



**Sri Lanka Tsunami Reconstruction Program (SLTRP)**  
**USAID Contract # 386-C-00-05-00166-00**

**Environmental Assessment for**  
**Arugam Bay Bridge Construction**  
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SLTRPR-0012



*In association with Chemonics International, DEVTECH, FNI, Engineering Consultants LTD.,  
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## Abbreviations

A/L	Advance Level
CBO	Community Based Organization
CCD	Coast Conservation Department
CEA	Central Environmental Authority
DS	Divisional Secretariat
EA	Environmental Assessment
EMAP	Environmental Management Action Plan
FO	Farmer's Organizations
GN	Grama Niladhari
GND	Grama Niladhari Division
GOSL	Government of Sri Lanka
INGO	International Non-Governmental Organizations
LA	Local Authority
MSL	Mean Sea Level
NBRO	National Building Research Organization
NGO	Non-Governmental Organization
PAA	Project Approving Agency
PCM	Participatory Coastal Management
PRDA	Provincial Road Development Authority
PS	Pradheshiya Sabha
RDA	Road Development Authority
REG 216	22 CFR 216 (Regulation 216)
Rs.	Sri Lankan Rupees
SLTRP	Sri Lanka Tsunami Reconstruction Program
STF	Special Task Force
TOR	Terms of Reference
USAID	United States Agency for International Development

## **Executive Summary**

### **Project background**

The Arugam Bay Bridge Replacement and Access Roads project is a sub-project of the Sri Lanka Tsunami Reconstruction Program (SLTRP), funded by USAID. SLTRP is contributing to Sri Lanka's efforts in post-tsunami rebuilding through improving damaged infrastructure in a number of areas in the coastal zone.

The Arugam Bay Bridge spans Arugam Lagoon, and is located in the Pottuvil Divisional Secretariat (DS) division of Ampara district. It consists of a 152 meter long steel bridge connected to a 110 meter long causeway, as well as a separate 25 meter steel bridge to the south. The bridge serves as a lifeline between the northern and southern areas of the Pottuvil DS, meeting the needs of people visiting, residing and working in these areas.

The 2004 tsunami severely damaged the bridge, rendering its access roads impassable. Although the bridge was temporarily restored after the tsunami, restrictions have been placed on the maximum load that can be taken across the bridge, thus causing severe inconveniences to transporters. It is in this context that the Arugam Bay Bridge Replacement and Access Roads project was proposed, justified, and formulated.

This document is the Environmental Assessment (EA) for the Arugam Bay Bridge and access road construction, and fulfills the environmental safeguard requirements as outlined in 22 CFR 216 (Regulation 216). It presents potential environmental impacts, identified through a combination of rapid field assessments, literature reviews, and other techniques described in the methodology section. As evidenced throughout this assessment, great lengths were taken to involve stakeholders at each step in the process, resulting in a comprehensive compilation of their ideas and concerns about the project.

### **Project description**

The main objective of the project is to meet the transportation requirements of the area by replacing the existing Arugam Bay Bridge with a new bridge, as well as reconstructing 500 meters of access roads on either side of the bridge. The new replacement bridge will be a steel truss bridge with a pre-cast concrete deck aligned 25 meters to the east of the existing bridge. The new bridge will be approximately 160 meters in length connected through the causeway to a new 25 meter long steel bridge over a tributary in the south. The access roads will be 500 meters in length on either side, and will be aligned approximately 25 meters to the east of the existing access roads. The project has been well-received by the general public in the area, as locals consider the reconstruction of the bridge to be an essential and urgent need.

### **Alternatives**

Several design alternatives were considered during the project planning stage. In terms of the bridge alignment, three proposals were evaluated: (a) a new bridge with a length of 690 meters on a completely new alignment; (b) a new bridge and access roads of similar alignment and length to the existing one; (c) no action. Out of these, alternative (a) has proven too costly given the available funds, and alternative (c) will hamper development in the area by failing to address existing transportation needs. As a result, alternative (b) has been accepted as the preferred option as it not only meets the

transport requirements of the area, but also calls for realistic construction costs, thus achieving the objectives of the project.

In terms of construction technology two alternatives have been considered: (a) cast-in-place technology; and (b) pre-cast technology. Evaluations of these two alternatives favored the pre-cast technology, as better quality standards can be achieved given that the bridge will be manufactured under factory conditions with minimal on-site construction.

**Construction work**

Several construction methods have been considered to initiate work. These include: (a) using a barge to transport the bridge components to the site through a channel cut into the lagoon; and (b) unloading the bridge components at a temporary jetty at a nearby beach, and transporting them to the site via an access road. A workforce of 100 skilled and unskilled laborers will be involved in this initial stage. The project will also involve a number of temporary works such as labor camps, a staging area, and rubble mounds to anchor cranes. Other important work includes not only the demolition of the old bridge upon completion of the new bridge, but also its disposal at a suitable location approved by the Road Development Authority (RDA).

## Impact Analysis & Mitigation

The key environmental issues associated with the construction stage and proposed mitigation measures are summarized in the table below. Mitigation measures should reduce all impacts to a low level.

	<b>Environmental Impacts</b>	<b>Activities</b>	<b>Degree of Impact without Mitigation Measures</b>	<b>Mitigation Measure</b>
	<b>Impacts on Soil</b>			
1	Loss of productive top soil	Site preparation, piling work, construction of land embankments, bridge approach roads and temporary access roads	Low	Conservation and reuse of top soil.
2	Soil erosion caused by removal of vegetative cover and excavated loose soil	Construction of land embankments, access roads, temporary access roads, labor camps, material storage areas,	Moderate – high	Repopulate with local vegetation as soon as possible; cover loose soil; store away from the edges of the lagoon.
	<b>Impacts on Water Resources</b>			
3	Degradation of water quality in the lagoon and bay due to increased turbidity	Driving of piles	Moderate – high	Monitoring of water quality and, if significant degradation is seen, use of silt curtains to prevent spread of suspended sediments
4	Changes in tidal dynamics in the lagoon	Breaching of the sand bar to transport bridge parts, creation of rock piles to anchor cranes	Moderate – high	Model the potential change to the water exchange mechanism and monitor the changes in the salinity of the lagoon waters; use of coffer dam
6	Flooding of local areas due to restricted flow at the mouth of the lagoon	Only if the mouth is restricted for a longer period which covers the rainy periods	Low – moderate	Monitor the water flows during the rainy periods and take action to remedy if there is a danger of flooding during construction period
7	Modifications to water flow paths	Excavations in the ground for construction of land embankments and access roads	Moderate	Avoid main drainage paths; restore areas as soon as possible
	<b>Impacts on Air Quality</b>			
8	Degradation of air quality in project area	Vehicle emissions, dust, mixing of raw materials	Moderate – high	Properly maintained vehicles and equipment, use of water trucks to control dust, stockpiles to be located away from sensitive receptors, enforce vehicle speed limits etc
9	Increase of noise pollution in surrounding	Construction vehicles, equipment and	Moderate	Regular maintenance of vehicles & equipment; avoid

	<b>Environmental Impacts</b>	<b>Activities</b>	<b>Degree of Impact without Mitigation Measures</b>	<b>Mitigation Measure</b>
	areas	other construction activities	– high	working during sensitive hours; avoid locating machinery close to sensitive receptors
	<b>Impacts on Eco-systems, Fauna and Flora</b>			
10	Loss or disturbance to terrestrial habitats due to clearance of land.	Access roads, land embankments, labor camps, parking areas for construction vehicles, stock piling of raw material	Low	The open areas that are grasslands can be used for construction but with appropriate safeguards to maintain material and dump sites from contaminating the lagoon and bay waters.
11	Loss or disturbance to aquatic habitats due to increased sedimentation, changes in salinity, etc.	Deepening of the near shore areas, sand bar and lagoon, piling work, digging the lagoon bed, forming of the riprap	Moderate – high	Use of silt curtains; modeling of the water exchange mechanism of the lagoon with the sea; monitor the changes before, during and after construction
12	Threats to local biota from invasive species	Construction material and vehicles	Moderate – high	Ensure that soil is obtained from nearby areas, which are free of invasive plants and monitor the surrounding areas for spread of invasive species. Clean the construction equipment and vehicles often.
	<b>Socio-economic concerns</b>			
13	Possible reduction in the income of fishermen due to loss of fish breeding sites	Turbidity caused by bridge construction; salinity changes due to a possible breach in the sand bar	Moderate	Use of construction practices that would minimize loss of habitats; monitoring of fish catch during and after construction

In addition to the above, there will be short-term employment opportunities available for local people during the construction of the bridge, which is a positive impact. A failure to include the local populace in the reconstruction program is one of the main concerns expressed by local stakeholders, and the contractor is advised to link with the community on this matter.



### **Environmental Management Action Plan**

An environmental management action plan (EMAP) has been developed to minimize adverse impacts on the environment as a result of the project activities. The EMAP is detailed in Section 5.

### **Recommendations & conclusions**

If recommended mitigation measures are followed, the environmental impacts of the project will be largely temporary and limited. Most of the significant potential impacts are associated with changes to: (a) tidal exchange mechanisms; (b) sand bar and nearshore habitats; (c) localized disturbance to turtle nesting habitats and terrestrial habitats (due to temporary transport routes); and (d) turbidity caused by activities in the lagoon bed. Impacts on (a) – (c) will depend upon the exact construction plan proposed by the construction contractor. Requirements for monitoring will be greatly reduced if project activities do not require artificial opening of the lagoon (i.e. cutting of the sandbar to allow movement of barges).

In regard to impact on potential sea turtle habitat, the possible construction of a jetty to allow barge docking is the most significant potential impact. Recommended mitigation measures include careful selection of the site (preferably in areas already disturbed by human activity); minimizing activities on the beach, especially artificial lighting during turtle nesting periods; and undertaking overall conservation activities with the surrounding communities including public awareness on conservation of protected species.

This environmental analysis also recommends monitoring of water quality, biodiversity, and fish catch, during the project period. The need for baseline assessments is reduced if no artificial opening of the lagoon is required.

# 1 Introduction

## 1.1 Project background

The Indian Ocean tsunami, triggered by a massive earthquake off the coastline of Sumatra in 2004, wreaked havoc in the region, claiming over 200,000 lives, displacing hundreds of thousands of people and destroying billions of dollars of property. In Sri Lanka, twelve coastal districts were affected in one of the worst natural disasters in the country's history.

The tsunami damaged and destroyed many infrastructure facilities in the coastal areas of the country, bringing life to a virtual standstill in the initial days following the catastrophe. The transport sector was severely affected with an estimated 1,615 kilometers of roads (including 1,137 kilometers of national roads), and 25 bridges destroyed, making access to affected areas extremely difficult (TAFREN, 2005).

Ampara district saw some of the worst impacts. In the area known as Arugam Bay, which is located in the Pottuvil Divisional Secretariat (DS) Division of Ampara district, approximately 80 percent of the houses along the coastline were destroyed (ARCADIS, 2005). The bridge that spans the Arugam Lagoon and connects the northern and southern sections of the Pottuvil DS divisions was severely damaged, with parts of it either completely destroyed or displaced. In the days immediately after the catastrophe, connectivity between the northern and southern areas of the DS division was restored by a boat service. The roads leading to Arugam Bay were also badly damaged and were rendered impassable by the tsunami. The bridge was restored with a temporary Bailey bridge by the Engineer Regiment of the Indian Army Task Force. Although the present bridge has addressed the immediate need to restore connectivity overland, further action is needed to address capacity constraints and meet growing transportation demands.

With regard to post-tsunami restoration and recovery efforts, the Government of Sri Lanka (GOSL) has made a commitment to "building back better" with the funding assistance extended by the international community. The United States Agency for International Development (USAID) is contributing to this objective of post-tsunami reconstruction and rehabilitation through SLTRP, which will improve the physical infrastructure in a number of sectors, including transportation. More specifically, the program will replace the existing bridge in Arugam Bay with a new and modern steel bridge. The goal of this document is to synthesize the findings of an assessment which evaluated the potential environmental and social implications of the proposed construction work under the Arugam Bay Bridge Replacement and Access Roads Project.

## 1.2 Purpose of the report

This document is the Environmental Assessment (EA) for the proposed Arugam Bay Bridge Replacement and Access Roads Project and fulfills the environmental safeguard requirements of the USAID as set out in Regulation 216 (22 CFR 216 Agency Environmental Procedures - USAID). The decision to prepare an EA for the proposed project has been determined by the Initial Environmental Examination (IEE) prepared by USAID for all of its SLTRP activities, which includes the Arugam Bay bridge replacement sub-project. The IEE was completed prior to commencement of project implementation.

Following the IEE, all key sub-projects of SLTRP received a positive determination and required separate EAs. A *positive determination* (or positive threshold decision) following an IEE establishes that an action is likely to cause a significant impact or a reasonably foreseeable chance of significant harm to the environment and that preparation of an EA or an environmental impact statement (EIS) will be required.

The report has been prepared in order to provide information pertaining to environmental and social dimensions of the project to decision makers, relevant stakeholders in Sri Lanka, and USAID in order to ensure they are each equipped with the best available information to make informed decisions that are in the best interests of the country and its people. It is structured as follows:

1. An analysis of all potential construction options that would achieve the project objectives. This is followed by a discussion of their potential environmental and economic ramifications, including the option of taking “no action”. Such an analysis provides sufficient information to stakeholders to ensure that the most appropriate option is selected.
2. A presentation of the significant potential impacts of the project on physical, biological and social environments, as well as a discussion of effective mitigation measures to alleviate adverse impacts.
3. The development of a project/site-specific Environmental Management Action Plan (EMAP), which sets out an environmental monitoring program to identify the environmental effects of the project as it proceeds, as well as to describe techniques to implement mitigation measures.

Finally, keeping with its goal of implementing a participatory approach, this EA report furnishes the general public with the information it needs to understand the potential environmental implications of the project as well as proposed mitigation measures.

### 1.3 Scope of the Environmental Assessment

The scope of the EA is defined by the Terms of Reference (ToR), which is presented in **Annex 1**. The salient aspects of the scope are given below:

- 1 **Temporal coverage:** The study establishes the existing environmental settings of the project area (present situation), defining potential impacts that are both short-term and long-term in nature.
- 2 **Geographic coverage:** The geographic area of the impact zone is defined as the 0.5 kilometer buffer zone of the bridge reconstruction area and the Arugam Bay Lagoon. Although this primarily includes areas that would be directly affected by the project, it also takes into consideration impacts that are more geographically distributed (i.e. air quality, watershed health, socio-economic factors, etc.).
- 3 **Extent of the analysis:** The analysis covers several areas, including the identification of possible construction alternatives, determination of significant project impacts and evaluation of the effectiveness of mitigation measures.

Although the scope of the environmental assessment was necessarily defined by the above, the construction project will be accompanied by a participatory coastal management (PCM) effort carried out by SLTRP. PCM staff will be involved in activities – such as promoting community monitoring of construction and building capacity of local government – that will allow the project to identify and respond to impacts that may arise outside the scope of this assessment.

#### **1.4 Methodology of the Environmental Assessment**

The physical, biological and social environments have been defined by data collected using a variety of methods described below:

- Literature review of all available and relevant physical and biological environmental information. Communication with experts was conducted to supplement the literature survey as needed.
- Collection of biodiversity information through a survey of fauna and flora in habitats found within a 0.5 kilometer radius of the points of contact of the bridge road to the land. Information was collected through direct observations as well as by utilizing three 25 meter line-transects leading away from the bridge (towards the land). All of the different habitats that occur in the area were studied, recorded, and are presented in Annex 2.
- Collection of information pertaining to the presence or absence of marine turtles and their nesting habitats through a two week long survey. Night transects were carried out along an eight kilometer stretch of the coastline which constituted the proposed project area. A total of ten transects were carried out between 9.30 pm to 1.30 am and 2.00 am to 6.30 am along this stretch. The terms of reference for the study is attached as Annex 3 and the detail survey report is attached as Annex 4.
- Collection of socio-economic data through a short survey of sources, such as statistics available at the Grama Niladhari (GN) offices and local community-based organizations (CBOs), interviews with officers of various organizations representing interests of various livelihood groups, and focus group discussions with target communities and other relevant stakeholders (such as fishermen, traders, hoteliers, religious leaders, etc.).
- Consultations carried out by the SLTRP team with communities in Pottuvil, Arugam Bay and Panama in order to raise awareness of the project and to solicit community feedback on concerns and opinions. More details pertaining to the process of stakeholder consultation is provided in Section 1.5.

A list of people met during the EA preparation is given in Annex 5.

Environmental impacts and mitigation measures were initially identified based upon a brainstorming session conducted by the EA preparers (Annex 6) in collaboration with SLTRP staff managing the bridge construction planning. These impacts and proposed measures are based on past professional experience of team members in executing similar projects, expert opinion, field knowledge of the Arugam Bay bridge environmental setting and relevant published literature.

Qualitative classifications of impacts as 'low', 'moderate' and 'high' were made mainly based upon expert opinion, referencing environmental criteria such as standards and threshold values, where applicable (for example, Central Environmental Authority (CEA) guidelines on air quality and noise levels). Criteria such as duration of impact, reversibility of impacts, aerial extent, and magnitude were evaluated as part of the classification.

Recommendations for the management of potential impacts focus on two areas: (a) avoiding the occurrence of impacts through standard best practices – the EMAP focuses primarily on this aspect and sets out a number of safeguard measures to be adopted by the contractor to proactively avoid negative impacts; and (b) minimizing the effects of long term impacts through intelligent implementation that avoids irreversible environmental changes. The monitoring plan sets out a program to establish baseline conditions with regard to critical environmental parameters in the lagoon. As a result, any significant adverse changes that occur due to project activities will be detected early on. This allows not only continuous monitoring, but also the implementation of necessary mitigation measures.

## **1.5 Stakeholder consultation**

Consultations with relevant stakeholders affected by the bridge construction in Arugam Bay were conducted on two different occasions: (a) technical consultations carried out by the sociologist on the EA team, which collected baseline socio-economic information and gained insight into feelings and concerns of various stakeholder groups about the proposed new bridge; and (b) public consultations carried out by SLTRP with communities in Pottuvil, Arugam Bay and Panama to share information about the proposed bridge project and its implementation, as well as to discuss their perceptions and concerns.

These consultations have been well received by the local people and have increased awareness about the project among the local populace. This kind of reception is an extremely important determinant of the project's success, as it: a) prevents the development of misconstrued perceptions due to poor communication which might jeopardize project implementation (especially given the ethnic tensions in the Eastern Province); and b) provides a platform for community members to voice their concerns which can then be built into the project design.

The meetings conducted by the SLTRP participatory team paid special focus to creating ownership among the local groups for the proposed project and voicing their concerns. Consultations were presided over by accepted local leadership such as Divisional Secretaries and other respected office bearers and moderated with the assistance of Local Authorities. In addition, the consultations focused on a wide and a representative audience of stakeholders comprising of all different ethnic and religious groups, both genders and various livelihood groups operating in the area. A complete list of stakeholders participating in consultations is presented in **Annex 5**.

In short, all stakeholder groups have welcomed the proposal to build a new bridge across the lagoon and are willing to cooperate with the project. More details on stakeholder feedback are presented under relevant sections in Chapter 3 and 4. The project will continue to address community concerns and encourage their participation

and involvement through further consultations, communication channels established with the local officers and other media such as local radio. The project intends to support periodic activities with the local radio service to provide a platform to share community voices and thereby promote a sense of community involvement and enthusiasm for the project, while also providing answers to contentious issues as necessary.

In conclusion, it is through these consultations that the community has gained a certain understanding of not only the implementation process and approximate dates of construction commencement, but more importantly the mechanisms that will be adopted for local labor hire. Through its insistence of including the Panama community, a minority Sinhalese village as well as women not generally active in public life (as this is a traditional Muslim community), SLTRP has clearly communicated a message of inclusiveness. In turn, the project has also had the opportunity to learn a great deal about community decision-making processes and structures, which will be built upon as the PCM component devises activities to strengthen capacity in coastal resource management and governance.

## 1.6 Approvals Needed or Obtained from the Government Agencies and Applicable Regulations/Laws

**Table 1** – Regulations and approvals applicable for the project

Subject Area	Regulation/ Legislation	Relevance of the Regulation to this Project	Approval Needed
Utilization of water resource from public streams	Crown Lands Ordinance	To control the right to use and manage water in public stream/lake.	Divisional Secretary
Reduce, mitigate and control environmental impacts due to the project	EIA regulations	The regulations are aimed at maintaining the environmental quality of the affected areas.	CCD/PAA
Acquisition of land (if necessary)	Land Acquisition Act	Acquisition of private lands for public works	Divisional Secretary
Local Authority development approval	Pradeshiya Sabah (PS) Ordinance	Planning/Development permit	PS
Pollution control	National Environmental Control Regulations	To control noise, water, and air pollution during demolition and construction	CCD
Disposal of solid waste and spoil	PS Ordinance	Manage the disposal of solid waste and spoil	PS, CCD
Demolish old Bridge, Change course of road	RDA Act PRDA Local Authority Ordinances	Breaking or any change to existing roads and to repair any damage to such roads due the project activities. Connecting internal roads to public roads.	RDA PRDA PS

## **2 Project Description**

### **2.1 Aims, Scope and Objectives of the Project**

The project involves the reconstruction of part of the main Pottuvil – Panama approach road as well as the bridges over Arugam Lagoon. These sections of the road and bridges are integral parts of the Sri Lankan National Road System, but were rendered impassable due to severe damage caused by the tsunami. The project aims to replace the existing damaged bridges over Arugam Lagoon with a modern steel bridge, and reconstruct approximately 500 meters of access road on either side of the bridge (approximately 25 meters to the east of the existing bridge/road alignment and meet the transportation requirement in the area).

### **2.2 Description of the existing situation**

The existing bridge at Arugam Bay is located approximately 1.5 kilometers south of Pottuvil, a small town on the eastern coast of Sri Lanka. The bridge is under the jurisdiction of the RDA, and consists of a steel truss built in the 1960s with a total length of 152 meters. It was connected to a 110 meter long causeway and a separate smaller single span concrete bridge over a tributary draining into the lagoon on the south side. The damage caused to the bridge on December 26, 2004 was severe. The causeway leading up to the bridge was completely washed out, thus creating and widening the mouth of the lagoon at the bridge site, from 150 meters to more than 260 meters. A temporary Bailey bridge of four spans was constructed by the 203<sup>rd</sup> Engineer Regiment of the Indian Army Task Force to connect the additional 110 meter of waterway.

### **2.3 Purpose and need of the project**

The Arugam Bay Bridge is a vital lifeline between the northern and southern areas of the Pottuvil Divisional Secretary's Division. Although less than 20 percent of the population of the Pottuvil DS division resides south of the bridge, the area contributes substantially to the economy of the area and to society in general. The bulk of the paddy lands and almost all of the tourist hotels and restaurants are located south of the bridge. Most of the owners of the paddy lands and tourist hotels and restaurants, however, reside close to the Pottuvil town, north of the bridge. There is a considerable amount of traffic across the bridge, taking goods and services to the southern areas. This includes raw material for cultivation, such as fertilizers, chemicals, and seed paddy; equipment such as tractors and trailers; groceries and food items; clothes and furniture; and finally building materials, such as sand, bricks, and cement. There is also considerable traffic transporting produce such as paddy and other crops, as well as fish and handicrafts from south of the bridge to the marketing points north of the bridge. The current restriction on the maximum load that can be taken across the temporary bridge causes considerable inconvenience to residents and increases the cost of transport.

A large number of individuals use the bridge on a daily basis. This includes local and foreign tourists, as well as individuals who reside in Pottuvil town or north of the bridge (such as hotel workers, agricultural laborers, teachers, fishermen and families). The bridge is also used by residents of coastal villages such as Panama, which is located south of the bridge in the Lahugala DS division. Local and foreign tourists visiting the Kumana bird sanctuary and Lahugala Bird and Wildlife Park commute across the bridge,

as do pilgrims during the annual Pada Yatra to Kataragama. Finally, individuals such as tourists, visitors and scientists wishing to see recent archaeological finds such as the 2000 year old Magul Maha Viharaya temple (which was reportedly discovered only 60 years ago, and lies just south of the outskirts of Pottuvil) must cross the bridge in order to do so.

For the reasons outlined above, the bridge is of strategic, economic as well as social importance, and is necessary to meet the needs of the various categories of people visiting, working, and residing in these areas. The general population of the area, both north and south of the bridge, welcomes the construction of the new bridge, supports the project, and wishes that consideration be given to their concerns during the design and implementation stages.

## **2.4 Alternatives Considered**

### **Bridge alignment**

In terms of the bridge alignment, three alternative options have been considered:

- A. Proposed action – a 690 meter long new bridge on a completely new alignment to the existing bridge and access roads;
- B. Alternative 1 – new bridge and access roads similar in length and alignment to the existing one, approximately 25 meters to the east;
- C. Alternative 2 – No action.

The originally proposed bridge design considered the replacement of the previous causeway and existing bridges across Arugam Lagoon on a significantly new alignment. According to the proposed new alignment the total length of the bridge was to be 690 meters, which far exceeds the total length of the existing bridge. The preliminary construction cost estimates for this alternative proved to be very high given the funds available under SLTRP.

An alternative design (Alternative 1) was developed which met the transport requirements of the area at a significantly reduced cost. This alternative, which is presently being pursued, is designed on an alignment offset 25 meters to the east from the existing alignment, as there are Buddhist shrines and fish landing sites on the western side of the existing bridge that must be protected.

The “No Action” alternative will allow the present situation to continue, at the cost of great inconvenience to all bridge users. It would also hamper development in the area. In this light, a new replacement bridge over the Arugam lagoon is considered highly essential and timely.

### **Construction technology**

In terms of construction technology the following two alternatives have been considered: (a) a bridge made of concrete using cast-in-place technology; and (b) a bridge made of steel using pre-cast concrete/prefabrication technology. Cast-in-place technology involves on-site concrete casting, which requires high input of quality control and supervision in order to guarantee good quality construction. Arugam Bay is a remote area with limited access and limited availability of skilled labor. Under such circumstances, it has been considered that achieving the required quality standards of in-situ construction would be a difficult task, thus risking the quality of the final product.



On the other hand, prefabrication technology involves the manufacturing of bridge sections under factory conditions, and assembling them on-site. This option is considered favorable as it would ensure high standards of quality and minimize on-site construction.

Given this background, construction of the replacement bridge offset 25 meters from the existing bridge (with a similar length and alignment) using prefabricated material is considered the preferable option. This design has received concurrence from USAID as well as RDA.

## **2.5 Description of the proposed project**

A new replacement steel truss bridge with a pre-cast concrete deck is proposed on a similar alignment, approximately 25 meters east of the present bridge. The new bridge will be approximately 160 meters in length, which will be connected through the causeway and a new, separate 25 meter long single span bridge on the southern side. The typical section of the proposed bridge will consist of a 7.4 meter carriage way and 1.5 meter sidewalk on either side. The new bridge will be assembled in place, with steel iron trusses and pre-cast concrete. The foundation will be large diameter bored piles taken to bedrock. The proposed bridge will be constructed adjacent to the existing bridge so that the existing bridge can continue to be used until the new proposed bridge is constructed. The old causeway shall be strengthened with pre-cast concrete panels. After work is completed on the new bridge, the existing bridge will be decommissioned and handed over to the RDA at one of its dump yards. Similarly, the Bailey bridge will also be decommissioned and handed over to the RDA. Section 2.7 of this chapter contains more details on the decommissioning of the old bridge.

## 2.6 Project Location Map



Figure 2 - Project Location

## 2.7 Details of Construction Activities

### 2.7.1 Method of Construction

As discussed previously, the new bridges will be constructed using total pre-cast/prefabricated technology including pre-cast pier and abutment caps supported on piles, structural steel rolled beams, and pre-cast deck panels. Use of cast-in-place concrete would be kept to a minimum due to the remote nature of the project site, poor conditions of local roads, a lack of skilled labor and security issues.

Several alternative construction methods have been considered to ensure the constructability of the site (PAR, 2006). These potentially include: (a) use of a barge to transport the bridge components to the site through a channel cut in the Arugam Lagoon (*this will require cutting open the sand bar and deepening the Arugam lagoon and possibly the near shore areas of the Arugam bay*); and (b) unloading of the bridge components at a temporary jetty to be constructed in a nearby beach area and then transported to the site through an access road overland (*this will require setting up a jetty on the beach and constructing a temporary access road to the site*). It will be the responsibility of the contractor to determine the final construction means and methods. It is anticipated that any temporary roads, culverts, road widening or strengthening that may be required will be done in environmentally disturbed areas; however, the contractor will be responsible for assessing potential environmental and social impacts that may result from any construction method not explicitly detailed here that may be necessary.

### 2.7.2 Materials Requirement and Sourcing

The construction will require the following material, which will have to be sourced and supplied to the site by the contractor.

**Pre-Cast Bridge Components** – The contractor will identify and propose the source for pre-cast parts; if any such parts are cast in Sri Lanka, the casting facility must operate in accordance with all applicable local and national laws.

**Water** – Water will be needed mainly for concrete mixing. Large quantities of water for construction work purposes will not be needed, as on-site concrete mixing will be kept to a minimum. The requirement is estimated to be four barrels of water per day, which could be obtained from a nearby freshwater stream. Although most of the rivers in this area are highly seasonal, the Heda Oya River flows through out of the year.

The problem of scarcity of drinking water exists at Pottuvil and Arugam Bay areas. At present, bowsers fulfill the drinking water requirements of some parts of Pottuvil. Residents in the area also use well water but wells in the tsunami-affected area have become brackish and hence have to depend on boswer supplies. Stream water is generally not use for domestic consumption. The hotels mostly use bottled mineral water for drinking purposes.

**Sand** – Sand for construction purposes will be taken from the rivers draining to Arugam Bay and Pottuvil areas. Heda Oya (Naval Aru) is one of the main sources of sand supply in the area. There are number of private vendors who engage in sand mining in these rivers with the necessary mining permits. A tractor load of sand is about Rs 1500. If sand is to be mined directly from the project, a permit needs to be obtained from the DS office

in Pottuvil and a payment of Rs 75 to Rs 100 per tractor load has to be paid to the same office. Impacts of mining large quantities of sand can vary from river bank collapse, erosion etc and should be done only with proper site supervision.

**Rocks** – Rocks will be needed for the road, embankments, rip rap and armoring and will be obtained from the small quarries operating in the area. These quarries operate with the necessary approvals. The price per tractor load of rock is around Rs 1700 to Rs 2000.

**Cement** - Cement is transported from Colombo to Pottuvil and it is readily available in the Pottuvil town. One bag of cement, which weighs 50 kilograms, is sold at Rs 550.

**Iron** - Iron is transported to Pottuvil from Colombo and is available in the town area.

### **2.7.3 Temporary Works**

The main temporary works involved in the project are as follows: (a) labor camps; (b) equipment storage areas; (c) coffer dam on the western side of the existing bridge to prevent saline water from reaching the lagoon in the event the sand bar is cut open to transport bridge parts on a barge to site; (d) temporary approaches made of rubble on either side of the lagoon where the land embankments would be placed to anchor cranes and other equipment; and (e) temporary jetty on the beach landing location and access roads to the site in the event the bridge components are transported through the sea – land route.

### **2.7.4 Construction Schedule**

The construction period would approximately be 18 months.

### **2.7.5 Waste Generation**

Waste will be generated from two main sources: (a) construction activities; and (b) labor camps. Construction waste will be mainly related to excavated material from the piles and new access roads. Disposal of these wastes will have to be made with approval from the Coast Conservation Department (CCD) at a designated dumpsite.

Labor camps will produce approximately 40 kilograms of solid waste daily (*source: Solid Waste Management Guidelines for Local Governments*) and the contractor will need to ensure that the labor camps are provided with adequate facilities such as garbage bins to collect the waste. The bins should be emptied on a regular basis at a site approved by the local authority. It is also important to take care that the sewage and wastewater systems are properly designed to prevent any pollution of ground or surface water (Approximately 6000 liters of grey water and 4000 liters of sewage will be produced daily at the labor camps; *source: Water Board Design Manual*). More guidelines on proper siting and maintenance of labor camps are provided in the EMAP, with which the contractor will be obligated to comply.

## **2.8 Demolition and disposal of the existing bridge**

The existing main bridge will be removed completely by the contractor once the new bridge has been constructed, and turned over to RDA at a nearby dumping location. Two options for the final disposal of the existing bridge are being considered: (a) disposal at an RDA dump yard; and (b) storage in a RDA site for re-erection elsewhere. The final

disposal method will determine the means and methods of demolition of the bridge by the contractor.

The original steel truss bridge, which is connected to the temporary Bailey bridge at present, is in very poor condition with extensive corrosion of its components and is not considered suitable for re-erection elsewhere by the engineers of SLTRP. The cost factor involved in the decommissioning of the bridge in a way that allows its parts to be re-erected elsewhere will be fairly high for the contractor and will be a serious consideration in the evaluation of options for final method of disposal. However, the options are still being evaluated and a decision will be taken together with the RDA of the final disposal method of the existing bridge. The Bailey bridge will be disassembled, itemized and returned to RDA at their Pottuvil maintenance yard.

All activities relating to demolition and disposal of the existing bridge shall take place with all the environmental safeguards and mitigation measures described in this report.

## **2.9 Details on Construction Work Force**

A construction workforce of 100 skilled and unskilled laborers will be employed during the construction period. The availability or willingness of labor to work in Arugam Bay may be problematic due to the history of civil unrest in the Eastern Province. Also, skilled labor will be in short supply in a remote area such as Arugam Bay. However, direct employment opportunities will be available for the local population in construction related work. The project will also explore opportunities for training local people in construction skills, so that chances of gaining project related employment opportunities are increased.

### 3 Description of the Existing Environment

#### 3.1 Physical Environment

##### 3.1.1 Location and Climate

Arugam Bay is located in the Pottuvil Divisional Secretariat Division of the Ampara District in the Eastern Province of Sri Lanka. The total area of the Pottuvil DS division is approximately 269 square kilometers, of which inland water bodies make up about 4 percent or 11.1 square kilometers.

Arugam Bay specifically receives an average annual rainfall of about 1500 milliliters (variable between 900 to 2000 milliliters as indicated in Table 2) from the northeast monsoons during October to February. 2004 was a wet year with about 2000 milliliters of rainfall, or the highest over the last six years. Temperatures vary from 30 and 35 degrees centigrade during the months May to September and from 25 to 29 degrees centigrade during the rest of the year. Winds are generally moderate, ranging from seven to 15 kilometers per hour, with the evening winds being stronger.

There are a total of 27 Grama Niladhari Divisions (GNDs) within the Pottuvil Divisional Secretary's Division. Of this number, 24 GNDs are north of the Arugam Bay Bridge. The rest of the three GNDs are located south of the bridge. Part of the Vattvely GND is also located south of the bridge, but is further inland and thus has alternate roads to reach Pottuvil town. Access from Pottuvil town to the coastal areas of the Lahugala DS division, including the Kumana bird and wildlife sanctuary is also through this bridge.

Month	1999		2000		2001		2002		2004	
	Rainfall	Rainy Days	Rainfall	Rainy Days	Rainfall	Rainy Days	Rainfall	Rainy Days	Rainfall	Rainy Days
Jan	292.1	4	358.1	15	389.9	18	302.5	18	375.8	15
Feb	-	-	193.9	14	306.5	18	83.0	7	100.4	8
Mar	2.6	1	9	2	35.4	7			85.5	6
Apr	17.1	1	101.9	6	-		132.3	14	165.9	6
May	17.4	3	4.6	3	9.3	2	21.0	2	70.5	5
June	-		1.5	2	24	2	63.2	4	23.1	2
Jul	36.4	3	1.6	1	78.3	2	11.3	3	42.8	2
Aug	-		23.8	2	10.3	2	15.7	3	16.3	4
Sept	40.6	3	101.7	7	80.2	5	17.1	4	70.5	6
Oct	56.3	3	159.9	11	48.1	8	69.7	5	85.5	8
Nov	274.1	8	364.7	13	438	18	150.5	10	766.7	24
Dec	300.1	10	76.2	7	310.2	16	220.1	15	135.9	5
<b>Total</b>	<b>1036.7</b>	<b>36</b>	<b>1396.9</b>	<b>83</b>	<b>1730.2</b>	<b>98</b>	<b>1086.4</b>	<b>85</b>	<b>1938.9</b>	<b>91</b>

**Table 2** – Monthly rainfall in the Pottuvil Divisional Secretariat Division

##### 3.1.2 Geology

The rocks in this area come from the pre-Cambrian era, and are of a type undifferentiated in the Vijayan series with trend lines (P.G. Cooray, 1965). There are several isolated hills and ridges that rise around 5 meters above the surrounding terrain. These are often characterized by rounded and worn rock outcroppings consisting mainly of gneisses and quartzites.

Silty sand is found near the rivers with soil rich in clay often occurring in the marshy areas surrounding the lagoon. Sandy regesols are found in the beach areas and sand dunes. The soils near Arugam Bay and east of Rottai are saline soils. In Sarvodayapuram, reddish brown soil occurs and in Passarichenai alluvial soil of various textures is found.

### **3.1.3 Topography**

The Pottuvil/Arugam Bay area is comprised of flat to slightly undulating terrain with elevations of five meters above mean sea level (MSL). There are several isolated hills and ridges that rise around five meters above the surrounding terrain. Small, shallow (1.5 to 2.5 meter deep) lagoons occur along the coastline. The lagoons in the study area are Kottukal Lagoon, Arugam Lagoon, and Pottuvil Lagoon. Kottukal and Pottuvil Lagoons are fresh water during the rainy season, brackish to very saline in the dry season, and often dry out altogether during prolonged droughts. The largest lagoon in this study area is Arugam Lagoon which has an area about 300 hectares. Arugam lagoon is reported to have freshwater conditions during both the wet and dry seasons.

A topographic map of the Arugam Bay and surrounding area is provided in **Figure 3** below.

### **3.1.4 Hydrology**

The main rivers in this area are Rottai Aru, Kirimitiya Aru, Karanda Oya, Sittu Aru, Goda Oya, and Heda Oya (from a north to south direction). The rivers of Kirimitiya Aru, Karanda Oya, Sittu Aru and Goda Oya drain into Arugam lagoon, and Heda Oya (Naval Aru) drain into the sea north of Panama. These rivers are highly seasonal with almost negligible flows during the dry months, with the exception of the Heda Oya River. During the wet season, the Arugam Lagoon flood plains, associated rivers, and delta area are typically inundated.

The Arugam Lagoon is generally a shallow lagoon with a sandy bottom and depths up to three meters. It is seasonally tidal with salinity increasing up to 30 parts per thousand (prior to the tsunami). It is connected to the sea by a narrow channel passing under a causeway. During flooding, the sandbar developed at the mouth of the lagoon is breached naturally, but this usually silts up rapidly and closes within one to two weeks. The influx of seawater from tsunami increased the salinity in the lagoon. It is thought that the floods that followed tsunami would have helped the situation to a certain extent by diluting the salinity and helping the lagoon in its recovery process.

There are small-scale irrigation tanks in the area, such as those in Savalai Kulam, Navaloor Kulam, Udakovai Kulam, and Aalayadi Kulam.

**Figure 4** provides a map of major rivers and tanks in the study area.

### **3.1.5 Land Use Pattern**

Thick forest cover the western (Lahugala forest) and south-eastern (Ullai sand dune forest) parts of the study area. The Arugam Lagoon occupies a major part of the land in the study area with a surface area of 300 hectares. The lagoon is surrounded by grass and sedge land with some open forest and scrub. Marshes and mudflats are integral components of the Arugam lagoon. The vegetation of these marshes and flats is highly variable, and dominated by various grasses. Areas north-west and south-west of



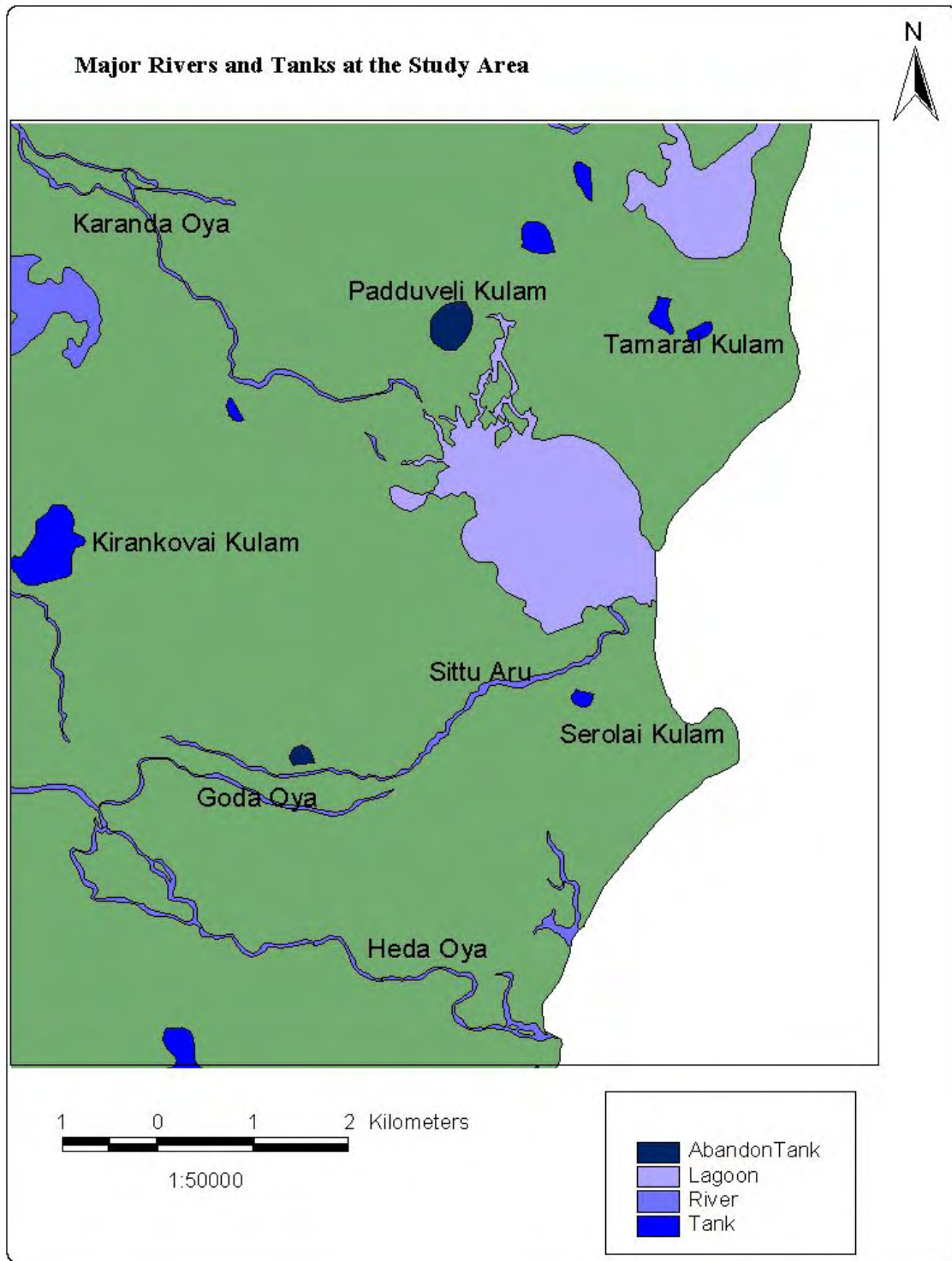
Arugam Lagoon are under paddy cultivation. Northern and southern parts of the study area are mostly built up with residential and commercial utilities.

Please refer to **Figure 5** for the land use map of the Arugam Bay area.

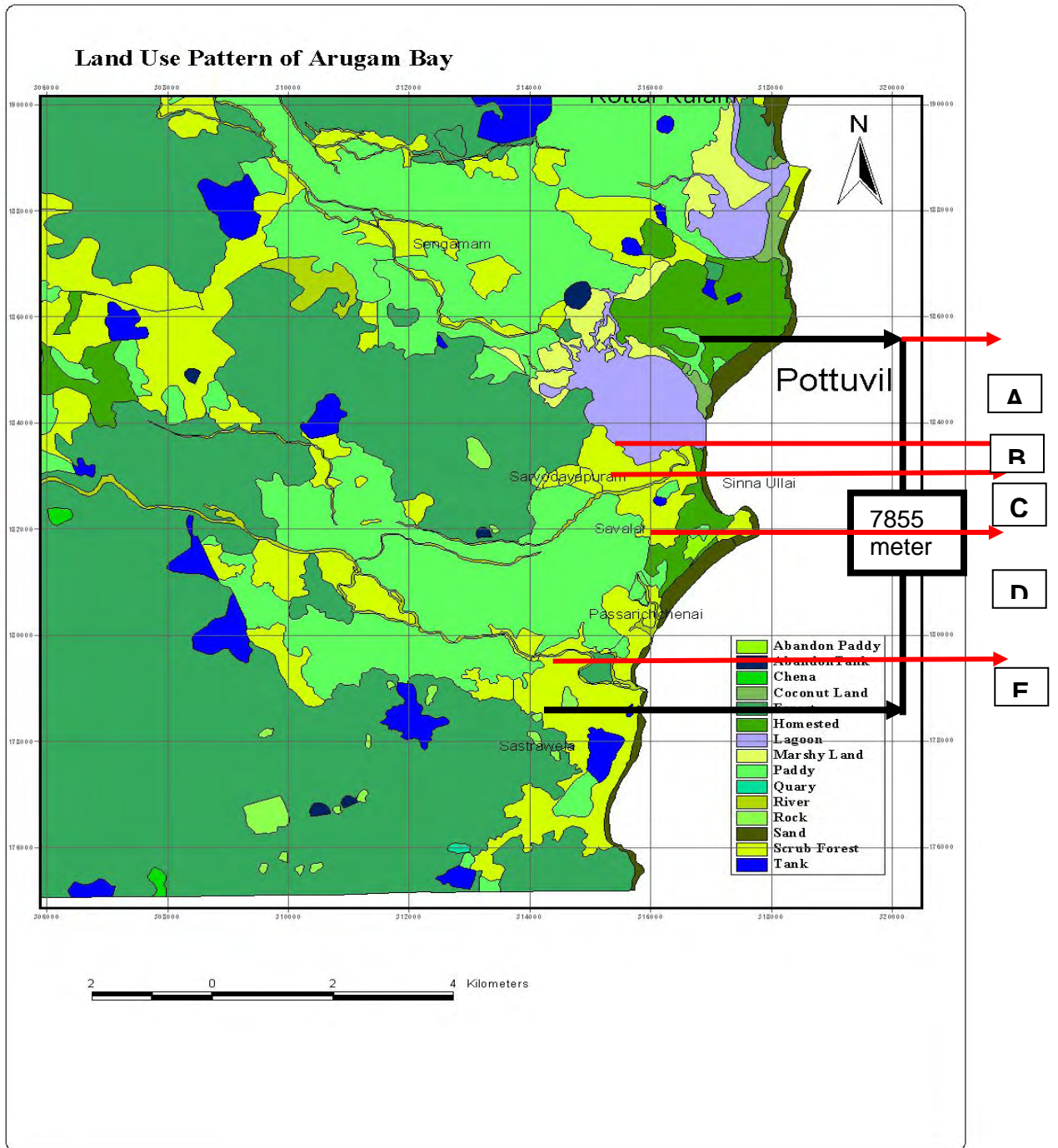


**Figure 3** - Topographic Map of the Arugam Lagoon and surrounding area





**Figure 4 – Major rivers and tanks Arugam Bay area**



**Figure 5 – Land use pattern of the Arugam Bay area**

### **3.1.6 Marine Environment**

Arugam Bay is an embayment with a wide, sandy beach and near shore coral habitats. Since significant coral reefs occur on the continental shelf of the eastern coastal belt of Sri Lanka, coral habitats at Arugam Bay may display high marine biodiversity and warrant further conservation (this has not been surveyed to date, however). As previously mentioned, Arugam Bay is popular with surfers for its huge rolling waves.

The continental shelf (delineated by the 100 meter isobath) is relatively narrow, with an average width of 20 kilometers. Bottom substrate is generally rocky, rough and uneven, but with interspaced patches of sand. The continental slope is steep, falling rapidly to the 1,000 meter isobath (average distance of 17.3 kilometers from shore), and then to abyssal depths of 2,000 to 3,000 meters within a few more kilometers.

The coastline consists of extensive sandy beaches broken by occasional rocky headlands such as Elephant rock and Crocodile rock. Sand bars are formed along the coastline, blocking entrances to rivers and lagoons. Well-developed sand dunes are also found along the coastline.

The coastal current generally moves in a northerly direction, resulting in a long-shore drift of sand northward. The offshore current is strongest during the monsoon and moves in an easterly direction. It is generally a stronger current, compared to that off the western coast of Sri Lanka.

The tidal range is small with spring tides within 0.7 meters and neap tides within 0.05 meters. The combination of weak tides and reduced river discharge during the dry season leads to the formation of sand bars, blocking entrances to rivers and lagoons. This produces long sandy beaches in the area.

## **3.2 Biological Environment**

### **3.2.1 Main ecological habitats of the area**

As discussed previously, Arugam Lagoon is considered a shallow lagoon that opens to Arugam Bay through an outlet channel closed by a sand bar. The sand bar opens periodically due to natural flushing of water, or is opened deliberately during the rainy seasons to prevent flooding of the surrounding shore habitats. The lagoon is one of the series of such shallow lagoons that are characteristic of the eastern coast of Sri Lanka, and is recorded as having freshwater conditions even during the dry season due to drainage of the rivers into it as illustrated in Figure 5 (Reference 1 and 2). Fishing and recreation are the two main economic activities of this area. The Arugam Lagoon is exceptional in that it may be freshwater during both the wet and the dry seasons whereas the others are brackish and become more saline (near sea water salinity) or dry up during the dry season (Anon. 2003). No studies on the water quality of the lagoon were available during the period of this environmental assessment.

Arugam Bay is a Special Area Management Site of the Coast Conservation Department (Coastal Zone Management Plan, Sri Lanka 1997). The environment and threats to Arugam Bay and lagoon have been studied as part of the Southern Ampara Biodiversity Zone Special Management Area in 2003 (Anon 2003a,b). (*Note: The Southern Ampara Biodiversity Zone Special Management Area has been identified as such for study*

purposes by the Eastern Coastal Community Development Project and has no legal status). Several reports and assessments carried out after the tsunami of December 26<sup>th</sup> 2004 cite damage done to the lagoon and the surrounding habitats of the lagoon. These assessments report that the lagoon not only contains debris, but also has become shallower due to the deposition of sand by the tsunami. It is highly likely that lagoon habitats that supported breeding of prawns and other fish have been negatively affected by the tsunami.

As part of the present environmental assessment, a rapid assessment of the type of habitats found in the project area and its floral and faunal components was carried out in early January 2006. The following table summarizes the main habitat types that occur in the project area. Although each habitat could not be surveyed for fauna and flora, each of the habitats types that occur in the area were studied. An additional effort was made to survey sea turtle habitat throughout the project area, as several marine turtle species were identified by the EA team as being potentially at risk; results of this survey are presented in Annex 4 and discussed below. The species composition of the habitats that were surveyed is provided separately in Annex 2.

Affected areas	Habitats
Arugam Lagoon	Grasslands
	River outlets
	Riparian zones
	Bottom sedimented areas
	Open water of the lagoon
Arugam Bay	Sand bar
	Sand dunes
	Beach
	Coral formations
	Near shore habitats

**Table 2** - The major natural habitats of the area

### 3.2.2 Images of the main ecological habitats in the area



Home garden I



Home garden II





Hotel and garden



Open waters of Arugam lagoon



The opening of the sand bar



The opening of the sand bar



Riparian habitats near the edges of the lagoon



Road sides



The sand bar



Shorter sand dunes

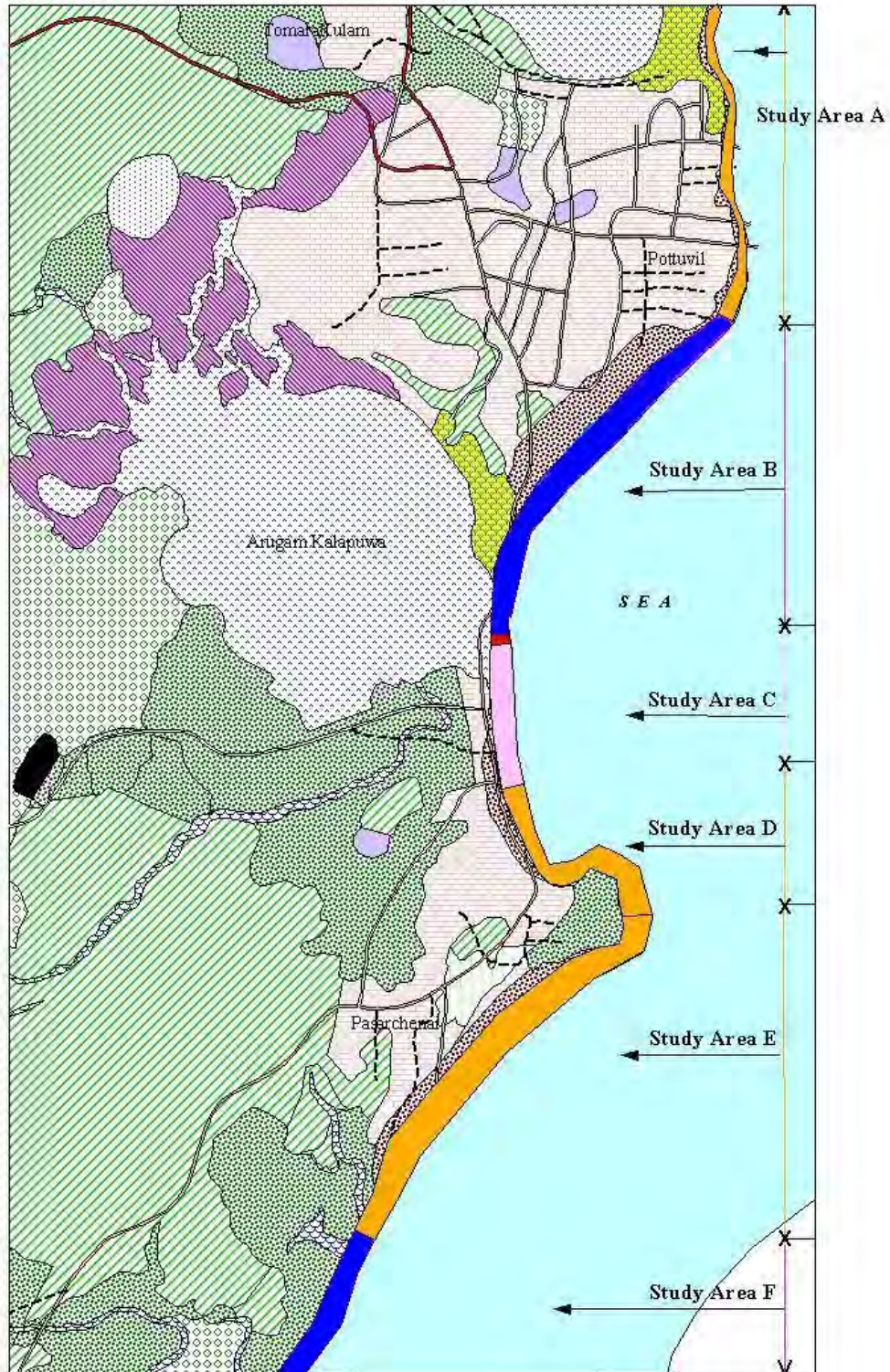
There are rocky outcrops with some coral formations in the Arugam Bay (Rajasuriya personal communication). Not only is information pertaining to the extent and status of the reef unavailable, but the coral habitats in the Arugam Bay have yet to be mapped. Sand dunes and sea shores are other important ecological systems in the area that are found on both sides of the bridge. The tall sand dunes are found further to the north of the bridge (**see Figure 6**).

### 3.2.3 Marine Turtle Nesting Habitat

The beach sections of the proposed project area are important for marine turtles as a nesting habitat during two seasons of the year. A map of the turtle nesting beaches identified through the survey is indicated in the map provided on the following page. The results of this survey based on tracks of sea turtles, live and dead specimens, egg pits, hatchlings and information collected from the community, clearly indicate that study areas B and F of the coastal area (indicated on the map) are the most commonly used areas for nesting by turtles. Study area C is moderately disturbed by human activities, and similarly a moderate level of turtle activity occurs here. Although small parts of study areas D and E are also appropriate habitats for nesting, in most of these stretches human activity coupled with physical barriers (i.e. sand formations and dead corals) prohibit extensive use by turtles. The opening of the lagoon is not used by turtles for nesting. It is found that higher numbers of turtle nesting habitats are found outside of the project area towards the southern side (*personal communication*). The chart below summarizes these findings with relation to potentially appropriate areas for use by construction contractors. The contractor will be required to verify these findings and to conduct due diligence in the site(s) ultimately selected for use in construction staging, material transport, etc.



# Turtle Nesting Areas - Arugam Bay



Study Area	Level of Use by Turtles	Potential for Use by Contractor (recommended)
A	Low	High
B	Heavy	Low
C	Moderate	Moderate
D	Low	High
E	Low	High
F	Heavy	Low

Most common turtle visiting the Arugam Bay area is the *Chelonia mydas* (Green Turtle). In addition *Caretta caretta* (Logger head turtle) and rarely *Dermochelys coriacea* (Leatherback Turtle) are also known to use the beaches in the area. The main season for turtles fall between January and mid-February, during which time about eight to ten animals visit the beach per day, as estimated by the information provided by local residents. During the period from July to August, a smaller number of turtles use the beaches of Arugam Bay.

One of the main threats to the marine turtles in Arugam bay area is the predation that is taking place on its eggs. It has been found during discussions that members of the community collect turtle eggs for sale to local as well as foreign consumers. The number of turtles killed purposefully is low, but is still carried out by some locals. The law enforcement in the area, although carried out to a certain degree, is inadequate to arrest the situation. A more detailed report on the turtle survey is attached as **Annex 4**.



A dead turtle found on the beach of Arugam Bay

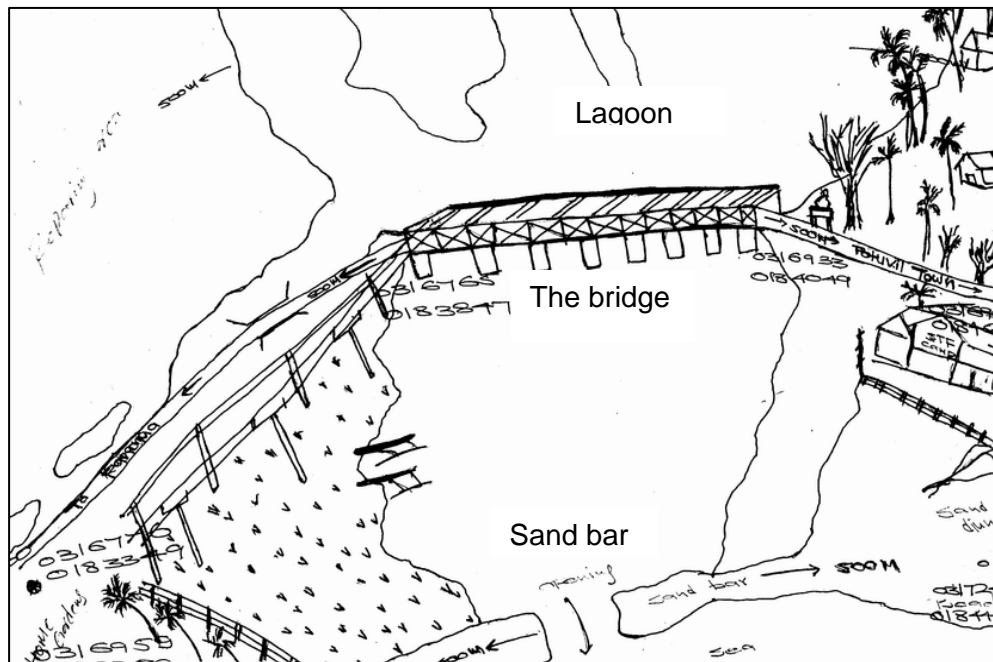
Land uses surrounding the lagoon include boat landing points, small scale tourist hotels, houses, grasslands (some open with others submerged and exposed over short periods of time) and riparian habitats through which freshwater streams drain into the lagoon. The natural habitats and the flora and fauna that might be directly affected by the bridge transport and construction were rapidly surveyed in a field visit from the 3<sup>rd</sup> to the 5<sup>th</sup> of January 2006, covering an area within a 0.5 kilometer radius from the point of contact of the road embankment with land on both the north and south sides of the bridge. Due to time constraints, the flora and fauna of the habitats were surveyed together in some habitats instead of separately. The species of fish and prawns of the lagoon and the



edge habitats of the lagoon were not surveyed, as such a survey would require an extensive period of time.

As stated previously, considerable amounts of sand and other debris from the surrounding human habitations and structures were deposited in the bed of the lagoon. This likely had an indirect impact in that the number of fishers, as the fish catch is much less as compared to pre-tsunami levels (Refer to section 3.3.8 of the report). It appears that even though immediate post-tsunami rapid assessments were carried out in 2005, there have not been any surveys of the bottom environment of the Arugam Lagoon, which would have indicated the detailed status of the fish and prawn breeding habitats. There do not appear to have been any dives reported in Arugam Lagoon since the tsunami (Rajasuriya personal communication). During this short visit, high species diversity was not observed in the terrestrial habitats. The only threatened species found were marine turtles. Although Arugam Bay is one of the recorded sites for a highly threatened rare plant (*Scaevola plumieri*) in Sri Lanka (Jayasuriya 2005), the species was not encountered during the biodiversity survey of the project area.

One of the important habitats close to the edges of the lagoon is the riparian zone, which consists primarily of fresh water plants. Measures must be taken to ensure this habitat is not adversely affected during construction and all care should be taken to prevent contamination and clogging of water flows.



**Figure 6** - Line diagram of the project environment

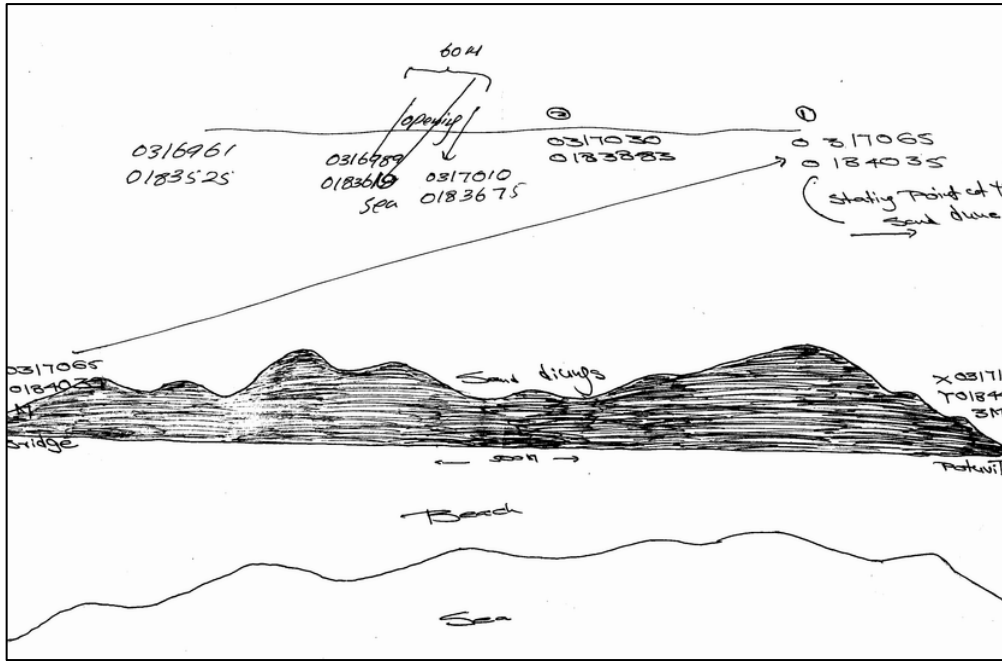


Figure 7 - Sand Dune at the Project Location

### 3.3 Socioeconomic Environment

#### 3.3.1 Demographic Characteristics

According to the population census of 2001, the total population of the division was 29,696 persons. The population was estimated to have increased to 36,231 in 2004 or an annual increase of about 7 percent. The majority ethnic group is Muslims, accounting for 78 percent of the population, followed by Tamils making up about 20 percent and Sinhalese, 2 percent. The population of a total of 18 GN Divisions, P 1 to 8 and P 12 to 21 is predominantly Muslim (98 to 100 percent), a further seven GN divisions P 9 to 11 and P 22 to P 25 is predominantly Tamil (80 to 90 percent) and that of the other two GN divisions is mixed. The birth rate was 12.5 per thousand of population in 2004, and about 65 percent of the children born were females. The death rate was about 4 per thousand of population in 2004, and 51 percent of the deaths were of females. The natural population growth rate in 2004 works out to approximately 1 percent. Therefore the bulk of the population growth appears to be due to inward migration to the division from areas outside of the division and not due to natural increases. The population density which was 109 persons per square kilometer in 2001 has increased to 135 in 2004.

The number of families residing within the division was estimated at 9,492, and the average family size works out to 3.8 persons. In 2004, about 60 percent of the population was between the ages 15 to 65, about 36 percent was below the age of 15, while the remaining 4 percent was above 65 years old. The dependency ratio works out to 67 percent. Table 4 provides the demographic characteristics of the population by GN divisions.

Name of GN Division	GND No	Area (square km.)	No. of Families	Total Population	Population Density per square km.	Average Family Size
Pottuvil Unit 1	P/01	0.25	210	975	3900	4.64
Pottuvil Unit 2	P/02	0.25	275	1040	4160	3.78
Pottuvil Unit 3	P/03	0.25	295	1221	4884	4.14
Jalaldeen Square	P/04	0.25	338	1326	5304	3.92
Sarvodyapuram	P/05	18.0	473	1785	99	3.77
Sinnaputhukudiyiruppu	P/06	0.25	459	1693	6772	3.69
Pottuvil 2 Unit I	P/07	0.50	283	1433	2866	5.06
Pottuvil 2 Unit II	P/08	0.25	203	765	3060	3.77
Kundumadu	P/09	1.00	329	1058	1058	3.22
Inspector Etham	P/10	0.50	267	907	1814	3.40
Vattively	P/11	0.75	138	595	793	4.31
Pottuvil Town	P/12	0.25	116	587	2348	5.06
Pakkiyavattai – I	P/13	0.50	268	965	1930	3.60
Pakkiyavattai – II	P/14	1.50	285	1045	697	3.67
Kalappukadu	P/15	1.00	900	2598	2598	2.89
VictorThoddam – I	P/16	10.0	330	1895	190	5.74
VictorThoddam - II	P/17	3.00	905	3428	1143	3.79
Sinna Ullai	P/18	5.00	387	1739	348	4.49
Pasarichenai	P/19	7.00	340	1058	151	3.11
Hithayapuram – I	P/20	2.00	440	1550	775	3.52
Hithayapuram – II	P/21	0.25	375	1735	6940	4.63
Sangamankandy	P/22	53.0	196	817	15	4.17
Komari – I	P/23	55.0	381	1505	27	3.95

Komari – II	P/24	58.0	420	1501	26	3.57
Kanakar Kiramam	P/25	28.0	176	698	25	3.97
Hijra Nagar	P/26	22.0	149	565	26	3.79
Razaak Moulana Nagar	P/27	0.25	554	1752	7008	3.16
TOTAL		269	9492	36236	135	3.82

**Table 4 - Population of Pottuvil DS Division by GN Divisions**

Source: Statistics, Pottuvil DS Division 2004, and Resource Profile 2004, Divisional Secretariat, Pottuvil.

A total of about 1,200 families were resident in the three GN divisions south of the Arugam Bay Bridge with a total population of about 4,600 persons and a population density of about 150 persons per square kilometer in 2004. The population density of the three GNDs was comparatively smaller than most other GNDs, with only five other GNDs having lower population densities. The GNDs north of Pottuvil town P22 to P26 have relatively large areas but with small populations. The GNDs closer to the Pottuvil town have small areas that are very densely populated. The bulk of the agricultural land of the population in the Pottuvil town area is located south of the Arugam Bay Bridge. In addition, there are five schools, six mosques, one kovil, 52 hotels / restaurants, and a few public institutions. As becomes apparent after examining these demographic trends, the bridge directly supports the livelihoods of the majority of the population of the Pottuvil DS division.

### 3.3.2 Household Income

Average household income is estimated at around Rs 2000 per month in the Pottuvil DS Division. The distribution of income is estimated as follows:

Monthly Income (Rs.)	Number of Families
500 – 1000	5832
1001 – 2500	1503
2501 – 3000	780
3001 – 5000	695
Above 5000	722
Total	9532

**Table 5 – Average household income in the Pottuvil DS area**

Source: Resource Profile 2004, Divisional Secretariat, Pottuvil

According to the statistics provided by the Pottuvil Divisional Secretariat, over 77 percent of local families receive less than Rs 2500 per month, and a large majority of the population (over 90 percent) is below the poverty line. Over 60 percent of the families receive Samurdhi benefits (*Note: Samurdhi is a social security scheme sponsored by the government where families falling under the poverty line receive a cash grant*) and about 77 percent of those receive Rs 400 per month while the remaining 23 percent receive Rs 140 per month. There are three Samurdhi Offices for the three GN divisions south of the Arugam bay. Details of Samurdhi benefits received in all the GN divisions are as follows:

<b>Samurdhi Benefits</b>	<b>Number</b>	<b>Percentage</b>
Families Receiving Rs 400 per month	4489	47
Families Receiving Rs 140 per month	1350	14
<b>Total Number of Families receiving Samurdhi</b>	5839	61
Total Number of Families	9492	100

**Table 6** – Number of people receiving Samurdhi benefits in the Pottuvil DS Division  
*Source: Statistics, Pottuvil DS Division 2004*

The above statistics of Samudhri recipients appear to confirm that a considerable proportion of the population is poor.

### 3.3.3 Employment

Most families are dependent on agriculture and fisheries for their livelihoods. Trade and tourism are the next two most important sources of income. Foreign employment, particularly in Middle Eastern countries, has emerged as an important income source in recent years. Details of employment of the population within the division are as follows:

<b>Employment Category</b>	<b>Number Employed</b>
Employees in the State Sector	<b>635</b>
Employees in the Private Sector	233
Self Employed	2313
No of Employers	1976
Employed Abroad	761
Farming	4900
Fishing	2500
Total	13318

**Table 7** – Livelihood types in the Pottuvil DS area  
*Source: Resource Profile 2004, Divisional Secretariat, Pottuvil.*

The total workforce (population between the ages 15 to 65) is estimated at 21,742 persons, while the number employed is estimated at 13,318. The unemployment rate on this basis is 39 percent. However, since the majority of the population is Muslim, the women usually do not work. Assuming that 35 percent of the workforce is unemployed because they are students or women, a revised rate indicates that only 18 to 20 percent of the population is without work. Of the employed category, only those working for the state and the private sector or working abroad (14 percent) are employed on a regular basis. The remainder (86 percent) are employed seasonally, intermittently or on a part time basis. The lack of a regular source of employment and income may be contributing to high poverty levels in this division.

As the skill levels of the local populace is low, it is difficult to hire skilled workers such as welders, carpenters, masons, and mechanics. There is a good supply of unskilled labor on the contrary, but this group is often plagued by inadequate employment opportunities. The housing and building construction activities after the tsunami generated some opportunities for employment, but a large number of the workers are hired from outside

of the area by the contractors. There are 47 graduates, of whom 24 or nearly half are unemployed. Details of education of the workforce are as follows:

Level	%
Uneducated	20
Educated up to Grade 9	52
Educated up to GCE O/L	21
Educated up to GCE A/L	6
Educated up to Degree Level	0.6
Others	0.4

**Table 8** – Education levels of the workforce

The education levels of the work force suggests that over 70 percent are either uneducated or are insufficiently educated to easily obtain gainful employment.

### 3.3.4 Education

There are a total of 23 State Provincial schools in the division, of which 16 are Muslim, five are Tamil and two are Sinhala. The total population of students in all schools was 8426 in the year 2004, and the total number of teachers was 272 (24 graduate and 227 trained teachers), giving a student to teacher ratio of 30:1. There are no private schools in the area. There were about 136 school drop-outs (of which 80 were female students) up to year nine (drop out rate 1.6 percent) in schools within the division. The student to teacher ratio ranged between 20:1 to 45:1 in most Muslim and Tamil Schools and between 8:1 and 12:1 in Sinhala schools within the division. Only one school had been graded as AB and conducted AL classes both in the science and arts streams, while three other schools graded C, had facilities for the conduct of non-science stream AL classes. The majority of schools lack facilities and adequate resources, including properly trained teachers, sufficient furniture and facilities for extra curricular activities. There are five schools which offer classes up to Year 11 (GCE – OL) and 14 schools with classes up to years five to eight. There are three schools located south of the bridge in the Arugam Bay area. Most students from the area study in these schools, with the exception of AL students who usually attend schools in the Pottuvil town area where they can receive AL studies. The teachers in the Arugam Bay area schools are mostly from outside of the area, but usually reside in the Pottuvil town area. As a result, both teachers and AL students in areas south of the bridge have to commute across the bridge on a daily basis.

### 3.3.5 Health

Health facilities are relatively poor throughout the Pottuvil DS Division. There is one government District Hospital with 55 beds, with a staff of three doctors, one regional medical practitioner (RMP), one nurse, one pharmacist, one attendant and 14 minor staff (although the full cadre of medical staff is about 30, including six doctors, two RMPs, one dentist, ten nurses, two pharmacists, four medical laboratory technicians (MLTs), four midwives, one attendant, and one clerk and 29 minor staff; only these aforementioned individuals are typically present). In addition to the District Hospital, there is a Central Dispensary located at Komari, which is also under-staffed. In 2004, about 15,000 indoor and 7,500 outdoor patients were treated at the District Hospital, and about 4000 indoor and 1000 outdoor patients were treated at the Central Dispensary. The major medical problems include fever due to viruses and malarial infections, and diarrhea or

communicable diseases. As there are no medical facilities in the GN divisions south of the bridge, all residents have to come to Pottuvil District Hospital for any medical treatment. The bridge thus serves as a necessary structure for transporting the sick for medical treatment.

### 3.3.6 Housing, Sanitation and Energy Use

Details of the housing conditions and facilities, including water services, energy use, toilet facilities, and more are provided in Table 9.

Description	Number of Households	Percentage of Total
Total Number of Housing Units	9466	100
Permanent Housing Units	4570	48
Semi-Permanent Housing Units	1675	18
Improvised Housing Units	3221	34
Protected Water Supply within premises	4638	49
Protected Water Supply outside premises	2745	29
Unprotected well	1893	20
River, tank and other sources	190	2
Electric lighting	4175	44
Kerosene lighting	5291	56
Other sources of lighting	197	2
Water sealed toilets	3760	39
Not stated	5816	61
Cooking – firewood	8226	86
Cooking – kerosene	240	6
Cooking – gas	267	2
Cooking – other	543	3

**Table 9 - Status of Housing, Sanitation, Water and Energy Use in 2004**

*Source: Resource Profile 2004, Divisional Secretariat, Pottuvil.*

About two thirds of resident families live in either permanent or semi-permanent houses, while the rest live in makeshift housing. As previously mentioned, there is currently no pipe water supply system in this area, and people used wells as the means of water supply before the tsunami. Approximately 50 percent obtained their water supply from protected wells within their housing premises, about 30 percent obtained their water supply from protected wells outside of their premises, and the remaining 20 percent obtained water from unprotected wells. An indeterminate, though very small percentage of residents also obtained water from rivers, tanks or other sources. Local groundwater basins are recharged from natural runoff. Prior to the tsunami, the area met almost all of its water needs using underground resources, rivers in this area and water storage tanks.

The tsunami greatly decreased the availability of fresh in the area. Wells have become brackish and can no longer be used as a source of drinking water. A temporary water treatment plant has been established in Pottuvil and the drinking water is supplied through bowsers in this area. Only about 40 percent of the households have water sealed toilets, the others have not indicated the type of toilet used. In conclusion,

housing conditions, water supply and sanitation need to be improved considerably in the area, especially in light of the extensive tsunami damage.

The main energy source used in cooking is firewood, which is used by 86 percent of the households. Kerosene and gas are used by a few households. The main source of energy used for lighting is kerosene, which is used by 56 percent of the households, while electricity is used by about 44 percent of the households. Access to grid electricity is far below that of the national average, and the electricity supply is very unreliable with constant disruptions experienced throughout the day and night. There is a clear need to develop a piped water supply system, as well as improve existing services and infrastructure such as electricity and sanitation. These improvements are not only essential if the area is to be developed for tourism, but also to improve the livelihoods of the resident populations.

### **3.3.7 Agriculture – Crops and Livestock**

Paddy is the main crop cultivated in the division and most of the paddy fields lie south of the bridge. Other crops grown in the area include coconuts, vegetables, fruits such as papaya and bananas and field crops such as groundnuts, maize, cowpeas, red onions and green gram and chilies. These crops are grown primarily in home gardens, paddy fields and chena lands. The owners/cultivators of the paddy fields reside close to Pottuvil town and commute to their fields during the cultivation season. The bulk of the produce that is produced on the southern side of the bridge must pass over the bridge in order to reach the markets. There are 35 Farmers Organizations (FOs) operating in 12 GN divisions, with a total membership of about 3,900 persons belonging to just over 3,300 families. The majority of these farmers cultivate paddy. About 3,200 ha of the fields are irrigated, while the remaining 1,700 ha are rain-fed. There are two major and thirty minor tanks which provide irrigation for crops within the division.

The GN division P – 5 Sarvodyapuram, located south of the bridge, has six FOs with a membership of 680 farmers belonging to 400 farm families. It also contains almost half of the total paddy land in the Pottuvil Division. About 4,700 ha of irrigated paddy and 1,300 ha of rain-fed paddy are grown each year, with an estimated production of about 26,000 metric tons of paddy annually. A further 1200 ha of paddy are grown in the Panama area in the adjoining Lahugala DS division. Inputs and outputs from this area are transported across the bridge, including about 20,000 metric tons of paddy. As evidenced by these figures, the bridge plays a vital role in the livelihoods of farmers.

Due to current regulations, trucks can only transport a maximum load of nine metric tons across the bridge, which is causing considerable hardship to farmers. Prior to the tsunami, trucks would oftentimes carry between two and four times this amount when transporting paddy. The current situation means considerable delays in taking produce to the markets, and greater expenses for the farmers.

The livestock industry is based on cattle, buffaloes, goats and poultry, of which cattle and buffaloes are the most important. Livestock farming is undertaken on an extensive basis, except for a few poultry farmers. Neat cattle and buffalo rearing are the major livestock enterprises undertaken by the farmers of the area, followed by goat keeping and poultry farming, including turkeys and ducks. Milk production is significant, with total milk production estimated at over 650,000 liters in 2004. Crop farmers oftentimes keep livestock to supplement their income.



### 3.3.8 Fisheries

Fisheries are an important source of income for residents of this division. Fisher families are distributed among all GN divisions. There are a total of over 1000 fisher families within the division, with a population of about 7000 fishermen, of whom about 2000 are active fishermen. Fish production is estimated at between 1100 to 1300 metric tons per annum, which includes sea and lagoon fish, inland fish, prawns, crabs and lobsters. There are ten fisheries cooperative societies, with a membership of over 1300 fishermen as well as seven fish landing organizations in the Pottuvil /Ullai area. There are a small number of migratory fishermen (52), who come to the area for fishing during certain seasons, who typically reside in temporary huts erected along the beaches of Arugam Bay.

Prior to the tsunami, fishermen used about 120 day boats with outboard engines, from which they used drift gillnets to catch small pelagic fish species, especially during the peak season from July to April. Approximately 80 fishers were involved in beach seining, while about 25 boats were equipped for trawling. Catches of coral reef fish were said to be good.

The local fisheries industry has been severely affected by the tsunami. Not only did almost all the fishermen lose their fishing boats and nets, but fish production in the lagoon has also been reduced considerably. International non-governmental organizations (INGOs) and other aid organizations have oversupplied fishing boats, but have not built sufficient homes for fishermen who lost their houses during the tsunami. Where there were only 350 boats prior to the tsunami, there are now 2000 boats in the area. Amongst other problems, there is insufficient landing area for all of these boats.

Fish breeding in the Arugam Bay lagoon has also been severely affected by the tsunami, and may face further declines with the construction of the new bridge. The tsunami not only reduced the depth of the lagoon, but also littered the bottom with debris, sand and rocks. It was reported that while 100 to 150 fishermen fished in the lagoon prior to the tsunami, this number has declined due to the scarcity of fish.

Fishermen complain of a myriad of obstacles they frequently encounter, including poor fishing facilities, the lack of a fisheries harbor and nearby toilet facilities, the absence of an adjacent market in which to sell the fish, and the hassle in transporting their catch over the existing bridge given the weigh restrictions. Although a laden weight of nine metric tons per vehicle has been approved for the temporary bridge, the police allow only five metric tons according to the fishermen, thus causing further grievances. Another concern of the fishermen, particularly those who fish in the Arugam Lagoon, is that the construction of the bridge will permanently affect the fishery resources of the lagoon, especially as it is a sensitive breeding area for prawns and other shellfish, as well as a variety of fish. Fishermen are particularly concerned about further damage to the fisheries, as there has already been a reduction in fishery resources due to the large amount of debris, stones and sand brought into the lagoon by the tsunami. This additional debris has caused the depth of the water in the lagoon to be reduced, and residents fear that the construction of the bridge will result in an even further reduction. As a result, many fisherman are going as far as to advocate that construction of the bridge be used as an opportunity to dredge the lagoon and increase its depth.

### **3.3.9 Tourism**

There were about 50 to 60 tourist hotels and restaurants prior to the tsunami (located mostly south of the bridge). Only five hotels were of a multi-storey type, and the rest were all single storey buildings. The majority of these buildings were either destroyed or badly damaged by the tsunami. About 75 percent of the hotels and restaurants have undergone renovations, and are back in operation.

Tourism had picked up over the last few years due to the popularity of Arugam Bay amongst surfers. The Arugam Bay area is considered the fourth best location in South East Asia and the 11<sup>th</sup> best in the world for surfing, primarily for skate or board surfing and to a lesser extent wind and kite surfing. About 3000 to 5000 foreign tourists visited the area annually prior to the tsunami. The majority of tourists are considered “low to medium spending”, generally visiting the area for relatively long periods for surfing. The few “high spending” short stay foreign tourists visit to enjoy the beaches, as well as view ecological and cultural sights. The Kumana Bird Sanctuary, the Lahugala Bird and Wildlife Parks, and ancient archaeological ruins are destinations for both local and foreign tourists. The local tourists are usually “medium spending” and demand moderately priced accommodation. Prior to the tsunami, most of the hotels were of the moderate to low end in terms of price ranges. Local tourists also frequently visit Kataragama through a route across the bridge. This is an ancient route involving walking through jungles to reach Kataragama, which is the center of religious worship for the Hindus, Buddhists and Muslims.

The local hoteliers usually employ locals, but many hoteliers from outside of the area prefer to bring their own staff to run their hotels or restaurants. As a result, the employment opportunities for locals are reduced. One of the concerns of local hoteliers is that after the bridge is constructed, local hotel and restaurant owners will be evicted and resettled elsewhere, thus making room for large outside and foreign investors to develop this area into a major international tourist resort. The locals are understandably vehemently opposed to such a move. Further, based upon the tourists who visit this area, it appears that the need is for small-scale low- and medium- priced hotels and restaurants, which can be managed successfully by the locals. The infrastructure facilities need to be improved considerably, particularly after the damage done by the tsunami, even for small-scale tourist development.

## 4 Impact Analysis and mitigation

The following section summarizes potential impacts and mitigation measures related to the project. Environmental specifications in the construction contract will assign responsibility for mitigation measures to the contractor, including all of those presented below in the EMAP. The table below summarizes the potential ecological and physical impacts that may result from the transport and construction of the bridge and access roads. Detailed narratives of the substantial impacts are given in the following paragraphs. As described in the methodology section, a 0.5 kilometer radius was taken into consideration when assessing the potential impacts on the Arugam lagoon. As illustrated in Figure 6, the area under evaluation also includes habitats on the fringes of the lagoon as well as the open water areas.

	Environmental Impacts	Activities causing the impact/s	Degree of impact before mitigation	Mitigation Measure
<b>Impacts on Soil</b>				
1	Loss of productive top soil due to site preparation and construction work	Piling, construction of land embankments, bridge approach roads and temporary access roads	Low	Refer to section 1 of EMAP
2	Soil erosion caused by removal of vegetative cover	Construction of land embankments, bridge approach roads, temporary access roads, labor camps, storage areas etc	Moderate	Recover with normal vegetation as soon as possible
3	Soil erosion caused by excavated loose soil	Improper storage of excavated soil	Moderate to high	Can be minimized. Refer to section 1 of the EMAP
<b>Impacts on Water Resources</b>				
5	Degradation of water quality in the lagoon and bay due to increased turbidity	Pile driving, creation of rock piles to anchor cranes	Moderate to high	Use of measures such as silt curtains to reduce turbidity from affecting the rest of the lagoon and to decrease sedimentation during construction
6	Changes in tidal dynamics in the lagoon	This will only take place if the sand bar is breached to convey bridge material to the site, creation of rock piles to anchor cranes	Moderate to high	Model the potential changes to the water exchange mechanism, and monitor the changes in the salinity of the lagoon waters at various points before, during and after construction
7	Alterations to bathymetry of lagoon and bay	This will take place only if there is significant deepening or shallowing of the lagoon and bay.	Low to moderate	Take steps to recover the deepened areas as soon as construction is over. Monitor the areas.
8	Flooding of local areas due to restricted flow at the mouth of the lagoon	Only if the mouth is restricted for a period which covers the rainy periods	Low to moderate	Monitor the water flows during the rainy periods and take action to remedy if there is a danger of flooding during the construction period
9	Degradation of water quality in the lagoon due to pollutants	Escape of pollutants such as waste oil, grease due to run-off, accidental spills, etc from construction vehicles,	Low to moderate	Avoid excessive storage of materials on site; locate vehicle parking and equipment & material piling sites (staging areas) a safe distance away from

	<b>Environmental Impacts</b>	<b>Activities causing the impact/s</b>	<b>Degree of impact before mitigation</b>	<b>Mitigation Measure</b>
		piling of equipment and material on the site		the edge of the lagoon
10	Modifications to water flow paths	Excavations in the ground for construction of land embankments and access roads	Moderate to high	Avoid carrying out excavations that impact drainage during monsoon season; monitor water flow following modifications and take action to remedy negative impacts such as flooding that may result.
<b>Impacts on Air Quality</b>				
11	Degradation of air quality in project area	Vehicle emissions, dust, mixing of raw materials	Moderate to high	Refer to section 4 of EMAP
12	Increase of noise pollution in surrounding areas	Operation of construction vehicles, equipment and other construction activities	Moderate to high	Refer to section 4 of EMAP
<b>Impacts on Eco-systems, Fauna and Flora</b>				
13	Loss or disturbance to terrestrial habitats due to clearance of land.	Access roads, land embankments, labor camps, parking areas for construction vehicles, stock piling of raw material	Low	The open areas that are grasslands can be used for construction, but with appropriate safeguards to prevent material and dump sites from contaminating the lagoon and bay waters.
14	Loss or disturbance to aquatic habitats due to increased sedimentation, changes in salinity etc.	If there is deepening of the near shore areas of the coast and of the sand bar at the mouth of the lagoon. Piling work, digging the lagoon bed and forming of the riprap	Moderate to high	Reduce sedimentation and turbidity during construction. Model the water exchange mechanism of the lagoon with the sea and monitor the changes before, during and after construction. Map out coral habitats to select route that is least damaging
15	Fragmentation of natural habitats/eco-systems	Not likely as the bridge is a replacement one.	Low	The riparian areas opening to the lagoon, the sand dunes and the seashore should not be degraded
16	Threats to local biota from invasive species	Construction material and vehicles	Moderate to high	Ensure that soil is obtained from nearby areas and is free of invasive plants, and monitor the surrounding areas for spread of invasive species. Clean the construction equipment and vehicles often.
17	Impacts on aesthetic quality of the environment	Bridge construction	Moderate to high	Complete construction in the shortest possible time, making use of allocated dumpsites.
<b>Impacts to socio-economic parameters</b>				
18	Reduction in the income of fishermen due to loss of fish breeding sites	Bridge construction	Moderate to high	Construction practices that would minimize loss of habitats. Monitoring of fish catch during and after construction

**Table 10 – Summary of potential impacts arising out of project activities**

## **4.1 Ecological and physical impacts**

### **4.1.1 Impact on soil**

The project will require the clearing of groundcover as well as earth excavations in numerous areas, including the location in which the construction of embankments will take place (the landside ends of the bridge), the new access roads to the bridge, and finally, the temporary access roads to work sites. These clearings will have some impact in terms of disturbance to the soil profile of the construction areas, and will likely increase the potential of soil erosion. The impact of altered soil profile will depend on the extent of land area subjected to clearing and earthwork, as well as the type of land use. As the areas earmarked for construction are not agricultural lands, the potential impacts stemming from the loss of soil productivity are relatively low and localized.

Erosion caused by runoff from disturbed and unsealed areas, leading to sedimentation of waterways is of greater concern, especially during the rainy season. It is therefore important that best management practices (BMPs) to control erosion from excavated loose soil and exposed areas are incorporated and implemented by the contractor during the construction period. Care should be taken not to block major drainage pathways in the temporary and/or permanent storage areas for excavated soil and other waste material. Best management practices for soil conservation and management are suggested in section 1 of the EMAP.

### **4.1.2 Impact on Water Bodies**

#### **Transportation of bridge sections**

The mode of transportation of bridge parts to the construction site has yet to be finalized. Two main possibilities are currently under consideration, as explained by the bridge planner. One option is to transport the bridge via bay/lagoon on a barge or boat, which would require cutting a temporary channel thus opening the sand bar for a period of at least three months. The most significant potential impact would be the interference with the normal water exchange dynamics between the lagoon and the bay, which would likely upset the existing ecological balance. The cutting of the channel would result in the influx of saline water into the lagoon, which would impact the fisheries and benthic communities. These impacts could lead to irreversible changes to lagoon habitats, which in turn would impact productivity. There are instances in Sri Lanka in which such interference led to the collapse of fisheries in lagoon-areas (i.e. Mawella Lagoon, Koggala Lagoon, and Rekawa Lagoon in the Southern Province).

The magnitude of the impact of opening of the sand bar will depend on the size of the opening, as well as the time period for which it stays open. It is advisable that prior to dredging the channel, the contractor model changes in the tidal exchange during neap and high tides for the period of time during which the sand bar would be open, and closely observe the impacts. It is expected that the opening in the sand bar will close by itself due to the prevailing water currents. However, the changes in the sand bar opening should be monitored and in the event that it does not close within a reasonable period of time, it may be necessary to artificially close it by addition of sand. All of the above situations must be carried out under the close watch of coastal engineers.

As the tsunami has already caused negative impacts on the lagoon, the type of impact due to deepening of the mouth is likely to interfere even more with the recovery process of the lagoon and its habitats. As there is no bottom contour map of the lagoon at this point of time, it is not possible to state the exact status of the lagoon. However, the fact remains that it is shallower than pre-tsunami conditions, as a result of the debris from surrounding areas that is still present.

Constructing a temporary physical barrier such as a coffer dam on the western side of the existing bridge has been suggested as one way of preventing saline water from moving upstream. This could be an effective way of minimizing the impacts of salinity in the middle and upper areas of the lagoon. However, the lower areas of the lagoon will still be exposed to changing levels of salinity – a crucial fact when considering that these areas are critical

prawn breeding grounds. Although edge habitats of the lagoon were not surveyed in the rapid assessment due to time constraints, it has been observed that approximately 100 fishermen engage in prawn fishery around the edges of the lagoon, especially on the sand bar and near the mouth area of the lagoon (see image below). During the season some fishermen earn up to Rs 2400 to 4000 per night depending on the catch (Bandara pers.com). The market for the catch is mainly the tourist establishments. Therefore, it is recommended that these measures are further studied under the guidance of an ecologist and coastal engineer to map out the exact nature and extent of the resulting impacts prior to reaching a final decision.



Prawn fishing at night on the sand bar



Casting of a net near the sand bar



Fishermen examining the catch of prawns near the lagoon mouth

The overall negative environmental impact of breaching the sandbar on the lagoon ecosystem is likely to be moderate to high, depending on the extent to which interference with water exchange mechanism will take place. This is a preliminary conclusion and as mentioned above, should be monitored. It is recognized that the RDA routinely opens the sandbar without monitoring, but the impacts of this are unknown.

Alternatively, the contractor can also explore the possibilities of transporting equipment and bridge sections during the period the sand bar is naturally or artificially opened to send the flood waters out. If this is possible, it would avoid all of the impacts discussed and described above. However, the natural opening of the sand bar coincides with the monsoon period from November to January and may not be most convenient time for the contractor. Also, the period for which it is opened may not be long enough to complete the transport of all equipment and material as the sand bar will close up immediately after the monsoon. However, this option is available and should be considered.

### **Bridge construction**

The bridge construction process will likely cause major disturbances to the surrounding area. Construction will require pile driving, as well as clearing the landward points for embankments. Re-suspension of bottom sediments due to dredging and increased sedimentation due to erosion is likely to be the most significant effects. The deterioration of lagoon water quality and its habitats that increased sedimentation may lead to is likely to be moderate to high if proper mitigation measures are not in place. The bridge construction work will also disturb the fishing activity to a certain extent that is taking place currently (especially at night for prawns) near the bridge and the sand bar.

Care should be taken to ensure localized sedimentation as much as possible, thus preventing it from settling on the littoral habitats of Arugam Lagoon. Erosion needs to be managed and minimized through necessary interventions, such as silt screens, which should be used during the digging of the lagoon bed to prevent the spread of re-suspended particles if the water quality changes significantly. Turbidity should be contained as much as possible to minimize impacts on littoral and deep water habitats.

In needed, the creation of the adjacent rock piles to anchor cranes used in bridge construction activities may interfere with the tidal exchange across the mouth of the lagoon. This needs to be considered carefully and planned in order to have the minimal impact. These rock piles will be removed at the end of construction of the bridge.

#### 4.1.3 Impact on biota

Deepening of the near shore areas off the coast and bay (if a channel is cut open through the sand bar) and digging of the lagoon bed can physically destroy benthic habitats. The disturbance to habitats found on the edges and in the deep waters of the lagoon due to sedimentation and changes in salinity is likely to be moderate to high. These potential effects will exacerbate the recovery period of the lagoon. These factors can ultimately lead to a loss of fishery productivity of the lagoon if mitigation practices are not incorporated to ensure that irreversible changes to the physical environment of the lagoon do not take place.

There are rocky outcrops and some coral formations in Arugam Bay. However the extent and the locations of these coralline habitats have not been mapped (Rajasuriya pers. com). Any damage to coral formations or even increased sedimentation settling on them due to transportation and construction activities will be an unacceptable environmental impact. Care should be taken to avoid damage to any coral formations or to cause any long lasting changes in the near shore habitats of Arugam Bay. As a result, it is of paramount importance that those transporting the bridge sections through the water pay close attention to their specific routes when in near-shore waters. In order to aid in this process, it is advisable that the contractor roughly map out existing coral habitats and select the least damaging route.

One of the important habitats close to the edges of the lagoon is the riparian zone, through which freshwater streams flow into the lagoon. These riparian habitats feature plant species that can grow in fresh water conditions. Efforts should be taken to ensure this habitat is not adversely affected during construction, especially those which prevent the contamination and clogging of water flows into the area. Similarly, there should not be any impact of destabilization on the sand dunes as they protect the hinterland from wind and wave action, as amply demonstrated during the time of tsunami. Material and dump sites should be maintained a safe distance away from the lagoon, bay, sand dunes and other important habitats.

In the event that the contractor decides to transport bridge sections via a sea route to a nearby beach, and then transport them overland, it may be necessary to build a temporary road or expand existing roads. Creation of any new roads or widening of existing roads to access the site should be done with caution, after carrying out necessary screening of its environmental impacts. Creating new access roads may require a separate EA, depending upon the proposed route and location. In addition, landing sites on either side of the Arugam Bay should be selected with reference to the findings and recommendations of the turtle survey as turtles nest majority of the Arugam Bay beach areas (Refer **Annex 4**).

The plan for conveyance of bridge sections via this method is still preliminary and no details are available as to where the landing site would be and how the road would be routed to the construction site. Therefore, at this point in time it is not possible to predict the exact type of impacts this activity would trigger.

Another aspect that ought to be considered in the conveyance of equipment and materials to the site is the potential for introduction of alien invasive organisms to the area. The likely impact of introduction and spread of invasive species in the project area, if not contained with necessary measure, will be moderate to high. Although the field visit has already revealed the presence of invasive plant species in the proposed project area, it is well known that biological invasions are more likely in disturbed environments such as construction sites. Further disturbance can exacerbate already present invasions, as well as introduce new ones. Sometimes the full impacts of invasions become clear only many years after it has been first introduced. Invasive species are well known to be carried along pathways of introduction such as humans, vehicles and the goods they carry. Invasive species need not come from overseas; they can be easily spread from one part of the country to another through human interventions. Soil from other parts of the country and even from within the



district of Ampara can carry seeds of highly invasive and potentially damaging plants. Sri Lanka has severe invasions of cacti and mesquite along its southern dry zone coastal areas, and serious invasions by aquatic weeds along many of its waterways. All care should be taken to prevent similar situations from developing along the coastline of Arugam Bay and lagoon as a result of this proposed activity. Roads are another type of habitat in which invasive species spread easily and rapidly along its sides. In order to minimize the risk of invasive species being introduced to the site, sand should be obtained from nearby sources where there are no records of invasive species. Cleaning the construction vehicles and equipment can also help in a major way. However, this requires more longer-term monitoring to observe the effects of any invasive species introduction.

#### **4.1.4 Impact on air, noise and vibration**

The construction of the bridge will last approximately for 18 months. During this time, there will be release of dust and other emissions from construction equipment and vehicles, which will affect the air quality of the project area. The residents and tourists living in the project area will be inconvenienced by the presence of dust and gaseous emissions, which can be potentially significant if mitigation measures are not incorporated. There is no data with regard to existing air quality in the Arugam Bay area. However, the levels of air pollution are likely to be low in the area given its rural nature and low traffic load on the road.

The project also will also cause temporary increases in the noise levels during the construction period, causing nuisance to local residents and tourists. Mitigation measures as proposed in section four of the EMAP should be incorporated to minimize the impact. However, these effects are temporary and there will be no increases in the ambient air quality and noise levels in the area. On completion of the project, the area's air quality and noise levels will revert back to normal.

#### **4.1.5 Waste disposal**

There will be several sources from which solid and liquid waste will be generated, namely; (a) worker camps, (b) construction site and (c) vehicle/equipment serving and maintenance yards. In the absence of proper waste management on site the impact of disposal of untreated waste to the environment will be significant.

The worker camps will accommodate approximately 100 workers. The generation of solid wastes at the camp is estimated to be 40 kilograms per day (*source: Solid Waste Management Guidelines for Local Governments*). The generation of waste water and sewage is estimated to be 6000 liters and 4000 liters per day respectively (*source: Water Board Design Manual*). It is of extreme importance that due consideration is given when siting labor camps. Environmentally sensitive locations such as beaches, dunes, riparian areas and the lagoon reservation should be avoided. The risk of pollution of surface and ground water will be high unless proper sanitary and garbage disposal facilities are provided in the worker camps.

There are several sources which have the potential to contaminate local soil and water. These includes waste oil, run-off from vehicles/equipment, maintenance yards containing fuel and lubricants, accidental spills of fuel/lubricants/chemicals, and run-off from material stock piles that contain particulate matter. Hence, proper waste management for all types of wastes generated on site is of high importance. Sections 1 and 2 of the EMAP suggest BMPs that should be employed to minimize the risk of pollution from waste disposal.

## **4.2 Social impacts**

### **4.2.1 Impact on the fishery**

One of the main concerns of the fishing community is that the reduction in the fishery resources in the lagoon caused by the tsunami could possibly be worsened by the bridge construction. As mentioned earlier, there is active fishing taking place near the sand bar and the lagoon mouth at night for prawns. These activities will be disturbed to a certain extent during the bridge construction. Any change in the salinity of the lagoon due to a breach in the sand bar will also adversely interfere with the fishery productivity and consequently with the fishermen's income. Their suggestion is that all measures should be taken to prevent any further damage to the fishery resources during the construction of the bridge. They would also prefer if the construction of the bridge can be made more beneficial by improving the environment in the lagoon to enhance fish and shell fish habitats, by clearing the lagoon of debris, stones and sand and increasing the depth of the lagoon to pre-tsunami levels.

Another concern of the fishing community is the possible loss of landing sites due to the new alignment of the bridge and new access roads. At present, there is tension between the Muslim/Tamil fishing community and government security forces over the proposed construction of a Buddha statue and an adjoining temple, as they feel it will take away some of their traditional boat landing areas. According to local stakeholders, landing areas have been reduced drastically and the presence of Special Task Force (STF) personnel near this area further inconvenience the fishermen's activities. With the new alignment of the bridge towards the east of the old bridge, fishermen fear that there will be loss of breeding areas as well as landing areas.

The contractor should take every possible precaution to minimize the impact on fishery productivity of the lagoon (as discussed in 4.1 section) and share information with the local fishery community. A program to monitor the impacts on fishery resources of the lagoon and the income of the fishermen should be commenced as discussed earlier, prior to construction and continued until the end of the project. A continuous dialogue with the fishery community would be most helpful in allaying any unwarranted fears as well as share their observations of any adverse changes taking place within the lagoon.

### **4.2.2 Impact of tourism**

A major concern of local hoteliers and workers is that the construction of the bridge will be used as a vehicle to implement the proposed tourism development plan, which envisages the relocation of the existing hotels and restaurants on the beach front further inland. The plan also proposes the redevelopment of the existing beachfront through private and foreign developers. Under such a plan, the existing road would be diverted inland and the present area including the road would be set aside for a marina and sea front area with walkways for tourists. The tourism stakeholders are intensely opposed to the idea of relocating the existing road away from the bridge further inland. They feel that they will be deprived of any income from tourism by this move. They also fear that their lands will be taken over by the government and outside private investors, with very little compensation for their losses. Thus, they feel that the bridge as well as the approach roads from both sides of the bridge should be reconstructed at least for a couple of kilometers on each side. The impact on tourism development should be monitored prior to the start of construction, to determine whether the bridge has brought benefits to the local tourist industry and future development of tourism.

Another related issue is that roads within the Pottuvil town and adjacent areas are in an extremely dilapidated condition, causing severe hardships to the local population, business community, tourists and others who use these roads on a daily basis. A new bridge alone may not completely ease the burden of the local and outside road users. Many stakeholders

and community leaders feel that the roads need to be rehabilitated concurrently with the bridge in order to ease the suffering of the community.

#### **4.2.3 Employment opportunities**

Another issue raised by the stakeholders was the issue of whether the construction of the bridge would provide employment and economic opportunities to the locals. This could be an issue of contention, as demands from multiple community groups are likely to be presented (SLTRP community consultations) and hence need to be handled with care. The bridge construction may require highly skilled workers, particularly since most of the components of the bridge are to be manufactured abroad. Skilled workers are scarce in the area, and those that do exist are already working on other construction and rehabilitation projects in the region. However, there are plenty of unemployed unskilled workers in the area, who are available to be employed during the construction of the bridge.

The task of hiring labor will be handled by the Contractor. The project will use the community contacts made through the consultation meeting activity with community representatives, including the Local Authority and Divisional Secretary offices, to guide and encouraged the community to make their voices heard in an organized way. In turn the Contractor will be briefed and guided to address community requests with sensitivity and communicate hiring mechanisms clearly to the community.

Discussions have also taken place with the USAID Revive project, which was involved in training of youth in construction skills with the intention of linking them with the Contractor's work at a relevant stage. The project is taking these efforts to promote local hire of labor by the Contractor. These are examples and stories that can be shared with the Community Radio in addressing issues that the community could bring up and supporting efforts for community participation and inclusion.

## **5 Environmental Management and Monitoring Plan**

The following section presents the Environmental Management Action Plan (EMAP), which details the environmental requirements that will be passed on to the construction contractor. Following the EMAP, a preliminary monitoring plan is presented to guide CH2MHill in overseeing compliance with those environmental requirements.

### **5.1 Environmental Management Action Plan**

The EMAP presented below will minimize adverse environmental/social impacts that could arise out of project activities for the Arugam Bay Bridge Replacement and Construction of Access Roads Project. The EMAP should form part of the bid documents and shall be considered alongside the construction specifications. The prescriptions detailed in the EMAP are mandatory in nature and contractually binding; all requirements herein will be incorporated into the construction contract. The EMAP will be equally applicable to sub-contractors including nominated sub-contractors, if any. CH2MHill will be responsible for contractor (including nominated subcontractors) compliance with the requirements of the EMAP. A project impact monitoring committee should be appointed comprising of the 'Engineer' on behalf of the employer, representatives from NGOs, civil society and other interest groups. The committee will be mainly responsible for enforcing and monitoring the compliance of EMAP by the contractor and reporting progress to all partners.

## Environmental Management Action Plan

Environmental Issues		Protection and Preventative Measures to be Undertaken by the Contractor	
1.	<b>Earthwork and Soil Conservation</b>		
	1.1	<b>Disposal of Debris and Spoil</b>	
		(a)	All debris and residual spoil material including any left earth shall be disposed only at locations approved by the engineer for such purpose and subjected to the Clauses 1.1.b and 1.1.c.
		(b)	If directed by the Engineer the contractor shall obtain the approval form the relevant Local Authority for disposal of debris and spoil at the specified location.
		(c)	The debris and spoil shall be disposed in such a manner that (i) waterways and drainage paths are not blocked; (ii) the disposed material should not be washed away by floods and (iii) should not be a nuisance to the public.
		(d)	If directed by the Engineer the debris and residual spoil material including any left earth shall be used, to fill the borrow areas as directed by the Engineer, subject to laying of topsoil as per EMAP Clause 1.2.
		(e)	If consented to by the Engineer contractor can dispose the debris and spoil as a filling material provided that the contractor can ensure that such material is used for legally acceptable purposes with disposed in an environmentally acceptable manner.
	1.2	<b>Conservation and Reuse of Top Soil</b>	
		(a)	Topsoil of the agricultural areas and any other productive areas where it has to be removed for the purpose of this project shall be stripped to a specified depth of 150mm and stored in stockpiles of height not exceeding 2m, if directed by the Engineer. If the contractor is in any doubt on whether to conserve the topsoil or not for any given area he shall obtain the direction from the Engineer in writing.
		(b)	Such stockpiled topsoil must be returned to cover the areas including cut slopes where the topsoil has been removed due to project activities. Residual topsoil must be distributed on adjoining/proximate barren areas as identified by the Engineer in a layer of thickness of 75mm – 150mm. Stockpiles should be placed outside flood affected areas.
		(c)	Topsoil thus stockpiled for reuse shall not be surcharged or overburdened. As far as possible multiple handling of topsoil stockpiles should be kept to a minimum.
	1.3	<b>Protection of Ground Cover and Vegetation</b>	
		(a)	Construction vehicle, machinery and equipment shall be used and stationed only in the areas of work and in any other designated areas by the Engineer.
		(b)	Contractor shall instruct drivers and operators not to destroy ground vegetation cover unnecessarily.
	1.4	<b>Borrowing of Earth</b>	
		(a)	Borrowing within the RoW is prohibited under this contract. However, earth available from excavation for roadside drains as per design, may be used as embankment material, subject to approval of the Engineer.

		(b)	Contractor shall comply with the environmental requirements/guidelines issued by CCD and the respective Local Authority in respect of locating borrow areas and with regard to all operations related with excavation and transportation of earth from such sites.
		(c)	All borrow pits/areas shall be rehabilitated at the end of their use by the contractor in accordance with the requirements/guidelines issued by CCD and the respective Local Authority.
		(d)	Borrow areas shall not be opened without the permission of the Engineer. The location, depth of excavation and the extent of the pit or open cut area shall be as approved by the Engineer.
		(e)	Establishment of borrow pits/areas and its operational activities shall not endanger adjacent properties. Also shall not be a danger or health hazard to the people.
<b>1.5</b>	<b>Safety against Soil Failures</b>		
		(a)	Contractor shall take all steps necessary to ensure the stability of slopes including those related to temporary works and borrow pits.
		(b)	If the area is classified as an area prone to soil failures / land slides by the National Building Research Organization (NBRO) contractor shall seek their advice prior to engage in deep excavations for earth extraction or any other construction purpose. The NBRO recommendations shall be submitted to the Engineer.
<b>1.6</b>	<b>Prevention of Soil Erosion</b>		
		(a)	Embankment slopes, slopes of cuts, etc. shall not be unduly exposed to erosive forces. These exposed slopes shall be graded and covered by grass as per the specifications.
		(b)	Work that leads to heavy erosion shall be avoided during the raining season. If such activities need to be continued during rainy season prior approval must be obtained from the Engineer by submitting a proposal on actions that will be undertaken by the contractor to prevent erosion.
		(c)	The work, permanent or temporary shall consist of measures as per design or as directed by the Engineer to control soil erosion, sedimentation and water pollution to the satisfaction of the Engineer. Typical measures include the use of berms, dikes, sediment basins, fiber mats, mulches, grasses, slope drains and other devices. All sedimentation and pollution control works and maintenance thereof are deemed, as incidental to the earthwork or other items of work and no separate payment will be made for their implementation.
<b>1.7</b>	<b>Contamination of Soil by Fuel and Lubricants</b>		
		(a)	Vehicle/machinery and equipment serving and maintenance work shall be carried out only in designated locations/service stations approved by the Engineer. Avoid sensitive location such as close to streams/rivers; just upstream of wells and springs used by community and areas of flooding.
		(b)	Waste oil, other petroleum products and untreated wastewater shall not be discharged on ground so that it causes soil pollution. Adequate measures shall be taken against pollution of soil by spillage of petroleum/oil products from storage tanks and containers. All waste petroleum products shall be disposed of in accordance with the guidelines issued by the CCD or the engineer.
		(c)	Sites used for vehicle and plant service and maintenance shall be restored back to its initial status. Site restoration will be considered as incidental to work.

	<b>1.8</b>	<b>Disposal of Harmful Construction Wastes</b>	
		(a)	Contractor prior to the commencement of work shall provide list of harmful, hazardous and risky chemicals/material that will be used in the project work to the Engineer. Contractor shall also provide the list of places where such chemicals/materials or their containers or other harmful materials have been dumped as waste at the end of the project.
		(b)	New disposal sites shall not be created as part of this project. Disposal of such waste shall be to the sites designated by the CEA or the Engineer.
		(c)	The contractor shall clean up any area including water-bodies affected/contaminated (if any) as directed by the Engineer at his own cost.
	<b>1.9</b>	<b>Quarry Operations</b>	
		(a)	Rock quarries from where metal aggregate is obtained shall have approval from the Geological Survey and Mines Bureau as well as the current Environmental Protection License. It is recommended not to seek material from quarries that have on-going disputes with community.
	(b)	The maintenance and rehabilitation of the access roads in the event of damage by the contractor's operations shall be a responsibility of the contractor.	
<b>2.</b>	<b>Water – Protection of Water Sources and Quality</b>		
	<b>2.1</b>	Loss of Minor Water Sources and Disruption to Water Users	
		(a)	Contractor shall protect sources of water (potable or otherwise) such as wells, springs used by the community so that continued use these water sources will not be disrupted by the work. In case the closer of such sources is required on permanent or temporary basis contractor shall provide alternative arrangement for supply. Alternative sources such as wells thus provided should be within acceptable distance to the original sources and accessible to the affected community.
		(b)	Contractor shall not divert, close or block existing canals and streams in a manner that adversely affect downstream intake(s). If diversion or closure or blocking of canals and streams is required for the execution of work, contractor must first obtain the Engineers approval in writing. Contractor shall also obtain the approval from the National Water Supply and Drainage Board or Local Authority or Divisional Secretary depending on the operating agency of the intake/water supply. Contractors shall restore the drainage path back to its original status once the need for such diversion or closure or blockage ceased to exist. During the affected period contractor shall supply water to the affected community.
		(c)	In case the contractors activities going to adversely affect the quantity or quality of water, the Contractor shall serve notice to the relevant authorities and downstream users of water sufficiently in advance.

	<b>2.2</b>	<b>Siltation of Water Bodies</b>	
		(a)	Contractor shall take measures necessary to prevent siltation of water bodies as a result of his work including construction of temporary/permanent devices to prevent water pollution due to siltation and increase of turbidity. These shall include the measures against erosion as per EMAP Clause 1.6. Water quality of the lagoon should be monitored monthly, started with a preconstruction baseline and to track changes during construction. Parameters include turbidity, color, suspended solids, salinity, pH, and COD/BOD.
		(b)	Construction materials containing small/fine particles shall be stored in places not subjected to flooding and in such a manner that these materials will not be washed away by runoff. In addition, stock piling of material should be done in a manner that excessive amounts are not unnecessarily stored on-site.
	<b>2.3</b>	<b>Alteration of drainage paths</b>	
	(a)	Contractor shall not close or block existing canals and streams permanently. If diversion or closure or blocking of canals and streams is required for the execution of work, contractor must first obtain the Engineers approval in writing. Contractor shall also obtain the approval from the relevant agency such as Irrigation Department/Agrarian Services Department/Divisional Secretary prior to such action is taken. Contractors shall restore the drainage path back to its original status once the need for such diversion or closure or blockage is no longer required.	
	(b)	The debris and spoil shall be disposed in such a manner that waterways and drainage paths are not blocked.	
	<b>2.4</b>	<b>Contamination of Water from Construction Wastes</b>	
		(a)	The work shall be carried out in such a manner that pollution of natural watercourses, ponds, tanks and reservoirs is avoided. Measures shall be taken to prevent the wastewater produced in construction from entering directly into streams, water bodies or the irrigation systems.
		(b)	Construction work close to the streams or water bodies shall be avoided during heavy rainy/monsoon periods.
		(c)	The discharge standards promulgated under the National Environmental Act shall be strictly adhered to. All waste arising from the project is to be disposed in a manner that is acceptable to the Engineer and as per the guidelines/instructions issued by the CEA.
	<b>2.5</b>	<b>Changes in Tidal Dynamics in the Lagoon</b>	
		(a)	The contractor shall carry out construction in such a way that any necessary alteration creates the minimum necessary disturbance to tidal dynamics in the lagoon, and mimics natural conditions (e.g. opening/closing of the sandbar) in all possible cases.
		(b)	The contractor shall assess the potential changes to the water exchange mechanism during neap and high tides for the period of time the sand bar will be open, if at all.
		(c)	The contractor shall monitor the changes in salinity of lagoon waters at various points before, during and after any alteration in the sand bar.



		(d)	Following any modification to the sand bar by the contractor, if any, the changes in the sand bar opening shall be monitored to ensure that natural closing occurs; if instructed by the engineer, the contractor will artificially close the sand bar by addition of sand.
		(e)	Monitor water flows through the mouth of the lagoon during rainy periods to identify potential for flooding that may occur due to contractor activities. The engineer shall be notified immediately if such potential is identified.
		(f)	The Contractor shall employ qualified coastal engineering expertise in planning and implementing any modifications to the sand bar that may be undertaken.
<b>2.6</b>	<b>Contamination from Fuel and Lubricants</b>		
		(a)	All vehicle and plant maintenance and servicing stations shall be located and operated as per the conditions and/or guidelines issued by the Central Environmental Authority. In general these should be located away from water-bodies and wastewater shall not be disposed without meeting the disposal standards of the CEA. Wastewater from vehicle and plant maintenance and servicing stations shall be removed of oil and grease and other contaminants to meet the relevant standards before discharging to the environment.
		(b)	Vehicle, machinery & equipment maintenance and re-fuelling shall be done as required in EMAP clause 1.7 to prevent water pollution as well.
<b>2.7</b>	<b>Locating, sanitation and waste disposal in construction camps</b>		
		(a)	Sitting of labor camps shall have the Engineers approval and comply with guidelines/recommendations issued by the CEA/LA. Construction laborers' camps shall not be located within 200m from waterways, within an area coming under DWLC or DoF, near to a site or premises of religious, cultural or archaeological importance and schools.
		(b)	Labor camps shall be provided with adequate and appropriate facilities for disposal of sewerage and solid waste. The sewage systems shall be properly designed, built and operated so that no pollution to ground or adjacent water bodies/watercourses takes place. Garbage bins shall be provided in the camps and regularly emptied. Garbage should be disposed off in a hygienic manner, to the satisfaction of the relevant norms. Compliance with the relevant regulations and guidelines issued by the CEA/LA shall be strictly adhered to.
		(c)	Contractor shall ensure that all camps are kept clean and hygienic. Necessary measures shall be taken to prevent breeding of vectors.
		(d)	Contractor shall report any outbreak of infectious disease of importance in a labor camp to the Engineer and the Medical Officer of Health (MOH) or to the Public Health Inspector (PHI) of the area immediately. Contractor shall carry out all instructions issued by the authorities, if any.
		(e)	Contractor shall adhere to the CEA recommendations on disposal of wastewater. Wastewater shall not be discharge to ground or waterways in a manner that will cause unacceptable surface or ground water pollution.
		(f)	All relevant provisions of the Factories Act and any other relevant regulations aimed at safety and health of workers shall be adhered to.
		(g)	Contractor shall remove the labor camps fully after its need is over, empty septic tanks, if instructed by the engineer shall be closed, remove all garbage, debris and clean and restore the area back to its former condition.

	<b>2.8</b>	<b>Wastage of Water and Waste Minimization</b>	
		(a)	The contractor shall minimize wastage of water in the construction process/operations.
		(b)	The contractor shall educate and made employees aware on water conservation, waste minimization and safe disposal of waste.
	<b>2.9</b>	<b>Extraction of Water</b>	
		(a)	The Contractor is responsible for arranging adequate supply of water for the project purpose throughout the construction period. Contractor shall not obtain water for his purposes including for labor camps from public or community water supplies without approval from the relevant authority.
		(b)	Extraction of water by the Contractor for the project purposes shall comply with the guidelines and instructions issued by the CEA. The Contractor shall not extract water from groundwater or from surface water-bodies without permission from the Engineer. If directed by the Engineer contractor must obtain approval from relevant agency for extraction of water prior to the commencement of the project.
		(c)	Construction over and close to the non-perennial streams shall be undertaken in the dry session. Construction over the irrigation canals, if disruption to the flow, quality of water and impact on the irrigation structure is expected (or probable in the view of the Engineer), will be undertaken under necessary permission from the Department of Irrigation.
		(e)	The Contractor may use the natural sources of water subject to the provision that any claim arising out of conflicts with other users of the said natural sources of water shall be made good entirely by the contractor.
<b>3.</b>	<b>Flood Prevention</b>		
	<b>3.1</b>	<b>Blockage of drainage paths and drains</b>	
		(a)	Contractor's activities shall not lead to flooding conditions as a result of blocked drainage paths and drains. The contractor shall take all measures necessary or as directed by the Engineer to keep all drainage paths and drains clear of blockage at all times.
		(b)	If flooding or stagnation of water is caused by contractor's activities, contractors shall provide suitable means to (a) prevent loss of access to any land or property and (b) prevent damage to land and property. Contractor shall compensate for any loss of income or damage as a result.
	<b>3.2</b>	<b>Work in Flood Prone Areas</b>	
		(a)	Contractor's activities shall not lead to aggravate floods in flood prone areas when working in flood prone areas.
	(b)	When working in flood prone areas during rainy season the contractor shall avoid storing materials, chemicals and other items of work in areas where those can be washed away by the floods.	
<b>4.</b>	<b>Air Pollution</b>		
	<b>4.1</b>	<b>Generation of Dust</b>	
		(a)	The contractor shall effectively manage the dust generating activities such as topsoil removal during periods of high winds or during more stable conditions with winds directed towards adjacent residences and other facilities

		(b)	All stockpiles shall be located sufficiently away from sensitive receptors
		(c)	All vehicles delivering materials shall be covered to avoid spillage and dust emission.
		(d)	The contractor shall avoid, where possible and take suitable action to prevent dirt and mud being carried to the roads (particularly following wet weather);
		(e)	The contractor shall enforce vehicle speed limits to minimize dust generation
		(f)	The contractor shall employ a water truck for dust suppression on all exposed areas as required (note: the use of waste water / waste oil for dust suppression is prohibited);
		(g)	All cleared areas shall be rehabilitated progressively.
		(h)	All earthwork shall be protected in a manner acceptable to minimize generation of dust.
		(i)	All existing highways and roads used by vehicles of the contractor, or any of his sub-contractor or supplies of materials or plant and similarly roads which are part of the works shall be kept clean and clear of all dust/mud or other extraneous materials dropped by such vehicles or their tires.
		(j)	Clearance shall be effected immediately by manual sweeping and removal of debris, or, if so directed by the Engineer, by mechanical sweeping and clearing equipment, and all dust, mud and other debris shall be removed satisfactorily. Additionally, if so directed by the Engineer, the road surfaces shall be hosed or watered using appropriate equipments.
		(k)	Plants, machinery and equipment shall be so handled (including dismantling) so as to minimize generation of dust.
		(l)	The Contractor shall take every precaution to reduce the level of dust emission from the hot mix plants and the batching plants up to the satisfaction of the Engineer in accordance with the relevant emission norms.
		(m)	The hot mix plant be sited in accordance with CEA guidelines and operated with an EPL and subjected to meeting the conditions stated in the EPL. The hot mix plants shall be fitted with dust extraction units in order that the exhausts comply with the requirements of the relevant current emission control legislation.
<b>4.2</b>	<b>Emission from Hot-Mix Plants and Batching Plants</b>		
		(a)	The hot mix plants and batching plants shall be sited in accordance with CEA guidelines. It is recommended that hot mix plants and batching plants to be located sufficiently away from sensitive receptors such as vulnerable habitats, religious, cultural and archaeological sites, residential areas, schools and industrial areas.
		(b)	The exhaust gases shall comply with the requirements of the relevant current emission control legislation. All operations at plants shall be undertaken in accordance with all current rules and regulations protecting the environment as well as the conditions given in the EPL.
<b>4.3</b>	<b>Odor and offensive smells</b>		
		(a)	Contractor shall take all precautions to prevent odor and offensive smell emanating from chemicals and processes applied in construction works or from labor camps. In a situation when/where odor or offensive smell does occur contractor shall take immediate action to rectify the situation. Contractor is responsible for any compensation involved with any health issue arisen out of bad odor and offensive smells.

		(b)	The waste disposal and sewerage treatment system for the labor camps shall be properly designed, built and operated so that no odor is generated. Compliance with the regulations on health and safety as well as CEA guidelines shall be strictly adhered to.
<b>4.4</b>	<b>Emission from Construction Vehicles, Equipment and machinery</b>		
		(a)	The emission standards promulgated under the National Environment Act shall be strictly adhered to.
		(b)	All vehicles, equipment and machinery used for construction shall be regularly serviced and well maintained to ensure that emission levels comply with the relevant standards.
<b>4.5</b>	<b>Air Pollution from Crusher</b>		
		(a)	All crushers used in construction shall conform to relevant dust emissions levels as stated in the EPL. Only the quarries approved by GSMB and holding current EPL shall be used.
		(b)	Crushing plants shall be sited sufficiently away from sensitive receptors such as houses, schools, hospitals, temples, shrines and outdoor recreation areas or as required by the engineer.
		(c)	Sprinkler system for dust suppression shall be installed.
<b>5.</b>	<b>Noise Pollution and Vibration</b>		
<b>5.1</b>	<b>Noise from Vehicles, Plants and Equipment</b>		
		(a)	All machinery and equipment should be well maintained and fitted with noise reduction devices in accordance with manufacturer's instructions.
		(b)	In construction sites within 150 m of the nearest habitation, noisy construction work such as crushing, concrete mixing and batching, mechanical compaction, etc., will be stopped between 2000 hours to 0600 hours. In silence zone (areas up to 100 m around such premises as hospitals, educational institutional and courts) no hot-mix, batching or aggregate crushing plant will be allowed. No construction shall take place within 100m around hospitals between 2000 hours to 0600 hours. Near noise sensitive sites, such as hospitals, educational institutional and courts noisy equipment shall not be used during noise sensitive times of the day.
		(b)	All vehicles and equipment used in construction shall be fitted with exhaust silences. During routine servicing operations, the effectiveness of exhaust silencers shall be checked and if found to be defective shall be replaced. Notwithstanding any other conditions of contract, noise level from any item of plant(s) must comply with the relevant legislation for levels of sound emission. Non-compliant plant shall be removed from site.
		(c)	Noise from equipment (measured 1 meter from edge of equipment in free field) such as compactors, rollers, front loaders, concrete mixers, moveable cranes, vibrators and saws shall not exceed 75 dB(A).
		(d)	Maintenance of vehicles, equipment and machinery shall be regular and proper, to the satisfaction of the Engineer, to keep noise from these at a minimum.
		(e)	Workers in vicinity of strong noise, and workers working with or in crushing, compaction, batching or concrete mixing operations shall be provided with protective gear.

	<b>5.2</b>	<b>Vibration</b>	
		(a)	Contractor shall take appropriate action to ensure that construction works do not result in damage to adjacent properties due to vibration.
		(b)	Prior to commencement of any activity, the Contractor shall undertake a condition survey of existing structures within the zone of influence, as agreed with the relevant government agencies and the engineer.
		(c)	Contractor shall carry out monitoring at the nearest vibration sensitive receptor during blasting or when other equipments causing vibration are used.
		(d)	The contractor shall modify the method of construction until compliance with the criteria, if vibration levels exceed the relevant vibration criteria.
		(f)	Contractor shall pay due consideration on vibration impacts of blasting on adjoining structures. Explosive loads shall be determined so that excessive vibration can be avoided and blasts shall be controlled blasting in nature. Notwithstanding to these provisions contractor is liable for any damage caused by blasting work.
	<b>5.3</b>	<b>Noise from Blasting or Pre splitting Operations.</b>	
	(a)	Blasting shall be carried out only with permission of the Engineer. All the statutory laws, regulators, rules, etc., pertaining to acquisition, transport, storage, handling and use of explosives shall be strictly followed.	
	(b)	Blasting shall be carried out during fixed hours (preferably during mid-day), as permitted by the Engineer. The timing should be made known to all the people within 500m (200m for pre-splitting) from the blasting site in all directions. People, except those who actually light the fuse shall be excluded from the area of 200m (50m for pre-splitting) from the blasting site in all directions at least 10m minutes before the blasting.	
<b>6.</b>	<b>Impact on Flora/Monitoring of Flora</b>		
	<b>6.1</b>	<b>Loss or Damage to Trees and Vegetation</b>	
		(a)	All works shall be carried out in a manner that the destruction to the flora and their habitats is minimized. Trees and vegetation shall be felled / removed only if that impinge directly on the permanent works or necessary temporary works. In all such cases contractor shall take prior approval from the Engineer.
		(b)	Contractor shall make every effort to avoid removal and/or destruction of trees of religious, cultural and aesthetic significance. If such action is unavoidable the Engineer shall be informed in advance and carry out public consultation and report on the same should be submitted to the Engineer.
		(c)	Contractor shall adhere to the guidelines and recommendations made by the CCD, if any with regard to felling of trees and removal of vegetation.
		(d)	Sand dunes and riparian areas adjacent to areas of contractor activity shall not be disturbed, degraded, or destabilized by contractor activities.
		(e)	If the trees and vegetations that require removal is in a forest plantation or natural forest under the jurisdiction of the Department of Forest, the contractor shall take prior approval form the DoF for such removal and adhere to conditions /guidelines imposed by the DoF if any.

			(f)	If the trees and vegetations that require removal is in a sanctuary, nature reserve, national park or protected area under jurisdiction of the Department of Wildlife Conservation, the contractor shall take prior approval from the DWLC for such removal and adhere to conditions /guidelines imposed by the DWLC if any.
			(g)	Impact on area flora using transect or quadrat will be monitored by assessments at midpoint and conclusion of construction, using this EA as baseline.
	<b>6.2</b>	<b>Chance found important Flora</b>		
			(a)	During construction, if a rare/threatened/endangered flora species is found, it shall be immediately informed to the Engineer. All activities that could destroy such flora and/or its habitat shall be stopped with immediate effect. Such activities shall be started only after obtaining the Engineer's approval. Contractor shall carry out all activities and plans that the Engineer instructed him to undertake to conserve such flora and/or its habitat.
<b>7.</b>	<b>Impact on Fauna</b>			
	<b>7.1</b>	<b>Loss, Damage or Disruption to Fauna/Monitoring of Fauna</b>		
			(a)	All works shall be carried out in such a manner that the destruction or disruption to the fauna and their habitats is minimum.
			(b)	Construction workers shall be instructed to protect fauna including wild animals and aquatic life as well as their habitats. Hunting, pouching and unauthorized fishing by project workers is not allowed.
			(c)	Any construction method that requires that a jetty be built or a channel cut in the nearshore areas will require that the contractor roughly map out coralline habitats that exist in the area of activity, in order to select the least damaging transport route. This mapping should be done by a qualified ecologist, and the resulting data and map should be provided to SLTRP to allow it to be used as a baseline for other actors to monitor coral structures in the area.
			(d)	Landing sites, labor camps, and other sites used by the contractor shall be selected with reference to the findings and recommendations of the turtle survey (see section 3.2.3 and Annex 4).
			(e)	The contractor shall be particularly cognizant of potential disruptions to turtle habitat during the months of January and February, and July and August. During this time the contractor should refrain from using flood lights on or near beach areas, and shall control noise levels (e.g. night work or loud music) from construction areas adjacent to sensitive habitat as indicated in the referenced sections of this EA.
			(f)	Construction workers shall not be allowed to trespass into sanctuaries, national parks, and protected areas if the road is traversing through such areas.
			(g)	Impact on area fauna using transect or quadrat will be monitored by assessments at midpoint and conclusion of construction; using this EA as baseline.
			(h)	Soil and/or sand needed for construction shall be obtained from nearby areas to minimize risk of transport of invasive species to the construction area.
	<b>7.2</b>	<b>Chance found important Fauna</b>		

		(a)	During construction, if a rare/threatened/endangered fauna species is found, it shall be immediately informed to the Engineer. All activities that could destroy such fauna and/or its habitat shall be stopped with immediate effect. Such activities shall be started only after obtaining the Engineer's approval. Contractor shall carry out all activities and plans that the Engineer instructed him to undertake to conserve such fauna and/or its habitat.
<b>8.</b>	<b>Disruption to Users</b>		
	<b>8.1</b>	<b>Loss of Access</b>	
		(a)	The Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses connecting the project road. Work that affects use of side roads and existing accesses shall not be undertaken without providing adequate provisions approved in advance by the Engineer.
		(b)	The works shall not interfere unnecessarily or improperly with the convenience of public or the access to, use and occupation of public or private roads, railways and any other access footpaths to or of properties whether public or private.
		(c)	On completion of the works, all temporary obstructions to access shall be cleared away, all rubbish and piles of debris that obstruct access be cleared to the satisfaction of the Engineer.
	<b>8.2</b>	<b>Traffic Jams and Congestion</b>	
		(a)	Detailed Traffic Control Plans shall be prepared and submitted to the Engineer for approval 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangements after cessation of work each day. If directed by the Engineer the contractor shall obtain the consent for the traffic arrangement from the Local Police.
		(b)	Temporary diversion of traffic to facilitate construction work shall have the approval of the Engineer. If directed by the Engineer the contractor shall obtain the consent for the traffic arrangement from the Local Police.
		(c)	Special consideration shall be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night.
		(d)	The contractor shall ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs.
		(e)	The temporary traffic detours shall be kept free of dust by frequent application of water, if necessary.
		(f)	Personnel used for traffic control by the contractor shall be properly trained, provided with proper gear including communication equipment, luminous jackets for night use. All signs, barricades, pavement markings used for traffic management should be to the standards and approved by the Engineer/ Police.
	<b>8.3</b>	<b>Traffic Control and Safety</b>	
		(a)	The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highways under improvement. The provision of traffic safety measures shall be considered incidental to work and follow ICTAD guidelines and instructions given by the Police, if any.

	<b>8.4</b>	<b>Monitoring of Fish Catch</b>	
		(a)	The Contractor will conduct a baseline assessment of fish catch in Arugam lagoon, as well including number of fishers involved, and income earned, and monitor these criteria monthly during the construction period.
<b>9.</b>	<b>Accidents and Risks</b>		
	<b>9.1</b>	<b>Public and Worker safety</b>	
		(a)	All reasonable precautions will be taken to prevent danger of the workers and the public from accidents such as fire, explosions, blasts, falling rocks, falling to excavated pits, breaking flood diversions, chemical sprays, unsafe power supply lines etc.
		(b)	The Contractor shall comply with requirements for the safety of the workmen as per the <u>international labor organization (ILO) convention No. 62 and</u> Safety and Health regulations of the Factory Ordinance of Sri Lanka to the extent that those are applicable to this contract. The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, boots, etc., to the workers and staff. The contractor has to comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.
	<b>9.2</b>	<b>Prevention of Risks of Electrocutation</b>	
		(a)	All electrical wiring and supply related work should confirm to British Standards (BS) or relevant Sri Lankan Standards. Adequate precautions will be taken to prevent danger of electrocuting from electrical equipment and power supply lines including distribution boards, transformers, etc. Measures such as danger signboards, danger/red lights, fencing and lights will be provided to protect the public and workers. All electric power driven machines to be used in the construction shall be free from defect, be properly maintained and kept in good working order, be regularly inspected and as per BS provisions and to the satisfaction of the Engineer.
	<b>9.3</b>	<b>Risk at Hazardous Activity</b>	
		(a)	All workers employed in hazardous activities shall be provided with necessary protective gear. These activities include mixing asphalt material, cement, lime mortars, concrete etc., welding work, work at crushing plants, blasting work, operators of machinery and equipment such as power saws, etc.
		(b)	The use of any toxic chemical shall be strictly in accordance with the manufacturer's instructions. The Engineer shall be notified of toxic chemicals that are planned to be used in all contract related activities. A register of all toxic chemicals delivered to the site shall be kept and maintained up to date by the Contractor. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product.
	<b>9.4</b>	<b>Lead Pollution</b>	
		(a)	No paint containing lead or lead products will be used except in the form of paste or readymade paint. Facemasks shall be supplied to workers who are working in spray painting or scraping lead paints.



	<b>9.5</b>	<b>Handling of Explosives</b>	
		(a)	Except as provided in the contract or ordered or authorized by the Engineer, the Contractor shall not use explosives. Where the use of explosives is so provided or ordered or authorized, the Contractor shall comply with the requirements of the following Sub-Clauses of this Clause besides the law of the land as applicable.
		(b)	The Contractor shall at all times take every possible precaution and shall comply with relevant laws and regulations relating to the importation, handling, transportation, storage and use of explosives. Contractor shall obtain Defense Ministry approval for importing and handling explosives and keep the Local Police informed of the same.
		(c)	Contractor shall take precaution to prevent injury to people and damage the structures/houses and vehicles in the vicinity at the locations of blasting work. Blasting should be controlled to prevent vibration damage to structures and injury to people. The vehicles and road users should be stopped at a reasonable distance from the site and people in the vicinity should be informed when the blasting is carried out. Any debris on the road should be removed promptly before clearing the road for users. Blasting work should be carried out in off peak hours but not during the hours of darkness or at other times, which may cause unacceptable disturbance to religious or other ceremonies.
		(d)	Sufficient and adequate warning shall be given prior to blasting. Use of flagmen, siren, etc. should be arranged to the full satisfaction of the Engineer. The public in the area should be informed well in advance about the blasting operation and timing.
<b>10.</b>	<b>Health and Safety</b>		
	<b>10.1</b>	<b>Prevention of Vector based Diseases</b>	
		(a)	Contractor shall take necessary actions to prevent breeding of mosquitoes at places of work, labor camps, plus office and store buildings. Stagnation of water in all areas including gutters, used and empty cans, containers, tires, etc shall be prevented. Approved chemicals to destroy mosquitoes and laves should be regularly applied.
		(b)	Contractor shall keep all places of work, labor camps, plus office and store buildings clean devoid of garbage to prevent breeding of rats and other vectors such as flies.
	<b>10.2</b>	<b>Workers Health and Safety</b>	
		(a)	Contractor shall comply with the provisions in Health and Safety regulations under the Factory Ordinance with regard to provision of health and safety measures and amenities at work place(s).
	<b>10.2</b>	<b>First Aid</b>	
		(a)	At every workplace, first aid kit shall be provided as per the regulations. At every workplace an ambulance room containing the prescribed equipment and nursing staff shall be provided.

	<b>10.3</b>	<b>Potable Water</b>	
		(a)	In every workplace and labor camps portable water shall be available through out the day in sufficient quantities. Water should be easily accessible. In general cold portable water is acceptable.
	<b>10.4</b>	<b>Hygiene</b>	
		(a)	The contractor shall provide and maintain necessary (temporary) living accommodation and ancillary facilities for labor to standards and scale approved by the resident engineer.
		(b)	At every workplace and labor camps sufficient number of bathing facilities, latrines and urinals shall be provided in accordance with the Health and Safety regulations and/or as directed by the Engineer. These bathroom and toilet facilities shall be suitably located within the workplace/buildings. Latrines shall be cleaned at least three times daily in the morning, midday and evening and kept in a strict sanitary condition. If women are employed, separate latrines and urinals, screened from those for men and marked in the vernacular shall be provided. There shall be adequate supply of water, within and close to latrines and urinals.
		(c)	The camp's sewage system must be properly designed, built and operated so that no health hazard occurs and no pollution to air, ground or adjacent watercourses occurs. Compliance with relevant legislation will be strict.
		(d)	Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a hygienic manner. Construction camps shall have a clean hygienic environment and adequate health care shall be provided for the work force.
		(d)	Unless otherwise arranged for by the Local Authority, the contractor shall arrange proper disposal of sludge from septic tanks. The contractor shall obtain approval for such disposal from the Public Health Inspector of the area.
<b>11</b>	<b>Protection of Archaeological, Cultural and Religious Places and Properties</b>		
	<b>11.1</b>	<b>Prevention of damage to Archaeological, Cultural and Religious Places and Properties</b>	
		(a)	All necessary and adequate care shall be taken to minimize impact on archaeological and cultural properties which includes cultural sites and remains, places of worship including temples, mosques, churches and shrines, etc., graveyards, monuments and any other important structures during construction. Work shall not encroach in to such properties, premises and precincts under any circumstances.
		(b)	Conservation and protection measures shall be taken up as per design and as per the instructions issued by the Department of Archaeology or Department of Cultural Affairs when working close to or within such sites. Contractor shall seek advice from the Engineer if such instructions are not available. Access to such properties from the road shall be maintained clear and clean.
		(c)	Blasting work shall not be allowed near or within archaeological and historical sites without prior approval of the Department of Archaeology and the Engineer.
	<b>11.2</b>	<b>Chance found Archaeological property</b>	
		(a)	All fossils, coins, articles of value of antiquity and structures and other remains or things of geological or archaeological interest etc. discovered on the site and/or during construction work shall be the property of the Government of Sri Lanka, and shall be dealt with as per provisions of the relevant legislation.

			(b)	The contractor shall take reasonable precaution to prevent his workmen or any other persons from removing and damaging any such article or thing and shall, immediately upon discovery thereof and before removal acquaint the Engineer of such discovery and carry out the Engineer's instructions for dealing with the same, awaiting which all work shall be stopped within 100m in all directions from the site of discovery.
			(c)	If directed by the Engineers the Contractor shall obtain advice and assistance from the Department of Archaeological of Sri Lanka on conservation measures to be taken with regard to the artifacts prior to recommencement of work in the area.
<b>12</b>	<b>Environmental Enhancement</b>			
	<b>12.1</b>	<b>Roadside Landscape</b>		
			(a)	Road landscape plantation, re-vegetation of road embankments and other slopes, edge treatment of water bodies shall be taken up as per either detailed design or typical design guidelines given as part of the Bid Documents. The contractor also shall remove all debris, piles of unwanted earth, spoil material, etc away from the roadsides and from other work places and disposed at locations designated or acceptable to the Engineer or as per Clause 1.1.
			(b)	On completion of the works, temporary structures shall be cleared away in full, all rubbish burnt, waste dumps and septic tank shall be filled and closed and roadsides, workplaces and labor camps, cleared and cleaned.
	<b>12.2</b>	<b>Utilities and Roadside Amenities</b>		
			(a)	Contractor shall replace all amenities such as bus shelters that were removed/relocated during the construction unless the Engineer directed the contractor not to do so.
			(b)	Contractor shall take care not to damage/destroy or affect the functional purposes of utilities such as water, electricity, telephone posts. Prior to commencement of work the contractor shall consult those service providers and agree on a plan for shifting or relocating these utilities temporarily or permanently as required. Contractor shall assist the service providers in whatever possible manner to minimize disruption to such services. The arrangements the contractor made with those service providers shall be informed to the Engineer in writing.
			(c)	In case of an inadvertent damage cause to a utility, the contractor shall immediately inform the service provider and help to restore the service without delay.
	<b>12.3</b>	<b>Road Furniture</b>		
			(a)	Road furniture including footpaths, railings, storm water drains, crash barrier, traffic signs, speed zone signs, pavement markers and any other such items will be provided as per design given in the Bid Documents.
			(b)	Intersections, rotaries, traffic islands, roadside protection and other structures or furniture shall be constructed, complete with the landscape elements as per design in the above manner.

	13	<b>Handling Environmental Issues during Construction</b>	
			<p>(a) The Contractor will appoint a suitably qualified Environmental Officer following the award of the contract. The Environmental Officer will be the primary point of contact for assistance with all environmental issues during the pre-construction and construction phases. He/She shall be responsible for ensuring the implementation of EMAP.</p> <p>(b) The Contractor shall appoint a person responsible for community liaison and to handle public complains regarding environmental/social related matters. All public complaints will be entered into the Complaints Register. The Environmental Officer will promptly investigate and review environmental complaints and implement the appropriate corrective actions to arrest or mitigate the cause of the complaints. A register of all complaints is to be passed to the Engineer within 24 hrs they are received, with the action taken by the Environmental Officer on complains thereof.</p> <p>(c) Contractor shall develop suitable method to receive complaints. The complain register shall be placed at a convenient place, easily accessible by the public.</p> <p>(d) The contractor shall be responsible in reporting the implementation of the EMAP to the employer based on an agreed reporting format either monthly or periodically, as agreeable. The report should carry observations of the 'Project Impact Monitoring Committee' who will be monitoring compliance with EMAP continuously. Periodic field supervision shall be undertaken by the employer (or representatives) to make observations on the implementation progress of the EMAP.</p>

## **5.2 Preliminary Environmental Monitoring Plan**

The table below presents an initial monitoring plan for CH2MHill to use in monitoring compliance with environmental requirements by the construction contractor. A number of factors, including methods and frequency of reporting, will be determined upon award of the construction contract to the successful bidder and the specific construction means and methods established at that time.

### Preliminary Environmental Monitoring Plan\*

Indicator	Indicator Definition	Data Source	Data Collection Method	Frequency of Analysis	Mode/ Frequency of Reporting to USAID**	Primary Responsible Entity
<b>Environmental Objective 1 – Construction contractor compliance with requirements stipulated in EMAP</b>						
Reporting mechanism established	Mechanism (e.g. committee) identified to monitor contractor compliance with environmental compliance throughout construction	Field Construction Manager	Discussion	Prior to finalizing construction contract (one-time event)	PCM Six-Month Report	Construction Contractor; Construction Manager; PCM Lead
EMAP Compliance	Fulfillment of all requirements stipulated in the EMAP	Construction Contractor	Reporting by Construction Contractor	Quarterly (or as determined by finalized construction contract)	Semi-annually (PCM Six-Month Report)	Construction Contractor
		PCM Staff and Construction Management Staff	Spot checks of issues of concern; community consultations	Intermittent (approximately quarterly)	Semi-annually	PCM Lead; Field Construction Staff
<b>Environmental Objective 2 – Disturbance to conditions in the lagoon minimized</b>						
Water quality	Water quality of lagoon	Construction Contractor	TBD (Method to be proposed by Construction Contractor)	CH2MHill will collect information from the contractor on a regular basis*** via contractor's standard reports.	Semi-annually	Construction Contractor
Fish catch	Levels of fish, prawns, and other species being harvested from the lagoon	Construction Contractor	As per construction contract requirements (Method to be proposed by contractor)	Quarterly (or as determined by finalized construction contract)	Semi-annually	Construction Contractor

Indicator	Indicator Definition	Data Source	Data Collection Method	Frequency of Analysis	Mode/ Frequency of Reporting to USAID**	Primary Responsible Entity
<b>Environmental Objective 3 – Disturbance to turtle habitat minimized</b>						
Siting of construction facilities	Selection of locations for staging areas, labor camps, etc. in accordance with turtle nesting habitat survey	Construction Management & Contractor	Plans presented by construction contractor	Prior to initiating activities on the ground, and on an ongoing basis as appropriate	Semi-annually	Construction Contractor; Construction Engineer
Noise/light level during nighttime hours	Management of disturbing sounds/lights during nesting seasons	Construction Management & Contractor	1) Reporting by construction contractor; 2) Site checks during nesting season by Engineer/PCM Lead	Semi-annually (January/February; July/August)	Semi-annually	Construction Contractor; Construction Engineer; PCM Lead
<b>Environmental Objective 4 - Disturbance of nearshore ecosystems minimized</b>						
Coral protection	Sound consideration of nature and placement of coral formations in areas where a channel will be cut, jetty placed, etc.	Construction Contractor	Mapping of coral formation by qualified personnel	One occurrence, prior to channel-cutting or placement of temporary jetty	PCM Six-Month Report (Oct. 2006)	Construction Contractor

\*to be finalized upon award of construction contract

\*\*priority issues will be communicated to USAID as they arise through the monthly report or other means

\*\*\*frequency based on finalized construction contract

## **5 Recommendations and Conclusions**

In summary, it is found that most of the significant impacts associated with the bridge transportation and construction scenarios discussed can be adequately mitigated by following the EMAP and the following key recommendations. For example, if potential negative repercussions on the water quality of the lagoon are seen due to re-suspension of bottom sediments from pile driving and construction of land embankments, these can be minimized through the use of a physical barrier such as silt curtains.

### **Conveyance by Sea/Lagoon**

In the event it is decided to carry the construction equipment and bridge sections via the sea/lagoon route, construction of a temporary channel through the sand bar would be necessary. The main issue of artificially opening the sand bar, which remains closed during most parts of the year, would be possible changes to the salinity regime of the lagoon and the potential impacts on the lagoon productivity. Since the scope of the present study is unable to predict the impacts caused by a seawater influx, if the contractor selects this option it is recommended that some periodic monitoring of water quality, fish catch and income be collected.

It is also recommended that the contractor explore the option of using the natural breach in the sand bar during the northeast monsoon period (November to January) to transport the material to the bridge site. This would avoid any artificial intervention at the site. However, this may be a limited option as this period coincides with the wet weather period when the sea is rough and the sand bar will close up immediately after the cessation of the monsoon.

If this method requires a channel to be cut in the nearshore areas to create the required depth to bring in boats or barges, it is recommended to roughly map out the coralline habitats in the near shore waters of the bay, in order to select the least damaging transport route. This mapping should be done by a qualified ecologist, and the resulting data and map should be provided to SLTRP to allow it to be used as a baseline for other actors to monitor coral structures in the area.

### **Conveyance by Sea and Beach**

In the event it is decided to convey the equipment and bridge sections via the sea and then beach land at a suitable point to be carried over land to the bridge site, the contractor should adhere to the specific recommendations with regard to the protection of marine turtles. In summary:

- (1) Priority should be given for locating the beach landing point in an area that is not nested by turtles at present (these areas have been identified and mapped in annex 4);
- (2) If this is unavoidable, due to reasons such as conflict over beach use with the present users, the bordering areas should be considered as a compromise. However, in such an event mitigation measures such as, restricted beach activity, restricted night operations, restricted night lighting, avoidance of peak turtle nesting periods, fencing off the landing area from the adjacent turtle nesting areas etc should be carried out.



**Conveyance Overland**

If carrying the equipment and bridge sections overland requires widening of an existing road or construction of a new road, attention will have to be paid to the associated environmental impacts. It is recommended that environmental impacts be identified at the outset so that management measures can be identified and incorporated into the EMAP.

**Conveyance by Alternative Means**

If an interested contractor elects to propose means of conveyance not discussed here, an assessment of environmental impacts of that alternative and plan for mitigation should be presented with the proposal for review by SLTRP staff and authors of this report.

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## **Annex 1: Terms of Reference for Environmental Assessment – Arugam Bay Bridge Replacement and Access Roads**

### Executive Summary

Chapter 1	–Introduction
Chapter 2	- Project Description
Chapter 3	–Description of the Project Environment
Chapter 4	- Project Impacts and Mitigation
Chapter 5	–Environmental Monitoring and Management Plan
Chapter 6	–Recommendations and Conclusions

### Annexes

#### **Chapter 1 - Introduction**

- Project background
- Purpose of the report
- Scope of the environmental assessment study
- Stakeholder consultation
- Approvals needed for the project

#### **Chapter 2 – Project Description**

- Aims, Scope and Objectives of the Project
- Description of the existing situation
- Purpose and need of the project
- Alternatives Considered
- Description of the proposed project
- Project Location Map and Layout Plan
- Details of Construction Activities – Method of Construction, Materials Requirement and Sourcing, Give Details of Temporary Works if any, Construction Schedule, Waste Generation and Facilities Required for Construction
- Details of demolition and disposal of the existing bridge and related structures.

#### **Chapter 3 –Description of the Existing Environment**

- Physical Environment – Land-use; Soil and Geology; Topography and Land forms; Climate; Hydrology; Marine Environment
- Biological Environment – Major Habitats in the Affected Area; Description of each Habitat giving information on flora and fauna and special functions of these habitats, if any; State whether these habitats are threatened, if so what are the reasons; State whether endangered and threatened species are in these habitats.
- Socioeconomic Environment- Socioeconomic profile of the area; Social and economic Importance of the Bridge; Special issues with regard to security situation, ethnic conflict; Skill levels in the Community;

#### **Chapter 4 - Project Impacts and Mitigation**

- Provide details on proposed mitigation measures. Provide cost estimate for implementation of each mitigation measure.

#### **Chapter 5 – Environmental Monitoring and Management Plan**

- Proposed a suitable monitoring plan for impact and compliance monitoring.
- Prepare an Environmental Management Plan for the project covering both mitigation measures and monitoring programs

#### **Chapter 6 – Recommendations and Conclusions**

## Annex 2: Bio-diversity survey methodology and the list of species recorded

**Methodology:** Direct observations were made to identify the flora and fauna in the natural habitats within a 0.5 km radius of the points of contact of the bridge road to the land. In addition three line transect surveys were carried out within the above areas leading away from the bridge towards the land. Fauna and flora present either side of the line transect up to 25 meters were recorded along with the habitat information.

### Annex 2 – Part 1

#### Habitats and list of flora recorded at the Arugam Bay project site

Three main natural habitats and two man made habitats were identified in the proposed project area with respect to flora.

##### *Natural Habitats*

1. River outlets and Lagoon
2. Beach, sand dunes and sand bar
3. Riparian areas

##### *Man made habitats*

4. Road sides
5. Home and Hotel Gardens

Note: Images of these main habitats are presented in the main report.

#### **River outlets and lagoon (aquatic)**

Fresh water aquatic plants were common in river outlets and in the lagoon area. *Pistia stratiotes* (Diya-paradel), *Salvinia molesta* (Salvinia), *Ceratophyllum demersum* are common aquatic species inhabiting river outlets and the lagoon. *Panicum repens* (Atora), *Eclipta prostrate* (Kikirindiya), *Alternanthera sessilis* (Mukunuwenna), *Typa angustifolia* (Hambupan) are common associated species. Salinity loving tree species, *Excoecaria agalocha* (Telakiriya) also inhabited the edges of river outlets and edges of the lagoon.

#### **Beach, sand dunes and sand bar**

Vegetation of unstable sand dunes is very poor. *Ipomoea pescaprae* (Mudu-bim-thaburu) is the only species on the sand dunes that showed considerable cover of this habitat. Other species such as, *Spinifex littoreus* (Maha-rawana-reula), *Cyperus arenarius*, *Cyperus stoloniferus*, *Mollugo pentaphylla*, *Pupalia lappacea*, *Crinum zeylanicum* (Goda-manel), *Pedaliium murex* (Ath-nerenchi), *Canavalia rosea*, *Hydrophylax maritima* were spreading on sand dunes, only in small numbers and covered small areas. Scatted trees such as *Borassus flabellifer* (Tal), *Acacia planifrons* were also found on sand dunes.

The sand bar at the mouth of the lagoon is nearly free of vegetation. But close to the water of lagoon, few individuals of *Panicum repens* (Atora), *Ipomoea pes-caprae* (Mudu-bim-thaburu), *Canavalia rosea* were found. Beach was free of vegetation.

#### **Riparian area**

Two main vegetation types were identified within the riparian areas, a tree dominated area and a grass dominated area. *Terminalia arjuna* (Kumbuk) is the dominant tree species inhabiting the tree dominated areas. *Syzygium cumini* (Madan), *Cassine glauca* (Neralu), *Limonia acidissima* (Divul), *Ficus benghalensis* (Maha-nuga), *Borassus flabellifer* (Tal) were the other tree species inhabiting the tree dominated area. *Phoenix pusilla* (Indi), *Memecylon*

*umbellatum* (Kora-kaha), were the shrub species in the tree dominated riparian area. In grass dominated riparian areas, *Panicum repens* (Atora) is the most dominant species.

### Road sides

Weedy herbs and shrub species were dominant in this habitat, which is a common occurrence. Herb species such as *Croton bonplandianus*, *Cleome viscosa*, *Cleome ruidosperma*, *Boerhavia diffusa*, *Achyranthes aspera* (Gas-karal-heba), *Gomphrena celosioides*, *Sida acuta* (Gas-bebila), *Tridax procumbens*, *Cynodon dactylon* were common along road sides. Shrub species such as *Abutilon indicum*, *Ricinus communis* (Endaru) were common on road sides.

### Home and hotel gardens

*Cocos nucifera* (Pol), *Borassus flabellifer* (Tal), *Azadirachta indica* (Kohomba), *Eucalyptus sp.* (Eucalyptus), *Casuarina equisetifolia* (Kasa), *Terminalia catappa* (Kottan) were common in these habitats.

A total number of 108 plant species including 01 endemic species were encountered in the project area during the field visit (Table 01). The species present in 1,2,3,4 and 5 sections with necessary information are given in Annex 1.

Table 1: Summary of flora species recorded during the field visit

Number of Species	Number of Families	Endemic Species	Native Species	Nationally Threatened	Globally Threatened	Exotic Species
108	45	01	90	0	0	17

### List of Abbreviations (Ref. Table 2)

<b>HA</b>	–	Habit
<b>TS</b>	–	Taxonomic Status
<b>CS</b>	–	Conservation Status
<b>HG</b>	–	Home and hotel gardens
<b>SD</b>	–	Sand dunes
<b>SB</b>	–	Sand bar
<b>RL</b>	–	River outlet and Lagoon
<b>RP</b>	–	Riparian area
<b>RS</b>	–	Road sides
<b>TR</b>	–	Threatened
<b>T</b>	–	Tree
<b>S</b>	–	Shrub
<b>H</b>	–	Herb
<b>E</b>	–	Endemic
<b>N</b>	–	Native
<b>I</b>	–	Introduced
<b>C</b>	–	Climber or Creeper

### List of Flora

Species Name	Common Name	HA	TS	CS	HG	SD	SB	RL	RP	RS
<b>Amaranthaceae</b>										
<i>Achyranthes aspera</i>	Gas-karal-heba	H	N	-	1	0	0	0	1	1
<i>Aerva lanata</i>	Pol-pala	H	N	-	1	0	0	0	0	1
<i>Alternanthera sessilis</i>	Mukunuwenna	H	N	-	0	0	0	1	1	0
<i>Amaranthus viridis</i>	Kura-tampala	H	N	-	0	0	0	0	0	1
<i>Gomphrena celosioides</i>		H	I	-	1	0	0	0	1	1
<i>Pupalia lappacea</i>		H	N	-	0	1	0	0	0	0
<b>Amaryliidaceae</b>										
<i>Crinum zeylanicum</i>	Goda-manel	H	N	-	0	1	0	0	1	0
<b>Apocynaceae</b>										
<i>Carissa spinarum</i>	Heen-karaba	S	N	-	0	0	0	0	0	1
<b>Araceae</b>										
<i>Pistia stratiotes</i>	Diya-paradel	H	N	-	0	0	0	1	0	0
<b>Arecaceae</b>										
<i>Borassus flabellifer</i>	Tal	T	I	-	1	1	0	0	1	1
<i>Cocos nucifera</i>	Pol	T	N	-	1	0	0	0	0	0
<i>Phoenix pusilla</i>	Indi	T	N	-	0	0	0	0	1	0
<b>Asclepiadaceae</b>										
<i>Calotropis gigantea</i>	Wara	S	N	-	1	1	0	0	1	1
<i>Pergularia daemia</i>		C	N	-	0	0	0	0	0	1
<b>Asparagaceae</b>										
<i>Asparagus racemosus</i>	Hatawariya	C	N	-	0	0	0	0	0	1
<b>Asteraceae</b>										
<i>Eclipta prostrata</i>	Kikirindiya	H	N	-	0	0	0	1	1	0
<i>Eupatorium odoratum</i>		S	I	-	1	0	0	0	0	1
<i>Mikania cordata</i>	Vatu-palu	C	N	-	0	0	0	0	1	0
<i>Tridax procumbens</i>		H	I	-	1	0	0	0	0	1
<i>Vernonia cinerea</i>	Monara-kudumbiya	H	N	-	0	0	0	0	0	1
<i>Xanthium indicum</i>	Uru-kossa	H	N	-	0	0	0	0	1	1
<b>Boraginaceae</b>										
<i>Cordia curassavica</i>		S	I	-	0	0	0	0	0	1
<i>Cordia dichotoma</i>	Lolu	T	N	-	0	0	0	0	1	0
<i>Ehretia laevis</i>		T	N	-	0	0	0	0	0	1
<i>Heliotropium indicum</i>	Athhoda	H	N	-	0	0	0	0	1	0
<b>Cactaceae</b>										
<i>Opuntia monacantha</i>	Pathok	S	I	-	0	0	0	0	0	1
<b>Capparaceae</b>										
<i>Capparis sepiaria</i>		S	N	-	0	0	0	0	0	1
<i>Cleome rutidosperma</i>		H	I	-	0	0	0	0	0	1



Species Name	Common Name	HA	TS	CS	HG	SD	SB	RL	RP	RS
<i>Cleome viscosa</i>		H	N	-	0	0	0	0	0	1
<i>Crateva adansonii</i>	Lunu-warana	T	N	-	0	1	0	0	0	0
<b>Casuarinaceae</b>										
<i>Casuarina equisetifolia</i>	Kasa	T	I	-	1	0	0	0	0	0
<b>Celastraceae</b>										
<i>Cassine glauca</i>	Neralu	T	E	-	0	0	0	0	1	0
<b>Ceratophyllaceae</b>										
<i>Ceratophyllum demersum</i>		H	N	-	0	0	0	1	0	0
<b>Colchicaceae</b>										
<i>Gloriosa superba</i>	Niyagala	C	N	-	0	1	0	0	0	1
<b>Combretaceae</b>										
<i>Terminalia arjuna</i>	Kumbuk	T	N	-	0	0	0	0	1	0
<i>Terminalia catappa</i>	Kottan	T	I	-	1	0	0	0	0	1
<b>Commelinaceae</b>										
<i>Commelina sp.</i>		H	N	-	0	0	0	0	1	0
<b>Convolvulaceae</b>										
<i>Ipomoea obscura</i>	Tel-kola	C	N	-	0	0	0	0	0	1
<i>Ipomoea pes-caprae</i>	Mudu-bim-thaburu	C	N	-	1	1	1	0	0	1
<i>Merremia tridentata</i>	Heen-madu	C	N	-	0	0	0	0	0	1
<b>Cyperaceae</b>										
<i>Bulbostylis barbata</i>		H	N	-	0	1	0	0	0	0
<i>Cyperus arenarius</i>		H	N	-	0	1	0	0	0	0
<i>Cyperus rotundus</i>	Kaladuru	H	N	-	0	0	0	1	1	1
<i>Cyperus sp.</i>		H	N	-	0	0	0	1	1	0
<i>Cyperus stoloniferus</i>		H	N	-	0	1	0	0	1	1
<b>Ebenaceae</b>										
<i>Diospyros malabarica</i>	Timbiri	T	N	-	0	0	0	0	1	0
<b>Euphorbiaceae</b>										
<i>Acalypha indica</i>		H	N	-	0	0	0	0	0	1
<i>Croton bonplandianus</i>		H	I	-	1	0	0	0	1	1
<i>Euphorbia hirta</i>		H	N	-	0	0	0	0	0	1
<i>Euphorbia thymifolia</i>		H	N	-	0	1	0	0	0	0
<i>Excoecaria agallocha</i>	Tela-kiriya	T	N	-	0	0	0	0	1	0
<i>Jatropha gossypifolia</i>		S	I	-	0	1	0	0	0	0
<i>Phyllanthus amarus</i>	Pitawakka	H	N	-	0	0	0	0	0	1
<i>Ricinus communis</i>	Endaru	S	I	-	1	0	0	0	0	1
<b>Fabaceae</b>										
<i>Acacia planifrons</i>		T	N	-	0	1	0	0	0	0
<i>Alysicarpus vaginalis</i>	Aswenna	H	N	-	0	0	0	0	1	1
<i>Canavalia rosea</i>		C	N	-	0	1	1	0	0	1
<i>Cassia occidentalis</i>	Tora	S	N	-	1	0	0	0	1	1
<i>Cassia roxburghii</i>	Wa	T	N	-	0	1	0	0	1	1

Species Name	Common Name	HA	TS	CS	HG	SD	SB	RL	RP	RS
<i>Cassia tora</i>	Tora	H	N	-	0	0	0	0	1	1
<i>Clitoria ternatea</i>	Katarodu	C	N	-	0	0	0	0	0	1
<i>Crotalaria verrucosa</i>		H	N	-	0	0	0	0	0	1
<i>Derris scandens</i>	Bo-kala-wel	C	N	-	0	0	0	0	1	0
<i>Desmodium triflorum</i>	Heen-udupiyaliya	H	N	-	1	0	0	0	1	1
<i>Mimosa pudica</i>	Nidikumba	H	I	-	1	0	0	0	1	1
<i>Tephrosia purpurea</i>	Pila	H	N	-	1	0	0	0	1	1
<b>Lamiaceae</b>										
<i>Leucas zeylanica</i>	Thumba	H	N	-	0	0	0	0	0	1
<i>Ocimum americanum</i>	Heen-maduruthala	H	N	-	1	0	0	0	1	1
<b>Malvaceae</b>										
<i>Abutilon indicum</i>		H	N	-	1	0	0	0	1	1
<i>Hibiscus micranthus</i>		S	N	-	0	0	0	0	0	1
<i>Pavonina odorata</i>		S	N	-	0	0	0	0	0	1
<i>Sida acuta</i>	Gas-bebila	H	N	-	0	0	0	0	1	1
<i>Thespesia populnea</i>	Suriya	T	N	-	1	0	0	0	1	0
<b>Martyniaceae</b>										
<i>Martynia annua</i>	Nagadarana	S	I	-	0	0	0	0	0	1
<b>Melastomataceae</b>										
<i>Memecylon umbellatum</i>	Kora-kaha	S	N	-	0	0	0	0	1	0
<b>Meliaceae</b>										
<i>Azadirachta indica</i>	Kohomba	T	N	-	1	0	0	0	1	1
<i>Walsura trifoliolata</i>		T	N	-	0	0	0	0	1	0
<b>Menispermaceae</b>										
<i>Tinospora cordifolia</i>	Rasakinda	C	N	-	0	0	0	0	1	0
<b>Molluginaceae</b>										
<i>Mollugo pentaphylla</i>		H	N	-	0	1	0	0	0	0
<b>Moraceae</b>										
<i>Ficus benghalensis</i>	Maha-nuga	T	N	-	0	0	0	0	1	1
<b>Myrtaceae</b>										
<i>Eucalyptus sp.</i>		T	I	-	1	0	0	0	1	0
<i>Syzygium cumini</i>	Madan	T	N	-	0	0	0	0	1	0
<b>Nyctaginaceae</b>										
<i>Boerhavia diffusa</i>		H	N	-	0	1	0	0	0	1
<b>Nymphaeaceae</b>										
<i>Nymphaea pubescens</i>	Olu	H	N	-	0	0	0	1	0	0
<b>Pedaliaceae</b>										
<i>Pedaliium murex</i>	Ath-nerenchi	H	N	-	0	1	0	0	0	1
<b>Poaceae</b>										
<i>Cynodon dactylon</i>		H	N	-	1	1	0	0	1	1
<i>Panicum repens</i>	Atora	H	N	-	0	0	1	1	1	1
<i>Spinifex littoreus</i>	Maha-rawana-reula	C	N	-	0	1	0	0	0	0

Species Name	Common Name	HA	TS	CS	HG	SD	SB	RL	RP	RS
<b>Rubiaceae</b>										
<i>Canthium coromandelicum</i>	Kara	T	N	-	0	0	0	0	1	0
<i>Catunaregam spinosa</i>	Kukuruman	T	N	-	0	0	0	0	0	1
<i>Hydrophylax maritima</i>		C	N	-	0	1	0	0	0	0
<i>Morinda coreia</i>	Ahu	T	N	-	0	0	0	0	0	1
<i>Spermacoce hispida</i>		C	N	-	0	1	0	0	0	0
<b>Rutaceae</b>										
<i>Limonia acidissima</i>	Divul	T	N	-	0	0	0	0	1	0
<b>Salvadoraceae</b>										
<i>Azima tetraantha</i>	Ballan-katu	S	N	-	0	0	0	0	0	1
<i>Salvadora persica</i>	Malithan	T	N	-	0	0	0	0	0	1
<b>Salviniaceae</b>										
<i>Salvinia molesta</i>	Salvinia	H	I	-	0	0	0	1	0	0
<b>Sapotaceae</b>										
<i>Manilkara hexandra</i>	Palu	T	N	-	1	0	0	0	0	1
<b>Solanaceae</b>										
<i>Datura metel</i>	Kalu-attana	S	N	-	0	0	0	0	1	1
<i>Physalis micrantha</i>	Heen-mottu	H	N	-	0	0	0	0	1	1
<i>Solanum trilobatum</i>	Wel tibbatu	C	N	-	0	0	0	0	1	1
<b>Sterculiaceae</b>										
<i>Melochia corchorifolia</i>	Gal-kura	H	N	-	0	0	0	0	0	1
<b>Tiliaceae</b>										
<i>Berrya cordifolia</i>	Halmilla	T	N	-	0	0	0	0	1	0
<i>Grewia orientalis</i>		S	N	-	0	0	0	0	0	1
<b>Typhaceae</b>										
<i>Thypha angustifolia</i>	Hambu-pan	H	N	-	0	0	0	1	0	0
<b>Verbenaceae</b>										
<i>Clerodendrum inerme</i>		S	N	-	0	0	0	0	1	1
<i>Gmelina asiatica</i>	Demata	T	N	-	0	0	0	0	0	1
<i>Lantana camara</i>	Ganda-pana	S	I	-	0	0	0	0	0	1

**Table 2** – List of floral species recorded from the project site

## Annex 2 – Part 2

### Habitats and list of faunal species recorded at the Arugam Bay project site

**Habitats:** The project area could be divided into four main habitat types; lagoon, riparian areas (where streams emptied onto the lagoon and where there was a mix of trees and grasslands indicating that freshwater conditions were present), sand dunes and sand bar across the mouth of the lagoon (See diagrams 1 and 2) In addition, a large number of seasonal ponds where water is stagnated were also present in the proposed project area. The man made habitats were home and hotel gardens.

**Terrestrial and aquatic fauna** - A total of fifty four (54) animal species recorded in the project area. These include four (4) species of butterflies, five (5) species of fish, three (3) species of reptiles, thirty four (34) species of birds and eight (8) species of mammals. However there can be some more butterflies, other invertebrates, amphibians, reptiles, fish, birds, mammals other than those listed in this report. No threatened or endemic species were recorded in the project area during this visit.

List of terrestrial and aquatic faunal species

SS: Species status

CS: Conservation status

LG- Lagoon

EX- Exotic

TR- Threatened

RA- Repering area

EN- Endemic

HG- Home Gardens

MI- Migrant

SDB- Sand dune and sand bar

IUCN Sri Lanka 2000

Family and Scientific Name	Common Name	SS	CS	Habitat Types			
				HG	SD&SB	LG	RA
<b>BUTTERFLIES</b> Order: Lepidoptera							
<b>Family: Papilionidae</b>							
<i>Papilio polytes</i>	Common Mormon			+			+
<b>Family: Pieridae</b>							
<i>Eurema hecabe</i>	Common Grass Yellow			+	+		+
<b>Family: Danaidae</b>							
<i>Euploea core</i>	Common Crow			+	+		+
<b>Family: Acraeidae</b>							
<i>Acraea violae</i>	Tawny Coster			+			+
<b>FISH</b> Class: Osteichthyes	<b>Bony fishes</b>						
<b>Family: Cichlidae</b>							
<i>Oreochromis mossambicus</i>	Tilapia	EX				+	
<b>Family: Anabantidae</b>							
<i>Anabas testudineus</i>	Climbing Perch					+	
<b>Family: Channidae</b>							
<i>Channa striata</i>	Murrel					+	
<b>Family: Cichliday</b>							
<i>Etroplus suratensis</i>	Karoliya					+	
Family: Gobidae						+	
<i>Glossogobius giuris</i>	Weligowwa					+	

Family and Scientific Name	Common Name	SS	CS	Habitat Types			
				HG	SD&SB	LG	RA
<b>REPTILES</b> Class: Reptilia	<b>Reptiles</b>						
<b>Family: Agamidae</b>							
<i>Calotes calotes</i>	Green garden lizard			+			
<b>Family: Varanidae</b>							
<i>Varanus salvator</i>	Water monitor					+	+
<b>Family-Gekkonidae</b>							
<i>Hemidactylus frenatus</i>	Common house gecko			+			
<b>BIRDS</b> Class: Aves							
<b>Family: Phalacrocoracidae</b>							
<i>Phalacrocorax niger</i>	Little cormorant					+	+
<i>Phalacrocorax carbo</i>	Great cormorant					+	+
<i>Phalacrocorax fuscicollis</i>	Indian Cormorant					+	
<b>Family: Ardeidae</b>							
<i>Casmerodius albus</i>	Great egret				+	+	+
<i>Mesophoyx intermedia</i>	Intermediate egret					+	+
<i>Egretta grazetta</i>	Little egret				+		+
<i>Ardea cinerea</i>	Grey heron					+	
<i>Bubulcus ibis</i>	Cattle egret			+	+	+	+
<i>Ardeola grayii</i>	Pond heron					+	+
<b>Family: Accipitridae</b>							
<i>Haliaeetus leucogaster</i>	White bellied sea Eagle					+	+
<i>Haliastur Indus</i>	Brahminy kite						+
<b>Family: Laridae</b>							
<i>Chlidonias hybridus</i>	Whiskered Tern					+	+
<b>Family: Rallidae</b>							
<i>Amaurornis phoenicurus</i>	White-breasted water hen			+		+	+
<b>Family: Charadriidae</b>							
<i>Himantopus himantopus</i>	Black-winged Stilt					+	
<i>Vanellus indicus</i>	Red wattled lapwing					+	+
<b>Family: Scolopacidae</b>							
<i>Actitis hypoleucos</i>	Common Sandpiper				+	+	
<b>Family: Columbidae</b>							
<i>Streptopelia chinensis</i>	Spotted dove			+		+	+
<i>Columba livia</i>	Domestic pigeon			+	+	+	+
<b>Family: Psittacidae</b>							
<i>Psittacula krameri</i>	Rose-ring parakeet			+			+
<b>Family: Halcyonidae</b>							
<i>Halcyon smyrnensis</i>	White breasted kingfisher			+	+	+	+
<b>Family: Cerylidae</b>							

Family and Scientific Name	Common Name	SS	CS	Habitat Types			
				HG	SD&SB	LG	RA
<i>Ceryle rudis</i>	Pied Kingfisher					+	+
<b>Family: Alcedinidae</b>							
<i>Alcedo atthis</i>	Common Kingfisher			+		+	+
<b>Family: Meropidae</b>							
<i>Merops philippinus</i>	Blue tail bee eater			+	+		+
<b>Family: Dendrocygnidae</b>							
<i>Dendrocygna javanica</i>	Lesser whistling duck					+	
<b>Family: Bucerotidae</b>							
<i>Ocyeros gingalensis</i>	Sri Lanka gray hornbill				+		
<b>Family: Coraciidae</b>							
<i>Coracias benghalensis</i>	Indian roller			+	+	+	+
<b>Family: Timaliidae</b>							
<i>Turdoides affinis</i>	Common babbler			+		+	+
<b>Family: Apodidae</b>							
<i>Apus affinis</i>	House swift						
<b>Family: Burhinidae</b>							
<i>Burhinus oedicephalus</i>	Great thick knee				+	+	
<b>Family: Jacnidae</b>							
<i>Hydrophasianus chirurgus</i>	Pheasant tailed jacana					+	
<b>Family: Charadriidae</b>							
<i>Himantopus himantopus</i>	Black winged stilt					+	
<b>Family: Corvidae</b>							
<i>Corvus splendens</i>	House crow			+	+	+	+
<b>Family: Sturnidae</b>							
<i>Acridotheres tristis</i>	Common myna				+	+	+
<b>Family: Passeridae</b>							
<i>Passer domesticus</i>	House sparrow			+		+	
<b>MAMMALS</b>							
<b>Class: Mammalia</b>							
<b>Family- Bovidae</b>							
<i>Bos indicus</i>	Domestic cow	D		+			+
<i>Bubalus bubalis</i>	Domestic water buffalo	EX				+	
<b>Family- Canidae</b>							
<i>Canis familiaris</i>	Domestic dog	D		+			+
<i>Felis catus</i>	Domestic cat	D			+		+
<b>Family- Sciuridae</b>							
<i>Funambulus palmarum</i>	Palm squirrel			+		+	+
<b>Family- Pteropodidae</b>							
<i>Pteropus giganteus</i>	Flying fox					+	+
<i>Rousettus leschenaultii</i>	Dog faced fruit bat			+		+	+
<i>Cynopterus sphinx</i>	Short nosed fruit bat			+		+	+

**Table 3** – List of faunal species recorded from the project site

### **Annex 3: Terms of Reference for the Study of Turtle Nesting Areas along Arugam Bay Beach**

The Sri Lanka Tsunami Reconstruction Program (SLTRP) will start the reconstruction of the tsunami damaged Arugam Bay Bridge towards latter part of this year. USAID (the funding agency) has appointed CH2MHill as the main contractor of this project. The EA conducted by the CH2MHill identified the Arugam Bay beach as an area used by sea turtles for nesting. The sea turtles have been identified as an endangered specie(s) by international conservation agencies. CH2MHill wish to ensure that habitats/nesting areas of this particular species not encroached/debilitated and also their nesting is not disrupted by construction activities. The purpose of this study is therefore (a) to identify turtle nesting areas along the Arugam Bay beach, (b) species of sea turtles nest in the area and their classification status in the threatened/endangered grouping, (c) nesting period, and (d) to explain the safeguards that contractor should take not damage the nesting areas and not to disrupt nesting.

#### **A Scope of Work and Outputs**

1. Consultants shall review this ToR and proposed methodology and submit to CH2MHill the consultant's views on the ToR/Methodology with suggestions for changes, if any.
2. Consultants shall provide the client a map of the coastal zone of Arugam Bay (Attachment I) and herein after defined as the "Project Area" clearly demarcating the areas of turtle nesting.
3. Consultants shall provide the client a report giving the details of (a) species of sea turtles and their status in the endangered/threatened species list, (b) nesting period (c) list of activities that can harm the nesting areas and disrupt nesting; and (d) safeguards that should be taken by construction contractors to prevent: damage to nesting areas and disruption to nesting. The report shall include a list of literature referred in this study.
4. A list of names of experts, members of relevant government/non government institutions, community members interviewed as part of this study.
5. All outputs shall be submitted to CH2MHill no later than March 10, 2006.

#### **B Methodology**

1. Consultants shall carry out a walk through survey of the entire project area including night survey and identify areas of nesting based on sightings of turtles, community inputs.
2. Areas of nesting should be identified using GPS instruments and marked in maps.
3. Literature review
4. Obtain expert opinion through consultations
5. Consultations with community, NGOs working in the conservation, other relevant institutions such as CCD, NARA, Universities, the Arugam Bay Task Force, WLCD, etc.

#### **C Level of Effort**

1. Two field ecologists familiar with turtle studies or coastal zone habitat mapping and use of GPS instruments
2. Senior ecologist with experience in coastal zone habitats ecology for providing guidance to field ecologists and report writing

## **Annex 4: Report of the sea turtle nesting habitats in the Arugam Bay bridge project area**

**Introduction:** A two week survey was carried out to fulfill the Terms of Reference (see Annex 3) provided to the consultants, Environmental Management Ltd. The overall goal was to investigate the presence/absence of marine turtles and their nesting sites in the proposed project area.

**Methodology:** The period of the survey was from 18<sup>th</sup> February 2006, to 1st March 2006. Night transects were carried out along an eight (8) km stretch of the coastline which constituted the Arugam Bay proposed project area. The proposed project area was divided into five sub sections labeled as A,B,C, D, and E (see map below) which can be located using the GPS readings provided in the table following the map.

Five major areas were identified in the proposed project area according to human activities and land features (See map below).

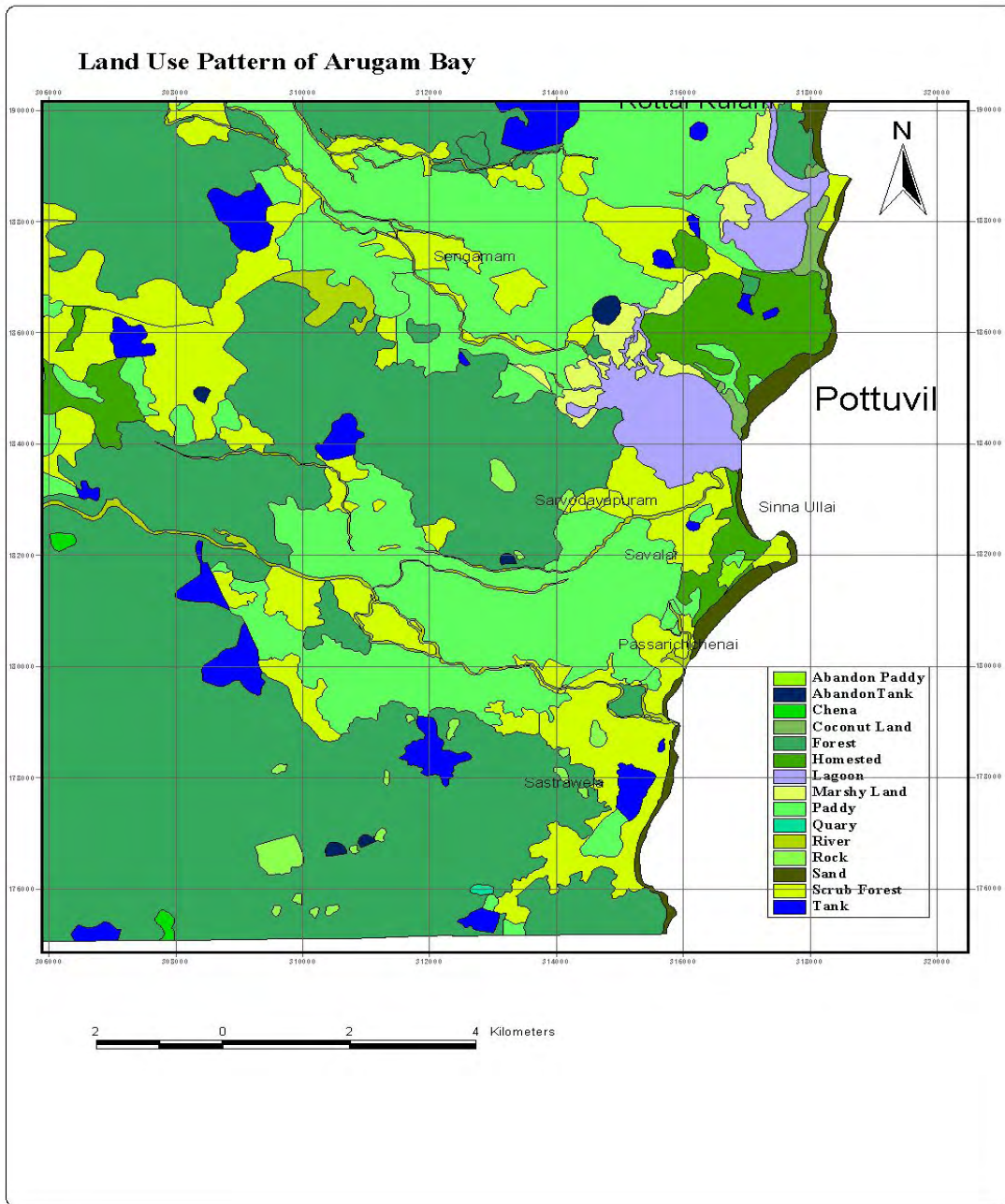
- A. Starting point close to *Magul Maha Viharaya* up to lagoon
- B. Starting point north Lagoon mouth
- C. Starting point from lagoon up to sand dune vegetation
- D. Starting point sand dune vegetation up to Crocodile Rock
- E. Crocodile rock up to *Sastrawela*

Five night transect ( a walk at a measured pace along the beach and observing the area on either side of the walk) survey were carried out from 9 pm to 1.30 am (five nights, one each for each sub section), and another five night transect survey was carried out from 2 am to 6.30 am. (five nights, for each sub section). Thus there was a total of ten transects for the whole area with two per each sub section. On each night transect, the following were searched: presence of sea turtles or their typical tracks, egg laying pits, clutches of hatchlings; In addition information was collected from the community living in the surrounding area including hoteliers, former turtle hatchery owners, turtle egg collectors, divers, people who come to surf, soldiers and Special Task Force officers, police officers all resident in the area,. Nesting sea turtle species were identified through both live and dead specimens, features of hatchlings, sizes of the egg and their tracks. In addition some photograph that belonged to the former hatchery owner and the hoteliers were examined to identify the species.

**Results:** It was clear that there were two distinct nesting seasons per year for marine turtles in the project area. They were:

- **July to August-** Small number of turtles come to the Arugam Bay area during this season,
- ❖ **November, December, January and up to mid February-** A large number of turtles visit the beaches during this season which coincides with the north-east monsoon. It was estimated from the information provided by the section of the community that is closely associated with the beach areas ( S.T.F officers and soldiers, police officers, fishermen, hoteliers, former hatchery owners, egg collectors, divers and surfers) during this season eight (8) to ten (10) turtles come to the beach per day. As our observations were carried out during the end of the nesting season (mid February) there were only a few sea turtles, hatchlings, tracks and eggs pits.





**Map** of turtle nesting areas on the Arugam Bay beach area

Section	Length (meters)	GPS points	
		From	To
A	2250	N 06 52 06.1 E 081 50 36.8	N 06 51 06.6 E 081 49 57.3
B	54	N 06 51 06.6 E 081 49 57.3	N 06 51 05.1 E 081 49 56.5
C	1820	N 06 51 05.1 E 081 49 56.5	N 06 50 14.3 E 081 50 24.3
D	2750	N 06 50 14.3 E 081 50 24.3	N 06 49 07.7 E 081 49 29.9
E	955	N 06 49 07.7 E 081 49 29.9	N 06 48 44.0 E 081 49 22.5

**Table** showing the GPS locations of the surveyed area

**Species of sea turtle nesting in the project area:** Three species of marine turtles come to Arugam Bay project area for laying their eggs. They are *Chelonia mydas*, (Green turtle), *Caretta caretta* (Logger head turtle) and *Dermochelys coriacea* (Leatherback Turtle). Of these the most common species observed in this area is the Green turtle. The Leatherback Turtle is a rare species using this area.

**Major areas identified in the proposed project area:** The results of this survey based on tracks of sea turtles, live and dead specimens, egg pits, hatchlings and information collected from the community, clearly indicate that sub sections A & E of the costal area are the most commonly used areas for nesting by turtles. Parts of sections C & D are also ideal habitats for the nesting. In the other parts of sections C and D where human activity is very high such as boat landing points and where there are sand barriers and dead coral formations, turtles do not visit them except perhaps very rarely. Sub section B being the opening of the lagoon is not a turtle nesting area.



Flat beaches in sections A & E – ideal turtle nesting habitats



Beaches with sand barriers that are not nested by turtles in the project area



Beaches with high human activity

It was found during discussions with members of the community that there is considerable amount of collection of turtle eggs no sooner than they are laid and selling it to consumers. It was stated that this thrives on the fact that there is a good demand for turtle eggs from among tourists who visit Arugam Bay. This surprising statement needs to be verified further as it is usually locals who consume turtle eggs and not overseas visitors. The number of turtles killed purposefully is low, but it is still found to be carried out by some persons. There is some degree of law enforcement by the police officers residing in the area but that is inadequate.

**Conclusion:** The beach sections of the proposed project area are important for marine turtles as a nesting habitat during two seasons of the year. The beach area extending south of the proposed project area is recorded as having higher numbers of turtle nesting sites than inside the project area (pers. com). Marine turtles are internationally threatened species and are targets of conservation efforts the world over. Therefore this project too should avoid carrying out any activity that will endanger the survival and nesting habitats of turtles.

## Recommendations

In terms of threats to the turtle nesting grounds in Arugam Bay beaches, arising as a direct result of the project are:

- A. Loss of turtle nesting grounds, disturbance to egg pits and hatchlings due to beach landing of construction equipment and bridge sections
- B. Possible increase in the consumption of turtle meat and eggs by the construction workforce

As mentioned earlier, marine turtles are an internationally threatened species and are subjects of conservation in the world over. Arugam Bay beach having been identified as a sensitive area for turtle nesting, the project should take every step to ensure that no significant harm is inflicted upon the arrival of turtles to these beaches and their nesting grounds. In order to achieve this objective, the following specific guidelines are recommended for adherence by the contractor.

### A. Siting of the jetty and beach operations

In terms of identifying a suitable area on the Arugam Bay beach for beach landing of construction equipment and bridge sections the most crucial issue are (a) the location of the jetty/landing point (b) operations on the beach.

In making the recommendation for the most suitable area for beach landing a comparison is made of the different sections surveyed in the project area in the following table (refer to map in previous page).

Description	A	B	C	D	E	Section north of A
Boat landing/fishing activity	x	√	√	√	x	√
Beach seine	x	x	√	√		√
Hotels	x	x	√	x	x	x
Sand barriers	x	x	x	√		x
Turtle nesting	√	x	Partly	Partly	√	x
Other human activities	x	x	x	x	x	√

As indicated by the table,

1. Sections A & E are the least disturbed sites and hence provide ideal habitats for turtle nesting. These sections should be avoided completely for any beach operation.
2. Section B is the sand bar and hence is not suitable as a landing site.
3. Sections C & D are currently having areas that are not nested by turtles due to disturbance by human activity or natural barriers. These sections should be considered with priority for locating the beach-landing site. Similarly, areas north of section A are also suitable as turtle arrival does not take place due to human presence. The contractor shall ensure that locating a beach landing site in an area already used by humans will not give rise to any new social tensions over beach use.
4. In the event, current beach users feel threatened by the presence of a beach landing site in their area of activity, the contractor shall consider the bordering turtle nesting areas within C & D. In such a case, the contractor in charge of operations shall adopt mitigatory measures as listed below, in order to minimize any threat to the turtles.

- i. Avoid construction during peak nesting seasons (July-August and November- February) if at all possible.
- ii. If the whole nesting period cannot be avoided, activities should be restricted to the day time.
- iii. Use of powerful lights on the beach and adjacent coastal sections in the night should be avoided or minimized with the lights directed towards the land. Directing the lights towards the sea will disorient the arriving turtles and the hatchlings going to sea
- iv. Use of machinery in the night or any activity that generates artificial noise should be avoided at night.
- v. The landing area will be fenced off from the adjacent turtle nesting areas so that human activity will be restricted to the site.

### **Other general recommendations for turtle nesting areas**

- Contractor shall ensure that collection of sand from the beach, movement of vehicles and humans over nesting areas that will disturb nesting sites and egg pits will be avoided completely.
- Contractor shall ensure that the beach is not used as a storage yard for construction material.

Contractor shall ensure that solid wastes and other forms of pollution by construction activities and workforce shall not take place on the beach used by turtles.

- Contractor shall not construct any barriers along the beach during the construction as such barriers will be hindrances to the arrival and movement of turtles along the beach

### **B. Consumption of turtle meat and turtle eggs**

At present deliberate killing of turtles is very low in this area (Bandara pers. com). This could increase with more interest in turtle flesh consumption expected with the arrival of labor work force for constructions. There will be greater demand for turtle eggs and with increase of price there will be greater pressure to collect eggs. At present there is considerable demand for eggs mainly due to the demand from overseas tourists. Contractor shall ensure that no poaching on turtles and turtle eggs will take place by the construction workers during their period of stay in the area. They will be instructed accordingly and made aware of the legal consequences of such actions.

### **C. Turtle Conservation Program**

It is also recommended that a longer-term intervention on conserving and protecting the marine turtles in Arugam Bay from its present threats be made by the project through a comprehensive turtle conservation program that can move forward independently beyond the lifetime of the project. This would be an ideal opportunity to make a positive change and could be accommodated in the SLTRP's Participatory Coastal Management component.

The program should raise awareness of the local community, increase law enforcement and establish institutions and processes for turtle conservation in this area.

The meaningful involvement of the main government stakeholders such as the Department of Wildlife Conservation, The Coast Conservation Department, National Aquatic Resources Agency, the local authorities and the law enforcement agencies is crucial. The local community and the tourist interests of the area should play key roles. The support of Sri Lankan and overseas corporate sponsors of wind surfing and other related activities should be obtained. Such a program should not be one that will start and stop with the bridge building operations. It should be made an independent program that will sustain itself beyond the lifetime of the project. There is ample experience of turtle conservation efforts in other

parts of the country, which could be made use of and studied for the purpose of designing a suitable turtle conservation program in Arugam Bay.

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## Annex 5: List of people met during the stakeholder consultations

### Part A - Technical consultations held by the socio-economist of the EA team

Name of the Organization	People consulted
Pottuvil/Arugam Bay Traders Association	Chairman and about 20 members of Association
Arugam Bay Hoteliers' Association	Mr. M.H.A. Raheem, Chairman, Mr. A.R.M.Mohideen Members
Khadiiriya Fishery Association Federation	Mr. Adam Bawa Meera Mohideen, Chairman Members of Federation
Teachers of Al Vidyalaya, Sinna Ullai.	Mr. Majeed, English Teacher Other teachers and students
VIP Community Organization (Citizen's Committee)	Mr. Aboobucker Mowlana, Chairman, Other members
Religious Leaders	Priest Sivasiri Sivanesaiyer, Pillayar Kovil Moulavi Adam Bawa, President, Jamayathul Ulema, Pottuvil I.Hassen, Secretary, Jumma Mosque Mr. H Aziz Moulavi – Secretary Jumma Mosque
Staff , Pradeshiya Sabha, Pottuvil	Mr. Zackariya, Previous Chairman, PS Mr. Jeganathan, Secretary, PS, Pottuvil Mr. Saffaideen, CC
Staff, Divisional Secretariat, Pottuvil.	Mr. M.M. Naufer, Divisional Secretary Mr. Asmy, Asst. DS Mr. I. Hassen, CC Planning Division Mr. N.M.Joufer, HRD Assistant, Mr. Jalaldeen, Rural Development Officer Mr. K.Azeez Moulavi, Program Assistant, (Land Adm.) Mr. M.A.Alimudeen, Program Assistant, Rural Development Division Mr. M.L.Abulhassan , Grama Niladhari, Pasarichenai - P 19 Mr. A.L.A. Razaak, Grama Niladhari, Sarvodyapuram – P 05 Mr. M.A. Azeez , Grama Niladhari, Sinna Ullai - P 18.
<b>Others</b> Development Assistant, Relief Rehabilitation and Reconciliation Dept. Environmental Officer RDS Contractor	A.R.M.Ashroff,  A.S.Rafee M.A.Abdul Latif

**Part B** – Public consultations held by members of the SLTRP

<b>Name</b>	<b>Position/Organisation</b>
Mr. Naufeer	Divisional Secretary, Pottuvil
Mr. Asmir	Assistant Divisional Secretary, Pottuvil
Mr. Hassan	Ex-Vice Chairman Pottuvil, and President of Deep Sea Fishermen's Cooperative
Mr. Jaganathan	Secretary
Mr. M.B.A. Raheem	Technical Officer, Local Authority
Mr. Shaafir	Community Officer, L.A
Mr. S A Q Maulana	Retired English teacher (and previously JICA Project officer)
Mr. Mohideen	Technical Officer, RDA
Mr. A S M Rafee	Divisional Environment Officer
Dr. H M M Issadeen	District Medical Officer
Dr. M M Sameer	Medical Officer of Health
Mr. Calanthis	Postmaster
Mrs. Hameem, English	Teacher, Central College, Pottuvil
Mrs. Carder	School, English Teacher, Teacher, Girls School Pottuvil
Mrs. Nadeera Ismail	Wise Parlour", Pottuvil
Rev. Chandraratne	Chief priest, Panama Temple
Mr. Chandrasena	Chairperson of the Lahugala LA and resident of Panama
Mr. R. Amarasinghe	Principal, Panama school



**Annex 6: List of Preparers**

<b>Name</b>	<b>Position</b>	<b>Responsibility</b>
Ms. Nadeera Rajapakse	Overall coordinator	Co-ordination, compilation, editing and final presentation of report
Dr. Nirmalie Pallewatte	Ecologist	Compilation of the ecological resources in the project area; discussion on ecological impacts
Dr. S.M.F. Marikar	Socio Economist	Compilation of the socio-economic environment; discussion on socio-economic impacts
Mr. S. Vithiyashankar	Civil Engineer/Project Coordinator	Compilation of the physical environment
Mr. Nalinda Pieris	Field Assistant – Flora	Compilation of floral species list
Mr. Bandara	Field Assistant - Fauna	Compilation of faunal species list
Dr.Vasantha Siriwardhena	Environmental Engineer	Review of the final report
Mr. Josh Moga	Environmental Management Specialist	Review of the final report
Ms. Amy Bodmann	Coastal Resources Management Specialist	Review of the final report

## **Annex 7: Conditions Applicable to the Project Implementation by State Agencies and USAID**

During the early periods of industrial development in Sri Lanka as elsewhere, environmental issues did not receive much attention. The times have changed and there is much awareness and concern. Central and provincial level institutions have come up to engage in handling environmental management issues in the country.

*The following are some statutes of importance*

- **Marine Pollution Prevention Act no 59. of 1981**

This Act provides for the prevention, reduction and control of pollution in Sri Lankan waters and to give effect to international conventions for the prevention of pollution of the sea. The discharge of oil and other pollutants into Sri Lankan waters has been made a criminal offence and the scope of the sections is wide enough to cover all possible sources that can cause marine pollution regardless of the locality. An offender can be fined up to one million rupees. This statute makes such acts civil offence and makes provision for claiming damages for harm caused by such acts and for the recovery of expenses borne by the authorities to control, reduce or remove such harm. The Act not only includes the sea, but also any activities associated with it such as fisheries, wildlife, and tourism, health and the well being of the coastal population. The Act also lays down that no one is allowed to dump oil or pollutants in Sri Lankan waters except under a permit from the Marine Pollution Prevention Authority and that any violation should also be immediately notified.

- **Sri Lanka Ports Authority Act No 51 of 1979**

Under section 55(9) of this act, any person who pollutes the water of the harbor by overflow or discharge of oil or any other impurity within the limits of any specified port or the limits of any specified port or the approaches to a port shall be guilty of an offence and shall be liable to a fine not exceeding 2,500 rupees or to an imprisonment up to an year or to both punishments.

- **Coast Conservation Act No. 57 of 1981**

Coastal management in Sri Lanka was first mandated by the Coast Conservation Act of 1981, which gave the CCD (Coast Conservation Department) primary responsibilities for;

- Policy formulation, planning and research
- Administration of permit procedure regulation, coastal development activities
- Construction and maintenance of shoreline protection works

However, even after the establishment of the CEA (Central Environmental Authority) in 1987, the CCD still acts separately under a different ministry and is responsible for coastal zone management activities.

- **National Environmental Act no 47 of 1980 and 56 of 1988**

This is the main enactment that was formulated to protect the national environment and to manage it in order to maintain environmental quality and to prevent pollution. It also paved the way for the establishment of the Central Environmental Authority (CEA).

The duties and functions of the CEA are spelt out under section 10. Section 10(9) states that one of the functions of the CEA is to regulate maintain and control the volume, types, constituents, and effects of waste, discharges, emissions, deposits or other sources or sub

sources of pollution, which are a danger or potential danger to the quality of the environment or any segment of the environment.

It defines a pollutant as any substance whether liquid, solid or gaseous emission, which directly or indirectly

- a) affects the quality of any segment or element of the receiving environment so as to affect any beneficial use adversely, or
- b) Is hazardous or potentially hazardous to health.

Section 23(g) states that, subject to section 23(a) no person shall deposit or emit waste into the inland waters of Sri Lanka except under standards or criteria set out under section 23a.

- **Public Nuisance Law**

The nuisance (both public and private) law relating to public nuisances is contained in Section 261 of the Penal Code and section 98 of the Code of Criminal Procedure Act, No 15 of 1979. Section 270 of the Penal Code relates to the fouling of the water of any public spring or reservoir (*the frequent disposal point for much of garbage today*) and section 271 to making the atmosphere noxious to health (*the effect of rotting garbage exposed to elements*). Sections 56 and 58 of the Police Ordinance, No 16 of 1865 authorizes Police Officers to abate/prevent public nuisances and make it their duty to do so. Owning or operating a rubbish dump, cess pit or other collection of filth that affects the health or habitability of a locality are activities that amount to environmentally damaging public nuisances.

Today individual groups have, under this procedure, taken many industries to courts. The closing down of the sulphuric acid factory at Ranala was under this law though the CEA's stipulated conditions had not being violated by the industry at the time of closure according to the documents submitted to the courts.

- **List of Environmental Legislation (both having indirect and direct impact)**

- Coast Conservation Act No. 57 of 1981 amended by Act No 64 of 1988
- Marine Pollution Prevention Act
- Fauna and Flora Protection Ordinance No 2 of 1987
- Soil Conservation Act No 25 of 1951
- Forest Ordinance No 16 of 1907 as amended by Act No 23 of 1995
- Fisheries and Aquatic Resources Act No 2 of 1996
- National Water Supply and Drainage Board Law of No 2 of 1974 amended by Act No 13 of 1992
- Nuisance Ordinance No. 15 of 1862 as amended by Act No 57 of 1946
- The regulations on ionizing radiation protection, Atomic Energy Authority Act No. 19 of 1969
- Urban Development Authority Law No 41 of 1978
- Colombo District (Low lying areas) Reclamation and Development Board Act No 15 of 1968 amended by Act No 52 of 1982
- Mahaweli Authority of Sri Lanka Act No 23 of 1979
- Irrigation Ordinance No 32 of 1946, amended by No 48 of 1968 and by No 13 of 1994
- Flood Protection Ordinance No 4 of 1924
- Natural Resources, Energy and Science Authority of Sri Lanka Act No. 78 of 1981
- State Land Ordinance No 8 of 1947

- Agrarian Services Act No 58 of 1979 amended by Act No. 4 of 1991
- Land Development Ordinance of 1935
- Mines and Minerals Act No 33 of 1980
- Municipal Councils Ordinance No 29 of 1947 amended by Act no 61 of 1981

Two Regulations have been gazetted under the NEA

1. The National Environmental (Protection and Quality) Regulations No. 1 of 1990 as amended by gazette  
Part 1: Environmental Protection Licensing (EPL) scheme  
Part 2: Hazardous Waste Management and Disposal
2. The National Environmental (Procedure for approval of projects) Regulations No. 1 of 1993  
Environmental Impact Assessment Procedure

### **Administrative framework**

The following table indicates the present institutional framework for the protection and management of the environment present.

<b>Ministries with the following subject areas</b>	<b>Government agencies and departments</b>
Forestry and Environment	Central Environmental Authority
Agriculture	Provincial Environmental Authorities
Lands	Board of Investment
Fisheries / Aquatic Resources	National Building Research Organisation
Irrigation / Power	Industrial Technology Institute
Housing / Urban Development	National Water Supply and Drainage Board

### **Environmental Compliance Laws of USAID**

*Foreign Assistance Act, Part I, Section 117 - Environment and Natural Resources*  
*This section provides overall environmental authority and requires environmental impact assessment procedures*

#### **Sec. 117 Environment and Natural Resources.**

(a) The Congress finds that if current trends in the degradation of natural resources in developing countries continue, they will severely undermine the best efforts to meet basic human needs, to achieve sustained economic growth, and to prevent international tension and conflict. The Congress also finds that the world faces enormous, urgent, and complex problems, with respect to natural resources, which require new forms of cooperation between the United States and developing countries to prevent such problems from becoming unmanageable. It is, therefore, in the economic and security interests of the United States to provide leadership both in thoroughly reassessing policies relating to natural resources and the environment, and in cooperating extensively with developing countries in order to achieve environmentally sound development.

(a) The President is authorized to furnish assistance under this part for developing and strengthening the capacity of less developed countries to protect and manage their environment and natural resources. Special efforts shall be made to maintain and where possible restore the land, vegetation, water, wildlife and other resources upon which depend economic growth and human well-being especially that of the poor. ``

(b) In carrying out programs under this chapter, the President shall take into consideration the environmental consequence of development actions." See also sec. 534 of the Foreign Operations, Export Financing, and Related Programs Appropriations Act, 1990 (Public Law 101-167; 103 Stat. 1228), as amended, relating to "Global Warming Initiative". See also sec. 533 of the Foreign Operations, Export Financing, and Related Programs Appropriations Act, 1991 (Public Law 101-513; 104 Stat. 2013), as amended, relating to "Environment and Global Warming". See also sec. 532 of the Foreign Operations, Export Financing, and Related Programs Appropriations Act, 1993 (Public Law 102-391; 106 Stat. 1666), relating to "Environment".

(b) In order to address the serious problems described in subsection (a), the President is authorized to furnish assistance under this part for developing and strengthening the capacity of developing countries to protect and manage their environment and natural resources. Special efforts shall be made to maintain and where possible to restore the land, vegetation, water, wildlife, and other resources upon which depend economic growth and human well-being, especially of the poor.

(c)(1) The President, in implementing programs and projects under this chapter and chapter 10 of this part, shall take fully into account the impact of such programs and projects upon the environment and natural resources of developing countries. Subject to such procedures as the President considers appropriate, the President shall require all agencies and officials responsible for programs or projects under this chapter-

Sec. 562 of the Foreign Operations, Export Financing, and Related Programs Appropriations Act, 1991 (Public Law 101-513; 104 Stat. 2026), added a new chapter 10 to part I of this Act, providing for long-term development in sub-Saharan Africa, and made a conforming amendment by inserting "and chapter 10 of this part" here.

(A) to prepare and take fully into account an environmental impact statement for any program or project under this chapter significantly affecting the environment of the global commons outside the jurisdiction of any country, the environment of the United States, or other aspects of the environment which the President may specify; and

(B) to prepare and take fully into account an environmental assessment of any proposed program or project under this chapter significantly affecting the environment of any foreign country. Such agencies and officials should, where appropriate, use local technical resources in preparing environmental impact statements and environmental assessments pursuant to this subsection.

(2) The President may establish exceptions from the requirements of this subsection for emergency conditions and for cases in which compliance with those requirements would be seriously detrimental to the foreign policy interests of the United States.

- **Foreign Assistance Act, Part I, Section 118 - Tropical Forests**

This Section provides authority and direction for USAID in working to conserve and manage tropical forests.

### **Sec. 118 Tropical Forests.**

(a) Importance of Forests and Tree Cover.--In enacting section 103(b)(3) of this Act the Congress recognized the importance of forests and tree cover to the developing countries. The Congress is particularly concerned about the continuing and accelerating alteration, destruction, and loss of tropical forests in developing countries, which pose a serious threat to development and the environment. Tropical forest destruction and loss--

(1) result in shortages of wood, especially wood for fuel; loss of biologically productive wetlands; siltation of lakes, reservoirs, and irrigation systems; floods; destruction of indigenous peoples; extinction of plant and animal species; reduced capacity for food production; and loss of genetic resources; and

(2) can result in desertification and destabilization of the earth's climate. Properly managed tropical forests provide a sustained flow of resources essential to the economic growth of developing countries, as well as genetic resources of value to developed and developing countries alike.

(b) **Priorities.**--The concerns expressed in subsection (a) and the recommendations of the United States Interagency Task Force on Tropical Forests shall be given high priority by the President--

(1) in formulating and carrying out programs and policies with respect to developing countries, including those relating to bilateral and multilateral assistance and those relating to private sector activities; and

(2) in seeking opportunities to coordinate public and private development and investment activities which affect forests in developing countries.

(c) **Assistance to Developing Countries.**--In providing assistance to developing countries, the President shall do the following:

(1) Place a high priority on conservation and sustainable management of tropical forests.

(2) To the fullest extent feasible, engage in dialogues and exchanges of information with recipient countries--

(A) which stress the importance of conserving and sustainably managing forest resources for the long-term economic benefit of those countries, as well as the irreversible losses associated with forest destruction, and

(B) which identify and focus on policies of those countries which directly or indirectly contribute to deforestation.

(3) To the fullest extent feasible, support projects and activities--

(A) which offer employment and income alternatives to those who otherwise would cause destruction and loss of forests, and

(B) which help developing countries identify and implement alternatives to colonizing forested areas.

(4) To the fullest extent feasible, support training programs, educational efforts, and the establishment or strengthening of institutions which increase the capacity of developing countries to formulate forest policies, engage in relevant land-use planning, and otherwise improve the management of their forests.

(5) To the fullest extent feasible, help end destructive slash-and-burn agriculture by supporting stable and productive farming practices in areas already cleared or degraded and on lands which inevitably will be settled, with special emphasis on demonstrating the feasibility of agroforestry and other techniques which use technologies and methods suited to the local environment and traditional agricultural techniques and feature close consultation with and involvement of local people.

(6) To the fullest extent feasible, help conserve forests which have not yet been degraded, by helping to increase production on lands already cleared or degraded through support of reforestation, fuelwood, and other sustainable forestry projects and practices, making sure that local people are involved at all stages of project design and implementation.

(7) To the fullest extent feasible, support projects and other activities to conserve forested watersheds and rehabilitate those which have been deforested, making sure that local people are involved at all stages of project design and implementation.

(8) To the fullest extent feasible, support training, research, and other actions which lead to sustainable and more environmentally sound practices for timber harvesting, removal, and processing, including reforestation, soil conservation, and other activities to rehabilitate degraded forest lands.

(9) To the fullest extent feasible, support research to expand knowledge of tropical forests and identify alternatives which will prevent forest destruction, loss, or degradation, including research in agroforestry, sustainable management of natural forests, small-scale farms and gardens, small-scale animal husbandry, wider application of adopted traditional practices, and suitable crops and crop combinations.

(10) To the fullest extent feasible, conserve biological diversity in forest areas by--

(A) supporting and cooperating with United States Government agencies, other donors (both bilateral and multilateral), and other appropriate governmental, intergovernmental, and nongovernmental organizations in efforts to identify, establish, and maintain a representative network of protected tropical forest ecosystems on a worldwide basis;

(B) whenever appropriate, making the establishment of protected areas a condition of support for activities involving forest clearance or degradation; and

(C) helping developing countries identify tropical forest ecosystems and species in need of protection and establish and maintain appropriate protected areas.

(11) To the fullest extent feasible, engage in efforts to increase the awareness of United States Government agencies and other donors, both bilateral and multilateral, of the immediate and long-term value of tropical forests.

(12) To the fullest extent feasible, utilize the resources and abilities of all relevant United States Government agencies.

(13) Require that any program or project under this chapter significantly affecting tropical forests (including projects involving the planting of exotic plant species)--

(A) be based upon careful analysis of the alternatives available to achieve the best sustainable use of the land, and

(B) take full account of the environmental impacts of the proposed activities on biological diversity, as provided for in the environmental procedures of the Agency for International Development.

(14) Deny assistance under this chapter for--

(A) the procurement or use of logging equipment, unless an environmental assessment indicates that all timber harvesting operations involved will be conducted in an environmentally sound manner which minimizes forest destruction and that the proposed activity will produce positive economic benefits and sustainable forest management systems; and

(B) actions which significantly degrade national parks or similar protected areas which contain tropical forests or introduce exotic plants or animals into such areas.

(15) Deny assistance under this chapter for the following activities unless an environmental assessment indicates that the proposed activity will contribute significantly and directly to improving the livelihood of the rural poor and will be conducted in an environmentally sound manner which supports sustainable development:

(A) Activities which would result in the conversion of forest lands to the rearing of livestock.

(B) The construction, upgrading, or maintenance of roads (including temporary haul roads for logging or other extractive industries) which pass through relatively undegraded forest lands.

(C) The colonization of forest lands.

(D) The construction of dams or other water control structures which flood relatively undegraded forest lands.

(d) PVOs and Other Nongovernmental Organizations.--Whenever feasible, the President shall accomplish the objectives of this section through projects managed by private and voluntary organizations or international, regional, or national nongovernmental organizations which are active in the region or country where the project is located.

(e) Country Analysis Requirements.--Each country development strategy statement or other country plan prepared by the Agency for International Development shall include an analysis of-

(1) the actions necessary in that country to achieve conservation and sustainable management of tropical forests, and



(2) the extent to which the actions proposed for support by the Agency meet the needs thus identified.

(f) Annual Report.--Each annual report required by section 634(a) of this Act shall include a report on the implementation of this section.

- **Foreign Assistance Act, Part I, Section 119 - Endangered Species**

This Section provides authority and direction for USAID in working to conserve and manage endangered species and biological diversity.

### **Sec. 119 Endangered Species**

(a) The Congress finds the survival of many animal and plant species is endangered by overhunting, by the presence of toxic chemicals in water, air and soil, and by the destruction of habitats. The Congress further finds that the extinction of animal and plant species is an irreparable loss with potentially serious environmental and economic consequences for developing and developed countries alike. Accordingly, the preservation of animal and plant species through the regulation of the hunting and trade in endangered species, through limitations on the pollution of natural ecosystems, and through the protection of wildlife habitats should be an important objective of the United States development assistance.

(b) \75\ In order to preserve biological diversity, the President is authorized to furnish assistance under this part, notwithstanding section 660,\76\ to assist countries in protecting and maintaining wildlife habitats and in developing sound wildlife management and plant conservation programs. Special efforts should be made to establish and maintain wildlife sanctuaries, reserves, and parks; to enact and enforce anti-poaching measures; and to identify, study, and catalog animal and plant species, especially in tropical environments.

(c) \77\ Funding Level.--For fiscal year 1987, not less than \$2,500,000 of the funds available to carry out this part (excluding funds made available to carry out section 104(c)(2), relating to the Child Survival Fund) shall be allocated for assistance pursuant to subsection (b) for activities which were not funded prior to fiscal year 1987. In addition, the Agency for International Development shall, to the fullest extent possible, continue and increase assistance pursuant to subsection (b) for activities for which assistance was provided in fiscal years prior to fiscal year 1987.

\77\ Pars. (c) through (h) were added by sec. 302 of Public Law 99- 529 (100 Stat. 3017).

(d) \77\ Country Analysis Requirements.--Each country development strategy statement or other country plan prepared by the Agency for International Development shall include an analysis of-

(1) the actions necessary in that country to conserve biological diversity, and

(2) the extent to which the actions proposed for support by the Agency meet the needs thus identified.

(e) \77\ Local Involvement.--To the fullest extent possible, projects supported under this section shall include close consultation with and involvement of local people at all stages of design and implementation.

(f) \77\ PVOs and Other Nongovernmental Organizations.-- Whenever feasible, the objectives of this section shall be accomplished through projects managed by appropriate

private and voluntary organizations, or international, regional, or national nongovernmental organizations, which are active in the region or country where the project is located.

(g) \77\ Actions by AID.--The Administrator of the Agency for International Development shall--(1) cooperate with appropriate international organizations, both governmental and nongovernmental;

(2) look to the World Conservation Strategy as an overall guide for actions to conserve biological diversity;

(3) engage in dialogues and exchanges of information with recipient countries which stress the importance of conserving biological diversity for the long-term economic benefit of those countries and which identify and focus on policies of those countries which directly or indirectly contribute to loss of biological diversity;

(4) support training and education efforts which improve the capacity of recipient countries to prevent loss of biological diversity;

(5) whenever possible, enter into long-term agreements in which the recipient country agrees to protect ecosystems or other wildlife habitats recommended for protection by relevant governmental or nongovernmental organizations or as a result of activities undertaken pursuant to paragraph

(6), and the United States agrees to provide, subject to obtaining the necessary appropriations, additional assistance necessary for the establishment and maintenance of such protected areas;

(6) support, as necessary and in cooperation with the appropriate governmental and nongovernmental organizations, efforts to identify and survey ecosystems in recipient countries worthy of protection;

(7) cooperate with and support the relevant efforts of other agencies of the United States Government, including the United States Fish and Wildlife Service, the National Park Service, the Forest Service, and the Peace Corps;

(8) review the Agency's environmental regulations and revise them as necessary to ensure that ongoing and proposed actions by the Agency do not inadvertently endanger wildlife species or their critical habitats, harm protected areas, or have other adverse impacts on biological diversity (and shall report to the Congress within a year after the date of enactment of this paragraph on the actions taken pursuant to this paragraph);

(9) ensure that environmental profiles sponsored by the Agency include information needed for conservation of biological diversity; and

(10) deny any direct or indirect assistance under this chapter for actions which significantly degrade national parks or similar protected areas or introduce exotic plants or animals into such areas.

(h) \77\ Annual Reports.--Each annual report required by section 634(a) of this Act shall include, in a separate volume, a report on the implementation of this section.