

## ANNEX II - ENVIRONMENT

### A. INTRODUCTION

1. Sri Lanka's coastal belt covering the districts of Jaffna, Mullaitivu, Trincomalee, Batticaloa, Amparai, Hambantota, Matara, Galle, Kalutara, Colombo and Puttalam was severely affected by a tsunami on December 26, 2004. The ramifications of the environmental degradation caused by the tsunami and the manner in which it will affect the country and its people in the short as well as long term needs to be considered. The affected region in Sri Lanka harbors many key marine and coastal ecosystems such as coral reefs, mangroves, seagrass beds, coastal sand dunes, mudflats, salt marshes, backwaters and lagoons, environmentally sensitive areas declared as national parks and sanctuaries, which includes a Ramsar wetland site, all of which plays a vital role in sustaining living natural resources on which many people in the affected region depend. The effect of the tsunami on these ecosystems has the potential to be very severe ecologically. In addition, the tsunami has created serious problems arising from adverse impacts to environmental capital or assets which are ecosystems that provide society and economies with environmental goods and services.

2. The mission team consulted with the Government and visited the districts of Colombo, Kalutara, Galle, Matara, Hambantota, Amparai and Batticaloa, which included field visits to protected areas of Yala, Bundala, Hikkaduwa, Kalametiya, Rumassala and Kiralakelle, during the period January 3-13, 2005.

### B. DAMAGE OVERVIEW

3. ***Damage to the coastline:*** Although virtually the entire coastline of Sri Lanka has been affected by the tsunami, the impacts vary considerably. The North East coastline appeared to have borne the brunt, with the affected areas reaching 2-3 km inland. Except in extremely small pockets, the tsunami has affected a much narrower strip in the Southern and Western coastlines, with the affected areas limited to approximately 500 meters or less and at elevations below about 2.5 to 3 meters. The property damage on the North East coast line is very significant, with virtually no area being spared. Yet there appears to be little visible impact on the fauna and flora in the affected zone. Ground cover and smaller trees and shrubs have been removed by the tsunami while most larger trees remain intact with little or no damage. It appears that the property damage to the North East coastline was not adequately protected by any natural barriers such as coral and granite reefs, mangroves and sand dunes. The situation in the southern and western coastline is different in that many areas have been protected by natural barriers and there is a visible difference in the level and extent of property destruction in areas protected by natural barriers. Areas protected by mangroves and sand dunes have been left virtually unaffected with minor or no damage to housing. Bays in the entire affected area have suffered devastating property damage, most likely as a result of a "funnel effect" created for the tsunami waters.

4. ***Impacts on protected areas in the coastal zone:*** While there has been no documented loss of fauna in the protected areas affected by the tsunami, there have been significant impacts on flora and biodiversity. Extensive washing off of soils as well as stress and dieback of flora was noted in areas of sea water intrusion. The following protected areas were affected by the

tsunami in varying degrees: Southern coast – Yala, Bundala, Hikkaduwa, Rocky Isles, Kalametiya, Nilwala, Rumassala and Kiralakelle; North East coast – Yala East, Lahugala, Pigeon Island, Chundikulam, Kokilayi, Sagamum, Little Sober Island, Seruwila Alleyi, and Paraithivu Island; Western coast – Wilpattu. Some of these protected areas, in particular Yala East, Yala, Bundala, Kalametiya and Pigeon Island have suffered significant ecological damage, albeit in a relatively narrow strip. The greatest ecological impacts are on freshwater bodies and fishery breeding grounds in the protected areas, which have now been contaminated with saline water. The long term impacts or reversibility of this situation is unknown at this stage. There is also quite significant property damage in certain protected areas especially in Yala National Park and Hikkaduwa National Park with some buildings being completely or partially destroyed.

5. ***Impacts on coral reefs and the marine ecosystem:*** The most significant environmental damage from the tsunami is expected to be marine-related. Based on damage assessments in other tsunami affected countries in the Pacific region, it is expected that the damage to the inter-tidal and sub-tidal area will be extensive. This could result in drastic changes in the coastal marine ecosystems, with potentially irreversible destruction of some areas, as well as immediate loss of living coastal resources such as fish, lobsters and crabs. This will have serious implications on fisheries, as many of Sri Lanka's fishermen are dependent on near-shore resources. The pelagic environment is unlikely to be severely affected.

6. No serious attempt has been made yet by authorities to assess the damage to marine ecosystems. Due to time constraints, the mission was also not able to assess the exact impacts on the marine ecosystem since there is no visible damage. It can be expected that many coral reefs may have lost their structure and biota and may even be reduced to rubble in certain areas due to mechanical damage. The force of the tsunami can move enormous boulders and sections of reef, as well as thousands of tons of smaller fragments, sand and silt, which dislodge, abrade, crush and kill marine biota. There could also be significant contamination by runoff from land, with large quantities of wastes and pollutants, debris, soil and organic matter. Many marine organisms that may have survived the wave itself, may now be adversely affected or killed due to deposition of debris and sand on reefs and seagrass beds. This is a very serious consequence that may have lasting effects. Mangrove areas, while having provided protection for property and life during the tsunami have now been damaged and their fronts have receded. Even coral reefs that may not have suffered structural damage may be adversely affected by suffering from exposure to direct sunlight caused by the receding water as the tsunami approached.

7. ***Debris disposal:*** The extent of debris, particularly from destroyed buildings, requiring disposal is enormous. The disposal of the rubble and waste material is proving to be huge issue because of the sheer volume and associated costs. Emergency clearance efforts have resulted in haphazard disposal of rubble along roads, in open fields, into drainage ditches, low lying lands and waterways, including the beaches. The practice of haphazard dumping of debris in inappropriate locations should stop immediately to prevent long term problems in flood control, clogging of waterways and pollution of beaches.

8. ***Surface and groundwater contamination:*** All dug wells in the coastal zone in areas where the tsunami resulted in sea water coming into land are contaminated by sea water which inundated most low lying areas as well as pollution due to wastewater and septage from septic

tanks that have been affected by the tsunami. This is a serious public health issue since most local water sources have been contaminated. In addition, the pipe borne water supply system in the coastal areas affected by the tsunami is largely out of service due to damage to the distribution network.

### C. RECONSTRUCTION AND RECOVERY NEEDS

#### *Short Term Priorities (3-12 months)*

9. ***Rubble and debris disposal:*** The tsunami-caused widespread deposition of vegetation, sand, construction debris, municipal waste from open dumps located on or close to the coast line, healthcare waste from affected hospitals and medical centers as well as human excreta from damaged septic tanks. The most immediate problem lies with disposal of such debris as rehabilitation has already commenced in certain affected areas. The amount of rubble is linked directly to the collapse of housing and other structures as well as vegetation that was removed by the tsunami. While a larger area has been affected in the North East coastline, the amount of debris for disposal may be about the same as in the Southern and Western coastlines due to the higher density of built up areas. Disposal of such wastes in an environmentally acceptable way will be a key consideration so that there will be no long term implications on flood retention areas and blocking of natural waterways. Furthermore, the possibility of recycling of rubble in non critical applications should be considered as a means of reducing the disposal volumes and costs. Reuse and recycling of building material from damaged buildings is a way to ensure the poor will be able to afford to rebuild as well as reduce debris disposal costs. Such efforts of reuse and recycling are evident even now in most affected areas. Burning of debris is also evident in certain areas but it is recommended that this practice be stopped immediately due to air pollution impacts. CEA has already issued instructions to stop the burning of debris as well as for debris to be collected and deposited in open areas such as playgrounds until proper sites for disposal are identified. In order to address the debris disposal problem in a comprehensive manner, appropriate guidelines will need to be developed to mitigate adverse environmental impacts. These guidelines need to be promptly issued to avoid haphazard disposal and reduce additional costs through repeated loading and dumping debris. The guidelines should address siting issues and be based on basic principles which minimize adverse environmental impacts. Recycling of building materials should be encouraged wherever possible. Options of using the demolition waste as sub base material for road construction should be explored. Since virtually no industrial facilities have been located in the affected areas, there is no likelihood of hazardous waste disposal being an issue. *The estimated budget for development of guidelines, removal of debris and disposal at suitable sites is US\$1.5 million.*

10. ***Study of the role of natural resources in minimizing tsunami damage:*** The pattern of damage, particularly in the southern and western coastline, clearly showed that healthier ecosystems have been less affected due to the tsunami. Observations clearly indicate that coastal destruction is very patchy in some severely affected areas in the southern coast, with less altered and more vegetated areas of the sea-land interface withstanding the tsunami to a much greater extent than areas where vegetation has been removed or the shoreline changed or encroached upon. Areas of healthy mangroves, sand dunes and probably structurally stable coral reefs have protected life and property better than areas of environmental degradation. Structures in more

obviously vulnerable locations, including many hotels and residential areas built too close to the sea or in coastal reservation areas, have fared worse and artificial canals that connect lagoons with the sea appear to have more aggravated damage by funneling water inland. A study of the role that natural barriers played in protecting life and property should be undertaken prior to future reconstruction. This will enable GOSL to better plan land use in coastal areas, rather than relying on a “one size fits all” solution of the proposed setbacks. This study should also take into account the manner in which other tsunami-prone countries in the Pacific region undertakes coastal zone planning. *The estimated cost of the study is US\$250,000.*

11. ***Clean up of dug wells and tube wells in affected areas:*** Most of the dug wells and tube wells in the affected areas have been contaminated with sea water as well as polluted by wastewater and septage from septic tanks. It is estimated that there are approximately 62,000 wells that have been affected. Cleaning/flushing of these wells is an urgent public health need prior to communities re-settling in affected areas. *The estimated cost for cleaning/flushing of the existing dug and tube wells is US\$3 million.*

12. ***Impacts on Protected Areas and other environmentally sensitive areas affected by the tsunami:*** Several Protected Areas and other environmentally sensitive areas such as mangroves and wetlands in the coastal zone have suffered ecological damage as a result of salt water intrusion. The immediate impacts on vegetation of browning and dieback were visible days after the tsunami. Yet it also appears that vegetation damage may most likely be able to make a natural recovery. It is recommended that a Biodiversity Survey be undertaken to establish the tsunami’s impacts on biodiversity in these affected areas. In addition, the tsunami affected areas provide a “living laboratory” for studying natural regeneration after saline intrusion. Fresh water bodies in environmentally sensitive areas and coastal Protected Areas have been contaminated by saline intrusion. A study needs to be undertaken to assess where natural systems are able to flush the salinity out or whether active intervention is needed for clean up. *The total estimated cost for the three studies is US\$750,000.*

13. ***Strategic Environmental Assessment of the Rehabilitation and Reconstruction Program:*** The plans and programs for rehabilitation and reconstruction must be subject to an Environmental Assessment. Considering the strategic nature of the proposed plans for rehabilitation and reconstruction, a strategic environmental assessment must be undertaken to understand the individual and cumulative environmental impacts of the proposed policies and programs for rehabilitation and reconstruction. *This study is expected to cost US\$200,000.*

#### ***Medium to Long Term Priorities (1-3 years)***

14. ***Long term environmental impacts on the marine ecosystems:*** Shorelines may already have changed, although may not be drastically. It was evident in the visit to Yala National Park that the shoreline has been reshaped. Sand dunes have been moved around as well as rivulets were running where there was none before. Even for shorelines that have not changed immediately after the tsunami, there is a likelihood that there may be increasing changes if the natural protection systems such as coral reefs, mangroves, seagrass beds have been wiped out. The effect of the loss of breeding fish populations, habitat and nursery grounds have severe implications for nutrition and livelihoods of coastal populations for years to come. Nesting

beaches for species such as globally threatened marine turtle populations in the affected regions may be damaged. Loss of key attractions such as beaches and reefs would also affect tourism which is a vital source of income for much of the coastal population.

15. The coastal ecosystems that may be affected by the tsunami in Sri Lanka are already stressed by unsustainable resource use, such as over fishing and habitat destruction, including development or indiscriminate cutting of mangroves for prawn culture. Further the El Nino related impacts of 1998, caused by elevated sea surface temperatures, has left the regions reefs struggling to recover, a process which has only recently been gaining momentum in parts of the South Asia region. Taking the right course of action is now essential to minimize and manage the ill effects as well as to promote the recovery of natural environments and the livelihoods of the survivors which so often depend on these natural environments. Assessment of the extent of damage caused by the tsunami to the marine ecosystem is essential. This requires the right data and information, and a firm commitment to foresighted, sustainable coastal planning. *The estimated cost of this rapid assessment study is US\$1.5 million.*

16. ***Development of sustainable waste management systems for affected areas:*** The present system of “open dumping” municipal solid waste and poorly designed septic tanks is environmentally unacceptable due to potential public health hazards. A sustainable waste management system should be in place for municipal solid waste and other local authority managed environmental services. Based on the principles of the National Solid Waste Management Strategy of GOSL, municipal solid waste should be subject to appropriate re-use and recycling systems and thereafter suitable treatment technologies and disposal systems developed that are affordable to participating Local Authorities in the coastal region. This will prevent the adhoc disposal of municipal solid waste on beaches (reducing the recreational use potential of the beaches) and other low lying lands and water bodies (resulting in the loss of flood retention areas). It is proposed that a Local Environmental Services Innovation Fund (LESIFA) be established for a technical assistance and grant facility, which will provide support for the design and implementation of innovative local environmental management solutions in Sri Lanka. The objective of LESIFA is to provide opportunities to self-selecting local authorities and their constituent communities to design, implement and sustain innovative solutions to local environmental service and management challenges. A combination of knowledge, technical assistance, training and capital grants will be available to local proponents on a competitive, demand driven basis. The outcomes of this work will be a variety of locally owned environmental management solutions throughout the country that will both improve real service delivery and serve as practical models. *The estimated cost for this facility is US\$6 million.*

17. ***Health care waste management:*** In the devastated areas of the country, approximately 42 health institutions have been totally destroyed. Another 45 institutions have been partly damaged by the tsunami. With the rehabilitation and reconstruction of these health care facilities, proper management of health care waste is vital to prevent public health impacts and environmental degradation. Appropriate waste treatment systems such as autoclaves for waste sterilization, will be needed for the larger hospitals in urban areas in the districts. In addition suitable waste disposal systems have to be established for disposal of the treated health care waste. In smaller hospitals and health centers where the volume of waste is very small, a treatment and disposal system may not be economically justified. In such instances, deep burial

according to WHO guidelines in specially prepared and secure disposal sites will be needed. *The estimated cost for this facility is US\$3 million.*

18. ***Reconstruction of damaged and destroyed buildings in National Parks:*** Several buildings in National Parks – such as in Yala and Hikkaduwa – have been damaged and destroyed, and need to be reconstructed. *The estimated cost of the reconstruction is US\$1.25 million.*

#### **D. ENVIRONMENTAL SAFEGUARDS**

19. An Environmental Management and Assessment Framework (the Framework) will be required to undertake environmental impact assessments for all rehabilitation and reconstruction activities to ensure adverse environmental impacts are minimized and appropriate mitigation measures are included in project design. The Framework will also assess the institutional capacity to undertake environmental assessments, the GOSL system for review and approval of the EIA's and the capacity to monitor the implementation of environmental mitigation measures. The preparation of the Framework is a pre-requisite to approval of the Emergency Recovery Credit. *The estimated cost of the preparation of the Framework is US\$100,000.*

**Table 1: Environmental Needs Resulting from the Tsunami Disaster  
(US\$ millions)**

<b>Project Proposal</b>	<b>Short Term (3-12 months)</b>	<b>Medium to Long Term (1-3 years)</b>	<b>Total (US\$)</b>
Rubble and debris disposal	1.5		1.5
Study of the role of natural resources in minimizing tsunami damage	0.25		0.25
Clean up of dug wells and tube wells in affected areas	3		3
Impacts on Protected Areas and other environmentally sensitive areas affected by the tsunami	.75		.75
Strategic Environmental Assessment of the Rehabilitation and Reconstruction Program	0.2		0.2
Long term environmental impacts on the marine ecosystems		1.5	1.5
Development of a sustainable waste management system for affected areas		6.0	6.0
Health care waste management		3.0	3.0
Reconstruction of damaged and destroyed buildings in National Parks		1.25	1.25
<b>TOTAL</b>	<b>5.7</b>	<b>11.75</b>	<b>17.45</b>