Environment Impact Assessment

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Sri Lanka: Wind Power Generation Project
Main Report

Prepared by Ceylon Electricity Board, Ministry of Power and Renewable Energy, Democratic Socialist Republic of Sri Lanka for the Asian Development Bank. This is an updated version of the draft originally posted in May 2017 on https://www.adb.org/projects/documents/sri-49345-002-eia

CURRENCY EQUIVALENTS
(as of 8 September 2017)

Currency unit	–	Sri Lankan rupee/s(SLRe/SLRs)
SLRe 1.00	=	$0.00654
$1.00	=	SLRs 152.90

ABBREVIATIONS

ADB	–	Asian Development Bank
CCD	–	Coast Conservation and Coastal Resource Management Department
CEA	–	Central Environmental Authority
CEB	–	Ceylon Electricity Board
DoF	–	Department of Forest
DS	–	District Secretary
DSD	–	District Secretaries Division
DWC	–	Department of Wildlife Conservation
EIA	–	environmental impact assessment
EMoP	–	environmental monitoring plan
EMP	–	environmental management plan
EPC	–	engineering, procurement and construction
GND	–	Grama Niladhari
GoSL	–	Government of Sri Lanka
GRM	–	grievance redress mechanism
IEE	–	initial environmental examination
LARC	–	Land Acquisition and Resettlement Committee
MPRE	–	Ministry of Power and Renewable Energy
MSL	–	mean sea level
NARA	–	National Aquatic Resources Research and Development Agency
NEA	–	National Environmental Act
PIU	–	project implementation unit
PRDA	–	Provincial Road Development Authority
PUCSL	–	Public Utility Commission of Sri Lanka
RDA	–	Road Development Authority
RoW	–	right of way
SLSEA	–	Sri Lanka Sustainable Energy Authority
WT	–	wind turbine

WEIGHTS AND MEASURES

GWh	–	1 gigawatt hour = 1,000 megawatt hour
ha	–	1 hectare = 10,000 square meters
km	–	1 kilometre = 1,000 meters
kV	–	1 kilovolt = 1,000 volts
MW	–	1 megawatt = 1,000 kilowatts

NOTE

In this report, “$” refers to US dollars.

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PREFACE

This document describes the environmental assessment and special studies conducted for the 100 MW Wind Power Project in Mannar, Sri Lanka. These studies were conducted between 2016 and 2017 on behalf of the Project Proponent - The Ceylon Electricity Board (CEB).

This environmental impact assessment (EIA) was prepared according to the requirements of the Asian Development Bank (ADB)'s Safeguard Policy Statement (SPS) 2009 for evaluation of project impacts and mitigation measure, and comprises of the following:

- Environmental management plan (EMP) including guidelines for Construction Method Statement
- Environment monitoring plan (EMoP), public disclosure and grievance redress mechanism
- Avian data - bird vantage point surveys at four locations, flight path studies and sector counts along wind farm blocks conducted by Dr. Devaka Weerakoon for 10 months between 2016-2017; ecology, and other environmental data, data on marine flora and fauna, hydrogeology and global positioning system (GPS) mapping collected for the entire Mannar island and the wind farm area on the island.
- Avian Critical Habitat Assessment Report and Avian Collision Risk Assessment Report (2017) by Dr. Steve Percival and Prof. Devaka Weerakoon based on avian data collected between 2016 and 2017.
- Terrestrial ecology, temporary pier construction, photomontages/wireframes, shadow flicker and noise assessment and future wind energy potential studies undertaken by Entura, RMA and their associates.

The EIA covers the following:

Main text which includes the environmental management plan (EMP). This presents the final assessment of the environmental impacts of the 100 MW Wind Power Generation Project and the cumulative impact assessment of the Mannar Island.

Annexures 1-11 include EMP and Construction Method Statement, Consent by Coast Conservation and Coastal Resource Management Department (CCD) to the IEE prepared by CEB in 2016 for the 100 MW Wind Farm Project by Project Approving Authority (PAA). The annexures also include the list of all public consultations held between 2016 and 2017 for the Project as well the terms of reference for the biodiversity management plan for the Vanakalai Sanctuary area and wind farm area. Letters stating CEB efforts to reduce impact on noise on navy quarters and through acquisition of Cabanas are also attached.

Appendices 1-10 include the Avian Collision Risk Assessment Report within the wind farm corridor, Avian Critical Habitat Assessment Report, Terrestrial Ecology, Temporary Pier Construction, Photomontages/Wireframes, Shadow Flicker and Noise Assessment Report and Background Noise Measurements data in Project Area and photographs of sample points on the Mannar Island. A study on tourism potential conducted by CEB for the area and a Future potential of wind generation is also included.

EXECUTIVE SUMMARY

Introduction

1. The Asian Development Bank (ADB) will be extending loan assistance to Sri Lanka's power sector focusing on renewable energy (solar and wind) and the overall improvement of network reliability. With this, the Ceylon Electricity Board (CEB) proposes for the development of a semi-dispatchable 100 megawatt (MW) Wind Power Generation Project and estimates the total project costs to be $256.79 million. The operation and maintenance expenditure throughout the lifetime of the proposed project is estimated at 2% of the capital cost per year. The main benefit from the project is electricity generation from wind power project of about 345 gigawatt hours (GWh) per year, which will be avoiding electricity generation from conventional power plants such as thermal power by an equal amount.[1]

2. The Wind Power Generation Project in Mannar will utilize wind energy to produce electricity. CEB will build and operate the 100 MW wind farm to harness the available wind electric potential in the Mannar region. The state-of-the-art wind energy conversion systems will be selected to ensure the generation of electricity in a sustainable manner.

Project Description

3. The project scope comprises the construction of the following major components: (a) a total of up to 39 wind turbines with a turbine specification and layout to comply with environmental constraints; (b) a collector substation and control building; (c) the collector cables, step-up transformers and switchgears and accessories; and the (d) supporting infrastructure. The main collector substation together with the control building will be setup in the Nadukuda village. This substation will be linked to the national grid via interconnection transmission line (associated facility). The control building will house all the required hardware and software facilities to acquire operational data, controlling and monitoring of wind farm, and to design and develop the operational and control strategies of the wind farm. The network of collector cables, step-up transformers, etc. will be established to link the individual wind turbines to the collector substation while the supporting infrastructure will consist of access roads, temporary storage facilities, temporary pier for unloading equipment, office building and staff accommodation facilities, etc.

4. Initially, the proposed project was to consist of 56 wind turbines but as a result of consultations with local people, non-government organizations such as Ceylon Bird Club, the number of wind turbines will now be 39 wind turbines.

5. Other project outputs include the installation of a total of 150 megavolt-ampere reactive (MVAr) reactors, and provision of project management and supervision of construction activities for CEB. These reactors are required to manage voltage levels within the planning limits and practical operational requirements to ensure the reliable operations of the wind farm. The 100 MVAr will be installed at the 220 kilovolt (kV) voltage level in the existing Anuradhapura grid substation in the North Central Province while the 50 MVAr will be installed at the 220 kV level at Mannar grid substations in the Northern Province which is being both of which were constructed also under ADB funding. Installation of the reactors will not cause adverse environmental impacts[2] but rather will ensure the integrity and reliability of wind power generation.

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[1] 345 GWh per year after environmental constraints.

[2] Pollution prevention and H&S measures may however be applied during construction and operation (oil spills etc.)

6. The proposed wind power farm will be located in the southern part of Mannar Island from Thoddaveli to Palavi, with a length of about 12.5 kilometers (km) along the coast. The first row of up to 33 turbines will be placed about 150 meters (m) to 160 m from the shoreline, and the second row of up to six turbines will be located about 1 km from the shore. The proposed wind farm has excluded the areas coming under the Adam's Bridge Marine National Park (by approximately 1 km) declared in 2015 by the Government of Sri Lanka (GoSL). The nearest village is about 800 m away from the second row of wind turbines. Several Navy camps and Navy observation points, boat landing sites, *ma-del* hauling sites, and fishermen vaadi/camps (seasonal), two investment cabanas, and a tourist hotel are found within the wind farm block. Access roads to the Navy camps, fishermen camps and fish landing sites from Mannar- Thalaimannar main road, and roads parallel to the coastline are also found within the wind farm.

7. This environmental impact assessment (EIA) is prepared following the environmental requirements of GoSL and the Safeguard Policy Statement (SPS) 2009 of ADB and other international standards suchs as World Bank's Environmental, Health and Safety (EHS) 2007 guidelines as well as EHS guidelines for wind energy. The main objective of this EIA is to identify and evaluate the potential direct, indirect, cumulative, and induced environmental impacts of the proposed wind power generation facility to the existing environment. The EIA provides mitigation and management measures including site-specific environmental monitoring plan to ensure sustainability of the project.

Description of Environment

Coastal aspects

8. The coastline of the project area is exposed to the swell throughout the year and the South- West monsoonal waves, but sheltered from the North-East monsoonal waves. Relatively shallow depths exist in the near shore area. The beach area consists of a gently sloping foreshore of fine sand, followed by a relatively flat sandy backshore area. Although sea outlets of several small water bodies are located along the coastline, sand bar formations, exist across all such outlets, most of the year. A coastal setback distance of 80 m is specified for the Mannar Island.

9. The wind season starts from 15 April until 15 September while the non-wind season is from 16 September until 14 April of each year. The general wind pattern and actual occurrence can vary by about 15 days.

10. As the wind turbines are located beyond the coastal setback, a direct impact on the coastline behavior due to the construction and operation is not envisaged. The construction activities will involve the use of a larger area around the locations of each wind turbine and clearing of vegetation, excavation, filling, compacting, leveling and other related activities during the construction phase. A possibility thus exists for soil erosion, siltation, blockage/restriction of natural drainage patterns leading to soil degradation and water logging/localized flooding in the area. However, in view of the relatively flat nature of the terrain and sandy soil with high infiltration capacity in the area, a severe impact due to construction activities is not expected. Potential localized water logging and flooding may result from changes in natural drainage patterns in the coastal zone due to construction of proposed access roads. The construction of temporary pier may potentially cause direct impacts on the coastline due to sediment trapping in its vicinity that could lead to coastal erosion and/or accretion on either side of the temporary pier. However, due to the permeable nature of the proposed pier, no significant level of sediment trapping in its vicinity is anticipated.

11. Construction practices prescribed in Construction Method Statement and other mitigation measures such as use of prescribed areas required for construction activities, provision of drainage systems-with silt traps at all tower sites and culverts on water channels for access roads to avoid obstruction of the existing drainage at the project site directly affected by the project, and restoration of the affected area immediately after the construction phase. Regular monitoring of coastal behavior will be done based on ocular inspections at coastal areas where needed, periodic clearing of accumulated sediments will be conducted to restore existing sediment transport patterns in the vicinity of the pier and beach nourishment in the areas affected based on advice of the Coast Conservation and Coastal Resource Management Department.

Coastal geomorphology

12. The morphological development of the coastal geomorphology and their formative processes are changed under the influence of the continental shelf morphology, coastline configuration, monsoon winds, waves, currents, and sea-level changes. Based on the morphological development of the Gulf of Mannar site, there are a series of coastal landforms that can be identified as follows; mud flats, sandspits, contemporary shoreline and the beach, incipient foredunes, Holocene beach and dunes, and waterways and water holes. These landforms are identified within the 300 meter-wide area from the shoreline to inland. At the construction stage, for the foundation for a wind turbine, it is necessary to remove sand, creeping vegetation and existing thorny bushes within 2.25 hectares for each turbine (installation of 39 wind turbines, access roads and staff accomodation shall require a total area of 90.3 hectares. Removal of vegetation and sands on each location will not severely affect the existing environment. After completion of construction works, the area topography will be restored by the Engineering, Procurement, and Construction (EPC) contractor.

Geology and soil

13. Geology and soil investigations of the project area show that there are some impacts due to possible soil excavations of the proposed project activities. Soil erosion and sedimentations in the shallow marine environment can be expected during the construction period which will be temporary and of short duration. Mitigation measures such as silt traps will be implemented to minimize the impacts and to protect the available sand dunes around the proposed wind farm area.

Hydrogeology

14. Due to construction activities, groundwater quality may be affected. Sheet piles[3] will be used to isolate the areas selected for excavation. It will help to prevent the collapsing of unconsolidated sand and to reduce the expected impacts to the groundwater. If pumping of groundwater will be required during excavation, electrical conductivity of the groundwater will be measured. If electrical conductivity of pumping water is more than 1500 µS/cm, it will be diverted to the sea after allowing for the sediments to settle in pits before discharge.

15. Workers will be provided with sanitary facilities such as wash up and toilet facilities along with soakage pits at construction sites. No groundwater well will be located within a minimum of 100 m from a toilet facility and vice-versa. The septic tanks will be constructed at relatively high

[3] Sheet piles are sections of sheet materials with interlocking edges that are driven into the ground to provide earth retention and excavation support. Sheet piles are most commonly made of steel, but can also be formed of timber or reinforced concrete.

elevated areas. Once septic tanks are filled with wastewater, it will be collected and transported to the nearest sewerage treatment plant located in the mainland at Thiruketiswaram. Monitoring of water quality will be included in the environmental monitoring plan that will be implemented by the EPC Contractor during construction and monitored for compliance by CEB.

Ecological environment

16. Altogether nine major habitat types were observed within the Mannar Island. These include natural vegetation of Palmyra stands, modified habitats of coconut cultivated lands, home gardens, natural habitats such as beach and sand dune-associated vegetation, scrublands, mangroves, salt marshes, mud flats and water bodies (both fresh and brackish water). A total of 201 plant species (63 families and 185 genera) including two endemic species and 178 indigenous species were recorded from seashore/coastal vegetation and coastal scrublands found in the site earmarked for the proposed project. 21 plant species recorded in the study area are introduced species. About 17 species are now naturalized and this indicates that the area is comparatively less disturbed by human influence. All recorded flora species are not unique or restricted to the project area. However, *Acacia planifrons* is the species that is restricted to Mannar region. It is not endemic species but an indigenous tree and more individuals can be seen in the Mannar Island. Of the 201 species recorded, there are seven threatened species and 13 species near threatened (see **Table 1**).

Table 1: Status of Terrestrial Ecology in the Project Area

Life form	Total species	National Red list 2012-Threatened (Near Threatened)	IUCN-GCS	Endemic	Indigenous	Introduced
Tree	40	1(3)	LC-7	1	32	7
Shrub	57	3(3)	LC-6	1	51	5
Herb	65	1(4)	LC-8	-	59	6
Climber/Creeper/Liana	34	2(3)	LC-2	-	31	3
Grass /Grass like	5	-	LC-1	-	2	-
Total	**201**	**7(13)**	**24**	**2**	**175**	**21**

LC = least concern
Source: Ecological Survey 2016.

17. The proposed site is predominantly natural habitats, scrub and coastal vegetation. Thus, faunal diversity was found to be low in these areas and comprised mostly of butterflies, reptiles, birds and mammals. The faunal assemblage in the project area is dominated by birds including 35 migrant species.

18. Impacts on the marine environment from the proposed project will be localized and mainly during the construction phase. Aside from the wind turbines, a temporary pier will be constructed to handle barge operations such as delivery of construction materials for the wind turbines. A Construction Management Statement will be implemented by the EPC contractor and monitored for compliance by CEB. Any potential impacts to benthic organisms can be considered moderate as construction works for the temporary pier will be localized and of short duration. The near shore environment is already turbid and devoid of any sensitive marine ecosystems.

19. Comprehensive underwater survey revealed that all the four sites considered in the

selection for the location of the temporary pier suggested identical uniform sandy bottom. None of the locations had any sensitive ecosystems, rare, threatened or organisms of conservation value.

20. There will be potential for highly localized loss of fish habitats, fishing grounds (mainly for ma-del operations) and other seabed habitat due to the construction of the temporary pier. The shore area facing the proposed wind farm block is traditional *ma-del* fishing area with *ma-del padus* located adjacent to one another in 500 m to 1,000 m intervals. *Ma-del* operation requires around 500 m stretch on the beach. One Madel owner whose Madel site (padu) stretching at a length of 594 m along the shoreline and located in the area proposed for the construction of the pier will be affected during pier construction and unloading of equipment. The Madel owner will not be able to engage in fishing activities for at least two fishing seasons as both pier construction and shipment of equipment are planned for the fishing season of October to March when the sea is not rough. Seawater quality (i.e., turbidity, temperature, etc.) around the area of the temporary pier will be part of the environmental monitoring plan.

Barge operations and Pier construction

21. Only barges that adhere to MARPOL and have regular maintenance service records will be used by the project as any accidental oil spill from barges would badly impact on the marine mammals, seabirds, fish and other marine organisms. Also, oil spill will have negative bearing on sensitive marine ecosystems such as sea grass beds in offshore areas of the project area (outside the direct project impact area). Only barges that have pollution emergency response plan and equipment (e.g., booms) available on board in case of an incident will be used by the project.

22. Ecological impact issues include construction effects on vegetation and the associated impacts on marine habitats. Specific issues include direct disturbance/pollution caused by construction equipment or from erosion, and impacts from structure placement such as temporary pier. Construction and dismantling of piers should be carefully handled to avoid long-term impacts to these marine habitats and ecosystems.

Anticipated environmental impacts and mitigation measures

Noise assessment

23. Major concern of the fisherfolks was the noise that may be generated from the wind turbine during operation phase. Noise generated in air at moderate distance of 150 m from the shore is very likely to attenuate considerably as sound tends to reflect off rather than get absorbed by water surface and only a small portion would be transferred into water, hence noise will have no impact on fish or fisheries. The underwater noise would be temporary during the period of jetty piling and barges ingress for unloading equipment. Other normal boat traffic in the area will not increase due to project, there will be no additional impact on that account.

24. Rotor blades when move through air produce an aerodynamic noise. This noise is noticeable when it is greater than the background noise. Noise limits for wind turbines operations have been defined at sensitive locations in the vicinity of the wind farm based on the International Finance Corporation (IFC) and World Bank Environmental, Health, and Safety (EHS) Guidelines.

25. Based on the noise modelling conducted for the project, unconstrained operation of all 39 wind turbine locations is likely to result in noise levels at receptor locations that will exceed noise limits (see **Appendix 5**). As such, the wind turbine suppliers will be required to propose a wind

turbine model and wind farm layout (39 or less locations) that will comply with the prescribed limits for the type of receptor and not result in significant disturbance (about >10 decibels (dB change in noise magnitude) at relevant receptors.

26. To provide wind turbine suppliers with further guidance and boundaries on the acceptable noise outputs of the wind farm, they will be required to adhere to the following:

- Wind turbines supplied for the project should have a maximum noise output of 106.5 dB. The modelling undertaken to date shows acceptable noise levels at all permanent residential settlements at this output, even with no operational constraints on noise and power output (noting that there are other relevant receivers that also need to be considered, and will require certain wind turbine locations to have a maximum sound output lower than 106.5 dB).
- Wind turbines supplied for the project must be able to operate in a noise constrained mode, in order to meet the seasonal day/night noise limit requirements defined by this report.
- Wind turbine noise should have no tonal component unless incorporated into the assessment as a penalty.
- During the tender process, the wind turbine supplier must propose a wind turbine model and wind farm layout that complies with the prescribed limits and does not result in significant disturbance at relevant receptors. Any requirements for reduced noise output (and hence reduced power output) must be quantified.
- Based on the capacity of the wind turbine offered, the wind turbine supplier will select a subset of locations from the 39 locations available in order to achieve a nominal 100 MW total installed capacity.

27. All Navy quarters in the receptor list would be now categorised as institutional. This is due to the fact that CEB has a verbal confirmation to relocate all sleeping quarters to the places where there is no impact on the Wind Farm layout. Similarly, The Kalthota Cabanas will be exempt from the list as well, as CEB has agreed to acquire the sites. During the high wind season (north east monsoon) which commenced in May 2017, additional measurements of background noise were conducted in order to determine allowable wind farm noise when ambient background noise exceeds fixed limits.[4] These background noise measurements are presented in **Appendix 5a** - Background Noise Measurements Report by Resonate Accoustics which are based on the World Bank/IFC EHS guidelines for wind energy. Careful design of the wind farm by the bidder, considering a specific wind turbine model's noise characteristics, and employing noise control modes to reduce noise and power output, a 100 MW wind farm can be designed to comply with the current noise limits.

28. To address noise issues at locations used for sleeping purpose, CEB will consider the land acquisition option for Kaluthota Cabanas to avoid potential noise impacts from the wind farm and has initiated consultation with the owner of the Cabanas. CEB is also closely coordinating with the concerned Naval Authority regarding the quarters of Navy at the naval outposts. According to the letters attached from CEB (**Annexure 11)**, CEB will initiate the land acquisition option to avoid/mitigate noise impacts toward the cabanas, and this will be fully informed and

[4] Entura's proposed method for using the current background noise, is to retain the fixed limits (as per the EIA) for lower wind speeds, but consider background noise in a conventional method for wind farms (and similar to the general IFC EHS guidelines), assuming the limit as [background + 3 dB] when background noise already exceeds the fixed limits for higher wind speeds. Separate calculations are required for South West and North East monsoon given influence of wind direction on background noise.

discussed with the affected owners. To ensure full awareness to concerned parties involved, one-on-one consultation by CEB will continue, if necessary and applicable, subject to environmental impacts once the wind design is finalised.

Shadow Flicker

29. The rotating blades of wind turbines can cast intermittent shadows to a person or property located in the shadow of the wind turbine – known as shadow flicker. Because wind turbines are tall structures, shadow flicker can be observed at considerable distances but usually only for a brief time at any given location. In some circumstances for some people, shadow flicker may cause annoyance, however, it is not generally associated with adverse health impacts. Sri Lanka does not have any specific guidelines for wind farm shadow flicker. The IFC/WB-EHS Guidelines for Wind Energy (August 2015) including the German guidelines for shadow flicker were applied to this project which recommends duration of shadow flicker at a sensitive receptor not to exceed 30 hours per year and 30 minutes per day on a worst affected day (based on worst-case scenario).

30. It is noted that wind turbine models that will be offered for this project will probably include wind turbines with an individual capacity of around 3.3 MW, so that 31 wind turbine locations are a likely configuration for the 100 MW project, and a reduced impact due to shadow flicker. Regardless of the number of wind turbines, shadow flicker will be mitigated by turning off wind turbines when there is potential for shadow flicker at receptors (typically around sunrise and sunset). Shadow flicker will be completely mitigated operationally with an estimated energy loss equivalent to approximately 1.5% of the annual energy output of a wind farm of 39 wind turbines, and 1.0% for an example wind farm of 31 wind turbines. Based on the final wind turbine configuration, the precise time of day when shadow flicker is present will be modeled for each day of wind farm operational life. Post-construction monitoring and consultations will be undertaken to determine whether the automated shutdown shadow flicker mitigation has been effectively implemented.

31. Blade glint is not expected to cause any issue, provided the wind turbine supplier ensures that blades supplied are coated with a low reflectivity treatment, as has been specified by the wind farm technical specifications.

Visual Amenity/Photomontage/Wire Frame

32. According to the Photomontages and Visual Impact Assessment study (see Appendix 7), it can be seen that distant views while not intrusive would harmonize better in the landscape with less contrast in color, if the wind turbine generators (WTGs) are colored grey. This will be part of the requirements of the wind farm technical specifications. The beach photomontages show the importance of configuration, scale, proportion and spacing of the WTGs. The sleek form of the structure lends elegance with the proviso that they will be vertical to the ground and well maintained. In the future development of Mannar Island and potential uses, the identification of landscape character units, conservation of vegetation, land use policy and developmental guidelines need to be formulated for the carrying capacity of the island. The visual impact would be considerable at Shell Coast Resort as well as tourism in the area for which photomontages and wire frames were developed showing the row of wind turbines along the beach with the Resort and fishing locations.

Temporary Pier, Equipment transportation and Bathymetry Report

33. A temporary pier of 50m length will be constructed at the project site which is designated

size that can handle barge operations with roll on-roll off (RO-RO) technology (see Appendix 1). The width of the work area will be the required width of the trailer track during the RO-RO operation. Based on independent studies conducted for the project, the most suitable modality determined for bringing in equipment to Mannar wind farm is through the sea route from Colombo and unloading at Mannar Wind farm beach area using appropriate mechanism. However, the EPC contractor will be free to use their own logistical arrangements provided with approval from the CEB and the authorities concerned.5 The bathymetry study conducted for the project by the National Aquatic Resource Research & Development Agency (see Appendix 4) has identified the most suitable depths (greater than 5 meters) installation of the pier and tentative approach path of barges for transportation of wind turbine equipment.

Critical Avian Habitats and Collisions

34. The wind farm corridor is used by any critical bird species. Also, the migratory season of birds does not coincide with the dominant wind season. A three-year bird study-cum-survey was conducted by CEB from January 2014 to April 2016. The focus area of this study is the entire Mannar Island including an off-shore belt of 500 m around the island as well as the Vankalai Sanctuary, that is between the Mannar Island and the mainland. The study documented the bird species present within the study area, temporal and spatial variations in their distribution and flight patterns, flight heights, and critical avifaunal habitats with the ultimate aim of identifying potential impacts that may arise due to the development of a wind farm and the associated transmission line. Aside from these, a vantage point count, a water hole count/block count and transect counts were done. Another bird study within the wind farm corridor was carried out from June 2016 to March 2017 where bird vantage point surveys at four locations, flight path studies, and sector counts along wind farm blocks were conducted.

35. An avian collision risk assessment study and an avian critical habitat assessment were also undertaken by CEB as part of this EIA (see **Appendix 2** and **Appendix 3**, respectively). Based on the data collected from 2016 to 2017, it clearly indicates that there are important bird populations that could be affected by the proposed development. Collision modelling was undertaken for the wind farm using the Band et al. (2007) model. Results of the modelling highlighted three critical habitat species at particular risk: Spot-billed Pelican, Indian Cormorant and Gull-billed Tern. The collision risk to all of these species could be potentially significant.[6] The waterbird and raptor counts made during the enhanced block counts in January-March 2017. The wind farm also has the potential to disturb birds from a zone around the wind turbines. Specific targeted counts of this area have shown that seven critical habitat species could be at risk: Little Egret, Indian Cormorant, Red-wattled Lapwing, Brown-headed Gull, Caspian Tern, Gull-billed Tern and Lesser Crested Tern. Most were restricted to the beach habitat and were uniformly distributed along the coast. Only little egret, Indian cormorant, red-wattled lapwing were found on the inland sectors (on the thonas wetland habitat)[7]. However, the numbers at risk were generally low, many of the birds there are habituated to presence of people (reducing their vulnerability to disturbance) and evidence from existing wind farms has shown similar species to be little-affected by such disturbance. The likelihood of disturbance is therefore considered to be low, though some

[5] If they use a different route then the EIA will need to be updated accordingly as no mitigation is currently included for road import etc.

[6] A signficiant impact on these species cannot be excluded and therefore implementation of BMP activities will mitigate these impacts.

[7] Thonas were included as these are inhabitaed by waterbirds. But none of the species that trigger critical habitat (CH) were recorded in the Thonas during ground counts and hence excluded in the map provided in EIA report. But little egret, Indian cormorant and red-wattled lapwing have been identified as CH species.

minor disturbance effects cannot be completely ruled out. To avoid collisions, no lighting on turbines will be installed besides a low intensity red beacon as suggested by Civil Aviation Authority of Sri Lanka (CAA) during operations (See **Annexure 8**, item 5).

36. A total of 129 faunal species including 4 endemic species, 1 nationally threatened species and 4 nationally near threatened species were recorded during the field survey from the project area. Based on the block counts carried out during the baseline survey, the critical habitats of these species have been identified (see **Table 2**).

Table 2: Species in Mannar Island and Vankalai Sanctuary that triggered critical habitat criterion

Species	Reason for Critical Habitat	Extent of Critical Habitat
Globally CR/EN		
Great Knot	>1% flyway population	Erukkalampiddy Lagoon
Nationally CR/EN		
Spot Billed Duck	Nationally important concentration of nationally critically endangered species	Korakulam and Vankalai sanctuary – transmission line corridor used as a feeding area
Caspian Tern	Nationally important concentration of nationally critically endangered species	Vankalai Sanctuary, Erukkalampiddy Lagoon and the north shore of Mannar Island.
Common Tern	Nationally important concentration of nationally critically endangered species	Vankalai Sanctuary, Erukkalampiddy Lagoon and the north and south shores of Mannar Island
Gull-billed Tern	Nationally important concentration of nationally critically endangered species	Vankalai Sanctuary, Korakulam, Erukkalampiddy Lagoon and the north and south shores of Mannar Island
Migratory and Congregatory Species		
Spot billed pelican	>1% global population of a migratory or congregatory species	Vankalai Sanctuary
Curlew Sandpiper	BirdLife International's Criterion A4 for congregations	Vankalai Sanctuary, Saltern and the north shore of Mannar Island
Northern pintail	Ramsar site Criterion 5	Vankalai sanctuary
Greater flamingo	Ramsar site Criterion 5 and 6	Vankalai sanctuary
Eurasian wigeon	Ramsar site Criterion 5 and 6	Vankalai sanctuary
Garganey	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary, Korakulam and the south shore of Mannar Island
Black-tailed godwit	Ramsar site Criterion 5 and 6	Vankalai sanctuary and Korakulam
Painted stork	>1% global population of a migratory or congregatory species	Vankalai sanctuary and Korakulam
Eurasian Spoonbill	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary
Black-headed Ibis	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary
Little Egret	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary
Indian Cormorant	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary, Korakulam and the north and south shore of Mannar Island
Yellow-wattled Lapwing	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary and Erukkalampiddy Lagoon
Red-wattled Lapwing	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary and the north shore of Mannar Island
Kentish plover	> 1% of the flyway population of a migratory/congregatory species	Vankalai sanctuary and Erukkalampiddy Lagoon
Lesser sand plover	>1% global population of a migratory or congregatory species	Vankalai Sanctuary, Saltern and north shore of Mannar Island
Little stint	>1% global population of a migratory or congregatory species	Vankalai Sanctuary, Saltern and north shore of Mannar Island

Species	Reason for Critical Habitat	Extent of Critical Habitat
Common Redshank	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary
Marsh sandpiper	>1% global population of a migratory or congregatory species	Vankalai sanctuary, Saltern
Brown headed gull	> 1% of the flyway population of a migratory/congregatory species	North and south shores of Mannar Island
Lesser Crested Tern	>1% flyway population of a migratory or congregatory species	North shore of Mannar Island

37. A Biodiversity Management Plan (BMP) as attached in **Annexure 10** will be implemented by the Department of Wildlife Conservation in partnership with CEB for the Vankalai Sanctuary and all critical habitats on Mannar island including Adam's Bridge National Park to ensure no net loss of biodiversity and to promote the conservation objectives of the sanctuary and also in accordance with the requirements of ADB's SPS 2009 and IFC's guidelines for critical habitats. CEB will fund/implement the BMP for the first five years for the project area inside the Vankalai Sanctuary and all critical habitats on Mannar Island including Adam's Bridge National Park (refer to the EIA for Mannar-Nadukuda Transmission Line also funded by ADB). CEB/contractor shall deal with any unanticipated impacts and undertake corrective actions as required during the construction and operation of the transmission line.

Socio-Economic aspects

38. The proposed wind power generation project to be situated 140 meters inward from the Mannar Island's southern coastline spreads over to a distance of 12 km between the Thoddaveli Grama Niladhari Division (GND) and the Thullukudiyiruppu GND. The project location falls within the administrative jurisdictions of the Northern Provincial Council, Mannar District Secretariat and the Mannar Town Divisional Secretariat. The local authority that governs the project area is Mannar Pradeshiya Sabah. The project location also cuts-across five Grama Niladhari Divisions (GNDs) namely Thoddavelli MN/62, Olaiththoduvai MN/60, Pesalai South MN/56, Pesalai West MN/55 and Thullukudiyiruppu MN/54. The entire project area falls within an "energy development area" declared by the Sri Lanka Sustainable Energy Authority (SLSEA) in the Mannar Island in 2014 (refer the extraordinary gazette No. 1858/2 of 17th April 2014 of the Democratic Socialist Republic of Sri Lanka). In May 2017, the Urban Development Authority (UDA) re-zoned this 'Energy Development Area' as 'Industrial Area' for the development of fishery, tourism and wind parks.

39. The total number of fishing vessels that operate within the project impact area is estimated at 662 vessels which include approximately 516 mechanized boats and 10 traditional fishing crafts. The number of *ma-dels* (beach-seine) that operate within the impact area is 22. The number of fishermen camps (*Vaadies*) of migrant fishermen is estimated as 39 camps. The estimated number of fisherfolks who operate within the project impact area is 1,463. The number of standing trees observed within the wind farm block includes 4,134 Palmyra trees; 825 coconut trees and 10 mango trees.

40. The land identified for the project is free of encumbrances and has not been used for any residential dwellings or productive purposes except for the presence of 190 Palmyra trees and 226 coconuts, produce of which is used by local communities for income-generating activities. The preliminary design of the project has directly avoided the settlements, structures, fishery-related activities and the valuable trees such as Palmyra and coconut being affected. The number of Palmyra trees and coconut to be cut down for the installation of 39 turbines is estimated at 9 and 37, respectively and acquisitions/purchases for the project will not cause physical

displacements or livelihood impacts to landowners. The persons affected by land acquisitions will be compensated at replacement value including for the trees and crops grown on such land. The wind farm area is not fenced out except during turbine erection period due to safety reason. The affected people have the other income resources apart from the land to be acquired. Therefore, no significant economic and livelihood impacts are expected. However, the project will result in temporary economic displacements to a cross-section of the fishery in the project impact area. These temporary economic displacements are due to two reasons. Firstly, the construction of the pier in Nadukuda and its operations over an estimated period of two fishing seasons, i.e., 12 months spread over two years will lead to temporary economic displacements to one Madel owner and 17 fish laborers and two tractor operators employed by the said Madel owner. The construction work of the pier and its operations linked with unloading shipments cannot be scheduled to commence during off-fishing seasons because of the rough seas that prevail from April to October. Secondly, there may arise temporary disruptions to livelihood activities of fishermen during transportation of wind farm equipment from the pier to their respective destinations and in the installation of wind turbines. Such temporary impacts however cannot be assessed at the time of preparing the Resettlement Plan for the project as they are largely dependent on EPC contractor's work plan, but the disturbance of livelihood will be compensated according to the entitlement matrix in the Resettlement Plan.

CO_2 Sequestration

41. The project will require clearing of nine Palmyra trees, 37 coconut trees and removal of *Pandanus* (Pandan or Screw Pine), Acacia shrubs/trees resulting to a reduction in CO_2 sequestration. However, environmental benefits of the project significantly outweigh the costs. Reduction in CO_2 sequestration due to vegetation clearing (i.e., Palmyra trees) was determined based on the CO_2 sequestration rate of 64.5 MT per year per hectare[8] and 143 Palmyra trees per hectare.[9]

42. The Sustainable Energy Authority of Sri Lanka (SLSEA) publishes the grid emission factor for Sri Lanka and the latest available is for 2015.[10] From these published grid emission factors, the combined margin specified to be used for new wind and solar projects is 0.7689 tonnes of CO_2 per MWh electricity generation. Thus, for the 345.6 GWh of generation expected from this project, the total greenhouse gas (GHG) savings expected is 265,731 tonnes of equivalent CO_2. Assuming approx. $12/t CO_2 value for the saved GHG, the additional annual economic benefit due to the project will be $3.18 million.[11]

Analysis of Alternatives

43. CEB considered the potential environmental impacts of various alternatives including a "do nothing" scenario. A technical assessment was conducted by CEB to demonstrate that the overall benefits from the project will substantially outweigh the project costs, including environmental costs; and that any conversion or degradation is appropriately reduced or mitigated to ensure the sustainability of the project.

44. Given the nature of wind power development, it is generally viewed as "green" on

[8] Indonesia and Oil Palm Plantations Amid Global Environmental Issues, Indonesian Palm Oil Association 2013.
[9] http://www.fao.org/docrep/006/t0309e/T0309E03.htm
[10] http://www.info.energy.gov.lk/
[11] Details from IEE Report (April 2016) prepared by CEB for Proposed 100 MW Mannar Wind Power Project. However, for the project economic benefit analysis, $36.3 per ton of CO_2 was used as it is the global social cost of carbon reported by the International Panel on Climate Change.

environmental impacts. The proposed site is considered the "best" site to develop wind energy based on the recommendations under the study, "Preparation of Renewable Development and Wind Park Master Plans and Business Model for Wind Park." This study identified 300 MW of wind power potential in the Mannar Island. The 300MW potential is technical estimation based on the wind resource assessment and will be adjusted based on further assessment of environmental and social safeguards. Any power development project may cause both positive and negative impacts and for the proposed project as follows:

- Increase in the availability, quality and reliability of electricity supply to the energy-deficit areas in the country including Mannar region with 345.6 GWh of green energy annually. This is the main positive impact.
- Potential impacts on birds resulting from the changed landscape of constructing the wind turbines about 160 m and 1 km from the shoreline. CEB will work with Department of Wildlife Conservation and Department of Coastal Conservation to develop an implementation plan for the BMP which is meant to support the maintenance of Vankalai Sanctuary and Adam's Bridge National Parks.
- Environmental impacts due to wind turbine erection, transportation of construction materials, disposal of debris, disturbance to the breeding season of migratory birds in Vankalai sanctuary, nuisance from dust, noise, vehicles, vibration, etc. due to construction activities are short-term negative impacts. The long-term impact will be related to the flight pattern of migratory birds during their arrival, breeding and departure seasons.
- There will be negligible loss to the local population on account of agricultural productivity in the area as well as cutting of home gardens of coconut and Palmyra trees which will be compensated based on the established rates by CEB.

Information Disclosure, Consultation, and Participation

45. The National Environmental Act 2002 of Sri Lanka requires public notice about the proposed project prior to approval by the Central Environmental Authority. As required by the Safeguard Policy Statement (SPS) 2009 of ADB, a total of seven community level consultations were conducted from March 2016 until February 2017 within the seven *Gram Niladharis* (GND) to inform the communities about the project and seek their concerns and perception about wind farm development. The project information including social and environmental aspects was given to the participants in English, Sinhala and Tamil during the community level consultations. Three from these consultations targeted women groups and were participated by 55 women. Another two consultations with NGOs were held on 20 February and 23 May 2017. These consultations were attended by a total of 594 persons. Consultations (as appropriate) will continue throughout the life of the project. A communications strategy plan will be developed by CEB to provide proper guidance during stakeholders' engagement.

46. Local people were generally supportive of the project in anticipation of employment generation and access to better infrastructures such as roads. Project-associated concerns include effects of noise generated by the wind turbines to fish catch, restriction to access within the wind farm block, potential increase in sand erosion, waste generation, release of radioactive pollutants during operation, safety risks from blade throw from wind turbines,[12] and potential impacts to local and migratory birds. Other major concerns were illegal fishing and/or trawlers from foreigners affecting local fisherfolks, continued desctructive fishing practices and

[12] Will be addressed by CEB separately from RP as applicable. Set back will be met or if not property relocated to meet the criteria.

uncontrolled exploitation of marine resources such as sea cucumber, conch (a tropical marine mollusk with a spiral shell), and bivalves (oysters). Marine expert from the consultants' team explained that noise generated from the proposed wind power generation project will not affect fish catch given the distance of the wind turbines from the shore (about 160 m and 1 km).

Grievance Redress Mechanism

47. CEB will establish a grievance redress mechanism to deal with potential complaints/grievance from the public. A grievance redress committee (GRC) will be set-up by CEB comprising of: project head, CEB, division secretary (or their nominee), representative of GND, women representative of village or council, and the environment officer at project management unit (PMU) or their nominee. Potential complaints can be redressed in two levels: (i) project site/field office, and (ii) through the grievance redress committee. Grievance lodged at the site office is expected to be resolved immediately while complaints raised to the level of GRC will be resolved no later than 90 days. At any stage, if the project affected person is not satisfied he can approach the court of law directly.

Environmental Management Plan

48. The Engineering, Procurement and Construction (EPC) contractor and CEB will implement the detailed Construction Method Statement (CMS) based on the outline given in **Annexure 4** and as part of the environmental management plan (EMP) in **Annexure 3.** CEB will ensure compliance of the EPC contractor to the CMS and the EMP, and other relevant requirements of GoSL and SPS 2009. A guideline for the development of CMS based on industry and international best practice is also included (see **Annexure 4**).[13] The EPC contractor and CEB will implement any required changes in the design of the wind farm layout to ensure all required mitigations are in compliance with above stipulations.

49. CEB shall adopt the recommended measures from the special environmental studies (e.g., bird collision risk, critical habitat assessment, etc.) to mitigate the operational impacts (measures to reduce collision risks of migratory birds likely to pass the wind farm and the south side of Mannar island). All stipulated mitigation measures to meet the ADB Critical Habitat requirements in these studies will be implemented during construction and operation phases.

50. Also, conditions set forth by the CEA, the CCD, and the PAA for the implementation of the 100 MW wind power generation project to meet the requirements of GoSL will be complied with by the EPC Contractor during the construction phase (monitored for compliance by the PMU, CEB) and the CEB during the operation phase.

51. The environmental monitoring plan will cover noise and shadow flicker measurements, marine water quality, fishing activities (i.e., fish catch, use of fishing gears, etc.), conditions of marine and coastal area (i.e., potential sedimentation, construction debris, etc.), bird and bat collision (i.e., pre-construction and post construction), and tree replantation at designated areas. The EMP and the environmental monitoring plan during construction phase will be implemented by the EPC Contractor and monitored for compliance by the PMU, CEB. During operation phase, the EMP and monitoring plan will be implemented and/or supervised by the CEB's Transmission Design and Environment Division and Wind Farm Project team.

Conclusions and Recommendations

[13] As per IFC's EHS guidelines 2007.

52. The development of the 100 MW wind power generation project is consistent with the renewable energy resource development plan of GoSL and the associated environmental requirements of GoSL have been followed by CEB. Additional environmental studies on avian collision risks, noise assessment, shadow flicker, critical habitat assessment, visual impact assessment, etc. have been conducted for more than a year to complement the EIA to ensure a comprehensive and robust assessment of the potential environmental impacts. Public consultations have been carried out also for than a year. The results of these environmental studies and consultations reduced the number of wind turbines from 56 turbines at the initial stage of project preparation to up to 39 turbines to ensure that the project will be implemented sustainably. CEB is committed to implement the measures and recommendations from the environmental studies.

53. While there are potential environmental impacts identified such as disturbance to some bird species, increase in noise levels at some sensitive receptors, etc., these can be mitigated through design specifications of wind turbines, good construction engineering practices, and operating procedures. An EMP and EMoP including a Biodiversity Management Plan (TOR attached as **Annexure 10**) will be implemented by CEB. A Grievance Redress Mechanism (GRM) is included and consultations will continue throughout the life of the project. The implementation of the proposed project will achieve the GoSL target of advancing renewable energy in meeting their energy requirements.

1.0 INTRODUCTION

1.1 Background

1. According to the report of the Sustainable Energy Authority (SEA),[14] a total wind capacity of 1,010 MW is likely to be available for grid electricity generation in Sri Lanka by 2020. As per approved CEB Long-Term Generation Plan 2015-2034, the total wind capacity which could be integrated to the Sri Lankan system by 2020 is 354 MW. In early 2014, the Government of Sri Lanka, with assistance from the Asian Development Bank (ADB), prepared a master plan for wind power development in the Mannar region. The CEB is currently developing a 100 MW wind power plant sited along the southern coast of the Mannar Island. According to the master plan study,[15] the total Mannar District wind potential was tentatively estimated as 375 MW, including 300 MW in Mannar Island and 75 MW in the mainland coastal stretch extending southwards. This potential is technical estimation based on the wind resource assessment. The technical feasibility of these projects was evaluated based on CEB's long-term transmission plan as well as additional load flow studies conducted by transmission planning and generation planning.

2. The Mannar wind power generation project is designed to have an electricity generating capacity of 100 MW, and is estimated by the Ceylon Electricity Board (CEB) to cost $256.7 million. The project is planned to be implemented over two years, of which the first year is mainly for manufacturing wind turbines and other project equipment, while the majority of on-site work is expected to be carried out in the second year. After commissioning, the proposed project is expected to operate at an approximate plant factor of 37% and to contribute 345.6 GWh annually to the national grid throughout its economic life of 20 years. This will have a positive impact on the annual generator schedule and dispatch of other power plants, especially thermal generation. The most notable feature is the avoidance of significant amount of thermal base power generation thereby reducing, approximately 4.8 million tons of CO_2 emissions over the life span of the project. The approval from several stakeholders has been received for establishment of the wind park (**Annexure 9**).

1.2 Project Objective and Justification

3. The following benefits associated with the project would justify the proposal to setup the proposed 100 MW semi-dispatchable wind farm in Mannar region.

- One of the high priority project proposed by CEB to contribute towards achieving 20% target from new renewable energy sources by 2020 which is in line with government policy framework goals.
- Project has the ability to generate a 345.6 GWh (including noise and shadow flicker constraints) of clean energy and thereby avoiding expensive thermal base power generation. This in turn would save significant amount of foreign exchange throughout the operational life of the project.
- The novel operational strategy (semi-dispatchable) proposed for this project is expected to provide hand on experience to CEB in formulating strategies for operation of future wind farms in Sri Lanka.
- Project is expected to benefit scale in economies associated with large scale wind power projects in the form of reduced cost of electricity.
- Avoiding 265,731 tons of CO_2 annually by way of displacing thermal base (coal,

[14] Renewable Energy Resource Development Plan 1/2012.
[15] Funded by ADB under TA 7837.

diesel and furnace oil) power generation from national grid.

- The Mannar region, which is one of the underdeveloped regions in Sri Lanka, is expected to benefit immensely from the project related activities.
- Contributes towards fuel diversification of national energy mix and hence improve the energy security of Sri Lanka.

4. Mannar Wind Power project is an electrical power generation project, which will utilize energy in the wind to produce electrical energy. The state of the art wind energy conversion systems (WECS) would be selected for the proposed wind farm to generate approximately 345.6 GWh of clean electrical energy in a sustainable manner.

1.3 Project Aim and scope

5. The CEB will build and operate a semi-dispatchable wind farm of 100 MW capacity as the first phase of harnessing the available wind electric potential in the Mannar region. The project scope would comprise of constructing following major components:

a. Total of approximately 39 wind turbines, depending on the installed capacity of each turbine and system operation strategy with following attributes would be selected;

- Probable wind turbine capacity: 2.75 MW to 3.5 MW
- Minimum hub height: 80 m
- Minimum rotor diameter: 130 m
- Minimum lower tip from ground: 25 m
- Minimum upper tip from ground: 155 m
- Minimum tower base height: 10 m
- Tower type: Steel tubular tapered tower

b. Collector substation and control building: The 220/33 kV main collector substation together with control building will be setup in Nadukuda village. This substation will be linked to the national grid via interconnecting 220 kV Nadukuda-Mannar transmission link (associated facility), a project funded by ADB. The control building will house all the required hardware and software facilities to acquire data, controlling and monitoring of wind farm and to design and develop the operational and control strategies of the wind farm.

c. Collector cables: The power network would comprise of collector cables, step up transformers, switchgears and accessories will be established to link the individual wind turbines to the collector substation.

d. Supporting infrastructure: This includes access roads, laydown and storage areas, temporary storage facilities, pier for unloading equipment, office building and staff accommodation facilities, etc.

1.4 Purpose and structure of the EIA document

6. The wind farm project is situated on Mannar Island which is deemed as a key habitat area situated on the southeastern flyway for the migratory birds some of which may be Vulnerable

(VU), Endangered (EN) and Nearly Threatened (NT). Establishment of wind farm project can have both negative and positive impacts on the wildlife and their habitats especially birds and bats.[16] Mannar Island is one of the key entry points of migratory birds and is well known for avifaunal richness especially migratory water birds. On the national requirements, the initial environmental examination (IEE) for the wind power generation project was approved by the Department of Coast Conservation and Coastal Resource Management (CCD). However, the Mannar wind power generation project is categorized as Category A under the ADB SPS 2009 requiring the preparation of an environment impact assessment (EIA). In addition, Mannar-Nadukuda Transmission Line that passes through a Ramsar Designated area – Vankalai Sanctuary to connect to the mainland is an associated facility[17] to this wind power generation project under the ADB SPS 2009.

7. Based on the baseline data collected, a critical habitat assessment was carried out for the entire Mannar Island and Vankalai Sanctuary using three critical habitat triggers, habitats used by species that are listed as globally critically endangered/endangered, habitats used by species that are listed as nationally critically endangered/endangered and migratory/congregatory species/habitats occupied by more than 1% of the flyway population (Endemics and restricted range species were considered in the Critical Habitat Assessment but none were identified that could be significantly affected by the wind farm).[18]

8. To conduct the ecological assessment of the wind farm project area and the Mannar Island, mapping of terrestrial, aquatic and marine habitats, detailed vegetation classification, quantification of habitat loss as a percentage of habitat presence, bird vantage point surveys, sector counts to record flight line of birds within the Mannar Island and support avian collision risk assessment need to be included. Accordingly, due diligence of all ecological variables in the area of influence and specifically in the following areas were conducted:

- Avifauna data collection and Critical Habitat Analysis - input from Ornithologist,
- Avian Collision Risk assessment inside Wind Farm area and the Mannar Island – input from International Ornithologist,
- Marine Ecology baseline information – input from Marine Biologist,
- Ecology of habitats/flora/fauna baseline information – input from Ecologist,
- Hydrological and hydrogeological information baseline,
- GIS data for the wind turbine sites,
- Noise Assessment studies, Visual Impact, photomontages and wire frames,
- Social Specialist for social inputs.

9. The project will be situated among three sensitive habitats and bird areas – Adam's Bridge Marine National Park, Vidathalathivu nature reserve and the Vankalai sanctuary area. Therefore, study of the impact of the proposed wind farm project on avifauna was identified as a major requirement during the environment assessment process of the proposed project as required by SPS 2009. Hence, a study on avifauna was initiated:

- Assessing the potential impacts of Wind Farm project on the avifauna that inhabits the Mannar Island.

[16] Berger, R.P (1995) Fur, feathers and Transmission lines: rights of way affect wildlife. Wildlife Resource Consulting Services, Inc., Canada, pp. 65.

[17] Associated facilities are not funded as part of the project but their viability and existence depend exclusively on the project and their goods or services are essential for successful operation of the project.

[18] Wetlands International, 2012. Waterbird Population Estimates, Fifth Edition. Summary Report. Wetlands International, Wageningen, The Netherlands.

- Compile all available sources of existing background information on the bird populations reported in the areas identified for the proposed wind farm project specifically and generally the entire Mannar Island and provide an ornithological assessment of the potential impacts and level of risk to the avifaunal population in the area.
- Establish and follow internationally acceptable survey methodologies, survey locations and data collection format to inform the ornithological assessment of wind farm and the entire Mannar Island.
- Prepare an inventory of birds that inhabit the areas identified for the Wind Farm area specifically and the Mannar Island generally and identify the presence of any endangered, endemic or restricted range species.
- Document the baseline conditions that exist at the site that can be used for future monitoring to assess the real impact arising due to the proposed development.
- Identify diurnal and seasonal patterns of avifaunal behavior and the factors that govern these behaviors such as wind, rain, etc.
- Identify the potential impacts that may arise as well as to provide recommendations towards minimizing potential harmful impacts that may arise due to the proposed development.
- Consult the relevant stakeholders regarding the proposal to establish wind farms in the Mannar Island.

1.5 Data Collection and Survey

10. The objectives of the work to be conducted are:

a. Physical features of the existing environment in the area selected for development of Wind Farm as well as the surrounding areas in sufficient details that will enable complete assessment of impacts that may arise due to proposed development and to provide a baseline against which predicted and future changes can be measured.

b. Description of the geology and soil types found in the project site, elevation, topography and landforms of the wind farm block including slope and terrain components, likely impacts on soil erosion, siltation due to construction activities

c. Coastal zone behavior of the area, mainly based on the information gathered on near-shore wave climate and coastline characteristics to be identified. Further information required and the project activities which are likely to cause impacts in the coastal zone will also be identified. The data/information gathered will be critically evaluated and the ones that are likely to give rise to adverse impacts will be studied in detail and mitigation measures to lessen such impacts will be proposed.

d. The availability of water resources and their conditions will be identified by using existing reports and maps. This information will be matched with the available water resources data in the area and it will be useful to identify the surface water conditions and groundwater occurrence and distribution pattern in the proposed project areas. The depth to different water bearing formations, thickness of water bearing formations, their inflow data will be collected from existing wells in the project area.

e. Nearest protected areas and ecological sensitive areas in the Mannar island and the wind power blocks.

f. Existing habitats/ vegetation formations within the Mannar Island and wind farm blocks:

- Enumerate number of Palmyra and other trees to be felled for wind turbine footing/ siting and the underground cables for evacuation of power from Wind turbines along with list of areas required to be cleared and the clearing methodology applicable.
- Type and number of existing trees which need cutting/lopping for wind turbine footing/ siting and power evacuation line corridors and tower bases of the line.

g. Project related impacts on marine environment mainly from construction of a temporary Pier. Survey to identify sensitive marine environments, specify anticipated impacts and also to plan mitigation, monitoring and management measures to be implemented to reduce or avoid the identified potential adverse impacts.

h. To ensure that proposed development is carried out with minimum impacts to the natural habitats - waterholes (‘Thonas’) within and adjacent to the project areas as well as avoidance of Protected Areas.

i. Social impact assessment to assess impacts of the project on communities living within the project influence area; study potential for community participation in the project cycle.

11. An assessment of project activities to specify anticipated impacts, plan mitigation, monitoring and management measures to be implemented to reduce or avoid the potential adverse impacts on the adjoining communities. The detailed studies shall consist of physical, ecological (biodiversity, flora and fauna) and social environment survey reports present site conditions (baseline information). Information will be collected on environmental parameters; public opinion will be assessed while requisite data will be collected using modern techniques. During the process of undertaking the detailed studies, the study team will survey the natural habitats as well as private lands likely to be affected due to the establishment of wind turbines. Reconnaissance and detailed survey of terrestrial habitats, aquatic habitats (thonas, marine and fresh water), and coastal habitats will be carried out.

12. The EIA report comprises baseline data on existing physical, ecological, economic, and social condition, together with the anticipated environmental impacts and proposed mitigation measures. Observations were made through transect walk along the proposed wind tower generator locations, as well as in and around the proposed wind farm from September 2016 to March 2017. Public consultations were held several times (attached in **Annexure 9**) with the project affected communities, stakeholders, NGOs including Bird clubs, Environmental Bodies and government officers that relate to existing environmental conditions around the proposed wind farm and the potential impacts that could happen due to project implementation. In addition, secondary data was collected from published data from GoSL documents, as well as from authorities such as CEB, Coast Conservation and Coastal Resource Management Department (CCD), MPRE and other departments.

13. The EIA present report and its appendixes present the results of the environment impact assessment conducted for the wind power project. Based on the CEA Guidelines of GoSL, the proposed wind power project is categorized as “prescribed.” IEE prepared by CEB has also been approved by the Coast Conservation and Coastal Resource Management Department (CCD), the PAA for the wind power project in **Annexure 7**. Consent letters from other agencies are attached in **Annexure 8**, which conforms to the Sri Lankan regulations.

14. Furthermore, the wind farm site qualifies for conducting “Critical Habitat Analysis,” though

it does not have any aquatic habitats and therefore all the species that trigger critical habitat criteria were observed either flying along the cost, feeding in off shore waters or resting on the beach. Therefore, even though the critical species habitat is triggered for the wind farm based on the presence of these species, the wind farm site is not directly used by any of these birds as a habitat.

2.0 POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

15. This section discusses the national and local legal and institutional framework within which the environmental assessment is carried out. It also identifies project-relevant international environmental agreements to which the country is a party. Aside from these relevant environmental regulations, the World Bank Group's Environmental, Health, and Safety (EHS) Guidelines (2007) and the Environmental, Health, and Safety (EHS) Guidelines for Wind Energy (2015) were also referred to consistent with the requirements of the Safeguard Policy Statement (SPS) 2009 of the Asian Development Bank (ADB).[19]

2.1 Applicable Sri Lankan Environmental Regulations and other Legislations

16. The requirement for Environmental Assessment in Sri Lanka is established by the National Environment Act No. 47 (1980), and the amendment to the act 1988, Act No. 56 Section 23A, for EPL procedure and the EIA regulation under Part 4C, under the provision of section 23Z. The procedures are defined in the environmental impact assessment (EIA) Regulations Gazette No. 772/22 (1993). The Prescribed Projects set out in the Gazette Extra Ordinary No. 772/22 of 24th June 1993, No. 1104/22 dated 6th November 1999, and No. 1108/1 dated 29th November 1999 for which environmental assessment is mandatory.

National Environmental Act

17. The National Environmental Act or NEA (1980/1988/2000) is the main national legislation in place for regulating all activities that affect the environment. It is implemented by the Central Environmental Authority (CEA), which functions under the Ministry of Mahaweli Development and Environment. The scope of this law virtually covers all aspects necessary to safeguard the environment and natural resources in the country. As per the Act, the CEA is entrusted with responsibilities regarding use of lands and the management and conservation of natural resources. Moreover, the CEA manages the standards of wastewater discharges into coastal water bodies and fresh water bodies and monitoring for environmental degradation. Part IV B, of the Act provides the provisions for the maintenance of environmental quality and to control the environmental pollution by setting relevant standards.

18. Part IV C of the Act provides the provisions for Approval of projects which needs an EIA and also detailing the EIA procedures. According to Section 23(z), the requirements for an EIA or IEE study to obtain the Environmental Clearance under the NEA No. 47 of 1980 and its amendments applies to prescribed projects that are specified in the Gazette (Extraordinary) No. 772/22 of 24 June 1993 and No. 859/14 of 23 February 1995.

Fauna and Flora Protection Ordinance (Amendment) Act No. 49 of 1993

19. The first law that provided protection to habitats in order to conserve wildlife is the Fauna

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[19] Asian Development Bank, Safeguard Policy Statement 2009, paragraph 33 of Appendix 1; World Bank Group, Environmental, Health, and Safety Guidelines for Wind Energy, August 7, 2015.

and Flora Protection Ordinance (FFPO), brought in 1937 and in operation since 1938. The mandate of this act is to protect the indigenous wild plants and animals and to prevent their commercial exploitation. Therefore, all the areas declared under this act are intended to achieve this end. The protected areas declared under the FFPO can be divided into two categories. They are the National Reserves and Sanctuaries. A National Reserve can be made only on state land while a sanctuary can be declared on state and private land. The ordinance provides the protection, conservation and preservation of the fauna and flora of Sri Lanka and prevention of the commercial exploitation of such fauna and flora. Amendments are made to include the control and management of national reserves, the protection of elephants and buffaloes in areas outside national reserves and sanctuaries, the capture and keeping protected animals, offences and penalties, prohibition of the import or export of protected animals, and protection of plants. The ordinance has six schedules containing the lists of protected animals.

Forest Ordinance

20. The Forest Ordinance is one of the oldest ordinances in the country, first enacted in 1887 under which the Forest Department was established in 1887. This act has been amended several times in the past. The Forest Reserves gazetted under the provisions of the ordinance and all proposed reserves that are not gazetted under these provisions but selected for conservation based on biological and hydrological importance should be taken into account in implementation of this project.

Pradeshiya Sabha Act No. 15 of 1987

21. Pradeshiya Sabha (PS) is empowered to formulate by-laws for governance of the areas under their jurisdiction on the subjects devolved to them under the Pradeshiya Sabha Act No. 15 of 1987. Some activities falling under this Project such as construction of GSS, waste disposal etc. come under the purview of the Pradeshiya Sabha (PS) and as such need its approval.

Sri Lanka Electricity Act No. 20/2009 and 2013 (as amended)

22. An Act to provide for the regulation of the Generation, Transmission, Distribution, Supply and use of Electricity in Sri Lanka with a view to enabling Sri Lanka to meet the increasing demands for Electricity in the future.

Felling of Trees Act No. 9 of 1951

23. Jak, breadfruit and female Palmyra trees can be felled only with a valid permit issued by an authorized officer, according to the order of 1962 Felling of Trees (Control) Act published by the Minister of Agriculture, Land, Irrigation and Power in the Gazette No. 18856 of October 13, 1962 under the Felling of Trees (Control) Act No. 9 of 1951 (Ch 452).

The *Ma-del* (beach seine) Regulations of 1984

24. *Ma-del* (beach seine) fishing regulations of 1984 and subsequent amendments are applicable to the beach seine fishery in the entire island. The key features of these regulations are the designation and protection of special areas where beach seining can be carried out and the limitation of entry into beach seine fisheries. These features are in line with the principles of community-based fisheries management and incorporate the traditional management practices of this fishery in the past.

25. All beach seine fishing operations are to be carried out exclusively from designated beach seine *warayas* (bays or harbors) identified in the regulations by name and an assigned number and only by beach seine owners who are registered and issued with permits for such operations at those *warayas* which are reserved for their use. Many *warayas* have more than one *padu* (the reserved portion of the beach for a registered beach seine owner). The length of a *padu*, reserved by law for the beach seine owner's exclusive use, ranges from 500 m to 1 km. A common feature of most of these regulations is the prominence given to the concept of community-based management in the ordinances, which in many cases approved and legalized the rules made by the inhabitants of the concerned areas where the rules would apply to their fishing grounds.

Some of the key features of the beach seine regulation

26. Where there are two or more registered owners or groups for a *padu*, a system rotation of turns, agreed upon by all owners, shall be observed. Within a beach seine *waraya*, the use of mechanized craft for the operation of a beach seine is prohibited. While a beach seine is in operation, no mechanized boats are to navigate within the waters of a beach seine *waraya*.[20] Boats other than those used exclusively for the operation of beach seines are prohibited to be anchored in the beach seine *waraya* or to be beached on the foreshore adjoining the beach seine *waraya.* Within the beach seine *waraya,* the use of any fishing gear or fishing boat other than those prescribed by these regulations are prohibited.

Acts and Ordinances that also have a bearing on the project

- Fisheries and Aquatic Resources Act No. 2 of 1996 (and subsequent amendments, No 22 of 2006, 35 of 2013
- Coast Conservation Act No 57 of 1981, amended by Act No 4 of 1996
- Marine pollution prevention Act No 35 of 2008

Table 2.1: Evaluation of the project wholly or partly falling within the relevant jurisdiction areas

No	Jurisdiction	Yes	No
1	100 meters from the boundaries of or within any area declared under the National Heritage Wilderness Act No 3 of 1988		**X**
2	100 meters from the boundaries of or within any area declared under the Forest Ordinance		**X**
3	Coastal Zone as defined in the Coast Conservation Act No 57 of 1981	**X**	
3a	Setback limits defined in the CZMP of 1997 in respect to Mannar Island (80 m)		**X**[a]
4	Within 100 meters from the boundaries of or within any area declared as a sanctuary under the Fauna and Flora Protection Ordinance (Chapter 469)		**X**
5	Within a distance of one mile of the boundary of a National Reserve declared under the Fauna and Flora Protection Ordinance.	**X**	
6	Any gazetted Beach seine (Ma-del) areas under the Fisheries and Aquatic Resources Development Act	**X**	
7	Dumping permit[b] from MEPA	x	
8	Any erodable area declared under the Soil Conservation Act (CM50)		**X**
9	Any flood area declared under the Flood Protection Ordinance (Ch 449)		**X**
10	Any flood protection area declared under the Sri Lanka Land Reclamation Corporation Act of 15 of 1968 as amended by Act No. 52 of 1982		**X**

[20] As per this regulation, when the jetty is put up or barges are used, the fishermen cannot use beach seine and will be compensated as per Resettlement Plan.

No	Jurisdiction	Yes	No
11	Sixty meters from the bank of a public stream as defined in the Crown Land Ordinance (Chapter 454) and having a width of more than 25 meters at any point of its course		X
12	100 meters from the high flood level contour of or within a public lake as defined in the Crown Land Ordinance (Ch 454) including those declared under section 71 of the said Ordinance		X
13	Any reservations beyond the full supply level of a reservoir		X
14	Any archaeological reserve, ancient or protected monument defined or declared under the Antiquities Ordinance (Ch 188)		X
15	Any area declared under the Botanic Gardens Ordinance (Ch 446)		X

CZMP = Coastal Zone Management Plan, MEPA = Marine Environment Protection Authority.
[a] All wind turbines are located about 140 m from coast.
[b] Waste material dumping law in municipal limits.

Clearances/Permits from Relevant State Agencies or Local Authorities

27. Table **2.2** shows the required permits/clearances relevant to the proposed project.

Table 2.2: Details of clearances/permits obtained or should be obtained

	Clearance/ Permit	Status
1	Provisional approval from Sri Lanka Sustainable Energy Authority	Obtained (Annex 3)
2	Letter of Intent from CEB to develop the Project	N/A*
3	Approval from the Coast Conservation Department	Obtained
4	Approval from the Divisional Secretary, Divisional Secretariat, Mannar	Obtained (Annex 3)
5	National Water Supply and Drainage Board Approval	Obtained (Annex 3)
6	Irrigation Department Approval	Obtained (Annex 3)
7	Mannar District Coordination Committee approval	N/A
8	District Land Utility Committee Approval	N/A
9	District Environmental Committee Approval	N/A
10	District Agricultural Committee approval	N/A
11	Approval from the Mannar Pradeshiya Sabah	To be obtained
12	Generating License	To be obtained
13	Civil Aviation Authority Approval for Wind Mast Construction	Obtained (Annex 3)
14	Approval from Road Development Authority for transportation of heavy vehicles and equipment	N/A
15	Approval from Department of Agrarian Development, Mannar	Obtained (Annex 3)
16	Approval from Coconut Cultivation Board	N/A
17	Approval from Ministry of Tourism	N/A
18	Approval from the Survey Department of Sri Lanka N/A	N/A
19	Approval from the Department of Wildlife Conservation	Obtained
20	Approval from the Forest Department	N/A
21	Approval from the Ministry of Defense, public Security, law and Order	N/A
22	Approval from Department of Archaeology	N/A
23	Solid waste disposal arrangement with Mannar Pradeshiya Sabah during operational phase of the project	To be obtained

N/A = not applicable

Note: Letter of intent is a document issued by the CEB to private developers who are developing small renewable energy power plants upon checking the interconnection possibility. Since CEB is the developer of this project and the wind farm is part of the long-term generation plan, this letter is not required.

Table 2.3: Summary of policies and statutory requirements

Sector	Name of the Act	Policy thrust/Instruments	Relevant Institution/s	Relevant Regulations
Environment	National Environmental Act No 47 of 1980 National Environmental Act (Act No. 56 of 1988) Part IV 'C' National Environmental (Amendment) Act, No. 53 of 2000.	Gazette Extra Ordinary No. 859/14 of 23rd February 1991 approving Project "Prescribed Projects" (PP) requiring Initial Environmental Examination (IEE) / and or Environmental Impact Assessment (EIA), Gazette Notification No: 1533/16 of 25.01.2008 which prescribes industries under three categories such as Part A, B and C & requiring obtaining the EPL from the CEA Provincial or District Offices.	Ministry of Mahaweli Development and Environment Central Environmental Authority (CEA)	EIA Regulations Water Quality Standards. Tolerance limits for the Discharge of Industrial Waste in to Island's Surface Waters. Ambient Air Quality Standards, which is the quality of air in our surrounding environment& Stationary Source Emission standards for stack emissions which are emitted from a particular activity. National Environmental (Noise Control) Regulations No.1 1996 dealing with noise Levels
	Fauna and Flora (Protection) Ordinance Act No 49 of 1993 & its amendments.	To provide for the conservation of the fauna and flora of Sri Lanka and their habitats; for the prevention of commercial and other misuse such fauna and flora and their habitats; for the conservation of the biodiversity of Sri Lanka	Department of Wildlife Conservation	Five categories of protected areas are established: Strict nature reserves, National parks, Nature reserves, jungle corridors, and Intermediate zones including sanctuaries. Any development activity within one mile from the boundary of any national reserve is required to be subjected to EIA/IEE, and written approval shall be obtained from the Director General, Department of Wildlife Conservation prior to project implementation.
	Soil Conservation Act No 25 of 1951 subsequent amendments: 25 of 1951; 29 of 1953; 57 of 1981; 24 of 1996	Enhancement and substance of productive capacity of the Soil; to restore degraded land for the prevention and mitigation of soil erosion; for the Conservation of soil resources and protection of land against damage by floods, salinity, alkalinity water logging. Regulation No 1 of 2009 published in gazette extra ordinary No 1633/4 dated December 21, 2009; gazette	Department of Agriculture	Soil conservation guidelines in planting plantation crops in conservation areas declared by the Act; Declaration of land as conservation areas

Sector	Name of the Act	Policy thrust/Instruments	Relevant Institution/s	Relevant Regulations
		extra ordinary No 1550/9 dated May 22, 2008		
	Felling of Trees (Control) Act No 9 of 1951 and its Amendments	The main purpose of this ordinance is to provide for the prohibition, regulation or Control of the Felling of Trees. This has been amended in two times (by 30 of 1953 of 2000) and last updated is by act no 1 of 2000.	The Divisional Secretary has Authority to issue a permit for felling up to 03 of the above-mentioned trees. The District Secretary could issue a permit to fell 3 to 15 of those trees.	Permits should be obtained for felling of Jack, Bread Fruit and female Palmyra trees because yield (nuts) of those trees are used as daily food of human beings If the numbers of those trees are above 15 the Secretary of the Ministry of Agriculture could issue a permit on the recommendation of the Divisional Agriculture Committee and the District Secretary
Land Acquisition	Land Acquisition Act No 9 of 1950 and Local Authority Regulations of 2008	Land acquisition for public purposes is guided by the provisions and procedures outlined in the Land Acquisition Act (LAA,) No. 9 of 1950.	Ministry of Lands Other relevant Ministries and the District and Divisional Secretaries.	Payment of Crop Damages
	National Involuntary Resettlement Policy	All involuntary resettlement resulting from land acquisition; development activities	Ministry of Lands	Payment of compensation
Energy including Non-Conventional Renewable Energy (NCRE)	Sri Lanka Electricity Act No 20 of 2009 & Amendments. Ceylon Electricity Board Act Public Utilities Commission of Sri Lanka Act No 35 of 2002. Sri Lanka Sustainable Energy Authority Act No. 35, 2007	National Energy Policy Sri Lanka Energy Sector Development Plan for a knowledge based Economy Generation, transmission, distribution and use of electricity in Sri Lanka by repealing previous Acts The electricity (Application for Licenses and exemptions) regulations, 2009 published in gazette No 1617/34 dated 3rd September 2009 requiring License for power generation	Ministry of Power and Energy Ceylon Electricity Board Public Utilities commission of Sri Lanka (PUCSL) Sri Lanka Sustainable Energy Authority (SEA)	
Construction of associated facilities such as buildings	Pradeshiya Sabha Act No. 15 of 1987	Require all building plans be approved by the Local Authority;	Local Authority (Pradeshiya Sabha, Municipal Council)	Regulations pertaining to set back limits: street line: assessment

28. A large number of recurrent and non-recurrent activities under establishment of wind power projects are presently not covered by the NEA. A summary of Government environmental compliance requirements applicable to the project is presented in **Table 2.4**.

Table 2.4: Government environment-related compliance requirements

Name	Scope and Objectives	Key Areas	Operational Agencies/Key Players
Agrarian Services Act (Nº 58 of 1979) Agrarian Development Act Nº 46 of 2000	To provide secure background to farmers and their agricultural premises	Regulates the acquisition of land that belongs to paddy and other activities, which are related to agricultural areas.	The Ministry of Agriculture Development and Agrarian Services
Ceylon Electricity Board Act, 1969	To provide for the establishment of an electricity board for the development and coordination of generation	Enters with joint schemes by such board with any government department or approved body for the generation of electrical energy, the irrigation lands, control of floods or other like objects, and to make provision for all matters connected there with or incidental thereto.	Ceylon Electricity Board
Electricity Act 2009	To provide reliable and cheap electrical energy	Regulates the generation, transmission, transformation, distribution, supply and use of electrical energy	Ceylon Electricity Board
Fauna and Flora Protection (Amendment) Act 1993 (Nº 49 of 1993).	To provide greatest protection to fauna and flora	Makes provision for the establishment of protected areas, regulates human involvements to such areas and their fauna and flora.	Department of Wildlife Conservation and Department of Forest
Felling of Trees (Control) Acts Nos. 9 of 1951, 30 of 1953. Felling of Trees (Amendment Act Nº 01 of 2000)	An act to provide for the prohibition, regulation felling of trees.	Regulates the removal of trees relevant to type and the compensation	Department of Forest
Fisheries and Aquatic Resources Act 1996	To provide for the management, regulation, conservation and development of fisheries and aquatic resources	Restricts detrimental or risk activities for aquatic fauna and flora	National Aquatic Resources Research & Development Agency (NARA) and CEA
Flood Act Nº 22 of 1955	Protection of areas subject to flood	Flood prevention	Department of Irrigation
Forest Ordinance Act Nº 13 of 1966 Forest (Amendment) Act Nº 65 of 2009	Conservation, protection and management of forest and forest resources for control of felling and transport of timber	Definition of Conservation Forest, Reserve Forest, Village forests	Forest Department
Irrigation Clauses Act 1973	To provide regulations for the construction of structures across the irrigation canals and water resources.	Regulates the construction of structures across the irrigation canals and water resources.	Department of Irrigation
Land Acquisition (Amendment) Act, Nº 13 of 1986	Establishes the procedure to be followed by the competent authorities for the acquisition of land for public purpose.	It includes, among other matters: investigations for selecting land to be carried out by a district officer appointed by the Minister; issue of notice of intended acquisition indicating the compensation to be paid for any damage caused during investigations; issue of notice of acquisition of land or	Department of Valuation

Name	Scope and Objectives	Key Areas	Operational Agencies/Key Players
		servitude for a public purpose.	
Monuments and Archaeological Sites and remains Act, 1958. Act Nº24 of 1958 Antiques Ordinance, 1960	An Act to provide for the preservation of ancient and historical monuments and archaeological sites and remains of national importance	For the regulation of archaeological excavations and for the protection of sculptures, carvings and other like objects etc.	Department of Archaeology
Motor Traffic Act Nº 60 of 1979	To provide sustainable approach for vehicle traffic	Regulates vehicle traffic during transportation of construction materials and the construction activities	
National Environmental Act Nº 47 of 1980, amendment Nº 56 of 1988, and other amendments	Provide protection, management, enhancement of the environment with prevention and control of pollution	Regulates sustainable utilization of almost all natural resources such as water, soil and air	Central Environmental Authority (CEA)
National Environmental (Protection & Quality) Regulations, No 01 1990.	To provide for the prevention and control of water pollution and enhancing the quality of water	Controls sewage and effluents into inland surface water	CEA
National Environmental (Ambient Air Quality) Regulations, 1994.	To provide for the prevention and control of air pollution	Controls emissions of air pollutants	CEA
National Environmental (Noise Control) Regulations Nº1 1996	To provide maximum allowable noise levels	Regulates noise pollution	CEA
National Involuntary Resettlement Policy	Land Acquisition Act does not deal with the broader social and economic impacts of the project. Thus, this policy was established to overcome these impacts.	To monitor land replacement, income restoration, relocation assistance and allowances, consultation and grievance redress, assistance to vulnerable groups and provision of resettlement sites and services.	Government of Sri Lanka/Land Acquisition and Resettlement Committee (LARC)
Public Utilities Commission of Sri Lanka Act, Nº 35 of 2002	Create an environment for all inhabitants of Sri Lanka and the contributors to its development, to have access to essential infrastructure and utility services in the most economical manner within the boundaries of the sustainable development agenda	Regulate all the utilities within the purview of the Public Utilities Commission of Sri Lanka, to ensure safe, reliable and reasonably priced infrastructure services for existing as well as future consumers in the most equitable and sustainable manner.	The Public Utilities Commission of Sri Lanka
Soil Conservation (Amendment) Act Nº 24 of 1996	Act for conservation of soil resources and productive capacity of land	Degraded Land, prevent damage against salinity, water logging, drought, floods	Soil Conservation Board
Sri Lanka sustainable energy Authority Act, Nº 35 of 2007	To develop renewable energy resources; to declare energy development areas; to implement energy efficiency measures and conservation programs; to promote energy security	Reliability and cost effectiveness in energy delivery and information management, function as a National Technical Service Agency of Clean Development Mechanism (CDM) in Sri Lanka that provides technical assistance to the Designated	Sri Lanka Sustainable Energy Authority

Name	Scope and Objectives	Key Areas	Operational Agencies/Key Players
		National Agency for Clean Development Mechanism and project developers, on energy sector clean development project activities	
National Institute of Occupational 1 Safety And Health Act, No. 38 Of 2009	An act to provide for the establishment of the national institute of occupational safety and health for the formulation of a policy on occupational safety and health standards; to create an environment for occupational safety and health at all workplaces to protect both the employers and employees; and for matters connected therewith or incidental thereto	Occupational safety and health standards	National Institute of Occupational Safety and Health

29. **Annexure 1** gives the details about the applicable laws and regulations, environmental clearance guidelines which are necessary for the proposed project activities.

2.2 Sri Lankan Health and Safety Legislation

30. In Sri Lanka, considerations on Occupational Safety and Health (OSH) was confined to Mines and to the relevant machinery since year 1896 till 1950, and extended only to Factories under Factories Ordinance to-date (1965). The shortcomings in relation to Occupational Safety and Health coverage in the formal sector is a key concern, as only about 30 per cent of the labor force is covered by the main statutory provision on OSH.

31. Realizing the need for wider coverage and taking on the responsibility of the State to ensure a safe and non-exploitative work environment for all Sri Lankans, the Ministry of Labor and Trade Union Relations has embarked on formulating new legislation in consultation with the relevant stakeholders, with technical assistance from ILO. The new Safety Health and Welfare at Work Act (2013) has been approved by Cabinet and is expected to be presented to Parliament for adoption.

32. To institutionalize the supporting activities associated with the introduction of the new OSH legislation the Ministry has established the National Institute of Occupational Safety and Health (NIOSH) The Institute will be responsible for all relevant studies, researches and analysis and setting up of National Standards on Occupational safety and Health. ILO will provide assistance in implementing the new Safety Health and Welfare at Work Act which will provide a safe and a productive environment to all workers.

2.3 Sri Lanka Sustainable Energy Authority Act, No. 35 of 2007

33. The wind farm is being developed under the Energy Development Zone under the Sri Lanka Sustainable Energy Authority (SLSEA) Act, No. 35 of 2007, which is described below:

Sri Lanka Sustainable Energy Authority Act, No. 35 of 2007
Certified on 18th September, 2007] and Published as a Supplement to Part II of the Gazette of the Democratic Socialist Republic of Sri Lanka of September 21, 2007 L.D.—O. 40/2006

An Act to provide for the establishment of the Sri Lanka sustainable energy authority; to develop renewable energy resources; to declare energy development areas;
To implement energy efficiency measures and conservation programmes; to promote energy security, reliability and cost effectiveness in energy delivery and information management; To repeal the energy conservation fund act, No. 2 of 1985 and to provide for matters connected therewith or incidental thereto.

Be it enacted by the Parliament of the Democratic Socialist Republic of Sri Lanka as follows:
1. This Act may be cited as the Sri Lanka Sustainable Energy Authority Act, No. 35 of 2007, and shall come into operation on such date as may be appointed by the Minister by Order published in the Gazette (hereinafter referred to as the "appointed date").

PART I: ESTABLISHMENT OF THE SRI LANKA SUSTAINABLE ENERGY AUTHORITY

2. (1) There shall be established an authority which shall be called the Sri Lanka Sustainable Energy Authority (hereinafter referred to as the "Authority").

PART 1V
DECLARATION OF ENERGY DEVELOPMENT AREA
12.(1) The Minister may, subject to the provisions of subsection (3) and having taken into consideration the recommendations made by the Board that any area is suitable for the conservation and management of renewable energy resources or is suitable for the promotion of renewable energy development projects, by Order published in the Gazette, declare such area as an Energy Development Area (in this Act referred to as "Development Area").

(2) The Minister shall prior to the declaration of any area as a Development Area under sub-section (1), consult such Minister or Ministers or any Minister of any Provincial Council, whom he considers necessary or appropriate to consult in the declaration of such area as a Development Area.

(3) An Order made under subsection (1) declaring an area as a Development Area, shall define that area by setting out the metes and bounds of such Area.

13. The Authority shall be responsible for conserving and managing all renewable energy resources within a Development Area and take all necessary measures to promote and develop such energy resources, with a view to obtaining the maximum economic utilization of those resources.

14. Notwithstanding anything to the contrary contained in any written law, an owner or occupier of any land situated within a Development Area shall not, except with the written approval of the Authority and subject to any terms and conditions that may be imposed by the Authority for that purpose, do any act or permit any other person to do any act, which may change the form of any renewable resource situated within such Development Area or cause the depletion of any such resource in such a manner or to such an extent, that the economic viability of developing that resource is substantially reduced.

15. (1) Subject to as hereinafter provided and the rights granted to any person by a permit issued under section 18 or section 25, the absolute ownership of all renewable energy resources on or below the surface of the land or the air space of the land within a Development Area, is hereby vested in the Republic, notwithstanding any right of ownership or otherwise which any person may have to such renewable energy resources within that Area.

(2) Notwithstanding the provisions of subsection (1), any person who is deprived of his right of ownership or otherwise to a renewable energy resources on or below the surface of his land or the air space of such land by virtue of the provisions of that subsection, shall be entitled to the payment of compensation as may be determined by an Advisory Committee, appointed by the Board for that purpose under section 9 of this Act. In the computation of the amount of compensation payable under this subsection, the person concerned shall be given an opportunity of being heard by such Advisory Committee.

34. The SLSEA Act empowers the Authority to designate usage of the wind development zone, its character and zoning. According to the gazette, the boundary of the wind resource development area is approx. 1.5 km by 15 km. With the development of the 100 MW wind power generation project in the southern part of the Mannar Island, the SLSEA on 21 April 2017,

requested the Urban Development Authority (UDA) under the Ministry of Megapolis and Western Development to declare the identified area as an industrial zone. On 2 May 2017, UDA granted the rezoning[21] and has declared that the energy development area of the Mannar wind power project will be an industrial zone (see **Annexure 8**).

2.4 Multinational Agreements

35. Sri Lanka has acceded or ratified around 40 Multilateral Environmental Agreements (MEA). The MEAs that are relevant to this project are shown in **Table 2.5**.

Table 2.5: Project-relevant international agreements to which Sri Lanka is a party

Agreement	Ratification Date	Objectives
Atmosphere		
Vienna Convention for the Protection of the Ozone Layer (1985)	15 December 1989	Protection of the Ozone Layer through international cooperation in the areas of scientific research, monitoring and of information exchange
Montreal Protocol on Substances That Deplete the Ozone Layer (1987)	12 December 1989	Reduction and the eventual elimination of the consumption and production of Un-anthropogenic Ozone Depleting Substances
United Nations Framework Convention on Climate Change (UNFCCC-1992)	23 November 1993	Stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climatic systems
Kyoto Protocol (1997)	3 October 2002	The Annex 1 parties (Developed Countries) to reduce their collective emissions of greenhouse gases by at least 5% of the 1990 level by the period 2008–2012.
Biodiversity		
International Plant Protection Convention (1951)	12 February 1952	To maintain and increase international cooperation in controlling pests and diseases of plants and plant products, and in preventing their introduction and spread across national boundaries
Plant Protection Agreement for Asia and Pacific Region (1956)	27 February 1956	To prevent the introduction into and spread within the region of destructive plants
CITES - Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973)	4 May 1979	To protect certain endangered species from being over-exploited by adopting a system of import/export permits, for regarding the procedure.
Convention on the conservation of Migratory Species (CMS-1979)	6 June 1990	To protect those species of wild animals which migrate across or outside national boundaries
Convention on Biological Diversity (CBD-1992)	23 March 1994	Conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including appropriate access to genetic resources and by

[21] As no community consultation by SLSEA/UDA/CEB involved in decision, CEB will conduct suitable community consultations.

Agreement	Ratification Date	Objectives
		appropriate transfer of relevant technologies and appropriate funding
Cartagena Protocol on Bio Safety (2000)	28 April 2004	To contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health, and specially focusing on trans boundary movements.
Land		
United Nations Convention to Combat Desertification (UNCCD- 1994)		To combat desertification and to mitigate the effects of drought in countries experiencing serious droughts and/ or desertification with the final aim being to prevent land degradation in the hyper arid, arid, and semi-arid, dry sub humid areas in the countries that are parties of the Convention
Ramsar Convention on Wetland	15 October 1990	To protect wetlands that serve as critical habitats for migratory birds. Sri Lanka presently has 6 sites designated as Wetlands of International Importance, with a surface area of 198,172 hectares.
Chemicals		
Basel Convention on the Control of Trans-Boundary Movements of Hazardous Wastes and Their Disposal (1989)	28 August 1992	To reduce trans boundary movements of hazardous waste; to dispose of hazardous and other waste as close as possible to the source; to minimize the generation of hazardous waste; to prohibit shipments of hazardous waste to countries lacking the legal, administrative and technical capacity to manage & dispose of them in an environmentally sound manner; to assist developing countries in environmentally sound management of the hazardous waste they generate
Rotterdam Convention (1998)	19 January 2006	To promote shared responsibility and cooperative efforts in the international trade of certain hazardous chemicals, to protect human health and the environment; to contribute to the environmentally sound use of those hazardous chemicals by facilitating information exchange, providing for a national decision-making process on their import/export
Stockholm Convention on Persistent Organic Pollutants (POPs - 2001)	22 December 2005	To protect human health and the environment from persistent organic pollutants (POPs).

2.5 Safeguard Policy Statement (SPS) 2009 of the Asian Development Bank

36. SPS 2009 provides for the environmental requirements and review procedures of ADB and applies to all projects and grants it finances. SPS 2009 comprises three key safeguard areas: environment, involuntary resettlement, and indigenous peoples; and aims to avoid adverse project impacts to both the environment and the affected people; minimize, mitigate and/or compensate for adverse project impacts; and help Borrowers to strengthen their safeguard systems and to develop their capacity in managing the environmental and social risks.

3.0 DESCRIPTION OF THE PROJECT

37. The CEB will develop 100 MW wind park to be constructed on southern coast of Mannar Island in the Northern Province of Sri Lanka (see **Figure 3.1**). Mannar Island is one of the five divisional secretary divisions of the Mannar district. The island has a land area of about 130 square kilometers (km^2) and is almost entirely surrounded by sea. Its topography is characterised by an almost flat sandy terrain gradually elevating towards the middle of the island up to about 8 meters above mean sea level (msl). The island's ecological features are characterised by mangroves, lagoon, mud flats, home gardens, coconut plantations, scrublands and natural Palmyra stands. To develop the wind park, the Government of Sri Lanka and CEB requested a loan from the ADB to finance the wind power generation project.

38. Overall, the Project consists of the following outputs:

(i) Output 1: Increase in wind power generation
   (a) 100 MW wind farm constructed in Mannar Island of the Northern Province;
   (b) Wind park infrastructure developed: This involves construction of wind park's internal medium voltage infrastructure, internal cabling and other arrangements; and
   (c) A renewable energy dispatch control center established: This involves establishing a dedicated renewable energy dispatch control center to forecast, control and manage intermittent resource-based 100 MW wind power generation;

(ii) Output 2: Installation of 150 megavolt-ampere reactive (MVAr) reactors; and,

(iii) Output 3: Provision of project management and supervision for construction activities.

3.1 Proposed 100 MW Wind Power Project

39. The proposed wind power park will be located in the southern part of Mannar Island from Thoddaveli to Palavi, about 12.5 km along the coast. The first row of up to 33 turbines are placed about 170 m to 185 m from the shoreline, and the second row of up to 6 turbines are located about 1 km from the shore.

Figure 3.1: The boundary and land use of the Wind Farm, present road network, locations for 39 wind turbines, eastern boundary of the Adam's Bridge National Park, and alternative sites selected for the construction of a pier.

40. The proposed wind farm is demarcated outside the Adam's Bridge Marine National Park declared in 2015. The national park includes the sand islands within the Sri Lankan maritime boundary. It stretches about 1.5 km on the land in Thalaimannar south. The wind turbines are placed outside the eastern boundary of the national park. The nearest village is about 800 m away from the second row of wind turbines.

41. Except for small portions of land occupied by the Sri Lanka Navy for their naval bases and security points, there is no state-owned land within the boundaries demarcated for the proposed wind farm. A preliminary land survey conducted by the project office within 500 meters inland from the coastline indicates that rest of the land located within this corridor belongs to three sources. They include (i) the Bishop of Mannar, (ii) private business companies; and (iii) private individuals. A list of land owners identified during the preliminary land survey is appended (see **Annexure 9**). The project land will be procured either through negotiated settlement or land acquisition process.

42. The Shell Coast Resort is the only tourist hotel found within the wind farm block[22] and the distance to the hotel, from the nearest wind turbines is about 350 m. Similarly, the two 'Investment Cabanas,'[23] several Navy camps/Navy observation points, fishermen restrooms, boat landing

[22] Two investment cabanas are exempt as CEB has agreed to acquire them.

[23] It is noted the two new tourist cabanas may be acquired by CEB which would negate their status as receptors.

sites, Ma-del hauling sites, and fishermen vaadi/ camps (seasonal) are found within the wind farm block. Access roads to the Navy camps, fishermen camps and fish landing sites from Mannar-Thalaimannar main road, and roads parallel to the coastline are also found within the wind farm block.

3.2 Major Components of the Proposed Wind Farm

43. The proposed 100 MW semi-dispatchable wind farm comprises of up to 39 state of the art wind turbines. The wind turbines and all the other associated infrastructure facilities will be designed and built sturdily, to provide wind generated electricity to the national grid during the economic life of the project.

44. The major components of the proposed wind farm include the following:

- Wind turbines;
- Wind turbine foundations and crane pads;
- Step-up transformers for each turbine;
- Power collector system of underground cables to Nadukuda collector substation;
- Wind energy control and dispatch center;
- Administrative building and workshops; and,
- Temporary structures[24] such as wind measuring mast (approximately 100 meters high), container type site offices, and storage areas at project site.

Wind Turbine

45. Based on the analysis of the available wind measurement data in Mannar Island and numerous siting restrictions, CEB has specified the wind turbine unit capacity to be in the range from 2.75 MW to 3.5 MW. A typical wind turbine consists of three major mechanical components: rotor, nacelle and the tower (see **Figure 3.2**) and is described as follows:

- ***Rotor:*** The rotor generally consists of three fiberglass blades that extend out of the hub. In most cases the rotor is mounted to a driveshaft within the nacelle (as described below) to operate upwind of the tower. The rotor attaches to the drive train emerging from the front of the nacelle. Hydraulic or electric motors within the rotor hub feather each blade according to the wind conditions, which enables the turbine to operate efficiently at varying speeds. The diameter of rotor is about 130 m, and the weight is about 60 metric tons. The lower edge of the blade will sit about 25 m high from the ground and whereas the top tip is about 155 m from the ground.

- ***Nacelle:*** The nacelle is a large housing that sits on top of the tower behind the rotor. It houses the main mechanical components of the wind turbine: drive train, power generator, yaw system and its accessories, and sometimes the wind turbine transformer and power electronics. The nacelle is generally externally equipped with anemometer and a wind wane that signals wind speed and direction information to an electronic controller. The nacelle is mounted over yaw gear, which constantly monitors the wind direction and positions the rotor upwind of the

[24] For regular operation of the wind farm, the measuring mast is not needed. The purpose of the specific mast is for power curve testing (performance validation) of the supplied WTs. However, keeping the installed masts on permanent basis to collect wind data would be useful.

tower. The heaviest part of a wind turbine is the nacelle and the weight of nacelle is about 80 metric tons.

- ***Tower:*** The tower supports the nacelle and rotor. Wind turbine towers will be made of steel and of tubular taper design. Tower will have an access door, power cable ladders and internal safety ladder, and/or elevator to access the nacelle. The hub height of the tower required for the project is in the range of approximately 80 to 100 m.

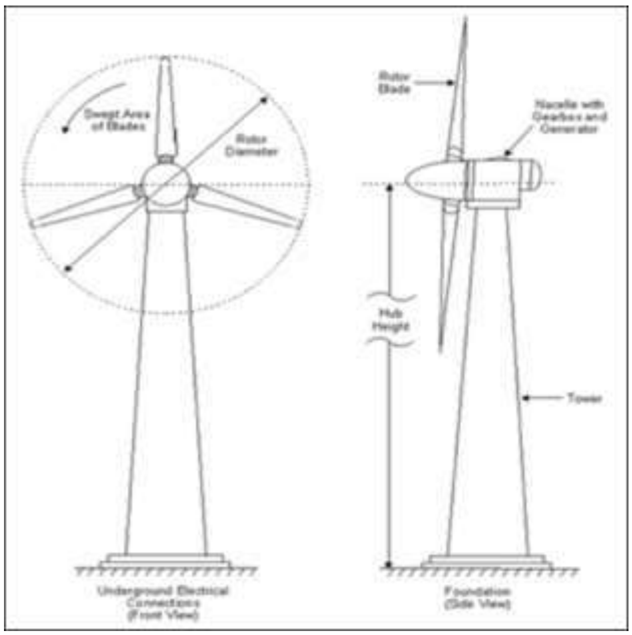


Figure 3.2: The components of a wind turbine, tower rotor and nacelle

Wind Turbine Foundations and Operating Pad

46. Pad type conical foundations with reinforce concrete of approximately 25 m diameter and 3 m depth will be casted. Land requirement for each turbine is estimated to be 150 m x 150 m as per the **Figure 3.2.** and has no buildings in this area. This is the maximum free area[25] required at each turbine footing to facilitate erecting of the turbine. However, only 25 m x 25 m block of land area will be used for excavation and foundation work of the turbine. The tower base height is about 10 m. The general spacing in between adjacent turbines in a single row would be approximately 350 m.

[25] Any value mentioned here would be only tentative, as the hard stand design will vary with the WT model selected by bidder. The land requirement is 150 m x 150 m, implying the WT will be 75 m from the boundary of the land block.

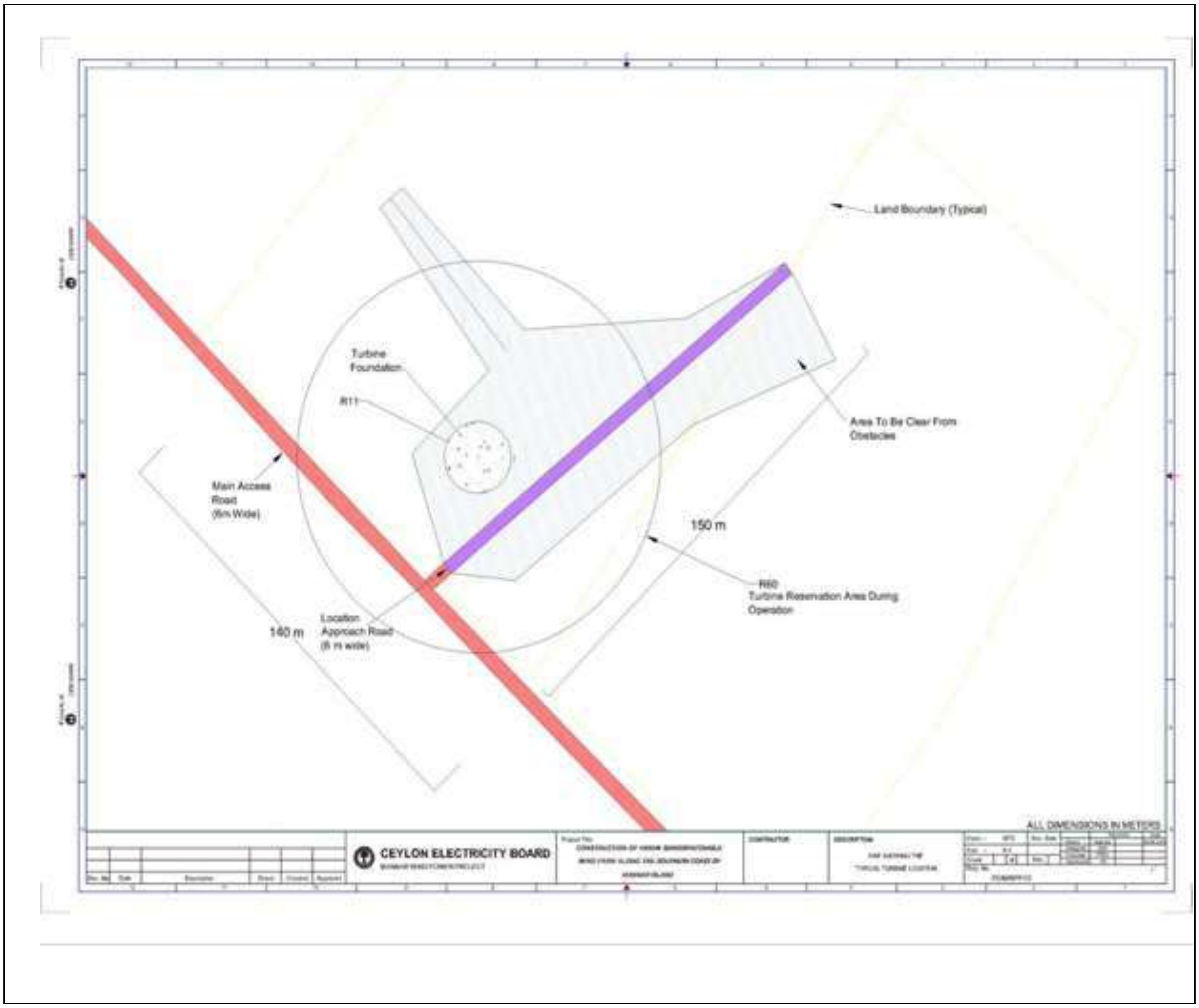


Figure 3.2: Layout plan of a single turbine.

Step-up Transformers

47. Typical generating voltage of modern wind turbines is 690 V. This will be increased up to 33 kV by means of step-up transformer which is located either at the turbine foot or inside the turbine tower/nacelle. The 33 kV side of the step-up transformer is connected to the wind farm collector substation via underground cables which will run along the side of the access road.

Wind Energy Control and Dispatch Centre

48. A dedicated dispatch center will be established, equipped with modern state of the art software and hardware tools and the supervisory control and data acquisition (SCADA) facilities for forecasting and managing the power generation of the wind farm according to the requirements of the CEB System control center.

Wind Masts in the Project Area

49. The project area will have two permanent masts for wind monitoring and they will be sited

inside the wind farm. Wind farm comprises of one permanent mast which will possibly be located between the vacant area originally designated for wind turbine WT 27 and WT 28 (which will not be used for locating wind turbines) without obstructing the microwave communication link of Sri Lanka Navy. The measuring height of this permanent mast will be equal to the turbine hub height which could be within a range of 80 m–100 m. **Figure 3.3** gives the location. Permanent and temporary met masts to be of guy wire type design using bird flight divertors to reduce bird collisions

50. The existing wind measuring mast at Nadukuda is owned by Sri Lanka Sustainable Energy Authority (SLSEA) located between WT 22 and WT 23. This was setup in 2012 using necessary funding from ADB. The height of this mast is 80m and measuring levels are at 80 m, 60 m, 40 m and 20 m. SLSEA will continue to maintain this mast.

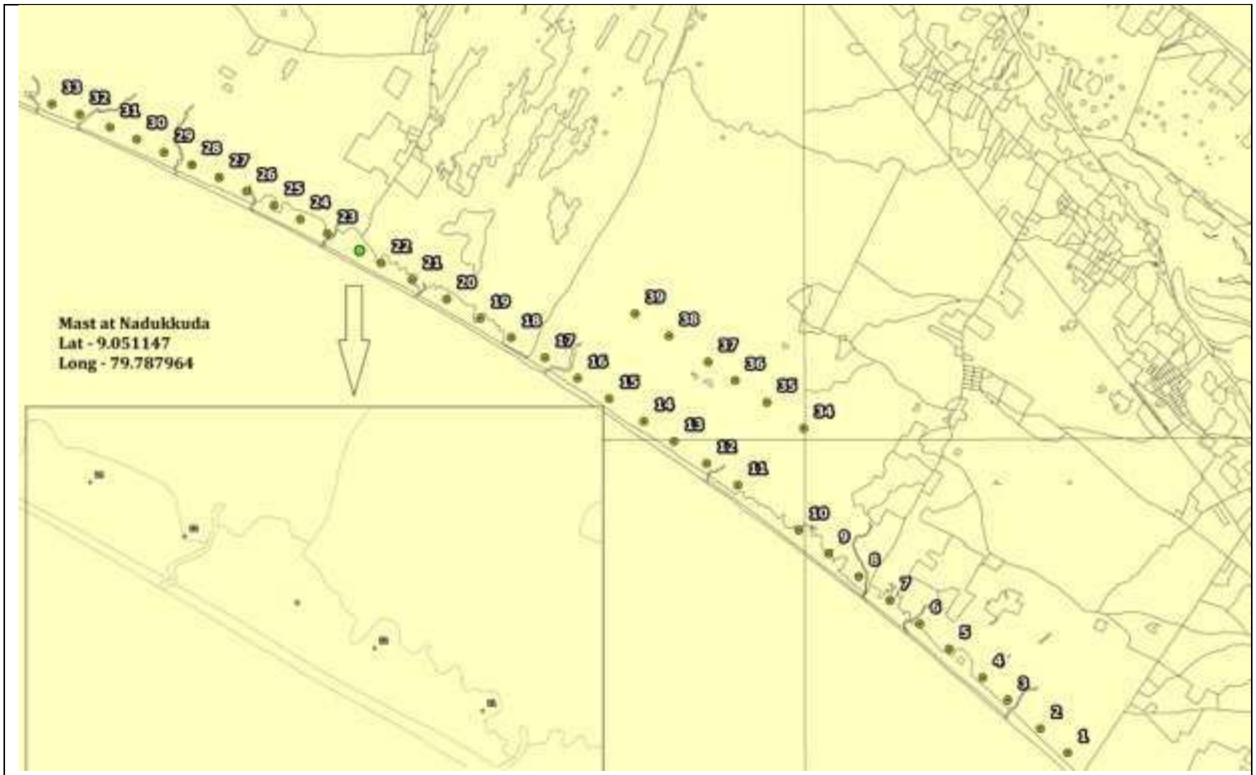


Figure 3.3: Wind Mast

3.3 Type of Project

51. The development of power evacuation system from clean energy sources (wind, solar, small hydro) and overall network efficiency improvement were the outcome from the Green Power Development and Energy Efficiency Improvement Investment Program of ADB. Some of the projects implemented under the program are:

- Mannar Nadukuda power transmission project passing through Vankalai Sanctuary; and
- Augmentation of transmission capacities associated with renewable park evacuation project, i.e., at Mannar and Nadukuda.

Temporary Structures

52. Wind-measuring mast of approximately 91.5 m high will be constructed to verify the performance of the wind machines and will be removed after one year of operating the wind machines. Two container type site offices will be utilized during the construction and commissioning phases which will be approximately 2 years. All these structures will be installed by the EPC contractor and will be taken away after completion of work. Temporary met masts are to be installed with bird flight divertors to reduce bird collisions.

53. **Project layout plan** and drawings, included at the end of the EIA (see **Maps 1-7**), show all project components, access roads to the site, reservation, etc. in order to get a clear picture of the project (Scale 1:1000). These include:

- Laydown areas, camps, storage, facilities (Map 1).
- Laydown areas, foundations, etc. (Map 2).
- Ancillary buildings and access roads (Maps 4, 5 and 6). The main access road is 8 m wide plus drains making the total width of the road as 14 m.
- Design of toilets (Map 7). No groundwater well will be located within a minimum of 100 m from a toilet facility.

Detail of Laying Out of Power Cables

54. The individual wind turbines will be connected to the 33 kV underground cables that will evacuate the power generated into the collector substation at the Nadukuda area. These medium voltage cables will be directly buried underground along the side of the access road (access road is 6 m minimum width) and the turbine approach road, so that the disturbance to the environment will be minimal. Therefore, there will be no aesthetics and visual impacts usually associated with overhead transmission lines.

Power Collector System

55. Power collector system of the underground cable network will be constructed along the access roads to the wind turbines. This will evacuate the power generated from wind farm to the national grid through the proposed Nadukuda Grid Substation (GSS). The layout drawing of the cable laying is illustrated in **Figure 3.4**.

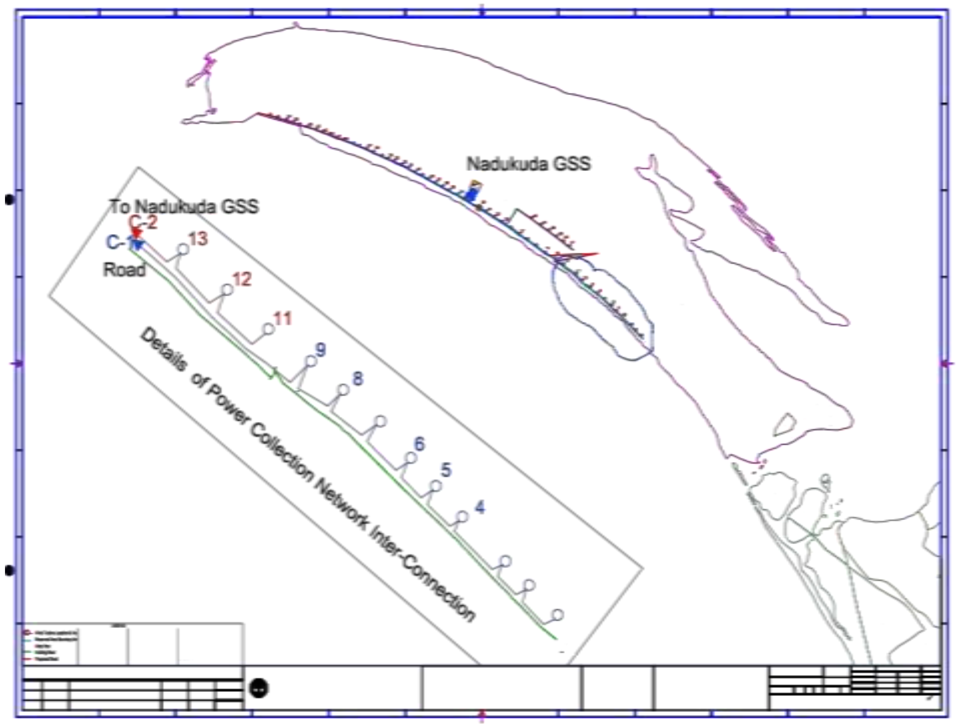


Figure 3.4: Layout of power collection network along the access road to Nadukuda GSS

Renewable Energy Dispatch Center

56. This dispatch centre will be established in the premises of the Nadukuda GSS which will be constructed to meet the requirements of all controlling and dispatching functions of wind farm control systems.

System Reactive Power Management Improved

57. Aside from the wind power farm, another project output is the system reactive power management to support the realibity of wind power generation. The reactor elements of 150 MVAr will be procured and installed at locations in the electricity network to manage voltage levels within the planning limits and practical operational requirements, and ensure reliable operation of the wind park. The reactors of total 100 MVAr will be installed at the 220 kV voltage level at the existing Anuradhapura grid substation in the North Central Province. One 50 MVAr will be installed at the 220 kV voltage level at Mannar grid substation in the Northern Province that are being constructed under the previous ADB financing. These reactors will be in operation during the low system load period (off-peak) and will be required to be automatically (or manually) switched off based on the system load in the area or voltage level. The control functions of the reactors will be designed by CEB. CEB will ensure features for pollution prevention since the facility will contain oil and cause noise generation.

Project Engineering Design Review and Supervision to Support CEB

58. Expert consultancy services will be procured to support CEB in project engineering design review and supervision. These advisory consultancy services will support CEB in ensuring

engineering oversight of the wind park detailed design, wind turbine installation, commissioning and testing activities, and technical certification of contractor's activities throughout construction period. The contractor will be responsible for commissioning and testing the wind farm, including:

(1) Factory acceptance tests;
(2) Site acceptance tests;
(3) Wind turbine performance tests, including:
    (i) Reliability tests of the installed wind turbines;
    (ii) A power curve test to determine whether the Power Curve Guarantee has been achieved;
    (iii) Power system model validation and performance verifications tests; and
    (iv) A wind turbine noise emissions test to be undertaken at the discretion of CEB.

59. The consultants will also support CEB to certify these tests.

3.4 Justification of the Project

60. The National Energy Policy of Sri Lanka had set a target of producing minimum of 10% of the country's electricity generation from Non-Conventional Renewable Energy (NCRE) in 2015. This target was met by the end of 2015, harnessing mainly small hydro and wind resources contributing to 8% and 3% respectively. The Development Policy Framework formulated in 2010 set the NCRE target as 20% by the end of 2020. Small hydro development has almost reached the economic potential and solar energy development is still taking place on a modest scale. Hence, wind remains the only major NCRE source in Sri Lanka that could contribute to reaching the NCRE target of 20% by 2020. The region that offers the highest economic wind potential encompasses Mannar area and the coastal belt extending northward towards Pooneryn.

61. Realizing this situation, the ADB assisted the government of Sri Lanka to prepare a wind development master plan for the Mannar region under TA-8167 SRI: Capacity Building for Clean Power Development Part B: Preparation of Renewable Development and Wind Park Master Plans and Business Model for Wind Park. The master plan had identified 375 MW of wind power potential in the Mannar region with 300 MW located in the Mannar Island and 75 MW in the coastal stretch extending towards Silavaturai in the mainland. The 300MW potential is technical estimation based on the wind resource assessment.

62. CEB has given priority to develop a wind farm of 100 MW on the southern coast of the Mannar Island due to its high plant factor and several other factors like availability of wind data, infrastructure etc. The feasibility and other required initial studies are being carried out to realize the remaining potential. A transmission line is being constructed from Vavuniya to Mannar mainland, terminating at the Mannar GSS currently under construction. Mannar–Nadukuda transmission line is also at the initial stages of construction along with the Nadukuda collector substation to facilitate interconnection of this 100 MW wind farm to the national grid.

3.5 Location

63. Project location spans a 12.5 km stretch of coastal land extending from Thoddaveli towards Thullukuduirruppu in Thalaimannar, that includes five Grama Niladhari Divisions (**Table 3.1**). Entire project area lies within an "energy development area" declared by the Sri Lanka Sustainable Energy Authority (SLSEA) in the Mannar Island (refer the extraordinary gazette No. 1858/2 of 17th April 2014 of the Democratic Socialist Republic of Sri Lanka).

Table 3.1: Location of proposed Mannar Wind Power Project

Provincial Council	District Secretariat	Divisional Secretariat	Local Authority	Grama Niladhari Divisions (GND)
Northern Provincial Council	Mannar District Secretariat	Mannar Town	Mannar Pradeshiya Sabah	Pesalai South MN/56
				Thoddavelli MN/62
				Olaiththoduvai MN/60
				Kattukarankudiruppu MN/53
				Thullukudiruppu MN/54

64. Mannar Island is characterized by a flat terrain with the highest elevation above mean sea level being less than 8 m. The shallow lagoons found in the area have an average depth below 1.5 m and experience daily tidal variation of 50–60 cm in amplitude. The area receives an average annual rainfall of about 950 mm, mainly during the north-east monsoon (December–February).

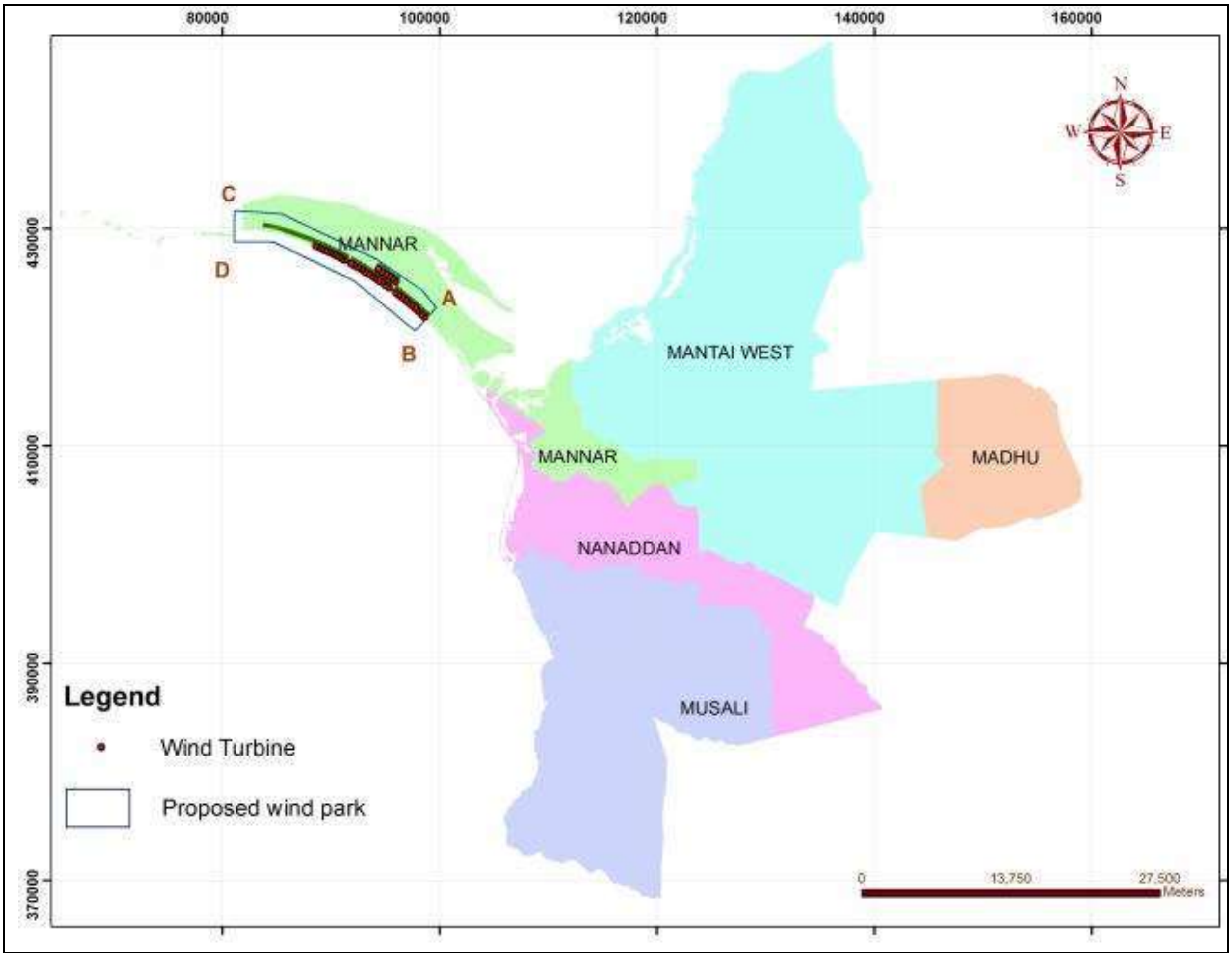


Figure 3.5: Divisional Secretariat Divisions and the location of the Wind Farm in Mannar District

The Wind Farm Site

65. Physical features such as the location of wind turbines are marked in **Figures 3.5** and **3.6** with administrative boundaries. The proposed wind farm site is demarcated outside the Vankalai Sanctuary as well as the Adam's Bridge Marine National Park. The wind turbines are placed

outside the eastern boundary of the Adam’s Bridge National Park, outside the buffer zone of the national park. The wind farm comprises two rows of wind turbines, the first row along the sea shore having up to 33 land blocks suitable to locate wind turbines and the second 800 m behind the first row, having up to six such land blocks for turbine location. There are no houses close to wind turbines. The nearest village is about 800 m away from the second row of wind turbines. The first row of 33 turbines are placed about 170 m–185 m from the shoreline, and the second row of 6 turbines are located about 1 km from the shore.

66. Except for small portions of land occupied by the Sri Lanka Navy as naval bases and security points, there is no state-owned land within the boundaries demarcated for the proposed wind farm. A preliminary land survey conducted by the project office within 500 meters inland from the coastline indicates that rest of the land located within this corridor belongs to three sources. They include (i) the Bishop of Mannar, (ii) private business companies; and (iii) private individuals.

67. The Shell Coast Resort is the only tourist hotel found within the wind farm block and the distance to the hotel, from the nearest wind turbines is about 350 m. Similarly, the two cabanas owned by Kaluthota Investments,[26] several Navy camps/Navy observation points, fishermen restrooms, boat landing sites, Ma-del hauling sites, and fishermen vaadi/ camps (seasonal) are found within the wind farm block. Access roads to the Navy camps, fishermen camps and fish landing sites from Mannar–Talaimannar main road, and roads parallel to the coastline are also found within the wind farm block.

[26] These properties may be acquired by CEB.

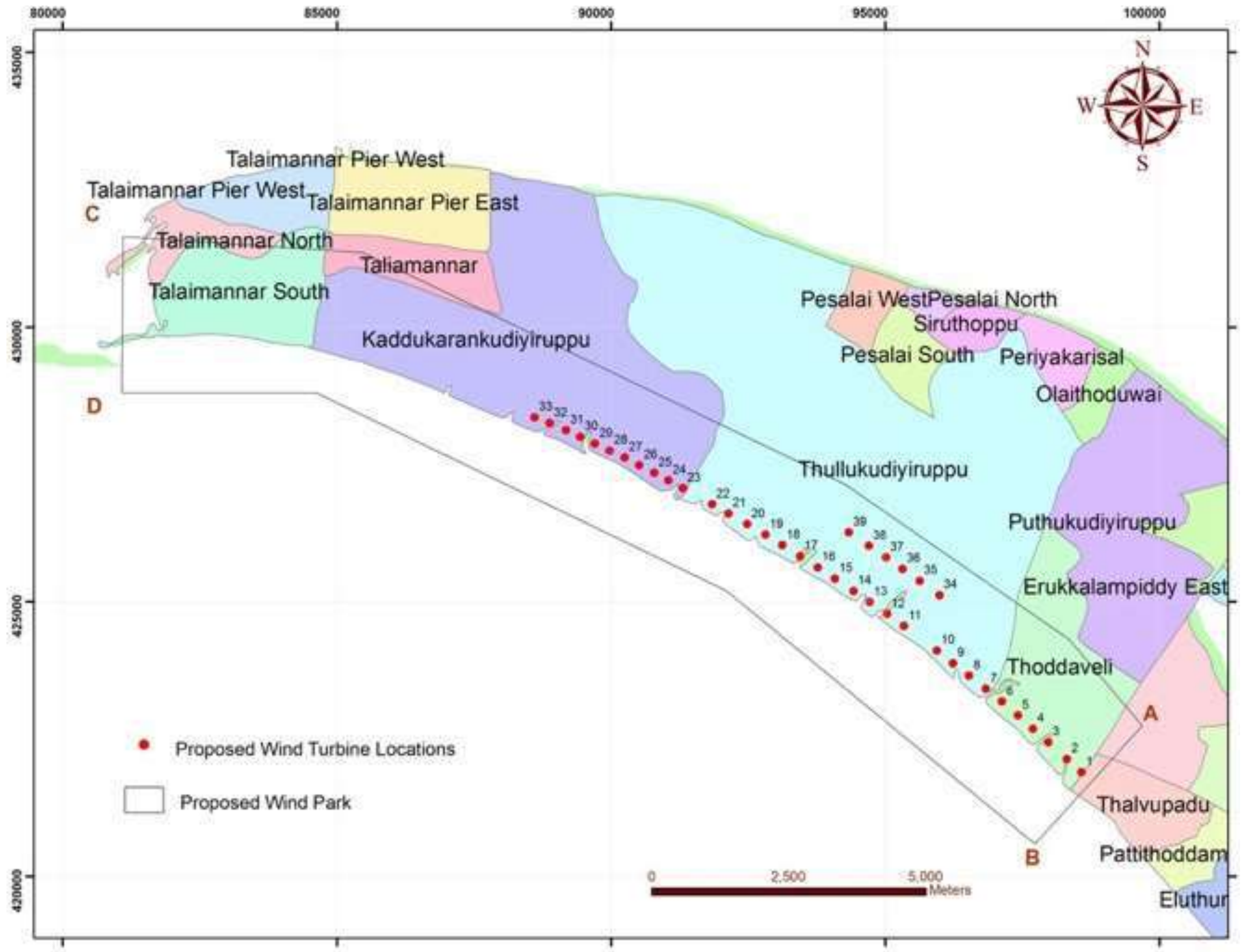


Figure 3.6: Proposed wind turbine locations (1-39) in the southern coast of the Mannar Island (in relation to GNDson the island).

68. Other areas adjoining the Mannar Island that are listed as ecologically sensitive areas include:

Ramsar Area Study Site

69. The area identified for the construction of the transmission line supports a rich avifaunal diversity. Further, Mannar is one of the key entry and exit points of migratory birds that use the Central Asian Flyway. The elevation in the area ranges from 0 to 5 masl. The shallow lagoons found in the area have an average depth below 1.5 m and experience daily tidal variation of 50 cm-60 cm in amplitude. The area receives an average annual rainfall of about 950 mm, mainly during the north-east monsoon (October–December). The average annual temperature is around 27°C. The shallow brackish water lagoons, mud flats and the sea-grass contribute to a highly productive near-shore ecosystem that supports a rich assemblage of fish and invertebrates which in turn supports a rich array of water birds. Further, this region also supports a number of bird species that are absent or seldom found elsewhere in Sri Lanka.

70. Therefore, an area of 4,398.95 hectares (ha) between Mannar and Mannar Island has been designated as a bird sanctuary, namely Vankalai Sanctuary in 2008 for the protection of birds. Vankalai Sanctuary is located close to the town of Mannar at 8° 56’ 15.17’’ N and 79° 55’

24.3'' E. The sanctuary includes part of the main land, coastal islands, sea-shore and part of the marine area. The sanctuary is bounded by Vankalai in the south, Puliyantivu Island in the west and Tiruketiswaram in the north and east including the causeway between the mainland and the Mannar Island. Sanctuary consists of several habitats and vegetation types such as arid-zone thorn scrubland, arid-zone pastures, maritime grasslands, sand dunes, mangroves, waterholes, tanks, salt marshes, lagoons, tidal flats and sea-grass beds. It also includes part of the shallow marine region especially in the northern region.

71. The Gulf of Mannar harbors more water birds during the migratory season, including the Northern Pintail (*Anas acuta*), Greater Flamingo (*Phoenico-pterus roseus*) and the Eurasian Wigeon (*Anas Penelope*). The site's coastal and marine ecosystems are important for over 60 species of fish, marine turtles, and rare species such as Dugongs (*Dugong dugon*). These ecosystems provide important spawning and feeding grounds for juvenile fish species such as Trevally (*Caranx* spp.), Snappers (*Lutjanus* spp.), and harbors a number of threatened species, including the Indian Spot-billed Duck *Anas poecilorhyncha*, marine turtles, namely Green Turtle *Chelonia mydas*, Olive Ridley Turtle *Lepidochelys olivacea* and the marine mammal Dugong (*Dugong dugon*). The marine turtles are listed in CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora).

3.6 Size and Magnitude of the Operation

Summary of Planning and Phasing of Works

72. The establishment of the wind farm can be considered as comprising construction, operational refurbishment and/or decommissioning phases.

Construction

73. The construction phase of the wind farm will include activities such as:

- Construction of a temporary pier
- Transportation of people, material and equipment to the wind farm site
- Civil works for access track upgrades and construction, wind turbine foundations, and trenching for power cables
- Establishment, operation and removal of approximately two concrete batching plants which must be located 100 m away from any surface water body or any well
- Potential use of rock crushing equipment, if required
- Potential use of piling in setting of jetty foundation
- Preparation of concrete foundations, which must be cured for many weeks prior to wind turbine installation
- Installation of wind turbines using large mobile cranes
- Installation of power collection system cables
- Construction of temporary offices and facilities
- Temporary storage
- Restoration and revegetation of disturbed onsite areas (including the temporary pier) on completion of construction works
- Pre-commissioning checks on wind turbines and all high-voltage equipment prior to connection to the electrical network

74. The construction process will be managed by an EPC contractor, including safety and environmental management plans.

Operational

75. A modern wind farm operates largely unattended. However, the wind turbines and other equipment require regular maintenance, and occasionally major repairs or component replacements are required. Routine maintenance on wind turbines is generally conducted on 6 monthly intervals, with a focus on maximizing energy output by conducting maintenance during low wind speeds, whenever possible.

76. Major repairs might include replacing wind turbine blades, generators or gearboxes, and these activities would generally require a mobile crane to be brought to the site.

77. Maintenance activities will be contracted to the wind turbine supplier, at least during the initial years of operation, while CEB builds their internal capacity to maintain the wind farm. The O&M contract will be implemented by EPC contractor while CEB will implement all health and safety related programs at the site as evident from implementation capacity of CEB from other other ADB funded programs.

78. An Environmental Monitoring Plan will be in place to monitor environmental aspects of operation. CEB will ensure that there is low risk to community health and safety through proper control of turbines through SCADA as well as how they will be maintained, serviced etc.

Refurbishment and/or Decommissioning

79. The wind farm will have a design life of 20 years, although the life of a modern wind farm is generally expected to be between 20–30 years. After which, wind turbines would be refurbished, replaced, overhauled or removed.

80. Replacements, refurbishment and recommissioning or decommissioning would involve similar road access arrangements to construction, and would require large cranes. Any refurbishment or replacement would need to comply with the requirements of the original project.

81. If decommissioned, all underground footings and cable trenches would remain in situ, while all above ground infrastructure would be removed. It is noted that the scrap value of wind turbines and other equipment is expected to be sufficient to cover the majority of the costs of their dismantling and site restoration.

82. **Figure 3.7** provides general location map for all projects proposed under the project. **Figure 3.8** shows the location of the wind turbines in relation to the three important bird areas.

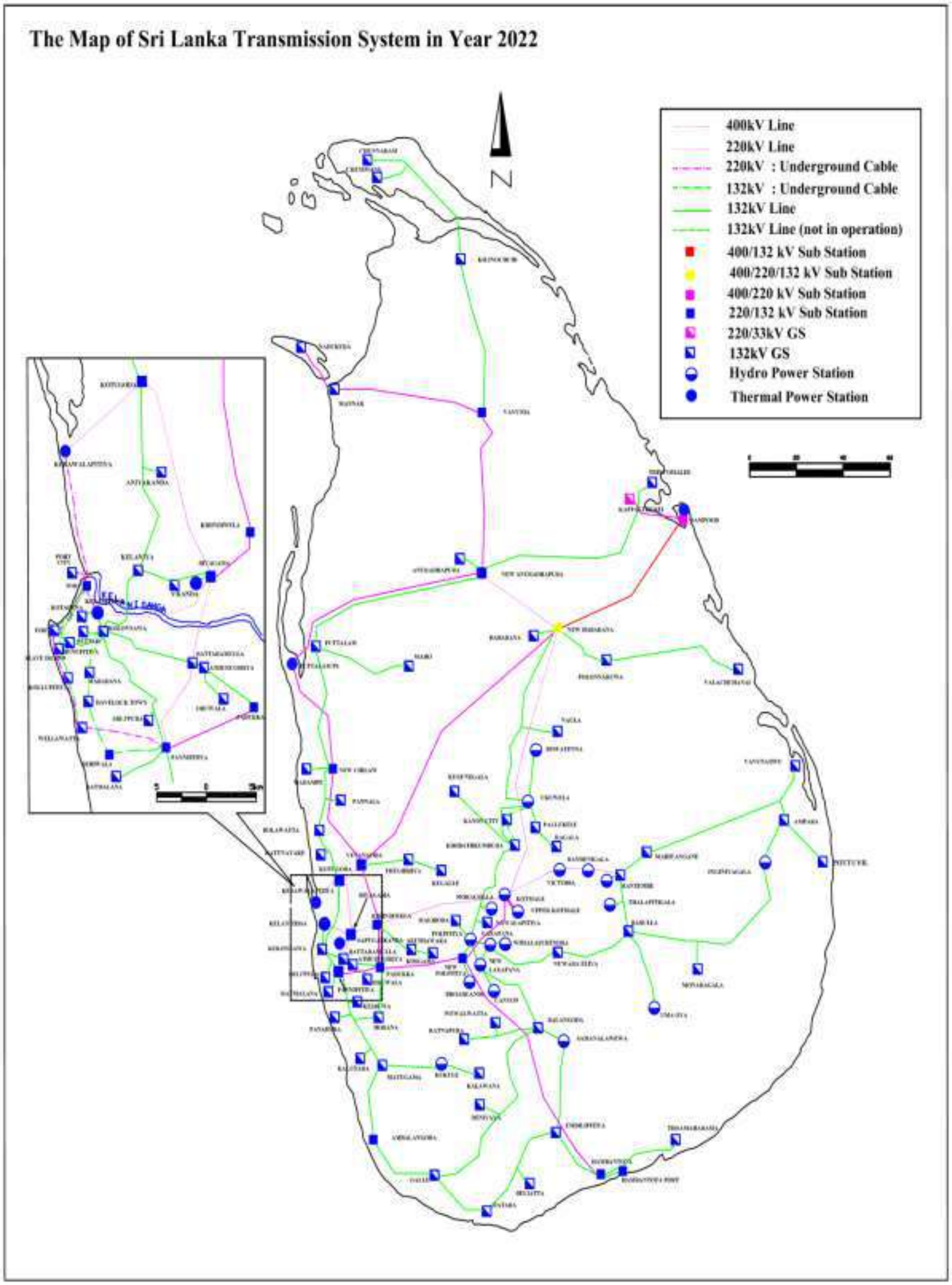


Figure 3.7: Map of Sri Lanka including details of Proposed Project Location and national grid infrastructure

Figure 3.8: Wind turbines location in respect to three important bird areas

4.0 DESCRIPTION OF ENVIRONMENT (BASELINE DATA)

4.1 Physical Environment

83. Mannar District is located in north-western Sri Lanka. It is one of five administrative districts of the Northern Province. The district covers 2,002 km^2, approximately 3% of the total land area of Sri Lanka and has 50% forest cover. A major part of this division is an island connected to the mainland by a 3-mile causeway and a bridge.

84. Geographically the bulk of Mannar is on the mainland within the arid and dry zone. High temperatures and low rainfall characterize the climate. The monthly temperatures range between 26.5°C and 30.0°C with highs normally recorded between May and August. Mannar receives nearly 60% of its rainfall during the northeast monsoon, which lasts from October through December. The land area is relatively flat and sits at low elevations. Towards the interior, the terrain is gently undulating, favoring the storage of rainwater in tanks that provide the majority of the irrigation for the district's arable land. The primary economic activities in Mannar are crop cultivation (mainly paddy), fisheries, and animal husbandry. Employment opportunities in the district are highly seasonal, and there are no institutional facilities for tertiary education.

4.1.1. Topography, Geology and Soil

85. Topography along the proposed wind farm can be explained in terms of contour, slope, aspect and land use. Contour map of the area is clearly demarcating very flat terrain along the proposed wind farm. Therefore, slope and aspects are not important for the proposed area. Major

topographical variation present in the area is due to small scale sand dunes. However, the sand dunes are not present within the distance of 130–150 m from the coast, demarcated for construction of wind turbines.

86. Therefore, the flat topography of the area has no threat in terms of landslides. There is no significant possibility for flooding and tidal impacts. However, there is a possibility for major tsunami incidences in the flat terrain, only during the massive tsunamis; water level rises can be expected. Because tsunami originated zone is not directly facing the proposed project site, there is no significant threat from major tsunamis on the proposed developments. However, earthquake-triggered tsunamis can take place at any location of the sea basin thus it is necessary to consider solid foundations for the wind turbines and locate electrical equipment above any flood level.

General Description of Geology

87. Sand dunes are hills of sand having different forms and sizes, built by the winds. The dunes can move to form different topography. Highly dynamic coastal topography is characterized by rapidly moving sand dunes and fluctuating shorelines. The distribution of windblown sand dune is very limited and left behind some significant geological challenges for the explanation of its formation in relation with the past climate conditions.

88. Field observations of the costal stretch along the proposed wind turbine locations indicate that the sand dunes are not dominantly developed during both dry and rainy seasons. Only small scale dunes are developed due to lower speed of wind (see the contours in land use maps). Especially winds arriving from south-west and north-east directions form minor scale dunes in the beach. Mainly around the south west region of the Mannar (Nadukuda) Island many medium scale dunes are present. Moreover, mineral segregations along the wind direction face and slip face of the dunes can be able to identify clearly. During the field survey three major zones are identified around the proposed wind turbine locations. Very closer to the coastal line indicates recent beach sands which consist of moderately developed small scale dunes. Minor scale heavy mineral segregations with respect to wind direction face and the slip face of the dunes could be easily identifiable. The second region is area probably represents previously migrated sands from the beach environment during the Holocene period. Hence there is no clear development of dunes of the area. The proposed wind turbine locations are located in this region. The third region is the medium scale sand dune dominant area. This area mainly consists of bushes and Palmyra groves/stands. This area is needed to protect in order to develop natural forest cover around them. The second row of the proposed turbine locations (wind turbine no 34-39, about 1 km from the sea shore) is about 300 m to the region of dominant sand dune formations.

89. In addition, western end of the Mannar Island, about 6.8 km away from the last wind turbine location (No. 33), mud flats are present. Those are represented by recent mud deposits which were formed by tidal influences on top of the paleo-sand layers.

General Description of Soil

90. Residual soils in the region are formed from a variety of rocks, mainly meta-igneous rocks and meta-sedimentary rocks. Soils along the proposed wind turbine locations are different from the other parts of the country due to dominant sand formation. Non-agricultural transported soils having variable properties and texture. General soil distribution map around the proposed wind farm is given in **Figure 4.1** and brief description for the major soils is given below in **Table 4.1**.

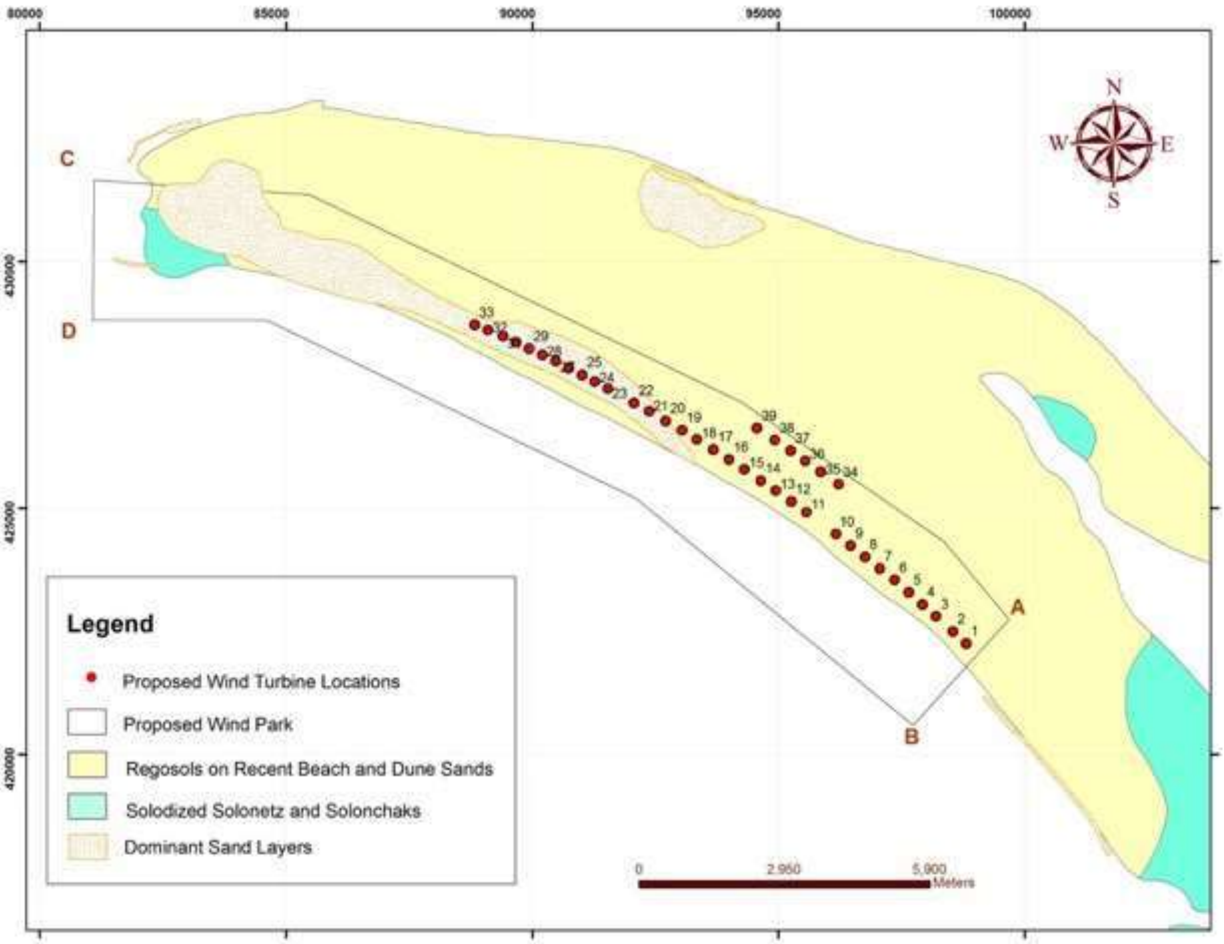


Figure 4.1: General distribution of soil in the proposed project site

91. Major soil types found in Mannar district are given in **Table 4.1**.

Table 4.1: Soil Types

Type	Nature of soil
Reddish brown earth	Good for other field crops, vegetables, horticulture and forestry.
Grumusol (clay soil)	High potential for paddy cultivation averaging 4.7– 5.4 Mt per ha.
Regosol	Mainly found in Mannar Island – good for vegetables, Palmyra and Coconut.
Yellow red latosol	Found distinctively in coastal regions – good for vegetables, horticulture and other field crops.

Source: Statistical Handbook 2002 – Mannar district. (Adopted from Resettlement Programme Mannar district).

Regosol on Recent Beach and Dunes

92. This soil type is dominantly present around the proposed wind farm project. It commonly occurs in the lean coastal areas. The soil has less organic matter, N and P, K, Ca, and Mg contain required levels and has better cation exchange capacity. Underground water is dominant and area is rich in water drainage. Coconut and cashew can be planted.

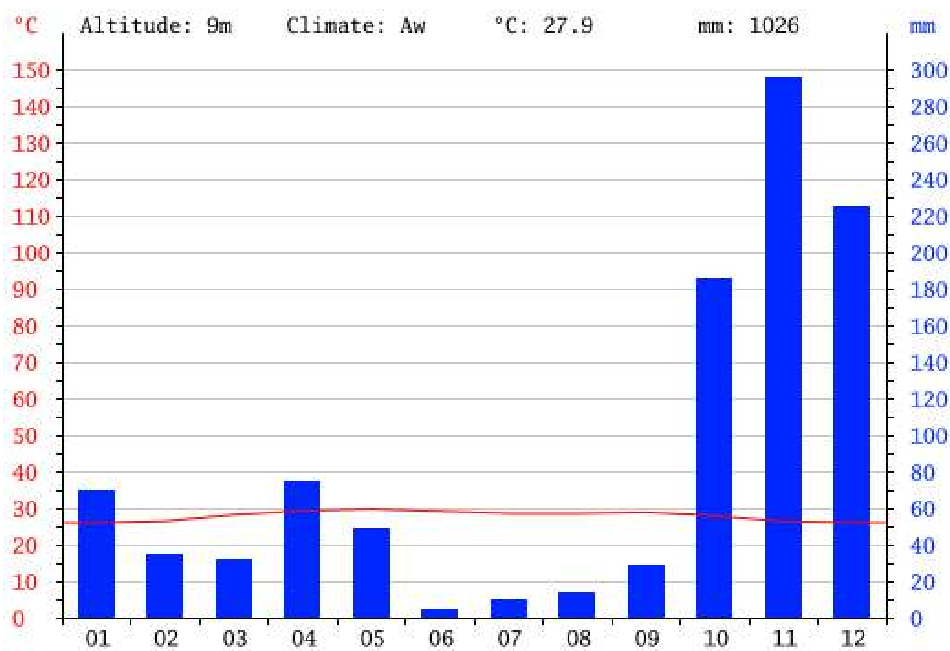
Solodized Solonetz

93. Solodized solonetz are developed due to mixing of sea water with the coastal soils hence base saturation is generally high. Also, metal corrosive salts can be present with this soil type. Thickness of the horizon A of Solodized Solonetz ranges from a few centimeters to 50 cm. Horizon B is dark in color and columnar structure is dominant. This is not very fertile soil. The amount of sodium is greater than 15% and pH is greater than 8.5.

4.1.2. Climate and Meteorological conditions

Climate and meteorology

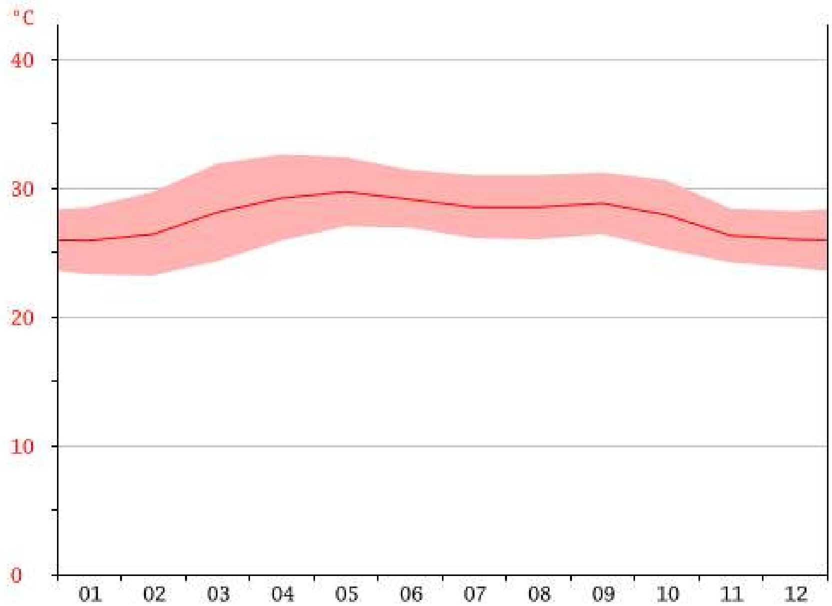
94. Western part of Mannar district, including the Mannar Island forms a part of Sri Lanka's Arid Zone while the rest of the areas of the district falls within the dry zone of Sri Lanka, where a tropical dry climate prevails. The area covered by the district receives somewhat low rainfall throughout the year. Annual rainfall in the western part of the district, including the Mannar Island, is less than 1,000mm while that in rest of the district is between 1,000–1,250 mm. The area experiences heavy rains from October to December, during NE monsoonal season. In comparison, amount of rainfall received during the rest of the months is extremely low (**Figure 4.2**).



Source: IEE for 100 MW Mannar Wind farm Project April 2016 by CEB

Figure 4.2: Monthly average rainfall in Mannar Island

95. The highest average monthly temperature is recorded in the months of April, May and June (33°C) while the lowest is encountered in the months of December, January and February (23°C). The mean annual temperature is about >27.5°C (**Figure 4.3**, **Table 4.2**).



Source: IEE for 100 MW Mannar Wind farm Project April 2016 by CEB

Figure 4.3: Monthly averages, high and low temperatures in Mannar Island

Table 4.2: Climate table for Mannar Island, difference in precipitation between the driest month and the wettest month is 291 mm, the average annual temperatures vary by 3.8 °C.

Month	1	2	3	4	5	6	7	8	9	10	11	12
Mm	70	35	32	75	49	5	10	14	29	186	296	225
^{0}C	25.9	26.4	28.1	29.2	29.7	29.1	28.5	28.5	28.8	27.9	26.3	26.0
^{0}C (min)	23.3	23.2	24.3	25.9	27.0	26.91	26.1	26.0	26.4	25.2	24.2	23.8
^{0}C (max)	28.5	29.7	31.9	32.6	32.4	31.4	31.0	31.0	31.2	30.6	28.4	28.2

Source: IEE for 100 MW Mannar Wind farm Project April 2016 by CEB

Agro-ecological Conditions

96. According to major climatic zones of the country, the proposed wind farm belongs to the dry zone. Agro-ecologically, the wind farm lies in the DL3 zone (low country dry zone) **Figure 4.4**.

97. The mean temperature is about 30 °C. The soils occur in valley bottoms of the region of undulating terrain are used for rice crop. However, the project area is dominated by sands and there is no rice cultivation area within the wind farm. An average of, 6-8 t/ha paddy yield can be expected during Maha with supplementary irrigation in Grumusols in Mannar district. However, average paddy yield under rain fed condition is about 2-3 t/ha. The main rice growing great soil groups in this region are Calcic Red Yellow Latasols, Grumusols and Alluvial soils situated in flat to undulating terrain. There are some Solodized- Solonetz and Solonchaks soils situated in flat terrain. The general landform pattern of the region is undulating and the slope varies from 2-8%.

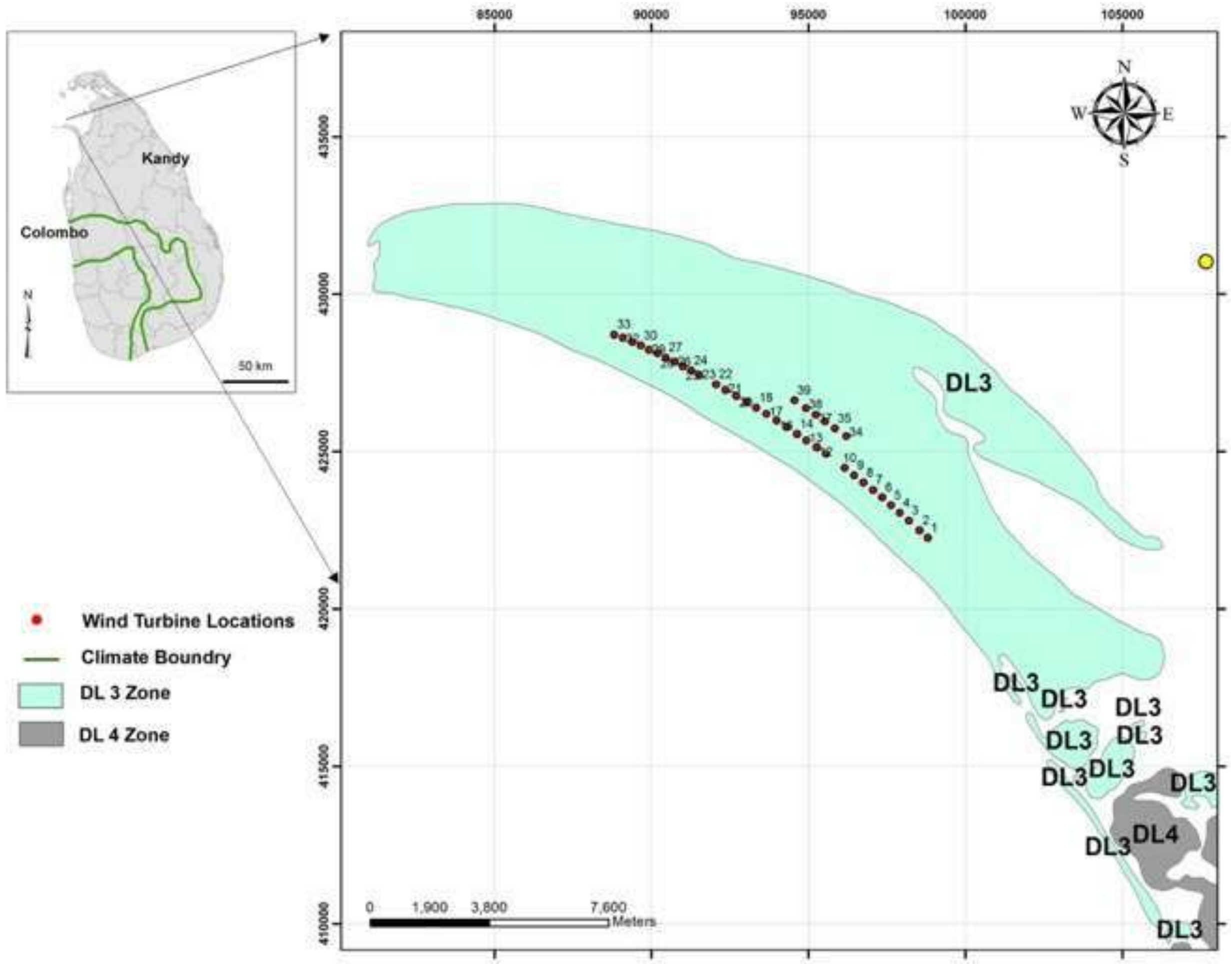


Figure 4.4: Agro-ecological map of the proposed wind farm area.

4.1.3 Wind

98. Wind direction and speed across the proposed wind farm is highly dependent on the terrain morphology. According to maps developed by the Department of Meteorology, wind roses are developed for months of January, April, July and October (**Figure 4.5**). According to the observations general winds are dominant during the northeast (NE) monsoons with heavy rainfall. However, during the southwest (SW) monsoons dry wind roses are present along the terrain without forming typhoons. Cyclones are not frequent in the Gulf of Mannar which faced its last typhoon in December 2000.

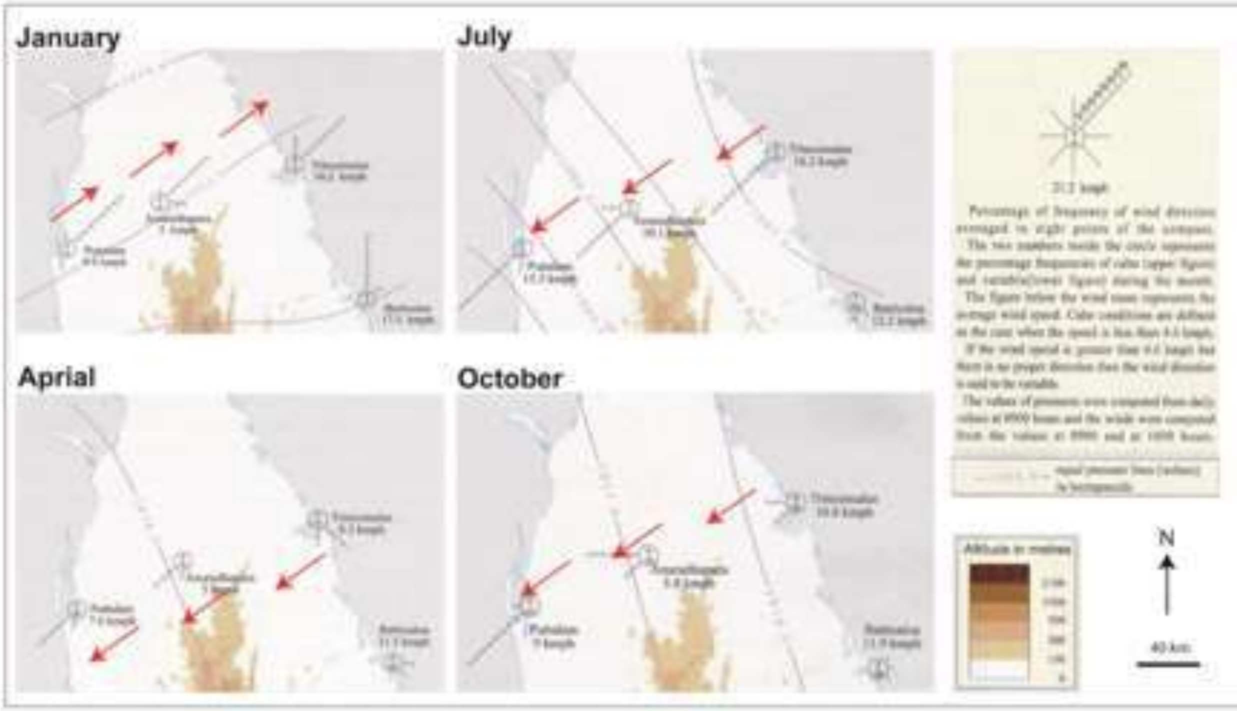


Figure 4.5: Wind directions around the proposed wind farm.

Wind Measurements in Nadukuda, Mannar Island

99. A triangle lattice aluminum mast, with a total height of 79.0 m, was built in Nadukuda for the wind measurements in Mannar Island in 2012. The measurement site was chosen by the RMA and GEO-NET. The mast was fixed with guy wires to three directions. The foundation of the mast was made with concrete. The met mast was delivered and erected by GeNet, GmbH, Germany.

100. The wind speed was measured with cup anemometers at 81.5 m, 80.0 m, 60.0 m, 40.0 m and 20.0 m height above ground. One anemometer was installed on top of the mast in 81.5 m. The other anemometers were mounted on side booms. The anemometer at 80.0 m height served as back-up anemometer for the 81.5 m anemometer and the anemometers at the lower heights served for the determination of the vertical wind shear. The wind direction was measured with wind vanes at 80.0 m and 60.0 m above ground. Northing of wind vane was performed according to GEO-NET quality management system. Data is shown in **Table 4.3**.

101. The air temperature and the air humidity were measured at 80.0 m above ground with a combined sensor of the type Galltec KPC 1/5. The air pressure was measured at 16.0 m above ground with a sensor of the type P-GE 6. The data of the sensors was recorded with a data logger of the type Campbell CR1000-CSL. The measurement interval was 1s and the storage static interval was 10-min-means. The data logger was calibrated before the start of measurements by Campbell Scientific Ltd.

102. The stored data was transmitted daily as daily data sets by means of GSM. The storage, conversion and regularly checking of data in the office was realized according to the quality management system of GEO-NET.

Table 4.3: Overview of wind speed average and extreme values

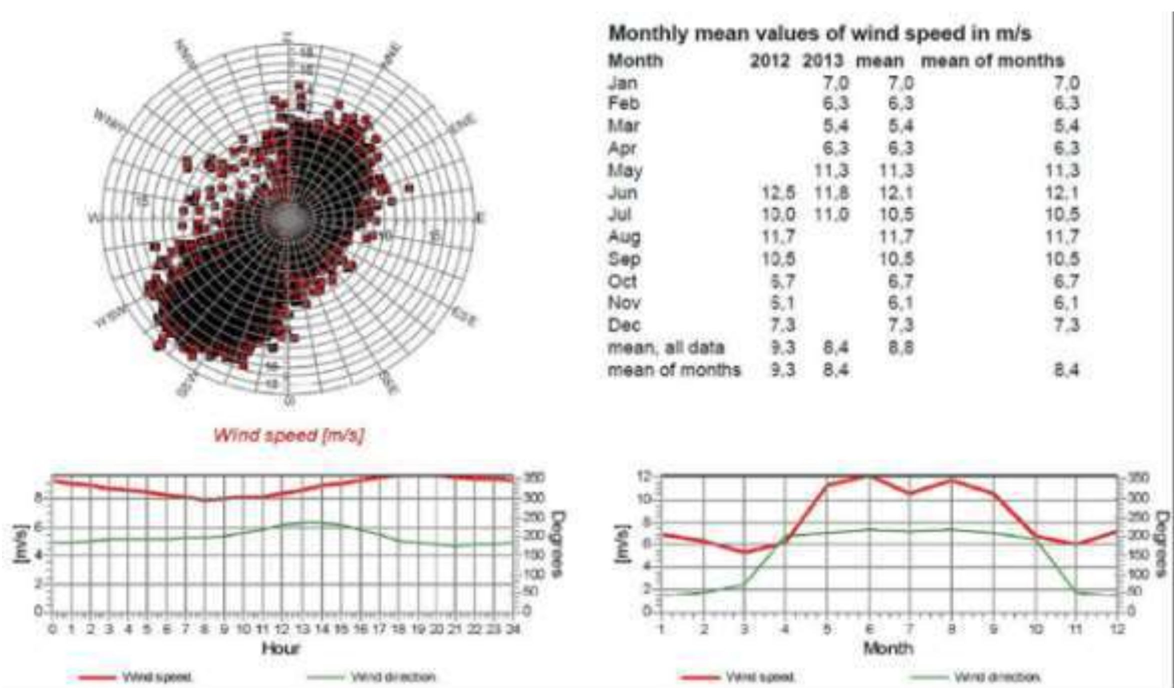
Height	Mean wind speed (m/s)	10-min maximum wind speed (m/s)	1-sec maximum wind speed (m/s)
81.5 m	8.85	19.95	24.06
80.0 m	8.81	19.78	23.84
60.0 m	8.54	19.92	23.19
40.0 m	8.22	18.65	22.41
20.0 m	7.59	17.39	21.68

103. Overview of air temperature, air pressure, air humidity and air density average values and extreme values are given in **Table 4.4**. **Figure 4.6 and 4.7** show the monthly mean values of wind speed in 2012 and 2013, and daily wind speed distribution at 81.5 m.

Table 4.4: Air temperature, air pressure, air humidity and air density (average values and extreme values)

Air temperature [°C] in 80.0 m			Air pressure [hPa] in 16.0 m			Air humidity [%] in 100.0 m		
Mean	**Max**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Max**	**Min**
27.8	32.3	22.4	1003	1011	974	84	100	45

Air density [kg/m³] in ~80.0 m with humidity			Air density [kg/m³] in ~80.0 m without humidity		
Mean	Max	Min	Mean	Max	Min
1.147	1.173	1.127	1.1608	1.185	1.142



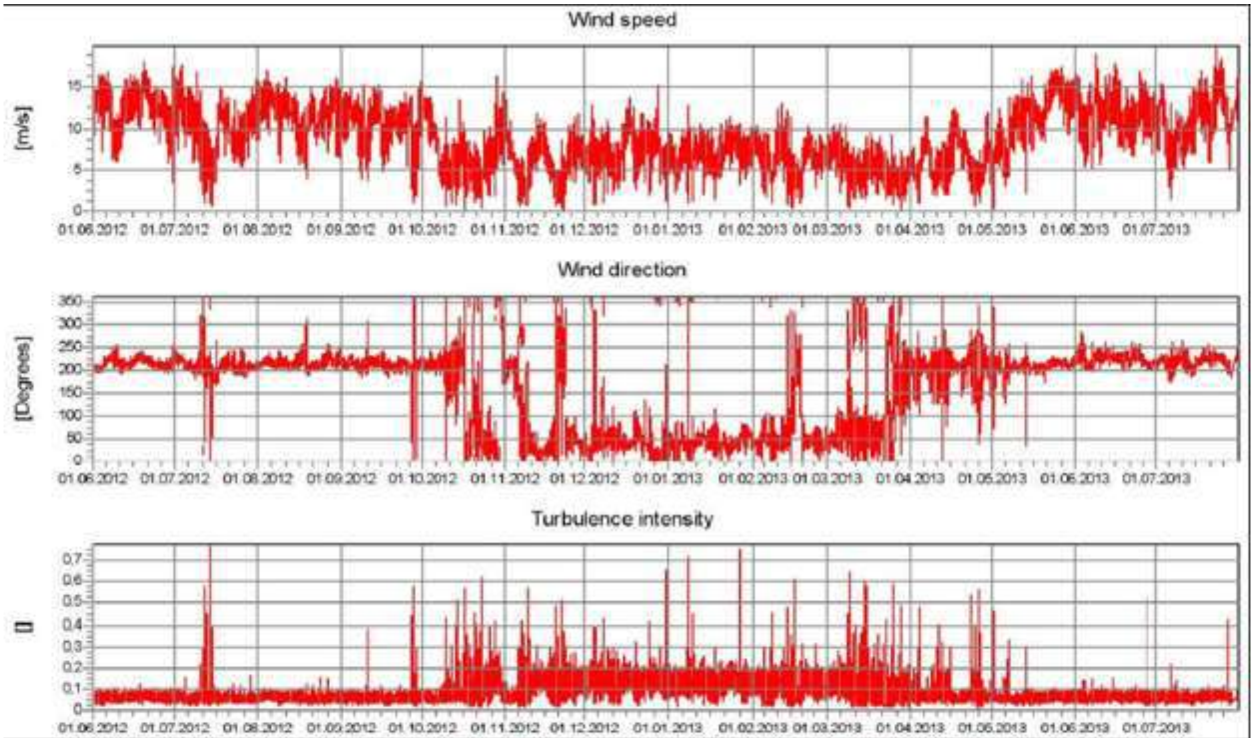


Figure 4.6: Daily distribution and time series at measurement height 81.5 m

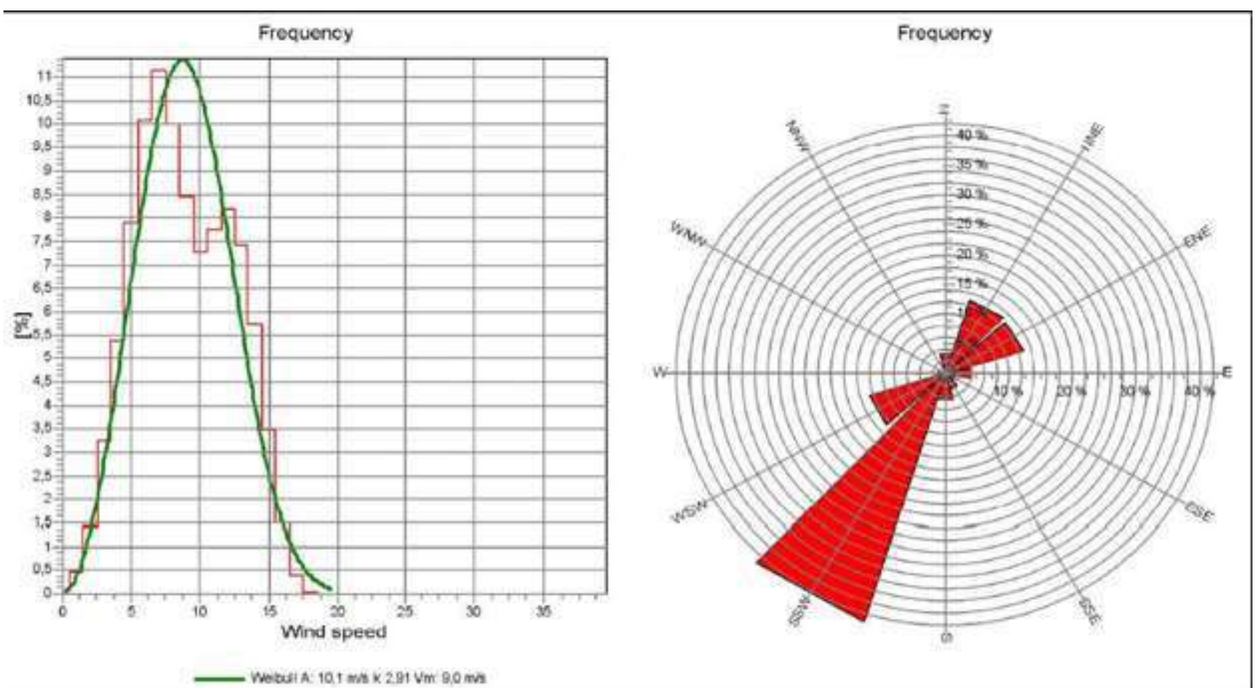


Figure 4.7: Wind speed distribution at 81.5 m and Weibull fit

4.1.4. Coastal Zone of the Area

104. The project site is located on the southern part of the Mannar Island as shown in **Figure 4.8.** It extends over 12.5 km (approximately) along the southern coast of the Island. The coastal zone, as defined in the Coast Conservation Act of Sri Lanka, extends 300 m inland from the permanent vegetation line along the coastline. (Along a water body connected to the sea, the coastal zone extends 2 km, perpendicular to the coastline across its sea outlet.) A coastal setback distance of 80 m is specified by the Coast Conservation and Coastal Resource Management Department (CCD) for Mannar Island which lies in the Coastal Segment 68. It consists of a reservation area of width 30 m and restricted area of width 50 m.

Proposed Developments in the Coastal Zone

105. The locations of the wind turbines (Numbers 1 to 39) are shown in **Figure 4.8**. As indicated, out of the 39 wind turbines, 33 are arranged in a single row, approximately 150-160 m from the vegetation line along the coast (a few are located approximately 165 m from the vegetation line along the coast). Most of the wind turbines are spaced at distances in the range of 295 m–385 m, with a few spaced at larger distances up to 750 m. The remaining six wind turbines are located in a row, approximately 1 km from the vegetation line along the coast, as shown in **Figure 4.8**.

106. A pier is to be constructed to meet the transport/delivery requirements of the project. The 4 locations initially identified as possible sites for the pier (**J1**, **J2**, **J3** and **J4**) are shown in **Figure 4.8**. These locations have been identified based on the availability of affording 5 m and greater depths closer to the coastline as per outcomes of the Bathymetric survey performed by NARA (National Aquatic Resource Research & Development Agency).

107. From the pier, access roads to reach all wind turbine locations are to be constructed. It is proposed to extend the existing roads stretches in the area for this purpose, whenever possible.

Near Shore Characteristics

108. The coastline extends in the direction of SE to NW and the near-shore area extends in the southwest (SW) direction as shown in **Figure 4.9.** The near-shore wave climate in the coastal waters of Sri Lanka is characterized by the swell approaching from the south throughout the year and the monsoonal waves during the SW and northeast (NE) monsoons. Considering the location and the orientation of the coastline of the area, it is evident that it is exposed to the swell throughout the year and the SW monsoonal waves during the period from May to September, but sheltered from the NE monsoonal waves.

109. Relatively shallow depths exist in the near-shore area extending from the coastline. The Admiralty Chart (**Figure 4.9**), published by the United Kingdom Hydrographic Office, for the area indicates that the 100 m and 10 m sea bed contours are located approximately at 40 km–45 km and 15 km–20 km from the coastline. The 5 m sea bed contour is located at an approximate distance in the range of 0.5 km–1.5 km from the coastline. It is located closer to the coastline in the locations identified for the proposed pier construction. These figures have been confirmed by the outcomes of the recent Bathymetric Survey conducted by NARA in the captioned sea areas on behalf of the project.

110. Except small plunging wave breaking at the coastline, no significant wave breaking in the near- shore area was observed during the field investigations conducted in March 2016, prior to

the onset of the SW monsoon. The satellite images available for the area indicate wave breaking closer to the coastline (within approximately 50 m from the coastline) during SW monsoon with no significant wave breaking in the near-shore area during other periods, as shown in **Figure 4.10**.

Source of Image: https://earth.google.com

Figure 4.8: Project Site

(Source of Image: United Kingdom Hydrographic Office)

Figure 4.9: Bathymetric Information

24-03-2016 Prior to SW Monsoon (SWM)

02-04-2014 Prior to SWM

27-06-2014 SWM

Source of Images: *https://earth.google.com*

Figure 4.10: Near-shore Characteristics: Wave Breaking

Coastal Zone Characteristics

111. The beach area consists of a gently sloping foreshore of fine sand, followed by a relatively flat sandy backshore area. The area next to the backshore is predominantly flat in terrain and is mainly covered by scrub vegetation. The coastal zone characteristics of three representative locations, **L1**, **L2** and **L3**, shown in **Figure 4.11**. Field investigations conducted in March 2016 revealed foreshore widths in the order of 10 m–15 m and backshore widths in the order of 10 m–30 m at many locations in the area. Sand deposits, similar to low dunes, are evident in the areas covered by vegetation, closer to the eastern edge (Location **L1**) of the project site.

Location L1

Location L2

Location L3

Figure 4.11: Coastal Zone Characteristics

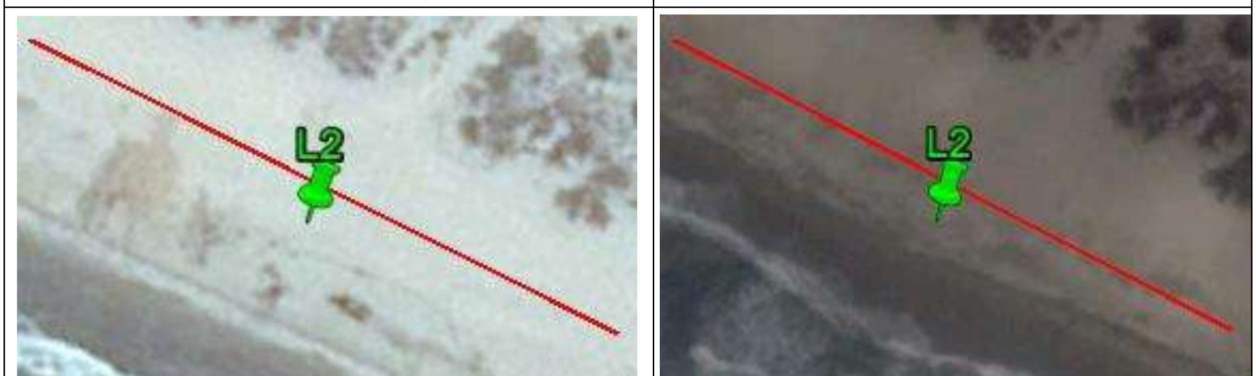
112. With no bays and rock outcrops/headlands present in the area, the coastline extends uninterrupted along the project area. Seasonal beach cusp formations are evident in the area (**Figure 4.11**). Although sea outlets of several small water bodies are located along the coastline, sand bar formations, as shown in **Figure 4.17,** exist across all such outlets, most of the year. The locations of the sea outlets of these water bodies, **WB1** to **WB17**, are shown in **Figure 4.12**. Breaching/overtopping of sand bar formations usually occurs during NE monsoon releasing high flood rates along such water bodies.

Figure 4.12: Sand Bars Formations at Sea Outlets of Water Bodies

113. The coastline behavior is governed by the sediment transport patterns along the shore and onshore/offshore of the area which are mainly dependent on near-shore wave, bathymetric and sediment characteristics. In the absence of detailed information of such characteristics, a comparative assessment of the coastline positions at location **L2**, in the vicinity of the proposed pier construction, was carried out to assess the variation of the coastline. The assessment revealed a seasonal coastline variation in the order of 10 m–20 m as shown in the satellite images in **Figure 4.13**.

29-09-2005 End of SWM 25-04-2008 SWM

03-05-2008 SWM 07-08-2013 End of SWM



02-04-2014 | or to SWM 27-06-2014 SWM

Source of Images: *https://earth.google.com*

Figure 4.13: Coastline Positions: 2005-2014

114. A similar assessment carried out on the eastern side of the project site indicates significant seasonal movement of sand bar formations on the western edge of the Adam's Bridge area, as shown in **Figure 4.14**. Significant levels of sediment activity are also evident along the coastline of the mainland, immediately to the south of Mannar Island, in the Vankalai area. Sand bypassing over a few groins, constructed as coast protection structures, is also evident in this area.

29-09-2005 End of SWM

06-05-2008 SWM

05-07-2013 SWM

02-04-2014 Prior to **SWM**

Source of Image: *https://earth.google.com*

Figure 4.14: Sand Bar Formations: Adam's Bridge National Park Area

115. The only coastal structures in the area are the pier used by the Sri Lanka Navy, at the location **SLN-J** shown in **Figure 4.15** and an abandoned pier, at the location **ABN-J** shown in

Figure 4.16. The details of these structures are shown in **Figure 4.15** and **Figure 4.16** respectively. As both piers are highly permeable structures constructed on steel piling, no sediment trapping and/or any significant coastal erosion or accretion is evident in the vicinity of these piers.

116. A few fisheries landing sites and beach seine sites are located along the coastline of the project area. However, no coastal structures/constructions are present at these sites.

Figure 4.15: Sri Lanka Navy Pier in the Area

Figure 4.16: Abandoned Pier in the Area, Old pier, Thalaimannar

Geomorphology of the Mannar Coastal Area

117. The island of Mannar is an initially coral island covered by multiple sand bars and spits, barriers, and dunes in Holocene Age (Silva *et. al*, 2013), and sands and sand dunes on the Gulf of Mannar side piled up by mainly SW monsoons and the Indian ocean swells. As a coral island, it is covering the Miocene limestone beneath (Swan, 1982). The piling of the sands in the study area clearly showed the SW and NE direction, which follow the monsoon wind, and the wind system helps to build the frontal dunes (contemporary beaches, incipient foredunes) and old dunes towards the Mannar Island crest. The shore facing the Gulf of Mannar is concave towards the sea.

118. The morphological development of the coastal geomorphology and their formative processes are changed under the influence of the continental shelf morphology, coastline configuration, monsoon winds, waves, currents, and sea-level changes. Further, it deals with the evolution of landforms such as shoreline, sandy shore and beaches, dunes, water ways and water holes, on which the process work and the changes take place accordingly. The coastal sediments are subject to multiple episodes of erosion, transportation and deposition and a net seaward transport takes place on local in micro scale.

119. Based on morphological development of the Gulf of Mannar site, there are a series of coastal landforms that can be identified as follows; Mud flats, Sand spits, Contemporary shoreline and the beach, incipient foredunes, Holocene beach and dunes, Waterways and water holes. For this study, the above-mentioned landforms are identified within the 300 m wide area from shoreline to inland.

Mudflats

120. Due to the amplitude of 0.5 m tidal level around Gulf of Mannar, intertidal flats are formed of bare mud and sand, drained by the flood tidal water. Mudflats have been a significant feature because of their ecological and geomorphological characteristics, but mud Flats are not formed in the proposed project area. These are apparently present only at both ends of the island.

Sand Spits

121. Well-developed sand spits in the Mannar Island can be identified both ends of the island and northeastern part of the island. These immature sand bars and spits are changing seasonally and annually due to natural processes, but this type of morphology has never developed along the coastal belt under study.

Contemporary Shoreline and the Beach

122. A loose aggregate of unlithified mineral particles/calcareous material of sand size gather forming a beach. There is relatively thick and temporary accumulation of loose water-borne material that is in active transit along, or deposited on, the shore zone between the limits of low water and high water **(Figure 4.17-4.18)**. It appears as contemporary shoreline and beach in Mannar Island are changing particularly due to erosion during the SW monsoon (May to September), on the other hand accumulation of mineral sands can be seen along same the area, Gulf of Mannar area, during the NE monsoon season (December to February). Moderate erosion and irregularly shaped shoreline is obvious in many places of the coastal stretch during the end of the First Inter Monsoon (April), SW monsoon and beginning of the second monsoon (October).

Incipient Foredunes

123. Foredunes are coastal dunes or a ridge that are parallel to the shoreline of a large sea or ocean and is stabilized by vegetation. They are in-between back dunes and beach/beach berm **(Figure 4.18)**. Extension of foredunes in Gulf of Mannar side is very low in height and extends further inland from the contemporary shoreline/beach to inland. Gulf of Mannar beach side, the irregular contemporary shoreline and beach, incipient foredunes have developed by windblown sand trapping by pioneer plant species behind the line of high tide. These foredunes are about 2.0 m to 3.5 m high from MSL.

Figure 4.17: Swash zone, beach face and low beach berm have developed on a contemporary wide beach (A = eastwards, and B = westwards from the starting point), Gulf of Mannar side, Photos were taken on 03.03.2016).

Figure 4.18: Foredunes along the Gulf of Mannar side. They are closer to the contemporary wide beach; Photos were taken on 03.03.2016.

Holocene Beaches and Dunes

124. Holocene beaches and sand dunes are separated into lower and upper deposits based on the wind action, height and the constitute material. The lower deposits contain roughly equal proportions of shell/coral fragments and quart grains as well as heavy mineral sands; the upper deposits are almost shell/coral fragments of other fine minerals. These dunes overlie on former beaches and incipient dunes, which probably accumulated behind an old stranded beach ridges at a time when sea level was some 2m–3m higher than today. Radiocarbon dating gives an age for the lower deposits between 6,240 and 3,600 years B.P., and for the upper deposits of less than 3,600 years B.P (Katupotha, 1995). The location of wind turbines as a line, from Nos. 01–39, is terminated at the lower deposit of Holocene beaches and dunes. The height of the wind turbine line of the lower deposit is varying between 2.5 m to 4.0 m from MSL. The upper deposit area is varying between 8.0 m and 11.0 m from MSL. The lower and upper sand dunes on study stretch are mainly covered by creeping and thorny scrub vegetation and perennial plant species **(Figure 4.19- 4.20)**.

Figure 4.19: Lower deposit of Holocene beaches and dunes. The height of the wind turbine line of the lower deposit is varying between 2.5 m to 4.0 m from MSL. Photos were taken on 03.03.2016.

Figure 4.20: Lower deposit of Holocene beaches and dunes, the height of the wind turbine line of the lower deposit is varying between 2.5m to 4.0m from MSL. Photos were taken on 03.03.2016.

Waterways (Channels) and Water Holes

125. The Gulf of Mannar side, there are number of waterways and water holes, but no proper directions or sizes. They appear as contemporary or seasonal pools elongated or parallel and low depressions between beach and dune ridges **(Figure 4.21-4.22)**. The depressions that can be designated as runnels or water holes and extending close to or sometimes below the ground water table. To the inland from the coast, they are filled by freshwater during the monsoon rains or brackish water, during the storm surges, the water holes are filled by salt waters/brackish water. In the study area, freshwater conditions of these landforms appear during the rainy seasons especially the monsoon and inter-monsoon periods.

Figure 4.21: Water holes (Thonas) formed among the dune depressions. Water gathers in these depressions by storm surges and by monsoon rains (Photos were taken on 03.03.2016

Figure 4.22: Water gathers as over wash salt waters by storm surges and from seasonal rainfalls (Photos were taken on 03.03.2016)

126. This section describes relevant physical, biological, and socioeconomic conditions within the study area. It also looks at current and proposed development activities within the project's area of influence, including those not directly connected to the project. It indicates the accuracy, reliability, and sources of the data.

4.2 Ecological environment (Terrestrial and Aquatic)

4.2.1 National Parks, Sanctuary, Important Bird Area's (IBA's)

Natural Reserves

127. There are three main wildlife reserves located in close proximity to the project site. These are Vankalai Sanctuary, Adam's Bridge Marine National Park, and Vedithalativu Nature Reserve (**Figure 4.23-4.24**). Out of these three protected areas Adams Bridge Marine National Park lying on the western boundary of the proposed project site is the closest protected area to the proposed

project. The Vankalai Sanctuary is located nearly 8 km east of the proposed site.

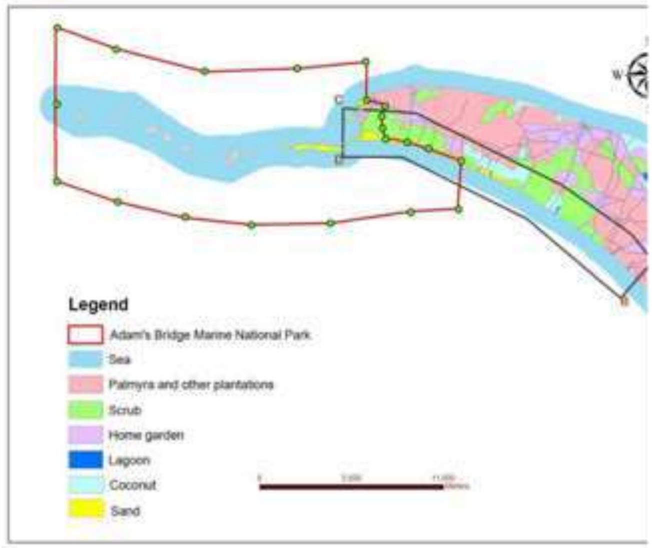


Figure 4.23: Adams Bridge Marine National Park

The Adam's Bridge Marine National Park

128. The Adam's Bridge National Park was declared on 22 June 2015, comprising the land and maritime belt of 18,990 ha situated within the Divisional Secretary's Division of Thalaimannar in the Administrative District of Mannar in the northern province of Sri Lanka. (**Figure 4.24**)

129. It is a critical breeding site for ground nesting sea birds. Adam's Bridge is a chain of limestone shoals that loosely connect Rameswaram Island, off the southeastern coast of Tamil Nadu, India, and Mannar Island, off the northwestern coast of Sri Lanka. Geological evidence suggests that this bridge is a former land connection between India and Sri Lanka. Hence this land connection played a vital role of biogeography of Sri Lanka. Adam’s Bridge is one of the key entry points used by thousands of migratory birds that arrive through eastern flyway. Birds that are coming from eastern flyway either enter from Jaffna peninsula or through Rameswaram via Adam’s Bridge to enter Mannar. It is believed that many weak-fliers follow Rameswaram - Adam’s Bridge to enter Sri Lanka. Hence, sand island chain plays an important role for migratory birds to Sri Lanka. Nine islands of the Adam’s Bridge lie within the Sri Lankan maritime zone and the third island west of Mannar island (Sand Island III 9.067°N 79.633°E), is the most important island for breeding seabirds in Sri Lanka. This 4 ha island is an important breeding site for several species of seabirds including *Onychoprion fuscatus* (Sooty Tern), *O. anaethetus* (Bridled Tern), *Sternula albifrons* (Little Tern), *S. saundersi* (Saunders’ Tern), *Sterna dougallii* (Roseate Tern), *S. hirundo* (Common Tern), *Thalasseus bergii* (Greater Crested Tern) and *Anous stolidus* (Brown Noddy). This is the only known breeding colony in Sri Lanka for these sea birds except for Greater Crested Tern and Little Tern.

Vankalai Sanctuary

130. Vankalai Sanctuary (8°56’N 079°55’E) extends over an area of 4,398.95 hectares between Mannar and Mannar Island and has been designated as a sanctuary in 2008 for the protection of birds. The sanctuary includes part of the main land, coastal islands, sea-shore and

part of the marine area. The sanctuary is bounded by Vankalai in the south, Puliyantivu Island in the west and Tiruketiswaram in the north and east including the causeway between the mainland and the Mannar Island. Sanctuary consists of several habitats and vegetation types such as arid-zone thorn scrubland, arid-zone pastures, maritime grasslands, sand dunes, mangroves, waterholes, tanks, salt marshes, lagoons, tidal flats and sea-grass beds. It also includes part of the shallow marine region especially in the northern region.[27]

131. The Vankalai sanctuary and the wetlands within the Mannar Island are inhabited by a large number of water bird species, including annual migrants travelling on the Central Asian Flyway. These birds use this area as an entry point to Sri Lanka, major wintering site as well as the staging point before they exit from Sri Lanka. More than 30% of the birds recorded in Sri Lanka (more than 150 species) have been recorded from this region. This region generally harbors more than 20,000 water birds during the migration season that spans from September to April. The area is also inhabited by some of the rarest species of birds recorded in Sri Lanka such as *Anas poecilorhyncha* (Spot-billed Duck), *Anas strepera* (Gadwall), *Sarkidiornis Melanotos* (Comb Duck). Further, Vankalai Sanctuary and Mannar Island supports number of species of birds that are restricted to the northern region of Sri Lanka or recorded seldom outside the northern region of Sri Lanka such as *Dicrurus macrocercus* (Black drongo), *Lanius schach* (Long-tailed Shrike), *Streptopelia decaoto* (Eurasian Collared-dove), *Francolinus pondicerianus* (Grey Francolin), *Milvus migrans* (Black Kite), *Phoenicopterus roseus* (Greater Flamingo), *Dromas ardeola* (Crab-plover), *Cursorius coromandelicus* (Indian Courser) and *Larus ichthyaetus* (Great Black-headed Gull). This area also supports more than 1% of the total population of at least three species of water birds *Phoenicopterus roseus* (Greater Flamingo), *Anas penelope* (Eurasian Wigeon) and *Limosa limosa* (Black-tailed Godwit). As a result, Vankalai Sanctuary has been designated as Sri Lanka's fourth Ramsar Site in 2010 under the International Convention on Wetlands of International Importance.

Veduthalativu Natural Reserve

132. The Vedithalathive Nature Reserve was declared on 25 February 2016, comprising the land and maritime belt of 29,180 ha situated within the Mannar Town Divisional Secretariat of the Mannar Administrative District in the Northern Province of Sri Lanka.

133. The nature reserve falls within the Arid Zone of Sri Lanka where the annual rainfall is less than 1,000 mm. The typical natural climax vegetation types found in the nature reserve include mangroves, salt marshes, sand dunes, strand vegetation and dry mixed evergreen forest. The nature reserve includes the stretch of land belonging to the coastal stretch from Mannar-Jaffna, the Mannar lagoon, northwestern edge of the Mannar Island Erukkalampiddy lagoon and Korakulam. The northwestern edge of the Mannar Island supports a rich mangrove and salt marsh habitats while Korakulam is the only freshwater body located within the Mannar Island that serves as an important feeding and breeding site for water birds that inhabit the Mannar area. Further, Erukkalmpiddy lagoon, Mannar lagoon and Korakulam is inhabited by a large number of water bird species including annual migrants travelling on the Central Asian Flyway, which use this area as an entry point to Sri Lanka, major wintering site as well as staging point before they exit from Sri Lanka. More than 150 bird species have been recorded in the nature reserve including some of the rarest species of birds recorded in Sri Lanka such as *Anas poecilorhyncha* (Spot-billed Duck), *Lanius schach* (Long-tailed Shrike) and *Dromas ardeola* (Crab-plover). The Wedithalathive Nature Reserve contains the only known habitat of the nationally critically

[27] Information sheet on Ramsar Wetlands 2009-2012 version prepared by Wijesurya, W.A.D.A., Bambaradeniya, C., Sirivardana, U. and Fernando, S.S. (www.ramsar.org/ris/key_ris_index.htm)

endangered bird species *Cursorius coromandelicus* (Indian Courser).

Important Bird Areas (IBAs)

134. These are located outside the Mannar island and far away from the right of way of the wind map.

- **Amaipaddukkai Bird Area:**[28] The Amaipaddukai Bird Area is located near the Mannar town (**See Figure 4.7**) at coordinates (79º 54.00' East 9º 1.00' North). It has an area of 500 ha. Amaipaddukkai IBA is designated for Curlew Sandpiper (*Calidris ferruginea*).[29] There are no forest areas but mangroves and salt marshes. It is situated within the Vedithalativu Nature Reserve declared recently. (http://www.birdlife.org/datazone/sitefactsheet.php?id=15257).

- **Periyakalapuwa mouth IBA:** Periyakalapuwa mouth IBA includes 800 ha of saltmarsh and other wetland habitat. Its key IBA trigger species is also its wintering Curlew Sandpiper population (Birdlife International 2016b). It lies within the Vankalai Sanctuary Ramsar site. (http://www.birdlife.org/datazone/sitefactsheet.php?id=15259).

[28] http://www.birdlife.org/datazone/sitefactsheet.php?id=15257.
[29] Source of data: Field Ornithology Group of Sri Lanka (Affiliate) - Important Bird and Biodiversity Areas (IBAs).

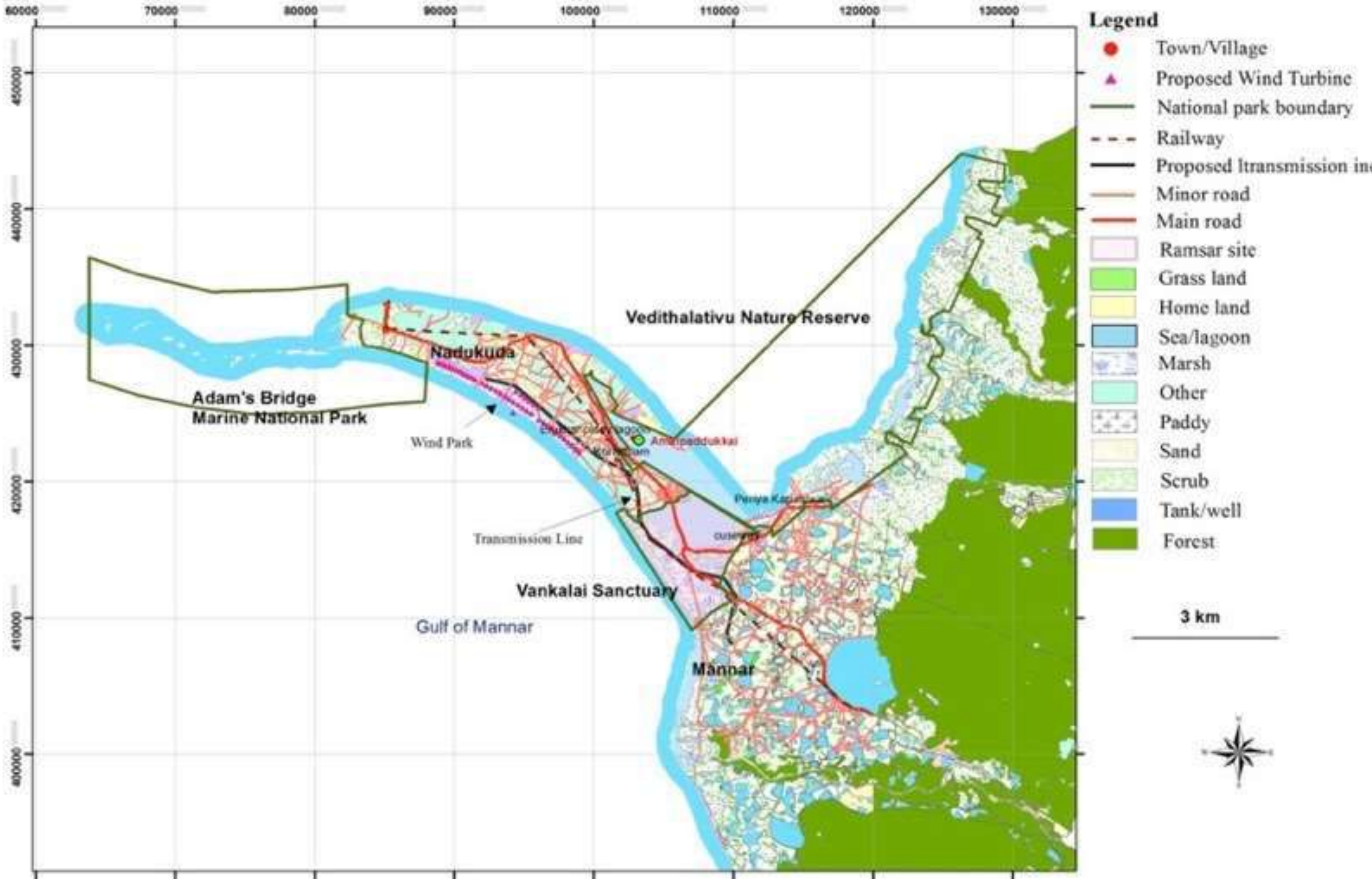


Figure 4.24: Newly declared Adam's Bridge Marine National Park boundary about 4.5 km from the proposed Nadukuda GSS and Amaipaddukkai Bird area (marked with green dot/written in red)

4.2.2. Habitats/ecosystems

4.2.2.1 Project Area

135. Altogether nine major habitat types were observed within the Mannar Island. These include Palmyra stands, coconut cultivated lands, Home gardens, beach and sand dune associated vegetation, scrublands, mangroves, salt marshes, mud flats and water bodies (both fresh and brackish water). All of these habitat types were observed in the direct and indirect impact zones of the proposed wind farm blocks. Distribution of these habitats within the study area is shown in **Figure 4.25** and a brief description of these habitats is given below.

Figure 4.25: Map of the study area indicating the main land use types present in the Mannar Island.

Palmyra Stands

136. This is a natural habitat dominated by Palmyra *Borassus flabellifer* (Tal) trees. Other trees, shrubs and herbs such as *Phoenix pusilla* (Indi), *Catunaregam spinosa* (Kukurumanna), Syzygium *cumini* (Madan), *Cassia fistula* (Ehela), *Ficus benghalensis* (Nuga), *Calotropis gigantea* (Wara), *Jatropha gossypiifolia*, *Flueggea leucopyrus* (Katupila), *Azadirachta indica* (Kohomba), *Morinda coreia* (Ahu), *Cymbidium aloifolium* are found scattered within this habitat.

Coconut Cultivated Lands

137. These are lands that have been used for cultivation of Coconut *Cocos nucifera* (Pol).

However, many of the coconut lands are not maintained properly and in some cases, they have been abandoned for many years. In such cases, even though these areas are defined as coconut lands in land use maps hardly any coconut trees can be seen. Instead the land is colonized by other plant species such as *Phoenix pusilla* (Indi), *Calotropis gigantea* (Wara), *Borassus flabellifer* (Tal), *Croton bonplandianus*, *Cassia roxburghii* (Ratu Wa), *Azadirachta indica* (Kohomba), *Syzygium cumini* (Madan), *Cynodon dactylon*, *Lannea coromandelica* (Hik), *Catunaregam spinosa* (Kukurumanna), *Morinda coreia* (Ahu).

Home Gardens

138. The home gardens in the Mannar area consist mainly of cultivated species such as *Cocos nucifera* (Pol), *Borassus flabellifer* (Tal), *Thespesia populnea* (Suriya), *Azadirachta indica* (Kohomba), *Musa x paradisiaca* (Kesel), *Moringa oleifer* (Murunga), *Tamarindus indica* (Siyambala), *Commiphora berryi* and *Mangifera indica* (Amba).

Beach, Sand Dunes and Associated Flora

139. The beach vegetation, a natural habitation, (some photographs in **Figure 4.26**) comprises of runners such as *Ipomoea pes-caprae* (Mudu Bin Thamburu), *Scaevola taccada* (Takkada) and *Spinifex littoreus* at the outermost edge closed to the littoral zone. This then changes into open scrub comprising of species such as *Cocos nucifera* (Pol), *Cynodon dactylon*, *Calotropis gigantea* (Wara), *Tridax procumbens*, *Pupalia lappacea* (Wel Karal Heba) *Launaea sarmentosa*, *Pedalium murex*, *Phyla nodiflora* (Hiramanadetta), *Cyperus stoloniferus*, *Aloe vera* (Komarika), *Pupalia lappacea* (Wel Karal Heba), *Citrullus colocynthis* (Yak Komadu), *Catharanthus roceus* (Mini Mal).

Figure 4.26: Typical vegetation associated with beaches in Mannar Island

Scrublands

140. This is a habitat that arises due to clearing the land for human and subsequently abandoned for a long period of time allowing plants to recolonize the land. Therefore, this habitat shows an intermediate state between abandoned lands and forest lands. The vegetation comprises of mostly shrubs, herbs with scattered tree species (photographs in **Figure 4.27**). The characteristic tree species found in the scrubland is *Acacia planifrons*, with an umbrella like tree crown. In some areas, it forms a consociation and the canopy cover is almost 100% allowing very little sunlight to reach the ground vegetation. The other plant species that can be seen in scrubland habitats include *Abrus precatorius* (Olinda), *Azadirachta indica* (Kohomba), *Azima tetracantha*, *Borassus flabellifer* (Tal), *Calotropis gigantean* (Wara), *Canthium coromandelicum* (Kara), *Carissa spinarum* (Heen Karamba), *Cassia auriculata* (Ranawara), *Cassytha filiformis*, *Catunaregam spinosa* (Kukurumanna), *Cissus quadrangularis* (Heressa) *Clerodendrum inerme* (Burenda), *Dichrostachys cinerea* (Andara), *Dodonaea viscose* (Eta Werella), *Ficus benghalensis* (Nuga), *Flueggea leucopyrus* (Katupila), *Gmelina asiatica* (Demata), *Ipomoea violacea, Morinda*

coreia (Ahu), *Pergularia daemia* (Wissani), *Phoenix pusilla* (Indi), *Premna obtusifolia* (Maha midi), *Scutia myrtina*, *Syzygium cumini* (Madan), *Toddalia asiatica* (Kudumiris), *Ziziphus oenoplia* (Heen Eraminiya) and *Ziziphus mauritiana* (Dembara).

Figure 4.27: Typical coastal scrubland habitats that can be seen in Mannar Island

Water Bodies

141. These include both freshwater and brackish water habitats such as tanks (Kora Kulam (**Figure 4.28**) and small tank at the turn off to Tharapuram), lagoons (lagoon in the center of the island and small coastal lagoons along the southern end of the island (photograph in **Figure 4.29**). The lagoons did not have any aquatic vegetation while some of the freshwater bodies had aquatic plant species such as *Nelumbo nucifera* (Nelum), *Persicaria attenuata* (Sudu Kimbul Wenna), *Aponogeton natans* (Kekatiya), *Neptunia oleracea* (Diya Nidikumba), *Ludwigia adscendens* (Beru Diyanilla), *Utricularia aurea*, *Cyperus* spp., *Fimbristylis* spp., *Crinum defixum* (Heen Tolabo), *Ipomoea aquatica* (Kankung) and *Typha angustifolia* (Hambupan).

Figure 4.28: Kora Kulam, a freshwater body located in the indirect impact zone

Figure 4.29: A typical shallow lagoon habitat that supports large number of waders

Mangroves

142. This habitat occurs around lagoons and estuaries where there is mixing of freshwater coming from inland and salt water brought in by the tides resulting in brackish water conditions. These areas are subject to continuous inundation and exposure due to tidal changes and only specialized trees that can withstand such conditions. Mangroves are present in four major locations of the island Urumalai area in the South-western end of the island, Pesalai area in the North-central part of the Island, Munthal area in the northeastern end of the island and the Santipuram area near the Mannar salt pans. *Avicennia marina* (Kanna) is the dominant species

present in the mangroves vegetation in the Urumalai area while *Rhizophora mucronata* (Kadol) is the dominant species observed in the Mangroves in the Pesali Area. The other common mangrove species observed in this habitat include *Lumnitzera racemosa* (Beriya), *Excoecaria agallocha* (Tela Kiriya) and *Pemphis acidula* (Kiri Maran). Further, mangrove associates such as *Pandanus odoratissimus* (Muhudu Keiya), *Thespesia populnea* (Suriya), *Cyperus stoloniferus*, *Fimbristylis triflora*, *Derris trifoliolata* (Kalawel), *Caesalpinia bonduc* (Kalu Waulatiya), and *Wedelia biflora* (Mudu Gam Palu) were also observed in this habitat. Mangrove species such as *Excoecaria agallocha* (Thela kiriya) and *Lumnitzera racemosa* (Beriya) are also found along the banks of seasonal water courses in the southern coast line that extends inlands into the island. Photographs shown in **Figure 4.30**.

Figure 4.30: Typical mangrove formation that can be seen in the Mannar Island

Salt Marshes

143. This is a habitat that can be seen in association with mangroves in most places where once again the soil conditions are saline and supports only specialised plant communities such as *Suaeda* communities and *Arthrocnemum* consociations. Such salt marshes can be seen in the Urumalai area in the south-western part of the Island and Erukkalmpiddy area in the North-eastern end of the Island (photograph in **Figure 4.31**). The salt marsh vegetation comprises of species such as *Arthrocnemum indicum*, *Halosarcia indica*, *Salicornia brachiata*, *Suaeda maritima*, *Suaeda monoica* and *Suaeda nudiflora*. *Cynodon dactylon* is the most widespread grass species that can be seen in the salt marsh while *Cyperus rotundus* is found confined chiefly to depressions in this habitat.

Figure 4.31: Typical salt marsh formations that can be seen in the Mannar Island.

Mudflats

144. The 0.5 m tidal fluctuations that takes place around Gulf of Mannar and Palk Bay has resulted in the formation of inter tidal flats that comprise of bare mud and sand, drained by the tidal flood water. Mudflats are a significant feature in the Mannar region because of their unique geomorphology. Further, these mud flats are highly productive ecosystems and therefore play a

critical ecological role, especially as feeding grounds for wading birds. Such mudflats are present in locations where tiny lagoons are formed. These tiny lagoons are temporary features in the area and their configuration is always changing due to waves, winds, currents, seasonal tidal amplitudes as well as storm surges (Photographs in **Figure 4.32**). During the dry periods the exposed mudflats are colonized by salt loving herbaceous species such as Cynodon dactylon, Cressa cretica, Blumea obliqua, Atriplex repens, Fimbristylis spp. and Cyperus stoloniferus.

145. Out of these habitats mangroves, salt marshes, mudflats, water bodies and home gardens occur only in the indirect impact zone/ outside the project area. The predominant habitats observed in the direct impact zone include scrublands and sea-shore/beach associated vegetation. The species assemblage observed in Palmyra stands and Coconut cultivated lands is very similar as the vegetation structure and composition are quite similar among these two habitats.

Figure 4.32: Typical mudflats that can be seen in the Mannar island (Urumalai/ Thalaimannar)

4.2.3 Marine and Coastal Environment

4.2.3.1 Survey Design and Methodology

146. Project related impacts on marine environment are mainly from construction of a pier. Survey was carried out to identify sensitive marine environments, specify anticipated impacts and also to plan mitigation, monitoring and management measures to be implemented to reduce or avoid the identified potential adverse impacts.

147. After recognizing and prioritizing the most suitable four sites by the project proponent for the construction of pier, a detailed underwater survey was carried along the full length of the pier and either side of the pier as well as from shore up to depth of 5m including intertidal zone in order to rule out places that would show high environmental sensitivity, or fish or fisheries important areas.

148. Shore perpendicular and parallel transects were conducted within the assessment area and using standard underwater survey protocols to identify the locations of sensitive marine resources and changes in community composition that may be directly or indirectly impacted by project construction and/or operation. Characterization of aquatic flora and fauna including phytoplankton and zooplankton was taken for qualitative assessments. Bottom sediment samples were also being taken to identify the benthonic fauna and also to study the sediment characteristics.

Underwater Visual Census

149. This qualitative biological survey was conducted over two days by a team of three divers led by the marine biologist and assisted by two field assistants. The specialist and trained divers conducted a roving diver census along a transect to compile a comprehensive list of marine organisms utilizing each habitat within the project area (See **Figure 4.33** for underwater survey approach).

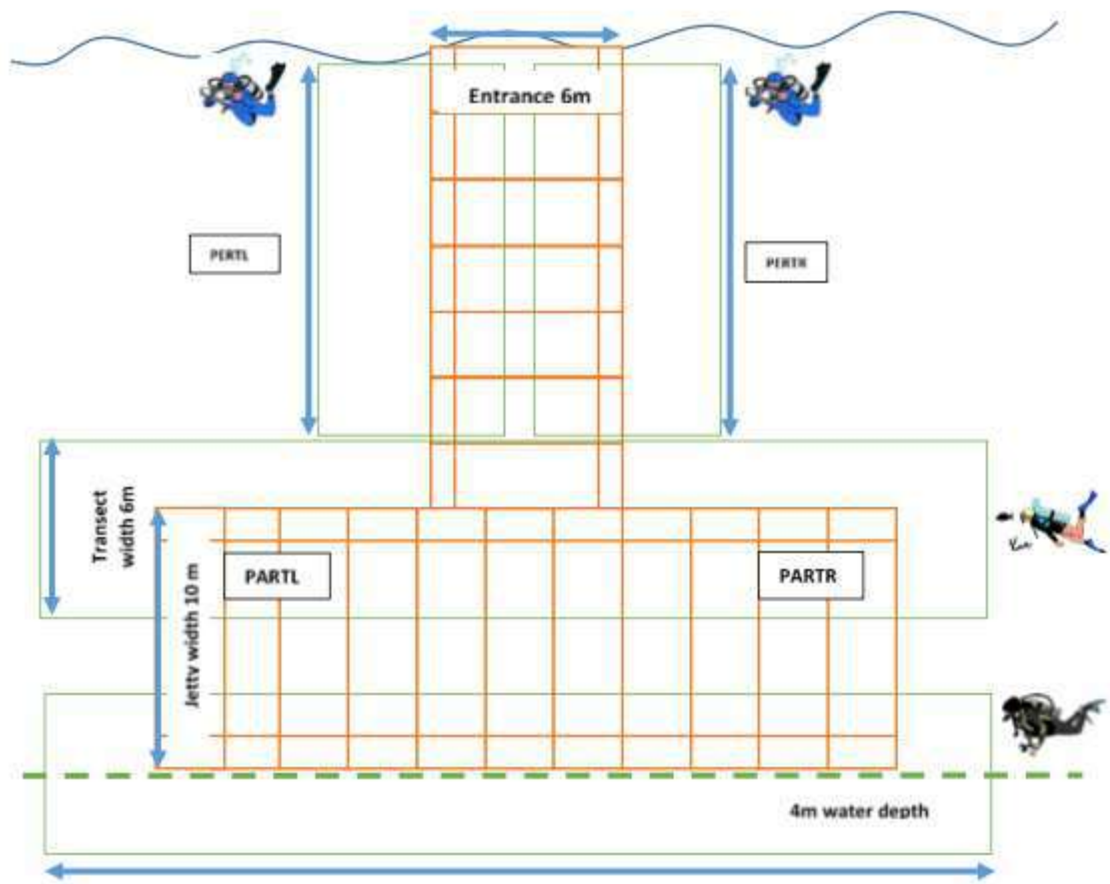


Figure 4.33: Schematic diagram of the paths of the underwater survey (not to the scale or engineering design of the pier). Sample photographs are shown in later in the text from these two perpendicular transects (PERTL, PERTR) obtained at 2 m depth and two parallel transects (PARTL, PARTR) obtained at 3.5 m depth for 200 m.

150. Digital photographs and videos documented various habitats for descriptive analysis of the communities of the benthic and vertical relief and also used for further identification and also to have permanent visual record of the underwater habitats. Data collected from snorkeling, diving, photos and video is used to produce seabed habitat maps and classification of habitats. All the images and video are obtained along with GPS data for geo referencing.

151. Survey was conducted to identify coastal Inter-tidal communities, soft substrate communities, hard substrate communities such as coral reefs, sea grass meadows, fish aggregations, breeding or feeding grounds or any other sensitive and significant habitats were

also recorded. **Figures 4.34-4.37** relate to data collection.

152. In addition, some physical and chemical parameters such as water and air temperature, dissolved oxygen (DO), electric conductivity (EC), total dissolved solids (TDS), salinity and pH were also recorded.

153. All the field surveys, assessments and data gathering was conducted for studying existing environment, project related anticipated impacts, mitigatory measures and environmental monitoring and management.

Figure 4.34: Sediment sample collection and underwater photography

Figure 4.35: Multiparameter reader (YSi Pro Plus) used to measure, temperature, DO, TDS, EC, salinity and pH

Figure 4.36: Temporary tide staff for recording water level changes

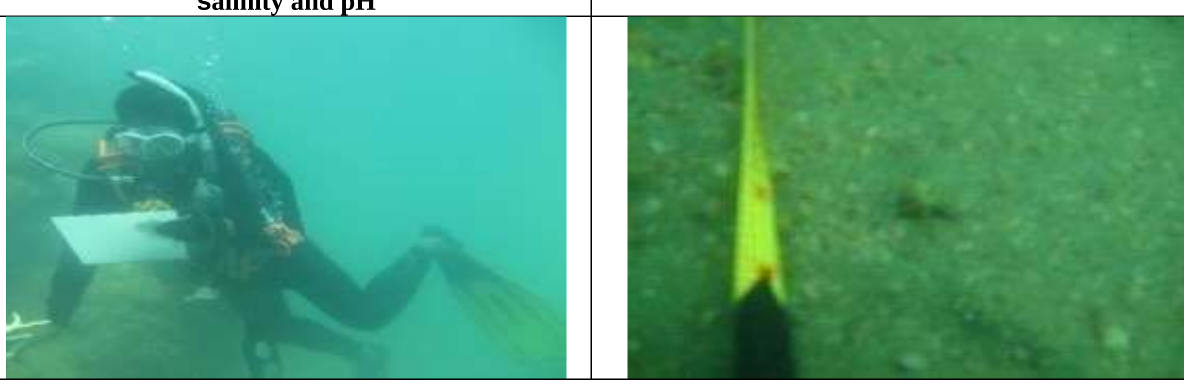


Figure 4.37: A diver observing and recording the underwater transects

4.2.3.2 Location of coastal and marine ecosystems, fauna and flora in respect to Project Area

154. No sensitive ecosystems such as sea grasses or coral reefs within or vicinity of the project sites **(Figure 4.38).** Survey data is attached in **Annexure 2**. Distance to reefs and seagrass beds are given in **Figure 4.38**

Figure 4.38: Locations of the Vankalai reef (18 km from project site and 8 km offshore, mostly a sea grass bed) and Pere reefs (20 km from project site and 11 km offshore, a dead reef covered with seaweeds)

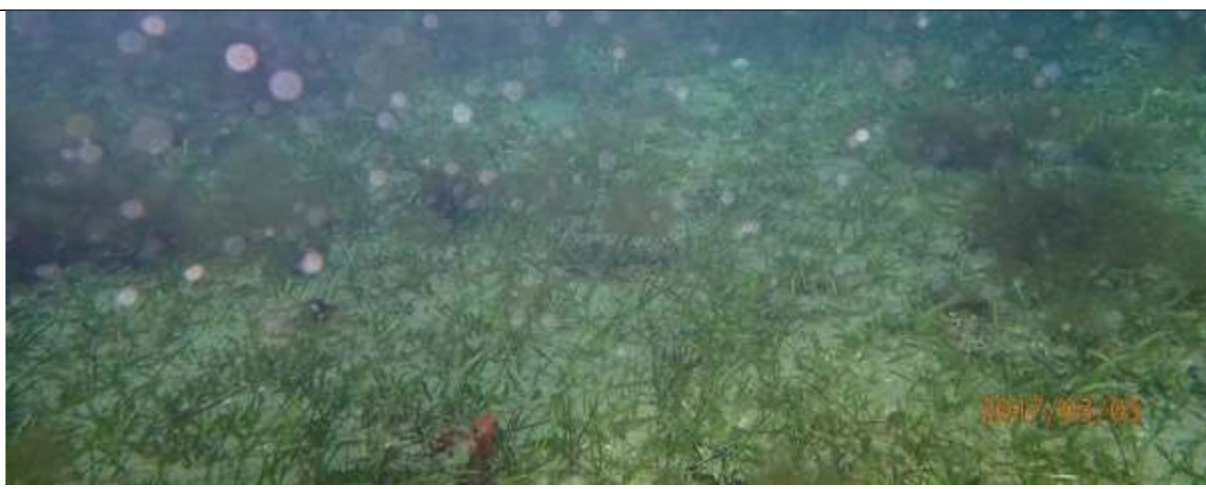


Figure 4.39: Rich offshore sea grass meadows off Vankalai

Figure 4.40: Uprooted sea grasses observed floating and washed onshore along the Mannar Island

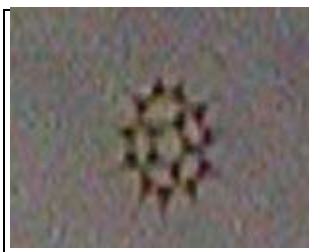
Figure 4.41: Dead reef covered with seaweeds observed offshore in Vankalai (Pere reef)

155. Even any breakoffs of corals were not observed. However, breakoffs of sea grasses and seaweeds were observed in subsequent field visits. Field investigations confirmed that those breakoff sea grasses were from sea grass beds found in deeper areas outside of the project and project impact area. **Figure 4.39, 4.40, and 4.41** show some picture mentioned above.

156. The coastal stretch of the project area in Mannar Island is formed with sand; essentially sand beach, sand dunes, and sand plains (**Figure 4.42**).

Figure 4.42: Sandy beaches in the coastal stretch of the project area

157. Plankton samples studied showed some common marine planktons (**Figure 4.43**). Fish egg or larval stages were not recorded among samples and therefore no strong evidence of fish using this area as breeding grounds. Highly turbulent, sandy and very murky waters are not preferred breeding locations for many fish species. Table 4.5 shows underwater marine survey results.

		
Pediastrum sp.	*Nitschia* sp.	*Staurodesmus* sp.
		
Nauplii	*Microcystis* sp.	*Melosira* sp
		
Dinobryon sp.	*Rhizosolenia* sp	*Tetraedron* sp.

		
Copepod	*Hyalotbeca* sp	Cladocera

Figure 4.43: Most common planktons observed from all the four sites

Table 4.5: Phytoplankton and zooplankton species recorded from the underwater survey area

Phylum/ Division	Order / group	Species	Conservation status
Chlorophyta	Chlorophyceae	*Pediastrum* sp	NE (Not Evaluated)
		Tetraedron sp	NE
Ochrophyta	Bacillariophyceae	*Nitschia* sp	NE
Ochrophyta	Bacillariophyceae	*Melosira* sp	NE
Ochrophyta	Bacillariophyceae	*Rhizosolenia* sp	NE
Charophyta	Desmidiaceae	*Staurodesmus* sp.	NE
Cyanobacteria	Cyanophyceae	*Microcystis* sp	NE
Chrysophyta	Chrysophyceae	*Dinobryon* sp	NE
		Hyalotbeca sp	NE
Arthropoda	Crustacea	Cladocera	NE
		Nauplii	NE
		Copepods	NE

General Marine and Coastal Biodiversity Outside Project and Project Impact Area

158. The shallow seas around Mannar Island encompass several sensitive ecosystems such as mangrove, sea grass beds, sand dunes and scattered corals reef patches. The Gulf of Mannar is an ecosystem with high biodiversity. The biodiversity of these ecosystems is very rich and supporting economically important fisheries resources such as fin fish, crustaceans such as shrimp, crabs, lobsters, mollusks, sea cucumber and seaweeds. Furthermore, it is also the area of distribution of the endangered dugong and in some extent sea turtles, whales and dolphins.

159. Coastal habitats in Mannar comprise an extensive system of estuaries and lagoons, mangroves, salt marshes, sand dunes, beaches, coastal marshy wetlands and mudflats supporting very high biodiversity. Coastal seas around Sri Lanka is characterized by productive ecosystems that support a plethora of species such as coral fishes; mangroves associated animals; fauna living among sea grasses; animals using lagoon and sea to complete their life cycle stages resulting the high rating in biological diversity. It is further strengthened by the migratory animals such as tunas, cetaceans, sea turtles and sharks.

160. Since it is located in the arid zone of Sri Lanka, high temperatures and low rainfall are the main characteristics of the climate. Annual rainfall is less than 1,000 mm. The area experiences heavy rains from October to December, during NE monsoonal season. In comparison, amount of rainfall receives during the rest of the months is extremely low. The highest average monthly temperature is recorded in the months of June, July and August (36°C) while the lowest is encountered in the months of January and December (25°C).

Sea Grass Beds

161. Sea grass beds are encountered in the shallow coastal areas and lagoons in Mannar. However, sea grasses were not recorded within the submerged coastal stretch studied during the field survey. However, some sea grasses were observed in subsequent field visits washed off to the shore within the project site and along the Mannar Island. These sea grasses have washed off from sea grass beds located offshore (minimum 8 km).

Coral Reefs

162. The continental shelf of Gulf of Mannar contains shallow coral reef habitats in the country (Rajasuriya, et.al. 1995). They are continental patch reefs and the largest of these are Vankalai reef, Arippu reef, Silavathurai reef (Rajasuriya, et.al. 1995). However, they are far from the project area (more than 18 km). There are smaller coral patches situated further to the south of Mannar Island. Their extent varies from a few square meters to few hectares and occurs in relatively shallow water to a depth of about 10–12 m. They are about 6 km offshore. The famous Pearl Banks of Sri Lanka are found in the shallow seas of Silavathurai and Arippu and they are more than 20 km south of the project area.

Marine Mammals

163. Sixteen species of marine mammals[30] have been recorded within the northwestern maritime zone of Sri Lanka (Illangakoon 2004). Particular significance is the population of globally endangered Dugong (*Dugong dugon*). *Dugong dugon*[31] which was one of the common marine mammals recorded a few decades back is now found occasionally more than 6 km off shore and is required for marine mammal observer (MMO) aboard barge to watch out for. According to the fisherman, there have been no sightings of dugong within shallow waters in Mannar in recent past. Therefore, it is very unlikely to encounter any dugong within project impact area.

Sea Turtles

164. Out of the five species of sea turtle reported to nest along the coastal belt of Sri Lanka, three of them have been recorded in the Gulf of Mannar region. The predominant species is the Olive Ridley[32] (*Lepidochelys olivaceae*), followed by the Green Turtle (*Chelonia mydas*) and the Hawksbill Turtle (*Erytmochelis imbricata*). During the survey, an olive ridley was observed dead about 300m offshore at 5m depth close to Nadukuda. Although some fishermen believe that sea turtles nest in the coastal stretch in the project area, evidences could not be obtained during field survey and from literature, though it cannot be completely ruled out. Also, wind turbine locations are not within the turtle nesting areas. **Figure 4.44** gives illustrative turtle nesting locations in Sri Lanka.

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[30] (Ref from Illangakoon, 2004), Marine mammals occur in deeper areas Valid for barge operation where onboard marine mammal observer (MMO) will be on duty.

[31] These are found in offshore areas and not a CH trigger for the project other than barge operation where MMO will look after.

[32] Although there are some records, turtles are found in southern part of the Island (already given a map with distribution). No tutles were recorded laying eggs in Mannar beaches. However, precausions are already discussed.

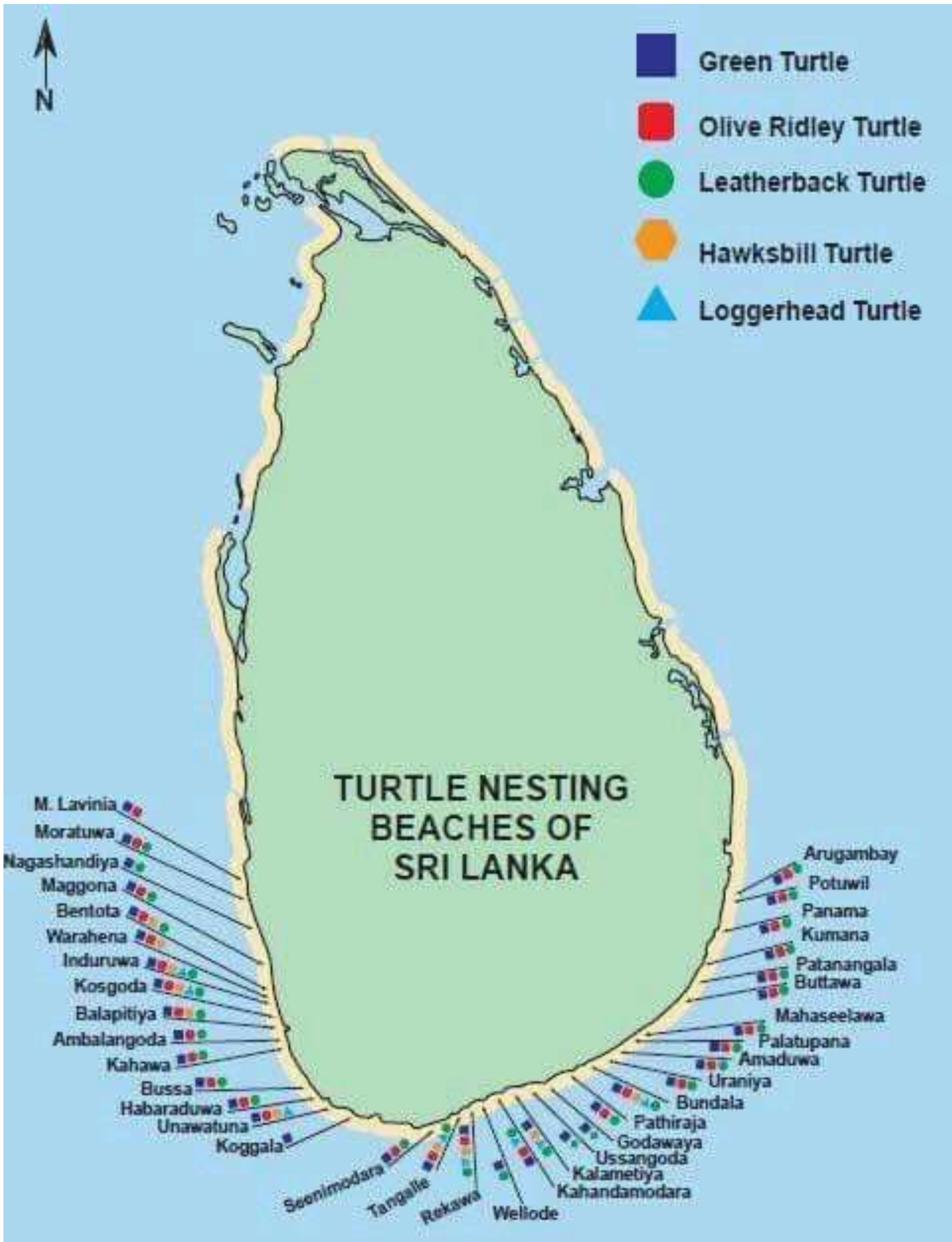

Figure 4.44: Map of the Turtle nesting beached of Sri Lanka

Source: Guidelines for Community-based Nature Tourism in Sri Lanka by IUCN Sri Lanka Country Office and CARE Sri Lanka *http://www.asiantribune.com/sites/asiantribune.com/files/imagecache/Original/images/2012/Turtles_1.jpg*

4.2.4 Activities in the Project Area (Including Beach Seine Fisheries)

Fisheries Survey Design and Sampling Methods

165. An assessment was carried out to collect information through scientific field studies, physical observation, working with key informants and semi-structured interviews with key informants including owner of *ma-del padu* (beach seine area) and leader of the beach seine operation. Field studies were conducted in the 4th week of February 2016. In addition, secondary data was collected mainly from the Department of Fisheries and Aquatic Resources Development

(DFAR), District Fisheries Office in Mannar (Assistant Director, Mannar).

166. The fllowing areas of fisheries important within the project area and in the vicinity of the project were assessed:

- Present fishing practices, fishing seasons, types of fishing gear and crafts within the project area including beach sein fisheries
- Major species involved in the fishery
- Fish catch data (Additional fish catch statistics from department of fisheries and Aquatic Resources Management)
- Fishing grounds covering the area of proposed pier construction
- Spawning and nursery grounds for fish and shell fish

Significant Marine Resources in Study Area

167. Marine environments surrounding Mannar Island are very rich in fishery resources. Fishing is a major contributor to the economy. It provides the principal source of livelihood for a large portion of the population, particularly in Mannar DS division, where over 50% of families rely heavily on fishing activities. Mannar is an important supplier of fresh and dried fish. Fishing season is between October to March following year. From May to September, it is the off season with very rough seas. No activities are possible in the sea.

Fishing Gear and Types of Fisheries

168. The coastal stretch along the project area is a well-known seasonal camps of migratory fishermen mainly traditional beach seine (*ma-del*) operated area. *Ma-del* areas locally referred to as *ma-del padu* (the reserved portion of the beach for a registered beach seine owner). Designated beach seine areas (*ma-del padus*) are demarcated almost adjacent to one another. Mannar District Fisheries Extension Office (DFEO) Division has 114 such *ma-del padus*, whereas in the study area there were nine. Kiriyankuduyiruppu has missed from the map. However, there is a high degree of variability in actual madel padus since they are adjacent to each other without physical boundaries to demarcate each. Also, no map depicting the area of *ma-del padu*.

169. **Table 4.6** summarizes the Fisheries Inspector (FI) Divisions, respective GN divisions and major fishing camp sites. **Figure 4.45**[33] shows fishing camp locations.

Table 4.6: Fishing camps/ beach seine areas (*ma-del padu*s) along the coastal stretch of project area

FI Division	GN div	Fishing camp (*Ma-del padu)*	Number of fishermen	Temporary/ Permanent[a]	Fishing period
Mannar	Thoddaveli (MN-62)	Malivady (Anchu Thennampillai)	20	T	Oct – Mar
Erukkalam piddy	Oolaithoduvai (MN-60)	Oolaithoduvai (Sinnakarisal)	80	T	Oct – Mar
	Puthukudiyiruppu (MN-60)	Uvari	25	T	Oct – Mar
Pesalai	Thullukuduyiruppu (MN-55)	Nadukuda 1	20	T	Oct – Mar
		Nadukuda 2	6	T	Aug – April[b]

[33] Green dots are from actual field surveys within project area overlayed on an old map. The Black dots shows fishing camps that are temperory (except Nadukuda) which may change it sites.

FI Division	GN div	Fishing camp (*Ma-del padu)*	Number of fishermen	Temporary/ Permanent[a]	Fishing period
		Kiriyankuduyiruppu	40	T	Oct – Mar
	Kaddukarankudiyiru ppu	Palavithotai (Thalaimannar Station)	20	T	Oct – Mar
			30		
		Old Pier 1	100	T	Oct – May
		Old Pier 2		T	Oct – Mar

[a] According to the information from fishermen, they leave these camps in off season, some structures may be permanent, but fishermen stay temporarily.

[b] Nadukuda fishers also engage in fishing in the northernside while staying at same location.

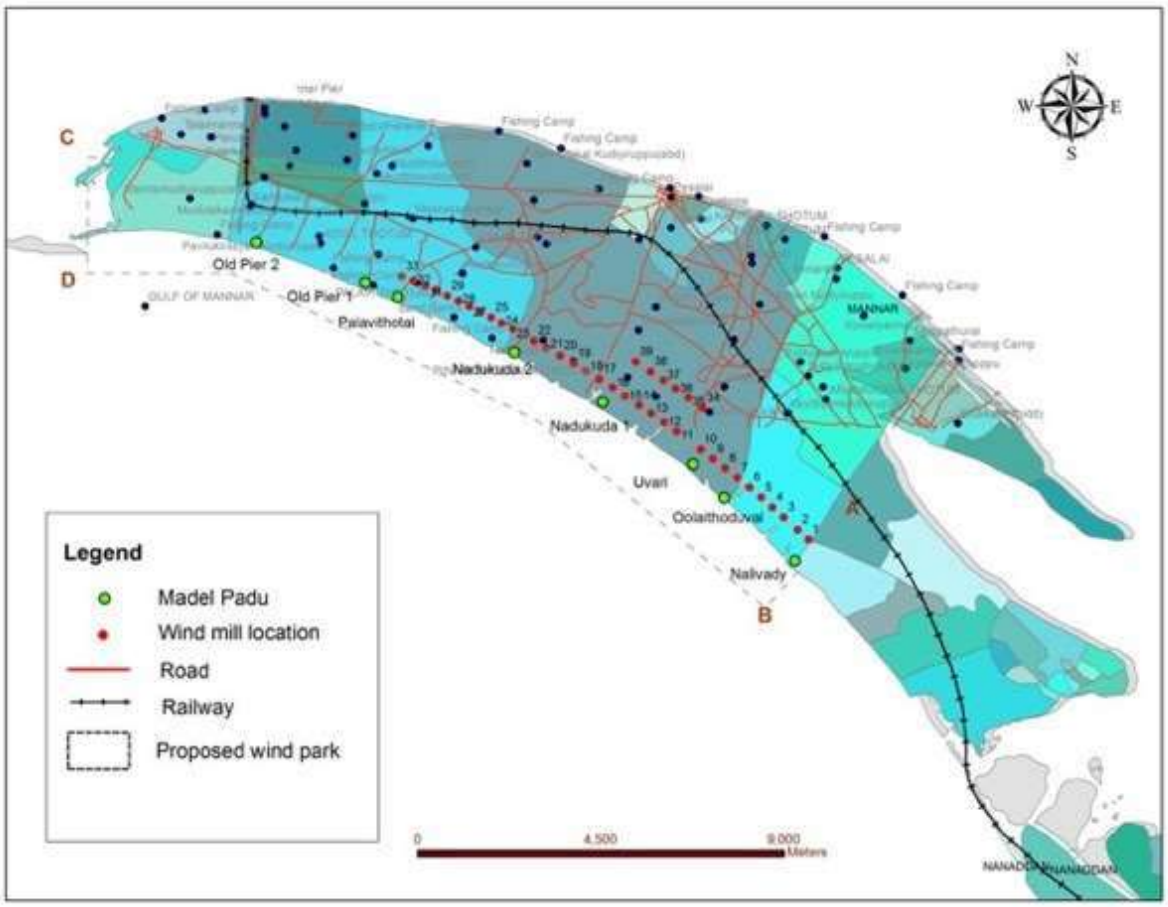

Figure 4.45: Map of the study area showing fishing camp locations within *Ma-del Padus*

Fishing Boats Operated

170. There is no fishery hour or anchorages in the area and usually landed on beach in scattered locations along the coast, although the beach landing location at Nadukuda is used more regularly. Only small crafts are operated. These include out-board engine fiber reinforced plastic boats (OFRP), motorized traditional boats (MTRB), non-motorized traditional boats (NTRB) and non-motorized beach seine boats (NBSB).

Fishing Season

171. The main fishing season for fin-fish in Mannar District is generally from October to March. Rough weather conditions with very high winds and blown dust between April to September prevent fishing operations and majority of the fishermen[34] have to vacate the area and move to other areas for livelihood. Most of the data in this report related to fisheries were derived from the semi structures interviews conducted with the owner of the *ma-del padu* or other key informants, in addition to personal observation on fishing operations, landings and camping sites. Some data were obtained from District Fisheries Office and personal communication with Assistant Director, District Fisheries Office, Mannar. **Table 4.7** summarizes the target fisheries in each of the fishing camps within the project area

Table 4.7: Fishing gear, boats used and target fisheries in each of the fishing camps within the project area

***Ma-del padu*/ key informant**	**Fishing gear/ methods used**	**Boats used**	**Major species targeted**	**Catch per operation[a] /kg**
Malivady	Scuba Diving upto 10km offshore 20-120 feet depth Ma-dal-2 Surukku del	OFRP – 6 NTRB (Vallam) -2	Sea Cucumber, lobster and chanks (sangu) Parawa, Kattawa, Salaya, Sudaya, Kumbalava, Anguluva, Karalla, Kumbalawa Cuttlefish, crabs, rock fish	50-75 pieces 500-1200
Oolaithoduvai	Ma-dal-3 Small size gill nets (1 ¼") *Kumbala* del (2 ½") during high wind months	OFRP – 40	Parawa, Kattawa, Salaya, Sudaya, Kumbalava, Anguluva, Karalla Habaraliya, Kumbalawa Herrings, mackerals	600-1200
Uvari	Ma-del-5	OFRP – 6	Parawa, Kattava, Salaya, Sudaya, Kumbalava, Anguluva, Karalla, Habaraliya, Kumbalawa	700-1000
Nadukuda 1	Ma-del-13	OFRP – 11	Parawa, Kattawa, Salaya, Sudaya, Kumbalava, Anguluva. Karalla, Habaraliya, Kumbalawa	500- 1000
Nadukuda 2	Ma-del-03	OFRP – 20	Parawa, Kattawa, Salaya, Sudaya, Kumbalava, Anguluva, Karalla, Habaraliya, Kumbalawa	800-1200
Kiriyankuduyir uppu	Ma-del Gillnet Madu del (10km offshore)	OFRP – 2	Parawa, Kattawa, Salaya, Sudaya, Kumbalava, Anguluva, Karalla, Habaraliya, Kumbalawa skates	500-600
Palavithotai	Ma-del-01 Gillnet	OFRP – 4 NTRB	Parawa, Kattawa, Salaya, Sudaya, Kumbalava, Anguluva, Karalla, Habaraliya, Kumbalawa	600-800

[34] Nadukuda camp fishing is used during April–August as some fishermen stay there and do fishing in the northern side of the Mannar island.

***Ma-del padu*/ key informant**	**Fishing gear/ methods used**	**Boats used**	**Major species targeted**	**Catch per operation[a] /kg**
	Kumbala del (2 ½")	(Vallam) - 1		
Old Pier – 1	Ma-del-02 Gillnet	OFRP – 05 NTRB (Vallam) - 2	Parawa, Kattawa, Salaya, Sudaya, Kumbalava, Anguluva, Karalla, Habaraliya, Kumbalawa	700-1000
Old Pier - 2	Gillnet Paraw- panna Kumbala del Handline	OFRP – 30 NTRB (Vallam) -6	Parawa, Kattawa, Salaya, Sudaya, Kumbalava, Anguluva, Karalla, Habaraliya, Kumbalawa	500-800

NTRB = non-motorized traditional crafts, OFRP = outboard motor fiberglass reinforced boats.
[a] Catch data from District fisheries office, Mannar, average catch during peak time

172. The project area was dominated by *ma-del* fishing operations. Uniform sandy bottom in shallow coastal stretch favored ma-del operations (**Figure 4.46**). In addition, gill nets are operated targeting sardines, carangids and mackerels. Only in MaliVaadi fishermen were using scuba and skin diving for sea cucumber, lobster and chanks (sangu).

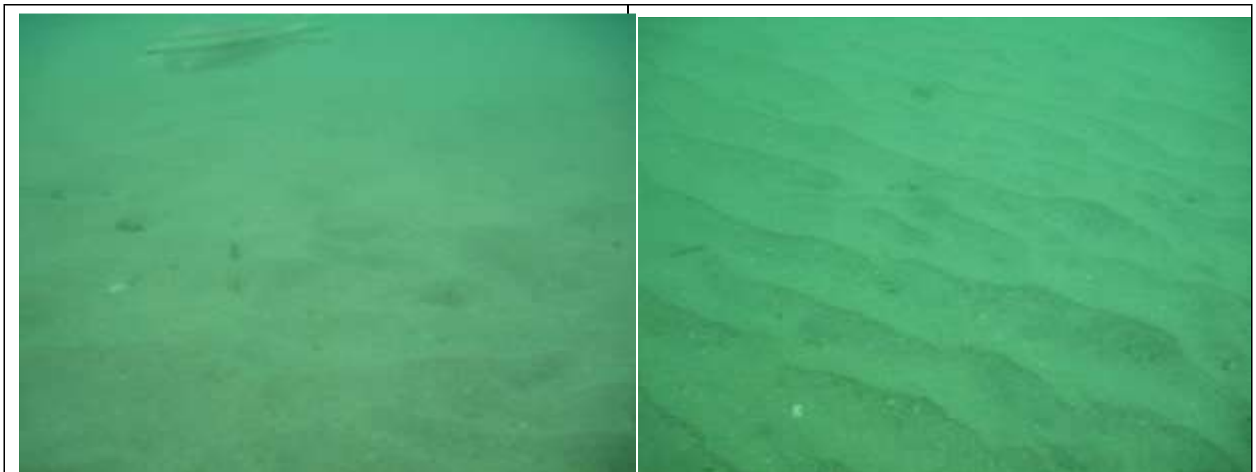

Figure 4.46: Uniform sandy bottom in the coastal zone in Mannar Island ideal for operating beach seines

Beach Seine Fisheries

173. The beach seine fishery is one of the oldest fisheries in Sri Lanka and the most important fishing gear in Sri Lanka until the 1950s (Canagaratnam and Medcof, 1956). It accounted for over 40% of the total fish landings until the 1950s. It is believed that the local name for beach seine, i.e. *ma-dela*, was derived from the Sinhalese words *maha dela*, which means, a huge net (Alexander, 1995). The term *ma-dela* is still used today in most legal documents.

174. The beach seines had been traditionally made from natural fibres, i.e., cotton, hemp and coconut fibres. These natural fibres have now been replaced by synthetic fibres. Beach seine fishing in Mannar is confined to coastal waters up to 2 km from the shore. Some of the ma-del padus belong to fishermen from Mannar and Pesalei where as others from Negombo, Wennappuwa, Marawila and Udappuwa, migrated to the NW shores of the country at the onset

of the NE monsoon and set up temporary fishing camps.

175. Beach seines are large nets with mostly detachable units; principally consist of a seine body, codend, wings, foot ropes, head ropes and hauling ropes, weights and floats. The mesh size in the cod end varies from about 6 to 18 mm, if small fish species are targeted, with a ply of about 27 (27 times Denier 210) to provide sufficient strength to withstand pressure from large catches in the range of 2 to 3 tonnes. Ropes are made of polyamide nylon twine. If shoals of larger fish are targeted, mesh sizes from 30 to 50 mm are used in the seine body. In most beach seines, the codend can be detached from the wings. Many beach seines have several codends with different mesh sizes so that fish species of different sizes can be more effectively targeted. **Figure 4.47** shows schematic beach seine fishing net.

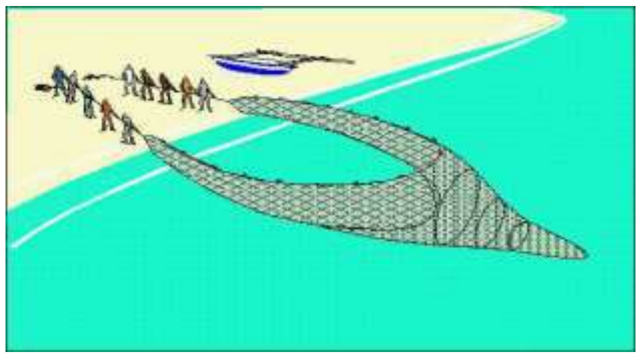

Figure 4.47: Schematic diagram of a typical beach seine net

176. A head rope is buoyed with rigifoam/wooden floats and the foot rope is weighted down with pierced stones, cement blocks or lead pieces. The cone-shaped body of the seine is made up of several cylindrical netting sections. The mesh size of the main body increases from 20 mm at the end to 60 mm at the mouth.

177. The weighted foot ropes and buoyed head ropes, which keep the wings in a vertical position with floats and sinkers, extend from the body along the wings up to the hauling ropes. The hauling ropes have diameters from 20 to 25 mm and a length from 400 to 3,000 m depending on the area to be encircled and on the type of operation. For ease of handling, the ropes are made into coils of about 75 m each. For the operation of larger beach seines, vallams and FRP boats are used.

Beach Seine Catches

178. During the study, species of sardines (Sardinella), ponyfish (Leiognathidae), mackerel (Rastrelliger), anchovies (Stolephorous), caranx (Carangidae) and spotted sardinella (Amblygaster sirm) were the most common varieties in the beach seine catches in the northwestern province. Of the recorded species, majority were belonging to the herring family (Clupeidae), horse mackerel family (Carangidae) and silver belly family (Leiognathidae). Most common species recorded in beach seine catches are shown in **Table 4.8** below:

179. None of the species recorded has significant conservation requirement.

Table 4.8: Species composition of Ma-del catches

Family	Scientific Name	English Name	Local Name
Prawns			
Penaidae	*Penaeus monodon*	Giant tiger prawn	Karawandu issa
Cuttlefish			
Sepiodae	*Sepiella inermis*	Spineless cuttlefish	Della
Cartilage fished			
Dasyatididae	*Dasyatis kuhlii*	Bluespotted stingray	maduwa
Ariidae	*Arius maculatus*	Spotted catfish	Gal anguluvu
Belonidae	*Ablennes hians*	Flat neeglefish	Moralla
Carangidae	*Alectis ciliaris*	African pompano	Kannadi parava
	Decapterus macarellus	Mackerel scad	-
	Caranx heberi	Blacktip trevally	Atanagul parava
	Scomberoides tala	Barred queenfish	Han kattava
Chirocentridae	*Chirocentrus dorab*	Dorab wolf-herring	Podi katuvalla
Clupedae	*Amblygaster sirm*	Spotted sardinella	Hurulla
	Anodontosoma chacunda	Chacunda gizzard shad	-
	Sadrdinella albella	White sardinella	sudaya
	Sadrdinella gibbosa	Goldstripe sardinella	Matta salaya
Fistulariidae	*Fistularia commersonii*	Bluespotted cornetfish	Malava
Leiognathidae	*Gazza minuta*	Toothpony	Pulunu karalla
	Leiognathus equulus	Common ponyfish	Mas karalla
Lehrinidae	*Gymnocranius elongatus*	Forktail largeeye bream	-
Muraenidae	*Uropterygius concolor*	Brown moray	-
Triacanthidae	*Pseudotriacanthus strilifer*	Longspined tripodfish	-
Serranidae	*Epinephelus faveatus*	Barredchest grouper	Pulli kossa
By catch			
Muraenidae	*Gymnothorax boschi*	Blacklined morey	Kalu iriya

Figure 4.48: Beach seine catches

Impact of Beach Seines on Fishery Resources and Aquatic Habitat

180. There is no national regulation for fishery prohibiting catching any (fish) species other than turtles, marine mammals and thresher shark (species under regular international agreements). Sri Lanka is party to Convention on International Trade of Endangered Species (CITES). The Department of Wildlife Conservation is the management authority for the Convention in Sri Lanka.

181. Beach seines are often regarded as having a negative impact on the environment. With small mesh sizes in the seine body and codend, the method is non-selective and negatively affects the aquatic fauna encircled by the seine, including larval forms, fry, juveniles and ova, while virtually scraping the seabed.

182. The catch of undersized fingerlings is a noticeable feature of the beach seine fishery. In addition to target species, these may contain fingerlings and juveniles of commercially valuable large fish such as tuna, caranx (*Carangidae*), Spanish mackerel (*Scomberomorus commerson*), prawns etc. Discards are usually negligible. However, poisonous fish such as puffer fishes and sea snakes, sponges, anemones, echinoderms, starfishes, tunicates, etc., found in the catch in small quantities (**Figures 4.48** above and **4.49**).

	
Morey eel	Puffer fish

Figure 4.49: Some by-catch from beach seine fishery

Other Fishing Methods

183. Gillnet fishing is the other fishing method that operate in the project area mostly using OFRP boats. The depth at fishing is mostly confined to 5–15 m targeting sardines. The key target species are herring (*Amblygaster sirm*), oil sardines (*Sardinella longiceps*), kelee shad (*Hilsa kelee*).

184. Surukku del is a mini-purse seine which encircles fish schools. The key target species are oil sardines (*Sardinella longiceps*), rainbow sardine (*Dussumieria acuta*), and herring (*Amblygaster sirm*). Operation of this gear has been banned in Sri Lanka.

185. Sea cucumbers, oysters and gastropods (eg., conch) are caught by skin and scuba diving.

Sea Cucumber (beche-de-mer) Fishery

186. Sea cucumber fishery is a lucrative business in the Mannar district where the processed

product is exported. October to April is the season for collecting sea cucumber. Of the sixteen species of sea cucumber found in the northwestern region, *Holothuria scabra* and *H. spinifera* are restricted to the Mannar area. Among the species collected in Mannar, *Holothuria scabra* (sand fish) is highest rated followed by *Stichopus choronotus* (green fish). *Holothuria spinifera* (brown fish), *Stichopus herrmanni* (curry fish) and *Holothuria atra* (lolly fish) are the other species recorded. Once cleaned, boiled and dried they are graded and packed for export.

Gastropod Fishery

187. *Conch shell collection:* Of the 10 sites surveyed fishermen in MaliVaadi, conch shells are collected by skin and scuba diving. This is generally an unregulated activity with very little or no supervision on the size of specimens collected. Diving as a fishing method is only operated by fishermen at MaliVaadi padu.

Crab Fishery

188. Crabs fetch high prices. Sea crab (*Portunus pelagicus*/blue swimming crab) is caught using nylon nets while mud crabs are caught in traps.

4.2.5 Rare, threatened, endemic Fauna of the Coastal area of study area

189. A total of 131 terresterial faunal species including four endemic species, five nationally Critically Endangered, four Vulnerable and five nationally near threatened species were recorded during the field survey within the study area (**Table 4.9**). The site selected for the establishment of the proposed wind farm predominantly comprise of scrub and coastal vegetation. The terrestrial survey area for wind farm included the entire area identified for wind development. Therefore, the faunal diversity was found to be low in these areas and comprised mostly of butterflies, reptiles, birds and mammals. The faunal assemblage in the project area is dominated by birds including 35 migrant species. Most of the migrant birds were observed along the coastline of the project area except for few common forest migrants observed within the project impacted area. A fruit bat colony comprising of approximately 100 bats were observed near the wind turbine No. 1. However, the bats are not passing through the proposed wind farm area as they feed mostly on the mainland.[35] The detailed list of fauna recorded during the field study is listed in **Annexure 2.**

Table 4.9: Summary of the faunal species recorded during the study

Taxonomic Group	Total Number	Endemic Species	National Conservations Status						Global Conservation Status			Migrant or Feral Species
			CR	EN	VU	NT	LC	NE	LC	NT	NE	
Butterflies	12	1	0	0	0	0	0	12	12	0	0	0
Reptiles	5	1	0	0	1	0	3	1	03	0	2	0
Birds	103	1	5	0	3	4	62	29	100	3	0	35[a]
Mammals (including Bats-2)	11	1	0	0	0	1	9	2	8	1	2	2[b]
Total	**131**	**4**	**5**	**0**	**4**	**5**	**74**	**44**	**123**	**04**	**04**	**37**

CR = critically endangered, EN = endangered, LC = least concern, NE = not evaluated, NT = near threatened, VU = vulnerable

[a] migrant bird species

[b] feral to Sri Lanka

[35] The two species of bats added to the list. Bats rarely pass through the windfarm area as was confirmed by the vantage point survey counts from June 2016 to March 2017. During this period, there were 10171 records of movements which bats comprise of only 24 records. Out of these 24 records, fruit bats made up 19 while the remaining five were insectivorous bats.

190. The two feral species [b] (Equus asinus and Equus caballus) as mentioned in the Table 4.9 above do not trigger critical habitat as these two are introduced species to Sri Lanka that have subsequently formed feral populations. Two species of bats - Pteropus giganteus and Pipistrellus tenuis mentioned in the above table were observed in the wind farm area but at a very low frequency.

191. Only four species of endemic fauna were observed within the project affected area. These include one butterfly species *Appias galena* (Lesser albatross), one reptile species *Sitana devakai* (Devaka's fanthroat lizard), one bird species *Tephrodornis pondicerianus* (Common Wood shrike) and one species of mammal *Moschiola meminna* (Sri Lanka Mouse Deer). All of these endemic species are widely distributed in Sri Lanka. *Sitana devakai* is found in coastal and inland habitats in the northwestern region while *Appias galena*, *Tephrodornis pondicerianus* and *Moschiola meminna* show an island wide distribution in Sri Lanka. None of the species that are recorded in the project site are listed as globally threatened species. It should be noted that eight species of birds and the reptile species *Sitana devakai*[36] are listed as Nationally threatened species (MOE, 2012). In the case of the eight species of birds listed as Nationally Threatened, this status only applies for their breeding populations. All these species also have a migrant population which is not considered threatened. Breeding populations of any of these species are not recorded within the project affected area and therefore what is observed here are migrant populations that do not qualify for the threatened status.

Rare, Threatened, Endemic Fauna Outside Study Area

192. *Holothuria scabra* has been listed as globally endangered, however, it is commercially exploited throughout its range for its high value. In Mannar, catching of *H scabra* is done only with permits from the fisheries authority. It is not found in the study area.

193. They are usually caught in 6–10 km offshore outside the Wind Farm project and project impact zone. Therefore, wind farm project activities will not have any impacts on this species and mitigation measures are not proposed. The project implementation agency, CEB has no control on capture of this species and it is outside the purview of the wind farm project.

4.2.6 Rare, Threatened and Endemic Flora Species in the Study Area[37]

Terrestrial Survey

194. A terrestrial survey[38] was conducted to prepare a plant species inventory in 39 locations, each having an area of 150 m x 150 m (2.25 ha), demarcated in two rows (33 in the first row and 6 in the second row) along the southern part of Mannar Island for the proposed Wind Power Project. The first row is about 150–160 m from the coast and the second row is about 900 m. All the plant species found in the 2.25 ha or 150 x 150 m area were recorded. The trees that will be removed within the hardstand (about 31% (0.7 ha[39]) of the area demarcated for the wind turbine)

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[36] *Sitana devakei* was formerly known as *Sitana ponticeraina* which was taught to show a islandwide distribution in Sri Lanka and shared with India. In 2014, *Sitana ponticeraina* was split in to two, *Sitana devakaei* and *Sitana bahiri* and both species are now listed as endemic to Sri lanka. *Sitana devakei* occurs in the northwestern part of the island while *Sitana bahiri* inhabits the southeastern part of the island.

[37] Study area- same as the project site, however, this includes proposed access roads as well.

[38] There is no standard methodology for conducting ecological studies. It changes according to the habitat (terrestrial/ aquatic) and type of activities of the proposed project.

[39] Google kmz map of the hardstands of each turbine location was given in the Figures 4.58-4.60 developed by CEB- the tab which has google earth can be used to locate the hardstand area

were counted or the area covered by trees, as a percentage of the total hardstand area, was estimated. All vegetation including trees, other than this hardstanding area, will be retained as per the Terrestrial Ecology report (**Appendix 8**).

195. A total of 201 plant species (63 families and 185 genera) including two endemic (*Vernonia zeylanica - Pupula* and *Cassine glauca – Neralu*) and 178 indigenous species were recorded from 39 turbine locations, each having an area of 150 m x 150 m (2.25 ha). 21 plant species recorded in the study area are introduced species. About 17 of them are now naturalized and this indicates that the area is comparatively less disturbed by human influence. All recorded flora species are not unique or restricted to the project locations. However, *Acacia planifrons* is the species that restricted to Mannar and some area of the mainland. It is the most common tree in Mannar Island and forms a continuous canopy about 100–150 m from the coast. The highest number of trees to be removed in the hardstand of all locations is Acacia trees. Scrubland and sand dune vegetation is the main vegetation types found in the 12 km stretch of the first row of wind turbines. In addition to scrublands, Palmyra groves/ stands and coconut plantations are found within the turbine locations 34 to 39. Most of the recorded plant species are locally common in the area.

196. There are seven threatened species (two shrub species, three creepers, one herb and one tree) (Red list 2012), 13 near threatened species and one categorized as data deficient (**Table 4.10**). Two plant species (*Vernonia zeylanica - Pupula* and *Cassine glauca - Neralu*) recorded during the field survey within the project site are endemic to the country. The revised Handbook to the Flora of Ceylon, Vol. X (pg.86-87) list the herbarium specimens of *C. galuca* (Neralu) were prepared from the specimens collected from localities in seven districts (Mannar, Vavunia, Puttalam, Anuradhapura, Trincomalee, Matale and Polonnaruwa) of Sri Lanka. Two endemic species, *Vernonia zeylanica* (Pupula) and *Cassine glauca* (Neralu) are categorized as LC in the National Red list (2012).

197. Seven threatened species were also listed during the field survey (**Table 4.11**). Another 13 species recorded are in near threatened (NT) category and one species considered as data deficient (DD) according to the National Red List of 2012, Ministry of Environment, Sri Lanka. No endemic species are in threatened or near threatened categories. All recorded endemic and indigenous flora species are not unique or restricted to the 39 turbine locations. **Appendix 8 (Table 3**) gives lists of all plant species recorded in Terrestrial Survey in 39 location.

Table 4.10: Number of plant species, threatened, endemic, indigenous and introduced species by life forms

Life form	Total species	National Status Threatened (NT)	IUCN-GCS	Endemic	Indigenous	Introduced
Tree	40	1(3)	LC-7	1	32	7
Shrub	57	3(3)	LC-6	1	51	5
Herb	65	1(4)	LC-8	-	59	6
Climber/Creeper/ Liana	34	2(3)	LC-2	-	31	3
Grass / Grass like	5	-	LC-1	-	2	-
Total	**201**	**7(13)**	**LC-24**	**2**	**175**	**21**

Table 4.11. Threatened plants (Red Data book, 2012 and Global Conservation Status- IUCN Global Red list) recorded in the turbine locations

Threatened species						
Family	**Species**	**Sinhala Name**	**H**	**TS**	**NCS**	**GCS**
Fabaceae	*Vigna marina*	Lee ma	C	In	EN	NA
Menispermaceae	*Hyserpa nitida*	Niri-wel	C	In	EN	NA
Vahliaceae	*Vahlia dichotoma*		H	In	EN	NA
Fabaceae	*Indigofera oblongifolia*	Nari Mun	S	In	VU	LC
Menispermaceae	*Tinospora cordifolia*	Rasa-Kinda	C	In	VU	NA
Rhamnaceae	*Colubrina asiatica*	Tel hiriya	S	In	VU	NA
Sapotaceae	*Manilkara hexandra*	Palu	T	In	VU	NA
Near Threatened and Data Deficient Species						
Family	**Species**	**Sinhala Name**	**H**	**TS**	**NCS**	
Menispermaceae	*Tinospora sinensis*	Rasa Kinda	C	In	DD	NA
Aizoaceae	*Sesuvium portulacastrum*	Maha-sarana	H	In	NT	NA
Aizoaceae	*Trianthema decandra*	Maha-sarana	H	In	NT	NA
Capparaceae	*Capparis brevispina*	Wal-dehi	S	In	NT	NA
Celastraceae	*Salacia chinensis*	Heen-himbutu-wel	C	In	NT	NA
Combretaceae	*Lumnitzera racemosa*	Beriya	T	In	NT	LC
Fabaceae	*Albizia amara*	Iha	T	In	NT	NA
Fabaceae	*Indigofera colutea*		H	In	NT	NA
Fabaceae	*Vigna trilobata*	Bin-me	C	In	NT	NA
Lythraceae	*Pemphis acidula*	Muhudu Wara	S	In	NT	LC
Olacaceae	*Olax imbricata*	Telatiya	S	In	NT	NA
Orobanchaceae	*Striga angustifolia*		H	In	NT	NA
Salvadoraceae	*Salvadora persica*	Malittan	T	In	NT	NA
Vitaceae	*Cyphostemma setosum*		C	In	NT	NA

C = creeper, E = endemic, EN = endangered, G = grass, GCS = global conservation status, H = herb, I = introduced (including naturalized exotics), In = indigenous, LC = least concern, NA = not assessed, NCS = national conservation status, NT = near threatened, S = shrub, T = tree, TS = taxonomic status, VU = vulnerable.

4.2.7 Avifauna in the Project Area

198. Sri Lanka supports a rich avifauna that stands at 495 species at present. This includes 240 species that are confirmed breeding residents that live year-round and breed in Sri Lanka. Out of the 240 breeding residents, 33 are found only in Sri Lanka (endemic to Sri Lanka). Approximately 125 bird species recorded in Sri Lanka are listed as regular winter visitors that arrive in Sri Lanka around September and depart Sri Lanka around April (the period that coincides with winter season in the northern hemisphere). Further, 21 species that are listed as breeding residents, also have migrant populations which also include migrants of different races than the species that occur in the country. The remaining species are listed as vagrants (recorded only several times or periodically), status unknown and oceanic birds.

199. The Mannar region, including Talaimannar and Adam's Bridge are important refuges of water birds, especially the annual migrants. The Gulf of Mannar region forms part of the Central-

South Asian migratory bird flyway. As such the wetland habitats of this area are of high ecological significance for annual migrants. The Mannar area provides excellent feeding and living habitats for a large number of water bird species, including annual migrants, which use this area also for landfall (on arrival in Sri Lanka), and as a last staging point (during their exit from Sri Lanka). (**Figure 4.50**).

200. The migrant birds that arrive in Sri Lanka enter the island through several paths of entry. One of the major entry points is located in the Mannar region which thousands of birds use as landing place before they disperse in to other internal wintering sites. Similarly, when leaving the country at the end of the season, they use this region as their last staging point. Based on a three-year study conducted the major entry point for migrants that enter through the northwestern region lies between Mannar and Vedithalaitivu where they are entering Sri Lanka using the passage north of the Mannar Island. The proposed site is not lying within this entry point. Some of the weak fliers such as small birds use the Adam's Bridge Marine National Park to cross over from Mainland India to Sri Lanka.[40] They enter the island through the Southwestern end of the Mannar Island (Urumalai point) and disperse into the island. This passage way lies 5 km from the proposed site. However, the proposed site lies in the southern boundary of this flight path and is not likely to interfere with this movement.

201. More than 30% of the birds recorded in Sri Lanka (more than 150 species) have been recorded from this region. This region generally harbors more than 200,000 water birds during the migration season that spans from September to April. The area is also inhabited by some of the rarest species of birds recorded in Sri Lanka such as *Anas poecilorhyncha* (Spot-billed Duck), *Anas strepera* (Gadwall), *Sarkidiornis Melanotos* (Comb Duck).

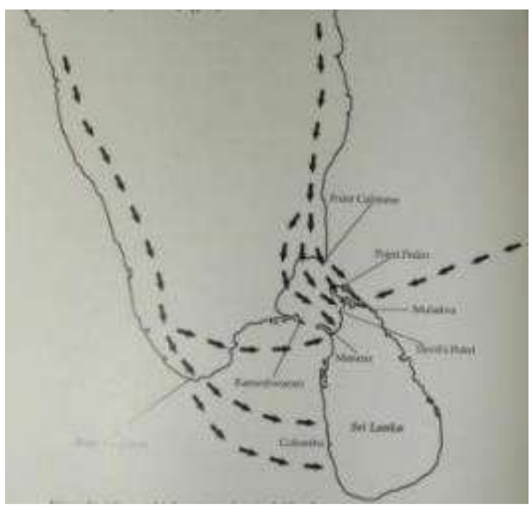

Figure 4.50: Migratory Birds entry points in Sri Lanka

[40] The scrub habitat used by migratory small birds lie mostly in Urumalai area which is within the Adam's Bridge National Park and does not overlap with the Wind farm corridor.

4.2.6.1 Avifauna Study

Methodology for Baseline Development for Avifauna in Project Area

Overall Approach

202. A literature survey was carried out to document all available data on birds of the Mannar Island. Based on this data a preliminary assessment was carried out to identify gaps in the available information and potential impacts of establishing a wind farm on the avifauna of the region. This was followed by baseline bird surveys to identify different types of habitats present in the study area. The type of avifauna inhabiting each of these habitats, their relative abundance, their conservation status and the movement patterns of the avifauna were documented. This information was used to identify potential impacts of the proposed development on the avifauna and mitigation measures that are required for the identified significant negative impacts.

Baseline Bird Surveys

203. Baseline bird survey work was led by Prof. Devaka Weerakoon of Colombo University, Department of Zoology, and had the specific objectives of the following:

- Compile all available sources of existing background information on the bird populations reported in the areas identified for the proposed wind parks in the Mannar Island and provide an ornithological assessment of the potential impacts and level of risk to the bird population associated with the proposed wind park.
- Establish and follow internationally acceptable survey methodologies, survey locations and data collection formats to inform an ornithological assessment of the wind park development in the Mannar Island.
- Prepare an inventory of birds that inhabit the areas identified for the wind park development in the Mannar Island and identify the presence of any endangered or restricted range species.
- Document the baseline conditions that exist in the Mannar Island that can be used for future monitoring to assess the real impact arising due to the proposed development.
- Identify diurnal and seasonal patterns of avifaunal behavior and the factors that govern these behaviors such as wind, rain, etc.
- Identify the potential impacts that may arise as well as to provide recommendations towards minimizing potential harmful impacts that may arise due to the proposed development.
- Consult relevant stakeholders regarding the proposed wind power development in Mannar Island.

204. The first phase of this work was undertaken to inform the full extent of the whole potential development, i.e., the full 375 MW wind farm and the transmission line route to the substation on the mainland. The surveys undertaken for this work comprised three main survey methods. Further details of the survey methods are given in **Appendix 2**.

- **Line Transect Surveys (Grid Counts)**: These surveys covered a high proportion of the study area, to determine temporal changes in bird composition, abundance and movement patterns within the study area with surveys carried out on a sample of 1x1 km squares over the whole survey area as shown **in Figure 4.51.**

- **Initial Vantage Point Surveys**: These surveys were undertaken to quantify bird flight activity through the study area, and identify any important flight routes.

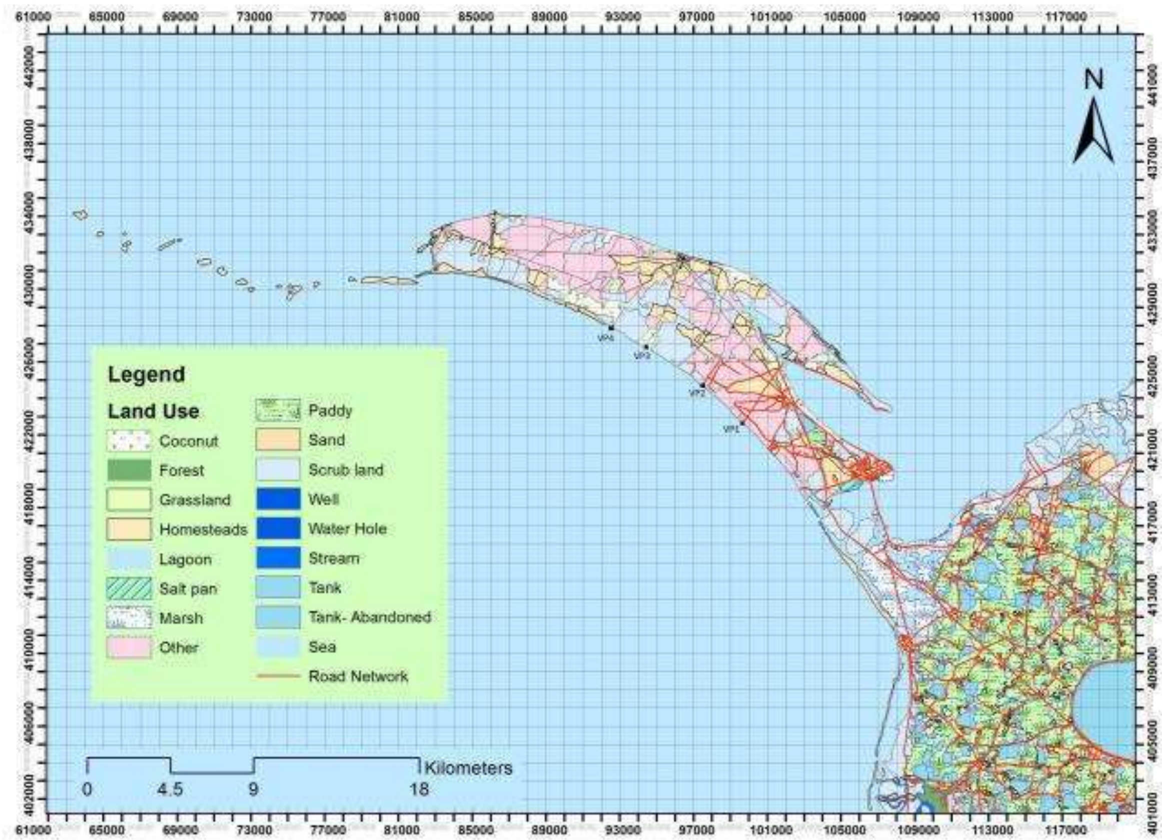

Figure 4.51: Map showing the 1 km grid used for quadrate sampling and the placement of the permanent sampling plots (indicated by black circles). Each 1 sq. km block in the grid is labeled using a 2-letter code, a letter from the English alphabet and an Arabic numeral (e.g. A1, B1 etc.)

- **Block Counts.** These surveys set out to determine the densities of water birds and waders. Six main sites were covered (see Figure 3); Kora Kulam, the northern beaches and southern beaches and Kralls of Mannar Island, the salt pans, the Erukkalampiddy lagoon, and the Vankalai Sanctuary (including both sides of the causeway, Periya Kalapuwa, Mantai Kulam and other water bodies in the Sanctuary). Of these count areas though, it is only the Mannar Island south shore that is relevant to the wind farm assessment, as all of the other areas lie outside the potential impact zone of the wind farm.
- Each site was divided into blocks and the birds in each block were counted using a spotting scope. These counts were carried out during the migration season (three counts, made during January/February 2014, 2015 and 2016) and non-migration season (two counts in May/June 2014 and 2015) to determine different usage of these water bodies by aquatic birds. The Erukkalampiddy lagoon was only counted in 2015 and 2016, as it was dry in 2014 so held very few waterbirds.
- **Wind Farm Vantage Point Surveys June 2016-March 2017.** Following a review of the above data, further specific surveys were carried out during June 2016–

March 2017, focusing more on the specific wind farm site and quantifying more precisely how many birds could be affected by the wind farm. These new surveys were undertaken from four vantage points (VP) along the southern Mannar Island shore, giving a view over the proposed wind farm site.

- The survey methodology was updated from January 2017 to include mapping of flight lines of key species from each vantage point, to provide more detail on the movements of key (Critical Habitat) species through the wind farm site.

Enhanced Ground Counts by Sector

205. The objective of these additional surveys was to obtain data to sufficient spatial accuracy to enable key species numbers within the potential disturbance zone of the wind farm to be more accurately calculated. They were carried out during January–March 2017. They comprised regular counts on a sector-by-sector basis of all habitats that could hold Critical Habitat species (primarily open coastal and any other wetland), including all of the area that could be affected by the wind farm.

Mass Migration of Birds

206. A detailed avian survey was carried from January 2014- March 2017 in the Mannar island. This included VP surveys along the transmission line and wind farm corridor to gather detailed information on bird movements and potential project impacts. The survey counted 1.2 million birds in the Wedathalithuvu area located almost 30 km north of the windfarm and transmission line corridor. The bird data shows that no mass migration of ducks or other species is supported by areas in and near the windfarm and transmission line corridor.

207. A full list of all of the species recorded during the baseline surveys, together with their scientific names and conservation status is given in **Appendix 3**.

4.2.6.2. Avian Collision Risk Modelling Methodology (Wind Turbines)

208. One of the main potential ornithological impacts of concern for the Mannar wind farm is collision with the operational turbines. Collision risk modelling (CRM) has therefore been undertaken following the method of Band et al. (2007), as extensively used in the UK and elsewhere. Details of the original SNH guidance on this model (Band 2000) are available from the SNH web site at <www.snh.gov.uk/docs/C205425.pdf>. Further details of this modelling are provided in **Appendix 2**.

209. The CRM has been carried out on the key species of concern (i.e. those listed in **Appendix 2, Tables 6 and 7**) that were observed flying within the collision risk zone at risk height, for both the wind turbines and for the overhead power line.

210. The collision modelling requires a range of input data on the wind turbine specifications, which have been provided by the CEB (**Table 4.12**). This modelling has taken a reasonable conservative approach, running the model for the turbine likely to give the highest collision risk of the options being considered. The model has been run for the current proposed 39 turbine layout being assessed. Consideration is also given to the risks that would be posed but the further phases of the wind farm.

Table 4.12: Wind turbine data used in the collision risk modelling.

Specification	Turbine input data
Number of turbines	39
Hub height	80-100m
Rotor diameter	130 m
Height to blade tip	155 m
Minimum height of blade above ground	25 m
Rotational speed (variable – mean of range used)	5-20 rpm (mean 12.5rpm)
Blade maximum chord	4.5m
Blade pitch (variable – mean value used)	6°
Turbine operation time (when not constrained by high/low wind speed or maintenance activity)	90%

211. The collision model also requires data on bird body size and flight speed. Body sizes and baseline mortality rates were taken from Robinson (2005) and Grimmet et al. (2012) and flight speeds from Alerstam et al. (2007).

212. The results of any collision risk modelling using the Band, et.al. (2007) approach is highly sensitive to the avoidance rate used (Chamberlain, et.al., 2006). Application of an appropriate rate is therefore of fundamental importance in undertaking such modelling. However, there are very few studies at existing wind farms where avoidance rates have been fully determined, comparing pre-construction flight activity with the actual numbers of collisions post-construction (Urquhart, 2010). The approach generally used to address this is to apply a precautionary rate based on the available data, such that any collision prediction is unlikely to be exceeded (i.e. represents a reasonable worst case). Where data on actual avoidance rates of particular species/groups have been established, then this has usually enabled a higher rate to be safely applied. For example, SNH has recently recommended a move from a 99% rate to 99.8% for geese based on recent research (Douse, 2013). SNH now recommends using a value of 99.8% as an avoidance rate for geese (Douse, 2013), 99% for several birds of prey (including Golden Eagle and Hen Harrier), and 98% for most other species (Urquhart, 2010).

213. There is a lack of specific avoidance rate data from Sri Lanka and on the species of concern at Mannar. As collision avoidance rates are not yet known for the species of concern, suitable overseas species have been used as proxies. The selection of appropriate rates followed SNH guidance and with reference to the bird-wind farm literature. As recommended in SNH guidance, a precautionary 98% was adopted as the default value (Urquhart, 2010) but the work has also explored whether particular species exhibit similar behavior to more vulnerable species such as White-tailed Sea Eagle and Kestrel, or such behavior that would reduce risk (and hence allow higher rates to be used as is recommended by SNH for Golden Eagle and Hen Harrier for example). The collision risk modelling results is presented for each layout for a range of avoidance rates to inform the assessment but the most appropriate rate to apply in each specific case will be indicated.

4.3 Critical Habitat Assessment

Critical Habitat Criteria

214. The highest ornithological sensitivity category relates to the ADB tests for Critical Habitat. Critical habitat is defined by ADB (2012)[41] as follows:

[41] Asian Development Bank. 2012. Environment Safeguards: A Good Practice Sourcebook Draft Working Document, December 2012.

"Critical Habitat is an area that has high biodiversity value and may include sites that are legally protected or officially proposed for protection (e.g. areas that meet the International Union for Conservation of Nature (IUCN) classification criteria, the Ramsar List of Wetlands of International Importance, and United Nations Educational, Scientific, and Cultural Organization (UNESCO) world natural heritage sites. Critical habitat includes:

- *habitat required for the survival of critically endangered or endangered species*
- *areas with special significance for endemic or restricted-range species*
- *sites that are critical for the survival of migratory species*
- *areas supporting globally significant concentrations or numbers of individuals of congregatory species*
- *areas with unique assemblages of species that are associated with key evolutionary processes or provide key ecosystem services*
- *areas with biodiversity that has significant social, cultural or economic importance to local communities*

Further, ADB's Good Practice Sourcebook (2012) states that " In accordance with the SPS, no project activity is permitted in areas of critical habitat unless: (i) there are no measurable adverse impacts, or likelihood of such, on the critical habitat that could impair its high biodiversity value or ability to function; (ii) the project is not anticipated to lead to a reduction in the population of any recognized endangered or critically endangered species, or a loss in the area of the habitat concerned such that the persistence of a viable and representative host ecosystem will be compromised; and (iii) any lesser impacts are mitigated to achieve at least no net loss of biodiversity.

215. A Critical Habitat Assessment has been undertaken following this guidance. The first step was to identify the internationally/nationally important designated areas that could qualify as Critical Habitat.

Birds Species of Conservation Concern

216. After that the species/populations of importance that triggered this Critical Habitat were identified through reference to the protected area designations and using the baseline survey data collected for the project EIA. This part of the assessment was done primarily using the 1% criterion[42] (Wetlands International 2012),[43] with an area considered Critical Habitat if it supported more than 1% of the relevant flyway population (though with reference also to the global and national populations). As the baseline data and historic data were sparse, a precautionary approach was adopted utilizing the overall peak count as the key population indicator. Flyway and global populations were taken from the most recently-published Wetlands International report (Wetlands International 2012).

217. As the Vankalai Sanctuary Ramsar site is also internationally important for its wintering bird assemblage, and given the high between-year variability in numbers recorded, all populations with more than 0.5% of the flyway population, and species occurring in higher numbers (>500 individuals) have also been considered as potential Critical Habitat triggers (as contributing to the overall assemblage in numeric terms).

218. Nationally important species listed as Critically Endangered and/or Endangered in the

[42] For non-water birds population, estimates are not available and hence this criterion is not used.
[43] Wetlands International, 2012. Waterbird Population Estimates, Fifth Edition. Summary Report. Wetlands International, Wageningen, The Netherlands.

Sri Lanka Red Data Book, endemics and range-restricted species have also been additionally considered, to determine whether there are any areas that could qualify as Critical Habitat on that basis (where nationally important numbers are present).

219. For the purposes of this assessment, therefore, the Vankalai Sanctuary Ramsar site (including the Periyakalapuwa mouth IBA) and the Adam's Bridge/Gulf of Mannar National Park have been considered as Critical Habitat. The following section considers all of the species/populations that trigger this Critical Habitat definition from all of the baseline surveys, then focuses on which of these would be specifically affected by the proposed wind farm.

Critical Habitat Triggers: IUCN Red-listed Species

220. The species recorded during the baseline surveys that are listed on the IUCN red data list are given in **Table 4.13**. This gives their IUCN global and Sri Lanka red data status and their status in the Mannar area (from the Ramsar Information Sheet). Only one, great knot, is globally endangered so is considered further in the Critical Habitat assessment on this basis.

Table 4.13: IUCN red-listed species recorded during the Mannar wind farm baseline surveys, 2014-17

Species	IUCN Global Red List	Sri Lanka National Red List	Status[a]
Painted Stork	NT	LC	common breeding resident
Asian Woollyneck	VU	NT	
Black-headed Ibis	NT	LC	very common breeding resident
Spot-billed Pelican	NT	LC	common breeding resident
Oriental Darter	NT	LC	common breeding resident
Great Thick-knee	NT	LC	common breeding resident
Eurasian Oystercatcher	NT	NE	migrant, regular here, very rare
Eurasian Curlew	NT	NE	migrant, common in the Mannar
Bar-tailed Godwit	NT	NE	migrant, common in the Mannar
'Western' Black-tailed Godwit	NT	NE	*limosa* very common migrant
'Eastern' Black-tailed Godwit	NT	NE	[*limosa*] *melanuroides* migrant, very rare
Great Knot	EN	NE	migrant, common
Red Knot	NT	NE	migrant, common here, rare elsewhere
Curlew Sandpiper	NT	NE	very common migrant
Pallid Harrier	NT	NE	migrant, common here, uncommon elsewhere

CR = critically endangered, EN = endangered, LC = least concern, NE = not evaluated, NT = near threatened, VU = vulnerable.
[a] source: Ramsar Information Sheet

Critical Habitat Triggers: Additional Sri Lanka RDB Red-listed Species

221. Additional species of Sri Lankan national conservation concern (red-listed) include Indian Spot-billed Duck, Black-winged Kite, Oriental Honey-buzzard, Black-crowned Night Heron, Kentish Plover, Little Ringed Plover, Eurasian Collard Dove, Crab-plover, Peregrine Falcon, Common Kestrel, Little Tern, Great Crested Tern, Saunders's Tern, Gull-billed Tern, Caspian Tern, Common Tern, and Grey Francolin, though it should be noted that this listing is based on breeding rather than migratory populations. Of these species, Spot-billed Duck, Gull-billed Tern,

Caspian Tern, Common Tern are listed as nationally Critically Endangered/Endangered Species, so are considered further in the Critical Habitat assessment. Further consideration is also given to the following species with restricted range in Sri Lanka; Long-tailed Shrike, Eurasian Collared-dove, Grey Francolin and Black Kite; and two Sri Lankan endemics; Common Woodshrike and Pompadour Green Pigeon. It was concluded though that there would not be any significant effects on any of these additional restricted range and endemics species.

Critical Habitat Triggers: Migratory/Congregatory Populations

222. All species with qualifying populations for the Ramsar/IBA sites were considered as Critical Habitat triggers. The baseline data showed that there was a range of additional species that also had internationally important populations in the survey area, based on their peak population counts. This used the same criterion as applied to the designation of Ramsar sites to identify such populations, i.e. >1% of the global/flyway population. Consideration was also given to other populations that contributed to the overall water bird assemblage.

223. **Table 4.14** gives the details of the Ramsar species totals from the systematic block counts of the key wetland habitats across the survey area, including the Vankalai Sanctuary and the other important wetlands. All of these species are considered to contribute to the wintering waterfowl assemblage, and therefore have been considered further in the Critical Habitat Assessment.

Table 4.14: Ramsar listed species (in bold) and other species recorded in internationally important (>1% flyway) numbers (in red) and contributing to the internationally important wintering bird assemblage

Species	Migrant overall peak	Non-migrant overall peak	1% threshold	% flyway population at peak
Lesser Whistling-duck	1321	4034	10000	0.4%
Garganey	5423	23	3500	1.5%
Northern Shoveler	1120	0	7100	0.2%
Eurasian Wigeon	2500	0	2500	1.0%
Northern Pintail	9410	12	20000	0.5%
Greater Flamingo	1800	0	2400	0.8%
Painted Stork	621	277	250	2.5%
Eurasian Spoonbill	589	112	230	2.6%
Black-headed Ibis	423	77	250	1.7%
Eastern Cattle Egret	612	2	20000	0.03%
Grey Heron	343	39	1000	0.3%
Great Egret	191	221	1000	0.2%
Intermediate Egret	333	134	1000	0.3%
Little Egret	2079	256	1400	1.5%
Spot-billed Pelican	188	72	100	1.9%
Little Cormorant	1530	340	2500	0.6%
Indian Cormorant	624	209	300	2.1%
Black-winged Stilt	1060	480	1700	0.6%
Pacific Golden Plover	355	0	710	0.5%
Kentish Plover	4033	588	710	5.7%
Lesser Sand Plover	13175	5008	1200	11.0%

Species	Migrant overall peak	Non-migrant overall peak	1% threshold	% flyway population at peak
Yellow-wattled Lapwing	18	75	70	1.1%
Red-wattled Lapwing	151	66	100	1.5%
Eurasian Curlew	376	11	1000	0.4%
Black-tailed Godwit	6344	104	1500	4.2%
Great Knot	88	1	30	2.9%
Curlew Sandpiper	15200	5010	2400	6.3%
Little Stint	17700	634	2400	7.4%
Common Greenshank	405	13	710	0.6%
Common Redshank	2377	952	1000	2.4%
Marsh Sandpiper	3073	5	1000	3.1%
Brown-headed Gull	10610	100	1400	7.6%
Heuglin's Gull	4330	2	10000	0.4%
Little Tern	376	595	710	0.8%
Gull-billed Tern	380	21	770	0.5%
Caspian Tern	3810	343	710	5.4%
Whiskered Tern	780	51	1000	0.8%
Common Tern	152	100	10000	0.02%
Lesser Crested Tern	3830	154	1600	2.4%
Greater Crested Tern	2632	26	10000	0.3%

224. Little egret and Indian cormorant, the populations of both these species recorded exceed 1% of the flyway population. Additionally, Indian Spot-billed Duck, though present in only small numbers in terms of the international flyway population, is very important from a national perspective (and on that basis, has been cited on the Ramsar designation).

225. A Critical Habitat Assessment was conducted for each of these species/populations, and its conclusions regarding the species that trigger Critical Habitat are summarized in **Table 4.15**.

Table 4.15: Summary of species for which critical habitat supported

Species	Reason for Critical Habitat	Extent of Critical Habitat
Globally CR/EN		
Great Knot	>1% flyway population	Erukkalampiddy Lagoon
Nationally CR/EN		
Spot Billed Duck	Nationally important concentration of nationally critically endangered species	Korakulam and Vankalai sanctuary – transmission line corridor used as a feeding area
Caspian Tern	Nationally important concentration of nationally critically endangered species	Vankalai Sanctuary, Erukkalampiddy Lagoon and the north shore of Mannar Island.
Common Tern	Nationally important concentration of nationally critically endangered species	Vankalai Sanctuary, Erukkalampiddy Lagoon and the north and south shores of Mannar Island
Gull-billed Tern	Nationally important concentration of nationally critically endangered species	Vankalai Sanctuary, Korakulam, Erukkalampiddy Lagoon and the north and south shores of Mannar Island

Species	Reason for Critical Habitat	Extent of Critical Habitat
Migratory and Congregatory Species		
Spot billed pelican	>1% global population of a migratory or congregatory species	Vankalai Sanctuary
Curlew Sandpiper	BirdLife International's Criterion A4 for congregations	Vankalai Sanctuary, Saltern and the north shore of Mannar Island
Northern pintail	Ramsar site Criterion 5	Vankalai sanctuary
Greater flamingo	Ramsar site Criterion 5 and 6	Vankalai sanctuary
Eurasian wigeon	Ramsar site Criterion 5 and 6	Vankalai sanctuary
Garganey	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary, Korakulam and the south shore of Mannar Island
Black-tailed godwit	Ramsar site Criterion 5 and 6	Vankalai sanctuary and Korakulam
Painted stork	>1% global population of a migratory or congregatory species	Vankalai sanctuary and Korakulam
Eurasian Spoonbill	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary
Black-headed Ibis	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary
Little Egret	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary
Indian Cormorant	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary, Korakulam and the north and south shore of Mannar Island
Yellow-wattled Lapwing	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary and Erukkalampiddy Lagoon
Red-wattled Lapwing	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary and the north shore of Mannar Island
Kentish plover	> 1% of the flyway population of a migratory/congregatory species	Vankalai sanctuary and Erukkalampiddy Lagoon
Lesser sand plover	>1% global population of a migratory or congregatory species	Vankalai Sanctuary, Saltern and north shore of Mannar Island
Little stint	>1% global population of a migratory or congregatory species	Vankalai Sanctuary, Saltern and north shore of Mannar Island
Common Redshank	>1% flyway population of a migratory or congregatory species	Vankalai Sanctuary
Marsh sandpiper	>1% global population of a migratory or congregatory species	Vankalai sanctuary, Saltern
Brown headed gull	> 1% of the flyway population of a migratory/congregatory species	North and south shores of Mannar Island
Lesser Crested Tern	>1% flyway population of a migratory or congregatory species	North shore of Mannar Island
Restricted range		
None		
Endemic		
None		

Critical Habitat Species at the Proposed Wind Farm

226. Species[44] flying through the wind farm site at risk of collision/barrier effect:

- Northern Pintail
- Little Egret
- Spot-billed Pelican
- Indian Cormorant
- Gull-billed Tern
- Caspian Tern
- Lesser Crested Tern

227. Species[45] at risk of disturbance - those that use habitats within the potential disturbance zone:

- Little Egret
- Indian Cormorant
- Red-wattled Lapwing
- Brown-headed Gull
- Gull-billed Tern
- Caspian Tern
- Lesser Crested Tern

Development of Critical Habitat Maps for the Study Site

228. A provisional critical habitat maps were constructed for the study site using metric sheets (scale 1:50,000) and satellite images (show in **Appendix 3**) for all identified species. These provisional habitat maps are based on reconnaissance surveys of the focal study area. Based on the findings of the reconnaissance surveys the habitat maps were used for identification of sampling sites for the detailed field investigations to document the density and distribution of avifauna in each of these critical habitats.

4.4 Land Use Assessment in Project Area

229. The detail land use maps along the proposed wind turbine locations are given in the **Figure 4.52**. According to the land use analyses most of the project area is covered by sand deposits, scrubland and Palmyra stands. In addition, lower percentages are covered by home lands and the coconut cultivations.

230. In general, field investigations revealed that the project area is fully covered by the paleo-marine sand deposits. Most of the home lands are associated with the Palmyra and coconut. Scrubland, mainly having scattered shrubs but in some areas, the shrub canopy is continuous. In addition, there is a very few infrastructures across the proposed wind turbine locations. Road networks are not effectively crossing the proposed project. The proposed wind turbine locations are not crossing main roads and these are placed parallel to the coast. Minor road network (Jeep and Cart track) is present along the proposed wind turbine locations.

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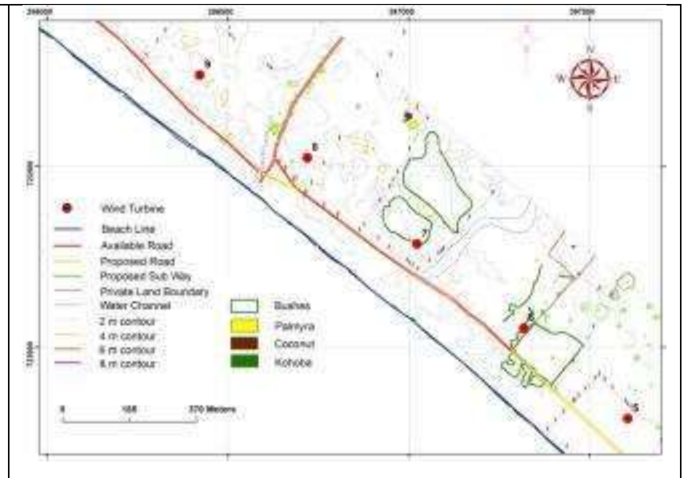
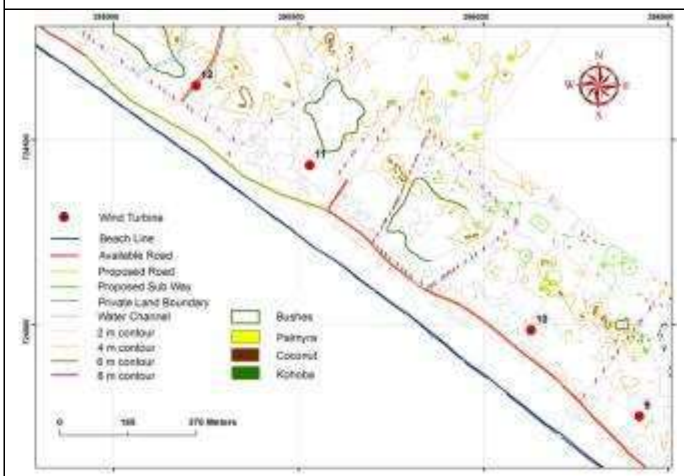
[44] These are CH species seen flying thorugh collison zone at risk height.
[45] These are species that were recorded using the habitat within the potential disturbance zone.

231. Surface water morphology of the area is quite simple, there are no major river channels present. Few temporary surface water accumulations are found around the proposed wind farm, which developed by the accumulation of rain water as well as inundation by sea water. The sea water inundated marshy land area is mainly covered by different soil type than the alluvial deposit.

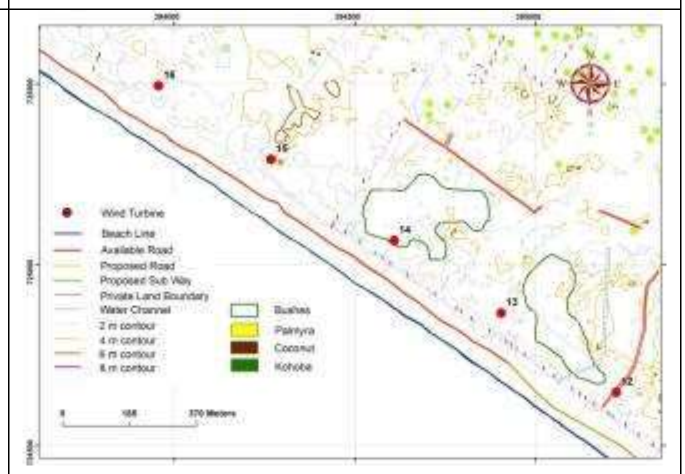
Wind turbines 2-5



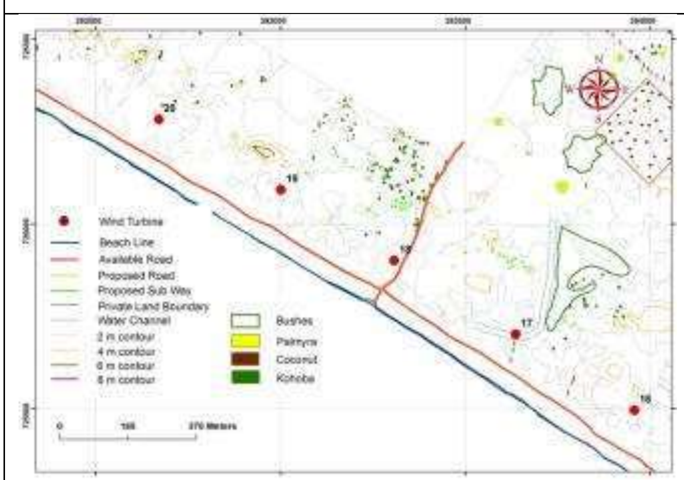
Wind turbines 6-9



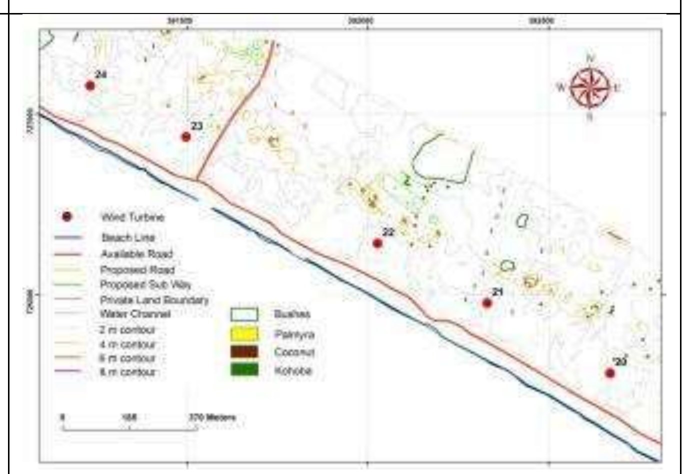
Wind turbine 10-12



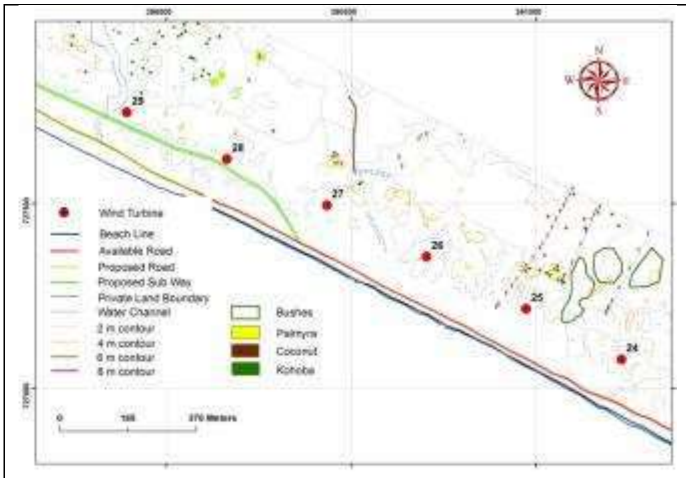
Wind turbine 12-16



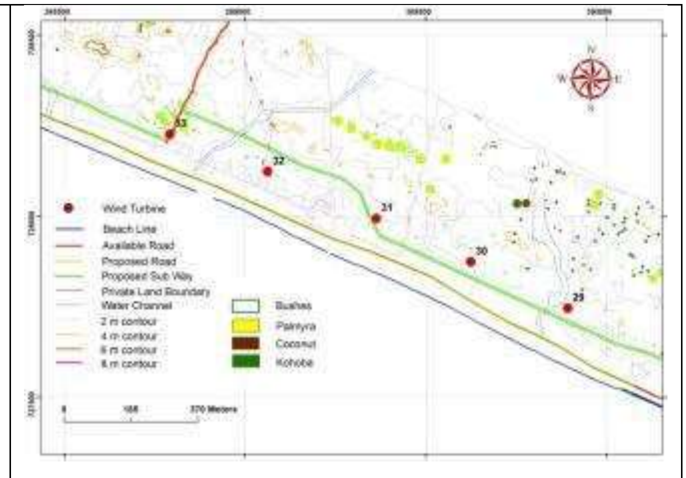
Wind turbines 16-20



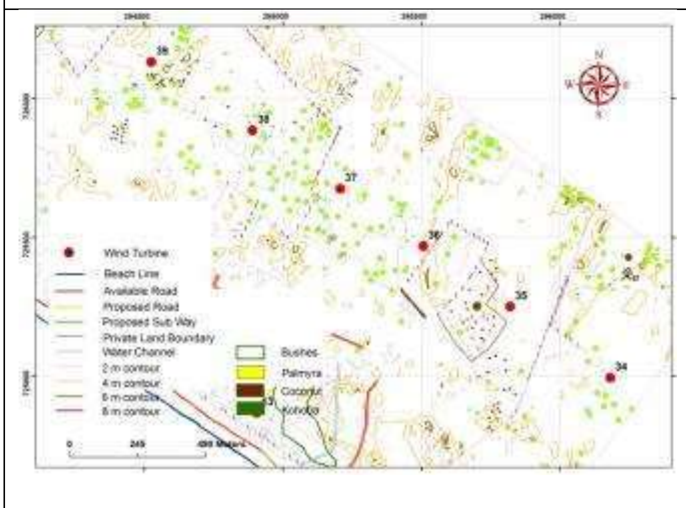
Wind turbines 20-24



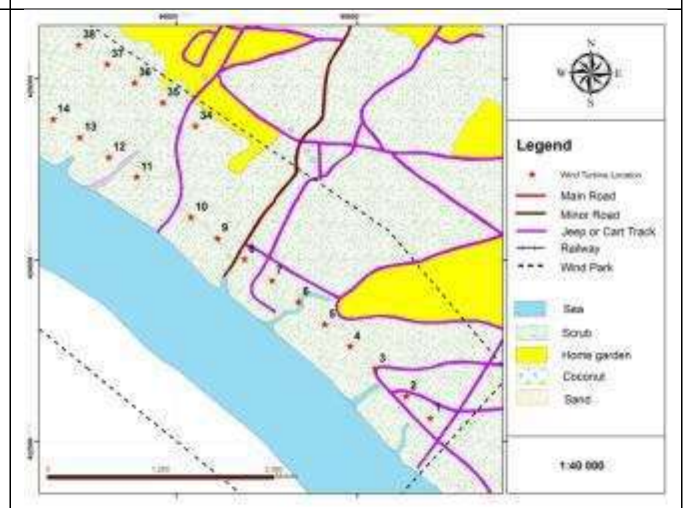
Wind turbines 24-29



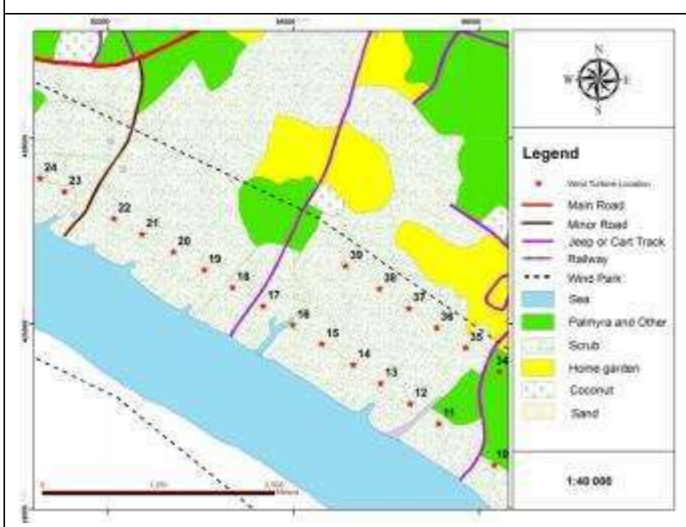
Wind turbines 29-33



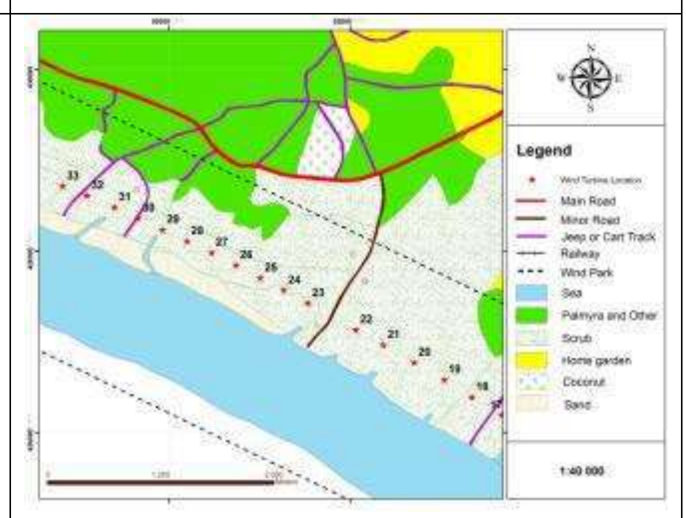
Wind turbines 34-39



Land use 1-14



Land use 10-24



Land use 17-33

Figure 4.52: Land use along the turbine locations 23-33

232. According to the land use analyses, wind farm block is mainly covered by the coastal vegetation and scrublands. Palmyra stands and coconut plantations are also found towards inland. However, this area is not earmarked for the establishment of wind turbines. Few home gardens are also found at the edge of the northern boundary of the wind farm. Most home gardens are associated with the Palmyra and coconut trees. In addition, there is a very few infrastructures across the proposed wind turbine locations. The main road network of the Island is not crossing the proposed project area. The proposed wind turbine locations are placed parallel to the coast. Minor road network (Jeep and Cart track) is present along the proposed wind turbine locations. **Tables 4.16** lists the land use categories and extents found in Mannar Island and the Wind farm block.

Table 4.16: Land use classes and extents of Mannar Island

No.	Description	Area (ha)	Land utilized by the wind farm (ha)
1.	Sand or Beach	739.5	7
2.	Home Garden	2,206.6	-
3.	Other Plantation	5,033.1	-
4.	Scrub	3,109.3	110
5.	Coconut	1,043.2	-
6.	Surface Water	43.2	-
7.	Paddy	66.9	-
8.	Tank with Bund - Working	61.3	-
9.	Jeep or Cart Tracks	455.1	-
10.	Marsh	66.5	-
11.	Salt Pans	59.9	-
12.	Minor Road	81.2	4
13.	Main Road - Class A	132.7	6
	Total	**13,098.5**	**127**

233. **Table 4.17** gives the distances of turbines to water channels in the project area. **Figures 4.53-4.56** give locations of water channels in the project area.

Table 4.17: Distances to water channels (Thonas) from the wind turbines locations in the wind power project site, Mannar

Turbine Location	X	Y	Distance to the water channels from the turbine (m)
6	9.017743	79.838148	60 (towards north west)
8	9.021983	79.832688	85 (east)
12	9.032113	79.819051	120 (south east)
16	9.039753	79.807517	105 (north west)
17	9.041606	79.804595	110 (south east)
19	9.045127	79.798808	25[a] (north west)
21	9.048590	79.792699	140 (south east)
22	9.050075	79.789936	25[a] (south)
23	9.052724	79.785108	55 (south east)
26	9.056499	79.777886	35 (east)
28	9.058868	79.772969	100 (west)
29	9.060004	79.770502	155 (east)
32	9.063394	79.762935	62 (south east)

[a] It is recommended to shift the hardstand area within the 150 m x 150 m to avoid the water channels (thonas), keep at least 25 m buffer zone for the water channels as the species diversity (aquatic & terrestrial) is higher in this habitat.

Fig. 4.53: Water channels close to the turbine locations 6 and 8

Figure 4.54: Water channels near turbine locations 16, 17 and 19.

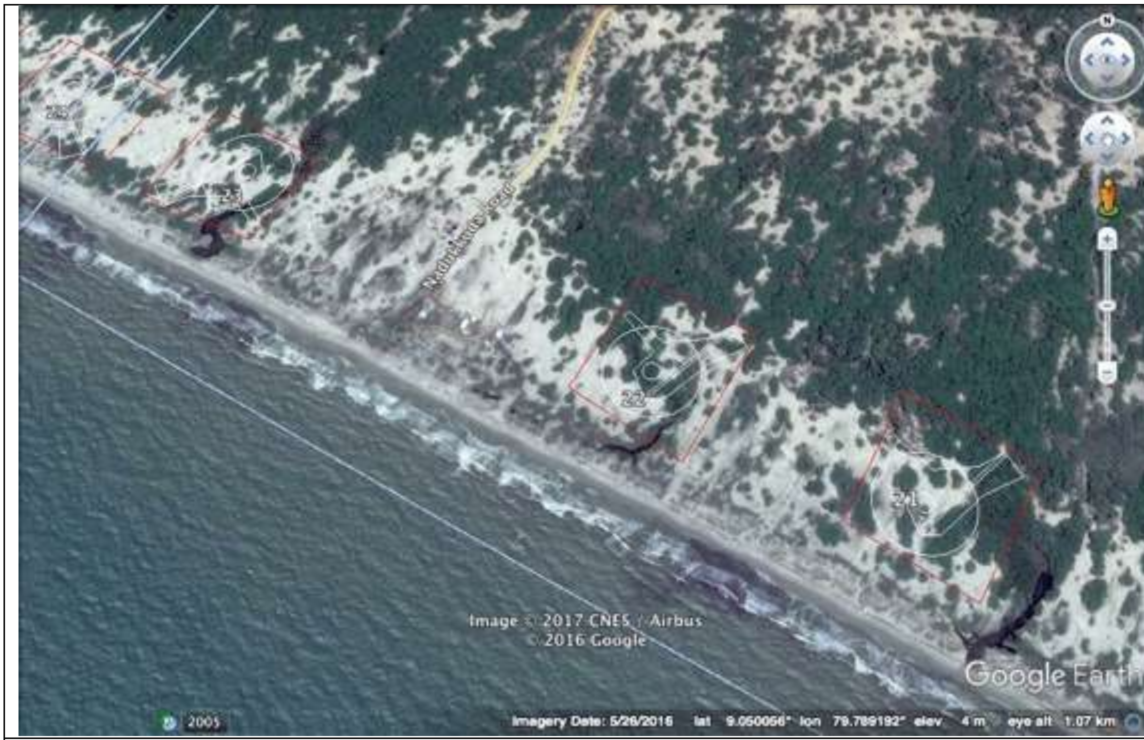


Figure 4.55: Water channels near turbine locations 21, 22 and 23.

Fig. 4.56: Water channels near turbine locations 26, 28, 29 and 32.

4.5 Social Environment

4.5.1 Population

234. The proposed wind farm site encompasses parts of five Grama Niladhari Divisions (GNDs) in the Mannar Town Divisional Secretariat Division. The GNDs are Thoddaveli MN/62, Olaiththoduvai MN/60, Pesalai South MN/56, Pesalai West MN/55, and Thullukudiyiruppu MN/54. The geographical spread of the 5 GNDs covers an area of 52.6 square kilometers. The total population in the GNDs is estimated at 7,819. The male composition of the population is48.6% whereas women constitute 51.4%. The total number of households in the GNDs is 1,984 of whom 99.3% belongs to the Tamil ethnic community. The Muslims represent 0.7%. There are no Sinhalese households in the five GNDs. The Muslim population is found in the Thoddavelli and Pesalai West GNDs. (see **Table 4.18**).

Table 4.18: Socio-Demography of the GNDs

GramaNiladhari Division	Population			No. Households	Ethnic composition (No. Households)		
	Male	Female	Total		Tamil	Muslim	Sinhalese
Thoddavelli MN/62	980	1,003	1,983	459	449	10	-
Olaiththoduvai MN/60	356	349	705	201	201	-	-
Pesalai South MN/56	1,250	1,290	2,540	560	560	-	-
Pesalai West MN/55	550	710	1,260	390	387	03	
Thullukudiyiruppu MN/54	661	670	1,331	374	374	-	-
TOTAL	**3,797**	**4,022**	**7,819**	**1,984**	**1,971**	**13**	**-**

Source: Records of the Grama Niladharis, January 2016 (Reference taken from Resettlement Plan for the project)

235. The socio-economic household survey conducted with 200 households pointed to a total population of 744. The female population exceeds their counterpart males with 50.5% and 49.5%, respectively. The children below the age of 5 years are 8.3% of the population. Both children and adolescents in the age group of 5 to 18 years constitute almost 25.5% of the population. The young adults in the age group of 18 to 30 years represent a 21.8%. The adult population in the age group of 30 to 60 years is 39%. Those over and above 60 years are 5.4%. The married population is 48.8% against a similar unmarried population of 48.4%. Persons who are widows and separated or divorced from their spouses are 2.8%. In terms of ethnicity, almost all household population is Tamil. The religious composition of the households includes 91% Catholics/Christians and 9% Hindus.

4.5.2 Migrant laborers

236. Apart from the local population that engages in a variety of economic activities, the project impact area is also occupied by a significant number of seasonal migrant laborers in the months of October to March. These seasonal migrant laborers are employed by the Ma-del owners for their fishing activities. A rapid survey conducted with a sample of 50 migrant laborers shows that majority (78%) of them have migrated to the southern coast of Mannar from the Puttalam and Batticaloa districts. The rest are the migrants from several other districts/areas such as Mullaitivu, Negombo, Kalpitiya, Kilinochchi and Jaffna. The ethnic composition of the migrant laborers included 62% Tamils, 36% Sinhalese and 2% Muslims. The age structure of the migrant laborers represented 50% in the age group of 40–55 years; 28% over and above 55 years; 14% between 25–40 years; and 8% below 25 years. The majority, 98% of them are married and 2% is single.

237. The migrant laborers are exclusively dependent on labor work and they would migrate in labor teams accompanied by Ma-del owners. Among those laborers, 74% has been migrating continuously to the southern coast of Mannar over the past 3 years. Another 16% has a history of migration varying from 3–6 years. The migratory period of the rest 10% exceeded more than 6 years. They would make occasional visits to their homes during their six months of stay in Mannar.

4.6 Economic Development

4.6.1 Economic Mineral Deposits

238. Economically important minerals are predominantly identified around the proposed wind farm area, particularly in the beach sands where minerals are mainly deposited by tidal influences. The garnet rich mineral sands may be accumulating in the Mannar sand bars due to wave action of Bay of Bengal sediment fan. However, there is no permission given for mineral sand mining around the Mannar Island.

4.6.2 Petroleum Resources in Mannar Basin

239. Mannar Basin has wider extension of igneous rocks, which may have formed by several episodes of volcanism during Late Cretaceous. Occurrence of an active petroleum system in the Gulf of Mannar Basin is established by recent natural gas discoveries in offshore Sri Lanka. Sandstones act as the reservoir. Dark greenish gray colored shale underlain by igneous rocks in the Mannar Basin could be a potential source rock for hydrocarbons.

4.6.3 Agriculture in Mannar District

240. Agriculture is one of the key economic sectors in the district providing livelihoods for over 15,000 families, approximately 67% of the population. Out of a land area of 200,206 ha, the total cultivable land is 37,160 ha (19%). Over 65% is under forest cover. The pattern of agriculture practiced is dependent on climate and tradition. The average rainfall in the district is 960 mm per year, the majority of which occurs during the NE monsoon from October to March.

4.6.4 Fisheries

In Mannar District

241. Fishing is a major contributor to the local economy of Mannar district. It provides the principal source of livelihood for a large portion of the population, particularly in Mannar and Musali Divisions, where over 50% and nearly 40% of families respectively rely heavily on fishing activities. Over 8,700 families in 52 villages are involved in fishing.

242. The district has a marine coastline of 163 km, fresh water area of 4,867 ha and a brackish water area of 3,828 ha. The marine fishing area in the district stretches from Thavenpiddy to the north to Mullikulam in the east and Talaimannar to the south. In addition, although the majority of anchorage facilities are damaged or destroyed, there are 29 separate, small fishing harbors spread around the coastline.

In the Project Area

243. The total number of fishing vessels that operate within the project impact area is estimated at 662 vessels which include approximately 516 mechanized boats and 10 traditional fishing

crafts. The largest number of fishing vessels are operated from Thalaimannar, Thullukudiiruppu (Nadukuda) and Olaithoduvai GNDs. The number of ma-dels (beach-seine) that operate within the impact area is 22, the majority being located at Thalaimannar, Thullukidiiruppu (Nadukuda) and Thoddaveli GNDs. The number of fishermen camps (Vaadies) of migrant fishermen is estimated as 39 camps. The estimated number of fisherfolks who operate within the project impact area is 1,463. Fishing is followed by people engaged in casual daily paid labor work largely in fishery sector work who account for 892 people.

4.6.5. Socio- economic status of the community

Land Ownership

244. The land on which 84.5% of the households live or cultivate is claimed as private property. Of them, 85% is self-owned and 15% is owned by parents or children or relatives of the household. 17.5% of households live/work on land obtained from the government on lease or permits. The encroached lands are occupied by 1% of the households. The land on which the rest 7% lived belonged to other parties.

245. Almost all the households reported having highlands and home gardens. However, households owned only limited extents of highlands. The size of highland owned by 98% is less than one acre. It is only the rest 2% who owned land more than 1 acre in extent. The average size of a highland owned by a household is 0.3 acres. Land prices varied considerably across project area from SLR100,000 to SLR800,000 an acre depending on a variety of factors such as location, accessibility etc.

Energy Use

246. Firewood is the main source of energy used by a majority of the households (96.5%) for cooking purposes. Liquefied petroleum gas is used by 2% for household cooking while another 1.5% uses a combination of firewood and electricity. Households that use electricity for household lighting are 93%. Kerosene is used for lighting by 7%. Not many households use energy sources for economic activities. Only 16% use energy for their economic activities. Of them, electricity is used by 31.3% and kerosene by 68.8%. Energy is used by 31.3% for irrigation purposes and 3.1% for lighting their different economic ventures. 65.6% of the households use electricity for operating their machines such as rice grinding machines, sewing machines, kitchen appliances related to food businesses.

Income Generation Sources

247. The people in the 5 GNDs are engaged in multiple economic activities and households would earn their incomes from more than a singular source of livelihood. Fishery is the main source of livelihood activity of the people in the five GNDs. The number of persons engaged in marine fishing is reported as 1,453 while another 10 are lagoon fishermen. Fishing is followed by people engaged in casual daily paid labor largely in the fishery sector work who account for 892 persons. The number of persons who are self-employed or in small-scale trade and business activities is 286 of whom around 65 persons are engaged in dry-fish processing as a source of livelihood. The number of persons employed in the formal sector either in government institutions or in private business sector is 337. Agriculture and livestock rearing is a source of livelihood for 102 persons. Manufacturing Palmyra products such as toddy, sweetmeats, handicrafts etc. generates incomes for another 102 persons. The number of persons employed in foreign countries is recorded as 113 (see **Table 4.19**).

Table 4.19: Livelihood Activities of GND Population

Grama Niladhari Division	Livelihoods (No. Persons)						
	Agri.& Livestock	Fishery	Govt. & Private Jobs	Casual Labor Work	Self-Employed/ Trade & Business	Manufact. Palmyra Products	Foreign Employment
Thoddavelli MN/62	15 (Livestock)	630 (10 lagoon and 620 marine)	56	65	85	-	45
Olaiththoduvai MN/60	37	63	20	62	8	2	13
Pesalai South MN/56	200 (Livestock)	400	180	325	50 (25 dry fish	-	20
Pesalai West MN/55	80	170	55	260	40 (15 dry fish	40	15
Thullukudiyiruppu MN/54	-	190	26	180	103 (25 dry fish	60	20
TOTAL	**332**	**1,453**	**337**	**892**	**286**	**102**	**113**

Source: Records of the Grama Niladharis, January 2016 (Reference taken from RP for the project)

Occupational Pattern in the Area

248. Access to emerging economic opportunities to families in the area is curtailed by several factors. Relatively low educational levels and human resource skills of the population, households' inability to pay for higher education or skills development training of their children, limited educational and vocational training opportunities available in the district and the transport difficulties to reach educational and other vocational and technical training institutes that are located in Mannar town are some of the factors that prevent particularly the youth in grabbing the new opportunities emerging within and outside the district. Thus, many school leavers remain unemployed. Most school leaving girls would stay at home while the boys would either work as crewmen to boats, laborers in agriculture or non-agriculture related activities or some casual employment in the urban centers.

249. Women in the project impact area are engaged in multiple activities. Apart from their roles such as household cooking, cleaning, fetching water, feeding children and helping in children's studies, women across the subproject areas also make a significant contribution to the household economy. Women also take a lead role in livestock farming and take care of the feeding of their cattle, goats and poultry. Home gardening is another important economic activity of women, produce of which is used for both household consumption and marketing. Other forms of economic activities conducted by women include manufacture of a variety of Palmyra based products, fishery related labor work, dried fish processing, retail trading, running food outlets, dress-making, handicraft-making, employment in garment factories. etc. A few women are employed in both government and private sector jobs. Lack of regular transport services, poor household economy and limited opportunities for education and skills development and employment curtail the mobility of women and girls.

250. Fishing is confined to a single season of the year for a majority of the households in the project impact area. It is only the fishermen in Pesalai who reported that they are engaged in fishing throughout the year by migrating to the northern coast of the Island when the season is over in the southern coast. They would carry their fishing vessels and gear from the southern coast to the northern coast or vice versa either over land or sea. The fishing season for the coastal communities in the south is from October to March when the sea is not rough. During construction,

there is a temporary impact to their fishing activities in the area. Home gardens are cultivated with a variety of crops such as drumsticks, brinjal, chillies, cassava, banana, papaw, mango, coconut, etc., produce of which is primarily used for household consumption. 60% of the households surveyed reported having coconut plantations in their home gardens while 7.5% have mango trees.

4.7 Infrastructure facilities in Project Area

251. Among the infrastructure facilities available within the five GNDs are commercial centers, industrial units, schools, hospitals and health centers and several religious institutions. The commercial centers account for 59 and they mainly include retail shops, groceries, restaurants and tea kiosks. The number of industrial units is rather limited and recorded as only two. There are four schools and two pre-schools, one health center, and 17 places of religious worship comprising churches, kovils and mosques spread over the five GNDs. The number of mechanized and non-mechanized boats operating within the five GNDs is counted as 449 and 217, respectively. Majority of those fishing crafts are in the Pesalai South and Thoddavelli GNDs (see **Table 4.20**).

Table 4.20: Assets and Infrastructure within GND

Grama Niladhari Division	Assets and						
	Mechanized Boats	Non-Mechanized Boats	Comm. Centres	Industrial Units	Schools	Health Centres	Religious Places
Thoddavelli MN/62	120	150	4	-	1	-	5 (4 churches and 1 mosque)
Olaiththoduvai MN/60	6	-	6	-	1 school and 2 pre-schools	1 (health centre)	6 (3 churches and 3 kovils)
Pesalai South MN/56	275	20	20	-	1	-	-
Pesalai West MN/55	17	30	17	-	-	-	1 (kovil)
Thullukudiyiruppu MN/54	-	40	12	2	1	-	5
TOTAL	**418**	**240**	**59**	**2**	**4 + 2 pre-**	**1**	**17**

Source: Records of the Grama Niladharis, January 2016 (Reference taken from RP)

4.7.1 Health

252. No chronic illnesses are reported from any of the communities in the project impact area. Medical services for people are available in three divisional hospitals, namely the Thalaimannar divisional hospital, the Pesalai divisional hospital and the Tharapuram divisional hospital. There is one physician in the Thalaimannar hospital and two physicians in the Pesalai hospital. A physician visits the Tharapuram hospital daily as there is no resident physician. Facilities such as laboratory and diagnostic services available for patients are limited in these hospitals. Except for a few pharmacies, there are no private clinics or dispensaries in the project impact area. People would go to Mannar base hospital for treatment of serious illnesses. For people in Thalaimannar, Sri Lanka Navy Base in Thalaimannar helps in transporting patients to the Mannar base hospital

who requires emergency medical care. The Navy also provides free medical services for school children. Pregnant mothers suffer from poor transportation services.

4.7.2 Education

253. A number of educational institutions are located within the project impact area. They include St. Lawrence School, Thalaimannar G.T.M.S School, Thullikudiruppu primary school and a number of other primary and secondary schools in Pesali, Thoddaveli, Olaithoduvai and Katukarankudiiruppu. Altogether, around seven schools are located in the project impact area. Children who study for GCE AL attend the Thalaimannar G.T.M.S School or Fatima College in Pesalai. Facilities for children to attend private tuition classes are rather limited.

254. The educational attainment of the sample household population shows that 33.8% have passed GCE OL or AL. Another 2.5% are either graduates or persons with professional qualifications. However, around 22.9% of the household population have education below grade 5 while another 40% have education between grades 5 to 10. The population that never had schooling is 0.9%.

4.7.3 Archaeologically important sites of Mannar district

255. Macro historical and archaeological context of Mannar is rich and varied, covering long span of human history. Mantai has played a cardinal role in ancient trade world during more than thousand years. Literary and archaeological sources including inscriptions provide a concrete background to understand the importance of this area. The name Mantai has been used in primary sources as Mahathota, Mahapatna, Mahavoti, Mahaput, Mavaththota and Mahathiththa, while the Tamil name had been Manthottam. One of the meanings of Pali 'Mahathiththa' is 'The Great Port'. The port of ‘Mahathiththa’ is situated at the Southern extremity of Palk bay and can only be reached by ships from the west by crossing the Mannar straits, a narrow stretch of water between the mainland and the Island of Mannar. Mantai was a center point, which can maintain inter-relationships with not only the main capital but also Eastern and Western international traders and trade routes. In addition, this port lay on two international trade routes; One proceeding along the Malabar Coast and thence to Arabia, Persia and Egypt and the other along the Coromandal coast to the Bay of Bengal and to Malacca, Sumatra, Java, Moluccas and China.

256. Archaeological investigations have been carried out in the site of Tirukesvaram (or Mantai) situated on the western coast of Ceylon across from Mannar. The mound proper rises to a maximum height of about twenty feet above sea level. Parts of it are covered with scrub jungle growth while the rest is the site of the famous Tirukesvaram temple. The site is located in the Palk Strait, on the route of ancient overseas trade from the Mediterranean to the east, and in close proximity to the south-eastern coast of India. According to tradition and historical evidence this was a great port town in ancient times, and it consequently has attracted the attention of several scholars over the years. These excavations revealed two ‘ancient’ roads, a pottery rimmed soakage pit and two stone-lined wells. A collection of potsherds in the Anuradhapura museum which belongs to the beginning of the Christian era. The pottery included such varied and clearly recognizable types as Roman red ware, Arikamedu-type rouletted ware, Chinese celadon and Persian glazed wares of medieval times, indicating a long occupation.

257. Recent investigations carried out in the Mannar district have revealed 64 archeologically important sites (**Figure 4.57**).

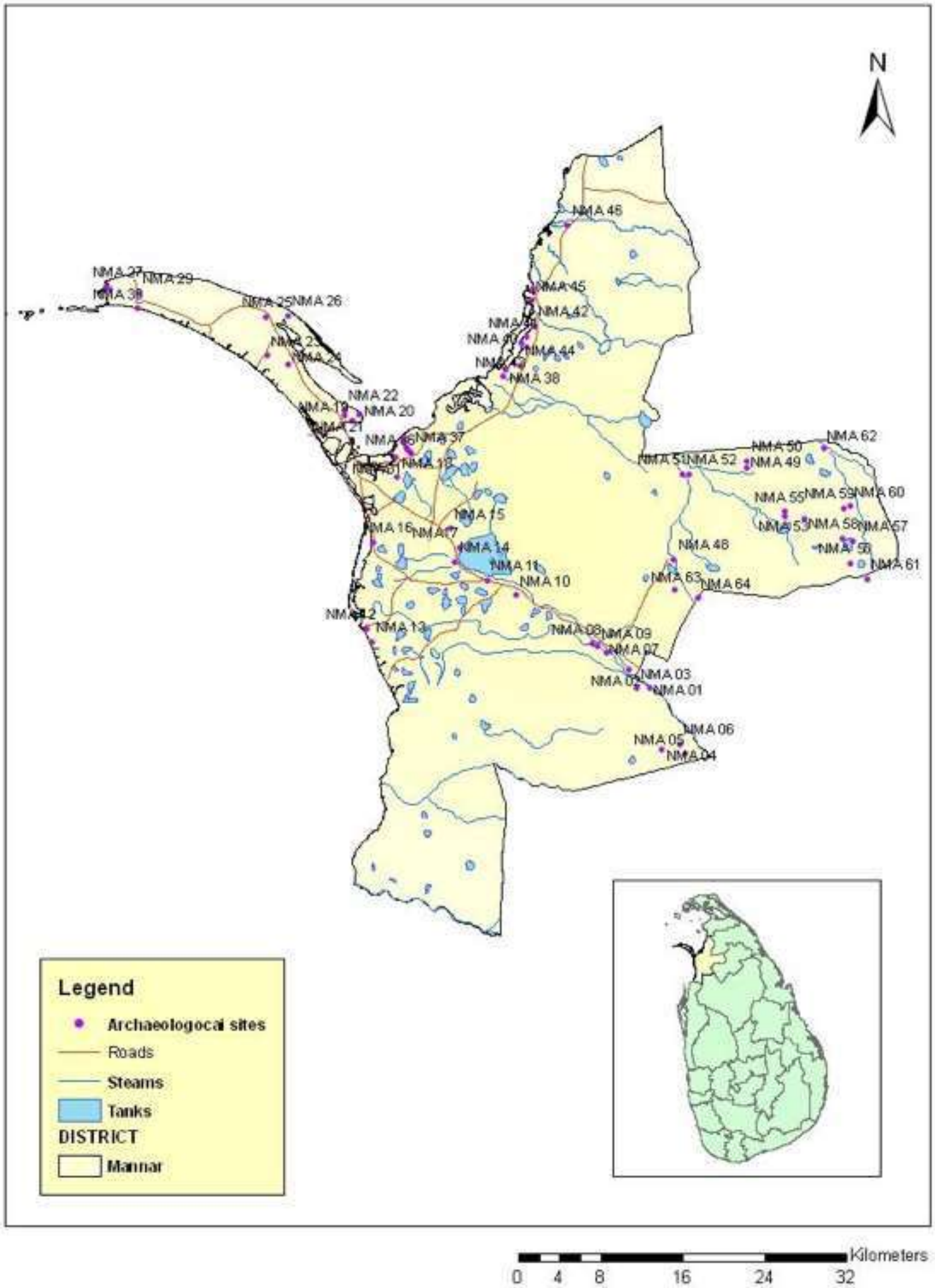


Figure 4.57: Archaeologically Important Sites of Mannar District

258. Out of 64 sites, 12 are situated in Mannar Island. They are Dutch Fort of Mannar (site 19), Baobab Tree (site 20), District Secretariat office of Mannar (site 21), St. Mary's Church (site 22),

Olutuduwa Kathar Church (site 23), St. Andres Church (site 24), Kappa Kovil Ruin Church (Old Dutch Church) (site 25), Dutch Watch Tower, Narapadu (site 26), Urumale Light House (site 27), Urumalai Adam's Tomb (site 28), Thalaimannar Old Hospital (site 29) and Old Pier (site 30). **Figure 4.58** shows places that are near the wind farm area.

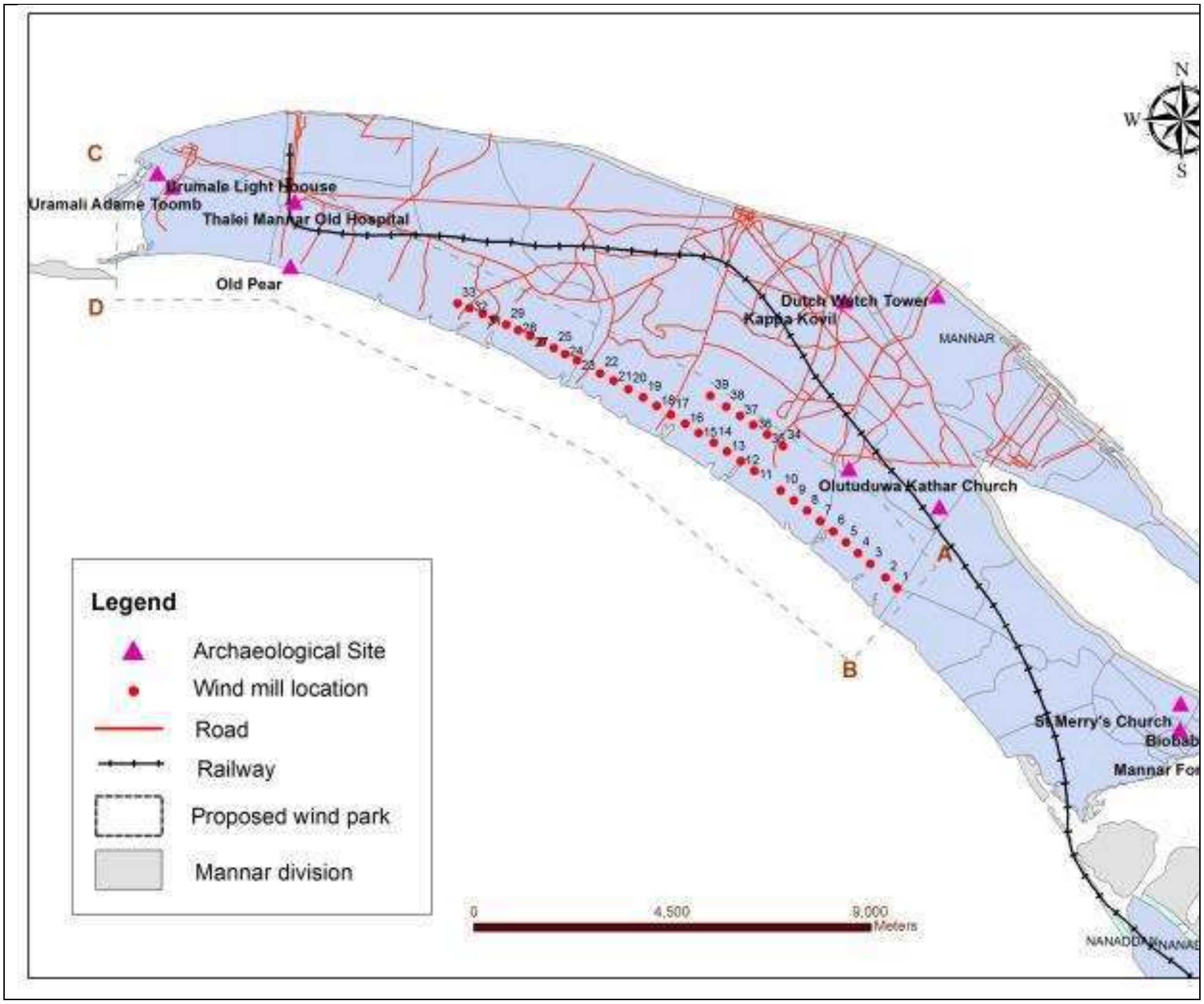


Figure 4.58: Archaeologically Important Sites in the Mannar Island in relation to the Wind Farm

259. According to the investigations following four sites are located about 2 km from the project area: Site 27 – Urumale Light House, Site 28 – Urumalai Adam's Tomb, Site 29 – Thalaimannar Old Hospital and Site 30 – Old Pier. The Light House of Urumal is situated at the Urumali village of the 49 Urumalai South Grama Niladhari division of the Mannar Divisional Secretariat. The Adam's Tomb of Urumalai is situated at the Urumali Village of the 49 Urumalai South Grama Niladari division of the Mannar Divisional Secretariat which is about 2.57 km from proposed WT 33. The Thalaimannar Old Hospital is situated at the Thalaimannar Village of the Mannar Divisional Secretariat. The Old Pier of Talaimannar is situated at the Old Pier village of the Mannar Divisional Secretariat. Apart from the above four sites which falls within the project area Olaiththoduvai Kathar Church is 1.6 km from the WT 8, 9, and 10.

260. According to the Antiquities Ordinance the Director General of Archaeology could limit the developments within a distance of 366 m of an Ancient or Protected Monument.

4.8 Baseline Data for Study Area

261. The baseline data collection for the Wind Park located in the Mannar Island is divided into the following sections:

- Physical Resources Assessment
    - Air, Water, Noise, Soil
- Hydrology Assessment
- Land use
    - GIS mapping
- Ecological
    - Terrestrial Habitats
    - Marine Habitats
    - Avifauna

4.8.1 Hydrology

Water Bodies Situated in the Project Area

262. The available perennial surface water bodies of the area are lagoons, Gulf of Mannar, and Indian Ocean that contains seawater (high conductivity water). This water cannot be used for domestic purposes without desalinization processes. The Indian Ocean is located at northern side of the Mannar Island and Gulf of Mannar is located at southern side of the island.

263. In addition, several stream segments are observed within the study area and these stream segments flow to the Gulf of Mannar, and these are named as SW1 to SW14, SW3 (**Figure 4.59**). Photographs of some stream segments are given in **Figure 4.60**. Generally, all stream segments are seasonal. During the rainy period, fresh water is available in the stream segments and flows to the sea.

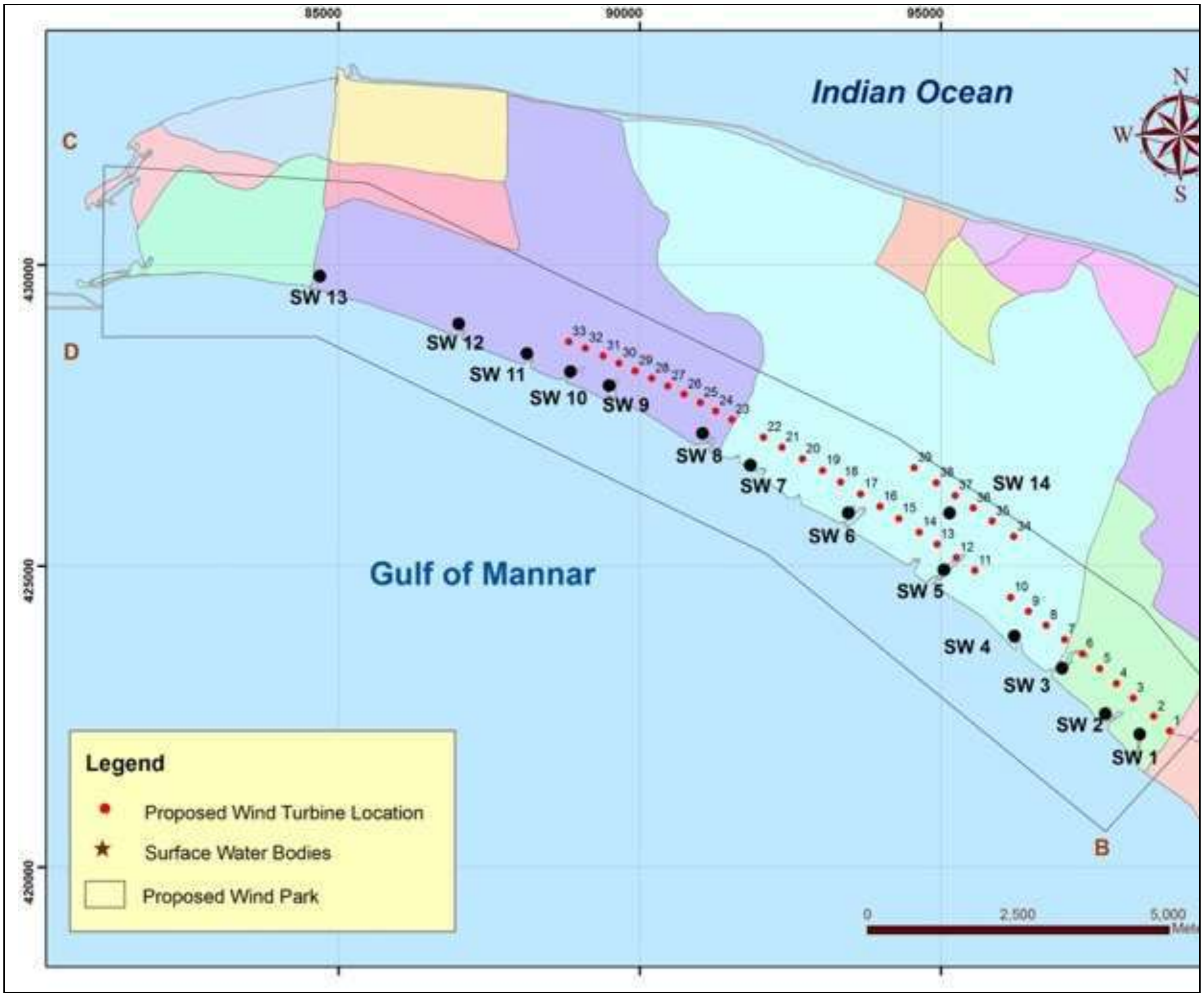


Figure 4.59: Surface water bodies (SW1-SW14) within the proposed wind farm block

Figure 4.60: Stream segments of the study area close to the sea, Mannar.

264. During the field surveys, it was noted that stagnated water observed at the lower part of some stream segments closer to stream mouth due to developing of sand barrier as a result of long shore sediment transport and less out flow from the streams (**Figure 4.61**). Also, stagnated water is mixing with sea water due to the tidal effect.

Figure 4.61: Development of sand barrier across the stream segment as a result of long shore sediment transport and less out flow from the stream.

265. During the rainy period, rain water stagnates over the depression areas within the inland areas of the Mannar Island due to the increasing of groundwater level close to the ground level. This water flows along the depressions to the sea mainly through stream segments and stagnated water appears as small surface water bodies such as SW 14 (**Figure 4.62**). However, this water is available only for one to three months after the rainy period.

Figure 4.62: Stagnated water bodies within the depression in middle part of the Mannar Island.

Surface Drainage Pattern of the Area and Name of Drainage Channels

266. The study area and Mannar Island (previous **Figure 4.59**) mainly consists of unconsolidated beach sand and dune sand and they develop high primary porosity naturally.

267. During the rainy period, considerable proportion of rainwater infiltrates into the ground and reaches to the groundwater table. As a result of continues raining, rain water stagnates over the depression areas due to the increasing of groundwater level close to the ground level. This water flows along the depressions to the sea mainly through stream segments and groundwater discharge. Therefore, development of streams in the middle part of Island could not be expected.

268. It was noted that several first order stream segments are observed within the study area and these stream segments flow to the Gulf of Mannar. The length of each stream segment is less than one kilometer and lower part of the stream segments show wider topography. Some stream segments show meandering features. These streams do not show any surface water drainage pattern. These streams segments are not named.

4.8.2. Surface and ground water quality and present use

269. The available surface water bodies of the area are sea water and stagnated water in the stream segments and depressions. Seawater cannot be used directly for the domestic purposes without desalinization processes. At present, these sea water bodies are mainly used for the fishing industry, recreation, and transport activities.

270. During the field visit, no water sample was collected from the sea for the analysis of chemical parameters. In general, the chemical water quality of the sea water does not show any significant variation from place to place. The general chemical and physical water quality parameters of the sea in Sri Lanka (location: Negambo) are given below (**Table 4.21**).

Table 4.21: Chemical and physical water quality parameters of sea water.

Parameter	**Sea Water**
Appearance	
Color	15
Turbidity in NTU	4
pH (lab)	7.2
Electrical conductivity in µs/cm (lab)	38110
Total Hardness in mg/l (as CaCO3)	3900
Total Alkalinity in mg/l (as CaCO3)	Not measured
TDS in mg/l	Not measured
Calcium in mg/l (as Ca)	Not measured
Magnesium mg/l as Mg	Not measured
Total Iron in mg/l (as Fe)	0.36
Chloride in mg/l (as Cl)	18
Fluoride mg/l as F	0.83
Nitrate mg/l as N)	1.2
Sulphate in mg/l as SO4	2400
Phosphate in mg/l PO4	3.2

Data Assessment: 21-22 February 2016.

271. During the field visit, electrical conductivity (EC) of the stagnated water in lower part of stream segments and depressions was measured using field conductivity meter and results are given in **Table 4.22**.

Table 4.22: Electrical conductivity of surface water SW1-SW14

Site description/Stream segment	Coordinates	Electrical conductivity(μs/cm)/Temperature (ºC)
SW 1	98524 E/421884 N	19850 at 35 ºC
SW 2	98000 E/422470 N	8160 at 36 ºC
SW 3	97045 E/423312 N	1141 at 34 ºC
SW 4	96521 E/423723 N	1170 at 36 ºC
SW 5	95113 E/42761 N	1715 at 35 ºC
SW 6	93624 E/425654 N	1453 at 36 ºC
SW 7	92186 E/426610 N	2900 at 36 ºC
SW 8	91271 E/427062 N	2470 at 36 ºC
SW 9	89995 E/427688 N	7980 at 35 ºC
SW 10	89001 E/428099 N	4850 at 35 ºC
SW 11	88354 E/428407 N	21000 at 35 ºC
SW 12	87224 E/428870 N	6930 at 34 ºC
SW 13	84748 E/429650 N	10190 at 34 ºC
SW 14	94773 E/425791 N	437 at 34 ºC

272. The electrical conductivity in SW1, SW 2, SW 7, SW 8, SW 9, SW 10, SW 11, SW 12, and SW 13 show high than 1000μs/cm due to the mixing of seawater. The electrical conductivity in SW14 show very low electrical conductivity (EC) due to these stagnated water bodies are located at middle parts of Island.

273. In addition, three water samples were collected from stagnated water at the lower part of stream segments for the analysis of chemical parameters. The collected water samples were analyzed at Water Resource Board Laboratory, Hector Kobbekaduwa Lane, Colombo 07 and analyzed water quality parameters are given in the **Table 4.23**.

Table 4.23: Chemical and physical water quality parameters of stagnated water, Wind Farm Project, Mannar[a]

Parameter	SLS potable water standards 614:2013		SW 2	SW 4	SW 7
	Maximum Requirement (mg/l)	Remark			
Appearance			Turbid & Yellowish	Yellowish	Turbid & Yellowish
Color	15		98	129	50
Turbidity in NTU	2 NTU		2.6	.48	2.86
pH (lab)	6.5-8.5		8.8	8.2	8.3
Electrical conductivity in μs/cm (lab)	750		8215	1168	1455
Total Hardness in mg/l (as CaCO3)	250		720	205	510
Total Alkalinity in mg/l (as CaCO3)	200		469	392	310
TDS in mg/l	500		4030	573	1455
Calcium in mg/l (as Ca)	100		104	46	69
Magnesium mg/l as Mg	30mg/L if SO4=250 150 mg/L if SO4<250 mg/L	If there is less sulphate, Mg up to 150 mg/l may be allowed.	112	22	82
Total Iron in mg/l (as Fe)	0.3	Total iron shall not exceed 0.3 mg/l	0.06	0.04	0.05
Chloride in mg/l (as Cl)	250		**2561**	175	**504**
Fluoride mg/l as F	1		**1.33**	**1.27**	0.87
Nitrate mg/l as N)	50		9.3	11.5	1.6
Sulphate in mg/l as SO4	250		**384**	ND	39
Phosphate in mg/l PO4	2		1.31	1.38	0.67

[a] No pollution related parameters measured. No industrial activity in this area currently, two under construction.

274. The analysis revealed that most of the parameters in the stagnated water in the stream segments are not within the Sri Lankan drinking quality standards (SLS 614:2013) mainly due to the mixing with sea water.

275. The available fresh water resource of the area is groundwater and it occurs in the sandy formation as lenses over the saline water. The study area mainly composed of unconsolidated beach sand and thick sedimentary rocks rested over the metamorphic rock basement. The upper part of the study area is mainly consisting of unconsolidated beach sand and it acts as unconfined aquifer. The relatively thick fresh water lenses occur mainly at the middle part of the island and thickness reduces gradually towards the coast. The thickness of the beach sand layer varies from place to place with a maximum of 13 m. The groundwater at the area close to the lagoon and coast is generally saline while groundwater at some places close to the coast line is fresh. The average thickness of fresh water lenses close to the coast is less than one meter.

276. The average depth to groundwater level during the investigation period is about 1 m below the surface level. However, the depth to groundwater with respect to ground level is totally depending on the topography of the area. The average groundwater level fluctuation of the area is about 1–2 m and comparatively low groundwater fluctuation is expected at the area close to the sea. During the rainy period, groundwater level reaches to the ground level and sometime, rain water occurs as puddles at depressions. The groundwater will be moved along the direction from land to coast.

277. In the area close to the coast, groundwater level, groundwater quality, and position of interface between fresh water and sea water slightly changes with respect to the tidal effect that is a natural occurring phenomenon. The influence area is very small and occurs along the coast and is totally depending on the coastal morphology. The sea water level variation of Sri Lanka is due to tidal effect is from 0.5 m to 0.75 m (Source: NARA, Mutwell Tidal gauge). The continuous measurement on variation of groundwater level with respect to tidal effect is not available in Mannar area or Sri Lanka. However, the literature revealed that groundwater level fluctuation due to tidal effect is very low and nonlinear, and is negligible in regional scale. Ex: Groundwater level fluctuation is 0.3 feet compared to the tidal fluctuation of about 10 feet at La Conner gage (USA).

278. It was noted that common dug wells are located at some places along the coastal stretch and at almost every house in the middle part of island and most of those wells are similar type. In addition, temporary dug wells along the beach have been constructed to obtain water for the temporary fishing camps and navy security points. Table 4.24 gives locations of dug wells in the project area.

Table 4.24 Locations of dug wells in the Wind Power Project site, Mannar, and the distance to the nearest wind turbines.

Well No.	Coordinates X	Y	Distance (m) to Wind Turbines		Remarks	photographs
1	09.00517	79.85284	194 to WT1	380 to WT2	At the sea cucumber drying facility, seasonally used,	Plate 1-2
2	09.02178	79.83708	278 to WT7	460 to WT6	In a coconut plantation, abandoned	Plate 3-4
3	09.02012	79.83416	143 to WT7	268 to WT8	Used by fishermen	Plate 5-6
4	09.02036	79.83347	201 to WT8	218 to WT7	Used by fishermen	Plate 7-8
5	09.02225	79.83388	132 to WT8	319 to WT7	Used by the villagers and construction laborers' at Kalutota cabanas[a]	Plate 9-10
6	09.02136	79.83238	79 to WT8	380 to WT7		Plate 11-12
7	09.02687	79.82565	199 to WT10	570 to WT11	Near Shell Coast Resort	Plate 13-14
8	09.02695	79.82556	211 to WT10	560 to WT11		Plate 15-16
9	09.02967	79.82513	365 to WT11	461 to WT10		Plate 17-18
10	09.03052	79.82026	176 to WT11	224 to WT12		Plate 19-20
11	09.03127	79.81875	99 to WT12	362 WT11	Near Navy check point	Plate 21-22
12	09.03337	79.81599	82 to WT13	363 WT12		Plate 23-24
13	09.03591	79.81241	116 to WT14	317 to WT15		Plate 25-26
14	09.04194	79.80269	212 to WT17	202 to WT18		Plate 27-28
15	09.05084	79.78748	282 to WT22	335 to WT23	Nadukuda Navy Camp	Plate 29-30
16	09.05097	79.78692	280 to WT23	347 to WT22	Outside navy camp	Plate 31-32
17	09.05319	79.78216	108 to WT24	303 to WT25	C-coy no.3 navy check point	Plate 33-34
18	09.06108	79.76617	140 to WT31	207 to WT30	Near wadi, Tube well, abandoned	Plate 35-36
19	09.06152	79.76589	83 to WT31	242 to WT30		Plate 37-38
20	09.06270	79.76214	117 to WT32	256 to WT33	Near Selvari area	Plate 39-40
21	09.06376	79.76221	90 to WT32	201 to WT33	Near Wadi, Selvari	Plate 41-42
22	9.03601	79.82497	182 to WT35	330 to WT34	Second row, in a coconut plantation	
23	09.04181	79.81811	136 to WT37	327 to WT38	Second row, in a coconut plantation	

Source: Date of Assessment: July 2017

[a] These properties may be acquired by CEB

279. The photos of inspected dug wells, tube wells, and temporary dug wells are shown in the **Figure 4.63** (Plates 1- 42). The depth of most of dug wells is less than three meters from the soil surface.

Figure 4.63: Photographs of dug wells within the wind power project site, distance to the nearest wind turbine is given.

	
Plate 1. Well No. 1 at the sea cucumber drying site, Thoddaweli, 194 m to WT1	Plate 2. Well 1 at the sea cucumber drying site, near WT1
	
Plate 3. Well 2 in a coconut plantation, near WT7, abandoned, 278 m to WT7	Plate 4. Well 2 in a coconut plantation
	
Plate 5. Well 3 at sea cucumber hatchery which is under construction, Oluthoduwai, 143 m to WT7	Plate 6. Well 3 at sea cucumber hatchery

1. 	
Plate 7. Well 4 at Olothoduwai at the entrance of sea cucumber hatchery site, 201 m to WT8	Plate 8. Well 4
	
Plate 9. Well 5, close to the road to Olothoduwai, used by the people working at Kalutota cabanas, 132 m to WT8	Plate 10. Well 5
	
Plate 11. Well 6, behind the wadi at Olothoduwai, near the junction of the road towards Shell Coast Resort, 79 m WT8	Plate 12. Well 6

Plate 13. Well 7, close to the road to Shell Coast Resort, 199 m to WT10

Plate 14. Well 7

Plate 15. Well 8, close to the road towards Shell Coast Resort, drinking water well, 211 m to WT 10

Plate 16. Well 8

Plate 17. Well 9 at Shell Coast Resort, extracting 4000 L in 1.5 hours, 365 m to WT11

Plate 18. Well 9 at Shell Coast Resort

Plate 19. Well 10, used by people during the fishing season, 176 m to WT 11

Plate 20. Well 10

Plate 21. Well 11 at the Navy check point No. 1, 99 m to WT 12

Plate 22. Well 11

Plate 23. Well 12 near fishing wadi, 82 m to WT 13

Plate 24. Well 12

Plate 25. Well 13, drinking water well, used by people during the fishing season, 116 m to WT 14.

Plate 26. Well 13

Plate 27. Well 14, near Navy check point, 212 to WT17

Plate 28. Well 14

Plate 29. Well 15 drinking water well at Nadukuda Navy Camp, 282 m to WT 22

Plate 30. Well 15

Plate 31. Well 16, outside the Navy camp, Nadukuda, 280 to WT23

Plate 32. Well 16

Plate 33. Well 17 at a Navy check ppint No.3, 108 m to WT 24.

Plate 34. Well 17

Plate 35. Well 18, abandoned tube well, near fishing wadi, 140 m to WT 31

Plate 36. Well 18

	
Plate 37. Well 19, used by fishermen in the fishing season, 83 m WT 31	Plate 38. Well 19
	
Plate 39. Well 20, behind fishing wadi, 117 m to WT32	Plate 40. Well 20
	
Plate 41. Well 21 near fishing wadi, 90 m to WT 32	Plate 42. Well 21

280. It is reported that these temporary dug wells are contaminated with sea water during rough sea period. Electrical conductivity of water in some wells located close to the beach is above the 4,000 µs/cm.

281. During the field visit, electrical conductivity of the water in the visited dug wells, and shallow tube wells was measured using field conductivity meter and results are given below (**Table 4.25**).

Table 4.25: Electrical conductivity of surface water dug wells and tube wells

Site description[a]	**Coordinates**	**Electrical Conductivity(**µs/cm**)/Temperature**(ºC)
DW 1	98746 E/421774 N	2100 at 35 ºC
TW 1	97534 E/422858 N	5470 at 36 ºC
DW 2	96680 E/423552 N	2520 at 35 ºC
DW 3	95262 E/424676 N	1485 at 36 ºC
DW 4	95149 E/424747 N	2150 at 36 ºC
DW 5	94354 E/425236 N	1418 at 36 ºC
DW 6	91543 E/426935 N	450 at 35 ºC
DW 7	91480 E/426948 N	573 at 34 ºC
DW 8	89201 E/428040 N	4280 at 35 ºC
TW 2	89250 E/428029 N	1006 at 35 ºC
DW 9	85190 E/429586 N	4010 at 36 ºC
DW 10	85188 E/429571 N	1070 at 36 ºC
DW 11	85729 E/429833 N	5320 at 35 ºC
DW 12	83726 E/429777 N	1300 at 36 ºC
DW 13	93549 E/426070 N	2170 at 36 ºC
DW15	94940 E/425845 N	504 at 34 ºC
DW 17	90327 E/428519 N	740 at 35 ºC
DW 18	87546 E/429625 N	600 at 33 ºC

DW = dug well, TW = tube well.

[a] Distances from wind turbines listed in previous table.

Note: Data Assessment: 21-22 February 2016.

282. The electrical conductivity in visited dug wells close to the beach except DW 6 and DW 7 are higher than 1,000 µs/cm as a result of mixing of sea water due to the over extraction of groundwater. Other dug wells show low electrical conductivity as they are located in middle part of Island.

283. The visited dug wells and shallow bore holes are shown in the **Figure 4.64**. 10 water samples were collected from dug wells and shallow tube wells were analyzed at Water Resource Board Laboratory, Hector Kobbekaduwa Lane, Colombo 07 and analyzed water quality parameters are given in **Table 4.26**.

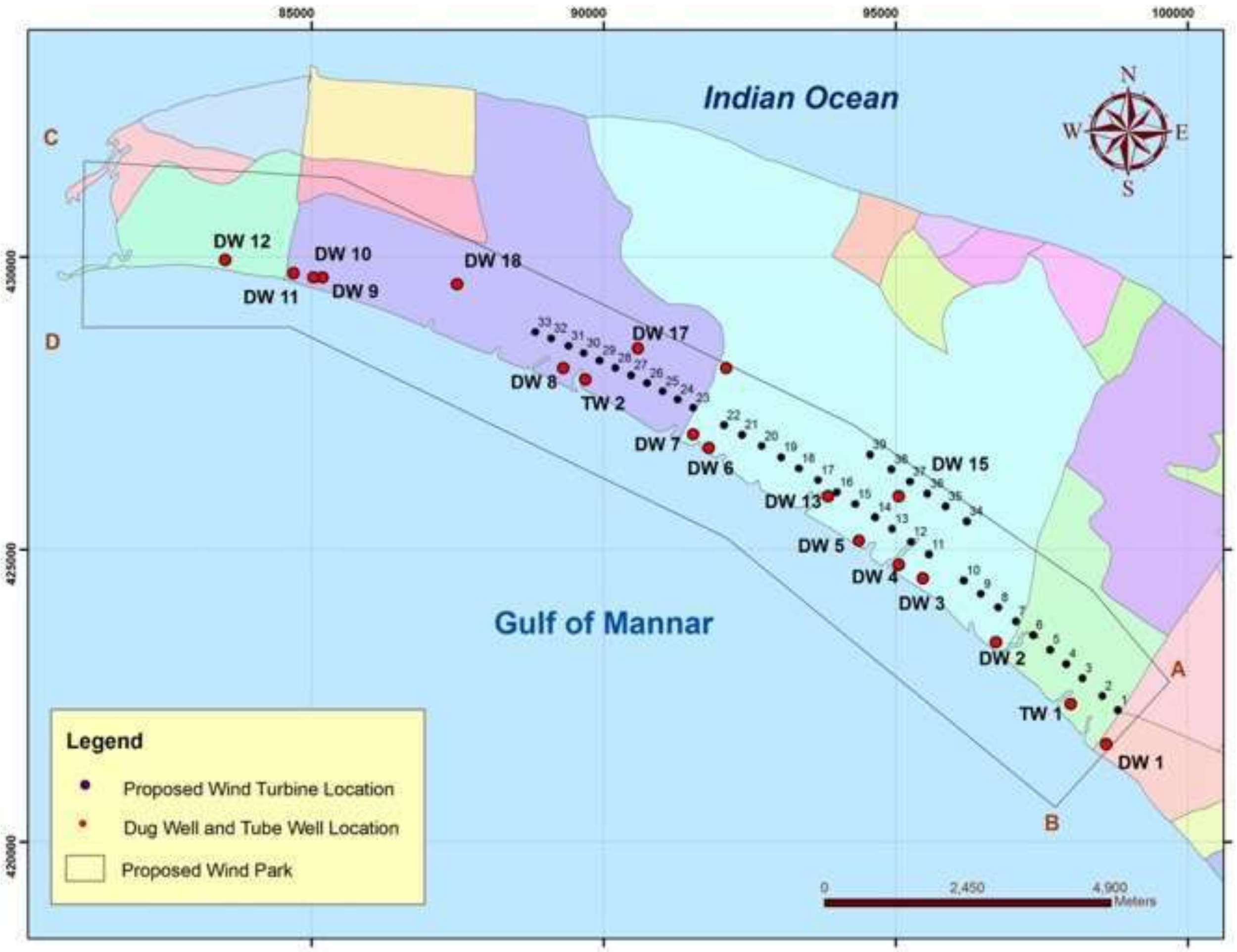


Figure 4.64: Wind turbine locations, dug wells (DW) and tube wells (TW) around the proposed wind farm block

Table 4.26: Chemical and physical water quality parameters of dug wells[a]

Parameter	SLS potable water standards 614:2013 Maximum Requirement (mg/l)	SLS potable water standards 614:2013 Remarks	DW 12	TW 2	DW 11	DW 16	DW 18	DW 15	DW 1	DW 3	DW 17	TW 1
Appearance			Clear	Yellowish	Yellowish	Yellowish	Clear	Slighty turbid	Yellowish	Yellowish	Yellowish	Yellowish
Color	15		ND	21	156	14	ND	ND	8	38	7	27
Turbidity in NTU	2 NTU		1	0.59	0.78	0.22	0.77	1.25	0.27	0.24	0.17	0.68
pH (lab)	6.5-8.5		7.7	7.9	7.5	7.4	7.8	7.8	7.9	9	7.7	7.7
Electrical conductivity in µs/cm (lab)	750		1285	984	5280	621	600	498	2708	1512	733	5475
Total Hardness in mg/L (as $CaCO_3$)	250		363	292	695	237	301	243	505	303	305	570
Total Alkalinity in mg/L (as $CaCO_3$)	200		396	292	695	237	301	243	378	335	337	646
Total Dissolved solids in mg/L (calculated)	500		630	483	2653	305	294	245	1371	741	360	2703
Calcium in mg/L (as Ca)	100		73	75	124	73	45	48	118	37	100	116
Magnesium in mg/L (as Mg)	30mg/L if SO_4=250 150 mg/L if	If there is less sulphate,	44	30	168	15	35	24	51	51	13	68

Parameter	SLS potable water standards 614:2013		DW 12	TW 2	DW 11	DW 16	DW 18	DW 15	DW 1	DW 3	DW 17	TW 1
	Maximum Requirement (mg/l)	Remarks										
	SO4<250 mg/L	Mg up to 150 mg/l may be allowed.										
Total Iron in mg/L (as Fe)	0.3	Total iron shall not exceed 0.3 mg/l	0.02	0.02	0.04	0.01	ND	0.01	0.02	0.02	0.01	0.03
Chloride in mg/L (as Cl)	250		209	134	1950	52	40	29	677	305	50	1467
Sulphate in mg/L (as SO_4)	250		121	57	50	2	11	13	142	48	34	263
Fluoride mg/l as F	1		1.09	0.35	1.35	0.98	0.82	1.76	0.52	0.59	1.47	0.49
Nitrate mg/l as N)	250		3.3	11.7	11.9	10.6	3.1	0.4	ND	4.8	3.1	14.2
Phosphate in mg/L (as PO_4)	2		0.73	0.64	5.2	3.8	0.63	0.64	0.35	4.9	2.69	0.25

[a] No parameter of pollution measured. No industrial activity in area yet, two under construction.
Note: Data Assessment: 21-22 February 2016

284. The analysis revealed that some of the parameters (EC, Cl, TDS, alkalinity, hardness) in the wells located close to the beach are not within the Sri Lankan drinking quality standards (SLS 614:2013) as a result of mixing of sea water due to the over extraction of groundwater. Also, analysis results revealed that most of parameters except alkalinity and phosphate in the wells located in the middle part of the island are within the Sri Lankan drinking water quality standards (SLS 614:2013). At present, the groundwater of the area is mainly used for the drinking and household purposes.

Observed Annual Flood Levels and Duration

285. Generally, Mannar Island shows flat topography in the regional scale. However, the study area shows rough ground surface in local scale due to the presence of discontinous sand dune structures. The elevation of sand dune at the area close to the beach varies from 0.5 m to 1.5 m with respect to flat ground surface (**Figures 4.65 and 4.66**).

Figure 4.66-67: Rough ground surface of the study area close to sea, Mannar.

286. During the field survey, it was noted development of the narrow sand barrier is along the beach line as a result of long shore sediment transport and average height of narrow sand barrier is about 0.5 m above the flat ground surface.
287. The study area is located within the dry zone of Sri Lanka. According to the rain fall distribution in

last 30 years (Department of Meteorology), lowest (625 mm) and highest rainfall (1,219 mm) had been received during year of 1980 and 2008. The annual average rainfall of the area is about 950 mm (10-year average) while calculated annual pan evaporation is about 2,100 mm (Source: Department of Meteorology). The main contribution of precipitation is received from NE monsoon.

288. During the days, considerable proportion of rain water infiltrates into the ground and reaches to the groundwater table. As a result of continuous raining, groundwater level gradually increases and reaches to the ground level and groundwater stagnates over the depression areas as surface water bodies. This water flows along the depressions to the sea mainly through stream segments and groundwater discharge. However, due to the presence of narrow sand barrier along the beach line, flooding conditions less than one meter especially at the low laying inland areas close to beach could be expected. These conditions could be seen in each and every year during the north east monsoonal period for a period of about two months.

Oceanography in the Gulf of Mannar

289. The large scale oceanic currents related to regional oceanic circulation which dominate waters beyond the continental shelf are controlled by winds and temperature differences, and their general pattern changes seasonally. Off the west coast, currents are strongest during the south west monsoon, and exhibit a westerly trend (De Bruin et al., 1994). Strong currents occur in the Palk Strait between India and Sri Lanka. Velocities of between 2.5–3 m/sec are common at the Indian end of Adam's Bridge. High velocities of this nature may contribute to increased sediment transport within this area. The ocean current is driven from the Bay of Bengal to the Arabian Sea during the north-east monsoon and from the Arabian Sea to the Bay of Bengal during the SW monsoon. The seas around Sri Lanka are micro tidal and are predominantly semidiurnal.

290. The shelf around northern and northwestern part of the island is broad and the shelf ends more abruptly in the south and east of the island. Within the shelf area, averaging 22 km. The mean water depth is about 75 m, but the submarine elevations drop abruptly to 900m within 3 km and 1,800 m within about 15 km of the shelf edge. Beyond this area is a steep descent of over 5,500 m bringing it to the general bottom level of the Indian Ocean (Madduma Bandara, 1989). The depth of the thermocline varies with the monsoons reaching 100–125 m on the west coast during the northeast monsoon and 40–60 m during the southwest monsoon period. On the east coast, south of Pedro Bank, the depth of the thermocline is at 50–70 m from the end of SW monsoon to the start of the NE monsoon, and 20–40 m at the start of the southwest monsoon (Maldeniya, 1997).

4.8.3 Air Quality

291. The proposed project area from Thoddaveli to Old Pier has no permanent houses or industries (fishmeal factory is under construction). A tourist hotel, navy camps and their observation points, fishing boat landing sites, fishing Vaadi and *ma-del* hauling sites are found along the coast. There is a fishmeal factory outside the project locations. The lands in the project area are consisting of coastal vegetation and scrublands. Therefore, air pollution is not taking place in the project area. There are few tractors and lorries often used for fishing activities and they run along the coast. However, the contribution of these sources to air pollution is negligible as there are prevailing winds throughout the year.

292. An overview of physical air quality parameters air temperature, air pressure, air humidity and air density at wind farm area are shown in **Table 4.27** as follows:

Table 4.27: Physical Air Quality Parameters

Air temperature [°C] in 80.0 m			Air pressure [hPa] in 16.0 m			Air humidity [%] in 100.0 m		
Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
27.8	32.3	22.4	1003	1011	974	84	100	45

Air density [kg/m³] in ~80.0 m with humidity			Air density [kg/m³] in ~80.0 m without humidity		
Mean	Max	Min	Mean	Max	Min
1.147	1.173	1.127	1.1608	1.185	1.142

Source: IEE report of CEB for Mannar Wind Farm Project (2016)

4.8.4. Noise (Inventory of Noise Sources and Levels)

293. The proposed project area, which is an Energy Development Area, is located within Pradeshiya Sabha limits, and was originally defined as a low noise area according to the National Environmental (Noise Control) Regulation No. 01 of 1996 Extraordinary Gazette No. 924/12, 1996. However, on 2 May 2017, the Urban Development Authority has declared the Energy Development Area as an 'Industrial Zone' resulting in the project site being reclassified as a high noise area[46] (see Annexure 8 for the official declaration from UDA).

294. No predominant noise sources have been identified other than noise arising from day to day human activities, noise coming from animals like birds and noise arises due to vehicular traffic (few tractors and lorries driven along the coast). Other relevant noise sources include the fish meal factory, which is running a generator (Minor source of air pollution) and fish processing machinery, and a proposed sea cucumber hatchery which will be complying with Industrial Standards for noise emissions.

295. Summary of measurement data on existing and background noise levels for eight measurement locations in Mannar Island conducted by the ITI, 2015 in the project area are presented in **Table 4.28** (24-hour locations).

Table 4.28: Existing and background noise levels, 24-hour measurement/locations

Date	Measurement Location		Assessment time period-Day			Assessment time period-Evening			Assessment time period- Night		
			ABL dB(A)	RBL dB(A)	ENL dB(A)	ABL dB(A)	RBL dB(A)	ENL dB(A)	ABL dB(A)	RBL dB(A)	ENL dB(A)
2015 October 05,06	N1	9° 0'51.13"N 79°51'33.22"E Thoddaveli Water Board Office	42	43	55	41	43	55	43	48	57
2015 October 05,06	N2	9° 1'27.44"N 79°50'39.69"E Mr. M. Mariyadas	43	46	54	41	44	50	42	46	49
2015 October 05,06	N3	9° 1'44.07"N 79°49'28.53"E Shell Coast Resort	41	43	47	39	46	50	42	44	48

[46] This area has been classified as an industrial area for noise purposes, mainly to facilitate the energy development. Clasificaiton is done by the Urban Development Authority according to the National Environment Act. There are industrial estates declared by the Industrial Development Board and Board of Investments, which cover borader aspects other than noise.

Date	Measurement Location		Assessment time period-Day			Assessment time period-Evening			Assessment time period- Night		
			ABL dB(A)	RBL dB(A)	ENL dB(A)	ABL dB(A)	RBL dB(A)	ENL dB(A)	ABL dB(A)	RBL dB(A)	ENL dB(A)
2015 October 05,06	N4	9° 4'32.66"N 79°49'8.09"E Julian Dias, Pesale	37	47	58	44	46	57	38	43	55
2015 October 06,07	N5	9° 3'26.00"N 79°47'45.81"E House, Nadukuda	41	42	48	39	39	43	40	42	47
2015 October 06,07	N6	9° 4'34.03"N 79°45'2.74"E Bishop House, Mannar	39	41	51	38	41	47	34	38	45
2015 October 06,07	N7	9° 4'32.14"N 79°43'51.12"E Old Pier Navy Camp, Thalaimanar	46	47	58	48	49	52	48	48	53
2015 –October - 06,07	N8	9° 5'5.13"N 79°43'36.34"E House, Thalaimannar	44	46	57	43	44	53	42	43	51

ABL = assessment background level (LA90, 15min), ENL = existing noise level (LAeq,h), h = hour, RBL = rating background level (LA90,15min), . Data Assessment: 21-22 February 2016

296. A second program of background noise measurements was undertaken from 6–12 March 2017, by National Engineering Research Development Centre of Sri Lanka, at six locations, with a total of 48 hours of data acquired at each location. Locations are displayed in Figure 4.67, and a summary of these measurement results is displayed in **Table 4.29**.

Figure 4.67: Locations for background noise measurements

Table 4.29: Existing and background noise levels, 24-hour measurement/locations

Day	L_{Aeq}			L_{90}		
	Ave	Min	Max	Ave	Min	Max
Sea cucumber drying compound near WT1	49.5	43.1	55.1	45.0	40.2	50.0
Kalutota Cabanas between WT7&8[a]	49.1	41.5	55.8	38.8	33.0	41.5
Fishing camp near WT7&8	45.3	39.1	49.5	39.1	31.7	43.9
Shell Coast Resort between WT10&11	41.1	32.5	49.5	35.5	25.1	45.4
Kalutota Cabanas between WT17&18[a]	43.1	37.3	51.7	37.0	30.8	46.3
Fishing camp near WT30&31	49.3	45.5	59.1	44.5	40.0	52.7

Night	L_{Aeq}			L_{90}		
	Ave	Min	Max	Ave	Min	Max
Sea cucumber drying compound near WT1	48.1	43.6	52.3	45.6	41.8	49.0
Kalutota Cabanas between WT7&8[a]	44.4	41.5	52.5	39.9	34.7	42.8
Fishing camp near WT7&8	47.0	40.0	54.8	41.5	36.0	52.6
Shell Coast Resort between WT10&11	43.3	40.7	49.7	41.7	38.9	43.2
Kalutota Cabanas between WT17&18[a]	40.4	35.9	50.5	36.8	33.0	44.2
Fishing camp near WT30&31	49.6	42.9	51.8	44.9	43.4	48.9

[a] These properties may be acquired by CEB
Source: Data by NERD, March 2017 for EIA.

Operational Sri Lankan Noise Guidelines

297. According to the National Environmental (Noise Control) Regulation No. 02 of 1996 Extraordinary Gazette No. 924/12, 1996 the maximum permissible noise level at the boundaries of the wind turbine farm in LAeq,T as follows (**Table 4.30**):

Table 4.30: Permitted Noise levels at boundary of project area as per SL Laws

Area	Day Time LAeq,T / dB(A)	Night Time LAeqT / dB(A)
High Noise	70	60
Medium Noise	63	50
Low Noise	55	45
Silent Zone	50	45

Note: “High Noise Area” means any export processing zone established by the BOI or industrial estates approved under Part IV C of the NEA; “Medium Noise Area” means an area located within any Municipal Council area and Urban Council area; “Low Noise Area” means an area located within any pradeshiya sabha area; “Silence Zone” means the area covered by distance of 100 m from the boundary of a courthouse, hospital, public library, school, zoo, sacred areas and areas set part for recreation or environmental purposes. ** Day time and Night time are 0600h to 1800h and 1800h to 0600h, respectively for above areas.

298. However, as per the Regulation 03 (Schedule 02) of the same at locations where the background Noise level exceed or marginal to the given level in the Regulation 01 (above table) an addition of +5 dB is allowed for High Noise areas.

299. Maximum permissible noise levels in at boundaries of the land in which the source is located in LAeq,T , for construction activities.

Day Time: 75 dB (A)
Night Time: 50 dB(A)

300. Day time and night time are 0600h to 2100h and 2100h to 0600h, respectively for construction activities.

Noise Guidelines used for Modelling Wind Farm Noise Output

301. As the specific wind turbine model and its characteristics will not be known until the conclusion of the tender process, the noise impact has been assessed by modelling an illustrative scenario that complies with noise limits at sensitive locations in the vicinity of the wind farm, as prescribed below.

302. In consultation with CEB and ADB, sensitive locations, or “receptors” have been classified as follows:

- Residential: permanent dwellings and community facilities in surrounding villages, Shell Coast Resort and two new tourist hotels (Cabanas) currently under construction (potentially to be acquired by CEB, which would negate their status as receptors), and Vaadies for sleeping purpose (and are not provided alternative accomodation).
- Institutional (sleeping): Naval camps (potentially to be classified as Institutional based on CEB agreement with the Navy), Naval outpost, churches and Vaadies for non- sleeping purpose.
- Industrial: Industrial facilities including the fish meal processing factory, and the proposed cucumber hatchery.
- Commercial: Fisher camps.

303. The Urban Development Authority in its letter has rezoned the Energy Development Area within Mannar Island gazette by the SLSEA under Act No. 35 of 2007 as an “Industrial Area” for application of the National Environmental (Noise Control) Regulations in accordance with the National Environmental Act. As required by the National Environmental (Noise Control) Regulations, given the site is a ‘high noise area,’ compliance with these regulations should be achievable for even a relatively small boundary around each individual wind turbine such as the 150 m x 150 m land parcels CEB are acquiring (see Noise Modelling in **Appendix 5**).

304. Noise limits have been defined in accordance with ADB requirements, referencing IFC World Bank Environmental Health and Safety Guidelines. Based on this guideline and in consultation with ADB, the proposed maximum allowable total noise levels at the identified receptors:

- At residential locations: no more than 50 dB (LAeq 1 hour) during day-time hours of 0600–1800, and 45 dB (LAeq 1 hour) during night-time hours of 1800–0600.
- At institutional locations (where people are sleeping): no more than 55 dB (LAeq 1 hour) during day-time hours of 0600–1800, and 45 dB (LAeq 1 hour) during night-time hours of 1800–0600.
- At institutional locations: no more than 55 dB (LAeq 1 hour) during day-time and night-time hours.
- At industrial and commercial locations: no more than 70 dB (LAeq 1 hour) during day-time hours of 0600–1800, and 60 dB (LAeq 1 hour) during night-time hours of 1800–0600.

305. Wind farm noise level is typically modelled at receptors without consideration of any potential additive effects of ambient background noise. As such, a 1 dB allowance for the additive effect of wind farm noise plus background noise has been assumed in this assessment, to estimate the total noise level

306. Under the IFC World Bank Environmental Health and Safety (EHS) Guidelines and Sri Lankan regulations, as an alternative to the fixed noise limits described above, noise limits can be set relative to existing background noise levels where background nosie already exceeds the fixed noise limits. Where background noise exceeds noise limits, an allowance of measured background noise +3 dB (LAeq 1hour)

is permitted by the IFC World Bank Environmental Health and Safety Guidelines. Background noise measurements have been made during the south-west wind season in June 2017, and additional measurements will be made during the north-east wind season, in order to define allowable wind turbine noise output during high background noise periods (October–March 2018). For the interim, modelling in this report is compared against only the fixed limits. These are high quality measurements of duration 2–3 weeks, as required by international wind farm noise measurement standards.[47] These additional measurements will enable wind farm noise output limits to be determined for periods when background noise exceeds the fixed noise limits (as described in **Appendix 5a).**

307. When background noise measurements are considered and they already exceed the fixed limits in the para 303, IFC World Bank EHS Guidelines require noise impact of the project to result in a maximum increase in background noise levels of 3 dB at receptor locations.

4.8.5 Bird Survey Results

308. A complete Avian Collision Risk Assessment report is attached as **Appendix 2**. The purpose of this risk assessment study is to undertake cumulative collision risk modelling for the projects and assist CEB in preparing the EIA's ornithological assessment. This assessment supports CEB in undertaking the ornithological assessment for the proposed power evacuation infrastructure and associated large-scale wind power developments. This includes analysis of the collected survey results and preparation of bird flight activity data for input to a collision risk model. Collision risk modelling was carried out along with the discussion on methodology, results, assumptions and limitations of collision risk modelling undertaken.

Avifauna Found in the Project Affected Area

309. Three major data sets (records of the FOGSL, Ceylon Bird Club and Ramsar data sheet) were used to compile the birds that have been recorded previously in the region. The Field Ornithology Group of Sri Lanka that has listed 109 species of birds, records of the Ceylon bird club that has listed 164 species for this area and bird list posted in the Ramsar website for Vankalai sanctuary which has listed 148 species. Based on these sources, a list of 184 species of birds has been compiled for the area (Mannar Island and Vankalai Sanctuary and the surrounding areas). Out of these, only 91 bird species have been recorded by all three sources while others were recorded in either one or two of the sources.

Bats

310. Two colonies of fruit bats were observed away from the wind farm area and the transmission line corridor. Altogether, four species of bats[48] were recorded in the entire Mannar Island. This includes one species of Megachiroptera (Fruit bats) and three species of Microchiroptera (Insectivorus bats). A fruit bat colony was observed near the wind farm. However, they fly away from the wind farm[49] as their feeding ground is located on mainland and therefore will not run the risk of collision with turbines. It is about 500 m from the wind turbine no.1 towards inland. (See **Figure 4.68** for fruit bat colony).

[47] IOA states "there is no compelling evidence that it is necessary to carry out background noise surveys at any particular time of year, or over two or more separate periods."

[48] These four are Pteropus giganteus, Hipposideros ater and Pipistrellus sp (two species of this genus can occur in this area. However, they could no be identified up to species level as these are small bats and nned to be captured in order to identify them down to species level). None of these species are listed as endemic, threatened or Range restricted.

[49] Bat outflights and inflights were trackedduring the extende survey June 2016 to March 2017 to identify flight directions

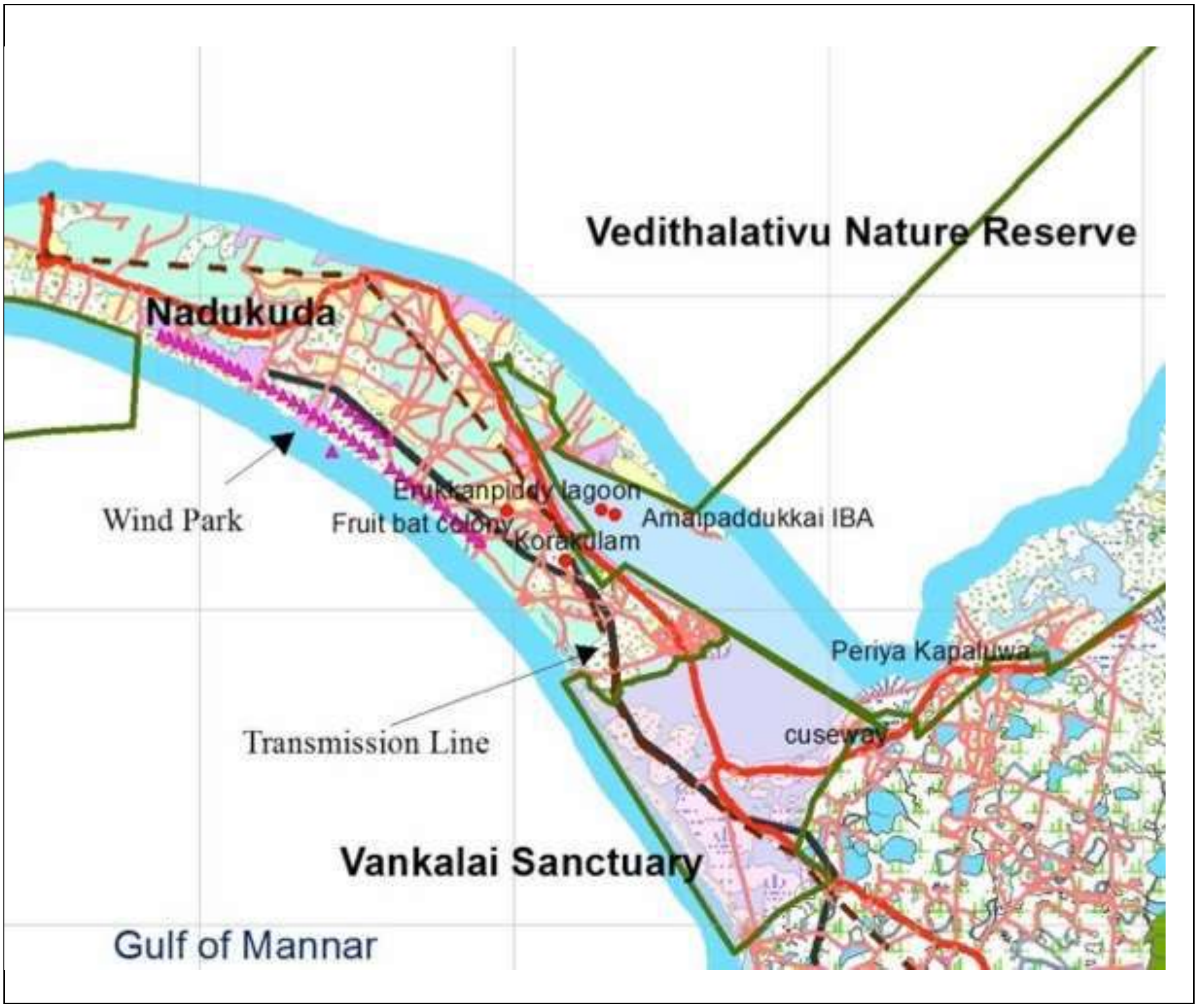


Figure 4.68: Location of fruit bat colony

311. The movement pattern of bat colony was studied separately. The movement was away from the windfarm in the direction of the mainland. This flight path does not overlap with the Vantage Point that was closest to the bat colony (VP1). Bats were recorded only several times during the additional study from June 2016 to March 2017. These records[50] are given below:

- June: 350 records during the VP surveys and no bats were recorded.
- July: 1775 records during the VP survey and no bats were recorded.
- August (VP1): 643 records during the VP surveys and fruit bat was recorded twice.
- September: 1320 records during the VP surveys and no bats were recorded**.**
- October: 1063 records during the VP surveys fruit bats were recorded six times in VP1 and seven times in VP3.
- November: 2136 records during the VP surveys fruit bats were recorded two times and insectivorous bats were recorded three times in VP2 and fruit bats were recorded two times and insectivorous bats were recorded two times in VP3.

[50] Since the number of observations on bats was negligible during the VP survey, this was excluded from the collision risk modeling.

- December: 1957 records during the VP surveys fruit bats were recorded four times in VP1
- January: 951 records during the VP surveys and no bats were recorded.
- February: 1311 records during the VP surveys and no bats were recorded.
- March: 622 records during the VP surveys and no bats were recorded.

Block Counts

312. The results available from the block count surveys of the South Shore count area (i.e., the area adjacent to the proposed wind farm site) are summarized in **Table 4.31**. These gives the count block peaks for the South Shore count area for each season (migrant/non-migrant). It should be noted that this count sector includes extensive areas outside the potential impact zone of the wind farm, so should only be used to give an indicative view of the baseline bird populations that could be affected by the wind farm.

Table 4.31: Water bird and raptor counts seasonal peak counts recorded in the 'South Shore' count area during the Block Count Surveys, migrant and non-migrant seasons 2014-2016.

Species	South Shore	
	Non-migrant	Migrant
Garganey	0	2000
White-breasted Waterhen	0	10
Purple Swamphen	0	16
Common Moorhen	0	12
Painted Stork	0	200
Asian Openbill	6	25
Eurasian Spoonbill	0	75
Black-headed Ibis	0	25
Indian Pond-heron	5	25
Eastern Cattle Egret	0	100
Grey Heron	11	50
Purple Heron	6	10
Great Egret	12	25
Intermediate Egret	30	60
Little Egret	34	350
Spot-billed Pelican	0	13
Little Cormorant	45	350
Indian Cormorant	10	250
Indian Stone-curlew	0	3
Great Thick-knee	12	8
Black-winged Stilt	10	45
Pacific Golden Plover	0	6
Common Ringed Plover	0	4
Little Ringed Plover	0	120
Kentish Plover	42	50
Lesser Sand Plover	40	100
Red-wattled Lapwing	10	15
Whimbrel	21	4
Eurasian Curlew	1	25
Black-tailed Godwit	0	10
Ruddy Turnstone	5	32
Curlew Sandpiper	0	75
Sanderling	0	32
Little Stint	0	180
Terek Sandpiper	11	56
Common Sandpiper	1	3
Common Greenshank	2	12
Common Redshank	2	25

Species	South Shore	
	Non-migrant	Migrant
Wood Sandpiper	0	12
Marsh Sandpiper	0	275
Brown-headed Gull	0	5000
Heuglin's Gull	0	3000
Little Tern	45	150
Saunders's Tern	8	20
Gull-billed Tern	5	110
Caspian Tern	300	400
Whiskered Tern	2	150
Common Tern	100	0
Lesser Crested Tern	4	250
Sandwich Tern	0	2
Greater Crested Tern	1	100
Oriental Honey-buzzard	0	2
Changeable Hawk-eagle	2	2
Booted Eagle	0	4
White-bellied Sea-Eagle	2	2
Brahminy Kite	3	15
Black Kite	1	5
Common Kestrel	0	1

Grid Counts

313. The results of the grid count line transect surveys for grid squares that overlapped the potential impact zone of the wind farm (taken as the wind turbines plus a 600 m buffer) are summarized in **Table 4.32**. This Table gives the peak monthly count made across all of the surveyed grid squares within this zone in the migrant (September–April) and non-migrant (May-August) seasons over the two survey years. The results of these surveys are again only indicative as only a small number of survey visits were made to each grid square (1–5 over the 2-year survey).

Table 4.32: Peak monthly bird counts of water birds and raptors recorded during the Grid Line Transect Surveys, during the migrant (Sep–Apr) and non-migrant (May–Aug) seasons, 2014-15 and 2015-16.

No.	Species	Migrant peak	Non-migrant peak
1	White-breasted Waterhen	0	1
2	Asian Openbill	10	7
3	Indian Pond-heron	2	0
4	Eastern Cattle Egret	20	0
5	Purple Heron	0	1
6	Great Egret	4	1
7	Intermediate Egret	5	0
8	Little Egret	40	3
9	Little Cormorant	3	0
10	Great Thick-knee	5	2
11	Black-winged Stilt	1	0
12	Grey Plover	1	0
13	Kentish Plover	4	0
14	Lesser Sand Plover	13	3
15	Red-wattled Lapwing	25	13
16	Whimbrel	2	0
17	Ruddy Turnstone	9	2
18	Sanderling	87	1
19	Common Sandpiper	13	1

No.	Species	Migrant peak	Non-migrant peak
20	Brown-headed Gull	136	3
21	Black-headed Gull	5	0
22	Heuglin's Gull	65	0
23	Little Tern	0	12
24	Gull-billed Tern	27	9
25	Caspian Tern	6	22
26	Whiskered Tern	7	0
27	Common Tern	2	0
28	Lesser Crested Tern	2	6
29	Greater Crested Tern	3	87
30	Booted eagle	1	0
31	White-bellied Sea-eagle	1	2
32	Brahminy Kite	33	10
33	Black Kite	2	0

Vantage Point Surveys (June-December 2016)

314. The water bird and raptor over-flying rates at rotor height (i.e., those at risk of collision) recorded during the June-December 2016 VP surveys are summarized in **Table 4.33**. This Table gives the mean over-flying rate recorded through the proposed wind farm site from each of the four vantage points for the migratory and the non-migratory seasons.

Table 4.33: Water bird and raptor flight rates (number of birds per hour) recorded through the proposed wind farm site, June-December 2016, from each of four vantage points.

Species	Migratory season (Sep-Dec) flight rate (birds/hour)				Non-migratory season (Jun-Aug) flight rate (birds/hour)			
	VP 1	VP 2	VP 3	VP 4	VP 1	VP 2	VP 3	VP 4
Northern Pintail	1.47	0	0	1.25	0	0	0	0
Indian Pond-heron	0.09	0.13	0.78	0	0	0	0	0
Eastern Cattle Egret	0	0.08	0	0	0	0	0	0
Purple Heron	0	0	0.06	0.04	0	0	0	0
Great Egret	0.03	0	0	0.04	0	0	0	0
Intermediate Egret	0.27	0	0.72	0	0.02	0	0	0
Little Egret	0.09	0.50	1.55	0.08	0.01	0.07	0	0
Spot-billed Pelican	1.50	0.42	0	0	0	0	0	0
Little Cormorant	0.03	0.38	0	0	0.05	0	0	0
Indian Cormorant	1.18	0	0	0	0.02	0	0	0
Heuglin's Gull	0.21	0	0	0	0	0	0	0
Gull-billed Tern	0.15	0.08	0.12	0	0	0	0	0
Caspian Tern	0.03	0	0	0	0	0	0	0
Little Tern	0	0	0	0	0.001	0	0.005	0.02
Lesser Crested Tern	0	0	0	0	0.001	0	0	0
Greater Crested Tern	0	0.13	0	0	0.02	0.004	0.04	0
Booted Eagle	0.06	0	0.06	0.04	0	0	0	0
White-bellied Sea-eagle	0.29	0	0.48	0.13	0.02	0.04	0	0
Brahminy Kite	1.59	2.96	0.84	1.38	0.30	0.18	0.77	0.23
Common Kestrel	0	0	0	0.04	0	0	0	0

315. The flight rates in **Table 4.33** relate to those birds passing through the wind farm itself. These rates were generally low, with most birds observed concentrated over the sea or along the long coastline rather than coming further inland where the wind turbines would be located. **Table 4.34** provides further information on this flight distribution. It gives the percentage of flights of each species that were recorded

more frequently (>10 flights) in each of the five distance categories from the shore. By locating the VPs looking along the shore, it has been possible to more accurately determine which flights remained along the shore and which came further inland and through the wind farm site. All flights inland from the beach have been considered as potentially at risk of collision.

Table 4.34: Distribution of flights recorded during the Jun-Dec 2016 VP surveys in relation to distance from the shore.

Species	Number of flights recorded	Sea / beach	0-50m from beach	50-100m from beach	100-150m from beach	>150m from beach
Indian Pond-heron	47	4%	40%	30%	17%	9%
Eastern Cattle Egret	52	40%	19%	29%	6%	6%
Purple Heron	10	0%	20%	30%	10%	40%
Great Egret	21	57%	10%	19%	5%	10%
Intermediate Egret	53	51%	21%	19%	8%	2%
Little Egret	298	72%	16%	8%	3%	1%
Spot-billed Pelican	5	0%	40%	20%	0%	40%
Little Cormorant	11	36%	18%	18%	18%	9%
Indian Cormorant	17	41%	18%	24%	12%	6%
Great Thick-knee	25	68%	24%	4%	4%	0%
Lesser Sand Plover	34	91%	9%	0%	0%	0%
Red-wattled Lapwing	18	0%	50%	44%	6%	0%
Ruddy Turnstone	16	88%	13%	0%	0%	0%
Sanderling	15	100%	0%	0%	0%	0%
Brown-headed Gull	187	100%	0%	0%	0%	0%
Heuglin's Gull	397	96%	3%	1%	0%	0%
Sooty Tern	11	100%	0%	0%	0%	0%
Little Tern	186	96%	2%	1%	1%	0%
Gull-billed Tern	1133	85%	12%	2%	0%	0%
Caspian Tern	35	94%	0%	3%	3%	0%
Whiskered Tern	24	92%	8%	0%	0%	0%
Lesser Crested Tern	185	99%	1%	0%	0%	0%
Greater Crested Tern	400	96%	3%	1%	0%	0%
White-bellied Sea-eagle	63	51%	16%	11%	10%	13%
Brahminy Kite	458	30%	20%	17%	19%	15%
Black Kite	12	50%	25%	17%	8%	0%

Vantage Point Surveys (January-March 2017)

316. The waterbird and raptor over-flying rates at rotor height (i.e. those at risk of collision) recorded during the January–March 2017 VP surveys (surveys further enhanced with more detailed flight mapping) are summarised in **Table 4.35**. This Table gives the mean over-flying rate recorded through the proposed wind farm site at rotor height from each of the four vantage points.

Table 4.35: Waterbird and raptor flight rates (birds per hour) recorded through the proposed wind farm site, January-March 2017, from each of four vantage points.

Species	Flight rate/hour (VP 1)	Flight rate/hour (VP 2)	Flight rate/hour (VP 3)	Flight rate/hour (VP 4)
Painted Stork	0	0	0.042	0
Intermediate Egret	0.028	0	0	0
Spot-billed Pelican	0	0	0.167	0
Indian Cormorant	0	0	0	0.208
Great Black-headed Gull	0	0	0.042	0
Heuglin's Gull	0.115	0	0.208	0
Gull-billed Tern	0.119	0	0	0.250
Caspian Tern	0	0.083	0	0
Greater Crested Tern	0	0.111	0	0
White-bellied Sea-eagle	0	0.028	0	0
Brahminy Kite	0.338	0.489	0.637	11.780
Black Kite	0	0.028	0	0
Common Kestrel	0.028	0	0	0

Enhanced Block Counts (January–March 2017)

317. The waterbird and raptor counts made during the enhanced block counts in January–March 2017 are summarised in **Table 4.36**. These surveys covered all of the potential disturbance zone around the wind farm, so show the bird populations that could be at risk of disturbance. This Table gives the count totals for each of the six survey days, and the overall peak count. Seven Critical Habitat species were recorded during these surveys: little egret, Indian cormorant, red-wattled lapwing, brown-headed gull, gull-billed tern, Caspian tern and lesser crested tern. Most were restricted to the beach habitat and were uniformly distributed along the coast. Only little egret, Indian cormorant, red-wattled lapwing were found on the inland sectors (on the thonas wetland habitat).[51]

Table 4.36: Waterbird and raptor block counts from in/around the proposed wind farm site, January–March 2017 (daily count totals). Critical Habitat species are indicated in bold.

Species	17-Jan	18-Jan	16-Feb	18-Feb	21-Mar	23-Mar	Peak
Indian Pond-heron	4	9	7	18	18	26	**26**
Eastern cattle egret	35	31	29	63	39	88	**88**
Great egret	40	41	25	53	44	78	**78**
Intermediate egret	40	20	30	34	57	98	**98**
Little egret	**124**	**83**	**78**	**98**	**80**	**124**	**124**
Little cormorant	2	2	5	14	11	29	29

[51] Thonas were included as these are inhabitaed by waterbirds. But none of the species that trigger critical habita were recorded in the Thionas during ground counts and hence excluded in the map provided in EIA report. But little egret, Indian cormorant and red-wattled lapwing have been identified as CH species.

Species	17-Jan	18-Jan	16-Feb	18-Feb	21-Mar	23-Mar	Peak
Indian Cormorant	**0**	**4**	**20**	**17**	**22**	**48**	**48**
Red-wattled lapwing	**7**	**4**	**4**	**7**	**6**	**9**	**9**
Whimbrel	9	6	4	2	2	3	**9**
Sanderling	4	5	3	3	1	4	**5**
Terek sandpiper	6	3	6	2	2	2	**6**
Common sandpiper	18	19	13	8	11	23	**23**
Brown-headed gull	**166**	**178**	**195**	**169**	**282**	**345**	**345**
Black-headed gull	27	20	30	22	41	27	**41**
Heuglin's gull	161	164	165	171	245	316	**316**
Little tern	41	44	52	60	54	75	**75**
Gull-billed tern	**97**	**78**	**70**	**86**	**64**	**81**	**97**
Caspian tern	**18**	**29**	**17**	**13**	**7**	**8**	**29**
Whiskered tern	104	128	135	180	177	218	**218**
Lesser crested tern	**14**	**53**	**68**	**61**	**92**	**83**	**92**
Greater crested tern	17	13	13	25	17	23	**25**
White-bellied sea-eagle	8	2	3	2	3	1	**8**
Brahminy kite	43	34	40	35	29	33	**43**
Black kite	2	5	4	6	6	0	**6**

5.0 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

5.1 Environment Impacts and Mitigation Measures

318. This section predicts and assesses the project's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic (including occupational health and safety, community health and safety, vulnerable groups and gender issues, and impacts on livelihoods through environmental interventions and physical cultural resources in the project's area of influence. In quantitative terms to the extent possible; this section also identifies mitigation measures and any residual negative impacts that cannot be mitigated; explores opportunities for enhancement; identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions and specifies topics that do not require further attention; and examines global, trans boundary, and cumulative impacts as appropriate.

5.2 Environment Problems due to Project Location and Design

319. The EHS Guidelines for wind energy include information relevant to environmental, health, and safety aspects of wind energy facilities. It should be applied to wind energy throughout the construction and operational phases. It presecribes a set of recommendations and strategies for noise-related mitigation options and toppling risk management. The necessity and exact number of affected structures and people are to be known after finalization of engineering designs by EPC contractor, as the impacts depend on the number of turbines and their specification. Thus, detailed survey regarding this environmental impact driven displacement can only be assessed after the finalization of the design. The wind farm is sited away from major settlements, and thick vegetation areas are avoided wherever possible; although it does include some Palmyra and coconuts and home gardens etc. The land identified for project construction is largely private land except for the CCD declared 80m wide corridor. CEB will follow two distinct approaches in securing the land required for the project. The first approach would be to obtain the land through negotiated settlement based on willing-buyer-willing-seller principle and the rest would be secured through land acquisition process.

5.3 Environmental Impacts Associated with Pre-Construction Stage

5.3.1 Acquisition/Clearance of home plantations and other lands

320. The first row of wind turbines, about 12 km in length, is located 140 m inwards from the island's southern coastline. The land earmarked for acquisition or purchase is largely fallow land covered with scrubs, hardly used for any productive or residential purposes and free of encumbrances. Therefore, neither physical displacements nor significant resettlement impacts are anticipated. The project impacts are primarily confined to temporary economic displacements for fishermen causing from the construction and operation of the pier and the intermittent disturbances during transportation of equipment to their respective destinations along the project site and the installation of wind turbines (WTs). The permanent economic impacts are on a small number of standing and commercial trees which will be either avoided in the final designs or compensated with cash.

321. The common habitats within the coastal belt of 170–185 m are sea shore vegetation and coastal scrublands. Species such as *Ipomoea pes-caprae* (Muhudu Bin Thamburu), *Spinifex littoreus* (Maha Ravana Reula), *Clerodendrum inerme* (Wal Gurenda), *Ipomoea macrantha*, *Wedelia biflora*, *Launaea sarmentosa*, *Pedalium murex* (Et- Nerenchi), *Sesuvium portulacastrum* (Maha Sarana) and *Premna obtusifolia* (Mahamidi) are common in the beach and sea shore vegetation.

322. The coastal scrublands are found after the sea shore vegetation towards inland. The characteristic tree in the scrubland is *Acacia planifrons*, with an umbrella type tree crown. In some areas, it forms a consociation and the canopy cover is almost 100% allowing very little sunlight to the ground vegetation. Towards the inland tall Palmyra (*Borassus flabellifer* - Thal) trees are found in the scrubland. The dominant species to be removed for the construction of wind turbines are Acacia shrubs/ trees, *Dichrostachys cinerea* (Andara), *Calotropis gigantea* (Wara), *Premna obtusifolia* (Maha midi) *Clerodendrum inerme* (Burenda), *Grewia orientalis*, *Catunaregam spinosa* (Kukuruman), *Ziziphus oenoplia* (Heen Eraminiya), *Carissa spinarum* (Karamba), and *Flueggea leucopyrus* (Katupila).

323. Thus, following measures will have to be taken prior to the project activities:

- Avoid migration and breeding season of migratory birds (September–April) in the area for wind turbine construction,
- Protect /preserve topsoil and reinstate after construction is completed,
- Repair/reinstate damaged water channels and pathways after construction is completed, and
- Compensation for loss of home garden, agricultural production (from Palmyra) etc.

324. The existing vegetation including trees will be cleared within 0.7 ha[52] at each turbine location, whereas they will be retained in the balance area (2.25 ha is the total plot area required for each wind turbine). The distance between two turbines is 300–350 m and therefore a section of natural vegetation between two turbine footprints will not be damaged. Once the construction activities are completed, it is expected that the natural regeneration of vegetation will take place. In addition, for landscaping the seedlings of the native species found in these habitats can be planted once the construction work of wind turbines is completed, to enhance the structure and floristic composition of the habitats found in the wind farm. This will increase the habitats for birds, small mammals, reptiles and amphibians living in the area.

[52] Area determined using the kmx google map.

5.3.2 Impacts on Temporary Use of Land

325. The mobilization of construction equipment and construction materials will require space for storage and parking of construction vehicles and equipment, construction material storage yards, disposal sites, and temporary labor day-camps for human resource to avoid environmental impact and public inconvenience. These locations must comply with the local laws and regulations and need approval from authorities to utilize these facilities (access roads, telecommunication, and pipe borne water supply). It is important that selection of temporary lands is done at least 500 m away from highly populated areas, water bodies, natural flow paths, agricultural lands, important ecological habitats and residential areas. Removal of trees and green cover vegetation should be minimized during preparation of access road and other facilities.

5.3.3 Aesthetic and visual environment

326. Every effort will be made to design and construct all the manmade structures in this project to blend with the surrounding environment. The appearance (color, dimensions and setting) of key physical features such as wind turbines, collector substation and control building will be designed with emphasis on surrounding environment and local architecture[53] in order to reduce the environmental and visual impacts. It is worth noting that the all electrical cabling work related to this project has been decided to be taken through underground routes to reduce the visual impact. Operational aspects are **discussed in Section 5.5 –** Operational aspects.

5.3.4 Risk of Natural Disasters

327. The project will not cause or increase the risk of any natural disasters. Being located in the coastal zone, the project site is potentially exposed to coastal hazards, mainly in the form of tsunamis and storm surges.

[53] CEB has prepared schematic architectural layouts to be followed by EPC contractor.

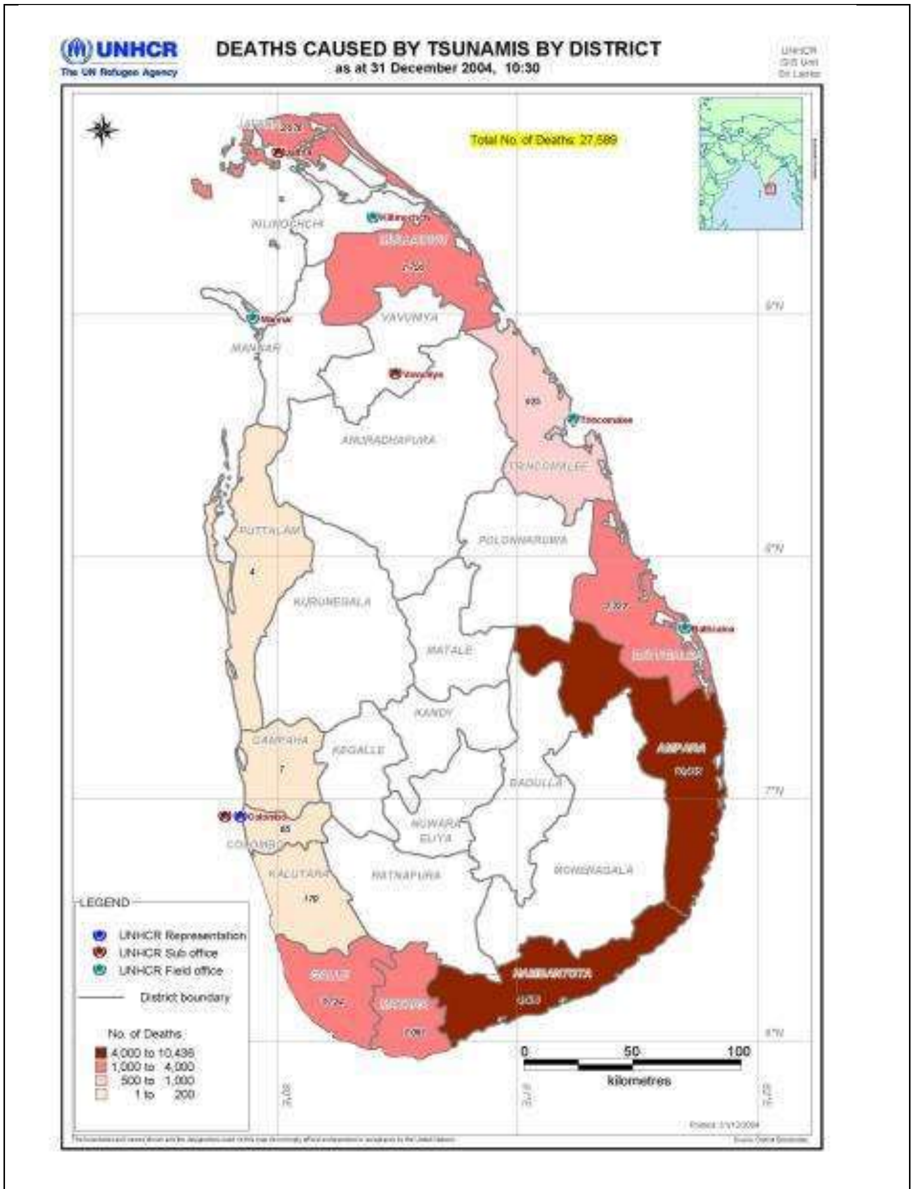


Figure 5.1: Tsunami Map of Sri Lanka

328. The coastline in the area was not affected by the Indian Ocean tsunami in 2004 (**See Figure 5.1**) although many other coastal areas in the country were severely affected. The location of the coastline can be considered as relatively sheltered, in comparison with the other coastal areas more exposed to potential tsunami events generated in the Sunda Arc, which is the source of the Indian Ocean tsunami and subsequent events for which alerts/warnings were issued in the country.

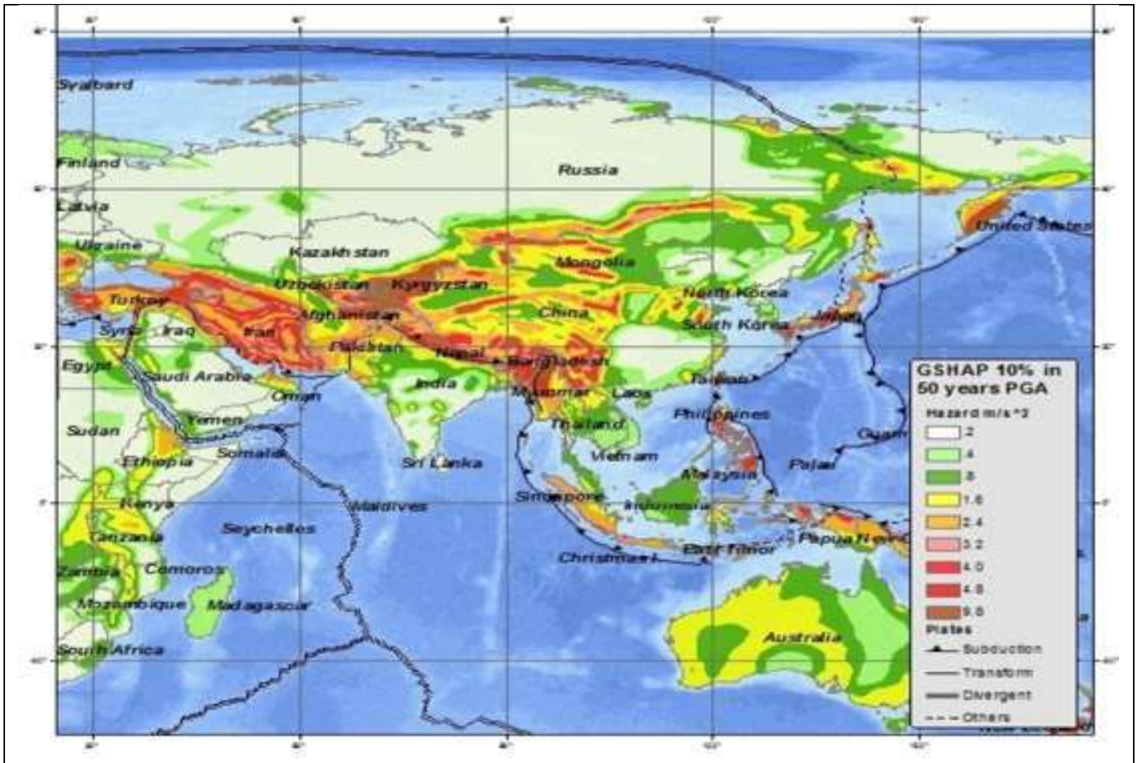


Figure 5.2: Seismic Map of Sri Lanka (USGS)

329. According to GSHAP[54] data, Sri Lanka lies in a region with low seismic hazard. Historically, mild earthquakes have been experienced in different parts of the island. Onshore hazard is low but earthquakes in the M5.0-6.0 range have occurred in the Gulf of Mannar historically that were all over Sri Lanka. M7+ events originating in the Sumatra-Andaman arc and events in the M6 range originating in the North Indian Ocean have also been felt (**Figure 5.2**).

330. Although not frequent, cyclones and storm surges could cause significant damages in coastal areas. Sri Lanka has been affected mostly by cyclone activity occurring in the Bay of Bengal with the Eastern, Northern and North Central regions being the main cyclone prone areas. There have been four severe cyclones during the last 100 years as well as a number of severe and moderate storms. The cyclones passing through Sri Lanka usually originate from the Bay of Bengal during the NE monsoon and cyclone incidence shows a strong seasonality and 80% of all cyclones and storms occurring in November and December. Incidences of cyclones passing through Sri Lanka in other seasons are rare due to geography and the regional climatology. The paths of historical cyclones over Sri Lanka are shown in **Figure 5.3**. Cyclone Nisha in 2008 was one of the recent events that caused significant damages in the Mannar area. 'High' storm surge levels are indicated in the Storm Surge Map for the Mannar area published by the Coast Conservation and Coastal Resource Management Department.

[54] Global Seismic Hazard Assessment Program (GSHAP) was launched in 1992 by the International Lithosphere Program (ILP) with the support of the International Council of Scientific Unions (ICSU), and endorsed as a demonstration program in the framework of the United Nations International Decade for Natural Disaster Reduction (UN/IDNDR).

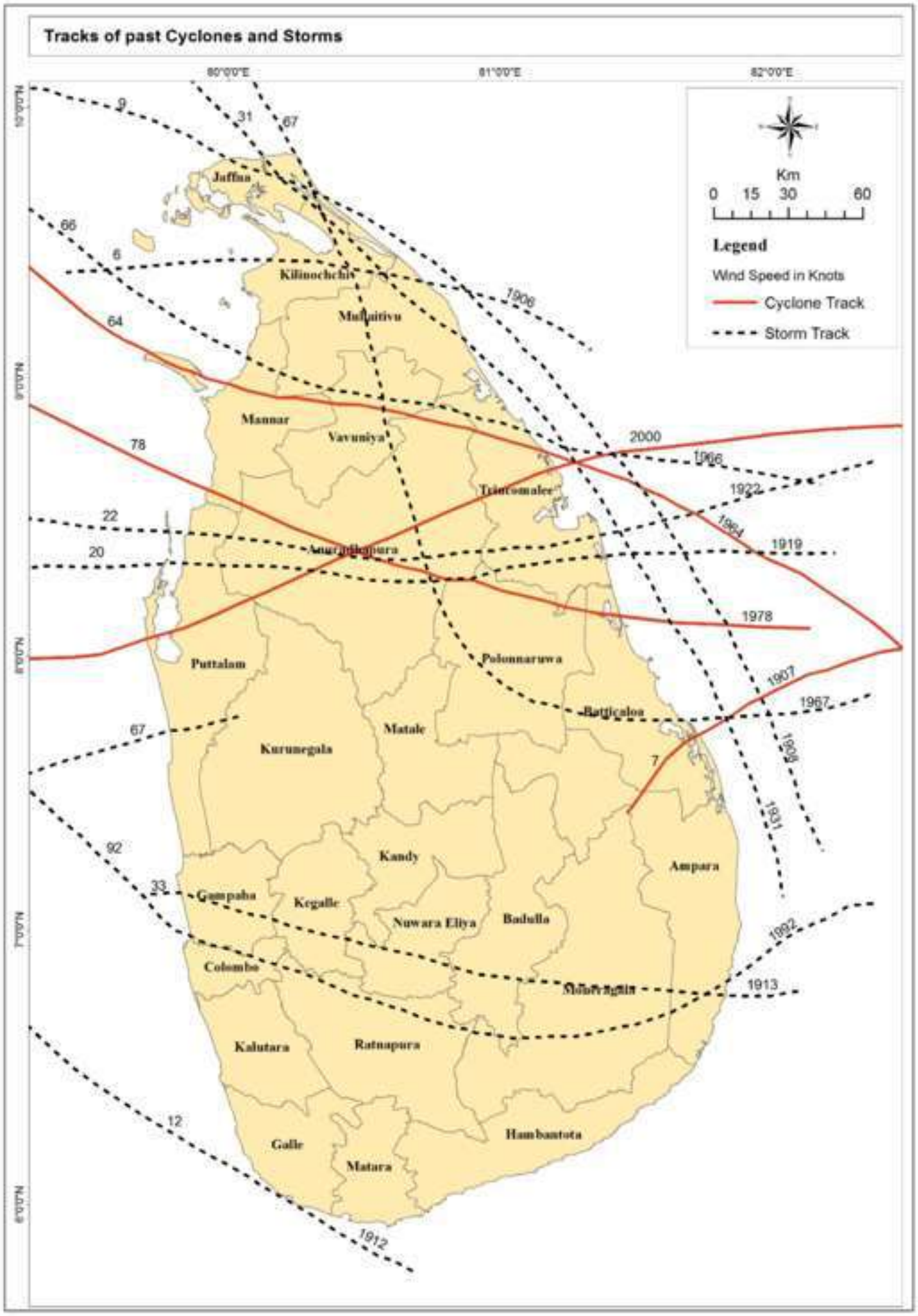


Figure 5.3: Paths of Cyclones over Sri Lanka

Source: Department of Meteorology, Sri Lanka (2016)

331. A two-pronged approach can be recommended for the mitigation of impacts of these hazards. In the case of proposed constructions, due attention should be focused on design measures to minimize the impacts against cyclones and tsunamis. CEB will ensure that EPC contractor incorporates sufficient structural engineering measures to develop hazard resilient structures, thereby minimizing potential impacts. In the case of both cyclones and tsunamis, the Disaster Management Center and the Meteorological Department provide warnings well in advance of the hazard events. For tsunamis arising

from earthquakes in the Sunda Arc, the warning time exceeds 90 minutes which provides sufficient time for evacuation to a safe location. Cyclone warnings are also issued well in advance.

5.4 Environmental Problems Associated with Construction Stage

Degree of Potential Impacts

332. In general, the degree of impact of a proposed wind farm is determined by the quality or uniqueness of the existing environment along the proposed area. The quality of the existing environment is influenced by several factors:

- **The uniqueness of the resources.** Proposed wind farm is reviewed for species or community types that are uncommon or in decline in the region or country. The environmental review evaluates whether the resource possesses a feature that would make it unique, such as its size, species diversity, or whether the resource plays a special role in the surrounding landscape.
- **The threat of future disturbance.** The resource is compared to surrounding land uses that may affect the quality of the resource over time. Considerations include whether the current and likely future land uses may threaten some aspect of the resource or whether the resource is valued by the adjacent community and therefore, likely to be preserved.
- **The degree of disturbance that already exists.** The significance of prior disturbance can be evaluated by determining how close the place resembles pre-settlement conditions.

Duration of Potential Impacts

333. The construction of a wind farm involves both long-term and temporary impacts. Long-term impacts would exist as long as the wind farm is in place, including land use restrictions, loss of vegetation, and concern on aesthetic impacts. However, long term impacts of wind farm on marine ecology and the water channels would be limited to the construction period.

334. Main construction activities inside the wind farm are:

- vegetation clearance
- access tracks, laydown areas
- foundation excavation and concreting
- office sheds, storage
- jetty for downloading equipment
- contractor’s day-time camp, yard and workshop
- waste disposal

335. The project activities during construction phase will involve clearing of scrubs, trees, coconut and Palmyra along the route alignment wherever required, excavation for civil works and erection related to Wind turbines, yard layout and underground distribution lines. It will involve excavation and civil works for control center, storage buildings, wind turbine foundations, access roads and culverts, lay down areas and their erection. During the operation phase, most of the construction phase impacts will get stabilized and the impacts will be restricted only to the operation and maintenance of the project, as well as noise, visual impacts, shadow flicker and any avian collisions due to operation of wind turbine.

336. The impacts on the environment from various activities of the project can be categorized as follows:

- Impact on Physical Resources
    - Impact on Topography
    - Impact on Climate
- Impact on Environmental Resources
    - Impact on Air Quality
    - Impact on Noise Levels
    - Impact on Surface Water Quality and Flows
    - Impact on Ground Water Quality and Flows
    - Impact on Soils and Geology
- Impact on Ecological Resources
    - Terrestrial Ecology
    - Aquatic Ecology
- Impact on Human Environment
    - Health and Safety
    - Agriculture
    - Socio-economics
    - Resettlement and Rehabilitation
    - Cultural sites
    - Traffic and Transport
    - Interference with other utilities and traffic
- Waste Disposal
    - Solid waste disposal
    - Liquid waste disposal.
    - Hazardous Waste disposal

337. The impacts of the project activities on various environmental attributes are discussed in subsequent sections. The following activities shall form an integral component in the planning stage before commencement of construction activity by the EPC contractor.

5.4.1 Impact on Physical Resources

Impact on Topography

338. During the construction of the wind farm, the topography will change due to erection of Wind turbine. The most prominent impact on the surface topography will be due to the removing of vegetation cover and soil as earthworks may be required to create flat platform for turbine construction (Hardstanding area) at the wind turbine erection site for construction facilitation as well as staff accomodation.

339. No topographical changes are envisaged during the operation phase of the wind farm. The existing access routes will be utilized during the operation and maintenance of the wind turbines and the yard.

Impacts to Land, Beach and Shoreline and their Vegetation

340. As the wind turbines, the main component of the project, are located away from the coastline and beyond the coastal setback distance of 80 m, a direct impact on the coastline behavior is not envisaged due to the construction and operation of such turbines. However, the construction activities would involve

the usage of approximately 0.7 ha area around the locations of each wind turbine, in view of the large scale of turbines and associated tower structures and the equipment/machinery to be used for construction. Clearing of vegetation, excavation, filling, compacting, leveling and other related activities are envisaged during construction phase. A possibility thus exists for soil erosion, siltation, blockage/restriction of natural drainage patterns leading to soil degradation and water logging/localized flooding in the area. However, in view of the relatively flat nature of the terrain and sandy soil with high infiltration capacity in the area, a severe impact due to construction activities is not envisaged. EPC Contractor shall utilise minimal areas required for construction, make provision of drainage systems-with silt traps where necessary, non-obstruction of existing drainage paths/flow in water channels,[55] with culverts provided where necessary. If some foundations are going to be in the vicinity of water channels, EPC contractor will have to engineer alternative drainage channels away from the foundations otherwise there will be a major impact on water flows. In addition, these measures need to be put in place prior to the rainy season[56] in the area, although it is desirable that all costruction is done in dry season.

341. A possibility also exists for adverse impacts associated with water logging and localized flooding caused by changes in natural drainage patterns in the coastal zone due to the construction of the proposed access roads. Therefore, provisions will be made for relatively uninterrupted drainage, in the form of culverts or other measures to drain all water from rains and flooding at locations where water logging could occur during construction and operational stages. The provision of such measures will be based on hydrological assessments during construction by the EPC contractor and will be made mandatory. Regular monitoring and maintenance of existing culverts (**Figure 5.4**) in the area will also be done to mitigate the adverse impacts associated with water logging/flooding in the area.

Figure 5.4: Culverts in the Coastal Zone in the Project Area

Impact on Climate

342. The proposed wind farm area has predominantly coconut/Palmyra plantation and home gardens. However, impact on the climate conditions from the proposed project both during the construction and operation phases will not be significant.

[55] Natural water channels shoud be avoided altogether as these habitats contain high bio diversity in Mannar island.
[56] CEB will need to determine the same based on viablility of the project implementation schedule.

5.4.2 Impact on Environmental Resources

Impact on Air Quality

343. During the construction phase, the activity would involve excavation for the Wind turbine erection, movement of transporting vehicles carrying the construction materials, etc. along the main haul road. In general, the construction of turbine foundation requires excavation of soil to a depth of 3 m and the area of excavation will be restricted to 25 m x 25 m. Therefore, air pollution by way of dust will increase during construction (due to truck/vehicle traffic to the project site, minor construction required to erect the wind turbines, earthwork, development of access roads, vehicle traffic on gravel road, etc.). Also, use of construction vehicles and equipment and idling of vehicles carrying construction raw materials add to the emissions.

344. The preparation of access road would require the scraping of top soil and compact the same with appropriate type of imported soil to handle the vehicular transportation of equipment and accessories. At majority of locations, access road will have to be constructed for movement of heavy vehicles. All these activities would give rise to emission of dust particles thereby affecting air quality marginally at the site which although will be transitory in nature. Proper dust control during construction will be done using mechanical water spray to minimize the dust nuisance.

Impact on Noise Levels

345. The proposed wind power project involves a variety of noise generating activities during the construction and operation phases. This includes the use of earthmoving equipment for access road construction, removal of vegetation, grading, excavation of tower foundations, tower erection, piling for temporary pier, the construction of ancillary structures, the operation of diesel generators, concreting, material movement, site cleanup and re-vegetation.

346. Noise levels generated by construction equipment vary significantly depending on the type and condition of equipment, the operation method and schedule and the site of the activity. Construction activities at site are expected to produce noise levels in the range of 84–109 dB(A),[57] with most work carried out during daytime. This level will be above the conditions for the noise levels [less than 75 dB (A) from 0600–2100hr and less than 50 dB (A) from 2100–0600[58] at the boundary of the land, however where there are receptors, use IFC EHS standard if it is more stringent]. This type of noise will be only temporary[59] and in order to minimize these temporary disturbances, the EPC Contractor and project management will ensure that:

a. All possible precautions to minimize noise are taken during each activity; particularly in the selection of equipment in good condition.
b. Activities during night-time are prohibited (between 9:00 pm to 6:00 am); and undertake all noisy construction work during non-fishing season April–August.
c. Contractors will undergo training in environmental protection.

347. The noise produced during the construction will have negligible impact on the village residents as the predominant land use are coconut/Palmyra plantations areas. There will be very limited presence of population among residents of the Shell Coast Hotel, the navy and fishermen who will be significantly exposed; especially when piling for temporary pier will take place during the construction phase. The

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[57] Based on 150 m x 150 m plot will need to be surrounded by a properly engineered noise barrier.
[58] As per Sri Lankan Noise standards for construction.
[59] Temporary pier piling will take less time, the Shell Coast Resort need not be closed for the period.

Cabanas were not considered for evaluation since CEB has proposed to acquire it.

348. Following measures will help to keep noise and vibration in acceptable level during construction phase:

- Contractor shall equip their heavy construction equipment and plants with exhaust silencers to limit the engine noise so as not to exceed 75 db (compacters, loaders, vibrators and cranes) and regularly maintain all construction vehicles and machinery that should meet the National Emission Standards.
- Contractor shall limit working time for activities that create noise only from 6:00 am to 9:00 pm except for construction site near public receptors which may have restrictions depending upon residents. Construction related activities closer to sensitive receptors have to be scheduled in coordination with the relevant authorities. The 150 m x 150 m plot will need to be surrounded by a properly engineered noise barrier
- Contractor and its suppliers of construction materials should strictly implement noise control regulations stipulated by the CEA in 1996 (Gazette Extra Ordinance, No 924/12) for all construction vehicles and equipment.

Impact on Surface Water Quality

349. There is no lagoon or estuary across the proposed wind farm area, surface water bodies are very limited and they are not permanent. The construction of foundations for wind turbines would require sand excavation which could change sedimentations in shallow areas in Gulf of Mannar. However, possible impacts seem to be not significant since wind turbines will be positioned about 140 m away from the tidal level.

350. The wind turbine construction will marginally impact the surface and ground water quality in the area during its construction period. Contamination of water bodies may result due to spilling of construction materials and surface runoff from the construction site joining the water body. There may be increase in the turbidity levels temporarily where the surface runoff during construction meets the water body. This can be avoided by careful selection of the wind turbine site and the access route so that the surface runoff does not meet the water channels.

351. Removal of scrubland vegetation and leveling of land are main activities during the preparation of site for wind turbine and these materials could be added to the stream segments during the flooding period. In addition, the soil erosion as well as sedimentation to the surface water bodies could take place during rainy period. The expected impacts from soil erosion could be very low due to the presence of flat topography. Also, all the activities would exist only until the completion of the construction period.

352. Proposed wind turbine construction activities may cause long term impacts to the existing drainage system in the area including natural flow paths, earth and line drains. Some impact may be permanent if they interrupt the flow path, as some turbines are very close to the water channel which would require the drainage channel to be engineered around the foundation. Stagnation of water will also create temporary breeding sites to mosquitoes, which may have direct impact on public health. Thus, incorporation of following measures will minimize anticipated impact due to obstruction of natural flow paths and existing drainage:

- Provisions of temporary drainage facilities to the particular locations if existing drains are obstructed due to construction activities.
- Maintenance of all drainage paths by avoiding blockages at all times.

- Contractor should minimize excavation of beds of any streams, and other water resources available in the project affected area.
- At the wind farm, EPC contractor shall locate the temporary day-time facilities such as drinking water, toilet/sanitary facilities by constructing temporary septic tanks for toilets and sealed containers for garbage collection which will be away from any water body. No water well will be located within minimum 100m of a toilet facility and vice versa.

353. Other possible contaminants during the rainy period are mainly from anthropogenic activities. The created wastewater is planned to collect and transport to the available existing water treatment plant for treatment of waste water.

354. The available waterways are seasonal and their length is less than 1 km. In addition, most of available waterways are already polluted with seawater. Therefore, any considerable impacts to the existing waterways due to contaminated storm water runoff could not be expected due to project activities.

Impact on Ground Water Quality

355. Due to the excavation and foundation activities the ground water layer at the turbine locations could be mixed with surrounding waters. However, it has been revealed from the water quality sample reports taken from adjacent dug wells that the existing ground water layer along the row of turbine is already contaminated with high salinity levels and sea water. Therefore, the impact to the ground water quality by sea water intrusion has no added adverse effect.

356. The main project activities are installation of 39 wind turbines and necessary facilities in selected locations for generation of power. For this purpose, 25 m diameter and 3 m depth is needed to excavate at each wind turbine site to install the concrete foundation for wind turbines.

357. The average depth to the groundwater level at the study is 1 m below the general ground level and thickness of fresh water column is less than one meter. The depth of the proposed pit for concrete foundation is 3 m below ground level and excavation is needed to undertake below groundwater level of the area. Manpower and machines are expected to use for excavation activities and sheet piles will be installed to avoid sides collapse during the excavation due to the presence of unconsolidated sand. Also, groundwater pumping will be involved during the excavation to the surrounding areas which will fed into a sedimentation pit to remove sediments before discharge to sea. Excavated sand will be backfilled and leveled in the area around wind turbine site. In addition, groundwater storage capacity (fresh and saline water) within unconsolidated sand formation due to the concrete foundation could be reduced by 11,000 m^3 and this amount is negligible compared to available groundwater storage within the island.

358. For wind farm construction activity, no chemical substance is used hence there is no impact on ground water quality. However, some oil will be spilled due to usage of construction machinery and equipment working at the site. The ground water pollution will take place, if chemical substances and oily waste get leached by precipitation of water and percolate to the ground water table. The silt discharge from the earthwork around water bodies, oil, grease and fuel release from the construction vehicles/equipment and spoil from construction related activities including any sewage from temporary day-time camp site will mix with runoff water. This situation will increase during the rainy season and if not controlled, will have impact on surface and ground water in the project area. Thus, following measures will be required in order to prevent deterioration of water from the wind turbine construction related activities:

- All construction vehicles and equipment should be maintained in proper conditions without any leakage,

- Contractors shall use silt traps and erosion control measures where the construction is carried out in close proximity to the water bodies to avoid entering of cement particles, rock, rubbles and waste water to the surrounding water bodies,
- Construction activities should be restricted to dry season (mostly April to September). Mannar has a very long dry season and a brief and light monsoon season during the winter months.)
- Waste oil should be collected properly and disposed to the approved location by Local Authorities/CEA.

Impact on Soil and Geology

359. Project activities including excavation, cut and fill operations, removal of scrubs, trees and vegetation etc., will enhance the soil erosion. The impact on soils will be due to the soil erosion at the Wind turbine construction site and along the access routes. Excavation activity and land clearance in the erosion prone areas have to be minimized while conducting site selection for wind turbine. Leveling and stabilization of wind turbine construction sites will be done after completion of construction activity, which will avoid increased acceleration of surface runoff and damage to the topsoil. The impact associated with excessive erosion and other civil works can be avoided or minimized by following mitigation measures:

- Maximum effort should be taken to minimize removal of trees and green cover vegetation.
- Minimize obstruction or destruction to natural drainage pattern of the surrounding area.
- Proper treatment of clearing and filling areas against flow acceleration.
- Restoration of side berms of the access roads should be taken after completion of construction around the wind farm.
- Contractors shall restrict cut and fill operation around sharp/deep slope areas.
- Digging for foundations will be restricted to non-rainy season;[60] otherwise the stock piled materials will spread all over the area and contaminate close by water bodies.
- Top soil (2–3 cm from the top of the soil), which is removed during construction from the cultivated lands must be stored separately for future utilization of near wind turbine locations.

Coastal Geomorphology Impacts

360. The location of the wind turbine line is stretched parallel to the coastline. The contemporary coastline is varying (erosion and accretion) due to main monsoons and inter-monsoon seasons. From starting point (wind turbine No. 1) to the end (wind turbine No. 39), it is possible to identify about 12 seasonal water channels that cut-across the space between WTs out of which 11 water channels (small and medium sized) close to beach front. Many of them are completely closed and others will be seasonally opened, and all wind turbine locations have avoided the water channels and water pools. Accordingly, there is no a considerable impact to water channels and water pools in the area owing to the construction of wind turbines (**Figure 5.5**).

[60] It depends on the selected contractor and the specific design of the foundation based on the bore hole tests they would undertake. The preliminary tests conducted suggest the foundations would not be piled.

Figure 5.5: Overwash salt-water pools (Photos were taken on 3 March 2016).

361. The proposed locations for wind turbines Location Nos. 1–5 are completely flat area, and there are no damages or impacts owing to construction. The Location Nos. 6–11 stretches along the incipient dune area. At the construction stage for the foundation, it is necessary to remove creeping vegetation and existing thorny bushes. But, this will not affect the existing environment, because due to the height of a wind turbine, it is possible to develop incipient and other dunes by sand moving from beach to inland due to wind. The location Nos. 12–25 also aligns on the incipient dunes as well as lower deposits of Holocene dunes. Removing of vegetation and sands on each location also will not affect the existing environment severely. After completion of construction, duns and vegetation development will develop gradually. The incipient dunes and Holocene low dune deposits are somewhat close to the beach than the other mentioned areas in wind turbine locations from 26 to 39. The height of the area varied 3–5 m from MSL. Removing of vegetation and dune sands volume in each location to designated disposal area allocated by authorities is somewhat larger than the other areas. However, damages or impacts due to such removal will not affect the environment highly. Moving of sand from beach to inland by wind action will help to fill the gap naturally.

Erosion and Changes of Shoreline Morphology

362. Coastal erosion and accretion are considered as natural processes that take place over a period of time and variety of scale. Shoreline changes due to erosion and accretion are predominantly governed by several natural forces such as wind, wave action, tidal currents, wave currents of drainage and storms that can easily move the unconsolidated sand and soils in the coastal areas.

363. Coastal sand serves as a barrier between sea and the land. Therefore, uncontrolled excavations associated with natural coastal erosion can cause range of environmental problems. Such as exacerbate the coastal erosion leading to jeopardizing opportunities for coasts to fulfill their socio-economic and ecological roles in the long term at a reasonable societal cost.

364. The proposed constructions will not severely impact coastal erosion since the excavated sites are covered by the wind turbine foundations and the excavated materials will be used as a backfilling material and the excess will be taken to dumping site.

5.4.3 Impact on Ecological Resources

Effect on Flora and Fauna

365. Removal of vegetation will result in loss of habitat for small mammals and birds. Also, the

clearance of vegetation shall be carried out in a limited area (0.7 ha) around each wind turbine site and the balance entire area (2.25 ha-0.7 ha) procured for each wind turbine will not be cleared. The locations identified for the wind turbines does not comprise of many trees in the immediate vicinity. The project may however remove trees within crane staging area and assembling area for suspended turbine components. The impact on ecological environment is assessed to be minor for the project.

Flora

366. The proposed project will not have any major adverse impacts on populations or communities of flora. Two endemic and seven threatened plant species were recorded from the wind farm block. However, previous surveys carried out in 2013 show that the populations of these species are found throughout the Island. Further, the project will not result in large scale vegetation clearing and therefore impact on flora is not significant. The number of standing trees observed within the project impact area includes 190 Palmyra trees and 226 coconut trees. Only 9 Palmyra and 37 coconut trees besides scrub vegetation will be removed during the construction period. In addition,

367. The impact on any flora and fauna that are rare, endangered, endemic or threatened is discussed in later sections. Migratory paths of small mammals and reptiles may be affected due to construction activities. However, noise, vibration and emission from construction vehicles, digging of foundations and working of equipment will occur during construction and pre-construction stages in temporary manner. The impacts related to above activities are temporary and can be mitigated through following measures:

- Strict attention on worker force regarding disturbance to surrounding habitats, flora and fauna including prohibiting hunting of animals and fishing in water bodies.
- Selection of approved locations for material storage yards and day-time labor camps away from the environmental sensitive areas.
- Avoid entering of construction waste (cement particles, rock, rubbles and waste water) and sanitary waste to the surrounding water bodies.

Fauna

368. As is the case of flora, the fauna that was observed in the site selected for the proposed project comprise common species with large populations. Only a few endemic or threatened species were observed. A total of 129 faunal species including four endemic species, one nationally threatened species and four nationally near threatened species were recorded during the field survey within the study area. Even though there are number of bird species that are restricted to the northern region of Sri Lanka, only the most common restricted species were observed in the site selected for the project.

Construction Period

369. The period of construction shall be finalised between the EPC contractor, CEB and Department of Coast Conservation and Coastal Resource Management. The seasons for construction can be decided based on the following schedule given in **Table 5.1**.

Table 5.1: Timing of Construction in Project Area (Wind Farm)

No.	Season	Period	Construction restrictions (ecology)
1	Dry Season	February-September	No ecological constraints preferred time for construction

No.	Season	Period	Construction restrictions (ecology)
2	Migratory period Wet Season (NW Monsoon)	October – January[a]	Civil works Construction of Temporary Pier, equipment unloading from barges
3	Breeding season for many of the native birds. Many of the ground nesting birds breed in Adams Bridge Marine National Park. Migrant birds are absent.	May - August	Wind turbine construction can be done.

[a] Construction is ideally avoided, no vegetation clearance, no earthworks, no noisy construction works (piling etc.) but CEB has requested construction and piling

370. The table above depicts the various season when the work can be done by the EPC contractor. For example, during the migratory season when the majority of birds are present in the project area and the greatest impact from construction disturbance will occur and hence no work must happen in the affected area.

371. The wind turbine erection must be done preferably between February–April to avoid both migratory and breeding season.

372. For operations, the wind season is usually between April 15 to September 15 and the non-wind season lies between 16 September to 14 April. The general pattern and actual season can vary by 15 days.

5.4.4 Impact on Terrestrial Ecology

373. The removal of herbaceous vegetation from the soil and loosening of the top soil generally causes soil erosion. However, such impacts would be primarily confined to the project site during initial periods of the construction phase and would be minimized through adoption of mitigation measures like paving and surface treatment and water sprinkling.

374. **Table 5.2** gives the number of Palmyra and coconut trees that are found within the area of hardstand in each turbine location.

Table 5.2: Details of trees found in Project Area

WT No	Village	Palmyra	Coconuts	Scrub	Scrub
1–2	Thoddaveli	08			Scrubs
2–3	Thoddaveli	05			Scrubs
3–4	Thoddaweli				Scrubs
4–5	Konniyankudiiruppu				Scrubs
5–6	Konniyankudiiruppu				Scrubs
6–7	Konniyankudiiruppu				Scrubs
7–8	Olaithoduwai				
8–9	Olaithoduwai	03			Scrubs
9–10	Olaithoduwai				Scrubs
10–11	Olaithoduwai	06			Scrubs
11–12	Uwari				Scrubs
12–13	Uwari				Scrubs
13–14	Uwari				Scrubs
14–15	Pesalai (St. Jude Road)				Scrubs
15–16	Pesalai (St. Jude Road)				Scrubs
16–17	Pesalai (St. Jude Road)				Scrubs
17–18	Pesalai (St. Jude Road)	01			Scrubs

WT No	Village	Palmyra	Coconuts	Scrub	Scrub
18–19	Pesalai (St. Jude Road)				Scrubs
19–20	Pesalai (St. Jude Road)				Scrubs
20–21	Nadukuda				Scrubs
21–22	Nadukuda				Scrubs
22–23	Nadukuda				
23–24	Nadukuda				Scrubs
24–25	Nadukuda				Scrubs
25–26	Nadukuda				Scrubs
27–28	Keeliyankudiruppu				Scrubs
28–29	Keeliyankudiruppu				Scrubs
29–30	Keeliyankudiruppu				Scrubs
30–31	Keeliyankudiruppu				Scrubs
31–32	Selvari	20			Scrubs
32–33	Selvari				Scrubs
34–35	Uvari	02	15		Scrubs
35–36	Uvari	40			Scrubs
36–37	Uvari	60	05		Scrubs
37–38	Peasalai (St. Jude’s Road)	30	200		
38–39	Peasalai (St. Jude’s Road)	15	06		Scrubs

Source: Data from Resettlement Plan for the project (2017)

375. Palmyra trees will be cut on the access road between Row 1 and Row 2. However, the most number of Palmyra and coconut trees will be cut in wind turbines 37 and 38 due to the access road that runs into coconut plantation fragmenting the same land into two sections and causing the removal of 37 coconuts and eight Palmyra trees. To reduce the impact on livelihoods, CEB will ensure if due to noise impact, telecom link or shadow flicker, if some of them cannot be constructed, these turbine locations which have higher risk than others may be removed to reduce impact.

Removal of Trees

376. Approximately nine Palmyra and 37 coconut trees will be removed from the wind farm area. The initial construction works involving land clearance, cutting, filling, and leveling may cause loss of vegetation. This will be irreversible impact. Care has been taken to avoid the plantations/vegetation as far as possible where the vegetation is thin. This will minimize the tree loss. Compensation is being paid to the tree owners in the private areas as per GoSL norms. Clearing of home gardens/plantations is involved and therefore appropriate amount for compensation for home garden and plantations will be paid directly to the farmers.

377. Generally, as a precautionary measure, if any forest/government trees are to be cut within areas belonging to forest /wildlife department, an amount of compensation as agreed with such institutions will be paid for the replantation of an equivalent area at a suitable location (i.e. at a ratio of 1:1). Thereafter the forest department would look after the trees, and be responsible for replacing any trees that die in the first five years of planting, until these get established in planting area.

378. The EPC Contractor shall clear the area of trees and vegetation for wind turbines the under guidance of the CEB without causing any nuisance to people in the area. The method removal is detailed under the Construction Method Statement in **Annexure 4**.

Construction of Access Roads

379. Most of the locations selected for erection of wind turbines and access roads have open sand

areas and scrublands. An area of 150 m x 150 m will be required during erection activities of wind turbines. However, top soil will be stripped in areas of approach roads, Crane Hard stands, Blade storage area and turbine foundations which will be restricted to an area of 0.3 ha at each turbine foundation and total area of 0.7 ha (area calculated by CEB based on kmz locations) including the soil stripped area as mentioned above would be kept without obstacles and high grown vegetation to facilitate systematic erection of wind turbine. Further, in order to minimize the impact on environment, existing roads will be utilized as much as possible. The land area required may slightly vary with the size and the make of the wind machine which would be installed.

380. Map 4 provides location of the access roads at the project site. Establishment of access to site will be one of the preliminary activities that will be undertaken as part of construction process. The existing route along the southern coast of Mannar Island will be extended and maintained as the site access road. Besides the site access road there will be internal roads for access to each turbine location and associated facilities within the wind farm area. The roads will be designed with a minimum width of 6m gravel compacted roads along the normal course with culverts and proper rainstorm water drainage system. Map 6 provides the design of the minimum 6m access road. The total length of the roads to be constructed has been provided in **Table 5.3**.

Table 5.3: Lengths of new roads and land acquisition requirements

Access Roads	**Total Length of the New Road Sections (km)**	**Length of roads for addition land acquisition (km)**	**Additional Land required (ha)**
Main Access Road	9.29	0.273	0.2
Access Roads between Row 1 and the Main	3.6	0.102	0.1
Access Road across Row 2	2.82	1.746	1
TOTAL	**15.71 km**	**2.12**	**1.3**

Source: Data from Resettlement Plan for the project (2017)

381. All these internal roads and site access road will not be restricted for the public during operation of the wind power park. The project will rehabilitate and develop a number of access roads which can also be used by local communities. The improved roads will increase the travel convenience of the villagers and reduce the cost of their transportation.

382. Out of the wind farm land requirement, except for the lands used for approach roads to the wind turbines and the foundation area of wind turbine (25 m diameter circle around the wind turbine) and hardstanding, all the other lands would be returned for the original usage after the project completion. The crane hardstanding area will not be vegetated in case maintenance is needed.

Cable Trenches for Power Evacuation Lines

383. The 33/11 kV lines will be laid underground and along the public roads in the park and up to the Nadukuda GSS in cable trenches (these will not cut across any private property other than notified by CEB). There will be some temporary disturbances and travel inconveniences during the installation of underground cables which will be managed by the contractors as per the national environmental and safety regulations. Accordingly, the contractor shall develop a traffic management plan during construction.

Temporary Road Construction on Tides and Turbidity

384. Disturbances to coastal sand in the tidal zone will not take place and therefore turbidity will not increase in the near shore water. Sea grasses and coral reefs that needs sunlight are not found in near

shore of the project area. It is required to minimize the environmental impacts from road construction. According to the proposed road construction plan, there is no significant impact on tidal areas as well as sand dunes. However, special attention will be drawn to avoid disturbance to the existing sand dune formations in the project area. Temporary jetty will impact the tubidity until it is decommissioned while the road connecting to the jetty will be temporary will interfere with tides.

Impacts on Dunes

385. In general, scatter distribution of medium scale dunes is present in the berm area. However, in beach area dunes are very rare. According to proposed construction plan, direct impacts on sand dunes are very limited. It can clearly show in the contour system of the 1:2,000 land use map of the area. However, the proposed construction locations are closer to the sand dunes thus indirect impacts can be expected.

Effect on Local Road Network

386. Heavy machinery, cables, sub-transformers, wind turbine material, construction equipment, iron bars, concrete materials, equipment etc. will be transported through the provincial and local road network to the project site. Transporting of large quantities of construction material could damage the road. This would lead to physical damages to local road network. Thus, it will be necessary to obtain consent from Road Development Authority (RDA) or Provincial Road Development Authority (PRDA) to use local roads prior to transportation. In addition, contractor should conduct a survery of the road sections outside project areawhich will be utilized for the construction related activities and ensure they are properly maintained.

387. Proposed access routes (utilizing existing roads and railway lines) can be used for such transportation of raw materials etc. (**Table 5.4**).

Table 5.4: List of roads etc. used for access of material

Route Number	Name	Location	GPS Coordinates N	GPS Coordinates E
Roads				
A 14	Medawachchiya - Mannar - Talaimannar	Sinnakankankulam	8°54'36.29"N	79°57'13.13"E
		Periyakalapuwa	8°55'45.56"N	79°55'48.49"E
	Thalladi - Arippu - Marichchukkaddi	Periyakalapuwa	8°55'56.25"N	79°55'31.35"E
	Thalvupadu - Mannar	Pattithottam	8°59'27.29"N	79°53'20.56"E
Railway				
8	Mannar Line	Thiruketiswaram	8°54'36.29"N	79°57'13.13"E
		Kora kulam	8°59'46.79"N	79°53'5.96"E

Local Buildings/Structures

388. The project impact area encompasses 80 residential structures, three Christian/Catholic churches, four retail groceries/tea kiosks, one tourist hotel, six naval detachments/observation points and fishing huts. The residential structures are located within the Thalaimannar, Kattakarankudiiruppu and Konnayankudiiruppu GNDs. The two cabanas are no longer considered impacted as they will be acquired by CEB. The project site is a 12.5 km coastal strip with scrublands and free of any permanent residential or government buildings in the right of way. Although there are temporary structures such as naval outposts, and fishing huts which are being lived in for at least six months per year.

Landing Site for Barges

389. The project will transport the wind turbines and its parts, via the sea up to the temporary jetty using a barge. Temporary jetty's (pier) location has been finalized (See Appendix 5 on Bathymetrc Study that shows the location where it will be constructed. Transportation of machinery and equipment through the sea will thus be temporary. The impact will be minimal given the marine survey has determined that there is no marine flora and fauna that exists in the area proposed for Pier site.

390. Due to the permeable nature of the proposed pier, no significant level of sediment trapping in its vicinity is envisaged. However, a possibility exists for sediment accumulation near the coastline at the pier due to the sheltering effect of the Steel columns near the coastline. A possibility also exists for such accumulated sediment to extend towards other piles of the pier closer to the coastline, forming a sediment barrier which could lead to coastal accretion and erosion on either side of the pier.

391. In view of the above considerations, it is recommended to carry out regular coastal monitoring in the vicinity of the proposed pier. The monitoring is to be in the form of surveys to obtain beach and coastal sea bed profiles, extending from the permanent vegetation line along the coast into the near shore areas. The profiles are to be taken at the location of the pier and on either side of it at specified distances and time intervals. It is recommended that profiles are to be taken at the proposed pier location and on either side of it at 25 m intervals up to a distance of 100 m from the pier location and then at 50 m intervals up to a distance of 250m from the pier location. The profile up to the edge of the pier is to be obtained at the pier location and the seaward extent can be progressively lesser in locations away from the pier. It is also recommended that surveys are to be conducted, prior to the construction of the pier, at the onset of the SW monsoon, at 3-month intervals during the SW monsoon, at the onset of the NE monsoon, at 3-month intervals during the NE monsoon over a period of at least one year. However, depending on the changes in the coastal zone, it may be necessary to expand the survey area and to conduct surveys at more frequent intervals over a longer period in order to assess the coastal impacts due to the proposed pier construction.

392. However, a bathymetric survey of the area in the vicinity of the proposed pier has been carried out. In this survey, bathymetric data in a 10 m x 10 m grid is available from the center line of the pier up to 100 m on either side. In addition, bathymetric data in a 100 m x 100 m grid is available up to 500 m to the east and 4,500 m to the west, including the location of permanent vegetation line. The survey has been carried out in March 2016. In addition, the location of the permanent vegetation line for the coastal area from Thavilpadu to Thalaimannar along a 19 km length, surveyed in October 2015 is also available. In view of these considerations, the information obtained from the surveys may be considered as baseline information with respect to the proposed development and coastal monitoring (i.e., for the surveys prior to the construction and at the onset of the SW monsoon).

393. It is recommended that regular assessments of coastal behavior be carried out based on the survey results, supplemented by field observations where necessary, and, if needed, appropriate mitigation measures be implemented, in the form of periodic clearing of accumulated sediments to restore existing sediment transport patterns in the vicinity of the pier which will be dismantled once all equipment has been erected and commissioned.

Disposal of Debris

394. Because of construction related activities, inert spoil and debris61 will be generated during the construction stage. Improper disposal of the debris will have an impact on the surrounding ecology, public

[61] Given each foundation is 25 m x 25 m and 3 m deep and the 17 km roads are minmum 6 m wide and 1 m depth is excavated, the total spoil would be about 175,125 cum of which about 50% dumped outside.

health, and scenic beauty. Following measures will minimize the impacts associated with disposal of debris:

- Spoiled materials (soil, sand, rock, etc.) generated from construction activities shall be used wherever possible for site leveling, back-filling, etc. outside the environmentally sensitive area.
- Dumped materials must be taken outside to government approved sites as it could interfere with the drainage pattern of the area, any water channels, agricultural lands, coastal land and/or any down slope in the project area.

5.4.5 Impact on Aquatic Ecology

395. The impacts on aquatic ecology of the area are envisaged during usage of the jetty, equipment handling. Care will have to be taken to avoid water pollution and disturbance to the aquatic fauna of the area.

5.4.6 Impact on Human Environment

Requirement of Labor

396. During the construction stage manpower ranging from 80 to 100 will be required during normal functions while peak construction activities will require 150–200 workers. The available semi-skilled and unskilled labor required for civil work related construction activities will be locally hired and therefore labor camps will not be required to be set up except for when the balance skilled workers are hired from outside. Skilled workers for crane operation and specific electrical works will be brought in from outside, which will be limited to 15–20 individuals. The workers coming from outside will be lodged in rented accommodation in Mannar town. Sufficient quantity of drinking water[62] available and toilet/sanitation[63] facilities will be provided at the construction site. **Table 5.5** below gives the estimated labor requirement during various stages of construction phase. About 30 workers would be required during the operation of the 100 MW Wind Power Project.

Table 5.5: Estimated Labor Requirement during Construction Phase Activities

Activities	Normal Period	Peak Period
Foundation and Civil Works	50	100
Transportation of turbine components (drivers of construction vehicles and project vehicles)	15-20	30-32
Stock yard (security and staff)	7-8	10-12
Site Office	2	5
Wind Power Operation	30	

Source: CEB IEE report 2016 for Mannar Wind Farm Project

Receptors in the Study Area

397. There are no residential dwellings of people within the individual boundaries earmarked for WTs or in the land areas between the WTs. The land between WTs is largely covered with different types of vegetation which includes scrubs, Palmyrah trees (approximately 190) and coconut trees (approximately 226). In addition, there are 12 seasonal water channels that cut across the spaces between the WTs.

[62] 20 liters of water availability per day per person (3 litres drinking, 15 lpd per bathing, 10 lpd for cooking). Source: Basic water requirements for human activities: Meeting Basic Needs, by Peter H. Gleick, Pacific Institute for studies in Development, Oakland, CA, USA.

[63] Approx 1.5 toilets for 12-14 persons as per Table 5.31.

The built structures that fall within these spaces include an industrial unit (a fish meal processing factory), two naval camps, one fishermen's rest room, a church, three roads and a proposed sea cucumber hatchery to be constructed between WT 7 and WT 8. The project has already taken appropriate measures in its design to avoid any adverse impacts on these built structures by increasing the space between WTs in such places. Recommendations from the Sri Lanka Land Reclamation Development Corporation (SLLRDC) have been incorporated into the design to avoid adverse impacts on natural water streams. Similar measures will be taken to minimize impacts on Palmyrah and coconut trees in the final designs of the project.

398. The activities, structures and service facilities found within the land area between the coastline and the main access road in the project impact zone include three boat landing sites, operation of about 516 mechanized boats[64] and 10 traditional fishing crafts, 39 fisher camps (vaadi), one naval camp and six naval observation units, 22 *ma-dels* (beach-seine fishing), three drinking water wells and one tea kiosk. The project will not have any significant impact on fishing related activities, naval bases and other service facilities as all these activities and structures are located and/or conducted 40–50 m away from the first row of the WTs.

399. The land area identified for the rehabilitation and construction of the main access road is largely covered with scrubs. There are seven seasonal water channels and one naval camp within this area. The project will avoid any adverse impacts on the water channels. A separate hydrological study carried out by the Sri Lanka Land Reclamation and Development Corporation (SLLRDC) recommended the necessary measures to avoid adverse effects on the natural drainage system within the area causing from project constructions. CEB will incorporate those SLLRDC recommendations to its designs. The naval base will be avoided. The land area identified for the construction of the access roads between the WTs on Row 1 and the main road are exclusively covered with scrubs. The interconnection between Row 1 and Row 2 will be facilitated through the rehabilitation of the existing St. Jude's Road. The land area through which the main access road between Rows 1 and 2 is covered with scrubs and one Palmyrah tree. Except for the road section between WTs 37 and 38, land area earmarked for the construction of the access road is covered with scrubs. However, the road section between WTs 37 and 38 will run through a coconut plantation fragmenting the same land into two sections, and causing removal of about 37 coconut trees and eight Palmyrah trees. The final design of the project will avoid land fragmentation and the felling of coconut and Palmyrah trees.

400. As far as possible, all important buildings such as schools, churches beside Vaadies, etc. are also identified in the **Figures 5.6 and 5.7** below.

[64] These boats are not permanently landed in a single location. They are landed intermittently in the landing sites of Nadukuda, Thoddaveli, Thavulpadu and Olaithoduvai during the southern fishing season.

Figure 5.6

Figure 5.7: Labourers stay at fishermen camps/Vaadi near Turbines 7&8 and 30/31.

401. **Table 5.9 and 5.10** below provides information about various project features from the wind farm site.

Table 5.9: Distance of sensitive receptors to Wind Turbine

#	Receiver/Sensitive receptor	Coordinates		Distance from Nearest Wind Turbine (WT) No.
		N	E	
1	Konniankuduiruppu village and Church	09.023800	79.848032	1.1 to 1.2 km from WT5, 6 and 7
2	Olaiththoduvai Church	09.033894	79.841213	1.6 km from WT8, 9 and 10
3	Olaiththoduvai School	09.035836	79.841329	1.8 km from WT9 and WT10, 1.9 km from WT8
4	Kaluthota Investment Cabanas (under construction)[a]	09.023615	79.833175	235 m from WT9

5	Shell Coast Resort	09.029868	79.825255	380 m from WT12, 465 m from WT11
6	St. Jude Road, Kaluthota Investment Cabanas (under construction)[a]	09.043360	79.805653	250 m from WT18
7	Nadukuda village	09.056977	79.795958	1.015 km from WT22 and WT23
8	KeelaiyanKuduiruppu village	09.065690	79.776068	850 m from WT29
9	Navy Camp, Selvary	09.073632	79.769459	1.2 km from WT32 and WT33
10	Uvary Village and Church	09.041630	79.830987	900 m from WT 47

[a] These properties may be acquired by CEB

Table 5.10: Distance to all receptors in project area

#	Receiver ID	Latitude	Longitude	X	Y	Distance from WTG	
1	Thalvupadu	8.995617	79.861650	374870	994562	1,625	
2	Thottavelly-Thalvupadu Rd	9.011612	79.858007	374475	996332	945	
3	N1 Thoddaveli Water Board Office	9.014202	79.859228	374610	996618	1,238	
4	N2 Mr Mariyadas	9.024288	79.844358	372979	997738	995	
5	Konniankuduiruppu village and church	9.023800	79.848032	373383	997683	1,217	
6	Konniankuduiruppu	9.015470	79.856766	374340	996759	1,167	
7	Konniankuduiruppu	9.018550	79.852700	373894	997101	1,119	
8	Konniankuduiruppu	9.021108	79.849508	373544	997385	1,103	
9	Konniankuduiruppu	9.022909	79.844180	372959	997586	875	
10	Naval observation unit	9.003662	79.852370	373853	995455	299	South of WT 1
11	Vaadi	9.004369	79.851967	373809	995533	210	South of WT 1
12	Vaadi	9.004580	79.852150	373829	995556	196	
13	Vaadi	9.004647	79.852044	373817	995564	184	
14	Vaadi	9.004732	79.852104	373824	995573	179	
15	Vaadi	9.004739	79.852227	373837	995574	185	
16	Vaadi	9.004757	79.851888	373800	995576	167	
17	Vaadi	9.004771	79.852024	373815	995578	171	
18	Vaadi	9.004778	79.851972	373809	995578	168	
19	Industrial unit (fish meal manufacturing company) boundary	9.007316	79.849115	373496	995860	115	Between WT 1 and 2
20	Industrial unit (fish meal manufacturing company) boundary	9.008699	79.850409	373639	996013	166	
21	Industrial unit (fish meal manufacturing company) boundary	9.008171	79.851268	373733	995954	221	
22	Industrial unit (fish meal manufacturing company) boundary	9.005842	79.850624	373661	995697	90	
23	Industrial unit (fish meal manufacturing company) estimated location	9.006921	79.849771	373568	995816	182	
24	Naval Camp - boundary	9.012398	79.842235	372741	996424	179	Between WT 4 and 5
25	Naval Camp - boundary	9.014013	79.843493	372880	996603	124	
26	Naval Camp - boundary	9.014064	79.840490	372550	996609	161	

#	Receiver ID	Latitude	Longitude	X	Y	Distance from WTG	
27	Naval Camp - boundary	9.015483	79.841733	372687	996766	106	
28	Naval Camp (building)	9.014491	79.841778	372692	996656	156	
29	Naval Camp (building)	9.013029	79.842520	372773	996494	138	
30	Vaadi	9.019702	79.833648	371800	997235	199	Between WT 7 and 8
31	Vaadi	9.019707	79.834037	371843	997235	156	
32	Vaadi	9.019837	79.833657	371801	997250	198	
33	Vaadi	9.019878	79.834052	371845	997254	154	
34	Vaadi	9.019945	79.833284	371760	997262	235	
35	Naval observation unit	9.020098	79.833253	371757	997279	217	
36	Vaadi	9.020117	79.833410	371774	997281	221	
37	Vaadi	9.020214	79.832789	371706	997292	196	
38	Sea cucumber hatchery and accomodation	9.020396	79.833619	371797	997312	203	
39	Vaadi	9.020416	79.833315	371764	997314	186	
40	Vaadi	9.020418	79.833087	371739	997314	178	
41	Vaadi	9.020485	79.833370	371770	997322	182	
42	Vaadi	9.020507	79.833385	371771	997324	180	
43	Fishermen’s rest room	9.020591	79.833349	371768	997333	170	
44	Tea kiosk	9.020612	79.833494	371783	997336	175	
45	Vaadi	9.020723	79.832240	371646	997348	148	
46	Vaadi	9.021023	79.832523	371677	997382	108	
47	Residential unit - Konniankuduiruppu	9.022980	79.844178	372959	997594	880	
48	Residential unit - Konniankuduiruppu	9.023097	79.843973	372936	997607	872	
49	Residential unit - Konniankuduiruppu	9.023187	79.843704	372907	997617	858	
50	Residential unit - Konniankuduiruppu	9.023984	79.842636	372790	997705	848	
51	Kalthota Finance Hotel (under construction) – boundary 8	9.023173	79.833850	371824	997619	183	Between WT 8 and 9
52	Kalthota Finance Hotel (under construction) – boundary 8	9.023713	79.832789	371707	997679	192	
53	Kalthota Finance Hotel (under construction) – boundary 8	9.024138	79.833734	371811	997726	265	
54	Kalthota Finance Hotel (under construction) – boundary 8	9.024480	79.833186	371751	997764	282	
55	Vaadi	9.024436	79.827631	371140	997761	192	Between WT 9 and 10
56	Vaadi	9.026435	79.825499	370907	997982	201	Between WT 10 and 11
57	Vaadi	9.026580	79.825329	370888	997999	223	
58	Vaadi	9.026659	79.825191	370873	998007	239	
59	Shell Coast Hotel - boundary	9.027873	79.824250	370770	998142	366	Between WT 10 and 11
60	Shell Coast Hotel - boundary	9.028142	79.823824	370723	998172	312	
61	Shell Coast Hotel - boundary	9.030251	79.825858	370947	998404	440	
62	Shell Coast Hotel - boundary	9.030533	79.825475	370905	998436	400	
63	Shell coast resort B	9.029868	79.825255	370881	998362	375	
64	Naval observation unit	9.031091	79.818791	370171	998500	116	WTG 12

#	Receiver ID	Latitude	Longitude	X	Y	Distance from WTG	
65	Vaadi	9.033376	79.815887	369853	998753	84	WTG 13
66	Naval observation unit	9.041663	79.802871	368425	999674	190	WTG 17
67	Olaiththoduvai	9.035289	79.841121	372627	998956	1,469	
68	Olaiththoduvai Church	9.033893	79.841213	372637	998802	1,487	
69	Olaiththoduvai School	9.035835	79.841329	372650	999016	1,493	
70	Residential unit - Uvary village and church	9.041623	79.831006	371517	999660	789	
71	Residential unit - Uvary village and church	9.041961	79.831501	371572	999697	847	
72	Residential unit - Uvary village and church	9.042238	79.831069	371525	999728	853	
73	Kalthota Finance Hotel (under construction) St. Jude Road – boundary	9.042641	79.807374	368920	999781	320	Behind WT 17
74	Kalthota Finance Hotel (under construction) St. Jude Road – boundary	9.042748	79.807477	368931	999793	331	
75	Kalthota Finance Hotel (under construction) St. Jude Road – boundary[a]	9.043275	79.805261	368688	999852	199	
76	Kalthota Finance Hotel (under construction) St. Jude Road – boundary[a]	9.043385	79.806479	368822	999864	286	
77	Kalthota Finance Hotel (under construction) St. Jude Road – boundary[a]	9.043871	79.805513	368716	999918	270	
78	Naval Camp - Nadukuda - boundary	9.050640	79.787194	366705	1000673	308	Between WT 22 and 23
79	Naval Camp - Nadukuda - boundary	9.050054	79.788119	366806	1000608	200	
80	Naval Camp - Nadukuda - boundary	9.050500	79.788417	366839	1000657	173	
81	Naval Camp - Nadukuda - boundary	9.051037	79.787584	366748	1000717	280	
82	Naval Camp - Nadukuda - boundary	9.050887	79.787494	366738	1000700	283	
83	Naval Camp - Nadukuda - boundary	9.050928	79.787378	366725	1000705	297	
84	Tea kiosk	9.050701	79.786816	366663	1000680	292	Between WT 22 and 23
85	Tea kiosk	9.050933	79.786980	366681	1000705	286	
86	Fishermen’s rest room	9.051021	79.787464	366735	1000715	291	
87	Church	9.051955	79.787616	366752	1000818	288	
88	Naval observation unit	9.053232	79.782245	366162	1000961	98	WTG 24
89	Nadukudda	9.059801	79.792260	367265	1001684	1,106	
90	N5 House, Naddukkuda	9.057222	79.796058	367682	1001397	1,023	
91	Residential unit - Nadukuda	9.056926	79.795957	367670	1001365	989	
92	Vaadi	9.060644	79.765815	364358	1001787	176	Between WT 30 and 31
93	Vaadi	9.060983	79.766127	364393	1001824	147	
94	Vaadi	9.061007	79.766001	364379	1001827	140	
95	Vaadi	9.061178	79.766078	364388	1001846	125	

#	Receiver ID	Latitude	Longitude	X	Y	Distance from WTG	
96	Naval observation unit	9.061296	79.765404	364314	1001859	107	
97	Vaadi	9.062276	79.761834	363921	1001969	173	Between WT 32 and 33
98	Vaadi	9.062531	79.761985	363938	1001997	141	
99	Vaadi	9.062546	79.762093	363950	1001999	132	
100	Vaadi	9.062601	79.762075	363948	1002005	129	
101	Vaadi	9.062656	79.761983	363938	1002011	133	
102	Vaadi	9.064384	79.757366	363431	1002204	341	Beyond WT 33
103	Vaadi	9.064428	79.757300	363424	1002209	348	
104	Vaadi	9.064544	79.757339	363428	1002221	345	
105	Vaadi	9.064548	79.757191	363412	1002222	361	
106	Residential unit - KeelaiyanKuduiruppu	9.065513	79.776344	365518	1002322	823	
107	Residential unit - KeelaiyanKuduiruppu	9.065571	79.776035	365484	1002328	814	
108	Residential unit - KeelaiyanKuduiruppu	9.065777	79.776355	365519	1002351	850	
109	Residential unit - KeelaiyanKuduiruppu	9.065848	79.775964	365476	1002359	839	
110	Navy Camp - Selvary	9.072829	79.769763	364797	1003133	1,255	
111	Vaadi	9.066393	79.754328	363098	1002427	712	Beyond WT 33
112	N4 Julian Dias, Pesale	9.075738	79.818914	370200	1003437	3,410	
113	N6 Bishop House	9.076119	79.750761	362710	1003504	1,685	
114	N7 Old pier (Navy camp) Thalimannar	9.075594	79.730867	360523	1003453	3,484	
115	N8 House Thalimannar	9.084757	79.726761	360075	1004468	4,340	

[a] These properties may be acquired by CEB

Note: All Vaadies will be used only for commercial and not residential purposes.

Health and Safety

402. Health and safety impacts will be in terms of risk of accidents caused due to electrocution, lightening, fires turbine toppling, and blade break. The impacts due to turbine toppling blade break have been assessed[65] based on IFC-WB EHS guidelines which would require displacing sensitive receptors to other places. The necessity and exact number of affected structures and people are to be known after finalization of engineering designs by EPC contractor, as the impacts depend on the number of turbines and their specification. Necessary training regarding safety aspects to the personnel working at the line will be provided by the contractor. Personal protective equipment such as safety belts, installation of safety nets for working at heights besides general safety items such as working gloves, helmet, mufflers etc. will be provided during construction period and during the maintenance work. First aid facilities will be made available at the worksite with trained nursing facilitywith doctors on call at designated hospitals at Mannar town when necessary. Workers are also covered by the statutory workmen compensation as per GoSL laws by the contractor.

403. Project activities may create accidental damage to public and the construction workers. Therefore, contractors should take necessary action to enhance personal safety during the construction through

[65] IFC-WB EHS Guidelines for wind energy include information relevant to environmental, health, and safety aspects of wind energy facilities

following measures:

- Organize awareness programs relevant to personal safety of the workers and public in the area.
- Provide protective safety belts, footwear, helmets, goggles, eye-shields, and clothes to workers depending on their duty.
- Construction work must be properly fenced off to prevent access to deep excavations etc.
- Arrangement of proper first aid unit and transport facilities to take injured people to the hospitals.

404. Safety measures for the workers will be provided following the procedures of the Department of Labor and the relevant provisions of the factories (Amendment) Law No.12 of 1976 and the IFC-WB EHS Guidelines (general and wind farm). Further the project will ensure to adopt internationally and nationally adopted safety regulations during the construction and operational phases of the project.

405. The following are the probable safety hazards that can cause harm to the people of the area, animals and the working staff. The possible causes and precautions are listed as follows:

a. Blade damages – keep sufficient gap as the safety buffer zone
b. Tower failures – keep sufficient gap as the safety buffer zone.
c. Generator fire – it is an isolated fire which will happen at a minimum height of about 80m, therefore chance of extensive damage is minimal. Firefighting equipment will be installed within the premises to extinguish any accidental fire that will be supervised and managed by the construction staff.
d. Electrocution – Safety buffer zone and warning signs and all electrical equipment must be enclosed and locked.
e. Fall hazards from height – Use fall protection measures for working people.

Socio-Economics

406. The project will create temporary employment opportunities for local communities during project construction and operation phase. Although most of the technical expertise required will be brought from outside skilled technical people in the area will have good opportunities being employed in the project and the capable people will be absorbed in to the operation staff after completion of the project. Manual labor work will be available for both men and women. Such employment opportunities will benefit the households who are dependent on seasonal and fluctuating incomes to enhance their household incomes and living standards. There will also be a limited number of employment opportunities available for local communities during the operation phase such as to work as security guards, sanitary workers, etc.

407. Sanitary facilities and other public requirements such as augmenting existing by roads in the vicinity of project site and construction of community center for the village community that fall under social corporate responsibility will be carried out by the project.

Turbine Topple During Construction

408. During construction, EPC Contractor shall ensure proper erection, i.e., avoiding turbine toppling during construction. Access to the site around wind turbines during construction will be strictly controlled and stringent health and safety measures during construction as well as operation period will be strictly enforced by CEB.

Loss of Property and Resettlement

409. The total land requirement for the wind project is estimated at 90.3 ha. Approximately, 15.71 km of new road sections would use the existing beach roads. Another 1.3 ha is required for the development of the access road for an additional length of about 2.12 km. Use of this road by the local communities will not be restricted. The land required for the installation of 39 wind turbines with permanent turbine foundations is 87.8 ha of the total land requirement. Another 1.2 ha is required for the establishment of the staff accommodation facilties.

410. The land identified for the project is free of encumbrances and has not been used for any residential dwellings or productive purposes except for the presence of 190 Palmyra trees and 226 cononut trees, produce of which is used by local communities for income generating activities. The project will not lead to any population displacements, relocation and resettlement. Neither the project creates any restrictions on the prospective expansions of the settlements nor would it encroach into the territories that would provide space for such future settlements. Any economic displacements caused due to the loss of incomes to the households who are dependent on the produce of the Palmyra trees. Those trees which may have to be removed for the turbine installation will be compensated by the project at replacement cost along with additional cash assistance for income restoration.

411. The land identified for project construction is largely private land except for the CCD declared 80 m wide corridor. CEB will follow two distinct approaches in securing the land required for the project. The first approach would be to obtain the land through negotiated settlement based on willing buyer-willing seller principle. Consultations conducted by CEB with the landowners/claimants in the past several months have shown that some landowners/claimants have expressed consent to sell their land to CEB. CEB will opt for direct purchase of such land from those willing sellers based on a negotiated settlement after verification and clearance of land ownership titles by CEB's legal department. The second approach would be to use the eminent domain to acquire the land under the Land Acquisition Act No. 9 of 1950. The land blocks for which the landowners'/claimants' have not given their consent as well as the land blocks for which the landowners/claimants have not been traced/identified will be secured through the acquisition process.

Impacts on the Local Communities in the Area

412. The land earmarked for acquisition or purchase is largely fallow land covered with scrubs, hardly used for any productive or residential purposes and free of encumbrances. The project impacts are primarily confined to temporary economic displacements for fishermen causing from the construction and operation of the pier and the intermittent disturbances during transportation of equipment to their respective destinations along the project site and the installation of wind turbines (WTs). The permanent economic impacts are on a small number of standing and commercial trees which will be either avoided in the final designs or compensated with cash. Further, considering environment, health and safety impacts due to noise and toppling, If the project will result in additional displacement, then compensation and assistance will be provided in accordance with the the resettlement plan. **Table 5.11** below shows the distance between the settlements and the nearest wind turbine.

Table 5.11: Distance between wind turbines and the settlements

Distance (km), sections from Thalaimannar	Name of the village	Name of the GND	Nearest wind turbine to the settlements[a]	Distance between settlements and wind turbine (km)
0-1	Thalaimannar Station	Thalaimannar	No.46	1.1
1-2	Kattukarankudiiruppu	Kattukarankudiiruppu	No.43	1.2
2-3	Swamy Thottam	Kattukarankudiiruppu	No. 39	1.7 (main road. No settlements)
3-4	Swamy Thottam	Kattukarankudiiruppu	No.36	1.7 (main road. No settlements)
4-5	Selvapuram/Sevari	Kattukarankudiiruppu	No.32 and 33	1.5
5-6	Keelankudiiruppu	Thollukudiiruppu	No.29	0.9
6-7	Nadukuda	Thollukudiiruppu	No.24 and 23	1.1
7-8	Nadukuda	Thollukudiiruppu	No.22	1.1
8-9	Nadukuda	Thollukudiiruppu	No.19	1.8
	Pesalai	Pesalai South	No.19	> 4.0
9-10	Pesalai	Pesalai South	No. 19 and 18	>4.0
10-11	Pesalai	Pesalai South	No.52	>4.0
11-12	Uvari	Olaithoduwai	No.47	0.9
	Olaithoduvai	Olaithoduwai	No.47	1.4
12-13	Olaithoduvai	Olaithoduwai	No.9	1.6
13-14	Konnayankudiiruppu	Thoddaveli	No. 6 and 7	0.8
14-15	Konnayankudiiruppu	Thoddaveli	No.4	1.2
	Thoddaveli	Thoddaveli	No.4	>3.0
15-16	Thoddaveli	Thoddaveli	No.1	2.5

[a] Refers to the numerical number assigned to each turbine in the preliminary design.
Source: Social Impact Assessment, March 2016.

413. The Table 5.11 above shows that, except in a few instances such as between 5th and 6th km (Keelankudiiruppu), 11th and 12th km (Uvari) and 13th and 14th km (Konnayankudiiruppu), where the distance between the settlements and the nearest turbine is less than 1 km, the rest of the wind turbines will be installed at a reasonable distance from the settlements. Thus, no adverse impacts are anticipated on the neighboring settlements.

414. Row 1 the of wind turbines will be installed 140 m inland from the southern coast while row 2 of the wind turbines will be 800 to 830 m towards north. The area demarcated for the turbines will only be fenced-off during construction. Further, considering environment, health and safety impacts due to noise and toppling, some fisher camps (Vaadies) near to WT but are outside of the project premises may need to be relocated. The impacts from noise and toppling are being assessed, and mitigations measures are being prepared. The necessity and exact number of affected structures and people are to be known after finalization of engineering designs by EPC contractor. If those Vaadies are required to be relocated, CEB will undertake the responsibility of engaging the affected fishermen in continuous consultation, carry out a full assessment of their impacts and losses, identify alternate locations for their resettlement with no or less livelihood impacts, pay cash compensation at replacement cost to reconstruct their Vaadies and extend any other resettlement assistance. During operations, the wind turbine area will not be fenced and there will be no restriction on access to fishing area. Therefore, the fishing communities can engage in their fishing activities without being interrupted by the turbines. The movements of vehicles along the coast such as the vehicles of the fish traders, tractors that are brought in to pull the *ma-dels*[66] and other vehicles that provide transport for the fishermen will not be blocked by the turbines. Communities can make use of the land for the same purpose for which they have been using the land prior to the project.

[66] Due to the scarcity of labor, *ma-del* owners use tractors to pull their *ma-dels* on to the shore.

415. Details for physical resettlement and rehabilitation involved in the project would be available in the Resettlement Plan for the project.

Loss of Palmyra

416. Palmyra trees are a vital part of the day to day life and the livelihood of people of Mannar. The community makes use of every part of the tree and sells many products made from the tree. These include handicrafts, toddy and honey. As stated earlier, the project requires cutting of nine Palmyra trees and 37 coconut trees resulting in loss of income to the dependents of the trees.

Availability of Employment

417. Projects of this nature generate many employment opportunities for skilled, semi-skilled and unskilled labor during construction and post construction period. Surveys conducted for this study revealed that availability of skilled and semi-skilled labor in Mannar is limited. However, unskilled labor is available. It was assumed for this analysis that the project will generate 150 employment opportunities (semi-skilled and unskilled) throughout the construction period for people of Mannar and ten employment opportunities after commissioning of the Wind Farm. It was also assumed that each of these employment opportunities will generate a monthly income of SLR25,000.

418. Regional infrastructure, such as access roads, are expected to be developed together with the Wind Farm for transportation of wind turbines and other project equipment. These developed infrastructures will have a positive impact on the regional economy due to improved access. Sectors such as tourism, fisheries and agriculture can be expected to grow. The actual growth in these sectors was not possible to be quantified as information on development plans for Mannar district is not available. This study assumes a net economic growth of $0.1 million in Mannar due to the project and a net annual growth of 15%, on real terms, up to end of project life, in comparison with the base case without the project.

Agriculture, Fishing and Grazing

419. Permanent and temporary loss of agricultural land occurs due to Wind turbine location in the agricultural field and loss of crop for access route, etc. The WF and its associated infrastructure facilities will be built on private land secured through the land acquisition process or direct purchase based on negotiated settlement. The total extent of land required for the project is 90.3 ha.

420. Instead, the planned rehabilitation and development work for the road that runs along the beach and other access roads under the proposed wind project will ease the movement of such vehicles and benefit the fishermen community at large. The project will not restrict communities’ access to and use of these developed roads. However, temporary disturbances and inconveniences to their livelihood activities will be experienced by the fishermen communities during project construction period. Access to grazing grounds of cattle and goats located within the project impact area will not be restricted by the project and it will not alter the existing land use patterns.

Physical Cultural Sites

421. Although, there are archaeological, historical, or cultural important sites in the Mannar Island and the mainland, none of them are present at the wind farm area. The proposed wind project will not adversely affect any national, social, economic and cultural heritage resources and values in the communities living within the project impact area. The project will not affect any of the three places of religious worship or any monuments of cultural or religious significance located within the project impact

area. The description of these sites is attached in section 4.

Traffic and Transport

422. During the construction phase, traffic disturbance needs to be minimized by through the Mannar town using proper traffic management by installations of signages, providing road marshalls during heavy equipment transportation for ensuring proper access roads and avoiding road blockage. However, most equipment will be transported by sea.

Navigation of Aircrafts

423. As the project area does not fall within an air traffic route, there will not be any adverse effects on aircraft navigation. The required approval has been obtained from the Civil Aviation Authority (CAA).

424. Sri Lankan CAA and military have no objection to the design as put forward in the EIA and that they do not require any anti-collision markings. They have specified only red beacon lights[67] with low-medium intensity and number of lights kept to a minimum. CAA has accorded its approval for heights of the wind turbine farm as well as instatllation or low intensity red beacons (**Annexure 8, item 5**). CEB has obtained the approval for installation of 40 WTGs of 160 m height from CAA. But we have paid the prescribed fee only for 29 locations which will be the minimum number of locations in case 3.5 MW machines are selected. Considering the actual number of machines as per the final design, the balance amount will be paid to CAA.

425. The Navy has been consulted regarding potential disturbances to their communications links, and appropriate precautions have been taken.

Interference with Television Signals

426. As per regulations enacted by GoSL, it is mandatory for CEB to seek clearance prior to construction from telecommunications and wherever necessary from aviation authorities that are likely to be affected by the construction of wind farm. The wind farm will affect nearby telecommunication circuits by causing electrical interference and induced voltage which may occur to nearby telecom circuit and suggested necessary protection measures will need to be adopted. This may require measures like rerouting of the telecom circuits, conversion of overhead telecom circuits into cables etc. to minimize the interference. The exact cost to mitigate the impacts of induction in neighboring telecom circuits would vary from case to case and would be surveyed and modeled by the EPC contractor. In general, the system is planned and executed in such a way that adequate clearance is maintained between Wind turbines, civil aviation and defense installations on the other. However, there is no airport in the area.

Temporary Outage of the Electricity

427. There will be no interruption of power and other utilities in the area. However, local population including any industrial places, which are located in project-affected area, which may face inconvenience for short periods; the following measures will have to be taken:

[67] Beacons are flashing warning lights on turbine nacelles are mostly for the benefit of aircraft flying at night which could be low intensity red color incandescent or LED-based units. (http://enr-ee.com /fr/manifestations/lecteur/conference-sur-les-impacts-des-parcs-eoliens-balisage-emissions-sonores-et-infrasons.html?file=files/ofaenr/02conferences/2017/170308_conference_impacts_des_parcs_eoliens/Presentations/09_ Clementine_Azam_CESCO_OFATE_DFBEW.pdf)

- Advance notice to the public about the time and the duration of the utility disruption, and
- Restore the utilities immediately to overcome public inconvenience.

5.4.7 Waste Disposal

428. The waste generated at site requires disposal measures and shall be dealt with as per the Waste Management and Handling guidelines in Sri Lanka. Improper disposal of waste can lead to contamination of soil and ground water, which could result in indirect impacts to humans, flora and fauna. The EPC contractor shall undertake the measures listed below to protect and enhance the quality of environment near the construction sites.

429. Construction waste will also consist of construction debris. Contractor should manage its construction wastes in accordance with the guidance given by the CCD. Contractor should handle and manage waste generated from the construction site without contamination to natural environment and it will reduce risk to public who stay close to sites, if any. The disposal of wastes from construction sites must be done regularly in a hygienic manner as per GoSL regulations. The main source of solid waste during the construction period is excavated soil from the cable trenches and Turbine footing foundations and foundations of the buildings. EPC contractor must ensure atleast 50%[68] of all excavated soil will be utilized for back-fill and earthen rampon road berms.

Recyclable Solid Waste Disposal

430. The solid waste generation will be at the location of the wind turbine erection site which will include metal scraps, wooden packing material packaging and crafting material of turbines, etc. Wooden waste and metal scrap will be collected and disposed of in compliance with applicable regulations and rules. Wastes will be disposed of through Environment Protection License (EPL) vendors who collect such wastes. EPC contractor must keep record of all waste generated and transfer notes to the EPL vendor.

Sanitary Waste Disposal at Construction Site

431. An Illustrative manpower requirement for wind power construction is shown below in **Table 5.12**. Mannar Pradeshiya Sabah maintains a solid waste disposal site at coordinates 8°59'24.91"N, 79°54'21.05"E in Sinnakadu Gram Niladhari division in Mannar Island. The project will use this site for solid waste disposal. No solid waste will be disposed of to an unlicensed solid waste disposal site.

Table 5.12: Illustrative manpower requirement for various stages of construction

Stage of Work	No. of People	Duration	Accommodation/Toilets
During the Survey, Supply of material and storage	One surveyor and 4 skilled labors and 4 unskilled labor	During first month	1st month 2 toilets two hired house/flat
During Foundation Construction and Access roads	**Excavation –** Two gangs each with Foreman, Excavator operator and 4 unskilled	From 1 to 8th month	2nd to 8th month 7 or 8 houses and 7 or 8 toilets by 4th month increased to 12 toilets 6th month increased to 18 toilets
	Re bar shuttering - 4 gangs - each with one Foremen and	During 2nd month to 10th month	8th to 15th month 10 or 15 houses with 18 or 20 toilets

[68] Given each foundation is 25 m x 25 m and 3 m deep and the 17 km roads are minmum 6 m wide and 1 m depth is excavated, the total spoil would be about 175,125 cu^m of which about 50% dumped outside.

Stage of Work	No. of People	Duration	Accommodation/Toilets
	6 skilled and 8 unskilled		
	Concreting - 4 gangs each with 4 skilled and 8 unskilled	During 4th month to 15th month	4nd to 15th month 10 or 15 houses with 18 or 20 toilets
During wind turbine erection	5 gangs each with one foremen and 5 skilled and 8 unskilled	During 6th month to 18th month	6nd to 18th month 10 or 15 houses with 18 or 20 toilets

432. Since no labor campsites will be set up during the construction phase of the project, waste water generation from the construction activities will be limited to washing and cleaning activities related to construction activities. At the wind farm, EPC contractor shall locate the temporary day-time facilities such as drinking water, toilet/sanitary facilities by constructing septic tanks for toilets and garbage collection which will be away from any water body. Portable toilet with septic tank soak pits will be provided at construction site to facilitate the disposal of sewage generated. No water well will be located within minimum 100 m of a toilet facility and vice versa.

433. Toilet facilities with septic tanks will be installed in the buildings. If the dwelling units are built during the construction period for the skilled labor force they will use this facility as it will be built at the beginning of the project. Once the septic tanks are filled with sewage/wastewater, a gully browser will be hired to empty the septic tanks. The collected wastewater will be transported to the nearest sewerage treatment plant located at mainland close to Thiruketiswaram. The treated wastewater should be discharged according to the SLS standards. Therefore, any impacts to the environment of study area could not be expected from the waste water.

434. The total requirement of manpower is not cumulative in nature as most of the activities take place intermittently and the workers tasks will overlap in above mentioned stages and therefore could be common for several activities mentioned above.

435. However, maximum number of persons required at any time by the entire project (both skilled and unskilled) is shown in Table 5.5. The unskilled labor from the area will be used and will be operating from their homes. The skilled and other technical persons would normally stay at a rented accommodation in a nearby town. In this case, Mannar town is the nearest and would use the EPC contractor’s vehicles for transportation. Usually in one rented accommodation about 8-10 persons can stay in 3-4 bedroom flat/house, about 4-5 accommodations will be rented by the EPC contractor. The rented accommodations have all amenities such as toilets, washing facilities as well as kitchen and meals facilities. Sufficient quantity of drinking water[69] available and toilet/sanitation[70] facilities will be provided by the EPC contractor of workers rented accommodations.

436. Since Mannar town is completely electrified and has LPG connections, no firewood, etc. will be used for cooking. Contractor should provide garbage bins at all workers’ accommodations. The local municipal body at Mannar collects waste in the town and disposes off in designated disposal areas.

Liquid Waste Disposal

437. However, minor wastes such as, waste oil, lubricant, cleaning fluids, paints, degreasers and other similar substances. No waste will be generated from operation of wind turbines whilst small quantities of

[69] 20 liters of water availability per day per person (3 litres drinking, 15 lpd per bathing, 10 lpd for cooking). Source: Basic water requirements for human activities: Meeting Basic Needs, by Peter H. Gleick, Pacific Institute for studies in Development, Oakland CA, USA.

[70] Approx 1.5 toilets for 12-14 persons as per Table 5.31.

waste oil/lubricant will be generated during maintenance works. The storage of these oils etc. will be at the Nadukuda center which needs to have a bunded area with impermeasble floor (110% capacity). The disposal of any type of waste oil will be carried out according to the Sri Lanka waste management regulations. Therefore, any impacts to the environment of study area could not be expected.

438. Specific areas will be allocated for controlled cleaning and maintenance of vehicles and all wastewater will be collected in soaking pits built to standards within the specific area. This will continue during the full operation period of the project.

Hazardous Waste Disposal

439. During the wind farm construction, generation of any hazardous waste generation is not expected. However, the EPC contractor will dispose of solid/hazardous waste (if generated at site) at a suitably licensed landfill by transporting the solid/hazardous outside of the project area in keeping with the good international practice. No hazardous waste will be disposed of to unlicensed hazardous waste disposal sites.

5.5 Environmental impacts associated with operational stage

5.5.1 Air Quality

440. During the operation phase, there will not be any smoke emissions and hence no adverse effect to air quality. The backup generator to maintain SCADA operations during power cuts will be sparingly used and would meet Sri Lankan AQ and noise standards.

5.5.2 Noise

441. Noise from the wind farm during operation is primarily from aerodynamic noise generated from the rotor movement through the air. There will also mechanical noise from wind turbine drive-train components (at the top of the tower), and electrical components such as transformers, located within the wind turbine or within an enclosed cabinet at ground level. There will be less noise generation from vehicle movements and machinery operation around the site for maintenance and repair purposes. However, since the receptors are situated close to the wind farm boundary, the noise monitoring at specified intervals would be required.

442. Some industrial noise including wind farm can be annoying and characterized by: tonality (humming, whining), modulation (regular variation in noise level or pitch) and impulsiveness (hammering, banging). In the case of noise generation from wind farm, the design of the wind turbines generally ensures that these characteristics are minimized or not present. In cases where they are present, these characteristics will generally become inaudible due to masking by other background noise at a distance where acceptable noise limits are satisfied.

443. Limits for the wind farm noise are defined in **Section 4.8.4**. The wind farm will be designed so that noise will be less than the defined fixed limits, or will result in a maximum increase in background levels of 3 dB at receptor locations.

Noise Assessment Study

444. A noise assessment study was conducted by Entura to determine the impacts of noise generation during the operation of the wind farm on the receptors in the project area (see **Appendix 5**). The compliance requirements of Sri Lanka, ADB and IFC-WB EHS Guidelines as well as the proposed noise

limits for the project are mentioned in Section 1.4 of the study. Receptor locations, noise model parameters, and predicted noise levels are mentioned therewith.

445. During the tender process, the wind turbine supplier will be required to propose a wind turbine model and wind farm layout (subset of 39 locations) that complies with the prescribed limits (and does not have a greater impact than predicted in this EIA if that is less than the prescribed limits) at relevant receptors. Any requirements for reduced noise output (and hence reduced power output) must be quantified, and a specific operational regime will be determined based on outputs of noise modelling.

446. For the purpose of this EIA, as an example of a nominal 100 MW wind farm design that complies with noise limits, a subset of 31 wind turbines for a 102.3 MW wind farm consisting of 3.3 MW wind turbines, has been designed, and noise output modeled:

- For this layout, WT 27 and WT 28 have been removed as requested by CEB.
- The following five locations have been removed due to their potential to generate relatively high noise levels at nearby receptors: WTs 4, 7, 8, 17, 22, 31.
- The remaining 31 locations are operating in noise modes ranging from the standard unconstrained 105.7 dB version,[71] to the noise constrained 101.0 dB version of the 3.3 MW. Further details on the concept of noise constrained operation are provided in **Section 9.3**.
- Due to ongoing land acquisition and micro-siting, there are likely to be changes to these wind turbine locations. The impact of such changes may require an update of the noise assessment.

447. The noise output at the 115 identified receptors that results from this wind farm design is presented in **Appendix 5**. This wind farm design has been demonstrated to be fully compliant with the noise limits as discussed in this document. Wind turbine locations are shown in **Figure 5.8.**

[71] ADB and CEB have agreed to place no limit on the individual wind turbine sound power level, but bidders should meet the noise limit at each of the receivers defined as the existing background noise level + 3 dB, or the base limit for each receiver type, whichever is the greater.

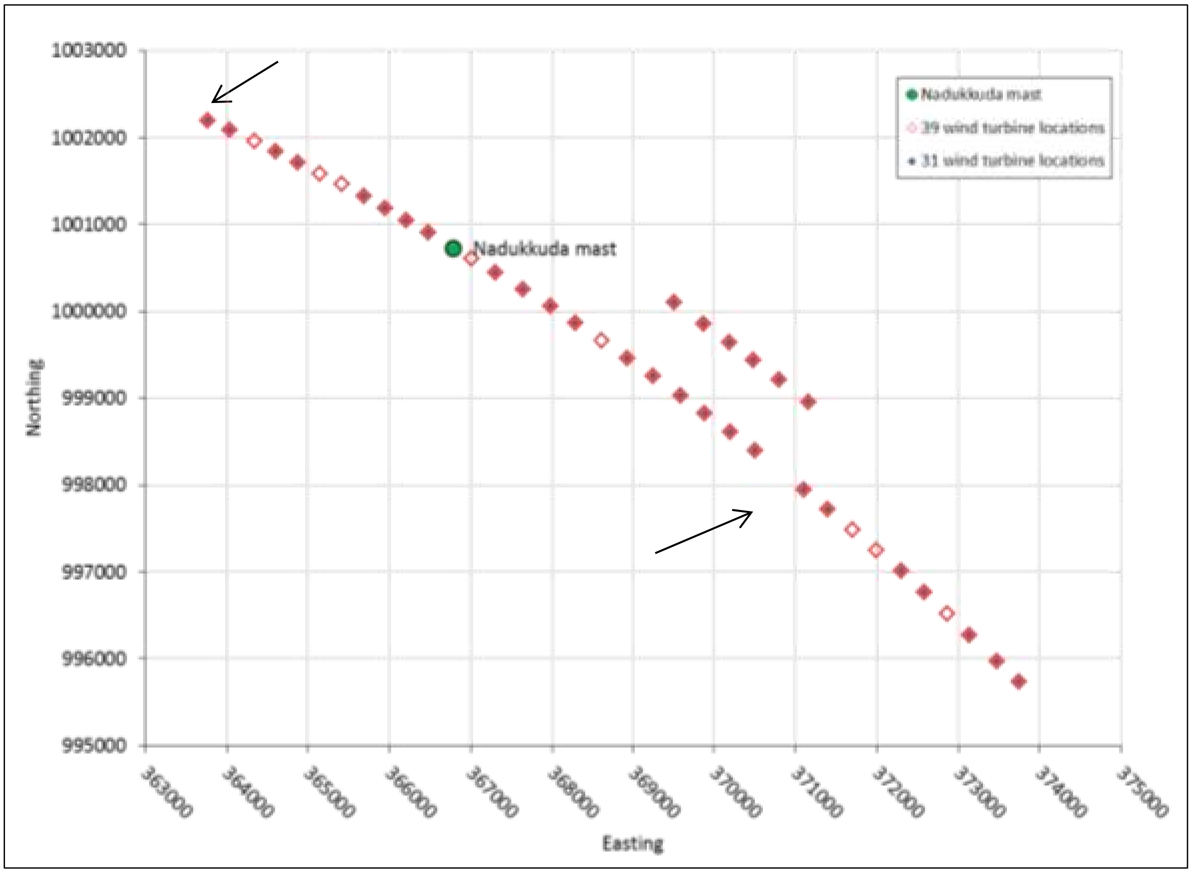


Figure 5.8 Wind Turbine Layouts

Source: Noise Assessment Study, Appendix 5

Note: Scenario C assumes such relocation of migrant labourers is achievable, and therefore location WT31 is used instead of WT5.

448. A comparison of measured background noise (over a 48-hour period, both during the low and high wind season) with modeled maximum noise level at selected receptors is shown in **Table 5.13** for Scenario C. It is noted that these measurements have been undertaken with limited quality control, so the uncertainty in results cannot be ascertained. **Table 5.14** shows day-night data.

Table 5.13: Modeled wind farm noise in comparison to background noise for Low Wind Season

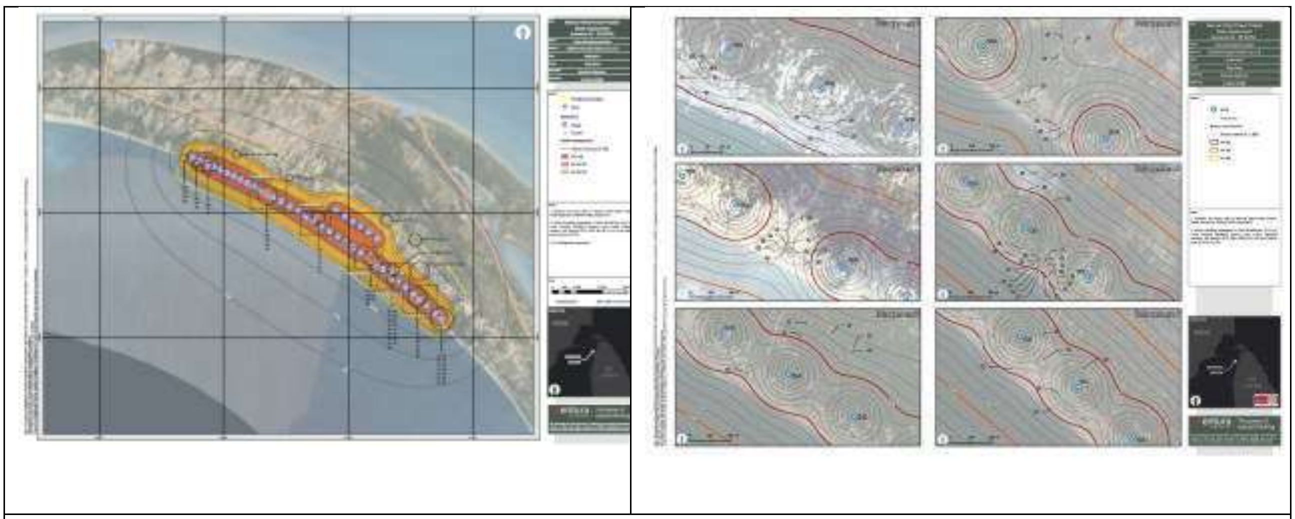
Noise monitoring location	Measured background noise (l_{a90})			Modelled wind farm noise (dB) Scenario C	Potential receptor sensitivity[a]
	minimum	average	maximum		
Sea cucumber drying compound near WT1	43.1	48.8	55.1	49.7	Medium (sleeping)
Kalutota Cabanas between WT7 and 8[b]	41.5	46.7	55.8	41.0 (night) – 46.3 (day)	High (sleeping/recreation)
Fishing camp near WT7 and 8	39.1	46.1	54.8	41.1 (night) – 43.4 (day)	Medium (sleeping)
Shell Coast Resort between WT10 and 11	32.5	42.2	49.7	43.9 (night) – 48.0 (day)	High (sleeping/recreation)

Noise monitoring location	Measured background noise (l_{a90})			Modelled wind farm noise (dB) Scenario C	Potential receptor sensitivity[a]
	minimum	average	maximum		
Kalutota Cabanas between WT17 and 18[b]	35.9	41.7	51.7	43.9 (night) – 47.7 (day)	High (sleeping/recreation)
Fishing camp near WT30 and 31	42.9	49.4	59.1	53.8	Medium (sleeping)

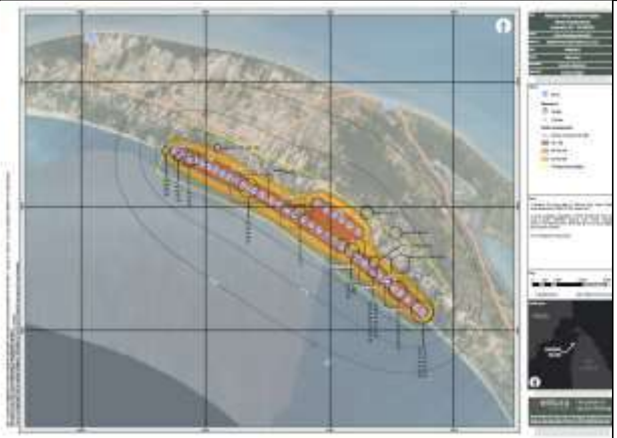
[a] Limits were usually set at either the fixed limits, or if background is higher, background +3dB (in this case).
[b] These properties may be acquired by CEB

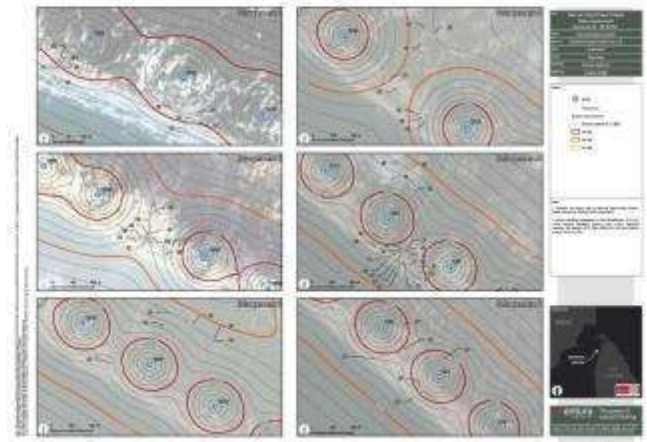
449. Caution is required when comparing short duration background noise measurements (and with no knowledge of concurrent wind speeds as SLSEA's mast was out of action during the period), with modeled wind farm noise. That said, for measurements that were logged during the low wind seasons (and therefore likely predominantly low wind speeds), the measured average background noise levels are relatively high. For high wind seasons (NE monsoon), the measured average background noise levels also remained relatively high.

450. **Figure 5.9** shows different scenarios considered for noise modelling. **Scenarios A1, A2 and A3** outline the potential noise impact of all 39 wind turbine locations for a range of wind turbine noise power curves. **Scenarios B and C** have been developed as better scenarios that illustrate a wind turbine layout of 31 x 3.3 MW wind turbines that is compliant with specified noise limits, through use of operational constraints on wind turbine noise output settings, which can be varied based on time of day and season (and potentially wind speed and direction). **Scenario C** assumes migrant labourers residing near WT31 can be relocated and thus, fewer wind turbines operate in a noise constrained mode.

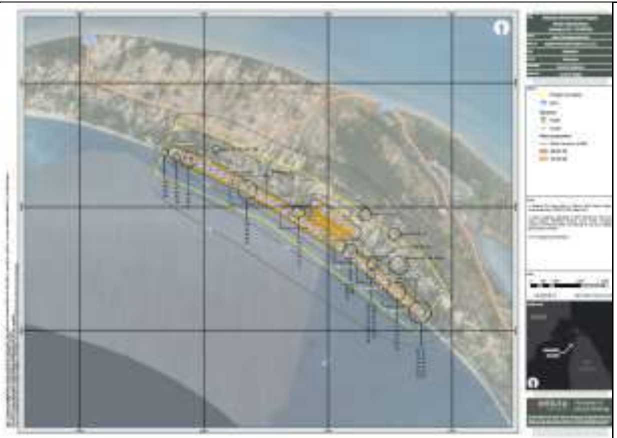


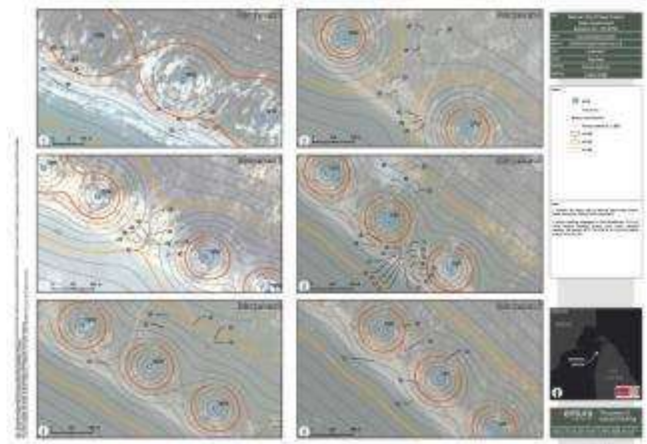
Scenario A1 with 39 Wind Turbines



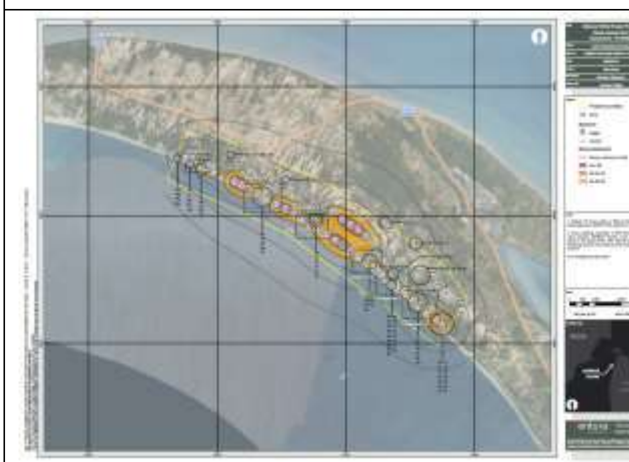


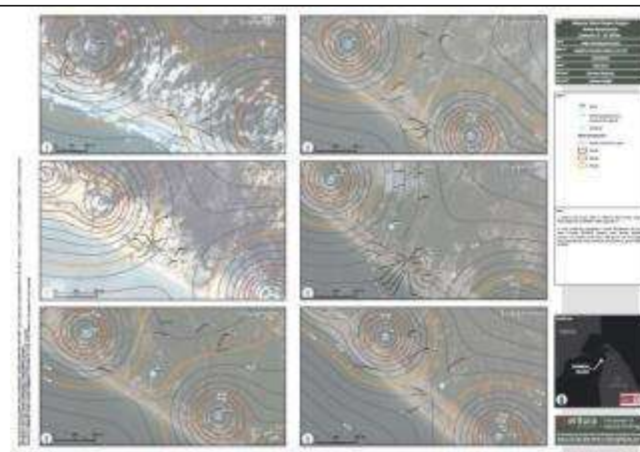
Scenario A2 with 39 Wind Turbines



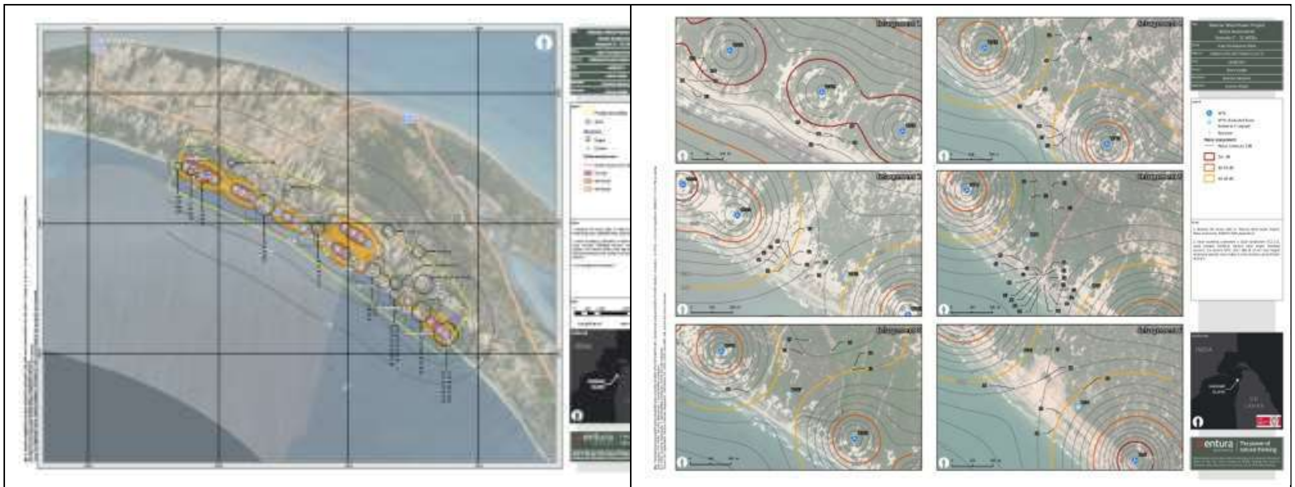


Scenario A3 with 39 Wind Turbines





Scenario B with 31 wind turbines



Scenario C

Figure 5.9: Noise modelling scenarios

451. **Table 5.14** shows fixed noise limits at receivers for the case where ambient background noise does not already exceed the limit for the two seasons (low wind and high wind). It is noted that noise limits at certain receivers depends on action still to be undertaken by CEB. All Navy quarters in the receptor list are now categorised as institutional based on agreement with Navy. This is due to the fact that CEB has a verbal confirmation to relocate all sleeping quarters to the places where there is no impact on the Wind Farm layout. Similarly, the Kalthota Cabanas will be exempt from the list as well, as CEB has agreed to acquire the sites.

452. To address noise issues at locations used for sleeping purposes, CEB will consider the land acquisition option for Kaluthota Cabanas to avoid potential noise impacts from the wind farm and has initiated consultation with the owner of the Cabanas. CEB is also closely coordinating with the concerned Naval Authority regarding the sleeping quarters of Navy at the naval outposts. According to the letters attached from CEB (**Annexure 11)**, CEB will initiate the land acquisition option to avoid/mitigate noise impacts toward the cabanas, and this will be fully informed and discussed with the affected owners. To ensure full awareness to concerned parties involved, one-on-one consultation by CEB will continue, if necessary and applicable, subject to environmental impacts once the wind design is finalised.

Table 5.14: Fixed noise limits based on EHS guidelines, before consideration of background noise

Location description	ID #	Receiver Name	Coordinates (WGS84)		Fixed Noise limits (dB)			
					1 May - 30 Sep		1 Oct - 30 Apr	
			Latitude	Longitude	Day (0600-1800)	Night (1800-0600)	Day (0600-1800)	Night (1800-0600)
	1	Thalvupadu	8.995617	79.861650	50	45	50	45
	2	Thottavelly-Thalvupadu Rd	9.011612	79.858007	50	45	50	45
	3	N1 Thoddaveli Water Board Office	9.014202	79.859228	70	60	70	60
	4	N2 Mr Mariyadas	9.024288	79.844358	50	45	50	45
	5	Konniankuduiruppu village and church	9.023800	79.848032	50	45	50	45
	6	Konniankuduiruppu	9.015470	79.856766	50	45	50	45
	7	Konniankuduiruppu	9.018550	79.852700	50	45	50	45
	8	Konniankuduiruppu	9.021108	79.849508	50	45	50	45
	9	Konniankuduiruppu	9.022909	79.844180	50	45	50	45
South of WT 1	10	Naval observation unit	9.003662	79.852370	55	55	55	55

Location description	ID #	Receiver Name	Coordinates (WGS84)		Fixed Noise limits (dB)			
					1 May - 30 Sep		1 Oct - 30 Apr	
			Latitude	Longitude	Day (0600-1800)	Night (1800-0600)	Day (0600-1800)	Night (1800-0600)
South of WT 1	11	Vaadi	9.004369	79.851967	70	60	-	-
	12	Vaadi	9.004580	79.852150	70	60	-	-
	13	Vaadi	9.004647	79.852044	70	60	-	-
	14	Vaadi	9.004732	79.852104	70	60	-	-
	15	Vaadi	9.004739	79.852227	70	60	-	-
	16	Vaadi	9.004757	79.851888	70	60	-	-
	17	Vaadi	9.004771	79.852024	70	60	-	-
	18	Vaadi	9.004778	79.851972	70	60	-	-
Between WT 1 and 2	19	Industrial unit (fish meal manufacturing company) boundary	9.007316	79.849115	-	-	-	-
	20	Industrial unit (fish meal manufacturing company) boundary	9.008699	79.850409	-	-	-	-
	21	Industrial unit (fish meal manufacturing company) boundary	9.008171	79.851268	-	-	-	-
	22	Industrial unit (fish meal manufacturing company) boundary	9.005842	79.850624	-	-	-	-
	23	Industrial unit (fish meal manufacturing company) estimated location	9.006921	79.849771	70	60	70	60
Between WT 4 and 5	24	Naval Camp - boundary	9.012398	79.842235	-	-	-	-
	25	Naval Camp - boundary	9.014013	79.843493	-	-	-	-
	26	Naval Camp - boundary	9.014064	79.840490	-	-	-	-
	27	Naval Camp - boundary	9.015483	79.841733	-	-	-	-
	28	Naval Camp (building)	9.014491	79.841778	55	55[1]	55	55[1]
	29	Naval Camp (building)	9.013029	79.842520	55	55[1]	55	55[1]
Between WT 7 and 8	30	Vaadi	9.019702	79.833648	70	60	-	-
	31	Vaadi	9.019707	79.834037	70	60	-	-
	32	Vaadi	9.019837	79.833657	70	60	-	-
	33	Vaadi	9.019878	79.834052	70	60	-	-
	34	Vaadi	9.019945	79.833284	70	60	-	-
	35	Naval observation unit	9.020098	79.833253	55	55	55	55
	36	Vaadi	9.020117	79.833410	70	60	-	-
	37	Vaadi	9.020214	79.832789	70	60	-	-
	38	Sea cucumber hatchery and accomodation	9.020396	79.833619	70	60	70	60
	39	Vaadi	9.020416	79.833315	70	60	-	-
	40	Vaadi	9.020418	79.833087	70	60	-	-
	41	Vaadi	9.020485	79.833370	70	60	-	-
	42	Vaadi	9.020507	79.833385	70	60	-	-
	43	Fishermen's rest room	9.020591	79.833349	70	60[1]	-	-
	44	Tea kiosk	9.020612	79.833494	70	60	-	-
	45	Vaadi	9.020723	79.832240	70	60	-	-
	46	Vaadi	9.021023	79.832523	70	60	-	-
	47	Residential unit - Konniankuduiruppu	9.022980	79.844178	50	45	50	45
	48	Residential unit - Konniankuduiruppu	9.023097	79.843973	50	45	50	45

Location description	ID #	Receiver Name	Coordinates (WGS84)		Fixed Noise limits (dB)			
					1 May - 30 Sep		1 Oct - 30 Apr	
			Latitude	Longitude	Day (0600-1800)	Night (1800-0600)	Day (0600-1800)	Night (1800-0600)
	49	Residential unit - Konniankuduiruppu	9.023187	79.843704	50	45	50	45
	50	Residential unit - Konniankuduiruppu	9.023984	79.842636	50	45	50	45
Between WT 8 and 9	51	Kalthota Finance Hotel (under construction) - boundary	9.023173	79.833850	50	45	50	45
	52	Kalthota Finance Hotel (under construction) - boundary	9.023713	79.832789	50	45	50	45
	53	Kalthota Finance Hotel (under construction) - boundary	9.024138	79.833734	50	45	50	45
	54	Kalthota Finance Hotel (under construction) - boundary	9.024480	79.833186	50	45	50	45
Between WT 9 and 10	55	Vaadi	9.024436	79.827631	70	60	-	-
Between WT 10 and 11	56	Vaadi	9.026435	79.825499	70	60	-	-
	57	Vaadi	9.026580	79.825329	70	60	-	-
	58	Vaadi	9.026659	79.825191	70	60	-	-
Between WT 10 and 11	59	Shell Coast Resort - boundary	9.027873	79.824250	50	45	-	-
	60	Shell Coast Resort - boundary	9.028142	79.823824	50	45	-	-
	61	Shell Coast Resort- boundary	9.030251	79.825858	50	45	-	-
	62	Shell Coast Resort - boundary	9.030533	79.825475	50	45	-	-
	63	Shell Coast Resort B	9.029868	79.825255	50	45	50	45
WT 12	64	Naval observation unit	9.031091	79.818791	55	55	55	55
WT 13	65	Vaadi	9.033376	79.815887	70	60	-	-
WT 17	66	Naval observation unit	9.041663	79.802871	55	55	55	55
	67	Olaiththoduvai	9.035289	79.841121	50	45	50	45
	68	Olaiththoduvai Church	9.033893	79.841213	55	55	55	55
	69	Olaiththoduvai School	9.035835	79.841329	50	45	50	45
	70	Residential unit - Uvary village and church	9.041623	79.831006	50	45	50	45
	71	Residential unit - Uvary village and church	9.041961	79.831501	50	45	50	45
	72	Residential unit - Uvary village and church	9.042238	79.831069	50	45	50	45
Behind WT 17	73	Kalthota Finance Hotel (under construction) St Jude Road - boundary	9.042641	79.807374	50	45	50	45
	74	Kalthota Finance Hotel (under construction) St Jude Road - boundary	9.042748	79.807477	50	45	50	45
	75	Kalthota Finance Hotel (under construction) St Jude Road - boundary	9.043275	79.805261	50	45	50	45
	76	Kalthota Finance Hotel (under construction) St Jude Road - boundary	9.043385	79.806479	50	45	50	45
	77	Kalthota Finance Hotel (under construction) St Jude Road - boundary	9.043871	79.805513	50	45	50	45

Location description	ID #	Receiver Name	Coordinates (WGS84)		Fixed Noise limits (dB)			
					1 May - 30 Sep		1 Oct - 30 Apr	
			Latitude	Longitude	Day (0600-1800)	Night (1800-0600)	Day (0600-1800)	Night (1800-0600)
Between WT 22 and 23	78	Naval Camp - Nadukuda - boundary	9.050640	79.787194	55	55[1]	55	55[1]
	79	Naval Camp - Nadukuda - boundary	9.050054	79.788119	55	55[1]	55	55[1]
	80	Naval Camp - Nadukuda - boundary	9.050500	79.788417	55	55[1]	55	55[1]
	81	Naval Camp - Nadukuda - boundary	9.051037	79.787584	55	55[1]	55	55[1]
	82	Naval Camp - Nadukuda - boundary	9.050887	79.787494	55	55[1]	55	55[1]
	83	Naval Camp - Nadukuda - boundary	9.050928	79.787378	55	55[1]	55	55[1]
Between WT 22 and 23	84	Tea kiosk	9.050701	79.786816	70	60	-	-
	85	Tea kiosk	9.050933	79.786980	70	60	-	-
	86	Fishermen’s rest room	9.051021	79.787464	70	60	-	-
	87	Church	9.051955	79.787616	55	55	55	55
WT 24	88	Naval observation unit	9.053232	79.782245	55	55	55	55
	89	Nadukudda	9.059801	79.792260	50	45	50	45
	90	N5 House, Naddukkuda	9.057222	79.796058	50	45	50	45
	91	Residential unit - Nadukuda	9.056926	79.795957	50	45	50	45
Between WT 30 and 31	92	Vaadi	9.060644	79.765815	70	60	-	-
	93	Vaadi	9.060983	79.766127	70	60[1]	-	-
	94	Vaadi	9.061007	79.766001	70	60[1]	-	-
	95	Vaadi	9.061178	79.766078	70	60[1]	-	-
	96	Naval observation unit	9.061296	79.765404	55	55	54	54
Between WT 32 and 33	97	Vaadi	9.062276	79.761834	70	60	-	-
	98	Vaadi	9.062531	79.761985	70	60	-	-
	99	Vaadi	9.062546	79.762093	70	60	-	-
	100	Vaadi	9.062601	79.762075	70	60	-	-
	101	Vaadi	9.062656	79.761983	70	60	-	-
Beyond WT 33	102	Vaadi	9.064384	79.757366	70	60	-	-
	103	Vaadi	9.064428	79.757300	70	60	-	-
	104	Vaadi	9.064544	79.757339	70	60	-	-
	105	Vaadi	9.064548	79.757191	70	60	-	-
	106	Residential unit - KeelaiyanKuduiruppu	9.065513	79.776344	50	45	50	45
	107	Residential unit - KeelaiyanKuduiruppu	9.065571	79.776035	50	45	50	45
	108	Residential unit - KeelaiyanKuduiruppu	9.065777	79.776355	50	45	50	45
	109	Residential unit - KeelaiyanKuduiruppu	9.065848	79.775964	50	45	50	45
	110	Navy Camp - Selvary	9.072829	79.769763	55	45	55	45
Beyond WT 33	111	Vaadi	9.066393	79.754328	70	60	-	-
	112	N4 Julian Dias, Pesale	9.075738	79.818914	50	45	50	45
	113	N6 Bishop House	9.076119	79.750761	50	45	50	45

Location description	ID #	Receiver Name	Coordinates (WGS84)		Fixed Noise limits (dB)			
					1 May - 30 Sep		1 Oct - 30 Apr	
			Latitude	Longitude	Day (0600-1800)	Night (1800-0600)	Day (0600-1800)	Night (1800-0600)
	114	N7 Old peir (Navy camp)Thalimannar	9.075594	79.730867	50	45	50	45
	115	N8 Housae Thalimannar	9.084757	79.726761	50	45	50	45

Notes: 1 scenario includes relocated sleeping quarters at naval camps and Vaadi.

Background Noise Measurements Report

453. High quality measurement for a duration of 2-3 weeks were obtained in June 2017 at the same six locations listed in **Table 5.13**, and are reported separately in **Appendix 5a** (Background Noise Measurements Report by Resonate Accoustics). The background noise measurements have been conducted in general accordance with the requirements of the UK Institute of Acoustics guidance document A Good Practice Guide to the Application of ETSU-R-07 for the Assessment and Rating of Wind Turbine Noise. The study presents the results of pre-construction background noise monitoring conducted at six representative noise-sensitive receiver locations around the site and establishes applicable operational noise limits for the project to achieve the ADB requirements, during the SW monsoon season. This report presents the results of approximately three weeks of background noise measurements at receivers in the vicinity of the proposed wind farm.

454. Wind farm noise requirements based on these most recent measurements are a combination of fixed limits at lower wind speeds as defined in this report,[72] and variable, generally increasing noise allowance at higher wind speeds as background noise increases. The study depicted the fixed limit do not change, but this monitoring allowed noise levesl to be correlated to wind speed and showed that at higher wind speed only can use background + <3dBA LAeq instead because the fixed limits are already exceeded by background.

455. CEB would request bidders to comprehensively demonstrate through noise modelling that their wind turbine model, noise control mode regime and proposed layout complies with the noise limits specified in the **Appendix 5a** for corresponding receptors and wind speeds. (Note: Noise limits specified represent the maximum allowable wind farm generated noise output and not a summation of wind farm and background noise). Bidders can choose suitable wind turbine model having one or more noise modes to achieve optimum AEP from the proposed wind farm subjected to the noise limits. This **Appendix 5a** data (listed in **Appendix F—Turbine noise limits for 81.5m AGL wind speed)**[73] will be updated after further background measurements during the NE monsoon season, and wind farm operational will need to comply with year-round limits.

Annual Energy Production

456. Entura has modelled the impact on energy output of the constrained operation that generates the maximum noise levels (see **Table 5.15**).

[72] However, for the purposes of this report, comparison is made against the fixed limits until such time the full complement of background noise measurements is available including during the north-east wind season and the wind turbine model selected for the project is known.

[73] Currently includes the cabana noise limits. CEB has confirmed that initiation process to acquire them.

Table 5.15: Annual energy loss as a percentage of annual energy output for Scenarios B and C (from draft energy report)

Scenario	May to September		October to April		Total
	Day	Night	Day	Night	
B	0.3%	6.4%	0.1%	1.7%	**7.8%**
C	0.1%	3.2%	0.0%	1.0%	**4.4%**[74]

5.5.3 Shadow Flicker Modelling

457. The rotating blades of wind turbines can cast intermittent shadows to a person located in the shadow of the wind turbine, termed as "shadow flicker." Because wind turbines are tall structures, shadow flicker can be observed at considerable distances but usually only for a brief time at any given location. In some circumstances, for some people, shadow flicker may cause annoyance, however it is not generally associated with adverse health impacts.

458. Sri Lanka does not have any specific guidelines for wind farm shadow flicker. The IFC-WB EHS Guidelines for Wind Energy refers to international sources of good practice, and ADB has confirmed the German guidelines for shadow flicker will be applied to this project. These guidelines include limits:

- 30 hr/yr and 30 min/day modelled shadow flicker at 'receptors'
- 8 hr/yr actual shadow flicker in a realistic scenario considering meteorological parameters

459. A primary concern of planning authorities has been whether wind turbine shadow flicker can lead to photosensitive epileptic seizures in individuals. There is little or no evidence of any such incidents ever occurring. Modern large wind turbines rotate more slowly than previous generations of wind turbines, and produce shadow flicker at a frequency of between 0.3 to 1.0 Hz. As such, the rotational frequency of wind turbine shadow flicker is much lower than the flickering light conditions that are associated with photosensitive epileptic seizures in an extremely small percentage of the population. As such, and based on their own surveys, organisations such as the UK epilepsy society have concluded the risk is minimal.

460. The extent to which shadow flicker is a nuisance to individuals is more difficult to gauge. However, for the short durations mandated by the guidelines below, the nuisance impact of shadow flicker is minimal. Further, in the Sri Lankan context it is possible that shadow flicker will be of little concern to people working in close proximity to the wind farm, such as at fisher camps, naval outposts and camps, and factories. The impact on amenity is perhaps more critical for patrons of the Shell Coast Resort.

461. The full results of the shadow flicker modelling by Entura are presented in **Appendix 6**. The modelling and the distribution of shadow flicker annual totals are shown across the site in the attached maps of the appendix. Note that unless otherwise stated, observations below refer to the worst-cast scenario where all 39 locations are used to develop the 100 MW project, and prior to any mitigation measures. The key observations from the results:

- Shadow flicker hours at the Shell Coast Resort are up to 164 hours (or less depending on the exact location modelled).
- Shadow flicker hours at the Kaluthota Investment Cabanas and St. Jude Rd., Kaluthota Investment Cabanas[75] are between 77 and 267 hours, depending on the exact location considered. However, the two cabanas may be acquired by CEB which would negate their

[74] Includes shutdown.
[75] These properties may be acquired by CEB.

status as receptors.

- The majority of Vaadi and naval outposts and camps, the fish meal and sea cucumber factories, and other assorted structures located along the coast and between wind turbine locations are calculated to receive shadow flicker well in excess of 30 hours.
- Where shadow flicker hours exceed 30 hours per year, there are a large number of days (typically > 100) where the 30 minutes per day limit is exceeded.
- Other sensitive locations surrounding the wind farm are have less than 30 hours of shadow flicker per year and less than 30 minutes per day.

462. Modelling a 31 x 3.3 MW wind farm layout (Scenario B) as a typical design that would fulfill the 100 MW requirement, significantly mitigates shadow flicker at some specific receptors located adjacent to the ‘removed’ wind turbine locations (WTs 4, 7, 8, 17, 22, 27, 28, 31). **Table 5.16** provides a consolidated modelling for wind farm noise in comparison to background noise and its correlation for shadow flicker hours (at single receptor). Note however that under the scenario where naval sleeping quarters are relocated and cabanas not considered, the following wind turbine locations are significantly less impacted by noise and shadow flicker: WTs 3, 4, 5, 6, 7, 8, 9, 15, 16, 17, 18, 19, 21, 22, 23, and 24.

Table 5.16: Modelled wind farm noise in comparison to background noise

WT	Nearest structure (m)	No. structures within 225 (m)	No. of structures within 500 (m)	Noise operational mode for the 31 WT layout	Shadow flicker hours (max at a single receptor)	Distance to the water channels from the turbine (m)	Edemics, palmyra, coconut
1	90	11	14	Unconstrained	617		
2	115	3	5	Unconstrained	481		
3	440	0	3	Heavily constrained at night	133		
4	124	3	6	Very heavily constrained night and day[a]	667		
5	106	3	6	Very heavily constrained night and day	833		
6	467	0	2	Heavily constrained at night	84	60	
7	154	5	18	Very heavily constrained night and day[a]	535		
8	108	14	21	Very heavily constrained night and day[a]	117	85	
9	262	0	7	Heavily constrained at night	204		
10	192	3	8	Heavily constrained at night	325		
11	312	0	6	Heavily constrained at night	163		
12	116	1	2	Heavily constrained at night	153	120	
13	84	1	2	Slightly constrained at night and day	78		
14	386	0	1	Unconstrained	0		
15	617	0	0	Heavily constrained at night	19		
16	320	0	4	Heavily constrained at night	85	105	
17	190	2	6	Very heavily constrained night and day[a]	351	110	
18	238	0	3	Heavily constrained at night	89		
19	588	0	0	Heavily constrained at night	36	25	
20	907	0	0	Unconstrained	35		

WT	Nearest structure (m)	No. structures within 225 (m)	No. of structures within 500 (m)	Noise operational mode for the 31 WT layout	Shadow flicker hours (max at a single receptor)	Distance to the water channels from the turbine (m)	Edemics, palmyra, coconut
21	516	0	0	Moderately constrained at night	87	140	
22	173	2	10	Very heavily constrained night and day[a]	451	25	
23	286	0	11	Heavily constrained at night	217	55	
24	98	1	1	Moderately constrained day and night	80		
25	304	0	1	Unconstrained	23		
26	600	0	0	Unconstrained	7	35	
27	865	0	0	Not used	18		
28	788	0	0	Not used	35	100	
29	493	0	1	Heavily constrained at night	72	155	
30	213	2	5	Very heavily constrained night and day	345		
31	107	5	10	Very heavily constrained night and day[a]	91		
32	129	5	10	Heavily constrained at night	235	62	
33	249	0	9	Heavily constrained at night	119		
34	580	0	0	Heavily constrained at night	10		
35	787	0	0	Moderately constrained at night	3		
36	928	0	0	Unconstrained	14		
37	939	0	0	Unconstrained	9		
38	908	0	0	Slightly constrained at night	16		
39	648	0	0	Heavily constrained at night	62		

[a] Not considered in the example layout of 31 wind turbines

463. Shadow flicker will be mitigated by turning off wind turbines during periods of time when there is potential for shadow flicker at receptors (typically around sunrise and sunset). Shadow flicker can be completely mitigated with an estimated energy loss equivalent to approximately 1.5% of the annual energy output of the wind farm for a 39-wind turbine layout, or 1.0% for the example 31 wind turbine layouts. This is discussed further in **Section 9.3**.

5.5.4 Visual Impact Study

464. The landscape and visual impact assessment study by Entura for the 100 MW Mannar Wind Power Project evaluates the existing landscape character in order to understand the degree of visual change likely to occur with the development of the Mannar Wind Farm. In this assessment 39 wind turbine locations were analyzed. The report has been prepared to meet the requirements of the IFC-WB EHS Guidelines for Wind Energy, which has been adopted by the Asian Development Bank as the appropriate guidelines for assessing the Mannar Wind Power Project. Nine viewpoints were selected for assessment. Viewpoints were selected to assess the visual impact on population centers (e.g., towns), regularly used places (e.g., beach) and sites of economic, cultural or natural significance. Photomontages were produced for all viewpoints. The photographs and wireframes are attached in **Appendix 7.** The visual impact would be considerable at Shell Coast Resort (the other cabanas are now exempt) as well as

tourism in the area for which photomontages and wire frames were developed showing the row of wind turbines along the beach with the resort and fishing locations. Given the current noise limits, it is likely that wind turbines will not be placed immediately adjacent to the Shell Coast Resort, which would also lead to reduction of the visual impact due to wind turbines.

465. It is recommended that a uniform size and design of wind turbines is maintained across the wind farm, and it is understood this is requirement of the wind farm technical specifications. **Figure 5.10-5.11** depicts an illustrative image of the location after wind turbine installation as well as the **Figure 5.12** shows two photomontages for two viewpoints.

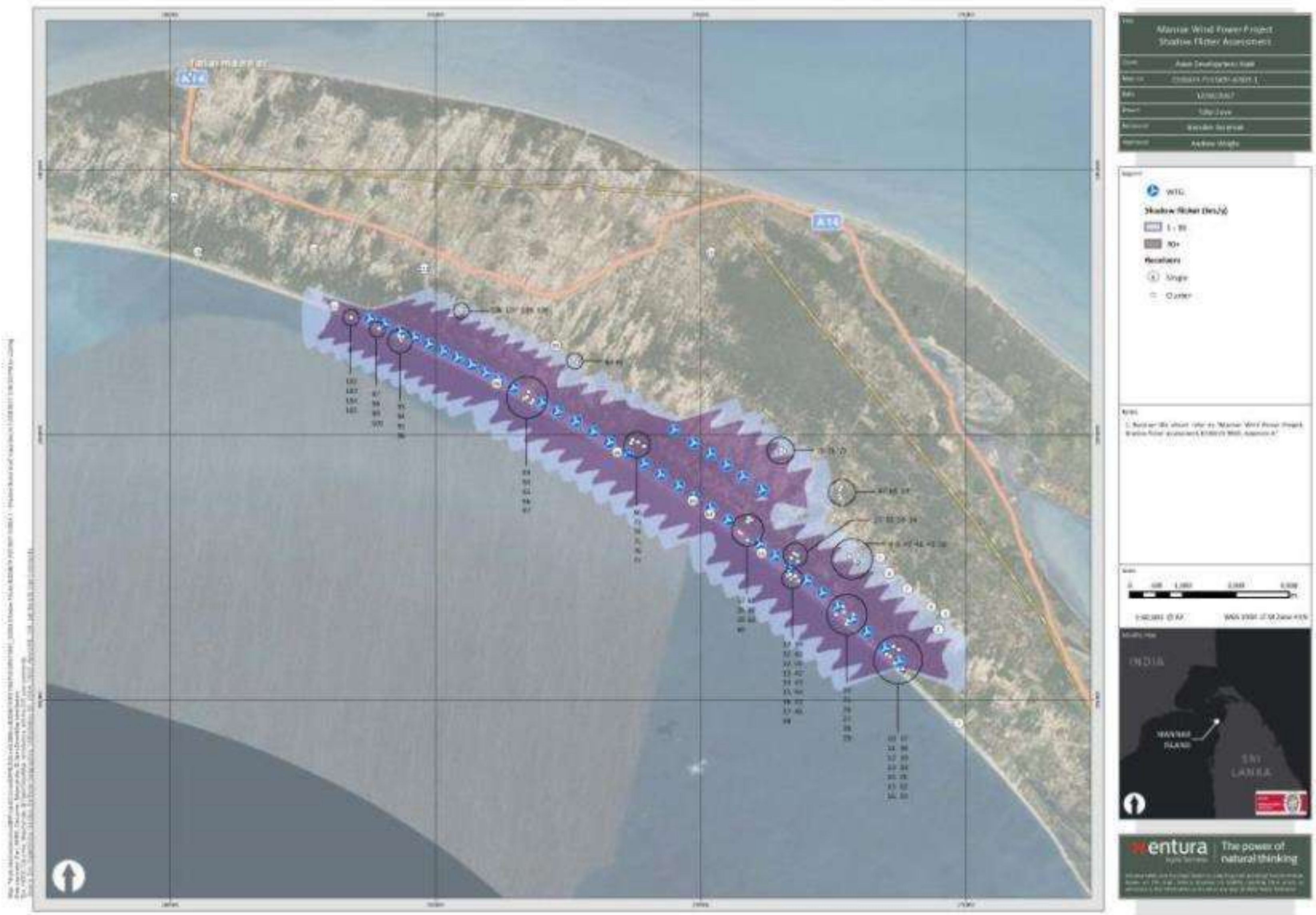


Figure 5.10: Extent of shadow flicker at project area.

Figure 5.11: View points

Figure 5.12: Photomontages for two locations

5.5.5 Other Operational Aspects

Blade Break

466. The following mitigations recommended by the IFC-WB EHS Guidelines will be implemented:

- Minimize the probability of a blade failure by selecting wind turbines that have been subject to independent design verification/certification (e.g., IEC 61400-1), and surveillance of manufacturing quality.
- Ensure that lightning protection systems are properly installed and maintained.
- Carry out periodic blade inspections and repair any defects that could affect blade integrity.
- Equip wind turbines with vibration sensors that can react to any imbalance in the rotor blades and shut down the turbine if necessary.

467. Separation between wind turbines and structure where people are residing or working is a common-sense practice to mitigate a very small risk, where the situation allows. Maintaining buffer distances between wind turbines and nearby structures is being considered. The impacts due to noise and toppling have been assessed and evaluated with preliminary concept of the wind farm, and based on the result mitigation measures have been prepared. One of the mitigation options is displacing sensitive receptors to other places. The necessity and exact number of affected structures and people are to be known after finalization of engineering designs by EPC contractor, as the impacts depend on the number of turbines and their specification. Thus, detailed survey regarding this environmental impact driven displacement can only be assessed after the finalization of the design.

468. Modern wind turbines from reputable suppliers do not often fail in a way that risks blade throw,[76] and there are many protection mechanisms to detect any imbalance in the rotor, and stop the wind turbine immediately. The likelihood of such failure during normal operation is very small, and the likelihood of injury from such failure is even smaller. The IFC-WB EHS guidelines[77] refer to very detailed study on these risks: "*Health and Safety Executive (HSE), "Study and Development of a Methodology for the Estimation of the Risk and Harm to Persons from Wind Turbines," Research Report RR968, (2013)."* This study concludes: *"The data in Table 12 indicates that the risk of fatality from wind turbines (at two hub heights or greater from the turbine) is low in comparison to other societal risks. It is roughly equivalent to the risk of fatality from taking two aircraft flights per annum."* This is indicative of the extremely low risk of injury from a large wind turbine. However, CEB has agreed to compensate as the Resettlement Plan for camps that need to be shifted to make it in compliance to the IFC-WB EHS guidelines.

Solid Waste

469. During the operational period the only source of solid waste would be garbage of the maintenance staff of the site. Facilities for solid waste disposal will be provided by the project and arrangements will be made with the Mannar Pradeshiya Sabha to transport the solid wastes to their licensed landfill sites.

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[76] Set back will be met or if not property relocated to meet the criteria.
[77] Para 1.3.1 Blade/Ice Throw of EHS Wind Energy Guidelines.

Vehicle and Equipment Maintenance and Cleaning

470. The turbine maintenance will be carried out as per recommended standards by the manufacturers as maintenance of the turbines is crucial to avoid risk of any untoward accident. The typical maintenance and repair activity during operation phase involves preventive and breakdown maintenance of wind turbines and/or the related equipment in accordance with the safety management plans and procedures as applicable and/or in accordance with accepted industry practices. Preventive maintenance involves labor as well as use of materials and consumables such as lubricants and oils, minor/low value electrical and mechanical parts etc., for preventive maintenance and upkeep of the equipment including unit transformer electrical maintenance, greasing of main bearings, yaw bearing, blade bearings and rotor bearing, topping up of hydraulic oil and painting of equipment, checking and replacing of brake pads for main brakes and yaw brakes, oil filters, dry filters, batteries, carbon brushes, coolant, cleaning detergents and solvents, pitch capacitors, all electrical panels, etc., maintenance of wind vane and anemometer installed on the wind turbine, maintenance of SCADA System, checking the 33 kV switch gears and associated protections.

471. The breakdown repair work involves labor and use of sub-assemblies/equipment, components, spares and consumables in the event of any breakdown or suspected breakdown due to any reasons. Major breakdown maintenance anticipated for wind farms[78] include, but not limited to, repairs/replacement of generator and motors, repairs/replacement of nacelle, rotor unit, hub, rewinding/repairs of transformers, repairs/replacement of transformer yard equipment, repairs/replacement of blades, repairs/replacement of frequency converter panels and control panels, repairs/replacement of tower components and electrical, replacement of oil in transformers, servicing of anemometer, wind vanes, wind sensors and other sensors, and limit switches, etc.

Electric Shock

472. This may lead to death or injury to the workers and public in the area. This can be minimized or avoided by:

- Security fences around substation.
- All electric equipment within turbine tower or in locked cabinent with no public access and warning signs.
- Careful design using appropriate technologies to minimize hazards.
- CEB/EPC to impart educational awareness raising on electrical hazards to local people.

Oil Spillage

473. Contamination of water on land/nearby water bodies by the wind turbine and sub-transformer oil can occur during operation due to leakage or accident. Sub-transformers will be normally located inside the tower. However, if they are situated outside, they should be installed within secure and impervious areas with capacity of 110%. The oil for their maintenance will be kept in storage yard having a storage capacity of 110% spare oil. Per wind turbine the amount of oils required are:

[78] Spare turbine parts and spare blades wil be kept offsite.

- Main gearbox oil – changed every 5 years, 600 liters. Not stored on site.
- Other gear oil – 1 liter stored on site.
- Hydraulic oil – 1 liter (amount varies significantly depending on the wind turbine type, but it is likely to have only very small hydraulic systems).
- Grease – 5 kg stored on site.
- Paint – 1 liter stored on site.

5.5.6 Electro Magnetic Interference (EMI)

474. Electric generators are considered a source of electric and magnetic fields, which may have a perceived effect on communication signals due to an effect called electromagnetic interference (EMI). Wind turbines cause EMI through the following three principal mechanisms:

- **Near field effects.**[79] When a wind turbine to cause interference to radio signals due to electromagnetic fields emitted by the generator and switching components in the turbine nacelle or hub.
- **Diffraction.** When an object modifies an advancing wave front by obstructing the wave's path of travel. Diffraction effects can occur when the object not only reflects part of the signal, but also absorbs the signal. The Blades could therefore cause diffraction of signal.
- **Reflection/scattering interference.** When turbines either reflect, or obstruct signals between a transmitter and a receiver. This occurs when the rotating blades of a turbine receive a primary transmitted signal and they act to produce and transmit a scattered signal. In this situation, the receiver may pick up two signals simultaneously (called a ghost effect in TV signals), with the scattered signal causing EMI because it is delayed in time (out of phase) or distorted compared to the primary signal.

475. Wind turbines can disturb electromagnetic signals used in telecommunications, navigation and radar services. The degree and nature of the interference normally depends upon wind turbine distance between receiver and transmitter, design material for wind turbine blades as well as the frequency of radio signal and its characteristic in coastal area, and technical specifications of transmitter and receivers. Usually, the interference to mobile radio services are usually negligible; and the interference to TV signals can be minimized by substitution of metal blades with synthetic materials or siting the turbine away[80] from line-of-sight of the broadcaster transmitter. Interference on communication systems can be avoided by careful wind farm design through relatively low cost methods such as installing additional transmitter masts.

476. However, there are no known issues for the marine fauna from EMI from wind turbine. The effect on avian fauna of the EMI is also not quantified.

Agriculture activities of the area

477. There are no agricultural activities in the proposed project area.

5.5.7 Impacts to Marine Biology

[79] Depends upon the final location of WT. Bidder will ensure proper disances from such installations.
[80] EPC contractor to determine WT locations.

478. The following activities include improving site access, site preparation, material disposal, site dewatering, and restoration after completion of activity.

Navigation of Boats

479. It is not anticipated that construction activities will significantly interfere with navigation of boats, fishing vessels in particular. Appropriate measures should be taken not to interfere with boat navigation.

Barge Route

480. Impact on fish by boats and barges are minimal and usually mitigation measures are not necessary, however, the main concern is on marine mammals especially whales, dolphins and dugongs on the marine route. No long-term studies have been carried out and there is no idea about when and where they are so it is not possible to establish a marine route of boats/barges to avoid such habitats. Because they are potentially present, it is recommended to have a trained/experienced marine mammal observer on board during barge operations.

Oil Spillage

481. The barge operator has to avoid any oil/fuel dripping from barges as they have to comply with local maritime laws, CCD laws and other international conventions such as MARPOL. However, the operator should conduct regular maintenance and repairs of the barges. Only barges that adhere to MARPOL and have regular maintenance service records will be used by the project.

482. However, any accidental oil spill from barges would badly impact on the marine mammals, seabirds, fish and other marine organisms. Also, oil spill will have negative bearing on sensitive marine ecosystems such as sea grass beds in offshore areas of the project area (outside the direct project impact area). Concern here should be on an accidental oil spill if any. Only barges that have pollution emergency response plan and equipment (e.g., booms) available on board in case of any accident will be used by the project.

Potential Impacts on Habitats

483. Ecological impact issues include construction effects on vegetation and the associated impacts on marine habitats. Specific issues include direct disturbance caused by construction equipment or from erosion, and impacts from structure placement such as Pier. Construction and dismantling of Piers should be carefully handled to avoid long-term impacts to these marine habitats and ecosystems. Prior to construction and dismantling, a translocation exercise will be undertaken within the working area plus buffer to remove all translocatable organisms (there are no such sensitive aquatic habitats in the project area.

Impacts on Fishery Related Activities due to Construction of the Project

484. Impacts on the marine environment from the proposed project will be due to (a) construction and operation of wind turbines; and (b) construction and operation of pier for barge operations.

485. Construction and operation of wind turbines will not have direct impact on marine

environment or marine organisms. However, there will be some indirect impacts that would result from sediment that would run off to marine environment during construction phase of the wind turbines. Such impacts will be short term in duration and can be minimized by maintaining good practices during earth excavation. The impact is rated low based on the criteria above.

486. During the construction and operational phases, the pier may have following impacts:

- Potential impacts to oceanographic conditions, specifically effects on near shore waves, associated with the construction and operation/maintenance of the proposed project and associated infrastructure.
- Construction and operation/maintenance phases of the proposed project and its infrastructure are expected to have impacts on near shore waters.
- Potential impacts to bathymetry associated with the construction and operation/maintenance phases of the proposed project.
- There are no threatened, endemic or vulnerable aquatic species such as near the proposed pier site

Alteration of Sea Bottom and Sediment Transport

487. The construction and operation of pier will affect sea bottom and sediment transport as serving a barrier for waves and long shore currents. The method of construction should allow bathymetry at the pier to remain similar to that existing although some local disruption to the sea bed can be expected as a result of construction.

488. Shoreline changes induced by coastal erosion and accretion are natural processes that take place over a range of time scales. Beach erosion is mostly induced by anthropogenic interference. Wind, waves and currents are natural forces that easily move the unconsolidated sand and soils in the coastal areas, resulting in rapid changes in the position of the shoreline. Changes in wave climate due to pier construction would negatively impact the shoreline and reduce water depth. Coastal stretch is well known for heavy sand accretion during monsoonal months. Therefore, some removal of sand may be required along the channel and the pier from time to time.

489. During decommissioning, the pile may be cut about 1 m below the bed or at depth determined to be sufficient to ensure that even with regular movement of sediment as per international best practise, they may not become exposed and catch on fishing nets or boat bottoms in the long term after construction is completed.

Impacts to Marine Benthic Habitat

490. Maintenance and near pier can cause seabed disturbance and release of suspended solids into the water as a result of commissioning of the pier and decommissioning of the same during the construction phase. The impacts to marine benthic habitats are expected to be medium given that construction activities will take place within the marine environment. However, the near shore environment is already turbid and devoid of any sensitive marine ecosystems and the therefore the impact is highly localized.

491. The overall significance of the potential impacts from the introduction of foreign species and diseases resulting from the proposed project and infrastructure are expected to be low.

492. Indirect impacts will be due to change in water quality such as elevated suspended

particles, and release of contaminants and changes in wave climate due to marine staging pile installation works. Changes in wave and current patterns due to construction of pier that would impact on fish and other organisms. Temporary/permanent loss of fish habitats, fishing grounds (mainly for *ma-del* operations) and other seabed habitat due to construction of a pier.
493. Certain area of the beach and near shore environment needs to be sacrificed for the construction of a pier. Since the area is traditional *ma-del* fishing area with *ma-del* padus located adjacent to one another in 500 m to 1000 m intervals and allocated range for *ma-del* operation by fisheries and aquatic resources department is about 500 m stretch on beach. One *ma-del* owner whose *ma-del* site (padu) stretching at a length of 594 m along the shoreline and located in the area proposed for the construction of the pier will be affected during pier construction and unloading of equipment. The *ma-del* owner will not be able to engage in his fishing activities at least for two fishing seasons as both pier construction and shipment of equipment are planned for the fishing season of October to March when the sea is not rough.

494. **Mobilization of fishing boats.** Near shore construction would affect the mobilization of fishing boats particularly ma-del operations. In addition, any support vessels for the project will also interfere with fishing boat operations. According to *ma-del* operation regulation, operation of other vessels within *ma-del* areas has restrictions and therefore during the period of construction of jetty and operation barges, there will be no *ma-del* operation in that one particular *ma-del* whose owns and workers will be compensated for lost days. CEB will liase with *ma-del* to cease operations during specified period and pay compensation as per RP.

495. The impact on mobilization of fishing boats is localized but can be frequent during construction phase and impact will be moderate. However, during the operational phase it will be less frequent and impact will be low.

Impact of Noise on Fish/Fishery

496. A major concern of the fishermen during field survey and interview with key informants were noise generated from turbine operation during operation phase. However, noise generated in air would have no impact on fish or fisheries. Noise during pile driving in the aquatic environment is matter of concern. However, very little is known about the effects of pile driving on fish or other aquatic life[81] and cannot be quantify the possible impacts. The following description provides latest finding on the impact of underwater noise generated on fish and other aquatic organisms.

Fish Bioacoustics Overview

497. Sound plays a major role in the lives of all fishes. Sound travels much further and faster (five times) in water than air, and it is not impeded by darkness, currents, or obstacles in the environment. Fishes can get a great deal of information about biotic (living) and abiotic (environmental) sources and get a good "image" of the environment to a very substantial distance. Fish have two sensory systems for detection of water motions: the inner ear (otolith, no outer ear) and the lateral line system. The inner ear serves to detect sound up to hundreds or even thousands of Hz (depending on the species), whereas the lateral line detects low-frequency sound, but is generally considered to be primarily a detector of water motion relative to the body. Air filled cavities such as swim bladder detects pressure variations.

498. Different fish species vary in absolute sensitivity and spectral range of hearing, which

[81] There are no dolphins in jettys area.

relates to an auditory detection continuum based on presence or absence of specially evolved morphological structures. In general fish hear best within 30–1,000Hz, while species with special adaptations can detect sounds up to 3,000–5,000 Hz. Some exceptional species are sensitive to infrasound or ultrasound. Many species of bony fishes (but not elasmobranchs) communicate with sounds and use sounds in a wide range of behaviors including, mating and communication, localization of food, avoiding predators, and navigation. Hearing range in fish overlaps in frequency with many anthropogenic sound sources, and interfere with the normal behaviors and even the survival of individuals, populations, or a species.

Hearing Sensitivity

499. Basic data on hearing provides information about the range of frequencies that a fish can detect and the lowest sound level that an animal is able to detect at a particular frequency. This level is often called the “threshold.” Sounds that are above threshold are detectable by fishes. Usually fishes cannot hear sounds above about 3-4 kHz, and the majority of species are only able to detect sounds to 1 kHz or below.

500. Very loud sounds of relatively short exposure, such as those produced during pile driving, can harm nearby fish. However, more moderate underwater noises of longer duration, such as those produced by vessels, could potentially impact much larger areas, and involve much larger numbers of fish.

501. How fish will react to sound is determined by the biology of the fish: (i) hearing ability; (ii) purpose they use sound; (iii) behavior; (iv) life history; (v) distance from the source - range of potential effects declines with increased distance from the source; (vi) whether the sound is generated underwater or in air – if the sound generated in air the impact underwater is minimum; and (vii) type and nature of sound – short duration, sharp and high in amplitude noise such as underwater blasting or pile driving, a lot of energy in a short time, that is repeated and effect would be critical.

502. Possible impacts of sound would be: (i) barotrauma (injury caused by a change in air pressure, affecting typically the ear or the lung but in fish swim bladder, tissues and hearing organs, even if the fish does not hear the sound); (ii) possible masking of biological signals and thereby affecting communication or senses; and (iii) impact on behavior.[82]

5.5.8 Impacts to Migratory Birds

503. The main potential effects of wind farms on birds are collision risk with the wind turbines, direct loss of breeding or feeding habitat, and indirect loss of habitat from disturbance (either temporary during construction or more permanent from operating turbines) (Percival, 2005; Dewitt and Langston, 2006).

504. The purpose of this risk assessment study is to undertake cumulative collision risk modelling for the projects and assist CEB in preparing the EIA’s ornithological assessment. This assessment supports CEB in undertaking the ornithological assessment for the proposed power evacuation infrastructure and associated large –scale wind power developments. This includes analysis of the collected survey results and preparation of bird flight activity data for input to a collision risk model, along with the discussion on the assumptions and limitations of the collision risk modelling undertaken. Discussion as to the most appropriate avoidance rates to apply is

[82] No behavioral studies done.

included in the following section. The CRM has been carried out on all of the key species of concern that were observed flying within the collision risk zone at risk height, for both the wind turbines and for the overhead power line.

505. The collision risk that the overhead transmission line may cause to birds from the Vankalai Sanctuary Ramsar site was assessed previously (Percival and Weerakoon, 2016), but the current section draws on that report as appropriate for the assessment of the transmission line as an associated facility of the wind farm, for the cumulative assessment in combination with the wind farm. The results of the modelling are summarized in **Table 5.17**. The results are presented for a range of avoidance rates, with 98% adopted as a reasonable precautionary position used to inform the further assessment (following SNH guidance, Urquhart, 2010). The percentage increase over the baseline mortality is also given, for that 98% avoidance. The 'baseline mortality' is the mortality that would occur in the absence of the wind farm (calculated from the population sizes and published mortality rates). The percentage increase over baseline mortality therefore sets the predicted wind farm mortality as a percentage of the mortality that would occur in the absence of the development. Collision risks below a 1% increase are usually considered to be not significant. In the context of the Mannar site, the predicted collision mortality has been set against the Ramsar population background mortality for each of the key species at risk of collision.

Table 5.17: Predicted annual number of collisions of key species with the proposed first 100MW phase of the Mannar Island wind farm.

Species	Avoidance rate				% increase over baseline mortality (98% avoidance)	Indicative magnitude of effect
	98%	99%	99.8%	99.9%		
Critical Habitat Species:						
Northern Pintail	2.1	1.1	0.5	0.2	0.02%	Negligible
Little Egret	2.7	1.3	0.7	0.3	0.5%	Negligible
Painted Stork	0.1	0.03	0.01	0.005	0.04%	Negligible
Spot-billed Pelican	1.5	0.7	0.4	0.1	9.7%	Medium
Indian Cormorant	0.8	0.4	0.2	0.1	1.7%	Low
Gull-billed Tern	0.46	0.23	0.12	0.05	1.0%	Low
Caspian Tern	0.2	0.08	0.04	0.02	0.2%	Negligible
Lesser Crested Tern	0.01	0.003	0.002	0.001	0.002%	Negligible
Other Important Species:						
Little Cormorant	0.51	0.3	0.1	0.1	0.4%	Negligible
Heuglin's Gull	0.35	0.2	0.1	0.0	0.07%	Negligible
Little Tern	0.33	0.2	0.1	0.0	0.1%	Negligible

506. This modelling has highlighted three Critical Habitat trigger species that could be at potentially significant risk of collision with the wind turbines: Spot-billed Pelican, Indian Cormorant and Gull-billed Tern. Though only low numbers of collisions were predicted, their local populations are also low and hence more vulnerable to any additional mortality. This will be mitigated through implementing environmental management plan and biodiversity management plan including shurbown during migrating season to ensure no net loss. The collision risk to other Critical Habitat species, and all other bird species, would not be significant.

Disturbance to Migratory Birds during Construction and Operation

507. The construction works for the wind farm will be prohibited during the main waterfowl winter season (September to April), so bird numbers at risk of disturbance will be substantially lower. As a result, only negligible magnitude disturbance effects are predicted during construction,

which would not be significant for any of the Critical Habitat trigger species.

508. Operational disturbance could displace birds, particularly from the beach and other coastal habitats. Specific targeted counts of this area have shown that seven Critical Habitat species could be at risk, including Little Egret, Indian Cormorant, Red-watted Lapwing, Brown-headed Gull, Caspian Tern, Gull-billed Tern, and Lesser Crested Tern. However, the numbers at risk were generally low, many of the birds using that area are habituated to presence of people (reducing their vulnerability to disturbance) and studies of similar species at existing wind farms has shown little evidence of any biologically significant disturbance effectcs. The likelihood of disturbance is therefore, considered to be low, though some minor disturbance effects cannot be completely ruled out. As the modeling has highlighted three Critical Habitat trigger species that could be at potentially significant risk of collision with the wind turbines; Spot-billed Pelican, Indian Cormorant and Gull-billed Tern. As a result, it will be necessary to implement mitigation measures to avoid any net loss of habitat to any Critical Habitat species. This will be mitigated through implementing environmental management plan and biodiversity management plan which include shutdoown criteria during migrating season to ensure no net loss. Additionally, the EPC contractor would bring in equipment during winter season when the sea is calm (October to April) and they can erect between April to September (high wind season) when the bird numbers are lower."

Impacts of Transmission Lines and Blades of the Wind Turbine on Bats

509. Four Indian flying fox (Pteropus giganteus) colonies were observed in the Mannar Island. Three of these colonies are located more than 2 km away from the proposed site and their flight path will not cross the proposed wind farm region. One of the bat colonies is located in close proximity to the eastern border of the site selected for the wind farm. However, their flight direction is away from the proposed wind farm site and therefore the probability of coming into contact with the turbines or the transmission line is very low. This inference is based on the grid survey that was carried out for birds throughout the Mannar Island where the Island was sub divided in to 2 x 2 km grids and each grid was surveyed for avifauna during winter and non-winter seasons. The four bat colonies were identified during this survey.

5.6 Cumulative and Induced Impacts

510. The Cumulative Impacts[83] are defined as the combination of multiple impacts from existing projects, the proposed project, and anticipated future projects that may result in significant adverse and/or beneficial impacts that cannot be expected in the case of a stand-alone project. The induced impacts are the adverse and/or beneficial impacts on areas and communities from unintended but predictable developments caused by a project, which may occur later or at a different location.

5.6.1 Development of Infrastructure – Access Roads, Urban Facilities

511. The wind farm does not involve any large-scale excavation and land loss is insignificant. However, due to change in land use to industrial zone for development of park, fish industry and other facilities, the local access roads, will be upgraded in the project area. The development of access roads in coastal area will lead to better access to fishermen community for processing and its egress from Mannar to the mainland. Due to better business environment, the demand for urban facilties such as hotels, transport, and housing will go up. This is one of the positive induced impacts for the local community.

[83] Environment Safeguards – A Good Practice Sourcebook Draft Working Document (December 2012).

512. The impact of these construction activities on the habitats in the area are discussed in detail in Section 4.

5.6.2 Rail Road Connectivity and Main Road Access to Island from Mainland

513. The induced impact of the rail/road network could be increased number of vehicles between mainland and island due to better availability of power and consequent increase in business activity in the area.

5.6.3 Transmission Line and the Wind Farm Projects

514. Mannar district is now coming under the rapid socio-economic development. Continued supply of electricity is an indispensable infrastructure facility for various development programs. It will facilitate the resettlement of people and opening of new industries and business along with the agricultural and domestic productions. The power from the wind farm will be evacuated through construction of a new 220 kV Mannar – Nadukuda transmission[84] line to evacuate power to the grid. The resulting power availability may result in addressing electricity supply issues to the northern island. This will provide a lasting solution to the low voltage problems encountered in the area and improve the reliability of electricity supply to consumers of the said areas.

515. Based on the future potential study of the wind farm blocks to come up in Mannar Island, the potential most certainly generates less than additional 275 MW. However, all power generated at Mannar from all future wind farm blocks, it will be evacuated using a power evacuation line between island and the mainland. The transmission line and project will not use any natural resources occurring in the area during construction as well as its operation cum maintenance phases. Construction materials such as equipment and cement, etc. shall come from factories mostly from abroad, while the excavated soil shall be used for backfilling to restore the surface and the balance will be removed to approved land disposal sites designated by local authorities.

516. As described in the EIA impact section, the wind farm project shall not cause any accelerated use of resources for short-term gains and all impacts related to construction are temporary.

517. An avian collision risk assessment informed by vantage points and waterholes surveys has been conducted and recommends the implementation of mitigation (as outlined in the Collision Risk Assessment in **Appendix 2**) to reduce mortality of birds hitting the wind turbine. Mitigation measures for a wind farm will never guarantee to bring collisions down to zero, but the magnitude of impact can be significantly reduced. A range of important species (including Spot-billed Pelican, Indian Cormorant and Gull-billed Tern) could also be at potentially significant risk of collision with the proposed wind turbines. CEB has agreed that if EIA of the wind farm cannot demonstrate negligible collision risk then wind turbines will be curtailed during the breeding and/or migratory period as appropriate. There is a need to consider here the mitigation provided by BMP and possible curtailment of turbines. Former may be rather more effective, but any plans for curtailment need very careful consideration/costing for project operator.

518. The cumulative collision risks from the wind farm and the transmission line would be

[84] CEB's 220 kV Mannar Nadukuda transmission line is funded under a separate project by ADB for which an EIA was prepared and disclosed. The line passes through Ramsar Wetland area and will undertake an extensive Biodiversity Management Plan for the line as well as the proposed wind farm(s).

additive, and they have been set out in **Table 5.18**. As the transmission line has now been approved and mitigation measures agreed, only the residual effects with that mitigation implemented have been considered here. A conservative assumption has been made applying 98% avoidance for the wind farm and 99.5% for the transmission line.

Table 5.18: Cumulative annual collision risk of the Mannar Island wind farm in combination with the transmission line

Species	Wind farm Phase 1 collision risk	Transmission line collision risk (mitigated)	Cumulative collision risk (transmission line + Phase 1 wind farm)	% increase of cumulative risk over baseline mortality	Magnitude
Critical Habitat Species:					
Garganey	0	15.2	15.2	0.4%	Negligible
Eurasian Wigeon	0	2.7	2.7	0.01%	Negligible
Indian Spot-billed Duck	0	0.6	0.6	4.9%	Low
Northern Pintail	2.1	51.5	53.6	0.5%	Negligible
Greater Flamingo	0	2.6	2.6	3.6%	Low
Little Egret	2.7	0.9	3.6	0.7%	Negligible
Painted Stork	0	3.3	3.3	2.5%	Low
Eurasian Spoonbill	0	0.4	0.4	0.4%	Negligible
Black-headed Ibis	0	0.8	0.8	1.3%	Low
Spot-billed Pelican	1.5	12.3	13.8	91.3%	Very high
Indian Cormorant	0.8	0.5	1.3	2.9%	Low
Lesser Sand Plover	0	1.7	1.7	0.1%	Negligible
Curlew Sandpiper	0	1.5	1.5	0.1%	Negligible
Brown-headed Gull	0	1.4	1.4	0.1%	Negligible
Caspian Tern	0.1	4.1	4.3	1.2%	Low
Gull-billed Tern	0.5	1.3	1.7	3.8%	Low
Lesser Crested Tern	0.01	0.0	0.01	0.002%	Negligible
Other Important Species:					
Lesser Whistling-duck	0	0.5	0.5	0.1%	Negligible
Northern Shoveler	0	0.3	0.3	0.1%	Negligible
Little Cormorant	0.5	4.2	4.8	3.7%	Low
Black-winged Stilt	0	1.0	1.0	0.4%	Negligible
Heuglin's Gull	0.4	0.1	0.4	0.1%	Negligible
Little Tern	0.3	0.1	0.4	1.0%	Low
Whiskered Tern	0	0.8	0.8	1.1%	Low
Peregrine Falcon	0	0.02	0.02	0.1%	Negligible

5.6.4 Barrier Effects

519. Both the wind farm and the associated transmission line have the potential to act as a barrier to bird flights, which could be important if they were located on routes that were used by large numbers of birds and there were no alternative routes around the barriers (or if any alternative route involved significantly greater energy expenditure). However, the baseline surveys of bird flight activity at the site have shown that the more important flight routes are broadly parallel to the transmission line and to the longer axis of the wind farm, so it is not considered that any barrier effects of either the transmission line or the wind farm would be significant.

5.6.5 Development of Industry and Commercial Activity

520. The project will increase availability and reliability of power. Power is a key input to the economic development of any area. Hence forth, there will be an increase in setting of new ice making factories, fish meal making units and the like, Experience indicates that economic development leads to generation of more jobs, which in turn should raise the living standards of poor. Thus, the project will provide opportunities for employment in project construction and fishing based economic activities. Most of persons engaged in fishing are employed seasonally. Hence unskilled labor requirement of the construction activities shall be fulfilled with locally available manpower. Generation of local employment during construction period will increase the income and socio-economic standards of the residents of the project area. This will be a positive cumulative impact that will have benefits to the local community living in the area of generations with unreliable power.

521. The EPC contractor and CEB will work as per the Construction Method Statement attached as part of the EMP and Monitoring plan (**Annexures 3-5)** compliance.

5.6.6 Tourism Development

522. The Mannar Island will soon come up with hotels and residential units. With Mannar having numerous religious places of importance, there will be more tourists in the area in the near future thereby increasing commercial activity in the area. The impact is also positive induced impact to the community in the area. Report was prepared by CEB and attached as **Appendix 9**. However, since the the area has been declared an “Industrial” Energy Development zone where Urban Development Authority has given directions regarding the use of land as well as height of structures in the area, it is assumed that this area though will be frequented by tourirsts, but no mass scale hotels will be developed in this area in future. There will be concerns in terms of visual impact; effect on birds, and noise from wind generation.

523. Overall, the project will have both negative and positive impacts that can be mitigated to acceptable levels. The cumulative impact on the communities will be positive in form of new commercial and industrial activity, increased tourism, etc. Some avian mortality could happen due to wind farm, which if necessary will be managed by shutting down requisite wind turbine generators that may lie in the migratory path during the bird migration period. The cumulative impact on the rich flora and faunal diversity in the coastal area will be negative and hence a construction management plan will be implemented by EPC contractor and CEB to ensure that the impact to the migratory and breeding birds in the Mannar Island is minimized using suitable measures.

6.0 ANALYSIS OF ALTERNATIVES

6.1 CEB’S Approach for Wind Power Site Selection

524. At the planning stage, one of the factors that govern the establishment of the wind power park is the infringement of scarce population/plantation area. Wherever such infringements are substantial, different alternative options for wind turbines will be considered. During site selection, all possible efforts are made to avoid the populated/plantation/cultivated area infringement completely or to keep it to the barest minimum. Whenever it becomes unavoidable due to the geographical locations/terrain, mitigation costs involved towards avoidance needs to be worked out. While identifying the land area for the wind power generation project, preliminary site assessments, prefeasibility studies have been conducted as part of the due diligence for

temporary pier, equipment and raw material transportation, bathymetric studies, noise and environmental studies in the area.

6.2 The "No Action" Alternative

525. As mentioned earlier, this particular wind power development project on Mannar Island is an essential part of a large-scale development renewable energy in Sri Lanka. Without this project, the amount of energy that will be generated by the Wind Farm will have to be generated using other means such as fossil fuel or coal based generation plants that will increase the GHG emissions and emission of other pollutants to the environment as well as expenditure of foreign currency. The Mannar Nadukuda transmission line that has been proposed to be constructed separately by CEB will help absorb the renewable energy developed in the National Grid.

526. Development of this project is invariably associated with environmental impacts as well as some social impacts in the area as the wind power project is situated close to three biodiversity rich areas: Adam's National Park, Vankalai Sanctuary (a Ramsar designated site) and two important bird areas (IBA). The social impacts are relatively much less as the area is sparsely populated and land value is relatively less (except Mannar town, which will not be affected). Social impacts include cutting down of trees (mainly Palmyra) and planting of wind turbine generator tower in private properties, both of which can be satisfactorily mitigated with adequate compensation. A considerable number of studies have been done on wind power potential for the area in the past while most recently a future wind potential study has been done by Entura attached in **Appendix 10**. These studies show that there will be comparably positive benefits that will arise from the proposed project then the negative impacts which will be considerably low. Therefore, a no-action alternative is not considered as acceptable.

6.3 The "With Project Alternative" Wind Farm Site Selection

6.3.1 National Requirement for Power

527. Sri Lanka has developed almost all the country's major potential sites to generate hydro power. In 2015, 37% of electrical energy served through the grid was from larger hydropower units, while a further 11% was provided from smaller hydropower plants, wind, solar and biomass power plants. Sri Lanka's electricity demand increased by 6.1% over 2011-2015. CEB, the Transmission Licensee forecasts that generation requirements will grow by 6.8% per year over 2016-2020, and at 4.5% per year in the longer term.[85] To meet the increasing demand, CEB's long-term generation expansion plan (LTGEP) specifies thermal power plants and different forms renewable energy-based power plants to be constructed. Between 2017 and 2020, the plan requires a new 300 MW diesel-operated combined cycle power plant (to be later converted into operation on regassified liquefied natural gas (RLNG)), 275 MW of other new oil-fired power plants, 170 MW of new hydroelectric power plants, and 485 MW of renewable energy power plants to be built. Power generation from renewable energy sources will displace power generation from both oil and coal in the immediate future, and would additionally reduce LNG imports in the longer term. Displacement of thermal power generation reduces power sector CO_2 emissions and helps to achieve national Green House Gas (GHG) reduction targets. This limits the need to implement expensive interventions to achieve similar GHG reduction levels.

[85] CEB Long-term Generation Expansion Plan 2015-2034, addendum, pages A11-11 to A11-17, approved by PUCSL September 2016.

528. The project will be located in the Mannar Island, in the Mannar district. Mannar is in the dry zone of Sri Lanka, and the annual rainfall is lower compared with other areas of the dry zone. Most of the areas selected for the project have very low altitude, and the land remains water logged during the rainy season. These factors limit the use of land for other economic activities. Owing to the availability of a good wind resource, economic benefits from the land in the Mannar Island can be gained by constructing wind power plants in this area.

6.3.2 Wind Turbine Technology consideration for Mannar Wind Farm

529. The proposed 100 MW Mannar Wind Farm will utilize three bladed up wind Horizontal Axis Wind Turbines (HAWT). HAWT has the main rotor shaft arranged horizontally with the electrical generator at the top of the tower. This is the most common, mature and commercially proven wind turbine technology deployed in all large-scale wind farms across the world. The global installed capacity of wind power at the end of 2016 is approximately 487,000 MW and a total addition during 2016 is 54,600 MW.

Figure 6.1: Wind Turbine

Classification of Wind Turbines Technologies[86]

530. The following text describes the range of wind turbine technologies highlighting relevant attributes in terms of axis of rotation, blade technology, supporting structure, etc.

[86] Design and technology choice by bidder.

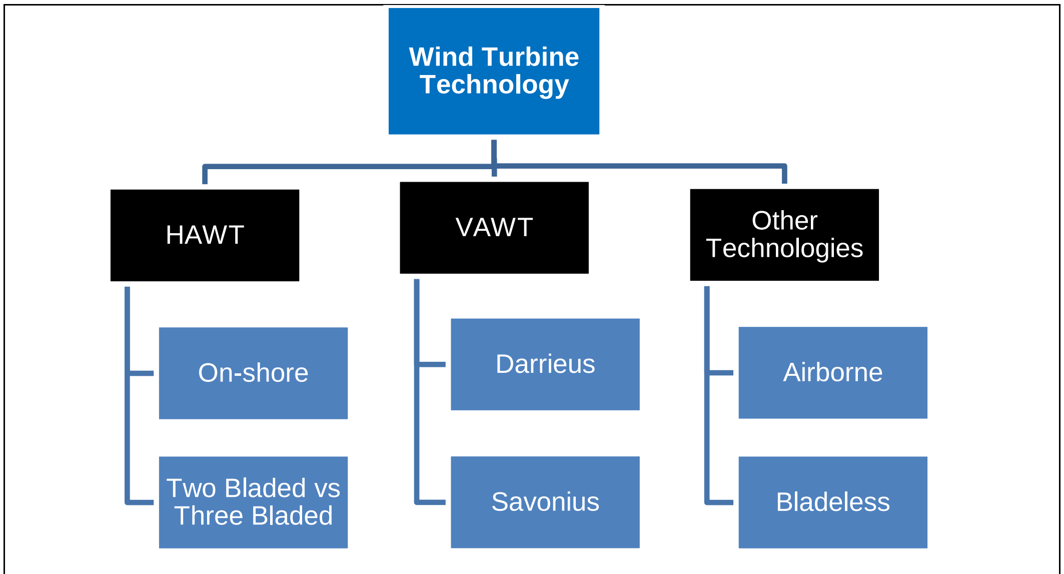

Figure 6.2: Types of Wind Turbine Technology

531. A comparison of these technologies and why HAWT are most preferred are described below.

Vertical Axis Wind Turbine (VAWT)

532. Industrial wind turbines fall into two general classes depending on the axis of rotation i.e., horizontal axis and vertical axis. VAWTs, have the main rotor shaft arranged vertically. VAWT includes different variants such as Darrieus Wind turbine (or "Eggbeater" turbines), Giromill Wind turbine which is a subtype of Darrieus turbine, Savonius wind turbine which are drag-type turbines and Twisted Savonius, a modified savonius, with long helical scoops to give a smooth torque.

	
Figure 6.3: VAWT	**Figure 6.4: VAWT**

533. VAWTs could have their own advantages over HAWTs in certain applications however the determining factors for selection of HAWT over VAWT are described below.

534. **Efficiency.** When wind blows on a vertical-axis turbine, only a fraction of the blades generate torque while the other parts passively rotate. The result is comparably reduced efficiency in power generation of VAWT in general compared to HAWT (in HAWT, the complete rotor plane interface the wind flow). Therefore, VAWT wind farm of a commercial scale would require more materials and space to generate a comparable amount of power compared to a farm equipped with horizontal-axis turbines leading to higher COE (Cost of Electricity).

535. **Visual appearance.** It is claimed that VAWTs have lower visual impact however this is only true for smaller wind generators, closer to the ground. To make VAWT economic for grid-scale generation, they would have to be big to have a larger swept area to achieve equal generation as HAWT.

536. Further, it is not certain the impact of avian mortality due to VAWT, since the VAWTs scaled up for utility generation capacity have not been assessed and hardly any large-scale wind farm in operation to assess such impact.

537. **General application of VAWT.** Vertical axis turbines are confined to small wind projects and residential applications. Large number of wind turbines would be required for grid connected applications since the individual capacity of wind turbine is limited to few kWs.

Two-Bladed Wind Turbines

Figure 6.5: Twin Blade Technology

538. A great majority of modern commercial wind turbines are based on three-blade design concepts. This is largely due to the number of technical benefits which are outlined below.

539. **Stability.** Two-bladed wind turbines have stability concerns when the uppermost blade bends backwards, because it gets the maximum power from the wind when the lowermost blade passes into the wind shade in front of the tower. Further the yawing of a two-bladed wind turbine need to take place slowly to limit fluctuating dynamic loads on turbine structure during the yawing operation.

540. The higher dynamic loadings also effect the fatigue lifetime of the two-bladed wind turbine which may lead to increase in O&M cost.

541. **Efficiency.** Under the same general wind conditions, two-bladed turbines are less efficient than three-bladed.

542. **Visual appearance**. Two-bladed wind turbines may not be as visually attractive as three-bladed wind turbines when they are turning and spinning.

Emerging Technologies

543. Some other alternative techniques are also discussed below which are mostly in conceptual stage.

Bladeless Technologies

544. There are some bladeless wind turbine options such as Vortex's cylinder design and Wind stalk concept; none of them are commercially proven. There is no evidence to suggest that Turbines of these technologies are implemented in large scale wind farms and not even in MW scale small projects.

Figure 6.6: Bladeless Technologies

545. **Efficiency.** The common propeller-type wind turbine has a big swept area by the blades compared to bladeless tubes and the efficiency of energy conversion appears to be less than a conventional wind turbine.

546. **Dimensions.** Dimensions of Vortex bladeless[87] wind turbines are given in Table 6.1 to have a comparison with HAWTs.

Table 6.1: Comparison of Vortex type turbines

	Vortex Mini (Prototype stage)	Vortex Grand (Conceptual stage)
Capacity	4 kW	1 MW
Height	12.5 m	150 m

547. A typical 1 MW HAWT utilizes approximately 50 m hub height and a rotor diameter of 45 m which results total turbine height less than 75 m, i.e., half the height of a 1 MW Vortex bladeless turbine.

548. **Noise.** As shown in Table 6.1, the cylinder gets taller and bigger with the increased capacity. The wind gets high at high altitudes and thereby it is very likely to generate range of frequencies. In fact, the tonality of creaking could be more piercing than the noise of a HAWT blade.

Airborne Wind Turbines

549. Airborne wind turbines have a rotor supported in the air without a tower. With different variants of WTs such as MARS & KiteGen, the Airborn technology is a design concept with no commercial wind farms deployed.

[87] Vortex type is an unproven and unworkable concept that is not compatible with design.

Figure 6.7: Airborne turbines

Sheer Wind INVELOX

550. Sheer Wind's INVELOX technology is a wind capturing and delivery system to a turbine. A large intake captures wind, and accelerates while passing through a tunnel. Turbines placed inside the Venturi section of the INVELOX converts kinetic energy to mechanical rotation.

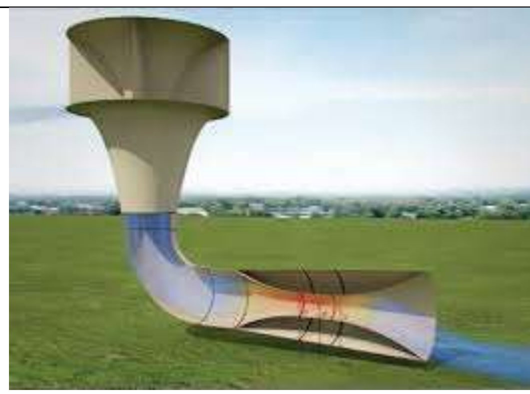

Figure 6.8: Sheer Wind Technology

551. Dimensions of INVELOX 1 MW and 5 MW systems are given in below table

Table 6.2: Comparison of Invelox type turbines

	INVELOX LEO 1 MW (Conceptual stage)	**INVELOX LEO 5 MW (Conceptual stage)**
Capacity	1 MW	5 MW
Height	57 m	124 m
Intake Diameter	71 m	159 m

552. There is no evidence to suggest that turbines of these technologies are implemented in large scale wind farms and not even in MW scale small projects.

Conclusion

553. Horizontal axis wind turbines dominate the majority of the wind industry. In large scale grid connected applications, horizontal axis wind turbine concept is the only choice. However, in small wind and residential wind applications (rooftop), vertical axis turbines can be deployed. The advantage of horizontal wind is that it is able to produce more electricity from a given amount of wind using lesser foot print at very competitive price. Therefore, in large-scale grid connected applications, horizontal axis three-bladed wind turbine technology is the only option.

6.3.3 Location of Wind Farm Blocks in SLSEA Energy Development Zone

Master Plan Study for Wind Farms in Mannar

554. In early 2014, the Government of Sri Lanka, with assistance from ADB, prepared a master plan for wind power development in the Mannar region. CEB is currently developing a 100 MW wind power plant sited along the southern coast of the Mannar Island. According to the master plan the total Mannar District (Mannar Island and the mainland coastal stretch extending southwards) wind potential was tentatively estimated as 375 MW. The potential is based on technical assessment. The Wind Farm in 15 blocks – 12 blocks in Mannar Island and three on mainland. ADB has funded a Master Plan for Wind Power Development in Mannar under the TA 7837-SRI: Clean Energy and Network Efficiency Improvement Project.

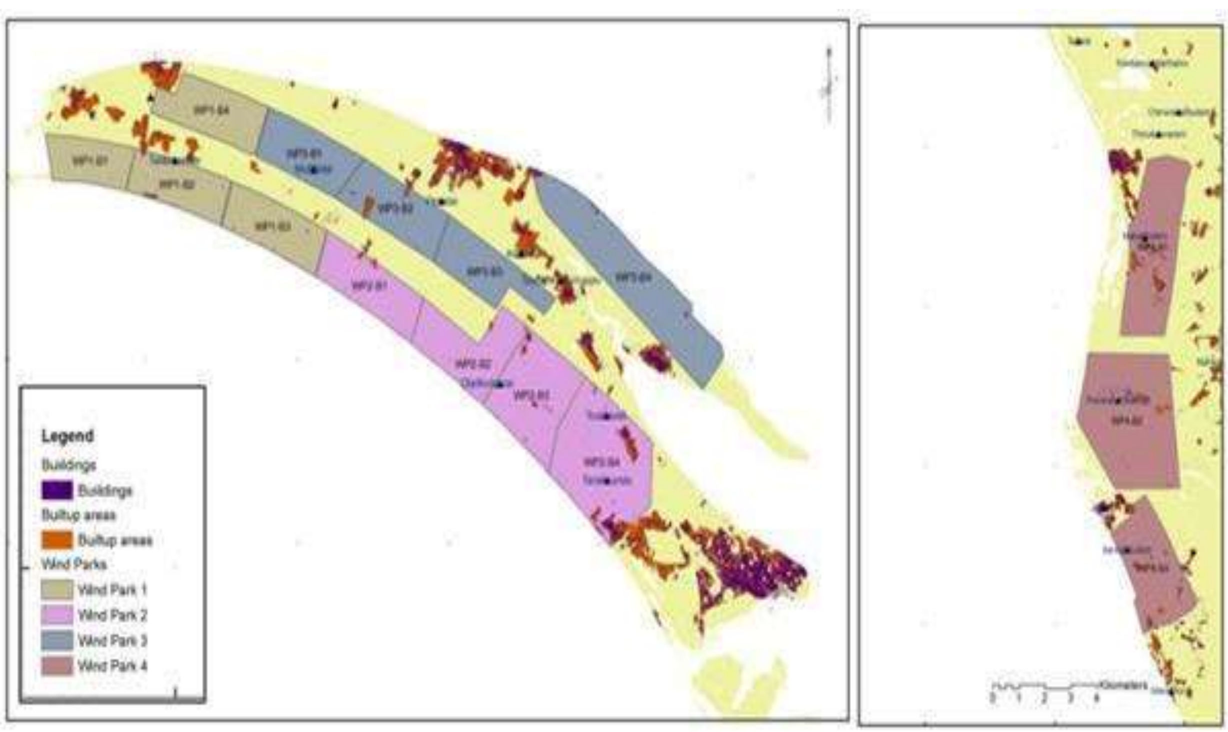

Figure 6.9: The master plan for wind power development in Mannar

555. The key outputs of the master plan study were: Selection of fifteen land blocks, each capable of supporting 25 MW of installed wind capacity (Figure 6.9). The following land uses were excluded in the selection process due to probable adverse impacts from wind development in these areas:

- Home garden – this included village settlements (closely spaced houses clustered within a village), dispersed houses and small scale cultivations
- Built-up areas – Mannar Town and small townships
- Wildlife sanctuary / forest – mainly the part of Wilpattu sanctuary extending to the Mannar district
- Environmentally sensitive areas – mainly the eastern edge of the island that is interspersed with tracts of marshlands inhabited by migratory birds
- Potential land route options for transporting wind turbine equipment (unit capacity was limited to 2 MW) to the selected sites were identified in a preliminary manner. Recommendations were made to carry out detailed studies on the marine transport options.
- Preliminary design of a power transmission network connecting the selected wind project sites to the grid substation being built in Mannar was developed
- Options for business models (and related contract documents) for private sector participation in wind power development
- Each block has a designed capacity of 25 MW. Wind Farms 1, 2 and 3 will consist of four blocks each, amounting to a capacity of 100 MW in each park. There are only three blocks in Wind Farm No 4, with a total capacity of 75 MW. Accordingly, once fully developed over 2015-2025, the installed generating capacity of the Mannar WPDZ will be 375 MW.

Table 6.3: Data on data of wind power blocks

Wind Farm No	Number of blocks	Power Generation Capacity allocated to each block (MW)	Total Generating Capacity of the Park (MW)
1	4	25	100
2	4	25	100
3	4	25	100
4	3	25	75
Total for Mannar Wind Power Development Zone (WPDZ)	**15**		**375**

556. Out of the above four wind farms, the proposed Mannar Nadukuda line will serve only the three wind farms in the Mannar Island (park numbers 1, 2 and 3). As park number 4 is in the mainland, the output of park number 4 will not flow through the proposed transmission line. Subject to confirmation in on-going studies by CEB, the wind farm numbers 1, 2, 3 and 4 will be developed and grid-connected in years 2017, 2019, 2021 and 2023, respectively.

557. The proposed 100 MW windfarm cuts across the above four wind farm blocks due to the limitation in design. The BMP for Mannar Island needs to consider appropriateness of the further wind farm development on the island if additional new wind farms projects are considered. However, the recent study on the future potential supercedes the masterplan study (attached in **Appendix 10** which concludes that there is limited development potential within the island).

Wind Farm Feasibility Study and Safeguards Assessment

558. The development of each wind farm will be done by a special purpose company established by Ceylon Electricity Board (CEB) (the Park Development Company, PDCo) with a majority shareholding. The role and responsibilities of the PDCo will include:

a) Acquisition/allocation of land and all the statuary clearances (such as EIA, environmental licenses and other clearances and approvals) for establishing the wind farms
b) Provision of secure and access controlled facilities within each wind farm (access control, however, is expected to be limited to a small area within a park, whereas, most of the park will not be access-controlled.
c) Investing in marine delivery facilities, if any, for the use of wind power investors, and maintaining the facilities.
d) Development of access roads within the common area of each wind farm and to each investor's project boundary, as required for transport of equipment.
e) Provisions of ancillary services such as security, landscaping of the common areas, road maintenance.
f) Maintaining the wind masts and recording of data.
g) Overall site management with legal accountability of the wind farm.
h) Ensuring that all developers develop within the blocks allocated to them, without infringing on the rights and the resource of other existing and future investors.
i) Investing in infrastructure, upgrading transmission lines, road extensions
j) Imposing service fees
k) Implementing the grievance redress mechanism for social and environmental issues
l) Statistical studies and publications
m) Optionally, provision of cranes for developers to use during wind turbine erection period, and thereafter.
n) Undertaking bird surveys and incorporating collision risk to design the wind farm, wind farm to be designed mapping environmental constraints.

Wind Farm Site Selection Criteria

559. For selection of appropriate site for wind farm, the following points are taken into consideration:

i) Ensure any protected areas and critical habitat areas are avoided in siting of the project.
ii) Public consultation and consultation with stakeholders such government bodies (tourism, urban body, navy y etc.) must to determine if the project can be sited in the area.
iii) Construction activities do not adversely affect the population living near the proposed wind farm and does not create any threat to the survival of any community with special reference to tribal community etc.
iv) The location of wind turbine does not affect any monument of cultural or historical importance.
v) No resettlement of households by the wind turbine site, no loss of livelihoods, siting of wind turbine away from schools, hospitals and other sensitive receptors, with due consultation with the community and local government units concerned.
vi) Ensure if the site selected will have low ground disturbance by taking into account of new construction techniques, logistics, laydown area designation and machinery selection.
vii) Wind turbine generator location/design to ensure that noise will not be a nuisance to neighboring properties.
viii) Site selection should consider seismicity and geography of the local area; the area should not be prone to land inundation or be unstable.

ix) The site proposed must be free from shadow flicker and blade throw constraints.

6.3.4 Future Potential for Wind Farm

560. The Action Plan[88] for wind power development in the Mannar region was recently developed which is attached as **Appendix 10**. In siting the wind farm, CEB considered both the Mannar Island and the coastal stretch around Silavathurai in the mainland. For this purpose, CEB prepared wind maps of both regions based on available wind data. According to these maps, both areas are well exposed to the SW monsoon winds that sweep across the Gulf of Mannar from May until early October. NE monsoon winds from December to February reach the Mannar Island unhindered over the sea surface in the Palk Strait. But, in reaching the Mannar mainland, NE winds undergo significant retardation due to their movement across the thickly forested landscape in the northern part of the country. The Silavathurai area in the south of the Mannar District was previously identified in the master plan as an area with potential for 75 MW of wind development. It was noted that land-related issues and human settlement in Silavathurai area was potentially a limiting factor. Based on recent discussions with the Urban Development Authority on economic and social development plans in the region, and the small parcels of agricultural land between villages, we conclude that large scale wind development in this area is unlikely.

561. Areas potentially available for locating future wind farms in the Mannar Island are shown in **Figure 6.10**. **Figure 6.11** gives locations Silvathurai area.

Figure 6.10: Areas potentially available sites for future wind farm development in the Mannar Island (only blue areas inside the rectangles A & B)

[88] Draft dated 28 June 2017 prepared by Entura and RMA under TA of Asian Development Bank.

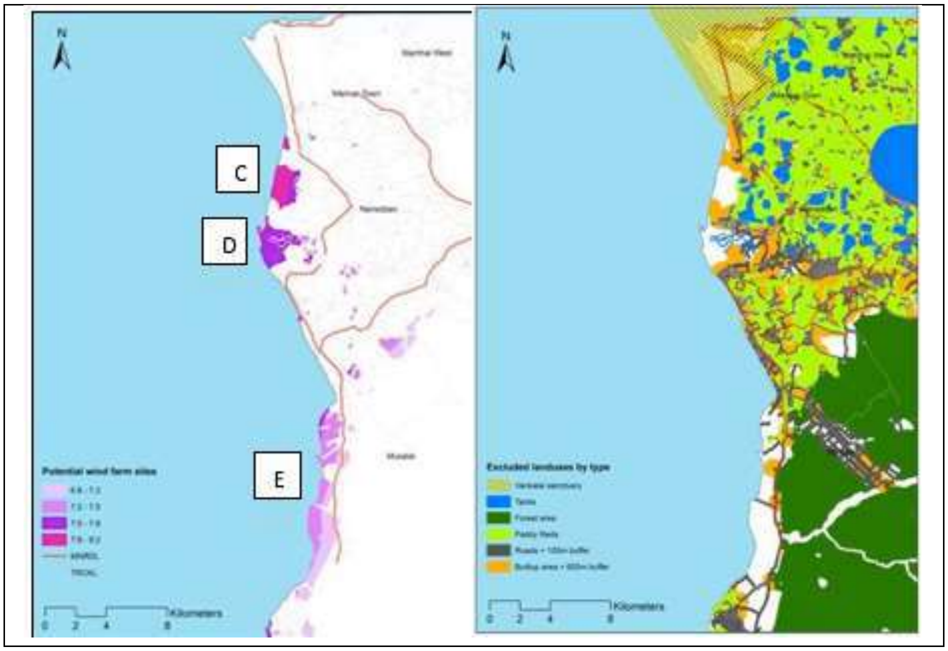

Figure 6.11: (a) Map of land use exclusions, and (b) potential locations for wind farms – Silavathurai area

562. For estimation of the wind power potential, indicative wind farm layouts were developed for each block of land that was selected as "potentially available." The layouts were based on spacing of approximately 3-rotor diameter x 7-rotor diameter (3D x 7D), for an assumed rotor diameter of 130 m to 140 m – a typical size of wind turbine that will be available from major suppliers in the near future. The estimated total wind power capacity that can be installed in these land blocks is based on a generator size of 4 MW, and is referred to as the 'developable wind power potential' (**Table 6.4).**

563. Even though the Survey Department's 1:50,000 maps do not show any dwellings in these areas, it is quite possible that isolated dwellings and home-gardens may be found in these areas. Such site-specific constraints including issues related to access and transportation were not considered in preparing these layouts. Buffers that envelop the roads were ignored from capacity estimation on the assumption that all or some of the minor roads could be re-routed to make way for a contiguous land block for a wind farm.

- Smaller patches of developable wind farm areas were ignored from the analysis, though some of them may be able to support smaller wind farms in the region of 6-8 MW depending on localised siting considerations.
- Sites A and B on Mannar Island are observed in aerial photographs to consist of tracts of land that are relatively free from existing infrastructure or inhabitants. Further, these locations are sufficiently close (5-10 km) to the proposed Nadukkuda substation that connects via a medium-voltage network that improves the possibility of being financially feasible.
- Site C in Silavathurai area is observed to consist of coastal lagoons and agricultural area further inland. It is bordered by villages to the north, south and east. An estimated capacity of 20 MW is conceived for this area. However, the lack of any transmission infrastructure will affect the viability.
- Site D in Silavathurai area is drained by several rivulets during the north-east monsoon season, and the terrain is likely unsuitable for construction of a wind

farm, hence this capacity was ignored.

- Site E stretches along the coastal fringe of the Wilpattu National Park, although some publicly available maps show the national park extending to the coastline. Regardless, the proximity of this narrow landmass to the national park is very likely to preclude large wind farm development, and hence Site C too was excluded from the analysis.

564. The total developable wind power potential in the entire Mannar region is summarised by **Table 6.4**. It should be noted that feasibility stage investigations of future wind projects could influence this estimate.

Table 6.4: Estimated potential capacity at each location

Region	Potential capacity (MW)
Mannar Island – Site A	120
Mannar Island – Site B	80
Silavathurai area – Site C	Negligible
Silavathurai area – Site D	Negligible
Silavathurai area – Site E	Negligible

Mannar Island Site Selection Justification

565. Selection of potential wind farm sites is a crucial part of wind farm development. There are many aspects involved in wind farm site selection. The principal non-technical consideration is the impact to the environment by proposed development work. Apart from meeting the environmental criteria, potential sites also have to meet certain technical and commercial criteria. The first criterion is that the wind resource must be sufficient. A wind farm's electricity output is dependent on the wind speed distribution over the project site. Therefore, project investment is best utilized by developing sites with excellent wind resources. The availability of land is crucial and the owners of lands must be willing to allocate those for wind farm development. In addition to this, site must be accessible to construction traffic either through land or sea routes or any combination of both. The access to grid connection also plays a vital role and needs to be implemented in a cost-effective manner for commercial viability.

566. The proposed wind farm site in Mannar Island was recognized in 2003 as an excellent location for a wind farm development, from an engineering perspective. The necessary investigative work in terms of assessing and validating the wind resource has been carried out on the site over several years. Recent environmental impact assessment (IEE) by CEB prepared as by TOR of the PAA concluded that the wind resource in Mannar Island can be developed in a sustainable and environmentally friendly manner. Any gaps that were noticed have been considered for study in this EIA document.

567. The proposed wind farm will be located along the southern coast of Mannar Island which receives excellent harvests of winds throughout the year. The development of 100 MW semidispatchable wind farm is the short-term target of the CEB. The long-term objective of the CEB is to develop the entire wind electric potential in the Mannar region (Mannar Island and main land areas in Mannar district) with ancillary services required for large scale integration of wind power. The background to the selection of the southern coast of Mannar Island for the proposed wind farm is outlined below.

- Availability of data from onsite wind measurement since 2001.
- Wind resource in the Mannar region has been assessed and identified through numerous studies and found to be excellent.
- Favorable site topography in terms of wind resource spread.
- Availability of land.
- 220 kV transmission links which is being constructed up to main land can be easily extended from engineering viewpoint and utilized for power transmission from wind farm.
- Southern coast can be easily accessible through sea route which offer hassle free transportation of equipment up to the project site.

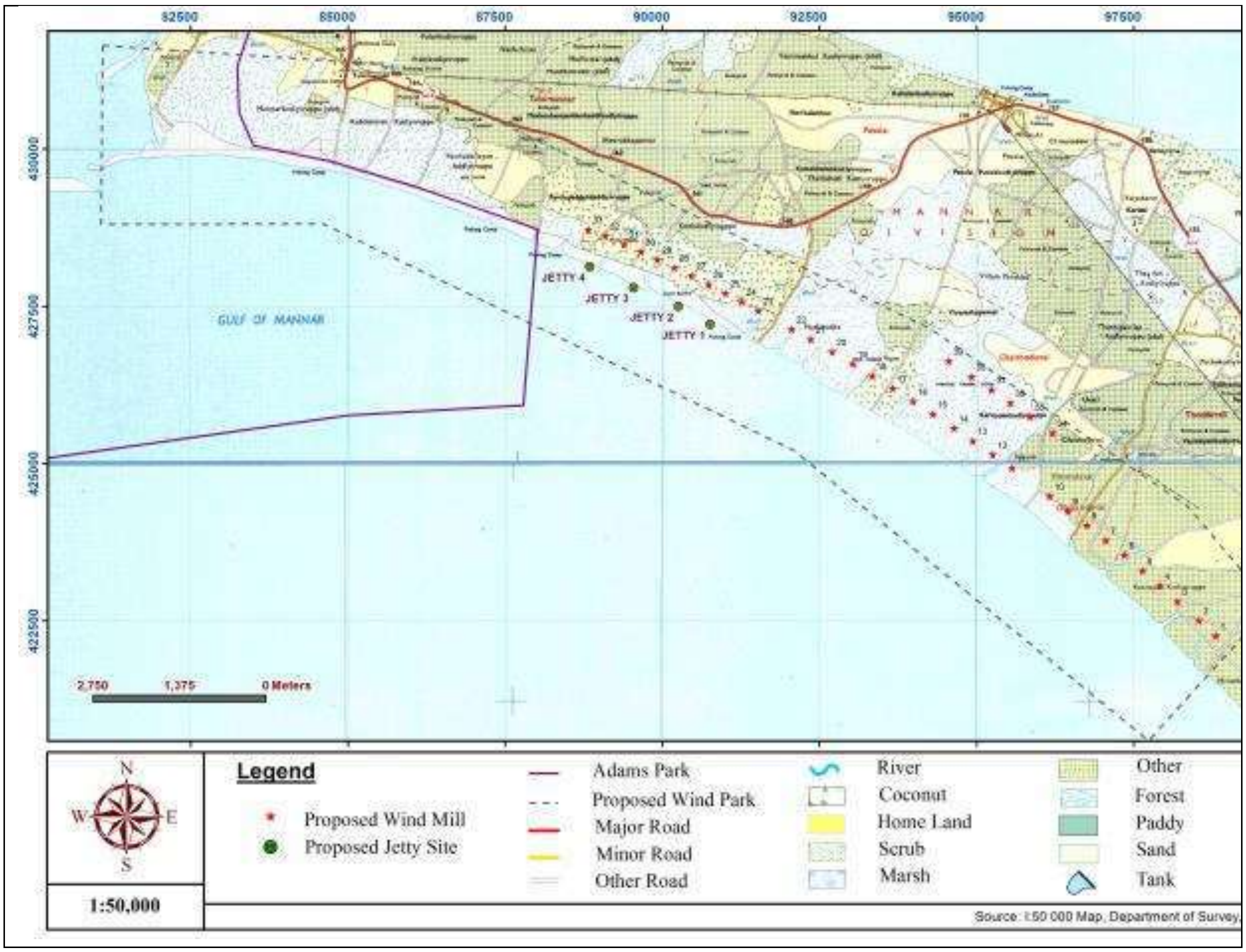

Figure 6.12: 100 MW CEB's proposed wind farm

Constraints to Wind Project Development

568. The wind power development master plan had identified potential sites to develop 375 MW of wind capacity in the Mannar district (300 MW on the Island and 75 MW along the coastal belt leading to Silavathurai). The potential is technical estimation based on the wind resource assessment and will be further adjusted based on further assessment of environmental and social safeguards. Social and environmental aspects also considered at a preliminary level though. Since finalising the WDMP in 2014, the Department of Wildlife Conservation has declared additional areas in the western edge of the Mannar Island as a reservation thus limiting a sizeable

part of the windy southern coastal belt from wind power development. This curtailed the available land for CEB's 100 MW wind project and forced them to alter the original plant layout.

569. Besides this, CEB is also facing several constraints in project development, mostly arising from estimated wind turbine noise levels and perceived impacts on bird mortality rates. The situation has been aggravated by the emergence of other economic activities (hotels, industries) within the project area causing further curtailment of land availability. This highlights the need to seek close collaboration with other stakeholders in planning wind development on a regional scale.

570. Further, social and regulatory attitudes towards wind development in the Sri Lankan context differ in comparison to international guidelines with respect to wind development. Specifically, international guidelines (as applied in localities such as Europe, North America, and Australia) require significant setbacks between wind turbines and existing surrounding residential, institutional, commercial, and industrial structures in the vicinity of the wind farm. These setbacks are generally for reasons of amenity, in relation to wind turbine noise output, and shadow flicker. It is noted that previous wind developments in Sri Lanka have involved placement of wind turbines in relatively close proximity to existing structures, at distances closer than international guidelines would generally allow.

6.3.5 Economic viability[89] of the Mannar wind farm site

571. The economic analysis was conducted in accordance with the Guidelines for Economic Analysis of Projects of the ADB and the Cost-Benefit Analysis for Development – A Practical Guide.[90] Reduction in quantities of imported fossil fuel owing to the displacement of power generation in thermal power plants by the wind power generation is the main economic benefit of project component 1. Reduction in CO_2 emissions owing to renewable power generation will bring indirect economic benefits.

Table 6.5: Assumed annual net economic growth in Mannar owing to the Project in excess of the base case without the Project

Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Net Economic Growth ($ Mn)	0.100	0.115	0.132	0.152	0.175	0.201	0.231	0.266	0.306	0.352

Year	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Net Economic Growth ($ Mn)	0.405	0.465	0.535	0.615	0.708	0.814	0.936	1.076	1.238	1.423

572. The economic evaluation was carried out for a period of 23 years from the base year of 2017. The project begins producing electricity from year 2020, and the economic evaluation covers 20 years of project operation. Fuel prices published by the World Bank were considered in the base case. Project EIRR is calculated to be 15.4%, exceeding the benchmark of 9.0%. The economic analysis indicates that the project would satisfy the benchmark EIRR of 9.0%, and that the result is robust against adverse changes in key parameters input to the analysis, except the marginal change with a 10% reduction in energy yield of the power plant, and when all adverse changes occur simultaneously (for reduction for shadow flicker and noise, and shut down of the

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[89] Result from Project Economic Evaluation report for the project prepared by Entura and RMA.
[90] http://www.adb.org/documents/guidelines-economic-analysis-projects.

turbines in the migratory season).

6.3.6 Approval from Project in SLSEA's Energy Development Zone

573. Attached in **Annexures 7 and 8** are approval letters from CCD and other stakeholders respectively giving approval to erect the 100 MW Wind Farm. The entire wind farm is being put up in the Sri Lanka Sustainable Energy Authority (SLSEA) notified energy development area at Mannar Island and the main land. The area within the dotted line in map enclosed in **Figure 6.12** shows the SLSEA Energy development area.

574. Although the SLSEA Act prohibits development in the notified zone, however construction has just started in the area. Besides the existing Shell Coast Resort, two investment cabanas,[91] sea cucumber factory, fish meal factory are being set up. CEB has approached SLSEA to check development of the facilities as that would seriously hamper the development of the wind farm in the area. According to the gazette,[92] the boundary of the wind resource development area (approximately 1.5 km x 15 km) and SLSEA has requested the Urban Development Authority to check unauthorized construction as they would restrict energy generation (and also meet noise contours given by them as an annex) according to the letter dated 21 April 2017 Ref: J/DP/MUC/02 and A-27520 in **Annexure 8,** attachment 9.

6.3.7 Equipment Transportation Options Assessment

575. Under the project, Entura was tasked to conduct a study on delivery of wind turbine (WT) components to the project site. The focus was on the appraisal of the transport infrastructure available in Sri Lanka for this project as well as proposing alternative transportation methods. Options for viable delivery methods, transport plan, infrastructure required at port of Colombo/Trincomalee and at delivery point for unloading (pier specifications, specifications of alternative unloading methods) were analyzed. The study scope involved evaluation of delivery options:

- Physical route survey from Colombo and Trincomalee to the project site at Mannar. Shipping cost up to the Colombo port and transport directly to the site in Mannar by barge.
- Port facilities and manoeuvrability survey. Temporary storage facility inside the Colombo Port area.
- Unloading from the carrying vessel of WT equipment and transfer to temporary storage area. Reloading of WT equipment from temporary storage area on to trailers/barges for sea/road transportation.
- Required equipment (barges, trailers, cranes and cradles) identification and specification.
- Route evaluation via secondary data.
- Marine transport survey.
- Data collection of annual weather patterns and tidal data.
- Evaluation for need of temporary pier, conceptual design and estimation of costs for constructions.

[91] It is noted that the two new tourist cabanas may be acquired by CEB which would negate their status as receptors.

[92] The entire project area falls within an "energy development area" declared by the Sri Lanka Sustainable Energy Authority (SLSEA) in the Mannar Island in 2014 (refer the extraordinary gazette No. 1858/2 of 17th April 2014 of the Democratic Socialist Republic of Sri Lanka).

- Delivery details of WT equipment from Colombo port by barge to the project site in Mannar.

576. Suitable tasks were undertaken to arrive at logistics options, conduct detailed route survey of land routes, conduct marine transportation evaluation as well as on-site inspection and secondary data collection and review. Different options were arrived at:

- **Road Transport.** Due to non-availability of proper roads up to the site (as per the above survey report), the movement of an appropriate WT and its components is not feasible to move by road from Colombo Port.
- **Marine Transportation.** The duration of marine transport operation is estimated at five months. The operation to be carried out during off-monsoon period (northeast) suggests the operation to commence in October and to be completed by April.
- **Construction of Pier.** It is being planned to move on the barges from Colombo Port to a pier that is to be constructed at the Mannar site. From the barges, the materials will be off loaded and stored in the yard at site. A suitable barge has been identified[93] and the pier design has been proposed accordingly. Unloading from the barges has also been considered with care and the selection of cranes has been made accordingly. The construction of temporary pier and the barge unloading shall occur between October and April as it is not possible to undertake any maritime activities during May to September due to rough sea.[94] All equipment brought in will be stored at hardstanding areas for each turbine location.
- **Alternative barge beaching method.** Use of ship launching rubber airbags to beach the barge is a method that would ensure a nominal foot print is left behind once unloading is completed. This would involve rubber roller's deployment, engaging boom truck, providing wire ropes, blocks and sheaves, land levelling, etc. to carry out barge beaching operations.

577. Hence, the most suitable modality determined for bringing in equipment to Mannar wind farm is through the sea route from Colombo and unloading at Mannar wind farm beach area using appropriate mechanism. However, the EPC contractor is free to use their own logistical arrangements which will need to be approved by CEB and concerned authorities concerned. However, EPC contractor shall update the EIA to confirm impacts of proposed logistical arrangements by them are no greater than those already assessed in this EIA report.

6.3.8 Temporary jetty (pier) for unloading equipment

578. A column and deck type pier of approximately 50 m in length and 6 m wide on steel columns extended sufficiently over the sea water surface is to be constructed for facilitating transport of wind turbine equipment, especially wind turbine blades which will be around 65 m in length.

579. The construction of the pier could potentially have a direct impact on the coastline, in view of the possibility of sediment trapping in its vicinity which could lead to coastal erosion and/or accretion on either side of the pier. The extent of the impact would depend on a number of factors associated with near shore wave, bathymetric and sediment characteristics. The four locations

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[93] Logistics report identifies no of barges, number of trips, etc. and the details are not part of EIA report. The report is available with RMA/CEB.

[94] CEB will compensate all concerned fishermen for loss of fishing period dur to temporary pier as per Appendix 1.

initially identified as possible sites for the pier (**J1**, **J2**, **J3** and **J4**) are shown in **Figure 6.14**. These locations have been identified based on the availability of affordable depth of 5 m and above closer to the coastline. Bathymetric surveys are being carried out to select the location of the pier. A sketch of the type of the pier proposed is shown in **Figure 6.13. Appendix 1** describes the temporary pier layout details.

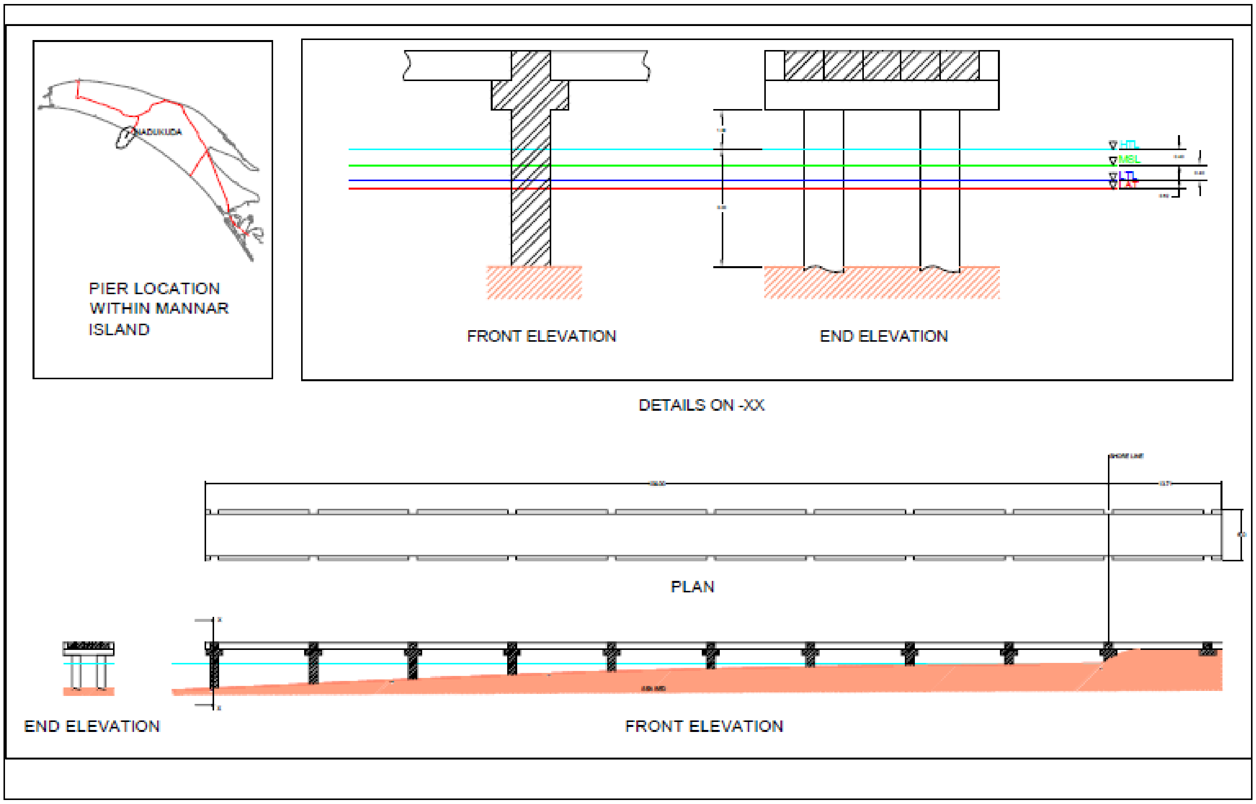


Figure 6.13: Illustrative Design of the Pier

580. As indicated in **Figure 6.13**, the pier is to be constructed over steel columns. The pier extends 50 m into the near-shore area, from the permanent vegetation line. The work area width is 6 m (which is the required width of the trailer track. The piles are spaced at 6 m intervals. The deck level is 3 m above the Mean Sea Level (MSL).

581. Underwater survey was conducted in four locations close to Nadukuda (**Figure 6.14**) to identify the ecologically least sensitive location to construct a jetty.[95] Photographs are appended in later paragraphs. **Annexure 2** contains all surey results (Tables 1-5) and report. Underwater survey was conducted along several dive transects. Rapid underwater surveys were conducted to explore the noteworthy ecosystems, fauna and flora within and proximity to the four sites identified for construction of a jetty. Underwater Visual Surveys (UVS) were conducted up to 5 m depth. In addition to direct observations; permanent visual records were obtained using photos and videos. Sediment samples were also obtained for classification of sediments and also to study any life forms.

582. Coastal habitats in Mannar comprise of an extensive system of estuaries and lagoons, mangroves, salt marshes, sand dunes, beaches, coastal marshy wetlands and mud flats

[95] See Section 4.2.3 Marine and coastal environment.

supporting very high biodiversity. However, the shallow coastal stretch adjoining the project area is devoid of such ecologically sensitive habitats.

Figure 6.14: Identified locations for constructing a jetty for barges

583. The underwater study revealed that all four locations were very identical in terms of sediment characteristics and life forms. The near shore continental shelf in the study area were very shallow with very little slope towards offshore. Sediments were mostly sand (fine sand to course sand) with some remaining of mollusk and other shells. Hermit crabs were the only observed life form other than very few intermittently free swimming fishes such as carangids (See Table 1 in **Annexure 2**. The water was very murky and could not see more that 2 meters underwater due to high sedimentation. Any sensitive ecosystems such as sea grasses turtle nests or coral reefs within or vicinity of the project sites are not found. Even any breakoffs of sea grasses or corals were not observed confirming that there were no such ecologically sensitive ecosystems in proximity.

584. Sample photographs (**Figure 6.15, 6.16, 6.17, and 6.18**) are shown in the following figures from these two perpendicular transects (PERTL, PERTR) obtained at 2 m depth and two parallel transects (PARTL, PARTR) obtained at 3.5 m depth. Since four of the locations studied are not ecologically sensitive (No sensitive ecosystems or noteworthy fauna or flora). Any of the four sites can be used for temporary pier construction.

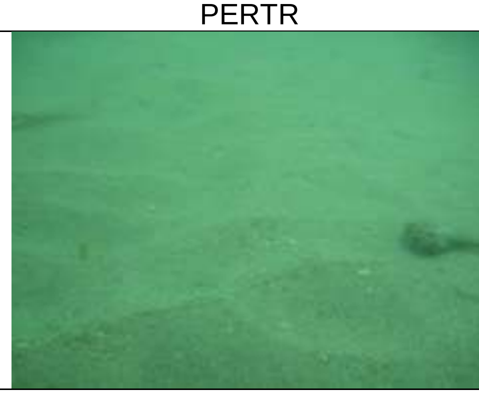
Site option 1

(Close to Nadukuda)

PERTL

PERTR

PARTL



PARTR

Figure 6.15: Sample photographs from two perpendicular transects (PERTL, PERTR) obtained at 2 m depth and two parallel transects (PARTL, PARTR) obtained at 3.5 m depth

585. At site option 1, sediments consist of very fine sand. Some dead mollusk shells were observed. Some of the dead shells were occupied by hermit crabs.

	**Site option 2**
PERTL	PERTR
	
PARTL	PARTR
	

Figure 6.16: Sample photographs from two perpendicular transects (PERTL, PERTR) obtained at 2m depth and two parallel transects (PARTL, PARTR) obtained at 3.5m depth

586. At site option 2, sediments consist of very fine to medium sand. Some dead mollusk shells were observed. Some hermit crabs were present.

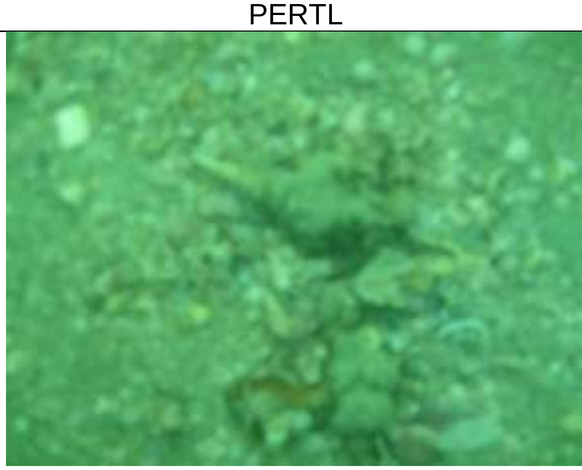
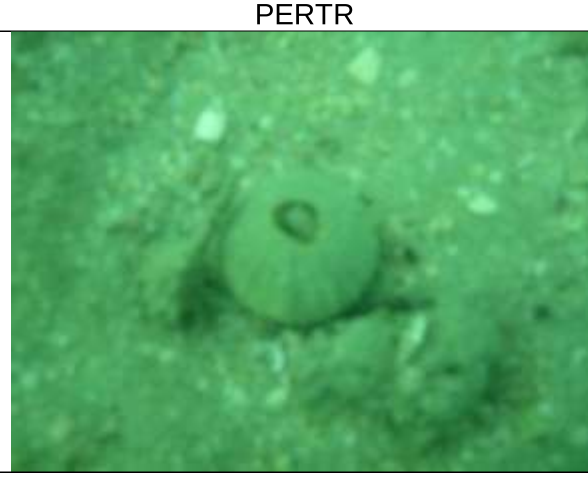
	**Site option 3**
	
PERTL	PERTR
	
PARTL	PARTR

Figure 6.17: Sample photographs from two perpendicular transects (PERTL, PERTR) obtained at 2 m depth and two parallel transects (PARTL, PARTR) obtained at 3.5 m depth

587. At site option 3, sediments consist of coarse sand. Some dead mollusk shells and sea urchin shells were observed. Some hermit crabs were occupied in abandoned mollusk shells.

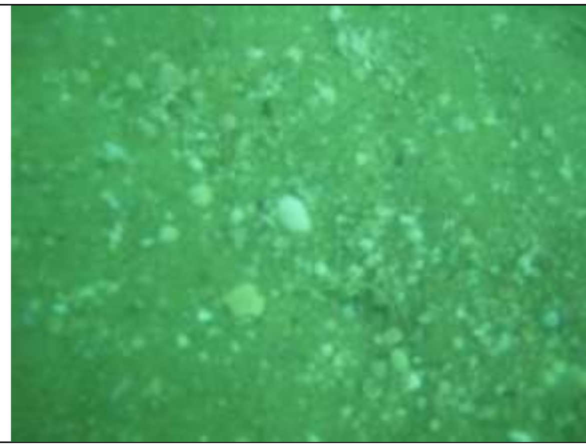
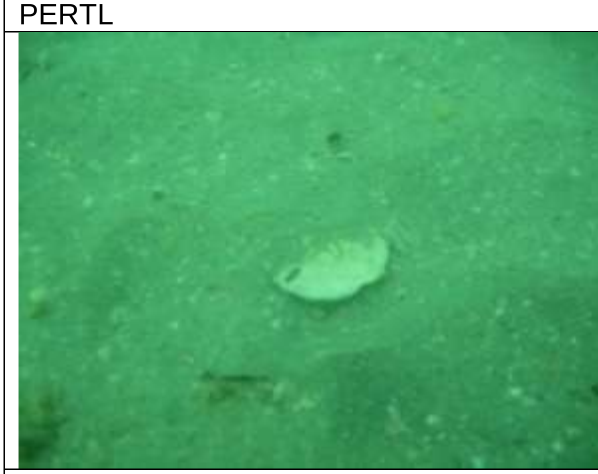
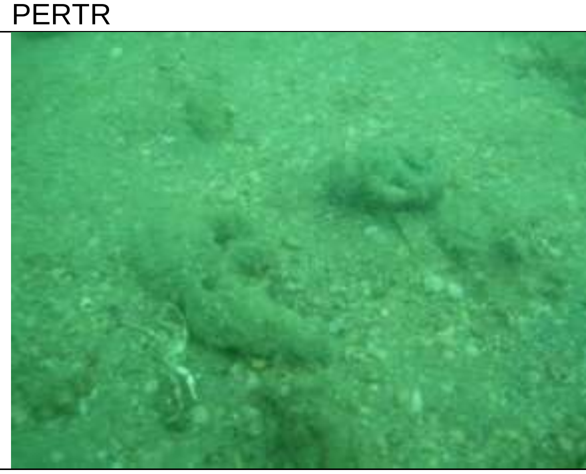
	**Site option 4**
	
PERTL	PERTR
	
PARTL	PARTR

Figure 6.18: Sample photographs from two perpendicular transects (PERTL, PERTR) obtained at 2 m depth and two parallel transects (PARTL, PARTR) obtained at 3.5 m depth

588. At site option 4[96] sediments consist of coarse sand in very shallow waters and fine sand towards deeper waters. Dead mollusk shells were very abundant. **Table 6.6** gives some physicochemical parameters, and classification of sediments.

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[96] A survey was conducted to identify any ecologically sensitive ecosystems within four options selected from bathymetry. There is no such sentitive ecosystems, so rest lie with the engineering design to select best site.

Table 6.6: Some physicochemical parameters, and classification of sediments

Site	Approximate distance from MSL to 4 m depth (m)*	Depth	T water	DO mg/l	Cond mS	TDS g/L	Sal ppt/ PSU	PH	Bottom details sandy, muddy, mix	Major fauna and flora
1	210	Surface	29.4	6.01	57.6	33.9	34.1	8.22	Fine sand	
		Bottom (4 m)	30.0	5.78	58.0	34.9	34.7	8.28		Hermit crabs
2	195	Surface	29.8	6.61	58.3	34.3	34.7	8.25	Fine to medium sand	
		Bottom	30.4	6.92	58.6	34.6	34.7	8.27		Hermit crabs
3	190	Surface	30.5	6.31	58.6	34.3	34.8	8.28	Coarse sand with mollusk shells	
		Bottom	30.6	6.15	58.9	34.4	34.7	8.27		Hermit crabs
4	145	Surface	30.6	6.41	58.4	34.3	34.7	8.26	Coarse sand with mollusk shells	
		Bottom	30.4	6.64	58.3	34.3	34.7	8.26		-

7.0 INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

589. This section describes the process undertaken during project design and preparation for engaging stakeholders, including information disclosure and consultation with affected people and other stakeholders; summarizes comments and concerns received from affected people and other stakeholders and how these comments have been addressed in project design and mitigation measures. The section also describes the planned information disclosure measures (including the type of information to be disseminated and the method of dissemination) and the process for carrying out consultation with affected people and facilitating their participation during project implementation.

7.1 Information Disclosure and Public Consultations

590. In line with the National Environmental Act (2002) of Sri Lanka, public consultation and information disclosure will be undertaken through public notice prior to the approval by the CEA for a particular project. According to ADB SPS (2009), public consultation and information disclosure is to be made during the initial stages by the client itself. For environment category A projects, such consultations need to be conducted at the early stage of EIA field work, another consultation once the draft EIA report is available, and again another consultation before project appraisal by ADB (if appraisal is required for the project).

591. Consultation and information disclosure provide project-affected persons and key stakeholders with a chance to give their views and perceptions about the proposed project and for CEB to understand and address their concerns to the extent possible. Suggestions and recommendations of affected persons on mitigation measures and environmental monitoring during project implementation will be considered and reviewed by CEB, to the extent possible.

592. The process of information disclosure and public consultations will continue throughout the lifetime of the proposed wind power generation project. CEB will include a stakeholders' communications strategy/plan to raise awareness of key stakeholders about environmental protection measures and other relevant issues. The stakeholders' communications plan will be

finalized by CEB prior to any civil works, in consultation with affected persons and key stakeholders.

593. A socio-economic household survey was conducted with a random sample of 200 households selected from among the seven GNDs who live in the project impact area. The survey collected household level information such as their composition, livelihoods, housing types and amenities, land ownership patterns and a range of other socio-economic data on education, poverty, energy use, etc.

594. Public consultations were conducted in each of the seven GNDs to inform the communities about the project and to elicit their views and suggestions on the project. These consultations also served to gather qualitative information on the socio-economic situation of the settlements in the project impact area. A total of seven consultations were conducted within March 2016 until February 2017. These consultations were attended altogether by 548 pesons (see **Table 7.1**). A consolidated summary of the consultation outcomes and the list of participants are given in **Annexure 9**. Three separate consultations were conducted exclusively with groups of women, attended by 55 persons, with a view to get the response of women to the proposed wind project and to understand the specific socio-economic issues that women are confronted with in their respective communities. Another pubpic consultation took place on 23 May 2017.

Table 7.1: Public Consultations held between March 2016 to August 2017

SNo	Location	Distance from Wind Farm Area	Date of consultations	Number of Participants at Consultation		
				Total	Male	Female
A. One-on-one consultation with NGOs and Shell Coast Resort						
1	Meetings with NGOs at BMICH Colombo	Colombo	23 May 2017	42	34	8
2	Email from Shell Coast Resort Manager	Mannar Island	18 Aug 2017			
B. Fact Finding Mission (one consultation before EIA disclosure)						
3	Meetings with NGOs at BMICH Colombo	Colombo	20 Feb 2017	42	27	15
	Public Meetings at villages with ADB	Within 5 km of project Area	17-18 Feb 2017			
4-A	Meeting held at Sinnakarisal with the fishery society	Same as above	18 Feb 2017	34	31	03
4-B	Meeting held at Konniyankudiyirupu church (9:45 am) with the Women's Rural Development Society		19 Feb 2017	41	22	19
4-C	Meeting with the Nadukuda Fishery society	Nadukuda community hall	19 Feb 2017	33	30	03
C. Project Consultation						
5	Five villages (Konniyankudiyrippu, Uvari, Olaiththoduvai, (including Valan Nagar), Nadukkuda, Keeliyankudiyiruppu, and Selvari	850 m to 1.5 km from the wind power generation project site	21 small group discussions in December 2016 and January 2017	73	43	30
6	Discussions with Migrant Fishermen Laborer	At wind farm site	Individual and small groups between December 2016-	50	50	0

SNo	Location	Distance from Wind Farm Area	Date of consultations	Number of Participants at Consultation		
				Total	Male	Female
			January 2017			
D. IEE Development in early 2016 (Added from the IEE report April 2016)						
7	Consultation in Villages	850 m to 1.5 km from the wind power generation project site	1-14 March 2016	194	144	50
8	Consultation with Women Groups	850 m to 1.5 km from the wind power generation project site	Same as above	55	00	55
9	Public Awareness Meeting Held with representatives of Fishing Community in Mannar Island	On site	850 m to 1.5 km from the wind power generation project site	29	29	00

7.2 Consultation Findings

7.2.1 Concerns and Fears of the Local Communities

595. The consultations conducted with local communities during the social impact assessment raised a number of issues, concerns and fears of the local communities, which need to be carefully reviewed, assessed and addressed during project planning and implementation. These issues and concerns largely evolve around the perceived impacts of the project by local communities on their livelihoods, common property resources, natural resources, social life and personal security. They include the following.

(i) Will the sound generated by turbine blades cause depletion of fish resource? It is the perception of the fishermen communities that the sound from the wind turbines (located closer to the sea) can disturb the fish resource in the shallow seas and drive them towards the deep seas. Such movements of fish can adversely affect the *ma-del* fishing industry conducted in the project impact area.

(ii) Will the project area be fenced off? If fenced off, cattle and goats will lose access to their grazing grounds. Fishermen in *Vaadies* will be displaced. Movements of vehicles will be obstructed.

(iii) Can the corridor of the wind turbines be moved beyond 250 m inland from the coast? It was reported that the Fishery Department has declared a 199 m zone for the fishing activities. If wind turbines were installed 150 m inland from the coast, fishermen would still lose 49 m of their fishing territory.

(iv) Will the sounds generated by the wind turbines disturb the tranquility of the community life?

(v) How can the communities expand their settlements along with prospective population increases when access to land is restricted by the project?

(vi) Will the project create any employment opportunities for community members?

(vii) Will the project create any social problems for local communities with permanent residence of outsiders who come for operation and maintenance services?

(viii) Can the project train and provide employment to local community members in maintenance services?

(ix) Will the wind turbines accelerate the sand erosion that regularly occurs within the project impact area? Any increase in the level of sand erosion can adversely affect the settlements and the residential dwellings of the people.

(x) Will the wind turbines fall down due to soil/sand erosion?

(xi) Will the wind turbines increase the temperature levels in the area and cause drying out of coconut and Palmyra tree leaves?

(xii) Will the wind turbines capture lightning during rainy season and affect the lives of people and particularly the fishermen community in the coastal areas?

(xiii) Will the blades of the turbines be blown off during rainy or windy season and cause harm to the lives of people?

(xiv) Will the wind turbine generate any solid or liquid waste and affect the ground water levels?

(xv) Will the wind turbines release any radioactive pollutants which are harmful to the lives of people?

(xvi) Will the wind turbines affect the lives of local and migratory birds?

7.2.2 Major issues with fisheries within Project area

596. According to the information from respondents, there were some illegal fishing operations such as dynamiting, Surukku del (mini purse seines), which are harmful and destructive types of fisheries. These gears are operated by fisherman visiting from other areas. Illegal fishing operations were major concern of the local fisherman and they claim that their fish catch are affected and going down due to these harmful fishing gear (See Table 6 in **Annexure 2**). The Department of Fisheries would collate all fish catch data before the mitigation and monitoring measures can be put in place. **Table 7.2** summarizes the major issues that the fishermen face. Another major concern was poaching in Sri Lankan waters by Indian trawlers.

Table 7.2: Major issues with fisheries and key respondents view on wind farm project

Ma-del padu/key informant	Issues facing related to the fishery	Response on wind farm project
Malivady Anthony from Pesalai	Poaching by foreign fishermen	Happy that project is being constructed in the area. They need access roads to be developed which the project can help provide.
Oolaithoduvai Alexander from Podukuduiruppu	Surukku del and dynamite operations by fishermen from other areas	Very positive and supportive of the project.
Uvari Abdul Cader Nizar	Surukku del and dynamite operations by fishermen from other areas is a big issue to reduce Ma-del catch	Some fish will not come closer due to sound of the wind turbines and that will affect their fishery.
Nadukuda 1	Foreign trawlers in our sea destroying seabed are a big problem for our fisheries. Some fisherman use surukku del which catch small fish and big fish who follow them will be reduced	Wind turbine sound will affect their fishery. Boat anchorage (Pier) is not necessary. If project needs a pier, it should be built close to old pier.
Nadukuda 2	Dynamite and surukku del is big problem for ordinary fisherman. No such illegal fishery before 2012 and fish catch has reduced with such operations.	Very happy if road and other facilities are developed with the project. A temporary or permanent pier is not necessary. If project needs a pier, it should be built close to old pier.
Kiriyankuduyiruppu	Illegal fishing such as surukku del is big problem for ma-del fishermen	Very happy if road and other facilities are developed with the project.
Palavithotai Susantha Perera from Negombo	None	Very happy if road and other facilities are developed with the project. Turbines

Ma-del padu/key informant	Issues facing related to the fishery	Response on wind farm project
		should not be close to road as fishing camps need developments.
Old Pier – 1 K A R Fernando Wennappuwa	None	Very happy if road and other facilities are developed with the project.
Old Pier - 2 Felix from Negombo	Illegal fishing such as surukku del is big problem for ma-del fishermen	Very happy if infrastructure facilities are developed with the project.

[a] Not possible as the old pier site not suitable due to depths which are lesser that the required barge depths.

7.2.3 Destructive Fishing Practices

597. Destructive fishing practices which will impact the fishery resources were observed during the study:

- Dynamiting – legally banned but still taking place.
- Monofilament nets (*Thangus*) – were being used in several sites.
- Surukku nets (mini purse-seining) - and other harmful fishing methods such as dynamiting banned island-wide long ago but has not been enforced in the Mannar District. However, with effect from 3 October 2010 fisheries authorities are making effort to enforce these regulations in the Mannar District as well.
- SCUBA diving to collect sea cucumber and conch – banned in GoSL without permits, but some fishermen are still operating. The collection of holothurians (sea cucumber), gastropods (conch) and bivalves (oysters) is prohibited without permits or without conforming to the conditions of the permit, especially on recommended sizes.

7.2.4 Uncontrolled Exploitation

598. Continued collection of marine resources: holothurians (sea cucumber), gastropods (conch) and bivalves (oysters) without permits or without conforming to the conditions of the permit, particularly on recommended sizes.

7.2.5 Poaching

599. There is an ongoing feud between fishermen of Sri Lanka and India. There are allegations and counter-allegations. Fishermen in the study area claim that large fleets of Indian fishing boats are poaching in Sri Lankan waters in large scale scraping the sea bottom by trawling and thereby reducing their catch while destroying the resource.

7.2.6 By-catch

600. It was observed during the field survey that the by-catch is discarded in an indiscriminate manner, causing significant pollution of the beach.

7.2.7 Respondents' View on Wind Farm

601. All survey respondents were very positive on the project and they are expecting some developments such as access roads to fishing camp sites and other basic infrastructure facilities. A major concern of many respondents on the project was that the sound generated by wind turbines that may potentially cause fish moving away and will adversely affect the beach seine

fishery.

602. During consultations, it was clearly explained to the fisherfolks that it is not sound but vibration that may affect fish movements. However, the wind turbines will be far from the coast and vibration from the moving parts of the turbine will be negligible and would not be sensed by the fish. Also, informed them that there are several such wind turbines in Kalpitiya area and there were no such complaints from the fisherfolks. The respondents were happy with the assurance that the project will not affect fish movements and thus, will support the implementation of the project.

Actions from Consultations

603. As follow-up of consultations with local fisherfolks in February 2017, the following issues have been elaborated by Marine expert.[97]

Discussion: Wind turbine Noise Impact on Near Shore Fish and Fisheries

604. During the field surveys, public consultations, interviews with key informants and meeting with fishermen groups, there was a great concern from fishermen that the fish inhabiting in near shore coastal environment and that are subject to get caught in Beach seine (ma-del) fishing would move away from the area due to noise from the wind turbines.

605. Rotor blades when move through air produce an aerodynamic noise. This noise is noticeable when it is greater than the background noise. Older operating wind turbines may produce a tonal noise. However, this is generally not the case with the modern large wind turbines proposed for this project. Following description provides basics of fish bioacoustics and latest findings on the impacts of noise on fish and other aquatic organisms.

- Fish have two sensory systems for detection of water motions: the inner ear (otolith) and the lateral line system. However, fish have no outer ears to detect direct sound. The inner ear detect sound up to hundreds or even thousands of Hz, whereas the lateral line detects low-frequency sound, but is generally considered to be primarily a detector of water motion rather than noise.
- It is known that sound travels much further and faster (5 times) in water than air. Fish can get a great deal of information about biotic (living) and abiotic (environmental) sources and get a good "image" of the environment to a very substantial distance detecting the motion in water. Many species of bony fishes communicate with sounds and use sounds in a wide range of behaviors including, mating and communication, localization of food, avoiding predators, navigation. However, in all these instances fish detect vibration that results underwater due to sound.
- Sounds that produce due to wind turbine are in low energy and produce in air more than 150 m away from the sea. Low energy sound source of this caliber and that far cannot produce vibration in sea water for fish to detect. Therefore, it is not possible for wind turbine noise to chase fish away from near shore environments. Extensive literature survey was conducted on this issue and there is no evidence for impact of on-shore wind turbines on fish or fisheries.

[97] Prof. Kamal Ranatunga (PhD In Marine Ecology, JCU Australia), Senior Lecturer, Department of Zoology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.

- However, there are studies (i.e., Andersson, 2011;[98] Snyder and Kaiser, 2009;[99] Thomsen, et.al., 2006;[100] Wahlberg and Westerberg, 2005)[101] confirming impact of noise generated from off-shore wind farms (wind turbines erected in seawater itself). Even in such situations the impact is limited to 50 m radius.

8.0 GRIEVANCE REDRESS MECHANISM

606. This section describes the grievance redress framework (both informal and formal channels), setting out the timeframe and mechanisms for resolving complaints about environmental performance as per Electricity Act 2009.

8.1 Awareness of Stakeholders

607. During public consultation sessions of the EIA study, the discussions with groups and individuals were conducted to make them aware of the proposed project. Thus, the project-affected community residing beside the proposed transmission line has gained a reasonable knowledge about the potential grievances, which will arise in the future.

608. A community awareness programme must be conducted one month prior to construction by the Project Implementation Unit (PIU) of CEB regarding the scope of the project, procedure of construction activities, utility of resources, identified impacts and mitigation measures. These awareness programs will help the community to resolve problems, and clarify their distrusts related to the proposed project at initial stage.

609. The community should be informed about the GRM, which is already established by the Public Utilities Commission of Sri Lanka (PUCSL), procedure for making complaints, including the place and the responsible person to contact in practical way in this regard. Almost all the stakeholders related to the GRM will also be made aware of the established grievance process, the requirement of grievance mechanism, goals, benefits, relevant laws regulations, etc.

8.2 The Grievance Redress Mechanism and PUCSL

610. The GRM for the infrastructure development project provides an effective approach for complaints and resolution of issues made by the affected community in a reliable way. This mechanism will remain active throughout the life cycle of the project. The Public Utilities Commission of Sri Lanka (PUCSL) Act creates an environment for all inhabitants of Sri Lanka and the contributors to its development, to have access to essential infrastructure and utility services in the most economical manner within the boundaries of the sustainable development agenda of the country. PUCSL's mission is to regulate all the utilities within its purview to ensure safe, reliable and reasonably priced infrastructure services for existing as well as future consumers in the most equitable and sustainable manner. According to PUCSL Act and passing of Sri Lanka Electricity Act No. 20 of 2009, PUSCL102 is empowered to review the complaints,

[98] Andersson, M. H. (2011). *Offshore wind farms-ecological effects of noise and habitat alteration on fish* (Doctoral dissertation, Department of Zoology, Stockholm University).

[99] Snyder, B., and Kaiser, M. J. (2009). Ecological and economic cost-benefit analysis of offshore wind energy. *Renewable Energy*, *34*(6), 1567-1578.

[100] Thomsen, F., Lüdemann, K., Kafemann, R., and Piper, W. (2006). Effects of offshore wind farm noise on marine mammals and fish. *Biola, Hamburg, Germany on behalf of COWRIE Ltd*, *62*.

[101] Wahlberg, M., and Westerberg, H. (2005). Hearing in fish and their reactions to sounds from offshore wind farms. *Marine Ecology Progress Series*, *288*, 295-309.

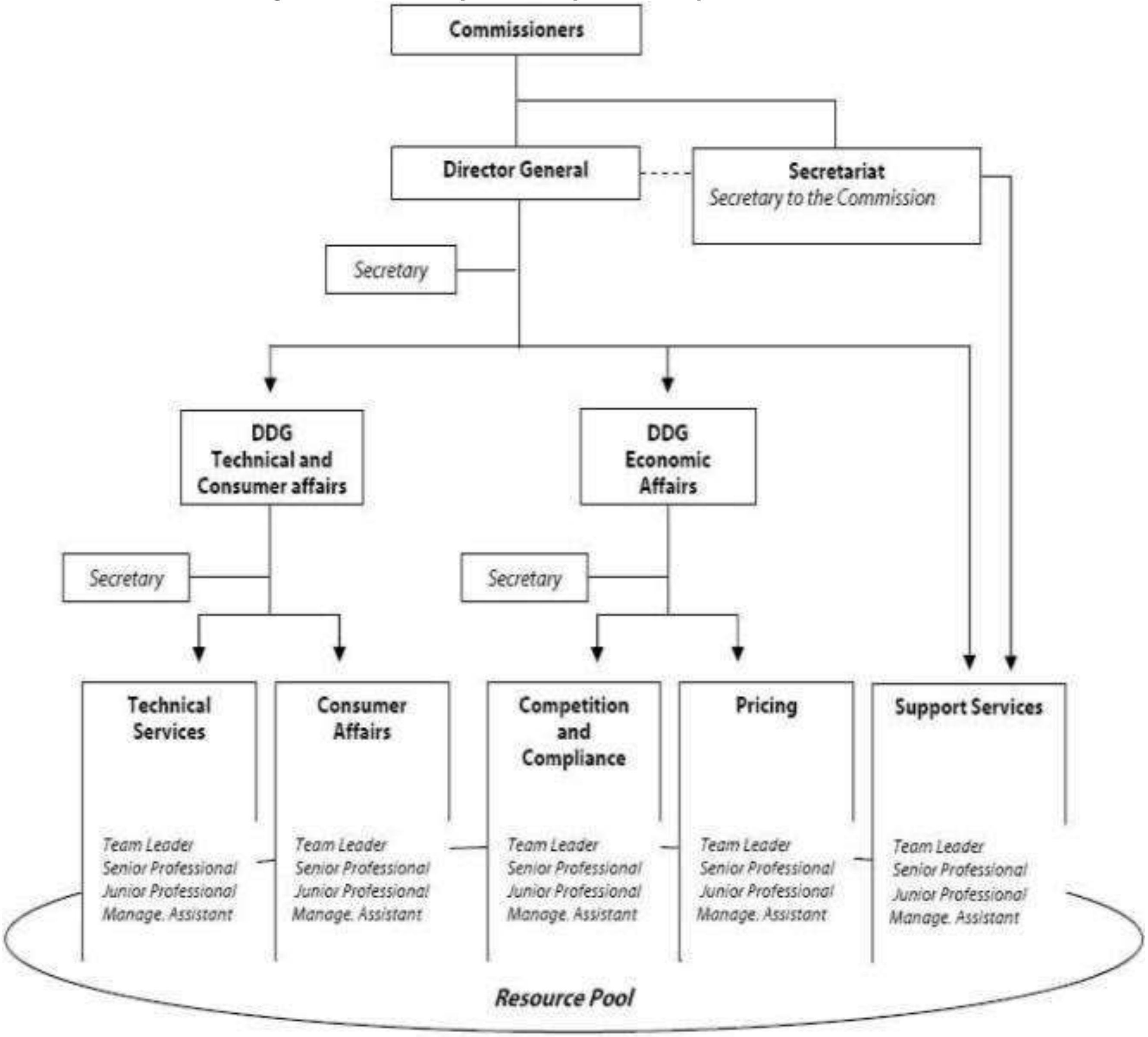
[102] http://www.pucsl.gov.lk/test_english/about-us/english-functions/

and determine by mediation disputes arising in any public utilities industry such as CEB and also set and enforce technical and other standards relating to the safety, quality, continuity and reliability of the public utilities industries. **Figure 8.1** depicts the PUCSL hierarchy.

611. All the members in PUCSL need to be informed by the PIU regarding procedures of GRM. The information should include procedures of taking/recording complaints, handling of on-the-spot resolution of minor problems, taking care of complainants and provisions of responses to distressed stakeholders, etc. PUCSL has a standard mechanism of (i) informing the affected people GRM and its functions; (ii) how peoples representatives in the GRC will be selected; (iii) procedure and the mechanisms adopted for making the complaints; (iv) supporting the complainants in communicating their grievance and attending the GRM meetings; and (v) implementing compliance to a GRMs' decision, its monitoring and communication to the people. Periodic meetings of PUCSL are to be conducted by the PIU so that all the members of the PUCSL are familiar with the problems and responses received by individuals in the PUCSL.

612. ADB procedures require CEB to establish a GRM having suitable grievance redress procedure to receive and facilitate resolution of affected peoples' concerns, complaints, and grievances about the subproject's environmental performance. The GRM will aim to provide a time-bound and transparent mechanism to voice and resolve social and environmental concerns linked to the project. A common GRM will be in place for social, environmental or any other grievances related to the project. The GRM will provide an accessible and trusted platform for receiving and facilitating resolution of affected persons' grievances related to the project. The GRM procedure for the project is outlined below, which follows a time-bound schedule, with responsible persons identified to address grievances and seek appropriate persons' advice at each stage, as required.

Figure 8.1: Responsibility Hierarchy of PUCSL



613. The GRM will be scaled to the risks and adverse impacts on environment due to the project type, size, type of area (sensitive area) and impacts. It should address affected people's concerns and complaints promptly, using a transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people at no costs and without retribution. This GRM would consist of a Grievance Redress Committee (GRC) headed by the Project Head. The committee would consist of the following constitution as listed in **Table 8.1**.

Table 8.1: Constitution of Grievance Redress Committee

1	Project Head, CEB
2	Division Secretary or their nominee
3	Representative of Gram Niladhari/Council
4	Women representative of village/council
5	Representative of EPC* contractor
6	Environment Officer at PMU or nominee

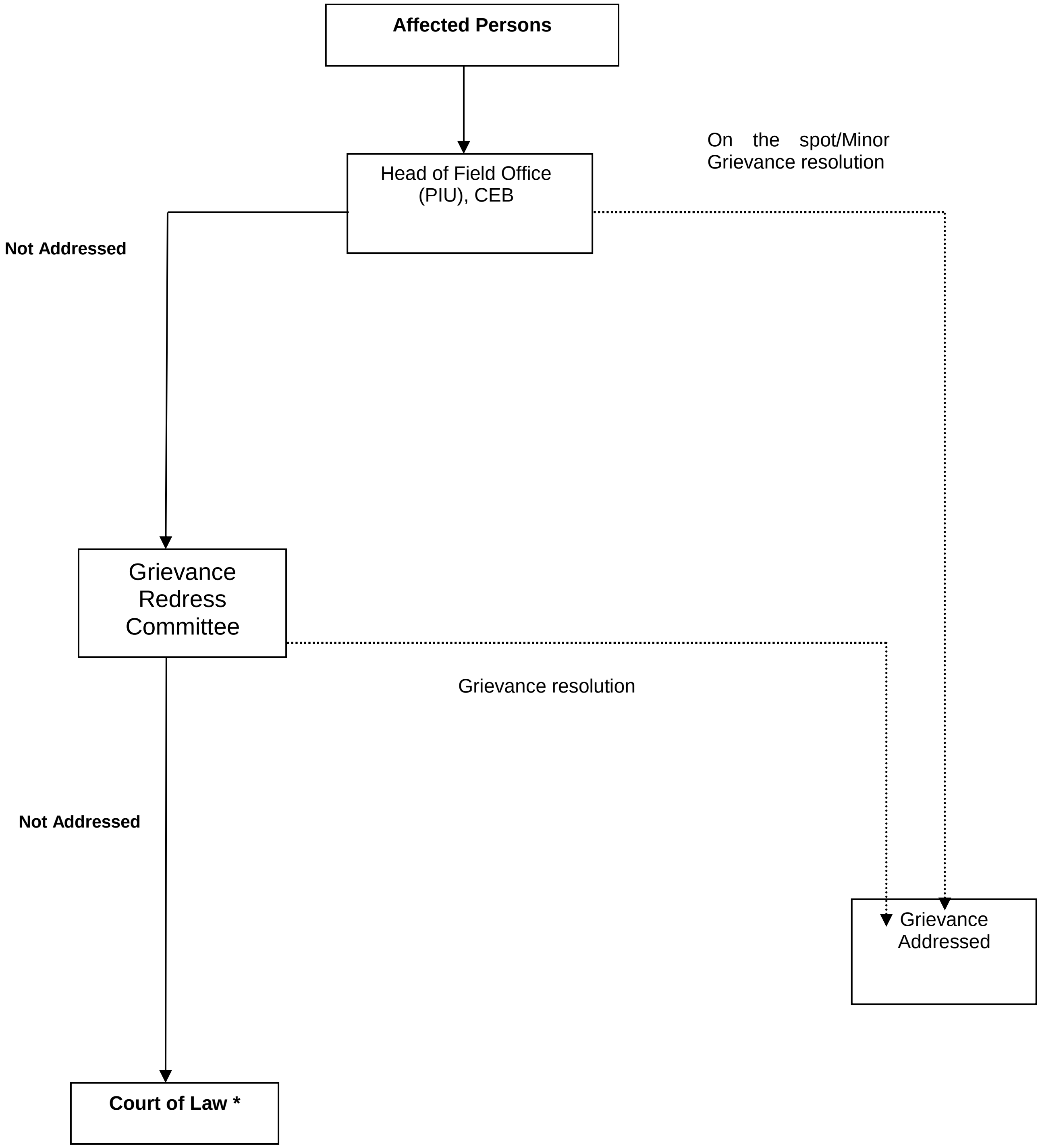
EPC = Engineering, Procurement and Construction Contractor.

614. The GRM would provide an effective approach for resolution of complaints and issues of the affected person/community. Project Management Unit (PMU) shall formulate procedures for implementing the GRM, while the PIUs shall undertake GRM's initiatives that include procedures of taking/recording complaints, handling of on-the-spot resolution of minor problems, taking care of complainants and provisions of responses to distressed stakeholders etc. paying particular attention to the impacts on vulnerable groups.

615. Grievances of affected persons (APs) will first be brought to the attention of the Project head of the PIU. Grievances not redressed by the PIU will be brought to the Grievance Redress Committee (GRC) set up to monitor project Implementation. The GRC will determine the merit of each grievance, and resolve grievances within an outer time limit of fourty five days of receiving the complaint. The proposed mechanism does not impede access to the country's judicial or administrative remedies. The AP has the right to refer the grievances to an appropriate court of law/PUCSL if not satisfied with the redress at any stage of the process.

616. The PIU will keep records of all grievances received including: contact details of complainant, date that the complaint was received, nature of grievance, agreed corrective actions and the date these were effected, and final outcome. The flow chart showing the GRM is presented in **Figure 8.2**.

Figure: 8.2: Flow chart showing Grievance Redress Mechanism



(*) Affected Persons can approach the court of law/PUCSL at time during the Grievance redress process.

9.0 ENVIRONMENTAL MANAGEMENT PLAN

617. This section deals with mitigation and management measures to be taken during project implementation to avoid, reduce, mitigate, or compensate for adverse environmental impacts. The EMP includes management plans and mitigation actions that identifies and summarizes anticipated significant adverse environmental impacts and risks and describes each mitigation measure including the type of impact to which it relates, as appropriate.

9.1 Environmental Management Plan

618. The Environmental Management Plan (EMP) prepared for the project discusses the anticipated impacts, monitoring requirements, and development of mitigation measures with respect to the following stages: (i) pre-construction, (ii) construction, and (iii) operation and maintenance. Detailed, site-specific mitigation measures and monitoring plans are developed and will be implemented during the project implementation phase. An effective environmental management system is a dynamic, continuous process initiated by management and involving communication between the project proponent, the workers, and the local communities directly affected by the project.

619. The EMP for the project is attached as **Annexure 3**, which identifies feasible and cost - effective measures to be taken to reduce potential significant, adverse, impacts to acceptable levels. Here, mitigation measures are proposed for each potential impact, including details on responsible parties for implementation of mitigation measures and supervision. The EMP includes proposed mitigation measures, environmental monitoring and reporting requirements, training measures, implementation schedule and cost estimates.

620. **Annexures 3, 4, and 5** must be read by CEB, their EPC contractor and other organizations with implementation responsibilities in conjunction with the EIA, which elaborates on the details of the mitigation measures to be implemented, the construction method statement to be followed and the monitoring requirements.

621. A summary environmental impact matrix and the mitigation measures are given in **Table 9.1**.

Table 9.1: Environmental Impact Matrix

Sl. Nº	Environmental attribute	Potential impacts	Nature of impact	Magnitude of impacts: Low	Medium	High	Mitigation measures	Implementation & Monitoring
A.			**Physical Resources**					
1.	Topography	Change in the surface features and present aesthetics due to the construction of the project.	Direct/Local/ irreversible		X		Removal of trees and vegetation will require approvals from appropriate Department.	Before construction phase
2.	Climate	No impacts on the climatic conditions	Direct/Local/ irreversible	X			No measure impact on the climatic conditions, hence no mitigation is required	
B.			**Environmental Resources**					
1.	Air Quality	Project will have marginal impact on air quality during the construction period due to increase in the dust emission.	Direct/Local/ reversible	X			Watering at construction site, limited bare soils, proper maintenance of vehicles etc.	During construction activity
2.	Noise	Noise due to general construction activities.	Direct/Local/ reversible		X		Restriction of noise generating activities at night and use of personal protective equipment like ear plugs, mufflers etc. Work only during between 6 AM-6PM.	During construction activity
		Noise arising from operation of wind turbines	Direct/Local/ reversible			X	Choose wind turbine type and locations to ensure noise to receptors is minimized	During construction and operational phases
3.	Surface and Ground Water quality	Runoff from the construction site	Direct/Local/ reversible	X			Careful siting of Wind turbines and access roads.	Before and during construction activity
		Domestic wastewater from construction sites	Direct/Local/ reversible	X			The workers will use rented accommodations at Mannar town with toilets, drinking water etc. At the wind farm site, the contractor shall provide septic tanks for construction workers at the site.	During construction and operation
4.	Soils and Geology	Soil erosion due to Wind turbine erecting and clearing of vegetation in the wind turbine locations and access roads.	Direct/Local/ reversible			X	Avoiding sites, which are prone to soil erosion. Adoption of proper soil restoration measures. Rehabilitation and stabilization of disturbed land. Carefully select access routes as these are permanent roads.	During and after the construction activity
		Damage due to seismic activity	Direct/regional / reversible	X			Site selection and proper Wind turbine foundation design considering the geological conditions and seismicity of the area.	Before the construction activity.
C.			**Ecological Resources**					
1.	Terrestrial	Loss of vegetation	Direct/Local/		X		Location of Wind turbines in plantation	Before the construction

Sl. Nº	Environmental attribute	Potential impacts	Nature of impact	Magnitude of impacts			Mitigation measures	Implementation & Monitoring
				Low	Medium	High		
	Ecology		irreversible				areas. Selection of degraded area for development of access roads. Compensation to the tree owners for which CEB will pay the estimated cost to them.	phase
2.	Terrestrial Fauna	Disturbance to the local fauna during construction	Direct/Local/ reversible	X			Wildlife routes and their habitats avoided as far as possible during the wind farm site selection.	Before and during construction phase
		Disturbance to the local fauna during operation. Avian Collision with turbines	Direct/Local/ reversible			X	Monitoring of area for carcass especially due to bird strikes during the operation. Use of radar suggested to shut down turbines during period of migration.	During operation phase
3.	Aquatic Ecology	Pier construction will lead to significant impact	Direct/Local/ irreversible			X	Proper muck management measures to ensure the soil etc. does not mix with the water body. Ensure proper care undertaken during piling/drilling of pier and then decommissioning at the end of construction. Ensure the piers are cut 1 m below the seabed to ensure nets or boat bottoms do not get entangled.	Before and during construction phase
4	Coastal area	Significant impacts if works are not undertaken carefully	Direct/local/irreversible		X		Minimize spoiling of area under contact for Wind turbine construction on the coastal area and near waterways Construction Method Statement based on outline CMS to be agreed and implemented by the EPC contractor.	During construction and operational phases
D.				**Human Environment**				
1	Fires	Minimal chance of any fire, explosion at the construction site.	Direct/Local	X			Use of personal protective equipment during construction.	During construction and operation phase
2.	Health and Safety	Accidents to workers and population due to wind turbine construction	Direct/Local/ reversible		X		Use of proper PPE for workmen at site. Also, ensure no fishermen or any unauthorized person is affected during wind turbine erection.	Before and after the construction phase.
		Blade break during operations	Direct/Local/ continuous			X	Wind turbine to be situated away from the settlement. Temporary fishermen huts falling within areas that do not meet noise limits and safety clearances wil be required to shift to locations outside such zones by CEB and compensation will be paid accordingly.	During operational phase

Sl. Nº	Environmental attribute	Potential impacts	Nature of impact	Magnitude of impacts			Mitigation measures	Implementation & Monitoring
				Low	Medium	High		
3.	Agriculture	Permanent and temporary loss of agriculture land due to tower erection and due to access routes.	Direct/Local/ reversible	X			Avoid prime agriculture land. Assessment of land quantity required and compensation. Construction activity in the field/cultivation area after crop is harvested and there after crop will not be sowed at the site until construction is complete.	Before and during construction phase.
4.	Socio-economics	Beneficial impacts from rural and urban electrification. Job opportunities during construction phase	Direct/regional		X		Unskilled labor and indirect benefits. Overall economic growth of the region.	During operational phase
5.	Resettlement	Resettlement of the house impacted by the wind farm.	Direct/Local/ reversible	X			Resettlement issues at wind farm will be dealt with as per Resettlement Plan for the project.	Before the construction phase.
6.	Cultural sites	No archaeological, historical or cultural important sites are affected by the construction of the wind farm.	Direct/Local/ reversible	X			Archaeological, historical or cultural important sites avoided, hence no mitigation required. Chance find procedure will be adopted.	--
7.	Traffic and Transportation	Traffic congestion due to movement of construction vehicles	Direct/Local/ reversible	X			Logistics of movement of equipment will be so planned to avoid high density traffic areas. Proper traffic signs at the construction site, ensuring proper access roads. Final detailed survey/route alignment of transportation routes will ensure proper care with railway and road infrastructure in the area.	During construction phase
8.	Solid Waste Generation	Probability of surface and ground water pollution	Indirect/Local/ reversible	X			Separated wooden and scrap will be collected and disposed of in compliance with applicable regulations and rules.	During operational phase

9.2 Construction Method Statement

622. A detailed Construction Method Statement (CMS) would be developed jointly by the Engineering Procurement and Construction (EPC) contractor and the project proponent (Ceylon Electricity Board (CEB)) that must list all measures undertaken during the construction to prevent harm to the endangered flora and fauna and affected persons (**Annexure 4**). Such a statement would generally specify precautions to be taken by the EPC contractor that are relevant to this ecological sensitive area.

623. CMS type of specialized statements can only be developed by EPC contractor who has trained engineers and technologists who worked in similar projects to prepare tasks, estimates, implementation scheduling etc. EPC contract bidders must have experience of working in coastal areas and must be requested to keep a flexible budget for this activity. In developing the detailed CMS, they shall include details of reduction of impacts through site design and mitigation to reduce impacts during the construction following industry best practice. EPC contractor must coordinate with CEB ecology staff, external ecological consultants, and staff officer designated by the Coastal Conservation Department for any design and construction related issues.

624. Given the sensitively of the project area, the EPC contractor must develop a construction method statement upfront to ensure that sensitive working methods are utilized. A Construction Method Statement checklist has been added to the EMP (**Annexure 3**).

625. Some of the mitigation measures that are included in the Outline Construction Method Statement (also discussed in **Annexure 4**) are as follows:

- Timing/schedule of works and details of hours of working. Particularly, work must be undertaken until one hour after sunrise to one hour before sunset. Construction timing as suggested in the EIA document earlier (**Table 5.1**) must be adhered to.
- Sediment control and pollution control measures at each Wind turbine site
- Measures to control the emission of dust and dirt during construction
- Areas for loading, unloading and temporary storage of materials used in construction of Wind turbine away from sensitive habitats
- Controlled movement of construction vehicles for material delivery, waste collection, cranes, parking area,
- Environmentally sensitive construction of access route to the wind turbine sites, usage of boat, etc.
- No disposal of construction waste from construction work at wind turbine site within the coastal area. Disposal only licensed landfill sites.
- Operations of barges, temporary pier construction and decommissioning.
- Transportation of equipment and raw material over land or sea.
- Noise impacts due to construction machinery at receptors such as fishermen huts, naval outposts, hotel, etc.

9.3 Mitigation Measures

626. The EPC contractor shall comply with detailed Construction Method Statement to be based on **Annexure 4** for compliance with ADB SPS 2009. The **Annexure 3** must be read together with Construction Method Statement (**Annexure 4**) and the EIA as a whole for ensuring environmental safeguards compliance.

9.3.1 Avi-fauna - Mitigation options for minimizing the impact of wind turbines

627. A package of mitigation measures for wind farm collisions will be required to satisfy the ADB Critical Habitat requirements. Through the collision risk assessment for the wind farm, several potentially significant risks have been identified, including three Critical Habitat species; Spot-billed Pelican, Indian Cormorant and Gull-billed Tern. Mitigation measures will therefore be needed to reduce collision risk.

628. A range of possible mitigation options have been considered, including (a) specific turbine shutdown on demand when risk of collision is imminent, (b) wider restriction of turbine operation in certain seasons/times of days associated with higher risks, (c) habitat management, (d) increasing turbine visibility, (e) use of deterrents and (f) compensation.

629. Of these, (b), (d) and (e) are considered unlikely to provide a deliverable solution at Mannar. With regards to (b), there are not any specific periods/seasons to which risk is restricted, so an economically viable scheme would be unlikely. Options (d) and (e) are not widely proven techniques and still in the developmental phase, so could not currently be relied upon. Each of the other three are discussed below:

Turbine Shutdown on Demand

630. Curtailment of the operation of wind turbines could potentially be a useful mitigation measure to reduce collision risk, but is often uneconomic. Recent developments of schemes that have very limited shutdown over short periods has made the implementation of such schemes more viable, and there are now several in operation globally (mainly in southern Europe). CEB are proposing to install a bird radar within the wind farm, which could provide the basis for delivery of this mitigation. The shutdown on demand criteria needs close coordination with the radar system provider, thus more details are available once the supplier is selected and these are to be incorporated in BMP. A system should be implemented at Mannar, if required, to provide a back-up response should the number of collisions actually approach the worst-case predictions, informed by the post-construction monitoring programme.

Habitat Management (On-site)

631. The key bird species at risk are just over-flying the wind farm site rather than using any of its particularly habitats, so on-site habitat management would not be able to deliver any reduction in collision risk.

Habitat Management (Off-site)

632. Habitat management measures implemented off-site have the potential to deliver a benefit that could outweigh the risk of any negative effect from the wind farm. A Biodiversity Management Plan for the Vankalai Sanctuary and other critical habitats on Mannar Island has already been agreed (TOR for Bioidveristy Management Plan is attached as **Annexure 10**) as part of the mitigation measures for the transmission line, and this could be extended to deliver a further benefit to the Critical Habitat species at risk from the wind farm itself. This should include measures to enhance the conservation value of the Adam's Bridge National Park as well as the Vankalai Sanctuary. A separate Future Wind Potential Study has been done by Entura under a TA attached as **Appendix 10.**

633. Additionally, mitigation will also be required to reduce impacts during the construction (and decommissioning) phase of the development (through the production and implementation of a Construction Method Statement following industry best practice). Mitigation measures for the Wind Farm will be implemented by CEB and their contractors, but the exact package of mitigation measures required for mitigating impacts of the final design of the Wind Farm would at a minimum take care of the proposed actions in this EIA besides any other impacts determined at that stage.

634. The wind turbines in the park were reduced to up to 39 numbers from the proposed 56 to ensure they do not adversely affect Adams Bridge national park in the vicinity. If EIA of the wind farm cannot demonstrate that the cumulative impact of the wind turbines on collision risk is negligible, CEB has agreed to curtail the turbines during the breeding and/or migration period as appropriate.

635. The details regarding the above requirements are in the Avian Collision Risk Assessment and the Avian Critical Habitat Assessment reports in **Appendix 2 and Appendix 3** respectively.

636. The proposed mitigation measured relating to the avifauna are shown in the **Table 9.2** below.

Table 9.2: Examples of Avifauna related mitigation strategies

Project Phase	Feature	Examples of Mitigation Methods
Design Phase	Location of wind turbines	Minimize noise, locational impacts including critical habitats
	Number of turbines	Reduced from 56 to 39 turbines, reducing impacts
Construction Phase	Timing - reduce construction phase disturbance	Undertake works outside main water bird migrant period, i.e. outside the period September - March.
	Minimize habitat impact and loss	Production and implementation of a detailed Construction Method Statement following attached outline in Annexure 12 and industry best practice
Post-Construction Phase	Temporary shut-down to reduce collision risk at critical times	Install radars to detect flight clusters of birds that may hit the turbines.
		Off-site habitat enhancement to deliver net benefit to Critical Habitat species
	Habitat Management	

9.3.2 Marine Life - Mitigatory measures

637. Excavation, foundation works, construction of Wind turbines and erection of the Pier are the main activities during the construction of the Wind Farm. No significant impacts expected to the hydrological environment during the construction stage. However, following measures could be made to minimize the impacts.

- During the siting of the wind turbines, location of foundations would be done to avoid any waterways or any sensitive marine area within 25 m. Disturbances or widening or deepening of the inlets and inlet areas will not be done for lowering of water table in waterways or removing of sea water into the waterways. The direction of surface water movement between waterways and the sea will not be changed.

- During the construction, sheet piles[103] will be used to isolate the wind turbine foundation locations and not to damage sediments in surrounding areas around tower locations. After completion of the installation activities of foundations, all excavated materials and unwanted materials (waste), if any, will not be dumped to the surrounding areas but taken out for disposal at designated dumping sites outside the project areas identified by local government.
- The topography of the surrounding area will not be changed during the installation of the wind turbines. The direction of the surface water flow will not be disturbed by putting excess soil.
- During construction of the pier, care must be taken no to disturb the sea bed to cause irreversible damage. Barge operation must be controlled not to damage the ecosystem near the pier.
- The EPC contractor shall monitor the surface water quality in the water channels on a monthly basis to observe any changes in water quality in the project area.

638. Construction of wind turbines would not have direct impact on marine and coastal organisms or ecosystems. However, indirect impact due to soil run off from excavations can be minimized by adhering to good construction practices. Impacts due to construction of pier include changes in oceanographic conditions, near shore wave climate, bottom and sediment transport. Impacts can be mitigated by proper design of the pier with minimum impact to changes in wave climate.

Nesting Habitats

639. Olive Ridley (*Lepidochelys olivaceae*), Green Turtle (*Chelonia mydas*) and the Hawksbill Turtle (*Erytmochelis imbricata*) are known to occur in the Mannar region. No evidences[104] could be obtained during the field survey, visual sight reports of fishermen and from literature that any of the sea turtles nest in the coastal stretch in the project area. Also, wind turbine locations are not within the turtle nesting areas and it is very unlikely that any shading or light effects on the beach where turtles lay eggs, since the turbine locations are further away from beach. Therefore, for turtles whilst other habitat is preferred, so to ensure if there is a small chance they could be present, the Executing Agency will adopt a watching brief by ecologist to ensure no nests before commencement of construction works. No bright or white lighting on turbines will be installed besides a low intensity red beacon as suggested by CAA during operations (See **Annexure 8**, item 5).

Mitigation of Impacts to Surface Waters

640. Techniques for minimizing adverse effects of constructing wind turbine foundations in water and stream environments include avoiding impacts, minimizing impacts, and/or effective remediation of the impacts. Impacts to waterways shall be avoided by placing the wind turbine away from the waterway, adjusting placements to evenly space the horizontal distance between two consecutive wind turbines. After construction, impacts shall be remediated.

Temporary/Permanent Loss of Fish Habitats, Fishing Grounds (mainly for *ma-del* operations) and Other Seabed Habitat due to Construction of a Pier

641. This impact is very low and highly localized. No record of fishing grounds in this very

[103] Sheet piles are not hammered. Piling by hammer is only required for Jetty pile erection.
[104] No other way as Madel fishing spoils the entire beach area andmakes it unfit for turtle hatching.

shallow and turbulent environment. Mitigating measures are not required as translocation of fish is not possible in naturally occurring environment.

Impacts on Boat Movements

642. Impact can be minimized by operating boats and barge out of the peak fishing hours in liaison with fishermen in the area. It is proposed to operate only one/tow barges for the whole operation to minimize idling time at loading/unloading points. The speed of a barge = 6 knots (approximately 11 kph) which means a barge will take almost a day to sail from Colombo to Mannar. Based on the cargo volume, the barge will have a turnaround time of five days between Colombo and Mannar. Assuming a loading/unloading time of 0.5 day at each end, a barge will be sailing every two days. Five trips will be done using a single barge, each trip taking five days. So, it will take about 3-6 months to complete the barge delivery leaving time for pier construction, barge deliveries will happen from December to May. The EPC contractor will decide on the additional number of barges to be used based on the delivery schedule of the wind turbine equipment from factories in Europe to Colombo port.

Temporary Pier, Equipment Transportation and Bathymetry Report

643. A temporary pier of 50 m length will be constructed at the project site by the EPC contractor which is designated size to handle barge operations with RO-RO (roll on-roll off) technology (**Appendix 1**). Based on several independent studies conducted on behalf of Entura, the most suitable modality determined for bringing in equipment to Mannar wind farm is through the sea route from Colombo and unloading at Mannar Wind Farm beach area using appropriate mechanism. However, the EPC contractor is free to use their own logistical arrangements which will need to be approved by CEB and concerned authorities concerned. The Bathymetry study by National Aquatic Resource Research and Development Agency (NARA) (attached in **Appendix 4**) has identified the most suitable depths (greater than 5 m) installation of the Pier and tentative approach path of barges for transportation of wind turbine equipment.

Vibrations Noise in Water due to Pile Driving

644. Noise due to pile driving impact on fish cannot be mitigated.[105] However, impacts on fish can be minimized by starting with slow movement where low noise generated will chase the fish away.

Oil Spillage from Barges

645. In an oil spill, response will depend on the amount, severity, type of oil, sea condition and distance from sensitive ecosystems. The developer/ contractor should be well aware and prepared for an immediate response to an accidental oil spill. Any of the following methods and/or combination may be applied in such situations.

- Booms, which are floating barriers to oil.
- Sorbents, which are big sponges used to absorb oil.
- Skimmers, which are boats that skim (scoop) spilled oil from the water surface.

646. However, any chemical dispersants are not recommended due to the ecologically sensitive nature of the project vicinity. Sri Lanka has developed a National Oil Spill Contingency

[105] Piling of steel pillar will require hydraulic hammer pile driver.

Plan (NOSCOP) and first respondents in an accident are identified and some training has already been given. Therefore, in an oil spill accident, Marine Environment Protection Authority (MEPA), Disaster Management Centre (DMC), Sri Lanka Coast Guards or Sri Lanka Navy can be contacted.

Summary of Mitigating Potential Impacts to Marine Biology

647. CEB will ensure lessening or mitigation of potential environmental impacts by adjusting the proposed wind turbine locations to reduce locational impacts. The project applicants should incorporate specific mitigation methods into the project design, construction process, and/or maintenance procedures. Examples of common mitigation techniques are shown in **Table 9.3**.

Table 9.3: Mitigation strategies for Marine species

Project Phase	Feature	Mitigation Methods	Benefit of mitigation
Design Phase	Select barge route	Carefully select barge route to avoid any negative impact sea grass meadows or marine life	Irreversible damage to sea grass due to irregular barge movement avoided.
	Color of the structures	The darker color of oxidized steel structures (grey in color) may blend in better with backgrounds.	To provide increased visibility to aviation crafts etc.
	Minor changes to Wind turbine locations	Making minor adjustments in Wind turbine locations to avoid water channels	Use flexible placement of Wind turbine by a few meters to either side to ensure minimal impact to water channels with advice of an ecologist
Construction Phase	Timing	Constructing during dry period to minimize impacts to coastal habitat and erosion.	Reduction in disturbance to critical habitats
	Pier Construction Equipment	Reduce excessive impact for drilling in the Pier foundation to reduce soil vibration and rutting in sensitive soils and natural areas.	Reduce damage to beach rock below the sandy soil
	Erosion Control	Installing and maintaining proper erosion controls during construction to minimize run-off of top soil and disturbances to natural areas.	Reduce turbidity due to loosen soil from water runoff (if any).
	Barge Operations	Oil Spillage from Barge engines, lubes from gearboxes of cranes used for unloading etc.	• Booms, which are floating barriers to oil. • Sorbents, which are big sponges used to absorb oil. • Skimmers, which are boats that skim (scoop) spilled oil from the water surface.
	Habitats	Hire services of Ecologist to ensure there are not nesting of turtles in the construction area.	If some hatchery is found, the EPC contractor will ensure the approach to the area is sealed off.

Project Phase	Feature	Mitigation Methods	Benefit of mitigation
Post-Construction Phase	Invasive Species Management	Annual surveying for new populations of invasive species caused by construction disturbances. Early detection of invasive species increases the likelihood of successful outcomes.	Increase in invasive species in the water channels will damage the marine and avifauna sensitive ecosystem in the area.
	Restoration after removal of Pier	Ensure no shoal formation is started, and rehabilitate area if required.	To restore any natural habitat to original condition for avifauna and marine species

9.3.3 Land/Coastal Area - Mitigation Measures

Soil Run-off

648. In order to control the surface runoff and increase the infiltration, soil compaction should be carefully carried out. Also, temporary road constructions and uses of heavy machineries kept at minimum during the construction phase. After the completion of construction work, in order to regulate the runoff and infiltration, maintenance of proper landscaping and drainage system is essential.

649. Soil excavation should be minimized during the rainy season (November to January) to reduce soil/sand erosion that lead to sedimentation in adjoining shallow sea water. During the dry season, wind erosion can be reduced by spraying water to the surface of the excavated soil. In addition, it is necessary to remove excess soil in the land to suitable location soon after the excavation. The excavated sand should transport through the recommended procedures and should backfill or dump in suitable locations offsite or disposed off at pre-approved government location. All construction material stored at site will be covered and or kept wet on surface to avoid dispersal with wind. All vehicles carrying construction material will be covered while travelling on public roads. Further, the excavated sand can be used as a construction material of the proposed project.

650. Soil excavation can be performed up to the groundwater level of the area without any casing but given health and safety considerations, EPC contractor must install sheet piles. However, after the level of groundwater table, excavation should have done with the casing in order to protect groundwater flow towards the excavated area. Because the casing can stabilize the prevailing groundwater condition of the region. However, all the above activities should be done under proper supervision and monitoring during and after the construction.

- Turbidity levels of the shallow sea in the Gulf of Mannar should be monitored during the construction time.
- Proposed wind turbine construction will not directly impact sand dune structures in the area. However, during and after the construction, surrounding sand dunes should be protected: (i) vehicles which are used for the construction activities should not move on the sand dune structures; and (ii) the sand dunes should not be contaminated by construction materials.
- Periodic monitoring of changes in sand dunes is necessary. It can be recommended to use 1:2,000 scale contour maps given in this report to use as

reference for the monitoring of changes in the sand dunes. In addition, it is necessary to maintain vegetative cover found on the sand dunes. Monitoring of changes in vegetative cover can be recorded using 1:2,000 land use maps.

Surface/Ground Water

651. The expected impacts to the surface water of the project area are will be significant given proximity of proposed wind turbine locations to some water channels. However, some considerable impacts could be expected to the groundwater of the area due to the proposed project activities. During the installation of wind turbines, groundwater is planned to pump and it will help to reduce the groundwater level and to deteriorate the groundwater quality of the wind turbine site and its surroundings. It is an unavoidable activity in this type of project. However, the expected possible negative impacts to the groundwater could be minimized by adopting following mitigatory measures.

- Sheets piles[106] should be inserted in the ground up to 4.5 m to isolate the areas selected for the excavation. It will help to prevent the collapsing of unconsolidated sand and to reduce the expected impacts to the groundwater.
- During the excavation, electrical conductivity of the pumping water should be measured. If electrical conductivity of pumping water is more than 1,500 µs/cm, pumped water should be diverted to the sea through pipes after sedimentation in pits.
- The removed overburden materials should immediately be used to level the areas around selected sites for wind turbines in order to avoid the flooding.
- It is needed to provide wash up toilet facilities along with soakage pit and septic tanks for all the workers in the construction and operation phases according to SLS standards. Septic tank should be constructed at relatively high elevated areas. No water well will be located within minimum 100 m of a toilet facility and vice versa. Once the septic tanks are filled with waste water, this should be transported to the nearest sewerage treatment plant located in the mainland at Thiuketiswaram.

Tree Felling and Replantation

652. The site clearance for tower erection, access road and ancillary facilities will be restricted to the necessary footprint area. Vegetation shall not be removed from areas falling in land not required for any construction activity. The crane staging area, intervening areas, overhead clearance for suspended turbine components shall be planned in such a way that minimum tree felling is required. Disturbed areas shall be re-vegetated as soon as the activities in the immediate surroundings are completed. CEB shall ensure that the endemic and threatened plant species are not removed during site clearance. In case removal is unavoidable, the same species shall be planted after completion of construction activities.

653. Mitigation Measures required for restoring the tree species that are Threatened, Near Threatened, Data Deficient in that area. There are seven threatened species (two shrub species, three creepers, one herb and one tree (Red list 2012), nine near threatened species and one categorized as data deficient.

[106] Sheet piles are sections of sheet materials with interlocking edges that are driven into the ground to provide earth retention and excavation support. Sheet piles are most commonly made of steel.

654. If the individuals are found in the hardstand, these will be removed or damaged due to the construction activities. Seedling of these species are found in nearby area and these should be introduced into the localities that were not affected by the project. The plants could also be grown in nursery for replantation. Also, these plants can be replanted outside the hardstand (once the constructions are over).

655. The project will require a tree/species related plantation program i.e., replanting them in the ratio of 1:1 (suitable as per ADB requirements and decided based on BMP between CEB and Department of Forests). This will be done by the EPC contractor under the supervision of CEB, after the construction work is completed. The CEB will decide the area for replanting (outside of the hardstand, access road, buildings etc. but within 150 m x 150 m area).

656. The EPC contractor under the supervision of CEB will implement replantation of the cut species. Assuming that CEB would like to retain the hard-standing area without plantation, the replanting area has to be decided after the construction of wind farm. The bidder will have the freedom to adjust the area of hardstand with limitations. At present, it is not possible to demarcate the area of replanting. The layout of turbine locations will be finalized by the EPC contractor.

657. CEB will decide the locations for tree replantation in consultation with Forest department of the Coastal Conservation Department after implementation. The location of replantation will be intimated to ADB and will be plotted on a Google map (or topographic map of the area) during operations monitoring period.

Electromagnetic Interference (EMI)

658. Although, the overall design of wind farm shall take into account the best international design and shielding practices in the equipment to minimize EMI, there may still be interference to local residents that need to be mitigated once the wind farm is operational. Some of the suggested mitigation measures are as follows:

- relocate antenna or direct antenna toward an alternative broadcast transmitter.
- installation of amplifier, higher quality or directional antenna.
- Installation of satellite or cable TV and/or construction of a new repeater station if the area affected is very big. EPC contractor shall conduct a baseline survey for the same and decide in cooperation with telecom authorities.

659. CEB has considered interruption of communication links in its development of the wind turbine layout, and locations have been selected accordingly.

Noise Due to Operation of Wind Turbines

660. As noted during the tender process, the wind turbine supplier must propose a wind turbine model and wind farm layout (subset of 39 locations) that complies with the prescribed limits at relevant receptors. Any requirements for reduced noise output (and hence reduced power output) must be quantified, and a specific operational regime will be determined from the noise modelling results.

661. The example scenario consisting of 31 x 3.3 MW wind turbines is a realistic scenario for a 100 MW wind farm. This scenario includes constraining certain wind turbine noise and power output to achieve compliance with noise limits, and results in a loss in annual energy output

compared to operating unconstrained by noise limits. Estimated annual energy loss as a percentage of annual energy described in **Appendix 5**.

662. To provide the tenderers with further guidance and boundaries as to the acceptable noise outputs of the wind farm, tenderers must adhere to the following requirements:

- Wind turbines supplied for the project should have a maximum noise output of 106.5 dB.
- Wind turbines supplied for the project must be able to operate in a noise constrained mode, in order to meet the seasonal day/night noise limit requirements defined by the background noise report, **Appendix 5a**.
- Wind turbine noise should have no tonal component unless incorporated into the assessment as a penalty.
- During the tender process, the wind turbine supplier must propose a wind turbine model and wind farm layout that complies with the prescribed limits at relevant receptors. Any requirements for reduced noise output (and hence reduced power output) must be quantified. They must undertake a noise assessment consistent with international good practice to demonstrate this is the case.
- Based on the capacity of the wind turbine offered, the wind turbine supplier will select a subset of locations from the 39 locations available in order to achieve a 100 MW total capacity.

663. To comply with noise limits at relevant receptors, the wind farm is likely to require operational controls that limit wind turbine noise output. The noise constrained operation will be implemented automatically as wind speed increases, with the specific noise mode selected to ensure the project is in compliance with the relevant seasonal day/night noise limits. Compliance will be demonstrated initially through modelling of the specific noise characteristics of the selected wind turbine (similar to the current assessment). Compliance can then be verified through post-construction measurements of noise at receptors. The actual mechanics of implementing noise controlled operation on a wind turbine is a simple control setting, based on season and time of day. For example, the wind turbine is programmed to a specifc mode based on the time of day and season. If the wind turbine is for example in mode 4 (instead of mode 0), as the wind speed increases, the wind turbine controller limits the maximum rotor speed, and therefore power output and noise is less at higher wind speed.

Wind Turbine Noise Constrained Operation

664. The noise output of a wind farm can be controlled by several means:

- **Design features:**[107] The wind turbines supplied for the project may contain design features, such as aerodynamic modifications to the blade to permanently reduce the noise output of a wind turbine model. There may be an associated cost to include such additional features, and there may or may not be an impact on the power curve/energy output.
- **Operational modes:** Modern wind turbines are equipped with programmable operational modes that can reduce the noise output of the wind turbine on-demand. There is typically an associated reduction in power output, which increases as the noise output decreases. These operational modes of reduced noise ouput are triggered automatically as wind speed, power output (and

[107] The suppliers decide the most effective method of complying with noise limits.

consequently noise output) increase. The operational modes are programmed for each wind turbine based on time of day and season.
Shut down: In extreme cases, wind turbines might be shut down (turned off) under certain conditions to eliminate noise output. This can also be programmed, based on wind speed and time of day/season. CEB will ensure that a protocol is to be developed to mitigate the noise impacts and meet the limit.

665. The noise constrained operation will be implemented automatically as wind speed increases, with the specific noise mode selected to ensure the project is in compliance with the relevant seasonal day/night noise limits, based on outputs from noise modelling.

666. The noise constrained mode is permanently implemented at each wind turbine based on time of day, and season. **Table 9.4** (from Entura's report, Table A.4) illustrates the different noise levels of the different modes. For example, at 6 m/s all modes have similar noise level (and consequently a similar power output). However above 6 m/s noise Modes 1 to 4 increasingly reduce noise level and power output (relative to the unconstrained Mode 0). Wind turbines will be set to operate in a specific mode depending on:

- day/night limits
- some locations that are sensitive only during some months of the year, there will be a time of year trigger.

667. The operational modes will be determined by noise modeling, such as the example design given in Entura's report.

Table 9.4: Example of Noise levels at different operational modes

Wind speed at hub height (m/s)	Sound power level at hub height (dBA)				
	0 – 105.7	**1 – 105.3**	**2 – 104.5**	**3 – 102.5**	**4 – 101.0**
3	91.3	91.3	91.3	91.3	91.3
4	91.6	91.6	91.6	91.6	91.6
5	93.5	93.5	93.5	93.4	92.1
6	96.5	96.5	96.5	96.4	94.6
7	99.8	99.8	99.7	99.2	98.0
8	102.8	102.7	101.9	100.6	99.3
9	105.0	104.7	102.8	100.9	99.5
10	105.7	105.3	103.2	101.1	99.6
11	105.7	105.3	103.6	101.4	99.9
12	105.7	105.3	104.1	101.8	100.1
13	105.7	105.3	104.1	102.1	100.4
14	105.7	105.3	104.1	102.3	100.8
15-20	105.7	105.3	104.1	102.5	101.0

Shadow Flicker during Operation of Wind Turbines

668. Shadow flicker will be mitigated by turning off wind turbines during time periods when there is potential for shadow flicker at receptors (typically around sunrise and sunset). Shadow flicker can be completely mitigated with an estimated energy loss equivalent to approximately 1.5% of the annual energy output of the wind farm for a 39-wind turbine layout, or 1.0% for the example 31 wind turbine layouts.

669. The precise shutdown regime for shadow flicker mitigation will be determined after the wind turbine model is selected by CEB's tender process, and further investigation of the sensitivity of each potential receptor, to shadow flicker. An automatic shutdown regime will be implemented on the individual wind turbines that exceed limits to reduce the hours of modelled shadow flicker to within the required 30 hours annually and no more than 30 minutes per day. Based on the final wind turbine configuration, the precise time of day when shadow flicker is present will be modelled for each day of wind farm operational life, and the responsible wind turbines will be shut down for that period. CEB will ensure that a protocol is to be developed to mitigate the show flickter impacts. As explained in this paragraph, the times where wind turbines cause shadow flicker are modeled, and the wind turbine is programmed to turn off precisely at those times Post-construction monitoring and consultation will be undertaken to determine whether the automated shutdown shadow flicker mitigation has been effectively implemented.

670. The EPC contractor shall develop protocols for shadow flicker measurement and reduction in dynamic mode to ensure their constrained mode operation–each wind turbine is programmed to shut down for a short duration each day, when it would otherwise be causing shadow flicker. It is a requirement of bid documents that offered wind turbines have this capability.

Blade Glint

671. All major wind turbine blade manufacturers currently finish their blades with a low reflectivity treatment as per mandatory technical requirement for the bidders to follow. This prevents a potentially annoying reflective glint from the surface of the blades and the possibility of a strobing reflection when the turbine blades are spinning. Therefore, the risk of blade glint from a new development is considered to be very low.

Visual Impact Assessment

672. Distant views while not intrusive would harmonize better in the landscape with less contrast in colour, if the WTGs are grey coloured. In the present scenario, the WTGs do not present a major visual impact. A new substation and control building will be constructed near Nadukudda village. This facility will likely be visible from the adjacent road. However, existing vegetation will screen the facility from nearby residences.

673. Activities during construction phase are expected to be more visually disrupting than during operation. Airborne dust to be controlled and speed limits imposed on construction vehicles. Removal of all construction debris and equipment after completion that affects visual and environmental quality. Construction crane/s for installation will be temporary. Vegetation to be re-instated and ground conditions made good at tower bases, underground cable paths and as otherwise used as access/camp during construction phase.

674. Conservation or addition of low beach vegetation is recommended to visually transit, merge and soften the base with the terrain. Reinstating of removed vegetation during construction phase is also necessary. This will be done in a manner that does not significantly increase the habitat available to attract additional fauna to the vicinity of the wind turbines.

675. The exact number of wind turbines has not yet been finalized through the tender process, and it is likely that fewer than 39 locations will be used to obtain the required 100 MW project. In such case, if any of the rear row of the array is needed to obtain the required number of locations for a 100 MW project, a minimum of three locations from the rear row of the array will be used. The regular arrangement of the front array will be maintained to the greatest extent possible.

676. A uniform size and design of wind turbines will be maintained across the wind farm.

677. A meteorological mast is currently installed at the site, and will likely remain in the future. An additional mast may be installed on a temporary basis at one of the proposed wind turbine locations for the purpose of post-construction power curve tests on the wind turbines.[108] The visual impact of these meteorological masts will be minimal, particularly in relation to adjacent wind turbines. A new substation and control building will be constructed near Nadukuda village. This facility will likely be visible from the adjacent road, however existing vegetation will screen the facility from the village.

9.4 Monitoring

678. All aspects of environmental monitoring programme have already been addressed in the EMP. The parameters to be monitored are: impacts to the land, beach and shoreline and their vegetation, Impact to the sea shore, ground water quality, storm water runoff, sewage, waste oil spills and waste water disposal, solid waste disposal, air quality, noise, vibration and dust due to construction activities, safety of people and animals in the area, ecological environment, socio-cultural and economic development, impacts on fishery related activities and impacts on agriculture activities.

679. Frequency of monitoring would be daily, weekly, monthly or quarterly during the construction phase and monthly (e.g., birds and bats monitoring), quarterly, semi-annually or annual monitoring during the operation phase depending on the activity. The implementing agency will be responsible for the cost of monitoring and coordination of monitoring activities with other agencies such as Coast Conservation and Coastal Resource Management Department (CCD), Water Resource Board, Central Environmental Authority, and Mannar Pradeshiya Sabah.

9.4.1 Environmental Monitoring Plan (EMoP)

680. The EMoP describes monitoring measures with technical details, including parameters to be measured, methods to be used, sampling locations, frequency of measurements, detection limits and definition of thresholds that will signal the need for corrective actions; and describes monitoring and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measures and document the progress and results of mitigation.

681. During the construction and operational phase of this project, the monitoring of the environmental aspects shall be done by a competent officer of the CEB. During the construction phase, the EPC contractor should ensure that activities like handling of earth works clearing work, access road construction, putting traffic signals and conducting ecological monitoring are monitored by a Project Implementation Unit (PIU) staff on a day-to-day basis during construction.

682. Monitoring of sanitary waste treatment should be done periodically to avoid water pollution. Other environmental good practices to be monitored include noise abatement, maintaining hygienic conditions, maintenance of fire and safety equipment, etc. Overall, the environmental good practices should be followed as per the IFC-WB EHS guidelines. The PIU will hire appropriate agency/ies for conducting ecological monitoring, other ongoing surveys and monitoring of bird/bat carcass from the wind farm during operations. THE EPC contractor will implement all health and safety (H&S) monitoring requirements in compliance with paras 91 to 93 of IFC-WB EHS guidelines on wind farms as well as IFC-WB EHS general guidelines.

[108] Permanent and temporary met masts to be of guy wire type design using bird flight divertors to reduce bird collisions

683. In addition to the EMP, to ensure that project would not be generating a negative impact to the overall environment quality, an EMoP has been prepared. The monitoring activities of the project include site supervision, verification of permits, monitoring of water quality, soil, noise and air. Monitoring of the quality of water, soil, air, and noise during the construction stage is a responsibility of the contractor, and of the approved government agency. PIU will supervise and monitor the contractor. The environmental monitoring results will be submitted by the PIU to the PMU, which will include the result of the environmental monitoring into its environmental monitoring report. The environmental monitoring reports will be submitted to ADB on a quarterly basis while works are ongoing and up to one year of operations; and semi-annually thereafter. The environmental monitoring activities along with their periodicity for developing the EMoP for the project are summarized in **Annexure 5**. The project Environment Safeguards Monitoring Report template is in **Annexure 6.**

684. As per ADB's Safeguards Policy 2009, ADB requires the borrower to retain external qualified experts or qualified NGOs to verify monitoring reports with significant impacts and risks for all Category "A" projects. The experts will produce an external monitoring report on a quarterly basis while works are ongoing and upto one year of operations; and semi-annually thereafter and submit it directly to ADB to verify whether sound environmental management practices are applied, and the set environment targets are being achieved. In case the implementation of EMP measures is not satisfactory, this external monitoring experts/NGO will recommend corrective actions to address environmental compliance. CEB may engage with NGOs through CSR activities for monitoring of EMP and EMoP for the wind farm project.

9.4.1.1 Water Quality Monitoring

685. **Table 9.5** provides the water quality monitoring in coastal areas during the construction phase.

Table 9.5: Water Quality Monitoring in Coastal Area

No	Potential Impact	Proposed Mitigation measures	Monitoring Means and frequency	Responsibility	Parameter monitored	Approximate Cost (US$)
A	**Construction Phase**					
1	**Soil erosion due to loss of vegetation**	Coastal vegetation should be minimally disturbed during the construction phase to reduce soil erosion and safeguard water channel protection	Inspection and mapping of vegetation cover by an ecologist Once before, weekly during and once after construction	EPC Contractor to ensure minimal disturbance and Supervising engineer to monitor	No change in ground cover in constructed areas	2,000.00
		Re-plant degraded areas with local species common in the area to complement natural vegetation regeneration to improve ground cover.	Routine Maintenance - Six monthly	Contractor responsibility to do the replanting. Supervising engineer to monitor	Re-vegetation per m^2)- Costing will be done by ecologist	2,000.00
2	**Surface and ground Water Pollution**	Maintenance of construction vehicles should be carried out in the Contractor's day-time camp.	Routine inspection, Maintenance records-weekly. Baseline to be developed by EPC contractor after	Consultant Supervising Engineer and Contractor	Water quality parameters DO, BOD, COD,	Part of contract provisions

No	Potential Impact	Proposed Mitigation measures	Monitoring Means and frequency	Responsibility	Parameter monitored	Approximate Cost (US$)
		Oil and grease in surface and ground water will be monitored.	vehicles are engaged at site		Water transparency, oil content, coliforms – quarterly	
3	**Coastal Waters**	During piling, coastal waters will be stirred up	Regulary everyweek during pilin	Contractor	Turbidity, TSS	Part of Contract Provisions
4	**Impact on fauna in water channels and sea**	Strict measures should be taken to minimize the impact on aquatic life in waterways	Scientific investigation should be undertaken downstream delineate the area impacted by the plume generated during excavations. **Once before, regularly monthly during and once after construction**	Consultant Contractor	Fish surveys are needed, of the fish catch as well to demonstrate no impacts on livlihoods with samples in the survey area but with a control site to cover other issues like poaching, etc. Ichthyoplankton surveys Zooplankton and phytoplankton surveys	2,000.00
5	**Management of Solid Waste, debris, soil erosion**	Contractor must dispose solid wastes away from the site to an approved licensed waste disposal site instead of waterways.	Routine Maintenance for entire duration	Contractor, Supervising Engineer		Contractors responsibility as part of contract provisions
6	**Drainage construction wind turbine base may interfere with the natural drainage systems and modify flow of surface water**	In sections along water courses, earth and construction waste will be properly disposed of so as to not block waterways, resulting in adverse impact on water quality. All necessary measures will be taken to prevent earthworks from impeding cross drainage at existing waterways and	Properly disposed waste	Contractor Supervising Engineer		Contractors responsibility as part of contract provisions

No	Potential Impact	Proposed Mitigation measures	Monitoring Means and frequency	Responsibility	Parameter monitored	Approximate Cost (US$)
		drainage systems				
7	**Impact on marine environment after completion of construction**	Measurement of the marine water quality, benthos, zooplankton, phytoplankton, and ichthyoplanton in comparison with the baseline information	Once after completion of construction. Baseline prepared for EIA document shall be used.	Contractor	Baseline	Contractors responsibility as part of contract provisions

9.4.1.2 Fish Monitoring Program

686. During the field surveys and public consultations, fishermen had serious concerns that the project would lead to reduction of fish catches (mainly for beach seine fishery). Although, there is no scientific basis for such reduction in fish catch due to on-shore wind farms. However, it would be important to develop some baseline data at this project site, since fisheries is one of the main livelihood of the community within the project area which the Department of Fisheries has agreed to provide a baseline for fish catch to CEB.

687. Accordingly, fish catch in one of the sites within the project area (i.e., Nadukuda) and another location outside of the project area but close by (i.e., Thavulpadu as control)[109] can be monitored for comparing catches. The fish catch could be done every month during fishing period from before start of construction, construction and into the operation period. The Department of Fishery could be an important partner in this aspect and also ensuring cooperation of fishermen of the area in such a study. Universities having research programs in this area could be encouraged to partner with CEB, Department of Fisheries to conduct this program for 2-3 years from start of operations of the wind park.

688. CEB in partnership with Department of Fisheries would collect data on species composition, average fish catches from each species (or by groups), by catch, fishing effort, catch per unit effort in the project area. These should be monitored before the start of project, during the construction and at a minimum of two years after the commissioning of the project.

9.4.1.3 Marine and Coastal Monitoring

689. **Table 9.6** provides monitoring costs for marine and coastal aspects of the project area.

Table 9.6: Marine and Coastal Environmental Monitoring

No	Potential Impact	Proposed Mitigation measures	Monitoring Means and frequency	Responsibility	Parameters	Approximate Cost (US$)
A	**Construction Phase**					

[109] Both control points within 12 km coastline along the wind farm

No	Potential Impact	Proposed Mitigation measures	Monitoring Means and frequency	Responsibility	Parameters	Approximate Cost (US$)
1	**Sedimentation in construction area due to construction or maintenance and disposal of excavated material**	Soils excavated for the erection of wind turbine base should be used for re-filling and should not be left exposed to wind or water for long periods. Sediment control measures such as retention weirs will be used, as necessary, to minimize sediment flowing into sea. Silt fencing will also be implemented to minimize erosion of soil stockpiles.	Inspection, Routine monitoring **Once before, monthly during and once after construction**	EPC Contractor	Water Quality let out to sea and TSS, soil texture	2,000.00
2	**Impact on aquatic resources**		A fish catch survey should be carried out to assess any impact on marine resources. Changes in fish catch. It is likely that complaints may be received from local fishermen regarding decreasing catches after the project. **Once before, monthly during and once after construction**	Consultant Contractor	Records of fish and shellfish impingement: • number and weight by species • fish catch data	2,000.00
3	**Impact on offshore sea grass meadows**[a]		A survey should be carried out to assess any impact on sea grass meadows in the offshore area. **Once before, regularly during and once after construction**	Consultant Contractor	Underwater survey for diversity and extent of sea grasses within direct impact zone	3,000.00
4	**Invasive species**		A survey should be carried out to assess any invasion of invasive species. **Once before, regularly during and once after construction**	Consultant Contractor	Surveying for new populations of invasive species resulted from construction to determine community dynamics.	2,000.00
5	**Barge Operations**	On board marine mammal observer in barges (when	On board marine observer in each	Barge Operator	Fish mortality	Part of Barge

No	Potential Impact	Proposed Mitigation measures	Monitoring Means and frequency	Responsibility	Parameters	Approximate Cost (US$)
		operating)	barge		during barge operations through visual observations	operator costs
	Total cost for Monitoring Marine Environment					**$11,000**
B	**Operations and Maintenance Stage Costs**					
1	**Impacts of Fish due to wind farm Turbine operation**	Fish catch monitoring program	Six monthly fish catch analysis from the area for three years	CEB and Department of Fisheries	Variation in Fish species composition and catch before construction and during operation of Turbines	$5,000 per annum x 3 years = $15,000

[a] Not mandatory, but fishers have serious concern on turbine impact on fisheries, Similar to monitoring fish catch, it is important to monitor seagrass beds which the fishery in of this area depends. In any loss of fish catch, fishers would blame the project therebymaking monitoring of seagrass essential.

9.4.1.4 Birds Collision Monitoring Program

Pre-Construction Monitoring

690. It is essential that the bird monitoring programme for the development should include continuation of pre-construction baseline surveys (vantage point surveys and block counts) for another year to provide more detailed information about bird activity (including flight activity) within the wind farm site (and complement similar surveys being undertaken for the transmission line). This work should include:

- VP surveys with flight line mapping for key species, with at least 36 hours' surveys from each VP and VPs covering a range of 2 km maximum, including both the wind farm and the power line, with sufficient VPs to cover all of the development site;
- Block counts of key species within and in proximity to (within 2 km) of the whole development footprint, with the survey area sub-divided into count sectors to enable spatial analysis of the data set, and with counts made twice-monthly through the key seasons (September–April).

691. These data will, as well as providing further baseline information for a post-construction monitoring programme, provide more detailed input to the site design process and identify where mitigation measures will be required (and how they would best be implemented, particularly any turbine shutdown).

Post-Construction Monitoring

692. Post-construction bird monitoring should be undertaken to better understand the impacts that actually occur and ensure that significant impacts are avoided (through feedback into the mitigation process).

693. The post-construction bird monitoring should include continuation, for an initial period of three years,[110] of the key species block surveys and enhanced[111] vantage point surveys, to compare bird distribution, abundance and flight 255ehavior before and after construction, and a programme to monitor the actual collisions that occur (with both the wind turbines and the overhead line where this is practical). These results should then be quarterly reviewed by an independent ornithological expert to be hired by CEB to determine whether any further monitoring would be required (if significant impacts were identified and if mitigation measures had not been effective).

694. The operational phase collision monitoring of birds and bats should follow the standard methodology developed for this purpose in the United States (Morrison, 1998). A core area of 100 m radius around a representative sample of turbines and sample lengths of the power line should be carefully searched on foot. The 100 m distance has been set conservatively as bird fatalities have rarely been documented over 70 m from turbines at other wind farms (Johnson, et.al., 2000). Sectors around the turbine/power line should be slowly searched, taking particular care to search any taller clumps of vegetation, rocks and openings of animal burrows. In addition, a further area 250 m around each turbine should be checked for larger bird carcasses. The precise location of any dead birds found should be recorded and mapped (by reference to the distance and direction to the nearest wind turbine, and using a GPS). All carcasses should be photographed as found then placed in a plastic bag, labeled as to the location and date (turbine number, distance and direction from turbine base), and preserved (refrigerated or frozen) until identified. Feather spots (e.g., a group of feathers attached to skin) and body parts should also be collected. For all casualties found, data recorded should include species, sex, age, date and time collected, location, distance and direction (degrees) to nearest turbine, condition, and any comments regarding possible causes of death. The condition of each carcass found should be recorded using the following condition categories:

- **Intact:** carcass that is completely intact, is not badly decomposed, and shows no sign of being fed upon by a predator or scavenger.
- **Scavenged:** entire carcass that shows signs of being fed upon by a predator or scavenger or a portion(s) of a carcass in one location (e.g., wings, skeletal remains, legs, pieces of skin, etc.).
- **Feather Spot:** 10 or more feathers at one location indicating predation or scavenging.

695. A sample of 50 dead birds (e.g., dark-feathered chickens) should be obtained in order to study the rate of carcass removal and to test observer search efficiency. These should be placed within the search area at intervals through the study by someone independent of the carcass searcher, at precise recorded locations (mapped in relation to distance and direction from the wind turbines), and marked appropriately (e.g., with cultured tape) to identify them as experimental birds. They should then be recorded by the observer on all subsequent visits, noting their precise location (distance and direction from nearest wind turbine) and condition, and left in place on site until they disappear. The amount of scavenger activity should inform the survey

[110] The three years' post-construction monitoring is recommended. See page 4 of the guideline. (http://migratorysoaringbirds.undp.birdlife.org/sites/default/files/factsheet%20Wind%20Farm%20Partner%20new%20logo%20PR.pdf)

[111] This refer to the methodology adapted during January to March 2017 where additional data were collected in VP surveys as opposed to the methodology followed previously.

frequency, but an initial programme of weekly visits is recommended as a starting point.

696. Similarly, the avian collision monitoring measures conducted by CEB through various agencies involved is shown in **Table 9.7** (during construction and operations stages).

Table 9.7: Avian collision environmental monitoring

Potential Impact	Proposed Mitigation	Monitoring Means and frequency	Responsibility	Parameters	Approximate Cost (US$)
Construction Phase					
Wind Farm construction	As per Construction timing conduct of surveys.	Bird Survey Once in Nov-April and once in May-October	CEB	All potentially significant disturbance effects avoided during construction	Contractors responsibility as part of contract provisions
O&M Phase					
Wind turbine operation, impacts on bats and birds	Fitting of radar during construction period to determine if any turbine (s) need to shut down to avoid fatalities during migration periods	A survey should be carried out to assess bird/bat distribution, as per Collision Risk Assessment recommendations Bird and bat carcass collection and monitoring program, as per Collision Risk Assessment recommendations	CEB to engage independent monitoring team of Consultants	Survey for collision victims showing number of collisions. Survey to compare bird distribution, abundance and behaviour before and after construction, and monitor the actual collisions that occur	Radar cost of $500,000 and operational cost per year of $10,000 approx to be borne by CEB Staff deployed for carcass collection = 500 per month
	Determine locations and shut down turbines at time of breeding etc. Details to be determined from results of pre-construction surveys i.e. before tubine operation stage.	Key species survey - block surveys and vantage point surveys, as per Collision Risk Assessment recommendations			Employ national Ornithologist of monitoring = 15,000
				Total cost for monitoring avian collision	

9.4.1.5 Ecology Monitoring for Tree Replantation

697. As evident from **Appendix 8** on Terrestrial Ecology, for T3 and T36 the hardstanding area will be designed and constructed to ensure that the maximum number of endemic plants are retained with no more than five Neralu plants lost, and no nationally EN plants lost. EPC contractor will ensure that for all other turbines the hardstanding area and associated infrastructure (including access tracks and cable routes) will be designed and constructed to ensure that no endemic or nationally EN plants are lost.

698. To ensure the above, prior to construction an ecologist will mark out and record the location all endemic and EN plants in and adjacent the construction working area. EPC Contractor staff will be given guidance on their identification through tool box talks and notices in site offices

and instructed not to clear them. The ecologists hired by the EPC Contractor and PIU will monitor the continued presence of the endemics and EN plants during the construction.

699. During the construction, monitoring should be done by CEB/EPC Contractor to record the exact number of trees/ shrubs removed from the hardstand, access roads and other areas cleared for building and other facilities, etc. Replanting/restoration programmes should then be designed to compensate the loss of trees/shrubs and the habitat can be enriched once the project activities are completed.

700. Since this is Categtory A project that has impact on some tree and shrubs that are endemic or nearly threatened,[112] external monitoring would be done by the Forest Department and the Department of Wildlife Conservation. CEB can give contract to a company specialized in maintaining plant nurseries/ landscaping/ gardening to ensure compliance.

701. Replanting and maintaining of plants for three years in 1 ha will cost SLR800,000. Total area (in ha) of replanting has to be calculated at the end of construction. The cost of monitoring of tree replantation will be borne by the CEB, every three month-one visit-three years. The cost will be SLR1,200,000 ($8,000 as shown in **Table 9.8**).

Table 9.8: Total costs for terrestrial ecology mitigation and monitoring

No	Potential Impact	Proposed Mitigation measures	Monitoring Means and frequency	Responsi bility	Parameters	Approx imate Cost (US $)
1	Removal of trees, degradation of habitats	Replanting and restoration	Every three months during the first three years of planting	CEB/ contractor	New plants, restoration of habitats	8,000

9.5 Environmental Management and Monitoring Plan Budget Costs

702. The main benefits of the environmental mitigation plan are (i) ensuring that environmental standards are met during design, construction, and operation of the project; (ii) providing offsets to negate project impacts especially ecological impacts. Without such expenditures, the project might generate large environmental impacts, causing the biophysical environment in the area to deteriorate and indirectly depressing the economies of local communities.

703. An indicative budget in the range of $1.35 million is proposed for land costs and $0.5 million for EMP implementation from the total project cost of $216.7 million. These costs include variable cost items such as implementation of Construction Method Statement (CMS), mitigation cost towards implementation of EMP & CMS (contractor's scope), EMP & CMS implementation and monitoring and its independent audit as specified in ADB's SPS 2009. **Table 9.9** provides illustrative project costs.

Table 9.9: Illustrative Details of Project Costs

[112] Seven threatened species were listed during the field survey (Table 2 of Appendix 8). Another 13 species were recorded in near threatened (NT) category and one specie considered as data deficient (DD) according to the National Red List of 2012, Ministry of Environment, Sri Lanka. No any endemic species are in threatened or near threatened categories.

Some Illustrative Project Costs* ($)	FC	LC	Total
Site Preparatory Work*	7,00,000	3,50,000	3,50,000
Land (90 ha @15,000/ha)		13,50,000	13,50,000
Access Roads/Cable Ducts (30 km)*	15,26,087	15,26,087	35,10,0000
Social management plans		2,50,000	2,50,000
Environmental Management Plan/mitigation including Construction Method Statement **		5,00,000	5,00,000
Radar*	5,00,000		500,000
Jetty Construction*	43,47,826		50,00,000
Barge Transportation	61,73,200	53,68,000	
Total Project (including taxes, financing, equipment etc.)	17,78,69,968	16,33,01,772	1,45,59,196

* These project cost items consist of all costs that have EMP related cost items that are part of EPC Contractor costs
** The EPC contractor shall perform mitigation actions as per EMP/Construction Method Statement within this budget.

Costs for Construction Method Statement (CMS)

704. A detailed CMS will be developed for the wind farm area using suitable consultancy arrangement. The Illustrative budget for the CMS is provided in **Table 9.9**.

CO_2 Sequestration

705. Based on the environmental survey carried out during the study, one notable negative environmental impact of the Project is the requirement to cut 9 Palmyra trees, 37 coconut trees and removal of Pandanus, Acacia shrubs/trees resulting in a reduction in CO_2 sequestration. However, environmental benefits of the project significantly outweigh the costs. Reduction in CO_2 sequestration due to cutting Palmyra trees was determined based on the CO_2 sequestration rate of 64.5 MT per year per hectare[113] and 143 Palmyra trees per hectare.[114]

706. The Sustainable Energy Authority of Sri Lanka (SLSEA) publishes the grid emission factor for Sri Lanka and the latest available is for 2015 (http://www.info.energy.gov.lk/). The combined margin specified to be used for new wind and solar projects is 0.7689 tonnes of CO_2 per MWh electricity generation by a wind or a solar power plant. So, for the 345.6 GWh of generation expected from this project, the total GHG savings expected is 265,731 tonnes of equivalent CO_2.

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[113] Indonesia and Oil Palm Plantations Amid Global Environmental Issues, Indonesian Palm Oil Association 2013.
[114] http://www.fao.org/docrep/006/t0309e/T0309E03.htm.

9.6 Institutional Arrangements

Implementation Plan

707. The construction of wind turbine generator involves private land purchase option or land acquisition in Nadukuda, whereas the land belongs to CEB at Mannar GSS. In case of construction of wind farm project, the project would involve survey work and clearance, design and engineering of plant equipment, floating tenders for procurement, civil work related to wind turbines, power evacuation, testing and commissioning. Total project work is expected to complete in 24 months. The total cost for the construction of 100 MW wind farm development in Mannar region is approximately $216.7 million. The overall project implementation schedule for the project is attached in **Table 9.10**.

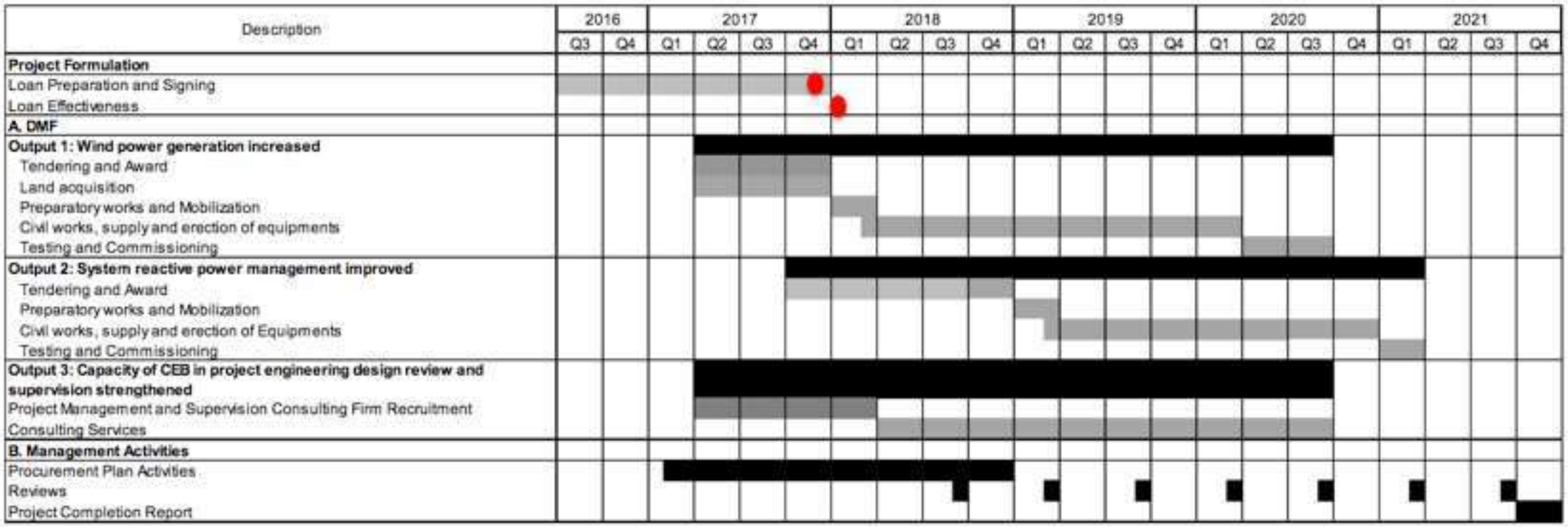
708. Implementation arrangements specify the implementation schedule showing phasing and coordination with overall project implementation; describes institutional or organizational arrangements, namely, who is responsible for carrying out the mitigation and monitoring measures, which must include one or more of the following additional topics to strengthen environmental management capability: technical assistance programs, training programs, procurement of equipment and supplies related to environmental management and monitoring, and organizational changes; and estimates capital and recurrent costs and describes sources of funds for implementing the environmental management plan.

709. The Government of Sri Lanka's (GoSL) Ministry of Power and Renewable Energy (MPRE) is the Executing Agency for overall coordination, whereas Ceylon Electricity Board (CEB) is also the Executing Agency and Implementing Agency for the 100 MW Mannar Wind Park Project. According to the National Environmental Act (NEA), there exists a mandatory requirement to obtain the environmental clearance from the Central Environmental Authority or a Project Approving Agency (PAA) which is authorized under the NEA for any kind of power plants and Transmission lines over 33 kV. Coast Conservation and Coastal Resource Management Department (CCD) is the designated PAA for the wind power project.

710. CEB has a Transmission Design and Environment Division (TDE)[115] for dealing with environment and issues at the corporate level to monitor and implement environmental and social good practices. The environmental assessment and review process for projects would be completed by the PMU at CEB and associated PIUs as described below.

[115] Supplementing their institutional capacity for mitigating environmental impacts from wind farm should be undertaken by the project.

Table 9.10: Overall Project Implementation Schedule



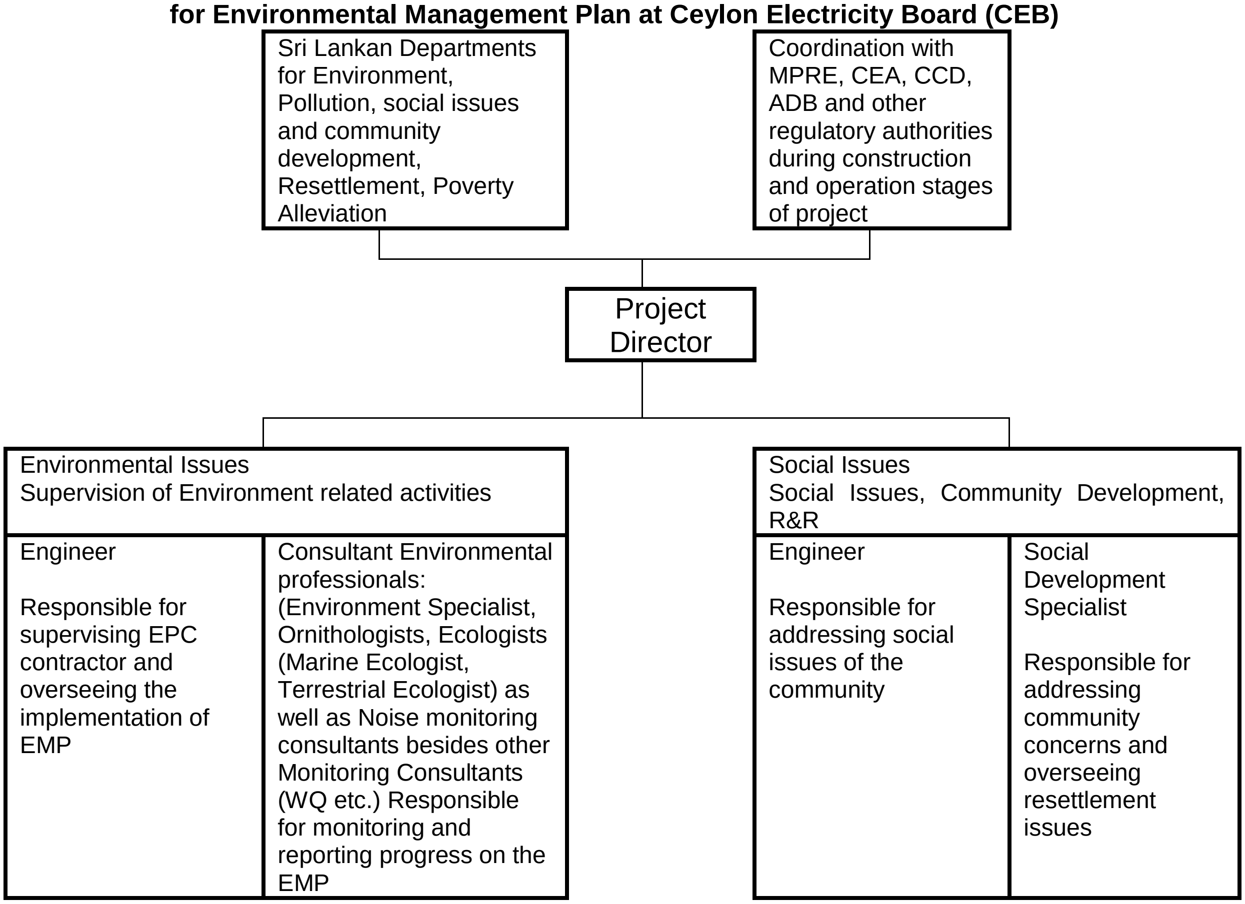
DMF = design and monitoring framework, Q = quarter.
Source: Asian Development Bank estimates.

Project Monitoring Unit (PMU)

711. CEB need to have overall responsibility with day to day delegated to PMU. The PMU will be responsible for overseeing project compliance with environmental and social safeguard requirements that include: (ii) updated project environmental assessments prepared in accordance with the SPS requirements; (iii) appropriate public consultations and disclosures; (iv) effective management of the grievance redress mechanism; and (v) compliance reported in the environmental monitoring report. The PMU structure is shown in **Figure 9.2**. The PMU head will be responsible for coordinating all external functions with ADB, MPRE, GoSL as well as coordinating the internal functions for coordination of Environment and Social/R&R reporting, Legal, Finance and Accounts, PIU monitoring and reporting, Procurement and Contracts, and other functions within CEB.

712. PMU has designated CEB's Environment Officer of Transmission Design and Environment Division (TDE) who has oversight responsibilities for monitoring for all projects in areas such as Environment, R&R and Social safeguards. To assist TDE in these specialist functions, CEB will hire appropriate External consultants (specific role mentioned in "Consultants etc. below) for monitoring Project implementation as deemed necessary for meeting SPS 2009 guidelines for Category A project.

Figure 9.2: Institutional Structures and Responsibility for Environmental Management Plan at Ceylon Electricity Board (CEB)



D&ED = Design & Environment Division, EMP = environmental management plan, MPRE = Ministry of Power and Renewable Energy, PIU = Project Implementation Unit, CCD=Department of Coast Conservation and Coastal Resource Management

713. The duties of the TDE will include at a minimum: (i) oversight of field offices and construction contractors for monitoring and implementing mitigation measures; (ii) liaising with the field offices and contractors and seeking their help to solve the environment-related issues of project implementation; and (iii) preparation of environmental management reports every three months (as required by ADB for Environmental Category A projects). TDE must coordinate with PIU for monitoring as well as designing appropriate mitigation measures to address environmental and social issues.[116]

Project Implementation Unit (PIU)

714. The PMU shall implement the ADB loan at the corporate level and the PMU will be supported for implementation activities through the CEB's Project Implementing Unit (PIU). Separate PIU has been created for the wind farm project. The PIU of CEB will assume primary responsibility for the environmental assessment as well as implementation of EMP and Construction Method Statement through EPC contractors or third party consultants. The PIU/Project Head will be assisted by the TDE.

715. Project Implementation Unit (PIU) includes experienced staff and is headed by senior officers will undertake day-to-day project planning and implementation activities and manage the site activities. For example, the PIU or its appointed technical consultants will conduct routine visual inspections of construction activities, including site pegging, vegetation clearance, earthworks, etc. Full-time project managers with qualified staff will be appointed to supervise projects under each component. The PIU will be responsible for overall project planning and implementation, including procurement, accounting, quality assurance, social and environmental issues and coordination with concerned agencies. For management of EMP, PIU will conduct overall coordination, preparation, planning, implementation, and financing of all field level activities.

716. To enhance the planning implementation, environment safeguard skills at the PIU level, PIU staff must include consultants - Environment Specialist, Ornithologists and Ecologists. PIU staff shall be sent for capacity building training programs periodically by ADB and others in consultation with TDE. These trainings will be identified by PMU in consultation with ADB.

<u>Consultants, Construction Contractors, Equipment Suppliers, and Other Service Providers</u>

717. CEB will ensure that contractors engaged for each project are engaged in regular EMP monitoring and implementation. EPC Contractor will have primary responsibility for environmental management, and worker health and safety at project construction sites under their control. They will be required to adhere to all national and state level environmental, health, and safety (EHS) guidelines and implement relevant project environmental management measures prior to and during construction.

718. EPC Contractor is required to employ an Environment Specialist, an H&S Officer, Ecologists[117] (Marine Ecologist, Terrestrial Ecologist) as well as noise monitoring consultants

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[116] ADB advises that all EAs develop in-house capability for environmental, health, and safety (EHS) program consistent with international best practices. The EHS program should include accounting for environmental benefits resulting from investment projects within three months of loan approval. The monitoring agency shall report on semi-annual basis directly to ADB and determine whether sound environmental management practices have been achieved, and suggest suitable recommendations and remedial measures for midterm correction and improvement.

[117] At least Specialist, H&S officer and the Ecologists to be on site during key periods, e.g., pier construction, vegetation clearance etc.

besides other Monitoring Consultants (WQ, etc.) for project monitoring and reporting. The Barge operator shall employ the services of a marine mammal observer (MMO) on board the barges to ensure there is fatalies of marine species during barge operations.

719. **Post Construction Monitoring**: An Ornithologist and a team of surveyors will be engaged by CEB for monitoring the bird's abundance, behaviour and mortality due to collision at the start of construction and for a span of three years post commissioning.

Stakeholders

720. CEB will coordinate with Department of Coast Conservation and Coastal Resource Management (CCD), Department of Wildlife Conservation (DWC) to designate the staff at project site that can assist CEB and also supervise EPC contractor work.

Performance Indicators

721. Performance indicators to be developed based on loan covenants to be signed between ADB and CEB. These will describe the desired outcomes as measurable events to the extent possible, such as performance indicators, targets, or acceptance criteria that can be tracked over defined time periods will be designed and implemented. Once it is in place, the performance monitoring shall be done by the project in charge of the CEB.

10.0 CONCLUSION AND RECOMMENDATION

722. The proposed construction activities of wind farm will cause avian collision risk, noise from turbine operation, shadow flicker as well as visual impacts. Most other potential environment impacts related to construction will be temporary in nature mainly restricted to the construction period. An Environment Management Plan (EMP) has been prepared and responsibilities for implementation have been assigned. The anticipated environmental impacts can be readily mitigated through the implementation of EMP. Overall; the environmental impacts associated with wind power projects would need to be mitigated to an acceptable level by implementation of recommended measures and by best engineering and environmental practices. During operation, the project impacts are mostly positive as it provides renewable energy and does not generate any gaseous, solid and liquid wastes.

723. EMP contains the guidelines for a “Construction Method Statement” (**Annexure 4**) to be developed and implemented by the EPC contractor to ensure no net loss of biodiversity and to promote the conservation aims in accordance with GoSL requirement and ADB's SPS requirements.

724. In terms of ecology, construction of wind farm will only have an impact on some natural habitats such as scrublands and sea shore/coastal vegetation. There are no critical habitats present along the proposed wind farm block. The fauna and flora observed in the project impacted area are common dry zone species that can easily adapt to change. A majority of bird species observed in the project affected area are species that show a wide distribution in the dry zone of Sri Lanka.

725. Construction of wind farm will result in removal of trees/shrubs (details of trees/shrubs etc. affected is attached as **Appendix 8**) removed from the hardstand, access roads and other areas cleared for building and other facilities, etc. Replanting/restoration programmes should then be designed to compensate the loss of trees/shrubs and the habitat can be enriched once the project

activities are completed.

726. Shadow flicker can be mitigated by stopping wind turbines during time periods when there is potential for shadow flicker at receptors. It is estimated that shadow flicker at receptors could be completely mitigated, with a resulting loss of energy equivalent to approximately 1.5% of the annual energy output of the wind farm if 39 wind turbines are considered, or a 1.0% loss if 31 wind turbines are considered.

727. The operations of wind turbines have a direct impact on the surrounding villages and residents near the project site in terms of noise. Wind turbines supplied for the project should have a maximum noise output of 106.5 dB. Wind turbines supplied for the project must be able to operate in a noise constrained mode, in order to meet the seasonal day/night noise limit requirements defined by this report. A noise assessment study was conducted by Entura to determine the impacts of noise generation during the operation of the wind farm on the receptors in the project area (see **Appendix 5**) where different scenarios considered for noise modelling. CEB would request bidders to comprehensively demonstrate through noise modelling that their wind turbine model and noise control mode regime and proposed layout complies with the noise limits specified in the **Appendix 5a** for corresponding receptors and wind speeds.

728. To address noise issues at locations used for sleeping quarters, CEB will consider the land acquisition option for Kaluthota Cabanas to avoid potential noise impacts from the wind farm and has initiated consultation with the owner of the Cabanas and has secured budget for its acquisition. CEB is also closely coordinating with the concerned Naval Authority regarding the sleeping quarters of Navy at the naval outposts (letters attached from CEB in **Annexure 11).**

729. However, bird collision, is a residual impact of the project that could be minimized by the recommended mitigation measures. The project area is also inhabited by few species of migratory birds. However, the project will not result in a significant reduction of their habitats. The wind farm site does not have any aquatic habitats and therefore all these avifauna species were observed either flying along the cost, feeding in off shore waters or resting on the beach. Therefore, even though the critical species habitat is triggered for the wind farm based on the presence of these species, the wind farm site is not directly used by any of these birds as a habitat.

730. Based on the avian collision risk assessment study (attached in **Appendix 2**) data collection between 2016-2017, a package of mitigation measures will be required to satisfy the ADB critical habitat requirements, including design mitigation, mitigation to reduce impacts during the construction phase of the development (through the production and implementation of a Construction Method Statement following industry best practice), and measures to mitigate the operational phase impacts particularly measures to reduce collisions with the wind turbines.

731. The wind turbines are located beyond the coastal reservation for the area. Although a temporary jetty will be erected during construction and barges will be used to transport equipment to the site, there is no other significant impact on the coastal zone is envisaged by the proposed project during operation. The minor impacts related to soil degradation and localized water logging/flooding can be minimized by adopting proper construction and maintenance practices. The proposed pier is to be constructed on piles and due to its permeable nature, no significant sand accumulation and coastal erosion/accretion issues are envisaged. However, regular coastline monitoring and mitigation measures in the form of regular clearing of any accumulated sand and/or sand nourishment are recommended, if needed.

732. Impacts on the marine environment from the proposed project will be due to the construction and operation of wind turbines. Construction of a temporary pier would have temporary impacts where as the construction and operation of wind turbines will not have direct impact on marine environment or marine organisms. However, there will be some indirect impacts that would result from sediment run off to marine environment during construction phase of the wind turbines. Such impact will be in short term and would be minimized by maintaining good practices during earth excavation. The impacts to marine benthic habitats are expected due to the construction activities that will take place within the marine environment. The near shore environment is already turbid and devoid of any sensitive marine ecosystems. Impact is highly localized and the temporary jetty construction will have very limited or small direct impact on marine environment or marine organisms, if any. Construction of a temporary jetty will have some impact on one madel fishery which will be duly compensated for CEB.

733. Comprehensive underwater survey revealed that all the four optional sites suggested for construction of a pier had identical uniform sandy bottom. None of the locations had any sensitive ecosystems, rare, threatened on any conservation needed organisms. Therefore, all four sites are not ecologically sensitive. A major concern of the fishermen during field survey and interview with key informants were noise generated from turbine during the operation phase.

734. The expected impacts to the surface water of the project area will be limited to proximity of a few water channels to some of the proposed wind turbine locations. However, some adverse impacts could be expected to the groundwater of the project site due to the project activities for installation of wind turbines. However, the expected possible negative impacts to the groundwater could be minimized by adopting mitigatory measures. It is recommended to undertake good monitoring system to monitor the hydraulic, physical, and chemical properties of the groundwater and surface water.

735. No reliable baseline information of water, air, and noise vibration in these areas with respect to wind turbine generator was available. Therefore, collection of baseline parameters of water, air, soil, and noise vibration was conducted at locations (**Section 4.8**). The EPC contractor/CEB will monitor changes of the quality of water, air, soil and noise during the construction and operation periods as per **Annexure 5.**

736. Proper GRM will have to be implemented through PUCSL to overcome public inconvenience during the proposed project activities. The project will ensure that meaningful consultations are continued with communities and affected persons and all relevant information is disclosed in a timely manner, in languages understood by communities and in places easily accessible to them.

737. The proposed project will have number of positive impacts and negative impacts to the existing environment as follows:

- Additional 10% available electricity supply to the project affected area and the nation as a whole thereby reducing reliance on fossil based energy generation in the country.
- Removal of fruit trees (coconut plantations and Palmyra stands) for the wind farm is the main negative impact to the proposed project area.
- Construction activity for wind farm shall be done within 1 km of the coastal area and in vicinity of three ecologically sensitive areas (Vankalai Sanctuary, Adam’s Bridge National Park and Vidathalathivu Nature Reserve) may affect the biodiversity if implementation of project is not done carefully.

- Environment pollution due to cut and fill operations, transportation of construction materials, disposal of debris, disturbance to the construction activities, nuisance from dust, noise, vehicle fumes, vibration, etc. due to construction activities are the short term negative impacts due to proposed project.

738. The proposed wind farm is of national significance. The power generated by the wind turbines will be added to the national grid. It will improve the reliability of electricity supply in the country and CEB will benefit from a cost reduction of electricity generation. The wind project does not bring any direct and immediate benefits to the local communities except for a few road improvements and casual labor work during project construction. Therefore, it is essential that the project avoids any possible harmful effects on its local populations and if possible the project should share part of its benefits with the local communities to enhance their standards of living and social wellbeing. Improvements to small village infrastructure, building vocational and technical skills of unemployed youth, etc. are some of the ways in which the project implementing agency can support the local communities to benefit from this mega development project.

739. The population living within the boundaries earmarked for the project implementation is extensively dependent on two major sources of livelihoods, namely marine fishing that brings them the main source of income to their households during the fishing season and the manufacture of a variety of Palmyra products that supplements their incomes particularly during off-seasons. Therefore, it is important that project implementing agency takes every possible measure to avoid or minimize any adverse impacts caused from the project on these two livelihood sources.

740. The land required for the project will be obtained either direct purchase based on negotiated settlement between the willing buyer and willing seller or through a procedure in complying with the national laws and regulations thus will avoid any involuntary land acquisitions as much as possible. Therefore, no population displacements and involuntary resettlements are anticipated. Land identified for the project is free of encumbrances. However, the project can cause temporary economic displacements particularly to the fishing communities during project construction period and if such a situation arose, affected persons should be provided with alternate fishing sites and compensation for their income losses.

741. It is also strongly recommended that the proposed wind farm should not make any significant deviations from the boundaries currently demarcated for project implementation as such deviations can create adverse implications on the neighboring communities and their sources of livelihoods. The project should not impose any restrictions to communities' access to public roads, fish landing sites, fishermen camps and grazing grounds of cattle.

742. Benefits far outweigh negative impacts. Overall, the major environmental impacts associated with wind farm are limited to the construction period and shall be mitigated to an acceptable level by implementation of the mitigation measures identified in the EMP as well as measures for protection of migratory birds from collision with transmission lines/Wind Farm. The EPC contractor must ensure implementation of recommended EMP and "Construction Method Statement" measures by utilizing best engineering and environmental practices. CEB has made provisions in the project design to cover the environmental mitigation and monitoring requirements, and their associated costs. An EIA was prepared based on the environmental assessment and surveys conducted for the project. Various public consultations were conducted with the stakeholders, NGOs/bird clubs/environmental bodies to hear about the public opinions (attached in **Annexure 9**) regarding construction in the coastal area.

743. The wind farm site does not have any aquatic habitats and therefore all these species were observed either flying along the cost, feeding in off shore waters or resting on the beach. Therefore, even though the critical species habitat is triggered for the wind farm based on the presence of these species, the wind farm site is not directly used by any of these birds as a habitat.

744. Based on the NEA, the proposed project will be categorized as “prescribed” and accordingly, CEB was granted approval by the Project Approving Authority (Department of Coast Conservation and Coastal Resource management) as per the IEE report submitted by CEB in June 2016. However, in accordance with the ADB’s SPS 2009, the proposed construction of wind farm falls under “Category A.” Thus, an EIA report has been prepared for the project for meeting ADB’s SPS 2009 guidelines supported by specific studies relating to migratory birds that inhabit the area in September–April every year.

ANNEXURES

Annexure 1. Applicable Environmental Policy and Procedures

A. Environmental Protection and Management

1. There are a number of legislative and regulatory instruments in Sri Lanka that address environmental management in both general and specific terms. Among these are the 1978 Constitution of Democratic Socialist Republic of Sri Lanka and a number of acts and regulations. The acts and regulations are of particular relevance to the proposed project are as follows:

- National Environment Act (NEA) No 47 of 1980 as amended by Act No 56 of 1988 and Act No 53 of 2000.
- EIA regulations gazetted under NEA (Government Gazette Extraordinary No.772/72 dated 24 June 1993 and in several subsequent amendments).
- Environmental Protection License (EPL) regulations gazetted under NEA (Government Gazette Extraordinary No. 1533/16 dated 25 January 2008).
- Environmental Standards stipulated under NEA:
    - Wastewater Discharge Standards- Gazette Notification No. 1534/18 dated 01/02/2008;
    - National Environmental (Noise Control) Regulations 1996-Gazette Notification no. 924/12 dated 23.05.1996.
    - Interim standards on Air Blast Over Pressure and Ground Vibration
- The land Acquisition Act No 9, 1950 and subsequent amendments
- Sri Lanka Electricity Act, No. 20 of 2009
- Mines and Minerals Act No. 33 of 1992
- Mahaweli Authority of Sri Lanka Act No. 23 of 1979 (Not relevant to this project area.)
- Soil Conservation Act No. 25 of 1951 and No. 29 of 1953 and amended by Act No. 24 of 1996
- Irrigation Ordinance No. 32 of 1946, Act No.1 of 1951 and No. 48 of 1968, Law No. 37 of 1973
- Fauna and Flora Protection Ordinance as amended by Act No. 49 of 1993 and subsequent amends.
- The Antiquities Ordinance, No.9 of 1940 (now Act) and the subsequent amendments, particularly the Antiquities (Amendment) Act No. 24 of 1998 is the primary Act.
- National Involuntary Resettlement Policy (NIRP)
- The Urban Development Authority Act No. 41 of 1978
- Local Authorities acts: The Municipal Council Act No. 19 of 1987 & Urban Council Act No. 18 of 1987
- The Irrigation Ordinance (Chapter 453)
- National Institute of Occupational Safety and Health Act, No. 38 of 2009

2. The constitution of the Democratic Socialist Republic of Sri Lanka under chapter VI: Directive Principles of State policy and Fundamental duties in section 27-14 and in section 28-f proclaim “The state shall protect, preserve and improve the environment for the benefit of the community”, “The duty and obligation of every person in Sri Lanka to protect nature and conserve its riches” thus showing the commitment by the state and obligations of the citizens.

3. The National Environmental Act No. 47 of 1980 (NEA) is the basic national charter for protection and management of the environment. The NEA has been amended twice to make improvements and to respond to the needs of the time; National Environmental (Amended) Act No 56 of 1988; and National Environmental (Amended) Act No 53 of 2000.

4. There are two main regulatory provisions in the NEA through which impacts on the environment from the process of development are assessed, mitigated and managed. These are:

a) The Environmental Impact Assessment (EIA) procedure for major development projects. Regulations pertaining to this process are published in Government Gazette Extraordinary No.772/72 dated 24 June 1993 and in several subsequent amendments.
b) The Environmental Protection License (EPL) procedure for the control of pollution. Regulations pertaining to this process are published in Government Gazette Extraordinary No. 1533/16 dated 25 January 2008.

B. Environmental Impact Assessment

5. The provision relating to EIA is contained in Part IV C of the National Environmental Act. The procedure stipulated in the Act for the approval of projects provides for the submission of two types of reports; Initial Environmental Examination (IEE) report and Environmental Impact Assessment (EIA) report. Such reports are required in respect of “prescribed projects” included in a Schedule in an Order published by the Minister of Environment in terms of section 23 Z of the act in the Gazette Extra Ordinary No. 772/22 dated 24th June 1993. Prescribed projects in the “installation of overhead transmission lines of length exceeding 10 km and voltage above 50 KV,” apply to the transmission line project. Furthermore, any project or undertaking irrespective of its magnitude, if located partly or wholly within an Environmental Sensitive Area, will become a prescribed project requiring approval under the EIA regulations.

6. Any developmental activity of any description whatsoever proposed to be established within one mile of the boundary of any National Reserve (see table below), should receive the prior written approval of the Director of Wildlife Conservation. The Fauna and Flora (Protection) Ordinance mandates that the project proponent should furnish an IEE or an EIA report in terms of the National Environmental Act for this purpose.

7. The EIA process is implemented through designated Project Approving Agencies (PAAs). The PAAs are line ministries and agencies that are directly connected with a prescribed project. They are responsible for administration of the EIA process under the NEA. Determination of the appropriate PAA will be based on the following unranked criteria:

- The PAA having jurisdiction over the largest area, or
- Having jurisdiction over diverse or unique ecosystems, or
- Within whose jurisdiction the environmental impacts (resource depletion) are likely to be the greatest,
- The PAA having statutory authority to license or otherwise approve the prescribed project.

8. A given organization cannot act both as the PAA as well as the project proponent. In such cases the CEA will designate an appropriate PAA. Similarly, when there are more than one PAA the CEA determine the appropriate PAA. The PAA for the 220 kV Mannar Nadukuda transmission line is CEA.

9. In order for a project to be approved the project proponent should submit either an Initial Environmental Examination (IEE) report or an Environmental Impact Assessment (EIA) report as determined by the PAA. Once an EIA report has been submitted, there is mandatory period of 30 days during which the public can inspect the document and comment on the report.

10. Further, a public hearing may be held to provide an opportunity to any member of the public to voice their concerns. A decision whether to approve the project will be made by the PAA only after public consultation is done and major issues are resolved.

11. The following key national agencies with a mandate for environmental management and protections are also relevant to the project activities: The Forest Department, the Department of Wildlife Conservation, Department of Archeology, Disaster Management Center and Geological Survey and Mines Bureau. They have their regional offices and staff to cater to and monitor the environmental safeguards as per the policies and regulatory provisions governing them. In addition, there are several national agencies that are impacting on the environment and adopting environmental safeguards as well. They are Urban Development Authority (UDA), Water Supply and Drainage Board, Road Development Authority (RDA), Department of Agriculture, Department of Agrarian Services and Irrigation Department.

12. The Local Authorities are also having provisions under their respective acts to safeguards and provide useful facility and maintain the same for the convenience of the public in their respective areas. The Municipal Council Act No. 19 of 1987 and Urban Council Act No. 18 of 1987 provide for the establishment of Municipal Councils and Urban Councils with a view to provide greater opportunities for the people to participate effectively in the decision-making process relating to administrative and development activities at a local level and it specifies the powers, functions and duties of such Local Authorities and provide for matters connected therewith or incidental thereto. These acts cover public health, drainage, latrines, unhealthy buildings, conservancy and scavenging, nuisance, etc. As explained in the previous section the Local Authorities are empowered to issue Environmental Protection License (EPL) under NEA for industries carrying out activities of low polluting nature.

C. Environmental Assessment Legislation

13. The requirement for Environmental Assessment in Sri Lanka is established by the National Environment Act No. 47 (1980), and the amendment to the act 1988, Act No. 56 Section 23A, for EPL procedure and the EIA regulation under Part 4C, under the provision of section 23Z. The procedures are defined in the environmental impact assessment (EIA) Regulations Gazette No. 772/22 (1993). The Prescribed Projects set out in the Gazette Extra Ordinary No. 772/22 of 24th June 1993, No. 1104/22 dated 6 November 1999, and No. 1108/1 dated 29 November 1999 for which environmental assessment is mandatory, and described as below:

Part I: Projects and undertakings if located wholly or partly outside the coastal zone as defined by Coast Conservation Act No. 57 of 1981.

- Reclamation of Land, wetland area exceeding 4 hectares.
- Extraction of timber covering land area exceeding 5 hectares.
- Conversion of forests covering an area exceeding 1 hectare into non-forest uses.
- Clearing of land areas exceeding 50 hectares.
- Installation of overhead transmission lines of length exceeding 10 kilometers and voltage above 50 kilovolts.

- All renewable energy based electricity-generating stations exceeding 50 Megawatts.
- Involuntary resettlement exceeding 100 families other than resettlement effected under emergency situations.
- Development of all Industrial Estates and Parks exceeding an area of 10 hectares.

PART II: All projects and undertaking listed in Part I above irrespective of their magnitudes and irrespective of whether they are located in the coastal zone or not, if located wholly or partly within the areas specified in part III of the Schedule.

a. Within 100 m from the boundaries of or within any area declared under
   - the National Heritage Wilderness Act No. 3 of 1988;
   - the Forest Ordinance (Chapter 451; whether or not such areas are wholly or partly within the Coastal Zone as defined in the Coast Conservation Act, No. 57 of 1981.

b. Within the following areas whether or not the areas are wholly or partly within the Coastal zone:
   - any erodible area declared under the Soil Conservation Act (Chapter 450)
   - any flood area declared under the Flood Protection Ordinance (Chapter 449) and any flood protection area declared under the Sri Lanka Land Reclamation and Development Corporation Act, 15 of 1968 as amended by Act, No. 52 of 1982.
   - 60 meters from the bank of a public stream as defined in the Crown Lands Ordinance (Chapter 454) and having a width of more than 25 meters at any point of its course.
   - any reservation beyond the full supply level of a reservoir.
   - any archaeological reserve, ancient or protected monument as defined or declared under the Antiquities Ordinance (Chapter 188).
   - any area declared under the Botanic Gardens Ordinance (Chapter 446).
   - within 100 meters from the boundaries of, or within, any area declared as a Sanctuary under the Fauna and Flora Protection Ordinance (Chapter 469).
   - within 100 meters form the high flood level contour of, or within, a public lake as defined in the Crown Lands Ordinance (Chapter 454) including those declared under section 71 of the said Ordinance.
   - Areas declared under the Urban Development Authority Act No 41 of 1978 and Act No. 4 of 1982 section 29 (this indicates in its definition that laws are valid to the areas of the Local authorities).

14. The requirement for EIA and the level of study required are determined by CEA after submission by the proponent of a Project Information Document (PID), plus supporting information, if relevant. There are two possible outcomes:

15. **Categorical Exclusion.** The activity is not on the list of prescribed projects in the EIA regulations, is not in or near a sensitive area, has not been the subject of public protest, and it is clear from the PID and supporting information that the project will have no significant environmental impacts. Environmental clearance is granted (with or without conditions) and the project may proceed.

16. Environmental Assessment: All other projects require Environmental Assessment and the CEA establishes a Scoping Committee to decide on the level of study (IEE or EIA) and prepare Terms of Reference (ToR). Alternatively, if the project lies wholly within the jurisdiction of a single government agency, only if it is a gazetted PAA. CEA may refer the project to this authority (as the PAA) to administer the EIA process. A Technical Review Committee (TRC) reviews the completed IEE or EIA report and recommends whether environmental approval shall be granted; the final decision is made by CEA.

17. There are further compliance requirements prescribed by other certain legislation, in particular the Coast Conservation Act, which requires clearance by the Department of Coast Conservation and Coastal Resource Management (CCD) for any development activity or structure in the coastal zone.[118] An EPL from CEA is required for the operation of the completed facilities (a list has been published by CEA).

18. No development or encroachment of any kind is permitted in archaeological reserves declared under the Antiquities Ordinance No. 9 of 1940 as amended (Section 34). The Director General of Archaeology is empowered to conduct an Archaeological Impact Assessment of areas that may be affected by development or other projects proposed by the government or any person.

19. No construction activities are permitted in national reserves (under the jurisdiction of the Department of Wildlife Conservation - the Fauna and Flora Protection Ordinance No. 2 of 1937, as amended) and forest reserves (under the jurisdiction of the Forest Department - see the Forest Ordinance of 1907 as amended). Sanctuaries, also declared under the Fauna and Flora Protection Ordinance, may include privately-held land. Clearance from the Department of Wildlife Conservation is required if construction is proposed in sanctuaries. Construction within o mile (1.6 km) radius of a national reserve, sanctuary or buffer zone needs permission from the Department of Wildlife Conservation (see the Fauna and Flora Protection Ordinance No. 2 of 1937, as amended). Any development activity within a fishery reserve[119] requires the permission and approval of the Director of Fisheries and Aquatic Resources (see the Fisheries and Aquatic Resources Act No. 2 of 1996). Any construction-taking place in close proximity to a forest reserve must be approved and cleared by the Forest Department.

20. Using paddy land for a purpose other than agricultural cultivation without the written permission of the Commissioner General is a punishable offence under the Agrarian Development Act No. 46 of 2000 (Section 32). In addition to environmental clearance, approval from the local authorities and CEA for site clearance; and consent from all relevant *Pradeshiya Sabhas*, Provincial Councils, and Divisional Secretaries shall be obtained before construction begins.

21. Clearance shall be obtained for the proposed development activities, if the area is declared under the UDA Act or Sri Lanka Land Reclamation and Development Corporation (SLLR and DC) Act.

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[118] The coastal zone is defined in the Coast Conservation Act No. 57 of 1981 "as the area lying within a limit of 300 meters landward from mean high water line (MHWL). In the case of rivers, streams, lagoons or any other body of water connected to the sea, either permanently or periodically, the landward boundary extends to a limit of 2 km measured perpendicular to the straight base line drawn between the natural entrance points thereof and includes waters of such rivers, streams and lagoons or any other body of water so connected to the sea."

[119] Certain areas adjoining earmarked reservoirs and water bodies can be declared as a fishery reserve with the concurrence of the Ministry of Wildlife and Natural Resources.

Table 2 summarizes the application procedures for the main environmental permits.

Table 2: Summary of Procedure for Obtaining Environmental Permits Required by the Government of Sri Lanka

Legislation	Regulatory, Agency	Summary of Procedure	Time scale
1. Central Environmental Authority - Environment Impact Assessment/Initial Environmental Examination (IEE/EIA) Clearance			
National Environmental Act No. 47 of 1980 and amended Act No. 56 of 1988; Government Gazette No. 772/22 of 24th June 1993 and No. 859/14 of 23rd February 1995	Central Environmental Authority (CEA)	1. Proponent to submit Project Information Document to CEA	During Feasibility Stage
		2. CEA to designate Project Approving Authority (PAA)	36 days
		3. PAA to appoint scoping committee; Issue of Terms of Reference (ToR) for the EIA/IEE	
		4. Proponent to conduct the environmental assessment and submit report to PAA	One and half years
		5. PAA to check adequacy	14 days
		6. For EIA, report will be open for public comments	30 days
		7. Technical Review Committee (TRC) to review report and forwarding comments	36 days
		8. PAA to recommend to CEA issuance of Clearance	
2. Coast Conservation Department Permit			
Under Section 5, 14, 15 and 16 of Coast Conservation Act No. 57 of 1981	Coast Conservation Department (CCD)	1. Proponent to submit application to CCD	During Feasibility Stage
		2. CCD to issue ToR for EIA/IEE	About 14 days
		3. Proponent to conduct the environmental assessment and submit report to CCD	One and half years
		4. For EIA, CCD will (i) invite Coast Conservation Advisory Council for comments; and (ii) open report for public comments	120 days (maximum)
		5. CCD to review comments	
		6. CCD to issue permit	
3. Environmental Protection License (EPL)			
National Environmental Act No. 47 of 1980 amended by Acts No. 56 of 1988 and No. 53 of 2000; Gazette Notification No. 1533/16 dated 25.01.2008	CEA	1. Proponent to submit application to CEA	Minimum of 30 days prior to the commencement of operation
		2. CEA to conduct field inspection and verification from relevant authorities	14 days
		CEA to prepare Inspection Report with Recommendations	14 days
		TRC to review report	
		Proponent to pay license fee	
		CEA to issue EPL	
4. Archaeological Impact Assessment Survey			
Under Section 47 read with Section 43(b) of Antiquities (Amendment) Act No. 24 of 1998; Gazette Notification No. 1152/14 dated 04.10.2000	Department of Archaeology	Proponent to submit application to Department of Archaeology.	During Feasibility Stage
		DA Regional Office to conduct Preliminary Observation and submit report to Department of Archaeology.	About 30 days
		(i) If there are no antiquities according to the recommendation and observation report, land will be released for the project.	
		(ii) If the preliminary observation report has proposed to carry out an archaeological impact assessment survey, steps will be taken to conduct the survey including scoping with other agencies.	30 days
		Department of Archaeology to call for quotations and award contract for Archaeological Impact Assessment (AIA) survey	
		Selected agency to conduct AIA survey and submit report to Department of Archaeology	42 days
		Department off Archaeology to submit AIA report to Minister in charge of approval	About 30 days
		Department of Archaeology to issue approval	

Legislation	Regulatory, Agency	Summary of Procedure	Time scale
5. Clearance from Department of Forest Conservation			
Under the ordinance enacted in 1907 No. 16, and subsequent amendment No. 23, 1995 and No. 65 of 2009.	Department of Forest Conservation (DFC)	Proponent to submit application to DFC	During Feasibility Stage
		District Forest Office along with the DFC officials to conduct preliminary observation and submit report to Conservator General of DFC for approval	About 60 days
		(i) If the project is located within the core protected area, the application will be rejected;	60 days
		If the project will utilize resources from the forest (timber or related) the application will be rejected (even if it is located outside the boundary and the buffer);	
		If the project is outside the boundaries and buffers of any Forest Reserves (FRs), DFC"s consent will be released.	
		DFC will refer to CEA if the proposed activities will cause negative impacts on forest conservation areas and there will be extraction of resources involved.	30 days
		- Under NEA, EIA will be conducted - DFC will become the project approving agency	116 days
		DFC will release the approval with the concurrence of the CEA.	

AIA = Archaeological Impact Assessment, CCD = Coast Conservation Department, CEA = Central Environmental Authority, DA = Department of Archaeology, DFC = Department of Forest Conservation, EIA = Environmental Impact Assessment, EPL = Environment Protection License, IEE = Initial Environmental Examination, PAA = Project Approving Agency, SLLR&DC = Sri Lanka Land Reclamation and Development Corporation, ToR = Terms of Reference, UDA= Urban Development Authority.

D. Environment Assessment and Review Framework Guidelines

Table 3: Environmental Criteria for Subproject Selection

	Components	Environmental Selection Guidelines	Remarks
1.	Overall Selection Guideline (applicable to all components)	Comply with all requirements of relevant national, state, and local laws, rules, and guidelines.	
		Site selection process will avoid where possible land acquisition and involuntary resettlement where possible including impacts on vulnerable persons and indigenous peoples.	
		Site selection will avoid where possible locations in protected areas, including notified reserved forests or biodiversity conservation hotspots (sanctuary/national park, etc.).	Approval from concerned authority if unavoidable
		Subproject location shall not result in destruction/disturbance to historical and cultural places/values.	
		The subproject will avoid where possible, and minimize to an extent feasible facilities in locations with social conflicts.	
		The subproject will avoid where possible tree cutting.	Approval from Forest Department
		Retain mature trees.	
		The subproject will reflect inputs from public consultation and disclosure for site selection.	
2.	Transmission Lines, Distribution Lines, Substations	Comply with all requirements of relevant national law. Provincial and Local Authority regulations	
		Locate all new facilities at least 100 m from houses, shops or any other premises used by people, thus establishing a buffer zone to reduce the effects of noise, dust and the visual appearance of the site.	Distance restriction may be reviewed depending on site availability and buffer zone planning as well as by-laws of respective local authorities
		Locate Substations at sites where there is no risk of flooding or other hazards that might impair functioning or present a risk of damage to its environs.	Flood statistics data of the project area needs to be reviewed.
		Consult the relevant national and/or local archaeological agencies regarding the archaeological potential of proposed sites and power lines to ensure that these are located in areas where there is a low risk of chance finds.	

	Components	Environmental Selection Guidelines	Remarks
		Locate towers/poles within the Right of Way (RoW) of other linear structures (roads, irrigation canals) as far as possible, to reduce the acquisition of new land.	
		Ensure that transmission routes do not require the acquisition of land from individual farmers in amounts that are a significant proportion of their total land holding (>10%).	
		Subproject will be implemented only with consent of CEA	
		Retain mature trees.	
3.	Solar and Wind Farms, augmentation of substations	Only projects proposed or requested by the relevant agencies shall be considered for implementation.	
		Subprojects shall involve improvements within the boundary of existing facilities only.	
		Ensure that any facilities involving hazardous or polluting materials (e.g. waste oil disposal, SF6) are designed to national and international standards, to protect human health, both within and outside the facility.	
		Where new facilities are required, these shall be sited on vacant government land and ROWs where feasible.	
		Ensure that waste disposal in constructed facilities are designed to national and international standards.	

Table 4: Summary of Environmental Compliance Requirements of the Project Components for EARF Consideration

	Subproject	Subcomponent	Applicable Legislation	Statutory Requirement	Authorizing Body
1.	New Transmission lines, Distribution lines, substations	All subcomponents in sensitive areas	National Environment Act (NEA)	Environmental Clearance (EC)	Central Environment Authority (CEA)
		All subcomponents falling within the coastal zone	Coast Conservation Act	Clearance	Coastal Conservation Department (CCD)
		All subcomponents that require site clearance	Municipal Councils Ordinance No. 29 of 1947, the Urban Councils Ordinance No. 61 of 1939 and the *Pradeshiya Sabha* Act No. 15 of 1987 as amended	Clearance	Municipal Councils, Urban Councils and *Pradeshiya Sabhas*
		All subcomponents that require cutting of trees	Felling of Trees (Control) Act No 9 of 1951	Tree-cutting Permit	Forest Department
		All subcomponents within a 1 mile (1.6 km) radius of a national reserve, sanctuary, or buffer zone	Fauna and Flora Protection Ordinance No. 2 of 1937 as amended	Clearance	Department of Wildlife Conservation
		All subcomponents in close proximity of a reserve forest	Forests Ordinance No. 16 of 1907 as amended	Clearance	Forest Department
		All subcomponents in and around fishery reserves	Fisheries and Aquatic Resources Act No. 2 of 1996	Clearance	Director of Fisheries and Aquatic Resources
		All subcomponent in proximity of archaeological reserves	Antiquities Ordinance No. 9 of 1940 as amended	Clearance	Department of Archaeology
		All subcomponent in and around irrigation development	Irrigation Development Act	Clearance	Director, Irrigation Department
		All subcomponent in and archaeological reserves around UDA declared areas	UDA Act No. 41 1978 and No. 4 of 1982	Clearance	Regional Director UDA
2	Solar Park, Wind Farm	All subcomponents in sensitive areas	NEA	EC	CEA
		All subcomponents falling within the coastal zone	Coast Conservation Act	Clearance	CCD
		All subcomponents that require site clearance	Municipal Councils Ordinance No. 29 of 1947, the Urban Councils Ordinance No. 61 of 1939 and the *Pradeshiya Sabha* Act No. 15 of 1987 as amended	Clearance	Municipal Councils, Urban Councils and *Pradeshiya Sabhas*
		All subcomponents that require cutting of trees	Felling of Trees (Control) Act No. 9 of 1951	Tree-cutting Permit	Forest Department
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		All subcomponents in and around fishery reserves	Fisheries and Aquatic Resources Act No. 2 of 1996	Clearance	Director of Fisheries and Aquatic Resources
		All subcomponent in proximity of archaeological reserves	Antiquities Ordinance No. 9 of 1940 as amended	Clearance	Department of Archaeology
		All subcomponents in and around fishery reserves	Fisheries and Aquatic Resources Act No. 2 of 1996	Clearance	Director of Fisheries and Aquatic Resources
		All subcomponent in proximity of archaeological reserves	Antiquities Ordinance No. 9 of 1940 as amended	Clearance	Department of Archaeology

CCD= Department of Coast Conservation and Coastal Resource Management, CEA = Central Environment Authority, EC = Environmental Clearance, NEA = National Environment Act, UDA = Urban Development Authority.

E. Applicable International Environmental Agreements

22. In addition to national rules and regulations, international conventions such as the International Union for Conservation of Nature and Natural Resources (IUCN), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on Migratory Species of Wild Animals (CMS) and Ramsar Convention on Wetlands of International Importance are applicable for selection and screening of subprojects under restricted/sensitive areas. Sri Lanka is a party to these conventions.

(i) **International Union for Conservation of Nature and Natural Resources (IUCN).** The IUCN Red List of Threatened Species (also known as the IUCN Red List or Red Data List), founded in 1963, is a comprehensive inventory of the global conservation status of plant and animal species. The IUCN is an authority on the conservation status of species. A series of Regional Red Lists are produced by countries or organizations, which assess the risk of extinction to species within a political management unit. The IUCN Red List is set upon precise criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world. The aim is to convey the urgency of conservation issues to the public and policy makers, as well as help the international community to try to reduce species extinction.

(ii) **Convention on Migratory Species of Wild Animals (CMS). CMS was adopted in 1979 and** entered into force on 1 November 1983. CMS, also known as the Bonn Convention, recognizes that local authorities must be the protectors of migratory species that live within or pass through their national jurisdictions, and aims to conserve terrestrial, marine, and avian migratory species throughout their ranges. Migratory species threatened with extinction are listed on Appendix I of the Convention. CMS parties strive towards strictly protecting these species, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them. Migratory species that need or would significantly benefit from international cooperation are listed in Appendix II of the Convention, and CMS encourages the range states to conclude global or regional agreements.

(iii) **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).** It is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. CITES was first formed, in the 1960s. Annually, international wildlife trade is estimated to be worth billions of dollars and includes millions of plant and animal specimens. The trade is diverse, ranging from live animals and plants to a vast array of wildlife products derived from them, including food products, exotic leather goods, wooden musical instruments, timber, tourist curios and medicines. Levels of exploitation of some animal and plant species are high and the trade in them, together with other factors, such as habitat loss, is capable of heavily depleting their populations and even bringing some species close to extinction. Many wildlife species in trade are not endangered, but the existence of an agreement to ensure the sustainability of the trade is important in order to safeguard these resources for the future. Because the trade in wild animals and plants crosses borders between countries, the effort to regulate it requires international cooperation to safeguard certain species from over-exploitation.

(iv) Ramsar Convention on Wetlands of International Importance 1971. The Convention on Wetlands of International Importance, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The Ramsar Convention is an international treaty for the conservation and sustainable utilization of wetlands The Ramsar Convention is the only global environmental treaty that deals with a particular ecosystem. According to the Ramsar list of Wetlands of International Importance, there are five designated wetlands in Sri Lanka need to be protected. Activities undertaken in the proximity of Ramsar wetlands shall follow the guidelines of the convention. Sri Lanka presently has 5 sites designated as Wetlands of International Importance, with a surface area of 32,372 hectares.

(v) United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Convention. The most significant feature of the 1972 World Heritage Convention is that it links together in a single document the concepts of nature conservation and the preservation of cultural properties. The Convention recognizes the way in which people interact with nature, and the fundamental need to preserve the balance between the two. The convention defines the kind of natural or cultural sites, which can be considered for inscription on the World Heritage List. The convention sets out the duties of states parties in identifying potential sites and their role in protecting and preserving them. By signing the Convention, each country pledges to conserve not only the World Heritage sites situated on its territory, but also to protect its national heritage. The states parties are encouraged to integrate the protection of the cultural and natural heritage into regional planning programs, set up staff and services at their sites, undertake scientific and technical conservation research, and adopt measures, which give this heritage a function in the day-to-day life of the community. It also encourages states parties to strengthen the appreciation of the public for World Heritage properties and to enhance their protection through educational and information programs.

F. Asian Development Bank’s Safeguards Policies

Asian Development Bank’s Environment Categorization

23. The ADB’s Safeguard Policy Statement (SPS) 2009 is applicable to all projects. These projects can be categorized as A, B, C or FI. **Table F1.1** provides a list of categorization of the activities related to Environment, Safeguards, as per ADB’s Safeguard Policy Statement 2009 requirements:

Table F1.1: Environment Safeguards Categorization: Definition

Category	Environment
A — Significant	Investments that anticipate significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works.
B — Less Significant	Investments with potential adverse impacts that are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be more readily designed than for Category A investments.
C — Minimal or No Impact	Investments that have minimal or no adverse environmental impacts.
FI — Financial Intermediation	Investment of ADB funds through financial intermediaries (FI)

ADB Prohibited Investment Activities List (PIAL)

24. At an initial stage of identifying project activities, the ADB's Prohibited Investment Activities List (described below) will apply. If the investment involves a prohibited activity, CEB will not consider the investment.

25. The following type of projects do not qualify for Asian Development Bank financing:
- (i) production or activities involving harmful or exploitative forms of forced labor[120] or child labor;[121]
- (ii) production of or trade in any product or activity deemed illegal under host country laws or regulations or international conventions and agreements or subject to international phase outs or bans, such as (a) pharmaceuticals,[122] pesticides, and herbicides,[123] (b) ozone-depleting substances,[124] (c) polychlorinated biphenyls[125] and other hazardous chemicals,[126] (d) wildlife or wildlife products regulated under the Convention on International Trade in Endangered Species of Wild Fauna and Flora,[127] and (e) trans-boundary trade in waste or waste products;[128]
- (iii) production of or trade in weapons and munitions, including paramilitary materials;
- (iv) production of or trade in alcoholic beverages, excluding beer and wine;[129]

[120] Forced labor means all work or services not voluntarily performed, that is, extracted from individuals under threat of force or penalty
[121] Child labor means the employment of children whose age is below the host country's statutory minimum age of employment or employment of children in contravention of International Labor Organization Convention No. 138 "Minimum Age Convention" (www.ilo.org).
[122] A list of pharmaceutical products subject to phaseouts or bans is available at http://www.who.int.
[123] A list of pesticides and herbicides subject to phaseouts or bans is available at http://www.pic.int.
[124] A list of the chemical compounds that react with and deplete stratospheric ozone resulting in the widely publicized ozone holes is listed in the Montreal Protocol, together with target reduction and phaseout dates. Information is available at http://www.unep.org/ozone/montreal.shtml.
[125] A group of highly toxic chemicals, polychlorinated biphenyls are likely to be found in oil-filled electrical transformers, capacitors, and switchgear dating from 1950 to 1985.
[126] A list of hazardous chemicals is available at http://www.pic.int.
[127] A list is available at http://www.cites.org.
[128] As defined by the Basel Convention; see http://www.basel.int.
[129] This does not apply to investee companies who are not substantially involved in these activities. Not substantially involved means that the activity concerned is ancillary to an investee company's primary operations.

(v) production of or trade in tobacco;
(vi) gambling, casinos, and equivalent enterprises;
(vii) production of or trade in radioactive materials,[130] including nuclear reactors and components thereof;
(viii) production of, trade in, or use of unbonded asbestos fibers;[131]
(ix) commercial logging operations or the purchase of logging equipment for use in primary tropical moist forests or old-growth forests; and
(x) marine and coastal fishing practices, such as large-scale pelagic drift net fishing and fine mesh net fishing, harmful to vulnerable and protected species in large numbers and damaging to marine biodiversity and habitats.

ADB SPS Requirements (SR1): Environment Policy

26. ADB's SPS sets out the policy objectives, scope and triggers, and principles for the environmental safeguards. To achieve the policy objectives and deliver the policy principles, ADB carries out the actions described in the "Policy Delivery Process" (subsection "B" of the SPS). To help borrowers/clients and their projects achieve the desired outcomes, ADB adopts a set of specific safeguard requirements that borrowers/clients are required to meet in addressing environmental and social impacts and risks. ADB staff, through their due diligence, review, and supervision, will ensure that borrowers/clients comply with these requirements during project preparation and implementation. These safeguard requirements are as follows:

Objectives: The objective of ADB's due diligence for the Project loan is that the Executing Agency ensures the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process.

Scope and Triggers: Environmental safeguards are triggered if a project is likely to have potential environmental risks and impacts.

Policy principles:

- Use screening process for each proposed project to determine the appropriate extent and type of environmental assessment so that appropriate studies are undertaken commensurate with the significance of potential impacts and risks.
- Conduct an environmental assessment for each proposed project to identify potential direct, indirect, cumulative, and induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence. Assess potential transboundary and global impacts, including climate change. Use strategic environmental assessment where appropriate.
- Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and document the rationale for selecting the particular alternative proposed. Also consider the no project alternative.
- Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental

[130] This does not apply to the purchase of medical equipment, quality control (measurement) equipment, and any equipment for which ADB considers the radioactive source to be trivial and adequately shielded.
[131] This does not apply to the purchase and use of bonded asbestos cement sheeting where the asbestos content is less than 20%.

planning and management. Prepare an environmental management plan (EMP) that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators. Key considerations for EMP preparation include mitigation of potential adverse impacts to the level of no significant harm to third parties, and the polluter pays principle.

- Carry out meaningful consultation with affected people and facilitate their informed participation. Ensure women's participation in consultation. Involve stakeholders, including affected people and concerned nongovernment organizations, early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with stakeholders throughout project implementation as necessary to address issues related to environmental assessment. Establish a grievance redress mechanism to receive and facilitate resolution of the affected people's concerns and grievances regarding the project's environmental performance.
- Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. Disclose the final environmental assessment, and its updates if any, to affected people and other stakeholders.
- Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports.
- Do not implement project activities in areas of critical habitats, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development, and management of renewable natural resources.
- Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gases emissions, waste generation, and release of hazardous materials from their production, transportation, handling, and storage. Avoid the use of hazardous materials subject to international bans or phase-outs. Purchase, use, and manage pesticides based on integrated pest management approaches and reduce reliance on synthetic chemical pesticides.
- Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and

response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities.

- Conserve physical cultural resources and avoid destroying or damaging them by using field-based surveys that employ qualified and experienced experts during environmental assessment. Provide for the use of “chance find” procedures that include a pre-approved management and conservation approach for materials that may be discovered during project implementation.

Annexure 2. Ecology Study

Table 1. Plant species found in and around the proposed wind power park, Mannar

Family	Species	Sinhala Name	H	TS	NCS	GCS
Acanthaceae	*Asystasia gangetica*	Puruk	H	In		NA
Acanthaceae	*Dipteracanthus prostratus*	Nil-puruk	H	In		NA
Acanthaceae	*Avicennia marina*	Manda	S	In		LC
Aizoaceae	*Sesuvium portulacastrum*	Maha-sarana	H	In	NT	NA
Aizoaceae	*Trianthema decandra*	Maha-sarana	H	In	NT	NA
Amaranthaceae	*Achyranthes aspera*	Karal haba	H	In		NA
Amaranthaceae	*Aerva lanata*	Polpala	H	In		NA
Amaranthaceae	*Pupalia lappacea*	Wal karal heba	H	In		NA
Apocynaceae	*Carissa spinarum*	Heen-Karamba	S	In		NA
Apocynaceae	*Calotropis gigantea*	Wara	S	In		NA
Apocynaceae	*Dregea volubilis*	Kiri-Anguna	C	In		NA
Apocynaceae	*Hemidesmus indicus*	Iramusu	C	In		NA
Apocynaceae	*Oxystelma esculentum*	Usepale	C	In		LC
Apocynaceae	*Pentatropis capensis*		C	In		NA
Apocynaceae	*Pergularia daemia*	Wissani	C	In		NA
Apocynaceae	*Secamone emetica*	Mudu Kiriya	C	In		NA
Apocynaceae	*Tylophora indica*	Mudu-bin-nuga	C	In		NA
Arecaceae	*Borassus flabellifer*	Thal	T	I		NA
Arecaceae	*Cocos nucifera*	Pol	T	I		NA
Arecaceae	*Phonix pusilla*	Wal indi	T	In		NA
Aristolochiaceae	*Aristolochia indica*	Sapsanda	C	In		NA
Asparagaceae	*Asparagus racemosus*	Heen hathavariya	C	In		NA
Asteraceae	*Blumea obliqua*	Mudu-mahana	H	In		NA
Asteraceae	*Eclipta prostrata*	Kikirindi	H	In		NA
Asteraceae	*Emilia sonchifolia*	Kadupahara	H	In		NA
Asteraceae	*Epaltes divaricata*	Heen-mudu-mahana	H	In		NA
Asteraceae	*Launaea sarmentosa*		H	In		NA
Asteraceae	*Vernonia cinerea*	Monorakudumbiya	H	In		NA
Asteraceae	***Vernonia zeylanica***	Papula	S	E		NA
Asteraceae	*Wedelia chinensis*	Ranwan-kikirindi	H	In		NA
Asteraceae	*Wollastonia biflora*	Mudu-Gampalu	S	In		NA
Asteraceae	*Xanthium indicum*	Uru-kossa	H	In		NA
Boraginaceae	*Cordia monoica*	Lolu	T	In		NA
Boraginaceae	*Ehretia laevis*		S	In		NA
Boraginaceae	*Ehretia microphylla*	Hin-Thambala	S	In		NA
Boraginaceae	*Heliotropium indicum*	Et-honda	H	In		NA
Cactaceae	*Opuntia dillenii*	Katu-pathok	S	I		NA
Capparaceae	*Capparis brevispina*	Wal-dehi	S	In	NT	NA
Capparaceae	*Capparis divaricata*	Wellangiriya	S	In		NA
Capparaceae	*Capparis sepiaria*	Rila Katu	C	In		NA
Capparaceae	*Capparis zeylanica*	Sudu-wellangiriya	S	In		NA
Celastraceae	***Cassine glauca***	Neralu	T	E		NA
Celastraceae	*Gymnosporia emarginata*	Katu pila	S	In		NA
Celastraceae	*Pleurostylia opposita*	Panakka	T	In		NA
Celastraceae	*Salacia chinensis*	Heen-himbutu-wel	C	In	NT	NA
Cleomaceae	*Cleome viscosa*	Ran-manissa	H	In		NA
Colchicaceae	*Gloriosa superba*	Niyagala	C	In		NA
Combretaceae	*Lumnitzera racemosa*	Beriya	T	In	NT	LC

Family	Species	Sinhala Name	H	TS	NCS	GCS
Combretaceae	*Terminalia catappa*	Kottamba	T	I		NA
Commelinaceae	*Commelina benghalensis*	Diya-meneriya	H	In		LC
Commelinaceae	*Commelina petersii*		H	In		LC
Commelinaceae	*Cyanotis axillaris*		H	In		NA
Commelinaceae	*Murdannia spirata*		H	In		LC
Connvolvulaceae	*Cuscuta campastre*		H	In		LC
Connvolvulaceae	*Ipomoea pes-caprae*	Mudu-bin-thamburu	C	In		NA
Connvolvulaceae	*Ipomoea pes-tigridis*	Divi-pahura	C	In		NA
Connvolvulaceae	*Ipomoea* sp.		C	In		NA
Connvolvulaceae	*Ipomoea violacea*		C	In		NA
Cucurbitaceae	*Citrullus lanatus*	Komadu	C	I		NA
Cucurbitaceae	*Coccinia grandis*	Kowakka	C	In		NA
Cucurbitaceae	*Momordica dioica*	Mal-thumba, Thumba karavila	C	In		NA
Cucurbitaceae	*Trichosanthes cucumerina*	Dum-mella	C	In		NA
Cyperaceae	*Cyperus arenarius*	Mudu-kalanduru	Gl	In		LC
Ebenaceae	*Diospyros vera*	Kaluhabaraliya	T	In		LC
Euphorbiaceae	*Euphorbia antiquorum*	Daluk	T	In		NA
Euphorbiaceae	*Euphorbia hirta*	Bu-dada-kiriya	H	In		NA
Euphorbiaceae	*Euphorbia indica*	Ela-dada-kiriya	H	In		NA
Euphorbiaceae	*Euphorbia rosea*	Mudu-dada-kiriya	H	In		NA
Euphorbiaceae	*Excoecaria agallocha*	Talakiriya	T	In		LC
Fabaceae	*Abrus precatorius*	Olinda	C	In		NA
Fabaceae	*Acacia chundra*	Rat-kihiriya	T	In		NA
Fabaceae	*Acacia eburnea*	Gini andara	S	In		NA
Fabaceae	*Acacia leucophloea*	Maha-Andara	T	In		LC
Fabaceae	*Acacia planifrons*		T	In		NA
Fabaceae	*Albizia amara*	Iha	T	In	NT	NA
Fabaceae	*Alysicarpus vaginalis*	Aswenna	H	In		NA
Fabaceae	*Bauhinia acuminata*	Koboleela	T	I		NA
Fabaceae	*Bauhinia racemosa*	Maila	T	In		NA
Fabaceae	*Caesalpinia bonduc*	Kumburu-Wel	C	In		NA
Fabaceae	*Canavalia cathartica*		C	In		NA
Fabaceae	*Canavalia rosea*	Mudu-awara	C	In		NA
Fabaceae	*Crotalaria retusa*	Kaha-Andanahiriya	S	In		NA
Fabaceae	*Derris trifoliata*	Kala-wel	C	In		NA
Fabaceae	*Desmodium triflorum*	Heen-undupiyaliya	H	In		NA
Fabaceae	*Dicerma biarticulatum*		S	In		NA
Fabaceae	*Dichostachys cinerea*	Katu andara	S	In		NA
Fabaceae	*Indigofera colutea*		H	In	NT	NA
Fabaceae	*Indigofera oblongifolia*	Nari Mun	S	In	VU	LC
Fabaceae	*Indigofera tinctoria*	Nil-Awariya	S	In		NA
Fabaceae	*Mimosa pudica*	Nidi-kumba	H	I		NA
Fabaceae	*Prosopis juliflora*	Katu-siyambala	T	I		NA
Fabaceae	*Senna auriculata*	Ranawara	T	In		NA
Fabaceae	*Stylosanthes fruticosa*	Wal-Nanu	H	In		NA
Fabaceae	*Tamarindus indica*	Siyambala	T	I		NA
Fabaceae	*Tephrosia purpurea*	Katuru pila	S	In		NA
Fabaceae	*Tephrosia villosa*	Bu-Pila	S	In		NA
Fabaceae	*Vigna marina*	Lee ma	C	In	EN	NA
Fabaceae	*Vigna trilobata*	Bin-me	C	In	NT	NA
Gentianaceae	*Enicostema axillare*		H	In		NA

Family	Species	Sinhala Name	H	TS	NCS	GCS
Gisekiaceae	*Gisekia pharnaceoides*	Atthiripala	H	In		NA
Lamiaceae	*Clerodendrum inerme*	Wal-Gurenda	S	In		NA
Lamiaceae	*Anisomeles indica*	Yak-wanassa	H	In		NA
Lamiaceae	*Gmelina asiatica*	Demata	S	In		NA
Lamiaceae	*Hyptis suaveolens*	Ali thala	S	I		NA
Lamiaceae	*Leucas zeylanica*	Geta-Thumba	H	In		NA
Lamiaceae	*Ocimum americanum*	Heen-tala	H	In		NA
Lamiaceae	*Platostoma menthoides*		H	In		NA
Lamiaceae	*Premna obtusifolia*	Maha-midi	S	In		NA
Lamiaceae	*Vitex negundo*	Nika	T	In		NA
Lauraceae	*Cassytha filiformis*		S	In		NA
Lythraceae	*Ammannia baccifera*		H	In		NA
Lythraceae	*Pemphis acidula*	Muhudu Wara	S	In	NT	LC
Malvaceae	*Hibiscus surattensis*	Hin-napiriththa	S	In		NA
Malvaceae	*Hibiscus tiliaceus*	Wal Beli	T	In		NA
Malvaceae	*Sida cordata*	Bevila	H	In		NA
Malvaceae	*Thespesia populnea*	Gansuriya	T	In		LC
Malvaceae	*Corchorus aestuans*	Jaladara	H	I		LC
Malvaceae	*Grewia orientalis*	Wel-keliya	S	In		NA
Malvaceae	*Melochia corchorifolia*	Gas-kura	H	In		NA
Malvaceae	*Triumfetta pentandra*	Epala	S	In		NA
Malvaceae	*Waltheria indica*	Punnikki	S	In		NA
Meliaceae	*Azadirachta indica*	Kohomba	T	I		NA
Menispermaceae	*Hyserpa nitida*	Niri-wel	S	In	EN	NA
Menispermaceae	*Tinospora cordifolia*	Rasa-Kinda	C	In	VU	NA
Menispermaceae	*Tinospora sinensis*	Rasa Kinda	C	In	DD	NA
Molluginaceae	*Glinus oppositifolius*	Heen-ala	H	In		NA
Moraceae	*Ficus benghalensis*	Maha-Nuga	T	In		NA
Moraceae	*Ficus racemosa*	Attikka	T	In		NA
Moraceae	*Ficus virens*	Kalawalla	T	In		NA
Myrtaceae	*Syzygium cumini*	Ma-Dan	T	In		NA
Nyctaginaceae	*Boerhavia diffusa*	Pita-sudu-pala	H	In		NA
Nyctaginaceae	*Boerhavia eracta*		H	In		NA
Ochnaceae	*Ochna lanceolata*	Bo-Kera	S	In		NA
Ochnaceae	*Ochna obtusata*	Mal-Kera	S	In		NA
Olacaceae	*Olax imbricata*	Telatiya	S	In	NT	NA
Olacaceae	*Olax scandens*		S	In		NA
Opiliaceae	*Cansjera rheedii*	Eta-Muru	S	In		NA
Orobanchaceae	*Sopubia delphinifolia*		H	In		NA
Orobanchaceae	*Striga angustifolia*		H	In	NT	NA
Pandanaceae	*Pandanus odorifer*	Mudu keyiya	S	In		LC
Passifloraceae	*Passiflora foetida*	Pada wel	C	I		NA
Pedaliaceae	*Pedalium murex*	Et-Nerenchi	H	In		LC
Phyllanthaceae	*Phyllanthus amarus*	Pitawakka	H	In		NA
Phyllanthaceae	*Phyllanthus maderaspatensis*		H	In		NA
Phyllanthaceae	*Phyllanthus reticulatus*	Wel-Kaliya	S	In		NA
Phyllanthaceae	*Sauropus bacciformis*	Eth-pitawakka	H	In		NA
Phyllanthaceae	*Breynia vitis-idaea*	Gas-kayila	S	In		NA
Phyllanthaceae	*Flueggea leucopyrus*	Heen Katu pila	S	In		NA
Plantaginaceae	*Bacopa monnieri*	Lunuwila	H	In		LC
Plantaginaceae	*Scoparia dulcis*	Wal koththamalli	H	I		NA

Family	Species	Sinhala Name	H	TS	NCS	GCS
Poaceae	*Panicum repens*	Etora	G	In		NA
Poaceae	*Spinifex littoreus*	Maha-rawana-revula	G	In		NA
Putranjiavaceae	*Drypetes sepiaria*	Wira	T	In		NA
Rhamnaceae	*Colubrina asiatica*	Tel hiriya	S	In	VU	NA
Rhamnaceae	*Scutia myrtina*		S	In		LC
Rhamnaceae	*Ziziphus mauritiana*	Dabara	T	In		NA
Rhamnaceae	*Zizyphus oenopila*	Hin-Eraminia	S	In		NA
Rhizophoraceae	*Rhizophora mucronata*	Maha Kadol	T	In		LC
Rubiaceae	*Benkara malabarica*	Pudan	S	In		NA
Rubiaceae	*Canthium coromandelicum*	Kara	S	In		NA
Rubiaceae	*Catunaregam spinosa*	Kukuruman	S	In		NA
Rubiaceae	*Hydrophylax maritima*	Mudu getakola	H	In		NA
Rubiaceae	*Ixora pavetta*	Maha-Rathambala	T	In		NA
Rubiaceae	*Morinda coreia*	Ahu	T	In		LC
Rubiaceae	*Oldenlandia biflora*	Heen kaududala	H	In		NA
Rubiaceae	*Oldenlandia umbellata*	Saummal	H	In		NA
Rubiaceae	*Paederia foetida*	Apasu madu	C	I		NA
Rubiaceae	*Spermacoce articularis*		H	In		NA
Rubiaceae	*Spermacoce hispida*	Hin-geta-kola	H	In		NA
Rubiaceae	*Tarenna asiatica*	Tarana	S	In		NA
Rutaceae	*Limonia acidissima*	Divul	T	In		NA
Rutaceae	*Pleiospermium alatum*	Tunpath-Kurundu	T	In		NA
Rutaceae	*Toddalia asiatica*	Kudu-Miris	C	In		NA
Salicaceae	*Flacourtia indica*	Uguressa	S	I		NA
Salvadoraceae	*Azima tetracantha*	Wel dehi	S	In		NA
Salvadoraceae	*Salvadora persica*	Malittan	T	In	NT	NA
Sapindaceae	*Allophylus cobbe*	Kobbe	S	In		NA
Sapindaceae	*Dodanaea viscosa*	Et-Werella	T	In		NA
Sapindaceae	*Filicium decipiens*	Pihimbiya	T	In		NA
Sapindaceae	*Lepisanthes tetraphylla*	Dambu	T	In		NA
Sapotaceae	*Manilkara hexandra*	Palu	T	In	VU	NA
Solanaceae	*Physalis peruviana*		H	I		NA
Solanaceae	*Solanum melongena*	Ela-Batu	S	I		NA
Solanaceae	*Solanum trilobatum*	Wal-tibbatu	S	In		NA
Typhaceae	*Typha agustifolia*	Hambu-pan	S	In		LC
Urticaceae	*Pouzolzia zeylanica*		H	In		NA
Vahliaceae	*Vahlia dichotoma*		H	In	EN	NA
Verbenaceae	*Lantana camera*	Rata-hinguru	S	I		NA
Verbenaceae	*Phyla nodiflora*	Herimana-detta	H	In		LC
Verbenaceae	*Stachytarpheta urticaefolia*	Nil-nakuta	H	I		NA
Vitaceae	*Cissus quadrangularis*	Heeressa	C	In		NA
Vitaceae	*Cyphostemma setosum*		C	In	NT	LC
Xanthorrhoeaceae	*Aloe vera*	Komarica	H	I		NA
Family	**Species**	**Sinhala Name**	**H**	**TS**	**NCS**	NA
Zygophyllaceae	*Tribulus terrestris*	Heen-nerenchi	H	In		NA

C = creeper, E = endemic, EN = endangered, G = grass, Gl = grass-like, H = herb, I = introduced (including naturalized exotics), In = indigenous, LC = least concern, NA = not available, NCS = national conservation status, NT = near threatened, S = shrub, T = tree, TS = taxonomic status, VU = vulnerable.

Fauna Species Recorded

Family	Scientific Name	English Name	Sinhala Name	TS	NCS	GCS
BUTTERFLIES						
Nymphalidae	*Acraea violae*	Tawny costor	Thambily panduru-	N	NE	LC
Nymphalidae	*Danaus chrysippus*	Plain tiger	Podu koti-thambiliya	N	NE	LC
Nymphalidae	*Phalanta phalantha*	Leopard	Podu thith-thambiliya	N	NE	LC
Papilionidae	*Pachliopta hector*	Crimson rose	Maha rosa papilia	N	NE	LC
Papilionidae	*Papilio polytes*	Common mormon	Kalu papilia	N	NE	LC
Pieridae	*Appias galene*	Lesser albatross	Kuda sudana	E	NE	LC
Pieridae	*Catopsilia pomona*	Lemon emigrant	Kaha piyasariya	N	NE	LC
Pieridae	*Cepora nerissa*	Common gull	Podu Punduru-sudana	N	NE	LC
Pieridae	*Delias eucharis*	Jezebel	Podu Maha-sudda	N	NE	LC
Pieridae	*Eurema hecabe*	Common grass yellow	Maha kahakolaya	N	NE	LC
Pieridae	*Ixias pyrene*	Yellow orange tip	Kaha maha sudana	N	NE	LC
Pieridae	*Leptosia nina*	Psyche	Kalu-thith sudda	N	NE	LC
REPTILES						
Agamidae	*Calotes versicolor*	Common garden lizard	Gara katussa	N	LC	LC
Agamidae	*Sitana devakai*	Devaka's Fanthroat lizard	Vali katussa	E	NE	NE
Gekkonidae	*Hemidactylus frenatus*	Common house-gecko	Sulaba gehuna	N	LC	LC
Gekkonidae	*Hemidactylus*	Bark Gecko	Kimbul Huna	N	LC	LC
Viperidae	*Echis carinatus*	Saw scaled Viper	Weli Polonga	N	VU	NE
BIRDS						
Accipitridae	*Accipiter badius*	Shikra	Kurulugoya	N	LC	LC
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-eagle	Kusa-ali Muhudukussa	N	LC	LC
Accipitridae	*Haliastur indus*	Brahminy Kite	Bamunu Piyakussa	N	LC	LC
Accipitridae	*Hieraaetus pennatus*	Booted Eagle	Kesarupa Rajaaliya	M	NE	LC
Accipitridae	*Milvus migrans*	Black Kite	Bora Parakussa	N	LC	LC
Accipitridae	*Spizaetus cirrhatus*	Changeable Hawk Eagle	Perali Kondakussa	N	LC	LC
Aegithinidae	*Aegithina tiphia*	Common Iora	Podu Iorawa	N	LC	LC
Alaudidae	*Alauda gulgula*	Oriental Skylark	Peradigu Ahas Thulikawa	N	LC	LC
Alaudidae	*Eremopterix grisea*	Ashy-crowned Sparrow	Kirulalu Gekurulu-	N	LC	LC
Alaudidae	*Mirafra affinis*	Rufous-winged Bushlark	Rathpiya Akul-thulikawa	N	LC	LC
Alcedinidae	*Halcyon smyrnensis*	White-throated Kingfisher	Layasudu Madi-pilihuduwa	N	LC	LC
Apodidae	*Cypsiurus balasiensis*	Asian Palm Swift	Asiaa Thal-thurithaya	N	LC	LC
Ardeidae	*Ardea cinerea*	Grey Heron	Alu Koka	N	LC	LC
Ardeidae	*Ardeola grayii*	Indian Pond Heron	Kana-koka	N	LC	LC

Family	Scientific Name	English Name	Sinhala Name	TS	NCS	GCS
Ardeidae	*Bubulcus ibis*	Cattle Egret	Geri-koka	N	LC	LC
Ardeidae	*Casmerodius albus*	Great Egret	Sudu maha-koka	N	LC	LC
Ardeidae	*Egretta garzetta*	Little Egret	Punchi Anu-koka	N	LC	LC
Ardeidae	*Egretta gularis*	Western Reef Egret	Para Anu-koka	M	NE	LC
Ardeidae	*Mesophoyx intermedia*	Intermediate Egret	Sudu Madi-koka	N	LC	LC
Ardeidae	*Nycticorax nycticorax*	Black-crowned Night Heron	Ra kana-koka	N	NT	LC
Artamidae	*Artamus fuscus*	Ashy Wood Swallow	Alu Wanalihiniya	N	LC	LC
Campephagidae	*Tephrodornis*	Common Woodshrike	Podu Wana-saratiththa	E	LC	LC
Caprimulgidae	*Caprimulgus atripennis*	Jerdon's Nightjar	Digupenda Bimbassa	N	LC	LC
Charadriidae	*Charadrius alexandrinus*	Kentish Plover	Kenti Oleviya	N/ M	VU	LC
Charadriidae	*Charadrius hiaticula*	Common Ringed Plover	Loku Mala Oleviya	M	NE	LC
Charadriidae	*Charadrius leschenaultii*	Greater Sand Plover	Raja Wali Oleviya	M	NE	LC
Charadriidae	*Charadrius mongolus*	Lesser Sand Plover	Heen Wali Oleviya	M	NE	LC
Charadriidae	*Pluvialis fulva*	Pacific Golden Plover	Sethkara Ran Maha-	M	NE	LC
Charadriidae	*Pluvialis squatarola*	Grey Plover	Alu Maha-oleviya	M	NE	LC
Charadriidae	*Vanellus indicus*	Red-wattled Lapwing	Rath-yatimal Kirella	N	LC	LC
Charadriidae	*Vanellus malabaricus*	Yellow-wattled Lapwing	Kaha-yatimal Kirella	N	LC	LC
Chloropseidae	*Chloropsis jerdoni*	Blue-winged Leafbird	Nilpiya Kolarisiya	N	LC	LC
Ciconiidae	*Mycteria leucocephala*	Painted Stork	Lathuwakiya	N	LC	NT
Cisticolidae	*Cisticola juncidis*	Zitting Cisticola	Iri Pawansariya	N	LC	LC
Cisticolidae	*Prinia inornata*	Plain Prinia	Sarala Priniya	N	LC	LC
Cisticolidae	*Prinia socialis*	Ashy Prinia	Alu Priniya	N	LC	LC
Columbidae	*Columba livia*	Rock Pigeon	Podu Paraviya	N	CR	LC
Columbidae	*Streptopelia chinensis*	Spotted Dove	Alu Kobeiyya	N	LC	LC
Columbidae	*Streptopelia decaocto*	Eurasian Collard Dove	Mala Kobeiyya	N	NT	LC
Columbidae	*Treron bicincta*	Orange-breasted Green- pigeon	Laya-ran Batagoya	N	LC	LC
Coraciidae	*Coracias benghalensis*	Indian Roller	Dumbonna	N	LC	LC
Corvidae	*Corvus levaillantii*	Large-billed Crow	Kalu Kaputa	N	LC	LC
Corvidae	*Corvus splendens*	House Crow	Kolamba Kaputa	N	LC	LC
Cuculidae	*Centropus sinensis*	Greater Coucal	Ati-kukula	N	LC	LC
Cuculidae	*Clamator jacobinus*	Pied Cuckoo	Gomara Kondakoha	N	LC	LC
Cuculidae	*Eudynamys scolopacea*	Asian Koel	Kowula	N	LC	LC
Cuculidae	*Phaenicophaeus*	Blue-faced Malkoha	Wathanil Malkoha	N	LC	LC
Dicaeidae	*Dicaeum erythrorhynchos*	Pale-billed Flowerpecker	Lathudu Pililichcha	N	LC	LC
Dicruidae	*Dicrurus macrocercus*	Black Drongo	Kalu Kawuda	N	LC	LC

Family	Scientific Name	English Name	Sinhala Name	TS	NCS	GCS
Haematopodidae	*Haematopus ostralegus*	Eurasian Oystercatcher	Eurasia Bolugulla	M	NE	LC
Hirundinidae	*Hirundo rustica*	Barn Swallow	Atu Wahilihiniya	M	NE	LC
Laniidae	*Lanius cristatus*	Brown Shrike	Bora Sabariththa	M	NE	LC
Laniidae	*Lanius schach*	Long-tailed Shrike	Dikpenda Sabariththa	N	VU1	LC
Laridae	*Chlidonias hybrida*	Whiskered Tern	Alupiya Kangul-lihiniya	M	NE	LC
Laridae	*Larus brunnicephalus*	Brown-headed Gull	Bora-hisa Galuviya	M	NE	LC
Laridae	*Larus cachinnans*	Heuglin’s Gull	Heuglin Galuviya	M	NE	LC
Laridae	*Sterna albifrons*	Little Tern	Punchi Muhudulihiniya	N	VU	LC
Laridae	*Sterna bengalensis*	Lesser Crested Tern	Heen Konda	M	NE	LC
Laridae	*Sterna caspia*	Caspian Tern	Caspia Muhudulihiniya	M	CR	LC
Laridae	*Sterna nilotica*	Gull-billed Tern	Galuthudu Sayurulihiniya	N/ M	CR	LC
Laridae	*Sterna saundersi*	Saunders’s Tern	Saunders Muhudulihiniya	N	CR	LC
Meropidae	*Merops orientalis*	Green Bee-eater	Punchi Binguharaya	N	LC	LC
Meropidae	*Merops philippinus*	Blue-tailed Bee-eater	Nilpenda Binguharaya	N/ M	CR	LC
Monarchidae	*Terpsiphone paradisi*	Asian Paradise- flycathcher	Asia Rahanmara	N/ M	LC	LC
Motacillidae	*Anthus rufulus*	Paddyfield Pipit	Keth Varatichcha	N	LC	LC
Muscicapidae	*Copsychus saularis*	Oriental Magpie Robin	Polkichcha	N	LC	LC
Muscicapidae	*Saxicoloides fulicata*	Indian Robin	Indu Kalukichcha	N	LC	LC
Nectariniidae	*Nectarina asiatica*	Purple Sunbird	Dam Sutikka	N	LC	LC
Nectariniidae	*Nectarina lotenia*	Loten’s Sunbird	Lotenge Sutikka	N	LC	LC
Nectariniidae	*Nectarinia zeylonica*	Purple-rumped Sunbird	Nithamba Dam Sutikka	N	LC	LC
Oriolidae	*Oriolus xanthornus*	Black-hooded Oriole	Kahakurulla	N	LC	LC
Pelecanidae	*Pelecanus philippensis*	Spot-billed Pelican	Thithhota Pasthuduwa	N	LC	NT
Phalacrocoracid	*Phalacrocorax fuscicollis*	Indian Cormorant	Indu Diyakava	N	LC	LC
Phalacrocoracid	*Phalacrocorax niger*	Little Cormorant	Punchi Diyakava	N	LC	LC
Phasianidae	*Francolinus*	Grey Francolin	Alu Ussawatuva	N	NT	LC
Phasianidae	*Pavo cristatus*	Indian Peafowl	Monora	N	LC	LC
Picidae	*Dinopium benghalense*	Black-rumped Flameback	Rath-karela	N	LC	LC
Pittidae	*Pitta brachyura*	Indian Pitta	Avichchiya	M	NE	LC
Psittacidae	*Psittacula krameri*	Rose-ringed Parakeet	Rana Girawa	N	LC	LC
Pycnonotidae	*Pycnonotus cafer*	Red-vented Bulbul	Kondaya	N	LC	LC
Pycnonotidae	*Pycnonotus luteolus*	White-browed Bulbul	Bamasudu Kondaya	N	LC	LC
Ramphastidae	*Megalaima*	Coppersmith Barbet	Rathlaye Kottoruwa	N	LC	LC
Ramphastidae	*Megalaima zeylanica*	Brown-headed Barbet	Polos Kottoruwa	N	LC	LC
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt	Kalupiya Ipalpawa	N	LC	LC
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper	Podu Siliththa	M	NE	LC

Family	Scientific Name	English Name	Sinhala Name	TS	NCS	GCS
Scolopacidae	*Arenaria interpres*	Ruddy Turnstone	Rath Galperaliya	M	NE	LC
Scolopacidae	*Calidris ferruginea*	Curlew Sandpiper	Kalika Hinna	M	NE	LC
Scolopacidae	*Calidris minuta*	Little Stint	Punchi Hinna	M	NE	LC
Scolopacidae	*Limosa lapponica*	Bar-tailed Godwit	Waira-penda	M	NE	LC
Scolopacidae	*Numenius arquata*	Eurasian Curlew	Eurasiya Kalikaya	M	NE	NT
Scolopacidae	*Numenius phaeopus*	Whimbrel	Wimburali Kalikaya	M	NE	LC
Scolopacidae	*Tringa nebularia*	Common Greenshank	Podu Palapa Silibilla	M	NE	LC
Scolopacidae	*Tringa stagnatilis*	Marsh Sandpiper	Waguru Silibilla	M	NE	LC
Scolopacidae	*Tringa totanus*	Common Redshank	Podu Rathpa Silibilla	M	NE	LC
Scolopacidae	*Xenus cinereus*	Terek Sandpiper	Terek Silinna	M	NE	LC
Sturnidae	*Acridotheres tristis*	Common Myna	Mayna	N	LC	LC
Sturnidae	*Sturnus pagodarum*	Brahminy Starling	Bamunu Sharikawa	M	NE	LC
Sylviidae	*Acrocephalus dumetorum*	Blyth's Reed Warbler	Blyths Panraviya	M	NE	LC
Sylviidae	*Acrocephalus stentoreus*	Clamorous Reed Warbler	Gosa Panraviya	N/ M	NT	LC
Sylviidae	*Orthotomus sutorius*	Common Tailorbird	Battichcha	N	LC	LC
Sylviidae	*Sylvia althaea*	Hume's Whitethroat		M	NE	LC
Timalidae	*Turdoides affinis*	Yellow-billed Babbler	Demalichcha	N	LC	LC
Upupidae	*Upupa epops*	Common Hoopoe	Podu Poroluwa	N	LC	LC
MAMMALS						
Cervidae	*Axis axis*	Spotted Derr	Tith Muwa	N	LC	LC
Equidae	*Equus asinus*	Donkey	Buruwa	F	NE	NE
Equidae	*Equus cabellus*	Pony	Ashwaya	F	NE	NE
Felidae	*Felis chaus*	Jungle cat	Wal Balala	N	LC	NT
Leporidae	*Lepus nigricollis*	Black-naped hare	Wal Hawa	N	LC	LC
Pteropodidae	*Pteropus giganteus*	Flying fox	Ma Wawula	N	LC	LC
Sciuridae	*Funambulus palmarum*	Palm squirrel	Leena	N	LC	LC
Suidae	*Sus scrofa*	Wild boar	Wal Ura	N	LC	LC
Tragulidae	*Moschiola meminna*	Sri Lanka Mouse deer	Meeminna	E	LC	LC

CR = critically endangered, EN = endangered, LC = least concern, F = feral, M = migrant, N = breeding resident, NCS = national conservation status, NE = not evaluated, NT = near threatened, TS = taxonomic status, VU = vulnerable,

Marine Ecology

Summary

1. Impacts on the marine environment from the proposed projects will be due to construction and operation of wind turbines and construction and operation of pier for barge operations and dredging.

2. After recognizing and prioritizing the most suitable four sites (**Appendix 4** on bathmertic study indicates the final choice) for the construction of pier, a detailed underwater survey was carried out along the full length of the pier and either side of the pier as well as from shore up to depth of 5m using standard underwater survey protocols to identify the locations of sensitive marine resources and changes in community composition that may be directly or indirectly impacted by project construction and/or operation. Characterization of aquatic flora and fauna including phytoplankton and zooplankton was taken for qualitative assessments. Bottom sediment samples were also being taken to identify the benthonic fauna and also to study the sediment characteristics.

3. Construction and operation of wind turbines will not have direct impact on marine environment or marine organisms. However, there will be some indirect impacts that would result from sediment that would run off to marine environment during construction phase of the turbines. Such impact will be short term in duration and can be minimized by maintaining good practices during earth excavation.

4. The construction and operation of pier will affect sea bottom and sediment transport as serving a barrier for waves and longshore currents. The method of construction should allow bathymetry at the face of the seawalls to remain similar to that existing although some local disruption to the sea bed can be expected as a result of construction. Changes in wave climate due to jetty construction would negatively impact the shoreline and reduce water depth. Coastal stretch is well known for heavy sand accretion during monsoonal months.

5. Seabed disturbance and release of suspended solids into the water is expected as a result of dredging and filling activities during the construction phase. The impacts to marine benthic habitats are expected to be medium given that construction activities will take place within the marine environment. The reclamation will smother some areas of the benthic community, either directly or through drifting of fill material during reclamation and dredging. However, the nearshore environment is already turbid and devoid of any sensitive marine ecosystems. Impact is highly localized. Therefore, impact rated as moderate.

6. Comprehensive underwater survey revealed that all the four optional sites suggested for construction of a pier had identical uniform sandy bottom. None of the four surveyed locations had any sensitive ecosystems, rare, threatened on any conservation needed organisms. Therefore, all the four sites are not ecologically sensitive. Option 4 (furthermost location from Nadukuda), 4 m depth is closest to the shore, whereas option 1 (closest to Nadukuda) was a central location with easy access.

7. The data related to Marine ecology is attached below.

Table 1: List of species reported in underwater survey

Phylum	Order / group	Common name	Species	Conservation status
Arthropoda	Malacostreca	Blue Striped Hermit	*Clibanarius longitarsus*	Least concern

Table 2: Phytoplankton and zooplankton species recorded from the underwater survey area

Phylum/ Division	Order / group	Species	Conservation status
Chlorophyta	Chlorophyceae	*Pediastrum* sp	NE
		Tetraedron sp	NE
Ochrophyta	Bacillariophyceae	*Nitschia* sp	NE
Ochrophyta	Bacillariophyceae	*Melosira* sp	NE
Ochrophyta	Bacillariophyceae	*Rhizosolenia* sp	NE
Charophyta	Desmidiaceae	*Staurodesmus* sp.	NE
Cyanobacteria	Cyanophyceae	*Microcystis* sp	NE
Chrysophyta	Chrysophyceae	*Dinobryon* sp	NE
		Hyalotbeca sp	NE
Arthropoda	Crustacea	Cladocera	NE
		Nauplii	NE
		Copepods	NE

NE = not evaluated

Table 3: Species recorded from sea cucumber (beche-de-mer) fishery in the study area

Phylum	Family	Common name	Species	Conservation status
Echinodermata	Holothuriidae	Sand fish	*Holothuria scabra*	EN
		Brown sandfish	*Holothuria spinifera*	DD
		Pinkfish	*Holothuria edulis*	LC
		Blackfish	*Actinopyga miliaris*	VU
		Surf redfish	*Actinipyga mauritiana*	VU

DD = data deficient, EN = endangered, LC = least concern, VU = vulnerable.

Table 4: Key species recorded from the Beach seine (Ma-del) catches in the study area

Family / group	Scientific Name	English Name	Local Name
Prawns			
Penaidae	*Penaeus monodon*	Giant tiger prawn	Karawandu issa
Cuttlefish			
Sepiodae	*Sepiella inermis*	Spineless cuttlefish	Della
Cartilage fish			
Dasyatididae	*Dasyatis kuhlii*	Bluespotted stingray	maduwa
Ariidae	*Arius maculatus*	Spotted catfish	Gal anguluvu
Belonidae	*Ablennes hians*	Flat neeglefish	Moralla
Carangidae	*Alectis ciliaris*	African pompano	Kannadi parava
	Decapterus macarellus	Mackerel scad	-
	Caranx heberi	Blacktip trevally	Atanagul parava
	Scomberoides tala	Barred queenfish	Han kattava
Chirocentridae	*Chirocentrus dorab*	Dorab wolf-herring	Podi katuvalla
Clupedae	*Amblygaster sirm*	Spotted sardinella	Hurulla
	Anodontosoma chacunda	Chacunda gizzard shad	-
	Sadrdinella albella	White sardinella	sudaya

	Sadrdinella gibbosa	Goldstripe sardinella	Matta salaya
Fistulariidae	*Fistularia commersonii*	Bluespotted cornetfish	Malava
Leiognathidae	*Gazza minuta*	Toothpony	Pulunu karalla
	Leiognathus equulus	Common ponyfish	Mas karalla
Lehrinidae	*Gymnocranius elongatus*	Forktail largeeye bream	-
Muraenidae	*Uropterygius concolor*	Brown moray	-
Triacanthidae	*Pseudotriacanthus strilifer*	Longspined tripodfish	-
Serranidae	*Epinephelus faveatus*	Barredchest grouper	Pulli kossa
Muraenidae	*Gymnothorax boschi*	Blacklined morey	Kalu iriya
		Puffer fish	Peththaya

Table 5: Noteworthy fauna found in the Mannar region* (Outside the direct project impact area)

Phylum/ / group	Order and family	Common name	Species	Conservation stutus
Chordata	Sirenia Dugongidae	Dugong	*Dugong dugon*	VU
Chordata	Reptelia, Chelonidae	Olive Ridley	*Lepidochelys olivaceae*	VU
		Green Turtle	*Chelonia mydas*	EN
		Hawksbill Turtle	*Eretmochelys imbricata*	CR

CR = critically endangered, EN = endangered, VU = vulnerable.

Table 6: Fishing gear, crafts used, target fisheries and average catch in each of the fishing camps within the project area

Ma-del padu/ **key informant**	**Fishing gear/ methods used**	**Boats used**	**Major species targeted**	**Catch per operation*/ kg**
Malivady	Scuba Diving upto 10km offshore 20-120 feet depth Ma-dal-2 Surukku del	OFRP – 6 NTRB (Vallam) -2	Sea Cucumber, lobster and chanks (sangu) Parawa, Kattawa, Salaya, Sudaya, Kumbalava, Anguluva, Karalla, Kumbalawa Cuttlefish, crabs, rock fish	50-75 pieces 500-1200
Oolaithoduvai	Ma-dal-3 Small size gill nets (1 ¼”) *Kumbala* del (2 ½”) during high wind months	OFRP – 40	Parawa, Kattawa, Salaya, Sudaya, Kumbalava, Anguluva, Karalla Habaraliya, Kumbalawa Herrings, mackerals	600-1200
Uvari	Ma-del-5	OFRP – 6	Parawa, Kattava, Salaya, Sudaya, Kumbalava, Anguluva, Karalla, Habaraliya, Kumbalawa	700-1000
Nadukuda 1	Ma-del-13	OFRP – 11	Parawa, Kattawa, Salaya, Sudaya, Kumbalava, Anguluva. Karalla, Habaraliya, Kumbalawa	500- 1000
Nadukuda 2	Ma-del-03	OFRP – 20	Parawa, Kattawa, Salaya, Sudaya, Kumbalava,Anguluva, Karalla, Habaraliya, Kumbalawa	800-1200

Ma-del padu/ key informant	Fishing gear/ methods used	Boats used	Major species targeted	Catch per operation*/ kg
Kiriyankudu yiruppu	Ma-del Gillnet Madu del (10km offshore)	OFRP – 2	Parawa, Kattawa, Salaya, Sudaya, Kumbalava,Anguluva, Karalla, Habaraliya, Kumbalawa skates	500-600
Palavithotai	Ma-del-01 Gillnet Kumbala del (2 ½”)	OFRP – 4 NTRB (Vallam) - 1	Parawa, Kattawa, Salaya, Sudaya, Kumbalava,Anguluva, Karalla, Habaraliya, Kumbalawa	600-800
Old Pier – 1	Ma-del-02 Gillnet	OFRP – 05 NTRB (Vallam) - 2	Parawa, Kattawa, Salaya, Sudaya, Kumbalava,Anguluva, Karalla, Habaraliya, Kumbalawa	700-1000
Old Pier - 2	Gillnet Paraw- panna Kumbala del Handline	OFRP – 30 NTRB (Vallam) -6	Parawa, Kattawa, Salaya, Sudaya, Kumbalava,Anguluva, Karalla, Habaraliya, Kumbalawa	500-800

Table 7: Species composition of *ma-del* catches

Family	Scientific Name	English Name	Local Name
Prawns			
Penaidae	*Penaeus monodon*	Giant tiger prawn	Karawandu issa
Cuttlefish			
Sepiodae	*Sepiella inermis*	Spineless cuttlefish	Della
Cartilage fished			
Dasyatididae	*Dasyatis kuhlii*	Bluespotted stingray	maduwa
Ariidae	*Arius maculatus*	Spotted catfish	Gal anguluvu
Belonidae	*Ablennes hians*	Flat neeglefish	Moralla
Carangidae	*Alectis ciliaris*	African pompano	Kannadi parava
	Decapterus macarellus	Mackerel scad	-
	Caranx heberi	Blacktip trevally	Atanagul parava
	Scomberoides tala	Barred queenfish	Han kattava
Chirocentridae	*Chirocentrus dorab*	Dorab wolf-herring	Podi katuvalla
Clupedae	*Amblygaster sirm*	Spotted sardinella	Hurulla
	Anodontosoma chacunda	Chacunda gizzard shad	-
	Sadrdinella albella	White sardinella	sudaya
	Sadrdinella gibbosa	Goldstripe sardinella	Matta salaya
Fistulariidae	*Fistularia commersonii*	Bluespotted cornetfish	Malava
Leiognathidae	*Gazza minuta*	Toothpony	Pulunu karalla
	Leiognathus equulus	Common ponyfish	Mas karalla
Lehrinidae	*Gymnocranius elongatus*	Forktail largeeye bream	-
Muraenidae	*Uropterygius concolor*	Brown moray	-
Triacanthidae	*Pseudotriacanthus strilifer*	Longspined tripodfish	-
Serranidae	*Epinephelus faveatus*	Barredchest grouper	Pulli kossa
By catch			
Muraenidae	*Gymnothorax boschi*	Blacklined morey	Kalu iriya
		Puffer fish	Peththaya

Table 8: List of marine mammals in Mannar region (After Illangakoon, 2002)
This is for reference only not necessary to add to the text

Scientific name	Common name	Global Red List Status*	Depth at which sighted (m)
Balaenoptera musculus	Blue whale	EN	2000
Balaenoptera acustorostrata	Minke whale	LC	
Megaptera novaeangliae	Humpback whale	LC	
Physeter macrocephalus	Sperm whale	VU	80-1500
Kogia sima	Dwarf Sperm whale	DD	
Lagenodelphis hosei	Fraser's dolphin	LC	1500-1900
Pseudorca crassidens	False Killer whale	DD	
Peponocephala electra	Melon-headed whale	LC	1800
Sousa chinensis	Indo-Pacific Humpback dolphin	NT	
Delphinus delphis	Common dolphin	LC	
Stenella longirostris	Long-snouted Spinner dolphin	DD	
Stenella attenuata	Pan-tropical spotted dolphin	LC	1500-1800
Stenella coeruleoalba	Striped dolphin	LC	1450
Tursiops truncatus	Bottlenose dolphin	LC	1800
Orcinus orca	Killer whale	DD	
Dugong dugon	Dugong	VU	

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Annexure 3. Environment Management Plan (EMP) including checklist for construction method statement

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
Pre-construction						
Temporary use of lands	Impact to the existing environment	39 turbine locations are available for the EPC contractor to use provided they can demonstrate that the impact at receptors will be same or less than that presented in this EIA (if design has a greater impact it cannot be accepted.) Selection of lands adhering to local laws and regulations and in close consultation with LAs Restrictions on location of temporary infrastructure: Tower foundations should be placed at least 140 m away from coastline, 25 m from water channels, natural flow paths, important ecological habitats and residential areas.	Air, Water, Noise and Soil quality	Baseline for air pollution, water pollution levels (Air quality Standards, CEA water quality standards and Noise standards etc.)	CEB	Detailed design
Wind turbine generator location and design	Noise generation Exposure to noise, Nuisance to neighboring properties	EPC Contractor to develop communications plan and appoint a fisheries liaison officer and community liaision officer Undertake pre-construction noise monitoring following IOA and ETSU methodology and collate concurrent wind data at 10 mi height for minimum period of two weeks during the SW (Entura) and NE (Contractor) monsoon in order that background noise levels correlated to wind speed are available during both high and low wind speed seasons Noise levels should first be minimized	Expected noise emissions based on wind turbine generator design, noise levels Turbine design and layout and accompanying noise assessment to be cleared by CEB and receive no objection from ADB before CEB can approve the Contractor's design	Noise control regulations in 1994 Noise levels to be specified in EIA document and its Appendix 5	CEB	Detailed design

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		through design. Turbines to be sited to ensure noise limits (turbines + background) can be met and minimize magnitude of change in noise level at adjacent properties Noise assessment following international good practice (assess octave frequencies as well as broadband sound) to be run for final turbine design and layout. The noise modelling assessment must demonstrate that during all months of the year (including the low wind speed season when low noise environment occurs) that the noise limits (B+T) can be met. Turbines must not have a tonal component unless this is included in the noise modelling assessment and it is demonstrated that the noise limits can be met with it included. Turbines adjacent to properties experiencing exceedence or noise limits (turbines + background) or more than a 3dB LAeq increase in noise levels above background to have low noise mode installed (achieve broadband noise 101dB, and per Table 3.1 of noise Appendix 5 in terms noise levels correlated to wind speeds) Noise assessment to be rerun with turbines in low noise mode (or shut down) to confirm that no significant noise impacts (no exceedence of the fixed noise limits and no predicted				

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		increase in noise levels about >10dB above background levels) will result including nuisance from impulsive or tonal noise. Protocol for operation of low noise mode (shut down) to be prepared for implementation during operational phase i.e. how turbines can be constrained or shut down proactively and how compliance at receptors is to be monitored				
	Disturbance to the adjacent lands and the people due to cut and fill operations	Maintain clearance, construction of retaining structures, minimize cut and fill operations adjoining to the dwellings	Proximity to houses and other structures	Technical specification	CEB	Detailed design
Location of Wind turbines and their alignment on coast and design	Exposure to safety related risks	Turbines to be sited to achieve set back of 1.5 x turbine height If 1.5 x turbine height cannot be achieved, RP to be updated to include for resettlement of the affected properties Turbines to be designed with vibration sensors that can react to any imbalance in the rotor blades and shut down turbine Turbines to be designed with lightning protection system Turbines selected to be subject to independent design verification/certification (IEC 61400-1) and surveillance of manufacturing quality Protocol for operation and maintenance of turbines to minimize blade throw risk be prepared for implementation during	Wind turbine location with respect to nearest dwellings Review of turbine design and layout including updated blade throw assessment and operational protocol	Setback distances to nearest houses No injury or loss of life as a result of blade throw (as per IFC-WB EHS Guidelines on Wind Energy)	CEB	Part of detailed survey and design

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		operational phase. Design of turbines to take into account earthquake, tsunami and cyclone risk following appropriate seismic design codes and design codes for wind loading – follow local codes but use international standards where there is no specific coverage in relation to the design of turbines. Design of turbines and associated infrastructure especially kiosks and substation to ensure all electrical equipment is inaccessible to members of the community using the wind farm area with warning signs of electrocution provided. Undertake community awareness raising consultation with beach occupant's and users of the wind farm area so that the community understand the health and safety risks associated with being in vicinity of turbines including blade throw and electrocution.				
	Impact on water channels/land/ residences Collisions of Birds with wind turbine	Consideration of Wind turbine location where they could be located to avoid avian breeding areas, water channels by minimum of 25 m. Follow IFC-WB EHS Guidelines on avoiding water pollution. Install a radar system capable of monitoring birds and bats (e.g. MERLIN Avian Radar System or equivalent) at an appropriate location on Mannar Island and ensure the system is fully operational Undertake one additional year of	Site location selection (distance to dwelling, water channels and/or agricultural land)	Minimum specified distances from buildings, water channels. Consultation with Urban Development Authority, local authorities, Dept. of Coastal Conservation	CEB	Part of detailed project sighting and survey and design

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		monthly bird surveys (vantage points and block counts) during migratory season prior to operation of the turbines Protocol for operation of turbines during the migratory season to be prepared for implementation during operational phase Develop biodiversity management plan covering Vankalai Sanctuary, Adam's Bridge National Park and other critical habitats on Mannar island and set aside funding for first 5 years of implementation, the biodiversity management plan to also consider constraints on future development of turbines at other locations on Mannar island Permanent and temporary met masts to be of guy wire type design using bird flight divertors to reduce bird collisions				
		No bright or white lighting to be installed on turbines and the design of associated infrastructure to avoid use of lighting (as this could attract bats near turbines). Use red light, low-medium intensity and number of lights kept to a minimum. (http://enr-ee.com/fr/manifestations/lecteur/conference-sur-les-impacts-des-parcs-eoliens-balisage-emissions-sonores-et-infrasons.html?file=files/ofaenr/02-conferences/2017/170308_conference_impacts_des_parcs_eoliens/Presentations/09_Clementine_Azam_CESCO_	Civil Aviation Authority (CAA) specified low intensity red color beacon lights on top of wind turbine	CAA approved beacon lights for aircrafts.		

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		OFATE_DFBEW.pdf)				
Equipment specifications and design parameters	Release of chemicals and harmful gases in receptors (air, water, land)	Ensure equipment design must be sound to avoid emissions for oil, gases etc.	Compliance with setback distances ("as-built" diagrams)	Setback distances to nearest houses	CEB	Detailed design
Encroachment into precious ecological areas	Loss of precious ecological values/ damage to precious species	Qualified Ecologist will be engaged by EPC contractor. The ecologist will mark out and record the location all endemic and locally EN plants as well as Palmyra and coconut in and adjacent the construction working area. Hardstanding area and access roads to be pegged out to minimize loss of these species. If T3 and T36 used then hardstanding design to be given careful attention to see if fewer than 5 endemic Neralu trees can be lost. At each turbine location, no more than 0.7 ha will be cleared permanently for the activities of construction of wind turbine and the vegetation (herbs, shrubs and trees) in the rest of the area (2.25ha-0.7ha) used for hardstanding area will allowed to grow back. The ecologist will record the baseline situation and monitor the continued presence of vegetation, especially the endemics and locally EN plants during the construction.	Floral and faunal habitats loss in coastal area	Flora and Fauna Protection Ordinance.	CEB	Detailed design
Involuntary resettlement or land acquisition	Loss of lands and structures	Compensation paid for temporary/ permanent loss of productive land/livelihood as per GoSL procedures as stated in Resettlement Plan.	Public complaints	Rates stipulated in the Resettlement plan for the	CEB	Prior to construction phase

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
				project		
Encroachment into farmland	Loss of agricultural productivity	Use existing access roads wherever possible Avoid siting Wind turbines on cultivated lands or land containing excessive Palmyra or coconut. Owners of land compensated for any permanent loss of productive land and trees that need to be removed at wind turbine site.	Tower location and line alignment selection Design/Implementation of crop and tree compensation (based on affected area) Statutory approvals for tree trimming /removal	Agrarian Service Act. Consultation with local authorities and design engineers	CEB	Part of detailed alignment survey and design
Interference with drainage patterns/water channels	Temporally flooding hazards/loss of ecology in water channels	Siting of Wind turbines atleast 5-10m away from Thonas (water channels) to avoid disturbing habitats in water channels.	Site location selection Sri Lanka Land Reclamation and Development Corporation (SLLRDC) recommended measures to avoid adverse effects on the natural drainage system within the area from project construction	Irrigation Act 1933. Consultation with local authorities and design engineers SLLRCD recommendation.	CEB	Detailed alignment survey and design
Explosions/Fire	Hazards to life	Provision of firefighting equipment to be located close to sub-transformers, power generation equipment.	Sub-transformer design compliance with fire prevention and control codes	Tender document to mention detailed specifications	CEB	Part of detailed layout and design /drawings
Wind Farm layout of its facilities	Temporary Jetty impact on marine flora and fauna	Collate daily and monthly fish catch data for 2-year prior for fishermen in the project area and a representative control site.	Fish Catch Survey Visual Survey of beach for turtle nests Visual Survey of jetty	None	CEB together with Department of Coastal	Part of detailed layout and design /drawings

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		Survey and undertake a translocation of any trans-locatable marine flora and fauna located within the working area of the jetty to similar habitat away from the working area Undertaken nightly survey the beach working area for at least 60-days prior construction (depending on time of year in relation to nesting season) to identify any turtle nests and if found fence off the nest and buffer zone from construction working area to avoid disturbance No bright or white lighting to be installed on turbines and the design of associated infrastructure to ensure no light spill onto the beach	area to observe any marine flora/fauna		Conservation	
	Visual impact	Uniform design of type of tower, rotor, nacelle and height to be used at all turbine locations. Turbines to have minmum hub height of 80 m and maximum height of 155 m with blades 25 m above ground, although smaller turbines preferable given the need to meet set back distances. Turbine layout to seek to maintain regular array with a minimum of 3 turbines placed in the back row if utilized. Turbines to be made of synthetic materials. Turbines to be painted light grey in colour. Turbines to have a matt, non-reflective finish to prevent blade glint. Design of associated infrastructure to	Design scope to include visual mitigation actions	Visual Aesthetics	CEB and EPC contractor	Part of detailed layout and design /drawings

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		be in keeping with the local vernacular (design and materials).				
	Shadow flicker	Turbines to be sited to minimize occurrence of shadow flicker at adjacent properties. Shadow flicker assessment to be run for final turbine design and layout. Turbines adjacent to properties experiencing more than 30 hour per year and 30 minutes per day shadow flicker to have shadow flicker control modules installed. Shadow flicker assessment to be rerun with turbines shut down to confirm that no significant shadow flicker impacts will result. Protocol for operation of shadow flicker control to be prepared for implementation during operational phase.	Review of turbine design and layout including updated shadow flicker assessment and operational protocol	Less than 30 hour per year and 30 minutes per day shadow flicker at all adjacent properties (as per IFC-WB EHS Guidelines on Wind Energy)	CEB	Part of detailed layout and design /drawings
	Telecomunication	Do not site turbines at location T27 and T28. Undertake electromagnetic interference study to confirm that adequate buffer is provided to ensure no significant impacts on operation of telecom links. Undertake a baseline survey to determine which properties within 5km of the wind turbines have radio/television and test existing quality of radio/television signal received (tests to cover all properties in 500m, sample of properties in each village up to 5km)[132].				Part of detailed layout and design /drawings

[132] Pl refer https://www.ofcom.org.uk/__data/assets/pdf_file/0026/63494/tall_structures.pdf

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
Healthy and Safety Enviornment (HSE)	Occupational and community health and safety	Turbines selected to be designed to international good practice standards (IEC 61400) and have means of working at height systems fitted to them. EPC contractor to ensure all staff have received appropriate health and safety training and are competent for their role before the commencement of work including working at height, working over water, and lifting operations. EPC contractor to develop a traffic management plan covering the import of materials and staff by road and use of local access roads for construction of the wind farm. Undertake a baseline survey to determine the condition of existing roads which will be used for importation.		No injury or loss of life to construction staff or members of the public (records of near miss, minor, major and fatal health and safety incidents to be maintained and monitored during the construction phase)		Part of detailed layout and design /drawings
Construction						
Construction at wind farm	Adverse impacts to flora/fauna/receptors in the area	EPC contractor to develop detailed site specific Construction Method Statement based on the outline construction management plan and measures set out in the general EHS Guidelines for construction and demolition and the sector IFC-WB EHS guidelines for Wind Energy.	Project area	EIA document and all regulatory requirements of Srl Lanka and IFC-WB EHS guidelines	CEB and EPC Contractor	Prepare before start of construction
Marine ecology	Temporary Jetty construction	Dredging works are prohibited Disposal of excavated material on the sand dunes, beach area or at sea is prohibited. Daily monitoring of turbidity during installation of the jetty and if turbidity level increases above background construction work to cease until levels	Water pollution in restricted coastal area of jetty construction.	Coastal Resource Management Act No 57 of 1981	Department of Coastal Conservation	Start of construction of temporary jetty

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		return to normal. Barge operations should be timed to minimise disturbance to boat and ma-dal fishing activities. CEB will compensate fishermen in the area whose Vaadies and madel will be affected in line with compensation earmarked in the RP. Appoint a fisheries liaison officer to work with the local fishing community to agree appropriate barge schedule and communicate information about construction Trained/experienced marine mammal observer on board during barge operations to monitor presence of marine mammals and direct the boat crew to reduce speed or redirect to avoid any collision or disturbance to them Engagement of construction workers in fishing activities is prohibited, any found to be fishing will be given a single warning before termination of employment/fine. Sedimentation during construction works: need to ensure return to background within 25 m of works, or at adjacent madal whichever is nearer (need to monitor turbidity daily to ensure no worse than current, and regular monitoring of SS levels etc)	Only barges that adhere to MARPOL and have regular maintenance service records will be used by the project as any accidental oil spill from barges would badly impact on the marine mammals, seabirds, fish and other marine organisms.			

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		Water pollution due to spills and leaks (construction plant, maintenance of boats etc.) Disturbance to madal fishers: nets caught in jetty and boat traffic whilst fishing taking place				
Removal or disturbance to other public utilities	Public inconvenience	Advance notice to the public about the time and the duration of the utility disruption Use of well trained and experienced machinery operators to reduce accidental damage to the public utilities and specifically any natural habitats. Restore the utilities immediately to overcome public inconvenient	Disruption of other commercial and public activities / Public complaints	Technical specification	CEB/ PRDA / NWSDB/SLT	Throughout the construction period
Temporary outage of the electricity	Loss of power supply to the local community, if any power distribution lines crossing the wind turbine location are switched off	Advance notice to the public about the time and the duration of the utility disruption Restore the utilities immediately to overcome public inconvenience.	Houses and commercial premises of power disruption	Regular monitoring during the period of construction	Contractor CEB	Throughout the construction period
Acquisition of plantations and other lands	Loss of agricultural productivity	Avoid bird's migration/breeding season wherever possible for the project activities. Ensure existing water channels/ irrigation facilities are maintained in working condition Protect /preserve topsoil and reinstate after construction completed Repair /reinstate damaged areas etc. after construction completed	Land area of agriculture loss Usage of existing utilities Status of facilities (earthwork in m^3)	Agrarian Service Act. Regular monitoring compliance with regulations	CEB, Contractor through contract provisions	Throughout the construction period

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		Compensation for loss in agricultural production	Implementation of compensation (amount paid, dates, etc.)			
Equipment layout and installation	Noise and vibrations	Selection of construction techniques and machinery to minimize ground disturbance.	Construction techniques and machinery	Minimal ground disturbance	CEB, Contractor through contract provisions	Construction period
Wind turbine foundation construction	Dumping of excess soil	Excess soil from the foundations to be disposed off-site after permission of local authorities. All construction material to be kept within the footprint of the area acquired. Loose construction material to be covered to avoid being carried into adjoining areas by wind.	Volume of soil to be disposed (area of site in m^2 and estimated volume in m^3)	Laws and regulations of respective LAs	CEB, Contractor through contract provisions	Construction period
	Water pollution	Storage facilities for fuels, oil, chemicals and cement will be within secured areas on impermeable surfaces, provided with bunds of at least 110% volume with clean up equipment immediately available for use All vehicles, machinery, and equipment maintenance and re-fuelling will be carried out on impermeable surfaces and in such a way that spilled materials do not seep into the adjacent soil. Fuel storage and refilling areas will be located at least 100 m from sea and water channels and will be protected by temporary drainage bunds of at least	Seasonal start and finish of major earthworks (pH, BOD/COD, Suspended solids, other)	Sri Lanka's National Environment Act and IFC-WB EHS guidelines 2007 (under revision)		Timing of major disturbance activities - prior to start of construction activities Construction period

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		110% volume to contain spills. Construction wastewater will not be discharged directly onto the surrounding soil or into surface water system, all wastewater to be passed through silt traps or temporary sedimentation screens. Oil-interceptors will be installed and oil-containing wastewater will be intercepted, collected and transported to central location for further treatment and disposal. Contractor will provide sufficient garbage bins at each turbine location and ensure that they are (i) protected from birds and vermin; (ii) emptied regularly (using the nearest licensed solid waste landfill); and (iii) are not left to overflow. Construction activities involving significant ground disturbance (i.e. foundation land forming) not undertaken during the monsoon season. Do not undertake any works within 100 m of a water channel during the wet season Arrangement for storm water management during construction period to be made to avoid sediment runoff from the site.				

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
Civil construction of towers	Pollution risk and waste management	EPC contractor to develop detailed site specific Pollution Prevention and Control Plan (covering wind-blown dust, soil erosion, emissions from plant and vehicles, construction noise, surface water runoff, storage of fuel, oil, chemicals, and including an emergency response plan) based on measures set out in the IFC-WB general EHS Guidelines for construction and demolition. EPC contractor to develop detailed site specific Site Waste Management Plan (covering wastewater, solid waste and hazardous wastes) based on measures set out in the IFC-WB general EHS Guidelines for construction and demolition.	Pollution aspects-air, water, noise related to construction	IFC-WB EHS Guidelines	CEB, Contractor through contract provisions	Construction period
Construction schedules	Noise nuisance to neighboring properties	Construction activities only undertaken during the day and local communities informed of the construction schedule. In vicinity of Shell Coast Resort (cabanas are now exempt), no piling or other noisy construction works to be undertaken for more than a 6-hour period or at any time on the weekend or public holiday Pier construction must ensure piling activity must not emit continuous high impact noise (of hammer). Turbine locations adjacent to Shell Coast resort and other occupied properties to be securely fenced using	Timing of construction (noise emissions, [dB (a)]) Daytime construction only	IFC-WB EHS guidelines for receptors	CEB, Contractor through contract provisions	Construction period

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		an acoustic barrier (see IFC-WB EHS Guidelines on noise for appropriate design) to reduce the construction noise disturbance				
	Nuisance to birds from wind turbine construction	Restrict construction work during the known period of migration (Oct-January) by the birds. Construction period to be finalized in keeping with the construction method statement (CMS). Work must be undertaken from 1 hour after sunrise to 1 hour before sunset.	Timing of Construction	Biodiversity Management Plan, Construction Timing - period of migration of birds	CEB, Contractor	Construction period
Provision of facilities for construction workers	Contamination of receptors (land, water, air)	Construction workforce facilities to include proper sanitation, water supply and waste disposal facilities in accordance with IFC-WB EHS Guidelines. Solid waste and hazardous waste to be disposed of offsite to a suitably licensed landfill. No waste to be disposed of to an unlicensed dump site. No water well will be located within minimum 100 m of a toilet facility and vice versa. Contractor to prepare and implement a pollution prevention and emergency response plan in accordance with IFC-WB EHS Guidelines.	Amenities for Workforce facilities	National Solid Waste Management Policy and IFC-WB EHS guidelines 2007 (under revision)	CEB, Contractor through contract provisions	Construction period
Surplus earthwork/soil	Runoff to cause water pollution, solid waste disposal	Any excess inert spoil material will only be used as fill material onsite or offsite after permission from local bodies. The disposal site restored in a manner that prevents erosion and does not block any drainage path. No solid or hazardous waste to be disposed of alongside excess inert spoil.	Location and amount (m^3) of fill disposal. Soil disposal locations and volume (m^3)	Appropriate fill disposal and dispersal locations. Pollution Prevention as per International best	CEB, Contractor through contract provisions	Construction period

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
				practices[133]		
Tree cutting/ vegetation harvesting, cut and fill operations	Loss of vegetation and deforestation	Construction workers prohibited from harvesting trees in the project area during their employment. Get approval for cutting female Palmyra trees from Divisional Secretary. During the construction, CEB/EPC contractor to record the exact number of trees/ shrubs removed from the hardstand, access roads and other areas cleared for building and other facilities etc. Replanting/ restoration programmes to compensate the loss of trees/ shrubs and the habitat can be enriched[134] once the project activities are completed.	Illegal tree/ vegetation harvesting (area in m^2, number of incidents reported) Monitoring for all tree/shrubs to be cut by EPC contractor	Complaints by local people or other evidence of illegal harvesting	CEB, Contractor through contract provisions External monitoring would be done by Forest Department and Dept. of Wildlife Conser vation.	Construction period
	Uprooting of EN and endemic species of plants and vegetation	To ensure EPC contractor does not remove any locally EN or endemic variety of flora/trees at any hardstanding area. Ecologist will be engaged by EPC contractor to oversee the above. The ecologist will mark out and record the location all endemic and local EN plants in and adjacent the construction working area. EPC Contractor staff will be given guidance on their identification through tool box talks and notices in site offices and instructed not to clear them. The ecologist will monitor the continued presence of the endemics and EN plants during the construction.	Hardstanding Area	Ecologist will ensure endemic and EN plants are not removed	EPC contractor through contract provisions	Construction period

[133] In accordance to IFC's Environment Health and Safety Guidelines 2007.
[134] Revegetation will not be done in hardstanding areas

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		No more than 5 endemic Neralu trees [135], 9 palmyra trees and 37 coconuts [136] will be removed from the project area.				
	Effect on fauna	Prevent work force from disturbing to the flora, fauna including hunting of fauna and fishing in water channels. No poaching allowed in the bird habitat area (Vankalai sanctuary, Adam's Bridge National Park, Vedithalativu Nature Reserve.) Proper awareness programme regarding conservation of flora, fauna including ground vegetation to all drivers, operators and other workers	Habitat loss	Fauna and flora protection Act.	CEB/ DWC/ CCD/DoF	Construction period
Site clearance	Vegetation removal	Marking of vegetation to be removed prior to clearance, and strict control on clearing activities to ensure minimal clearance. Localized sprinkling of water at areas where vegetation is removed shall be undertaken for the entire duration of construction. Private trees/plantations will be compensated as per GoSL norms.	Vegetation marking and clearance control (area in m^2)	Felling of trees (Amendment Act. Nº 01 of 2000 and act of felling of trees control). Clearance strictly limited to target vegetation	CEB, Contractor through contract provisions	Construction period Re-vegetation cost will have limited capital cost as seedlings can be obtained from Horticulture/ Forest Department.
	Soil erosion and surface runoff	Construction in erosion prone areas should be restricted to the dry season. Outline construction Method Statement	Soil erosion	Visual inspection (Turbidity and sedimentation)	CEB, Contractor through	Construction period

[135] For T3 and T36 the hardstanding area will be designed and constructed to ensure that the maximum number of endemic plants are retained with no more than 5 Neralu plants lost, and no nationally EN plants lost.
[136] Same as Resettlement Plan for the project.

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		shall be the basis for construction practice by the EPC contractor. Treat clearing and filling areas against flow acceleration and foundation/road construction work should be carefully designed to minimize obstruction or destruction to natural drainage. All earthwork disturbance areas shall be stabilized within 30 days after earthworks have ceased at the construction site.	 Reengineering of drainage channels wit 25 m of the Wind turbine foundation as well as along access roads.		contract provisions	
Mechanized construction	Noise, vibration and operator safety, efficient operation, equipment wear and tear	Construction equipment to be well maintained. Check for pollution prevention and oil dripping etc. from vehicles while working in bird habitat and other area. Adopt pollution prevention measures in accordance with IFC-WB EHS Guidelines. Use of inherently quiet plant and equipment as far as reasonably practicable and regular maintenance to ensure noise emissions are maintained at design levels. Turning off plant not in use. Noise sources to be acoustically treated, for example with silencers, acoustic louvers and enclosures. Provision of rubber paddings/noise isolators at equipment/machinery used for construction.	Construction equipment - estimated noise emissions and operating schedules	Technical specifications, safety regulations, Noise control regulations (1994), Pollution Prevention as per International best practices[137]	CEB, Contractor through contract provisions	Construction period
Noise and Vibrations from Pier	Disturbance to habitations and fauna during construction for	Integral noise shielding to be used where practicable and provide make shift noise barriers near high noise	Pile Construction equipment - estimated noise	Technical specifications, safety	CEB, Contractor through	Construction period

[137] In accordance to IFC's Environment Health and Safety Guidelines 2007.

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
construction	pier.	digging/piling (if any)/and pier erection equipment to minimize horizontal propagation of noise. No work in coastal area during high tide period.	emissions and operating schedules	regulations, Noise control regulations (1994), Pollution Prevention as per International best practices[138]	contract provisions	
Construction of roads for accessibility	Increase in airborne dust particles Increased land requirement for temporary accessibility	Existing roads and tracks used for construction and maintenance access to the site wherever possible. New access ways restricted to 8m carriageway width. Access road shall be planned to cause minimal disturbance to the terrain topography. Existing surface drainage pattern to be retained to the extent possible. All equipment will be maintained to a high standard to ensure efficient running and fuel-burning. All vehicle emissions will be in compliance with relevant Sri Lankan emission standards. All vehicles carrying soil, sand, or other fine materials to and from the construction sites will be covered.	Access roads (length and width of new access roads to be constructed)	Use of established roads wherever possible	CEB, Contractor through contract provisions	Construction period
Transportation and storage of materials	Nuisance to the general public Hazardous waste from machinery, generators etc. (lube oil, hydraulic	Transport loading and unloading of construction materials should not to cause nuisance to the people by way of noise, vibration and dust. Avoid storage of construction materials	Soil, water and air quality Every 3 months after commencement of construction.	National Environment Act Laws and regulations of respective LAs National	CEB/LAs	Construction period Storage: No additional cost is envisaged.

138 In accordance to IFC's Environment Health and Safety Guidelines 2007.

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
	oil, waste oil etc. from cranes etc.)	beside the road, around water bodies, residential or public sensitive locations No storage of construction material near waterways and beach area. Construction materials should be stored in covered areas to ensure protection from dust, emissions and such materials should be bundled in environment friendly and nuisance free manner. Random stocking of raw material, storage of debris, piling of loose soil etc. to be strictly controlled. Other wastes like wood packaging material, metal, etc. will be sold to scrap dealers. Housekeeping of the area to be maintained by deputing sweepers to remove dirt/debris from the sites on daily basis In case of any accidental spill the soil to be cut and stored securely for disposal with hazardous waste. Hazardous waste will be stored at a secure location and only be sold to authorized vendors.		Emission Standards, Hazardous waste laws and CEA water quality standards Weekly		Water quality monitoring cost – SLR 3,500 per sample Performance parameters – Suspended Solids (SS), Total dissolved solids (TDS), oil, grease, Biological oxygen demand (BOD), Total coliforms, Fecal coliforms
Trimming/cutting of trees	Fire hazards Loss of vegetation and deforestation	Felled trees and other cleared or pruned vegetation to be disposed of as authorized by the statutory bodies. Forest trees, if any, would be planted on basis of 1:1 replacement. Any trees that die within 5 years are to be replaced.	Species-specific tree retention as approved by statutory authorities (average and maximum tree height at maturity, in meters) Disposal of cleared	Felling of trees (Amendment Act. No 01, of 2000 and Act of felling of trees control) Presence of target species following	CEB, Contractor through contract provisions	Construction period

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
			vegetation as approved by the statutory authorities (area cleared in m^2)	vegetation clearance.		
Health and safety	Injury and sickness of workers and members of the public	EPC contractor to undertake risk assessment (named person assigned for management of all medium and above risks) and develop detailed site specific Occupational Health and Safety Plan (including emergency response plan) based on measures set out in the IFC-WB general EHS Guidelines for occupational and community health and safety and the sector IFC-WB EHS guidelines for Wind Energy including procedures for eliminating and reducing working at height, working over water, and lifting operations and use of appropriate working methods and equipment where elimination is not possible. Construction site to have a well stocked first aid box at each turbine location and be staffed by qualified first-aid trained personnel Construction site around each turbine to be securely fenced to prevent public access with 24-hour security when deep excavations are left open overnight Establish exclusion zone for all members of the public and workforce during working at height and lifting operations	Contract clauses (number of incidents and total lost-work days caused by injuries and sickness)	Health and safety regulations and IFC-WB EHS guidelines 2007 (under revision)	CEB (Contractor through contract provisions)	Construction period

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		No construction staff to be exposed to a noise level greater than 85 dB(A) for more than 8 hours per day without hearing protection. No unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB(A). Construction staff to be provided with a source of clean drinking water (groundwater not suitable due to saline intrusion) that is tested weekly to comfirm meets Sri Lankan Drinking Water standards. Sufficient quantity of drinking water[139] available to construction staff and toilet/sanitation[140] facilities provided at the construction site in accordance with EHS general guidelines on occupational H&S Contract provisions specifying minimum requirements for construction of day-time camps including sanitation and welfare facilities in accordance with IFC-WB EHS Guidelines Contractor to prepare and implement a				

[139] 20 liters of water availability per day person (3 litres drinking, 15 lpd per bathing, 10 lpd for cooking) Source; Basic waer requirements for human acitities: Meeting Basic Needs, By Peter H. Gleick, Pacific Institute for studies in Development, Oakland CA, USA.

[140] Approx 1.5 toilets for 12-14 persons as per Table 5.31

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		health and safety plan in accordance with IFC-WB EHS Guidelines. Arrangement for fire control measures. Display of phone numbers of the city/local fire services, etc. at site. Ensure good housekeeping at the construction site to avoid slips and falls. Contractor to arrange for health and safety awareness programmes.				
	Working at heights Operation of heavy machinery Accidents leading to injuries fatalities Occupational health hazards	All personal protective equipment like gloves, helmets, ear muffs, safety belts etc.) for construction workers through the contractors. Ensure effective work permit system for hot work, electrical work, working at height, working in confined space etc. Lifting /Dropping/lowering of construction material or tool to be restricted and undertaken only under strict supervision, if required.	Contract clauses (number of incidents and total lost-work days caused by injuries and sickness). Operation of Cranes to follow a Crane Safety Plan	Health and safety regulations and IFC-WB EHS guidelines 2007 (under revision)	CEB (Contractor through contract provisions)	Throughout construction phase
Nuisance to nearby properties	Losses to neighboring land uses/ values	Contract clauses specifying careful construction practices in accordance with IFC-WB EHS Guidelines. Incorporating good construction management, design engineering practices. Productive land will be reinstated following completion of construction Appoint a community liaision officer to work with the Shell Coast Resort (cabanas not considered) to agree	Contract clauses Design basis and layout Reinstatement of land status (area affected, m^2) Implementation of Tree/Crop compensation (amount paid)	Public Nuisance Ordinance No.: 15 of 1862. IFC-WB EHS guidelines 2007	CEB (Contractor through contract provisions)	Construction period Consultation with affected parties immediately after completion of construction

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		appropriate construction schedule, communicate information about construction and be a conduit for receipt of any grievances in relation to disturbance EPC Contractor to plan working days and hours within 500m of the Shell Coast to avoid peak seasons and times (e.g. weekends, public holidays) Avoid cutting any trees between the turbines and Shell Coast (cabanas are exempt) as these provide screening of the turbines.			EPC Contractor	
Avian Collision	Possible collision of migrant birds with wind turbine	Install Radars to determine migration period birds that may collide with wind turbines.	Installations on selected wind turbine	BirdLife International (2012) and APLIC (2012) guidance	CEB and EPC contractor	Construction period
Road infrastructure	Possible crossing of ecological and ornithologicallly habitat. Access to local population to roads infrastructure	Ensure wind turbines and access roads to avoid any critical habitats Villages will get access to all approach roads to the coast/shore built for accessing the project facilities.	Site Plan to minimize such occurrence and facilitate community convenience.	IFC's GN6 and incorporation of good construction management, design engineering practices	CEB and EPC contractor	Construction period
Operation and Maintenance Phase						
Electric shock	Death or injury to the workers and public	Security fences around substation. Establishment of warning signs Careful design using appropriate technologies to minimize hazards	Periodic maintenance of fences and sign boards Usage of appropriate technologies (lost work days due to	IFC-WB EHS guidelines	CEB	Throughout the operation

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
			illness and injuries) Number of programmes and percentage of staff /workers covered			
Coastal area erosion	Erosion/Accretion of the coastline in the vicinity of the pier and the surrounding areas	Periodic clearing of accumulated sediments (sand) and sand nourishment in the areas affected or other measures specified by the Department of Coast Conservation and Coastal Resource Management	Field observations and coastal surveys prior to construction of the pier and at and after the completion of construction	As specified by the Department of Coast Conservation and Coastal Resource Management	CEB/Project proponent	Throughout the operations
Avian Collision	Mortality of birds	Design of wind turbine to follow international good practice i.e. to provide adequate spaces between each turbine for movement of birds which would reduce the potential for accidental collision. Do not permit free spinning of turbine rotors under low wind conditions when turbines are not generating Operate radar system and implement protocol for operation (shut down) of turbines to ensure negligible collision risk for birds during the migratory season Undertake post-construction monthly bird surveys (vantage points and block counts) of wind farm, review findings and update shut down protocol as needed to ensure negligible collision for birds (adaptive management process) Undertake bird and bat carcass surveys	Conduct periodic surveys to check collisions Engage an expert to periodically assess bat and bird status. The expert to train the staff at site and address incidents of bird hit/ injury/carcass collection.	Zero Collision Mortality	CEB	Throughout the operation Quarterly Monitoring cost through external expert (SLR 200,000 – 500,000 per year)

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		of the wind farm area, review findings and update shut down protocol as needed to ensure negligible collision for birds and bats (adaptive management process) Implement agreed biodiversity management plan covering Vankalai Sanctuary, Adam's Bridge national park and other critical habitats on Mannar island				
Turbine Noise generation	Nuisance to the community around the Wind turbine site	Operate turbines according to the agreed noise protocol so that no adjacent property experiences significant noise impacts including nuisance from impulsive or tonal noise Noise compliance testing to be undertaken to verify the modelled level of noise (referring to the baseline data obtained during SW and NE monsoon) as well as consultation with beach occupants regarding noise disturbance occurances and if necessary adjust the operational protocol to ensure that no significant noise impacts will result including nuisance from impulsive or tonal noise Nadukuda camp fishing is used during April – August as some, fishermen may stay there and do fishing in the northern side of the Mannar island who may be affected by noise around the entire yerar	Noise level	Noise level (db)- Once a year	CEB	Throughout the operation
		Maintenance and repair of turbines will be undertaken on regular basis	Turbines certified by IEC to be engaged	Performance parameters- Leq-	Project Manager	Throughout the operation

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		Implement a complaint resolution procedure to assure that any complaints regarding operational noise are promptly and adequately investigated and resolved	Monitor noise at all nearby village	day, Leq-night and Leq- average -Annually	EHS officer of O&M	Monitoring cost SLR 50,000per year
Interference in telecommunications	Exposure to electromagnetic interference	Survey the EMI interference in neighboring areas to change locations of telecommunication towers or take suitable mitigatory measures such as installation of cables etc. If complaints occur immediately survey quality of radio/television signal during operation and if existing quality of radio/television signal received found to have deteriorated provide solution to affected properties or villages as set out in the IFC-WB EHS Guidelines on Wind Energy (if cable or satellite connection provided CEB to cover cost of subscription)	Required distances (meters)	IEC Electromagnetic Emission Standard, EN 61000-6-4– Once a year	CEB	Throughout the operation
Used Oil spillage	Contamination of land/nearby water bodies	Used oil to be securely stored and sold only to approved vendors. Sub-transformers located within secure and impervious bundled areas in accordance with IFC-WB EHS Guidelines.	Sub-transformers bounding (“as-built” diagrams)	National Environment Act, Bounding capacity and permeability. IFC-WB EHS guidelines 2007 (under revision)	CEB	Throughout the operation
HSE activities	Occupational and community health and safety	Given public access is not prohibited place warning signs on access roads and and at each turbine about hazards (blade throw, electrocution) with 24-hour manned emergency contact number Turbines selected to be operated and	Wind Farm area	No injury or loss of life to construction staff or members of the public (records of near miss, minor, major and fatal	CEB	Throughout operation

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		maintained to international good practice standards (IEC 61400) and have means of working at height systems fitted to them Immediate base of turbines to be fenced to prevent public access to tower ladder Doors to towers, kiosks and substation to be kept locked at all times to prevent public access EPC contractor to ensure all staff have received appropriate health and safety training and are competent for their role before the commencement of work including working at height, working over water, and lifting operations		health and safety incidents to be maintained and monitored during the construction phase)		
Blade throw		Monitor vibration sensors and immediately shut down turbine if any anomaly is observed, do not restart turbine until qualified and experienced personnel has carried out blade inspection Qualified and experienced personnel to carry out 2-yearly blade inspections, if any anomaly is observed do not restart turbine until qualified and experienced personnel has carried out repair inspection Provide compensation for any damage caused in the event of blade throw in line with RP	Two yearly blade inspections	EHS Wind Energy guidelines Set back will be met or if not property relocated to meet the criteria	CEB	Throughout operations
Visual Intrusion/Shadow flicker	Shadow flicker on properties during operation of turbine	Operate turbines according to the agreed shadow flicker protocol so that no adjacent property experiences more than 30 hours shadow flicker per year and 30 minutes per day based on the pre-construction assessment	Fall of shadow from all turbines to be observed and vegetative shield to be opted if required	EHS Wind Energy guidelines	CEB	Throughout operations

Project Activity	Potential Environmental Impact	Mitigation Action	Monitoring Scope	Monitoring Standards	Institutional Responsibility	Implementation Schedule
		Shadow flicker compliance testing including recording of shadow flicker occurence by beach occupants to be undertaken and if necessary adjust the operational protocol to ensure that no significant shadow flicker impacts will result All turbines located along the edges close to habitation to have a minimum set off of 800 m or further[141] to negate the spread of any distinct shadow at the village. To help screen turbines from view provide tree screen planting to the Shell Coast should owners request it at any point within the first 3 years of turbine operation. Maintain the tree screen for a period of up to five years to ensure its establishment replacing any trees that fail. Tree screen planting to use native species but to avoid creating new habitat that could attract more birds to the project area.				

[141] Based on Entura Shadow Flicker Modelling Study in Appendix 6.

CONSTRUCTION METHOD STATEMENT
Illustrative CMS Checklist for periodic reporting by EPC contractor

(The EPC contractor shall comply with Annexure 4 on Construction Method Statement for compliance with ADB SPS 2009.)
The EMP (Annexure 3), the EMoP (Annexure 5), and the Construction method statement (Annexure 4) shall be read together for environmental safeguards compliance for working within the wind farm project area by the EPC contractor. The following checklist will be reviewed by CEB and more details may be added as deemed suitable.

SNo.	Procedure to be followed	Yes/No	Impact	Action Taken
A	General Procedures			
1	Site induction for each workman prior to commencing activities on site. Penalties of violating any EMP/regulatory requirements must be explained and agreed			
B	Pre-Construction & Site Preparation			
1	Mark work areas, exclusion areas that are situated in the coastal/private areas. Make arrangement as per design and location finalised by CEB/CCD for toilets at site. No water well will be located within minimum 100 m of a toilet facility or vice versa.			
2	Designate and fence using sheets all laydown areas, material storage area, personnel area			
3	Provide orientation training to construction staff on working methods that relate to air, water, noise and soil pollution, avian, avifauna and mammal life in the area. Instructions on not to damage any property of local fishermen should also be given. Fishing is not allowed by construction staff withing project area.			
4	Designated area can only be used for storage of water, oil, construction material etc. with marked area for construction. Park equipment within the same area specified by CEB as per design.			
C	Access Road to each Wind turbine site in the coastal area			
1	Ensure minimal disturbance to flora and fauna during construction of access route to Wind turbine footing			
2	Ensure water channels are not blocked. Make use of culverts as required			
3	Remove extra sand/soil from site and store it in areas of depression. Do not throw any waste into the waterways to pollute ecosystem			
D	Laydown areas next to each Wind turbine site in the coastal area			
1	Ensure minimal disturbance to flora and fauna during construction of laydown area next to Wind turbine footing			
2	Make arrangements to rereoute water channels near the consruction			

SNo.	Procedure to be followed	Yes/No	Impact	Action Taken
	areas if avoidance is not possible in consultation with the project Ecologist.			
3	Remove extra sand/soil from site and store it in areas of depression until it is disposed of at locations specified by local authorities offsite.			
E	Wind turbine Foundation construction			
1	Excavator must not disturb flora and fauna while working on Wind turbine foundation site			
2	Planning for stacking of dugout sand/soil from foundation. Sheet piles to be used to avoid caving in of the sand sidesinto the wind turbine foundation before concreting.			
3	Dewatering of the area excavated for Wind turbine foundation erection into a pit for sedimentation and any oil removal before letting of to the sea- prevention of pollution and damage to marine flora and fauna			
4	Pre-cut/bent steel to be brought to Wind turbine site for fixing in the dugout foundation			
5	Usage of premix concrete lorry[142] with long boom to fill concrete.			
6	Backfilling and compaction at foundation to be followed by removal of excess soil to designated offsite location while ensuring no marine flora or fauna is damaged/killed			
F	Wind turbine, Nacelle and Blades Erection			
1	Crane should not traverse directly over water course – use culverts			
2	Carefully position heavy cranes and structures inside hard standing area for Wind turbine to ensure no damage			
G	Construction/Decommissioning of Pier for equipment			
1	Noise for digging of piles to be monitored. Construction only during prescribed working timing of the area. Night time working not allowed.			
2	Decommissioned pier to be removed entirely from the project site and the piles will be cut atleast 1 m below the coast sand to ensure that the fishing nets do not entangle into its protruding edges			
H	Digging/Construction of Cable Trenches			
1	To ensure minimum water course crossing in the coastal area. Trenches to run along the access roads and be covered to avoid soil erosion.			
2	Construct sheet piles at corners of waterways areas to avoid damage to waterways			
I	Removal of construction waste material			
1	Remove all waste material from coastal area including excess soil			

[142] Premix concrete shall be sourced from mainland concrete supplier and not situated in the project area

SNo.	Procedure to be followed	Yes/No	Impact	Action Taken
	preventing water flow to designated waste containment areas specified by the local body.			
2	Remove all liquid waste material from coastal area			

Annexure 4. Construction Method Statement

1.0 INTRODUCTION

1. The Engineering Procurement and Construction (EPC) Contractor, in agreement with CEB, shall ensure the wind farm construction shall be carried out strictly in accordance with the approved Environmental Management Plan (EMP) and permits of the Department of Coastal Conservation (CCD), the Project Approving Authority (PAA).

2. This type of specialized statements can only be developed by EPC contractor who has trained engineers and technologists and worked in coastal areas to prepare tasks, estimates, implementation scheduling etc. EPC contract bidders must be requested to keep a flexible budget for this activity. They will most likely include design mitigation – reduction of impacts through site design, mitigation to reduce impacts during the construction following industry best practice. EPC contractor must coordinate with staff officer designated by the Coastal Conservation Department for any construction related issues, and environmental safeguard staff from CEB.

2.0 DESIGN PHILOSOPHY

3. All construction works in the wind farm will be constructed in accordance to formal approval received from relevant statutory organizations such as Coast Conservation and Coastal Resources Management Department (CCD) and Mannar Pradeshiya Sabha etc.

Period of Working inside wind farm

4. The period of construction must be finalized between the EPC contractor, CEB and Department of Coastal Conservation. The seasons for construction can be decided based on the following schedule given in Table below.

Table: Timing of Construction in wind farm

No.	Season	Period	Construction work
1	Dry Season	February-September	No ecological constraints preferred time for construction
2	Migratory period Wet Season (NW Monsoon)	October – January	Civil works Construction of Temporary Pier, equipment unloading from barges
3	Breeding season for many of the native birds. Many of the ground nesting birds breed in Adams Bridge National Park. Migrant birds are absent	May – August	Wind turbine construction can be done.

[a] Construction is ideally avoided, no vegetation clearance, no earthworks, no noisy construction works (piling etc.) but CEB has requested construction and piling.

5. The table above depicts the various seasons when the work can be done by the EPC contractor. For example, during the migratory season when the majority of birds are present in the project area and the greatest risks from construction disturbance will occur. CEB is proposing construction of pier and equipment unloading from barges during low wind season as the same

cannot be done in rough seas.

6. No work will be undertaken until one hour after sunrise to one hour before sunset. Typically, all work prior to the commissioning, including access to the site by lorries except for the delivery of wind turbine equipment parts and its erection shall be restricted to the hours of 08:00–18:00 except other than to prevent or remedy any environmental or health and safety risks or where the quality of the project or construction element could be compromised. No works will be undertaken outside the hours of 06:00–21:00.

Ecological Monitoring

7. The EPC contractor should have at least an environment specialist designated as Environment Manager (covering construction disturbance, pollution prevention, etc) H&S specialist, and ecologists (marine and plants) who will be stationed fulltime during construction works.

8. An Environment Manager (EM) (with the assistance of a suitably qualified and experience ecologists) will be appointed by the EPC contractor to demarcate areas that have endangered/critical endangered/vulnerable/nearly threatened species of flora, fauna, avifauna and marine life identified in the EIA documents. The EM will issue written guidelines for use by all construction staff that will adhere to the construction method statement, the EMP and environment monitoring plans (EMoP) as mentioned in the EIA document. The EM will also conduct onsite monitoring during construction period, conduct regular training, and direct all construction staff to use caution while working in water channels, birds breeding area, mammals and sensitive fauna. The EM will serve as the key person for working together will Department of Coastal Conservation, Department of Wildlife, Department of fisheries and project affected persons.

Wildlife/biodiversity management

9. Any marine fauna and avian fauna shall be protected from entering and becoming trapped in any part of the civil works on the site which must be prevented by erecting fences, provide crossings or escape routes where necessary. EPC contractor shall develop paths for their egress from inland to the sea through water channels as well as culverts below the access roads.

10. To avoid introduction of any invasive species in the wind farm due to on-going construction work, all barges, and newly brought in plant and machinery should be completely cleaned before use so as to not transfer seeds/rhizomes from outside area.

Physical Cultural Resources

11. There is no archaeological sensitive area inside the proposed project boundary. The EPC contractor shall develop a chance find procedure based Sri Lankan Laws[143] and get it approved by CEB. Given that excavation and earth moving works will be involved, the chance find procedures will be applied.

Local labor/content

12. The EPC contractor will try to use local skilled and unskilled labor, petty contractors, plant and materials to maximize the benefit to the local community.

[143] Monuments and Archaeological Sites and remains Act, 1958. Act Nº24 of 1958 and Antiques Ordinance, 1960

Equipment Noise

13. Where available the quietest plant and/or machinery will be employed and maintained in good working order with appropriate silencers, mufflers or acoustic covers fitted. Stationary noise sources will be shielded by acoustic barriers.

Communications

14. Throughout the construction period, the EPC contractor will communicate with all stakeholders of the project – bird clubs, NGOs, government agencies, and the local public, etc. A grievance redressal committee has been setup by the PIU to ensure speedy redress to public grievances. The EPC contractor is required to record all grievances received and will be the first point of contact for public and any other entity.

General

15. The working plant and machinery would be well maintained and inspected regularly to ensure that all the pollution control measures are functioning effectively and to evaluate if any further measures are required.

3.0 PLANNING AND PHASING OF WORKS

3.1 Wind turbines Generators

16. The hub height of the wind turbines proposed to be of about 80-100 m would require extensive foundations which would extend to a depth of about 2.5 to 3m. The depth of foundation will be dependent on soil and surface conditions. The wind turbine foundation structure will be floating type which is essentially a gravity foundation that relies upon soil overburden and concrete to provide sufficient weight to resist overturning of the foundation at extreme wind loads.

17. The wind towers will be initially segmented (four pieces) for ease of transportation and will require bolting works to put the tower together during installation. The erection of tower would require cranes and preparation of platforms for installing cranes. Crane platform will require a maximum area of 1,300 m^2 [144] which will be prepared soil, rock and gravel to support the weight of the equipment. The crane will undertake the lifting activities to erect the turbines; the nacelle will be installed at the top of the tower followed by installation generator, rotor and blades.

18. Construction of related structures will involve civil and steel work for installation of pooling stations, transformers, substation, and electric cables and signal wires. About 10 m^3 of water will be required daily for construction on an average while the peak demand is estimated to be 20 m^3/day from a ground water borewell away from any coast area by 500 m. Ready mixed concreting will be done for all concreting activities and will be sourced from a batching plant outside Mannar Island, However, it is set up in Mannar Island, it must be located atleast 500 m from any sensitive receptor. The water required for construction will be arranged by the construction contractors through authorized tanker water suppliers.

[144] Hardstanding area is 150 m x 150 m less 0.7 ha. The area is sufficient. However final platform will depend on the type of crane the EPC contractor would bring.

Wind turbines and Step-up Transformers

19. Soil testing will be carried out at each wind turbine foundation location using bore holes to identify the quality of soil and water to decide the type of foundation and concrete for the foundation. Excavation for foundations will be done as per the design drawings based on the results of soil testing. During excavation, sheet piles will be used to avoid collapsing of side walls of the foundations. In case of excavation below water table is necessary, dewatering will be carried out using water pumps. This wastewater will be collected in a sedimentation pit to remove sand and other pollutants before releasing into the sea. After completing of excavation, a lean concrete to a thickness of at least 50 mm will be laid before laying reinforcements and foundations bolts will be positioned as per the manufacturer's drawings using templates. Ready-mix concrete as per the design requirements will be used for casting the foundations. Foundations will be cured and erection of wind turbine and step-up transformer will be carried out after verifying the strength of concrete of the foundation.

3.2 Wind Farm Road and Hard-standing Construction

20. The final design methodology would be determined by a detailed pre-construction ground investigation and consideration of any constraints relevant to the locations (including sand slide risk). The route of access roads would be pegged out ahead of construction operations, preferably 500 m – 1,000 m in advance of required operations, depending on the terrain. This would allow for minor deviations to the center line where constraints are identified according to the micrositing requirement of the Wind Farm. Drainage crossing points and passing places would also be identified at this stage.

21. Gravel required for the site roads and hard standing areas would be sourced from off-site from suitable licensed quarries. A number of suitable rock sources will need to be identified. This transportation of rock would have transport related environmental impacts of and increase traffic impacts on the public roads as well and thus increase associated emissions.

Access Roads

22. The site road network has been planned to provide access for construction and wind turbine delivery vehicles to each wind turbine. Main access road as shown in **Map 6** is minimum 6 m exclusive of the drains and cable trenches.

23. A number of factors have influenced the design of the site road layout and these have been incorporated into the design principles:

- Requirements to maintain water flows across the line of the road and minimize disruption to the coastal hydrology
- Minimize the crossing of water channels and effects on local hydrology.
- Serviceability requirements for construction and wind turbine delivery vehicles
- Build ability considerations- create loops where practical in the road system, to avoid the need for turning circles for large wind turbine delivery vehicles.
- Avoid identified environmental and archaeological constraints
- Roads shall fit into the landscape avoiding unstable ground, areas of technical constraint and constructed to a uniform longitudinal and horizontal profile.

24. Where the road alignment crosses existing drainage channels, pipe bridges will be used. The pipes will be sized according to the width of the crossing and installed in such a manner that will not interrupt the flow of the water course or artificially raise or lower the water bed.

Laydown Areas, Site Compound and Parking

25. The daytime temporary storage area should be constructed at the one location at wind farm site away from any water channels. The area will be selected so that trucks, concrete mixer must have enough place to reverse without spoiling area outside the track and causing any collision risk with other vehicles and construction crew in the area. Some site roads will also be used as vehicle standing areas during deliveries and for parking of site vehicles.

Dust Control

26. Careful material handling would control dust. To prevent the escape of dust, relevant delivery vehicles would be covered, materials would be stored appropriately (see below) and any conveyors would be covered or enclosed. When necessary (e.g., under dry conditions), the area would be watered down, and a wheel wash installed to reduce dust and prevent the escape of dust. Run off would be collected and treated appropriately.

Concrete

27. Concrete is highly alkaline and corrosive and can have a detrimental impact on water channels. No concrete trucks, holding pans, tools, equipment or materials must be washed in coastal area or near waterways. Concrete mixing and material storage areas will not be situated in the coastal area. Sulphate resistant concrete shall be used where geological conditions dictate thereby preventing long term corrosion of concrete.

Material Storage

28. Aggregates would be stored on a hard standing area, with suitable windshields and appropriate covering where necessary to minimize wastage and pollution through washout and as dust. Any additives and other chemicals would be stored in a designated bunded area.

3.3 Working in the Vicinity of Water/Buffer Zones (The buffer zone extends about 1 km before the Adam’s Bridge National Park.)

29. No work can be performed in the buffer zone of the Adam’s Bridge National Park. The following procedures apply to the general construction activities either within water channels or in the vicinity of water channels.

- Roads and storage areas to be built outside buffer zone and preferably away from a water channel. If access roads have to cross water channels, a design that maintains ecology of the water channel must be prepared and water culvert constructed before road development works can start.
- The work should be planned in dry season in order to minimize generation of pollutant laden runoff.
- Cement and concreting operation to be kept outside buffer zones and water channels to avoid their contamination. If water channel is very close to the wind turbine foundation, the foundation layout design may be altered to esure distance

between water channel to WT foundation is at least 25 m or the new pathway of water channel may be so constructed to ensure no damage to inland ecosystems.

- Runoff from any tower excavation shall not be pumped directly to the sea and any water channel. Where dewatering is required, water shall be pumped out to a predesigned lined pool where it can be treated to remove colloids prior to reentry to any natural drainage.

Noise

30. All works will be carried out in accordance with the Sri Lanka's noise legislation or IFC-WB EHS[145] guidelines which ever is more stringent. EPC contractor and its suppliers of construction materials should strictly implement noise control regulations stipulated by the CEA in 1996 (Gazette Extra Ordinance, No 924/12) for all construction vehicles and equipment.

Vegetation Clearance Works

- The coastal scrubland is present across parts of the project site. The EPC will ensure prior clearance in the hard standing areas in line with CCD guidelines prior to the construction of the project.
- Felling/tree cutting, selective clearing of areas will be kept minimal. Land disturbance will be stabilized as soon as possible. Working timeframes shall take into consideration other factors such as bird nesting season and other ecological constraints. Approval should be undertaken from the Divisional Secretary for cutting female Palmyra trees. Branches of trees extending over the area occupied by the road footprint shall also be trimmed to give a clear height of 6 meters above the road and shoulder pavement surface.

3.4 Drainage Plan

Ground and surface water table

31. Short-term lowering of the groundwater table may occur in the vicinity of the tower site during dewatering of foundation excavations. The area is subject to changed surface and groundwater levels frequently and dewatering would not have significant impact on aquatic inhabitants.

Soil erosion, drainage and sediment

32. The project area is characterized by many waterways, construction of foundations may interfere with the natural drainage systems and modify flow of surface water, and these changes can contribute to soil erosion, flooding, channel modification, downstream scouring and sedimentation in downstream and other drainage channels.

33. EPC contractor shall conduct temporary drainage and silt management study prior to startup of earthworks (including preliminary or enabling works) proceeding to construct wind turbine bases, access roads, laydown areas, buildings and other infrastructure. Temporary bunds/fences should be erected in areas where risk of pollution to any water channels

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[145] www.ifc.org/wps/wcm/connect/554e8d80488658e4b76af76a6515bb18/Final%2B-%2BGeneral%2BEHS% 2BGuidelines.pdf?MOD=AJPERES

is identified.

34. Surface water drainages that run through the site and storm water discharges should be managed to minimize water quality impacts to nearby surface water resources such as lagoon, salt marshes and floodplain. A drainage plan will be required by the construction contract to manage the flow of water offsite in a responsible manner.

35. Sediment control measures such as retention weirs can be used, as necessary, to minimize sediment transport offsite. Measures such as silt fencing may also be implemented to minimize erosion of soil stockpiles. Sediment control measures may also be required for near access routes, particularly at stream crossings. The site drainage plan will address runoff from the equipment staging areas.

3.5 Environmental and Waste Management

36. EMP lays out the details for environmental management and waste management measures to be adopted during the construction phase. For waste and sanitation facilities at the construction site, any waste will be collected and transported off site, and emergency use facilities (if any) will be completely sealed with no discharge to waterways and coastal area. Mannar Pradeshiya Sabah maintains a solid waste disposal site at coordinates 8°59'24.91"N 79°54'21.05"E in Sinnakadu Gram Niladhari division in Mannar Island. The project will use this site for solid waste disposal.

Sanitary wastes

37. An offsite disposal contractor or a small package sewage treatment system can be employed to treat sanitary wastes. Under no circumstances should untreated sewage be discharged into local waterways.

Hazardous Waste Disposal

38. During the construction, there won't be any hazardous waste generation besides some small amount of oil dripping from construction machinery. However, the EPC contractor will dispose of any solid/hazardous waste (if generated at site) at a suitably licensed landfill by transporting the solid/hazardous outside of the project area in keeping with the good international practice. Transportation of the same shall be in sealed trucks to avoid any spillage in the wind farm area.

39. The EPC contractor shall ensure all construction machinery and equipment are maintained so that dripping of oil from gearboxes is contained.

3.6 Emergency Response Plan

40. A written emergency response plan should be prepared and retained on site and the workers should be trained to follow specific procedures in the event of a spill. There must be proper equipment available for workers to contain and treat a spill in the event of an emergency.

Danger Marking

41. The area to be used as storage for materials will only be marked at the corners using rods and Danger Tape. Any construction site shall be clearly marked. Warning notices must be

displayed for each specific health and safety issue that could result in personnel accident.

4.0 CONSTRUCTION

42. The work involved and the necessary construction equipment are as follows:

- Construction of access roads, culverts and improvement to existing road network - scrappers, dump trucks, water pumps, water bowsers and earth compacting rollers, etc.
- Construction of foundations – excavators, water pumps, ready-mix concrete transport trucks, poker vibrators, etc.
- Compaction of crane operating pad – dump trucks, water bowsers, earth compacting rollers, etc.
- Transport and Installation of wind turbine and associated facilities – barges, heavy and long trucks, cranes and winches.
- Installation of temporary meteorological towers – crane, winch, etc.
- Power evacuation system of underground cables to main collector substation - mini excavator, soil compactor, etc.

43. The erection of wind turbines will require development of designated wind farm site which will involve soil investigation, site survey, site leveling, construction of internal roads, etc. The proposed site has a flat terrain adjacent to the southern coastline of Mannar Island. It may not require extensive leveling of the entire area but each turbine location will require clearing and grading of a 0.7 ha around the tower site. There will be removal of ground vegetation, removal of trees and shrubs.

44. The major civil work involves wind turbine foundations and erection of wind turbines. Minor works involved are security kiosks, roads, equipment unloading pier and drainage. For the improvement of existing roads and for proposed new roads, the required type of soil will be imported from approved barrow pits with relevant statutory approvals.

4.1 Vegetation Clearance

45. EPC contractor will ensure that for all turbines the hardstanding area and associated infrastructure (including access tracks and cable routes) will be designed and constructed to ensure that no endemic or nationally EN plants are lost. For example, for T3 and T36 the hardstanding area will be designed and constructed to ensure that no more than five Neralu endemic plants and no nationally EN plants are lost.

46. To ensure the above, prior to construction an ecologist will mark out and record the location all endemic and EN plants in and adjacent the construction working area. EPC Contractor staff will be given guidance on their identification through tool box talks and notices in site offices and instructed not to clear them. The ecologist will monitor the continued presence of the endemics and EN plants during the construction.

4.2 Access roads

47. In total, approximately 15.71 km of access roads would be upgraded or constructed with a typical carriageway width of minimum of 6 m. There will also be some local widening on the bends, junctions and around tower bases for the safe passage of large vehicles and working area.

Roads would be constructed from graded gravel, envisaged to be sourced from offsite borrow pits. All machinery shall work within the construction corridors as indicated on contract drawings.

48. The EPC contractor shall video survey of the proposed access route and will identify any existing defects regarding its usability by heavy cranes and large trailers carrying blades from jetty to turbine location. This video report will be used to determine if any construction needs better layout plan of the access roads. Well-graded granular fill will be spread and compacted in layers to provide a homogeneous running surface. The thickness of layers and amount of compaction required will be decided by the EM based on the design that will take into account the characteristics of the material and the type of compaction plant to be used.

49. All roads would be surfaced with hard, durable, weather resistant material. All roads require suitable culverts to enable free drainage along the surface as no blockage is allowed. Dust control measures will be required to avoid excessive dust due to the road surface. Existing access roads in the area would be upgraded by widening and placing of additional surfacing from gravel. Once the road has been constructed, the two slopes on either side of the running width would be reinstated with sand overburden and the verges must be revegetated.

50. A drainage channel must be formed that would intercept any rainwater runoff, which would then be directed under the road via appropriate sized pipes or culverts. All drainage would be intercepted before it reaches a watercourse and directed into suitably sized settlement ponds and soak-always. Where necessary additional culverts would be installed to maintain the site hydrology. All culverts would be installed as deemed necessary by and in consultation with the on-site ecologist.

51. During construction, it is mandatory for EPC contractor to ensure that coastal vegetation does not get disturbed thereby ensuring natural breeding areas for bird species are not degraded.

Cable Trenches

52. Cable trenches would be cut running parallel to the site road. Cables or cable ducts would then be installed prior to the replacement and compacting of the excavated soil.

Road Maintenance

53. During construction, the road would be regularly inspected and maintained and road conditions monitored to ensure other public roads in the area are not contaminated with mud or dust. Accessed roads will need to regularly spray water onto the site tracks to dampen down the airborne dust.

54. Great care will be taken to ensure dust/mud from the site roads does not become a hazard on the routes in the area. A monthly monitoring regime will be set up and the weekly site safety checklist will be amended to include a visual check once per week (minimum). The area will be visually inspected and observations recorded daily.

55. The following regular activities shall take place:

- The road network shall be inspected for potholes, and where they occur they would be filled;
- Drainage ditches cleared,
- Culverts, bridges and cross-drains inspected and cleared,

- Regular emptying of catch-pits (particularly when the road is newly constructed).

56. During the operation of the wind farm, the roads would be maintained to a sufficient standard to enable all maintenance activities to take place, and allow emergency access to the wind turbines. If major works are required (for example, works that require a crane) the roads would be inspected to check they are of sufficient strength and quality to carry out the work, and if necessary repaired to a suitable standard.

4.3 Hard standing Areas

57. The hard standing area would be formed by excavating the sand to a suitable load bearing strata, and filling with suitable graveled rock to form an adequate bearing surface for the crane. A hard standing area of approximately 150 m by 150 m would be constructed at each wind turbine location. The hard standing area is required for the cranes and delivery vehicles involved in erecting the wind turbine generator. The final dimensions of the hard standing and its location in relation to the wind turbine may vary depending on the local topography and the wind turbine selected.

58. Two secondary crane pads of approximately 10 m by 10 m each may be required at each wind turbine location to assist with the set-up of the main crane (final base size will be decided by the bidder). The requirement of these crane pads depends on the type of crane used.

59. Hardstanding area for each turbine may be required to accommodate turbine erection - a trestle area for blades and hard standing for the assembly of the rotor.

Foundation Construction

60. Each wind turbine would require a reinforced concrete foundation buried beneath the ground and founded on suitable bearing strata. The base would typically have a diameter of approximately 25 m with a depth of approximately 3 m deep. The exact dimensions of the foundation would depend on the choice of wind turbine used, and the ground conditions at the foundation location.

61. Ground investigations would be carried out at each wind turbine location prior to construction. The construction methodology for wind turbine foundations would depend on the strength and depth of the sand specific to each location as well as the strength of the strata. Where ground conditions at the level of the underside of the foundation are found to be of insufficient bearing capacity, local ground strengthening works would be required, these would be carried out following the appropriate guidance.

62. Excavated wind turbine foundations will result in large volumes of displaced inert spoil/excavated materials. EPC contractor through the EM must supervise measures required to manage silt laden runoff from spoil, silt laden runoff from pumped dewatering, and contamination from concrete from foundation:

- Concrete mixture must not be allowed to enter water channels and drainage from tower excavation where concrete is being poured will not be discharged directly into existing water channels without appropriate treatment.
- Stockpiling of materials and locating essential stockpiles as at least 25 m away from water channels or outside buffer zones (wind turbines may be relocated based on distance from water channels or the water channels will be re-routed).

Excavated clays are to be battered back and covered by topsoil in order to minimize potential for runoff from exposed clays. Any excess inert spoil from construction must be disposed of as per directions of the regulatory body.

63. Typical method of construction for foundation in sandy soil:

- Install temporary drainage around the perimeter of excavation to prevent run off reaching natural drainage channels or water channels.
- Construct cofferdam around the perimeter of the foundation,
- Excavate the sand up to solid strata. This would be laid aside and maintained to be reused elsewhere on site.

Foundation Drainage

64. Whilst the foundation excavation is open, it would need to be kept free of water to allow construction of the reinforced concrete base. Water ingress could be from ground water, surface run-off or direct from rainfall. To prevent run off and the risk of pollution entering natural water channels cut off ditches would be installed around the compound and all water within the compound would be collected before being treated.

Dewatering of foundations

65. The EM must supervise dewatering activities and ensure that all dewatering from foundation excavations is controlled and pollution prevention measures are applied.

66. It will be necessary to dewater excavations during construction of some of the facilities; water from such operation should be disposed of properly. Water from dewatering activities has the potential to contain suspended solids and oil and grease. Measures that may be taken to remove settle able solids prior to discharging water from the site include the use of sediment sumps or other sediment control structures. Any visible oil and grease can be skimmed off the surface using absorbent pads. If required, the wastewaters from construction process should be collected and disposed properly.

Reinforced Cement Concrete (RCC)

67. A layer of concrete blinding will be laid approximately 75 mm thick directly on top of the newly excavated flat level surface at suitable depth. High tensile steel reinforcement will be fixed in accordance with the designer’s drawings. The foundation anchorage system will be installed, leveled and secured to the blinding. Ductwork/formwork will be erected around the steel cage and propped; and concrete will be placed using a concrete mixer truck and compacted when in the forms using vibrating device in shape and size as per drawings. Upon completion of the concreting works the foundation base will be covered and allowed to cure. Following the curing period, the formwork will be removed and the foundation will be backfilled with a cohesive material, where possible using the material arising during the excavation, and landscaped using the turf set-aside during the excavation.

68. Off-site transport routes would be agreed in advance with the relevant local authority. Transport routes would be designated, both on public roads and on-site. This will mitigate against the impact of extra traffic on public roads and also ensure consistency in the timings of arrivals of concrete deliveries.

4.4 Pier Construction

69. A pier is to be constructed to meet the transport/delivery requirements of the project. From the pier, EPC contractor will construct access roads to reach hard landing area of all wind turbine locations. The contractor must extend the existing roads stretches in the area for this purpose, whenever possible. However, no other permanent ramp must be put up inside the coastal area. Temporary structure may be used accordingly. Suitable permissions must be taken by the EPC contractor from the Department of Coast Conservation and Coastal Resource Management. Pier construction and demolition could be carried out only during low wind season. CEB has informed ADB by the letter No. PE/PL/03/2017 dated 17 March 2017 of Secretary, Ministry of Power and Renewable Energy. A copy of the letter is attached in **Appendix 1**.

70. The EPC contractor shall perform detailed bathymetric survey/sea bed profile with required resolution to plot sea bed accurately along the proposed pier axis line to a distance having sufficient depth suitable for the barges.

71. Drilling/piling may be required to install the pier. However, it is advised not to use hammer drill continuously as that will scare the birds due to its extreme impact noise as well as ground vibrations.

72. As pier is highly permeable structure constructed on steel piling, the contractor must ensure no sediment trapping and/or any significant coastal erosion or accretion takes place in the vicinity of these piers. It is also recommended that regular assessments of coastal behavior be carried out based on surveys and, if needed, appropriate mitigation measures be implemented, in the form of periodic clearing of accumulated sediments to restore existing sediment transport patterns in the vicinity of the pier and sand nourishment in the areas affected or other measures specified by the Department of Coast Conservation and Coastal Resource Management.

4.5 Wind turbine Installation

Wind turbine Delivery

73. The wind turbine components, turbine towers, blade and nacelles, are likely to be transported by trailers with self-steering rear axles directly to the specific wind turbine locations[146] under construction from the temporary jetty (depending on site layout and traffic management). The vehicles would move at set times of day to minimize disruption on the public roads. The erection sites would be clear to allow the vehicles to drive in without hindrance. Each vehicle would follow a detailed and designated route to ensure the minimum amount of maneuvering and disruption to the access road network. A typical wind turbine requires approximately eight to twelve delivery vehicles to deliver all components.

74. It is recommended to have a trained/experienced marine mammal observer on board during barge operations to ensure no mammals are harmed by barges as well as the crew.

Cranes

75. At least two large cranes would be required for the duration of the project to assemble and erect the wind turbines. The cranes would be delivered through the barge and unloaded at the

[146] Since turbine equipment will be imported in migration season but no works permitted, they will at individual hardstanding areas for each turbine under construction.

temporary jetty. At least six smaller auxiliary mobile cranes would also be used for unloading, assembling the large crane and to assist the main crane in lifting the tower sections from the horizontal delivery position to the vertical mounting one.

76. The cranes would be maintained where a risk assessment indicates low risk to the public, workforce or the environment. As with all other vehicles, refueling would be carried out in accordance with site procedures to minimize the risk of spillage or pollution. All lifting operations would be carried out with qualified staff designing, supervising and carrying out the lifts.

77. During lifting operations, the area around the lift would be cordoned off. No members of the public or non-essential workers would be allowed in this area. The area would be controlled to ensure enforcement.

Tower Erection

78. The wind turbine towers would be delivered in sections. Work would not start until a suitable weather window was available. Each section would be lifted off the trailer and bolted in place. The delivery lorry would turn at the designated location before returning to base.

Nacelle Installation

79. The precise details of the delivery vehicle would depend on the wind turbine selected and may lead to minor changes in the method described. The nacelle would be delivered to the desired location. The crane would lift the unit into place on top of the tower. The installation team would then bolt the nacelle to the tower.

Blade Installation

80. Three methods can be used to attach the blades. All these methods may be used, depending on the terrain and the wind turbine location.

- The blades can be attached to the hub on the ground. The hub and blades are then lifted as one unit. This is a quicker method than the other methods. However, this method requires a large lay down area and light vehicles have to move in this area. The forestry may limit this type of maneuver; however, it would be possible for a number of locations.
- The hub can be attached to the nacelle and two blades attached to the hub while the nacelle is on the ground. The nacelle is then lifted into position and the third blade lifted into place separately. This requires maneuvering of several components on the ground and usually repositioning of cranes.
- The third method is to lift the nacelle and hub as one unit and then lift the blades one at a time rotating the hub between lifts. The blade lifting operations do not require repositioning of lifting equipment. This method is generally preferred for areas with limited room for maneuvering; such as forested areas.

Wind turbine Fitting Out and Connection

81. Once all the components have been bolted together, the wind turbines are fitted out internally. This involves connecting the pre-assembled units installed in the major components. The wind turbines would then be checked and left in a safe state until the electrical connection is available. Once the electrical connection is available, the connection is made internally to the wind

turbine. All the systems are progressively checked to make sure the wind turbines are safe to run. The settings on adjustable equipment are checked and safety systems tested. The wind turbines then go through a closely monitored run in period of at least 240 hours before being cleared for automatic operation.

4.6 Waste Management

Solid Waste

82. Construction work may involve disposal of excavated material which can flow into the sea if not prevented by erecting barriers around it. No such material can be allowed to flow into the sea. EPC contractor shall dispose off excess material away from the wind farm to sites approved by local authorities. Sufficient quantity of drinking water [147] available and toilet/sanitation [148] facilities will be provided at the construction site.

83. Solid topsoil wastes from the sites will be the main form of solid waste. Some of the excavated soil will be reused as backfill while the rest will be disposed of to the designated areas. Other solid wastes will include metallic pieces, wooden planks, and stone debris. All these wastes should be disposed of properly in a designated place with the consultation from local authority.

Waste Concrete

84. Ready-mixed concrete will be sourced externally; the advantage of sourcing concrete off site is that the dry materials and water sources are kept off site; however, the contractor would need to control ingress quantities of materials which could lead to wastage. The associated problems dealing with waste concrete requires more vehicle movements on public roads. There is also less control over continuity of supply.

85. Waste concrete would be dealt with by:

- **Waste Minimization.** Tight controls over quantities of materials required would largely eliminate any waste. Where required any waste would be placed in a washout pit, where the concrete can be washed through and aggregates and sand recovered and the wastewater treated.
- **Washout Pit.** Designated areas would be provided for concrete vehicle washout. Any wastewater from the washout would be treated to remove any solids before being recycled or discharged to an appropriately designed soak-away. The sand and gravel would be recycled.

Storage of Fuels, Oils and Chemicals

- **Plant Refueling.** Where possible, mobile/immobile equipment/plant will be refueled in a designated filling area that is lined/bunded to avoid spillage to soil and the waterways. Any fuel and/or oil deliveries shall take place within the designated refueling area only.
- **Diesel Generators.** Generators (if required) will be kept in the designated refueling

[147] 20 liters of water availability per day per person (3 litres drinking, 15 lpd per bathing, 10 lpd for cooking) Source: Basic water requirements for human activities: Meeting Basic Needs, by Peter H. Gleick, Pacific Institute for studies in Development, Oakland CA, USA.

[148] Approx 1.5 toilets for 12-14 persons as per Table 5.31.

area and will be refueled every day.
- **Maintenance.** Plant and site vehicles are to be well maintained and any vehicles leaking fluids must be removed from site immediately. Any servicing operations would take place over drip trays.

Pollution Control

- In the event of a hazardous waste spillage such as oil, fuel and chemicals, occurring on a tower construction site, mitigation measures shall be taken to avoid any potential environmental impacts/risks associated with such hazard.
- All waste oils and lubricants from maintenance of construction equipment should be disposed of at the notified area after collecting them
- Accidental spills of fuels, waste oil or other materials from construction equipment pose a potential for contamination of coastal or inland waters. Precautions should be taken to prevent spills and all workers should be trained in the proper handling, storage, and disposal of hazardous or toxic materials.

86. **Barge Operations.** The barge operator has to avoid any oil/fuel dripping from barges as they have to comply with local maritime laws, CCD laws and other international conventions such as MARPOL. However, the operator should conduct regular maintenance and repairs of the barges. Only barges that adhere to MARPOL and have regular maintenance service records will be used by the project. However, any accidental oil spill from barges would badly impact on the marine mammals, seabirds, fish and other marine organisms. Also, oil spill will have negative bearing on sensitive marine ecosystems such as sea grass beds in offshore areas of the project area (outside the direct project impact area). Concern here should be on an accidental oil spill if any. Only barges that have pollution emergency response plan and equipment (e.g. booms) available on board in case of an incident will be used by the project.

87. **Temporary pier.** Ecological impact issues include construction effects on vegetation and the associated impacts on marine habitats. Specific issues include direct disturbance/pollution caused by construction equipment or from erosion, and impacts from structure placement such as temporary pier. Construction and dismantling of piers should be carefully handled to avoid long-term impacts to these marine habitats and ecosystems. Prior to construction and dismantling, a translocation exercise will be undertaken within the working area plus buffer to remove all translocatable organisms.

5.0 RESTORE/REPAIR AFTER WORK COMPLETION

Restoration of Surface Water Channels

88. The spare sand overburden from excavated road sections and wind turbine bases, could damage the integrity of the water channels if exposed to erosion at the site. Hence, any excess soil must be removed by EPC contractor of offsite locations approved by the local authorities.

89. If any the access roads are decommissioned, any cross drains should be restored to the original flow design. If any excessive volumes of wastewater containing silt and other contaminants have collected in the drainage ditches, it must be dewatered using suitable equipment and disposed. Any wet cement and raw concrete that is clogging them should be manually scraped and removed from project area.

Preserving Top Soil

90. Permanent spoil heaps or berms left standing after completion of WTB foundations should be covered with biodegradable matting in order to expedite establishment of vegetation.

91. The berms of access roads need to be re-vegetated to avoid erosion. Appropriate hydro seeding techniques would be utilized for this, and where necessary would be carried out in consultation with the on-site ecologist.

Reseeding and Restoration

92. On wet and marshy ground, it is necessary to store excavated materials on a geotextile in order to minimize disturbance to the vegetation below. Upon completion of the project, the access road will be decommissioned by backfilling the area with the material arising during excavation, landscaping with topsoil and seeding with native species if advised by the DWC.

93. Cut cable trench and install cable(s) or cable ducts, replace and compact excavated sand. Re-vegetate verges using either turfing or reseeding methods.

Disposal, Waste Management, Treatment and Storage

94. Any recyclable waste if still stored at the time of completion of wind turbine erection and work site dismantling must be removed by a certified recycler. Care must be taken that **c**hemical containers, used oil and filters, solvents, paints, electrical items, contaminated materials and hazardous refuse, if any, which are all classified as "special waste" should be removed and disposed of through licensed contractors at licensed landfill site in keeping with international good practice. Similarly, any inert excavated spoil/waste generated must be transported to a designated place by the EPC contractor under advice of local regulatory body.

Restoration of Habitats

95. It is of paramount importance to minimize disturbance to flora and marine/avian fauna whilst carrying out the construction works, and to ensure that disturbed habitats regenerate quickly after completion of the works. Re-vegetation will be done in consultation with the community and the CCD. After construction, the EPC contractor will conduct a review of marine water quality, benthos, zooplankton, phytoplankton, and ichthyoplanton in comparison with the baseline information for the project. Similarly, the EPC contractor shall also record the fish catch[149] of the fishermen from the madels from within the project area that can be correlated with the proposed fish monitoring program and the baseline information collected for the project.

Decommissioning of Temporary Pier

96. This temporary pier that will be installed by the contractor to ramp down the Turbine, Nacelle, rotor and blades as well as the main tower portions will be decommissioned after the delivery is complete. Care must be taken to ensure no permanent damage is done to the coastal area during its removal. The piles of the pier should be cut a minimum of 1 m below the sea bed (as beach is shifting and can easily shift 1 m) so that it should not interfere with Ma-del nets.

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[149] Since sea cucumber is not harvested from the project area, the EPC contractor may record the sea cucumber catch but location specific data from where these were harvested may not be available.

97. The EPC contractor shall also ensure proper removal of the decommissioned pier, reinstating the area, sea bed, shore and other affected area after completion of works. The pier piles will be cut 1 m below the sea bed level to ensure sufficient depth so that with regular movement of sediment, they may not become exposed and catch on fishing nets or boat bottoms in the long term after construction is completed.

6.0 ILLUSTRATIVE CMS CHECKLIST FOR EPC CONTRACTOR

Mitigation Measures

98. Some of the mitigation measures that must be performed by the EPC contractor include:

- timing/schedule of works and details of hours of working. Construction timing as suggested in the EIA document earlier (Table attached earlier) must be adhered to.
- sediment control and pollution control measures at each tower site
- measures to control the emission of dust and dirt during construction
- areas for loading, unloading and temporary storage of materials used in construction of wind turbine
- movement of construction vehicles for material delivery, waste collection, cranes, parking area, laydown areas
- construction and decommissioning of Pier for unloading of heavy equipment from barges.
- construction of access route and cables to each wind turbine site
- disposal of construction waste from construction work at tower site.

7.0 OTHER ENVIRONMENTAL REQUIREMENTS

99. The EPC contractor identifies environmentally safe working practices and standards for Wind turbine erection that must be implemented by all subcontractors. In addition to the above requirements, EPC shall implement the following plans:

- Health and Safety Plan.
- Emergency Procedure in the event of a contaminant spill/accident.
- Water Quality Monitoring Procedure: Water quality monitoring will be undertaken during the entire process. Parameter listed in the EIA document (such as total suspended solids, biological and chemical oxygen demand, ammonia, nitrates and phosphates, turbidity and presence of oils) will be monitored.
- Seawater quality (including turbidity, water transparency) around the jetty location to be monitored before, during and after the construction.

An illustrative checklist for the EPC contractor is attached below. The following checklist will be reviewed by CEB and more details may be added as deemed suitable.

SNo.	Procedure to be followed	Yes/No	Impact	Action Taken
A	General Procedures			
1	Site induction for each workman prior to commencing activities on site. Penalties of violating any EMP/regulatory requirements must be explained and agreed			
B	Pre-Construction & Site Preparation			
1	Mark work areas, exclusion areas that are situated in the coastal/private areas. Make arrangement as per design and location finalised by CEB/CCD for toilets at site. No water well will be located within minimum 100 m of a toilet facility or vice versa.			
2	Designate and fence using sheets all laydown areas, material storage area, personnel area			
3	Provide orientation training to construction staff on working methods that relate to air, water, noise and soil pollution, avian, avifauna and mammal life in the area. Instructions on not to damage any property of local fishermen should also be given. Fishing is not allowed by construction staff withing project area.			
4	Designated area can only be used for storage of water, oil, construction material etc. with marked area for construction. Park equipment within the same area specified by CEB as per design.			
C	Access Road to each Wind turbine site in the coastal area			
1	Ensure minimal disturbance to flora and fauna during construction of access route to Wind turbine footing			
2	Ensure water channels are not blocked. Make use of culverts as required			
3	Remove extra sand/soil from site and store it in areas of depression. Do not throw any waste into the waterways to pollute ecosystem			
D	Laydown areas next to each Wind turbine site in the coastal area			
1	Ensure minimal disturbance to flora and fauna during construction of laydown area next to Wind turbine footing			
2	Make arrangements to rereoute water channels near the consruction areas if avoidance is not possible in consultation with the project Ecologist.			
3	Remove extra sand/soil from site and store it in areas of depression until it is disposed of at locations specified by local			

SNo.	Procedure to be followed	Yes/No	Impact	Action Taken
	authorities offsite.			
E	Wind turbine Foundation construction			
1	Excavator must not disturb flora and fauna while working on Wind turbine foundation site			
2	Planning for stacking of dugout sand/soil from foundation. Sheet piles to be used to avoid caving in of the sand sidesinto the wind turbine foundation before concreting.			
3	Dewatering of the area excavated for Wind turbine foundation erection into a pit for sedimentation and any oil removal before letting of to the sea- prevention of pollution and damage to marine flora and fauna			
4	Pre-cut/bent steel to be brought to Wind turbine site for fixing in the dugout foundation			
5	Usage of premix concrete lorry[150] with long boom to fill concrete.			
6	Backfilling and compaction at foundation to be followed by removal of excess soil to designated offsite location while ensuring no marine flora or fauna is damaged/killed			
F	Wind turbine, Nacelle and Blades Erection			
1	Crane should not traverse directly over water course – use culverts			
2	Carefully position heavy cranes and structures inside hard standing area for Wind turbine to ensure no damage			
G	Construction/Decommissioning of Pier for equipment			
1	Noise for digging of piles to be monitored. Construction only during prescribed working timing of the area. Night time working not allowed.			
2	Decommissioned pier to be removed entirely from the project site and the piles will be cut atleast 1 m below the coast sand to ensure that the fishing nets do not entangle into its protruding edges			
H	Digging/Construction of Cable Trenches			
1	To ensure minimum water course crossing in the coastal area. Trenches to run along the access roads and be covered to avoid soil erosion.			
2	Construct sheet piles at corners of waterways areas to avoid damage to waterways			

[150] Premix concrete shall be sourced from mainland concrete supplier and not situated in the project area

SNo.	Procedure to be followed	Yes/No	Impact	Action Taken
I	Removal of construction waste material			
1	Remove all waste material from coastal area including excess soil preventing water flow to designated waste containment areas specified by the local body.			
2	Remove all liquid waste material from coastal area			

Annexure 5. Environmental Parameters and Periodicity for Environmental Monitoring Plan

Environ-mental component	Project stage	Parameters to be monitored	Location	Frequency	Standards	Rate (SLR)	Implementation	Supervision
1. Air Quality	A. Pre-construction stage (The project after assigning to contractor)	CO, PM10, PM2.5, SPM[151]	Inside and outside (0.5 km[152]) of the proposed wind farm	A single time	NAAQS of Sri Lanka	Per sample SLR 9,000	Contractor by engaging approved monitoring agency (Sri Lankan Government)	Contractor/ CEB
	B. Construction Stage	CO, Pb, PM10, TSPM	Inside and outside (0.5 km) of the proposed wind farm	Daily visual inspections, overall monthly monitoring	NAAQS of Sri Lanka	Per sample SLR 9,000	Contractor by engaging approved monitoring agency (Sri Lankan Government)	Contractor/ CEB
	C. Operation Stage	CO, Pb, PM10, TSPM	Inside and outside (0.5 km) of the proposed wind farm	A single time unless exceedences noted	NAAQS of Sri Lanka	Per sample SLR 9,000	CEB by engaging approved monitoring agency (Sri Lankan Government)	CEB
2. Surface Water Quality	A. Pre-construction stage (The project after assigning to contractor)	EC, TSS (turbidity & suspended sediment), DO, BOD, COD, P^H Oil and grease, E Coli (fecal coliforms), , hydrocarbon	All water channels within 100m of working area	A single time	CEA Water Quality Regulations	Per sample SLR 14,000	Contractor by engaging approved monitoring agency (Sri Lankan Government)	Contractor/ CEB
	B. Construction Stage	EC, TSS (turbidity & suspended sediment), DO, BOD, COD, P^H Oil and grease, E Coli (fecal Coliforms), hydrocarbon	One each from water channels inside wind farm.	1 time/ 3 months	CEA Water Quality Regulations	Per sample SLR 14,000	Contractor by engaging approved monitoring agency (Sri Lankan Government)	Contractor/ CEB

[151] Parameter of concern is dust.
[152] At all receptors within 500 m of wind farm.

Environ-mental component	Project stage	Parameters to be monitored	Location	Frequency	Standards	Rate (SLR)	Implementation	Supervision
	C. Operation Stage	EC, TSS (turbidity & suspended sediment), DO, BOD, COD, P^H Oil and grease, E Coli (fecal Coliforms), hydrocarbon	One each from water channels inside wind farm.	1 time/ 12 months	CEA Water Quality Regulations	Per sample SLR 14,000	CEB by engaging approved monitoring agency (Sri Lankan Government)	CEB
3. Ground Water Quality	A. Pre-construction stage (The project after assigning to contractor)	EC, TSS (turbidity & suspended sediment), DO, BOD, COD, P^H Oil and grease, E Coli (fecal Coliforms), , hydrocarbon	All wells within 100m of working area	A single time	CEA Water Quality Regulations	Per sample SLR 14,000	Contractor by engaging approved monitoring agency (Sri Lankan Government)	Contractor/ CEB
	B. Construction Stage	EC, TSS (turbidity & suspended sediment), DO, BOD, COD, P^H Oil and grease, E Coli (fecal Coliforms), hydrocarbon	One from nearest well around wind farm and one from well near coast.	1 time/ 3 months	CEA Water Quality Regulations	Per sample SLR 14,000	Contractor by engaging approved monitoring agency (Sri Lankan Government)	Contractor/ CEB
	C. Operation Stage	EC, TSS (turbidity & suspended sediment), DO, BOD, COD, P^H Oil and grease, E Coli (fecal Coliforms), hydrocarbon	One from nearest well around wind farm and one from well near coast.	1 time/ 12 months	CEA Water Quality Regulations	Per sample SLR 14,000	CEB by engaging approved monitoring agency (Sri Lankan Government)	CEB
4. Marine	A. Pre-	EC, TSS	Jetty Location.	A single time	CEA Water	Per	Contractor by	Contractor/

Environ-mental component	Project stage	Parameters to be monitored	Location	Frequency	Standards	Rate (SLR)	Implementation	Supervision
Water Quality	construction stage (The project after assigning to contractor)	(turbidity & suspended sediment), DO, BOD, COD, P^H Oil and grease, E Coli (fecal Coliforms), , hydrocarbon			Quality Regulations	sample SLR 14,000	engaging approved monitoring agency (Sri Lankan Government)	CEB
	B. Construction Stage	EC, TSS (turbidity & suspended sediment), DO, BOD, COD, P^H Oil and grease, E Coli (fecal Coliforms), hydrocarbon	One from jetty area and one during time when one barge is berthed at jetty.	1 time/ 3 months And when jetty being constructed/decommissioned can do daily test of the turbidity (and cease construction if gets elevated above background)	CEA Water Quality Regulations	Per sample SLR 14,000	Contractor by engaging approved monitoring agency (Sri Lankan Government)	Contractor/ CEB
5. Noise/ Vibration	A. Pre-construction stage (The project after assigning to contractor)	Noise level (dB level)	Inside park and at nearest receptor of the wind farm[153]	Single time during NE and one single time during SW monsoon [154]	National Environmental (Noise Control) Regulations, NAAQS	Per sample SLR 6,500	Contractor by engaging approved monitoring agency (Sri Lankan Government)	Contractor/ CEB
	B. Construction Stage	Noise level (dB level)	Inside and outside (0.5 km) of the proposed wind farm	Every month for construction noise Weekly during Piling for temporary pier	National Environmental (Noise Control) Regulations, NAAQS	Per sample SLR 6,500	Contractor by engaging approved monitoring agency (Sri Lankan Government)	Contractor/ CEB
	C. Operation Stage	Noise level (dB level)	Inside and outside (0.5 km) of the	3 times during SW monsoon, 3 times during NE	IFC-WB EHS Guidelines	Per sample SLR 6,500	CEB by engaging approved monitoring agency (Sri Lankan	CEB

[153] At receptors within 500 m of the wind farm (can choose representative receptors e.g. Shell Coast, navy outposts (declared institutional) and fishing huts (cabanas exempt)

[154] Monitor per IOA and ETSU during the SW monsoon and during the NE monsoon.

Environ-mental component	Project stage	Parameters to be monitored	Location	Frequency	Standards	Rate (SLR)	Implementation	Supervision
			proposed wind farm	monsoon year	to be followed as most stringent at receptors in place of (National Environmental (Noise Control) Regulations, NAAQS.		Government)	
6. Soil	A. Pre-construction stage (The project after assigning to contractor)	$P^{H,}$ Sulfate (SO_3), Chloride, ORP, Salinity, Resistively, Organic Matter, Moisture Content[155]	Inside and outside (just close to the proposed site, 2 locations) of the proposed wind farm	A single time	Technical specifications	Per sample SLR 13,500	Contractor by engaging approved monitoring agency (Sri Lankan Government)	Contractor/ CEB
	B. Construction Stage	$P^{H,}$ Sulfate (SO_3), Chloride, ORP, Salinity, Resistively, Organic Matter, Moisture Content	Inside and outside (just close to the proposed site, 2 locations) of the proposed wind farm	1 time/ 3 months	Technical specifications	Per sample SLR 13,500	Contractor by engaging approved monitoring agency (Sri Lankan Government)	Contractor/ CEB
	C. Operation Stage	$P^{H,}$ Sulfate (SO_3), Chloride, ORP, Salinity, Resistively, Organic Matter, Moisture Content	Inside and outside (just close to the proposed site, 2 locations) of the proposed wind farm	A single time unless exceedences noted	Technical specifications	Per sample SLR 13,500	CEB by engaging approved monitoring agency (Sri Lankan Government)	CEB

[155] To determine corrosive properties of soil with concreting process and ensure, leaching etc. Resistivity important for conductivity testing, etc.

Environ-mental component	Project stage	Parameters to be monitored	Location	Frequency	Standards	Rate (SLR)	Implementation	Supervision
7. Bird and bat collision's	A. Pre-construction stage (The project after assigning to contractor)	Bird and bat monitoring survey	Near wind farm boundary as per Collision Risk Assessment Report (adopt same methodology for bats and birds)	Once	Negligible collision	Installation of radar and maintenance annual cost of $10,000 per year by CEB	CEB	CEB
	Operation stage	Bird monitoring surveys Bird and bat carcasses	Near wind turbines as per Collision Risk Assessment Report (adopt same methodology for bats and birds)	Monthly	Negligible Collision	Installation of radar and maintenance annual cost of $10,000 per year by CEB	O&M operator of line and wind farm	CEB
8. EMI	A. Pre-construction stage (The project after assigning to contractor)	Electric Field (kV/m), Magnetic Field (μT) and Antenna Field Electric strength dBμV/m	TV/radio signal at the property on boundary in line of sight of wind farm	Once	IEC Electromagnetic Emission Standard, EN 61000-6-4	$500	CEB	CEB
	Operation Stage	Electric Field (kV/m), Magnetic Field (μT) and Antenna Field Electric strength dBμV/m	TV/radio signal at the property on boundary in line of sight of wind turbines near receptors	Annual	IEC Electromagnetic Emission Standard, EN 61000-6-4	$500 per annum	O&M operator	CEB
9. Fish catch	Pre-construction, construction,	Collate daily (for fish catch data (amount	Madels in front of the wind farm	Daily data	Coastal Resource Manage	$5,000 /annum x 3	Department of Fisheries, Construction and	CEB, Department of Coastal

Environ-mental component	Project stage	Parameters to be monitored	Location	Frequency	Standards	Rate (SLR)	Implementation	Supervision
	operation	of catch, no fishers, no of boats, value of catch etc.)) and monthly fish catch data for 2-year prior for fishermen in the project area and a representative control site and continue through construction and 3 years of operation			ment Act no 57 of 1981	years = $15,000	O&M operator	Conservation
10. Health and Safety	Construction, operation	Monitoring of accidents to workers and community in construction and operation	Wind turbine locations, access roads, jetty, staff quarters	Weekly	IFC EHS standards	No additional costs	Construction and O&M operator	CEB and contractor through contract provisions

BOD = biological oxygen demand, CEB = Ceylon Electricity Board, CEA = Central Environmental Authority, CO = carbon monoxide, DO = dissolved oxygen, EC = electrical conductivity, IEC = International Electro-technical Commission, NAAQS = National Air Quality Standards, NO_2 = nitrogen dioxide, NWQS = National Water Quality Standards, Pb = lead, PM10 = particulate matter <10, SO_2 = sulphur dioxide, TSPM = total suspended particulate matter, TSS = total suspended soils.

Note: Transport and accommodation cost, NBT, VAT, etc. are not included for the EMoP. Rates valid for the period of 60 days. Information based on the quotation provided by NBRO (National Building Research Organisation).

Environmental Safeguard Monitoring Report

Reporting Period {From Month, Year to Month, Year}
Date {Month, Year}

SRI: Wind Power Generation Project

Prepared by the Ceylon Electricity Board for the Asian Development Bank

Table of Contents

Annexure 7 Approval letter of IEE by Coast Conservation and Coastal Resource Management Department, the Project Approving Authority

PERMIT FOR A DEVELOPMENT ACTIVITY ISSUED UNDER PART III - SECTION 14 OF THE COAST CONSERVATION & COASTAL RESOURCE MANAGEMENT ACT No. 57 OF 1981

Permit No. : P/16/985

Name of Permit Holder : Additional General Manager (Transmission)
(Surname) (Other Names)

Postal Address : Ceylon Electricity Board, No.50, Sir Chiththampalam A Garden Mawatha, Colombo 02

Nature of Development Activity : Development of 100MW Wind Park consist of 40 nos of Wind Turbine units

Location of Development Activity : Southern Coast of Mannar Island (as per the map submitted with the approval letter of the Department of Wildlife Conservation

Province : Northern

District : Mannar

Local Authority : Mannar

Particulars of Survey Plan submitted by Applicant :

Duration of Permit : 08.07.2016 - 07.07.2017

Conditions Attached : 1. All constructions should be confined to the map submitted by the Developer with the approval letter No. WL/6/1/1/328 dated 06.06.2016 issued by the Department of Wildlife Conservation.

Director General
Coast Conservation &
Coastal Resource Management.

Date : 08 - 07 - 2016

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2. This approval is only valid for installation of 40 Nos of wind turbine units in Southern Coast of the Mannar Island.

3. Separate approval should be obtained from Coast Conservation & Coastal Resource Management Department for construction of proposed pier which is used for unloading of equipments and material for the project.

4. A 130 m set back area Landward from the permanent vegetation line of the beach front should be kept for the proposed wind towers.

5. The Developer should inform to the Coast Conservation & Coastal Resource Management Department to obtain assistance to demarcate the coastal set back prior to commencement of the construction activities of the proposed project.

6. All constructions should be carried out in accordance with the structural plans submitted to the Coast Conservation and Coastal Resources Management Department by the developer.

7. Any alterations / extensions of the structures should not be carried out without a prior approval of the Coast Conservation & Coastal Resource Management Department.

8. The Developer will be bound to adhere to any additional conditions given by the Coast Conservation and Coastal Resource Management Department.

9. All mitigation measures should be implemented to mitigate the Environmental and Socio Economic Impacts due to the proposed project during the construction and operation period as indicated in the IEE Report.

10. Necessary clearance from Pradeshiya Saba – Manner, Department of Fisheries & Aquatic Resource, Wild Life Conservation Department, Central Environmental Authority, Sri Lanka Sustainable Energy Authority, Civil Aviation Authority and other relevant government agencies should be obtained prior to commencement of constructions.

11. Environmental Protection License should be obtained from the Central Environmental Authority prior to commencement of operation of the proposed project.

12. All necessary waste management measures should be taken to avoid pollution due to proposed project activities as indicated in the IEE Report

13. The existing fishing activities including beach seine fishing activities and beach access should not be obstructed by the proposed project

14. The developer should coordinate with the Department of Fisheries and Aquatic Resources on fishing activities in the area in order to avoid user conflicts during construction and operation period of the proposed project.

Permit No. : ..P/16/985..

15. Awareness programme in coordination with the Department of Fisheries and Aquatic Resource should be carried out for the relevant communities and other stakeholders regarding the proposed activities.

16. The natural drainage pattern should not be obstructed by any activity of the proposed project.

17. Proper drainage system with silt traps , culverts should be implemented to avoid disturbance of existing drainage pattern of the area as indicated in the IEE Report.

18. Stilt traps and drains should be incorporated in the project area to prevent soil erosion and siltation of lowlands

19. All precautionary measures should be taken to avoid the flooding of the area as indicated in the IEE report.

20. Existing waterways in the vicinity of the project area should not be disturbed and should be maintained and monitored

21. All precautionary measures should be taken to avoid ground water pollution during the construction period

22. Solid waste, sewage or waste water should not be emitted to the beach or the coastal waters.

23. The developer should implement the solid waste disposal mechanism as indicated in the IEE report and the agreement should made with Pradeshiya Saba Mannar for disposal of solid waste prior to commencement of construction.

24. All precautionary measures should be taken in consultation with the Department of Wildlife Conservation to minimize the bird accidents from blades of wind turbines during the operation of proposed project .

25. Noise level of the wind turbines should adhere to noise standards imposed by the Central Environmental Authority.

26. All precautionary measures should be taken to mitigate anticipated impacts on noise, vibration, dust and air quality during the construction period as indicated in the IEE report.

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Permit No. :......................,

27. Separate approval should be obtained from Central Environmental Authority for the maintaining of noise levels at the boundaries of the project site according to the standard levels stipulated in the National Environmental Act.

28. Appropriate mitigation measures should be adopted in order to maintain the vibration levels generated by construction activities, operation of machineries and equipments, vehicle movements within the interim standards as stipulated by Central Environmental Authority.

29. The developer should be liable to pay potential damages to the existing roads due to transportation of equipments ,materials during the construction phase.

30. The developer should coordinate with the Pradeshiya Saba- Mannar and relevant government agencies for the development ,maintenance and repairs of the existing roads.

31. Risk of Potential damages to the proposed project due to the natural disasters should be born by the developer.

32. All mitigation measures should be implemented to mitigate the Environmental and Socio-Economic impacts due to the proposed project.

33. The Environmental Management Plan (EMP) including Monitoring Plan (MP) which should be implemented to mitigate the possible environmental impacts as indicated in the IEE Report. Adequate amount of funds should be allocated to implement the Environmental Management and Monitoring Plan. Competent recognized institution should implement the monitoring plan.

34. Adequate amount of funds should be allocated to make necessary arrangements to pay compensation for affected parties or properties due to the proposed project.

35. The developer should take all responsibilities to mitigate the possible impacts on coastal erosion due to proposed project activities including construction of prior.

36. All mitigation measures should be taken to mitigate the impacts on coastal and marine resources including coastal vegetation, sand dunes, coastal water bodies in the area during construction and operation of the proposed project as indicates in the IEE Report.

37. This permit will be invalid if violation of the any of the above conditions. In such a case this department will take legal action according to the Coast Conservation and Coastal Resources Management Act No. 57 of 1981.

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Permit No. : P/16/985

38. A copy of this permit should be kept in the project site at all times for purpose of perusal by concerned agencies.

39. This Permit will not be consider the ownership of the land

A.H. Gamini Hewage
Actg. Director (Coast Conservation)
For Director General / Coast Conservation &
Coastal Resource Management.

Copies to :

(1)	Chairman	-	Pradeshiya Saba, Manner
(2)	Chairman	-	Sri Lanka Sustainable Energy Authority, Colombo 07
(3)	District Secretary	-	District Secretariat, Manner
(4)	Divisional Secretary	-	Divisional Secretariat, Island North, Manner
(5)	Director(ISTA)	-	Central Environmental Authority, Battaramulla
(6)	Director General	-	Department of Fisheries & Aquatic Resources
(7)	Director General	-	Civil Aviation Authority
(8)	Deputy Director General (EM&A) – Central Environmental Authority, Battaramulla.		
(9)	Director (Enforcement)-Urban Development Authority		

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Annexure 8. Consent Letters from Stakeholders to CEB's 100 MW Wind Farm

1. Letter of Approval from Department of Wildlife Conservation
2. Letter of Approval from Sustainable Energy Authority
3. Letter of Approval from Department of Agrarian Development, Mannar
4. Letter from Civil Aviation Authority of Sri Lanka, Fees Deposited.
   CAA approval for installation of Wind turbines with low intensity red beacons.
5. Letter from Irrigation Department
6. Letter from RSC (North) National Water Supply and Drainage Board, Vavuniya
7. Letter from Divisional Secretariat Mannar Town
8. Letter from SLSEA to Coastal Conservation Department about encroachments in the Energy Development Zone
9. SLSEA Request to Urban Development Authority (UDA) to declare the Energy Development Area of Mannar Wind Power Project as Industrial Zone

10: UDA letter dated 02.05.2017 declaring the Energy Development Area of Mannar Wind Power Project as an Industrial Zone

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வனசீவராசிகள் பாதுகாப்புத் திணைக்களம்
DEPARTMENT OF WILDLIFE CONSERVATION

ප්‍රධාන කාර්යාලය - අංක 811/ඒ, ජයන්තිපුර පාර, බත්තරමුල්ල
பிரதான அலுவலகம், இல. 811/ஏ, ஜயந்திபுர வீதி, பத்தரமுல்லை
Head Office - No. 811/A, Jayanthipura Road, Battaramulla

මගේ අංකය / எனது இல. / My No. WL/6/1/1/328 | ඔබේ අංකය / உமது இல. / Your No. | දිනය / திகதி / Date 06.06.2016

Project Director,
Mannar Wind Power Project,
Ceylon Electricity Board,
Udumulla Road,
Battaramulla.

Dear Sir,

Request for Approval Letter
Development of 100 MW Wind Plant along the Southern Coast of Mannar Island Under Mannar Wind Power Project (MWPP)

This refers to your letter numbered PD/MWPP/03-30 dated 2016.05.09 regarding the above subject.

02 This is to inform you, that the Department of Wildlife Conservation grants consent for the above project, subject to the following conditions.

2.1 Project activities should be conducted according to the conditions and recommendations given by the Initial Environment Examination Report (IEE)

2.2 This approval is given for 40 wind turbines (Turbine NO 1-34 and 47-52) as shown in figure 1.3 of the IEE Report. 16 wind turbines (No 35-46 and 53-56) proposed to locate near Adam's Bridge National Park should be removed to minimize the disturbance to the migratory bird pathway.

2.3 Wind turbines should be temporary shutdown at the intervals of migaratory birds arrival and departing in such area.

2.4 If bird collisions to the wind turbines increase at considerable level, project proponent should install a radar system within 1 year period to identify bird migration in advance and should shut down the turbines temporally to avoid bird strikes.

2.5 Action should be taken to minimize the damage to the environment and especially bird habitats when installing turbines.

2.6 The DWC reserves the right to cancel/suspend/withdraw this approval in the event that major environmental and /or social problems arise due to the operation of the project or in a situation where the surrounding environment has been altered or changed due to the natural factors or otherwise.

2.7 All the activities should be adhered to the provisions of Flora and Flora Protection Ordinance and National Environmental Act.

Yours Faithfully,

Manjula Amararathne
Deputy Director (Natural Resources Management)

Sgd/ Dr. Sumith Pilapitiya
Director General of Wildlife Conservation

Cc- -
Director General,
Department of Coast Conservation & Coastal Resource Management - For Your Kind Information
Assistant Director (Mannar) - -do-

617

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Sri Lanka Sustainable Energy Authority

විදුලිබල හා බලශක්ති අමාත්‍යාංශය மின்வலு மற்றும் எரிசக்தி அமைச்சு Ministry of Power & Energy

PROVISIONAL APPROVAL UNDER PARAGRAPH (a) OF SUB-SECTION (2) OF SECTION 17 OF THE ACT NO 35 OF 2007

Ref No: SEA/REP/**A-27520**

09-06-2015

19 JUN 2015

Ceylon Electricity Board
A. G. M. (...

104

Registration Number	:	**R-127520**
Provisional Approval Number	:	**PA-227520**

Name	:	
Title (if applicable)	:	**General Manager**
Company Name (if applicable)	:	**Ceylon Electricity Board**
Address	:	**No. 50, Sir Chittampalam A. Gardinar Mawatha Colombo 02.**
Project Name	:	**Semi Dispatchable Wind Farm - Mannar**
Date of granting Provisional Approval	:	**09-06-2015**
Project Type	:	**Wind**
Project Capacity	:	**100000 kW (installed generating capacity)**

PD (Mannar Wind PD)
Pna pn
15/6
u: DGM (EPD)
DGM (TAP)

This refers to the application submitted by you on **14-08-2013** to engage in and carry on the above mentioned on-grid renewable energy project. The Project Approving Committee of Sri Lanka Sustainable Energy Authority (herein after referred to as the "Authority"), acting under paragraph (a) of sub-section (2) of section 17 of the Sri Lanka Sustainable Energy Authority Act, No. 35 of 2007, has granted Provisional Approval to the said Project. The Provisional Approval Number specified above should be used in all future correspondence with the Authority, and in all reports and other documentation about the Project.

You are hereby required to submit the documents and information mentioned under item A and B in the Annex I hereto within six months of receipt of this communication. In the event that you are unable to submit the required documents and the information within such period, you are entitled to request from the Director-General for an extension of this period, provided the maximum of such extension shall not exceed a period of an additional six months. This Provisional Approval shall stand automatically cancelled at the end of the validity period of one year as per sub-section (4) of Section 17 of the Act No. 35 of 2007 in the event the documents and other information request for are not submitted within the validity period of the provisional approval.

AGM (T/)

Block 05, 1st Floor, BMICH, Bauddhaloka Mawatha, Colombo 07, Sri Lanka.

Office +94(0)11-267-7445 | Facsimile +94(0)11-268-2534 | E-mail Info@energy.gov.lk | Web Site www.energy.gov.lk

GENERAL

* The Authority will assist you in obtaining any approval or clearance that is required to be obtained from any agencies, in order to engage in this project.

* Any costs incurred by you in obtaining the documents and information required as specified in this Provisional Approval, should be borne by you and the Authority shall not be in anyway responsible for any expenses incurred.

* Change of ownership or controlling interest of the legal person to whom a Provisional Approval is issued, required to be duly notified to the Authority and will be effected up on the payment of an administrative fee equivalent to the application fee.

***This Provisional Approval is granted based on the location marked in 1:50,000 topographic maps given along with the application submitted to this Authority. Therefore, you are strongly advised that, the change of the project location at a later stage is not possible under any circumstances.**

Director General
SRI LANKA SUSTAINABLE ENERGY AUTHORITY

cc : Director General
Public Utilities Commission of Sri Lanka

: Chairman and Members of the Project Approving Committee
1. Director General, ID
2. Conservator General, FD
3. Director General, CEA
4. Director General, DWL
5. Director General, MASL
6. Land Commissioner General, LCGD
7. Director General, CCD
8. Director/Secretariat, BOI

: Director General
Urban Development Authority

: **Mannar** Divisional Secretariat

Map (1:50000 - **15,11-Mannar, Talaimannar)** showing the location of the Projects is attached herewith for your information and necessary action.

PA Lett No SV

Annex-I

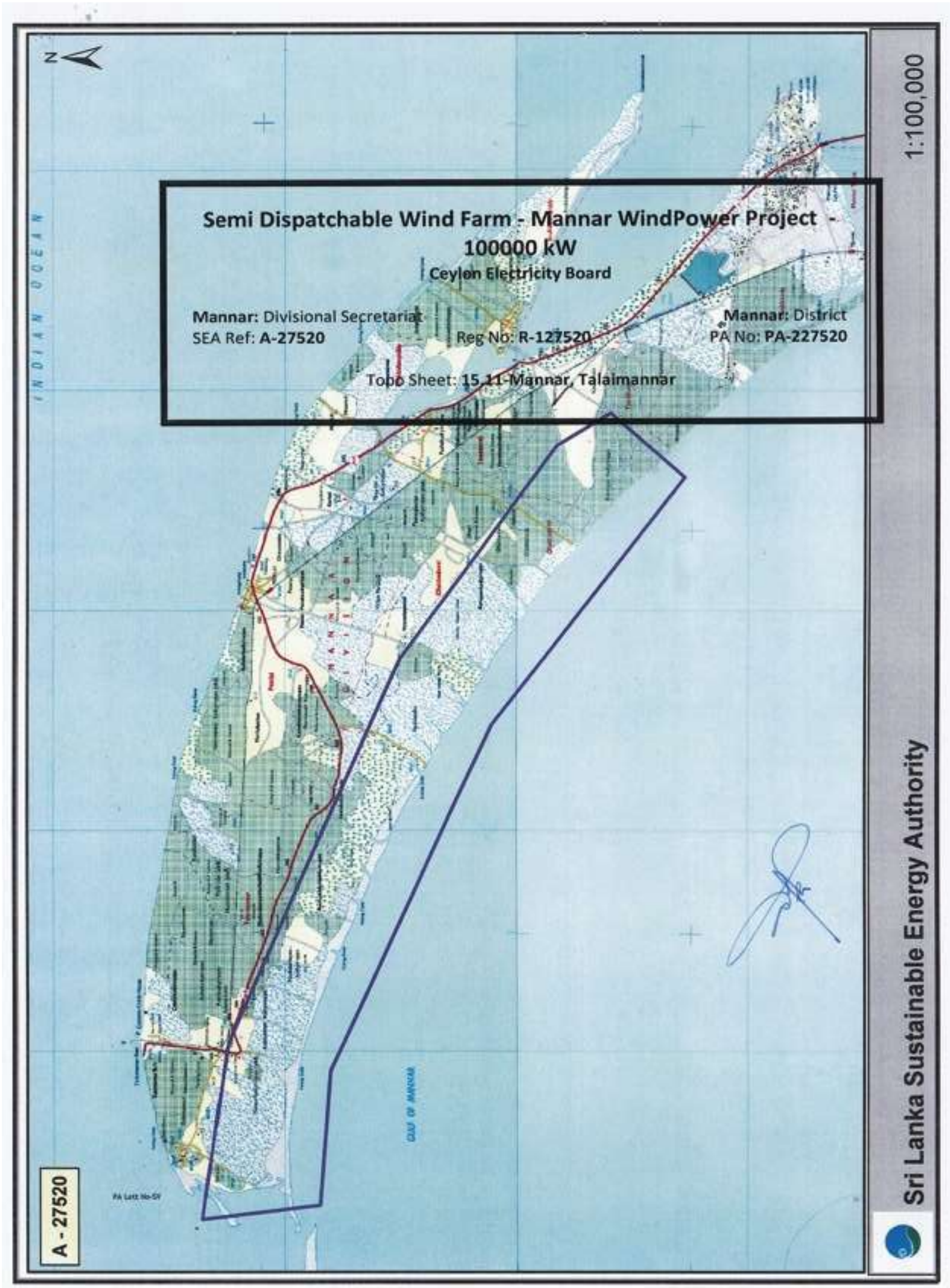
Schedule of Information and Documents requested

Applicant Details	:	***Ceylon Electricity Board***			
Project Details	:	***Semi Dispatchable Wind Farm - MannarWind Power Project***	***Reg No.***	:	***R-127520***
		Installed Generating Capacity - 100000kW	***PA No.***	:	***PA-227520***

A	Documents Requested	Documents Submitted* Yes / No / Not Applicable
A1	Letter of Intent from CEB	
A2	Grid Interconnection Proposal from CEB	
A3	No objection letter from the Divisional Secretary	
A4	Approval of Construction Drawings by Local Authority/UDA	
A5	Approval of NWS&DB	
A6	Approval of the Department of Agrarian Services	
A7	Approval of Department of Irrigation	
A8	Approval of the Department of Coast Conservation	
A9	Approval of the Department of Forests	
A10	Approval of the Department of Wild Life Conservation	
A11	Report on Resource Assessment	
A12	Detailed survey plan	
A13	Report on Comprehensive Feasibility Study	
A14	Tenement list of relevant land plots	
A15	Documents in proof of availability of debt and equity funds	
B	**Information Requested**	
B1	Period which covered the resource assessment	
B2	Status report on the process of granting the Environmental Clearance	
B3	Status report on the procurement of land resources required	
B4	The manner in which the project is to be financed	
B5	A status report on public perception of the project (affected public only)	
B6	Likely obstacles to implementation	

Note:

- Documents and Information provided by applicants is subject to validation by directly contacting reference sources provided by the applicant.
- *Mark √ if ***YES,*** X if ***NO*** and leave **BLANK** if not applicable
- If the documents were not sent before, please attach
- Applicant may use additional papers if the schedule is insufficient for a complete response


Semi Dispatchable Wind Farm - Mannar WindPower Project -
100000 kW
Ceylon Electricity Board
Mannar: Divisional Secretariat
SEA Ref: A-27520
Reg No: R-127520
Mannar: District
PA No: PA-227520
Topo Sheet: 15,11-Mannar, Talaimannar
INDIAN OCEAN
1:100,000
Sri Lanka Sustainable Energy Authority
A - 27520

கமநல அபிவிருத்தி திணைக்களம்,மன்னார்.
ගොවිජන සංවර්ධන දෙපාර්තමේන්තුව,මන්නාරම.
Department of Agrarian Development, Mannar.
023-2222162

My No : 11/5/ Request/2015

Date:03.10.2015

RECEIVED
04 NOV 2015
Mannar Wind Power Project

Project Director
Mannar Wind power Project
Ceylon Electricity Board

Sup:Request for Approval letter
Ref: Proposed Development of 100 MW Wind power plant along the Southern Coast of Mannar Island under Mannar wind power project (MWPP)

Reference your letter number PD MWPP/PA/dated 21.09.2015 on the above subject

I wish to inform that department of Agrarian Development Mannar do not have any objection on the implementation of wind power plants as it does not have any implication on the farmers of the District.

02) This project also more useful fo the District to supply National energy

03) I give my approval for the electricity Board to effectily Nationally important flagship please.

B. Thevarathan
Assistant Commissioner
Dept. of Agrarian Development
Mannar District

B. Thevarathan
Assistant Commissioner
Dept of Agrarian Developmen
Mannar

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இலங்கை சிவில் விமானப் போக்குவரத்து அதிகார சபை
Civil Aviation Authority of Sri Lanka

"Safe skies for All"

P. O. Box 535

No. 04, Hunupitiya Road, Colombo 02, Sri Lanka.

My Ref. No. : AE/06/04

Date : March 9, 2012

Director General
Sri Lanka Sustainable Energy Authority
3G-17, BMICH
Bauddhaloka Mawatha
Colombo 07

Dear Sir,

APPROVAL FOR THE ESTABLISHMENT OF WIND MEASURING TOWERS

Reference your letter dated SEA/RE/R/8001/Wind 2010 dated 13th February 2012 on the above subject.

This Authority has no objection to the establishment of an 82m Wind Measuring Tower by the Sustainable Energy Authority at Nadukuda, Mannar.

Yours faithfully,

Yovinda Amarasekara
Aerodrome Inspector
For Director General of Civil Aviation

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இலங்கை சிவில் விமானப் போக்குவரத்து அதிகார சபை
Civil Aviation Authority of Sri Lanka

"සැමට සුරක්ෂිත අහසක්"
"அனைவருக்கும் ஆபத்தற்ற ஆகாயம்"
"Safe Skies for All"

තැ. පෙ. 535
அ. பெ. இல. 535
P. O. Box 535

අංක 04, හුණුපිටිය පාර, කොළඹ 02, ශ්‍රී ලංකාව.
இல. 04, ஹுணுப்பிட்டிய வீதி, கொழும்பு 02, இலங்கை.
No. 04, Hunupitiya Road, Colombo 02, Sri Lanka.

මගේ අංකය :
எனது இல. :
My Ref. No. : AE/6/4

දිනය :
திகதி :
Date : 23rd January 2017

RECEIVED
27 JAN 2017
D2.
Mannar Wind Power Project

Project Manager (Wind Plants)
Mannar Wind Power Project
Ceylon Electricity Board
No.12, Udumulla Road
Battaramulla

Dear Sir,

Height Clearance for Proposed Wind Power Project at Mannar Island

This has reference to your letter PD/MWPP/03 dated 4th January 2017 requesting height clearance for proposed wind power project at Mannar.

This Authority has **no objection** for the installation of 29Nos. of wind turbines at the land area identified by the geographical coordinates given below as per your submission, with a maximum height of 160m above ground level.

Location	Geographical Coordinates in WGS84	
A	N 8.999341°	E 79.84864°
B	N 9.026853°	E 79.81414°
C	N 9.054853°	E 79.75381°
D	N 9.076936°	E 79.76335°
E	N 9.057763°	E 79.80974°
F	N 9.026708°	E 79.85131°
G	N 9.013071°	E 79.86061°

Please note that the painting and lighting of the wind turbines shall be done as described below and shall be maintained in proper condition at all times.

1. The rotor blades, nacelle and at least upper 2/3 of the supporting mast of wind turbines shall be painted in white colour.
2. A red colour low intensity (Type B) fixed obstacle light with minimum intensity of 32cd shall be installed on the nacelle of each wind turbine.

Yours faithfully,

Sherina Casseer
Head of Section-Aerodromes

① PM(I)
P.a. 27/01
PM(WP)
for PD.
② EE (Ronald.)
f.n.a. plc.

ප්‍රධාන කාර්යාලය / பிரதான அலுவலகம் / Head Office :
දුරකථනය / தொலைபேசி / Tel.: +94 - 11 - 2358800 ෆැක්ස් / தொலைநகல் / Fax: +94 - 11 - 2304644 ඊ මේල් / மின்னஞ்சல் / e - mail: info@caa.lk
වෙබ් / இணையம் / web: www.caa.lk

ශ්‍රී ලංකා සිවිල් ගුවන් සේවා අධිකාරිය
இலங்கை சிவில் விமானப் போக்குவரத்து அதிகார சபை
Civil Aviation Authority of Sri Lanka

"සැමට සුරැකි අහසක්"
"அனைவருக்கும் ஆபத்தற்ற ஆகாயம்"
"Safe Skies for All"

තැ. පෙ. 535
அ. பெ. இல. 535
P. O. Box 535

අංක 04, හුණුපිටිය පාර, කොළඹ 02, ශ්‍රී ලංකාව.
இல. 04, ஹுணுப்பிட்டிய வீதி, கொழும்பு 02, இலங்கை.
No. 04, Hunupitiya Road, Colombo 02, Sri Lanka.

RECEIVED 24 JUN 2016 02. Mannar Wind Power Project

මගේ අංකය / எனது இல. / My Ref. No. : **AE/6/4A**

දිනය / திகதி / Date : **24th June 2016**

Project Director
Mannar Wind Power Project
Ceylon Electricity Board
12, Udumulla Road, Battaramulla.

Dear Sir

Charges for 29 Wind Power Towers – Ceylon Electricity Board.

Reference your letter PD/MWPP/03 on 15th June 2016.

This letter replaces AE/6/4A on 20th May 2016 being charges for 56 wind power towers.

Please be informed that charges for the 29 Wind Power Towers are as follows:

Tower Charges = (Evaluation fee + Grant fee) + VAT+NBT+ Stamp Duty

LOCATION	***CHARGES***
Southern Coast of Mannar Island (29 No. of Towers)	*957,000.00*
NBT	*19,517.00*
VAT	*146,479.00*
Stamp Duty	*9,425.00*
Grand Total	**Rs.1, 132,421.00**

Please note that the application will be processed subject to above payment.

Yours faithfully

Sherina Casseer
Head of Section-Aerodromes

VAT # 409162002-7000

RSC (North)
National Water Supply and Drainage Board
Mannar Road, Vavuniya.

Fax :- 024-2225720
Tel No :- 024 2225719
E Mail : - dgmnorth@waterboard.lk

My No: DGM (N)/Mannar/CEB/2016/02 Date: 27.03.2016

Project Director,
Mannar Wind Power Project,
Ceylon Electricity Board

Sub: NWSDB Consent Letter
Ref: Proposed Development of 100MW Wind Power Plant along the Southern Coast of Mannar Island under Mannar Wind Power Project (MWPP)

This refers to your letter No: PD/MWPP/62-22 dated 08.03.2016 on the above mentioned subject.

Based on the data given by you; NWSDB has ***No Objection*** to carry out the Proposed Development of 100MW Wind Power Plant along the Southern Coast of Mannar Island under Mannar Wind Power Project (MWPP) as shown by you in the map.

T.B

Eng.T.Barathithasan
Acting. Deputy General Manager (N)

C/C:

Addl.GM (N/C)	-	f.y.i.pls
AGM (N)	-	f.y.i.pls
RM (J/V)	-	f.y.i & n.a.pls

RECEIVED
07 APR 2016
Mannar Wind Power Project

பிரதேச செயலகம் மன்னார் நகரம்
ප්‍රාදේශීය ලේකම් කාර්යාලය මන්නාරම
DIVISIONAL SECRETARIAT MANNAR TOWN

எஸ்பிளனேட் வீதி, மன்னார், இலங்கை.
එස්පිලනේඩ් පාර මන්නාරම
Esplanade Road, Mannar, Sri Lanka.

எனது இல / මගේ අංකය / My No - DS/MN/DPU/GEN/2016
திகதி / දිනය / Date - 06.04.2016

http://www.mannartown.ds.gov.lk, e-mail: dsmnar@yahoo

Project Director
Mannar Wind Power Project
Ceylon Electricity Board
No12, Udumulla Road
Battaramulla.

No objection Letter

Development of 100MW Wind Power Plant along the Southern Coast of Island

This refers to your letter ref; PD/MWPP/03 – dated 04th April 2016 on the above subject.

We hereby inform that we have no objection on implementing the 100MW Mannar Wind Power Project along the southern coast of Mannar island as illustrated in the map (Annex 1) and according to the provisional approval no PA-227520 given by Sri Lanka Sustainable Energy Authority subjected to obtaining necessary statutory approvals prior to the commencement of construction activities and complying with the recommendations of environment approval (IEE) by project approving authority – Coast Conservation and Coastal Resources Management Department.

Divisional Secretary
Mannar Town

K.S. Vasanthakumar
Divisional Secretary
Divisional Secretariat
Mannar.

ශ්‍රී ලංකා සුනිත්‍ය බලශක්ති අධිකාරිය
இலங்கை நிலைபெறுதகு சக்தி அதிகாரசபை
Sri Lanka Sustainable Energy Authority
A Statutory Authority of Ministry of Power & Renewable Energy

07 March 2017

My Ref: A-27520

Director General,
Department of Coast Conservation & Coastal Resource Management,
4th Floor, New Secretariat Building,
Maligawatte,
Colombo 10

Dear Sir,

Construction Activities within Energy Development Area Impacting the Mannar Wind Power Project

This refers to the proposed 100 MW Wind Farm in Mannar Island which is currently being developed by the Ceylon Electricity Board (CEB).

I wish to inform you that Sri Lanka Sustainable Energy Authority (SLSEA) has granted the exclusive land rights within the aforesaid Wind Farm area for CEB to carry out development works. The same area has been included in the gazette notification 1858/2 of 2014.04.17 as an Energy Development area. Since then, project has progressed significantly by obtaining necessary approvals from following government agencies.

a. Divisional Secretariat Mannar Town, MannarPradeshiyaSabha, Department of Wildlife Conservation, Coast Conservation Department, Civil Aviation Authority of Sri Lanka, Irrigation Department, Department of Agrarian Development-Mannar, National Water Supply Drainage Board, Forest Department and Sri Lanka Navy

b. Approval from External Resource Department to obtain a direct funding worth of USD 200 million from Asian Development Bank

Block 5-1st Floor, BMICH, Bauddhaloka Mawatha, Colombo 07, Sri Lanka.

Office	Facsimile	E-mail	Web Site
+94(0)11 267 7445	+94(0)11 268 2534	info@energy.gov.lk	www.energy.gov.lk

It has been recently observed that some construction activities, led by both private and public institutions, are being carried out within the Energy Development area allocated to the proposed Wind Farm (map attached). Some of these activities are illegal encroachment to the Energy Development area whereas others have not obtained necessary permission from SLSEA. It is to be noted that Land use change within the Energy Development area such as construction of tall buildings and man led activities could significantly reduce the energy in the wind, as it is dissipated on such obstacles and thereby preventing maximum economic utilization of the wind energy resource. This would no doubt have negative impact on financial viability of the proposed Wind Farm.

Therefore we kindly request you to take necessary actions to prevent these activities and in future make it mandatory to refer such cases (which envisage on land use changes within Energy Development Area) to SLSEA for case by case evaluation and consideration for approval.

Yours sincerely,

M.M.R.Pathmasiri
Director General
Sri Lanka Sustainable Energy Authority

Copy to: Project Director (Mannar Wind Power Project), Ceylon Electricity Board

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இலங்கை நிலைபெறுதகு சக்தி அதிகாரசபை
Sri Lanka Sustainable Energy Authority
A Statutory Authority of Ministry of Power & Renewable Energy

21st April 2017
Your ref: J/DP/MUC/02
My ref: A -27520

Mr.Y.G.K. Gunathilake
Director (Northern Province)
Urban Development Authority
Northern Province

Dear Sir,

Request to Declare the Energy Development Area of Mannar Wind Power Project as an Industrial Zone

This is further to our previous correspondences on the above subject. This letter also refers to the recent discussions CEB officials had with the Director General of UDA and you. We write this letter to present certain underlying concepts and processes related to the renewable energy development and to request to declare the Energy Development Area under reference as an Industrial Zone.

Energy Development Areas

The Sri Lanka Sustainable Energy Authority Act No. 35 of 2007 requires this Authority to explore, map and incorporate areas with good resource potential. The relevant sections of the act are quoted below.

Section 13 — The Authority shall be responsible for conserving and managing all renewable energy resources within a Development Area and take all necessary measures to promote and develop such energy resources with a view to obtaining the maximum economic utilisation of those resources.

Once such good resource sites are earmarked for development, these areas are declared as Energy Development Areas through a regulation. The regulation ensures that the renewable energy resource to be developed is preserved and conserved for exploitation and development. The provisions given in the Act to ensure this are as follows:

Section 14 — Notwithstanding anything to the contrary contained in any written law, an owner or occupier of any land situated within a Development Area shall not, except with the written approval of the Authority and subject to any terms and conditions that may be imposed by the Authority, for that purpose , do any act or permit any other person to do any act, which may change the form of any renewable resource situated within such development are or cause the depletion of any such resource in

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such a manner or to such an extent, that the economic viability of developing that resource is substantially reduced.

Energy Permit

The renewable energy resources of the country were vested in the republic through the same Act. Thus the utilisation of such a collectively owned resource is done by way of an energy permit. The relevant sections of the Act are as follows:

Section 16(1) Notwithstanding the provisions in any other law to the contrary and subject to the provisions of Section 71, no person shall engage in or carry on an on-grid renewable energy project for the generation and supply of power within a development area, except under the authority of a permit issued in that behalf by the Authority.

The regulation issued in defining the conditions of Energy Permit is cited as On-grid Renewable Energy Projects Regulation 2009 published in the Gazette No. 1599/6 of 27th April 2009, and amended by Gazette 1705/22 of 2011 10th May 2011.

Exploitation of Full Potential

Any activity which causes the depletion of the renewable energy resource (obstruction of wind flow in the case of a wind power project) will not be permissible in the Energy Development Area. In our opinion **construction of any building with more than two floors** (Ground + 1) can be considered as a factor which affects the wind resource. Given the complex nature of interaction of wind flow with land based objects, we strongly recommend to refer any planned changes to land use within the Energy Development Area to Sri Lanka Sustainable Energy Authority for case by case evaluation which we carry out using advanced wind flow modeling software before approval.

When a Energy Permit holder commence construction activities of the Wind Farm and subsequently proceed to utilize the renewable energy resource and generate electricity, the Energy Development Area becomes an Industrial concern, having power generating equipment, associated supporting infrastructure such as power handling transformers, current carrying conductors, switch gear and operation & maintenance of the facility. When deploying modern wind turbines in a good resource location, they are expected to harness the full potential of the resource. When in such full power operation, even the best engineered modern turbines emit noise. The noise emitted by the turbine will get quickly attenuated with few hundred meters from the turbine location. **As required we enclose herewith the expected noise distribution map of the proposed Mannar Wind Power project within the Energy Development Area.**

As emphasized in our previous letter to you, we believe that in areas where excellent wind energy potential prevails, it is important to give priority to renewable energy development, as the economic impacts of renewable energy far outweigh the likely economic impact of the most of the other development programmes. As you are aware, this landmark project in the country has already secured financing worth USD200million from the Asian Development Bank and speedy implementation of same will be invaluable to the country at this moment. Accordingly we kindly request you to declare the Energy Development Area under reference as an industrial zone to facilitate the immediate launch of the project.

Thanking you
Yours faithfully

Director General
Sri Lanka Sustainable Energy Authority

CC:	Director General, Urban Development Authority-	For your kind information please
	Project Director (Mannar Wind Power Project) -	For your kind information please

Expected Noise Distribution of Mannar Wind Farm

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MINISTRY OF MEGAPOLIS & WESTERN DEVELOPMENT

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6 மற்றும் 7ஆம் மாடிகள், செத்சிறிபாய, பத்தரமுல்ல
6th & 7th Floors, Sethsiripaya, Battaramulla

File No: J/PR/SED/60
Urban Development Authority,
Sethsiripaya,
Battaramulla.

02.05.2017

The Director General,
Sri Lanka Sustainable Energy Authority,
3G-4A, BMICH,
BauddalokaMâwatha,
Colombo -07

Dear Sir,

Request to Declare the Energy Development Area of Mannar Wind Power Project as an Industrial Zone

This has reference to your letter dated 21st April, 2017 regarding the above mentioned matter.

This area (Southern Part of Mannar Island) has been identified to be developed under proposed development plan for Mannar Island - 2030 prepared by the Urban Development Authority (UDA) for tourism, fishery and wind energy parks as the dominant land uses, taking in to account the prevailing development pattern and the resource availability. All these three land uses have to be co-developed for maximum economic use of the area.

Except for Phase I (100 MW Mannar Wind Power Project) development work submitted to us, further wind power development shall be aligned with the relevant section of Annex 1 given by the UDA prepared in consultation with the Ceylon Electricity Board (CEB) and the other relevant agencies & stakeholders.

In consideration of the identified land uses mentioned above and the request made by you, we have decided to rezone the Energy Development area within Mannar Island gazetted by the Sri Lanka Sustainable Energy Authority (SLSEA) under Act No. 35 of 2007 as an 'industrial area' for application of the National Environmental (Noise Control) Regulations in accordance with the National Environmental Act. The same 'industrial area' will be incorporated into UDA plan for year 2030 which will be gazzeted within this year. Special guidelines & development regulations for this area has to be formulated and submitted to UDA by the SLSEA & the CEB focusing on optimum use of the wind resource in the area.

Furthermore, you are advised to comply with all other regulations of the Central Environment Authority and Planning & Building Requirements of the UDA before undertaking any physical developments within this zone.

Director General,
Urban Development Authority.

Copy: Project Director (Mannar Wind Power Project), CEB - For your information pl.
Director (Northern Province), UDA - For your information pl.

Annexure 9: Consolidated Summary of Public Consultations

A. Consultations with NGOs and one-on-one cummnication with Shell Coast Resort

9.1. Public Consultation on the Mannar Wind Power Project on 23 May 2017 Meeting at BMICH, Colombo

Date : 23 May 2017
Time : 15:00
Venue : Auditorium, Ceylon Electricity Board's (CEB) Regional Centre for Lighting, BMICH
Participants: List of the participants is attached

Preamble

According to Asian Development Bank's (ADB) Safeguard Policy Statement (SPS) 2009, public consultation and information disclosure are to be made starting from the initial stages of project preparation by an executing or implementing agency for projects, for which ADB financing is requested. For environment category A projects, it is required to post a draft Environment Impact Assessment (EIA) report in the ADB's website for public disclosure and consultation for a period of 120 days prior to the expected ADB Board consideration.

Consultation and information disclosure provide project-affected persons and key stakeholders with a chance to give their views and perceptions about the proposed project, and for CEB to understand and address their concerns to the extent possible. Suggestions and recommendations of affected persons on mitigation measures and environmental monitoring during project implementation will be reviewed and considered to the extent possible by CEB.

Accordingly the draft EIA for the 100 megawatt (MW) Mannar Wind Power Project was publicly disclosed in the ADB's website on 18th May 2017, and subsequently CEB arranged a public consultation meeting with stakeholders and non-government organizations (NGOs), including members of the Ceylon Bird Club, on 23rd May 2017. This is the third such public consultation apart from numerous discussions and information sharing sessions that CEB had with relevant stakeholders since the inception of project preparation.

Consultation Session

The consultation session commenced at 15:00 by Eng. D. D. U. Dompege, Project Manager, Mannar Wind Power Project of CEB. He welcomed the participants and explained the objectives of the public consultation. Eng. A. M. A. Alwis, CEB and Prof. D. Weerakoon, University of Colombo delivered presentations on wind turbine technology, site selection and consideration of other alternative sites, the potential social and environmental impacts and proposed mitigation measures. This was followed by a presentation by the Ceylon Bird Club on their request. Thereafter, the meeting was opened for discussion and voluntarily moderated by Dr. Sumith Pilapitiya, Environmental Specialist.

No.	Questions	Reply
1	Why the Coastal Conservation Department (CCD) is	CEB explained that according to the National Environment Act, any Project Developer has to submit the request to CEA for obtaining the environmental approval. CEB followed the same

	appointed as the project approving agency instead of the Central Environment Agency (CEA) for the Mannar Wind Power Project despite there are three most important wetland bodies in this area?	procedure and submitted the application for the environmental approval to CEA. It was a decision of CEA to appoint CCD as the Project Approving Agency for this project.
2	Are there feasibility studies done by CEB other than for Mannar, as alternative project sites?	CEB explained that feasibility studies based on ground based wind measurements have been carried out for Southern low lands and Kalpitiya peninsula. It was further explained that the decision on implementation of wind farm projects depends on various technical, social and environmental factors other than wind speed.
3	Can CEB share such study reports?	CEB replied that they can share the available reports.
4	What is the procedure for public to comment on the draft EIA?	CEB and ADB explained that the draft EIA has been already published in the ADB and CEB websites. Therefore, public can refer to this document and send their comments to CEB or ADB within 120 days from date of publishing the document. It is preferable to send such comments, if any, early in the process.
5	What is the next level of actions to be taken once the comments are received from the public? Does CEB arrange to publish the draft EIA report in National Newspapers (in three languages) for reference by the public?	CEB explained that being a responsible Government organization, it would welcome public comments and accommodate all constructive suggestions in project implementation. CEB mentioned that they will publish a notice in National Newspapers (in three languages) informing the general public about the availability of the draft EIA report in the ADB and CEB websites for public reference.

6	The Ceylon Bird Club and other NGOs pointed out that the procedure adopted for the environmental approval was not legitimate and contradict with the provisions under the National Law. Further, they asked whether the Project Approving Agency is still existing or is it different for EIA.	CEB explained that they have followed all the procedures as explained under the National laws and regulations for obtaining the environmental approval. This EIA has been conducted in fulfilment of the requirements of the project financing agency (ADB) and will be submitted to ADB for the final approval of the project funding. Local project approving authority is not involved in this approval. ADB explained that all public comments are considered in the approval of project financing.
7	What is the procedure for project financing if ADB withdraws financing of the project?	CEB explained that such decisions shall be taken by the Government.
8	What is the extent of the area under detection through a radar system to capture bird movements and the time taken to respond after detecting the bird movements?	CEB mentioned that 12 kilometre (km) zone will be under the surveillance of the proposed Radar system and a wind turbine can be stopped within two to three revolutions.
10	The Ceylon Bird Club and other NGOs accepted wind as a good renewable energy resource. However, their concern was the suitability of the proposed Mannar site? They are of the view that Silawatura would be a better option where the negative impacts are minimum.	CEB explained that proposed Mannar site has been identified as the most suitable site for development of 1st large scale Wind Park in the country according to the pre-feasibility and detailed feasibility studies. However, CEB has been aware of the impacts on birds and that is why CEB has shifted the original site layout towards South of the island reducing the number of turbine locations to 39 instead of 56 as in the original plan. CEB has further agreed to control wind generation during the bird migration seasons to mitigate the impacts on birds as per the Environment Management Plan and Biodiversity Management Plan proposed in both the original IEE and subsequent EIA studies.
11	Can CEB guess the minimum number of	CEB mentioned that it is difficult to inform the exact number of birds to be captured by the radar at this moment.

	birds to be captured on a radar system for it to shut down a turbine?	
12	What is the purpose of the Biodiversity Management Plan proposed by CEB?	CEB and ADB explained that the Biodiversity Management Plan is to ensure that there is no net loss to the critical habitat in the proposed project area, which is a requirement of ADB. The Biodiversity Management Plan will be submitted to the Wildlife Conservation Department and upon receipt of the approval construction will be commenced.
13	Has ADB considered the impacts of wind turbine shut downs due to bird issues in their financial analysis?	ADB explained that project viability has been evaluated for various scenarios, including curtailment, and found to be viable.
14	Will ADB consider the financial feasibility in approving the project?	ADB explained that the financial feasibility is an important consideration in project approval
15	Why ADB approved a transmission line sub project before looking at the feasibility of the proposed wind farm project?	ADB explained that this question has been answered in several occasions and during the previous consultation meeting as well. ADB has considered the proposed Mannar Wind Power Project as an associated facility when assessing the overall environmental impacts and mitigation measures in the process of approving the EIA for the transmission line. CEB explained that the transmission line need to be implemented irrespective of the proposed Wind Farm, due to poor power quality and reliability of the power supply to the Mannar Island. Over the past years, the Mannar Island has been fed from Vavuniya through a very long medium voltage line. Consequently, the power supply to the Mannar Island has suffered significantly in terms of poor power quality and frequent failures. The situation has been aggravated owing to the increased demand during the recent past after the conflict ended.
16	Why the IEE and EIA done by CEB considered different bird migrating seasons compared to the periods as explained by the Ceylon Bird Club? (Bird migration season is from August to May as indicated	The environmental specialist who was engaged for the studies on behalf of CEB explained that the bird migratory seasons may vary slightly, year to year due to various factors.

	during the presentation by the Ceylon Bird Club)	
17	What is CEB's action plan if the independent monitoring team in Sri Lanka concludes that the proposed Mannar wind farm will adversely impact the environment and migratory birds?	CEB explained that the project has been initiated with all environmental assessments and feasibility studies. However, the Wind Farm will be monitored for a period of five years after commissioning, during the operations. CEB will take all mitigatory measures to minimize the environmental impacts if any such adverse impacts are present.
18	Is it possible to set up the wind farm in Silavathura area and run throughout the year instead of the Mannar Island with six month operations and with many operational constraints? Has CEB planned for another wind farm at Silawatura, as highlighted during the 3rd meeting with NGOs/Ceylon Bird Club.	CEB explained that Silavatura region is characterised by large scattered built-up areas and lots of paddy fields and lagoon and marshy areas. Wind turbines need to be sited away from settlements to meet noise limits. Accordingly, large number of land parcels need to be set aside. This makes very difficult to set up a large-scale wind farm. CEB responded that this will affect the livelihood of the people in these areas.
19	What is the reason for large variation in bird data between CEB's studies (low numbers) and Ceylon Bird Club's records (large numbers).	Bird surveys were done by CEB with the assistance of experienced and qualified ornithologists since 2014 to observe bird mobility and their behaviour and to study the impacts to them due to the proposed wind farm. The studies were focused mainly for the project site area and the associated area as well. These studies were refined with the assistance of international experts served for CEB in the studies under the Project Preparatory Technical Assistance (PPTA) provided by ADB. The data presented by CEB is based on these studies and surveys. It was further mentioned that there are large numbers of birds in Vankalai area but these birds do not appear in the proposed Wind Farm area.
20	Ceylon Bird Club/NGOs mentioned that the recorded birds (during the Bird Survey	It was explained that all the birds were considered, observed and recorded during bird surveys.

	studies) are mostly water birds, but thousands of forest birds are also available in this area.	

In concluding remarks Dr. Sumith Pilapitiya requested all parties to work with CEB and jointly review the draft EIA considering comments given by the public and arrive at common consensus during the 120 days' period.

Eng. Kelum Niranjana delivered the vote of thanks and extended CEB's appreciation for all the participants for attending the consultation and providing valuable inputs.

The meeting was adjourned at 18:30.

<u>Photographs of Public Consultation with NGOs</u>




List of Participants

Mannar Wind Power Project
NGO Consultation

Venue - RCL, BMICH
Date - May 23, 2017
Time - 1500 to 1830

No.	Name & Representing Institute	Contact Details	Signature
01	Vishnumana Bandara (Young Zoologists Association) YZA	0714657785	[illegible]
02	G.A. Oshani Dhananja YZA	011 7878212	[illegible]
03	Sumith Fernando RMA	0777 143495	[illegible]
04	BMP Singhakumara RMA	0714439300	[illegible]
05	Kamini Vitarana. Ruk Rakaganno.	0777315226	[illegible]
06	Tanya Perera. Ruk Rakaganno	077-6444758	T. Perera
07	Aiming Zhou ADB		[illegible]
08	Angela Bernaldo ADB		[illegible]
09	Mukhtor Khamudkhanov ADB		[illegible]
10	Yoojung Jang ADB		[illegible]

Mannar Wind Power Project
NGO Consultation

Venue - RCL, BMICH
Date - May 23, 2017

No.	Name & Representing Institute	Contact Details	Signature
11	Eng. M.P. Kumara, CEB	0702594612	[illegible]
12	Eng. V.A. Samadara CEB	0712130361	[illegible]
13	M L Weerasinghe CEB		[illegible]
14	Amila Wickramasinghe	0714810281	[illegible]
15	Sevwandi Jayakody EFL	0772036130	[illegible]
16	Gayani Hewawasam EFL	0772449116	[illegible]
17	Dishane Hewavithana EFL	0777113308	[illegible]
18	G. J. Alwathge CEB	0718731110	[illegible]
19	Sameth Pelpatge	0777 259265	[illegible]
20	Kanchana Weerakoon	0715098847	[illegible]

Mannar Wind Power Project
NGO Consultation

Venue - RCL, BMICH
Date - May 23, 2017

No.	Name & Representing Institute	Contact Details	Signature
21	D. Wanakagala CRC	0112817370	
22	Udithe Hettige udithabirder@amail.com	0112892904	
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24	Chamindra Weerackody	0777517361	
25	Kelum Niranjana	0714115693	
26	A. Rathnayake	0703271511	
27	Ravishka Wimalasena (ADB)	0777699096	
28	P. Samarasinghe	0773971840	
29	[illegible]	0776378242	
30	V. Abeyratne	0112107700	

Mannar Wind Power Project
NGO Consultation

Venue - RCL, BMICH
Date - May 23, 2017

No.	Name & Representing Institute	Contact Details	Signature
31	Kamal Ileperuma, CEB	0714150724	
32	wildpubus@gmail.com Pasada Weeraratne Y2A	0774021951	
33	K. Ranjee, CEB	0718740954	
34	D. Weerakoon	0776150184	
35	Lakdan Fernando	lakdanf@gmail.com 0777348999	
36	Dahara Makerita, CEB (MWPP)	0719495911	
37	R. Y. Wijeratne, CEB (MWPP)	0710422027	
38	P. Pushpanthan, CEB (MWPP)	0771858323	P. Pu
39	S. P. M. B. Senadhira, CEB (MWPP)	0773819768	
40	D. D. U. Dompage, CEB (MWPP)	0714115587	

Mannar Wind Power Project
NGO Consultation

Venue - RCL, BMICH
Date - May 23, 2017

No.	Name & Representing Institute	Contact Details	Signature
41	A-A-T. Eraejeewa, CEB (MOPP)	0714150597	
42	Pradeep Udayanath, CEB (MOPP.)	0718179792	
43			
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45			
46			
47			
48			
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9.2 A letter dated 30 August 2017 from Center for Environmental Justice (CEJ)

No.	CEJ Comments	Actions/Replies
1	CEB only prepared an IEE	According to the Sri Lanka National Environmental Act, the Central Environmental Authority (CEA) as a Project Approving Authority (PAA) approved the Initial Environmental Examination (IEE) for the proposed 100MW wind farm. However, in line with ADB's Safeguard Policy Statement 2009 (SPS 2009) requirements, ADB required CEB to prepare an Environmental Impact Assessment (EIA), and subsequently a draft EIA was posted for public disclosure and consultation for 120 days on the ADB's website. ADB requested CEB to follow the public consultation procedure and ensure that all relevant information is shared with interested stakeholders, including NGOs. CEB has published newspaper advertisements in Dinamina, Thinakaran and Ceylon Daily News on 13th June 2017 in Sinhala, Tamil and English languages respectively on publication of the EIA in the ADB's website.
2	Negative cumulative impacts of the development of remaining wind potential and the transmission line	The two EIAs (for 220 kV Transmission line as well as for 100 MW Wind Farm) contain assessments of cumulative impacts of the wind farm and the T-line. Bird collision risk modelling both for the wind farm and T-line has been undertaken considering the cumulative impacts. All negative impacts have dealt with the environmental management plan (EMP) sections and measures have been elaborated. In addition, as per recommendation of the EIA's, a Biodiversity Management

		Plan (BMP) is being prepared and funded by ADB for both the T-line and the wind farm areas to ensure no net biodiversity loss. The BMP will be submitted to the Wildlife Conservation Department and upon receipt of the approval construction will be commenced. The updated EIA for the T-line project which addressed the comments from ADB's Peer Review Meeting and public consultations can be found from the following link. Section 3 of Volume 2 (Page 120) provides the assessment on the species at potential risk of collision and/or electrocution from the T-line and species at potential risk of collision with wind turbines of the 100 MW Wind Power Generation Project as an associated facility, as well as the mitigation measures. Cumulative collision risk of the T-line, and the 100 MW Wind Power Project. (Table 8, page 164 of Volume 2). https://www.adb.org/sites/default/files/linked-documents/47037-005-ld-02.pdf For further assurance, environmental provisions have been included in loan agreements. Please find the following link to the loan agreement for the T-line project. Para 3-5 in Schedule 5 (page 21) cover loan covenants regarding the requirements to mitigate the potential impacts from both the wind farm and T-line projects. https://www.adb.org/sites/default/files/project-document/219806/47037-005-mlo1.pdf The loan agreement of the wind farm, which will be disclosed upon project approval, also has a provision that the turbines installed on Mannar Island shall be curtailed during the bird migratory seasons as specified in the EIA.
3	Bird issue: a. the mass migration March/April information; b. shut down turbines as an iron-clad prerequisite; c. other biodiversity concerns.	a. A three-year detailed survey was carried out from January 2014 to April 2016 and additional survey was undertaken from June 2016 to March 2017 with the assistance of experienced and qualified ornithologists in the Mannar island including vantage point surveys along the transmission line and wind farm corridor to gather detailed information on bird movements and to study the impacts to them. Based on the data collected, there are about 1.2 million birds which were counted in Wedathalithuvu area but the location is almost 30 km far from windfarm or transmission line corridor. During these studies, data on birds reported in the Mannar region in the wetland counts do not support any mass migration of birds anywhere near the windfarm or transmission line corridor. b. The project has been initiated with all environmental assessments and feasibility studies, including various scenarios and curtailment, and found to be viable. However, the shut down on demand criteria needs close coordination with the radar system provider, thus more details are available once the supplier is selected, and will be incorporated in the BMP. To repeat, the loan agreement

		includes assurance provision that the turbines installed on Mannar Island shall be curtailed during the bird migratory seasons as specified in the EIA. Further, the wind farm will be monitored for a period of three years during the operation phase after commissioning. All mitigatory measures to minimize the environmental impacts will be taken if any adverse impacts are present. c. A BMP is being prepared and funded by ADB for both the T-line and the wind farm areas to ensure no net biodiversity loss. The BMP will be submitted to the Wildlife Conservation Department and upon receipt of the approval construction will be commenced.

9.3 A letter dated 6th September 2017 from Environmental Foundation (Guarantee) Limited (EFL)

No.	EFL Comments	Actions/Replies
1	Information disclosure	The EIA was disclosed on ADB website on 18 May 2017 to meet the 120 days' disclosure requirement. Community level consultations were also conducted at 20 different villages and 317 persons participated in the consultations. CEB has published newspaper advertisements in Dinamina, Thinakaran and Ceylon Daily News on 13th June 2017 in Sinhala, Tamil and English languages respectively on publication of the EIA in the ADB's website.
2	Bird survey	A three-year bird study-cum-survey was conducted by CEB from January 2014 to April 2016. The focus area of this study is the entire Mannar Island including an off-shore belt of 500 m around the island as well as the Vankalai Sanctuary, that is between the Mannar Island and the mainland. Another bird study within the wind farm corridor was carried out from June 2016 to March 2017 where bird vantage point surveys at four locations, flight path studies, and sector counts along wind farm blocks were conducted. Further monitoring will be conducted by biodiversity management team from September 2017 to 2020 for bird species as well as a more detailed mapping and assessment of their nesting and breeding habitats. The result will be incorporated in the BMP. Further, according to the loan agreement, the turbines installed on Mannar Island shall be curtailed during the bird migratory seasons (August to May) as specified in the EIA, thus it is expected that the actual impact can be further mitigated through this measure.
3	Model for the radar system	Based on the findings in EIA and further monitoring results, the protocol/criteria including potential shut-down-on-demand frequencies, will be developed. As, this requires close coordination with the radar system supplier, more details are available once the supplier is selected. The protocol/criteria will be included in environmental safeguards documents (e.g. BMP) which will be made publicly available.

9.4. One-on-one communications with Shell Coast Resort at Mannar Island dated 18 August 2017

No.	EFL Comments	Actions/Replies
1	Noise disturbance and buffer distance	The distance to the hotel from the nearest wind turbines is about 350 m which is more than 1.5 of the wind turbine height (155m), thus there would not be any satefy issues considering the buffer distance. The overall noise limit at each of the receivers around the project is defined as the existing background noise level* + 3 dB, or the base limit (day: 50dB / night: 45dB) for each receiver type, whichever is the greater in accordance with international guidelines. This limit will be met through specified mitigation measures for the shall coast hotel, these include: • In vicinity of Shell Coast Resort, no piling or other noisy construction works to be undertaken for more than a 6-hour period or at any time on the weekend or public holiday; • Turbine locations adjacent to Shell Coast resort and other occupied properties to be securely fenced using an acoustic barrier to reduce the construction noise disturbance; and • EPC Contractor to plan working days and hours within 500m of the Shell Coast to avoid peak seasons and times (e.g. weekends, public holidays). Further, cutting trees between the turbines and Shell Coast will be avoided as these provide screening of the turbines. ** The current noise (without wind farm) level on and around the hotel is ranged from 25~50dBLeq.*
2	TV and radio signal disturbance	The baseline survey will be undertaken to determine which properties within 5km of the wind turbines have radio/television and test existing quality of radio/television signal received (tests to cover all properties in 500m, sample of properties in each village up to 5km). If complaints occur immediately survey quality of radio/television signal during operation and if existing quality of radio/television signal received is deteriorated, solutions and other measures will be provided to affected properties.
3	Tourism interruption and visual impact	The recent study result in Scottland (http://www.biggareconomics.co.uk/wp-content/uploads/2016/07/Research-Report-on-Wind-Farms-and-Tourism-in-Scotland-July-16.pdf), concluded there was no evidence to suggest windfarms had an adverse effect on tourism in an area. There are cases which show wind farms can attract tourist instead. The Burgos wind farm in Philippines is an example which has become very popular tourist destination as it is in beautiful location, right on a wind swept beach.

		Regarding the visual impact, it is hard to aovid the impact entierly but the trees - to be preserved to the extent possible - between the turbines and Shell Coast will mitigate visual impacts.

B. Fact Finding Mission (one consultation before EIA disclosure)

9.5 Meetings with NGOs at BMICH Colombo on 20 February 2017

No	Question:	Answer
1	EFL Only IEE is done for this project. We can’t actually comment on this project now. Because this area is a very sensitive area which is located in between three protected areas. After completing EIA and once public consideration is completed, comprehensive evaluation can be done. Is the existing information sufficient to accept this project?	Prof. Devaka This information is extracted before EIA, after doing EIA, all issues will be addressed. Further investigations will be conducted for migratory paths
2	Wildlife and Nature Protection Society This process is not clear to us. Before doing EIA how are you conducting these things? EIA is essential in this case.	Answer: EIA is required to be conducted by ADB for its funding.
3	Why are you conducting this meeting before doing EIA. You have only completed IEE. It is not clear to us. Can you explain it.	Prof. Devaka EIA will be completed in April 2017. For the EIA, the study focused on issues to know whether these areas are suitable for wind farm or not.
4	Nature Protection Society Is this EIA for only Mannar region or sites? Bird activities are carried out in whole area. Have you concerned about them?	Prof. Devaka We considered the whole region. Before starting the project, suitable sites were identified while unsuitable sites were rejected. Bird flight path monitoring activities are carried out everywhere (can’t consider all of them). Here we consider only about collisions and damages which can occur from wind turbines and how many birds are passing the area.
5	Nature Protection Society This research team has done researches for certain regions and some locations are removed. Why is that? In addition, locations of models are questionable?	These models are proposed by an international expert from the United Kingdom. The relevant issues will be addressed after generating all required information and data.
6	You have done EIA only for the transmission line. This is wrong. When you focus on a specific project whole project should be considered as one. Doing EIA separately for the transmission line and wind farm is completely wrong. You said that EIA which has been done for the transmission line is already accepted. Money has been invested on the transmission line now. What you are going to do if EIA for wind farm is not	ADB: The wind park was considered as an associated facility of the transmission line, and as such it was taken into consideration in the assessment. The wind park is likely to be accepted because according to the EIA of the transmission line there is no critical problem here. The question regarding process of IEE approval in Sri Lanka can be answered by CEB.

No	Question:	Answer
	accepted? All the money spent on transmission lines will be wasted.	
7	So you are telling that somehow this EIA will be accepted. Whether it is correct or not? Since CEB/ADB has already invested money on this project? This is wrong. There are more than 3 projects in this area. How many turbines can be established in this area by CEB? In addition, what are the accumulated impacts of this project and what is the technology that is used for wind turbines? Birds are not only affected party. Then what about other affected parties?	Since this is a sensitive area, an EIA was required for ADB and IEE for Govt. of Sri Lanka. First EIA was conducted for only transmission lines and all details are included on CEB web site. Additional surveys are required for migratory paths and bird collisions. During migrant seasons, CEB has agreed to reduce the impacts that can be negatively affected for birds.
8	This process of EIA is out of standard. And it is required there should be a separate EIA and IEE for this project. Will CEB conduct them in a proper way?	Draft of EIA as per ADB requirements is on the web site of CEB. All researches related to this project, such as bird collisions, noise snd other assessments, are conducted according to international standards.
9	Are the transmission lines approved by DWLC?	Yes, all instructions are given by the DWLC to construct transmission lines.
10	All details are related to construct transmission lines. Then what are the impacts associated with power generation? If wind power project is not ok, then what is the worth of transmission lines?	ADB Power generation is an associated facility to the transmission lines and the effects are combined. The EIA documents prepared for the line complied with ADB policies.
11	After conducting EIA that must be open for public comments. It should be announced by a newspaper advertisement in all Sinhala, English and Tamil. Can we know when this is done for this EIA. If done in which newspaper?	Question is not answered.
12	If this wind power project will be created along migratory paths, how is the project approved by ADB?	According to ADB policies EIA is required. Unless EIA is accepted, the wind farm project cannot be funded.
13	ADB has expressed that EIA for transmission lines is approved while CEB expressed that it is as an IEE. What is correct?	CEB conducted IEE for transmission lines and wind park under the Environmental Act. However, ADB requires EIA for both projects and these EIAs adhere primarily for ADB policies.
14	Are there different funds for transmission lines and power generation? Is that the reason to discuss about only transmission lines?	There is no separation. If there is any critical issue with the proposed park, ADB will not approve the project. And if there is any doubt that negatively impacts of the either of the project cannot mitigated, the projects will not be approved by ADB.
15	IEE is not opened for the public comments. Then how this was approved? And how go for an EIA?	IEE is approved by CEA and CEB is not responsible for it.

No	Question:	Answer
16	Are these researches done in a proper way?	Although these studies were done by Prof. Devaka, Data was analyzed by international expertise.
17	Have you found any alternative sites? In EIA there must be alternative sites. Purpose of an EIA is to find alternative sites. So there can be alternatives to generate wind power. CEB should consider about these alternatives instead of this Mannar region?	Master plan study was conducted for wind development from Mannar region. Presently, no alternative site is available.
18	Bird club We have found that there is a new technology to build wind power system without using this large turbines and blades. Those are very environmental friendly and sustainable things, we have already informed to ADB and CEB about these things. Have you read those documents?	We haven't. We will check it and discuss it in the EIA document.

Follow-up Comments

- ADB follows international standards that are satisfactory. However, if the project fails, it will be loss to Sri Lanka. Therefore, the wish that the wind power development should be done in a sustainable way.
- Bird club suggests that a proper bird survey should be conducted by an international competent authority.
- Also, they suggested that for next EIA, their comments should be included and it will be better to update EIA with their comments.
- Sri Lanka is a small country. Development must take place with harmony with the environment. We have to do development projects with minimum impacts. Alternatives are better than mitigations and projects should focus in alternative solutions.

Photographs of Participants

Persons at BMICH Meeting at Colombo

No	Name of the participant	Male/ Female	Occupation/Status	Organisation
1	Prof Lakdas D. Fernando	Male	Past President	Wildlife and Nature Protection Society
2	Dr. Nimali de Silva	Female	Course Director	University of Moratuwa Society
3	Kanchan Weerakoon	Female	President	Eco Friendly Volunteers (ECO-V)
4	Gayani Hewawasan	Female	Manager Investigations and Legal Projects	Environmental Foundation (Guarantee) Limited
5	Hemantha Withanage	Male	Executive Director/Environmenta l Scientist	Center for Environmental Justice
6	Kamini Meendeniya Vitarana	Female	President	Ruk Rakaganno – The Tree Society
7	Dishane Kalya Hewavithama	Male	Research and Projects Officer	Environmental Foundation (Guarantee) Limited
8	Uditha Hettige	Male	Director	Bird and Wildlife Team (Pvt.) Ltd.
9	K G S L kumara	Female	Project Coordinator	Eco Friendly Volunteers (ECO-V)
10	Tanyam Perera	Female	Member	Ruk Rakaganno – The Tree Society
11	CEB Engineers			CEB
10	RMA team			RMA
11	Entura team			ENTURA
12	ADB team			ADB

letter dated 8 March 2017 from Environmental Foundation (Guarantee) Limited (EFL)

No.	EFL Comments	Actions/Replies
1	IEE/EIA matters	According to the Sri Lanka National Environmental Act, the Central Environmental Authority (CEA) as a Project Approving Authority (PAA) approved the Initial Environmental Examination (IEE) for the 220kV Mannar-Nadukuda transmission line on 24th February 2016 and the proposed 100MW wind farm. However, in line with ADB's Safeguard Policy Statement 2009 (SPS 2009) requirements, ADB required CEB to prepare Environmental Impact Assessments (EIAs) for the two projects and to ensure the public consultation procedure was followed.
2	Sequencing the wind plant and transmission line, site selection	Mannar Island has been selected as the best economically and technically dispatchable wind site in the country through various studies conducted by National Renewable Energy Laboratories, USA and Sri Lanka Sustainable Energy Authority. Subsequently, at the government request ADB provided a technical assistance grant for conducting detailed assessment of the Mannar region to forecast the wind resource potential. The proposed Mannar wind park was selected based on these studies. The updated EIA for the T-line project which addressed the comments from ADB's Peer Review Meeting and public consultations can be found from the following link. Section 3 of Volume 2 (Page 120) provides the assessment on the species at potential risk of collision and/or electrocution from the T-line and species at potential risk of collision with wind turbines of the 100 MW Wind Power Generation Project as

		an associated facility, as well as the mitigation measures. Cumulative collision risk of the T-line, and the 100 MW Wind Power Project. (Table 8, page 164 of Volume 2). https://www.adb.org/sites/default/files/linked-documents/47037-005-ld-02.pdf For further assurance, environmental provisions have been included in loan agreements. Please find the following link to the loan agreement for the T-line project. Para 3-5 in Schedule 5 (page 21) cover loan covenants regarding the requirements to mitigate the potential impacts from both the wind farm and T-line projects. https://www.adb.org/sites/default/files/project-document/219806/47037-005-mlo1.pdf The loan agreement of the wind farm, which will be disclosed upon project approval, also has a provision that the turbines installed on Mannar Island shall be curtailed during the bird migratory seasons as specified in the EIA.
3	Public consultations	From May 2016 to February 2017 With NGOs, 3 consultations held in May 2016 and 1 consultation in February 2017. As the result of these meetings, NGO's feedbacks were taken into consideration in designing the proposed wind power project, e.g. to reduce turbines from 56 to 40, to curtail wind turbines during the migration and breeding seasons, to adopt the best available technologies to mitigate the potential environmental and social impacts/risks etc.. With stakeholders, several consultations were undertaken from December 2016 to February 2017, including e.g. 21 small groups in five villages, community based organisations, 200 households, 7 Grama Niladharis, 32 madel owners, as well as fishery and women's rural development societies.

9.6 Notes on public consultations with the affected parties during ADB Fact Finding Mission to Mannar Wind Power Development Project on 18 and 19 February 2017

9.6.a. 18 February 2017 (2:00 pm) meeting held at Sinnakarisal with the Fishery Society

Around 20 fishermen were there for the meeting.

No	Concerns of Fishermen:	Answer
1	When you unload things from the ships we can't do Ma-del fishing in that particular area. So will you pay compensation for us on those occasions?	Yes. The CEB will pay the compensation on the fair basics to everyone those who lose their income while we do any kind of project related activities at the sea as well as on the sea shore.
2	What is the distance between the beach and the wind turbine?	The wind turbines will be built 150-160 m distance from the beach.
3	Did the other villagers accept this project?	We are not asking consent from any other villagers. As per the policy of the ADB we are discussing and getting their views about this project from the people.
4	According to me the fishing is affected because of the Sethu Samudran plan. Is it true?	It is not part of this project. This is just a proposal and it was not done. Then the fishing is affected mostly by the bottom trawling of the Indian trawlers.
5	Can you do something to solve this Indian	We can't do anything but that has to be solved by the two

No	Concerns of Fishermen:	Answer
	trawling problem?	government authorities.
6	These days we are mostly staying at home without enough fishing. Can you give us some work opportunity during the construction time?	Surely, we will consider the people from this area according to their qualification. Now CEB also has decided to give some permanent job opportunity to the people those who are affected by the project.
7	I have read an article which says that in Ilanthaijadi (Puttalam) the fish is chased away from the sea shore to deep sea because of the noise which comes from the tower. Is it true?	Nowhere in the world these kinds of things happened and this kind of things are not proved scientifically. We have done so many researches on this topic and there is no possibility to occur such kind of activity.
8	Will the wind turbine fall down or break down? If it happens it will affect the people?	The project is located away from all permanent settlements. The minimum distance between the project location and the settlement is 800m. Besides there are some temporary Vaadies. This project will also follow the maximum safety precautions because the money invested in this project is quite huge. So, everything will be done with high technology guidance and safety.
9	If anything goes wrong in future what will you do?	There is no possibility for any mistakes or problem in the project in future. We will also be doing continuous maintenance. The wind mill project which is there in Puttalam has been set up by the private sector but here it is going to be erected by the CEB, a government body. CEB will do the best which suits the people. We will not do something that will harm the people. All erection work will be done under the quality engineering supervision from the government.
10	When the fans circulates continuously will it create dryness, soil erosion and air pollution in and around of the tower location?	When the rotors circulate they don't produce air or heat because they circulate due to the wind force in that area. Similarly, the machine doesn't release any waste gas and therefore there is no air pollution. The noise comes from the blades, when it faces the wind to circulate and it doesn't come from the machine so there is not heat generated in that area that may cause dryness.
11	How are you going to transmit the electricity produced by the wind mill?	The cables from the wind turbine will be laid up to the Nadukuda substation through the underground cable system. From there it will be transmitted to Puthukamam substation through 220 kV overhead transmission line.
12	Will you reduce the prices of the electricity after this project?	The electricity prices are not fixed by us it is fixed by the Public Utility Commission. The cost of producing electricity from this project is very low comparing to the other methods of producing electricity. If they reduce the price it will be for all the consumers throughout Sri Lanka.
13	Will this project have any impact on water or water sources?	No, this project will not have any effects on water or water sources. The project is situated away from the settlements. We will also do some community services by setting up some dug wells and tube wells.
14	Do you have any idea to build up wind farms in the Northern costal side?	This project is not building wind mills in the Northern costal side. Any future development of the wind turbines will use the Northern wind energy also.
15	We do Ma-del by seeing the birds flying above the sea. So when you put up turbines in the costal belt the birds which go from Southern to Northern side will be affected. Whether the birds follow the fish to go to the Northern side or they go by crossing the land area?	The birds follow the group of fish or they fly along the costal belt to go to the Northern costal side. They don't cross the land area to go to the other side. We are studying about the birds' behavior for more than 3 years. The area we have selected for the project is a less impact area for birds.

No	Concerns of Fishermen:	Answer
16	If there are no negative effects, why are you often coming to meet us?	It is the policy of the ADB to consult the people from the project area before, during and after the project. Therefore, we are consulting you very often about this project.
17	How are you going to transmit the electricity from the Nadukuda substation?	From Nadukuda, the electricity will be transmitted through a 220 kV transmission line to Puthukamam, then from there onwards, it will be transmitted to Vavuniya and then onward connect to the national electricity supply chain.
18	Will you pay compensation to the Palmyra trees which will be cut down during the transmission line construction?	Yes, we will value the price of the Palmyra tree. Then we will pay the compensation. We will also try our maximum to minimize the numbers of the trees to be cut down because most of the women from Mannar depend on Palmyra production.
19	If the transmission lines break up in any point in its way will there be forest fire?	In Sri Lanka, there are so many transmission lines all over the country. Nowhere such incident happened because the right of way of the transmission line is 17.5m for each side and we will clear the tall trees. So, there is no possibility for forest fire. The project will be constructed following high international based safety methods.

	Questions from the ADB consultants	
	Questions	Answers
1	How many fishery society are there in the project location and from which society they belong to?	There are 06 fishery societies in the project area from Sinnakarisal.
2	Do all the fisher men are members of one society?	Yes, the mechanized boat owners, Ma-del owners and the Ma-del labors are members in one society. But the migrant Ma-del labors are not members in the society.
3	How do they pay to the Ma-del laborers?	They divide the profit into three and the Ma-del owner takes 1/3 of the income and the balance 2/3 income will be shared among the labors equally. But the migrant Ma-del labors are paid fixed salary if the owner is also from the out of the district.
4	Do the Ma-del fishermen stay at the beach?	The local Ma-del labors stay at the hut at the beach if they do the fishing at night but the migrant Ma-del labors and the owners stay at the hut at the beach continuously throughout the season between October to April.
5	What is the time of day/night they prefer to have the less noise at the beach?	We prefer less noise during the day time because after the night fishing activity we sleep during the day time so we prefer less noise during the day time. But during fishing season, we will stay continuously in the hut at the beach. So, we may sleep during day and as well as night time according to we do the Ma-del fishing.
6	There are 2 ways to build jetty. One is digging the soil to deepen the sea bed and another one is building by using iron rods. Which one do you like?	We prefer the jetty which is going to be built by using the iron rods because even you cover the digging area after the project sometimes there may be soil erosion in that area. If there is soil erosion we will not be able to do Ma-del fishing in that particular area. If you want to clarify these issues speak with the Ma-del owners from Pesalai because they do the Ma-del fishing in that area.
7	How many of you have seen the wind mill?	Three of us have seen closely but others have seen it while travelling.

Public consultation at Siinakarisal Community hall with the Fisheries societies





List of participants
Participant Group: Fishery Society
Venue: Sinnakarisal Community Hall
Date: 18 February 2017

No	Name of the participant	Male/Female	Occupation/Status
1	C.N.Delvin Culas	M	Grama Niladari
2	V.Rex Culas	M	Fisher Man
3	A.Emiliyanis Pillai	M	Fisher Man
4	A.Anantham	M	Fisher Man
5	A.Kamildan	M	Fisher Man
6	T.Dinosan Coonghe	M	Fisher Man
7	K.Selvanayakam	M	Fisher Man
8	S.Jude Jenujan	M	Fisher Man
9	R.Nesan	M	Fisher Man
10	M.Sebamalai fernando	M	Fisher Man
11	S.Jeyachandran	M	Fisher Man
12	M.Theva Thayaparan	M	Fisher Man
13	R.Thinesh	M	Fisher Man
14	S.R.Sunthar	M	Fisher Man
15	C.T.C.Selvaratnam	M	Fisher Man
16	S.Chandru	M	Social Service
17	S.Rajenram	M	Fisher Man
18	A.A.T.Eranjeewa	M	Engineer
19	J.A.S.A.Jeyasinghe	M	Engineer
20	R.Y.Wijeyaratna	M	Engineer
21	P.Pushaparuban	M	Engineer
22	Ranjith Kumara	M	Engineer
23	Kelum Niroshana	M	Engineer
24	T.Sasinath	M	Electrical Superintendent
25	S.Douglas	M	Research Assistant
26	Dr.Kamal Ranathunga	M	Marine Researcher
27	Thilak Hewawasam	M	ADB consultant
28	Devaka Weerakoon	M	ADB consultant
29	Rajat Jain	M	ADB consultant
30	Yun Zhou	F	ADB Staff
31	Emma Marsden	F	ADB
32	Yoojung Jang	F	ADB
33	S.A.Fernando	M	GN Admin
34	Andrew Wright	M	Wind consultant

9.6.b 19 February 2017, meeting held at Konniyankudiyirupu church (9:45 am) with the Women's Rural Development Society.

Around 19 women participated in the meeting.

No	Concerns of Fishermen:	Answer
1	We heard from the people that the noise from the wind turbine reduce the amount of catching the fish. Is it true?	The wind turbines are located 140m from the vegetation. The sound which comes from the wind turbine will be heard as sound of an A/C machine after 150m. So it is not a big noise and it will not be transmitted into water. The fish do not react to the sounds from outside and they react to the vibration. The fish resource is at risk because of the pollution and over fishing.
2	Won't it affect the Ma-del fishing? We fear that it may reduce sea shore fish resource.	It is not true. All over Sri Lanka the fishermen are struggling without enough catchment of fish. It is because as I have said

No	Concerns of Fishermen:	Answer
	Is it true?	earlier the fish resource is at risk because the reproduction of the fish resource is controlled by over fishing. So you have to reduce the number of the fishermen or have to reduce the number of days. In other days you can use your boats and nets for tourism such as to show the fishing methods to the tourists.
3	Are there any health related issues by this project?	This project will not release any gas or gasoline wastes. It is an environment friendly project. It will not pollute the air or water. Therefore, there won't be any problem to the health of the people.
4	If there is any problem in the future where shall we go to inform our problem about this project?	There is a wind energy project office at Emil Nagar, Mannar. You can go there and speak with the officers about your problems or else you can also speak through your Grama Niladhari
5	Can you give us a consent letter that whenever we come to your office to speak about any issues you will solve that problem immediately?	This project is going to be done by the CEB. It is a government organization. If they don't listen to you in future then you can make complain to the public utility commission. They will have the rights over CEB to inquire about the problem.
6	How do you pay compensation for the trees and land?	There will be a committee to value the trees and the properties. Then through them we will pay the compensation to the public.
7	Some wells are becoming salty water, what is the reason for that?	In Mannar area there is a good water source as well as the salt water source. When you use it continuously by pumping the water through the water pump for any agricultural purposes, the salt water also comes up.
8	When the fans circulates continuously will it create dryness in and around of the tower location?	When the fans circulate they don't produce air or heat because it circulates due to the wind force in that area. The noise comes from the blades, when it faces the wind to circulate and it doesn't come from the machine so there won't be heat in that area to create dryness.
9	Will the turbines use the northern wind also to circulate?	Yes, the turbines will turn to the Northern side when there is a windy season. It produces 2/3 electricity from the Southern windy season and 1/3 of electricity from the Northern windy season.
10	There is a bat colony in our village; will this project disturb the bat colony?	No, this project will not disturb them and the bats don't fly towards the beach side.

Suggestions from the participants

- There is a 1 km short cut road to the beach from our village through the forest. 100m of that gravel road is already there. If you can please make that balance road for us, so that we can easily go to beach.
- When selecting laborers for the construction work please give priority to our villagers.

List of participants
Consultation with Women's group- Konniyankudiruppu Church, 19 February2017





Participant Group: Women's Rural Development Society
Venue: Konniyankudiyirupu
Date: 19 February 2017

No	Name of the participant	Male/Female	Occupation/Status
1	V.Mary Rebeka	F	Student
2	R.Pilominal	F	House wife
3	C.Priyatharshini	F	House wife
4	K.Mariya Thasan	M	Labor
5	J.Gnasekaram	M	Fisherman
6	S.Mary Kanista	F	House wife
7	V.Phillipa	F	House wife
8	M.Gnanasothy	F	House wife
9	J.Jenibereata	F	House wife
10	L.Amalajothy	F	House wife
11	K.Reginakumary	F	House wife
12	P.Mary Vijilija	F	House wife
13	D.Washintina	F	House wife
14	M.Mariyai	F	House wife
15	P.Mary	F	House wife
16	A.J.Sahayarani	F	House wife
17	P.Sahayamary	F	House wife
18	S.Thusiyanthan	M	G.N
19	A.A.T.Eranjeewa	M	Engineer
20	J.A.S.A.Jeyasinghe	M	Engineer
21	R.Y.Wijeyaratna	M	Engineer
22	P.Pushaparuban	M	Engineer
23	B.M.P.Singhakumara	M	RMA
24	S.Kaneshamoorthy	M	E.S
25	T.Sasinath	M	E.S
26	S.Douglas	M	Research Assistant
27	Dr.Kamal Ranathunga	M	Researcher
28	Thilak Hewawasam	M	ADB consultant
29	Devaka Weerakoon	M	ADB consultant
30	Rajat Jain	M	ADB consultant
31	Yun Zhou	F	ADB Staff
32	Emma Marsden	F	ADB
33	Yoojung Jang	F	ADB
34	S.A.Fernando	M	GN Admin
35	Andrew Wright	M	Wind Energy consultant
36	S.Parisuthan	M	E.S
37	V.Nitharsan	M	E.S
38	K.P.D.Kariyawamsam	M	E.S
39	A.J.M.Hasumayan	M	E.S
40	L.K.Senanayaka	M	CEB
41	S.Anthonikama	F	House wife

9.6.c 19 February 2017 meeting held at the Nadukuda community hall with the Nadukuda Fishery society.

	Questions from ADB	
	Questions	Answers
1	How many Ma-del labors are here in the meeting?	One was present there but there are many Ma-del labors in the village. There were 5 boat owners in the meeting but there are 25 registered boats in their society. Nadukuda is their landing side - they don't have any other landing side. During the off season, few boats go to the northern sea for fishing. They don't stay in the beach at night. They come back home after the fishing activity.
2	What is your idea about the temporary jetty?	They lay nets 1 km from the sea shore for Kumbala fish. When you unload the things the nets may be carried towards the jetty by the water current which will be created by the ships that come to the shore to unload the things. The nets may get torn when it struck with the iron rods of the jetty. They have requested earlier to shift the jetty 100 m towards Nadukuda so that we will also benefit by the compensation.
3	When the unloading of things at Jetty will take place, Ma-del will not be able to fish in the area.	CEB will pay the compensation during the time they lose their income. The compensation will be paid after the proper assessment by a committee designated for it.

Suggestions from the people

- You can hire the boats and labors for the construction from us.
- When you hire the labors for the construction give priority to villages that are very closest to the project location.
- When you pay compensation consider us more than the fishermen from Pesalai because they have landing side and Ma-del padu in the southern and Northern costal belt.

Meeting with the Fishery society- Nadukuda community Hall, 19 February 2017

List of participants

Participant Group: Fishery Society
Venue: Nadukuda Community Hall
Date: 19 February 2017

No	Name of the participant	Male/Female	Occupation/Status
1	T.Estan	M	Fisherman
2	A.Arokianathan	M	Fisherman
3	A.Anthony	M	Fisherman
4	J.Kristin	M	Fisherman
5	T.Manuvel Francis	M	Fisherman
6	T.Gnanaprakasam	M	Fisherman
7	M.Vivek	M	Fisherman
8	S.Vaseekar	M	Fisherman
9	V.Sebastiyan	M	Fisherman
10	L.Susanthan	M	Fisherman
11	T.M.Francis	M	Fisherman
12	Anthonythas	M	Fisherman
13	S.Jude	M	Fisherman
14	A.A.T.Eranjeewa	M	Engineer
15	J.A.S.A.Jeyasinghe	M	Engineer
16	R.Y.Wijeyaratna	M	Engineer
17	P.Pushaparuban	M	Engineer

No	Name of the participant	Male/Female	Occupation/Status
18	B.M.P.Singhakumara	M	RMA
19	S.Kaneshamoorthy	M	E.S
20	T.Sasinath	M	E.S
21	S.Douglas	M	Research Assistant
22	Dr.Kamal Ranathunga	M	Marine Researcher
23	Thilak Hewawasam	M	ADB consultant
24	A.J.Dias	M	Research Assistant
25	V.Nitharsan	M	E.S
26	Yun Zhou	F	ADB Staff
27	Emma Marsden	F	ADB
28	Yoojung Jang	F	ADB
29	S.A.Fernando	M	GN Admin
30	L.K.Senanayaka	M	CEB
31	S.Parisuthan	M	E.S
32	K.P.D.Kariyawamsam	M	E.S
33	A.J.M.Hasumayan	M	E.S

9.6.d Meeting with the Director / Fisheries Mannar- Dept. of Fisheries, 19 February 2017 (Stakeholder)

C. Project Consultation (December 2016-2017)

9.7 Consultations with six villages

1. 21 small group discussions in December 2016 and January 2017, in six villages (Konniyankudiyrippu, Uvari, Olaiththoduvai (including Valan Nagar), Nadukkuda, Keeliyankudiyiruppu, and Selvari, about 850 m to 1.5 km from the wind power generation project site).

Brief Description of the village Konniyankudiyiruppu

2. Konniyankudiyiruppu village has almost 300 years of history as said by the villagers. Now there are 55 households. The villagers displaced in 1991 due to war. And after that they were resettled in the village by a local NGO SewaLanka in 2001. SewaLanka provided them temporary shelter. In 2006 Arbeiter-Samariter-Bund Deutschland (ASB) Germany based INGO built permanent houses to the villagers. The main income generating activity of this village is fishing. Most of them are fishery laborers. There is only one ma-del fishing net for the village. The villagers are having ma-del fishing area problem with Pesalai people. The villagers also engage in preparing Palmyra products. The women earn nearly Rs.20,000 to Rs.25,000 per year by selling Palmyra roots. Villagers have cattle. There are nearly 60 cows and 150 goats. The animals found in the nearby jungle are pig, deer, mongoose, wild cat, land monitor, peacock, monkey (two types: ash color with black face, and brown color with red face), rabbit and crocodile. The village is flooded if there is a heavy rain, mostly in November and December. A local NGO (World Vision) is doing a 4-year project in Konniyankudiyiruppu. They provide vegetable seeds and seedlings of trees to the villagers.

Brief Description of the village Uvari

3. Uvari is a very small village close to Olaithiduwai. There are only six households in the village. They all are close relatives. Altogether there are 17 individuals in Uvari, five men and 12 women. There are three school going children at the village. Two girls go to Olathoduwai school and one girl goes to St. Xavier’s Girls College. Uvari people displaced from their village in 1990 due to the war. Before 1990 there were 12 families with 60 individuals.

4. There is a church in Uvari (St. Antony’s Church). Holy mass is conducted in the church every first Tuesday of every month. The church comes under the Thoddaveli Parish.

5. Wild boar from the nearby forest damage their Palmyra seed beds while the monkeys break the drumstick trees.

Brief Description of the village Olaiththoduwai

6. Olaiththoduwai is an old Roman Catholic Village. According to villagers the people form Thoddaveli moved to Olaiththoduwai after the King Sankiliyan killed the Hindus who converted themselves as Catholics. There are 15 households with 70 individuals in this village. The people displaced form Olaiththoduwai in 1990 due to the war and returned in 2001. In 2004 NEHRP provided a housing scheme to the villagers. The church in Olaiththoduwai is famous for Catholics. Many Catholics from all over Mannar visit this church. This church was built in 1834. There is a school in Olaiththoduwai. The students can continue their studies up to Grade 10.

7. Nine women are engaged in Palmyra juice production activity. They get fifty rupees per liter.

8. The main environmental threat is sand mining. The private land owners mine the sand. Villagers are afraid of this activity.

9. There is another village in Olaiththoduwai it is called Valan Nagar. People from different areas in north who displaced due to the war were settled in this village. The 7-acre land which belongs to Church is divided in to 1/8 acre and given to people. There are 43 households in Valan Nagar with 150 individuals. The villagers were provided with a housing scheme by UNDP housing project during the years of 2006-2008. Most of the villagers are fishery laborers.

Brief Description of the village Nadukuda

10. Nadukuda is a fishery village with 65 households. Total number of individuals in this village is 225. All the families are Roman Catholics except 2 Hindu Families. Each family has nearly one-acre land. There is a Velankanni Church in Nadukuda. Most of the Nadukuda people are from India. In 1998 World Vision provided 15 permanent houses to the villagers. Again, in 2008 UNDP provided another 16 permanent houses to the villagers.

11. There are 20 mechanized boats in Nadukuda. The villagers have no landing site or *ma-del* fishing area for them. Nadukuda people worked as fishery laborers to Pesalai people for a long time. Their parish and G.N Division also were joined with Pesalai. Later Nadukuda was separated and have a separate G.N Division. However, the Maadel fishing area belongs to Alkar Sammaddi, a famous Mudalai (vendor) from Pesalai. Nadukuda people are trying to register the Madal fishing area for their village. And they were told that this year (2017) they might have a Ma-del fishing site.

12. Most of the Nadukuda people wish the jetty proposed under the Mannar wind park project to be a permanent one. Because if the jetty is permanent and it belongs to their village, they can use the jetty for the fishing activities.

Brief Description of the village Keeliankudiyiruppu

13. Keeliankudiyiruppu is the village next to Nadukuda. It is in either side of Talaimannar - Mannar main road. The houses are located both sides of the road. There are 63 households in Keeliankudiyiruppu. All of them are Tamils. Forty-five families are Roman Catholic and the others are non-Roman Catholic.

14. The villagers displaced due to war in 1990 and returned in 2004. The average household land area in Keeliankudiyiruppu is half an acre. In 2000 World Vision supported some villagers to build the houses. In 2006 UNDP built 27 houses for the villagers.

15. St. Xavier church and St. Xavier preschool are in this village. The preschool teachers are paid by a local NGO called Valvuthayam. There are no primary or secondary schools in this village.

16. Most of the villagers have cattle. There are nearly 300 cows and 500 goats in Keeliankudiyiruppu. They take their cattle to graze to the nearby forest close to beach.

17. The villages said that they had seen wild boar, deer, wild cat, land monitor, fishing cat, rabbit, palm civet, monkey (two types: ash and black, brown and red), fox, mongoose, land turtle (three types) and crocodiles in their nearby forest area.

18. Most of the villagers are fishery laborers. There are four boat owners in the village. They are also engaged in animal husbandry.

Brief Description of the village Selvapuram (Selvari)

19. Selvapuram is a newly settled village belongs to Kaddukarankudiyiruppu GN Division. There are 40 households in Selvapuram with 28 Tamil families and 12 Sinhala families. The Sinhala families were settled in 2014 and Tamils were in 2003 and 2004. There are 28 Roman Catholic Families, 10 Hindu Families and 2 Non-Roman Catholic families in Selvapuram. The whole land belongs to Land Reclamation Commission (LRC). The average household land area of the villagers is 10 to 15 perches.

20. The people in Selvapuram do not have permanent houses. Only two houses are permanent, all the other houses are temporary. Except for three houses, all other houses have toilets. The toilets were built by the Red Cross.

21. Most of the villagers are fishery laborer (six women go to Talaimannar fish market to process the fish), and there are laborers and masons too.

22. According to the villagers, pig, deer, wild cat, rabbit, monkey (two types: ash and black, brown and red), fox, mongoose, land turtle (three types) and crocodiles are found in their nearby forest.

23. There are three Thonas (water bodies) in their area. There are only four goats in Selvapuram. But there are hens in almost every house.

24. There is an Army camp near Selvapuram. Flooding is the major environmental problem in Selvapuram. The village gets flooded in December every year and it takes nearly one month to drain the water.

#	Questions	Participants' Opinion, Comments and Suggestions
A.	General area related	
1	General perception about the Wind power project and the awareness about the proposed project.	No objection to the project as it is a government project. [Keeleankudiyiruppu] This project will definitely solve our district electricity problem so we support the project. [Konnaiankudiyiruppu] As there are no bad impacts by this project we support it. [Nadukkuda] The community is eager to learn more about the project. But they support the project. [Olaiththoduvai]. As it is an ecofriendly project we support. [Selvapuram] The villagers support the project if there are no harmful effects of animals' habitats as their village is close to the forest as well as to the project site. They fear if the animals are disturbed they may move to the village area. [Uvari]
2	Type of agriculture/crops in the area.	All the villagers are fishery villagers. They don't grow crops, but in all villages [Keeleankudiyiruppu, Konnaiankudiyiruppu, Nadukuda, Olaiththoduvai, Uvari]

#	Questions	Participants' Opinion, Comments and Suggestions
		home gardening is done in a small scale for the domestic uses. The vegetables grown are same in all villages [snake gourd, lady's finger, Brinjal (egg plant), long beans, green chilly, ground nuts, beans, red onion, and bitter gourd etc.] In Olaiththoduwai GN there is village called Valan Nagar. Their land is very small which is not enough to keep a home garden. In Selvapuram the villagers are not engaged in home gardening.
3	Number of households in the area/village, population of ethnic minorities etc.	In Keeleankudiyiruppu there are 63 households with nearly150 individuals. All of them are Tamils. 45 families are Roman Catholics and others are Non-Roman Catholics. All the people in Konnaiankudiyiruppu are Tamils and Roman Catholics. There are 55 households in Konnaiankudiyiruppu. There are 65 households with 225 individuals in Nadukuda. 2 families are Hindu Families the other families are Roman Catholics. 15 households are in Olaiththoduvai with 70 individuals. All of them are Roman Catholics. 43 households are in (Valan Nagar) Olaiththoduvai and 150 individuals. All of them are Tamils. In Selvapuram there are 40 households. 28 families are Tamils and 12 Families are Sinhala. There are 28 Roman Catholic Families, 10 Hindu families and 02 Non-Roman Catholic Families. In Uvari there are only 6 households. All of them are Tamils and Roman Catholics.
4	Loss of residential/ commercial/ agricultural structures /fishermen huts, if any due to the project	Except Nadukuda none of the villagers have any residential/ commercial/ agricultural structures /fishermen huts in the project area. In Nadukuda the fishermen rest room is nearly 80 m from the beach and St' Antony's church is 150 m from the beach. And also, there is a cemetery too which is 170 m from the beach. The area of the cemetery is 1 acre. Furthermore, very close to the sea (nearly 70 m) there are two temporary tea stalls. All these are not too close to the project area and not affected by the project activities.
5	Type of trees in the area: Fruit/non-fruit/commercial protected/rare/endangered species etc.	The vegetation found in these areas are same in all the villages. There are no protected/ rare / endangered spices. Fruit trees – mango, madan, palmyra, coconut, lemon, papaya, pomegranate and banana Commercial crop- palmyra, coconut, drumstick, madan, cashew Non-fruit trees – margosa
6	Will the project siting adversely impact the water or soil resource in the area? Which water supply points are being used by local people	The water supply point used by the villagers is private wells in home gardens. The depth of the well is between 3 -5 m. [Keeleankudiyiruppu, Konnaiankudiyiruppu, Nadukkua, Olaiththoduvai, Uvari] Selvapuram villagers collect water from a public well and some of them having wells in the home garden.
7	What/how much water is sourced from any inland water collection and stream in that location.	People do not collect water from Thonas (inland water channels) or inland water bodies.

#	Questions	Participants' Opinion, Comments and Suggestions
8	Any endemic, endangered birds/ mammals in the area. What type and numbers of rare/ endangered birds species and bats you have seen in the area	There are no endemic, endangered birds/ reptiles, and mammals in these areas, except Toque monkey, which is a common species in other parts of the country. There are number of birds, spotted deer, land turtles (three types- Indian star tortoise, black turtle (*gal ibba*), flapshell turtle (*kiri ibba*), land monitor, water monitor, garden lizard, *veli katussa*, fruit bats, sri lanka toque monkey, grey langur, jungle cat, fishing cat, brown mongoose, rabbit, wild cat, palm civet, wild boar, crocodiles (in thonas- water channels), peacock, etc.
9	Have you seen any nesting turtle/ dugongs on the beach as well in the coastal waters.	Nesting turtle is not seen recently. About three years' ago villagers had seen a few nesting turtles 15 – 50 m from the sea. The villagers said these days the turtles visit Adam's Bridge sand islands to lay eggs. The villagers say the wild boar eats the turtles' eggs when laid in the coastal area close to villages. There are 14 small islands in Adams bridge. We often see turtles in the coastal water nearly 1 km from the coast. And many are caught in ma-del nets during November and December. We release them back to the sea. There are no sea grasses in the sea close to the coast. Dugongs are seen in the sea very rarely. They were seen mostly in pairs. And they were 5 – 10 km from the coast and they were seen in March and April. Recently the Keeliyankudijiruppu villagers have seen 4 dugongs in 1 km from the coast (4 km form Old pier towards Mannar). The depth of water in the sea may be about 10 m. Last year the villagers have seen one dead dugong on the beach close to Nadukuda. More Dolphins are seen very often in the sea. The dolphins are seen very close to the coast.
10	Loss of community life such as any market Places or community activities that can be affected	No loss of community life. The project will not affect any market place or community activities.
11	General socio-economic standing: What are the economic activities besides fishing in the area? Land use in WT area – navy, residential, commercial, industrial etc. Average land holding size etc.	All the villages are fishery villages [Keeleankudiyiruppu, Konnaiankudiyiruppu, Nadukkua, Olaiththoduvai, Uvari and Selvapuram]. Besides, fishing the villagers are engaged in fishing related activities. [fishery laborer, cutting fish] rather than these almost all villagers are engaged in Palmyra related income generating activities [cutting Palmyra stroke, cutting Palmyra trees, toddy tapping/ collection. The villagers in Konnaiankudiyiruppu, Nadukkua, Olaiththoduvai, and Uvari collects firewood and sell them. During the off season the villagers are engaged in skilled labor works. [e.g. Mason] Few adults from Nadukuda work at Fish meal factory as laborers. And few women from Selvapuram go to Talaiamnnar fish market to cut fish.
12	Status of current environmental conditions in the area – air, dust, water pollution, noise conditions in the area.	All the villages come under the low noise zone. And there are no issues about water pollution or dust pollution. But in Keeleankudiyiruppu and Nadukkua people informed that they are experiencing bad smell from the Cool man ice and fish meal factory which is 1-2 km from both villages. Especially from September to April the smell is strong.

#	Questions	Participants' Opinion, Comments and Suggestions
13	Distance from protected areas (national park, protected forest, religiously sensitive sites, historical or archaeological sites), if any in the boundary or vicinity of wind park	The distance from Vankalai Sanctuary to the 1st WT is about 6.4 km. Vedithalativu Nature Reserve is about 3 km from the project site. WT 33 is about 800 m from the eastern boundary of Adam's Bridge Marine National Park.
B	Wind turbine related	
1	Are you aware that there will be noise interference- ie. the wind turbine may have noises related gearbox as well as wind shear and rotation of blade. Do you think it will be a nuisance to you.	The villagers were explained about the noise issue but they say their villages are far from the project. The shortest distance from wind turbines to a village is about 850 m (from WT 34 in second row to Uvari village).
2	Are there any livestock for cattle sheds in the area (what is the distance from WT) the turbines might cause temporary short-term annoyance or disturbance, but farm animals may eventually adjust noise pollution produced by wind turbines.	None of the villages have any livestock for cattle sheds in the project area. But the cattle use the area to go to the beach during the windy season to be free from mosquitoes at nights.
3	The wind turbine shall cause Shadow and light interference on your property. Do you have any issue on this.	The community have no issue on shadow and light interference. Reason- the settlements are far from the project area.
4	Have you seen the wind farm in Puttlam, do you think there is any adverse impact due to - visual impact, or noise or shadow flicker of blades	Only some villagers have seen the wind farm in Puttlam. They said that there would not be any negative impact by this project. Most of the villagers are very eager to see the Puttlam wind farm.
5	Do you think many turbines in landscape will cause any problem i.e. Spoiling of village or town views. (Pl show Photomontages if available). Do you think the layouts and photos are okay or you like to suggest some changes,	The turbines will add beauty to our environment. If the turbines are constructed in a straight line it will be more beautiful. The beach area will be beautiful after the construction of these turbines.
6	Are there any WT locations proposed near your belongings? Are they too close?	In Nadukuda there are two temporary tea stalls. But they are not too close.
7	Are you living in a temporary shed/camp which is situated besides the WT. Are you willing to move to a new location to avoid exposure to noise of the WT.	There are no temporary sheds or camps beside the WT.
8	Do you think that wind turbines would contribute to reduction in air pollution in Sri Lanka, oil and coal saving and also make the need for new power plants become less important	Definitely the turbines would contribute to the reduction of the use of coal power plants in our country.
9	Do you think that any of the WTGs proposed will cause danger for bats, migratory birds and local birds	There are bats in the forest area near the Konnaiankudiyiruppu and Nadukuda villages. But they fly to the nearby villages for food. The project area is not the crossing area of the migratory birds. Some migratory birds stay in the thonas. If the thonas are not filled there won't be any problem to the birds. Migratory birds come mostly in November and December.

#	Questions	Participants' Opinion, Comments and Suggestions
		And they land in the water therefore the wind turbine may not disturb them. We don't know whether the noise from the blades disturb the birds in the jungle.
10	WTGs could cause interference with radio or television in your area. What is the current type of TV/Radio/Cellphone reception in your area? Are you aware of any Masts/towers in the area whose Line of sight would be impacted.	We don't know
C	Impact on Fishing activity	
1	Status of the fishing community and their fishing activity during construction period). CEB will identify specific areas within the fishing area that will not be used for the project once the design for access road and design for Jetty pier is completed	The access roads to the beach should not be blocked during the construction period.
2	Do you think the fishing activity will be impacted by Jetty construction temporarily/permanently?	The fishermen who engage in ma-del fishing in the particular area will be affected during the construction and after the construction. The situation will continue until the jetty is dismantled. And also, the particular place can't be used as landing side. The arrival of the barges may disturb the ma-del fishing. In the other side, fish may breed in the jetty area and they can catch some fish there.
3	What is the season that local populations suggests for construction of jetty to minimize impacts.	The villagers suggest April – August which is off season for them and they don't engage in fishing during these months in the southern coast.
4	Area fishing community can continue to use the area after the jetty for fishing purposes is dismantled.	Please make sure that the pier/ jetty is dismantled completely. Because the foundations of the jetty may tear off the ma-del nets.
D	Safety measures during construction	
1	There is no waste generated except the maintenance required - oil or petroleum-based products. Wind turbines would require a periodic oil changes, particularly lubricants for the nacelle, but the process (of changing/using oil or lubricant) will be carried out as prescribed by the manufacturer with no problems to surrounding communities.	Do not dump solid waste in the village areas.
2	Fencing of area is not planned except protection of equipment parameter	Keep free access to the beach all the time. We need to graze the animals (cattle, goats) close to the beach and go for Ma-del fishing.
3	Construction sites will be cordoned or fenced off temporarily as a safety and security measure but fencing will not be done at the same time since wind turbine will not be constructed simultaneously.	We have no objections for fencing only the construction area of each turbine.
4	Although it is not possible, but you think that any blade can fall off or the WT could topple and cause injuries.	No. Even these fall off or WTGs topple it will not make impacts for our villages as we are more than 800 m away from the project site.

#	Questions	Participants' Opinion, Comments and Suggestions
5	Areas that will be affected by the construction activities CEB and its contractors will restore areas to their old condition that will be affected by the construction activities	Plant the trees once the constructions are over. We need to see the vegetation as these areas that were before the project.
E	Ecotourism Potential at Mannar	
1	Do you think that Mannar has enough attractive eco-tourism potential for development?	Mannar has enough attractive eco-tourism potential for development. Mannar is famous especially for its sandy beaches and sand dunes. Sand dunes are mostly found in Pesalai and Thalaimannar. And many local and foreign tourists visit Adam's Bridge. The other tourist attractive places in Mannar are Dutch Fort, Talaimannar Light House, Thoddaveli Church, Madhu Church, Thiruketheswarm Temple and 40 feet man's tomb.
2	Will the wind park lead to any interference in scenic areas/nature	The wind parks may add beauty to our environment.
3	Which stakeholder do you think is the most important roles in the process of ecotourism development in Mannar? A- Government and related departments B- Non-Profit organizations (i.e. environmental groups, NGOs) C- Business organizations (i.e. tour operators, travel agency) D- Local community and people E- Visitors F- Others	C- Business organizations are playing the major role in tourism in Mannar. [e.g. Kaluthota Finance, Shell coast hotel, Palmyra House etc.]
F	Benefits	
1	Wind farm development will bring a lot of commercial activity to the Mannar island - preparation of municipal development plan and budget They can be assured that the level of activity at the wind farm site will increase with the presence of the contractors working on the civil works, cable trenches, site surveying, etc.	People are aware that the wind power project will bring development to the Mannar island. People suggested to hire them as laborers and semi-skilled workers for the project during the construction and operation. People for technical jobs could be hired outside. The outside workers would stay in Mannar town or in project site facilities but not in the villages.
2	Hiring of staff for foot patrol for the wind farm will done for operations and management	Villagers are expecting that they would get job opportunities such as security guards/ watchers
3	Will CEB increase its CSR programs as it starts to generate electricity	All the villagers requested to upgrade/ repair the internal roads to their villages. Repairing the Kalachikadu internal (Gravel) (1.5 km) road. [Keeleankudiyiruppu] Upgrading the internal road and if the CEB builds a common building (community hall) for our village we will be happy. [Konnaiankudiyiruppu] Upgrading the internal roads and developing the beach area for tourism. [Nadukkua] Upgrading the internal road and constructing the parapet

#	Questions	Participants' Opinion, Comments and Suggestions
		wall to Community hall. [Olaiththoduvai] Upgrading the internal road [Selvapuram]. Upgrading the internal road from Olaithoduvai and repairing the street lights. (there are 3 lights, but only one is working) [Uvari]
F	Others	
1	What other organizations of an environmental nature (NGOs/CBOs/ Civil Society) active in the area? Name of these organizations	World Vision is the active NGO in the villages for environmental issues. World vision is doing a four-year (2013-2017) project in the villages. [Keeleankudiyiruppu, Konnaiankudiyiruppu, Nadukkua, Olaiththoduvai, Uvari]. Selvapuram Village is not selected by World Vision for this project. They provide some fruit plants such as mango, guava coconut, pomegranate and some vegetable seeds (beans, brinjal, bitter gourd and lady's finger). Palmyra Development Board also planted Palmyra seeds in Konnaiankudiyiruppu area. Last year (2016) Agricultural Department has given some fruit plants (Mango and Drumstick) to Nadukkua villagers. Keeleankudiyiruppu villagers got hens and goats from Kachcheri (Divisional Sec. office) through Samurdhi and Selvapuram villagers received Mango, pomegranate and coconut plants.
2	Any critical environmental issue or concern by the local people regarding the project?	Flooding is the main issue in all the villages. During November and December, the villages get flooded. It takes nearly 20 days to drain. The water drain through the thonas (water channel). The community is very concerned about the thonas and they suggest not to change the features or block the thonas when carrying out the project. The others minor issues are related with grazing animals. [Keeleankudiyiruppu] The dogs in the coastal area attack the goats. Keeleankudiyiruppu villagers suggest to keep enough spaces between the wind turbine which come very close to their access roads to the beach. Deforestation may cause drought so avoid cutting trees. There are some Banyan trees where bats roost at day time, avoid cutting those trees too. [Konnaiankudiyiruppu] Soil/ sand erosion is the main environmental issue in our village. The strong wind takes away the sand from our village. We have to grow cover plant to control the soil erosion. [Nadukuda] Sand dunes are the special features of our area. Please avoid mining sands from the dunes for the construction work. [Olaiththoduvai] Please avoid clearing the trees/ vegetation such as Pandanus trees and other bushes/ shrubs in the beach. [Uvari]

Small group discussions, Environmental questionnaire (Mannar Wind Power Development Project)

No.	Date/Time	Village	Coordinates/ Distance from the nearest WT	Name of the area	No. of Participants
1	29.12.2016	Konniyankudiyrippu	09.02258 79.84779 1.1 km from No.5	Near the shop (Shop owner - J.Vethanayakam)	02
2	29.12.2016	Konniyankudiyrippu	09.02347 79.84505 985 m from No.6	Near the shop (Shop owner - D.Voshingtina)	03
3	29.12.2016	Konniyankudiyrippu	09.02226 79.84870 1.152 km from No. 4	In a house at the church road (House Owner - C.Regena Kumari)	05
4	29.12.2016	Uvari	09.04250 79.83150 904 m from No. 34	In a house near Uvari church (House owner - P.Cathareena)	04
5	29.12.2016	Olaiththoduvai	09.03677 79.84133 1.895 km from No. 8	In a house, opposite to the public well (House owner - S.Edward)	03
6	30.12.2016	Olaiththoduvai	09.03642 79.84097 1.830 km from No. 9	In a house opposite to Olaiththoduvai school (House owner- J.Mariya Koratti)	05
7	30.12.2016	Valan Nagar	09.03903 79.84309 2.195 km from No. 9	In a house in the first lane (House Owner - A.Amaladhas)	04
8	30.12.2016	Valan Nagar	09.03936 79.84198 2.155 from No. 9	In a shop near the Olaithoduwai main road. (Shop Owner - J.G.Maxsimas)	03
9	30.12.2016	Valan Nagar	09.03958 79.84248 2.225 km from No.8	In a house at the second lane (House Owner - V.Rex Culas)	02
10	30.12.2016	Konniyankudiyrippu	09.02139 79.84966 1.136 km from No.4	In a house at the entrance of the village (House owner - G.Mariathasan)	04
11	31.12.2016	Nadukkuda	09.05753 79.79519 1.005 km from No. 22	In a house at the end of the village (House owner - S.Grogory)	03
12	31.12.2016	Nadukkuda	09.05069 79.78680 350 m from No. 22, 290 m from No. 23	In a tea stall at the beach (Tea stall owner - A.Anat Jancy Rani)	02
13	31.12.2016	Nadukkuda	09.06139 79.79341	In a house in front of the church (House	03

				Owner - T.M.Francis)	
14	31.12.2016	Nadukkuda	09.06298 79.79489 1.532 km from No. 22	In a house in the first lane (House owner - J.Christine)	04
15	22.01.2017	Keeliyankudiyiruppu	09.06893 79.77815 1.251 km from No. 28	In a house at the beginning of the road just opposite to the church (House owner – M.Emiliyanus)	04
16	22.01.2017	Keeliyankudiyiruppu	09.06592 79.77599 850 m from No.22	In a house at the end of the village. (Sea side) (House Owner – S.Soosiyappu)	04
17	22.01.2017	Keeliyankudiyiruppu	09.06831 79.78452 1.495 km from No.26	In a house, close to Mannar – Talaimannar Main road. (House owner – P.Xavier)	04
18	22.01.2017	Selvari	09.07525 79.77050 1.552 km from No. 31	In a hut near the Selvari army camp	05
19	22.01.2017	Selvari	09.07580 79.77097 1.625 km from No. 31	In Selvari Community hall	05
20	23.01.2017	Uvari	09.04250 79.83150 904 m from No. 34	In a house near the Uvari church (House Owner – P.Cathareena)	04
21	23.01.2017	Keeliyankudiyiruppu	09.06828 79.78214 1.390 km from No. 26	In a house in the road just opposite to the bus halt (House owner – A. Wilfred)	02

LIST OF PARTICIPANTS

S	Name of the Participant	M/F	Name of the village	Occupation
1	M.Emiliyanus	M	Keeleankudiyiruppu	Employee in a foreign country
2	K.Sutharsan	M	Keeleankudiyiruppu	Fishing
3	S.Gowerytharan	M	Keeleankudiyiruppu	Painting
4	S.Dilaxsan	M	Keeleankudiyiruppu	Labourer
5	S.Soosaiyappu	M	Keeleankudiyiruppu	Labourer
6	P.Arulseelan	M	Keeleankudiyiruppu	Carpenter
7	S.Fatima	F	Keeleankudiyiruppu	Housewife
8	S.Jenita	F	Keeleankudiyiruppu	Student
9	P.Xavier	M	Keeleankudiyiruppu	Fishery laborer
10	P.Robinsion	M	Keeleankudiyiruppu	Labourer
11	P.Rosemary	F	Keeleankudiyiruppu	House wife
12	P.Prinson	M	Keeleankudiyiruppu	Student
13	A.Wilfread	M	Keeleankudiyiruppu	Fishing
14	T.Esline	M	Keeleankudiyiruppu	Fishing
15	C.Regena Kumari	F	Konnaiankudiyiruppu	House wife
16	J.Amalashlee	F	Konnaiankudiyiruppu	House wife
17	S.C.Killer	M	Konnaiankudiyiruppu	Mason
18	M.Mariyai	F	Konnaiankudiyiruppu	House Wife
19	U.Pirakasam	M	Konnaiankudiyiruppu	Fishing
20	J.Vethanayakam	M	Konnaiankudiyiruppu	Fishing
21	V.Mary Juditta	F	Konnaiankudiyiruppu	House wife
22	S.Francis	M	Konnaiankudiyiruppu	Fishing
23	F.David	M	Konnaiankudiyiruppu	Security Guard
24	D.Voshingtina	F	Konnaiankudiyiruppu	House wife
25	M.Manoharan	M	Konnaiankudiyiruppu	Fishing
26	G.Mariathasan	M	Konnaiankudiyiruppu	Fishing
27	S.Suba	M	Konnaiankudiyiruppu	Fishing
28	J.Sebastian	M	Konnaiankudiyiruppu	Attendant
29	S.Grogory	M	Nadukkuda	Fishing
30	G.Christeena	F	Nadukkuda	House wife
31	G.Silvia	F	Nadukkuda	Student
32	E.Arul Kajenthiran	M	Nadukkuda	Fishing
33	A.Anat Jancy Rani	F	Nadukkuda	House wife
34	T.M.Francis	M	Nadukkuda	Fishing
35	A.Pirasath	M	Nadukkuda	Fishing
36	F.Maria Mathalena	F	Nadukkuda	House wife
37	J.Christine	M	Nadukkuda	Fishing
38	M.Nesanayagam	M	Nadukkuda	Fishing
39	C.Viyakulamery	F	Nadukkuda	House wife
40	N.Arokiyam	F	Nadukkuda	House wife
41	A.Salamon	M	Olaiththoduvai	Fishing
42	J.Mariya Koratti	F	Olaiththoduvai	House wife
43	S.Jerosiya	F	Olaiththoduvai	House Wife
44	S.Maristella	F	Olaiththoduvai	Student
45	A.Dorin	F	Olaiththoduvai	Student
46	S.Edward	M	Olaiththoduvai	Fishing
47	V.Pavulina	F	Olaiththoduvai	House wife
48	V.Amirthanayagam	M	Olaiththoduvai	Labourer
49	A.Sakayam	M	Olaiththoduvai	Fishing
50	J.G.Maxsimas	M	Olaiththoduvai	Fishing

51	M.M.Nirmalaraj	M	Olaiththoduvai	Fishing
52	A.Amaladhas	M	Olaiththoduvai	Fishing
53	A.Karolin Rani	F	Olaiththoduvai	House wife
54	A.K.Thekkilamma	F	Olaiththoduvai	House Wife
55	S.Vimal Dabancious	M	Olaiththoduvai	Private Sector Employee
56	V.Rex Culas	M	Olaiththoduvai	Fishing
57	M.Theva Thayaparan	M	Olaiththoduvai	Fishing
58	J.Koneswaran	M	Selvapuram(Selvari)	Meason
59	S.Jegatheeswaran	M	Selvapuram(Selvari)	Fishing
60	K.Thileepan	M	Selvapuram(Selvari)	Fishing
61	K.Mohnathas	M	Selvapuram(Selvari)	Fishery Labourer
62	S.Jeganathan	M	Selvapuram(Selvari)	Fishing
63	M.Vijayaluxmi	F	Selvapuram(Selvari)	Labourer
64	S.Ramani	F	Selvapuram(Selvari)	Fishery laborer
65	P.Thanaluxmi	F	Selvapuram(Selvari)	Fishery laborer
66	R.Siri	F	Selvapuram(Selvari)	Fishery laborer
67	A.Mery Vijaya	F	Selvapuram(Selvari)	House wife
68	P.Victoria	F	Uvari	House wife
69	P.Cathareena	F	Uvari	House wife
70	P.Esthar	F	Uvari	Student
71	A.Antony Mary	F	Uvari	House wife
72	S.Jacobu	M	Uvari	Fishery Labourer
73	F.Jerosious	M	Uvari	Fishery Labourer

Plate 1 Small group discussion 1- Konniyankudiyiruppu

Plate 2 Small group discussion 1- Konniyankudiyiruppu

Plate 3 Small group discussion 2- Konniyankudiyiruppu

Plate 4 Small group discussion 2- Konniyankudiyiruppu

Plate 5 Small group discussion 3- Konniyankudiyiruppu

Plate 6 Small group discussion 3- Konniyankudiyiruppu

Plate 7 Small group discussion 4- Uvari

Plate 8 Small group discussion 4- Uvari

Plate 9 Small group discussion -5 Olaththoduvai

Plate 10 Small group discussion 5- Olaththoduvai

Plate 11 Small group discussion 6- Olaththoduvai

Plate 12 Small group discussion 7- Valan Nagar

Plate 13 Small group discussion 8- Valan Nagar

Plate 14 Small group discussion 9- Valan Nagar

Plate 15 Small group discussion 10- Konniyankudiyrippu

Plate 16 Small group discussion 10- Konniyankudiyrippu

Plate 17 Small group discussion 11- Nadukuda

Plate 18 Small group discussion 12- Nadukuda

Plate 19 Small group discussion 13- Nadukuda

Plate 20 Small group discussion 14- Nadukuda

Plate 21 Small group discussion 15- Keeliyankudiyiruppu

Plate 22 Small group discussion 15- Keeliyankudiyiruppu

Plate 23 Small group discussion 16- Keeliyankudiyiruppu

Plate 24 Small group discussion 16- Keeliyankudiyiruppu

Plate 25 Small group discussion 17- Keeliyankudiyiruppu

Plate 26 Small group discussion 17- Keeliyankudiyiruppu

Plate 27 Small group discussion 18- Selvari

Plate 28 Small group discussion 18- Selvari

Plate 29 Small group discussion 19- Selvari community hall

Plate 30 Small group discussion 19- Selvari

Plate 31 Small group discussion 20- Uvari

Plate 32 Small group discussion 20- Uvari

Plate 33 Small group discussion 21- Keeliyankudiyiruppu

Plate 34 Small group discussion 21- Keeliyankudiyiruppu

9.8 Consultation with Migrant Laborer Fishermen

25. The six Grama Niladhari Divisions within which the WF cuts-across contains 418 mechanized boats (these boats are not permanently landed in a single location. They are landed intermittently in the landing sites of Nadukuda, Thoddaveli, Thavulpadu and Olaithoduvai during the southern fishing season); 240 non-mechanized boats and 1,497 fishermen as reported by the respective Grama Niladharis.

26. The inventory that we prepared for the Wind Farm area which includes the land area

between the coastline and the main access road contains three boat landing sites, about 516 mechanized boats [1] and 10 traditional fishing crafts, 39 fishermen camps (vaadi), and 22 *ma-dels* (beach-seine fishing).

27. Individual consultations were conducted with 50 migrant fish laborers who have been living in the project impact area. Consultations were part of a rapid survey conducted with migrant laborers. Of the 50 laborers, 47 (94%) have never heard about the wind farm project whereas the rest three laborers knew only a very little about the project. A majority, 42 laborers (84%) did not make any comment on the proposed project whereas another six (12%) mentioned that they are unable to comment on the project as they are completely outsiders to the area. Of the rest two laborers, one expressed his support for the project while the second objected to the project. The laborer who was in support of the project thought that the project would contribute to the development of infrastructure in the area and the illumination of the project area with lighting will secure their boats and fishing gear from theft and fishermen would be able to clean and mend their nets in the nights. The laborer who contended the project was of the view that the project will restrict the fishermen’s access to the beach by fencing off the area and the noise generated from the wind turbines would cause depletion of fish resource and the Ma-del industry. He suggested that wind turbines should be erected at least 500m from the areas occupied by the fishermen.

Meetings held with Fishermen for Fish Catch/*Ma-del* operations

Fish camping sites and interviewing key informant from each of the fish camping site.

	
Malivady (Anchu Thennampillai padu)	
	
Oolaithoduvai	

Uvari

Nadukuda 1

Nadukuda 2

Kiriyankuduyiruppu

	
Palavithotai	
	
Old Pier – 1	
	
Old Pier - 2	

Fish camping sites (left) and interviewing key informant from each of the ma-del padu (right)

Various moments of Ma-del Operations

	
Specially designed winches are common in Mannar for hauling the beach seine in order to reduce the man power	
	
Tractor used without winch can disturb the beach	

D. <u>IEE Development (March 2016 consultation performed during the conduct of IEE report of April 2016)</u>

9.9 Consultation with Villages: Date of Consultation 11-14 March 2016

Name of the villages: (i) Siluvai Nagar, (ii) Thalaimannar Station, (iii) Kattukaaran Kudiyiruppu, (iv) Konnayan Kudiyiruppu, (v) Nadukuda, (vi) Olaithoduvai, (vii) Pesalai
Name of the GNDs: (i) Thalaimannar South Village, (ii) Thalaimannar Town, (iii) Thullukudiyiruppu MN 53, (iv) Thodaveli MN 62, (v) Thullukudiyiruppu – Nadukuda, (vi) Olaithoduvai MN 60, (vii) Pesalai Ward - 08
Name of the DS Division: Mannar

No.	Issues discussed	Response
1.	**Immediate response to proposed project and critical issues**	We cannot say whether the project is good or bad. We have to discuss with the parish priest and the church committee. Decisions with regard to village issues are taken by the church committee in the Village. *'We all people are relations in this village. If we want to take any decision, we have to come together, and decide*. Many people in this village are engaged in '*ma-del*' fishing for their livelihoods. The project may affect the space available for fishing. Will the project cause loss of private properties of the people? How would the project take over the private land if required? Will the project supply electricity directly to our village? Because we still have problems with electricity. If you give electricity directly to us it is good for our society. Several villagers are engaged in animal husbandry such as rearing cattle and goats. Will the project affect the grazing grounds of cattle and goats? Will the project create any employment opportunities for people in the area? **(Siluvai Nagar; Thalaimannar Station; Kattukaaran Kudiyiruppu; Konnayan Kudiyiruppu; Nadukuda).** Huge waves and noise arise on full moon (poya) days. During such times, fishermen cannot engage in *ma-del* fishing because fishes move from shallow seas to the deeper seas due to this noise. Thalaimannar is one of the best places in Sri Lanka for abundant fish resource. Thalaimannar seas have a variety of fish. We have the fear that the noise generated by the wind turbines will affect our fish resource. Therefore, we need to discuss this with the fishery cooperative society and the fishery department in Mannar. Will the project affect ground water in this area? Will the project affect fish transportation and *ma-del* industry? There is a birds' sanctuary near the Old Pier in Thalaimannar. Can the project affect local and migrant birds that come to this area? **(Thalaimannar Station; Kattukaaran Kudiyiruppu; Nadukuda)**; We altogether can support this project if it benefits the people in this village. We have to discuss with the fishery committee because many of the people in this village depend on marine fishing. It is a concern for us. We have seen wind turbines in Puttalam. Will the project affect *ma-del* industry? Because some people find their livelihoods through the engagement as laborers for *ma-dels*. There are 5-6 *ma-dels* in this village. Will the project fence off the area where wind turbines are installed? If it was done, it would interrupt our transportation services along the beach. Will the project affect our private land and trees? Will the wind turbines affect our environmental species and dry out trees and their leaves? Will the wind turbine generate heat and affect our vegetation? Will the leaves of Palmyra and coconut trees be dried up? Will the project cause any oil leakages? **(Kattukaaran Kudiyiruppu; Konnayan Kudiyiruppu; Nadukuda).** We heard that people in Puttalam picketed against the construction of wind turbine in their area. Will the project cause any earth quakes? Will the noise of turbine fans reduce the reproduction of fish resource? How would the project affect *ma-del* industry? There are 5 *ma-dels* operated by fishermen from Pesalai. People of Konnayan
		Kudiyiruppau do not own any *ma-dels*. Will the project cause any solid waste problem? Will there be oil leakages from the wind turbine which in turn can pollute our ground water levels? **(Konnayan Kudiyiruppu).** We have seen the wind turbine in Puttalam. We want to know whether this project is good or bad. Our houses are affected by sand erosion during windy season. We fear whether wind tower fans will accelerate the sand erosion and affect our homes. Will the fans capture lightning during rainy season and affect our lives? Our settlements are closer to the project area. One participant said, 'We never experienced any problem with lightning during rainy time until now. But, after the implementation of this project we can be affected'. Can the project help to rehabilitate our village access road for better transportation? **(Nadukuda; Olaithoduvai).** Will the project be stopped/abandoned if it affected the fish resource and people's livelihoods? You mentioned that the distance between two turbines is 400 meters. If there was any access road in between the two wind turbine, what would happen to those access roads? **(Olaithoduvai).** This is a good project because it can reduce the cost of producing electricity in Sri Lanka. We can support this project if it benefits the people.

No.	Issues discussed	Response
		However, we need to discuss this project with the fishery committee because many of our people are dependent on marine fishing. A variety of birds come to Pesalai coastal area and they are both local and migrant birds from other countries. Will the project rehabilitate the Pesalai road during the project construction period? Will the villagers have access to use the road after its rehabilitation? A number of hotels are being built by people in the coastal area within an area of 250 meters from the coastal belt. Will this project affect such hotel construction works? Can the wind turbines be erected beyond 250 meters? Participants expressed their desire to visit and gain experience on how the other wind power projects such as the one in Puttalam operates. The Fishery Department has declared 199 meters from the coastal belt as a fishery zone for *ma-del* fishermen. But now if the wind turbine are erected within 150 meters from the coastal belt, *ma-del* fishermen will lose 49 meters from their declared zone. Will the project affect *ma-del* fishing? Mannar is a small island. If a buffer zone of 300 meters from the wind turbine is declared how the communities can expand their settlements in future? Will the project create employment opportunities for local communities? Will outsiders come for operation and maintenance work of the project? Will that create problems for our local communities? Can the project train and recruit local people for such maintenance work? Will the wind turbine be erected closer to the fishermen Vaadies? **(Pesalai).**
2.	**Type of compensation expected for losses**	None of the villagers have private land. All land belongs to the Church. The church has given the land to people on a small payment. Therefore, people cannot sell land to outsiders. They only can share land with family members or sell land to village people. Siluvai Nagar village is always under the control of the church. The project implementation agencies should talk with the parish priest. If the church has consented to the project, people will not oppose the project. There are no Palmyra or coconut trees in project area. However, there are some timber trees like '*Paalamaram' and Naaval maram'* in this area **(Siluvai Nagar).**Villagers do not own any land in the area identified for the project. However, we fear losing Palmyra trees for the project **(Thalimannar Station)**. All the villagers in this area have private land. But, none of their land would be affected by this project. But, some of Palmyra trees, *palu* and *damba* trees grown in the project area will be affected **(Kattukaaran Kudiyiruppu).** All the families have their own private land. We do not know how the project would affect our properties because we live about 2 km away from the coastal area **(Konnayan Kudiyiruppu).** All of families have private land. We do not have land in the project area. But, some Palmyra trees will have to be cut down. We do not know about compensation for losses. We always go and do the fishing in the coastal belt **(Nadukuda).** Families own private land. In this settlement, one side is occupied by natives of the village while on the other side is occupied by families resettled and who came from Batticoala, Jaffna and Kilinochchi. As such, there are internal conflicts between the two settlers. The land identified for the project in this area is government land and therefore will not affect the private land. But some Palmyra and other forest trees may have to be cut down (**Olaithoduvai).** The project will not affect any private land of the villagers **(Pesalai)**
3.	**Socio-economic background of the community**	This village is called Siluvainagar. It has 164 households who are Tamil Catholics/Christians. There are a pre-school, a multi-purpose community building, a community hall of the women's rural development society and 2 small grocery stores **(Siluvai Nagar).** This village is called Thalaimannar station town. It has 766 families and 200 housing units. The village population consists of Tamil Catholics/Christians, Hindus and Muslims. This village is known as a multi religious community in Mannar. The public places are 1 preschool, 1 primary School, 1 secondary School, 1 multipurpose building, 1 library, 7 shops , 1 hotel, 1 retail grocery , 2 Churches, 1 Hindu Temple, and 1 Mosque **(Thalaimannar Station).** This village is called Kattukaaran kudiyiruppu. It has 56 households who are Tamil Catholics/Christians. The number of housing units is 47 **(Kattukaaran Kudiyiruppu)**. This village is called Konnayan Kudiyiruppu. It has 56 households who are Tamil Catholics/Christians. The number of housing units is 45. There are a pre-school, a multi-purpose community building, a community hall of the

No.	Issues discussed	Response
		women's rural development society, a toddy selling center, and 3 retail groceries **(Konnayan Kudiyiruppu).**This village is called Nadukuda. It is located in the Thullukudiyiruppu GN division. There are 63 households who are Tamil Catholics/Christians. There are a Preschool, 1 multipurpose building, 1 fish storage building which is now abandoned, and 2 retail groceries and 1 church **(Nadukuda).** This village is called Olaithoduvai. It has 15 households who are Tamil Catholics/Christians (**Olaithoduvai).** This village is called Pesalai, ward No 8. It has 720 households who are largely Tamil Catholics/Christians. There are about 5 households who are Hindus. The number of housing units is 550. There are a Sathosa, Pradeshiya sabha sub office, railway station, a pre-school, a multi-purpose community building, a community hall of the women's rural development society, two hotels - John Mary and Akward hotel, 2 grinding mills, a cool bank, 1 small industry, and about 20 retail groceries **(Pesalai).**
4.	**Land ownership pattern**	Every household has ¼ acre of land on which they built houses while the rest is used for home gardening. Because of the coconut plantations people are unable to cultivate any vegetables. During the rainy season people cannot cultivate their land because the area is going under floods **(Siluvai Nagar).** The average size of the home garden is ¼ acre. They cultivate chilies, brinjal, drumstick, ladies finger, papaw etc. The produce from coconut trees are used for family consumption **(Thalaimannar Station; Kattukaaran Kudiyiruppu; Nadukuda).** Home gardens of the families are about ¼ acre of land. Families also own another 2 to 3 acres of highland grown with Palmyra trees **(Kattukaaran Kudiyiruppu; Konnayan Kudiyiruppu; Olaithoduvai; Pesalai).** The average size of the home garden of a family is ½ an acre (**Olaithoduvai; Pesalai**).
5.	**Current market price of highland**	The price of land varies with the location. Approximately, one acre of land would be around SLR 100,000 **(Siluvai Nagara).** A ¼ acre of land would be around SLR 30,000 **(Thalimannar Station).** One acre of land would be around SLR 300,000. An acre of land would be around SLR 200,000 (**Konnayan Kudiyiruppu).** On average, ¼ acre of land would be around SLR 100,000 **(Nadukuda).** One acre of land would be around SLR 150,000 (**Olaithoduvai**). One acre of land would be around SLR 800,000 **(Pesalai).**
7.	**People's livelihoods and external linkages**	The main source of livelihood of the people is fishing and fishing related activities. There are 10 fiber glass boats with outboard motors, 25 *Theppams* and 1 *ma-del* in this village. They also engage in secondary sources of livelihoods like manufacturing Palmyra products, cultivation of highland crops, toddy tapping (*Thalraah*) etc. People engage in marine fishing, ma-del and lagoon fishing. But fishing can be conducted only for a single season of the year from October to March. People who do not have boats, *Vallam* and *Theppam*, would work as daily paid laborers in the boats. People would also engage in labor work during the off season. The off season is the windy season from May *to* September. Some people are engaged in masonry and carpentry work. Women would go to the beach for cutting fish for dry fish making during the season. They are paid SLR 6.00 per kilogram of fish that they cut. Women who manufacture dried Palmyra roots (*kottakelengu*) would earn SLR 70,000 to SLR 100,000 per season. There are both men and women who are engaged in dry fish making and sell them to traders coming from outside or in the local market **(Siluvai Nagar; Thalaimannar Station; Kattukaaran Kudiyiruppu; Nadukuda; Olaithoduvai)**. The majority of the people are engaged in marine fishing, *ma-del* and lagoon fishing in the southern coast during a single season. There are 5 *ma-dels* operated by fishermen in Thalaimannar. Only labors are used for dragging *madals* and no tractors are used. In addition, there are 5 fibreglass boats, 23 *Theppams* in this village. Both women and men are manufacturing Palmyra products such as dried/boiled Palmyra roots. Some women go to garment factories. Inadequate transport facilities affect such working women **(Thalimannar Station).** There are five *ma-dels* in this village but their owners are fishermen from Pesalai. People in this village work as laborers to these ma-del owners. There are about 15 toddy tappers in this village who sell one litre of toddy for SLR 59/- to a small industry set up by the Palmyra Board. A few women make small boxes weaved out of Palmyra leaves which are used for

No.	Issues discussed	Response
		containing *thal hakuru* (juggery made out of Palmyratoddy). These small baskets are called *kuttan*. Each kuttan is sold at SLR 3.00 to Palmyra Board industrial centre. A woman would produce about 75 *kuttans* per day with the help of her family members (**Kattukaaran Kudiyiruppu)**. The main source of livelihoods of the people are fishing and highland cultivation where they grow drumsticks, brinjal, papaya, ladies fingers, chillies, green gram, cassava and coconuts. There are 05 boat owners, 1 *vallam* 01, and 2 *ma-dels*. People also manufacture Palmyra products and toddy (*Thalraah*). There are 12 toddy tappers in this village who sell a bottle of toddy at SLR 59/- (**Konnayan Kudiyiruppu).** Villagers are engaged in marine fishing, *ma-del* and lagoon fishing during the season from October to March. People who do not have boats, *Vallam* and *theppam*, work as day paid laborers in the fishing vessels. There are 9 *madals* in this village. Those *ma-dels* belong to people who live in Pesalai. There are 16 tractors that are used by people to pull those *ma-del*s during the season due to labor shortages. Labours are used only for 3 *ma-dels*. There are people who take Palmyra trees on lease during its season to manufacture Palmyra products. It is called '*Vaadi'.* Around 25- 30 people are collecting Palmyra seeds during the season. There are about 400 Palmyra trees and about 50 coconut trees in the project area **(Nadukuda).** There are 350 boats with motors, 100 *Theppams* and 16 *ma-del* in this village. Earlier, there had been an ice factory to store the fish, but it does not operate now. Fishermen sell their fish catch directly to the traders coming to the beach from Mannar and Colombo. There are 2 grinding mills and 2 hotels. There are 2 fishing seasons. They are called as north and south sea fishing. Fishermen carry their boats and other equipment either over the sea or land while they migrate from south to the north of the Island or vice versa **(Pesalai).**
8.	**Socio-economic stratification and poverty in the village**	Almost all the people in this village are poor. Their incomes are seasonal. In the off-season, people live on loans obtained from CBOs and banks, One of the male participants said '*I don't know any other job except fishing. Therefore, I get loans during off season and repay them when fishing season comes.'* The number of Samurdhi recipient families in the village is 69 (out of 164 families). Samurdhi recipient families are selected from among the families who have relatively low incomes, higher number of members in the family and the female headed families. There are 15 female headed families in this village. Seasonal incomes and youth unemployment are the main causes of poverty **(Siluvai Nagar; Thalaimannar Station).** There are 85 families who receive Samurdhi food **(Talaimannar Station).** The number of Samurdhi recipient families in the village is 47. Families of government employees and those who own boats are not entitled to receive Samurdhi subsidies (**Kattukaaran Kudiyiruppu).** Almost all the people in this village are poor. But only 32 families are given Samurdhi food stamps. During the off-season, men would engage in labor work. Seasonal incomes and youth unemployment are the main causes of poverty (**Konnayan Kudiyiruppu).** Almost all the people in this village are poor because of seasonal incomes.There are 55 families who receive Samurdhi food stamps **(Nadukuda).** There are around 5 families who receive Samurdhi food stamps (**Olaithoduvai).**
		There are poor and middle income families. People's incomes are seasonal. In the off-season, people go for daily paid labor work. When such earnings are insufficient, they would borrow money from money lenders. The number of Samurdhi recipient families in the village is 227. Samurdhi recipient families are selected from among the families who have relatively low incomes, higher number of children in the family and the female headed families. But not always correct recipients are selected. One participant said *'if I have a boat, I will be rejected to be a Samurdhi beneficiary, though we don't have a regular income'.* Fishermen who go for marine fishing go to the sea only on Mondays, Wednesdays, Fridays and Saturdays because of poaching by Indian trawlers on other days of the week **(Pesalai).**
9.	**Unemployment levels in the village**	Unemployment is very serious in this village. There are about 25 males and 25 females who do not have permanent jobs. Most of them have GCE O/L and GCE A/L qualifications and

No.	Issues discussed	Response
		some have vocational training experience as well. When youth cannot find proper employment they go for fishing because of the poor family economy. Some youth would go to Mannar town or other districts like Vavuniya and Colombo for work in the private enterprises and hotels. One woman said '*We apply for all kinds of jobs but our names are never accepted by government'* **(Siluvai Nagar; Thalaimannar Station; Konnayan Kudiyiruppu; Nadukuda).** There are about 60 youth who do not have a permanent job **(Thalaimannar Station).** There are about 6 males and 4 females who do not have permanent jobs. Some of them go for daily paid jobs in Mannar or elsewhere or garment factories in Mannar (**Kattukaaran Kudiyiruppu).** There are about 10 males and 15 females who do not have permanent jobs (**Konnayan Kudiyiruppu**). Unemployment is a problem among both male and females. There are no job opportunities for people who undergo vocational training. There are 40 youth who do not have permanent jobs **(Nadukuda).** There are about 4 males and 3 females who do not have permanent jobs. People are given jobs based on political favours. Poor people find it difficult to find jobs **(Olaithoduvai).** More than 100 persons are graduates but none of them have a permanent job. There are about 500 males and females who do not have permanent jobs. They are either engaged in daily paid labor work or employed in garment factories. A boy who was qualified to go to the University to study engineering is now engaged in masonry work **(Pesalai).**
10.	**Source of drinking water**	The Water Supply and Drainage Board provides drinking water to this community. There are about 25 families who are not connected to drinking water supplied by the Board. Some of them have their own wells. People pay around SLR 100 per month for water. Water supply is given only for 4 hours a day from 6.00 a.m. to 8.00 a.m. and then from 5.00 p.m. to 7.00 p.m. During flooding, wells are affected by saline water **(Siluvai Nagar).** Households expect pipe- born water facility to be supplied by the National Water Supply and Drainage Board **(Thalaimannar Station).** Households have individual wells and they use water for their domestic purposes and gardening. The water quality is good. During the dry season most of wells are affected by saline water (**Kattukaaran Kudiyiruppu; Konnayan Kudiyiruppu; Nadukuda; Olaithoduvai; Pesalai).** Around 15 families do not have private wells **(Nadukuda).** Around 3 families do not have their own wells **(Olaithoduvai).** One woman said '*we all people are blessed by God to get pure water in this area'* **(Pesalai).**
11.	**Household use of electricity**	People use electricity for lighting, cooking, entertainment, rice cookers, education, cooling, heaters etc. There are refrigerators in the 2 retail groceries. Electricity is mostly used for household activities. Firewood is used for cooking purposes. The average electricity bill of a household is SLR 500.00 per month **(Siluvai Nagar).** Monthly electricity bill of a household varies between SLR 700-1000 **(Thalaimannar Station).** People use electricity for operating small water motors which they use to irrigate the Palmyra seeds buried for their germination and vegetables such as brinjal, chillies and drumstick etc. grown in their home gardens. The average electricity bill of a household is SLR 500.00 per month (**Kattukaaran Kudiyiruppu; Konnayan Kudiyiruppu; Olaithoduvai).** People hardly use electricity for hot-plates, Immersing heaters, fans, televisions, and rice cookers. Electricity is mainly used for lighting. "Although *we now collect firewood for cooking purposes, firewood is gradually getting scarce'.* Monthly electricity bill of a household is around SLR 500 **(Nadukuda).** There is one refrigerator that helps in retail of groceries. The average electricity bill of a household is SLR 400.00 per month. Two women use electricity for sewing machines **(Olaithoduvai).** Electricity is used for grinding mills, cool bank, and food businesses and in hotels. They also use electricity for watering their home gardens with small water motors. People use electricity for lighting, cooking, entertainment, rice cookers, education, cooling, heaters etc. There are refrigerators in the 20 retail groceries). Electricity is mostly used for household activities. The average electricity bill of a household is SLR 2000.00 per month **(Pesalai).**

No.	Issues discussed	Response
12.	**Issues related to electricity**	Around 30 households do not have electricity facility. Power drops and fluctuations are frequent. People said 'our household goods like televisions, heaters, and bulbs get burnt during power fluctuations. In addition, people experience dim lighting from 7.00 p.m. to 9.00 p.m. daily **(Siluvai Nagar).** Almost 90% of the families are connected to electricity. People experience electricity related problems during rainy season. One person died last year due to electrocution **(Thalaimannar Station).** About 15 households do not have electricity facility. Power drops and fluctuations are frequent. In addition, people experience power cut 3-4 times a week (**Kattukaaran Kudiyiruppu; Konnayan Kudiyiruppu; Olaithoduvai).** Around 3 households do not have electricity facility (**Konnayan Kudiyiruppu).** There are 17 families who do not have electricity. Those households use kerosene for household lighting. They use 1 ½ litres of kerosene per week. The reason for not having electricity is because their houses are situated far away from the electricity line (**Nadukuda).** Around 3 households are not connected to electricity **(Olaithoduvai).** Some of households do not have electricity facility. Power drops and fluctuations are frequent every week. Power cuts are very common during children's' exam times which badly affect the children **(Pesalai).**
13.	**Issues related to children's education**	Most of students of this village go to St. Lawrence school by walking. It is about ½ km from this village. This school conducts classes upto GCE OL. Students who pursue GCE A/L have to go to Thalaimannar G.T.M.S, which is 3 km from the village. Both schools do not have adequate teachers. There is no science teacher for GCE O/L. There is a pre-school in the village and attended by 22 children. The pre-school teachers are paid partly by the church and partly from the fees collected from the parents **(Siluvai Nagar).** Students attend Thalaimannar G.T.M.S school or schools in Mannar for their primary and secondary education. They go by walking, bicycles and bus. There are no tuition class facilities. Teachers available for English and Maths are inadequate. GCE AL students attend Thalaimannar G.T.M.S school or schools in Mannar. Thalaimannar school is situated around 1km away from this village **(Thalaimannar Station).** Children attend the Thullikudiruppu primary school, G.T.M.S. School in Thalaimannar and a secondary school in Pesalai. The schools do not have adequate teachers for science subjects (**Kattukaaran Kudiyiruppu).** Most of students of this village go to primary and secondary schools in Olaithoduvai and Thaarapuram. Olaithoduvai school does not have adequate teachers. There is no mathematics teacher for GCE O/L (**Konnayan Kudiyiruppu).** Most of students of this village go to schools in Pesalai, Thalaimannar, Mannar and Thullukudiyiruppu schools for their primary and secondary studies. Some children walk to their schools while others go by bicycle or bus. Thullukudiyiruppu school is located 2 ½ km away from the village. This school has classes upto GCE OL. Students do not have tuition class facilities in this area. Students who want to pursue GCE AL have to go to Thalaimannar G.T.M.S or Mannar schools. Thalaimannar school is situated 4 km away from this area. Adequate teachers are not available in Thalaimannar and Thullukudiyiruppu schools **(Nadukuda).** Most of the students of this village go to Olaithoduvai secondary school by walking. It is about 200 meters away from this village. This school conducts classes upto GCE OL. Students who pursue GCE A/L have to go to Thalaimannar G.T.M.S, or Pesalai which are 3 km from the village. Olaithoduvai school does not have adequate teachers. There is no mathematics teacher for GCE O/L **(Olaithoduvai).** Most of the primary students attend St. Mary's G.T.M.S school. They go by walking because it is only about 500 meters away from this village. This school conducts classes upto grade 5. Students who pursue GCE A/L have to go to Pesalai Fatima College or schools in Thalaimannar and Mannar. Children do well in their studies and tuition classes are available in the area. But not all parents can afford to send children for tuition **(Pesalai).**
14.	**Other social problems in the village**	Fishing nets are stolen quite often. Availability of Palmyra toddy is a serious problem. There is bottled toddy as well. Males particularly during fishing season drink quite a lot of toddy and harass their wives, children and neighbours **(Siluvai Nagar; Thalaimannar Station; Konnayan Kudiyiruppu; Nadukuda; Olaithoduvai);** Fishermen consume

No.	Issues discussed	Response
		arrack and toddy after returning from sea. They spend SLR 80/- for a bottle of toddy **(Thalaimannar Station).** Alcohol use is very high. Around 1,000 bottles of toddy produced and brought from Madampe are consumed by villagers per week. Each bottle costs SLR 80/- (**Kattukaaran Kudiyiruppu).** The fishermen of this village mostly drink arrack and toddy on Sundays. They would spend SLR 5,000 per week for alcohol **(Nadukuda).** There is a wine shop in Pesalai. Most of the youth consume beer and arrack frequently. When they are drunk, they fight with others. There is bottled toddy as well. Kasippu (illicit liquor) and bottled toddy are extensively consumed due to high price of arrack **(Pesalai).**
15.	**Chronic illnesses and medical and health facilities in the village**	There are no chronic illnesses in the village. People go to Thalaimannar divisional hospital for medical treatment, which is 3 km away from this village. Facilities such as diagnostic services available for patients are limited. There is only 01 doctor. Except for a pharmacy, there are no private hospitals/clinics in the village or in Thalaimannar **(Siluvai Nagar).** People go to Thalaimannar divisional hospital for medical treatment. It is around 1 Km away from this village. In emergencies, Sri Lanka Navy located close by help in transporting patients to the Mannar hospital. The Navy also provide free medical services for school children **(Thalaimannar Station).** There are no chronic illnesses in the village. People go to Thalaimannar and Pesalai divisional hospitals for medical treatment. There are 3 doctors both at Pesalai and Thalaimannar hospitals. There are no private hospitals/clinics in the village or in its surroundings (**Kattukaaran Kudiyiruppu).** People go to Thalaimannar divisional hospital and the rural hospital in Thaarapuram for medical treatment, which is 3 km away from this village. One doctor comes to Tharapuram hospital daily but there is no resident doctor. Midwife comes to village once a month for child care and maternal clinic **(Konnayan Kudiyiruppu).** People go to Pesalai divisional hospital for medical treatment. This hospital is 3 km away from the village. Hospital does not have adequate facilities for patients. Laboratory facilities are limited. Only a single doctor is available. There are no private dispensaries in the vicinity of this village. There is only, a pharmacy. Anti -malaria campaigns are not conducted **(Nadukuda).** People go to Pesalai divisional hospital for medical treatment, which is closer to the village. Facilities such as diagnostic services available for patients are limited. There are 2 doctors in the hospital. People prefer to go to Mannar Hospital for serious illnesses **(Pesalai).**
16.	**Awareness on HIV/AIDS**	An awareness program about HIV/AIDS had been conducted by World Vision, an NGO. Some have gained knowledge of this disease through television and leaflets. People requested that a good awareness program should be conducted in this village **(Siluvai Nagar; Thalaimannar Station; Kattukaaran Kudiyiruppu; Konnayan Kudiyiruppu; Nadukuda; Olaithoduvai; Pesalai).**
17.	**Community based organizations and their roles**	The village CBOs includes WRDS, RDS, Fishery Society, Samurdhi Society and Church Committee. The WRDS provides loans to villagers in the range of SLR 40,000 at low interest. Samurdhi society conducts *shramadana* work in this village specially to clean public places like church and school **(Siluvai Nagar).** They have a fishing committee with 12 members, and they provide small donations for community activities like conducting *shramadana* and other special events in the village. WRDS provides loans to their members in the range of SLR 50,000 which has to be repaid in 10 months. WRDS undertake contract work and it built a new multipurpose building under 100 days' project **(Thalaimannar Station).** The WRDS provides loans to villagers in the range of SLR 50,000 at a low interest. There are 20 people who received loans from WRDS. WRDS motivates people to save the money by making small women groups. Women use the loan money to buy Palmyra nuts which are sold at SLR 1.50 per nut (**Kattukaaran Kudiyiruppu).** The WRDS provides loans to villagers in the range of SLR 15,000- 40,000 at low interest rates **(Konnayan Kudiyiruppu; Olaithoduvai).** The Fishery Cooperative Society has 130 members. The Society provides little financial support for community activities like *shramadana* and special events celebrated in this village. The Society also brings kerosene to the village and sells to the fishermen.

No.	Issues discussed	Response
		WRDS, RDS, Fishery Society, Samurdhi Society and Church committee are the CBOs in this village. The WRDS provides loans to the value of SLR 50,000 at low interest rate. Loans have to be repaid within 10 months. Village **(Nadukuda).** The village CBOs includes WRDS, RDS, Fishery Society, Samurdhi Society, School Committee, and Church Committee. WRDS conducts micro credit programs and savings schemes among small groups of women **(Pesalai).**
18.	**Recent major development activities in the village**	A multi-purpose community building was constructed in 2015 under 100 days' project. The WRDs rehabilitated the pre - school building. The pre-school building was provided with pipe- borne water supply and electricity **(Siluvai Nagar).** The Government provided funds to build a new multipurpose building under 100 days' project **(Thalaimannar Station).** The WRDS received financial support from the World Vision to provide toilet facilities for people who live in this village and to rehabilitate a drinking water well (**Kattukaaran Kudiyiruppu).** This village did not get any development projects from the Government for the past two years. The church was built with contributions from village people. The Bishop also supported the construction work of the church **(Konnayan Kudiyiruppu).** There were no development activities in this village since 2 years **(Nadukuda).** The World Vision provided cattle and poultry to poor people to improve their living conditions **(Olaithoduvai).** RDS rehabilitated one local road and constructed the community center in 2015. The WRDs received funds from the World Vision to build toilet facilities for poor people in this village **(Pesalai).**
19.	**Decision-making in the household and in the community**	The parish priest and the church committee take decisions for the benefit of the villagers and also intervene in problem-solving. Also, the un-resolved problems are brought to the notice of the Grama Niladhari and the Police **(Siluvai Nagar; Kattukaaran Kudiyiruppu; Nadukuda; Olaithoduvai).** As the village is a multi-ethnic and multi-religious community, village level issues and problems are brought to the notice of Grama Niladhari and the Police **(Thalaimannar Station).** The parish priest visits the village every Tuesday and Sunday. The church committee takes decisions for the benefit of the villagers and also intervenes in problem-solving. Also, the un-resolved problems are brought to the notice of the Grama Niladhari (**Konnayan Kudiyiruppu).** *'We are all Catholics'.* Therefore, the parish priest and the church committee take decisions for the benefit of the villagers and also intervene in problem-solving. Also, the un-resolved problems are brought to the notice of the Grama Niladhari and the Police **(Pesalai).**

List of Participants at Public Consultations

Date	Venue/Village	No.	Name of the Participant	Occupation/Status
11.3.2016	Thalaimannar South	1	V. Antony	Fisherman
		2	A. Gnanapragasam	Fisherman
		3	S. Romold Croos	Fisherman
		4	V.Spellman	Fisherman
		5	J. Sakayarani	Housewife
		6	A. Sakaya Rose Mary	Housewife
		7	A. Thasnevi	Housewife
		8.	Y. Sakayaseeli	Housewife
		9	S. Anthony Thasan	Fisherman
		10	G. Anthony Pavulin	Fisherman
		11	P. Anistan	Fisherman
		12	J. Defni	Fishing
		13	R. Nevis	Housewife
		14	I. Pamilarose	Housewife
		15	I. Kamala	Housewife

Date	Venue/Village	No.	Name of the Participant	Occupation/Status
		16	V. Victoria	Housewife
		17	L. Punitha Seeli	Housewife
		18	A. Yuditta	Housewife
		19	B. Mariya Goratty	Housewife
		20	N. Selva Pakiam	Housewife
		21	T. Soosainat	Fisherman
		22	A. Mariyammah	Fishing
		23	R. Katharin	Housewife
		24	I. Nithya	Housewife
12.3.2016	Nadukuda	25	A. Arul Prasath	Fisherman
		26	A. Nesanayakam	Fisherman
		27	A. Uthistan	Student
		28	R. Anthonythas	Fisherman
		29	A. Nathan	Fisherman
		30	T. Mahendran	Fisherman
		31	M. N. Nesanayakam	Fisherman
		32	V. Sebastian	Fisherman
		33	S. Sinthuja	
		34	J.Mary Magdaline	
		35	S. Albons	
		36	A. Althakiya	
		37	S. Jenad	
		38	S. Menirta	
		39	S. Innasiyammi	
		40	G. Kuna Kurthamma	
		41	J. Nagam	
		42	R. Mariyansi	
		43	P. Buwaneshwari	
		44	S. Thewanayaki	
		45	S. Christina	
		46	B. Vettrimary	
		47	M. Jesintha	
		48	T. Shamini	
		49	K. Christina	
		50	M. Mariya Maththalena	
		51	A. Mariyanoiline	
		52	D. Gunaseeli	
		53	R. Jenirtha	
		54	N. Dalsi	
		55	K. Viyakulamary	
		56	N. Arokkiyam	
		57	D. Selriamma	
		58	A. Anthony Rani	
		59	Saknayagan	
12.3.2016	Thalaimannar	60	R. Gnanasegaran	F.C.S
		61	W. Nicluss	Fisherman
		62	M.C. Vasantha	Fisherman
		63	N. Nadaraj	Fisherman
		64	W. Bernard Peiris	Fisherman
		65	T. Savithiri	Fishing
		66	G. Riees	Fisherman
		67	M.S. Roseline	Fishing

Date	Venue/Village	No.	Name of the Participant	Occupation/Status
		68	V. Sagayamary	Fishing
		69	A. Bumitha	
		70	T. Thevaraja	Fisherman
		71	S. Suhirthan	
		72	S. Savalu	
		73	S. Soosainathan	
		74	S. Rathishwary	
		75	W. Jesus Fernando	
		76	R. Venthan	
		77	R. Mathan	
		79	S. Nalanitham	
		80	V. Anthony	
		81	V. Mukunthira	
		82	V. Vellayan	
		83	W. Selvi	
		84	R. Thevi	
		85	K. Vinothan	
		86	M. Mali	
		87	A. Anton	
		88	R. Santhi	
13.3.2016	KattukaranKudi yiruppu	89	V. Menaka	Housewife
		90	A. SelvaKumari	Housewife
		91	J. Sarkunathevi	Housewife
		92	A. Panimayanayagei	Housewife
		93	S. Keetha	Housewife
		94	J. Aknesamma	Housewife
		95	M. Selvakumari	Housewife
		96	S. Coods Merina	Housewife
		97	S. Lawrence	Housewife
		98	P. Mary Adel Queen	Housewife
		99	S. Anthoniamma	Housewife
		100	R. Desi	Housewife
		101	S. Kolastika	Housewife
		102	A. Paththinayagi	Housewife
		103	W. Akanesan	Housewife
		104	M. Jeyakumar	Housewife
		105	J. John Nihal	Driver
		106	R. Darshani	Housewife
		107	D. Anushiya	Housewife
		108	S. Jeganathan	Housewife
		109	A. Benedict	
		110	K. Mohanthas	Labourer
		111	A. Yakoran	Labourer
		112	A. Jegan	Land Officer
		113	A. Sakayanathan	Labourer
		114	I. Niroshini	Housewife
		115	J. Amalanayagi	Housewife
		116	K. Usha	Housewife
		117	M. Juvanees	Samurdhi Officer
		118	S.S. Logu	Grama Niladari
		119	A. Vinson	Painting

Date	Venue/Village	No.	Name of the Participant	Occupation/Status
		120	S. Selvanayaki	Housewife
13.3.2016	Olaithoduvai	121	A. Nevil Antony	Pronto Lanka Pvt
		122	A. Kamildan	Student
		123	A. Anartha	Vice President
		124	S.A. Jesman	Pronto Lanka Pvt
		125	A. Vethanayakan	Kovil Labourer
		126	A. Salamon	
		127	S.T. Sehamal	
		128	S. Edward	
		129	S. Jeroshiya	
		130	A. Karolin Rani	
		131	A. Kaythekiamma	
		132	J. Mary Darshini	
		133	P. Katharina	
		134	J. Kalista	Sewing
		135	A. Amalathas	
		136	A. Amalaraj	Insurance Agent
		137	P. Rosalyn	
		138	A. Jeyatheepa	
		139	A. Mary Theresa	
		140	A. Gnana Theresa	
		141	S. Thiyogupillai	Divinaguma Development Officer
		142	M.M.D. Goos	GramaNiladari
		143	A. Joruhes	
14.3.2016	Pesalai	144	C.M. Xavier Fernando	Retired Principal
		145	A.S. Packicvathy Thueem	W.R.D.S
		146	R. Thisaanthy Mascringhe	W.R.D.S
		147	S. Rueeli	W.R.D.S
		148	J. MariyaKorinthy	W.R.D.S
		149	R. Jenettri Logus	W.R.D.S
		150	A. Thiresa Kulal	W.R.D.S
		151	R. Lizy Croos	W.R.D.S
		152	R. Jesumariya	W.R.D.S
		153	A. Maria Stella	W.R.D.S
		154	L. Santhavena	W.R.D.S
		155	S. Moriffeeles	
		156	P. Denei	
		157	A. Maria Theresa	
		158	J.B. Pirakkiran	
		159	K. Pellikilal	
		160	S. Lucas	W.R.D.S
		161	M. Mary	
		162	A. Kamalapragasam	Labourer
14.3.2016	KonnayanKudiyiruppu	163	S. Jusithamman	
		164	A. Mary Katherine	Labourer
		165	V. Philipa	Labourer
		166	M. Gnanaseeli	Labourer
		167	P. Sofia	Labourer
		168	S. Yogeshwaran	Labourer
		169	P. Sakayamary	
		170	Robinson	Labourer
		171	P. Mary Vijiliya	Student

Date	Venue/Village	No.	Name of the Participant	Occupation/Status
		172	S. Gnana Mary	Student
		173	J. Jeni Pereira	Housewife
		174	M. Mariyai	Housewife
		175	S. Vettrimary	Housewife
		176	J. Mariya Rohini	Housewife
		177	M.J. Avanrosi	Housewife
		178	K. Gnaneswari	Housewife
		179	B. Niroshan	Labourer
		180	C. Agileshan	Labourer
		181	S. Mary Theresa	Housewife
		182	M. Santhana	Housewife
		183	A. Gnanamary	Housewife
		184	V. Mary Judirtha	Housewife
		185	D. Voshintana	Housewife
		186	P. Christina	Housewife
		187	A. Gnanamary	Housewife
		188	R. Kalinton	Fisherman
		189	P. Sutharshan	Fisherman
		190	R. Christina	Fishing
		191	S. Francis	Fisherman
		192	S. Simian	Labourer
		193	S. Francis	
		194	Y.S. Croos	Pensioner

9.10 Consolidated Summary of Consultations with Women's Groups

Name of the Project: 100 MW Wind Farm along Southern Coast of Mannar Island
Name of the villages: (i) Siluvai Nagar, (ii) Konnayan Kudiyruppu, (iii) Nadukuda
Name of the GNDs: (i) Thalaimannar South Village, (ii) Thodaveli- MN 62, (iii) Thullukudiyiruppu
Name of the DS Division: Mannar

Issues discussed	Response
Women's response to proposed project and their concerns, issues and suggestions	We have no major objection to this project, provided it does not make any harm to us. We think this is a good project to produce electricity to this village and the country. But we fear whether the fans of the wind turbines will fall down and harm us **(Siluvai Nagar; Nadukuda).** **Response:** There are 4 wind power projects in different parts of Sri Lanka and none of them reported any falling down of fans and damaging people's lives or properties. We may be affected by the noise of the fans of the wind turbines. Construction of wind turbines will therefore make our lives uncomfortable **(Siluvai Nagar; Nadukuda).** **Response:** The height of a tower including blades will be 150 meters and the noise of fans would be felt only for a distance of about 300 meters. The wind turbine are also constructed 150 meters away from the coastal belt. Therefore, settlements will not be affected by noise. We cannot say whether this project is good or bad but the final decision is on our husband's hand. We do not have any major objection to this project, provided it does not make any harm to us. One woman said that, she has seen wind turbine in Puttalam and it is a good project to produce electricity to this village and nation. But we fear whether the fans will make a huge noise in the particular area. We also heard that people in Puttalam earlier protested against this project. Will the project affect the cattle and goats that go for grazing near the project area whether the noise would disturb their grazing practices **(Konnayan Kudiyruppu).**

Type of compensation (cash/kind) expected for different losses	We would prefer to find labor work if available for women during the construction period. Income that we can get from such employment will certainly help our families **(Siluvai Nagar; Nadukuda).** We do not know whether the project will affect our private properties. But if the Palmyra trees were cur down for the project it will affect several families who are dependent on Palmyra based products for their livelihoods **(Konnayan Kudiyruppu).**
Roles/activities that women perform	Most of the women engage in domestic work throughout the day. One participant said '*men only go for fishing and when they come back they take rest. But, we are doing every work at home'.* Women also engage in poultry and animal husbandry, sewing, weaving Palmyra boxes, collecting Palmyra nuts etc. There is no particular leisure time for women in this village. Watching TV and chatting with friends are some leisure time activities **(Siluvai Nagar; Konnayan Kudiyruppu; Nadukuda).** Most women are confined to domestic work. Women will go for collecting firewood cutting for sale and collecting Palmyra dried leaves for weaving **(Konnayan Kudiyruppu).**
Use of energy for household activities and economic activities, energy conservation and energy related issues.	Firewood is mainly used for cooking. Only in raining season, they use rice cooker and immersing heater. They all use CFL bulbs. Electricity bill for a household is in the range of SLR 500.00 per month. Women would switch off fridges at night to conserve energy. And, they are not much interested in ironing clothes and operating other electrical appliances like grinding and hair driers. At times when electricity bills increase, they would use firewood for cooking. One woman said *'I always switch off all lights after 9.30 p.m. to conserve energy and it will reduce our electricity bills'***.** However, they experience dim light, and power fluctuations **(Siluvai Nagar; Nadukuda).** Firewood is mainly used for cooking. Only in raining season, they use rice cooker and immersing heater. But Pinja and Vidhari wood is used for cooking during rainy season. They all use CFL bulbs. Electricity bill for a household is in the range of SLR 400.00 per month. There are snakes around this area and we have to have a light outside our house to protect ourselves from snakes **(Konnayan Kudiyruppu).**
Women's contribution to the family economy	Women engage in manufacturing Palmyra products as a source of livelihood. Most women would produce dried Palmyra roots (*kottakelengu*) from Palmyra nuts. Their incomes from such Palmyra products range between SLR 70,000 to SLR.100,000 for a season. When women produce Palmyra products in bulk they use tractors to transport the Palmyra nuts. The transportation by tractor costs them around SLR 3,500. Women also engage in dried fish making and slicing fish in the fish landing sites. Women are paid SLR 6.00 per kilogram of fish they cut. On average, a woman would cut 200 kg of fish per day thereby earning SLR 1,200 **(Siluvai Nagar).** Women engage in manufacturing Palmyra products as a source of livelihood in the Palmyra season. Some of them sell Palmyra wood to outsiders at SLR 7/- per Palmyra stick. Most women would produce boiled and dried Palmyra roots (*kottakelengu*) from Palmyra nuts. They produce 2 ½ kg of *kottakelengu* from 100 fresh roots. One *kottakelengu* is sold at SLR 3/-. Their incomes from such Palmyra products range between SLR 40,000 to SLR.70,000 for a season. They have 2 to 3 acres of additional land where they bury Palmyra nuts for germination. Women who manufacture Palmyra products in bulk use tractors to transport the Palmyra nuts collected from gardens. The transportation by tractor costs them around SLR 3,000. Women also engage in dried fish making and slicing fish in the fish landing sites (**Konnayan Kudiyruppu).** Women manufacture Palmyra products and earn around SLR 60,000 to 75,000 in a one season. Some women received training in producing Palmira handicrafts are now earning around SLR 5000 per month. Around 10 women work in a garment factory in Mannar. Their monthly earnings are around SLR 15,000 to SLR 20,000. Women spend their earnings on children's education and to buy some jewelry for their daughters **(Nadukuda).**
Disparities between men and women	Both women and men are paid equal amounts for slicing fish and incomes vary with the quantities of fish they can cut per day. If they work in the Crab factory, women are paid SLR 600.00 while men are paid SLR 1,000 per day. Some women do overtime work in this factory to get extra income. Husbands do not encourage women to go outside for

	daily work. The daily incomes of men are in the range of SLR 1,500 **(Siluvai Nagar; Konnayan Kudiyruppu).** Women do not prefer to go out for labor work. They prefer to find work within the village **(Konnayan Kudiyruppu).** Women and men do not get equal wages for daily paid work. A woman is paid SLR 800/- a day while men are paid SLR 1,000. One woman said '*all males are thinking that females should be under the control of men even in wages'.* There is one woman who goes to see with her *Theppam.* **(Nadukua).**
Opportunities/facilities that women/girls have in the community for higher education; vocational and technical training; and employment	The vocational training for women in dress-making, beauty culture, and handicrafts making are available in the Mannar town. However, long distance between the village and Mannar town and poor transport services make it difficult for girls and women to engage in such training programs. When women return home in late evenings, it can pose security issues for them. Youth do not have computer knowledge or related qualifications. This is a major reason for their unemployment. They expect vocational training programs to be proactive because there are many women who participated in vocational training programs, but could not find employment. One girl stated *"I have got vocational training in makeup and other facial works. But, I don't have enough money to start that self- employment in this village. Now, I am doing some of work free of charge"* **(Siluvai Nagar; Konnayan Kudiyruppu; Nadukuda).** Youth do not have computer practical knowledge or qualifications. This is a major reason for their unemployment **(Nadukuda).**
Social, economic and cultural barriers that prevent women pursuing higher education, technical and vocations skills training; and accessing employment	Women will have security issues when they return home from Mannar after their vocational training. Parents are worried until they return home. Most of the parents prefer to send their children for higher education, but the financial constraints prevent them from sending their children to pursue higher education. In case they sent their children they spend the time in fear until they return home. Some families would find a groom for their daughters from foreign countries because of the economic problems in the family. One participant said *'We spend a lot of money for children, and they too study well. Finally they will not have job to go forward and therefore we are mentally affected. So, we have to ask why should we send our children for higher studies?'* **(Siluvai Nagar; Nadukuda).** Girls who want to pursue vocational training face transport difficulties. One woman said "my child goes to Mannar for vocational training, and it is 7'o clock in evening when she returns home , therefore her father goes to Thaarapuram to pick her up" (**Konnayan Kudiyruppu; Nadukuda).**
Chronic illnesses that are generally prevalent among women and their root causes and frequency; issues connected with their access to health/medical services, their satisfaction/ dissatisfaction with health services including maternal and child care	Health facilities in this village are inadequate. Only midwife comes once a month to WRDS building to conduct child care clinic. Women go to Thalaimannar divisional hospital for medical treatment. For normal child deliveries, mothers are admitted to Thalaimannar hospital. For cesarean deliveries, they are admitted to Mannar base hospital. Pregnant mothers suffer from poor transportation services. There is no medical officer of health **(Siluvai Nagar; Nadukuda).** Women do not have chronic illnesses. Health facilities in this village are inadequate. People go to Thaarapuram hospital once a month for child care clinic. Women go to Thaarapuram rural hospital, Thalaimannar divisional hospital and Pesalai for medical treatment (**Konnayan Kudiyruppu).**
Women's knowledge about transmission of HIV/AIDS.	Women have some awareness on HIV/AIDS through a program conducted by the World Vision, an NGO. They have also learnt about the disease through television and leaflets distributed. However, they prefer to participate in another awareness raising program **(Siluvai Nagar; Konnayan Kudiyruppu; Nadukuda).**
Assets (e.g. house, land, animals, jewelry etc.) that women own/possess and	All land in this village is under the church committee. Long time ago (25 years), the church donated land for people for which they had to pay SLR 500.00. The current market value of land is now in the range of SLR 100,000 an acre. Both men and women own houses. If a house was not given as part of dowry, ownership remains with men.

reasons if women do/do not have ownership to assets	Cultivable land is generally owned by men. Jewelry is owned by women **(Siluvai Nagar).** Jewelry is owned by women and the land is divided among their female children (**Konnayan Kudiyruppu).** If a girl wanted to marry a boat owner, her dowry would include jewelry worth of 10 sovereigns and SLR 300,000. Jewelry can be kept with the girl after marriage**.** Both males and females own houses. Parents divide the land among their children when they get married. Some men would not ask for dowries and they would buy land with their own earnings **(Nadukuda).**
Role of women in decision-making processes at household level.	Both men and women make joint decisions on household matters. Since men are the breadwinners of the families, there is nothing wrong in men taking the decisions on family finances, education and marriage of children and all other matters **(Siluvai Nagar; Konnayan Kudiyruppu; Nadukuda).**
Community based organizations that women are involved in and the kind of community development work they carry out	The women's rural development society (WRDS) is very active in this village. It provides loans in the range of SLR 25,000 at 1% interest for poor people who are members of WRDS. Members of WRDS conduct *Shramadana* campaigns once a month **(Siluvai Nagar; Nadukuda).** The women's rural development society (WRDS) provides loans in the range of SLR 40,000 at 4% interest, for their members. Loans have to be repaid within 10 months. Members of WRDS conduct *Shramadana* campaigns once a month. Some women in the church committee conduct religious classes for children (**Konnayan Kudiyruppu).** WRDS encourages women to engage in manufacturing Palmyra products **(Nadukuda).**
Women's participation in political bodies at local, regional, and national level.	Women do not have an interest to engage in active politics due to their low educational attainment and cultural barriers. Women are under the control of men and therefore they are unable to engage in politics **(Siluvai Nagar**; **Konnayan Kudiyruppu).** Some of women participate in election campaigns during the election period. We are not interested in politics. One woman said, 'We only look our domestic work and we do not have sufficient time for politics' **(Nadukuda).**
Threats and fears of women for their personal security e.g. domestic violence, dowry issues, sexual abuse etc.	Girl children face safety issues due to poor transportation which makes them late when returning home after classes. Some men beat their wives and children after alcohol consumption. Though there is no major dowry issue, some families expect the girls' families to provide them with dowry at marriage **(Siluvai Nagar; Nadukuda).** Theft is a problem in this village. There is a toddy collecting/selling centre in the village and outsiders come to consume toddy and they engage in theft (**Konnayan Kudiyruppu).** Some men beat their wives and children after use of alcohol. Some men ask for dowries at marriage. One woman said that *'we don't have street lamps in this village therefore we have to fear at night to go out'* **(Nadukuda).**

List of Participants at Consultations with Women

Date	Venue/Village	No.	Name of the Participant	Occupation/Status
11.3.2016	Thalaimannar South	1	N. Selvapakkiyam	Housewife
		2	D. Thiyopin	Housewife
		3	R. Catherine	Housewife
		4	Seetha	Housewife
		5	Sahayarani	Housewife
		6	P. Dilarin	Housewife
		7	J. Sahayarani	Housewife
		8	J. Defni	Housewife
		9	S. Ganaswnthari	Housewife
		10	G. Santhamary	Housewife
		11	Nithya	Housewife
		12	Kamala	Housewife
		13	Agastra Dias	Housewife
		14	R. Nevis	Housewife
12.3.2016	Nadukuda	15	N. Arokiyam	Housewife

		16	K. Vijayakulamary	Housewife
		17	J. Nakomi	Housewife
		18	Anat Jansi	Housewife
		19	S. Thevanayaki	Housewife
		20	J. Mary Magilin	Housewife
		21	S. Cristina	Housewife
		22	T. Samini	Housewife
		23	R. Jenita	Housewife
		24	Sithakiya	Housewife
		25	S. Menita	Housewife
		26	Mariannoyalin	Housewife
		27	K. Cristina	Housewife
		28	M. Mariamathel	Housewife
		29	S. Jenad	Housewife
		30	S. Innusiyamma	Housewife
		31	D. Sebastian	Housewife
		32	Yasa	Housewife
		33	K. Vettrimary	Housewife
		34	P. Puvaneswary	Housewife
		35	S. Alponsa	Housewife
14.3.2016	Konnayankudiiruppu	36	D. Vasinton	Housewife
		37	P. Cristina	Housewife
		38	V. Mary Jufilta	Housewife
		39	Sakyarani	Housewife
		40	S. Unanamalar	Housewife
		41	J. Jenipierera	Housewife
		42	M. Satahana	Housewife
		43	S. Mary Theresa	Housewife
		44	P. Sakyamary	Housewife
		45	P. Maryvijiliyan	Housewife
		46	S. Vettrimary	Housewife
		47	J. Mariarohini	Housewife
		48	S. Nithya	Housewife
		49	M. Mariyal	Housewife
		50	K. Gnnaneswari	Housewife
		51	H. Gnnasothi	Housewife
		52	V. Philipa	Housewife
		53	M. Gnnaseeli	Housewife
		54	Mary	Housewife
		55	S. Yukirthampal	Housewife

9.11 Report on Public Awareness Meeting Held on 1 June 2016 for the representatives of Fishing Community in Mannar Island

Ceylon Electricity Board Public Awareness Meeting Held on 1 June 2016 for the representatives of Fishing Community in Mannar Island

Introduction

28. The final report of the Initial Environmental Examination (IEE) has been considered at the Technical Evaluation committee meeting held on 16 May 2016 at the department of Coast Conservation & coastal resources management department. In the above meeting the contents

of the IEE report was discussed in detail and one of the facts have been identified for further consideration was to conduct an additional public awareness meeting among the fishing community representatives to get their views and to clarify the concerns further so that the public perception about the project among the local fishing community will be substantially improved.

Correspondences for Awareness Meeting

29. Accordingly, CEB took initiatives towards conducting such an awareness meeting with a wide participation of fishing community and representatives. Highlighting the above facts CEB requested Department of Fisheries and Aquatic resources to organize the awareness meeting at Mannar which would be chaired by District Secretary-Mannar.

Awareness Meeting

30. The awareness meeting was held on 1 June 2016 at the Auditorium of District Secretary's office Mannar which was chaired by the District Secretary, Mannar with a wide forum of participation including following key government officials and Community representatives;

Key Government officials	**Key Community representatives**
1. District Secretary Mannar	1. Chairman- Mannar District Fishing Federation
2. Divisional Secretary Mannar	2. Ex. Chairman- Mannar Pradeshiya Sabha
3. Director Planning- Mannar District	3. Secretary- Church Pastoral Council, Pesalai
4. Assistant Director-Mannar-department of Fisheries & Aquatic Resources	
5. Secretary Mannar Pradeshiya Saba	

Minutes of Meeting

31. At the end of the awareness meeting it was agreed that the Mannar Wind Power project has to be implemented while giving due considerations to the concerns and agreements reached in the meeting.

Recommendations of AD Fisheries-Mannar

32. Upon receipt of Minutes of Meeting, Assistant Director, Mannar, Department of Fisheries and Aquatic Resources issued the recommendations as per the request made by CEB and the recommendations are summarized below:

1. Affected fishing community including beach-siene fishery during implementation of the project should be reasonably compensated by CEB.
2. The proposed machine unloading Pier is preferred to be constructed in the vicinity of No. 32 wind turbine.
3. Renovation of three existing by roads, Construction one new road and providing Sanitary and drinking water facilities to the fishing community (details given)
4. When employing local work force in the project related works, the affected fishing community due to the constructional activities of the project shall be given the priority.
5. Interruption for fishing activities has to be minimized during undertakings of construction

CEB's Position

33. CEB fully agree with the above recommendations except No2 above of Assistant Director, Mannar, Department of Fisheries and Aquatic Resources. CEB has already performed high resolution bathymetric survey about 2.5 km away from the location proposed by the fishing community for construction of pier and identified that the sea bed characteristics are almost similar throughout the area. Therefore, CEB principally agree with the Item 2 above the recommendations which could be considered during implementation phase of the project after conducting fresh high resolution bathymetric survey within the proposed area by the fishing community.

Photographs

34. Few snap shots of the Awareness meeting are attached as ***Annex-2.***

Annex

<u>Photographs of the Awareness Meeting</u>

Welcome Speech by PM(MWPP)-CEB GA Mannar is in attention to the Presentation

Presentation to Participants Presentation

Participants are in attention to Presentation


Commencement of Discussions. GA Mannar Briefing his Views


President Mannar District Fishing Federation Ex. Chairman Mannar PS

Annex


Participants explain their concerns


A Participant explain his concerns A Participant explain his concerns

AD Fisheries Mannar explain his views Secretary Pannar PS Explain his views

Annexure 10. Terms of Reference for Biodiversity Management Plan

Terms of Reference (TORs) for
Biodiversity Management Plan for the Implementation of
220 kV Mannar-Nadukuda Transmission Line Project within Vankalai Sanctuary and
100MW Wind Power Generation Project in Mannar Island

1.0 Background

1. A 100 megawatt (MW) wind park is expected to be developed by the Ceylon Electricity Board (CEB) at Mannar Island, Sri Lanka. The power generated from this wind park will be evacuated through a 220 kilovolt (kV), 29.1 kilometers\ (km) long power transmission line between Mannar Island and the main island, starting from the proposed Nadukuda grid substation (GSS), and ending in Mannar GSS (currently under construction), referred to as the Mannar-Nadukuda Transmission Line (TL). Out of the 29.1 km-long transmission line, about 7.5 km will traverse through the Vankalai Sanctuary that is declared as a designated wetland under Ramsar Convention[156] and an Important Bird Area.[157] The sanctuary consists of shallow wetlands and terrestrial coastal habitats. The common habitat types found in the sanctuary are thorn scrubland, water holes and tanks, arid-zone pastures and maritime grasslands, mangroves, salt marshes, lagoons, tidal flats, sea-grass beds and shallow marine areas. The avian species supported by the Vankalai Sanctuary are at potential risk of collision with the transmission line, which traverses it, as well as from the wind park. **Figure 1** shows all the ecologically or ornithologically critical habitats found in Mannar Island and the Vankalai Sanctuary.

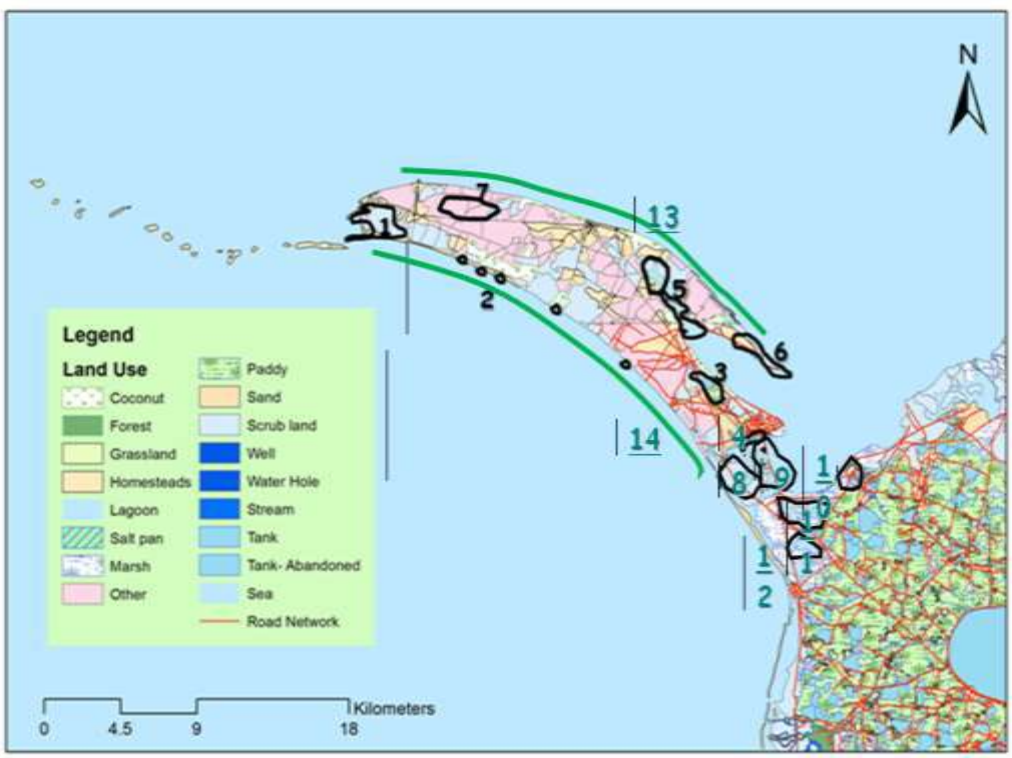


Figure 1: Critical Habitats in Mannar Island

156 https://rsis.ramsar.org/ris/1910
157 http://www.birdlife.org/datazone/sitefactsheet.php?id=15259

The critical habitats in Mannar Island are listed below:

1. Urumalai Point within Adam's Bridge National Park;
2. Series of Thonas (salt water marshes) found along the south shore;
3. Korakulam within Vedithalathive Nature Reserve;
4. Saltern;
5. Erukkalampiddy lagoon and the scrub/grass habitat located immediately north-west of the lagoon;
6. Erukkalampiddy Point within Vedithalathive Nature Reserve;
7. Scrub habitat between Pesali and Talaimannar;
8. Wetlands on either side of the railway line;
9. Wetlands on either side of the Causeway;
10. Wetlands in the northwestern edge of the Vankalai Sanctuary;
11. Periya Kalapuwa in the Vankalai Sanctuary;
12. Wetlands in the southwestern end of Vankalai Sanctuary;
13. North Shore of Mannar Island; and
14. South shore of Mannar Island.

2. The 220 kV Mannar-Nadukuda TL project will be funded by the Asian Development Bank (ADB). It has been categorized under Safeguard Policy Statement (SPS) 2009 of ADB as "A" on environment, as about 7.5 km of the transmission line traverses directly through the Vankalai Sanctuary. The proposed wind park will be an associated facility to the Mannar-Nadukuda TL for power evacuation. ADB also considers funding the 100 MW Wind Power Generation Project. The Wind Power Generation Project is also categorized as "A" on environment under the SPS 2009 given its proximity to the ecologically or ornithologically critical habitats in the Mannar Island and the Vankalai Sanctuary. Two maps giving the details of the Mannar-Nadukuda TL and the Wind Power Generation Pojects are attached as **Annex 1** and **Annex 2**, respectively. The relevant coordinates of the angle towers, wind turbines, boundaries, etc. of the two projects are shown in **Annex 3** and **Annex 4**, respectively.

3. In accordance with the SPS 2009, CEB conducted an environmental impact assessment (EIA) for the Mannar-Nadukuda TL project and submitted it to ADB; the draft EIA was publicly disclosed in ADB's website in July 2016. The final EIA was posted in the ADB's website in November 2016. CEB also prepared a draft EIA for the Wind Power Generation Project that was publicly disclosed in the ADB's website on 18 May 2017. The SPS 2009 sets out the requirements to be met for natural habitat, critical habitat, and legally protected areas (see paragraphs 5-7). For natural and critical habitats, these include (i) that "mitigation measures will be designed to achieve at least no net loss of biodiversity. They may include a combination of actions, such as post-project restoration of habitats, offset of losses through the creation or effective conservation of ecologically comparable area that are managed for biodiversity…", and (ii) for legally protected areas, that the borrower to "implement additional programs, as appropriate, to promote and enhance the conservation aims of the protected area."

4. Considering the presence of large number of migratory birds within the Vankalai Sanctuary, the EIA included an Avian Collision Risk Assessment Report. This report shows that Mannar Island and the Vankalai Sanctuary support a range of internationally important bird populations. Bird populations of highest conservation importance are those species associated with the Vankalai Sanctuary. Bird survey data show that several of the bird species are not restricted to the Vankalai Sanctuary but range more widely and hence, could be affected by the wind park and the transmission line. Bird collision modelling was undertaken in areas of about

7.5 km section of the transmission line, the Wind Park Generation Project, and potential future wind park development. Major risk to bird species is collision to the transmission line and the wind turbines particularly the large and less maneuverable birds.

5. The modelling highlighted key species at risk of collision with the transmission line: Indian Spot-billed Duck, Northern Pintail, Greater Flamingo, Painted Stork, Black-headed Ibis, Spot-billed Pelican, Indian Cormorant, and Caspian Tern. The collision risks to these species could be potentially significant requiring implementation of appropriate mitigation measures. For the Wind Power Generation Project, the key species potentially at risk include: Little Egret, Indian Cormorant, Red-wattled Lapwing, Brown-headed Gull, Caspian Tern, Gull Billed Tern, and Lesser Crested Tern.

6. Implementation of mitigation measures for the Wind Power Generation Project will be needed to comply with the biodiversity requirements of the SPS 2009. Mitigation will include design adjustments and measures to minimize impacts during construction and decommissioning phase. Construction Method Statements, following industry best practice, will be enforced by CEB, and appropriate markers to increase visibility to birds will be installed. The EIA for the Mannar-Nadukuda TL includes the outline for the Biodiversity Management Plan (**Annexure 5**) and the Construction Method Statement (**Annexure 12**). The EIA for the Wind Power Generation Project also includes a Construction Method Statement (**Annexure 4**). CEB will complete the Biodiversity Management Plan (BMP) including the Construction Method Statements (CMS) which need to be approved by the Department of Wildlife Conservation (DWC) of the government and ADB before the implementation of the Mannar-Nadukuda TL project. As provided for by relevant loan covenants (Schedule No 5 of the ordinary operations Loan Agreement, Loan No. 3483-SRI: Green Power Development and Energy Efficiency Improvement Investment Program – Project 2, dated 27 December 2016) pertaining to this transmission line (Lot B1 of Package 2), CEB shall ensure that no works are undertaken within the Vankalai Sanctuaryuntil the detailed BMP, which is consistent with the requirements of the EIA and the Environmental Management Plan of the EIA, including the Construction Method Statements has been submitted to and cleared by DWC.

2.0 Objective and Scope of the Biodiversity Management Plan

7. Consultants will be engaged to prepare the required details of the BMP and CMS. The BMP will address the potential impacts of and proposed mitigation measures of the Mannar-Nadukuda TL project, the 100 MW Wind Power Generation Project, and the potential future wind park development, to the extent feasible, to ensure compliance to the biodiversity requirements of the SPS 2009. The design of mitigation measures and CMS will be developed by the Engineering, Procurement and Construction (EPC) Contractors for the transmission line and wind power generation projects in coordination with CEB. The consultants will review and provide inputs to ensure that appropriate working methods are utilized and to clearly outline project avoidance, minimization, and restoration measures that will, where possible, ensure no net loss of biodiversity as required by the SPS 2009. This information will form Part 1 and Part 2 of the BMP.

8. Even with international best practice mitigation, however, it is anticipated that the project will have some residual impacts on biodiversity. Building on the findings of the EIA Reports, the Consultants will quantify the residual impacts following the implementation of Part 1 and Part 2 of the BMP. The consultants will also determine the extent of offset measures that will be required under the transmission line and wind power generation projects to ensure no net loss of biodiversity at Mannar Island and the Vankalai Sanctuary.

9. Since there is no existing biodiversity conservation plan for Mannar Island and the Vankalai Sanctuary, the project will fund the development of a Biodiversity Conservation Plan (BCP) for the critical habitats and its implementation for the first five years. The BCP will form Part 3 of the BMP. The primary focus of the BCP will be the Vankalai Sanctuary but will also address the management of other critical habitats at Mannar Island (see **Figure 1**). Based on the estimate of residual impacts from the BMP, the BCP will detail additional enhancement and/or protection measures for identified habitats and species of conservation value supported by Mannar Island and the Vankalai Sanctuary. This aims to offset residual impacts, to ensure no net loss of biodiversity, and to facilitate a net gain in the critical habitats. The BCP will also detail a program of measures to promote and enhance the conservation aims of the Vankalai Sanctuary in accordance with the requirements of the SPS 2009 for legally protected areas. DWC is the responsible department authorized by the Government of Sri Lanka (GoSL) to work with the Ramsar Convention of Parties in developing and implementing any activities and/or conservation programs in the Vankalai Sanctuary, and thus, will be consulted throughout the development of the BCP. DWC will also take on long-term administration of the BCP after completion of the construction phase and initial operation phase of the transmission line project. The BCP needs to be at the level of detail, technical complexity, targets and goals appropriate to the current institutional capacity of DWC and its partners. Ultimately, DWC will be the lead implementer of the BCP and will facilitate collaboration with the Ramsar Convention Secretariat for the development and operation of the BCP so that their recommendations can be brought into it.

10. The consultants will include suitable supervision and monitoring protocols for the construction and operation phase to ensure that Parts 1 and Part 2 of the BMP are being satisfactorily implemented by the CEB and their EPC Contractors.

11. The consultants shall keep a close coordination with DWC, CEB and the EPC Contractors. The consultants will submit the draft of the detailed BMP and will address all comments given by CEB, DWC and ADB before finalizing the detailed BMP.

3.0 Detailed Tasks for the Preparation of Biodiversity Management Plan

12. The BMP, as it relates to the transmission line and Wind Power Generation Project must sufficiently demonstrate how the projects will achieve no net loss of biodiversity and to promote or enhance the conservation aims of the Vankalai Sanctuary as a legally protected area. It should focus on measures for conserving important resources, recommending avoidance of impacts by modifying design of specific project activities and/or components if practical, management measures for indirect or induced impacts, institutional arrangements including coordination mechanisms that need strengthening, description of roles and responsibilities, and budgetary resources required.

13. The BMP will be developed based on the contents and approach set out in **Annex 8** of the EIA, and this TORs, and submitted to and cleared by DWC and ADB before any works are undertaken by CEB and the EPC Contractors. The following describes the tasks prepare the BMP:

<u>Construction Method Statements (Part 1) – Detailed Tasks</u>

14. Annex 5 of the EIA report for the transmission line project includes an outline of a CMS. The route of the proposed transmission line has already been chosen to minimize habitat loss within the Ramsar site, utilizing the same route as the existing rail track. To further minimize the

impacts of tower construction on this Ramsar wetlands and Important Bird Area (IBA), CEB and their EPC Contractor will develop a detailed CMS based on the outline CMS to demonstrate how construction and maintenance work inside the Vankalai Sanctuary will be implemented. Similarly, CEB and their EPC Contractor for the Wind Power Generation Project will prepare a detailed CMS for the Wind Power Generation Project.

15. The consultants will review and provide inputs to the CMS for both projects and will guide the CEB and their EPC Contractors through the process of drafting and finalizing the CMS. The consultants will accompany them on walk-through surveys and mark acceptable working areas and critical habitats or breeding areas where access will be prohibited. The consultants will review and provide comments to the draft detailed CMS to ensure that it is consistent with the EIA and **Annex 5**, meets the biodiversity requirements of the SPS 2009, reflects international best practices including the requirements of the Ramsar Convention and other relevant international conventions prior to submission to DWC and ADB for clearance.

16. The detailed CMS for the transmission line and the Wind Power Generation Project should have been approved by DWC before any work commences. The following need to be considered in preparing the detailed CMS:

- Prepare a plan to protect the identified habitats during and post construction (maintenance) based on detailed maps of habitats of conservation value developed by DWC.
- Necessary clearance of areas suitable for breeding birds will be undertaken outside of the breeding season. Even if work is undertaken outside of the breeding season, areas of suitable habitat within 10 m will be checked by a qualified ecologist from the DWC prior to commencement of works. If a bird nest is present, a suitable exclusion area will be set up and no works will take place within an appropriate buffer zone agreed with DWC until birds have fledged and nesting activity is completed.
- No mature trees will be removed from the Vankalai Sanctuary area and to avoid disturbance to birds and marine life, works will be carried out only during normal daylight working hours as specified in the CMS and from 1 hour after sunrise to 1 hour before sunset.
- Prepare a plan for road access, including clear demarcation of areas to be cleared during construction and get approval from the CEB and DWC.
- Prevent and reduce mortality of birds and wildlife from collision due to construction vehicles and work practices within the sanctuary area providing details of control measures.
- Identify and delineate temporary work area and storage or assemblage area under ecological supervision of DWC staff.
- Facilities control (vehicle type, vehicle speed, material, spoils, etc.) within Project Area to minimize disturbance to avian and marine species with details of control measure.
- Create crossing points for temporary site access roads to ensure no damage to lagoons and critical habitat/breeding areas are not disturbed.
- Review the previously conducted biodiversity surveys for species of conservation value - plants, reptiles, amphibians and birds, etc. and update the survey results, if necessary.
- Educate CEB and construction staff about BMP, CMS, etc.

- Inform construction and maintenance staff (including the EPC contractor) on the habitats of conservation value, protected and threatened plant species, marine and avifaunal species within Mannar Island and the Vankalai Sanctuary.
- Undertake habitat restoration within laydown and construction (tower erection and stringing) areas in Vankalai Sanctuary.
- EPC contractor in partnership with CEB and DWC will conduct community meetings with local people to promote awareness of the importance of habitats, and plant and animal species of conservation value.

Operational Mitigation (Part 2) - Detailed Tasks

17. **Annex 8** of the EIA report for the Transmission Line project includes an outline BMP elaborating on the operational mitigation required. Through design of the projects, CEB will implement the operational mitigation for the habitats and species of conservation value at Mannar Island and the Vankalai Sanctuary aiming for no net loss to biodiversity. The key risk to the bird population is collision. Impacts related to collision of birds with transmission line will be reduced by installation of line markers.

18. Operational mitigation for transmission line construction, potential electrocution and collisions of bird species should be consistent with **Annex 8** and following international best practice for the following:

- Tower and line design or configuration
- Line markings and warnings
- Insulation either the Swan-Flight Diverter (at 10 m to 30 m separation) or Aerial Marker Spheres (at 30 m to 100 m separation) as discussed in EIA Volume 2 Section 2 (Avian Collision Risk Assessment Report)
- Perch management techniques, and deterring birds from power lines
- CEB will operate and maintain any mitigation provisions such as line markings (to ensure ongoing protection to birds) and to minimize the impacts of any maintenance activities in the Vankalai Sanctuary.

19. Operational mitigation for the 100 MW Wind Power Generation Project will be consistent with the measures identified in the draft EIA (May 2017) which includes:

- To stop (curtail) turbines during breeding and/or migratory seasons, as appropriate
- Installation of radar monitoring system to identify birds' movement and auto cease of the turbine functioning before collision of birds

20. The design work will be undertaken by CEB and their EPC Contractors with relevant technical inputs and review from the Consultants. The Consultants will guide the CEB and their EPC Contractors through the process of designing the operational mitigation measures. The Consultants will ensure that the operational mitigation measures will comply with the biodiversity requirements of the SPS 2009, reflects international best practice, and the requirements of relevant international conventions such as the Ramsar Convention and other agreements before submitting for approval to DWC and for clearance to ADB.

21. The detailed designs for the operational mitigation measures of the transmission line and the Wind Power Generation Project will be approved by DWC before any work commences on the 7.5 km length of transmission line traversed inside the Vankalai Sanctuary.

Supervision and Monitoring of Parts 1 and 2 – Detailed Tasks

22. The consultants will include in the BMP suitable supervision and monitoring protocols for the construction and operation phase to ensure that Parts 1 and 2 of the BMP are being satisfactorily implemented by CEB and their EPC Contractors.

23. Protocols will include details of roles and responsibilities including engagement of consultants. For the construction and operational mitigation measures, this will be managed and monitored on a day-to-day basis by the ecology staff of the EPC Contractor and reported in accordance with the agreed management system, and the requirements of the SPS 2009 for reporting of environmental monitoring. The monitoring protocol will include a procedure for reporting incidents by site staff. A recording and evaluation system will be established which will be reviewed by CEB ecological staff no less than on a weekly basis with regular spot checks by the external ecological consultants. Corrective measures will be taken immediately, where necessary, including appropriate actions for infringements.

24. Post-construction biodiversity monitoring will be completed for at least three years after the end of construction, this will include habitat condition monitoring and bird surveys in accordance with the recommendations of the Collision Risk Assessment. Monitoring requirements will specify performance indicators to be met with respect to all critical habitat triggers, i.e., zero reduction or an increase in the number of birds (total and by species) surveyed yearly.

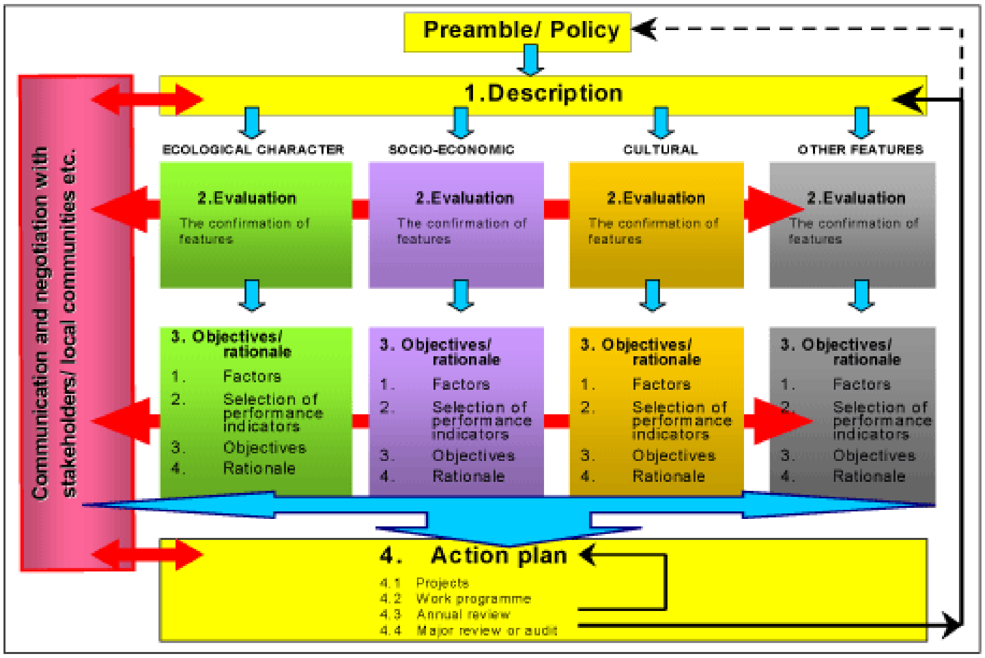
Residual Impacts and Offsets – Detailed Tasks

25. In order to consider the required amount of biodiversity offset with respect to the residual impacts of the transmission line and the wind power generation projects, the Consultants will develop a biodiversity offset metric that captures the type (habitat and species of conservation value), amount, and condition of biodiversity impacted. Suitable approach to quantify loss and gain of biodiversity shall be recommended with reference to international best practices and agreed by DWC and ADB. The amount of biodiversity offset to be delivered through the BCP will then be calculated based on the estimated residual impacts.

Development of Biodiversity Conservation Plan (Part 3) - Detailed Tasks

26. The Consultants, in conjunction with CEB and DWC, will undertake the following steps to develop a BCP that aims to implement enhancement and/or protection measures for the habitats and for identified species of conservation value. The goal is to achieve no net loss to biodiversity and a net gain to critical habitats. Development of the BCP will be in accordance with the management plan guidance of the Ramsar Secretariat.[158] The recommended structure of the BCP will be consistent with those guidelines as follows:

[158] http://archive.ramsar.org/cda/en/ramsar-documents-guidelines-new-guidelines-for/main/ramsar/1-31-105%5E20857_4000_0__



- **Initial baseline assessment and screening** - building on data gathered through the preparation of the EIA reports for the transmission line and the wind power generation projects, the Consultants will work with all relevant stakeholders (including Ceylon Bird Club, DWC, NARA, IUCN, etc.) to gather and synthesize all available information on the Mannar Island critical habitats and the Vankalai Sanctuary, their existing management regimes, ecological condition status on habitats, species of conservation value supported, threats to biodiversity and opportunities for enhancement. As well as ecological survey data to inform the assessment of ecological condition status, this information will include details of any existing plans and strategies that relate to the legally protected areas-Vankalai Sanctuary but also Adam's Bridge National Park and Vedithalathive Nature Reserve, existing administrative arrangements for their management, existing staffing and budgets available for management, management aims and objectives, any current monitoring protocols and surveys being undertaken, and any existing enforcement arrangements. It will also include collation of information about the use of the critical habitats by the local population – livelihoods or recreational – conducting surveys for this purpose. The outcome of the initial baseline assessment and screening will be documented in the detailed BCP. GIS maps, demonstrating ecological functional zones of critical habitats at Mannar Island and Vankalai Sanctuary (with habitat compartments as smallest units) will be prepared as part of the initial baseline.

- **Conservation needs assessment** - facilitate a participatory dialogue process with all relevant stakeholders (including the local population) to review the conservation needs of Mannar Island critical habitats and Vankalai Sanctuary, taking into consideration both direct and indirect drivers of change and threats and opportunities. This will focus on issues that can be directly addressed through improved management (e.g. management of invasive species), as well as external threats that may require broader scale interventions such as changes in land use planning and policy (e.g. encroachment and conversion from other land uses including roads, railways, transmission lines and the future wind park development). The outcome of the conservation needs assessment will be documented in the detailed BCP.

- **Assessment of management effectiveness** – undertake a baseline assessment of the existing management arrangements and effectiveness for ensuring the ecological condition status of the Mannar Island critical habitats and the Vankalai Sanctuary is improved or maintained. This will use the World Bank/WWF and Global Environment Facility Protected Area Management Effectiveness Tracking Tool to review existing management arrangements and facilitate dialogue with relevant stakeholders on improvements to the existing management system that can be implemented through the BCP.[159] The outcome of this management effectiveness assessment will be documented in the detailed BCP.

- **Monitoring arrangements**- undertake a review of existing monitoring protocols and surveys. Taking note of this, develop protocols for an appropriate long-term monitoring program consistent with the requirements of the EIA reports. Monitoring of implementation and success of CEB and EPC Contractor construction and operational mitigation measures are not the subject of the BCP. Nonetheless, the BCP will include long term-monitoring indicators that can measure the Mannar Island critical habitats and Vankalai Sanctuary's ecological condition/status, and thus the impact of the projects. The monitoring program will include:(a) regular monitoring of habitats and vegetation (habitat mapping of types, areas, conditions); (b) targeted species monitoring (particularly for migratory, congregational, and threatened species), and (c) threat monitoring (e.g. invasive species, poaching). Monitoring will include bird species as well as a more detailed mapping and assessment of their nesting and breeding habitats. The monitoring program will be used both to assess the effects of the projects on the bird population, and thus, must be in accordance with the recommendations of the Collision Risk Assessment Reports. This may require inclusion in the BCP of additional baseline studies on bird species that may be potentially affected by the projects to inform future management of the Mannar Island critical habitats and the Vankalai Sanctuary. The results of monitoring activities will feed into updates to the construction and operational mitigation measures as well as broader critical habitat management. The monitoring plan will be documented as part of the detailed BCP, including a mechanism for annual public reporting of the results of the long-term monitoring program by DWC.

- **Preparation of site biodiversity conservation plan and budget** –based on the outcome of the above assessments, the Consultants will work closely with DWC to develop (with support of CEB) a detailed operational BCP for the Mannar Island critical habitats and the Vankalai Sanctuary that prioritizes key conservation actions as well as monitoring, enforcement, and associated stakeholders' engagement and partnerships. The detailed BCP will include the outcome of the above steps, and draw on these outcomes and existing baseline data to define a conservation (species and habitat) management program.

  This will, in effect, be the future management plan for the Mannar Island critical habitats and the Vankalai Sanctuary legally protected areas. It should, thus, be not only comprehensive but also readily implementable – including simple, clear tables of necessary management actions. For each management action, the BCP should detail the frequency at which actions should be implemented, responsible parties, relevant monitoring indicators to assess success of actions, and financial resource needs. The scale and complexity of planned actions should be tailored to the context, with a level of prioritization where necessary to reduce annual actions to a manageable and affordable level. The BCP will also include recommendations for sustainable financing options. Sustainable financing may be generated from careful structuring of initial investment and/or outside income to the sanctuary (e.g., from user fees from eco-tourism by birdwatchers). It is anticipated that annual costs for management of the

[159] https://www.thegef.org/documents/gef-biodiversitytracking- tool

Mannar Island critical habitats and the Vankalai Sanctuary are unlikely to be high. Careful structuring of initial project investment in some kind of trust fund mechanism may thus provide the best opportunity to generate sufficient annual income for management into the long-term and so such options should be explored in detail.

- **Identification of management actions to be prioritized as project biodiversity offsets –** the Consultants will select priority management actions, with agreement of DWC, to provide a biodiversity offset for residual project impacts (determined as above) as well as additional conservation support to comply with the requirements of SPS 2009. Implementation of the BCP will be financed by the project for the first five years. Prioritized management actions will be financed over other actions to ensure that the necessary offsets are delivered. If appropriate trust fund mechanisms are identified in the BCP, careful investment of project resources may enable funding of the BCP into the longer-term.

  Areas for prioritization are particularly likely to include those which can produce measurable conservation gains in terms of habitat extent or quality, or species populations, thus providing clear offsets for any project residual impacts. These are likely to include habitat restoration – such as revegetation, invasive plant species management, and management of wetland hydrology to suit priority bird species – and should be sufficient in scale to compensate for any residual impacts estimated by the Consultants. Other actions for prioritization will focus on those that promote and enhance the conservation aims of the protected area, such as: (i) protection of breeding and nesting habitats from future development and disturbance; (ii) habitat protection, including boundary demarcation, signs and patrols; (iii) awareness-raising and collaboration with local communities and stakeholders on conservation goals and sustainable management; and (iv) sustainable conservation-orientated tourism development, such as eco-trails and bird-watching facilities.

4.0 Resource Requirements

27. The assignment will require a Team of Experts in the relevant fields, assisted by a field team of support personnel. Professionals with adequate experience in the following areas/fields are preferred as the Team of Experts:

- **International Team leader (biodiversity management)**

  The international team leader will lead and coordinate all consultants in developing the BMP including the review of the CMS and the detailed design and operational mitigation measures for both project (transmission line and wind power generation), and the development of the BCP. The output requirements are given in the previous discussions.

  The Team Leader should have a minimum of a Master's Degree in Wildlife Conservation or Ecosystem Management or related discipline. It is essential to have working knowledge of ADB's Safeguard Policy Statement 2009, familiarity with similar safeguard policies, able to bring in and/or incorporate relevant international best practices to the projects.

  The consultant should have a minimum of 15 years of applied experience in wetland habitat management, biodiversity conservation-related activities involving protected areas including experience working with government conservation authorities, NGOs, and project developers. He/She must have adequate working experience and knowledge in designing and implementing protected areas or other site-based biodiversity management plans including managing construction of infrastructure in wetland habitats, and design of detailed biodiversity offset plans. The working experience should include stakeholders' engagement, development of monitoring plans to measure project impacts on biodiversity, designing management measures with measurable outcomes that can balance residual project impacts, and in quantifying and documenting such a plan to achieve no net loss in a natural habitat or net gain in critical habitat.

Ornithological expertise and/or working experience (particularly in relation to waterbirds) would be highly preferred to understand project residual impacts on birds, and potential management measures that could provide appropriate gains to compensate for these impacts. Specific experience in management of invasive plant species and in management of hydrology for wetland birds would be beneficial, as these are likely to be key site management actions. It would be helpful to have prior experience leading conservation needs assessments, identifying sustainable funding solutions (including trust funds), and using the World Bank/WWF/Global Environment Facility Protected Area Management Effectiveness Tracking Tool.

Strong communication skills and good oral and written English are essential. Working experience in Sri Lanka or the South Asia region is preferred.

- **International Ornithologist**

Under the Team Leader and together with other consultants, the Ornithologist will provide technical inputs in developing the BMP, the CMS including the design of operations mitigation measures, and the development of the BCP (see previous paragraphs on the requirements of the outputs).

He/She should have a minimum of a Master's Degree in Wildlife Conservation or Ecosystem Management and related subjects. He/She should have a minimum of 15 years of applied experience in designing and implementing high tension transmission line projects and wind farm projects specifically with respect to impacts on ornithology and stakeholders' engagement. It is essential to have working knowledge of ADB's Safeguard Policy Statement 2009, familiarity with similar safeguard policies, and able to bring in and/or incorporate relevant international best practices to the projects. It would be helpful to have prior experience in conservation needs assessments, identifying sustainable funding solutions (including trust funds), and using the World Bank/WWF/Global Environment Facility Protected Area Management Effectiveness Tracking Tool.

Strong communication skills and good oral and written English are essential. Working experience in Sri Lanka or the South Asia region would be preferable.

- **National Zoologist with an ornithological background**

The National Zoologist with ornithological background will provide technical support to the International Ornithologist, Team Leader, and other BMP Consultants on relevant data and information required to develop the BMP, CMS, design of operations mitigation measures (refer to previous paragraphs on requirements of the outputs. Aside from this, the activities include but are not limited to the following:

    - Together with the team of Consultants of the BMP, work closely with the technical design team of CEB to identify the breeding areas of bird species of national and global conservation status and delineate the buffer zone to guide EPC Contractors during construction phase of the transmission line and wind power generation project. Identify clear demarcation of areas to be cleared for access roads, right-of-way for transmission line, and identify species of terrestrial flora and fauna of conservation status that will be affected.

- Provide inputs, as appropriate, on the requirements to apply/use the World Bank/WWF/Global Environment Facility Protected Area Management Effectiveness Tracking Tool.
- Recommend areas within the Vankalai Sanctuary that can be used for temporary work, storage and assembly, and other relevant works needed to install the transmission line.
- Provide inputs in developing the biodiversity monitoring plan, implementation arrangements, costs estimates which will be incorporated in the BMP.
- Provide inputs in developing biodiversity offset metric, suitable approach in quantifying loss and gain of biodiversity.
- Provide estimates of budget for implementation of the BMP and BCP.
- Together with CEB, EPC Contractors, and DWC supervise the clearing works for the transmission line within Vankalai Sanctuary.
- Support the Team Leader and other BMP consultants in developing the BMP, BCP and CMS.
- Together with other national consultants, organize and document stakeholders' engagement in designated areas, participatory dialogue process, and invite local stakeholders to participate.

He/She should have a PhD in zoology, ornithology, or wildlife biology with a minimum of 15 years applied experience in ornithological studies, impacts on migratory birds from high tension transmission line and wind farm projects, developing and implementing biodiversity conservation and/or management plan, and stakeholders' engagement. Work experience should be able to demonstrate that he/she can bring in relevant best practices to the project in dealing with impacts on birds associated with the construction and operation of transmission line and wind power generation including biodiversity offset at the national level. It is essential to have strong communication skills and good oral and written English.

- **National Ecologist**

The National Ecologist will provide technical support to the Team Leader and other BMP consultants on relevant data and information required to develop the BMP, CMS, design of operations mitigation measures (refer to previous paragraphs on requirements of the outputs). Aside from this, the activities include but are not limited to the following:

- Provide inputs, as appropriate, on the requirements to apply/use the World Bank/WWF/Global Environment Facility Protected Area Management Effectiveness Tracking Tool.
- Guide the CEB and their EPC Contractors on appropriate areas for temporary work, storage/warehouse, etc. within the Vankalai Sanctuary and the project area for the Wind Power Generation.
- Provide guidance to CEB and their EPC Contractors on habitat restoration within laydown and tower construction areas within Vankalai Sanctuary as well as in the Mannar area for wind power generation.

- Provide inputs in developing the biodiversity monitoring plan, implementation arrangements, costs estimates which will be incorporated in the BMP.
- Provide inputs in developing biodiversity offset metric, suitable approach in quantifying loss and gain of biodiversity.
- Provide estimates of budget for implementation of the BMP and BCP.
- Together with other national consultants, organize and document stakeholders' engagement in designated areas, participatory dialogue process, and invite local stakeholders to participate.

He/She should have a PhD in Ecology or related discipline with expertise in biodiversity conservation, natural resources management, environmental management or related areas and a minimum of 15 years relevant working experience. Professional experience on impacts to biodiversity and ecosystems from the implementation of high tension transmission line and wind farm projects will be given preference. Work experience should be able to demonstrate that he/she can bring in relevant best practices to the project in dealing with ecological impacts associated with the construction and operation of transmission line and wind power generation including biodiversity offset and biodiversity offset metric at the national level. Strong communication skills and good oral and written English are essential.

- **National Marine Biologist**

The National Marine Biologist will provide technical support to the Team Leader and other BMP consultants on relevant data and information required to develop the BMP, CMS, design of operations mitigation measures (refer to previous paragraphs on requirements of the outputs). Aside from this, the activities include but are not limited to the following:

- Provide inputs, as appropriate, on the requirements to apply/use the World Bank/WWF/Global Environment Facility Protected Area Management Effectiveness Tracking Tool.
- Guide the CEB and their EPC Contractors on appropriate areas for temporary work, storage/warehouse, etc. within the project area in Mannar Island for the Wind Power Generation.
- Provide guidance to CEB and their EPC Contractors on habitat restoration within the project area in Mannar Island for wind power generation.
- Provide inputs in developing the biodiversity monitoring plan, implementation arrangements, and costs estimates for the areas affected by the wind power generation which will be incorporated in the BMP.
- Provide relevant inputs in developing biodiversity offset metric, suitable approach in quantifying loss and gain of biodiversity within the areas affected by the wind power generation.
- Identify areas (if any) that will require restoration near Adam's Bridge Marine National Park that will be included in the BMP.
- Identify suitable fishing practices and compliance monitoring to be incorporated in the BMP.
- Provide estimates of budget on marine conservation and resources management for implementation of the BMP and BCP.
- Together with other national consultants, organize and document stakeholders' engagement in designated areas, participatory dialogue process, and invite local stakeholders to participate.

He/She should have at least a Master's Degree in Marine Biology with minimum 10 years of relevant experience on marine conservation management. Professional experience on reef ecology, benthic communities, visual mapping, and relevant field deployment will be given preference. Strong communication skills and good oral and written English are essential.

- **National GIS expert**

The National GIS expert will provide technical support to the Team Leader and other BMP consultants on relevant data, information, and mapping required to develop the BMP, CMS, design of operations mitigation measures (refer to previous paragraphs on requirements of the outputs). Aside from this, the activities include but are not limited to the following:

- Create maps from the results of initial baseline assessment and screening showing ecological functional zones of critical habitats at Mannar Island and Vankalai Sanctuary.
- Interpret available relevant satellite photos and imagery, remote sensing data, and maps that can be useful in developing the BMP.
- In coordination with national experts in the Team, create maps showing the breeding sites in Mannar Island, Vankalai Sanctuary, and Adam's Bridge Marine National Park.
- Conduct the mapping and create the required maps for the BMP.

He/She should have at least a minimum of Bachelor's Degree in GIS or related discipline with more than 10 years work experience in mapping, reporting, and autoCAD drawing. Strong communication skills and good oral and written English are essential.

- **National Social Specialist**

The National Social Specialist will provide technical support to the Team Leader and other BMP consultants on relevant data and information required to develop the BMP, CMS, design of operations mitigation measures (refer to previous paragraphs on requirements of the outputs). Aside from this, the activities include but are not limited to the following:

- Carry out data collection, research and analysis of socioeconomics and gender
- In coordination with other consultants in the Team, conduct stakeholder mapping, consultation and engagement to ensure that social dimension is incorporated in the BMP.
- Provide inputs, as appropriate, on the requirements to apply/use the World Bank/WWF/Global Environment Facility Protected Area Management Effectiveness Tracking Tool.
- Provide guidance on social aspects to CEB and their EPC Contractors on habitat restoration within laydown and tower construction areas within the Vankalai Sanctuary as well as in the Mannar area for wind power generation.

- Provide inputs on social aspects in developing the biodiversity monitoring plan, implementation arrangements, costs estimates which will be incorporated in the BMP.
- Provide inputs in developing biodiversity offset metric, suitable approach in quantifying loss and gain of biodiversity relevant to social dimensions.
- Provide estimates of budget relevant to social aspects (if required) for the implementation of the BMP and BCP.

He/She should have a minimum of Bachelor's Degree in social science or related discipline with at least 10 years relevant work experience in social impact assessment of power development projects focusing on renewable energy. Strong communication skills and good oral and written English are essential.

5.0 Institutional Arrangements

CEB

28. CEB, in consultation with DWC, can "design" and "implement" mechanisms for implementation of the "biodiversity management plan" as it relates to the transmission line and Wind Power Generation Project. The delivery of other aspects of the biodiversity management plan will be through a combination of governance, legal and institutional arrangements to administer future management to enhance biodiversity value of the Mannar island critical habitats and the Vankalai Sanctuary. In the long-term, the biodiversity conservation plan will be administered by DWC.

DWC

29. DWC is the responsible department authorized by GoSL to work with the Ramsar Convention of Parties to develop and implement any activities/conservation programs in the Vankalai Sanctuary area. Accordingly, DWC will provide inputs to the needs assessment study and help develop the detailed biodiversity conservation plan and long-term monitoring program, which will form part of the BMP. GoSL, acting through DWC, will ensure formal collaboration with the Ramsar Convention Secretariat in developing and operating the biodiversity conservation plan. DWC will ensure fulfilling any environmental mitigation measures during construction and operation stages of the project and its associated facilities mandated by the Secretariat and its partners at any time in the future.

6.0 Completion Schedule and Final Deliverables

30. The BMP will be completed within three months from the date of signing of consulting contract agreement. The Consultants will submit the final report in both hard and soft copy within 3 weeks of acceptance by CEB, DWC and ADB.

Deliverables	Duration
1. Inception Report containing the work plan, outline of the BMP including key issues to be covered and methodology	Within 7 days from the date of signing of the contract
2. Complete Draft Final Report (DFR) including all annexures for review by CEB	Within two months from the date of signing of the contract
3. CEB to provide comments	Within 5 days from submission of DFR

Deliverables	Duration
4. Revised DFR incorporating CEB comments	Within 5 days from the date of issue of such comments
5. Submit revised DFR to ADB and DWC for review	Within 5 days from completion of revised DFR
6. ADB and DWC to provide comments	Within two weeks from the date of receipt of the revised DFR
7. Submit the Final Report incorporating comments from ADB and DWC	Within 5 days from completion of revised DFR
9. ADB and DWC accept the Final Report	Within 5 days from receipt of the Final Report

Annexure 11: Addressing Noise issues in sleeping areas

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இலங்கை மின்சார சபை
CEYLON ELECTRICITY BOARD

Your ref: My ref: PD/MWPP/72-104 Date: August 30, 2017

Mr. Mukhtor Khamudkhanov
Principal Energy Specialist
Asian Development Bank

Dear Sir,

Relocating of Sleeping Quarters of Sri Lanka Navy and Acquisition of Lands/Buildings claimed by M/s Kaluthota Hotels (Pvt) Ltd. Located within Energy Development Area of Mannar Wind Power Project – Ceylon Electricity Board

This has reference to the agreements reached in the Meeting and Teleconference held on 23.08.2017 at ADB-SLRM Colombo to discuss draft EIA and proposed Bio Diversity management plan (BMP) for the Mannar Wind Power Project and associate facility Mannar Nadukuda Transmission Project.

There, it was discussed that the necessary initiative measures have been taken by MWPP-CEB for relocating the sleeping quarters of Sri Lanka Navy and for acquiring of lands from the M/s Kaluthota Hotels (Pvt) ltd. to comply with the Noise Receptor table requirements prepared by ADB Due Diligence consultants.

Further, it was agreed to provide the relevant correspondence on the matter, and the consent letter from SL Navy to relocate the sleeping quarters is anticipated in next weeks. It will be forwarded promptly once it is received by CEB.

We herewith submit the copy of the letter indicating the commitment for initiating formal Land Acquisition process by General Manager-GM, CEB for acquiring of lands from the M/s Kaluthota Hotels (Pvt) ltd.

Yours Faithfully

CEYLON ELECTRICITY BOARD

Eng. L. R. Vidanapathirana
Project Director
Mannar Wind Power Project

Eng. L R Vidanapathirana
Project Director (Mannar Wind Power Project)

PROJECT DIRECTOR – MANNAR WIND POWER PROJECT

Ceylon Electricity Board, No. 12, Udumulla Road, Battaramulla 10120, Sri Lanka.
Tel: +94 11 288 9640 / Fax: +94 11 286 9631 | e-mail: pdmwpp@ceb.lk | www.ceb.lk |

Office of Project Director
Mannar Wind Power Project
Ceylon Electricity Board
No. 12, Udumulla Road
BATTARAMULLA 10120

Date: August 18, 2017

Your Ref:
My Ref: PD/MWPP/72

General Manager (CEB)
Through
Additional General Manager (Projects)

Recommended M.
3-1/8
Eng. S. D. W. Gunawardana
AGM (Projects)

Sub: Acquisition of land plots belongs to Kaluthota Hotels (Pvt) Ltd. located within the Energy Development Area allocated to Mannar Wind Power Project
Ref: 100 MW Wind Power Project in Mannar Island - Ceylon Electricity Board

This is further to the discussions between PMU of Mannar Wind Power Project and Asian Development Bank (ADB) on matters related to social safeguards & resettlements works pertaining to Mannar Wind Power Project which took place during final stages of EIA, carried out for fulfilling the requirements of ADB.

The project design and proposed layout of Mannar Wind Farm has been achieved subjected to wide range of constraints such as technical, environmental and social issues. During the project design stages we observed that M/s. Kaluthota Hotels (Pvt) Ltd has initiated unauthorized constructions works (Cabanas) within the Energy Development Area (EDA) of Mannar Wind Power Project. They have already setup series of Cabanas in close proximity to Wind Turbine positions (WTG positions 08, 09, 16, 17 & 18) which are well within the EDA allocated to Mannar Wind Power Project. We also noted that none of these Cabanas were constructed prior to the declaration of EDA (Gazette notification no: 1858/2 of 2014.04.17) by Sri Lanka Sustainable Energy Authority (SLSEA). These construction activities can be considered as illegal encroachment to the EDA and most of these activities commenced even after the project approval. We have already brought these developments to the notice of SLSEA (correspondence with SLSEA are given in Annex 2).

The construction of these Cabanas has resulted in underutilization of wind resource due to direct and indirect reasons, namely, depletion of wind resource due to presence of structures within EDA and curtailment of wind plant operation because in accordance with the ADB Safeguard Policy , even for illegal encroachments/constructions to the EDA those should adequately be compensated (removing WTG positions 08, 17 and curtailing operation of WTG positions 07, 09, 15, 16, 18, 19, 38 & 39 in order to be compliant with noise limits imposed by ADB) respectively.

However, this issue can be addressed in a manner acceptable to ADB's Safeguard Policy by formal acquisition of Lands and buildings claimed by M/s. Kaluthota Hotels (Pvt) Ltd by properly compensating. Therefore, it is recommended to acquire the specific land blocks which includes Cabanas

(Annex 1) of M/s. Kaluthota Hotels (Pvt) Ltd., which are directly impacting on wind farm operation. Potential benefits of acquiring these land blocks are outlined below.

Potential benefits

Significant increase of energy generation capability of the project site can be achieved through saving of two wind turbine positions (WTG8 & WTG 17). In addition to this restrictions in operation of number of Wind Turbines can be relaxed. With this total energy generation capability of the project site can be increased by 30 GWh per year; approximately which corresponds to annual revenue gain of LKR 485 million (assuming an average selling price of 16.18/kWh).

Cost implications

Estimate cost of proposed acquisition need to be assessed, as per the prevailing land acquisition policy. The cost of land alone can be estimated at the rate of LKR 2 million per hectare. Amount of land which needs to be acquired to ensure free operation of wind farm is approximately 21 hectares. Accordingly, as per the present valuation rates the cost of land acquisition is LKR 60 million. In addition to this according to prevailing land acquisition policy, affected party need to be properly compensated considering the cost of structures and loss of income.

Recommendation

It is recommended to initiate the process to acquire the identified land plots belongs to M/s. Kaluthota Hotels (Pvt) Ltd., by properly compensating as per the prevailing land acquisition policy.

Approval sought

Your approval is sought for the above recommendation, please.

Eng. L R Vidanapathirana
Project Director
Mannar Wind Power Project

Project Director
Mannar Wind Power Project

DGM(P)
Agreed
30/8/18

Eng. A. K. Samarasinghe
General Manager, CEB

Annexures:

Annex 1 - WTG positions indicating land plots recommended for acquisition
Annex 2 - Correspondences with SLSEA

Tel: (94 11) 288 9640 Fax: (94 11) 286 9631 e-Mail: pdmwpp@ceb.lk

Annex 1

6.9 hectares needed to be acquired near WTG 08

13.4 hectares needed to be acquired near WTG 17

APPENDICES

MAPS