

# **Holistic Development of Great Nicobar Island at Andaman & Nicobar Islands**

## **Pre-Feasibility Report**

**March 2021**

## Quality information

**Prepared by**

---

Alexa Heidrich  
Virender Kattarya  
Saurabh Sharma  
Dinesh Arora  
Umesh Kathpalia  
Sharvari Sadadekar

---

**Checked by**

---

Abhishek Malhotra  
Somnath Mukherjee

---

**Approved by**

---

John Bachmann

---

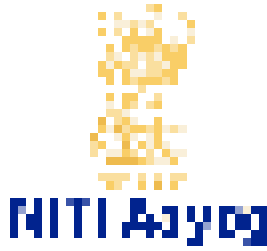
## Revision History

| <i>Revision</i> | <i>Revision date</i> | <i>Details</i> | <i>Authorized</i> | <i>Name</i> | <i>Position</i> |
|-----------------|----------------------|----------------|-------------------|-------------|-----------------|
|                 |                      |                |                   |             |                 |
|                 |                      |                |                   |             |                 |
|                 |                      |                |                   |             |                 |

## Distribution List

| <i># Hard Copies</i> | <i>PDF Required</i> | <i>Association / Company Name</i> |
|----------------------|---------------------|-----------------------------------|
|                      |                     |                                   |
|                      |                     |                                   |
|                      |                     |                                   |
|                      |                     |                                   |

**Prepared for:**



Sansad Marg, Sansad Marg Area, New Delhi, Delhi 110001

**Prepared by:**



**AECOM India Private Ltd.**

9th Floor, Tower C, Building  
No. 9, DLF Cyber City, DLF  
Phase II Gurgaon 122002,  
Haryana  
India

T: +91 124 4830100

© 2021 AECOM India Private Limited. All Rights Reserved.

*This document has been prepared by AECOM India Private Limited ("AECOM") for sole use of our client (the "Client") in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client. Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.*





## LIST OF FIGURES

|   |    |
|---|----|
| Figure 1: Great Nicobar Island showing the Project Area .....                                 | 14 |
| Figure 2: Locational Advantage of Great Nicobar .....   | 16 |
| Figure 3: Locational setting of Great Nicobar Island with respect to major Indian ports ..... | 17 |
| Figure 4: Transshipment Dynamics in Great Nicobar Catchment Area .....                        | 17 |
| Figure 5: Location of Four Interlinked Projects .....   | 24 |
| Figure 6: Location of Great Nicobar Island in India .....                                     | 25 |
| Figure 7: Map showing the proposed ICTT Port .....  | 27 |
| Figure 8: Seismic Zoning Map of India as per IS-1893 Part 1-2002.....                         | 29 |
| Figure 9: Location of National Parks, Forest Reserve and Revenue Land .....                   | 36 |
| Figure 10: Project Area Overlaid on Topographic Map .....                                     | 37 |
| Figure 11: Alternative Site Locations for Port.....   | 41 |
| Figure 12: Galathea Bay Location – Proposed Layout ( Site 1) .....                            | 42 |
| Figure 13: Casuarina Bay Location – Proposed Layout ( Site 2) .....                           | 43 |
| Figure 14: Anderson Bay Location – Proposed Layout ( Site 3).....                             | 44 |
| Figure 15: Pemayya Bay Location – Proposed Layout (Site 4).....                               | 45 |
| Figure 16: Campbell Bay Location – Proposed Layout (Site 5).....                              | 46 |
| Figure 17: 5 Alternative Sites for Airport .....  | 49 |
| Figure 18: 3 Alternative Sites for Airport .....  | 50 |
| Figure 19: OLS for Airport North Site .....   | 51 |
| Figure 20: OLS for Airport Central Site .....   | 52 |
| Figure 21: OLS for Airport South Site .....   | 53 |
| Figure 22: Preferred airport site location.....   | 57 |
| Figure 23: Aerial Perspective of alternate Concept Plan option .....                          | 58 |
| Figure 24: Alternate sites for Power Plant.....   | 59 |
| Figure 25: Employment and Population Projection Methodology .....                             | 62 |
| Figure 26: Range of common aircraft types in service worldwide .....                          | 70 |

Figure 27: Benchmarking with the other airfields in the region such as 1) Campbell Bay in the island of Great Nicobar, 2) Car Nicobar and 3) Port Blair; all these runways are oriented in the first and third quadrant. .... 72

Figure 28: Windrose Diagrams ..... 73

Figure 29: Concept Land use Plan ..... 77

Figure 30: Factor contributing to Sustainable Development within GNI's Carrying Capacity..... 81

Figure 31: Galathea Bay Location – Recommended Master Plan Layout..... 91

Figure 32: Galathea Bay Location – Google image showing Port Area ..... 91

Figure 33: Map showing preferred Airport site ..... 94

Figure 34: Master Plan of recommended Airport site ..... 95

Figure 35: Layout Plan of Power Plant (Recommended site).....111

Figure 36: Water Balance Diagram..... 114

Figure 37: Location of WTP and STPs ..... 117

## LIST OF TABLES

|   |    |
|---|----|
| Table 1: Great Nicobar Island Population .....  | 20 |
| Table 2: Population of Revenue Villages .....   | 20 |
| Table 3: Occupational Structure of Great Nicobar Island (2016-17) .....                             | 20 |
| Table 4: Site Specific Surveys .....  | 27 |
| Table 5: Landside General Soil Profile .....  | 28 |
| Table 6: Marine Side General Soil Profile .....   | 28 |
| Table 7: Land Requirement of Proposed Projects .....  | 32 |
| Table 8: Power Generation Sources .....   | 33 |
| Table 9: Comparative Analysis for Alternate Sites .....   | 46 |
| Table 10: Analysis of Alternative Sites .....   | 54 |
| Table 11: Analysis of Alternative Sites .....   | 60 |
| Table 12: Assumptions for Employment Estimation .....   | 63 |
| Table 13: Projection of Total No. of Employees .....  | 64 |
| Table 14: Projection of Total Population .....  | 64 |
| Table 15: Preliminary Projections of Transshipment Port Traffic (million TEUs) -Excluding FTWZ..... | 65 |
| Table 16: Dimensions of the Smallest and Largest Ship .....   | 66 |
| Table 17: Dredged Depth Summary.....  | 66 |
| Table 18: Aerodrome reference code by ICAO .....  | 68 |
| Table 19: Fleet Mix .....   | 69 |
| Table 20 Summarisings the Stretches .....   | 70 |
| Table 21: Critical design aircraft envelopes .....  | 71 |
| Table 22: Wind Direction .....  | 72 |
| Table 23: Take-off Climb Surface Dimensions and Slopes .....  | 74 |
| Table 24: Approach Surface Dimensions and Slopes .....  | 74 |
| Table 25: Runway Dimensions.....  | 75 |
| Table 26: Permissible Values of Slopes As per ICAO .....  | 76 |

|  |     |
|--|-----|
| Table 27: Land Use Categories .....  | 78  |
| Table 28: Land Use Area Breakdown .....  | 80  |
| Table 29: Key Performance Indicators for Managing Tourism & Urban Development..... | 83  |
| Table 30: CEA Recommendation .....   | 85  |
| Table 31: Electricity supply code Recommendation .....                             | 85  |
| Table 32: List of Equipment for ICTT .....   | 89  |
| Table 33: Phase-wise Port Development over Master Plan Horizon .....               | 92  |
| Table 34: Block Cost Estimates .....   | 92  |
| Table 35: Main Parallel Taxiway Dimension .....                                    | 95  |
| Table 36: Apron Dimension .....  | 95  |
| Table 37: Summarized facilities at proposed Airport .....                          | 100 |
| Table 38: Preliminary cost estimate .....  | 104 |
| Table 39: Tentative area for the main components of gas-based power plant. ....    | 111 |
| Table 40: Water Demand details .....   | 114 |
| Table 41: Waste Water/Sewage Generation Details .....                              | 115 |
| Table 42: Raw & Treated Sewage.....  | 115 |
| Table 43: Details of the households in revenue villages .....                      | 122 |

## LIST OF ABBREVIATIONS

ICTT- Integrated Container Transshipment Terminal  
ICAO-International Civil Aviation Organisation  
CEA- Central Electricity Authority  
GDP-Gross Domestic Product  
IOR- Indian Ocean Region  
MOEF&CC- Ministry of Environment Forest & Climate Change  
MSL- Mean sea level  
BRO- Border Road Organisation  
BRT-Bus Rapid Transit  
TOD-Transit Oriented Development  
ITV- Inter Transfer Vehicles  
RMQC- Rail Mounted Quay Crane  
RTG- Rubber Tyred Gantry  
WAPCOS- Water and Power Consultancy Services (India) Limited  
VTMS-Vessel Traffic Management Systems  
STP-Sewage Treatment Plant  
ETP- Effluent Treatment  
MLD- Million litres per day  
KLD- Kio litres per day  
WC-Water Closet  
UV-Ultra violet  
MW-Megawatt  
MVA- Megavolt amperes  
TEU- Twenty-foot equivalent units  
ECBC- Energy Conservation Building Code  
CD- Chart Datum  
TGS- Twenty Feet Ground Slots  
ICRZ-Island Coastal Regulation Zone  
PIZ- Project Influence Zone  
GNIIA-Great Nicobar Island International Airport  
ATC-Air Traffic Control  
IFR-Instrument Flight Rules  
RESA-Runway End Safety Area  
DG – Diesel Generator  
APFC- Automatic Power Factor Control  
CNS-Communication, Navigation & Surveillance  
CCTV- Closed Circuit Television  
DFMDs- Door Frame Metal Detector  
HHMD-Hand Held Metal Detector  
ILS- Instrument Landing System  
DVOE-DME - Doppler Very High Frequency Omni Range Distance Measuring Instrument  
CCR- Central Control Room  
FID- Flight Information Display System  
lpm- litres per minute  
CCTV - Close Circuit Surveillance System  
ppm- parts per million  
lpcd- litres per capita per day

CPWD- Central Public Works Department  
CFT- Crash Fire Tender  
SAR- Synthetic Aperture Radar  
AFI-Air Force Station  
ARFF-Aircraft Rescue and Fire Fighting  
CP- Controlled Percolating  
RRL-Reinforced Rubber Line  
ATM- Air Traffic Management  
AAI-Airports Authority of India  
OLS- Obstacle Limitation Surface  
DGCA-Director General of Civil Aviation  
IATA- International Air Transport Association  
NBC-National Building Code  
VHF Channels:  
ADC-Arrival Departure Control  
SMC-Surface Movement Control  
ATN-Aeronautical Telecommunication Network  
AMSS- Automatic Message Switching System  
AFTN-Aeronautical Fixed Telecommunication Network  
ATIS-Airport Terminal Information System  
MLC-Military Liaison Cell  
ADC-Air Defence Clearance  
NPA-Non-Precision Approach  
LPDME - Low Power Distance Measuring Equipment  
ASR-Airport Surveillance Radar  
VFR-Visual Flight Rules  
PAPI-Precision Approach Path Indicator  
CCR-Constant Current Regulators  
RVR-Runway Visual Range  
RWY-Runway  
GSE-Ground Support Equipment  
MSSR-Monopulse Secondary Surveillance Radar  
ASSR- Airport Surface Surveillance Radar  
AGL-Air field Ground lighting  
FAA- Federal Aviation Agency  
ORAT-Operational Readiness and Transition  
NOC-No Objection Certificate  
SOS- Security of Supply  
EDAN Islands - Electricity Department of Andaman and Nicobar Islands  
LNG-liquefied Natural Gas  
NTPC-National Thermal Power Corporation Limited  
GIS-Gas Insulated Sub Station

## **EXECUTIVE SUMMARY**

The goal of the project 'Preparation of Master Plan for Holistic Development of Great Nicobar Island in Andaman & Nicobar Islands' is to provide a framework for development of a new 'greenfield city' with a diverse and robust economy based on maritime services and tourism, amongst other drivers. The development of the new economic base will depend heavily on investment in catalytic infrastructure facilities, including an International Container Transshipment Terminal (ICTT), Greenfield International Airport, and Power Plant. A new Township will link the infrastructure facilities into complete the physical framework of the new city. These four interlinked projects (Port, Airport, Power Plant, and Township) form the core of the new city and the main components of the holistic master plan. From an environmental assessment perspective, the ICTT is considered the primary project.

The proposed port will allow Great Nicobar to participate in the regional and global maritime economy by becoming a major player in cargo transshipment. The proposed airport will support the growth of maritime services and enable Great Nicobar Island to attract international and national visitors to experience the outstanding natural environment and participate in sustainable tourism activity.

Mixed-use urban development in the vicinity of these major infrastructure works will also be necessary to support quality of life for the residents and visitors alike. Urbanisation will require the development of primary and secondary urban infrastructure networks and services, including roads, public transport, and energy, water, wastewater, and storm water. The proposed power plant will ensure the production of sufficient electrical power to run the new city. These physical infrastructure networks will form the backbone of the township master plan. Developable areas have been identified along the south-western and especially south-eastern coasts of the island.

The vision for the development of Great Nicobar Island is formulated as: 'To leverage the locational advantage of being on International sea route and develop Great Nicobar as a sustainable, green, global destination for business, trade, and leisure'.

The scope of services of this commission is to analyse the site and development potential, plan the city and its key infrastructure facilities, and identify the modalities for financing and implementation. The scope also includes preparation of an Environmental Impact Assessment for securing environmental clearance of the project. This Pre-Feasibility Report has been structured as per the MoEF&CC Guidelines to cover all the essential required aspects, described in detail under respective sections of: Introduction, Project Description, Site Analysis, Planning Brief, Proposed infrastructure, Rehabilitation and Resettlement, and Analysis of Proposal.

Siting studies were carried out for each of the interlinked projects. Alternatives were identified and evaluated against predetermined criteria, including environmental impact, operational performance, and economic viability. Sub-criteria included coastal morphology, density and diversity of the terrestrial ecosystem, density and diversity of coral, compliance with ICRZ notifications, and impact on the Tribal people. The basic aim for site selection was to ensure that the natural habitat and its attributes are preserved and the impact of the construction and operation of the project is at minimum and to an acceptable level.

Galathea Bay was recommended as the preferred site for the ICTT and the power plant. This site includes no human habitation. The back port area will have to be developed by reclamation, which will extend up to the intertidal zone. No cutting of hills is required. Minimal dredging is envisaged. The area falls partly under ICRZ Zone 1B. A small portion of the west breakwater and backup area falls in tribal reserve. Turtle nesting sites are observed at the western beach of Galathea.

It is proposed to locate the airport at Gandhi Nagar and Shastri Nagar (South site), the only site within the project area flat enough to facilitate bidirectional take-off and landing. The flight path of the aircrafts will run over sea and there will be minimal disturbance to local population and the tribal areas due to over flying of aircrafts at low altitude. Some of the existing households in those villages will be affected by the project. The site includes a large area of revenue land, and minimal forest land will be affected.

As the western and the northern parts of the island have never been the permanently settled or occupied by mainlanders, these pristine areas were excluded from development alternatives. Moreover, several Shompen habitats along the western and north-eastern coastline were deliberately avoided. The coastal stretches on the western coast are used both by Shompens and Nicobarese for fishing purposes. The area around the Casuarina Bay and Pemayya Bay which was initially considered for Port was finally excluded due to Environmental and other technical considerations.

An alternate concept master plan was considered. It includes 75 sq.km of urbanised area, including 33 sq.km of residential area and 42 sq.km of commercial development. The combined urbanised area is significantly higher than the preferred option, which includes approximately 45 sq.km of urbanised area. Since under the alternate plan the 75 sq.km area does not fit within the current revenue land (approximately 44 sq.km), it was distributed to the forested areas between the revenue villages and to the west of the villages. The alternate layout results in considerably more deforestation and more redevelopment of hilly, forested land to urban uses. The lower environmental costs associated with the more compact layout led to its selection as the preferred concept master plan for Great Nicobar Island.

Supporting urban infrastructure systems have been planned and identified for development of the city. As concerns water supply, 40 MLD of fresh water demand can be met from surface water of Galathea River and Alexandria River. Approximately 40% of the water demand will be met through water re-use. Distributed waste water treatment plants at selected locations along the south-east coast will result in lower energy usage and more economically viable waste water service delivery.

The ICTT can be developed at a cost of INR 35,959 Crore. The international airport can be developed over a 5-year period, including one year for procurement. The cost of the project is estimated at INR 10,359 Crore.

On final analysis, the set of four interlinked projects will add considerable socio-economic value at a relatively low social and environmental cost. The ICTT and Power Plant project sites are uninhabited. Only the airport project requires resettlement, and the number of affected persons is low. The large majority of the existing corals have been avoided through careful siting. The urban development will be kept on a small footprint along the edges of the island that are least frequented by the Shompen and the Nicobarese. Compact development will result in higher environmental sustainability and diversion of less forest land to non-forest uses. Low-intensity and low-impact ecotourism uses are deployed in forested areas within the project area and along the south-eastern coastline. More than 1 lakh new direct jobs and 1.5 lakh indirect jobs can be created on the island during the next 30 years. The local business community is aware that the public sector mindset has changed, and that development on GNI can grow in harmony with the natural environment and aboriginal peoples.

# 1 INTRODUCTION TO THE PROJECT

## ■ Identification of Project Area

The project is located on Great Nicobar Island, the southernmost last mass of the Andaman and Nicobar Islands. The regional context is given in Section 2.2 of this report. Great Nicobar Island has a total area of 910.074 sq.km. The island includes two national parks, a biosphere, and is home to the Shompen and Nicobarese tribes. With a view to preserving the valuable ecological and anthropological assets on Great Nicobar Island, the development area has been limited to a 166.1 sq.km area along the south-eastern and southern coastlines. It extends from the north of Campbell Bay to Indira Point and further up to the Pemayya Bay area in the south. While the east and South of the site are edged by the Indian Ocean, the west and north are flanked by mountainous terrain and forests of the Galathea National Park. The development area does not include any area within the national parks, though a small portion falls within the Biosphere reserve. The project area has been carefully delineated after considering the parameters of topography, drainage pattern, preservation of rich ecological central core of the island, national parks and its eco-sensitive buffers, mangroves and other ecological assets, presence of existing habitation on the western coast and considering all the natural features.



Figure 1: Great Nicobar Island showing the Project Area

## ■ ■ Nature of the Project

Great Nicobar is an integrated urban development project planned on a pristine tropical island with exceptional natural and cultural assets and distinct economic advantages. The project will (1) strengthen India's presence in the Andaman Sea and the Southeast Asian region and (2) create an economic hub in the Andaman & Nicobar Islands that functions simultaneously as a major cargo transshipment centre and a global tourism destination.

This project is in fact four 'interlinked' projects that together constitute the new Greenfield city at Great Nicobar. The four projects are the port, airport, power plant, and township. Each of these four projects is considered separately — and together, as an integrated whole — in each section of this pre-feasibility report. From an environmental assessment perspective, the port is considered the primary project.

For several reasons, successful development of Great Nicobar Island requires a sensitive, holistic approach. First, the island is home to a dwindling number of indigenous people whose traditional culture is considered an international resource. Development plans must not only consider the impact of growth on these people, but also be formulated in order to generate benefits for them as well as for future in-migrants and investors. Second, the world-class ecological resources must be conserved and enhanced during the proposed integrated development at Great Nicobar Island.

While it is clear that development on Great Nicobar will have environmental impacts, the holistic master plan must enable environmentally and socio-culturally sustainable development and identify effective mitigating measures for any anticipated negative impacts. A systematic and thorough method for evaluating the socio-cultural and environmental impacts of different planning infrastructure project proposals has been employed. Trade-offs are identified and quantified, and alternatives that perform better from a socio-cultural and environmental perspective are prioritised. The preferred alternatives will be those that strike the appropriate balance between the environmental, social, and economic goals of the project.

## ■ ■ Need for the Project and Its Importance

Great Nicobar Island is a jewel of an island, the development of which can address several pressing concerns related to maritime security, economic growth, and quality of life for the local population.

The development of Great Nicobar Island is significant from the point of view of national security. This is in light of the ongoing consolidation of the Indian Ocean region and the military and economic impact of this consideration. The Indian Ocean Region (IOR) in general and the Indian Ocean in particular has turned into a strategic hotspot in recent years. In response to the increasing strategic value of this IOR, a critical mass of development in the Andaman & Nicobar Islands is necessary for strengthening India's regional presence.

In addition, Great Nicobar Island represents a significant economic development opportunity. The main east-west shipping route that links East Asian exports with the Indian Ocean, Suez Canal and Europe runs just to the south of Great Nicobar Island, the southernmost landmass in India. By building a container port in this location, India can participate more fully in the global shipping trade, creating employment opportunities for its citizens and improving quality of life for current and future residents of Great Nicobar Island.

In addition to this overarching rationale for undertaking the project, each of the four interlinked projects has its own rationale, as described below.

### ■ ■ **International Container Transshipment Terminal**

The development of a new cargo Transshipment terminal and associated industrial facilities will allow India to leverage its excellent access to major shipping routes between East Asia and South Asia in order to capture a significant share of the regional maritime economy.

Due to geographical and logistic constraints, deep water berths in the ports along the East & West Coasts of India have not been developed for berthing large inter-continental vessels of drafts over 15 m. The present major Transshipment hubs in South Asia at Colombo and Singapore provide deep water ports for main line vessels carrying cargoes for smaller ports in the region. Feeder vessels presently call Singapore and Colombo for loading cargoes bound for smaller ports in the Bay of Bengal, Andaman and the Arabian Sea. The result is that India is losing substantial revenue in terms of facilities and higher rate of landings.

It has also been observed that other countries like Myanmar, China and Sri Lanka are gearing up to develop deep water facilities for taking major share of trade by developing suitable harbour facilities. From the foregoing, it is quite evident that India should move towards setting up dedicated deep-water berths for primarily Transshipment activities in its waters thereby generating revenue.

Great Nicobar Island is strategically located equidistant from Colombo, Port Klang and Singapore and is also very close to the East-West international shipping corridor.



Figure 2: Locational Advantage of Great Nicobar

Development of Transshipment terminal at South Bay would attract existing traffic of ports along East Coast of India, Bangladesh and Myanmar as they form primary catchment for Transshipment terminal for the following reasons

- Proposed Terminal is strategically located on the East West container trade route.
- Strategic location advantage leads to overall cost savings for containers shipping costs.



Figure 3: Locational setting of Great Nicobar Island with respect to major Indian ports

The proposed site is endowed with natural depth of 20 m as close as one Nautical Mile from the sea coast. As may be appreciated, due to natural depth availability, the site needs minimal capital dredging requirements and thus low costs (as compared to the any other port in India within a reasonable distance from the East-West Shipping axis). The proposed site has minimal Littoral drift and as such would hardly require any maintenance dredging during the years of operation. This will result in low O&M Costs. The proposed site is away from mainland / urban / city limits, and thus can be master planned and shaped by the professional and experienced developers as per their own efficient designs and needs.

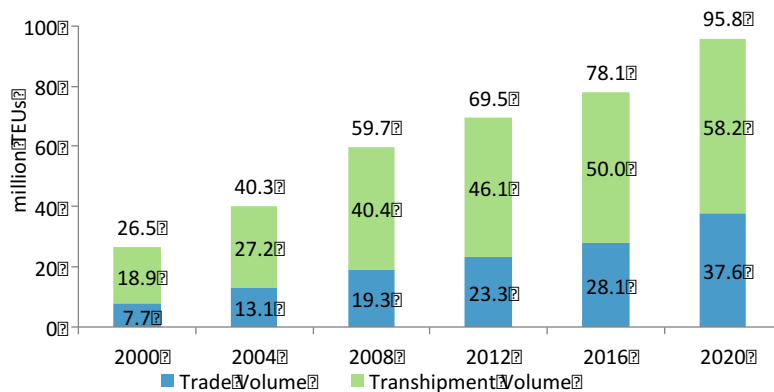


Figure 4: Transshipment Dynamics in Great Nicobar Catchment Area

Great Nicobar Container transshipment terminal would have business prospects from following 2 avenues:

- Transshipment of Containers for feeder ports in the region
- Development of Storage and Re-processing zones

The majority of Transshipment terminals in Asia have developed large warehouses behind Transshipment terminals. This includes Singapore, Jebel Ali, etc. The free trade zones in these regions act as storage

and distribution centre of the region. Some of the Free Trade zones also allow minimal packaging and processing for re-export. Singapore is the nearest competitor of proposed Great Nicobar Transshipment terminal. Following 3 factors determine the dynamics of Free trade zones beside Transshipment terminal

- Large economy of Scale
- Availability of large parcel of lands at economical rates
- Availability of low-cost manpower to work in Free Trade Zones

The Project can provide direct and indirect employment to over 4200 people. During construction an estimate 2000 people are expected to be employed. It would increase the employability of the local population on the island.

### **■ ■ ■ Greenfield International Airport**

The island and the archipelago feature world class ecological resources that, with the right level of infrastructure development, can attract international and Indian tourists. An international airport is necessary to improve connectivity to Great Nicobar and open up the island to tourism.

Given its geographical context, an airport at Great Nicobar can serve not only the island but also adjoining areas. Locational advantage of the islands is their close proximity to international tourist island destinations like the upcoming Senang City, the Phuket Island and Langkawi Island. Thus, the islands present a great opportunity for a tourism-oriented island development that would put Andaman and Nicobar on the global tourist destinations map.

Econometric modelling using various parameters individually and in combination (as input independent variables) are in the process of being undertaken to find the most correlated factor(s). The projections will also be informed by inputs from key stakeholders. In the absence of any concrete data and very minimal economic & tourist activity, it has been assessed that the projections would be akin to what prevails at Port Blair. Currently, Port Blair Airport handles approx. 2000-2500 passengers per day bringing to an annual figure of approx. 1.8 million passengers in 2019. It can be reasonably assumed that by the time the airport opens, this international airport will also have an identical influx of passengers. Hence, it is being assumed that the airport should be capable of handling at least 1million passengers at the instance of opening and thereafter be adequate to sustain a figure of approx. 10MPPA wherein after it would require further enhancement.

### **■ ■ ■ Township and Area Development**

Mixed-use urban development is a necessary component of future development on Great Nicobar Island. The people who manage and operate the transshipment terminal need a place to live. Development of hotels and associated commercial land uses are essential for growth of the tourism industry. The ancillary economic sectors, including professional services, education, research others yet to be identified, also need real estate and public services in order to grow. While the main drivers of the economic growth and robust national presence on Great Nicobar Island are the transshipment terminal and the tourism industry, the city fabric is necessary to grow an urban agglomeration substantial enough to support and facilitate these economic initiatives.

### **■ ■ ■ Power Plant**

Electric power is necessary for operation of the port, airport, and township. Without power, there will be no Greenfield city at Great Nicobar Island. While the port and airport are catalytical infrastructure facilities

to the extent that they will generate and economic growth, the power plant is an enabling and supporting infrastructure facility that the city and the economy need in order to grow and prosper.

Power or electricity is the most convenient and versatile form of energy. All forms of economic activity, whether it be agriculture, industry or services rely upon the uninterrupted power supply, as well as it is the most crucial source of supplying domestic energy requirement. Diesel Generating (DG) sets are the major source of energy in this Union Territory of A&NI.

The primary objective of the power infrastructure design is to provide good quality, reliable electrical energy without interruptions. System design ensures the continuity of power supply in the event of outage of any one primary component of the system. Design of network is in tune with the phasing strategies of the overall master plan.

For the proposed development at GNI such as industrial, residential and commercial buildings, mobility, public built spaces and other urban arrangements, the network of energy provision is basic requirement of these development. Thus, higher level electricity is pre-requisite for better quality of living, and it is better to plan additional generation from renewable sources for GNI.

An uninterrupted energy supply will be a key component in increasing the GDP of any cities or island. Handling this urban evolution is a challenge and we need to address the energy and climate implications it will entail.

With power infrastructure being vastly complex and intense as the channelling of supply goes through various cities, island, towns and villages it now has become paramount to have technology interference to conventional system.

Business and the economy in digital era depend upon reliable and quality power supply. So far, the focus of the sector was limited to providing uninterrupted power supply to consumers. This was understandable at the time of deficit when the limited supply of power was available to meet peak demand and the expectation of end consumers was availability of power supply.

## ■ ■ Existing Population and Occupation

The population of Great Nicobar Island combines aboriginal tribes that have inhabited this island for thousands of years with ex-servicemen that were settled here by the Government of India during the 1970s. The new residents came from Punjab, Maharashtra and Andhra Pradesh. Thus, a 'Mini-India' exists in Great Nicobar Island, with Indians from all parts of the country harmoniously residing here.

Great Nicobar Island is inhabited by aboriginal mongoloid Shompen. The Shompens are hunter-gatherers and depend on the forest and marine resources for sustenance. They live where natural water source is available and use the surface water for drinking. Another Mongoloid Tribe, the Nicobarese, used to live in settlements along the west coast. After the tsunami in 2004, which devastated their settlement on the western coast, they were relocated to Afra Bay on the north coast and to Campbell Bay. They survive on fish caught from the sea. There are about 237 Shompen and 1,094 Nicobarese individuals.

The areas where the tribal dwell have been declared as Tribal Reserve. The Shompens move between the Core and Buffer Zones, while the settlers and Nicobarese live in settlements spread along the coast in the Transition zone. The area of the tribal reserve is 751.070 sq.km. Of this 84.10 sq.km falling under tribal reserve, is proposed to be denotified. Andaman & Nicobar Administration proposes to renotify 45.23 sq.km of land in Campbell Bay and Galathea National Parks and 31.73 sq.km land outside the National parks. Therefore effectively 7.11 sq.km will be required for de-notification for the project.

The settlers and mainlanders, which number over 8,000, live along the southeast coast of the island, practising agriculture, horticulture and fishing. The settled area includes seven revenue villages, namely: Campbell Bay, Govind Nagar, Joginder Nagar, Vijay Nagar, Laxmi Nagar, Gandhi Nagar, and Shastri Nagar. The remaining villages in Great Nicobar Island are not identified as revenue villages.

**Table 1: Great Nicobar Island Population**

| Male | Female | Total |
|------|--------|-------|
| 5025 | 3342   | 8,367 |

Source: Census of India 2011

**Table 2: Population of Revenue Villages**

| Sr. No. | Village        | Population |
|---------|----------------|------------|
| 1       | Campbell bay   | 5736       |
| 2       | Govind Nagar   | 676        |
| 3       | Joginder Nagar | 693        |
| 4       | Vijay Nagar    | 100        |
| 5       | Laxmi Nagar    | 230        |
| 6       | Gandhi Nagar   | 69         |
| 7       | Shastri Nagar  | 15         |

Source: Census of India 2011

According to census data and local officials and residents, the primary economic activities of people on the island are agriculture, horticulture and fishing. Prior to Tsunami 2004, Great Nicobar had extensive paddy cultivation and coconut plantations. The paddy fields were severely impacted by the tsunami and the cropping pattern has now shifted away from paddy to coconut, fruits, and vegetables. In terms of fisheries, the site has huge potential for oceanic tuna, which is virtually unexploited, and offers ample scope for deep sea fishing. But the main bottleneck is lack of connectivity for export of fish from the island.

**Table 3: Occupational Structure of Great Nicobar Island (2016-17)**

| Sr. No. | Category            | Population |
|---------|---------------------|------------|
| 1       | Main Workers        | 3350       |
| 2       | Cultivators         | 118        |
| 3       | Agricultural Labour | 80         |
| 4       | Marginal Workers    | 491        |
| 5       | Other Workers       | 3152       |
| 6       | Non-Workers         | 4526       |
| 7       | Total               | 11717      |

## Environmental Conditions

Great Nicobar Island harbours a range of ecosystems, including tropical wet evergreen forests, mountain ranges reaching a height of nearly 650 m (Mt. Thullier) above sea level, and coastal plains. The island is noted for its rich biodiversity. It houses 650 species of angiosperms, ferns, gymnosperms, bryophytes and lichens among others. The tract is rich in plant diversity and fosters a number of rare and endemic species,

including *Cyathea albosetacea* (tree fern) and *Phalaenopsis speciosa* (orchid). A total of 14 species of mammals, 71 species of birds, 26 species of reptiles, 10 species of amphibians, and 113 species of fish have been reported. The region also harbours a large number of endemic and endangered species of fauna. To date, 11 species of mammals, 32 species of birds, 7 species of reptiles and 4 species of amphibians have been found to be endemic. Of these, the well-known Crab-eating Macaque, Nicobar Tree Shrew, Dugong, Nicobar Megapode, Serpent Eagle, salt water crocodile, marine turtles and Reticulated Python are endemic and/or endangered.

The area harbours coral reefs. These reefs are present around the island with varied thickness and diversity. The corals were severely affected due to 2004 tsunami. In 2008, due to rise in sea water temperature, significant number of corals were bleached all over the world; the corals of Nicobar Island also experienced bleaching. However, the exact quantity of coral bleaching has not been estimated. The corals generally exist along the rocky coastal stretches with varied thicknesses. The island has plates of dead and live corals. In few areas, new coral recruits were also observed. As a part of the EIA study for this development, Zoological Survey of India (ZSI) has surveyed the area. The data collection is underway, and the report is awaited.

Along the coastal beaches of the Nicobar Island, Leatherback and Olive Ridley turtles are known to nest. The tsunami of 2004 modified the coastal morphology significantly and the turtles stopped visiting the beaches for nesting. However, with the passage of time, some turtles have returned for nesting. Each Leatherback turtle lays about 100 eggs, and the survival rate of the hatchlings is around 2-5%. Various reports suggest that one out of one thousand turtles reach adulthood.

Megapode nesting sites can be seen in various places around the island. Megapodes are mainly solitary birds that do not incubate their eggs with their body heat as other birds do, but bury them in mound consisting of decaying vegetation. ZSI is studying the megapode nesting sites as a part of the EIA. The report is awaited.

The island is known for salt water crocodiles. There has been an increase of man-crocodile conflict and the attacks on human have increased significantly over the years. There have been petitions by locals for culling of crocodiles.

The GNI suffered severely during the 2004 tsunami. The Sumatra earthquake (Mw 9.3) of 26 December 2004 was one of the most important earthquakes from the point of view of plate tectonics. This event occurred along the plate boundary marked by the subduction zone between the Indian Plate and the Burmese Plate (a part of the Eurasian Plate). The southern portion of the Great Nicobar Island seems to have subsided by about 3 m, as supported by changes in the natural water levels. The entire Megapode Wildlife Sanctuary was submerged due to the submergence and does not exist anymore. On the eastern coast also, the sea has advanced to the coast by about 200-500 m, depending on the topography.

This sudden 'land drowning' (due to tectonic subsidence), coupled with the tsunami, altered the structure of mangrove forests. As per the study by WII, the mangrove cover in the Nicobar Islands declined by around 97 percent, which is higher than the earlier estimation. The researchers from Centre for Ornithology and Natural History (SACON) documented 20 mangrove species from 34 sites across the Nicobar Islands, of which eight species were recorded for the first time from the island group. There could be two major reasons for the new reports of eight mangrove species. These islands are often underexplored, so the species could have been there but not reported. The second factor could be that the tsunami may have carried the seed material of the unreported species from nearby sources (such as

Malaysia, Indonesia and Singapore) along with the huge pile of debris that it dumped on the Nicobar coasts.

## 2 PROJECT DESCRIPTION

### ▪ ▪ Type of Project, Including Interlinked and Interdependent Projects

The proposed development at Great Nicobar Island includes four interlinked projects<sup>1</sup>:

1. International Container Transshipment Terminal (ICTT) under Category 7 (e), Port, Harbours. This is the primary project.
2. Greenfield International Airport under Category 7(a)
3. Township and Area Development under category 8(b)
4. Power Plant under category 1(d)

The EIA process will be undertaken in line with the OM dated 24<sup>th</sup> December 2010 for interlinked projects. Thus, an integrated TOR for interlinked projects will be obtained from MOEF&CC. Further a common EIA will be prepared covering all sectors and one public hearing on the EIA report so prepared will be held. The ICTT is considered the primary project.

---

<sup>1</sup>as per the EIA Notification of 14th September 2006



1. International Container Transshipment Terminal
2. International Airport
3. Township and Area Development
4. Power Plant

Figure 5: Location of Four Interlinked Projects

### ■ Location- Regional Context

The Andaman and Nicobar Islands are a cluster of about 836 offshore islands of India located to the east of the Bay of Bengal and west of the Andaman Sea. The clusters comprise of two island groups, the Andaman Islands and the Nicobar Islands, separated by the 150 km wide Ten Degree Channel, with the Andaman Islands to the north and the Nicobar Islands to the south. The Union Territory's capital city is Port Blair which is the current focal point of all development and connectivity in the Islands.

The Great Nicobar Island is located in the Nicobar district to the south of the Andaman Islands. It is the largest of the cluster of islands with an area of about 910.074 sq. km and the southernmost of the group

of Nicobar Islands located at a distance of approximately 520 km from Port Blair. Indira Point, earlier known as Pygmalion Point, lies at the tip of the Great Nicobar Island and is the southernmost point of the country. It is at an approximate distance of 144 km from the Sumatra Island of Indonesia.

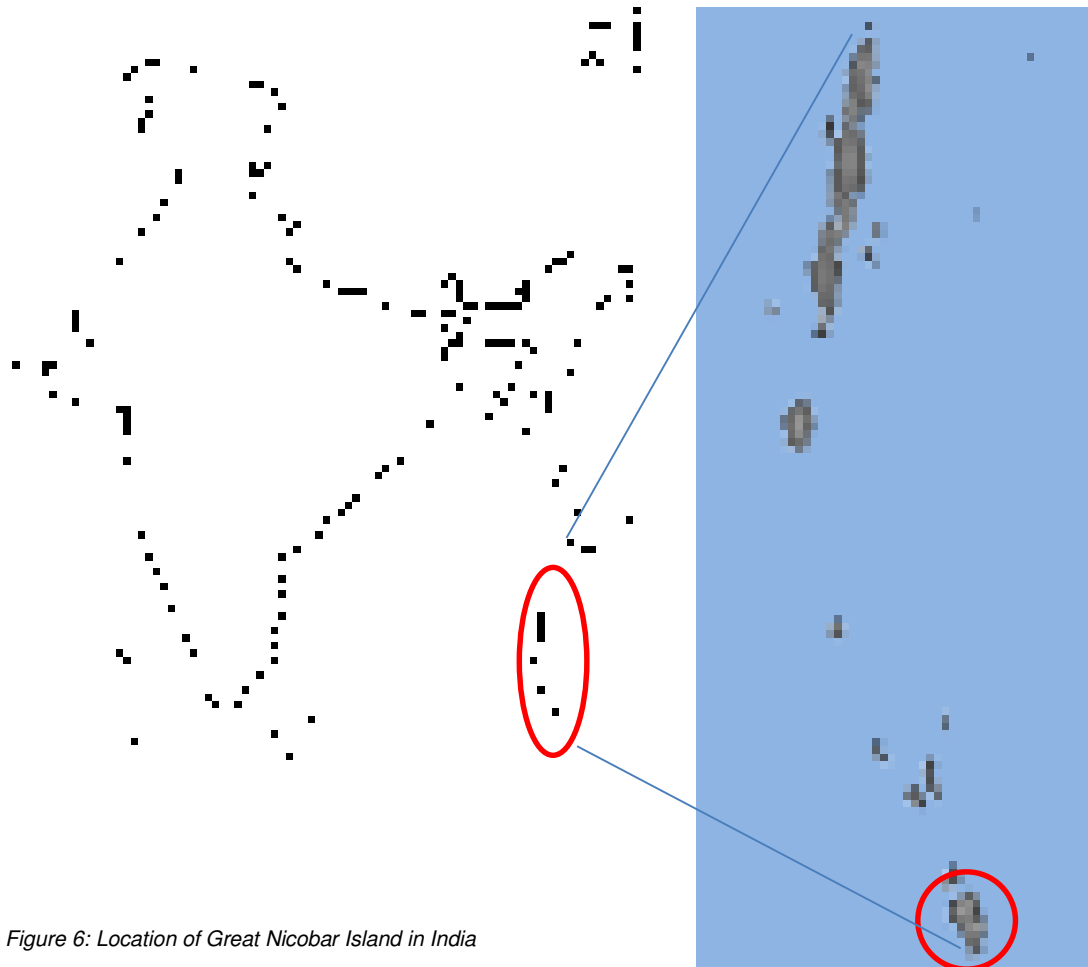


Figure 6: Location of Great Nicobar Island in India

As described in Section 1.3, this strategic location of the island to International Shipping route, ferry terminals, airports, major ports and tourist destinations presents immense opportunities to further strengthen India's trading position in the world.

## ■ Site and Project Description

This integrated urban development project is composed of four interlinked projects: the Port, Airport, Township, and Power Plant. Taken together, these four projects constitute development of Great Nicobar City- a new port city and tourism destination at the southernmost tip of India. Each of the four projects, and its corresponding site, is described below. The Site Analysis is presented in Section 3.

### ■ International Container Transshipment Terminal

The proposed project is to develop an International Container Transshipment Terminal (ICTT) Port facility, including for establishing the container Transshipment port at Great Nicobar Island. The total project area for port is 993 ha (out of which 766 ha is on land and 227 ha shall be created through reclamation). The port land will be used for developing port infrastructure, Port & Utility buildings and facilities, Workshops, Container stacking yards, Reefer Areas, Vehicles and ITV parking and movement areas, Port roads, Pavements and green areas.

The site selection process is described in Section 3 below. The selection of Galathea Bay as the proposed site was done with a view to minimising negative environmental impacts and complying with the requirements of the environmental regulatory framework, including the provisions related to Island Coastal Regulation Zones.

The Galathea Bay site includes no human habitation. The Backup area will have to be developed by reclamation, which will extend up to the intertidal zone. No cutting of hills is required. Minimum Dredging is envisaged. The area falls partly under ICRZ Zone 1B. A small portion of the west breakwater and backup area falls in tribal reserve. Turtle nesting sites are observed at the western beach of Galathea.

- **Site Conditions**

General-

The proposed Project land does not have permanent habitation by people, show cultivation, pasture grazing or water reservoirs (ponds). The proposed site comprises an intertidal zone and forest.

Site Specific Surveys & Studies-

Following site specific surveys & investigations have been conducted forming base for this Pre-Feasibility Study for the proposed container Transshipment port at Great Nicobar Island.

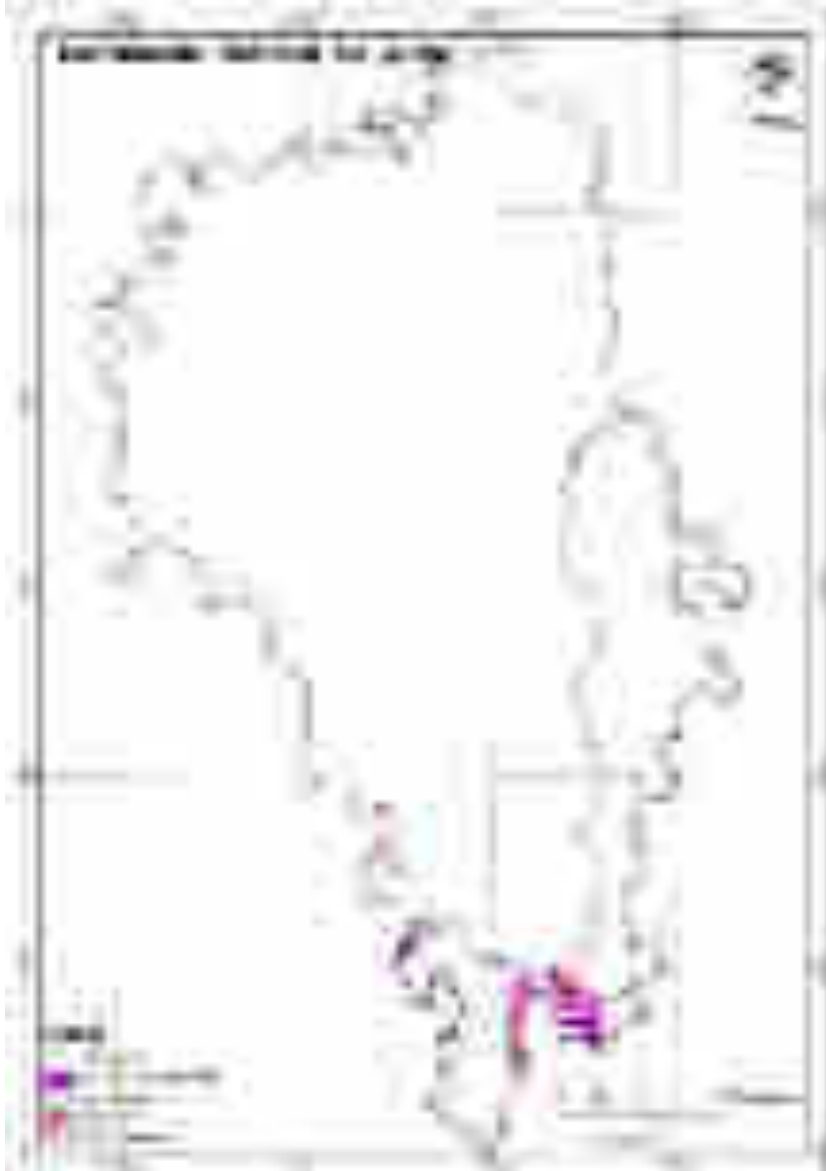


Figure 7: Map showing the proposed ICTT Port

The site-specific surveys details are summarised in **Table 4**.

**Table 4: Site Specific Surveys**

| Sr.No | Survey   | Agency | Survey Extent   |
|-------|--|--------|---|
| 1     | Bathymetric surveys  | WAPCOS | Covering an area of about 21.5 sq. km encompassing the proposed site  |
| 2     | Topographic Survey   | WAPCOS | Covering an area of 12 sq. km   |
| 3     | Land borehole investigations                               | WAPCOS | 04 land borehole  |
| 4     | Maine geotechnical investigations                          | WAPCOS | 06 marine borehole  |
| 5     | Sea-bed Samples, Water Samples, Current meter observations | WAPCOS | Tide and Current measurements for 1 lunar cycle of 30 days at 1 location. Sea-bed and Water samples collected at 7 locations. |

**Topography-**

Most of Great Nicobar Island is hilly and undulating, with average of +15m to +20m height is observed on land, and somewhere +100 heights are also observed. +2m, +3m, +4m contours are very near to seashore. +19m, +17m, +15m, +13m, +11m, +9m, and +7m contours are at a distance 0.82 km, 0.78 km, 0.75 km, 0.69 km, 0.59 km, 0.56 km and 0.50 km respectively from the high-water line.

**Bathymetry-**

The shortest distance of -20m, -10m and -5m contour are at a distance about 700 m, 400m and 250m respectively from the high-water line. It is observed that 10m and 20m contour come closest to coast at this site near Indira Point and thereafter they become parallel to the coast.

- **Geotechnical Condition**

**Landside-**

The landside ground investigations in the region comprised 04 boreholes drilled to depths of between 25 m and 27 m. The sequence of strata anticipated on the site, in terms of superposition is estimated to comprise as presented in Table-5.

**Table 5: Landside General Soil Profile**

| Strata | Description   | Thickness of Strata |
|--------|---------------|---------------------|
| 1      | Silty Sand    | 1.5m - 2.0m         |
| 2      | Sandy Silt    | 2.0m - 3.0m         |
| 3      | Silty sand    | 3.0m - 6.0m         |
| 4      | Sandy Clay    | 6.0m - 10.5m        |
| 5      | Clay          | 10.5m -16.5m        |
| 6      | Cemented Land | 16.5m – 21.0m       |
| 7      | Soft Rock     | 12.0m – 27.0 m      |

The marine ground investigation in the region comprised 06 boreholes drilled to depths of between 21 m and 28.8 m. The sequence of strata anticipated on the site, in terms of superposition is likely to comprise the following strata. The marine side general soil profile is presented in Table-6.

**Table 6: Marine Side General Soil Profile**

| Strata | Description      | Thickness of Strata |
|--------|------------------|---------------------|
| 1      | Silty Sand       | 0 m varying Depth   |
| 2      | Silty Sandy Clay | 10.5 m-15.0 m       |
| 3      | Cemented Sand    | 15 m-21 m           |
| 4      | Soft Rock        | 21 m-21.8 m         |

The region lies in Seismic Zone V designated by the IS-1893 Part 1-2002 as shown in Figure 8. It is also cyclone prone. All structures will be designed to make them earthquake and cyclone resistant.



Figure 8: Seismic Zoning Map of India as per IS-1893 Part 1-2002

- **Marine Conditions**

The tidal levels observed at the South Bay (Galatea) with respect to Chart Datum of admiralty chart are given below:

- MHWS + 1.6 m
- MHWN + 1.1 m
- MSL + 0.9 m
- MLWN + 0.7 m
- MLWS + 0.2 m

The maximum tidal range in the region is about 1.4 m.

- **Meteorological Conditions**

The mean wind speed prevailing in the area is around 7.2 km/hr. The direction of wind in different seasons are as indicated below

- i. Monsoon – mostly south easterly and east
- ii. Summer – mostly north easterly and east

May and November are transition months when direction of wind changes. The climate of the region is Tropical, and the area is situated in the Hot or Torrid Zone. The atmosphere is damp and warm all the year round though when the sun is soothing the nights may be cool. The mean maximum temperature is 29.1°C and mean minimum temperature is 24.3°C. Mean highest air temperature is 32.4°C.

The project site receives greater part of annual rainfall from South West (May to December) monsoon accounting for nearly 86% of annual rainfall and the remaining 14% of the rainfall is recorded during the rest of the year. The rainfall is heavy due to annual monsoon and its anything between 2700 and 4000 mm annually and the number of wet days per annum vary from 150 to 220. The area receives an average annual rainfall of 3157.5 mm. The heaviest rainfall occurred in 24 hours on 18th August 1969 which was about 350.4 mm.

Relative humidity varies from month to month, being maximum during the month of October i.e., during monsoon and minimum during the month of February and March. The mean average humidity in the month of October is 90% and that in February and March is 82% with an average humidity of 86%.

- **Site Connectivity / Access**

The proposed Project site is in not connected through any road. Currently the access is through sea route only. Approach road shall be developed.

- **Existing Infrastructure**

Water-

There is currently no reliable water source or water supply system near the site for intended development.

Power-

At present, there is no power supply to the project site.

Social Infrastructure-

The proposed project site vicinity has no social infrastructure.

## ■ ■ **Greenfield International Airport**

Great Nicobar Island International Airport (GNIIA) has been decided to be developed as an International Airport in Great Nicobar, Nicobar Islands of India. The airstrip will be developed to cater for operation of Airbus A-380 type of aircraft in all weather conditions having peak hour passenger's capacity of 4000 PHP. This will involve construction of new runway with all allied facilities like terminal building, Apron, Taxi Track, Shoulder boundary wall, perimeter roads, parking facilities, ATC, Fire Station, Technical block, electric substation etc.

The airport will occupy a 1039 Ha site (for air side, Land Side, approach road & a defence apron). The proposed project falls in Category 7(a) of the Schedule vide EIA notification 2006 amended to date involving preparation of Environment Impact Assessment study and Environment Management Plan.

Development of Great Nicobar Island airport shall be developed for IFR operation of Airbus A-380 for all weather conditions.

The site of the airport has been recommended after consideration of five alternative sites, as described in Section 3. The

The Gandhi Nagar site (South Site) includes a large area of revenue land, and minimal forest land will be affected. In order to achieve the required length of the runway, reclamation of the sea coast in North and South will be required; however, reclamation can be optimally reduced with erecting the approach lights over pedestals. The approach takes off and flight path of the aircrafts will run over sea and there will be minimal disturbance to local population and the tribal areas due to over flying of aircrafts at low altitude.

The airport will include the following components:

**A. Civil Works:** The airside civil works are-

- Runway having 4000x75m length, Basic Strip 280m, RESA 2x240x150, Runway Overrun 2x60x60.
- Taxiway having 4800x45m, (including shoulders)
- An apron to accommodate 4 no. wide body aircrafts (like Airbus A-380/ Boeing 747) and 28 narrow body aircrafts (like Airbus-320 etc.) having an area 2,52,800 sq.m has been proposed to be constructed
- Category 9 level of protection, minimum 3 No. of Crash Fire Tender is required to be provided.
- RCC framed with filler bricks, boundary wall of height 3m (with 0.60m concertina wire on top) is proposed.
- Chain link fencing is proposed to be erected to segregate operational area with non-operational area and the length of the fencing shall be approximately 4,800 m.

**B. Terminal Building-** The peak hour traffic for medium horizon period of 16 years (Year 2037) is 2000 Peak Hour Passengers (arrival + departure) considering 24 sq.m /passenger a terminal building of 48,000 Sq. m is planned to be constructed in. The building shall be extended later on to handle 4000 Peak Hour Passengers (arrival + departure) in year 2047 for long term horizon period of 25 years. Car parking for adequate peak hour traffic shall also be developed.

**C. Miscellaneous Facilities-** Information and mandatory signage, canopies on city as well as on air side, new sub-station and AC plant room, landscaping and horticulture work, provision of hooter system for access points, provision of explosive detection system.

**D. Electrical Works & Other Equipment/Services-** Electric substation building of 6,300 Sqm is proposed to be constructed on city side to house HT and LT panels, DG set, Transformers, APFC Panel, Bus duct cabling etc. with control office. Pump house and UG sump shall also be developed alongside of the substation for water supplies to the airport.

**E. Communication, Navigation & Surveillance (CNS) Planning Works-** Provision of security system surveillance CCTV, Baggage Scanner, DFMDs, HHMDs, ILS, DVOR-DME, Flight Information Display, Intelligent building management, energy efficient internal / external lighting, LED TVs etc.

## ▪ **Township and Area Development**

The Township and Area Development project consists of a mixed-use development area that will form the heart of Great Nicobar city, while also connecting and engaging the key infrastructure facilities and making

them part of a complete urban system. In addition to the port, airport, and power plant, the urban infrastructure that underpins the development of the Township includes the systems for water supply, waste water, storm water, electrical transmission and distribution, other energy systems as required (e.g., district cooling), roads, public transit, and solid waste.

Within the township area, the Concept Master Plan calls for the development along the coast of a series of compact, walkable, mixed-use urban centres separated by natural features such as forested hills and stream buffers. Set against the backdrop of the steep forested hills towards the interior and set back from the coastline to build resiliency to natural shocks, this will be a 'city in the forest' that brings the 'forest into the city'. Compact development is not only more liveable and attractive; it will also reduce Great Nicobar's future carbon footprint, promote conservation of resources, and limit the overall development area, thereby preserving more of the existing forest and other natural resources. The largest urban centre will be at Campbell Bay.

The large majority of the land on Great Nicobar is forest land; there is little non-forest land available for development. It is therefore unavoidable that some of the existing forest land is identified for future urban development. However, the approach is to minimise the impact of non-forest uses on forest land by:

- Using compact settlement patterns that require less land; in this way, much of the proposed development can be accommodated on the existing revenue land;
- Using forest land for low-impact development such as institutional campus development (compact school, research or other institutional campuses surrounded by forest) and very low residential development (with minimum plot sizes for single family housing of 5-10 ha. and restrictions on the amount of forest that can be cleared on those plots).

The land requirement of proposed project sites is given in **Table-7**.

**Table 7: Land Requirement of Proposed Projects**

| Proposed Projects           | Area in Hectares |
|-----------------------------|------------------|
| ICTT                        | 766              |
| Airport                     | 845              |
| Township & Area Development | 14960            |
| Power plant                 | 39               |
| <b>Total</b>                | <b>16610*</b>    |

\*This area excludes the reclamation areas for port and airport which are as under:

Port= 227 ha of reclamation area

Airport= 194 ha of reclamation area

The urban layout, land uses, and coastal management strategies are described in more detail under Section 4, Planning Brief.

### **Power Plant**

It is proposed to develop a power plant near the ICTT facility with capacity to accommodate a city-wide demand of 450 MVA.

The power generation plan for the project envisages the solar plants, Gas based plant and some Diesel generating stations in initial days. For generation capacity addition and power procurement plans is proposed for energy requirement and power demand. To meet the power demand requirement of Great Nicobar Island, some broad level sourcing points have been identified for and stated below:

- Diesel Generating power plant.
- Gas Power Plant
- Solar Power plant.

'Clean and Green Energy Initiatives' have been taken up in both Andaman & Nicobar Islands. In addition, LNG-based power plant for 50 MW is being established by NTPC.

To reduce the dependency on diesel for power generation, priority shall be accorded to improvement in energy efficiency. It is proposed to use of solar power and other non-conventional energy sources (de-dieselization) for maintaining a clean, green and healthy environment in the islands.

Diesel Gensets shall be used in initial phase of development and shall be about 15% of the total Demand of 450 MVA. About 10% is planned through solar panels. Balance shall be gas based. Details are as shown in the table below.

**Table 8: Power Generation Sources**

| Type and %         | Capacity | Area  |
|--------------------|----------|-------|
| LNG based (75%) -  | 337 MVA  | 39 ha |
| DG Set Power (15%) | 68 MVA   |       |
| Solar Power (10%)  | 45 MVA   |       |

Natural gas is a relatively clean energy source, which produces much less pollution than coal or oil. During liquefaction process the natural gas volume is reduced by the ratio of 1/600. Through this volume reduction liquefied natural gas can be transported by ships and stored in storage tanks. In the next step the LNG is pumped to required pressure and transformed into vapour phase. Vaporized natural gas is transferred into pipeline system. A high efficiency, natural gas-fired combined-cycle power plant might consume about 7000 BTUS of gas to produce one kilowatt-hour of electricity. Therefore, it would therefore take about 7000 cubic feet of gas to produce one megawatt-hour

An area of 39 hectares is earmarked including space for Diesel Generating units to be at single location. The space allocation also shall have space for switching station, to a Step up the voltage level. The plant shall be set-up two parallel trains in a phase manner. To start with the power plant in its initial phase of implementation would be further augmented, integrated and optimized in the final phase of the project with the installation of the second train.

Smart grid connected with distributed power generation that significantly generates reliable security of supply (SOS) and quality of electric energy shall be presented. This concept is practical and reliable as numerous types of energy sources become available, such as diesel, solar, wind, biomass, and hydropower as a hybrid case.

### 3 SITE ANALYSIS

This section contains the study of the current conditions within the Great Nicobar project development area (166.1 sq.km.) following a review of available secondary data, existing reports, and a field visit. Numerous elements have been considered in the site context analysis, including a review of surrounding and site-specific conditions with regards to transport, development, environment, and infrastructure. This examination of the existing site conditions provides key insights that will help shape future development decisions.

#### Connectivity

Presently there is limited connectivity to Great Nicobar Island from the mainland. The island can only be accessed by air and sea routes from within the Nicobar Islands. For air routes, it takes approximately 2.5 hours from the nearest airports in cities like Kolkata, Chennai, Vishakhapatnam and Bengaluru to reach the Veer Savarkar International Airport, located at Port Blair in Andaman. From there a helicopter can be taken to reach INS BAAZ at Campbell Bay in Great Nicobar Island. This INS BAAZ air landing facility, located in Campbell Bay, is the first naval air station in the Nicobar group of islands. For sea routes it takes approximately 3 days from the nearest ports in cities like Kolkata, Chennai and Vishakhapatnam to sail to the Port located at Port Blair in Andaman. Further, from Port Blair jetty it takes about 1 day to reach Great Nicobar Island. Ferries arrive at, or depart from, either the Campbell Bay Jetty or the Breakwater Jetty in Great Nicobar. There is a 106 m length wharf that is capable of handling medium size ship vessels and has been proposed to be extended by another 45 meters to handle large size ship vessels.

The south-eastern coast is only area on the island with permanent settlements. (The Shompen move seasonally from one part of the island to another in search of food.) In the south-east, there is a modest network of paved and unpaved roads. A single main north-south spine connects the seven revenue villages from Campbell Bay area in the north to Shastri Nagar in the south. An extension of this road across the Galathea River and down to Indira Point is under construction by the Border Roads Organization (BRO). The Campbell Bay has a local road hierarchy that serves the local population. Informal and unpaved roads serve communities that are located along the coastal villages.

Primary mobility on the project area is by bus, car, bike, or on foot. Buses are run by state transportation services and provide transportation between the villages.

#### Land Use and Ownership

The Great Nicobar Island is rich with the presence of dense forests, abundant flora and fauna, and two national parks (Campbell Bay National Park in north and Galathea National park in South). The project area (166.1 sq.km) is outside of the national parks and the area frequented by the Shompen. It includes the revenue villages, the only developed portion of the island. This project area includes low density residential and small-scale commercial development, as well as community facilities and services.

Of the total 166.1 sq.km project area, the revenue land area is 44.2 sq.km, which comprises of the following

- Revenue land (allotted) = 23.53 sq.km.
- Revenue land (vacant)= 6.62 sq.km
- Revenue land (encroached) = 2.0 sq.km.
- Others (roads and water bodies) = 3.16 sq.km.

- Revenue land (Deemed Forest) = 8.88 sq.km.

This revenue land was allotted to settlers on the island as tenants. They have occupancy rights but not ownership of the land. There is no lease and no time limit. Households can sell/transfer their rights of land in lieu of payment. They cannot change land use without permission. At present, tenants can only make improvements, but it requires approval by Deputy Commissioner.

1.65 sq.km of Defense land is falling under the proposed Port at Galathea bay; 7.849 sq.km. of Defense area is near Indira Point in the south and 1.43 sq.km. is at Campbell bay. The forest land in the project is 121.87 sq.km, alongwith Deemed forest of 8.88sq.km. These are Tropical Evergreen and Tropical Semi-Evergreen forests. There is agricultural land in the villages and few grasslands as well. The map showing land ownership is shown in **Figure-9**.

### **Eco-Sensitive Zone**

It is to be noted that the proposed project site is falling outside the eco-sensitive zones of Campbell Bay and Galathea National Parks.

Galathea National park is spread over an area of 107.103 sq.km and is located in the south of Great Nicobar Island in Nicobar district of Andaman and Nicobar Islands. MoEF&CC has issued a draft notification on 28<sup>th</sup> October 2020 mentioning boundary description of Eco-sensitive zone around the Galathea National park. The copy of the Gazette S.O 3874 (E) is given in **Annexure-1**.

Further Department of Environment & Forests, Andaman and Nicobar has de-notified the Galathea Bay Wildlife Sanctuary (11.44 sq.km) at Great Nicobar Island, vide notification dated 25<sup>th</sup> January 2021. The copy of the notification is given in **Annexure-2**.

For Campbell Bay National Park, a draft notification was issued by MoEF&CC on 28<sup>th</sup> October 2020, with regard to boundary description of Eco sensitive zone (ESZ) around the Campbell Bay National Park. The copy of the Gazette S.O 3873(E) is given in **Annexure-3**.



Figure 9: Location of National Parks, Forest Reserve and Revenue Land

## ■ Topography and Hydrology

Great Nicobar Island's topography is characterized by relatively flat areas near the coasts and steep hills and mountains in the interior, especially in the northern half. Great Nicobar Island has complex topography and terrain with higher peaks and deeper valleys and ridges that cross the Island. Mount Thullier is the highest peak on the island, with an elevation of 642 m above mean sea level (msl). The project area includes flat land sloping towards the coast on the east and south of the island. Here there is habitation and plantations of coconut, spice, vegetables, etc. The western edge of the project area is a hilly terrain of undulating landform covered with dense forest.

Great Nicobar Island has three rivers that flow west including Alexandria, Dogmar and Amritkaur; one that flows north, which is Jubilee; one that flows south, which is the river Galathea and is the largest of the five rivers and its mouth opens at Galathea bay falling in our area of interest. There are several streams many of which are perennial in nature, making water available throughout the year. There is, however, a need for engineering interventions to utilize the available water for long term sustainability. The mountains on the west have these numerous streams flowing from there into the sea towards the east and south. The map showing topography of project area is shown in **Figure-10**.

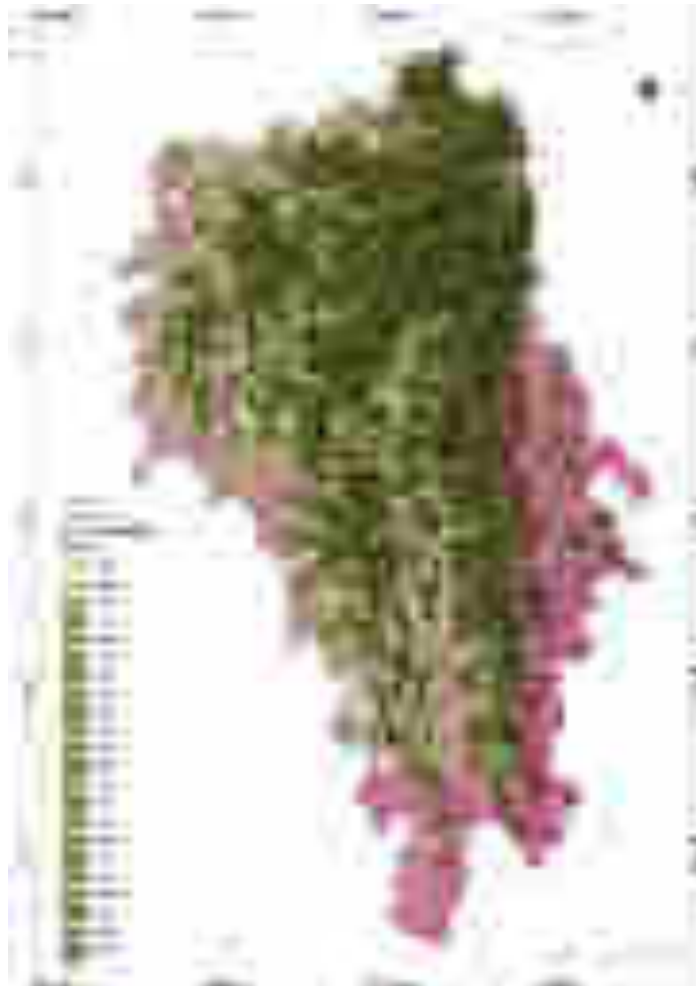


Figure 10: Project Area Overlaid on Topographic Map

## ■ ■ Existing Physical and Social Infrastructure

An inventory of the existing infrastructure on the project area/site which can be classified into physical infrastructure and social infrastructure is presented below:

### ■ ■ Physical Infrastructure

Physical infrastructure comprising roads, jetties, wharf, air landing facilities etc. are as follows:

- **Road Infrastructure**

There are two major roads in the Great Nicobar Island: the North South Road and the East-West Road. The North South Road, 51 km long before the Tsunami, is now reconstructed only up to 35 km. The East West Road is 43 km long but is blocked beyond 13 km and needs major repairs.

- **Campbell Bay Jetty**

Travelling by ship still remains the lifeline for the local population, which transports people and business commodities. The MV Campbell Bay transports around 500 passengers from Port Blair to Campbell Bay en route to the Nan Cowry group of Islands in Nicobar District and is the most popular means of transport amongst the masses. The passengers of the ship are debarked at the Campbell Bay jetty where a passenger hall or waiting hall is set up for their convenience.

- **Breakwater Jetty**

Adjoining the Campbell Bay Jetty is the Breakwater Jetty where a large number of passenger and transport ship's deck. It is among one of the most attractive places for people who love the calmness of the sea, the soothing sea breeze, the splash of water and darkness of night. The cold storage for fish is near the Fisheries Jetty for the convenience of fishermen to load and unload their daily catch and to store them too.

- **Air Landing Facilities**

The INS BAAZ, commissioned on 31 July 2012 is the first naval air station in the Nicobar group of islands. One of the primary functions of INS BAAZ is to provide information based on airborne maritime surveillance with the help of aircrafts and UAVs. It is located in Campbell Bay HQ.

### ■ ■ Social and Commercial Infrastructure

- **Administration**

The overall administration of the Great Nicobar Island is monitored by the Assistant Commissioner / SDM, Campbell Bay who is assisted by all other heads of the departments. The AC (Assistant Commissioner's) office remains the hub of government activities at Campbell Bay. The residence of AC Campbell Bay is also close by for effective and prompt administration and management. A Station House Officer (SHO) is posted with adequate staff for timely and prompt enforcement of law. To redress the grievances of people, a court of the Judicial Magistrate is also situated there on the island. A jail with sufficient manpower is also built on the island, for execution of penal punishment. Three government guest houses at Campbell Bay cater to tourists and provide lodging and boarding facilities.

- **Banks**

Banks along with ATM facilities are available for financial services. Two such banks are the Syndicate Bank and the Cooperative Bank. There is a post office on the island for postal communication with the outside world.

- **Anganwadi Centre**

An Anganwadi centre is also present under the Integrated Child and Development Scheme.

- **Schools**

There are primary, secondary and senior secondary schools run by the Education Department, Andaman and Nicobar Administration. There is also a Coast Guard Public School and a Zonal Library, which stock all necessary and latest books.

- **Sports**

A badminton court and a well-equipped gym at the Mini Stadium at Campbell Bay are source of recreation for the local population. The Mini Stadium is not only a hub for sports activities, such as cricket, football, volleyball and Kho—Kho matches, but is also the venue for hoisting the national flag on Independence Day and the Republic Day. It also hosts state functions, cultural programmes and inter-school sports meet.

- **Transport**

The latest addition to the island is the southernmost petrol pump of the nation which is run by the Andaman and Nicobar Islands Integrated Development Corporation; it supplies petrol and diesel to the local population and was inaugurated on 4 January 2018. Buses run by the state transport service are the lifelines for transport of the local population in the village.

- **Recreation**

There is a Children's Park at the village for the entertainment of children and adults. Children can be seen playing in the park after school hours. There is a small Recreation Hall, which is generally used to celebrate social functions, marriages, parties, etc.

- **Lifestyle**

Despite being geographically isolated, the youth and people of Campbell Bay keep pace with fashion and with the latest trends. Popular hairstyles are displayed by saloons; these are then followed by the local crowd.

- **Markets**

There is a local market and a fish market at Campbell Bay to cater to residents' daily needs.

- **Religion**

One can find various places of worship, belonging to every religion across the island. Some examples are the Mariyappan Temple, the Krishna Temple, the Ayyapa Temple, the Ram Temple, the Shakti Vinayaka Temple, the Shri Guru Singh Sabha Gurudwara (Dashmesh Nagar, Campbell Bay), St Joseph Church, Redemption Church and the Juma Masjid.

- **Health**

Also present is a primary health centre to cater to the needs of the local population round the clock with a stationed medical team consisting of medical officers.

- **Orchidarium**

The orchidarium has a collection of a variety of orchids that are bred there. This is managed by the forest department of the Andaman and Nicobar Islands and is one of its kind.

- **Emergency Operation Centre**

An emergency operation centre functions 24x7 at Campbell Bay. It is there to respond to emergency situations and to coordinate rescue operations on the island. It is directly linked to the State Disaster Management authority and was set up after the devastating tsunami of 2004.

## ■ Soil Classification

Based on observations made during the field visit, the top layer of soil appears clayey followed by hard clay layer and very soft rock. This rock is very fragile to the extent that it can be easily broken by hand and disintegrates into pieces when thrown from a height of approximately 2m. The beaches are white sandy with rocky formations along with few beaches formed due to dead corals. At Galathea Bay beach, the Western side has more flat land and wide beach as compared to Eastern side.

## ■ Climate

The island's climate is categorized as tropical rainforest, with a temperature range typically between 18° C and 36° C. Relative humidity is typically between 70-90%. The island experiences a monsoon season in two phases: May to September and November to December. North-easterly winds blow from November to December, and southwesterly from May to October. The calmest weather can be experienced between January to April.

Average annual rainfall of Andaman and Nicobar Islands is 2300 mm. Rough weather prevails during the monsoon season in Andaman and Nicobar Islands. The Island experiences more than 130 numbers of rainy days, during the monsoon period May to December which is the monsoon period and dry period extends for 3 to 4 months from January to April. The predominant wind directions are SW and NE with the recorded maximum wind speed is being 26.5 km/h.

Located on the southeastern coast of the Island, the project site is most exposed to sea breezes.

## ■ ICTT Site Analysis

Following Five alternative sites were examined for the development of the Project. Facilities for selection of the most suitable site based on the multicriteria analysis.

- Alternative Site 1 – Galathea Bay
- Alternative Site 2 – Casuarina Bay
- Alternative Site 3 – Anderson Bay
- Alternative Site 4 – Pemayya Bay
- Alternative Site 5 – Campbell Bay

The location of the five alternative sites in the Great Nicobar Island is shown in Figure 11.



Figure 11: Alternative Site Locations for Port

The harbour layouts at each of the above alternative sites have been developed considering the direction of waves, water depths to minimize dredging and also ensuring at the same time that the breakwater does not extend to deeper waters that would increase the cost of development.

#### Alternative Site 1 – Galathea Bay

This site is located near the southernmost tip of the Great Nicobar Island and is approximately 40 km away from the mainline shipping route. The sea-bed contours are steep, and the water depths of 20 m and 30 m are available within a distance of 2.3 km and 3.6 km from the shoreline respectively. The site offers the water area of about 517.60 hectares between shoreline and the 20 m contour which could be optimally utilised for the development of the harbour facilities. It could be observed that about 6.07 km of total berth length is possible to be developed on the western side of the bay. Two breakwaters of length 2.53 km and 1.37 km respectively provide round the year wave tranquillity. The port would be developed in phased manner and the berths would be added as per the traffic growth. However, the breakwaters would need to be fully constructed at the initial phase only.

**Environmental Sensitivity:** The site is away from any habitation. The Backup area will have to be developed by reclamation which will extend up to the intertidal zone. No cutting of hills is required. Minimum Dredging is envisaged. Area falls partly under ICRZ Zone 1B. A small portion of the West Breakwater and backup area falls in tribal reserve. Turtle nesting sites are observed at the mouth and west of Galathea river.

The indicative layout of the container Transshipment port is presented in Figure 12



Figure 12: Galathea Bay Location – Proposed Layout ( Site 1)

#### **Alternative Site 2 – Casuarina Bay**

This area falls outside project boundary and is away from the overall development plan of the Nicobar Island. The site can offer adequate Harbour area, but it would involve slightly higher dredging as compared to site 1 which eventually leads to higher risk of involving rock dredging. Two breakwaters of length 4.150 km and 0.88 km respectively provide round the year wave tranquillity. The port would be developed in phased manner and the berths would be added as per the traffic growth.

**Environmental sensitivity:** The site is away from any habitation. The Backup area will have to be developed through reclamation which extends into the intertidal zone and slightly into tribal reserve, protected forest and biosphere reserve areas. Berths and Breakwaters extend into the coral reefs. Dredging anticipated is more than Galathea bay. No hill cutting is envisaged. Location falls partly under ICRZ Zone 1A.

The indicative layout of the container Transshipment port is presented in Figure 13.



Figure 13: Casuarina Bay Location – Proposed Layout ( Site 2)

#### Alternative Site 3 – Anderson Bay

The site is located in a creek just south of Campbell Bay. Further the entire site is relatively exposed to the sea and thus would require longer breakwaters. The site is close to the habitation near Campbell bay. Two breakwaters of length 4.00 km and 1.660 km respectively provide round the year wave tranquillity. The port would be developed in phased manner and the berths would be added as per the traffic growth.

**Environmental sensitivity:** The berths and breakwaters extend into coral reefs. Significant dredging is required including coral reef areas. The backup area extends well beyond the intertidal zone into the creek, agricultural land and hilly areas. The area of the creek is very much limited and therefore lot of hill cutting would be needed to create the required harbour area. Dredging required is more than Galathea and Casuarina bay. Turtle nesting grounds are present in the area. Area falls partly under ICRZ Zone 1A.

The indicative layout of the container Transshipment port is presented in Figure 14.



Figure 14: Anderson Bay Location – Proposed Layout ( Site 3)

#### Alternative Site 4 – Pemayya Bay

The entire site is relatively exposed to the sea and thus would require longer breakwaters. Two breakwaters of length 4.20 km and 1.55 km respectively provide round the year wave tranquillity. The port would be developed in phased manner and the berths would be added as per the traffic growth. This area may conflict with the proposed naval facilities planned near the Indira Point.

**Environmental Sensitivity:** The site is away from any habitation. The reclamation area extends into intertidal zone, creek, Tribal reserve and protected forests. The area of the creek is very much limited and therefore lot of hill cutting would be needed to create the required harbour area. Breakwaters and berths extend into coral reefs. Turtle nesting grounds are present in the area. Area falls partly under ICRZ Zone 1A.

The indicative layout of the container Transshipment port is presented in Figure 15.



Figure 15: Pemayya Bay Location – Proposed Layout (Site 4)

#### Alternative Site 5 – Campbell Bay

Campbell bay has existing three jetties and a small breakwater. The site is in the vicinity of an INS BAAZ airstrip, permanent settlements and habitation. The location has defence land and is a highly restricted zone.

One additional breakwater of length 1.20 km shall be provided for round the year wave tranquillity. The port would be developed in phased manner and the berths would be added as per the traffic growth. The port development would require the existing airport to be shifted to some other location as not only the container cranes would be under direct flight path but also the airport land would be required to create the backup land for the container terminal.

**Environmental Sensitivity:** The overall area of the bay is small and extensive dredging would be needed to create the harbour facilities for the proposed container transshipment terminal. Significant hills also will be required to be cut to create the harbour facilities. The backup area extends into the Govindnagar creek having mangroves because of which the area falls partially under ICRZ Zone 1A.

The indicative layout of the container Transshipment port is presented in Figure 16.

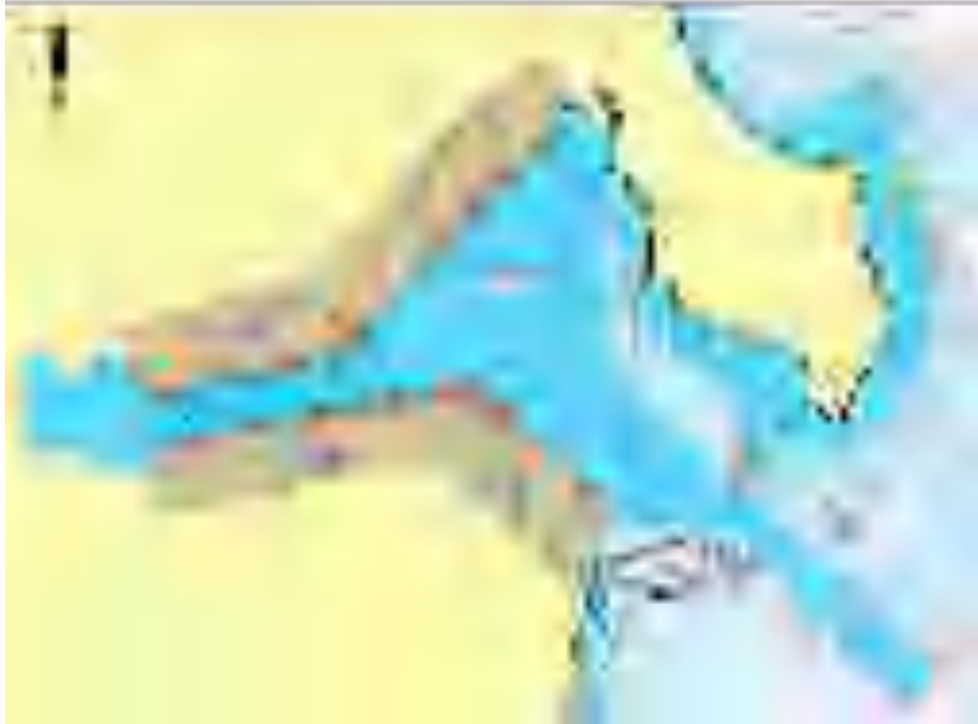


Figure 16: Campbell Bay Location – Proposed Layout (Site 5)

The alternative sites were evaluated using Multicriteria Analysis as presented in Table 9.

The comparison and site evaluation were carried out considering the various factors and the outcome of the evaluation is given in.

**Table 9: Comparative Analysis for Alternate Sites**

| Sr No. | Factor Description                  | Galathea Bay  | Casuarina Bay  | Anderson Bay  | Pemayya Bay   | Campbell Bay                                       |
|--------|-------------------------------------|---|--|---|---|--|
| 1      | <b>Proximity to shipping routes</b> | Closest to the International Shipping line (only 40 km away)        | Additional distance of 35 km from Site 1                           | Additional distance of 25 km from Site 1  | Additional distance of 15 km from Site 1  | Additional distance of 30 km from Site 1           |
| 2      | <b>Cost Risks</b>                   | Minimal   | Risk of rock dredging higher as compared to site 1                 | Significant as hills have to be cut for creating the Harbour basin. Presence of rock would make dredging very expensive | Significant as hills have to be cut for creating the Harbour basin. Presence of rock would make dredging very expensive | Risk of rock dredging higher as compared to site 1 |
| 3      | <b>Land Development</b>             | Requires Reclamation of Land to develop Onshore Storage Facilities. | Reclamation Required is slightly more as compared to Galathea Bay. | Reclamation required is less than in Galathea bay.  | Reclamation required is slightly more than in Galathea Bay.   | Reclamation required is less than in Galathea Bay. |

| Sr No.                        | Factor Description               | Galathea Bay   | Casuarina Bay  | Anderson Bay  | Pemayya Bay  | Campbell Bay  |
|-------------------------------|----------------------------------|--|--|---|--|---|
| 4                             | <b>Breakwaters</b>               | Small length of breakwaters required.  | Length of breakwater is more than Galathea bay but less than Anderson bay and Pemayya bay                    | Length of breakwaters is significantly more than the length required for Galathea bay | Length of breakwaters required is maximum of all locations | Small length of breakwaters required as compared to all other locations |
| 5                             | <b>Environmental sensitivity</b> | <b>ICRZ-Zone</b>   |  |   |  |   |
|                               |                                  | Area falls partly under ICRZ Zone 1B.  | Area falls partly under ICRZ Zone 1A. Area within biosphere reserve and partly within Campbell National Park | Area falls partly under ICRZ Zone 1A  | Area falls partly under ICRZ Zone 1A                       | Area falls partly under ICRZ Zone 1A                                    |
|                               |                                  | <b>Turtle Nests</b>  |  |   |  |   |
|                               |                                  | Turtle nesting sites are present at the mouth of Galathea river. These sites will be avoided while planning the development. | Turtle nests present at site   | Turtle nests present at site  | Turtle nests present at site                               | NO Turtle nests at site   |
|                               |                                  | <b>Megapode Nest</b>   |  |   |  |   |
|                               |                                  | No Megapode Nests at site  | No Megapode Nests at site  | No Megapode Nests at site   | No Megapode Nests at site                                  | No Megapode Nests at site   |
|                               |                                  | <b>Crocodile Nests</b>   |  |   |  |   |
|                               |                                  | NO crocodile nests at site   | NO crocodile nests at site   | NO crocodile nests at site  | NO crocodile nests at site                                 | NO crocodile nests at site  |
|                               |                                  | <b>Hill Cutting</b>  |  |   |  |   |
|                               |                                  | No hill cutting envisaged  | No hill cutting envisaged  | Significant Hill cutting required   | Hill cutting required is maximum                           | Significant Hill cutting required                                       |
| <b>Habitation</b>             |                                  |  |  |   |  |   |
| Site away from any habitation | Site close to Shompen habitation | Site close to habitation at Campbell bay   | Site close to proposed Naval facilities at Indira point and to Nicobarese habitation                         | Site close to habitation and INS BAZZ facilities.                                     |  |   |
| <b>Dredging</b>               |                                  |  |  |   |  |   |

| Sr No.                               | Factor Description                                 | Galathea Bay  | Casuarina Bay  | Anderson Bay  | Pemayya Bay   | Campbell Bay  |
|--------------------------------------|--|---|--|---|---|---|
|                                      |  | Sufficient water depth is available close to shore. Minimal dredging is required  | Shallower water depths near to shore. Dredging volume required is slightly more than Galathea bay but less than Anderson and Pemayya bay | Shallower water depths near to shore. Significant volume of dredging required. Dredging required is max among all locations | Shallower water depths near to shore. Significant Dredging required. It is more than Galathea bay and Casuarina bay | Shallower water depths near to shore. Dredging volume Required is significantly more than Galathea bay.   |
| <b>Disturbance to Shompen Tribes</b> |  |   |  |   |   |   |
|                                      |  | No disturbance  | No disturbance   | No disturbance  | No disturbance  | No disturbance  |
| 6                                    | <b>Compatibility with Overall development plan</b> | The location gels well with the overall development plan .However its proximity with the proposed air strip needs to be confirmed as the 125m high cranes falls within the runway funnel zone | Location falls outside Project boundary and is very far from proposed township at Campbell bay.  | Rehabilitation issues. Site more suitable for township development  | Development is restricted. It may overlap with the defence land   | Does not gel well with the overall development plan as residential, commercial office and mixed-use development have been planned at the location. Backup area fouls with the INS BAZZ Airstrip and its facilities which will have to be relocated. Area falls under highly restricted zone and CTT will have to be co-located with naval facilities. |

It could be observed from above that Transshipment Port site at Galathea appears to be the best in terms of attracting transshipment container traffic, minimal capital investment risk and on overall considerations for technical, environmental and financial parameters- all site conditions have been considered. Therefore, this site is recommended for further detailed evaluation.

## ■ ■ Airport Site Analysis

The site selection criteria are as follows:

1. Open, Longitudinal, fairly level and well drained site.
2. Prevailing wind to be facilitating operations.
3. Obstructions to Air Navigation.

4. Environmental concerns, Avi-fauna safety/concerns, National Parks, Tribal areas etc.
5. Earthwork Economics
6. Connectivity / access to population centres; existing roads vis a vis new developments/ alignment

Based on above broad parameters, five sites were identified on the island which were partially meeting the first iteration. Three of these sites were located on the East Coast, one the West Coast and one located near mid of the island. These sites are as marked in Figure below.



*Figure 17: 5 Alternative Sites for Airport*

Detailed analysis and examination revealed that the Site No 2 & 4 were deficient on two important factors, namely: -

- Length of Runway availability was restricted
- Wind direction was across the runway orientation and hence was not conducive to air operations for considerable amount of time in a year.

Moreover, other major disadvantages of the West site was its proximity to depicted Shompen Tribe areas; secondly, no connectivity either by land/ road or by sea to connect the site and would entails cutting a new

road through virgin forest zone for development abinitio; and lastly the proposed habitation would be on the East coast and the airport would be diagonally across the island on the West coast. Hence, the West coast site was rejected. Hence, out of five, three sites were shortlisted which partially met the requirements and were further analysed in detail. They are shown in fig below as per;

- North Site – Ranganatha Bay
- Central Site – Existing Runway of INS BAAZ
- Southern Site- Shastri Nagar



*Figure 18: 3 Alternative Sites for Airport*

- **North Site**

**Topography:** The site is approx. 4200 m long, running along the length of a seasonal stream which runs south to North and discharges in sea at its North end. The site lies in the catchment area of the Ridge line on the West and few high isolated knolls on the East. Number of spurs jets out from mother ridge into the valley from both the side which need to be erased in the event of selecting this site.

**Wind Direction:** The site is oriented in North South direction approximately and hence suitable for preferred Runway orientation.

**Obstruction to Air Navigation:** The site is towered by ridge line running North- South, which is over 100 m high, and thus penetrating into the obstacle limiting surface of Inner Horizontal Surface, Conical Surface and Outer Horizontal Surface.

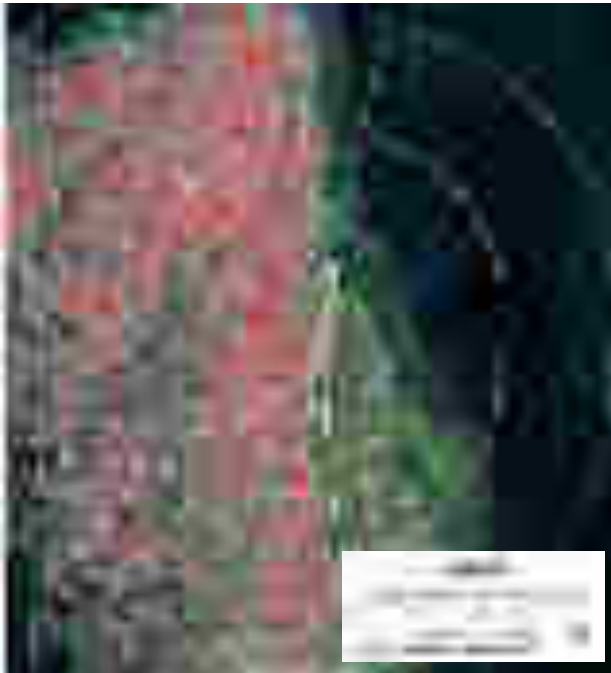


Figure 19: OLS for Airport North Site

**Air Approaches to the Site:**

- a. Approach from North. The approach is over Sea and mostly clear except for some obstructions on the coastline.
- b. Approach from South. The approach from South is obstructed and hampered by hill features which lie right in the Approach surface. These hills are serious obstructions to approaching aircraft and will endanger safe flying operations.

**Airport Availability:** Due to the restrictions of approach from South, the Airport could be approached from Single direction only; hence, the airport will be available for operations only when the Wind is from third quadrant or is in calm realm. Thus, the availability of airport would be about 50% of the time.

**Environment Sensitivity:** The site lies in the catchment area of two hill slopes and is covered with dense forest growth. This will entail clearing of the forest cover and levelling the catchment area. The access to habitation and Campbell bay is non-existent and fresh roads will need to be constructed. The

approach takes off and flight path of the aircrafts will run over the island and there will be need to put in noise reduction procedures for aircraft operations.

- **Central Site**

**Topography:** The site is the existing Runway of Indian Navy. The runway is about 1000 m long and has to be extended to about 4000 m to make wide body aircraft operations possible. The site is dominated by a hill feature in the North and the southern edge is the shore of Campbell Bay. The site has very limited scope for future expansion and will not be able to accommodate the required infrastructure for an International Airport. This site if extended, would run through the existing habitation and split the settlement into two parts.

**Wind Direction:** The site is oriented in North- East to South- West direction and hence suitable for preferred Runway orientation.

**Obstruction to Air Navigation:** The site is dominated by a hill feature on the North which is over 80 m high thus penetrating the Inner Horizontal obstacle limiting Surface & Conical Surface. Similarly, the approach and take off surfaces are also hindered.

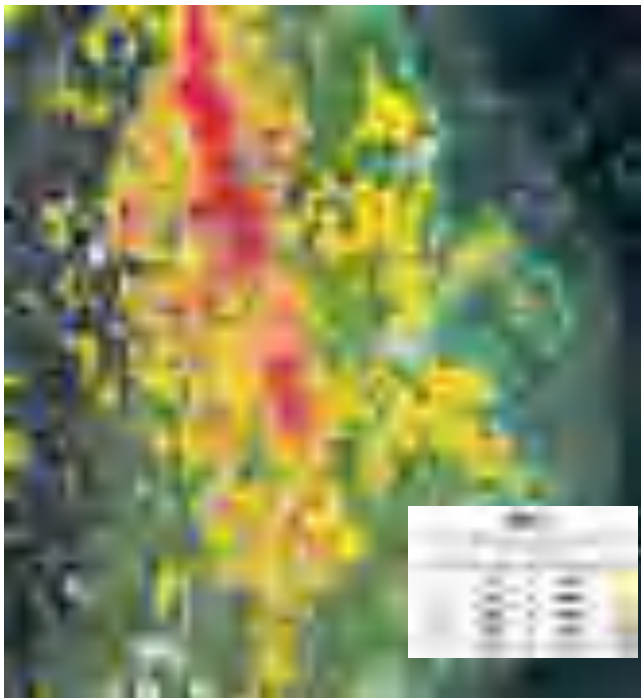


Figure 20: OLS for Airport Central Site

**Air Approaches to the Site:**

- a. Approach from North- East. The approach is over Sea and is mostly clear.
- b. Approach from South. The approach from South is obstructed and hampered by hill features which lie right in the Approach surface. These hills are serious obstructions to approaching aircraft and will endanger safe flying operations.
- c. Airport Availability: Due to the restrictions of approach from South, the Airport could be approached from Single direction only; hence, the airport would be available for operations only when the Wind is from third quadrant or calm realm. Thus, the availability of airport would be about 50% of the time.

**Environment Sensitivity:** The site lies on the existing airstrip at Campbell bay and will require approx. 75 % further extension to facilitate operations of the type of aircrafts envisaged. This site on extension will split the existing town in two parts as the extension will run through the build-up area and farm land. In order to achieve the required width of airport, reclamation of the sea coast will be required along the length of runway. The approach take off and flight path of the aircrafts will run over the width of the island, forest zones, habitation and over the tribal nominated areas.

- **South Site**

**Topography:** The site is approx. 4000 m long, running along a flat open patch. The site is dominated by a 100 m high ridge line on the West and has two isolated knolls on the East. A few of spurs jets out from either direction which can be levelled in the event of selecting this site. The site has tidal area jutting inside which would need to be filled and levelled. A part of the tidal area could be developed into a Sea Jetty for High speed boats connecting the Airport with the Port and Campbell bay. Establishing of approach lights, ILS etc. for the first runway and providing full length second runway (if required in future) will require some reclamation of land on North and South.

**Wind Direction:** The site is oriented in North South direction approximately and hence suitable for preferred Runway orientation.

**Obstruction to Air Navigation:** There exists a dominating ridge line on West of the site running North-South with some heights over 100 m thus penetrating the obstacle limiting surface of Inner Horizontal Surface and Conical Surface. However, this ridge line also separates the Airport and the proposed port site and provides a buffer zone between the two. The site proposed as a major Sea Port across the ridge line at Galathea Bay will have tower cranes installed for loading and unloading of ships; these cranes will also be an obstacle, however, their potential as an obstacle needs to be assessed by Airport Authority of India as these will lie in the shadow of the separating ridge line. Suitable and appropriate ATM procedures need to be established by AAI for safe navigation if this site is recommended.



Figure 21: OLS for Airport South Site

**Air Approaches to the Site:**

- a. Approach from North: The approach is over Sea and is mostly clear.
- b. Approach from South: The approach is over Sea and mostly clear except for some levelling on the Coastline and reclamation of land. Obstacle Limitation Surface (OLS) Airport Availability: The airport is available from both the approaches and hence is assessed that it will be available for over 95 % of time which is a requirement of International Civil Aviation Organisation (ICAO).

**Environment Sensitivity:** The site has fairly large portion on revenue land and minimal forest land will be affected. There is existing road connectivity to main island habitation and will facilitate movement of men and materials from Campbell Jetty to the airport site. In order to achieve the required length of the runway, reclamation of the sea coast in North and South will be required; however, reclamation can be optimally reduced with erecting the approach lights over pedestals. The approach takes off and flight path of the aircrafts will run over sea and there will be minimal disturbance to local population and the tribal areas due to over flying of aircrafts at low altitude.

All the proposed alternative sites were evaluated using Multicriteria Analysis as presented in Table-10.

**Table 10: Analysis of Alternative Sites**

| S No | Description                      | Site Characteristics               |   |   |
|------|----------------------------------|------------------------------------|---|---|
|      |                                  | Site N                             | Site C                                    | Site S  |
| 1    | Approx. Length of Land available | 4200 m                             | 3900 m                                    | 4000 m  |
| 2    | Approaches                       | Only North                         | Only NE                                   | Both  |
| 3    | Obstructions to Air Navigation   | High Ridge Lines<br>Venturi effect | Small Hill on North                       | Hills on W<br>Port Cranes                                     |
| 4    | Favourable Wind Direction        | Partial availability of Airport    | Partial availability of Airport           | Airport available most time in year                           |
| 5    | Earth work Economics             | Expensive                          | Intermediate                              | Intermediate  |
| 6    | Environmental Sensitivity        | a. Most Sensitive;                 | a. Fairly Sensitive;                      | a. Fairly Sensitive;  |
|      |                                  | b. Virgin Forest area;             | b. Large part is Revenue Land             | b. Large part is Revenue Land<br>Minimal forest Land affected |
|      |                                  | c. No Habitation on Site           | c. Existing Town will Split in two parts: | c. Existing Town of Shastri Nagar will need to be shifted     |

| S No | Description              | Site Characteristics  |   |   |
|------|--------------------------|---|---|---|
|      |                          | Site N  | Site C  | Site S  |
|      |                          | d. Needs new green field Highway for Connectivity to Airport Site   | d. Existing Road Connectivity   | d. Existing Road Connectivity   |
|      |                          | e. Needs reclamation of large shore line for Runway systems   | e. Needs reclamation of large shore line;   | e. Needs reclamation of large shore line for Runway systems   |
|      |                          | f. Flight path over entire length of island and habitation  | f. Flight path over entire width if island, tribal areas and over all habitation                                | f. Flight path over Sea; Minimal disturbance to population  |
|      |                          | g. Likely Disturbance to Tribal areas   | g. Likely Disturbance to Tribal areas   | g. Unlikely Disturbance to Tribal areas   |
| 7    | Concerns on Avifauna     | a. Flight path might interfere with avifauna flight paths & habitat   | a. Flight path might interfere with avifauna flight paths & habitat   | a. Flight path over Sea; Minimal disturbance to Avi fauna and population  |
|      |                          | b. Active and Passive measures need to be instituted at the Airport to safeguard Flight operations and Avifauna | b. Active and Passive measures need to be instituted at the Airport to safeguard Flight operations and Avifauna | b. Active and Passive measures need to be instituted at the Airport to safeguard Flight operations and Avifauna |
| 8    | Turtle Nesting Areas     | Not affected  | Not affected  | Not affected  |
| 9    | Crocodile infested areas | Affected  | Affected  | Affected  |
| 10   | Megapode                 | Not affected  | Not affected  | Not affected  |

| S No | Description   | Site Characteristics  |   |  |
|------|---------------|---|---|--|
|      |               | Site N  | Site C  | Site S   |
| 11   | ICRZ          | Effects on North End and Centre of Runway : Mangroves and falls in ICRZ Zone IV B | Minimal Effects on South side of Runway; Part in ICRZ Zone IV B | Minimal Effects on North and South Ends of Runway Part in ICRZ Zone 1 A & IV B |
| 12   | Access by     |   |   |  |
| a    | Road          | Yes   | Yes   | Yes  |
| b    | Speed Boats   | No  | Yes   | Yes  |
| c    | Sea Aerodrome | No  | No  | Yes  |

The map showing the site location is shown in Figure-22.



*Figure 22: Preferred airport site location*

## ■ ■ Township Site Analysis

The concept master planning process included the consideration of alternative layouts. The primary alternate was a layout that called for lower density development spread over a larger land area. While the total project area (166 sq.km) was the same, the *urbanised* area was larger because the net density of the residential, commercial and institutional areas was lower.

The alternate concept master plan is shown in the figure below. It includes 75 sq.km of urbanised area, including 33 sq.km of residential area and 42 sq.km of commercial development, in the form of an Office and Technology District. The combined area is significantly higher than in the concept master plan described in the previous section, which includes approximately 45 sq.km of urbanised area. Since under the alternate plan the 75 sq.km area does not fit within the current revenue land (approximately 44 sq.km), it was distributed to the forested areas between the revenue villages and to the west of the villages. The alternate layout results in considerably more deforestation and more redevelopment of hilly, forested land to urban uses.



Figure 23: Aerial Perspective of alternate Concept Plan option

The lower environmental costs associated with the more compact layout led to its selection as the preferred concept master plan for Great Nicobar Island. The project area, 166 sq.km, is the same in both alternatives. The land uses in the preferred land use plan are defined in Section 4.6.

## ■ ■ ■ Power Plant Site Analysis

Three alternative sites were examined for the proposed LNG power plant. The alternative sites are Option 1-Near Campbell bay, Option 2-Near Shastri Nagar and Option 3-Near port. The alternate sites for Power Plant are shown in Figure-24.

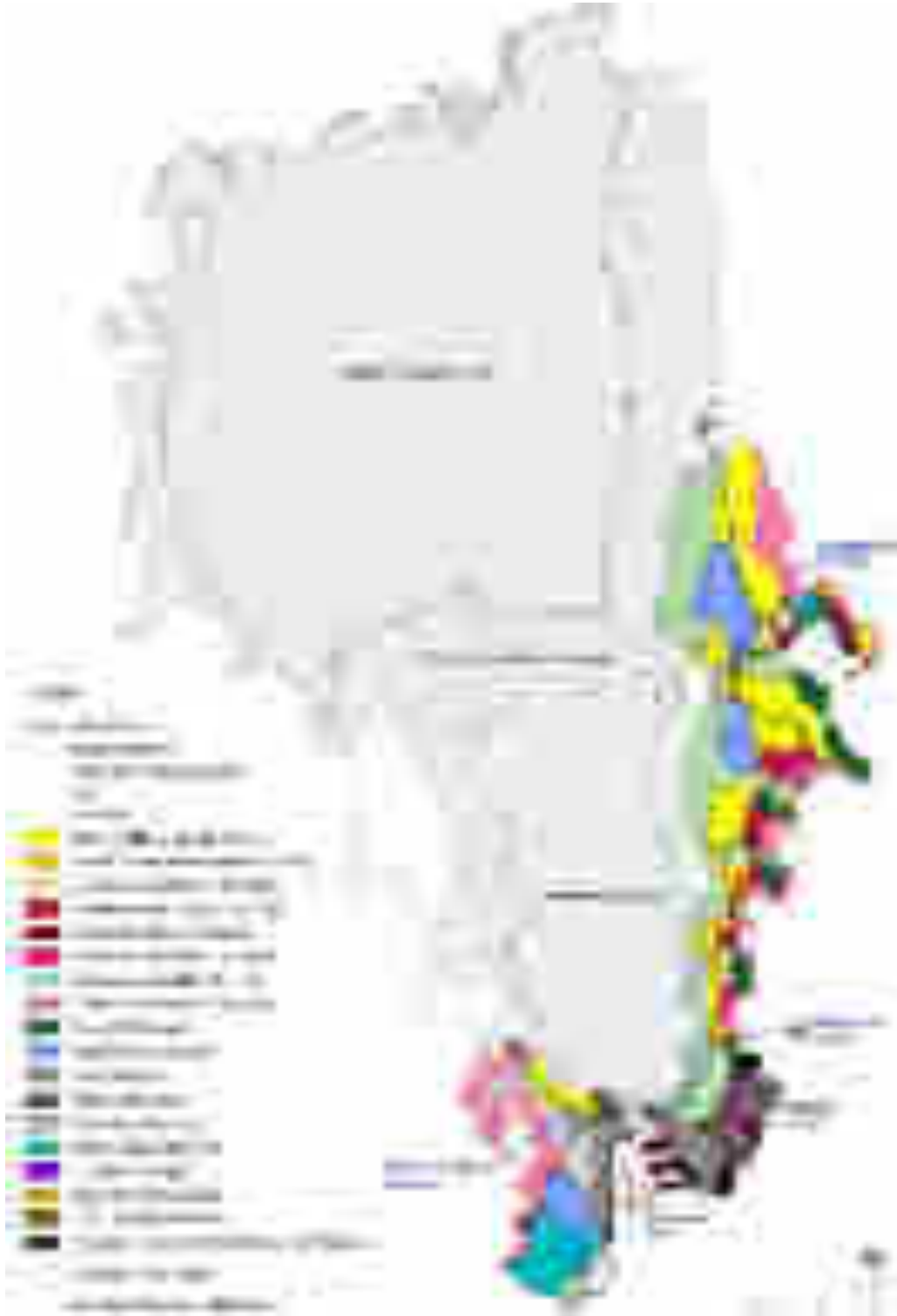


Figure 24: Alternate sites for Power Plant

The alternative sites were evaluated using Multicriteria Analysis as presented in Table-11.

**Table 11: Analysis of Alternative Sites**

| <b>S. No.</b> | <b>Description</b>                  | <b>Option-1</b><br>(Near Campbell bay)                       | <b>Option-2</b><br>(Near Shastri Nagar)                   | <b>Option-3</b><br>(Near Port)                            |
|---------------|-------------------------------------|--|---|---|
| 1             | Approx. Area of Land available      | 96 Acres   | 96 Acres  | 96 Acres  |
| 2             | Earth work Economics                | Expensive  | Intermediate  | Intermediate  |
| 3             | Environmental Sensitivity           | Most Sensitive: Site comes near densely populated territory. | Fairly Sensitive: Site comes densely populated territory. | Less Sensitive: Site comes near less populated territory. |
| a)            | Turtle Nesting Areas                | Not affected   | Not affected  | Not affected  |
| b)            | Crocodile infested areas            | Not affected   | Not affected  | Not affected  |
| c)            | Megapode                            | Not affected   | Not affected  | Not affected  |
| d)            | ICRZ                                | Not affected   | Not affected  | Must avoid intertidal areas                               |
| 4             | Equitable Growth of Different Areas | Long distance from the major upcoming load centre            | Long distance from the major upcoming load centre         | Near Load centre  |
| 5             | Transportation                      | Expensive Transportation cost of Fuel                        | Intermediate Transportation cost of Fuel                  | Less Transportation cost of fuel                          |
| 6             | Generation Expenses                 | High   | Intermediate  | Less  |

The preferred site is option 3, which is near to the ICTT facility.

## 4 PLANNING BRIEF

### ■ Planning Concept

The Master Plan has been prepared with a view to charting a balanced path forward that can achieve Great Nicobar Island's ambitious economic development goals, while conserving the natural environment and improving the quality of life of local residents. With that perspective in mind, an Island-wide settlement pattern has been set forth, that preserves the ecological core of the Island and concentrates development along the eastern coast.

With respect to the project area, the development extends from Ranganatha Bay on the east coast southwards to Galathea Bay and around the corner of Indira Point to Pemayya Bay. All development is contained within the 166.1 sq. km. area along this coastal strip of land between 2 and 4 km width.

In keeping with the Great Nicobar development potential highlighted earlier, four principal anchors have been identified for holistic development of Great Nicobar: The International Container Transshipment Terminal (ICTT), International Airport, Township and Power plant focussing on overall development of Nicobar Islands. Alternative sites for the port and the airport were examined and Galathea Bay and Gandhi Nagar/ Shastri Nagar villages were selected respectively. The large majority of the township area extends north-eastward from this multimodal hub north to Campbell Bay and to Ranganatha Bay. It also includes a small logistics development area west of the port.

Within the township area, the Concept Master Plan calls for the development along the coast of a series of compact, walkable, mixed-use urban centres separated by natural features such as forested hills and stream buffers. Set against the backdrop of the steep forested hills towards the interior and set back from the coastline to build resiliency to natural shocks, this will be a 'city in the forest' that brings the 'forest into the city'. Compact development is not only more liveable and attractive; it will also reduce Great Nicobar's future carbon footprint, promote conservation of resources, and limit the overall development area, thereby preserving more of the existing forest and other natural resources. The largest urban centre will be at Campbell Bay.

### ■ Employment and Population Projection

A number of different economic sectors will contribute to future growth on Great Nicobar Island. Each sector will in turn be driven by specific infrastructure investments and development zones like International Container Transshipment Terminal (ICTT) and associated logistics facilities, Airport, Tourism, Commercial, Light Industrial, etc.

These key facilities and development zones are anticipated to spur the development of ancillary industries, further cementing the economic growth trend. A preliminary analysis has been carried out to identify potential direct employment growth in each of the key economic sectors as well as indirect employment in the ancillary industries. This section presents preliminary employment and population forecasts based on market conditions, the size of the facilities, and industry norms. The projections will be refined in future stages of the master planning assignment.

The establishment of robust estimates of population and generated employment is of critical importance to the planning of the city, since they underpin all the land use proposals for the region. The population and employment estimates for Greater Nicobar Island have been derived from a model that includes

number of variables and assumptions. The model forecasts jobs in the primary economic drivers (anchor sectors), leading to the forecast of secondary employment (ancillary sectors). The population is forecasted, on the basis of total primary and secondary employment generated. The employment and Population Projection Methodology is shown in **Figure-25**. The population model developed for the region is illustrated in the **Table 12**.



Figure 25: Employment and Population Projection Methodology

To benchmark the development, a number of actual case study locations have been analysed. The case studies have informed the assumptions, shown in Table 12, that are used in the model.

**Table 12: Assumptions for Employment Estimation**

| Particulars   | Value                    | Notes   |
|---|--------------------------|---|
| <b>ICTT and Logistics and Power Plant / Export Processing Zone</b>  |                          |   |
| Processing Area   | 1,373 Ha                 | 30% of total area allocated to economic sector  |
| Employee per Ha.  | 35                       | Industry norms  |
| <b>* Other Amenities include worker housing, primary healthcare and education centres, Internal infrastructure like roads, STP etc.</b> |                          |   |
| <b>Industrial Processing Zone</b>   |                          |   |
| Processing Area   | 360 Ha                   | 30% of total area allocated to economic sector  |
| Employee per Ha.  | 35                       | Industry norms  |
| <b>* Other Amenities include worker housing, primary healthcare and education centres, Internal infrastructure like roads, STP etc.</b> |                          |   |
| <b>Tourism / Airport</b>  |                          |   |
| No. of Visitors   | 9.80 Lakh PA             | Benchmarked with the total visitors in the developed Islands in vicinity of Project Site with well-developed tourist infrastructure |
| Business Travellers   | 0.44 Lakh PA             | Benchmarked with the total employment   |
| Employment in Tourism   | 4.3% of annual tourist   | Industry Norms  |
| Employment at Airport   | 19% of annual passengers | Industry Norms  |
| <b>Macro-economic Assumption</b>  |                          |   |
| Multiplier Effect   | 1.5                      |   |
| Dependency Ratio  | 1.5                      |   |
| Household Size  | 4                        |   |

On basis of above-mentioned assumptions, total employment in economic anchors is forecasted. It is anticipated that these core economic drivers will generate and sustain additional jobs in the ancillary industries, such as commercial, administrative, institutional, residential and recreational sectors. These jobs will enable the island to develop into a self-sustaining and economically diverse city. The number of employees generated by direct and indirect employment is shown in the **Table 13**.

**Table 13: Projection of Total No. of Employees**

| Sectors                        | No. of Direct Employees | No. of Indirect Employees | Total Employees |
|--------------------------------|-------------------------|---------------------------|-----------------|
| ICTT & Logistics & Power Plant | 27,573*                 | 41,360                    | 68,933          |
| Export Processing Zone         | 20,475                  | 30,712                    | 51,187          |
| Food Processing Zone           | 12,600                  | 18,900                    | 31,500          |
| Tourism                        | 43,863                  | 65,794                    | 109,656         |
| Airport                        | 530                     | 796                       | 1,326           |
| Power plant                    | 100                     | 150                       | 250             |
| <b>Total</b>                   | <b>105141</b>           | <b>157711</b>             | <b>262852</b>   |

\*Includes employment at port, estimated as 4,200

The demand for workers from the economic drivers would translate into the residing population for the region. The population would be composed of all employees (direct and indirect employment) and their dependents. With the migration of both skilled and unskilled labour to the project site, dependents are also expected to migrate eventually. The dependent population would contain those in 0-14 yrs. and 65+ age groups as well as those individuals in the employable age group who are unemployed (by choice or by force). The dependency ratio is estimated to be 1.5. The population projections made are given as in below Table. With the below mentioned population, the density of the region would be approximately 27 person per hectare. The projection of total population is given in **Table-14**.

**Table 14: Projection of Total Population**

| Particulars             | Population (lakh) |
|-------------------------|-------------------|
| Working population      | 2.6               |
| Dependent Population    | 3.9               |
| <b>Total Population</b> | <b>6.5</b>        |

Thus, as discussed above, it is anticipated that investment in the Transshipment hub, tourism facilities and the airport, among other economic activities, will generate approximately 105,141 jobs by 2050. This direct employment will have multiplier effects in service and support industries that will generate another 157,711 jobs. The total number of employees is anticipated to be approximately 2.6 lakh thirty years from now. Associated with that employed population is a dependent population estimated at about 3.9 lakh. The total population in 2050 is estimated at approximately 6.5 lakh.

In terms of the phasing of the investment, employment generation, and urban growth, it is anticipated that approximately 2.5 lakh of the anticipated population growth will take place during Phase 1 (2021-2036), while the balance growth of 4 lakh population will take place over the 15 year period after that (Phase 2 = 2037-2051). The population growth for Phase I is derived considering the following factors:

- The growth in population is a function of growth in employment. Typically there is a lag between generation indirect employments after the direct employment is generated for the Greenfield projects. Thus, total most of the indirect employment potential will be generated in Phase II only
- Initially, the workforce moves without families because there is a lack of social infrastructure, security etc. Therefore, the Work Force Participation Rate is high, thereby the population will not grow to its full potential (from economic perspective).

## Amenities

The new amenities at Great Nicobar Island will cater to the resident population and the tourists and other visitors. The distinctive amenities, which separate Great Nicobar from other destinations, include the ecological amenities, such as access to the beach, sea, as well as to the rich and lush tropical forest. These amenities will consist of access facilities (roads, paths, marine transit) and vertical facilities (welcome centres, cultural centres, marinas, dive shacks, etc.) The urban centres of this proposed city will also include standard commercial amenities associated with a culturally and socially vibrant lifestyle, including restaurants, cafés, theatres, museums and other cultural and entertainment amenities. The urban centres will also include recreation amenities such as parks and sports fields.

### International Container Transshipment Terminal

The planning framework for the ICTT starts with demand projects, as shown below.

**Table 15: Preliminary Projections of Transshipment Port Traffic (million TEUs) -Excluding FTWZ**

|   | 2025       | 2030       | 2035       | 2040       | 2045        | 2050        | 2055        |
|---|------------|------------|------------|------------|-------------|-------------|-------------|
| India (East Coast)                          | 0.9        | 1.4        | 1.9        | 3.7        | 4.7         | 5.9         | 7.4         |
| Bangladesh                                  | 1.2        | 1.7        | 2.0        | 2.2        | 3.0         | 3.3         | 3.6         |
| Myanmar                                     | 0.5        | 0.8        | 1.0        | 1.2        | 1.8         | 2.0         | 2.3         |
| Sri Lanka<br>(Repositioning)                | 0.0        | 0.0        | 0.0        | 0.1        | 0.1         | 0.1         | 0.1         |
| Malaysia (Smaller<br>Ports & Repositioning) | 0.2        | 0.5        | 0.5        | 0.6        | 0.6         | 0.6         | 0.6         |
| Singapore<br>(Repositioning)                | 0.1        | 0.1        | 0.1        | 0.1        | 0.1         | 0.2         | 0.2         |
| <b>Total</b>                                | <b>3.0</b> | <b>4.5</b> | <b>5.6</b> | <b>7.8</b> | <b>10.2</b> | <b>12.0</b> | <b>14.2</b> |

The container volume of a Transshipment terminal is counted twice the trade volume. A container brought to Transshipment terminal large container carrier (mother vessels) is unloading in terminal. Unloaded container is again re-loaded into feeder vessels for final delivery. Hence, every container gets counted twice for single trade. The tariff of Transshipment terminal (THC – Terminal Handling Charges) is charged once. The projections for Great Nicobar Transshipment terminal in above table would have to be halved while calculating THC revenue from Transshipment terminal.

### Planning Criteria

- **Land Use**

Land use has been worked out to get the most out of the planned Transshipment terminal. As per the estimated traffic of 14.2 Million TEU's during Final Phase, the total reclaimed land (227 Ha) has been redistributed between berths (13%), container storage (70%), building & utilities (1%), road & pavements (9%) & Green areas (6%). Green zone has been assigned keeping in view of the diverse flora & fauna of the Nicobar region.

- **Harbour Planning Criteria**

#### Ship Sizes

Based on the market assessment detailed earlier in section above, the target cargo volumes and ship size adopted for planning of the container Transshipment port is presented in this section. Economy of scale effects in container shipping have led to a rapid increase in size for all types of vessels, from feeders to

the large inter-continental carriers. The trend towards larger ships has accelerated in recent years. The facilities planning shall be based on the maximum size of the container ship that would be visiting the port. For coal will be governing the harbour / channel depth for the proposed Project. Container ships are classified into six broad categories viz. Feeder, Feeder Max, Handy, Sub-Panamax, Panamax and Post-Panamax. The following table, which has been compiled through data from the Shipping Register of Lloyds Fair play database, gives a broad outline of the principal dimensions of the ships under the different categories. The Table 16 gives the dimensions of the smallest and the largest ship in each category. This will help in planning the layout of the container Transshipment port and the other facilities.

**Table 16: Dimensions of the Smallest and Largest Ship**

| Category             | Capacity (TEUs) | Dimensions(m) |      |              |
|----------------------|-----------------|---------------|------|--------------|
|                      |                 | LOA           | Beam | Loaded Draft |
| Feeder               | 1,000           | 175           | 27   | 10.0         |
| Feeder Max           | 2,000           | 210           | 32   | 12.0         |
| Handy to Sub-Panamax | 6,000           | 285           | 40   | 14.5         |
| >Panamax             | 8,000           | 335           | 42   | 14.5         |
| Post-Panamax         | 12,500          | 397           | 56   | 16.0         |
| Super Post-Panamax   | 18,000          | 400           | 59   | 16.0         |
|                      | 19,650          | 398           | 61.5 | 16.6         |

[Source: Lloyds Fair play Database]

- **Positioning of Facilities**

This section examines the layout of facilities for the proposed Project. Since the Coastline is exposed to open sea, breakwater(s) will be required to shelter the manoeuvring area and the berths. The orientation of the breakwater shall be such as to provide tranquillity at the berths (wave heights limited to 0.5 m) for round the year operations. The harbour should be sized adequately so as to provide adequate stopping distance and manoeuvring space for the largest ship to be handled at the port. The berths have to be planned and designed so that they can handle the largest and smallest ships visiting the port. Also, the berths should be located where the significant wave heights under operational conditions do not exceed 0.5 m.

- **Dredged Depths**

The dredged depths required in various parts of the harbour area are based on the design vessel sizes provided in the earlier section & are calculated as below adopting standard norms as shown in Table 17 below.

**Table 17: Dredged Depth Summary**

| Sr.No. | Location         | Depth      | Remarks   |
|--------|------------------|------------|---|
| 1      | Approach Channel | -19.8 m CD | 20% additional over the Loaded Draft of 16.5 m of the largest container vessel.   |
| 2      | Turning Basin    | -19.0 m CD | 15% additional over the Loaded Draft of 16.5 m of the largest container vessel. Similarly, the diameter of turning circle adopted is 800 m which is 2 times the LOA of largest vessel |

| Sr.No. | Location      | Depth      | Remarks   |
|--------|---------------|------------|---|
| 3      | Berth Pockets | -18.2 m CD | 10% additional over the Loaded Draft of 16.5 m of the largest container vessel. |

It needs to be ensured that the harbour area is located so that the capital dredging required to create the above water depths is optimal by way of eliminating the rock dredging to the extent possible as that can seriously impact project financials. On the other hand, adequate plans must be made for disposal of the dredged material, which will be salty and therefore cannot be disposed of on land.

- **Reclamation**

In view of the container handling practices the backup area should ideally be located immediately behind the berths for operational efficiency. Based on the project annual throughput of the terminal the requirement of the backup area has been arrived at. Based on the layout of the harbour and arrangement of the berths, the backup space shall be created either through site grading or through reclamation. The limit for land reclamation shall be determined through an initial economic assessment of the cut and fills balance of material, ease of dredging and environmental considerations rather than a requirement to provide additional site area.

## ■ ■ Greenfield International Airport

### ■ ■ Planning Criteria

The purpose of this section is to present the Planning Concepts for the proposed Great Nicobar Island Airport, in terms of both their vision and reasoning. Therefore, several basic assumptions have been established, which are intended to direct the future planning of the Airport. These assumptions are supported by the aviation activity forecasts and include a commitment for continued airport operation, which supports local and regional needs.

Airport planning and design primarily depends upon availability of land, its topography, orientation, accessibility, etc. Traffic is the other major factor that decides the size of runway, terminal building and other related infrastructure required for the proposed airport. Based on the site and traffic studies the planning and conceptual design of the proposed airport is discussed in this chapter.

### ■ ■ Planning Concept

Because all airport functions relate to and revolve around the basic runway/ taxiway layout, airside planning recommendations must first be carefully examined and evaluated. It is essential that the initial development of the Airport be commensurate with the anticipated needs and requirements of the airport users; however, the long-term expansion capabilities of the facility must also be considered and planned for to ensure the future success of the project. The main objective of the proposed project is to ensure design requirement to cater to the passenger demand.

As discussed, peak hour traffic of 4000 passengers both ways are considered for planning of airport. Accordingly, it is proposed that the airport shall be planned for the operations of Code F type of aircraft. After the commencement of operations from this airport, continual monitoring of the traffic shall be done to observe the actual traffic scenario after the opening of Great Nicobar Island Airport. Important planning parameters considered for planning of various facilities for the proposed Airport are discussed.

The recommended planning parameters are presented and discussed in this section. Where gaps exist, these recommended planning parameters are supplemented by other assumptions based on existing data/experience as well as other information/opinion that we have gathered.

The proposed site is for a Greenfield airport project. The following are design criteria for the proposed project air-side activities.

Key design and development reference standards that need to be complied with are as follows:

- Director General of Civil Aviation (DGCA) Aeronautical Information Circular No.22/1992 provides standards that must be complied with in order that an aerodrome shall receive an aerodrome licence.
- International Civil Aviation Organisation (ICAO) – International Standards and Recommended Practices, Aerodromes, Annex 14 to the Convention on International Civil Aviation. Volume 1 Aerodrome Design and Operations – Eighth Edition, 2018.
- ICAO Aerodrome Design Manual (Doc 9157).
- Airport Services Manual (Doc 9137).
- Conform to US National Fire Protection Association (NFPA) standard on Airport Terminal Buildings, Fuelling Ramp drainage and loading Walkways.
- Conform to best practice as set out in International Air Transport Association (IATA) Airport Development Reference Manual, 11th Edition.
- Conform to the National Building Code (NBC), which sets out safety and durability aspects to be incorporated into building structure.
- Conform to the relevant code for the specific aspect of development. The Indian Standard Codes are a comprehensive range of Standards and practices as per Bureau of Indian Standards, to be adopted in all aspects of design and construction in India.
- Meet all requirements of the statutory agencies, including Directorate General of Civil Aviation (DGCA), Bureau of Civil Aviation Security, Ministry of Défense, Customs and Immigration authorities, Ministry of Environment & Forests, Pollution Control Board.
- Adhere to all conditions, regulations, measures and all requirements of whatever kind imposed by local byelaws and other applicable Central, State and Local Government laws.

• **Airside Planning**

The aerodrome reference code based on ICAO Criteria remains 4F. Aerodrome Reference Code is defined by the characteristics of the aircraft intended to use the airport. The parameters to categorize the Aerodrome reference code by ICAO are mentioned in Table 18.

**Table 18: Aerodrome reference code by ICAO**

| Code No | Aero plane reference field                 | Code | Wingspan                        |
|---------|--|------|---------------------------------|
| 1       | Less than 800m                             | A    | Up to and not including 15m     |
| 2       | 800m up to 1200m but not including 1200m   | B    | 15m up to and not including 24m |
| 3       | 1200m up to 18000m but not including 1800m | C    | 24m up to and not including 36m |
| 4       | Over 1800m                                 | D    | 36m up to and not including 52m |
| 5       | -  | E    | 52m up to and not including 65m |
| 6       | -  | F    | 65m up to and not including 80m |

Source: ICAO Annex 14 (Eighth Edition July 2018)

The anticipated fleet is tabulated in Table-19.

**Table 19: Fleet Mix**

| Aircraft Type                     | ICAO CODE | Wingspan (m) | Overall Length (m) | Tail height(m) | Forecast Fleet mix (%) |
|-----------------------------------|-----------|--------------|--------------------|----------------|------------------------|
| A380-800                          | F         | 79.75        | 72.73              | 24.10          | 2%                     |
| B747-400                          | E         | 64.94        | 70.67              | 19.51          |                        |
| B777-F                            | E         | 64.80        | 63.73              | 18.85          |                        |
| B787-800                          | E         | 60.12        | 56.72              | 16.92          |                        |
| A330-200                          | E         | 60.30        | 58.37              | 18.23          |                        |
| B 767                             | D         | 51.9         | 61.4               | 16.8           | 5%                     |
| A 310                             | D         | 43.9         | 46.66              | 15.8           |                        |
| B737-800                          | C         | 35.79        | 39.47              | 12.55          | 90%                    |
| B737-900ER                        | C         | 34.32        | 42.11              | 12.55          |                        |
| A321                              | C         | 34.15        | 44.50              | 12.10          |                        |
| A320                              | C         | 34.10        | 37.57              | 11.76          |                        |
| Bombardier 400                    | C         | 28.40        | 32.81              | 8.34           |                        |
| Rotary wing aircraft & sea planes |           |              |                    |                | 3%                     |

- **Aircraft Wingspan**

As described above, ICAO Annex 14 groups aircraft by wingspan and outer main wheel span. In practice, the aircraft manufacturers design aircraft within these groupings. Airport aprons have typically been planned for a maximum aircraft wingspan based on these groups rather than being based on a particular aircraft with its defined wingspan.

In the 1990's, prior to adoption by ICAO of a Code F group, the largest group was Code E. Prior to development of the B747-400, Code E was for an aircraft with maximum wingspan up to but not including 60m. Annex 14 was subsequently amended to provide Code E with up to but not including 65m wingspan aircraft. Many airports around the world were obliged to create greater spacing between Code E stands to accommodate these larger wingspan aircraft and runway to taxiway and taxiway to taxiway/taxi lane separations were also increased. However, since the adoption of Code F group, it is expected that there will be no further amendment to the current Code E group requirements as aircraft with larger wingspans will be classified as Code F.

- **Aircraft Length**

The Annex 14 Code Letter provides aircraft classification with reference to wingspan and wheel track width only. The other key dimension required for planning apron areas is aircraft length. The aircraft length to be adopted for planning purposes is based on the lengths of current and proposed aircraft types and a judgement as to what may be the longest aircraft length in the future. Most aircraft types have been stretched during their life from the initial version introduced into service to later higher capacity versions of the same aircraft.

Figure-26 illustrates stretches that have been designed for a range of common aircraft types in service worldwide.



Figure 26: Range of common aircraft types in service worldwide

Table-20 summarizes the stretches and indicates that, on average, the length of aircraft has been stretched by some 19.5% throughout their life, within a range of 7.8% to 27.3%.

**Table 20 Summarisings the Stretches**

| ICAO Code Letter       | Initial Aircraft | Overall Length(m) | Derivative Aircraft | Overall Length | Increase in length (m) | % increase in length |
|------------------------|------------------|-------------------|---------------------|----------------|------------------------|----------------------|
| C                      | A320             | 37.57             | A321                | 44.50          | 6.94                   | 18.5                 |
| C                      | B737-200         | 32.92             | B737-900            | 41.91          | 8.99                   | 27.3                 |
| Average Code C - 22.9  |                  |                   |                     |                |                        |                      |
| D                      | B757-200         | 47.33             | B757-300            | 54.08          | 6.75                   | 14.3                 |
| D                      | B767-200         | 48.51             | B767-400            | 61.37          | 12.86                  | 26.5                 |
| Average Code D – 20.4m |                  |                   |                     |                |                        |                      |
| E                      | A340-200         | 53.61             | A340-600            | 74.90          | 15.48                  | 26.1                 |
| E                      | 777-200          | 63.73             | B777-300            | 73.90          | 10.17                  | 16.0                 |
| E                      | B747-100         | 70.66             | B747-8              | 76.30          | 5.64                   | 7.8                  |
| Average Code E – 16.6  |                  |                   |                     |                |                        |                      |

It can, therefore, be expected that in the future, when airlines require aircraft with greater capacity than current types, aircraft that are significantly longer than current types will be introduced into service. Based on the above analysis, for Code C aircraft approaching 46m and Code E aircraft approaching 80m in length could reasonably be expected.

Currently, no aircraft in operation and in development has an overall length larger than 80m. Aircraft models in development with an overall length larger than 80m are very likely to be classified as Code F aircraft.

• **Recommended Design Aircraft Envelopes**

Based on industry trends and the above analysis, the following recommendations are made with respect to the critical aircraft to be adopted for apron and taxiway / taxi lane separation planning as shown in Table 21.

**Table 21: Critical design aircraft envelopes**

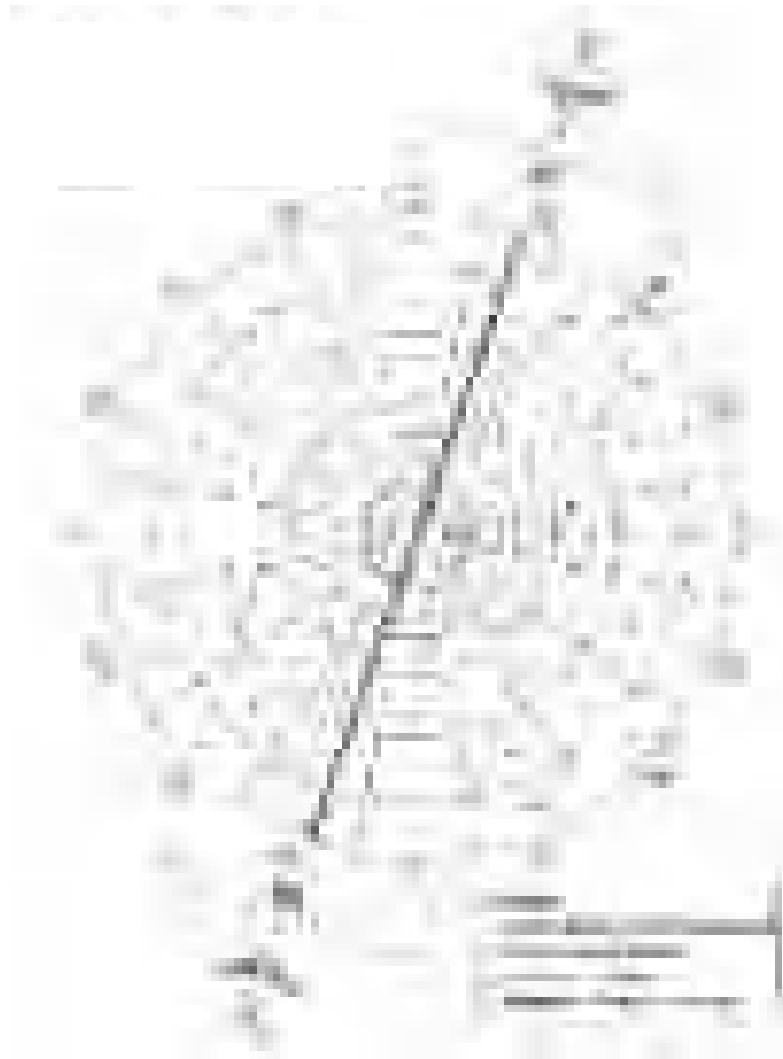
| ICAO Code Letter | Wingspan (m) |                                  | Length (m)  |                               |
|------------------|--------------|----------------------------------|-------------|-------------------------------|
|                  | Recommended  | Critical Aircraft                | Recommended | Critical Aircraft             |
| E                | 65           | B747-400 <sup>1</sup><br>(64.9m) | 80          | A340-600 <sup>2</sup> (75.4m) |
| C                | 36           | B737-800w<br>(35.8m)             | 50          | A321 <sup>3</sup><br>(44.5m)  |

Remarks:

- B747-400 has the largest wingspan among all Code E aircraft, which approaches the maximum limit as required for ICAO Code E group.
- A340-600 has the longest overall length among all Code E aircraft. Recommended wingspan has made reservation for future Code E aircraft with longer overall length.
- B727-200 is the longest Code C aircraft that was manufactured, with an overall length of 46.68m. It has already been discontinued and retired from operation. Recommended wingspan has made reservation for future Code C aircraft with longer overall length.

• **Runway Orientation**

Based on analysis of wind data as provided in the WAPCOS report which has considered 20 years of wind data, the predominant wind direction is such that the runway must be oriented in first and third quadrant for 95% availability. As per analysis of the wind data, the runway availability for this orientation is 98.4%. The Benchmarking with the other airfields in the region such as 1) Campbell Bay in the island of Great Nicobar, 2) Car Nicobar and 3) Port Blair; all these runways are oriented in the first and third quadrant is shown in Figure-27.



1) Campbell Bay - RWY 05-23      2) Car Nicobar – RWY 02-20 3) Port Blair – RWY 04-22

Figure 27: Benchmarking with the other airfields in the region such as 1) Campbell Bay in the island of Great Nicobar, 2) Car Nicobar and 3) Port Blair; all these runways are oriented in the first and third quadrant.

The wind data noted from the WAPCOS report, Sep 2020 is reproduced in Table-22.

**Table 22: Wind Direction**

| SPEED<br>(kmph) | Percentage Number of Days Wind from |      |      |      |      |      |      |      |
|-----------------|-------------------------------------|------|------|------|------|------|------|------|
|                 | N                                   | NE   | E    | SE   | S    | SW   | W    | NW   |
| 0               | 0.01                                | 0.03 | 0.00 | 0.03 | 0.05 | 0.02 | 0.02 | 0.02 |
| 0-5             | 0.54                                | 0.99 | 0.14 | 0.47 | 0.29 | 0.62 | 0.39 | 0.96 |

| SPEED<br>(kmph) | Percentage Number of Days Wind from |       |      |      |      |       |      |      |
|-----------------|-------------------------------------|-------|------|------|------|-------|------|------|
|                 | N                                   | NE    | E    | SE   | S    | SW    | W    | NW   |
| 6-12            | 2.17                                | 4.23  | 0.52 | 1.16 | 0.51 | 1.97  | 0.92 | 3.51 |
| 13-19           | 4.06                                | 10.04 | 0.76 | 1.40 | 0.86 | 3.58  | 0.78 | 2.86 |
| 20-25           | 3.89                                | 12.28 | 1.04 | 1.40 | 1.36 | 10.01 | 0.63 | 0.66 |
| 26-38           | 0.11                                | 1.71  | 0.40 | 0.72 | 1.38 | 13.59 | 0.11 | 0.05 |
| 39-50           | 0.01                                | 0.10  | 0.05 | 0.18 | 0.38 | 5.61  | 0.02 | 0.00 |
| 51-61           | 0.00                                | 0.00  | 0.00 | 0.03 | 0.01 | 0.33  | 0.00 | 0.00 |
| > 61            | 0.00                                | 0.00  | 0.00 | 0.00 | 0.00 | 0.00  | 0.00 | 0.00 |

Source: Adapted from WAPCOS Report dated Sep 2020

It can be observed from the Table above that the wind is predominantly from South-West, North-East direction.

The wind rose diagrams from the nearest observatory is presented in Figure 28.



Figure 28: Windrose

Diagrams

- **Obstacle Limitation Study**

Obstacle Limitation Surfaces

Guidance on the characteristics of the different obstacle limitation surfaces is provided in ICAO Annex 14 as well as the Gazette of India G.S.R. 751 (E).

The Take-off Climb and Approach Surfaces utilize the dimensions and slopes shown in Table-23. As can be seen from these tables both ICAO and G.S.R. 751 (E) requirements are identical. The approach surface dimensions and slopes is given in Table-24.

**Table 23: Take-off Climb Surface Dimensions and Slopes**

| Measurement              | ICAO Annex 14 Table 4-2 | GSR 751 (E) Table 2.1 |
|--------------------------|-------------------------|-----------------------|
| Length of inner edge     | 180m                    | 180m                  |
| Distance from runway end | 60m                     | 60m                   |
| Divergence each side     | 12.5%                   | 12.5%                 |
| Final Width              | 1,200m                  | 1,200m                |
|                          | 1,800m                  | 1,800m                |
| Length                   | 15,000m                 | 15,000m               |
| Slope                    | 2%                      | 2%                    |

**Table 24: Approach Surface Dimensions and Slopes**

| Surface          | Measurement             | ICAO ANNEX 14<br>TABLE 4-1 | GSR 751 (E) |      |
|------------------|-------------------------|----------------------------|-------------|------|
| Conical          | Slope                   | 5%                         | 5%          |      |
| Inner Horizontal | Locus from strip edge   | 4,000m                     | 4,000m      |      |
| Approach         | Length of inner edge    | 300m                       | 300m        |      |
|                  | Distance from threshold | 60m                        | 60m         |      |
|                  | Divergence each side    | 15%                        | 15%         |      |
|                  | Slope                   | First Section<br>(3,000m)  | 2%          | 2%   |
|                  |                         | Second Section<br>(3,800m) | 2.5%        | 2.5% |
| Total Length     | 15,000m                 | 15,000m                    |             |      |
| Transitional     | Slope                   | 14.3% (1:7)                | 14.3% (1:7) |      |

For a precision approach runway, the obstacle limitation surfaces as listed in the table below are established according to Annex 14. Fixed objects shall not be permitted above the inner approach, inner transitional and balked landing surfaces. Annex 14 further recommends that obstacles penetrating other surfaces should, as far as practical, be removed, except when after an aeronautical study it is determined that the object would not affect the safety or the regularity of aircraft operations. The system of obstacle limitation surfaces for the proposed runway has been established. The layout of the composite inner horizontal surface is designed according to ICAO, Airport Services Manual, and Part 6 - Control of Obstacles. The total area of land to be acquired for the airport is 1039 Ha. (Includes reclamation area of 194 ha) A hill of elevation varying from 200-225m is penetrating the Inner Horizontal Surface (IHS). This challenge can be mitigated by designing suitable flight procedures and bringing in changes to the profile of the hill features.

Study of Obstacles:

As per Annexure 14 of ICAO, the following obstacle limitation surfaces shall be established for a non-precision approach runway:

- Conical surface;
- Inner horizontal surface;
- Approach surface;
- Take-off Surfaces and;
- Transitional surfaces.

The above obstacle limitation surfaces are proposed to be studied as per requirements of Code 4F aircraft which is proposed to be operated from this airport accordingly an obstacle limitation plan will be prepared in detailed design stage. The runway alignment 02/20 was found most suitable from wind direction, obstruction management, land economics and safety standpoint.

#### Runway Length

The development of Great Nicobar Island Airport will include a single Code 4F runway. The runway length requirement is basically dependent on the critical/design aircraft likely to operate at the airport. After a range of aircraft were analysed for their landing and take-off performance requirements, based on the assumed temperature and elevation characteristics of the proposed new airport at Great Nicobar Island, a runway length of 4000 m is recommended. The details of runway dimensions are presented in Table-25.

**Table 25: Runway Dimensions**

| Item                          | Dimension   |
|-------------------------------|-------------|
| Length                        | 4000m       |
| Width                         | 45m         |
| Isolation Bay                 | 112m x90 m  |
| Runway End Safety Area (RESA) | 240m x 150m |
| Runway overrun                | 60m x 60m   |

#### Runway Strips & Safety Areas

Runway End Safety Areas (RESA) is provided at each end of the runway strips. The area extends 240m from the strip and has a width of 150m on each side of the extended centreline of the runway.

Runway overrun are along-with the strips at both ends in between strips & RESA, with length of 60m & width of 60m meter.

#### Runway Geometry

The runway is planned for Code F type aircrafts. The proposed width of the runway is 45 m and length of 4000 m leaving a space of approximately 900 m on both runways ends for the approach lighting. The

orientation of the runway for airport is 02-20. The permissible values of slopes as per ICAO are given in Table -26:

**Table 26: Permissible Values of Slopes As per ICAO**

| Name          | Slope        | Permissible  |
|---------------|--------------|--|
| Runway        | Longitudinal | 1.25% (Max.) with Max. slope of 0.8% in the last quarters on both ends and overall slope not to exceed 1.00% |
|               | Transverse   | 1.50% (Max.) 1.00% (Min.)  |
| Runway Strip  | Longitudinal | 1.50% (Max.)   |
|               | Transverse   | 2.50% (Max.)   |
| Taxiway       | Longitudinal | 1.50% (Max.)   |
|               | Transverse   | 1.50% (Max.)   |
| Taxiway Strip | Transverse   | 2.50% (Max. Downward)  |
|               |              | 0.50% (Max. Upward)  |
| Apron         | Longitudinal | 1.00% (Max.)   |
|               | Transverse   | 1.00% (Max.)   |

Source: ICAO Annex 14

## Area Development and Township Project

### Land Use Planning

The land uses have been defined by 'land use categories' that each combine multiple uses. The objective is to create vibrant neighbourhoods and destinations that combine commercial, residential, institutional, and other uses in compact clusters of development that are accessible by foot and offer a broad range of amenities to residents and tourists alike.

Ecotourism is a future pillar of the Great Nicobar economy. Tourism land and facilities are not geographically isolated — as seen in many beach resorts where resorts are developed with specialized tourism zones. Rather, tourism facilities (hotels, resorts, dining, shopping, and entertainment) are to be developed within the urban centres up and down the coast. Often, they will be located on the seaside, to facilitate access to the beach. Ecotourism resources are marine and terrestrial; they include the beaches, the sea, on one hand, and the interior tropical forest on the other. These two very distinct areas will be opened up to tourists and residents in an environmentally sensitive manner that will help conserve the integrity of these world class resources.

### Concept Land Use Plan

The major urban centre is located at Campbell Bay. Starting at Anderson Bay, secondary urban centres are proposed at each of the five largest bays along the coast to Gandhi Nagar. The urban centres are linked together by a major arterial road that integrates a mass transit solution (either light rail or Bus Rapid Transit (BRT), to be determined at a later date. The urban centres are anchored by the transit stations and laid out using Transit Oriented Development (TOD) principles and layouts. There are mixed use commercial areas around many of the stations. Beyond those and moving towards the shoreline, there are residential mixed-use areas and tourism and hospitality areas that include hotels, food and beverage establishments, housing entertainment, and social infrastructure, as well as general public open space.

To the west of the main road in the mountainous, forested areas, the plan calls for Ecotourism uses (described above), extremely low-density residential development (minimum plot size 10 ha.), and the occasional institutional campus (higher education establishment, research facility, etc.) which can be built on some of the rare relatively flat areas found within the mountains.

The multimodal transport hub, including the port and the airport, is centred at Galathea Bay and Shastri Nagar respectively. All mixed use and tourism development are on the east of this bay. To the west, is a logistics zone and some land zoned for institutional campuses also part of the development area of proposed Township.



*Figure 29: Concept Land use Plan*

The approach to management of the coastal areas is based on the Island Coastal Regulation Zone provisions. Settlement areas and infrastructure facilities have been located away from the most ecologically sensitive areas. (The environmental sensitivity of different siting proposals for the port and airport are discussed in detail in Section 3 of this report.) Setbacks and use restrictions will be defined in the master plan for inhabited coastal areas. In keeping with the requirements of ICRZ IIIA land, the first 150 meters of land above the high tide line will be a No Development Zone. These areas will be preserved as natural areas such as beaches, mangroves, and or coconut plantations. These areas will also serve public open space needs of residents and tourists. In the next 250 meter wide area, which includes ICRZ IIIB land and some additional inland areas, the 'Coastal Tourism' land use category encompasses a number of low impact uses and activities that can take place along the shoreline, while avoiding major construction along the beach.

Similarly, the 'Ecotourism' land use category in the forested, hilly areas to the west of the main settlement areas will allow tourists to enter the tropical forest, learn about the natural environment and the indigenous people that inhabit it, and experience the forest by walking through it. Major construction projects will not be permitted in these forested areas.

The land use categories are defined in **Table-27**.

**Table 27: Land Use Categories**

| Land Use Category                      | Permitted Land Uses   | Description   |
|--|---|---|
| <b>COMMERCIAL</b>                      |   |   |
| Commercial Mixed-Use                   | Office<br>Retail<br>Hotel<br>Food & beverage<br>Entertainment<br>Institutional<br>Multifamily residential           | Compact, walkable, medium-density mixed-use development located in city centre or near transit stations. Long list of by-right uses; some conditional uses can also be identified. High quality public realm  |
| Commercial-Office                      | Office  | -   |
| Tourism and Hospitality                | Hotel<br>Food & beverage<br>Entertainment<br>Retail<br>Mice (Convention Centres, etc.)                              | Walkable medium- to low-density development at the edge of town centres, with access to the sea and the forest.   |
| <b>RESIDENTIAL</b>                     |   |   |
| Residential Mixed-Use (Medium Density) | Multifamily residential<br>Row housing<br>Duplexes/Triplexes<br>Retail<br>Hotel<br>Food & Beverage<br>Institutional | Compact, walkable, medium-density residential development located near transit stations or adjacent to Commercial Mixed-Use districts. Multiple housing types permitted. Neighbourhood-serving commercial development also permitted. High quality public realm |
| Residential (Medium Density)           | Multifamily residential<br>Row housing<br>Duplexes/Triplexes  | Compact, walkable, medium-density residential development located near transit stations or adjacent to Commercial Mixed-  |

| Land Category             | Use    | Permitted Land Uses  | Description   |
|---------------------------|--------|--|---|
|                           |        |  | Use districts. Multiple housing types permitted.  |
| Residential (Low Density) |        | Single-family housing  | Single-family houses on large plots (>10 ha) in forested areas. Light touch, minimal impact on forest. No clearing allowed, except at residence. Serves as buffer between urbanized areas (mostly on revenue land) and forest outside Project boundary. |
| <b>INSTITUTIONAL</b>      |        |  |   |
| Urban Infrastructure      | Social | School<br>Health facility<br>Religious   | Integrated into new urban communities.  |
| Institutional-Campus      |        | College<br>Research centre<br>Health facility  | Stand-alone campus built on relatively flat land within forested areas. Light touch, minimal impact on forest. No clearing allowed, except at campus site. Ceiling on % of total area allowed to be developed as campus                                 |
| <b>INDUSTRIAL</b>         |        |  |   |
| Industrial                |        | Light manufacturing  | Industrial estates and warehouses with ready access to power, port and airport. No residential or commercial development.   |
| <b>TRANSPORT</b>          |        |  |   |
| Ports and Marine          |        | Port<br>Transshipment hub<br>Container storage<br>Administration<br>Jetty<br>Marina      | Marine facilities for Transshipment and passenger traffic and leisure.  |
| Aviation                  |        | Airport– Aeronautical<br>Airport– Non-Aeronautical<br>Cargo<br>Air catering<br>Fuel farm | Airport and associated facilities.  |
| Transit Station           |        | Landside transit station<br>Seaside transit station                                      | Does not include right-of-way; only facilities (stations).  |
| Logistics                 |        | Port allied activities, light industrial, go down, etc.                                  |   |
| Roads                     |        | Road<br>Bus Rapid Transit  | -   |
| Railway                   |        | Light rail<br>Heavy rail   | -   |
| <b>UTILITIES</b>          |        |  |   |
| Water Supply              |        | Water treatment plant<br>Pump station  | Facilities required for water supply treatment and distribution system.   |
| Wastewater                |        | Wastewater treatment plant<br>Pump station   | Facilities required for wastewater collection and treatment system.   |
| Energy                    |        | Electrical power plant<br>District cooling station<br>Pump station                       | Facilities required for electrical power and district cooling systems.  |
| <b>OPEN SPACE</b>         |        |  |   |
| Park                      |        | Regional park  | Natural parks at all scales.  |

| Land Category                  | Use | Permitted Land Uses                                | Description  |
|--------------------------------|-----|--|--|
|                                |     | Nature reserves<br>Local park<br>Playground        |  |
| Plaza                          |     | Plaza<br>Square                                    | Hardscape public open space.   |
| Sports and Recreational Greens |     | Sports fields / facilities                         | Recreational facilities.   |
| Ecotourism                     |     | Museum<br>Cultural Centre<br>Camping               | Vertical development limited to Welcome Centre, museum or other facility.<br>Vehicular access to facility.<br>Walking paths in forest. |
| Coastal tourism                |     | Sports<br>Recreation<br>Low-impact hotel<br>Marina | -  |

**Table 28: Land Use Area Breakdown**

| LANDUSE AREA CHART- GNI                         |                |                |
|---|----------------|----------------|
| Land Use Category                               | Area (sq.km.)  | Percentage (%) |
| <b>RESIDENTIAL</b>                              | <b>36.66</b>   | <b>22.07</b>   |
| Residential Mixed-Use (Medium density)          | 29.1           |                |
| Residential (Medium Density)                    | 2.98           |                |
| Residential Low Density                         | 4.58           |                |
| <b>COMMERCIAL</b>                               | <b>6.44</b>    | <b>3.88</b>    |
| Commercial Mixed-Use                            | 4.33           |                |
| Commercial Office                               | 0.41           |                |
| Tourism and Hospitality                         | 1.70           |                |
| <b>INSTITUTIONAL</b>                            | <b>15.14</b>   | <b>9.11</b>    |
| Institutional Campus                            | 15.14          |                |
| <b>INDUSTRIAL</b>                               | <b>0.31</b>    | <b>0.19</b>    |
| Industrial                                      | 0.31           |                |
| <b>TRANSPORT</b>                                | <b>24.01</b>   | <b>14.46</b>   |
| Ports and Marine                                | 7.66           |                |
| Aviation  | 8.45           |                |
| Logistics                                       | 7.90           |                |
| <b>UTILITIES</b>                                | <b>1.2025</b>  | <b>0.72</b>    |
| Power Plant                                     | 0.39           |                |
| Other Utilities (includes Solid Waste disposal) | 0.81           |                |
| <b>OPEN SPACE</b>                               | <b>73.0575</b> | <b>43.98</b>   |
| Greens  | 9.61           |                |
| Eco-Tourism                                     | 40.81          |                |
| Coastal tourism                                 | 22.64          |                |
| <b>DEFENCE AREA</b>                             | <b>9.28</b>    | <b>5.59</b>    |

|                           |               |               |
|---------------------------|---------------|---------------|
| <b>TOTAL</b>              | <b>166.10</b> | <b>100.00</b> |
| <b>ONLY TOWNSHIP AREA</b> | <b>149.60</b> |               |
| <b>RECLAMATION AREA</b>   | <b>4.21</b>   |               |
| Reclamation for Airport   | 1.94          |               |
| Reclamation for Port      | 2.27          |               |

### ■ ■ Environmental Carrying Capacity

This carrying capacity framework has been developed to assess the impact of future development and tourism on Great Nicobar on the island's valuable natural and human assets.<sup>2</sup> This framework is meant to provide a structure to determine maximum carrying capacity on GNI in order to avoid degradation of the assets resulting from excessive urban development or tourism. The framework is based on three primary considerations: environmental conservation, socio-cultural preservation, and the legal and policy considerations for development and tourism. Several Key Performance Indicators (KPIs) have been developed to guide development and tourism and are meant to help arrive at a maximum carrying capacity for population (year-round) and tourism (seasonal).

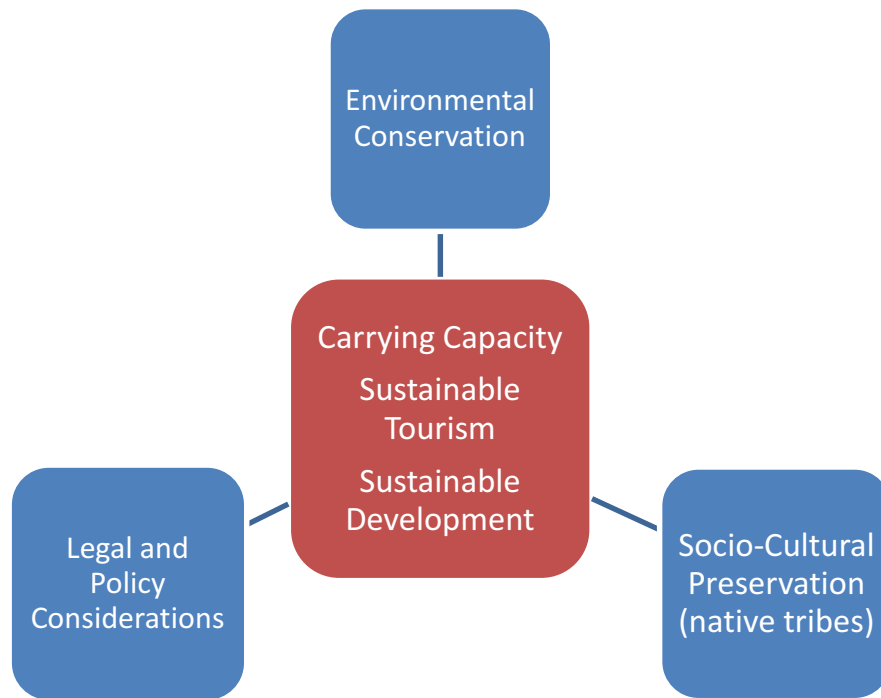


Figure 30: Factor contributing to Sustainable Development within GNI's Carrying Capacity

**Environmental Conservation** — Great Nicobar Island is infused with natural beauty and home to a variety of animal species that all contribute to its unique ecosystem (see Section 2). Some areas will remain off-limits to development and tourism, while other areas will be utilized as building blocks for development and tourism. The development of these areas and the influx of residents and visitors as a result of urban development and tourism should not generate undue negative environmental impacts.

**Socio-Cultural Preservation** — The Shompen and Nicobarese tribes are native to Great Nicobar Island. GNI has a tribal reserve with both core and buffer areas. The aboriginal tribes will have to option to

<sup>2</sup> All built and natural resources have a carrying capacity. When that capacity is exceeded, the resource fails to function or thrive as intended or hoped. Once their carrying capacity is exceeded, it may be impossible to restore.

maintain their separate existence in their natural habitat, as is their current preference. Furthermore, tourism and development should not generate undue negative impacts on the existing tribes, nor should interaction initiated unilaterally by tourists or residents be permitted. The tribal reserves, including their core and buffer areas, will remain largely for the exclusive use of the native tribes.

**Legal and Policy Considerations** — As a Union Territory, Andaman & Nicobar Islands has created a legal framework to regulate urban development, coastal zone management, tourism and infrastructure. Robust laws regulate the island's natural environment and restrict development in most areas of the island. GNI has several protected areas, including the GNI Biosphere Reserve (GNBR), which covers a majority of the Island and includes two national parks, Campbell Bay National Park and Galathea National Park, as well as two wildlife sanctuaries. Native tribal laws and policies like the Shompen Policy (2015) and PAT Regulation 1956 seek to preserve and protect the lifestyle and cultural heritage of the tribals.

### **Outcomes to Be Avoided**

Managing development and tourism on the island in a way that is consistent with Great Nicobar Island's environment carrying capacity is about avoid long-term impacts that would erode the value of the ecological and socio-cultural assets on the island. An illustrative list of environmental and socio-economic impacts that should be avoided is presented below with a view to facilitating evaluation of the carrying capacity framework and methodology, including the definition of Key Performance Indicators in the following sub-section.

- Depletion of water resources—Surface water will be harvested and treated for distribution to residents and visitors. The amount of water generated, re-used and reintroduced into the environment should be consistent with the ability of the hydrological system to generate more surface water.
- Loss of tropical forest—while some development of urban uses in currently forested areas is probably necessary for urban development, the proportion of that development should not be so high as to compromise the quality of the remaining forest or the ability of the forest (and more generally, the Biosphere Reserve) to generate positive environmental impacts for the planet.
- Contamination of surface or ground water — Ground water supplies are limited. Most of the rivers are rain-fed. Nevertheless, waste water and solid waste must be managed so that naturally occurring water supplies are not unduly damaged.
- Degradation of the natural habitat in the Tribal Reserve Areas —This could make it harder from the aboriginal peoples to gather and hunt food the forest and the sea.
- Intrusion of outsiders into Shompen and Nicobarese areas — such intrusions, which are known to be unwanted by the Shompen, could cause harm to the aboriginals and exacerbate their quality of life.

### **Key Performance Indicators of Carrying Capacity**

Given the unique biodiversity and ecological fragility of GNI, the major objective of forest and ecosystem management should be biodiversity conservation and protection of the habitat of the native tribal people living in the forests. The carrying capacity for GNI shall be determined using a threshold approach. Development scenarios and tourism projections should be measured against the KPIs found in the table below. Development and tourism are encouraged up until the point where they no longer meet environmental conservation KPIs, cultural preservation KPIs, and/or comply with applicable laws and policies. Monitoring measures and enforcement of KPIs are included in the table below.

**Table 29: Key Performance Indicators for Managing Tourism & Urban Development**

| <b>Dimension / Objective</b>   | <b>Key Performance Indicator</b>  | <b>Measurement / Calculation</b>   |
|--|---|--|
| <b>OVERARCHING*</b>  |   |  |
| Economic impact of tourism   | Tourism output<br>Tourism employment  | Island-wide cumulative GDP of tourism activity<br>Tourism GDP as % total island-wide GDP   |
| <b>NATURAL ENVIRONMENT</b>   |   |  |
| Development does not generate undue negative environmental or socio-cultural impacts             | Development containment   | % of new (re)development land within area zoned for development, including coastal tourism and ecotourism zones  |
|  | Development sustainability  | % of new development land area compliant with sustainable development standards  |
|  | Surface water quality   | % change in contaminants in untreated drinking water supplies (river water)  |
| Tourism does not generate undue negative environmental or socio-cultural impacts                 | Health of coral reefs   | Average rating of reef quality along east coast<br>Change in average rating of reef quality along east coast   |
|  | Endangered species  | Number of endangered species<br>Average annual % change in population of endangered species  |
|  | Surface water level   | % change in surface water level of Galathea River<br>% change in surface water level of Galathea River   |
| <b>SOCIO-CULTURAL</b>  |   |  |
| Protect native tribes (Shompen and Nicobarese) from excessive exposure to mainlanders / tourists | Incursions into Tribal Reserve land   | # of unauthorized incursions/year<br>% change in unauthorized incursions/year  |
|  | Incidence of infectious disease   | # of Shompens that contracted infectious diseases due to interaction with outsiders<br>% change in # of Shompens that contracted infectious diseases due to interaction with outsiders |
|  | Access to food  | % change within Tribal Reserves of quantity of animals and plants that are routinely gathered/hunted by Shompens   |
| <b>LEGAL / POLICY</b>  |   |  |
| Comply with land development relevant laws and policies  | Use of land and development complies with section 40 of the Andaman and Nicobar Islands Land Revenue and Land Reforms Regulations, 1966 | Ha of conforming land divided by Ha of total urbanized land  |
| Comply with environmental protection laws and policies   | Development and tourism compliance with Forest (Conservation) Act 1980; Environment (Protection) Act of 1986                            | Use standard monitoring data collected by MoEF   |

| Dimension / Objective                                   | Key Performance Indicator                                   | Measurement / Calculation   |
|---|---|---|
| Comply with native peoples protection laws and policies | Development and tourism compliance with Shompen Policy 2015 | Number of uncompliant projects per year (including interactions, preservation, and use of protected land) |

\*Measuring the economic value of these sectors is important for evaluating any negative socio cultural and environmental impacts.

## ❏ Power Plant

The electrical load demand is the basic requirement for Design and Planning of an Electrical Network. As it has direct bearing on the system. Under assessed load demand results into an inadequate Electrical System, leading to poor Voltages to the consumers and more losses of energy in the Electrical Network. Over assessed load demand will require more capital returns, as the network will be large for load demand considerations. More overload and underload running of electrical equipment has bearing on losses / efficiency / financial viability. On the other hand, it is also difficult to have exact load demand for mixed type of development at planning stage.

- **Load Norms**

For Power demand calculation and selection of voltage level for proposed development, following references are considered.

- Utility norms / standards / Guidelines
- Past Project Reference
- ECBC (Light Power Method) etc.
- CEA guideline for Manual on Transmission Planning Criteria

- **Broad Power Demand**

Power demand has been assumed for all types of industries, non-industrial buildings (residential, commercial & Institutional building), industrial amenities and common utilities (water supply, STP, CETP, street lighting, ICT). Diversity factor (demand factor) has been applied by considering the type of industry, commercial & residential buildings, operating hours and group of end users.

The broad design basis for the demand factors considered, kVA/Acre value for each type of land use. Since, the total loads shall not be occurring at the same time, a diversity factor is to be considered for different voltage levels.

Based on upon load norms and as per our past projects' references, the proposed broad level power demand is approx. 450 MVA.

- **Selection of Voltage Level**

In order to handle this huge power, different types of voltage will be the required which is also in line with the "CEA guideline for Manual on Transmission Planning Criteria" recommendations. Also establishing the infrastructure with different voltage level can facilitate in integrating with the future upcoming and planned substations. A CEA guideline recommendation is shown in Table-30 for reference:

**Table 30: CEA Recommendation**

For other voltage levels following capacities shall be considered in designing. The electricity supply code recommendation is given in Table-31.

**Table 31: Electricity supply code Recommendation**

| Connected Load      | Nominal Voltage level |
|---------------------|-----------------------|
| 80kW / 100kVA       | 415Volt               |
| 101kVA to 4000kVA   | 11kV                  |
| 4001kVA to 20000kVA | 33kV                  |
| 20001kVA to 150 MVA | 132kV                 |
| Above 150 MVA       | 220kV                 |

Final voltage level selection shall be depending upon as per power generation, transmission and distribution of power and it shall be finalized after detailed design.

### ■ ■ Identification of Power Source

Because the entire load is not concentrated in one sector and is distributed over a large area, it is prudent to identify multiple source points. Existing Generation and power houses are also considered.

Due to the geographical and topographical peculiarities of these islands, including separation by sea over great distances, there is no single power grid for all the electrified islands and instead, separate power houses cater independently to the power requirements of separate Islands.

Electricity Department of Andaman and Nicobar (EDA&N) Islands is responsible for managing the generation sector. Since the islands are isolated from the mainland of India and are not connected with each other, the generation in the individual island is managed by standalone generating systems with associated distribution system. Due to the large distances from mainland, the islands are expected to depend on these isolated systems.

The Electricity Department is operating power generation, transmission and distribution systems & networks in these islands for providing electric power supply to the general public and various categories of consumers in different part of these islands. The Electricity Department also functions as a Nodal Agency for implementing Renewable Energy Programmes and schemes and Integrated Rural Energy Programmes of the Ministry of Non-Conventional Energy Sources in these islands.

The power generation in A&N Islands is through 53 Power Plants in 25 PHs in Nicobar District. Great Nicobar Island has an installed capacity of approx. 3 MW from 11 DG sets of capacity ranging from 12 kW to 800 kW. Most of the generation is from Diesel Generation units owned by the EDA&N. Petronet

LNG has proposed to install a 30 MW (expandable to 50 MW) LNG based generation plant in south Andaman Island in recent future to reduce the consumption of diesel in the island.

Some DG sets installed in the islands have either aged beyond rated life or have high specific fuel consumption. The units at Campbell bay have aged beyond 30 years.

## ■ ■ ■ **Substations and Distribution Network**

### ● **Proposed Power Distribution Network**

HV distribution system shall be designed as an economical and technically viable distribution system. Since the present HV system existing of project is overhead bare conductor, the same voltage level lines shall be maintained and shifted to underground cables. For each location, HV & LV cables shall be underground with HDPE duct with spare HV cables as radial feeders. In case of fault in any one feeder, the spare cable shall be able to take the full load of those locations.

11kV supply from 33/11kV Substations shall be distributed in the following way:

- The proposed Spare feeder concept is a significant betterment over the outdated and inefficient distribution concept. The spare feeder concept will provide improved reliability and redundancy to the entire site distribution network.
- All HV power distribution up to distribution transformer and LT distribution system shall be directly buried underground system with HDPE duct.

Main receiving substation (MRSS) shall comprise of 400kV / 220kV / 132kV/110 kV substation. Based on load demand of various clusters and distribution network length. The voltage shall be stepped down to 66kV or 33kV or 11 KV by using power transformers.

Further distribution to project site shall be through various Zonal (clustered) substations which may be of 66/11kV or 33/11kV. With project advancement the distribution shall be underground. Switching station, ring main units (RMU), package substations shall be proposed wherever required. The Substation shall be Gas Insulated Sub Station (GIS) to optimize the land requirement land requirement and to have efficient O&M. As required may for smaller loads concentrated at one end/location to mitigate voltage drops in cables, Compact Substation may be proposed to optimize both the cost and technical constraints.

## 5 PROPOSED INFRASTRUCTURE

### ■ ■ International Container Transshipment Terminal

#### ■ ■ Facilities Requirements for the Purpose of Layout Development

The following facilities are envisaged for the proposed container Transshipment port:

- **Breakwaters**

Breakwaters of suitable length and orientation would be required to provide round the year tranquillity in the harbour with significant wave heights not exceeding 0.5 m under normal wave conditions.

Breakwaters 3.90 Km (2.53 km east breakwater & 1.37 km west breakwater).

The east and west breakwater extends till the 20 m & 25 m contour respectively. Both the breakwaters are envisaged to be rubble mound and shall be constructed using marine mode.

- **Capital Dredging**

To create the required water depths in navigational channel and harbour area capital dredging would be needed Capital dredging of approximately 17.7 million cum in Final phase & 6.4 million cum in initial Phase will be required.

Based on assessment of the site investigation information, the material to be dredged will be mainly silty sand and silty sandy clay. From the available boreholes data, soft rock is observed in the deeper layers and therefore the involvement of rock dredging would be minimal in the chosen layout. It is estimated that only part of the dredged material shall be suitable for reclamation (only 50%). The unsuitable material shall be disposed at an identified offshore location in about 40 m contour as per dredging guidelines.

- **Berths**

The number of berths to be provided depends upon the Berth capacity (measured in twenty-foot equivalent units or TEU) which is dependent upon many factors as give below:

- Design Vessel Sizes – Mainline vessels as well as Feeder vessels
- TEUs exchange per Vessel Call – Higher TEUs exchange per vessel increases the berth capacity
- Dock Cranes Assigned per Vessel – 5 to 6 in case of mainline vessels Vs 3 to 4 in case of feeder vessels
- Productivity per Dock Crane - Depends on the crane capacity of moving Boxes per hour. It also increases in case more 40' units are to be handled and ability of twin lifting (moving two containers at a time)
- Maximum Practical Berth Utilization – Ideally 50% for up to 3 berths but can go up to for 60% to 65% in case of higher number of berths
- Operational Time - Modern terminals operate 24 hours per day
- Unproductive Time at Berth – Shall be limited to 2 hours per day

In view of the above the berth capacity to handle the mainline vessels would be different than that in the case of feeder vessels. In case of the proposed container Transshipment terminal envisaged the share of containers to be handled by mainline and feeder vessels will be 50% each.

For operational reasons it is preferable to have the berth contiguous to the backup area. Depending upon the construction methodology of the reclamation, time frame and costs, the berths shall be built using piles or sheet pile walls or block work. The berths shall be provided with the fixtures like fenders, bollards, crane rails, storm anchors, safety ladders, mooring hooks, utility ducts etc.

The berths are proposed in such a manner so as to enable getting higher berthing length within the limited area. The ships shall be berthed in respective basins. The area created between the respective basins shall be used for transit storage of containers.

Total berth length of about 6.07 km in Final phase & 2.42 km in initial Phase for handling container vessels. One Material offloading Berth with provision for fuel handling and one harbour crafts jetty will be required though in the initial stages they would be handled at container berths.

- **Approach Channel**

An approach channel in natural water depths and a turning circle of 800 m Diameter is provided. The approach channel is proposed to be 300 m wide to cater to the design ship size with beam of 61.5 m. As the 20 m contour is very close to the shoreline, the channel length is in natural water depths to cater for vessels proposed. The channel is oriented NNE.

- **Reclamation and Site Grading**

To develop the backup area container parking yard, port buildings, workshops, utility buildings etc., reclamation as well as site grading would be needed. The source and quantity of reclamation material will be specified in the Preliminary Engineering Design Report.

- **Back Area Development**

It is estimated that about 32.2 million cum (227 hectare) in Final phase & 13.7 million cum (102 hectare) in initial Phase respectively is required develop the backup area. Part of it shall be obtained from the dredged material and the balance requirement shall be met through the borrowed fill, either through hill cutting nearby or brought from distant locations through the barges/ships. The ground improvement would be carried out by suitable means to enable the back area to take the loads of containers and yard equipment.

Back up area development consisting of container yard and other allied infrastructure facilities like administration building, operations building, workshops, substation, fuel depot, ancillary buildings will be developed. Water supply, fire fighting system, drainage, sewerage system including STP, Power Supply and distribution system including diesel generators shall also be developed.

- **Container Yard**

The size of the container yard dependent on following factors:

- Mean Dwell Time: The number of days a container sits inside the container
- terminal (dwell), which significantly varies for Transshipment (usually 2 to 3
- days) vs. the gateway traffic (varies from 3 to 7 days). In the present case a value of 3 have been considered on conservative side.

- TGS Capacity: Represents the static storage capacity in terms of total number of twenty feet ground slots (TGS) or net acres available to store those containers inside the container yard per hectare.
- Mean Storage Height: A mean storage height is calculated which considers the peak stacking height of the machine and various utilization factors than can be applied. It is proposed to stack containers 5 high for planning purposes.
- Seasonal Peaking Factor: It is assumed that a peak demand of container yard
- Will be 25% higher than the average demand.
- Capacity of the Handling Equipment (RTGs): Depends on the crane capacity of moving Boxes per hour.

Basis above it is estimated that container yard area of 42.8 Ha in initial phase and 160 Ha in final phase would be required.

• **Equipment**

The equipment required for the proposed container Transshipment port is estimated in Table 32.

**Table 32: List of Equipment for ICTT**

| Sr.No    | Equipment   | Initial Phase | Final Phase | Incremental over Initial Phase |
|----------|---|---------------|-------------|--------------------------------|
| <b>1</b> | <b>Equipment For Containers</b>                   |               |             |                                |
| 1.1      | RMQCs - Mainline                                  | 12            | 40          | 28                             |
| 1.2      | RMQCs - Feeder                                    | 5             | 18          | 13                             |
| 1.3      | Reach Stacker                                     | 6             | 19          | 14                             |
| 1.4      | ITVs  | 102           | 348         | 246                            |
| 1.5      | Forklift  | 6             | 18          | 12                             |
| 1.6      | RTGs  | 51            | 174         | 123                            |
| <b>2</b> | <b>Equipment for Material Offloading Facility</b> |               |             |                                |
| 2.1      | Crane   | 1             | 3           | 2                              |
| 2.2      | Hoses   | 1             | 3           | 2                              |
| 2.3      | Pipeline  | 1000m         | 3000m       | 2000m                          |
| <b>3</b> | <b>Weigh Bridge</b>                               |               |             |                                |
| 3.1      | Weigh Bridge                                      | 2             | 6           | 4                              |

• **Aids to Navigation**

The port shall be equipped with navigational aids as below:

- 5 Tugs of 50 T bollard pull capacity, including 1 standby in initial phase & 15 Tugs of 50 T bollard pull capacity, including 2 standbys in final phase
- 2 Pilot cum Survey Launches in initial phase & 6 Pilot cum Survey Launches in final phase
- 2 Mooring Launches initial phase and 6 Mooring Launches in final phase
- Channel marking buoys
- Manoeuvring area buoys

- Leading & transit lights
- Breakwater Beacon Lights
- Berth lights
- Racon
- VTMS

- **Power Requirement and Source**

The estimated power requirements for the port in initial phase and Final phase is about 13 MW & is about 45 MW respectively. The same would be sourced from either single or combination of gas/solar/hydro power plant.

Initially it is proposed to source the power through diesel Gensets and subsequently a gas based captive power plant shall be built as part of the overall development plan of the Nicobar Island.

- **Water Requirement and Source**

A water demand of 0.4 MLD & 1.7 MLD is estimated in initial phase and final phase respectively. .The same will be sourced from the surface water and sea water. A desalination plant will be provided if in case water is sourced from sea at a later stage.

- **Waste Management**

Wastewater from WC, urinals, etc. will be collected separately through soil pipes, and discharged directly into the sewerage pipeline system, while wastes from wash basins, showers, kitchens will be collected separately to the nearest manhole, through gully trap / grease trap. Sewage will flow by gravity through external sewer lines up to the last manhole and sump, from where it will be pumped to the Sewage Treatment Plant (STP) of capacity 70 KLD during initial Phase and 240 KLD during final phase, for treatment and recycling. The treated water from STP will be used for green belt. ETP is envisaged for treatment of solid waste generated during the washing of equipment. The capacity & detailed assessment of the ETP shall be studied in detail at the later stage of project study.

- **Fire Safety**

A zonal fire detection and alarm system for all buildings covering substations, control rooms, workshops, etc., are planned to be installed. The type of fire detectors planned would include smoke detectors, UV detectors, rate of heat rise detectors, etc. The system shall be complete with manual call points, break glass stations, sirens and zonal and central fire alarm panels. Fire extinguishers appropriate to the location are also planned.

- **Other Requirements**

- Adequate Security arrangements
- Communication system.
- Greenbelt / green area

### 3.1. Recommended Transshipment Port Layout

Location of cranes is marked on the recommended layout. A fuel Jetty can be accommodated near the tip of the East breakwater as shown in Figure 31.



Figure 31: Galathea Bay Location – Recommended Master Plan Layout



Figure 32: Galathea Bay Location – Google image showing Port Area

## 4.1 Phasing of the Port Development

The development of Transshipment Port shall be taken up in phases i.e. Initial Phase (Year 2025) & Final Phase (Year 2055). The key port facilities that shall be developed in the phased manner over the Final Phase are indicated in Table 33.

**Table 33: Phase-wise Port Development over Master Plan Horizon**

| Parameter                      | Initial Phase | Final Phase | Incremental Over Initial phase |
|--------------------------------|---------------|-------------|--------------------------------|
| Turning Circle Diameter (m)    | 800           | 800         | 0.0                            |
| Length of Breakwaters (km)     | 3.90          | 3.90        | 0.0                            |
| Length of Quay (km)            | 2.42          | 6.07        | 3.65                           |
| Dredging Quantity (Mcum)       | 6.40          | 17.69       | 11.29                          |
| Reclamation Filling Qty (Mcum) | 13.71         | 32.22       | 18.51                          |
| Cutting Quantity (Mcum)        | 0.0           | 0.0         | 0.0                            |

## 4.1.1 Project Schedule & Cost Estimates

### • Project Schedule

The project development activities are proposed to commence at the site in the year 2022 -23 and the port is expected to be commissioned by the year 2027 - 28. This includes the time required for statutory approvals and financial closure. Construction of breakwaters would be a major time-consuming activity as the quarry material will have to be brought from the mainland through one or more ports along the east coast of India. Similarly, other construction material would also need to be brought to site through marine mode.

### • Cost Estimates

The capital cost estimated for the initial phase & final phase of the project is as presented in Table 34:

**Table 34: Block Cost Estimates**

| Sr. No. | Item                                       | Initial Phase Cost (INR in Crore) | Final Phase Cost (INR in Crore) | Incremental Cost (INR in Crore) |
|---------|--|-----------------------------------|---------------------------------|---------------------------------|
| 1       | Project Preliminaries and Site Development | 35                                | 100                             | 65                              |
| 2       | Dredging and Reclamation                   | 4,594                             | 10,994                          | 6,401                           |
| 3       | Breakwaters & Shore Protection             | 7,641                             | 7,866                           | 225                             |
| 4       | Berths                                     | 2,178                             | 5,607                           | 3,429                           |
| 5       | Storage Areas                              | 432                               | 1,606                           | 1,174                           |
| 6       | Equipment                                  | 1,826                             | 6,195                           | 4,369                           |
| 7       | Buildings                                  | 83                                | 184                             | 101                             |
| 8       | Roads & Pavements                          | 31                                | 61                              | 31                              |
| 9       | External Power, Water & Telecommunication  | 22                                | 43                              | 22                              |
| 10      | Utilities and Others                       | 156                               | 468                             | 312                             |
| 11      | Port Crafts and Aids to Navigation         | 274                               | 799                             | 525                             |

| Sr. No. | Item   | Initial Phase Cost (INR in Crore) | Final Phase Cost (INR in Crore) | Incremental Cost (INR in Crore) |
|---------|--|-----------------------------------|---------------------------------|---------------------------------|
| 12      | <b>Total</b>   | 17,271                            | 33,780                          | 16,653                          |
| 13      | Contingencies @3%                                      | 518                               | 1,103                           | 500                             |
| 14      | Detailed Engineering & Project Management Services @3% | 518                               | 1,103                           | 500                             |
| 15      | Cost of Land Acquisition                               | 0                                 | 0                               | 0                               |
| 16      | <b>GRAND TOTAL COST (Rs. in Crores)</b>                | 18,308                            | 35,959                          | 17,652                          |

*\*\* (Note: The capital cost estimates exclude cost of land acquisition if any & Financing and Interest Costs)*

### **Resource Optimisation**

Water-

The wastewater shall be treated and reused for green belt maintenance and toilet flushing.

Solar Powered Lighting

At least 25% of the installed external lighting in the Marine facility is recommended to be solar powered for Green Marine facility development.

Common Amenity Building-

All the buildings within marine terminal development are planned to be energy efficient as per the Energy Conservation Building Code (ECBC).

Social Infrastructure-

Social infrastructure which includes the educational, medical facilities is proposed in the overall development plan of Great Nicobar. These facilities will include schools, clinics, recreational facilities & other allied infrastructure required for people residing during construction & operation phases as well.

### **Material Sourcing**

No construction material is available at site. All the construction material like rock, cement, sand, aggregates & steel will have to be brought to site by sea route from one or more of the Indian ports on the east coast.

## **International Greenfield Airport**

The concept master plan for the proposed international airport is shown in the figures below.



*Figure 33: Map showing preferred Airport site*



Figure 34: Master Plan of recommended Airport site

### Taxiways & Apron

One parallel taxiway is planned along the runway which will connect to the main apron. The runway is connected to main parallel taxiway by 5 runway exits.

Details of dimension of Taxiway given in Table-35.

**Table 35: Main Parallel Taxiway Dimension**

| Item   | Dimension |
|--------|-----------|
| Length | 4800 m    |
| Width  | 45m       |

An apron to accommodate 04 Code F Aircraft (MARS Stands) & 14 Code C aircraft (252,800 sqm) has been proposed to be constructed. Sufficient space has been kept for future extension. The apron dimension is presented in Table-36.

**Table 36: Apron Dimension**

| Sizing                    | Area (Sqm) |
|---------------------------|------------|
| Commercial aircraft apron | 252,800    |
| Cargo aircraft apron      | 56,700     |
| General Aviation Apron    | 15,640     |
| GSE Area                  | 12,400     |

- **Isolation Bay**

An isolation bay of 10,080 sqm has been proposed to be constructed as per requirements.

#### Pavement

Runways shall be constructed as flexible pavements in order to secure optimal runway surface evenness for aircraft landing and taking off. Only the runway ends shall be constructed as a rigid pavement so that aircraft can perform a 180° turn on the runway without damaging the flexible pavement.

Aprons and aircraft stands shall be constructed as rigid pavement. Concrete pavements are necessary on aprons since fuel spillage during re-fuelling is likely to occur. Flexible pavements are not able to withstand fuel spillage or high temperatures of summer in combination with static loads from aircraft without being damaged.

Taxiways can be constructed both as rigid and flexible pavements. Both pavement types have advantages and disadvantages but none of the disadvantages are of such a character that one type is preferred over other. It should therefore be left to the detailed design to find the most economically beneficial pavement type.

#### Air Traffic Control Tower

A fully functional low activity ATC Tower with a tower cab floor area of about 50 sqm is required. To meet the minimum line of sight and grade intersection angle of 0.80, the height of the tower is recommended as 35m above GL with an eye level of more than 3m above the average runway level, which will facilitate un-obstructed view of operational areas as well as surrounding air space. The Tower will provide Aerodrome Control and Flight Information Services. On the ground and first floor tower will have administrative block of 6,000 sqm area.

#### Height of control tower

Besides the general requirements mentioned above, Federal Aviation Agency (FAA) recommends that the line of sight from the control tower to the runway ends should not be less than 0.80 when measured against the ground line between the runway end and tower ground level. Tentatively, a height of 30m is required to achieve an angle of 0.80 to the runway end 02 & 20. However, a detailed study will be carried out during the design phase.

#### Airside Roads

The airside service road system is planned to connect the different apron and service areas with each other. The road system has been laid out with as few intersections with taxiways as possible. And a crash road system leading from the aircraft rescue and fire-fighting stations to the runways is established.

- **Communication Navigation Surveillance & Air Traffic Management**

Proposed facilities:

- **Land Side**

Sub Station equipment along with HT & LT distribution network.

- Area Lighting.

- Building Electrification.
- X-Ray Baggage Scanner.
- Baggage Conveyor.
- Non-illuminated Retro Reflective Sign Boards inside the building.
- Door Fitted Metal Detectors and Handheld Metal Detectors.
- Sliding doors.
- Water Coolers Hand Driers.
- Flight Information Display System (FID)
- Close Circuit Surveillance System (CCTV) (IP based)
- Public Address System (IP based)
- Fire Alarm Type (Addressable Type)
- Flight Information Display
- Intelligent building management system
- Escalators / travellers
- **Air Side**
  - ATC communication equipment
  - Meteorological equipment
  - Revolving Beacon
  - Landing T / H indicator
  - Runway / taxiway / apron edge lighting (CAT-1)
  - Cat-1 approach lights on both ends of main runway
  - Runway -end / threshold lights
  - PAPI
  - DVOR-DME
  - ILS Cat-1
  - ASSR
- **Communication**

Communication facilities associated with Air Traffic Services will be as follows:

- VHF Channels: Arrival Departure Control (ADC), Approach Control (APP), Surface Movement Control (SMC), Apron Control and Search & Rescue (SAR) channels to aircraft, channel to the SAR Jeep & Channel to Crash/Fire Fighting Vehicles.
- Aeronautical Telecommunication Network (ATN) Compatible Router/ Automatic Message Switching System (AMSS) for Flight Plan through-put and other Aeronautical Fixed Telecommunication Network (AFTN) related messages.
- VHF Broadcast Airport Terminal Information System (ATIS).
- Direct Speech Circuits (DSS) to Diabolism (Approach Control) and Mumbai (Area Control).
- Data and Speech lines or wireless network to cover all NAVAID and Surveillance Locations (VOR/DME, Localizers, Glide Slopes and Airport Surveillance Radar sites) with remote control facility from Maintenance Control and Remote Display at ATC.
- Speech Circuit to Military Liaison Cell (MLC) for Air Defence Clearance (ADC).
- Speech-cum-Data Satellite Communication Node on Airport Authority of India's countrywide network.

- **Navigation**

Navigational Aids for both, Non-Precision Approach (NPA) and Precision / Instrument Approach & Landing (IAL), will be as follows:

- Doppler Very High Frequency Omni Range (DVOR) and High-Power Distance Measuring Equipment (DME).
- Dual Frequency Capture Effect Instrument Landing System (ILS) with Low Power DME (LPDME) collocated with the Glide Slope. For Runway 02 and runway 20.

- **Surveillance**

Surveillance Aids required will be as follows and shall be installed:

- An S-Band Airport Surveillance Radar (ASR) with a range of 60 NM.
- An ADS-B Node.
- Visual Aids
- Visual Aids required for Day & Night operation in good visibility under Visual Flight Rules (VFR) will be as follows:
- Precision Approach Path Indicator (PAPI) for both approaches (02 & 20).

- **Airfield Lighting**

The need for a High Intensity Runway Lighting System along with Constant Current Regulators (CCR) and Remote Digital Control from the ATC will be studied. The light segments to be covered are as under:

- Precision Approach Category III lighting system extending to 900 meters from the runway thresholds for approach RWY 02 & CAT I for RWY 20.
- Runway Threshold Lights for both thresholds (02 & 20)
- Runway Edge Lights.
- Runway End Lights (at both ends)
- Taxiway edge lights
- Apron Lights (Including Isolation Bay)

- **Meteorological Systems**

Following Meteorological Sensors/Instruments are required to provide vital weather inputs to pilots and air traffic controllers to enable flight operations without jeopardizing air safety:

- Standard Anemometer or an Ultrasonic Sensor: To measure Wind Speed & Direction.
- Dry & Wet Thermometers: To measure Temperature and Humidity
- Mercury or Aneroid Barometer: To measure ambient pressure
- Transmission meter at each Runway end: To measure Runway Visual Range (RVR)

Laser-based Ceilometers on the extended centre line of runway: To measure and record Cloud Base. As a low-cost alternative, a Binocular Laser Ranger can be provided which enables measurement, without automatic recording

- **Assessment of Infrastructure Demand**

#### Water Requirement & Supply

The total requirement of water will be approx. 1MLD. Out of this, part will be met from fresh water & balance will be met from recycled water.

#### Wastewater Management

Treated wastewater shall be mainly used for landscaping and flushing. Efforts will be made to fully utilize the wastewater to eliminate the risk of land or water contamination. The main source of drainage generation will be the discharges from toilets (water closet), urinals, sinks, pantry's, kitchen and other similar utilities.

#### Solid Waste Management

During construction phase solid waste will be collected and disposed as per established laws and Procedures. The Organic waste will be treated at site.

During the operation phase, twin bin waste collection system– green bins for bio-degradable wastes and blue bins for non-biodegradable wastes shall be provided. Waste collection shall be done on a door to door basis, and temporarily stored at identified locations before disposing as per established laws and procedures at the waste disposal site.

Hazardous waste shall be treated in accordance with Hazardous Waste Management Rules 2016, Batteries waste shall be handled in accordance with Batteries Management Rules, 2020 and E waste as per E-waste Guidelines, 2016 and subsequent amendments.

#### Car Parking

Parking space to handle a peak hour passenger traffic of 4000 and airport staff will be planned for the proposed project. The project parking area will be utilized during the arrival and departure of the flight.

#### • **Support Amenities**

The following facilities will be available in the proposed airport

- Baggage handling system
- Passenger boarding bridges
- Flight information and displays
- Sewage treatment facility
- Firefighting system
- Security equipment
- Restaurants
- Medical facilities
- Quarantine facilities

### ■ ■ **Summarized Project Facilities & Area Details**

Project facilities & area details are summarized in Table-37.

**Table 37: Summarized facilities at proposed Airport**

| S. No. | Description                                     | Specifications          |
|--------|---|-------------------------|
| 1      | Aerodrome Reference Code                        | 4F                      |
| 2      | Design Aircraft                                 | Code F                  |
| 3      | Flights per hour                                | 20 flights in peak hour |
| 5      | Passenger Terminal Capacity (million per annum) | 4000 PHP                |
| 6      | Runway  | 4000m x 45m             |
| 7      | Turning Pads                                    | Not Provided            |
| 8      | Taxiway   | 4800x25 m               |
| 9      | Apron   | 252,800 sqm             |
| 10     | RESA  | 2X240X150 m             |
| 11     | Isolation Bay                                   | 10,080 sqm              |
| 12     | Taxiway to Isolation Bay                        | Link Provided           |
| 14     | Overruns  | 2 x 60m                 |
| 15     | GSE area  | 9,185 sqm               |
| 16     | Peripheral Road                                 | √                       |
| 17     | Terminal Building sqm                           | 48,000 sqm              |

| S. No. | Description   | Specifications |
|--------|---|----------------|
| 19     | Fire station Building   | 10,800 sqm     |
| 20     | ATC Tower – sqm   | 6,000 sqm      |
| 21     | STP   | √              |
| 22     | Internal Roads  | √              |
| 23     | Car Park  | √              |
| 24     | Boundary Wall - 3.0m high with 0.6 m concertina coil on top   | √              |
| 25     | Operational Chain Link Fencing - 2.0m high                    | √              |
| 26     | Gates   | √              |
| 27     | Estimated Electrical Load                                     | √              |
| 28     | Transformer rating  | 10 MVA         |
| 29     | DG set rating   | 10 MVA         |
| 30     | Sub Station equipment along with HT & LT distribution network | √              |
| 31     | Building Electrification and Area Lighting                    | √              |
| 32     | Central Air conditioning of terminal building                 | √              |
| 37     | Close Circuit Surveillance System (CCTV) (IP based)           | √              |
| 38     | Public Address System (IP based)                              | √              |
| 39     | Flight Information Display System                             | √              |
| 40     | ATC communication equipment                                   | √              |
| 41     | Automated Weather observation system                          | √              |
| 42     | Revolving Beacon  | √              |
| 43     | Landing T / H indicator                                       | √              |
| 44     | Airfield Ground Lighting (AGL) in interleaved circuit.        | √              |
| 45     | Simple & CAT – I approaches                                   | √              |
| 46     | Apron High Mast lighting                                      | √              |
| 47     | Navigation equipment / system                                 | √              |
| 48     | ASSR / MSSR   | √              |

The number of people to be displaced is being worked out.

### ■ ■ ■ Project Schedule & Cost Estimates

#### • Quantities

Quantities of the runway pavements, buildings, electrical works, navigational equipment's and other associated works for development of the airport are calculated based on preliminary high-level analysis, assessment of requirements based on codes and specifications. Detail designs not done at this stage.

#### • Facilities Included

The various facilities considered in the Capital Expenditure of the proposed development are as follows

##### Site Preparation & Earthwork (Cut & Fill Works)

- Clearing & Grubbing
- Cutting/Filling and levelling
- Aeronautical Facilities
- Runway System

- Taxiway System
- Apron Works (Commercial Apron, Cargo Aircraft Apron, General Aviation Apron, Ground Support
- Equipment Apron, Defence Enclave, Isolated Aircraft Parking, etc.).
- Passenger Terminal Building
- ATC And Technical Building
- Cargo Building
- ARFF
- DVOR/DME
- ASR/MSSR
- GSE Maintenance Building
- Runway Approach System
- Meteorological Equipment

#### Non-Aeronautical Facilities

- Vehicular Parking
- ESS and Power Station
- Space for Solar Panel
- Sewage Treatment Plant & Waste Disposal Plant
- Fuel Farm
- Access Road
- Airline Services Catering
- Peripheral Road
- Space Reserved for Support Activity
- Solar Farm
- **Utilities**
  - Storm water drainage
  - Sewage and water supply systems
  - Solid waste management

- **Basis of Estimate**

## Unit Cost

Site Preparation & Earthworks (Cut & Fill Works), Runways, Taxiways, aprons, at grade parking, road works

- It is assumed that the site comprises of hilly terrain requiring balancing of cutting and filling.
  - For preliminary estimates, it is assumed that hills are soil, clay or may be very soft rock. Cutting of hills will be required to be undertaken for safe air operations.
  - An average lead of 5kms is considered for estimating cost
  - The rates are adopted based on CPWD DSR 2018 rates plus 192 % escalation
  - Pavement Works (Runway, Taxiway, Taxi lanes/Apron, Peripheral Roads and Access Roads)
  - The Proposed Pavement Sections will be designed as per FAA practice of pavement design.
  - The unit cost has been worked out using CPWD DSR Rates 2018, duly enhanced with 192 % escalation till Jan 2021
- **Terminal Buildings, other Support Services - Buildings & Utility Buildings / Structures**

For the scheduled items, the rates have been taken as per CPWD PAR-2020, duly enhance with 192 % escalation per year till Jan 2021. For non- scheduled items, rate has been adopted based on similar works carried out at other airports and inputs obtained from the vendors / specialized agencies during 2020, duly enhanced with 192 % escalation till Jan 2021.

For E&M elements the unit cost has been worked out using Plinth Area Rates (PAR) 2020 for Specialized E&M Works of CPWD, duly enhanced with 192 % escalation till Jan 2021.

For Specialized Items the unit Price worked out based on benchmarking of recently completed airport projects of similar nature and magnitude and also rates obtained from specialized agencies during 2020, duly enhanced with 192 % escalation till Jan 2021

• **Contingency**

As the project is at Concept stage, a certain amount of cost contingency is required to be added to the base estimates to account for the cost variations due to uncertainty as to the precise content of all items / work elements in the estimate, any other project requirements and challenging site conditions, which may occur but are not identifiable at this stage of estimate. The quantum of the contingency is influenced by the project size, complexity, associated level of risks and level of information available during different stages of the project development.

The traditional approach of providing cost contingency is through a fixed percentage of the base cost estimate based on the experience on the past projects and such percentage is usually @ 10 percent.

In view of above, the provision of contingencies has been considered in the current cost estimate on the basis of current concept stage.

• **Preliminaries**

The cost of office establishment for project team (Project office), temporary site office at site, Establishing permanent survey pillars, fixing boundary stones, initial survey / geotechnical investigation, Topographical Site Survey, Obstruction Survey works for initial engineering, temporary road, temporary gates, Monsoon protection works, fencing, construction power, Operational Readiness and Transition (ORAT) and various other miscellaneous activities which are not covered anywhere under any cost heads is required to be accounted as part of Preliminaries cost. In the current cost estimate @ 3% cost has been considered towards Preliminaries.

- **Insurance & Permits**

Cost for Insurance, CAR policy, and Government Authorities / Local bodies approvals / NOC such as Building Layout Approval from Development Authority/Municipality, DGCA NOC/Approval / Permit, Temporary & Permanent Water & Power connection Approval / NOC, Consent to Establish & Operate from Pollution Control Board, Height clearance NOC/Approval of Buildings / Structures/ Masts from the Directorate of Air Traffic Management, Airport Authority of India (AAI), Fire clearance NOC, Permission for Excavation / Royalty payment from Collector, Other Common Facilities e.g. telecom, gas, Oil Company etc., approval / NOC (Internal Infrastructure services), Lift Escalator Installation Approval/NOC from (PWD / CPWD), Electric substation, Transformers, DG Set NOC, etc. In the current cost estimate @1% cost has been considered towards Insurance & Permits. The preliminary cost estimate for is given in Table-38.

**Table 38: Preliminary cost estimate**

- **Resource Optimization**

The resource optimization is always prerequisite for any development project and saving the precious. This requires a new approach to viewing, evaluating, understanding, and communicating, which ultimately requires new approaches to science, engineering, and economics. In quest towards resource optimization in proposed project the tradition practices are substituted by modern practices involving water reduction, rainwater harvesting, energy conservation etc.

- **Water Saving Practices and Reduction**

In India, the average domestic water consumption is 4.1% of the total water use. As per the Bureau of Indian Standards, the per capita water requirement varies with building type. As per BIS, for residential buildings with a population of 20,000 - 1,00,000, the per capita consumption is 100-150 LPCD and for those with population above 1,00,000, the consumption is 150-200 LPCD. Out of the 150 to 200 litres per

head per day, 45 litres per head per day may be taken for flushing requirements and the remaining quantity for other domestic purposes. For the other types of buildings, the water requirement varies between 30 to 340 LPCD. Water usage for applications such as flushing, bathing and washing is as high as 93% of water demand in any building. However, measures can be adopted to reduce this demand through use of water efficient practices and devices (efficient plumbing fixtures). These would result in significant saving of water and contribute towards protection of the environment. Some of the common practices and devices that can save water are covered below:

#### Monitoring Water Use

Use of water meter conforming to ISO standards should be installed at the inlet point of water uptake and at the discharge point to monitor the daily water consumption. This would also enable the user to identify if there are any points of leakages.

- **Use of Water Saving devices/ Fixtures**

About 40% of all water used indoors is in the bathroom and toilets and more than 10% of that used is in the kitchen. The conventional fixtures used in toilets use water at the rate of 12-15 litres per flush. In normal scenario, the taps and showerheads in buildings consume water at the rate of 20 litres of water per minute. The flow rates of these fixtures depend on the pressure at which these are operated. However, there exists the opportunity to lower the consumption through the use of following efficient fixtures:

#### Low Flow Flushing Systems

Water consumption is more for flushing applications in any building. Use of more efficient water saving toilets having dual flush system can result in a saving of at least 50% of water. Dual flush systems can be installed in order to allow different volume of water for flushing liquids and solids. To facilitate efficient cleaning at low volume, it is possible to install suitable water closets. Sensor based fixtures: Sensors based fixtures functions only in the presence of user. Various types of sensor-based technologies are magic eye sensor for urinals, solenoid self-operating valves etc. Infrared and ultrasonic sensors discharge a set amount of water only when the taps are being used thus resulting in water saving as compared to manually operated valves. In addition to its advantage in reducing water consumption, sensor operated taps also result in better hygiene particularly in a public place.

#### Urinals

By using automated flushing urinals usage of water is very high. By replacing these with sensor-based urinals such as magic eye sensor, the water use is reduced to 0.4 litres per flush. In place of conventional urinals, if the low flow urinals are used, water saving amounts to 3 litres per flush.

#### Waterless Urinals

Waterless urinals are an efficient technique to save water. The system works without any water but with the use of biodegradable liquid in the cartridge fitted at the bottom of the urinal. Each cartridge is adequate for 7000 uses.

#### Water Taps

A normal tap works at a flow rate as high as 20 lpm. Use of low flow faucets along with other water saving devices such as auto control valves, pressure reducing devices, aerators and pressure inhibitors for constant flow, magic eye solenoid valve, self-operating valves can result in 25 – 50% of water savings.

#### Tap Aerators

Tap aerators can be effective by facilitating cleaning through increasing the pressure at which the water is delivered even at low flow rates. Installation of flow regulators can be done where the aerators cannot be installed.

#### Auto Control Valves

Automatic shut-off valves can be used to control the flow of water for a present time limit and with use, which is linked to the release of the lever or handle.

#### Pressure Reducing Device

The reducers can be used to control the pressure in the water line, which will affect the discharge rate and to maintain uniform flow at different levels. A pressure reduction device can be installed when the pressure in the line exceeds 50-60 psi. It is observed that a reduction of pressure from 80 to 65 and 50 psi can result in a reduction of water flow of 10% and 25%, respectively.

#### Dual Plumbing System

Introduction of dual pipe in the buildings for use of water with different water quality namely ground water with high hardness, municipal supply water, treated soft water and recycled water can result in optimal use of water for different applications thus saving on the high-quality water. Installation of dual pipe plumbing for using recycled water / rainwater can save the potable water from municipal supply or ground water. There can be two lines, one supplying fresh water for drinking, cooking and bathing etc. and other for supply of recycled water for flushing, landscape irrigation, car washing, thermal conditioning etc. This result in saving of more than one-third of fresh water demand and life of existing sewerage can be improved and promotes decentralized treatment system. This system needs space for establishment and initial investment and retrofitting.

**Water Quality:** In addition to providing adequate water supply for building occupants, quality of water is also a key concern. Bureau of Indian Standards has recommended a set of parameters which should be complied with as per IS 10500:2012.

#### Water use Reduction

To estimate the reduction in water use achieved by the building by following the mitigation measures, use following steps: (i) Step 1: Estimate total water demand based on the occupancy and type of building; (ii) Step 2: List various efficient fixtures and other measures and (iii) Step 3: Calculate demand reduction as compared to the BIS per capita water consumption.

#### Domestic use for 24 hrs.

Under normal conditions, water consumption per person for flushing is 45 litres (9 litre/flush with 5 number of uses). With efficient fixture (3 and 6 litre/flush), water use is 21 litres (3 litre/flush with 3 uses and 6 litre /flush with 2 uses). Water use per person for washing with normal fixture with a flow rate of 20 litres per minute is 40 litre (assuming use for 2 minutes), while with efficient fixture (flow rate of 7.5 lpm) is 15 litres.

#### Water Use during Construction

Water used shall be clean and reasonably free from injurious quantities of deleterious materials such as oils, acids, alkalis, salts and microbial growth. Generally, potable water shall be used. Where water can be shown to contain any sugar or an excess of acid, alkali or salt, that water should not be used. As a

guide, the following concentrations may be taken to represent the maximum permissible limits of deleterious materials in water.

Limits of Acidity: To neutralize 200 ml sample of water, it should not require more than 2 ml of 0.1 N caustic soda solutions.

Limits of Alkalinities: To neutralize 200 ml sample of water it should not acquire more than 0.1 ml of 0.1 N hydrochloric acid.

Percentage of Solids should not exceed:

Organic 200 ppm (0.02%)

Inorganic 3000 ppm (0.30%)

Sulphates 500 ppm (0.05%)

Alkali Chlorides 1000 ppm (0.1%)

- **Water Requirement & Supply**

#### Water Source & Demand

The project will utilize the ground water and water supply from the catchment dams that will be constructed over Galathea River. The daily consumption of water during operation phase will be about 387.33 KLD of which 201 KLD will be fresh water and 170.5 KLD will be recycled water.

#### Water Storage

Since the hours of supply may not be continuous, it is recommended to go for 3 days bulk storage at the main receiving tanks, wherein the domestic water will receive the desired level of treatment. Further to bulk storage, individual Buildings / Utility will have their own storage tanks catering to a day's requirement

#### Water Distribution

Treated water will be pumped into the main header pipe to distribute water to the storage tanks located in the individual building / utilities i.e. Terminal Building, Maintenance Building, ATC Tower, Commercial Building, Shopping Area and Admin Office Building.

The pump system at the receiving tank will be hydro-pneumatic type with pressurized diaphragm tank for starting & stopping pumps.

Storage tanks in individual buildings will have solenoid controls to regulate & control the inflow. From these storage tanks water will be pumped into the internal plumbing system of respective buildings through variable speed hydro-pneumatic pumps.

The Terminal building, especially, will witness periodic peak flow surge along with relatively very low demand periods. It is recommended for optimization of energy to go for multiple pump configurations to offset such variance in demand. It is proposed to integrate the water system with Building Management controls.

- **Waste-Water Generation and Treatment**

The main source of drainage generation will be the discharges from toilets (water closet), urinals, sinks, pantry's, kitchen and other similar utilities. The total wastewater generation in operation phase will be 323 KLD and that during construction phase is 350 KLD. The wastewater will be treated in 400 KLD STP.

- **Storm Water Drainage**

Storm drainage will be designed using the rational formula

$$Q = C ia$$

Where,

C = Coefficient of Run off

i = Intensity of rainfall in m/sec

a = Contributing area in m<sup>2</sup>

Runoff coefficients to be assumed are as below:

- Paved area = 0.9
- Building Roofs = 0.85
- Soil / Grass = 0.30
- Gravelled Area = 0.50

Since the airport is in a rain belt having annual rainfall exceeding 3000mm, it is recommended to design the storm drainage system for suitable intensity.

- **Power Requirement & Supply**

Total load estimation for Great Nicobar Island International Airport works out to 10,000 KVA (approx.) or 10 MVA. The bulk power supply will be from DG sets. In addition, a solar farm of area 133,200 sqm is being planned which is likely to generate 0.8 KW/sqm. All the electrical HT & LT cables shall be laid as per the stipulations of CPWD specifications.

- **Solid Waste Management**

Construction Phase

About 2% of construction materials generally end up as construction waste. During construction phase, solid waste will be refilled for levelling etc. What cannot be disposed of on site will enter the municipal solid waste disposal system. Organic waste will be treated at site.

Operation Phase

Twin bin waste collection system– Green bins for bio-degradable wastes and blue bins for non-biodegradable wastes shall be provided. Waste collection shall be done on regular basis, and temporarily stored at identified locations before disposing as per established laws and procedures. Hazardous waste shall be treated in accordance with Hazardous Waste Management Rules 2016, Batteries waste shall be

handled in accordance with Batteries Management Rules, 2020 and E waste as per E-waste Guidelines, 2016 and according to their subsequent amendments.

- **Fire Safety**

#### Fire Suppressions

This section only deals with the fire protection services related to Hydrants, Sprinklers and Extinguisher. Fire protection in the context of this project is required for the following:

- Protection of occupied buildings like Terminal Building, ATC Tower, AFI, Commercial Development.
- Protection of ancillary buildings like Maintenance buildings, Workshop & utilities etc.
- Protection of amenity centres like Shopping & Kiosks.
- Protection of Fuel Farm.
- Protection of Apron & Runways
- Electric substation, Plant rooms
- Aircraft related fires

#### Fire Reserves

The type of fire within an aircraft complex may range from those caused in the human occupied structures like Terminal Building, ATC Tower, Offices, Shopping & Commercial, where human safety is of prime consideration to the workshop and hanger where equipment protection is primary objective. Besides this is the additional task of aircraft fire rescue. Considering the diverse requirement of air and land side fire service multiple underground fire reserve with pumping stations are proposed.

Category 9 level of protection is required to be provided to meet the of design aircraft. For category 9 level of protection, minimum 3 No. of Crash Fire Tender are required to be provided. A fully equipped

Ambulance shall also support the Crash Fire Rescue Services. Two fire stations of 5400 sqm each is proposed to house the CFTs, Ambulance and an SAR vehicle.

Airside hydrants are also proposed to supplement the water requirements for fire fighting vehicles. Thus, the following is proposed:

Pilot Fire Reserve tank with pumping arrangement and ring main, serving air and land side.

For Air side - Fire Water Reserve of adequate capacity for ARFF station.

For Land side - Static Fire Water Reserve of adequate capacity for both Hydrant & Sprinklers system located in Terminal Building.

#### Pumping Agreement

Pump house and UG sump shall also be developed alongside of the substation for water supplies & fire emergency for the airport.

#### Fire Fighting Fitments

External yard Hydrant shall be provided on the land side accompanied by a Hose cabinet, weatherproof type, housing branch pipe, nozzles, two 15m long CP Fire Hoses and one coupling for Foam Systems. Pressure more than 7.0 kg /cm<sup>2</sup> will be controlled with provision of orifice plates in the Hydrant.

All landside buildings/structures shall be provided with Landing Valve, each valve serving a design influence area of 1,000 sqm. The landing valves are tapped from the hydrant risers or the external ring main in case of Ground structures. In addition to the Landing valve, swing type Hose Reels with 20mm rubber tubing along with 63 mm RRL Hoses Nozzles, Branch Pipe and fireman axe all housed in a Fire Hose cabinet will be provided.

- **Air Conditioning System**

The cooling requirements for the proposed project have been estimated based on the following design assumptions.

#### Outside Ambient Conditions

Peak temperatures are:

Summer: 34.35 oC

Monsoon: 32.83 oC

#### Inside Design Condition

Room Temperature: 23o C +/- 1.1o C

Relative Humidity: 55% +/- 5%

#### ■ ■ ■ **Material Sourcing**

The construction material used in proposed project will be sourced from the mainland (Chennai, Vizag, Tuticorin) through the contractor and the specification will be as per the conditions laid in contract. The contractors work will be monitored, approved and certified by the Engineering-In Charge.

■ Power Plant

The proposed layout and association land area breakdown for the power plant are shown below.



Figure 35: Layout Plan of Power Plant (Recommended site)

The proposed land use of proposed Project contains development of different sizes. The target segment proposed will be mainly food and export processing, industrial units. In addition to industries, there is also provision for residential, commercial, Institutions, airport, port & utility areas as per vision document. Further zones are divided in different blocks. In addition to these blocks, some of the common services area are also provided such as commercial, Community, Governance, Utility service Area etc.

**Table 39: Tentative area for the main components of gas-based power plant.**

| S. No. | Description | Area in Acre |
|--------|-------------|--------------|
|--------|-------------|--------------|

|   |   |            |
|---|---|------------|
| 1 | Fuel Tank & Unloading Area  | 20.0 Acre  |
| 2 | Pump & Stack  | 5.0 Acre   |
| 3 | Generation Area   | 30 .0 Acre |
| 4 | Substation/Switchyard (400kVA)  | 20.0 Acre  |
| 5 | Other Areas i.e. Road, Green, parking, I/C, O/G cables, control room, SCADA room, Admin Building, Storage , diesel gensets etc. | 21.0 Acre  |

## ■ Other Physical Infrastructure

The assumptions for development of trunk urban infrastructure systems, above and beyond the major interlinked projects discussed above, are as follows:

- Based on the limitations of surface water availability, about 40-50% of the water demand shall be met by surface water resources and balance by sea water desalination plant, at a later stage.
- Sewage Treatment Plant shall be established with Tertiary Treatment for reuse for non-potable usages. No disposal into sea.
- The runoff shall be collected through check dams on the existing rivers and lakes/ponds planned as per Master Plan.
- The solid waste shall be segregated at source, so for the degradable can be bio methanation can be done, recycle part recycle can be done and only non-degradable /non-recyclable shall be to landfill.

## ■ Water Supply, Recycled Water and Sewerage

The main Objectives for the Water, Recycle Water and Sewerage/wastewater services in the proposed project area are:

- To make available water and sewerage/wastewater services as per global standards to the consumers in the project area, at an affordable price and sustainable basis;
- To design fully automated water supply system with online measuring devices and centralized control as per standards.
- To design fully automated sewerage/wastewater supply system with online measuring devices and centralized control standards.
- Use recycled/treated wastewater to achieve zero discharge and minimize the dependence on fresh water.
- To collect and dispose the storm water in an efficient manner to prevent water logging.

Our understanding of the project is to arrive at a careful balance between technical sophistication and optimum costs which should be adapted to the specific requirements of the proposed development.

### Water Supply:

The assessment and design of the new water supply system are, but not limited to the following broad design parameters: - Estimate water demand for next 30 years. Demand of potable water in initial days of development can be meet through surface water, however as the development proceeds the demand will be met in combination with Sea Water. The Water Demand shall be based as per below:

- Land Use prototype/area map/existing area Master Plan.
- Domestic water demand – by population projection and a litres per capita consumption rate as per Manual on Water Supply by Government of India.

- Institutional and commercial water demand as per NBC/ Manual on Water Supply by Government of India. Industrial Demand as per Type of industry with optimization of use for Recycled Water.
- Provision for Unaccounted for Water in distribution limited to 15%.
- The total fire demand is estimated as 1% of the total water demand. Fire Hydrants shall be proposed on potable water network along with dedicated fire tanks and pumping machinery as required.

Since Great Nicobar Island is an island, the source of water for this shall be a combination of Sea Water and surface water. Sea Water shall be treated at Desalination Plant (at a later stage) and Surface Water shall be treated through different process. The Great Nicobar Island is the land of five rivers, namely, the Galathea, Alexandria, Amritkaur, Dogmar and Jubilee. The rivers Alexandria, Dogmar and Amritkaur flow towards the West, Jubilee towards the North and the largest river Galathea flows towards the south of the island at South beach (41 km from Campbell Bay).

The major source shall be Galathea River, which is rain fed and provisions shall be made to store water for the proposed project.

The project shall have dedicated continuous pressurized water supply and a Dedicated Sewerage Collection System to convey generated Sewerage from the source/s to the Treatment Plant, including the Treatment Plant is planned.

The sewerage shall be treated in dedicated sewage treatment plants to remove impurities, to re-use the treated sewage for non-potable usages.

The sewage after treatment shall be used for non-potable usages such as irrigation water/landscaping water requirement, washing at port etc., thus reducing the ever-increasing burden on the fresh water source and creating a sustainable system. The sludge generated shall be utilized as manure for Landscaping within the city. This will be a perfect case of reduce-recycle and reuse in line with principle of the central government.

Traditionally sewage treatment plants were used to be planned on centralised approach where large flows are brought to a single location generally at the outer area of the island/zone. Evidently this involves higher investments in sewage collection & transportation through network, including multiple pumping stations. It also involves relatively higher electricity /operating costs towards pumping of sewage and deeper excavations.

On the other hand, decentralised approach of sewage treatment at habitation/zonal level/Load centres involves STPs of lower capacities. Further, the decentralised wastewater treatment systems are characterised by maximum utilization of the natural slopes, lesser pumping, lower electricity consumption and thus relatively lower capital costs. The operation and maintenance of such systems is also perceived to be less complex and hence involve comparatively lower OPEX. However, strategic planning of the number and locations of the STPs as well as pumping stations and treatment technology selection will play vital roles in deciding the long-term sustainability and operation of the treatment plants.

A dedicated sewerage system including sewage treatment plants will bring tangible benefits such as better health with abridged water borne & Vector borne diseases. A better health leads to better life, as it is said Better health is vital to human happiness and economic wellbeing.

The sewage treatment plant shall be based on membrane based treatment to utilize for non-potable usages. The Plant shall be sustainable with environment on optimized foot print and optimized sludge generation, as the bacteria shall be under endogenous phase.

The use of recycled water shall be adopted to meet the non-potable water demand, and a recycled water network will be designed. Therefore, a dual piping system for the building, wherein the recycled (treated waste water) shall be supplied for non-potable usages like flushing of toilets etc. Due care needs to take in the event of wrong plumbing leading to serious health hazards. In other cases, to meet the demand for washing, landscaping and other non-potable usages recycled water shall be used to the best possible extent and a separate network shall be designed, to deliver the treated waste water for non-potable usages within the proposed township.

The total Water Demand for the project area is estimated at 160 MLD (Fresh Water Demand 90 MLD and Recycled Water Demand 70 MLD). 40 MLD of the Fresh Water demand shall be met from surface water of River Galathea and part from Alexandria during Phase 1 of the development of the city (2021-2036); and balance 50 MLD shall be met through Desalination Plant (RO based) at a later stage during Phase 2 (2037-2051).

Taking into consideration the fresh water availability, the same shall suffice to a resident population of approximately 1.8-2 lakh, along with fresh /potable water requirements for other developments. So this is about 30% of the total resident population. According to the assessment, this should suffice for first 10-12 yrs. approximately. On storage arrangements: the area for raw water storage is accounted in the Water Works area, for the fresh water availability for a day's demand. Check dam details will be worked out during EIA stage.

Sewage generation for the proposed developments is 110 MLD, depending upon final type of industries to be selected. The Demand for Non-potable water of 70 MLD shall be met by recycling the Sewage within the Project Area. The Water Balance Diagram is given below-

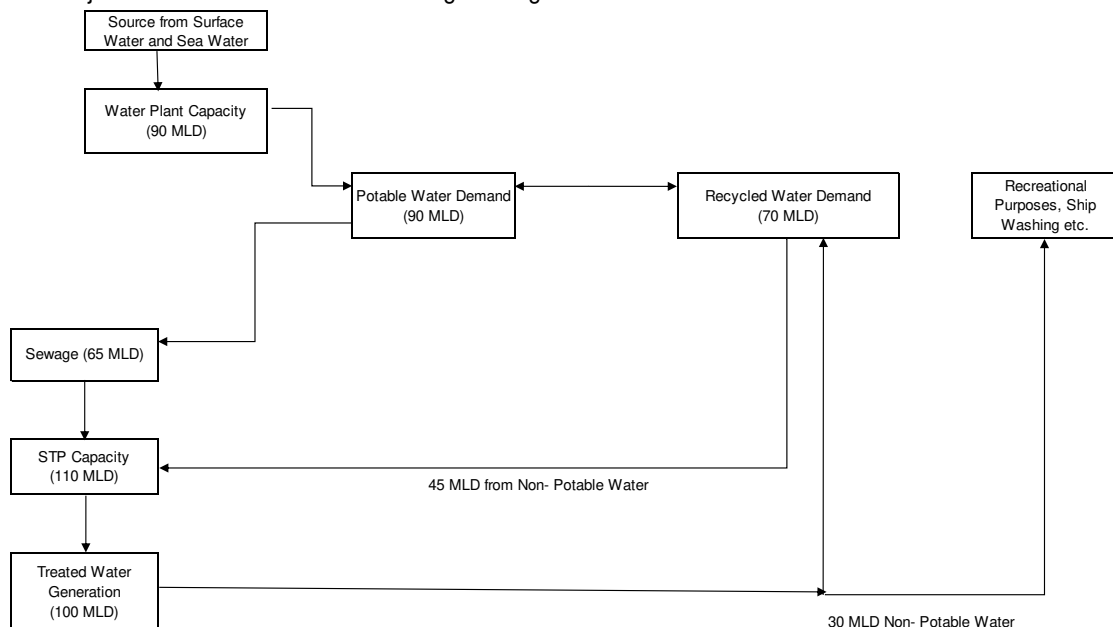


Figure 36: Water Balance Diagram

Water Demand break up is mentioned as below:

**Table 40: Water Demand details**

| S. No. | Description  | Water Demand in MLD |
|--------|--|---------------------|
| 1      | For Resident Population @ 150 LPCD + 15% unaccounted water as per CPHEEO for Mega Cities | 113                 |
| 2      | For Floating Population @ 60 LPCD + 15% unaccounted water                                | 15                  |
| 3      | Proposed Industries  | 5                   |
| 4      | Green area/Open area/Road Gutter Washing etc.  | 10                  |
| 5      | Port, Airport etc.   | 3                   |
| 6      | Hospitals/Medical Care etc.  | 5                   |
| 7      | Defence Area, Euro Tourism, Utilities etc.   | 7                   |
| 8      | Fire Demand 1% of Total (Round Off to nearest whole number)                              | 2                   |
|        | <b>Total</b>   | <b>160 MLD</b>      |

| S. No. | Purposes  | Quantity (MLD) |
|--------|---|----------------|
| 1      | Domestic water and other potable water requirement: | 90             |
| 2      | Flushing and other non-potable requirement:         | 70             |
|        | <b>Total water requirement</b>                      | <b>160</b>     |

The breakup of Waste-water/sewage generation are mentioned as below: -

**Table 41: Waste Water/Sewage Generation Details**

| S. No. | Purposes  | Quantity (MLD) |
|--------|---|----------------|
| 1      | Waste Water/Sewage Generation from Potable water Demand     | 65             |
| 2      | Waste Water/Sewage Generation from Non-Potable water Demand | 45             |
|        | <b>Total wastewater generation</b>                          | <b>110</b>     |

The parameters of raw & treated sewage are as below: -

**Table 42: Raw & Treated Sewage**

| Sr.no | Parameters of Raw Sewage              | Values  | Unit  |
|-------|---------------------------------------|---------|-------|
| 1     | BODs                                  | 200-300 | mg/l  |
| 2     | COD                                   | 500-600 | mg /l |
| 3     | Suspended Solids                      | 300-350 | mg /l |
| 4     | pH                                    | 6.5-8.5 |       |
| 5     | Total Alkalinity as CaCO <sub>3</sub> | 300-400 | mg /l |
| 6     | Chlorides                             | 250-300 | mg /l |
| 7     | Sulphate                              | 100-150 | mg /l |
| 8     | Total Kjeldahi nitrogen               | 40-50   | mg /l |
| 9     | Ammonical Nitrogen                    | 35-40   | mg /l |
| 10    | Total Phosphorous                     | 5-7     | mg /l |
| 11    | Temperature                           | 15-35   | °C    |

| S. No. | Parameters of treated sewage | Values | Unit  |
|--------|------------------------------|--------|-------|
| 1      | BODs                         | <5     | mg /l |
| 2      | COD                          | <30    | mg /l |
| 3      | TSS                          | <1     | mg /l |

|    |                    |         |       |
|----|--------------------|---------|-------|
| 4  | TKN                | <5      | mg /l |
| 5  | Ammonical Nitrogen | <2      | mg /l |
| 6  | Total Nitrogen     | <10     | mg /l |
| 7  | Total Phosphorus   | <1      | mg /l |
| 8  | pH                 | 6.5-8.5 | mg /l |
| 9  | Turbidity          | <1      | NTU   |
| 10 | Bacteria Removal   | 5 Logs  |       |
| 11 | Virus Removal      | 6 Logs  |       |

Location of 01 No. WTP cum Desal plant/ Water Works and 03 Nos. STPs is worked out and is shown as below: -



Figure 37: Location of WTP and STPs

### ■ ■ ■ Drainage

The primary objective of flood control /drainage design is to protect the area during the design storm events. The drainage system is designed to collect storm water run-off from roadway surface, right-of-way and entire plot/project surface and convey it through a network of storm water system to discharge into a receiving body/outlet without causing adverse site impacts. A separate collection network is proposed for collection of Storm water.

Storm runoff is that portion of the precipitation which drains over the ground surface. Estimation of such runoff is dependent on the intensity and duration of rainfall, characteristics of tributary area and the time required for such flow to reach the drain.

Providing sustainable Drainage is one of the basic parameters for measuring infrastructure status of any Urban Town. The system shall contain dedicated storm water through RCC drains/Pipe Drains/Swales etc., designed with features such as energy dissipation structures etc. to mitigate the sudden fall in velocity, while at the same time maintaining the self-cleaning velocity. This shall not only mitigate the ponding in the system but make the system self-enough to carry the discharge for which it is designed to the final sink.

A Well designed & Operated Storm water will bring tangible benefits such as better health with abridged water borne & Vector borne diseases. A better health leads to better life, as it is said Better health is vital to human happiness and economic wellbeing.

- **Rainwater Harvesting**

Surface run-off collected from the terrace floor will be diverted to the rainwater harvesting ponds. The ponds will be adequate to handle the monsoon season. These shall be part of the development and to harvest the rain water. These shall act as rain water harvesting system and to be used as source of fresh water. These shall be able to mitigate the deficiency from river, as site has very good rainfall potential.

### ■ ■ **Solid Waste**

For designing an effective solid waste management system, various aspects shall be considered, such as population, waste type and waste quantity, technology, legal, institutional, regulatory framework, finances and public attitude and awareness.

The solid waste likely to be generated will include domestic waste (general and hazardous waste), street sweeping waste, green waste from landscaped areas, industrial waste (hazardous and non-hazardous), biomedical waste, electronic waste (E) and Construction and Demolition (C&D) waste. Effective management of such huge quantities of waste is paramount to avoid any issues related to public health and environment protection. Hence, a comprehensive Solid Waste Management Plan, which will comply with the statutory requirements of the Municipal Solid Waste (Management and Handling) Rules, 2000 (MSW Rules, 2000). Municipal, hazardous and biomedical and E-waste management facility is to be provided at an appropriate location. The facilities will include storage, sorting, treatment and disposal facilities. A total of about 10 ha will be required.

The quantities of waste likely to be generated during construction and operation phases have been estimated on the basis of population and land use characteristics. Apart from municipal waste and industrial waste, solid waste in the form of dried sludge will also be generated from sewage treatment plant and other treatment plant.

About 600 MT of Solid Waste including sludge waste from Sewage Treatment Plant is envisaged per day.

### ■ ■ ■ **Power and ICT Systems**

Smart grid connected with distributed power generation that significantly generates reliable security of supply (SOS) and quality of electric energy shall be presented. This concept is practical and reliable as

numerous types of energy sources become available, such as solar, wind, biomass, and hydropower as a hybrid case.

The proposed development will spur demand for a wide array of spin-off businesses and will offer the full array of services required for a mega-scale city and the communities located within it. For the purpose of understanding and project of this magnitude, it becomes important to adopt a systematic & rigorous methodology & approach for power supply planning and overall demand. The demand like wet utilities shall be done for the horizon period.

The entire development will be divided into various cluster groups i.e. Residential, Commercial, Industrial, etc. The Built-up Area considering growth plans & Population density of various clusters will be used in assessment of the power demand and infrastructure planning of electrical power system. The Optimum Built-up Area for each Plot area is based on Floor Space Index norms and population density as applicable for each type of area.

Since each Cluster group is a mix type plot, at this stage it remains uncertain to identify whether it is dedicated for the specific purpose. For example, the cluster Residential zone may comprise of Residences, Commercial offices/retail, Leisure/hospitality, Community facilities, local public open space, roads, and utilities. Thus, based on overall land use plan average load shall be worked out for these plots based on utility norms / past project references.

The main objective of carrying out the demand assessment for complete development is to estimate the power demand, identify the right source for feeding the power and also to select the correct voltage levels for Transmission & Distribution (T&D) purposes.

Ring Main Unit (RMU) is a compact, sealed for life metal-enclosed switchgear widely used in Urban Power Distribution Network has been proposed. The brief features shall be as below:

- Feature-Rich Compact Designs: Ring Main Unit SF6 insulated compact Switchgear. Its compact design requires least possible space to install and operate.
- Time and Cost Savings: RMU is a complete switchgear and is easy to install, saving installation and commissioning time.
- Safety and Performance: Modern compact design and latest technology of the RMU ensure complete safety, connectivity, reliability, and efficiency.
- Smart Capabilities: Intelligent Electronic Devices and Communication capabilities the RMU is easy to integrate with Distribution Management System and in building a Smart Grid solution.

Chemical earthing has been proposed as the same is more efficient than the traditional Earthing. Street Lighting shall be LED with Glass Reinforced Poles to mitigate corrosion. The Street light shall be on auto mode with time/location and grouped for ease in operations.

Main receiving substation (MRSS) shall comprise of 400kV / 220kV / 132kV/110 kV substation. Based on load demand of various clusters and distribution network length the voltage shall be stepped down to 66kV or 33kV or 11 KV by using power transformers.

Further distribution to project site shall be through various Zonal (clustered) substations which may be of 66/11kV or 33/11kV. With project advancement the distribution shall be underground. Switching station, ring main units (RMU), package substations shall be proposed wherever required.



The Substation shall be Gas Insulated Sub Station (GIS) to optimize the land requirement land requirement and to have efficient O&M. As required may for smaller loads concentrated at one end/location to mitigate voltage drops in cables, Compact Substation may be proposed to optimize both the cost and technical constraints.

Understanding of Telecommunications and Control network and facilities of Subject Site and surrounding areas; number of lines available at present and future for the Subject Site and surrounding areas. Type of network (overhead, underground) available, type of cable (copper, fibre optics), latest technology and services available. Based on the data collected central Control room will be planned. A smart city also includes the city of a safe city. Surveillance shall be thoroughly planned. E-governance shall be planned. The communication may be wired if so, the cables will run underground from the property boundary to the central Command room and all facilities or may be wireless.

## ■ Industrial Area

The industrial area proposed during this phase of the development of the Township is a strip of coastal land at Campbell Bay that is currently put to industrial, logistics and transport use. There are two existing jetties within this area. The Concept Master Plan proposes to retain the existing industrial land use and allow parcels to be redeveloped as higher performing, more cutting-edge industrial facilities. These could include expansion of cold storage facilities (critical for development of the fishing industry) as well as ship repair and/or warehousing of goods for local consumption. Fish processing and packing is another potential activity on this industrial land. The anticipated industrial mix will be identified during the preparation of the Development Sector Identification Report. In addition to this is included a logistics centre at the west of the port. After the port is functional, this land can be programmed for the development of warehouses and other logistics facilities. Given the minor environmental impacts associated with future light industrial development, it is anticipated that the island's future wastewater collection and treatment system can also serve the industrial area. Pre-treatment may be required for industries such as seafood processing. The industrial area will also be served by municipal water and power systems.

## ■ Residential Area

Most residential areas proposed in the Concept Masterplan incorporate other uses such as neighbourhood-serving commercial. An exception is the Residential Low-Density land use category, which includes only single-family housing. Residential areas will be served by water supply, wastewater, storm water, electrical power and solid waste services. High-density mixed-use areas in Campbell Bay may be served by district cooling systems. (Economic and technical viability to be ascertained later in the study.)

## ■ ■ Greenbelt

Rather than a green belt, the Township development in Great Nicobar includes green buffers separating the city from the national parks and the biosphere, on the one hand, and running along the coastline, on the other. The Coastal Buffer is as described above, and the forest buffer is described under the Ecotourism land use category. One-third of the project area will be green area.

## ■ ■ Social Infrastructure

Future residents of Great Nicobar will enjoy a high level of social infrastructure services, including healthcare facilities, schools and community centres. The coverage area of these services will vary with the size of the urban centre. The city centre at Campbell Bay will be the site of a new or improved hospital and will also include public schools at all levels. The smaller sub-centres from Anderson Bay to Gandhi Nagar will have individual or shared primary healthcare clinics, primary and secondary schools and community centres. The current residents of the site clearly expressed to the consultant team during their visit, their desire for improved social infrastructure (especially schools and healthcare) to be provided as part of the future development of the city, which shall be catered to in the Masterplan.

## ■ ■ Connectivity

External and internal connectivity are both critical for the future success of the proposed city. External connections by air and by sea to Port Blair must become more frequent, faster, and more affordable. Great Nicobar will require direct air connections from other Indian cities and connections to Southeast and East Asian destinations. The internal connectivity will be greatly improved by the construction of a central transport spine—combining a parkway that integrates rapid transit service (e.g., light rail or bus rapid transit) from the port to Campbell Bay. All communities in this area will have 'last mile' road, bicycle and pedestrian connections to the central spine.

## 6 REHABILITATION AND RESETTLEMENT

### International Container Transshipment Terminal

No rehabilitation and resettlement of existing residents is anticipated for this project. There are currently no residents on the proposed site.

### International Greenfield Airport

The proposed area is sparsely populated and there are only two villages in the area of proposed airport. Most of the area is revenue land except for approximately 32 ha, which is under forest land. The revenue villages lying in the area of proposed airport are Gandhi Nagar and Shastri Nagar, part of which will need to be displaced. The land to be utilised for the proposed airport is presently part vacant, tsunami submerged land, part is owned by villager's part owned by the Government. In view of this, a limited rehabilitation and resettlement plan for human habitat is required or is foreseen. The details of the population in revenue villages are given in Table-43

**Table 43: Details of the households in revenue villages**

| S. No. | Revenue Villages | Population | Remarks                          |
|--------|------------------|------------|----------------------------------|
| 1      | Gandhi Nagar     | 69         | Partial displacement anticipated |
| 2      | Shastri Nagar    | 15         | Total displacement anticipated   |
|        | <b>Total</b>     | 84         |                                  |

### Township and Area Development

Very little rehabilitation and resettlement of existing residents is anticipated for this project. Only the development of infrastructure will require resettlement. The development of a new north-south road will require some land takings for public utility. The planners that fix the road alignment will make every effort to avoid any settled areas, including tsunami villages. It is possible that some of the other infrastructure facilities (sewage treatment plants, etc.) may require resettlement, including acquisition of private land and/or homesteads. The total number of affected people will be modest. The specific impacts will only be determined at the Detailed Project Report stage.

### Power Plant

No rehabilitation and resettlement of existing residents is anticipated for this project. There are currently no residents on the proposed site.

## 7 ANALYSIS OF PROPOSAL

### ■ International Container Transshipment Terminal

The project site faces no social issues. The final phase for marine infrastructure has been conceptualised in such a manner so as to reduce the environmental impacts of the project developments on the surrounding elements and the marine ecology.

The site has good marine access. The bathymetry at the harbour is good as it is deep enough to only require a moderate amount of dredging whilst not being excessively deep for breakwater construction. The site location is well balanced in terms of wave climate and sedimentation. The new harbour is expected to be relatively free from major sedimentation issues which can be a serious environmental problem.

The site falls partly under ICRZ Zone 1B. It has Turtle nesting site on the western side near the mouth and western beach of Galathea River. To preserve the turtle nesting site development of berths on the west side of Galathea bay will be avoided.

The project shall bring major investments to the region covering a wide range of sectors connectivity, shipping industry, social infrastructure.

The project once fully operational shall bring total employment potential of 1,250 and 4,200 persons and an investment of INR 18,308 Crores and INR 35,959 Crores during initial Phase and Final phase respectively, thereby opening up employment opportunities for the youth in the region.

The proposed container Transshipment terminal therefore immensely adds to the social economic value to the Great Nicobar Island.

### ■ International Greenfield Airport

Greater Nicobar Island needs to be developed in a holistic manner to ensure that it comes up with an infrastructure setup at par with the rest of the country. This island has considerable potential to be developed as an integrated hub supporting tourism, industry, Transshipment port and a viable place for the local population to flourish.

The precursor to development is infrastructure and connectivity; the current connectivity is limited to painstaking sea journey from Port Blair alone and a few flights a week by helicopters with limited capacity. Hence, there is need to plan a self-sustaining envelope of activity on this island that can support each other and provide economic viability.

The proximity to Indonesia, Malaysia, Myanmar and Thailand provides adequate opportunity to develop this island as a tourist destination by developing an airport which can support international operations.

The availability of adequate land coupled with the impetus by the Government both at Centre and UT can be the right opportunity to undertake the construction of an International airport which can obviate the primary hurdle of reaching there and being connected to the mainstream by providing air and sea connectivity.

The present site has always had a sizeable low-lying area which has further increased after the Boxing Day tsunami of 2004. The fluctuating water levels have further rendered part of this area inappropriate for

any other task but for this project. The grading of higher areas will generate considerable earth which will be utilised to provide fill for the low-lying areas.

Site drainage will be profiled to ensure safe and efficient drainage of water and adequate green areas will be maintained to ensure the environment is given due consideration.

In view of the forgoing discussions, the site appears to be feasible and the opening of Great Nicobar Island International Airport could generate a significant number of jobs over the next two decades and catalyse the socio-economic growth of the local population in addition to improving connectivity and developing eco-tourism of the region.

## Township and Area Development

The development of a township on the majority of the 166 sq.km of the project area appears to be technically, socially, environmentally and economically viable.

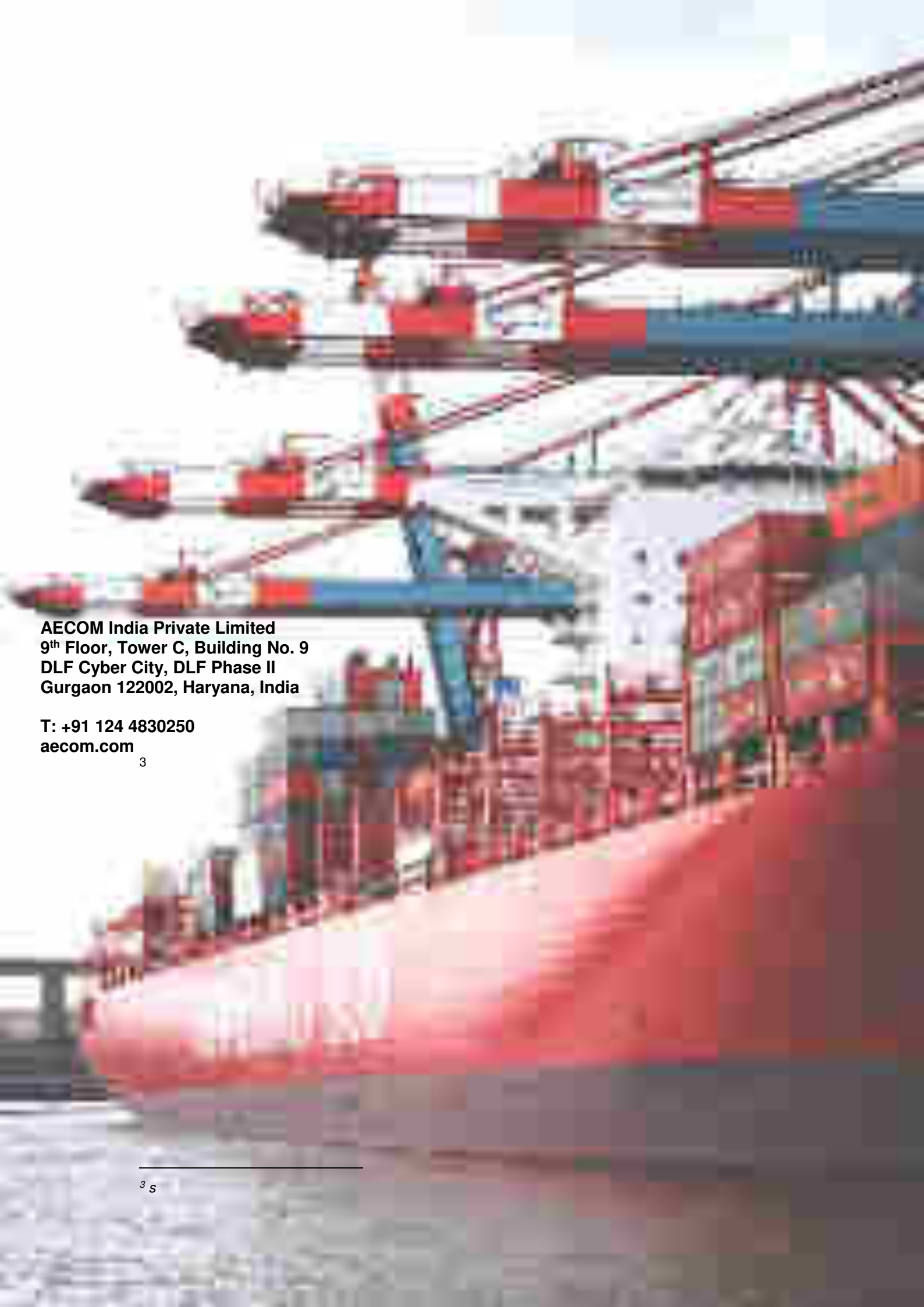
The revenue lands can be redeveloped into compact, diverse, highly sustainable urban sub-centres connected by low-carbon rapid transit (land and sea). The key supporting infrastructure systems — water supply, waste water, storm water, roads, public transport and solid waste — can be feasibly developed on the island.

Connectivity to customers and markets is key to the development of the tourism sector at Great Nicobar Island. Up- market, high-end tourism is likely to be the most viable on GNI, given space constraints. It is also consistent with the eco-sensitive focus and high quality of the assets.

The A&N business community is willing and able to participate in development of the tourism and shipping sectors on the island. But given the scale of the projects, participation by large Indian and/or international players is also required. Breaking megaprojects into smaller chunks can help secure more local business participation. The business community is informed that the public sector mindset has changed, and that development on GNI can coexist with defence functions, in harmony with nature, aboriginals and the new city development.

## Power Plant

The power plant is a viable investment that is anticipated to perform well economically and environmentally. The evolution of the source of power from diesel to liquid natural gas responds to the expediency of jump-starting the operation of the city and the port, on the one hand, and to the long term environmentally sustainable operation of the facility, on the other. No resettlement is required; the social costs of the project are minimal, and the social benefits in terms of reliable access to 24/7 power supply are anticipated to be considerable.



**AECOM India Private Limited**  
9<sup>th</sup> Floor, Tower C, Building No. 9  
DLF Cyber City, DLF Phase II  
Gurgaon 122002, Haryana, India

**T: +91 124 4830250**  
**[aecom.com](http://aecom.com)**

3