.2 – 0.5</td>
</tr>
<tr>
<td><strong>b Disinfection By-products</strong></td>
<td></td>
</tr>
<tr>
<td>Chlorite</td>
<td>0.2</td>
</tr>
<tr>
<td>2.4.6 trichlorophenol</td>
<td>0.2**</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>0.9</td>
</tr>
<tr>
<td>Trihalomethanes</td>
<td></td>
</tr>
<tr>
<td>Bromoform</td>
<td>0.1</td>
</tr>
<tr>
<td>Dibromochloromethane</td>
<td>0.1</td>
</tr>
<tr>
<td>Bromodichloromethane</td>
<td>0.06</td>
</tr>
<tr>
<td>Chloroform</td>
<td>0.2</td>
</tr>
</tbody>
</table>

* Analyze only where chlorination is used for disinfection purposes
** Represents health-based guideline value for phenolic substances

### Table 5. Standard Values for Radiological Constituents

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Activity level (Bq/litre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross alpha activity</td>
<td>0.1</td>
</tr>
<tr>
<td>Gross beta activity</td>
<td>1</td>
</tr>
</tbody>
</table>

* Analyze only when appropriate; not for regular monitoring purposes.*
ACCOUNTABILITY STATEMENT OF THE PROJECT OWNER

This is to certify that to our knowledge all the information in the enclosed Initial Environmental Impact Assessment (IEIA) for Bavet (Svay Rieng Province) is true, accurate, and complete. Should we learn of any information which would make the enclosed IEIA inaccurate, we shall bring said information to the attention of the Ministry of Environment.

We hereby bind ourselves jointly and solidarity with the preparers for any penalties that may be imposed arising from any misrepresentations or failure to state material information in the enclosed IEIA.

Ministry of Industry, Mines and Energy

Title/Designation