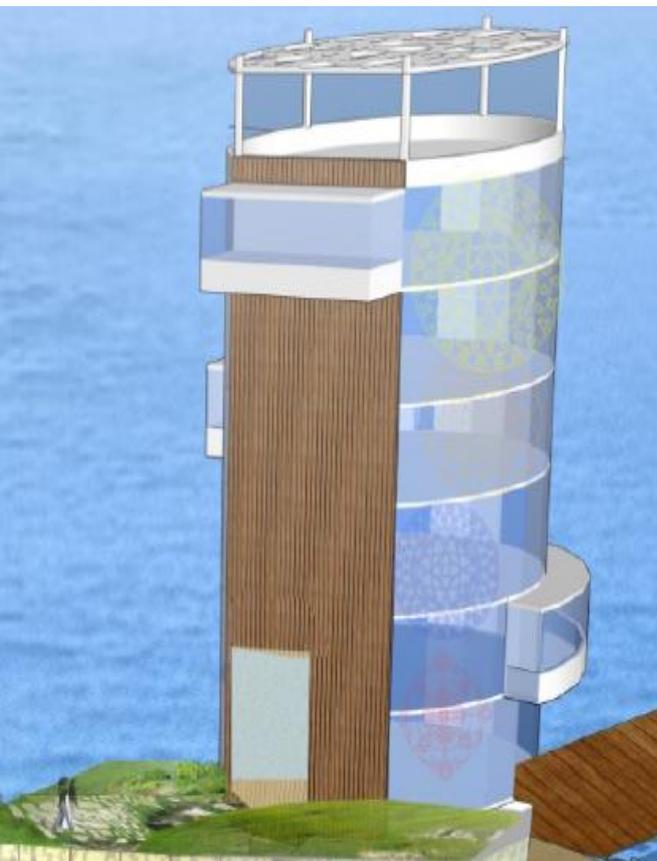


TECHNO-ECONOMIC FEASIBILITY OF AN UNDERWATER VIEWING GALLERY AND RESTAURANT AT BEYT DWARKA (GUJARAT)



Prepared for:

Prepared by:



Indian Ports Association



Techno-economic Feasibility of an Underwater Viewing Gallery and Restaurant at Beyt Dwarka (Gujarat)

Draft Techno-economic Feasibility Report

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January 2017

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Quality Information

| | |
|----------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| Client: Indian Ports Association | Contract No. (if any): NA |
| Project Title: Techno-economic Feasibility of an Underwater Viewing Gallery and Restaurant at Beyt Dwarka (Gujarat) | Project No.: DELD16112 |
| Document No: DELD16112-REP-10-0000-CP-1004 SharePoint Ref: | Controlled Copy No: |
| Document Title: Draft Techno-economic Feasibility Report | |
| Covering Letter/ Transmittal Ref. No: | Date of Issue: 12 January 2017 |

Revision, Review and Approval Records

| | | | | |
|----------|------------------------------------------|----------------------|----------------------|----------------------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| A. | Draft Techno-economic Feasibility Report | RG/RP 10.01.2017 | RP 10.01.2017 | SG 12.01.2017 |
| Revision | Description | Prepared by/ date | Reviewed by/ date | Approved by/ date |

Document Revision Register

| Issue no. | Date of issue | Section | Revision Details | Revision By Name & Position |
|-----------|---------------|---------|------------------|-----------------------------|
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1.0 INTRODUCTION

1.1 Project Background

Beyt Dwarka is located in the newly formed district of Dev Bhoomi Dwarka. It is a small island having a total population of about 7000. The development on the island is concentrated in a radius of about 500 m from the main temple complex. The total length of island on the longer axis is approximately 12 km. The width varies from 300 m to 1800 m. The overall physical infrastructure on the island is not very developed. The locals depend on the passenger ferry service in order to travel to Okha for their basic health, education other daily needs. The water and power requirements are met through the undersea connections with Okha. The condition of roads is extremely poor on the island with only part Island accessible. There is no sewerage treatment plant and solid waste management mechanism on the island. Portions of sewerage line under construction can be seen on certain areas only

The place has religious importance and is associated with Lord Krishna. The Beyt Island also has several temples and mosques, where thousands of tourists visit every year. However, there is no tourism infrastructure such as hotels, motels, passenger vehicles, tourist information centre etc. on the island. Three wheelers are the only mode of transport available on the island. The temple complex lacks in support infrastructure like, holding areas, tourism amenities, proposer circulation, security etc.

Other than religious activity, the Beyt also has beautiful untouched beaches on the Northern direction of the island, i.e. Dunny Point. During summer and winters, temporary camps are established to cater to the tourists interested in recreation activities and leisure. However, this number is very small as compared to persons visiting as pilgrimages.

Considering the religious importance and poor mainland connecting infrastructure, the government is keen to develop this location not only to provide connectivity to locals, support current pilgrimage activities but also to develop it as a tourist destination.

1.2 Proposed Developments at Beyt Dwarka

Considering the religious importance and tourism potential of the island, the Government is proposing multiple projects for the development of this area. The overarching objective is to make this island a tourism destination. The present initiatives for the island being undertaken are:

- Development of a sea link/ road bridge connecting the Beyt to Okha mainland under MoRTH
- Rehabilitation and beautifying the Dwarkadhish Temple at Beyt Dwarka and its surroundings under Tourism Corporation of Gujarat Limited
- Development of an underwater restaurant and viewing gallery project under Ministry of Shipping.
- Beyt Development Program under District Collector, Khambhalia

1.3 Terms of Reference of the Present Assignment

The Ministry of Shipping, as part of Sagarmala Programme, has planned to develop various places along the coastline for the purpose of tourism. Several projects relating to light house development, marinas and cruise shipping are in the pipeline. The proposed underwater viewing Gallery and Restaurant is also envisaged to meet the objective of promoting the tourism and improve the current infrastructure of the Beyt Island. The broad terms of reference of the proposed assignment are given below:

1. Study the number of tourists and their profiles (national, international, gender based and age-wise), who visit Beyt Dwarka currently and estimate the potential increase in the long term horizon of 20 years.
2. Collection of existing information as well as primary data especially on the hydrography, geotechnical, water quality, sediment, ecology and archaeological settings of the project area.
3. Coordination with National Highway Authority of India (NHAI), Ministry of Shipping (MoS), Ministry of Road, Transport and Highway (MoRTH), Tourism Corporation of Gujarat Ltd. (TCGL), Gujarat Maritime Board (GMB), Archaeological Survey of India (ASI), National Institute of Oceanography (NIO) to collect information relevant to the project.
4. Assess the possibility of setting up of Underwater Viewing Gallery and restaurant having see-through walls to enable watching of marine life and heritage resources.
5. Identify an appropriate location for the facility based on presence of spectacular marine life, heritage resources, proximity to proposed bridge/link being planned by MoRTH and other existing tourist spots.
6. Evaluate various similar facilities world-wide and their suitability to the proposed project location.
7. Determine and suggest an appropriate environmentally sensitive design options for an underwater viewing facility/ observatory and restaurant and suggest most suitable option to be recommended for implementation.
8. The proposal must address and resolve technical challenges from the start and created a realistic, practical and cost-feasible design.
9. Prepare the perspective views of the proposed structure along with floor plans.
10. Preparation of the capital cost estimates and financial feasibility estimate of the project along with the implementation schedule.
11. Assessment of environmental, ecological sensitivity of the proposed facility, especially heritage resources within the study area (both off shore and onshore) and assess the significance and severity of the project on the resource arising from pre-construction, construction and operational phase.
12. Preparation of Environmental Management Plan covering environmental, social, emergency response, and monitoring aspects for pre-construction, construction and operational phase.
13. Identify all relevant stakeholders, clearances, approvals and permits required for the project.

1.4 Present Submission

The present submission is a Draft Techno Economic Feasibility Report as per requirement of the terms of assignment. It spells out features of the project, site reconnaissance and market surveys, features of the identified location, evaluation of the possible concepts and details of the recommended development.

2.0 SITE CONDITIONS

2.1 Project Location

Beyt Dwarka is an island situated about 2 km SE of Okha Port at the mouth of Gulf of Kuchchh (**Figure 2.1**). The island is about 9 km long and 0.5 to 2 km wide. The island is reached only by ferry boats plying regularly between ferry terminals at Beyt Dwarka and Okha.



Figure 2.1 Location of Okha Port and Beyt Dwarka Island

2.2 Access to Beyt from Mainland

Beyt Dwarka is about 2.5 km from Okha and has access through ferries. It was reported that a total of 160 small motor boats operate between Beyt Dwarka and Okha. GMB has registered each of these boats for a capacity and they operate according to their turns. Maximum capacity of these boats varies between 80 – 120 passengers.

Okha is about 30 km from the main city of Dwarka and is connected through National highway 947 or State highway 6A. NH 947 connects Dwarka and Beyt Dwarka to Jamnagar and Rajkot. On the other side Dwarka is connected to Porbander and Somnath through NH6.

2.4 Dwarkadhish Temple and Surrounding Areas

The habitation on Beyt Dwarka Island is limited to a very small area (**Figure 2.2**) around the Dwarkadhish temple, which is located close to Ferry terminal. A very narrow concrete road connects ferry to the temple having shops on both the side. Other than this, the island only has Kutcha (unpaved) non-motorable roads.

It is reported that a total of 6000 – 7000 people reside at Beyt and about 90% of the total population is Muslim. Hindus at the Island are mostly associated with temple activities.

Northern part of the island is uninhabited and dense vegetation is observed there. Further on North East, Dunny point has pristine sand beaches. On the southern side of the Island a large land parcel is designated as Reserve Forest.

The western side of the island has steep and high banks while Eastern side has gentle slopes forming beaches.



Figure 2.2 Location on Beyt Dwarka Island

| | |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |
| Entrance of Dwarkadhish Temple | Narrow Road Leading to Temple |
|  |  |
| Jetty Approach at Beyt Dwarka | Ferry and Passengers |
|  |  |
| Settlement on the Waterfront at Beyt | Sand Beach at Dunny Point |
|  |  |
| Kutch Road | Three-Wheelers Mode of Public Transport |

Figure 2.3 Pictures Taken at the Site

2.5 Other Places of Religious Importance at Beyt

Other than Dwarkadhish temple, the Beyt Island has few other prominent religious places such as:

- Dandi Hanuman Temple
- Abhya Mata Temple
- Hazi Kirmani Mosque (Dargah)

2.6 Tourism Activities

The major attraction of this island is Dwarkadhish Temple. It is estimated that about 2,000 – 3,000 people visit this temple every day and this number mounts to about 15,000 – 20,000 on festivals like Janmashtmi, Holi, Deepawali, Poornima and Christmas.

Several people visit hanuman temple during Hanuman Jayanti while during Id festival Hazi Kirmani is reported to be visited by thousands of Muslims from Gujarat.

2.7 Site Data

2.7.1 Meteorology

2.7.1.1 Climate

The site has subtropical hot semi-arid climate. These areas are generally dry and receive very low rainfall during monsoon.

The temperature was found to vary between 24°C to 32.5°C, having January as the coldest month and June being hottest (**Table 2.1**). Rainfall is very scanty in the region and area receives most of its rainfall in the months of June, July and August. Relative Humidity is 80% to 87% for eight months in the year due to its proximity from the sea.

Table 2.1 Meteorological Conditions at Okha

| Month | Daily Max. | Daily Min. | Monthly Rainfall | Relative Humidity |
|-------|------------|------------|------------------|-------------------|
| | °C | °C | mm | % |
| Jan | 24.1 | 18.8 | 2.0 | 65 |
| Feb | 25.0 | 19.6 | 1.8 | 72 |
| Mar | 27.3 | 21.9 | 1.5 | 80 |
| Apr | 29.8 | 24.3 | 0.1 | 84 |
| May | 31.8 | 26.5 | 1.4 | 81 |
| Jun | 32.5 | 27.6 | 54.5 | 82 |
| Jul | 31.1 | 26.6 | 120.8 | 85 |
| Aug | 30.0 | 25.7 | 80.6 | 87 |
| Sep | 30.2 | 25.3 | 16.0 | 85 |
| Oct | 30.0 | 24.6 | 8.2 | 82 |
| Nov | 28.7 | 23.5 | 9.0 | 68 |
| Dec | 25.7 | 20.4 | 1.4 | 63 |

[Source: Okha station, Climatological Normals (1961 -1990), Indian Meteorological Department, 2010.]

2.7.1.2 Wind

Mean wind speed reported by IMD at Okha varies between 13 and 23.7 kmph. Months of May, June, July and August were found to have high wind speeds of more than 20 kmph (**Table 2.2**).

The rose diagram indicates the predominant wind direction to be North West and West (**Figure 2.4**).

Table 2.2 Mean Wind Speed at Okha

| Month | Mean Wind Speed (kmph) |
|-------|------------------------|
| Jan | 17.4 |
| Feb | 16.8 |
| Mar | 17.4 |
| Apr | 18.6 |
| May | 21.8 |
| Jun | 22.0 |
| Jul | 23.7 |
| Aug | 20.5 |
| Sep | 15.7 |
| Oct | 13.0 |
| Nov | 15.6 |
| Dec | 17.1 |

[Source: Okha station, Climatological Normals (1961 -1990), Indian Meteorological Department, 2010]

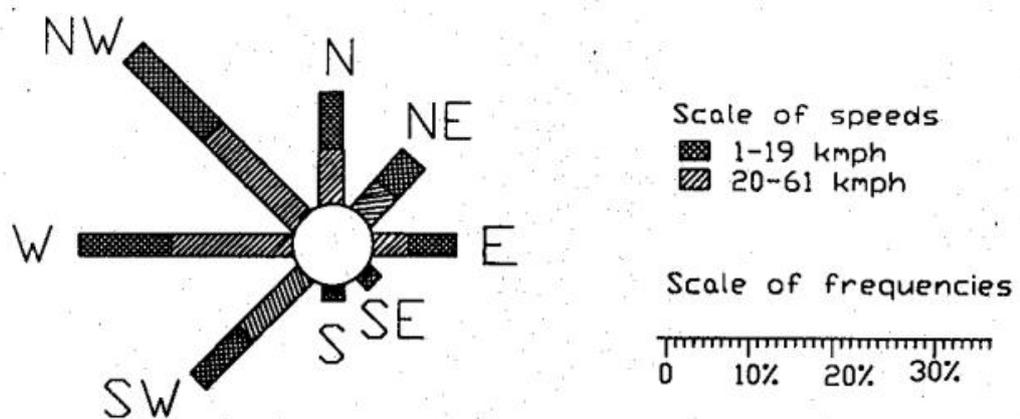


Figure 2.4 Wind Rose (IMD, 1965 -1995; Okha Port)

2.7.2 Oceanography

2.7.2.1 Waves

The ferry terminal location at Beyt is well protected from the direct action of waves due to natural protection provided by Okha headland. The ferry operations are possible all-round the year.

2.7.2.2 Currents

The currents in the bay area between Okha and Beyt Island are low and insignificant for navigation purposes.

2.7.2.3 Tides

The region experiences semi diurnal tide. The recorded tidal levels with respect to Chart Datum (CD) at Okha Port are provided in **Table 2.3**.

Table 2.3 Water Levels at Okha

| Water levels | Levels Above Chart Datum |
|----------------------------------------|--------------------------|
| MHHW (Mean Highest High Water Level) | 3.47 m |
| MLHW (Mean Lowest High Water Level) | 2.96 m |
| MHLW (Mean Highest Low Water Level) | 1.20 m |
| MLLW (Mean Lowest Low Water Level) | 0.41 m |
| MSL (Mean Sea Level) | 2.04 m |

2.7.2.4 Bathymetry Information at Site

Water depths observed near the jetty were close to 2 m with respect to CD (**Figure 2.5**). The 2 m water depths were observed all along the jetty at a distance of 150 to 300 m on the South of the Jetty. Many rocks are also present close to the bank on the southern side, which are exposed during low tides



Figure 2.5 Bathymetry of The Area

2.7.2.5 Turbidity

Visual observations made during site visit (Mid of September) suggest that the water is reasonably clean (**Figure 2.6**). Jetty piles and submerged structures were visible till about 1.0 – 1.5 m of water depth and it was reported by GMB officials that visibility shall further improve in the during the winter months (November to February). During monsoon months (mid-May to mid-September) the water is very turbid with poor visibility.



Figure 2.6 Visibility through Water (end of September)

2.7.3 Cyclone

Storm tracks relevant for the study area from 1947 to 2011 were extracted from IMD e-Atlas and UNISYS database. The cyclones that have passed through the region are given in **Figure 2.7**.

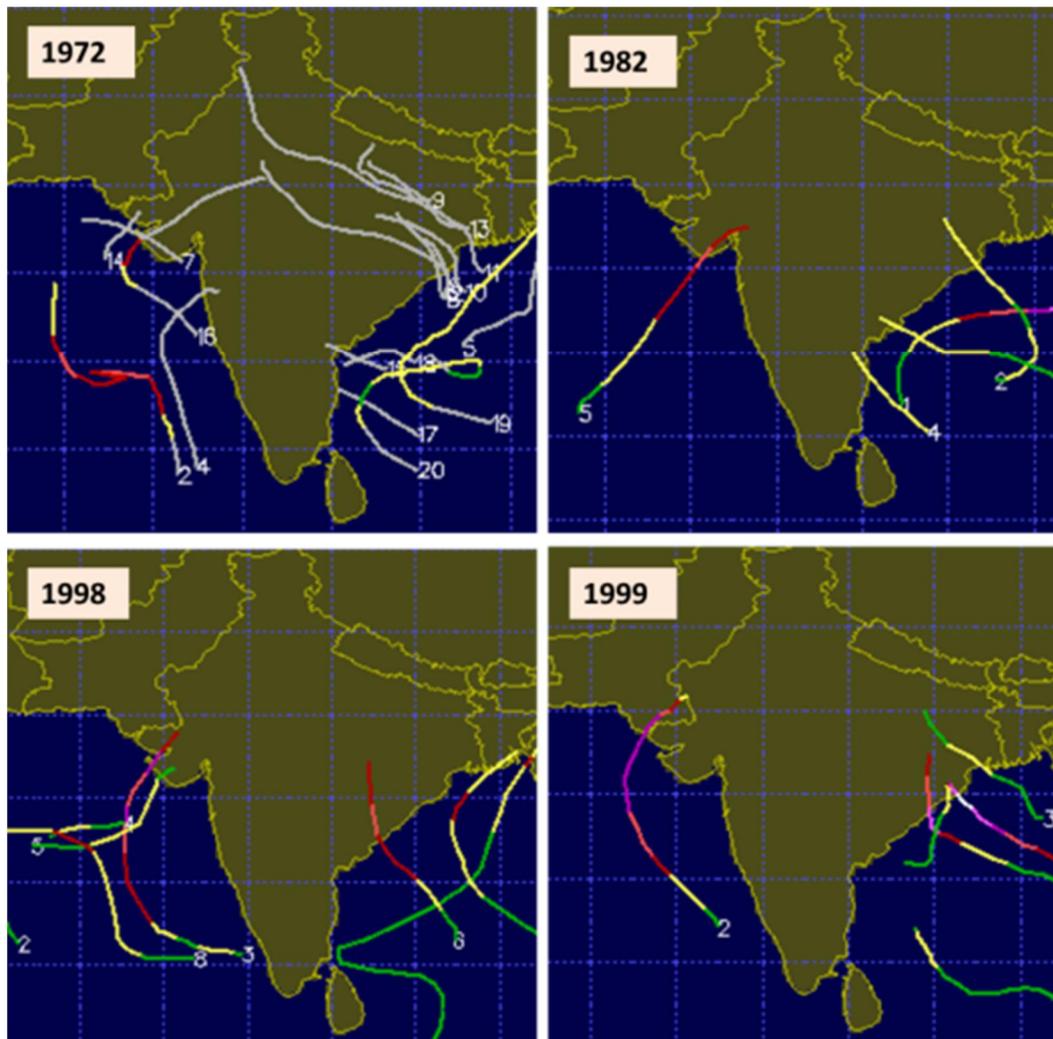


Figure 2.7 Most Significant Cyclone that have Passed Close to the Site

2.7.4 Geotechnical Data

No geotechnical data is available for site. However looking at the rocky outcrops along the shore line and steep sea bed slope it is likely that the rock would be present at or very close to the sea bed level near shore area of Beyt.

2.7.5 Topography

The site presents an uneven topography. Levels vary between 4 m to 7 m with reference to MSL. The middle of the island has higher elevations (**Figure 2.8**).

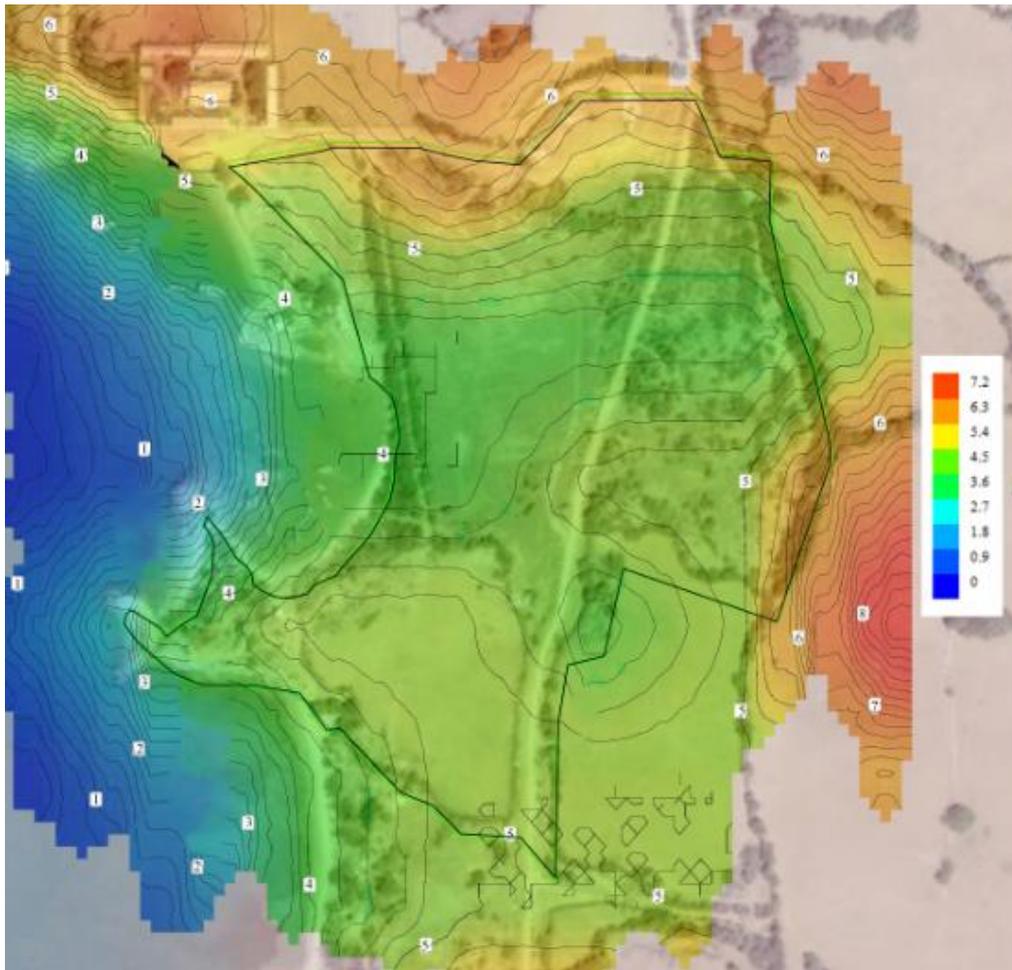


Figure 2.8 Topography of the selected land parcel w.r.t. MSL.

3.0 SECONDARY DATA COLLECTION AND ANALYSES

On receipt of Letter of Intent (LOI) from Indian Ports Association, AECOM has mobilised the core team of experts with required specialisation and other support personnel to collect secondary data and information relevant to the project. Meeting and communications with various stakeholders was also identified as one of the major tasks in order to get desired information on the site settings, its demography and site features etc.

A list of important stake holders was firm up during the project initiation meeting as listed below and accordingly are been contacted to gather data and also their suggestions on the project.

- Ministry of Shipping
- Gujarat Maritime Board
- Archaeological Survey of India
- CSIR - National Institute of Oceanography, Goa
- Conservator of Forests, Marine National Park, Jamnagar
- Gujarat Pollution Control Board
- District Collector, Devbhoomi Dwarka
- Ministry of Road and Transport/ Roads and Building Department (State), Gujarat
- Tourism Corporation of Gujarat Limited
- Gujarat Ecology Commission

3.1 Data Collected

The most important data set for the present project are land details, number of the visitors and their profile, environmental conditions, archaeology and coastal zone category. **Table 3.1** describes the data sources.

Table 3.1 Data and its Sources

| S. No. | Data | Source |
|--------|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| 1. | Land Ownership Details | District collector's Office; Inception Report and Alignment study Report for the Okha – Bet Dwarka Bridge prepared by DELF Consultant |
| 2. | No. of Passengers and Boats Plying Between Okha and Beyt | Port Office, Okha, Gujarat Maritime Board; 2000 - 2016 |
| | Number of tourists visiting Dwarka Temple | Devasthan Samiti, Dwarkadhish Temple, Dwarka |
| 3. | Air, Water, Noise, Soil data | EIA study for Proposed Setubandh, Part II: Terrestrial Environment; NIO, 2000 |
| 4. | Water, Sediment, Flora/Fauna | Marine EIA for Proposed Repairing/Strengthening of GMB Passenger Jetties at Okha and Beyt Dwarka in |

| S. No. | Data | Source |
|--------|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| | | Mithapur Bay, NIO, 2005 |
| 5. | Coastal Land Use Maps | Coastal Zone Information Maps, Prepared by SAC (ISRO) |
| 6. | Map of Narara Marine National Park and its buffer area | Assistant Conservator of Forest, Jamnagar |
| 7. | Archaeological sites and findings | Literature Available on NIO's Website and in Journals |
| 8. | Location and Details of the proposed road Bridge | Inception Report and Alignment study Report for the Okha – Bet Dwarka Bridge prepared by DELF Consultant; Roads and Building Department (State). |

3.2 Land Ownership Details

Availability of land and its suitability for the envisaged development is a key consideration for any project planning. During the site visit it was understood that Beyt Island is densely populated within a 500 m radius around the temple and the jetty. The closest water front available for development is around Gaushala (survey No. 478) as depicted in **Figure 3.1**.

In order to understand the land use and ownership around the water front and land beyond Gaushala, land details were collected as given in

Table 3.2. The details showed that a large parcel of land under survey number 69 (new survey no. 37 and 567). Most of this land is identified as Government Land, which is found to be suitable for the proposed development considering the size and also the available waterfront.

It is also important to mention that many survey numbers have been designated as 'Agricultural' land but no active farming was noticed when reconnaissance survey was undertaken during the site visit. The land was found to be mostly scrub type.



Figure 3.1 Survey Numbers at Beyt Dwarka

Table 3.2 Land Details* of the Survey Numbers at Beyt

| S. No. | Survey No. | Area, sqm | Land type/ownership |
|--------|------------|-----------|----------------------|
| 1 | 478 | 10110.00 | Agriculture/ Gauchar |
| 2 | 63 | 8867.00 | Agriculture |
| 3 | 64 | 7509.00 | Agriculture |
| 4 | 62 | 12062.00 | Agriculture |
| 5 | 460 | | Mosque |
| 6 | 69 | 95715.80 | Pond/dense scrub |
| 7 | 70 | 5788.97 | Agriculture |
| 8 | 71 | 5298.44 | Dense scrub |
| 9 | 76/1 | 6556.05 | Scrub |
| 10 | 76/2 | 5478.13 | Scrub |
| 11 | 75 | 6605.30 | Agriculture |
| 12 | 77 | 6009.58 | Agriculture |
| 13 | 78 | 8138.73 | Agriculture |
| 14 | 479 | 69039.14 | Scrub |
| 15 | 74/1 | 99905.37 | Agriculture |

*Note: Details as per the information provided by GMB and land department

3.3 Visitors – Port Office data

The Port Office at Okha collects data on the number of passenger travelling per data between Okha and Beyt. The data is available time and date wise for number of boats and travelling passengers. Data between January 2015 and September, 2016 has been collected and is presented in **Figure 3.2** and **Figure 3.3**.

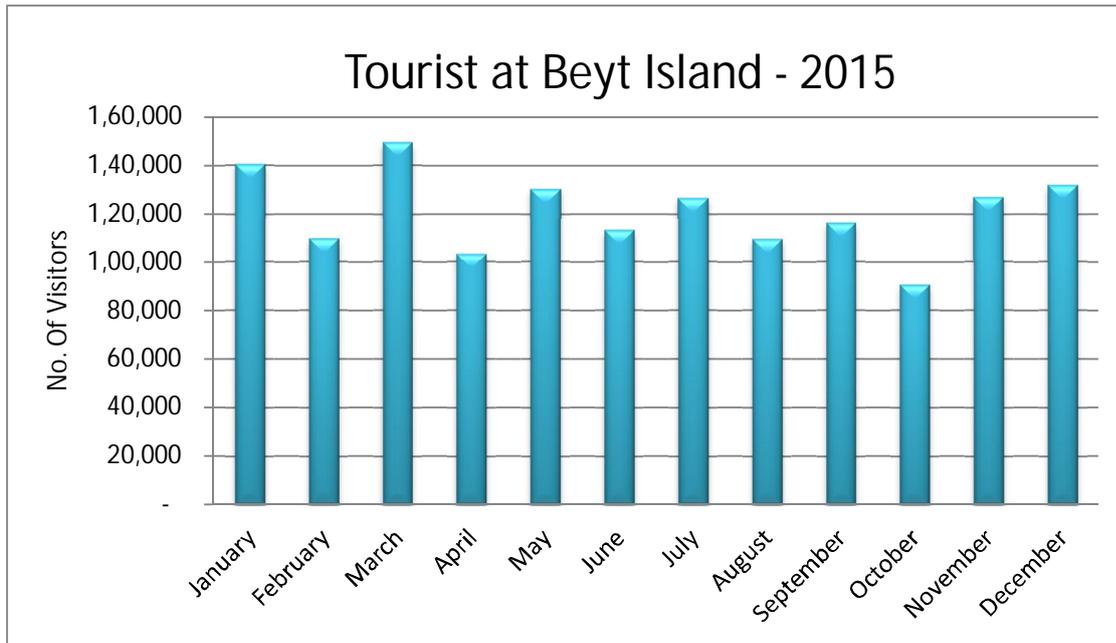


Figure 3.2 Tourist reported at Beyt Island for Year 2015

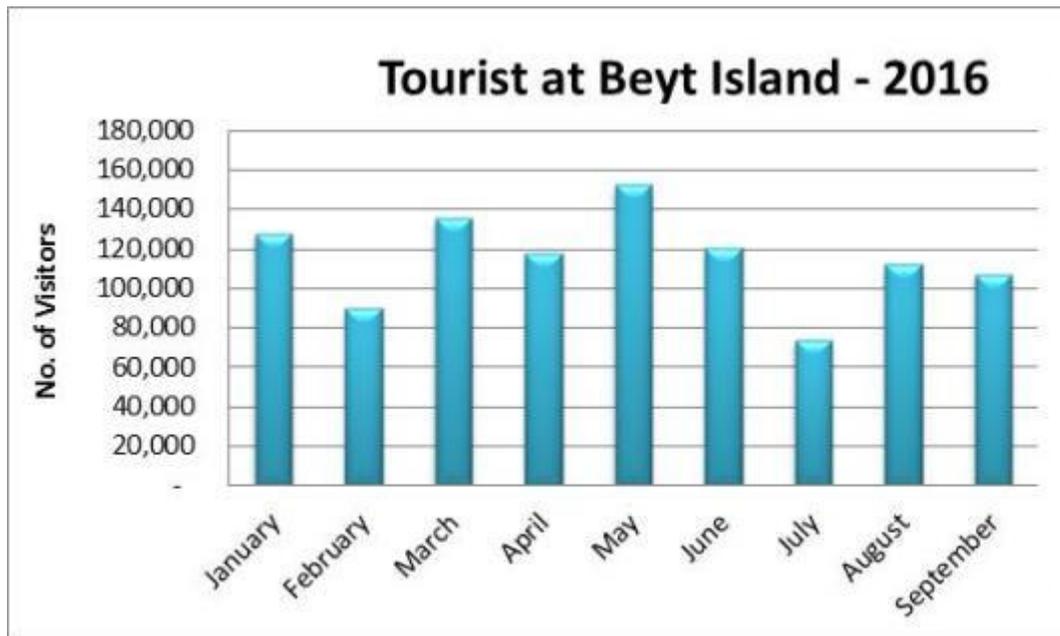


Figure 3.3 Tourist reported at Beyt Island for Year 2016 (January – September)

It was observed that days like first Poonima of the year, Holi, Kalashtmi, first day of Sawan month, Gujarati New Year and Christmas record highest number of visitors (**Table 3.3**).

Table 3.3 Maximum Number of Tourist in a Single Day

| Relevance | 2015 | |
|--------------------|---------------------------|-----------------|
| | Date | No. of Visitors |
| Ist Poornima | 2 nd January | 9100 |
| Holi | 5 th March | 12000 |
| Kalashmti | 7 th July | 7482 |
| Beginning of Sawan | 15 th August | 11025 |
| Gujarati New Year | 13 th November | 8898 |
| X-mas | 25 th December | 10319 |

3.4 Environmental and Ecological Data

The area has ecological significance due to its proximity to the Narara Marine National Park, which is rich in biodiversity. It was very relevant to establish a baseline for environment and this section presents the air, water, noise, sediment quality and ecology of the area close to the site.

3.4.1 Air and Noise Quality

The air data was collected during winter season in the year of 2000 at many locations (**Table 3.4**). Out of all these locations, Okha and Beyt stations were of direct relevance to the present project. The SPM was found to be higher due to the dust suspension from the rural roads and emission from the ferries operating on diesel. The concentration of SO₂ and NO_x were found to be well within the stipulated standards for industrial, residential and rural areas.

Table 3.4 Observed Ambient Air Quality during Winter, 2000 (in µg/m³)

| Sampling Station | SPM Concentration | | SO ₂ Concentration | | NO _x Concentration | |
|---------------------------------|-------------------|----------------|-----------------------------------------------------------------------|----------------|-------------------------------|----------------|
| | Okha | Bet Shankodhar | Okha | Bet Shankodhar | Okha | Bet Shankodhar |
| Min. | 212 | 116 | Not Detectable (Minimum Detectable limit was 6 µg/m ³) | | 28.5 | 10.6 |
| Max. | 550 | 274 | | | 64.0 | 29.2 |
| Mean | 384 | 194 | | | 42.1 | 19.8 |
| CPCB Standard, 2009 (24 hr Av.) | 500* | | 80 | | 80 | |

* SPM was one of the parameter in earlier standards, now standards are specified for PM₁₀ and PM_{2.5}. Source: EIA study for Proposed Setubandh, Part II: Terrestrial Environment; NIO, 2000.]

The noise levels were found to be well within the standards except during day at Okha port location (Table 3.5). The high noise levels at Okha might be due to the human activity and equipment operation at the port site.

Table 3.5 Observed Ambient Noise Levels during Winter, 2000 (in dB(A))

| S. No. | Location | Day | Night |
|--------|---------------------------------|------|-------|
| 1. | Neelkanth Mahadev Mandir | 38.4 | 34.6 |
| 2. | Okha Port | 67.4 | 53.4 |
| | CPCB Standard, 2009 (dB(A) Leq) | 65 | 55 |

[Source: EIA study for Proposed Setubandh, Part II: Terrestrial Environment; NIO, 2000.]

3.4.2 Water Quality

The water temperature of the Mithapur Bay was found to vary between 24.2 and 28.6 considering both pre-monsoon and post-monsoon season (Table 3.6 and Table 3.7). The pH was stable and the average Suspended Solids (SS) were also observed to be low at the mouth of the Gulf (14 -29 mg/l) as compared to Okha Jetty location (28 -69 mg/l). The average Dissolved Oxygen (DO) was always more than 4 mg/l at both the stations, while Biochemical Oxygen Demand (BOD) was also found to be less than 3 mg/l except one or two instances. The traces of phosphate and nitrate were also low suggesting unpolluted state of water. Petroleum Hydrocarbons (PHc) were found to be higher at Okha Jetty due to the operating ferries and probable leaks or spills of fuel or its residues.

Table 3.6 Observed Water Quality during Pre-monsoon within Mithapur Bay

| Parameter | Level | 1997 | | | | | | 2003 | | | | | |
|----------------|-------|---------------|------|------|-----------------|------|------|---------------|------|------|-----------------|------|------|
| | | Mouth of Gulf | | | Near Okha Jetty | | | Mouth of Gulf | | | Near Okha Jetty | | |
| | | Min | Max | Av | Min | Max | Av | Min | Max | Av | Min | Max | Av |
| Temp (°C) | S | 26.0 | 27.5 | 26.9 | 26.5 | 28.6 | 27.5 | 24.8 | 24.8 | 24.8 | 23.6 | 25.1 | 24.2 |
| | B | 26.4 | 27.1 | 26.8 | 26.5 | 28.1 | 27.3 | 25.0 | 25.2 | 26.8 | 23.8 | 25.5 | 24.2 |
| pH | S | 8.1 | 8.2 | 8.1 | 8.2 | 8.6 | 8.3 | 8.2 | 8.2 | 8.2 | 8.2 | 8.3 | 8.3 |
| | B | 8.1 | 8.2 | 8.2 | 8.1 | 8.6 | 8.3 | 8.2 | 8.2 | 8.2 | 8.2 | 8.3 | 8.3 |
| SS (mg/l) | S | 18.0 | 33.0 | 26.0 | 25.0 | 45.0 | 35.0 | - | - | 22 | 20.0 | 42.0 | 29.0 |
| | B | 19.0 | 39.0 | 29.0 | 27.0 | 41.0 | 34.0 | - | - | 62 | 14.0 | 40.0 | 28.0 |
| Salinity (ppt) | S | 36.1 | 36.3 | 36.3 | 36.2 | 37.3 | 36.6 | 36.4 | 36.4 | 36.4 | 36.5 | 37.6 | 36.9 |
| | B | 36.1 | 36.8 | 36.5 | 36.0 | 37.5 | 36.6 | 36.0 | 36.0 | 36.0 | 36.5 | 37.6 | 36.9 |

| Parameter | Level | 1997 | | | | | | 2003 | | | | | |
|----------------------------------------------|-------|---------------|-----|------|-----------------|-----|-----|---------------|-----|-----|-----------------|-----|-----|
| | | Mouth of Gulf | | | Near Okha Jetty | | | Mouth of Gulf | | | Near Okha Jetty | | |
| | | Min | Max | Av | Min | Max | Av | Min | Max | Av | Min | Max | Av |
| DO (ml/l) | S | 4.3 | 4.7 | 4.5 | 3.2 | 5.6 | 4.6 | 5.0 | 5.2 | 5.1 | 2.1 | 4.7 | 3.9 |
| | B | 3.6 | 4.5 | 4.3 | 4.3 | 5.4 | 4.6 | 4.8 | 5.2 | 5.0 | 2.5 | 4.7 | 4.2 |
| BOD (mg/l) | S | 2.2 | 3.0 | 2.6 | 1.7 | 2.2 | 1.9 | - | - | 2.1 | 0.5 | 6.0 | 3.7 |
| | B | - | - | 0.8* | 0.6 | 3.8 | 2.2 | - | - | 1.5 | ND | 6.3 | 3.0 |
| PO ₄ ³⁻ -P (μmol/l) | S | 0.5 | 0.9 | 0.7 | 0.2 | 0.9 | 0.5 | 0.3 | 0.3 | 0.3 | 0.2 | 0.7 | 0.4 |
| | B | 1.1 | 2.5 | 1.6 | 0.2 | 1.2 | 0.6 | 0.7 | 0.8 | 0.8 | 0.5 | 0.7 | 0.6 |
| NO ₃ -N (μmol/l) | S | 0.6 | 9.9 | 4.6 | 2.9 | 7.9 | 5.6 | 1.0 | 1.3 | 1.2 | 1.9 | 2.7 | 2.2 |
| | B | 4.3 | 5.8 | 5.1 | 3.7 | 7.1 | 5.4 | 0.7 | 1.2 | 1.0 | 2.2 | 4.2 | 2.8 |
| NO ₂ -N (μmol/l) | S | 0.5 | 0.8 | 0.7 | 0.5 | 0.9 | 0.7 | 0.3 | 0.4 | 0.4 | 0.1 | 0.3 | 0.2 |
| | B | 0.4 | 0.8 | 0.6 | 0.4 | 1.0 | 0.6 | 0.3 | 0.7 | 0.5 | 0.1 | 0.2 | 0.1 |
| NH ₄ ⁺ -N (μmol/l) | S | 0.3 | 1.0 | 0.6 | ND | 1.3 | 0.4 | 0.3 | 0.8 | 0.6 | 0.2 | 1.5 | 0.5 |
| | B | 0.2 | 0.5 | 0.4 | ND | 1.9 | 0.6 | 0.6 | 0.9 | 0.8 | 0.2 | 0.6 | 0.3 |
| PHc (μg/l) | 1m | - | - | 3.1 | 1.1 | 5.7 | 3.4 | - | - | 0.8 | 0.1 | 2.1 | 1.0 |

[Source: Marine EIA for Proposed Repairing/Strengthening of GMB Passenger Jetties at Okha and Beyt Dwarka in Mithapur Bay, NIO, 2005]

Table 3.7 Observed Water Quality during Post-monsoon within Mithapur Bay

| Parameter | Level | 1995 | | | | 2003 | | | |
|-----------|-------|---------------|--|-----------------|------|-----------------|------|------|------|
| | | Mouth of Gulf | | Near Okha Jetty | | Near Okha Jetty | | | |
| | | Av | | Min | Max | Av | Min | Max | Av |
| Temp (°C) | S | 25.0 | | 26.1 | 27.3 | 27.5 | 27.0 | 28.5 | 27.7 |
| | B | 25.2 | | 26.1 | 27.5 | 27.5 | 27.0 | 28.2 | 27.8 |
| pH | S | 8.1 | | 8.0 | 8.6 | 8.3 | 8.1 | 8.3 | 8.2 |
| | B | 8.1 | | 8.0 | 8.6 | 8.6 | 8.1 | 8.3 | 8.2 |

| Parameter | Level | 1995 | | | | 2003 | | |
|------------------------------------------|-------|---------------|-----------------|------|-----------------|------|------|------|
| | | Mouth of Gulf | Near Okha Jetty | | Near Okha Jetty | | | |
| | | Av | Min | Max | Av | Min | Max | Av |
| SS (mg/l) | S | 7.0 | 25.0 | 25.0 | 15.0 | 39.0 | 52.0 | 46.0 |
| | B | 14.0 | 26.0 | 27.0 | 39.0 | 47.0 | 90.0 | 69.0 |
| Salinity (ppt) | S | 35.4 | 34.1 | 36.4 | 34.4 | 36.8 | 37.3 | 37.0 |
| | B | 37.7 | 34.4 | 36.1 | 36.7 | 36.8 | 37.3 | 37.0 |
| DO (ml/l) | S | 4.7 | 4.3 | 5.5 | 5.1 | 3.2 | 5.1 | 4.2 |
| | B | 4.5 | 4.5 | 5.3 | 4.9 | 2.7 | 4.9 | 4.3 |
| BOD (mg/l) | S | 4.0 | 2.1 | 3.0 | 1.8 | 2.7 | 2.8 | 2.8 |
| | B | 1.5 | 0.6 | 0.9 | 2.1 | <0.2 | <0.2 | <0.2 |
| PO ₄ -P (µmol/l) | S | 1.2 | 0.2 | 0.7 | 0.6 | 0.3 | 1.4 | 1.0 |
| | B | 1.3 | 0.2 | 1.0 | 0.6 | 1.3 | 1.8 | 1.5 |
| NO ₃ -N (µmol/l) | S | 3.6 | 1.4 | 5.6 | 7.3 | 1.2 | 8.4 | 4.7 |
| | B | 4.6 | 1.9 | 6.4 | 6.4 | 2.6 | 9.5 | 5.1 |
| NO ₂ -N (µmol/l) | S | 0.6 | 0.4 | 0.5 | 0.4 | 0.2 | 0.5 | 0.3 |
| | B | 0.6 | 0.3 | 0.6 | 0.4 | 0.2 | 0.5 | 0.3 |
| NH ₄ ⁺ -N (µmol/l) | S | ND | 0.1 | 4.7 | 0.7 | 0.4 | 1.7 | 0.7 |
| | B | - | 0.1 | 1.8 | 0.1 | 0.4 | 1.0 | 0.7 |
| PHc (µg/l) | S | 10.0 | 21.0 | 21.0 | 14.0 | 35.0 | 43.0 | 39.0 |

[Source: Marine EIA for Proposed Repairing/Strengthening of GMB Passenger Jetties at Okha and Beyt Dwarka in Mithapur Bay, NIO, 2005.]

Surface water samples taken from Beyt Island showed unpolluted status of the water bodies (**Table 3.8**). Sample taken from Beyt Jetty represents marine conditions having high hardness, and ions of Sulphate, Calcium, Sodium and Potassium, while, Nitrate and Phosphate were found to be higher in the Pond water. Ground water samples taken from Balapur Village at Beyt were found to have higher alkalinity and hardness than pond water, which indicates ingress of saline water into the ground water.

Table 3.8 Observed Surface Water Quality on Beyt Island

| Parameters | | Surface Water | | Ground Water |
|----------------------------------|-------|----------------------|------------|-----------------------------|
| | | Ranchor Talab (pond) | Beyt Jetty | Balapur Village (Open well) |
| pH | | 8.8 | 8.1 | 8.5 |
| Turbidity (NTU) | | 25 | 18 | 2.5 |
| Conductivity (mS/cm) | | 4.12 | 41.3 | 11.3 |
| T.D.S. | | 2640 | 26432 | 7309 |
| S.S. | | 15 | 13 | 9 |
| T.S. | | 2655 | 26445 | 7300 |
| Alkanity as CaCO ₃ | | 106 | 106 | 415 |
| Hardness as CaCO ₃ | Total | 272 | 6402 | 1506 |
| | Ca | 68 | 1009 | 186 |
| | Mg | 204 | 5393 | 1320 |
| SO ₄ -- | | 135 | 1575 | 280 |
| CL- | | 827 | 20330 | 4150 |
| F- | | 0.25 | 1.37 | 0.73 |
| Na+ | | 860 | 11000 | 2250 |
| K+ | | 160 | 425 | 158 |
| NO ₃ | | 0.6 | 0.2 | 7.8 |
| NH ₃ -N | | 2.75 | 2.75 | 1.96 |
| DO | | 3 | 5.8 | |
| Po ₄ 3- | | 5.75 | 2.19 | 0.29 |
| COD | | 207 | 28 | |
| Fe | | 0.13 | 0.11 | 0.13 |
| Zn | | 0.05 | 0.21 | 0.09 |
| Cu | | 0.03 | 0.05 | 0.02 |
| Co | | 0.05 | 0.18 | 0.05 |

| Parameters | Surface Water | | Ground Water |
|------------|----------------------|------------|-----------------------------|
| | Ranchor Talab (pond) | Beyt Jetty | Balapur Village (Open well) |
| Mn | 0.06 | 0.12 | 0.04 |
| Cr | 0.11 | 0.11 | 0.15 |
| Pb | 0.01 | 0.06 | 0.01 |
| Cd | ND | 0.06 | ND |
| Ni | 0.037 | 0.39 | 0.04 |

[Source: EIA study for Proposed Setubandh, Part II: Terrestrial Environment; NIO, 2000.]

3.4.3 Sediment Quality

Sediment samples were also collected in the Bay (**Table 3.9**). The sediment was recorded to be sand in the outer Gulf (85%) as well as Okha Jetty (81%). The heavy metal contents were quite low which is expected due to negligible industrial activities in the region.

Table 3.9 Sediment quality of Mithapur Bay during 1995-2004 (conc. in µg/g)

| Station | Al (%) | Cr | Mn | Fe (%) | Co | Ni | Cu | Zn | Hg | Pb | C _{org} (%) | PHc |
|---------------------|--------|----|-----|--------|----|----|----|----|------|-----|----------------------|-----|
| 1995 | | | | | | | | | | | | |
| Mithapur Bay | 2.2 | 31 | 592 | 2.4 | 19 | 20 | 16 | 32 | - | 10 | - | 0.1 |
| Post monsoon (2004) | | | | | | | | | | | | |
| Mouth of Gulf | 3.7 | 40 | 383 | 1.5 | 4 | 14 | 20 | 34 | 0.17 | 594 | 0.4 | 1.0 |
| Near Okha Jetty | 3.8 | 36 | 365 | 1.4 | 96 | 16 | 21 | 27 | 0.05 | 738 | 0.7 | 5.2 |

[*Dry weight basis except PHc which is in wet weight

Source: Marine EIA for Proposed Repairing/Strengthening of GMB Passenger Jetties at Okha and Beyt Dwarka in Mithapur Bay, NIO, 2005]

3.4.4 Ecology and Biodiversity

Southern coastline of Gulf of Kutch is declared as Narara Marine National Park/Sanctuary (Figure 3.4). The Beyt Dwarka Island does not come under the Marine National Park and it is about 5 km from its boundary on the South West side, while about 2.5 km away on the South East side (Figure 3.5).

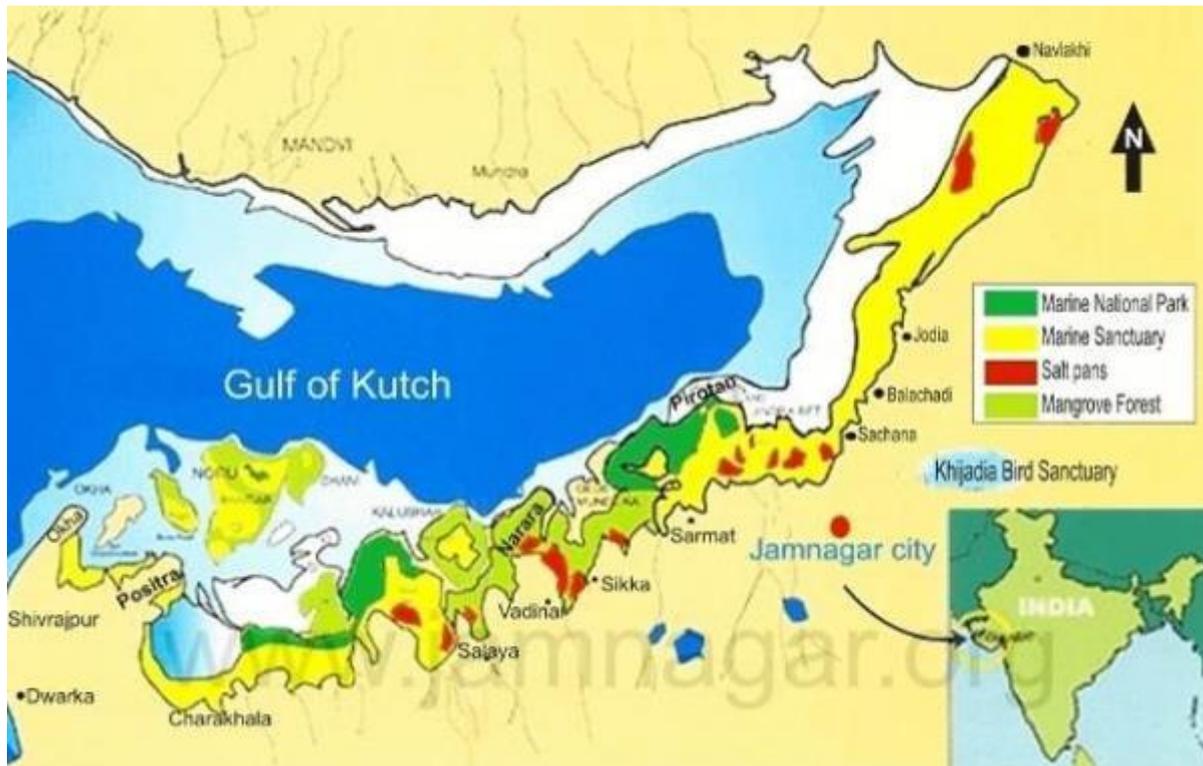


Figure 3.4 Narara Marine National Park and Sanctuary

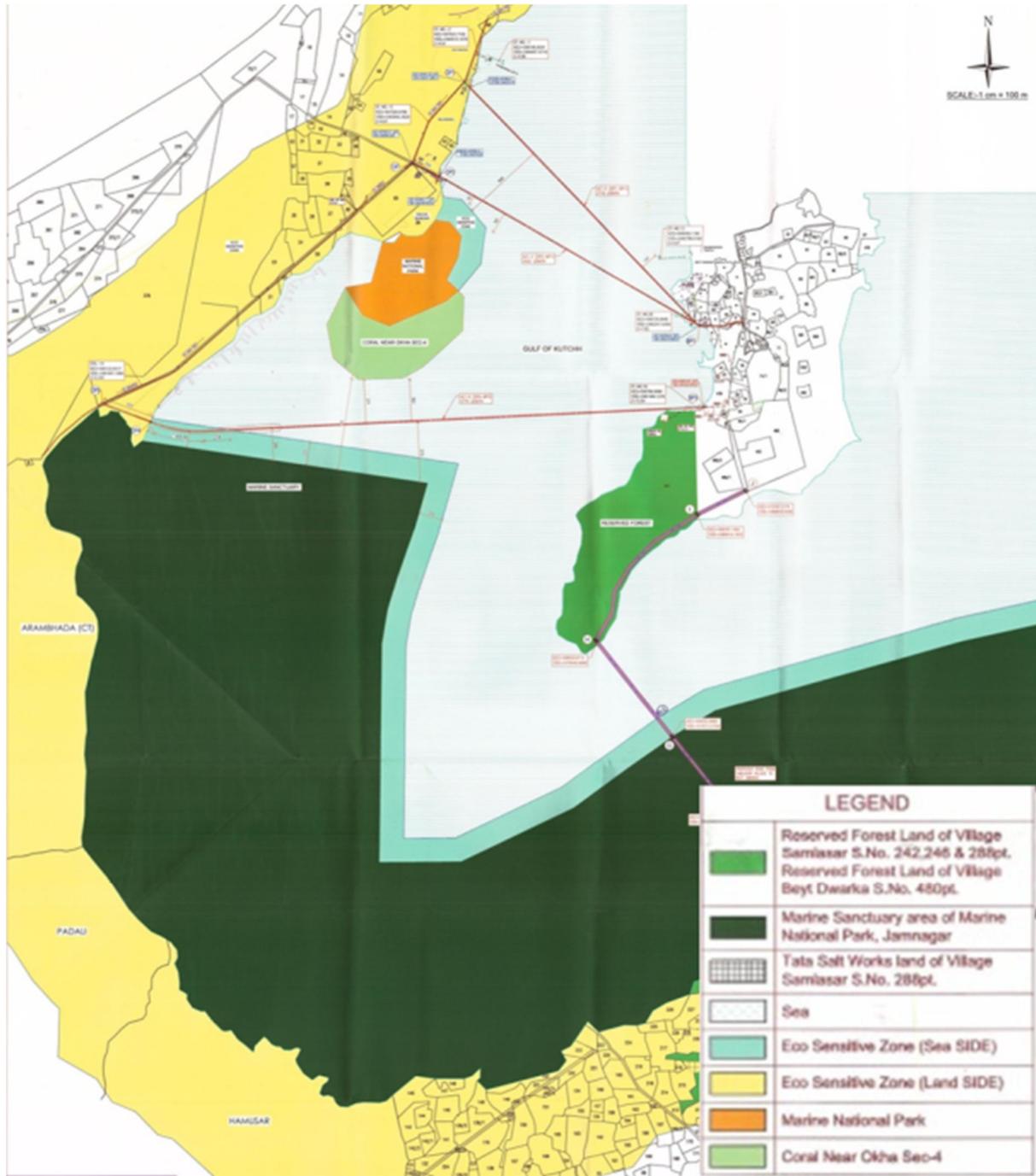


Figure 3.5 Boundary of Narara Marine National Park with Respect to Beyt Dwarka

Location further North of the Hazi Kirmani Mosque has presence of the Forest and Marine National Park (Figure 4.1), while the entire area on the southern side of the island is marked as reserved forest.



Figure 3.6 Map showing Forest and Marine National Park Area around the Beyt Dwarka

The area around Beyt Dwarka is rich in biodiversity and is known to have Coral Reefs, Hard & Soft Corals, Sponges, Prawns, Crabs, Molluscs, Endangered Sea Turtles like the Green Sea, Oliver Ridley & Leather Back, Porpoise, Common dolphins (Indo-Pacific bottlenose dolphins and Indo-Pacific hump-backed dolphins), Dugongs, ray fishes, brown, green & red Algae, mangroves and many birds.

3.4.5 Flora and Fauna near Study Area

3.4.5.1 Marine Flora and Fauna

The Marine water samples indicate poor phytoplankton concentration which was also evident from the pigment concentration (**Table 3.10** and **Table 3.11**). Nitzschia, Thalassiosira, Navicula, Pleurosigma and Chaetoceros were recorded to be the most dominant genera observed in the study area.

Similarly, zooplankton biomass also indicated very low secondary productivity (**Table 3.12**). Copepods, Foraminiferans, decapod larvae and gastropods were dominant in the study area.

The study area is rocky and shallow along with poor phytoplankton and zooplankton diversity could be a significant reason for absence of fish resources. The area does not support any fishing activities.

Table 3.10 Phytoplankton in Mithapur Bay during November 2004

| Station | Chlorophyll a (mg/m ³) | | Phaeophytin (mg/m ³) | | Major Genera | |
|-----------------|------------------------------------|--------------------|----------------------------------|-------------|-------------------------------------------------------------|----------------------------------------------------------|
| | S | B | S | B | S | B |
| Mouth of Gulf | 19.6* | 32.8* | 8* | 12* | Nitzschia, Navicula, Thalassiosira, Pleurosigma | Nitzschia, Bacillaria, Skeletonema, Chaetoceros |
| Near Okha Jetty | 12.8-50.4 (31.6) | 8.2-33.6 (20.9) | 11-16 (14) | 9-3 (11) | Nitzschia, Skeletonema, Chaetoceros, Thalassiosira | Nitzschia, Chaetoceros, Rhizosolenia |

() Average

Source: Marine EIA for Proposed Repairing/Strengthening of GMB Passenger Jetties at Okha and Beyt

Dwarka in Mithapur Bay, NIO, 2005

Table 3.11 Phytoplankton Pigments in Mithapur Bay during November 2004

| Station | Chlorophyll a (mg/m ³) | | Phaeophytin (mg/m ³) | | | Ration of Chl a to Phaeo |
|-----------------|------------------------------------|------------------|----------------------------------|------------------|------------------|--------------------------|
| | S | B | S | B | S | B |
| Mouth of Gulf | 0.2-0.2 (0.2) | 0.4-0.4 (0.4) | 0.2-0.4 (0.3) | 0.6-0.9 (0.8) | 0.5-1.0 (0.8) | 0.4-0.7 (0.6) |
| Near Okha Jetty | 0.2-0.4 (0.3) | 0.2-0.2 (0.2) | 0.2-0.5 (0.3) | 0.4-1.0 (0.8) | 0.4-2.0 (1.1) | 0.2-0.5 (0.3) |

() Average

Source: Marine EIA for Proposed Repairing/Strengthening of GMB Passenger Jetties at Okha and Beyt

Dwarka in Mithapur Bay, NIO, 2005

Table 3.12 Zooplankton in Mithapur Bay during November 2004

| Station | Biomass (ml/100 m ³) | Population (nox10/100m ³) | Total groups (no) | Major groups (%) |
|---------|----------------------------------|---------------------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------|
| 1 | 0.5-0.8 (0.7) | 1.5-2.3 (1.9) | 8-12 (10) | Copepods (79.5), foraminiferans (8.2), gastropods (6.3), decapodlarvae (4.6), Others (1.4) |
| 2 | 1.2-3.2 (1.9) | 2.0-16.4 (5.5) | 9-18 (13) | Copepods (77.4), decapod larvae (7.4), mysids (6.2), gastropods(4.4), foraminiferans (2.1), lamellibranchs(1.1), Other (1.4) |

() Average

Source: Marine EIA for Proposed Repairing/Strengthening of GMB Passenger Jetties at Okha and Beyt Dwarka

in Mithapur Bay, NIO, 2005

3.4.5.2 Terrestrial Flora and Fauna

Shankodhar Island Reserve Forest represents tropical dry mixed deciduous shrub and desert thorn type of forest. Owing to less rainfall and hot climate vegetation is xerophytic in nature.

Prosopis juliflora is a dominant tree species along with Acacia nitatica, Acacia Senegal. Azadirachta indica, Emplica officinalis, Pithecellobium ducle, Prosopis cineraria, Tamarindicus indica, Ziziphus mummularia and Ziziphus oenopli. Shrubs such as Euphorbia nerifollia, Euphorbia nivulia, Calotropis gigantea, Calotropis procera, Lantana camera, Nerium indicum were also reported during the study.

A total of 65 species were identified from the study region and Common Myna, Black Myna, Rosy Pastor, Redvented Bulbul, Whitechecked Bulbul, Drongo, Bluerock Pigeon, Purple Sunbird, House Crow, Jungle Crow, Cattle Egret, House sparrow are commonly observed birds.

3.5 Coastal Zone

It is very important to ascertain the Coastal Regulation Zone (CRZ) status of the site proposed for the marine facility. Any development has to abide to the CRZ Notification, 2011 and is also required to obtain environmental clearance.

Coastal Landuse maps prepared by SAC (ISRO) were obtained from the GMB in order to identify the coastal zone of the area (Figure 3.7).

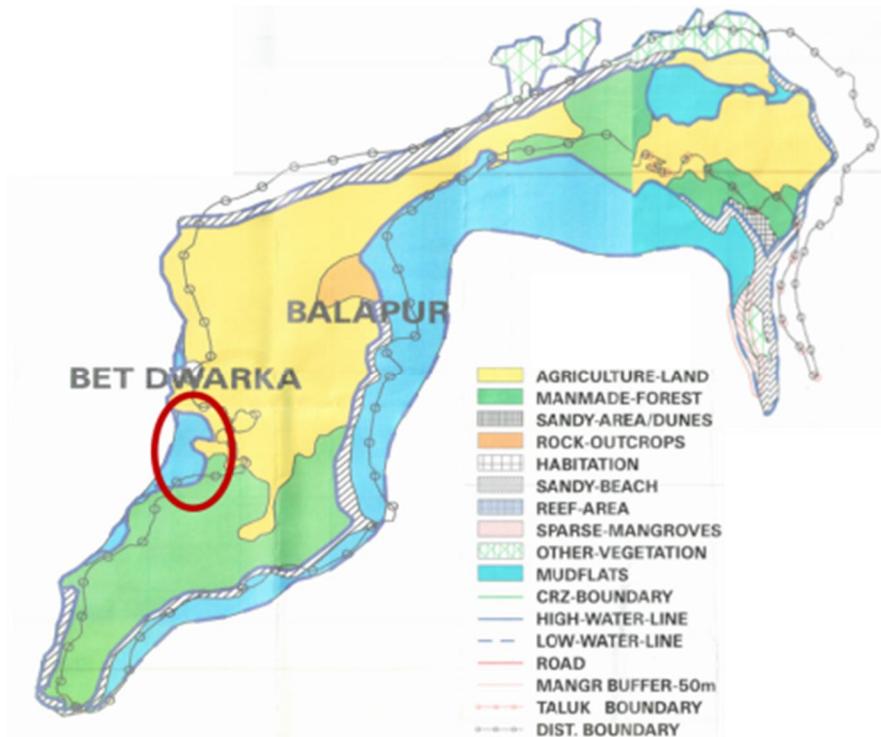


Figure 3.7 Coastal Landuse Map, Coastal Zone Information Maps, Prepared by SAC (ISRO)

The Low water line (blue dotted) and high water line (solid blue) are marked in the maps suggest that CRZ 1B zone (area between HWL and LWL) extends from 200- 250 m at the proposed location. The onshore land from HWL to 200 m may be categorised as CRZ III A (rural/urban area without substantial built) and from land from 200 to 500 m from HWL could be categorised as CRZ IIIB. The water area from LWL towards sea is CRZ IV.

It is important to mention that no construction of the proposed nature will be allowed in CRZ 1 and CRZ IIIA. However, development of vacant plot in designated areas for construction of hotels or beach resorts for tourists or visitors is permissible in CRZ IIIB. Most of the activities in CRZ IV are regulated and hence require CRZ clearance.

Thus in short, a facility on piles away from LWL will be permissible on obtaining the CRZ and Environmental clearances. These finding were further corroborated during the meeting with Mr. Hardik Shah, MS, GPCB and Mr. Atul Sharma, GMB, both are the members of State CRZ authority.

3.6 Archaeological Significance

Beyt Dwarka has been identified as an important archaeological site. National Institute of Oceanography (NIO), Goa had undertaken many excavation works within intertidal zone as well as on the land.

The earliest excavation work on the island was undertaken in 1930s, while work carried out during 1969 and 1970 provided a large number of evidences, i.e., potsherds from late Harappan to Medieval period. Many investigations were undertaken between 1981 and 2002.

All these studies were mainly have been carried out at 8 locations (**Figure 3.8**). Of all the locations, site **BDK V** is located close to Khuda Dost Mosque and is only 150 m from the identified site for the proposed marine facility (**Table 3.13**).



Figure 3.8 Excavations Sites at Beyt Dwarka

Table 3.13 Coordination of the Excavation Sites Close to the Proposed Marine Facility

| Site | Lat | Long | Remark |
|---------|-------------------------|--------------------------|---------------------------|
| BDK-I | 22 ⁰ 25' 40" | 069 ⁰ 05' 24" | Early historic |
| BDK-II | 22 ⁰ 25' 52" | 069 ⁰ 05' 40" | Early historic |
| BDK-III | 22 ⁰ 25' 53" | 069 ⁰ 05' 46" | Early historic |
| BDK-IV | 22 ⁰ 26' 03" | 069 ⁰ 06' 13" | No archaeological remains |
| BDK-V | 22 ⁰ 26' 41" | 069 ⁰ 05' 46" | Early historic |
| BDK-VI | 22 ⁰ 27' 38" | 069 ⁰ 06' 22" | Proto historic |

Source: Correspondence with NIO, Goa

A number of articles such as shell remains of beads, bangles, columella, fish hook, coins, amphorae, lead anchors, potsherds, stone anchors, Harappan Seal, Rubble wall/ fortification were found during these excavations (**Figure 3.9**).

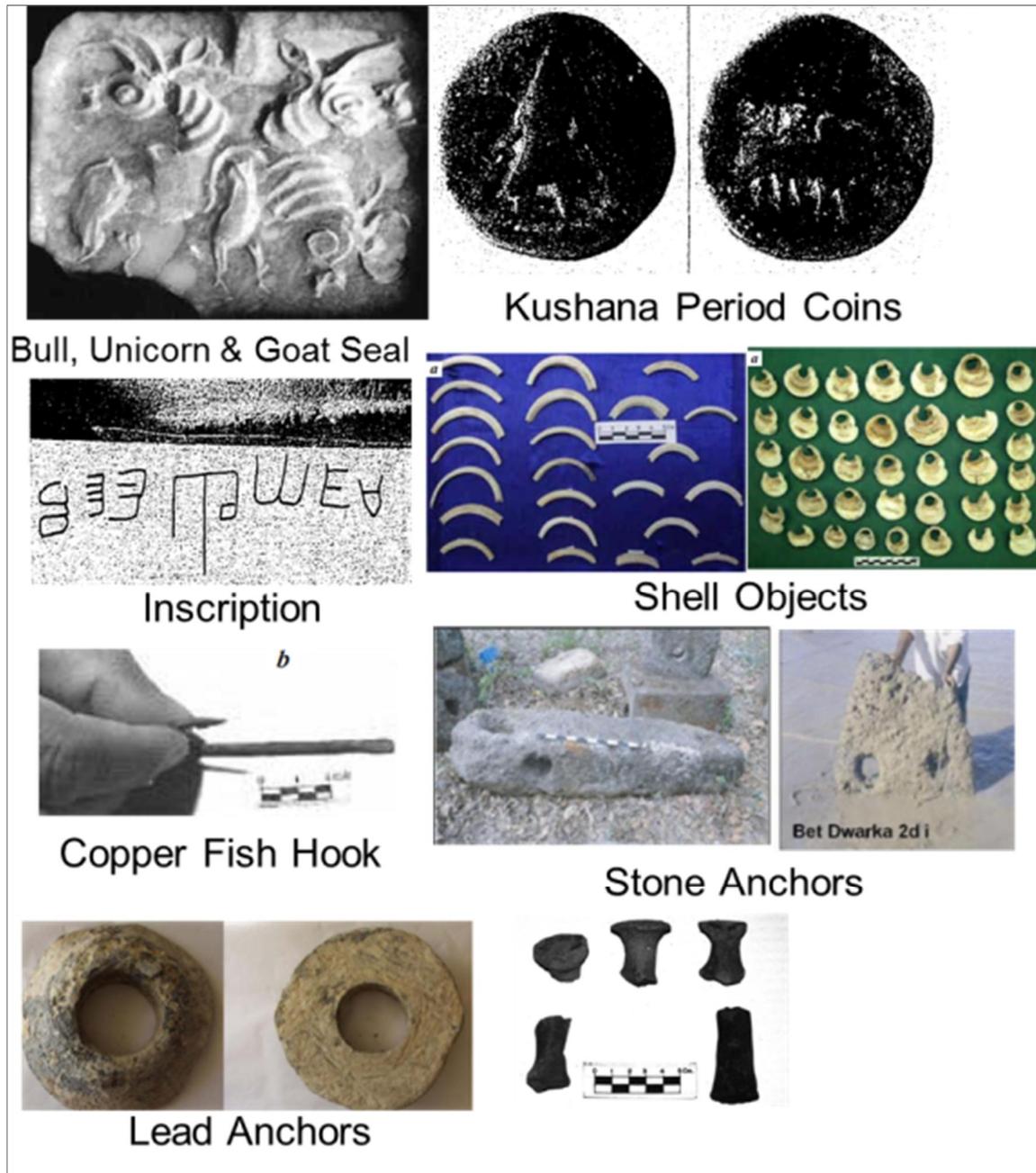


Figure 3.9 Archaeological Findings in and around Beyt Dwarka

Based on large number of archaeological evidences, it is mentioned in a number of publications that habitation was believed to flourish at Beyt during late Harappan period (4000 - 3000 year BP). Thereafter, no such evidences found until Historic period (8th Century BC). It was mentioned that probably due to a large seismic activity the habitation was erased or abandoned until Historic era. During historic times the region was believed to have proliferating maritime activities and also an established industrial sea shell artefact making hub. The island had been under occupation since early Historic times to the modern days, which includes medieval and British period,

3.7 Proposed Sea Link Bridge Connecting Okha with Beyt Dwarka

Presently the lack of adequate transportation facilities all-round the day for the locals for their daily needs is a serious problem. The problem gets further aggravated in the case of emergencies during night. To obviate this problem, the Government of Gujarat has decided to join Beyt Dwarka to the mainland by providing a bridge from Okha to Beyt Dwarka.

Earlier feasibility study for bridge connecting Beyt Dwarka and Okha was carried out by GMB through M/s WAPCOS Ltd. However, due to notification of marine national park & marine sanctuary in this area the alignment of bridge suggested could not be accepted and was dropped.

Recently, the matter was again taken up on the necessity of the bridge and in this connection DELF consultants were appointed to prepare a feasibility report for the proposed bridge.

3.7.1 Functional Requirements for Bridge Planning

In the Alignment Study Report, DELF considered the a 15m wide bridge connecting Beyt with Okha (**Figure 3.10**), which will have pedestrian lane so that pilgrims coming to Beyt Dwarka by foot can avail this bridge. The bridge is proposed to provide a 2 lane carriage way with footpath on both sides.

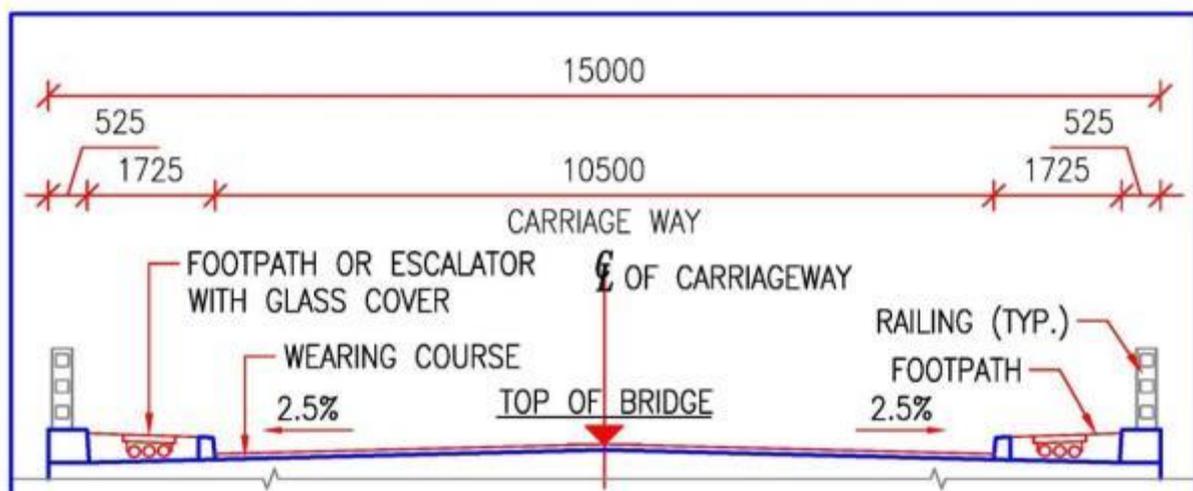


Figure 3.10 Typical Cross Section of the Proposed Bridge

The key considerations while delineating the alignment were to be away from the eco-sensitive zone notified as marine sanctuary/ marine national park and also to avoid land acquisition. It is emphasised to utilise the land available with either GMB or Indian Coastguard. It is proposed to strengthen the internal road and develop amenities like parking etc.

3.7.2 Preferred Alignments of the Bridge

Considering various factors such as the existing road network, port activities, functional requirement, possibility of locating the bridge approaches, existence of Eco Sensitive zone, Marine National Park and Marine sanctuaries, forest area etc., DELF identified a total of 6 alignment options, as shown in **Figure 3.11**. Out of these 6 alignment options, alignment options 3 and 6 have been shortlisted for further analysis.



Figure 3.11 Proposed Alternative Alignments for the Road Bridge

3.7.2.1 Alignment 3

Alignment 3 starts from mainland at 1.5 km south of Okha port and terminates at Beyt Island in a natural bay near lower corner of Gaushala, which is about 650 m from Dwarkadhish temple. Total length of the bridge is about 2340 m.

The proposed road on the Okha side connects to road link of 21m width and passing between Indian Navy boundary and Dalda Bandar boundary. No land acquisition is anticipated as required land is government land which under encroachment.

Towards Beyt Dwarka, required land is available as there are no habitations and agriculture activities are observed near Gaushala. Widening and strengthening of existing road link to the temple of 978m length is also proposed along with the bridge.

This alignment is about 76 m away from the eco-sensitive zone of Marine National Park.



Figure 3.12 Alignment of Alternative 3

3.7.2.2 Alignment 6

Alignment 6, starts from mainland at about 4.5 km south of Okha port and terminates at Beyt Island at a natural bay, about 1.5 km south of Dwarkadhish temple. Total length of the bridge is about 4450 m.

The advantage of this alignment is that the entry point from Okha side near Creek will not create congestion for the Okha Port traffic and it is also away from any boat/fishing activities as well as from the Navy coast guard establishments.

However, the approach from the Okha side passes through the eco sensitive zone for a length of 1075 m. To resolve this, either special approval would be needed or the alignment would need to be adjusted and taken through the unauthorized fishing facilities. Towards Beyt Dwarka side the approach is just north of Abhaya Mata Temple.



Figure 3.13 Alignment for Alternative 6

3.7.3 Current Status of the Bridge Project

Alignment 3 is shortest and estimated to cost over Rs. 350 crores. It passes near the navy area and also through the main road leading to Okha. The alignment 6 is longer and expected to cost about Rs. 505 crores but will not have any impact on the activities of Navy, Coastguard and Fishermen.

A meeting for the various stakeholders was conducted by the District Magistrate on 30th July, 2016 comprising of the officials from Forest and Wildlife department, Road and Building department, Indian Navy, Gujarat Maritime Board, Okha Marine Police etc. and as per the minutes of the meeting it is observed that most stakeholders preferred alignment 3 but a couple of stakeholders like GMB have suggested alignment 6. Therefore following aspects are still pending for decision:

1. The final alignment of the bridge is yet to be decided.
2. It is yet to be decided whether the bridge would cater to all commercial traffic in which case vehicle parking facilities would need to be created at Beyt Dwarka side or whether the bridge shall be restricted to the battery operated vehicles for tourists only in which case vehicle parking shall be built at Okha site.
3. Decision is yet to be taken if bridge connectivity is only for providing access to the local population and tourists visiting Dwarkadhish temple or whether it will be part of larger development of the Beyt Island to enable tourists having direct access to Dunny beach at the north, waterfront development near bridge including underwater viewing Gallery and Restaurant.

4.0 SITE SELECTION

4.1 Criteria for Site Selection

The success of any developmental activity/ project for tourism depends to a large extent on the proper selection of the site. A number of factors contribute in the site selection process, for Beyt the following criteria were found to be most relevant to analyse the suitability of the site.

- Proximity to the Temple and Ferry Terminal
- Suitability of the Waterfront
- Availability of Land
- Proximity to the Proposed Road Bridge
- Environmental Criteria

Based on the site visit and data collected, an assessment was undertaken to select the location for the proposed facility.

4.1.1 Proximity to the Temple and Ferry Terminal

One of the key considerations for the proposed development is to keep these facilities near the existing ferry terminal and the temple. This was important to attract tourists directly to the facility without putting much effort in travelling. Considering the current dense habitation pattern around the Temple and jetty, vacant land is not available within 500 m radius from the Temple.

4.1.2 Suitability of the Waterfront

The nature of the facility that is envisage require waterfront. Waterfront on the both the side of the Jetty is all occupied with either houses or fishing activities.

On the north, a total length of 700 m is unavailable and further North Hazi Kirmani Mosque is located. Thus, a very limited water front of only 350 m will be available for development.

After about 500 m on the southern side of the jetty, waterfront is available and site seems to be conducive for the development.

4.1.3 Availability of Land

As mentioned, all the settlements on Beyt Dwarka Island are mainly concentrated in a radius of 500 m around the Dwarkadhish temple. Many shops and other commercial establishments are also located in the immediate vicinity of the Temple. Thus, land availability close to the temple is a constraint. On the south side, large land parcels are available to locate the facility.

4.1.4 Proximity to the Proposed Road Bridge

As discussed in earlier section, Landfall point towards Beyt for both alternatives 3 and 6 under consideration for the proposed bridge are proposed on the South of the existing jetty. Thus,

proposed underwater viewing gallery / restaurant shall also be logically located South of the jetty and close to the proposed bridge to attract maximum visitors to this facility.

4.1.5 Environmental Criteria

Locations further North of the Hazi Kirmani Mosque were not considered due the presence of the Forest and Marine National Park area (**Figure 4.1**). On the extreme South, the entire area marked as reserved forest is also kept out of the purview of the development. Any development of forest land or close to marine national park may impact the ecology and will also require many statutory approvals leading to delays in development.



Figure 4.1 Map showing Forest and Marine National Park Area around the Beyt Dwarka

4.2 Location Identified for Development

Based on the site visit and data collected and assessment based on abovementioned criteria, the proposed facility is planned on the South of the Dwarkadhish temple due to the following reasons:

- Close to the temple as well as bridge
- Relatively protected site with respect to weather conditions i.e. waves.
- Availability of Government land along the waterfront
- Away from sensitive habitat.

A waterfront as close as 350 m South of the temple, having good water depth close to shore, is observed but adjacent land is all agricultural private land thus requiring land acquisition. To avoid any rehabilitation and resettlement this location was left out of proposed development.

A waterfront, 800 m south of the existing jetty was found to be suitable (**Figure 4.2**). About 200 m of shoreline is available and has ample back up area to support the development. From Jetty connectivity through a Kutcha road is also available to the proposed waterfront.

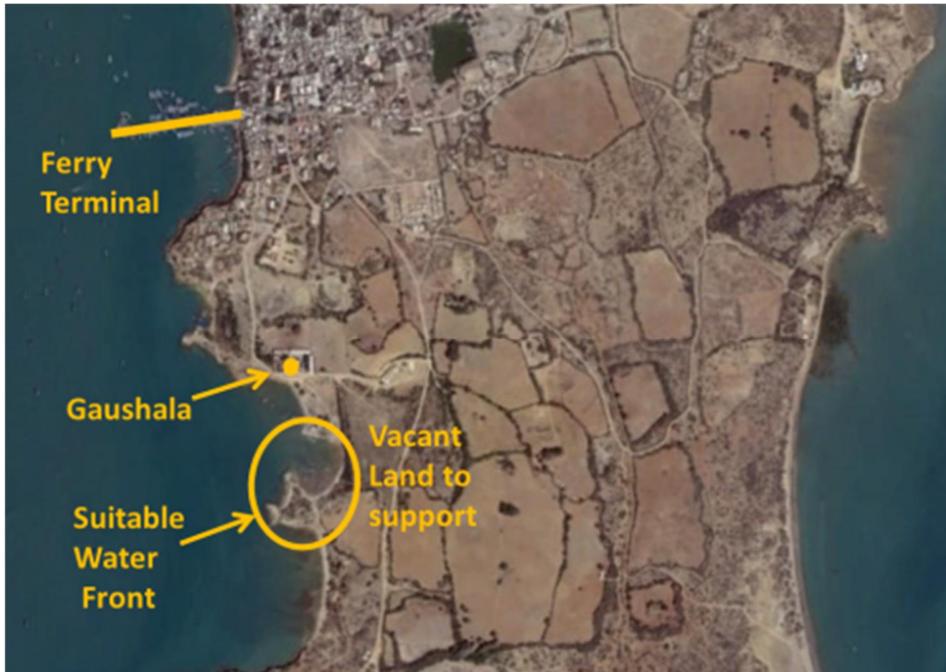


Figure 4.2 Location of Proposed Development

Identified waterfront comprises of a small bay and headland, have a gentle slope towards the sea unlike steep banks which were noticed close to jetty (**Figure 4.3**). Rocky outcrops are also seen at this location near the coast.



Figure 4.3 Proposed Location

5.0 PRIMARY SURVEY AND DEMAND ASSESSMENT

5.1 Classification of Available Markets

5.1.1 General

The baseline profile and visitation volume to the existing Beyt Dwarka town includes both tourist (pilgrims, leisure) and resident population living in the proximity of the proposed facility. The analysis of the current visitation is very relevant for understanding various key impact factors which would determine the demand of various proposed / shortlisted themes at the proposed site.

AECOM had conducted primary site visit during which secondary level data was collected from the local GMB's office on the number of passenger travelling through ferries. It was then found that there isn't any historical inventory data for the tourist visitation at the Beyt Dwarka which could readily be used for analysis; thus, AECOM devised a primary visitor survey with sample size of more than 400 primary interviews conducted randomly with the arriving visitors at Beyt and Okha ferry terminals. **Figure 5.1** shows the blank sample questionnaire, which was finalized to capture information in three critical categories.

5.1.1.1 Traveller Profiling

This section records the responses to establish the traveller based on arrival, Gender and Age. This section of questionnaire was critical to establish the nature of visitation i.e. Individual/ Group / Multi-Party Travel Group.

This section also recorded the origin of visitors based on drive distances from their home locations. The responses were decked in categories – Local, Regional, and National and International in order to further identify hinterland of existing temple facility.

5.1.1.2 Visitation Profiling

This section of questionnaire records the nature of visitation based on which it is further qualified in terms of repeat visitations and typical time slots for visitations. The responses also capture the appropriate but range bound budgeting in various categories to understand the expenditure pattern profile wise.

The key relevance of collecting this information in the above two head would guide the following decisions and analysis:

- Attraction/Activities selection based on – Age, Gender profiling
- Sizing, Holding capacity, Covered Vs waiting area, Tourist assistance facilities – Lockers, Threshold Planning
- Tourist Catchment Area – Primary, Secondary and Tertiary

- Defining penetration rates – with bridge / without bridge scenario
- Qualifying Visitation – would guide theme selection
- Guide – Duration for Theme, Selection of Activities.

| Visitor Profiling Survey - Beyt Dwarka Project | | | | | | | | | | |
|------------------------------------------------|--|--------------------------|--|-----------------------------------|-----------------|------------|---------------------------|--------------|-------------|--------|
| A Traveller Profiling - General | | | | | | | | | | |
| 1 Who's travelling | | | | | | | | | | |
| | | (Tick appropriate) | | In Nos | | | | | | |
| Individual | | <input type="checkbox"/> | | Men | Women | Youngsters | Kids | | | |
| Family | | <input type="checkbox"/> | | | | | | | | |
| Travel Group | | <input type="checkbox"/> | | | | | | | | |
| Multi-Travel Party | | <input type="checkbox"/> | | | | | | | | |
| 2 Travelling from | | | | | | | | | | |
| | | (Tick appropriate) | | Name | | | | | | |
| Local (< 2 hr drive) | | <input type="checkbox"/> | | | | | | | | |
| Regional (3 to 8 hr drive) | | <input type="checkbox"/> | | | | | | | | |
| National | | <input type="checkbox"/> | | | | | | | | |
| International | | <input type="checkbox"/> | | | | | | | | |
| B Visitation Profiling | | | | | | | | | | |
| 3 Nature of Visit | | | | | | | | | | |
| | | (Tick appropriate) | | No. of Visit Here in last 5 years | | | Average Duration (in Hrs) | | | |
| | | | | < 2 Times | 2-5 Times | > 5 Times | < 1 Hr | 1-3 Hrs | > 3 Hrs | |
| Pilgrimage | | <input type="checkbox"/> | | | | | | | | |
| Picnic / Recreation | | <input type="checkbox"/> | | | | | | | | |
| Work / Business | | <input type="checkbox"/> | | | | | | | | |
| Visiting Friends / Relatives | | <input type="checkbox"/> | | | | | | | | |
| Others | | <input type="checkbox"/> | | | | | | | | |
| 4 Tour Budgeting | | | | | | | | | | |
| | | | | In Rs. Per person / Day | | | | | | |
| | | | | < Rs. 200 | Rs.200 - Rs.500 | > Rs. 500 | | | | |
| Slay / Lodging | | <input type="checkbox"/> | | | | | | | | |
| Travel | | <input type="checkbox"/> | | | | | | | | |
| Food and Beverage | | <input type="checkbox"/> | | | | | | | | |
| Retail / Shopping | | <input type="checkbox"/> | | | | | | | | |
| Others | | <input type="checkbox"/> | | | | | | | | |
| | | | | | | DATE | | | | |
| | | | | | | TIME | < 10 AM | 10 AM - 1 PM | 1 PM - 5 PM | > 5 PM |
| | | | | | | SLOT | | | | |

Figure 5.1 Sample Questionnaire

5.1.1.3 Tour Expenditure

This section recorded the amount of money visitors are presently spending while visiting Beyt. This was important to guide pricing sensitivity for theme selection.

5.1.2 Visitor Market Analysis - Primary Survey Results

This section of the report presents the analyses and inference of the outputs from the primary interviews conducted over a week time based on random sampling and capturing data for 438 samples at various time slots to ensure holistic survey results.

5.1.2.1 Traveller Profiling

The survey respondents were found to be categorized in three distinct forms which were dominated by Family group. These travellers are accounted as homogenous pilgrimage group of party size varying from 4 to 8 which includes both adults and young kids (**Figure 5.2**).

The total arrivals in Beyt Dwarka is predominantly in group formats which accounts for more than 75 % of total arrivals followed by Individual arrivals which account for 24%. The responses when further qualified by purpose of travel were analysed, it was reflected that the majority of individual travellers were visiting Beyt either for work or business were daily commuters to the town and thus wouldn't qualify for tourists.

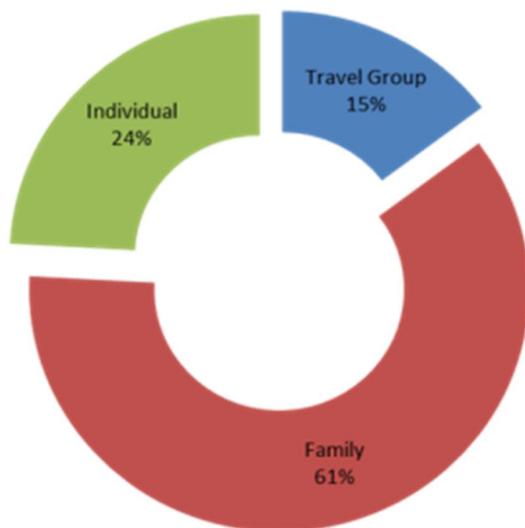


Figure 5.2 Traveller Profile – Group vs Individual vs Family

The analysis of responses to the most preferred visitation timing clearly shows the alignment with the temple prayer timings (**Figure 5.3**). The highest visitation is experienced in the morning to noon hours and least during the post noon hours. This can be attributed to the prayer and darshan timings which coincide as the temple doors are closed between 1 to 5 pm.

Also, this trend is helpful to guide in selection of activities and the theme for proposed integrated tourist site which shall extend the visitor stay and enhance the visitation volume during the lean time slots between the noon and evenings.

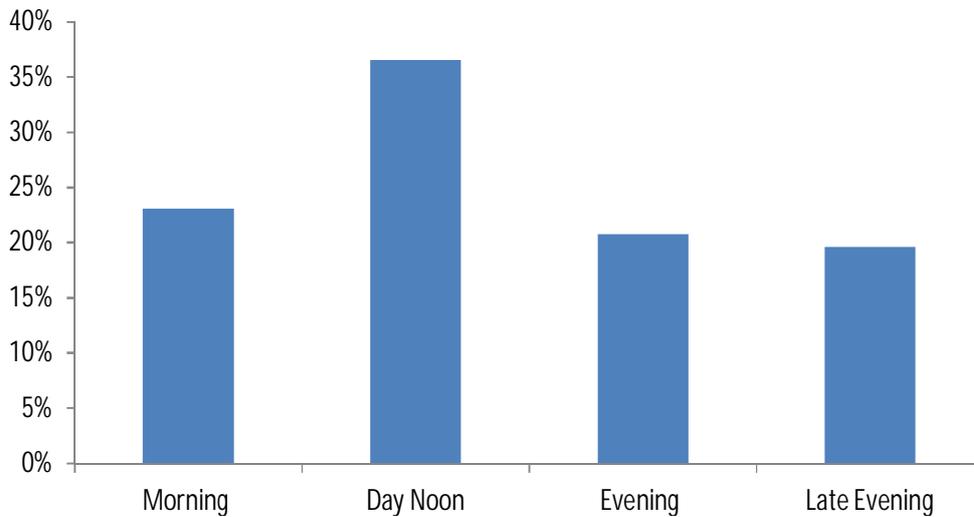


Figure 5.3 Visitation – Time Slot Qualified

The gender profile visitation data shown in the responses would be important to ascertain more inclusive tourist centric theme planning. For instance, while planning a theme based show or restaurant it would be built in design to incorporate gender balanced audiences (less of dark, aggression, high pitch music etc.).

It is important to make a note of young teens and kids which account for 1/5th of the total age profiled visitors in the survey (**Figure 5.4**). This information reflects a good opportunity to examine and explore activities and themes which could appeal this age group which is accompanied by parents / grandparents. This also illustrates that there is an equal opportunity to enhance the existing pilgrimage led experience to family entertainment led FnB themed experience.

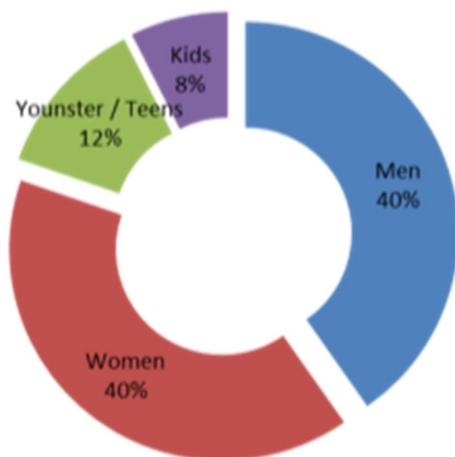


Figure 5.4 Visitation – Age/Gender Group Qualified

The analysis of responses to the query for registering the place of origin for the visitors arriving in Beyt Dwarka gave an interesting comparative in which its lead by regional travellers which includes drive distances varying from 2 hours to 12 hours (**Figure 5.5**). The majority of regional tourist traffic comes from larger cities in neighbouring districts i.e. Rajkot, Porbandar, Jamnagar, Junagard and Ahmedabad.

During the interviews, it was recorded that Beyt Dwarka visitation is considered as an extended itinerary for most of the pilgrims visiting Somnath and Dwarka Temples. There were very minimum international tourists recorded during the interview, however, it can be attributed to limited road and air connectivity to larger tourist attraction towns in Gujarat.

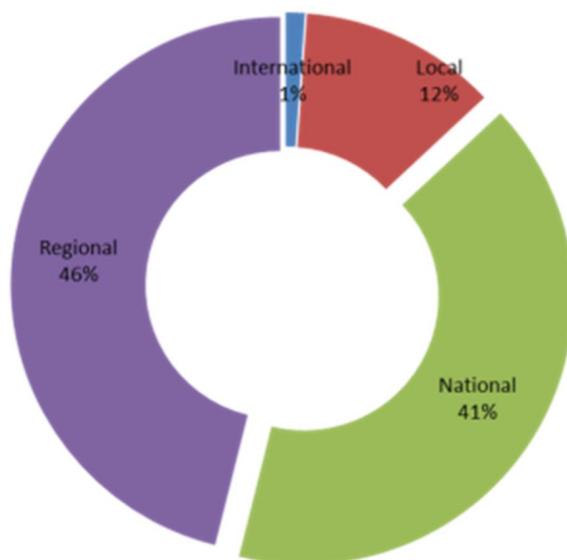


Figure 5.5 Traveller – Place of Origin

5.1.2.2 Visitation Profiling

Quite clear from the respondent's data analysis that visitation are primarily "pilgrimage" in nature (**Figure 5.6**). Although, as stated in earlier section too, there is no official mapping of the annual visitation which could show the historic trend of the volume of pilgrims visiting Beyt Dwarka. However, AECOM which conducting primary surveys also interviewed the port official at the district headquarters and gathered the passenger data for the ferry terminal. It reflects the total annual visitation in past year range bound between 11 – 13 lakhs. It interesting to find 3% of picnic led visitations as well in the overall data, which extends the opportunity to develop an integrated public realm led tourist facility at the said site.

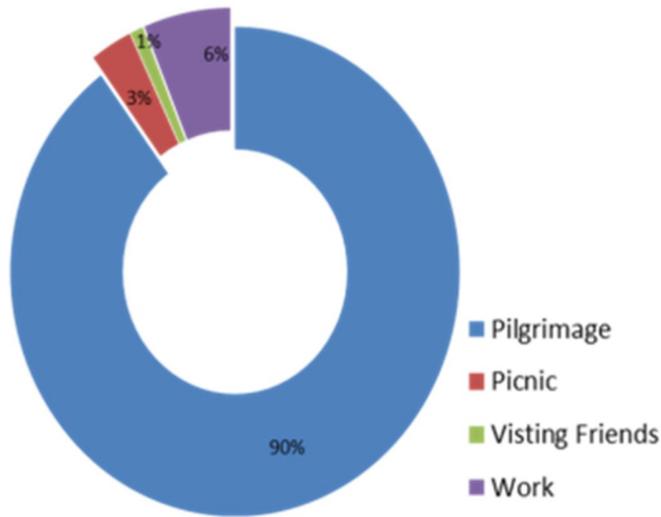


Figure 5.6 Nature of Visitation – Qualified by Purposed

The natures of visitation which have been recorded above were further qualified based on the traveller profile to understand who visits for what purpose. This would assist in understanding the penetration rates at currents levels. Clearly, the international, national and regional tourists are visiting the town for pilgrimage purpose only (**Figure 5.7**). However, there is an opportunity from local resident market perspective to develop tourist led recreation facility as well in this temple town.

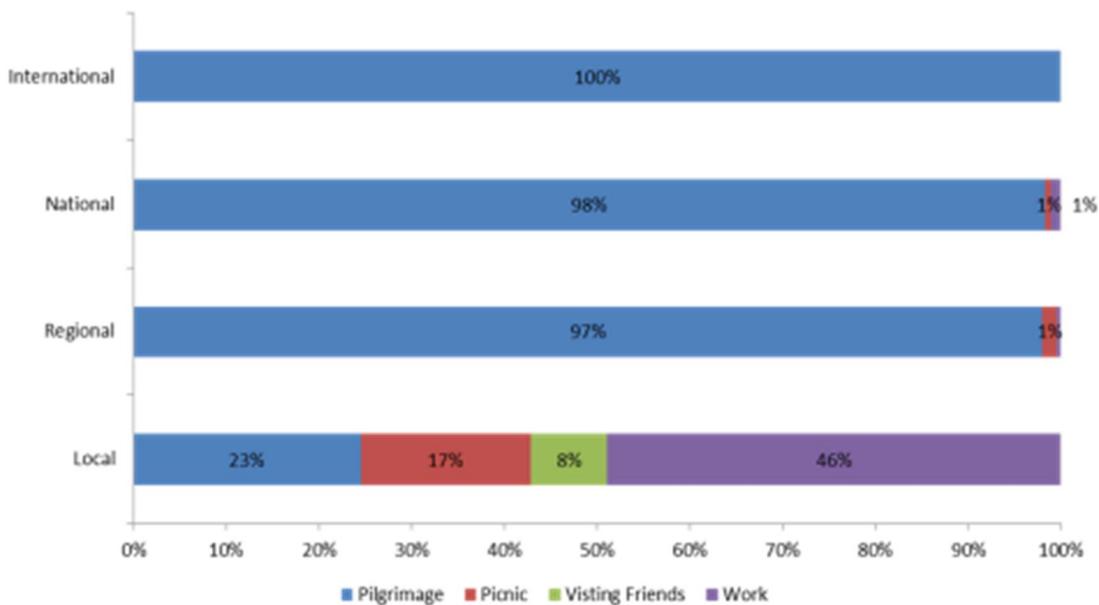


Figure 5.7 Nature of Visitation – Qualified by Tourist Profile

In order to understand the repeat visitation pattern to the temple town we've qualified the response from the survey based on the origin of travellers and have found that most of the visitors are either first time travellers or have visited less than 2 times in last 5 years (**Figure 5.8**). This information helps to establish that repeat the pilgrimage and facilities around the temple aren't driving repeat visitation at least at the regional scale, however, there is potential which could be induced if a tourist led theme program is proposed within the town.

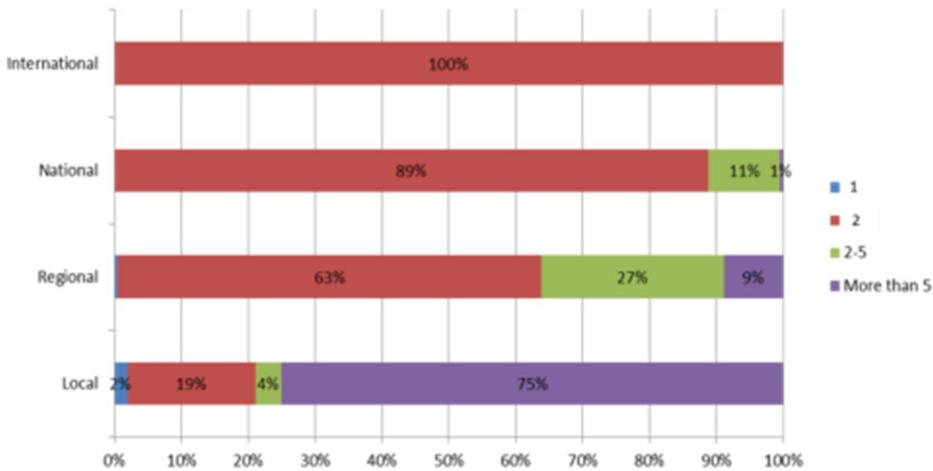


Figure 5.8 Repeat Visitation Profiling - Qualified by Place of Origin

The average duration of stay plotted based on place of origin explains that the majority of visitors are completing their trip within 3 hours which includes the visit to the temple as well as boat ride to get back to main land ferry terminal (**Figure 5.9**). This duration of stay is key element to be addressed while we proposed to develop a theme which either fits in this duration of itinerary or enhance the stay to benefit the footfall volumes. The local visitors staying beyond 3 hours are there for work and would not be target for this expansion of visiting hour trends.

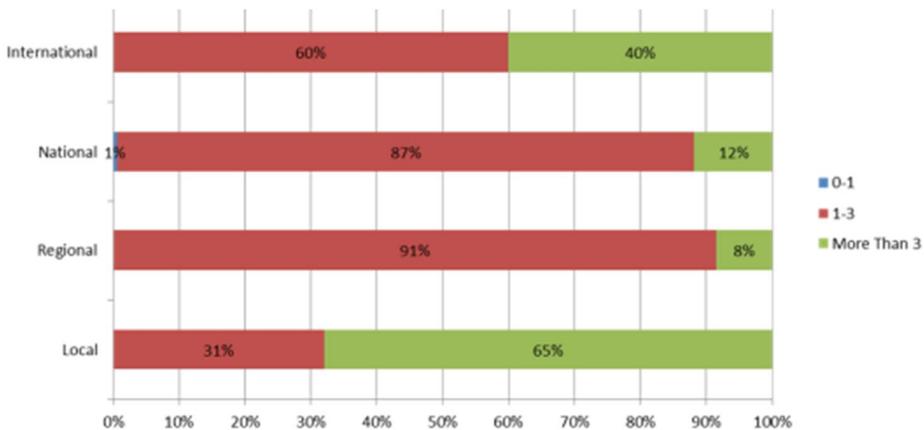


Figure 5.9 Average Duration of Stay - Qualified by Place of Origin

5.1.2.3 Tour Budget Profiling

The responses to categories of the expenditure profile of all the visitors in 5 broad areas shows average spent in the range less than INR 200 across all key areas (**Figure 5.10**). The most relevant data for guiding the possibility of developing a mass footfall to the facility is the volume of average spent by visitors on FnB currently which is around 80% in the range between INR 1 to 500 per capita.

Another perspective to look at this analysis would state the missing opportunity as there aren't good sit down full service restaurants neither at Beyt nor at main Dwarka town. Thus, infusing a supply which corresponds to the mid to low income category visitors would target higher spending and be successful if it has local delicacies on menu price reasonably.

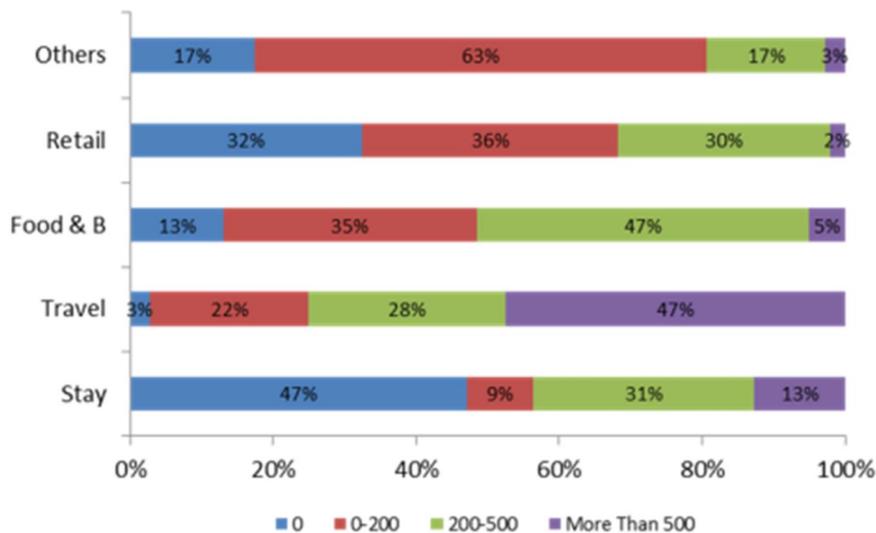


Figure 5.10 Tour Budget – Expenditure by Categories

5.1.3 Survey Conducted in Earlier Studies

Gujarat Ecology Commission (GEC) with intend to establish a Marine Research, Conservation & Information Centre (MRCI) had entrusted a prefeasibility study to KPMG. The suitability for setting up a MRCI was studied, at five locations across the Gulf of Kutch namely Dwarka, Shivrajpur, Okha, Positra and Narara, based on four aspects, i.e., importance as a tourist location, connectivity infrastructure, accommodation infrastructure and future prospects. Evaluation of the locations over the identified parameters has shown that Dwarka is the most suitable location.

During this study, a primary market survey was also conducted, where 240 respondents were interviewed face to face to fill in a detailed questionnaire in four cities, i.e. Dwarka, Ahmedabad, Vadodara and Saputara.

In one of the responses, it was understood that out of total 240 respondents, 35% had visited Dwarka and about 38% had shown willingness to visit Dwarka. About 75% of the people visited Dwarka had stated purpose of visit as religious and 73% were repeat visitors. The length of stay was 2-3 days for about 65% of the respondents and over 70% of the respondents had a free time of more than 2 hrs during their trip. About 93% of the people were interested to utilise their free time in alternate activity if available. About 78% of the respondents were found to be very enthusiastic to visit a Marine Facility. The 240 respondents were willing to pay a total of INR 297 including INR 64 as basic fess and rest for add on features (dolphin shows, penguin display, game zone and restaurant).

Similarly, 10 schools and 11 tour operators were interviewed to understand their preferences and features of a MRCI facility. Based on the interviews with mentioned 3 groups, the MRCI centre was suggested to have a walkthrough tunnel with 180 degree view, a dolphin show, a restaurant, game zone and a souvenir/ gift shop. The schools in particular were enthusiastic to have educational activities. The school were ready to spend a total of INR 208 including 148 as basic fee, while tour operators suggested a total fee up to INR 300 to be reasonable for the visitors. Based on the past behaviour and intention to visit the MRCI centre, an estimate for footfall for the first year of operation was arrived at as about 4 lakhs.

The results of this study were quite favourable for setting up a marine facility near Dwarka.

5.2 Resident Market Analysis

The resident market analysis for the potential visitation to the Beyt Dwarka is conducted based on the guidance we've got from the primary survey responses. This analysis primarily estimates the potential footfalls from the defined hinterland based on drive distance where in Beyt Dwarka is the locus point for all trips. Based on the primary survey response analysis we found that the hinterland spans up to 8 -10 hours drive distance and thus the categories considering the highest proximity of repeat visitation to the temple town are defined (**Table 5.1**).

Table 5.1 Resident Market Categories

| Drive Distance | Resident Category | Market | Identified Regions |
|--------------------------|---------------------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0-2 Hours | Primary Catchment | | District Devbhoomi Dwarka – Okhamandal, Khambhalia, Kalyanpur, Bhanwad |
| 5-2 Hours | Secondary Catchment | | District Jamnagar – Jamnagar, Jodiya, Dhrol, Kalavad, Lalpur, Jamjodhpur District Junagarh – Manavadar, Vanthali, Junagadh, Mendarda, Keshod, Mangrol, District Rajkot District Porbandar |
| More than 5 Hours | Tertiary Catchment | | Selective urban agglomeration more than 5 Million in the state – Ahmedabad, Surat, Vadodara, Bhavnagar |

For the ease of collection and analysis of the data we've adopted the administrative boundaries as defined in the census 2011 and have conducted district to block level demographic analysis to compute the resident population. During the data collection we found that the project site falls in the newly formed district of Devbhoomi Dwarka which was carved out from Jamnagar district post the 2001 census by agglomerating the four sub-districts / talukas namely *Okhamandal, Khambhalia, Kalyanpur and Bhanwad* (Figure 5.11).

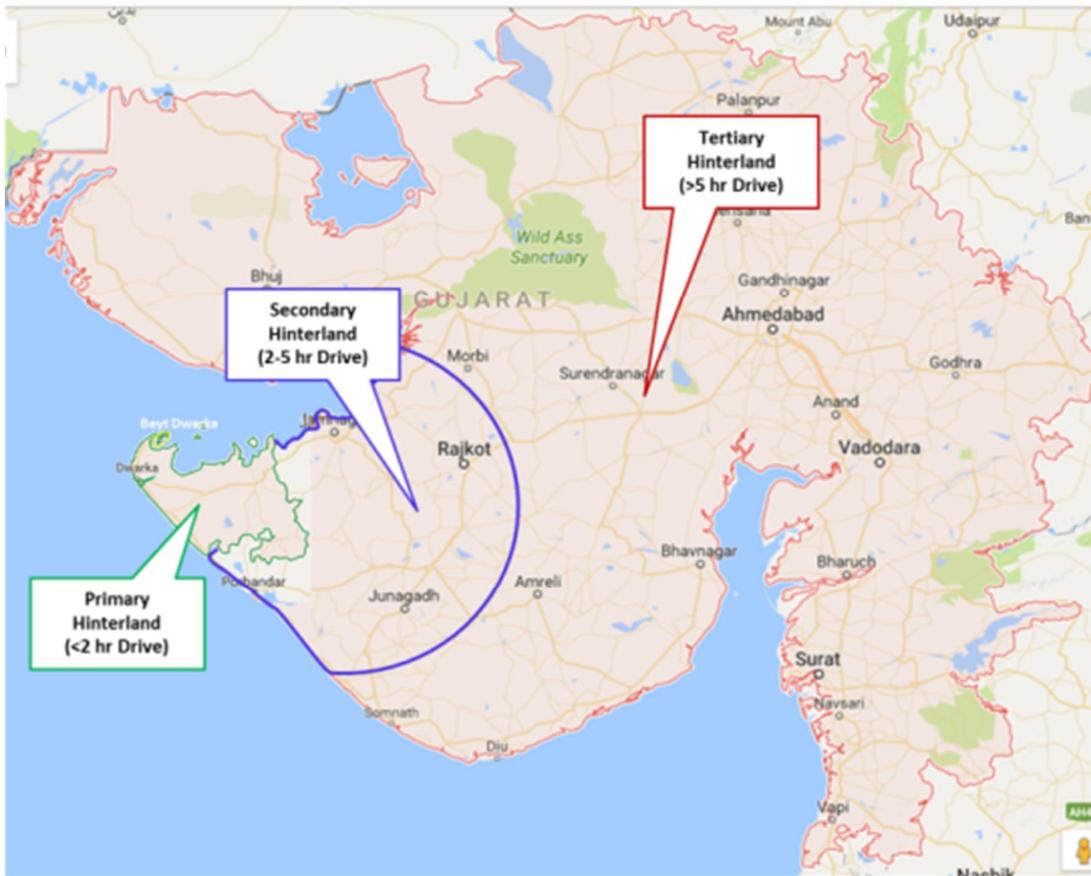


Figure 5.11 Map showing Primary, Secondary and Tertiary Market

AECOM has used census 2001 and 2011 for benchmarking the baseline demographic information and projection of future population for the resident markets. **Table 5.2** shows the projected resident population in the catchment in the three categories over next decade i.e. 2031.

Table 5.2 Visitation Projections for Resident Market Categories

| Year | | 2016 | 2020 | 2025 | 2030 | 2035 |
|------|-------------------------------|-------------|-------------|-------------|-------------|-------------|
| 1 | Defining Available Markets | | | | | |
| 1 A | Resident Market (Nos in Mn.) | | | | | |
| | Drive Distance wise | | | | | |
| | 0-2 Primary Resident Market | 0.8 | 0.9 | 1.0 | 1.0769 | 1.2 |
| | 2-5 Secondary Resident Market | 7.5 | 8.0 | 8.6 | 9.2843 | 10.0 |
| | > 5 Tertiary Resident Market | 16.6 | 17.0 | 17.5 | 17.995 | 18.5 |
| | Total Resident Market | 24.9 | 25.8 | 27.0 | 28.4 | 29.7 |

The projection is made based on the past decadal growth rate which vary between 1.9% and 0.6% and we've used the same rate of growth to remain realistic in the projection, based on which it's estimated that the total resident population for Beyt Dwarka by 2035 would be 29.7 Million.

Table 5.3 shows the penetration rates which are benchmarked to the actual data collected during the primary interviews from the field. The sample survey was distributive for local, regional and beyond the state visitors, thus, by dividing the total visitors in each category to the respective resident market category we have found that the penetration of visitation ranges from 14% (primary resident) to 10% in the Secondary and Tertiary resident markets. Further, AECOM has made an assumption that this rate could increase by 10% and 3% annually for projection over next 20 years, this would be impacted if the proposed elevated road link to the island town is completed timely which shall facilitate the arrivals of the visitors from local resident market.

Table 5.3 Penetration Rate for Resident Market Categories

| Penetration Rate | | 2016 | 2020 | 2025 | 2030 | 2035 |
|------------------------------|----------------------------------|------------|------------|------------|------------|------------|
| Resident Market | | | | | | |
| | | | | | | |
| 0-2 | Primary Resident Market | 14% | 17% | 22% | 28% | 36% |
| 2-5 | Secondary/Tertiary Resident Mark | 10% | 12% | 16% | 20% | 25% |
| Resident Market (Nos in Mn.) | | | | | | |
| 0-2 | Primary Resident Market | 0.1 | 0.2 | 0.2 | 0.3 | 0.4 |
| 2-5 | Secondary Resident Market | 0.7 | 1.0 | 1.3 | 1.8 | 2.5 |
| > 5 | Tertiary Resident Market | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Total Resident Demand | 0.9 | 1.1 | 1.6 | 2.1 | 3.0 |

5.3 Visitor Market Analysis

AECOM team during the site visit and data collection stage acquired the visitor data from the port authority which keeps the record of the passenger traffic ferrying between Okha and Beyt Dwarka. The limitation of information on tourist traffic to the town was adjusted by using the passenger data as a proxy and reducing the percentage share of work trips as estimated from the primary interviews conducted by AECOM.

The annual passenger traffic recorded in the year 2015 is range bound up to 1.45 million (*resident & tourist*) which includes the high seasonality arrivals during the Navratri festive times, this applying the share of national and international travellers estimated from the primary interviews which account for 42% and 2% respectively (**Table 5.4**). Thus projecting that their share to grow at a rate between 6% and 3% respectively we estimate a total 1.7 million visitor arrivals to Beyt Dwarka by year 2035.

Table 5.4 Visitor Market National and International

| Visitor Market (Nos in Mn.) | 2016 | 2020 | 2025 | 2030 | 2035 |
|-----------------------------|------------|------------|------------|------------|------------|
| | | | | | |
| Domestic (National) | 0.6 | 0.8 | 1.1 | 1.4 | 1.9 |
| Domestic (International) | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| Total Visitor Market | 0.7 | 0.8 | 1.1 | 1.5 | 2.0 |

5.4 Total Potential Demand (Resident & Visitor)

The projected potential demand from both resident and visitor market is estimated to be 5.0 million annually in the year 2035 (**Table 5.5**). The realistic scenario includes the existing infrastructure present in the vicinity of the island town and no elevated road connection with the main Dwarka town there would be significant drop in the penetration growth rate in the primary resident market, which is estimated to result 5.9 million potential footfall number annually by year 2035 (**Figure 5.12**).

Table 5.5 Total Attendance Demand

| Year | | | 2016 | 2020 | 2025 | 2030 | 2035 |
|----------|-------------------------------------|----------------------------------|-------------|-------------|-------------|-------------|-------------|
| 1 | Defining Available Markets | | | | | | |
| 1 A | Resident Market (Nos in Mn.) | | | | | | |
| | Drive Distance wise | | | | | | |
| | 0-2 | Primary Resident Market | 0.8 | 0.9 | 1.0 | 1.0769 | 1.2 |
| | 2-5 | Secondary Resident Market | 7.5 | 8.0 | 8.6 | 9.2843 | 10.0 |
| | > 5 | Tertiary Resident Market | 16.6 | 17.0 | 17.5 | 17.995 | 18.5 |
| | | Total Resident Market | 24.9 | 25.8 | 27.0 | 28.4 | 29.7 |
| 1 B | Visitor Market (Nos in Mn.) | | 2016 | 2020 | 2025 | 2030 | 2035 |
| | | Domestic (National) | 0.6 | 0.8 | 1.1 | 1.4 | 1.9 |
| | | Domestic (International) | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| | | Total Visitor Market | 0.7 | 0.8 | 1.1 | 1.5 | 2.0 |
| 1 C | Total Available Market (Nos in Mn.) | | 25.5 | 26.7 | 28.2 | 29.9 | 31.7 |
| 2 | Penetration Rate | | 2016 | 2020 | 2025 | 2030 | 2035 |
| 2 A | Resident Market | | | | | | |
| | 0-2 | Primary Resident Market | 14% | 17% | 22% | 28% | 36% |
| | 2-5 | Secondary/Tertiary Resident Mark | 10% | 12% | 16% | 20% | 25% |
| 2 B | Resident Market (Nos in Mn.) | | | | | | |
| | 0-2 | Primary Resident Market | 0.1 | 0.2 | 0.2 | 0.3 | 0.4 |
| | 2-5 | Secondary Resident Market | 0.7 | 1.0 | 1.3 | 1.8 | 2.5 |
| | | Total Resident Demand | 0.9 | 1.1 | 1.6 | 2.1 | 3.0 |
| 2 C | Visitor Market (Nos in Mn.) | | | | | | |
| | | Total Visitor Demand | 0.7 | 0.8 | 1.1 | 1.5 | 2.0 |
| 2 D | Total Attendance Demand | | 1.5 | 2.0 | 2.7 | 3.6 | 5.0 |

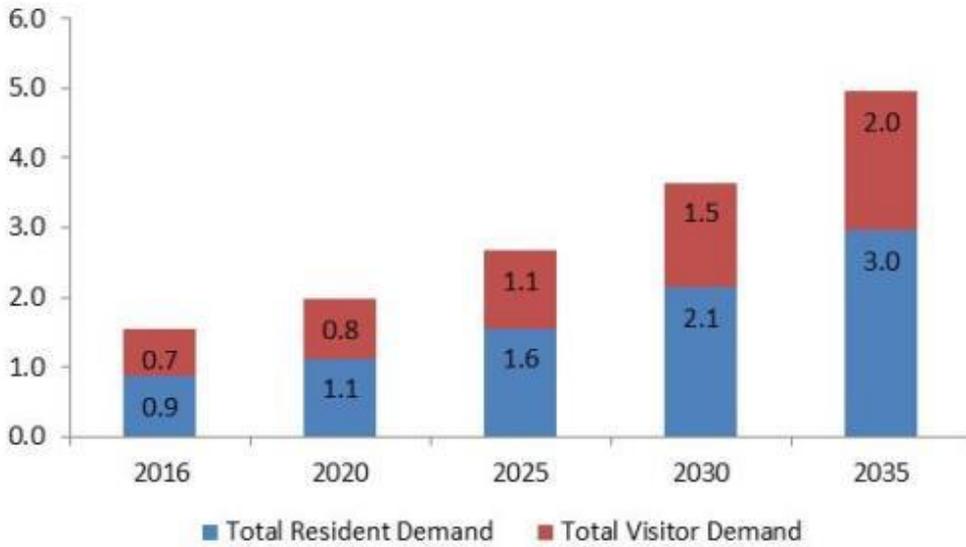


Figure 5.12 Total Potential Demand – Realistic Scenario

The projected number are also predicted for the scenario (*optimistic*) in which there would be multiple infrastructure improvements that include and are not limited to elevated road connecting the island town, improved parking and tourist facilitation amenities on both ferry terminal side and overall regional transportation network improvements with the populated hinterland within Gujarat.

This scenarios has increased the number of foot fall to the facility and it is estimated that a total of 9.5 million of people are expected to visit Beyt Dwarka town in next 20 years.

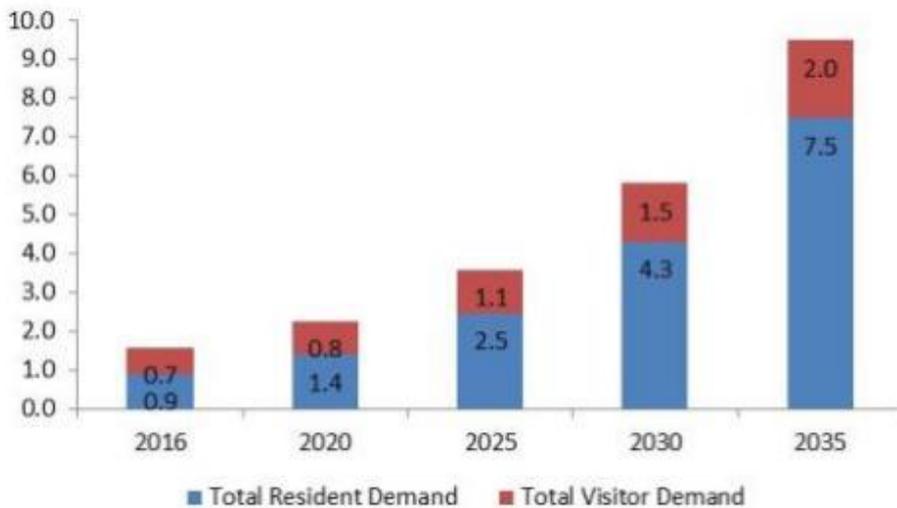


Figure 5.13 Total Potential Demand – Optimistic Scenario

The footfall numbers estimated above are for the visitors to Beyt Island, it is expected that a subset of these numbers will visit the proposed facility. It is assumed that initially a total of only 30% of the people visiting Beyt will visit the facility and this number will increase in subsequent 10 years to 85% and thereafter the demand is assumed to be saturated. Further, museum may be visited by only few out of the tourist to the facility and this number is assumed to be 30% throughout the period.

With these assumptions, a total of 4.2 million visitors are expected to the new facility by 2035.

Table 5.6 Total Attendance to the proposed facility

| Total Footfalls to the Proposed facilities | 2020 | 2025 | 2030 | 2035 |
|---------------------------------------------------|-------------|-------------|-------------|-------------|
| | 30% | 53% | 85% | 85% |
| Park | 0.6 | 1.5 | 3.0 | 4.2 |
| Museum | 0.2 | 0.5 | 0.9 | 1.3 |

6.0 TRENDS AND CASE STUDIES: EVALUATION OF PRODUCTS BY BENCHMARKING

6.1 Possible Concepts/ Themes

In previous chapter, footfall numbers are estimated and it suggests that the site has good potential to attract more tourists if additional tourist attractions and facilitation are provided.

The project has been primarily conceived as an underwater viewing gallery and a restaurant. During the field visit it was observed that the visibility through water is limited and also the site is not very rich in marine life. Locals have reported that rarely any big fish is spotted around the Island. Considering this fact the proposal of developing underwater facility needed the further considerations:

1. It was reassessed to have a underwater viewing gallery in natural environment vis-à-vis artificial underwater facility created close to the coast.
2. An artificial marine park/ aquarium may also be examined to show case the rich marine life towards eastern side of the Beyt Island. The possibility to develop a coral park around the artificial underwater facility shall also be considered.
3. It is considered to locate restaurant/ Museum/ Aquarium etc. above water and create the visual impression of having the underwater facility through floor and side walls.
4. Another option is to plan for an artificial underwater museum having historic and religious theme along with a garden and food court on the surface to attract visitors.

Based on the understanding of the site potential/constraints, average footfall which ranges between 1.2 to 1.5 million annually, its religious and archaeological significance, lack of basic public facilities/ amenities, the following key anchor themes shall be tested, for their appeal and performance factors in order to achieve a product meeting aspirations in large i.e., developing Beyt Dwarka a regional tourist destination, for shortlisting further:

- Submersive Dining
- Aquarium
- Waterfront led Landscaped Public Realm
- Museum and Gallery
- Themes Artisan / Heritage Village- (*Retail, Novelties, FnB*)

This section provides various concepts that are been examined which may be suitable for the proposed site. The task is also to study the various concepts and facilities in India and across the world to gain in depth understanding on their features, foot fall and cost.

6.2 Submersive Dining

The mandate of testing underwater restaurant has been the prime anchor theme of the study based on the initial understanding that area has beautiful coals and rich marine life. Hence to show case that marine life and also to give an exotic experience to the visitors, an underwater restaurant was also assessed to be a possibility on the island.

Considering the various formats of existing comparable facilities around the world we've attempted to understand this under the larger category of "SUBMERSIVE DINING" theme. As we've experienced, almost all the underwater/submerged dining facilities are a trophy / anchor theme attached to either a nature based exclusive hospitality property, an exclusive anchor dining facility in organised retail format or a large theme water park with aquarium centred dining. The northern side of island is reported to have natural corals which attracts limited enthusiast however, the subject site which is being considered for development lies in the western side along the proposed bridge landing alignment where coral habitat is non- existent. Thus considering these as points in mind we've shortlisted two properties which would be case examples to understand the operational and cost features of developing similar facility in Beyt Dwarka (**Figure 6.1**).



Figure 6.1 Map showing Location of Selected Case Study Properties – Submersive Dining

6.2.1 Ithaa Undersea Restaurant, Maldives

Ithaa Underwater restaurant is part of Hilton Maldives Resort & Spa and is located on island called Rangali, Maldives. It is rated as world's most beautiful restaurant by the New York Daily News in 2014. Ithaa is five metres below the surface, offering 180-degree panoramic views of the vibrant coral gardens surrounding it. Ithaa's entrance is a spiral staircase in a thatched pavilion at the end of a jetty.

Ithaa was constructed in 2004 using 12.5 mm thick clear acrylic material in Singapore and was shifted to Maldives through a barge where it was sunk with the help of 85 tonnes of sand ballast. The life span of the facility is estimated to be 20 years.

It serves some of the most exotic sea food at a cost of US\$ 195 for lunch and US \$320 for dinner for a person.

| Seating Capacity | Key Elements | Opened In |
|------------------|---------------------------|-----------|
| 14 | F&B Aqua Theme Restaurant | 2005 |



Figure 6.2 Photographs of Ithaa Undersea Restaurant, Maldives

6.2.2 Al Mahara - Dubai

Al Mahara restaurant is located on the ground floor of Burj Al Arab and it is a floor-to-ceiling aquarium where diners can enjoy delicious food while watching colourful fish swim among luscious plants in bright blue water. The place is famous for its sea food delicacies.

The aquarium is run by the National Marine Aquarium of Plymouth, UK. It has large acrylic tanks holding marine life. The walls of the tanks are cleaned every couple of days. The fish are fed each day, some by hand, by experts who spend hours per day preparing the food.

| Capacity | Key Elements | Opened In | Pricing |
|---------------------------------------|-----------------------------------------------------------|-----------|-------------------------------------------|
| Seated Capacity 74 + 1 Event Space | F&B (Seafood especially Oysters) Aqua Theme Restaurant | 2016 | A dinner for two cost 600\$ to 1400\$. |



Figure 6.3 Photographs of Al-Mahara Restaurant, Dubai

6.3 Aquarium

The Gulf of Kuttch has rich biodiversity and most of its southern bank has been notified as a Marine National Park. The area has live corals and many rare species of fishes. This makes it quite a case for provision of an aquarium facility in the region where its biodiversity richness may be displayed. Such a facility may further be added to have dolphin shows, sharks display, jelly fish etc.

India does not have any such facility at present and thus two similar facilities in Asia and one in USA were studied. These three properties were chosen considering their size, footfall and capital cost of development.



Figure 6.4 Map showing Location of Selected Case Study Properties – Aquarium

6.3.1 Underwater World – Pattaya, Bangkok

Underwater World located at South Pattaya, is a popular tourist attraction showcasing rich marine life found in the region. This facility also supports many educational programs and recreational activities.

The main attractions at this aquarium includes **Diving with sharks and rays** along with professional scuba divers, **Koi Fish feeding**, **Touch pool** which allows visitors to see and interact with underwater lives such as sharks, stingrays, turtles, starfishes, seahorses, many species of fishes, seaweeds, coloured corals, small creatures, etc., **Living in the ocean** programme where one can sleep with the oceanic view inside tunnel, right beneath the fascinating marine creatures and jellyfish zone to watch these beautiful and majestic creatures float and dance through the water.

It has a 100-meter-long, 6.4-centimeter-thick acrylic walk-through underwater tunnel filled with dozens of marine species. The aquarium has more than 4,000 marine animals, from 200 different species found in the region as well as some rare creatures from overseas.

The theme park covers a total area of 4.7 acres and has an entry fee of INR 950 for adults and INR 570 for children.



Figure 6.5 Photographs of Underwater World, Pattaya

6.3.2 S.E.A. Aquarium - Singapore

The SEA aquarium is located inside Resorts World Sentosa, situated in southern Singapore and is spread over 20 acres of land.

The S.E.A. Aquarium is one of the world's largest aquarium by total water volume as it contains a total of 45,000,000 litres of water and more than 100,000 marine animals of over 800 species. The centrepiece of the Aquarium is an open ocean tank with more than 18,000,000 l of water and 50,000 animals. It has a 36 m wide and 8.3 m tall viewing panel which provides visitors a feeling of being on the ocean floor.

The facility has dining facility surrounded by marine life and also a souvenir shop. The entry fee varies from INR 750 to 1600 for residents and tourists and also for various age groups like children, adult and senior citizens.

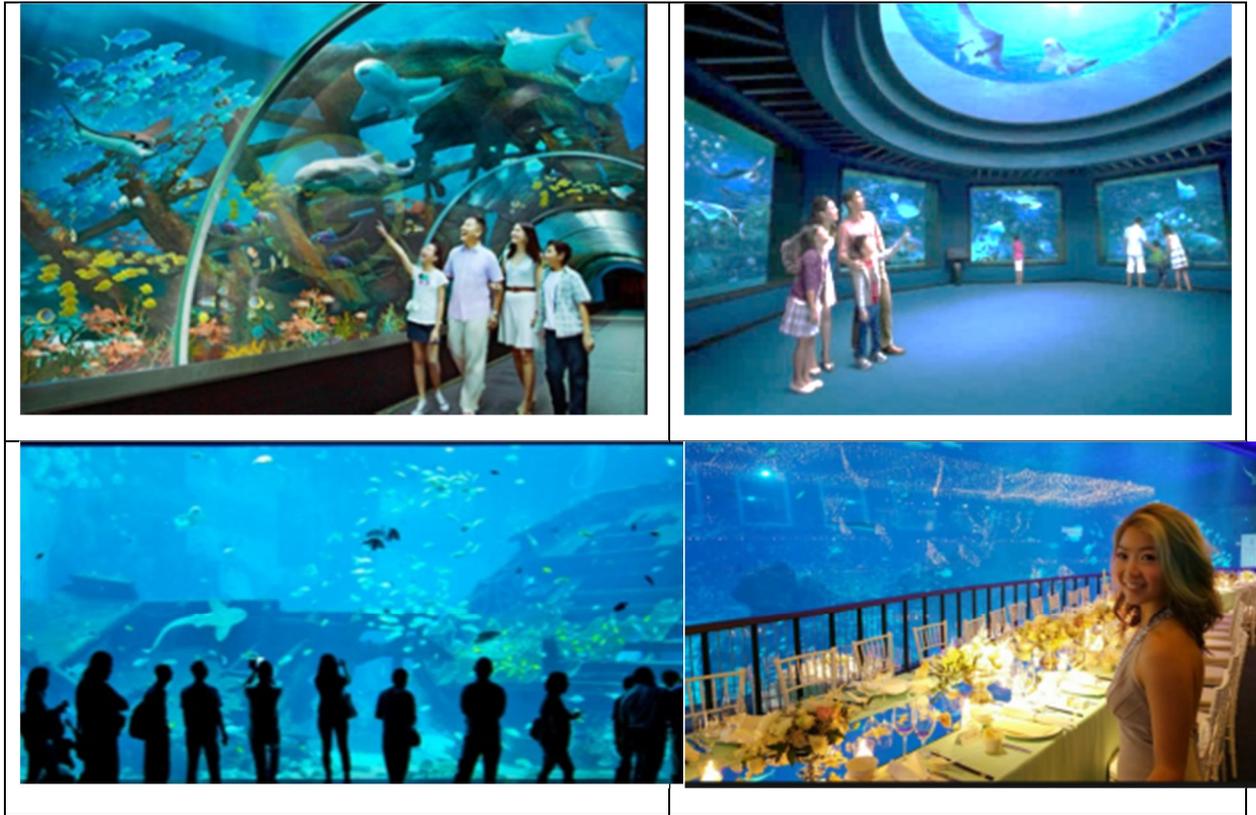


Figure 6.6 Photographs of SEA Aquarium, Singapore

6.3.3 Downtown Aquarium, Denver - United States

Downtown Aquarium (formerly Colorado's Ocean Journey) is a public aquarium and restaurant located in Denver, Colorado. It is a very large aquarium that is home to hundreds of unique aquatic animals.

The entertainment and dining complex features a public aquarium having over 500 species of terrestrial and marine species. It has many ecosystems depicted such as:

- **North America Continent** showing the wonderful creatures of the continent
- **In The Desert** showcasing desert life and creatures
- The Rainforest ecosystem
- **Under the Sea** exhibiting the coral reef in sea conditions, caves and crevices.
- **Sunken Temple** keeping with ancient ruins of world's most amazing mysteries underwater
- **Shipwreck** area has the paintings on the walls replicate a shipwreck

It also has a 4-D theatre to impart immersive movie experience through a 15 minute film. The facility also organise an underwater mermaid show choreographed to music.

Furthermore, a dining facility for guests is also part of the aquarium offering freshest fish, seafood, steaks. A ballroom and lounge is also operating at the aquarium.

| Area | Key Elements | Opened In | Gate Price |
|----------------------------------------------|-------------------------------------------|-----------|--------------|
| 17 Acres Floor Space 9,900 m ² | Aquarium cum F&B Aqua Theme Restaurant | 2005 | Approx. 20\$ |

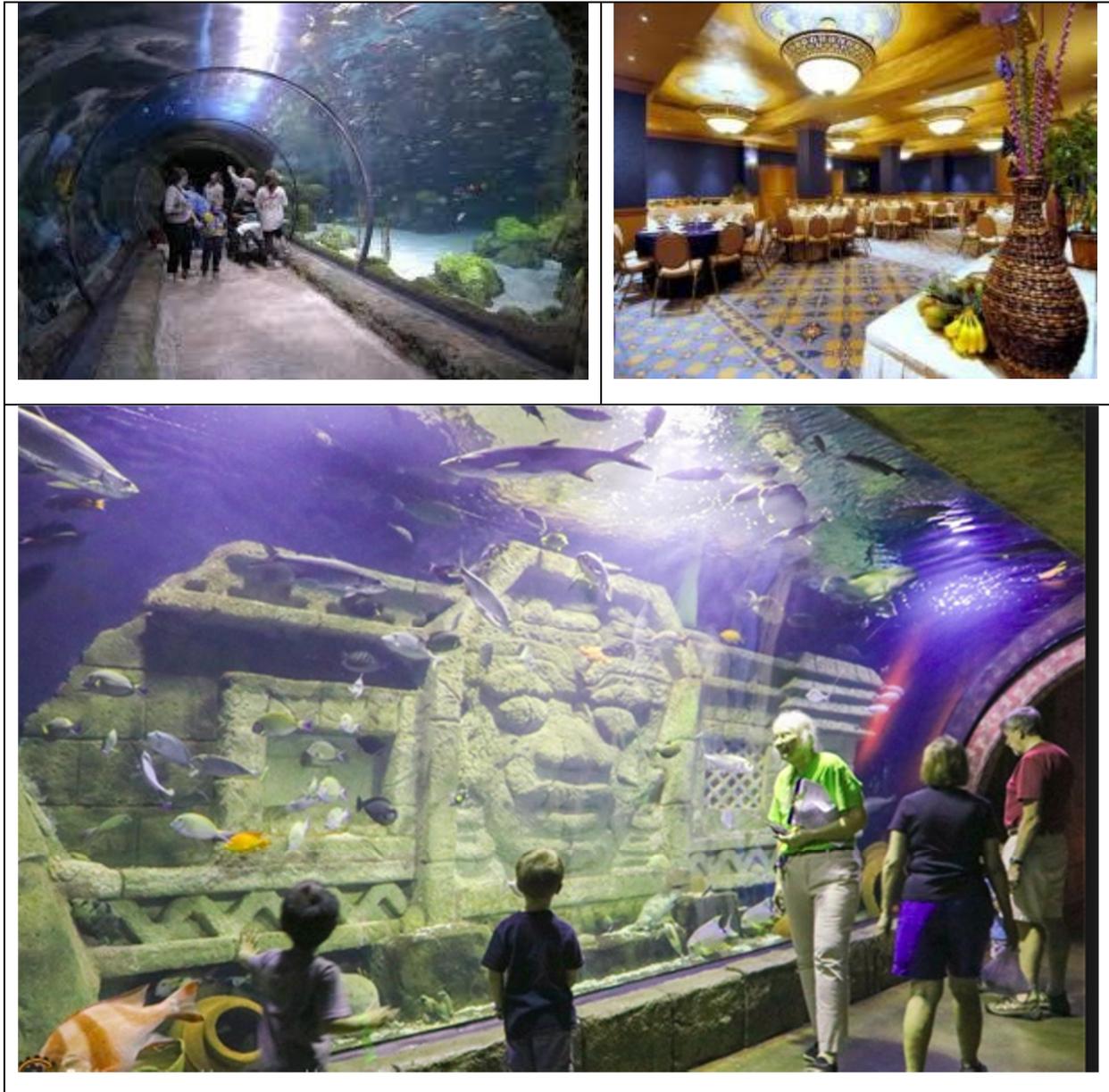


Figure 6.7 Photographs of Downtown Aquarium, Denver, USA

6.4 Waterfront/Theme Landscaped Public Realm

Most of the people visit Beyt for religious reasons and stay for only 2-3 hours. The visitors were observed to be rural poor and have limited spending power. Moreover, apart from the small tea shops, the Island does not have any facility where these people can relax and wait for a while.

Thus, an anchor facility is required at the Island where people may spend some time without much expenditure. This garden may be planned to have a play area for kids, landscape areas utilising local species, fountains, sculptures, walking trails with ocean view, covered resting or sitting spaces, cafeterias etc.

This region has hot climate with limited rainfall. The flora and fauna at Beyt represent xerophytic vegetation and have limited grass species. Thus, landscaping must have restricted use of exotic or fresh water plant species. The area under plantation must also be carefully planned to reduce the freshwater requirements.

To plan this facility, a total of four similar facilities in India and outside were studied fulfilling the following criteria:

- Low maintenance and fresh water requirements
- Limited green area
- Presence of hard structures
- Presence of water related aesthetics



Figure 6.8 Map showing Location of Selected Case Study Properties – Waterfront/Theme Landscaped Public Realm

6.4.1 Rock Garden of Chandigarh

The rock Garden at Chandigarh is famous for its sculptures that are been built from the trash and discarded household, electronic and construction waste. The garden spreads over an area of 40 acres. It also has green area as well as fountains and ponds in between the sculptures. The small food court is also provided within the garden.

The Rock Garden is visited by more than 5000 people daily. The Garden is open for all age groups and has an entry fee of INR 20 for adults and INR 10 for Children.

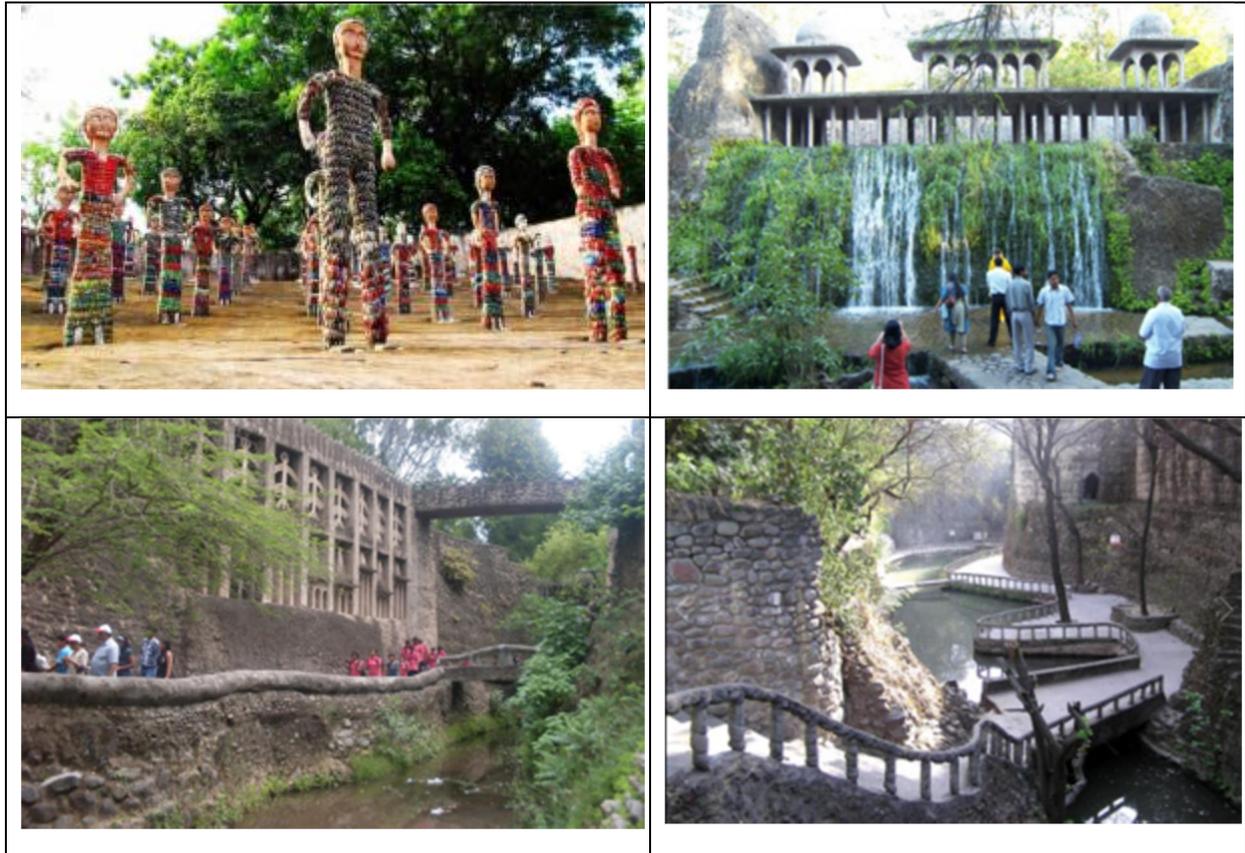


Figure 6.9 Photographs of Rock Garden, Chandigarh

6.4.2 Brindavan Garden, Mysore

The Brindavan Gardens is a major tourist attraction in the state of Karnataka. The Garden is located adjoining to Krishnarajasagara dam which is built across the river Kaveri. It is spread across an area of 60 acres (240,000 m²).

The garden has three terraces and each of them have many fountains, landscaping, topiaries (sculptures of animals created by clipping shrubs), pergolas (shaded passageway covered by creepers) and gazebos. The main attractions of the park are the musical fountains. There is also a lake within the garden with boating facilities for visitors.

The Garden is visited by more than 2 million tourists annually with an entry fee of INR 15.



Figure 6.10 Photographs of Brindavan Garden, Mysore

6.4.3 Frederiksborg Castle

Frederiksborg Castle in Denmark was built as a royal residence for King Christian IV of Denmark-Norway in the early 17th century. The castle also has Denmark's most notable garden in the Baroque style.

The garden has symmetrical features around four centre fountains from which water cascades down the terraces to the lake. The garden is beautifully landscaped with terraces, winding paths, hedges, flower and shrub beds, canals, waterfalls and artificial lakes.

The park is open for all and there is no entry fee for visiting the garden.





Figure 6.11 Photographs of Frederiksborg Castle Gargen, Denmark

6.4.4 Frogner Park, Oslo, Norway

Frogner Park is a public park located in the city of Oslo in Norway. The Park is a unique and world's largest sculpture park made by a single artist called Gustav Vigeland. The sculpture area at Frogner Park covers about 25 hectares to accommodate more than 200 sculptures in bronze, granite and wrought iron along with a famous Monolith plateau. Most of the statues depict people engaging in various typically human pursuits, such as running, wrestling, dancing, hugging, holding hands etc. The park also has large structures such as bridges and fountains. Frogner Park has a summer-open café and a restaurant.

The park is protected under the Heritage Act and is the most popular tourist attraction of Norway. It registers between 1 and 2 million visitors annually and remains open to the public at all times for free.

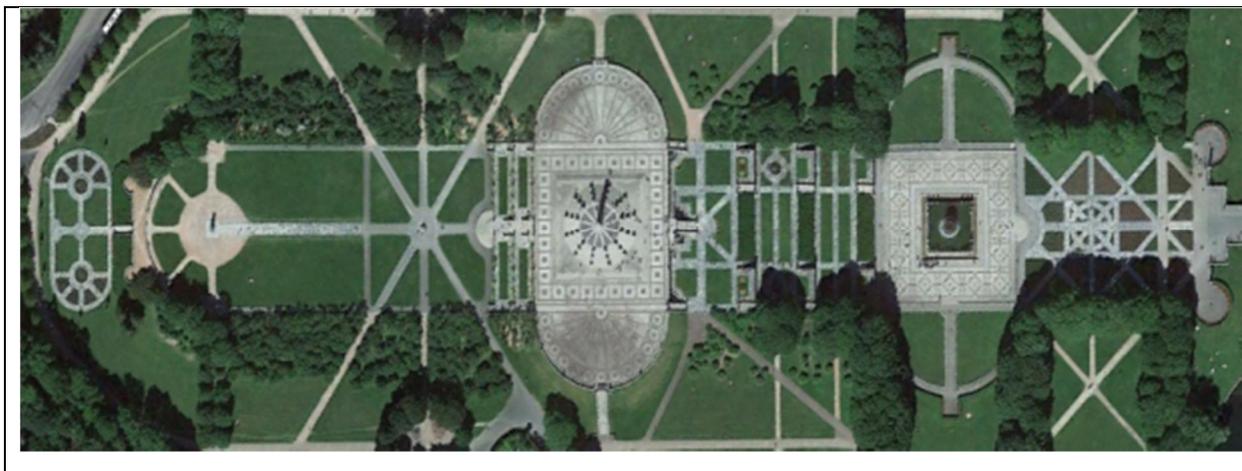




Figure 6.12 Photographs of Frogner Park, Oslo, Norway

6.5 Museum

Beyt Dwarka has been identified as an important archaeological site. Many articles such as shell remains of beads, bangles, columella, fish hook, coins, amphorae, lead anchors, potsherds, stone anchors, Harappa Seal, Rubble wall/ fortification were found at Beyt which dates back to late Harappa period (5000 - 3000 year BP) and Historic period (8th Century BC).

At present all these articles are kept in a museum at National Institute of Oceanography (NIO). These archaeological collections may be of great interest to a number of visitors, school students and researchers and hence a museum could also be an added attraction.

The museum may have features like display of original articles, replicas to give visual imprint of age old practices, curated themes, display of replicas or artificial curated themes submerged in water (Glass tanks), audio-visual room etc.

Keeping the conceived features in mind three different museums have been selected to qualify as case studies.



Figure 6.13 Map showing Location of Selected Case Study Properties – Museum

6.5.1 National Museum - Delhi

The National Museum, New Delhi is located in the majestic building on the corner of Janpath and Maulana Azad Road is the prime museum in the country.

The Museum has in its possession approximately 2,00,000 works of exquisite art of diverse nature, both Indian and foreign and its holdings cover a time span of more than five thousand years of our cultural heritage. While the splendid chronological display of selected art objects in the various galleries, screening of educational films related to art and culture, guided tours, gallery talks by the experts, special lectures and training programmes, facilities for photography and access to the reserve collection and library for the study, and advice on identification of art objects have brought immense laurels to the Museum.

It's rich holdings of various creative traditions and disciplines which represents a unity amidst diversity, an unmatched blend of the past with the present and strong perspective for the future, brings history to life. Apart from the collections of Pre-historic Archaeology, Archaeology, Jewellery, Paintings, Decorative arts, Manuscripts, Central Asian Antiquities, Arms and Armour, etc. The museum today has a separate branches of publication, Hindi, Public Relations, Education, Library, Exhibition cell, Display, Modelling, Photography, Security and Administration.

| Key Elements | Opened In | Gate Price |
|-----------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Museum (Archaeology, Archaeology, Jewellery, Paintings, Decorative arts, Manuscripts, Central Asian Antiquities, Arms and Armour) | Established in 1949 | The Adult Ticket costs INR 20 , Foreigners Ticket costs INR 650 , Students up to class 12th have free entry ticket |

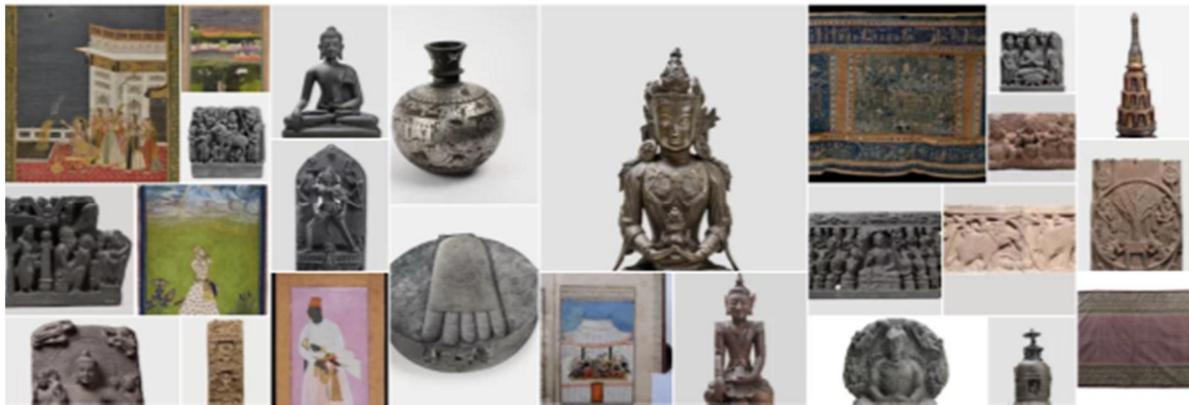


Figure 6.14 Photographs of National Museum, Delhi

6.5.2 National Museum of Natural History, Washington DC

With more than 126 million artefacts on display, this robust Smithsonian museum attracts millions of visitors each year. Some of the museum's highlights include tarantula feedings in the O. Orkin Insect Zoo and the replicas of giant whales and other marine life in the 23,000-square-foot Saint Ocean Hall.

| Footfall | Area | Key Elements | Entry |
|-----------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 8 Million | ~30,000 sqm | The Museum collects artefacts of all kinds—from gowns to locomotives—to preserve for the American people an enduring record of their past. | Free |

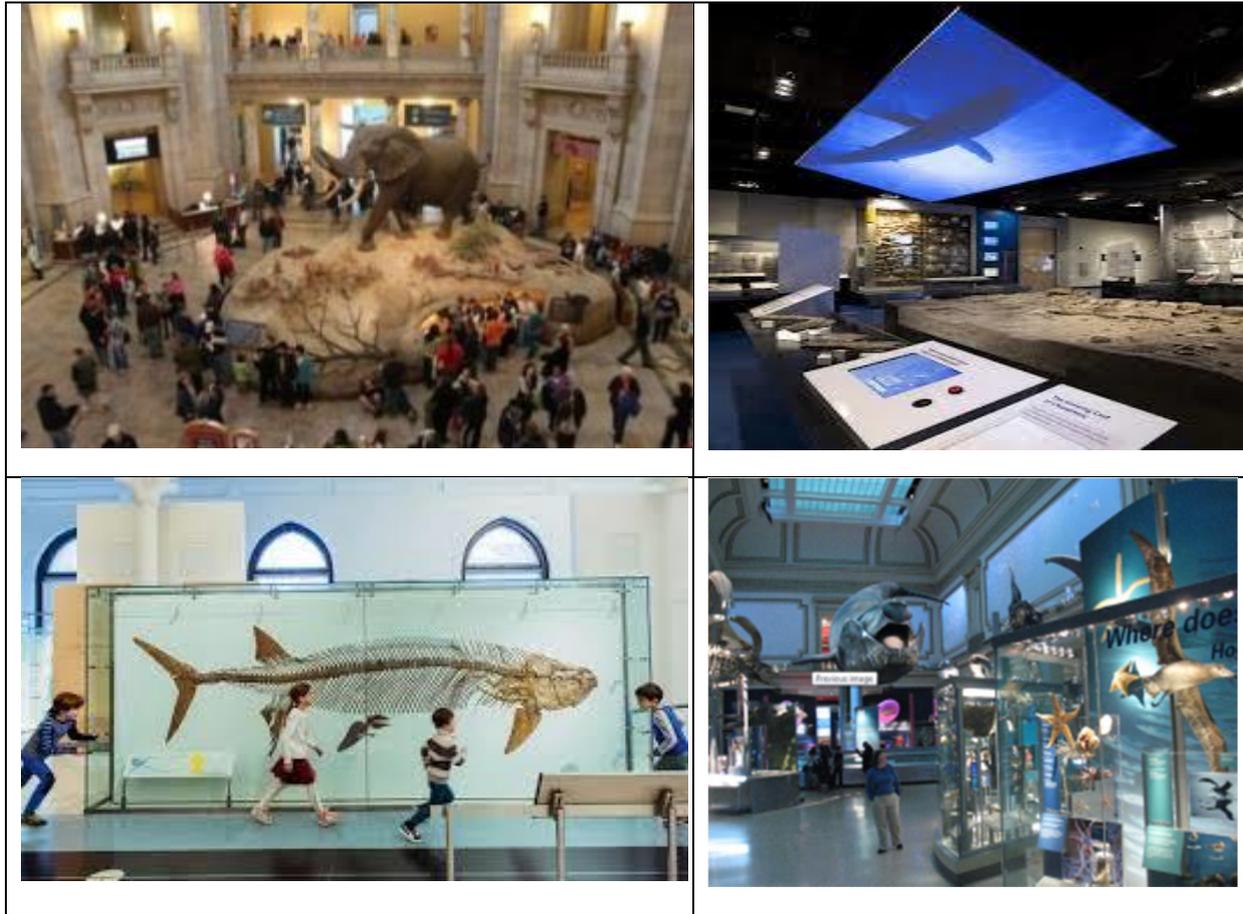


Figure 6.15 Photographs of Natural Museum of Natural History, Washington, USA

6.5.3 Herakleion Archaeological Museum, Crete, Greece

The Herakleion Archaeological Museum is one of the largest museums in Greece, which presents artefacts from all the periods of Cretan prehistory covering a chronological span of over 5,500 years from the Neolithic period to Roman times.

The two-storeyed building has 27 galleries, a gallery for audio-visual displays, extensive modern laboratories, a cloakroom, a cafeteria and a museum shop that sells museum copies, books, postcards and slides.

The museum organizes temporary exhibitions in Greece and abroad, collaborates with scientific and scholarly institutions, and houses a variety of cultural events.

| Footfall | Area | Key Elements | Entry |
|-----------|-----------|-------------------|---------|
| 3 Million | ~6000 sqm | Minoan collection | 10 Euro |



Figure 6.16 Photographs of Herakleion Archaeological Museum, Crete, Greece

6.6 Themes Artisan / Heritage Village- (Retail, Novelties, FnB)

During the Demand Assessment Survey, it is noted that there is no proper place to sit and eat for people visiting Beyt Dwarka. At present there are only small local shops. Therefore a food court and Shopping/ Retail facility could be developed as one of the options or this could be combined with some other facility as annual visitation is 1.1-1.3 million.



Figure 6.17 Map showing Location of Selected Case Study Properties – Theme Artisan/Heritage Village

6.6.1 Dilli Haat - Delhi

Dilli Haat is an open-air food plaza and craft bazaar and unlike traditional markets it is a permanent market run by Delhi Tourism and Transportation Development Corporation (DTTDC).

Out of three such establishments, Dilli Haat at INA Market is most famous. It is spread over 6 acres of land. It has 62 stalls allotted on a rotational basis to craftsmen at a payment of INR 100 per day for a maximum period of 15 Days. Products offered here may include rosewood and sandalwood carvings, embellished camel hide footwear, sophisticated fabric and drapery, gems, beads, brassware, metal crafts, and silk and wool fabrics. A number of shows promoting handicrafts and handlooms are held at the exhibition hall in the complex. Food stalls serving cuisines of various states are the main attraction of this place.

On summer weekdays between 2,000 and 3,000 people turn up. On Sundays and holidays, around 4,000 to 7,000 come here. Monthly visitors are now pegged at 180,000, with at least 500 of these being foreigners.

| Area | Key Elements | Opened In | Gate Price |
|---------|-----------------------------|-------------|--------------------------------------------------------------------------------------------------|
| 6 Acres | Food Plaza and Craft Bazaar | March 1994. | For Indian nationals is INR. 30 for Adults, INR 10 for Children. Foreigners are charged INR 100. |



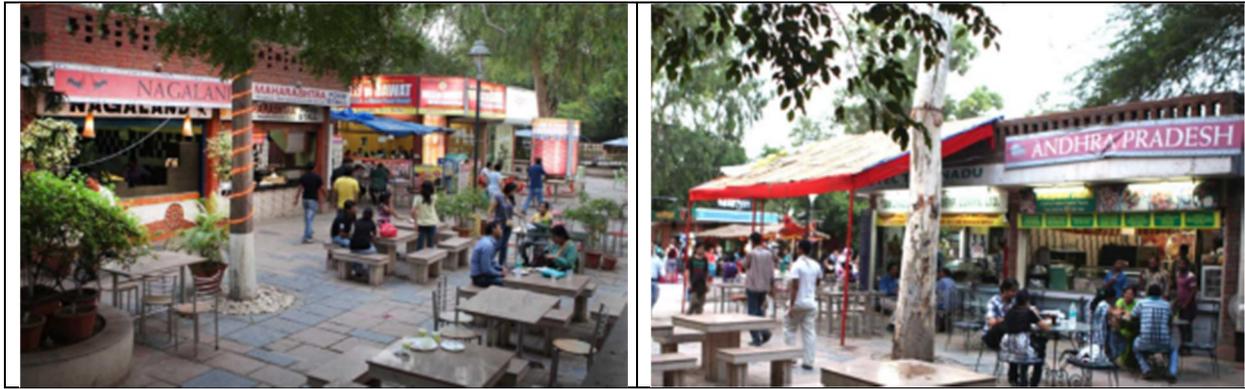


Figure 6.18 Photographs of Dilli Haat, Delhi

6.6.2 Law Garden – Ahmedabad

Law Garden is a public garden in the city of Ahmedabad, India. The market outside the garden is very famous for the goods sold by local people such as handicraft and ethnic stuff like the ghagra-cholis and Kurtis etc. Shops are generally open till late in the night.

The road at the side of the garden is filled with street hawkers selling all kinds of food items. It is visited by a large number of locals as well as visitors.

| Area | Key Elements | Gate Price |
|----------|-------------------|--------------|
| 15 Acres | Garden / Shopping | No Entry Fee |





Figure 6.19 Photographs of Law Garden, Ahmedabad

6.6.3 Chatuchak Weekend Market, Bangkok - Thailand

Chatuchak Weekend Market, Bangkok, Thailand is the largest market in Thailand and the world's largest weekend market. This market contains almost 15,000 stalls and is visited by about 200,000 visitors each day. It is one of Bangkok major tourist's attractions and is probably visited by almost every tourist visiting the city.

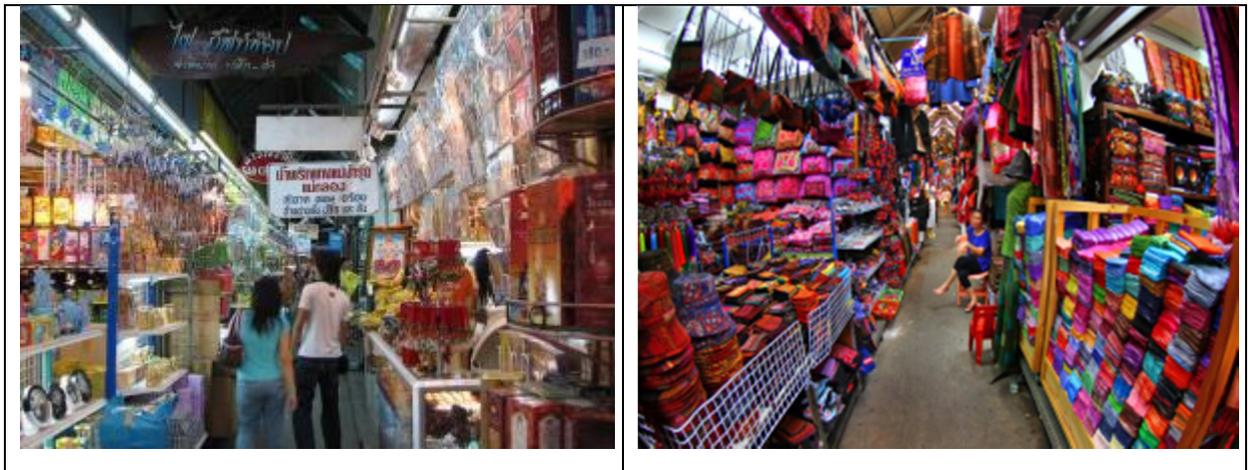


Figure 6.20 Photographs of Chatuchak Weekend Market, Bangkok, Thailand

6.6.4 Grand Bazaar - Istanbul

The Grand Bazaar is one of the largest and oldest enclosed markets (covered markets) in the world. The market contains 61 covered streets with over 3,000 shops. The famous grand bazaar, one of Istanbul's symbols, receives 250,000 – 400,000 visitors each day.



Figure 6.21 Total Potential Demand – Realistic Scenario

6.7 Comparison of Studied Themes for Beyt Dwarka

Table 6.1 shows a comparative assessment of all five themes based on the area requirement for the calculated footfall, price model, duration of visit, acceptability to various age groups.

It clearly suggests that submersive dining and aquarium in a realistic environment are not suitable for the present case. However these facilities can be created using suitable visual effects and artificial sub sea environment. Landscaped public realm, museum and Themes Artisan / Heritage Village are more likely to attract the visitors and may be conceived, sized and designed accordingly.

Table 6.1 Comparative Assessment of Themes

| Concept Themes | Submersive Dining | Aquarium | Waterfront Landscaped Public Realm | Museum Gallery and | Themes Artisan / Heritage Village |
|----------------------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------|----------------------------------------------|---------------------------------------------|----------------------------------------------|
| Sizing Range | 300 – 1,500 Sq. Ft | 15,000 – 50,000 Sq. Ft | ~ 15 acres | 10,000 – 50,000 Sq. Ft | 2- 10 acres |
| Pricing Model | Exclusive Dining price | Pay one Gate Price | Free/ Minimal Fee | Pay one Gate Price / Free | Pay one Gate Price / Pay as you go |
| Average Length of Stay | 1-2.5 Hours | 4-4.5 Hours | 2-4 Hours | 0.5-1.5 Hours | 1-3 Hours |
| Concept Positioning | HNI market - Strong Destination Drawing Power with international Branding | Children's market - Innovative new concept - Strong Appeal, Education Based | High appeal for Families with Young children | Broad Appeal, Unique Educational Attraction | High appeal for Families with Young children |
| Market Context | | | | | |
| Appeal to Local Market - Primary | ↓ | ↔ | ↑ | ↑ | ↑ |
| Destination Draw Regional Market | ↓ | ↔ | ↑ | ↑ | ↑ |
| Age Group | | | | | |
| Toddlers / Kids / Teens | ↓ | ↑ | ↑ | ↑ | ↔ |
| Young Adults/ Couples | ↑ | ↓ | ↑ | ↓ | ↔ |
| Families | ↔ | ↔ | ↑ | ↓ | ↑ |
| Seniors | ↓ | ↓ | ↑ | ↔ | ↑ |
| Note: | Low Appeal - Misfit | Medium Appeal – Fit with minimum sizing | High or strong Appeal – Fit | Medium Appeal – Fit with minimum sizing | High or strong Appeal – Fit |

7.0 RECOMMENDED CONCEPT / THEME

7.1 Evaluation of the Possible Concepts/Themes

7.1.1 General

In previous chapter many themes are discussed which may be possible at Beyt Dwarka considering its rich heritage (archaeology and religious), biodiversity and development needs. This chapter provides the feasibility of each of those themes with respect to the capital cost for their development, ease of maintenance, spending capacity of the visitors, its synergy with the planned development and also the available market or demand for such theme.

7.1.2 Underwater Restaurant

Based on the comparative analysis conducted in the case studies it is found that all underwater restaurants are found to be anchored with one or the other facilities like resorts, hotels, theme parks and aquariums. These facilities form a part of larger attraction program, which assists in sharing the high costs by utilizing the novelty value of this dining attraction, else it would be un-successful as a standalone venture. It is found that the appeal is limited to regional / international visitors, which also excludes younger age group attendants to whom it offers low attraction appeal. Moreover, these facilities require a high capital and maintenance cost, making these restaurants quite expensive. Most of these restaurants are specialised in sea food cuisines and bars.

In addition, Beyt Dwarka is a holy place for Hindus, where prohibition on serving non-vegetarian food and alcoholic drinks is observed. Moreover, a restaurant must have repeat visitation and the resident market (nearby areas) is also not very affluent to provide sustained clients. On discussion with experts working in hospitality field it was thus understood that underwater restaurant is not a suitable theme for this location.

Considering the site conditions of Beyt Dwarka, any underwater facility will not be possible due to limited depths available near the Island. Limited visibility and marine life near the Island are also not favourable for such facility. Thus, this kind of facility will have to be over ground and must be artificially created to house marine life.

7.1.3 Aquarium

Aquarium in other parts of the world like U.S., Europe and Asia have been established as major tourist attractions spots. The overall economic sustainability of aquariums varies depending on their unique location (established tourist destinations), features and efficient maintenance. These facilities have either been freestanding attractions; components of other natural history attractions such as zoos, museums or nature centres; or a part of larger marine animal theme parks. Additional features such as scuba diving, fish feeding, underwater mermaid shows, shows involving seals, dolphins, polar bears are also timely introduced to keep their uniqueness and also to invite repeat visitation.

The costs associated with building and operating an aquarium, are relatively high. It also requires skilled manpower trained to handle delicate marine life and other biodiversity features (Corals, ferns etc.). Recently, such facilities are been criticised for exploiting and keeping so many creatures away from their natural habitat.

In a country like India, an oceanarium or aquarium will be a unique experience as not even a single facility of this sort exists. However, high capital cost, skills required for maintenance, site features like low water depths nearby and high turbidity vis-a-vis profile of visitors at Beyt suggests it to be a non- viable venture. However an artificial aquarium in a building could be considered.

7.1.4 Waterfront/Theme Landscaped Public Realm

Theme landscaped public realm space /gardens worldwide have been created to give visitors a pleasant feel as an anchoring facility. It was found from the primary interviews conducted while data collection that the island city lacks a public retiring space which could act as layover area while they wait for the boat ride or during the off peak hours when the temple doors are closed. This waterfront theme landscape garden would be very helpful to activate the footfall volume from the primary market perspective too as it would enhance the visitation volume from religious purpose to more leisure and family getaway destinations.

The art of landscape gardening includes development of a new land form and then shaping it using natural elements such as landform, trees, shrubs, and water to form a pleasing harmony. The climatic conditions of the Beyt Island are hot and humid and only scanty vegetation is been reported. Thus, landscaped facilities will not only add to aesthetics of the area but also benefit the environmental quality. It is recommended to landscape the area to provide people an enhanced experience which shall elongate and diversify the visitation at regional scale too.

7.1.5 Museum

The museum is a significant theme for the area due to its archaeological importance. As reported that many pre-historic and historic era artefacts are found for the Beyt and at present these articles are kept in a museum at NIO, Goa for public viewing.

A museum at the site showcasing old artefacts and the historical evidences may present a unique experience of the historic sequence of development in and around Beyt. Its rich heritage as a Harappa site and maritime hub may be glorified at this museum. This facility could also be developed for educational and research purposes.

It seems to be suitable theme considering the archaeological and cultural heritage importance of Beyt.

7.1.6 Shopping/Retail Market and Food Court

Beyt is an underdeveloped site from the tourism perspective. People do not spend more than 2-3 hours to visit Dwarkadhish temple at Beyt. There are no good restaurants or eateries at the Island. Only 20-25 small shops were observed while passing through the narrow road to the temple and these shops are selling small toys, earthen articles, idols of gods and goddesses etc. Most of the tourists were observed to be buying these items as souvenirs from the Beyt.

Currently, the Dwarkadhish temple is under renovation and many other programs are under execution to increase Beyt's tourism appeal. The current study is also undertaken to develop some tourist attraction other than the temple on the island. It is prudent to provide the tourists with good shopping and dining experience if the time of the stay is to be increased at Beyt. Thus, an artesian village with small food court is a must have theme for this place.

7.2 Suggested Features for the Selected Themes

From the section above it must be concluded that a combination of a landscaped garden, Museum and market-cum-food stalls shall be considered as a package at the Beyt. This section presents some of the features that may be adopted within each of the suggested themes.

7.2.1 Features for Landscaped Garden

Considering the climatic conditions and vegetation type of the site, it is recommended to introduce some water related features as well as hard structures in this facility along with greenery. The landscaped area may have Promenade¹, mazes, fountains and rock sculptures. It is also recommended to provide some sitting spaces facing sea to enhance the marine experience of the visitors.

7.2.1.1 Covered Resting Place

These structures may be created with their tops covered to avoid scorching sun rays but shall be open from sides to enjoy the sea breeze. There are many concepts around the world that are been developed and some are presented as photographs in **Figure 7.1**.

¹ A paved public walk, typically one along the seafront at a resort.

A combination of small size features scattered around the garden would be a good approach to avoid congestion and concentration of tourist at a single place.

| | |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|  |  |
| <p>Huweishan Park, Xiamen, China</p> | <p>Marbury Country Park, UK</p> |
|  |  |
| <p>Bradner Gardens Park, Seattle</p> | <p>Random images from home garden</p> |

Figure 7.1 Suggested Features - Covered Resting Place within Landscaped Public Realm

7.2.1.2 Hard Structures - Sculptures

Statues of Lord Krishna and also thematic sculptures from Mahabharata can be positioned within the landscaped gardens. Regional artisans and artists would be encouraged through a design competition to provide ideas that may be made out of rock, metal or ceramic.

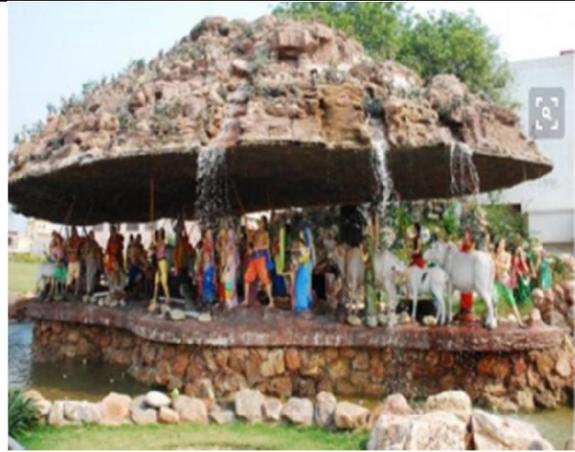
In addition, sculptures or wall sculptures would also be proposed, creating displays of historic events, marine life, culture etc.



Arjuna Wijaya Ceramic Statue, Jakarta



Narasimha Swami Temple, Nampally, Karimnagar, Andhra Pradesh



A small landscape, Vrindaban

| | |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|  |  |
| <p>A statue from Vrindavan Temple</p> | <p>Rusted Iron and Brick Statue, Sculpture Garden, Burghley House, Stamford</p> |
|  |  |
| <p>Wall sculptures</p> | |

Figure 7.2 Suggested Features - Sculptures within Landscaped Public Realm

7.2.1.3 Promenade

A promenade, along the waterfront will add to the tourist appeal. This walk way may also have some sitting spaces, statues created in a manner that allows tourist to take interactive photos. A spot can be designed to capture pictures of proposed signature bridge also.

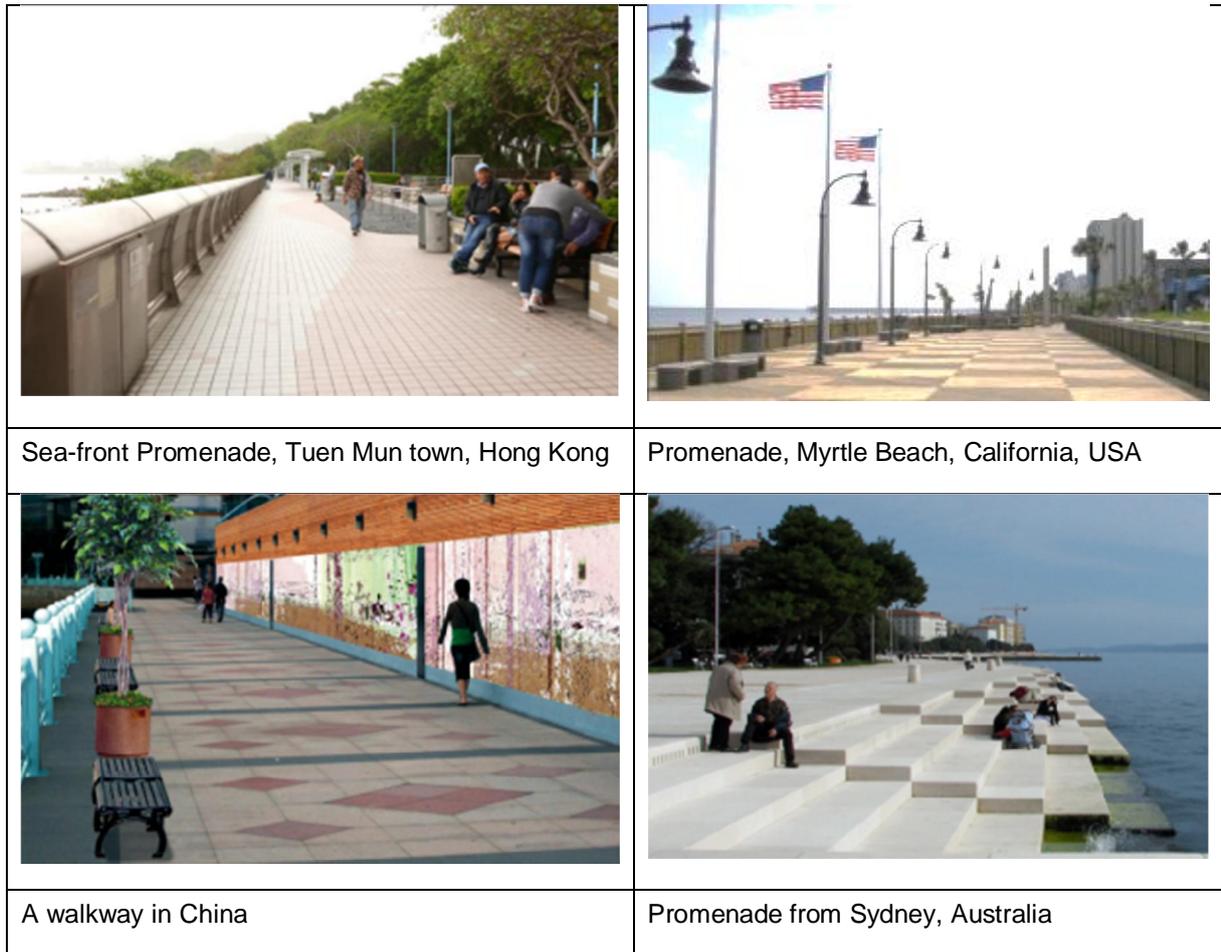


Figure 7.3 Suggested Features - Promenade within Landscaped Public Realm

7.2.1.4 Fountains

Fountains are seen as a must have feature in any landscaped areas. Their primary function is not only to add to the aesthetics but also to regulate temperature of the area. A mix of modern and traditional, medium and small sized structures may be planned considering the spaces and their locations in the park.

However, considering the water scarcity at the location and the high maintenance requirements it is not proposed to provide any major fountains but small interventions at appropriate locations shall be considered.

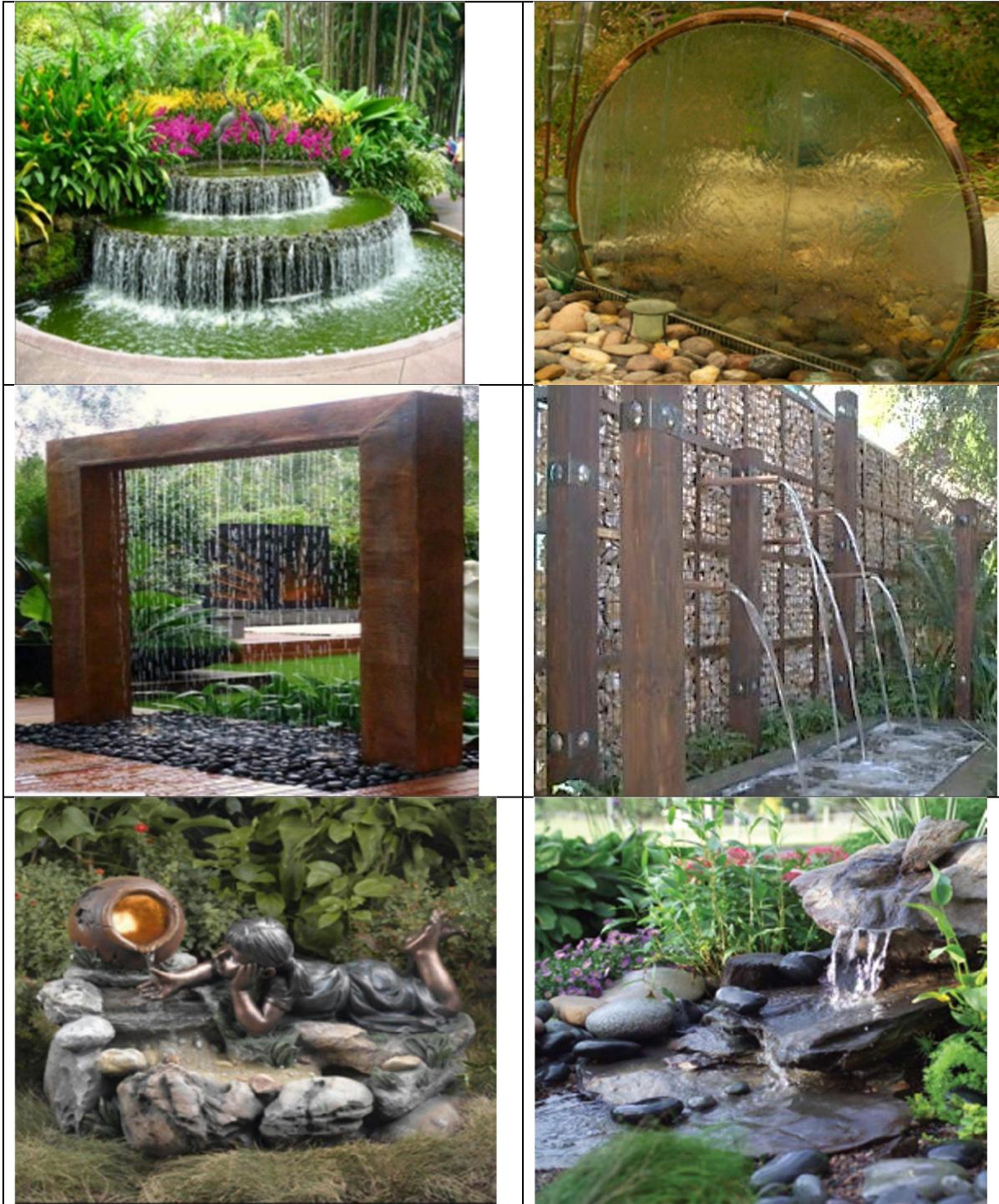


Figure 7.4 Suggested Features - Fountains within Landscaped Public Realm

7.2.2 Features for Museum

The museum at Beyt must not be just a building having display of only artefacts but must be developed to amalgamate some of the modern concepts where state of art audio visual rooms with 3-D facility may be planned. Underwater themes may be curated to depict trade and maritime activities or legend of Dwarka.

A section of the museum may also be developed as natural history museum where rich marine flora and fauna of this area, their habitats and characters may be showcased as pictures, paintings, real life dummies, audio-visuels etc. This section may also have medium to large aquariums either in the form of a see through tunnel, displaying marine life, at the entrance to the museum or a separate section in a room with see through walls showing marine life and art effects or replicas of the archaeological evidences.

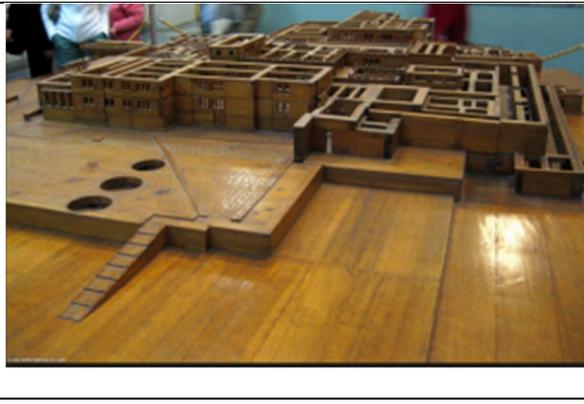
| | |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |
| <p>Heraklion Archaeological Museum, Crete, Greece</p> | <p>Ellis Island National Museum Of Immigration, USA</p> |
|  |  |
| <p>A random still of a museum, from photo gallery</p> | <p>Knossos model, Heraklion Archaeological Museum, Crete, Greece</p> |



Figure 7.5 Suggested Features – Museum

7.2.3 Features for Themes Artisan / Heritage Village

It is suggested that the artisan heritage village should have a mix of both permanent and temporary retail vending shops. The space shall be groomed with rustic and local design art form which shall provide a market place for the promoting state handicraft and artefacts. This area would include multi-cuisine food and beverage offering in street food formats with limited inventory and no fixed seating dining rather more informal and shared dining space would be envisaged.



Figure 7.6 Suggested Features – Theme Artisan/ Heritage Village

8.0 DETAILS OF THE PROPOSED FACILITY

In previous chapters, themes suitable for the development at Beyt has been identified and selected, land parcel conducive for development delineated, footfall numbers and size of facilities has been estimated. Based on these aspects, layout of the facility and other details have been worked out, as presented in this chapter.

8.1 Overall Layout of the Facility

The proposed facility is planned entirely on government land, i.e., survey No. 69 having a size of 25 acres. A total of 17 acres of land is proposed to be delineated for this project. Entire land parcel will be created as a landscaped public realm, having the following components.

- Skyview Tower with Restaurant
- Underground Museum
- Waterfront/ Promenade
- Jetty connection to Skyview tower
- Amphitheatre
- Shopping Area
- Food Stalls
- Parking
- Basic Amenities

The overall layout of the facility is shown in **Figure 8.1**.



Figure 8.1 Layout of the Facility

8.2 Sky View Tower

A 30 m high sky view tower is proposed close to the sea, which will have provision to provide a bird's eye view of the facility, Beyt Island along the ocean. The tower will have provision of lift as well as stairs.

The tower will be circular in shape with a diameter of 20 m.

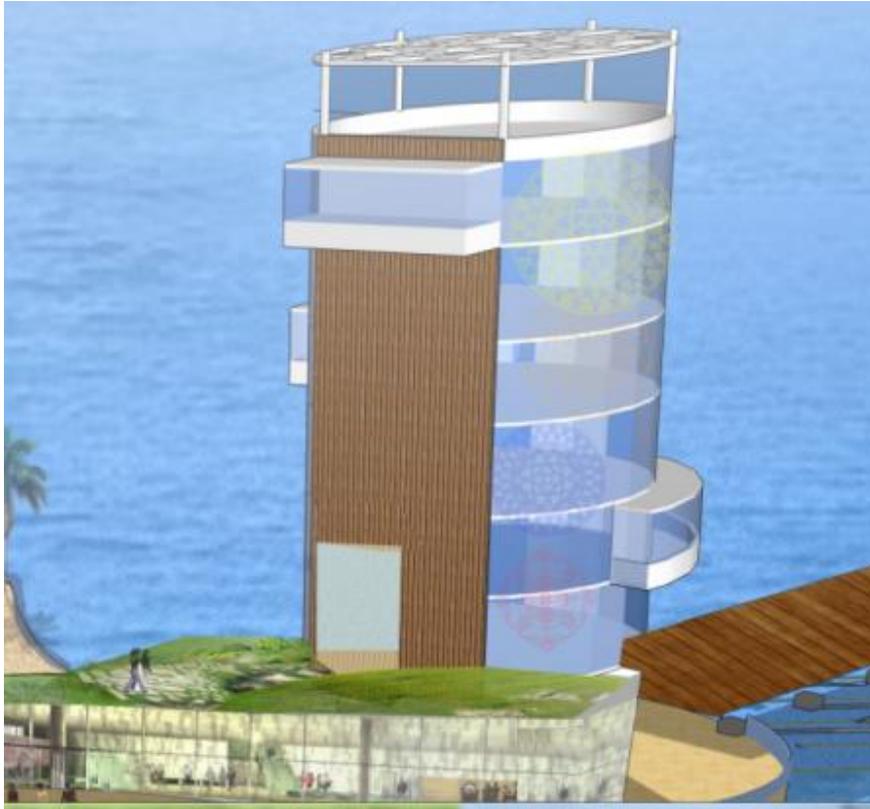


Figure 8.2 View of the Sky View Tower

With an understanding of the constraints with respect to an underwater restaurant, it is proposed to have a superior dining facility within the proposed Viewing Tower and two floors of the tower may be dedicated to have an air conditioned restaurant. The proposal for an iconic structure allied with food and beverage has the potential to become a regional landmark. With an island footfall of +- 14000 people a day in the final phase without factoring the increase in visitation upon completion of the road bridge or enhanced marine taxis, the opportunity exists for a restaurant with a locally themed menu that caters to the net higher income visitor (NHIV). The structure could house local artisan works along with pictorial references to the culture and past events of importance. The large viewing deck on top of the structure would allow vistas along the coast and across to the mainland.

An entire floor may also be dedicated to the administrative building that may be required for operating and maintaining this facility.

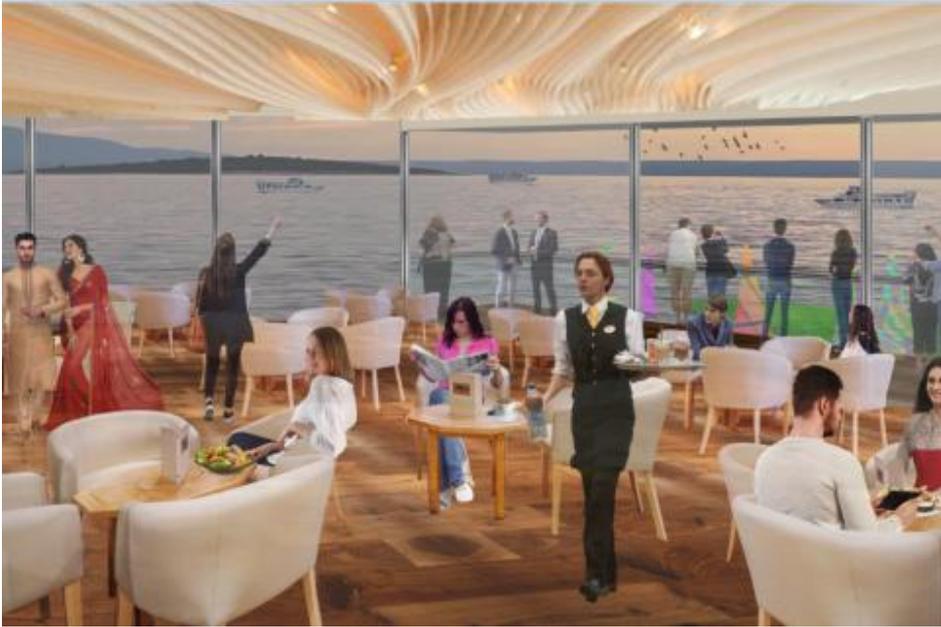


Figure 8.3 Conceptual View of the Proposed Restaurant within the Sky View Tower

8.3 Museum

The design and construction of an ecologically sustainable building using existing limestone material from the site and siting the building partially underground to enhance the passive cooling and reduced HVAC demands is suggested. The structure would have a large atrium entry with water feature, to represent the Aquarium precedent and glass panel walling opening to a paved public realm for eating and shaded areas. Extensive views out to sea from one side of the building would be balanced with a view over the landscaped facility.



Figure 8.4 Conceptual view of Museum

The green roof would be trafficable with opportunities to take in the views, sit on the grass or watch a documentary on the historical significance of the site and its surrounds on the sail screens along the waterfront. The Museum shall hold artefacts that are found in the region within special tanks and interpretive screens could tell the story of the object and its significance.

The building would have revenue opportunities through an internal theatre, paid visitation to highlight elements of the artefacts on display. An underground tunnel would connect the Museum to the Skyview Tower providing further opportunities for an enhanced visitor experience i.e., interactive or live streaming panels showcasing marine life found in the region.



Figure 8.5 Cross-sectional View of the Museum

The museum may have large acrylic water tanks to showcase themes like sunken Dwarka, ship wrecks, old maritime history etc. In addition, artefacts, paintings, audio-visual presentation etc. may also be incorporated.

8.4 Jetty or Gandola

Allied with the Sky Tower is the connection to the jetty where the potential exists for a fast boat to transfer (NHIV) from the mainland to the Skyview Tower. The Jetty could also facilitate short cruise options around the island or to key points of interest within the Marine Park. This development is however not proposed in the initial phase but later once the proposed facility is built and operated for few years.

Either the jetty or Gandola could be connected to the mainland by means of a conventional approach trestle or through a ropeway. This aspect shall be examined in detail at the implementation stage.

8.5 Landscaping

Significant opportunities exist to enhance the visitation experience through improvements to the landscape. Our proposal reviews the current opportunities and provides alternative types of recreation and amenity and provides realistic options for visitors. Climatic conditions dictate the usage and occupation of a site and Beyt Dwarka, with its long hot summers requires careful attention in the landscaped elements in mitigating these effects. Enhanced shaded areas incorporating playful mazes and arched structures are proposed along the shared path network for pedestrians and e-rickshaws.

Public Open Space (POS) is also proposed with themed playgrounds and larger open areas to allow for large scaled events including kite flying competitions etc. The internal path network will capture visitors at key locations such as the main entry, aligned with the existing port service, car parking and vendor spaces aligned with the proposed access bridge and from the visitor car parks located on the eastern boundary of the site. Pedestrians and e-rickshaw users can walk/ride from these locations to key points within the park, the range of services will be determined by the user experience provided and funded by ticketing of specific areas.

Sculptural elements to be constructed in local material or material suitable to the local climate, these panels will be carved to provide a narrative of Lord Krishna's life, closer to the temple, while the same 'spine' walkway will have marine themed panels along the shaded path culminating at the Marine museum.

Considering the climatic conditions and vegetation type of the site, it is recommended to introduce minimal water features to reduce potential maintenance issues but provide specific responses in identified key locations. The landscape elements within the site will take advantage of existing vistas, places of significance and shade structures.

The proposed open structures will be constructed with permeable tops reducing the effect of the scorching sun and U.V rays but shall be open from sides to enjoy the sea breeze.

8.6 Promenade

A promenade has been proposed along the waterfront adjacent to the Marine Museum and Skyview Tower which will add to the tourist appeal. This walk will also have some sitting spaces. At key locations photo opportunities can be designed to capture pictures of significant sites and the proposed signature bridge.

8.7 Amphitheatre

It is proposed to keep a provision for a small amphitheatre adjacent to the Museum and near the promenade. This would provide seating space for the visitors and can be used for organising events in open air.

8.8 Shopping Area and Food Court

Public amenities including F&B in a shaded setting with playground facilities, seats and WC facilities may be considered. Opportunities for vendors would be provided to showcase local wares. Rather than multiple outlets a controlled single operator with spaces made available at reasonable rentals for local retailers.

8.9 Access Road

As a part of the development, it is suggested to strengthen that road adjacent to the facility and it is proposed to make it a 2 lane paved road that shall connect to Abhya mata temple on the South of proposed facility.

It is also propose to upgrade the existing road between the main temple and the proposed facility. This road shall be developed as Heritage Walk. The part between the facility and the temple will have sculptures, walls, pillars etc. celebrating life and also teachings of Lord Krishna.



Figure 8.6 Heritage Walks - Connecting with the Heritage of Land and Water at Site

8.10 Basic Amenities and Services

The required basic amenities like washrooms and drinking water shall be provided at appropriate places.

Due to scarcity of water, it is proposed to provide a small desalination plant at the site. The daily water requirement is calculated to be of the order of 0.5mld in the ultimate stage of development and therefore it is proposed to provide a sea water storage tank of 500 cum capacity, which shall be filled with sea water drawn through submersible pumps located at the approach of the existing passenger jetty and brought to the facility site through a pipeline. The water shall be fed to desalination plant from where after desalination it shall be transferred to a water sump of 200 cum capacity for further distribution to the required places through smaller pipelines.

The electricity shall be needed at various parts of the facility for lighting, air conditioning, services etc. The connected load for the facility is estimated to be about 30 KW only. The power shall be tapped through the substation located at the Beyt Island and then brought to the facility where a small substation shall be located. From this substation the power shall be supplied to various areas of the facility. It is proposed that power demand of the facility for lightening of the pathways will be met through solar lighting system.

Small STP having capacity of 50 KLD shall be provided initially at the facility and it shall be augmented suitably with the increase in visitation. The sewage from the washroom shall be transferred to STP through the underground pipelines for treatment and disposal into the sea.

As discussed in section 8.2, administrative Building/ offices may be located within the sky view tower on one of the floors, preferable ground or first floor.

9.0 ENVIRONMENT AND SOCIAL IMPACTS AND MANAGEMENT PLAN

9.1 Introduction

This section presents environmental conditions in and around the proposed port location at Beyt Dwarka. The environmental and social settings have already been discussed in chapter 2 and 3, here identifies environmental issue that may arise due to the considered project and its components are identified to suggest mitigation measures to minimise adverse impacts. This section also details environmental policies and legislation to highlight the permissions and clearances required for the project.

9.2 Environmental Policy and Legislation

Table 9.1 presents Environmental regulations and legislations relevant to this project, along with the details of the competent authority for implementation.

Table 9.1 Summary of Relevant Environmental Legislations

| S. No. | Act/Rule/ Notification, Year | Relevance | Applicability | Implementing Agency |
|--------|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| 1. | Environment Impact Assessment Notification and amendments made thereafter, 2006 | For environmental clearance to new development activities following environmental impact assessment | Yes, Category B. Area Development Project | SEIAA |
| 2. | Coastal Zone Regulation Act, 2011 | Any activity planned in CRZ needs approval | Yes, due to jetty and development in CRZ zone | SCZMA |
| 3. | Indian Forest Act, 1927 Forest (Conservation) Act, 1980 | <ul style="list-style-type: none"> Conservation of Forests, Judicious use of forestland for non-forestry purposes; and to replenish the loss of forest cover by Compensatory Afforestation on degraded forestland and non-forest land Permission for tree felling | No forest land is involved in the project. | MoEF&CC; Department of Forest, GoG |
| 4. | Wild Life (Protection) Act, 1972 | <ul style="list-style-type: none"> To protect wildlife in general and National Parks and Sanctuaries in particular Permission for working inside or diversion of sanctuary land | Not Applicable as Site is away from Marine National Park | Chief Conservator of Wildlife, Wildlife Wing, Forest Department, GoG; |
| 5. | The Water (Prevention and Control of Pollution) Act, 1974 | <ul style="list-style-type: none"> CPCB/ SPCB to establish water quality and effluent standard; monitor water quality; prosecute offenders Issuance of Consent to Establish (CTO) and Consent to Operate (CTP) | Yes, Consent required to establish and not to pollute water during construction and operation (desalination and effluent treatment) | Gujarat Pollution Control Board |

| S. No. | Act/Rule/ Notification, Year | Relevance | Applicability | Implementing Agency |
|--------|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|---------------------------------|
| | | | plant) | |
| 6. | The Air (Prevention and Control of Pollution) Act, 1981 | <ul style="list-style-type: none"> • CPCB/ SPCB to establish air quality and emission standard; monitor air quality; prosecute offenders • Issuance of Consent to Establish (CTO) and Consent to Operate (CTP) | Yes, Consent required to establish and not to pollute air during construction | Gujarat Pollution Control Board |
| 7. | Noise Pollution (Regulation and Control) Rules, 1990 | <ul style="list-style-type: none"> • Standard for noise | Yes, construction machinery to conform to noise standards | Gujarat Pollution Control Board |
| 8. | The Motor Vehicle Act, 1988 Central Motor Vehicle Rules, 1989 | <ul style="list-style-type: none"> • Licensing of driving of motor vehicles, registration of motor vehicles, with emphasis on road safety standards and pollution control measures, standards for transportation of hazardous and explosive materials. • Issuance of Pollution Under Control (PUC) certificate to vehicles used in | Yes, all vehicles shall comply with these provisions | State Motor Vehicle Department |
| 9. | Public Liability and Insurance Act, 1991 | <ul style="list-style-type: none"> • Protection to general public from the accidents due to hazardous material | Yes, Any hazardous material used as raw material or waste for activities | District Collector |
| 10. | Hazardous Wastes (Management and Handling Rules), 1989 | <ul style="list-style-type: none"> • Guidelines for generation, storage, transport and disposal of Hazardous waste • Issuance of authorisation for all above mentioned activities. | Yes, NOC to handle any hazardous waste, i.e., waste oil from machineries etc. | Gujarat Pollution Control Board |
| 11. | The building and other construction workers (regulation of employment and conditions of services) Act, 1996 | <ul style="list-style-type: none"> • Employing labour/ workers | Yes, as construction workers will be appointed | District Labour Commissioner |

Apart from the environmental stipulations mentioned above, other acts applicable for the project are Child Labour (Prohibition and Regulation) Act, 1986; The Factories Act, 1948 and The Minimum Wages Act, 1948.

9.3 Anticipated Environmental Impacts and Mitigation Measures

It is important to note that various project components, i.e., a jetty, sky view tower, museum, shopping and dining areas, parking, public conveniences and walkways. Most of the project is envisaged on the ground beyond HTL. This project is planned for only for recreational and educational purposes.

Potential impacts on environment due to the proposed project have been summarized in **Table 9.2**. The impacts due to the project location are generally irreversible and cannot be mitigated through environmental enhancement measures. However, impacts related to construction are normally short term, which can be off-set to a large extent by observing a set of precautionary measures. The impacts during operation phase are permanent and can be mitigated following environment management plan provided in next section strictly.

Table 9.2 Potential Environmental Impacts

| Environmental Aspects | Pre-construction/ Land Acquisition/Construction | | Operation | |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| | Activities | Potential Impacts | Activities | Potential Impacts |
| Impact on Land & Soil Environment | <ul style="list-style-type: none"> Quarrying for fill material Construction of road Clearing of site and land levelling Dumping of liquid and solid waste from labour camps, stack yards, workshops etc. | <ul style="list-style-type: none"> Change in land use Loss of trees/vegetative cover hence increase in soil erosion Soil contamination due to dumping of solid waste (municipal and construction) and spillage of hazardous waste, i.e., oil or other chemicals. | <ul style="list-style-type: none"> Dumping of solid waste by tourists on land and sea. | <ul style="list-style-type: none"> Contamination due to spillage |
| Impact on Water Environment | <ul style="list-style-type: none"> Construction of road Setting up of Labour camps | <ul style="list-style-type: none"> Change in natural drainage Water Pollution from labour camps Increase in turbidity due to jetty construction activities Contamination due to spillage of chemicals used during pile diving. | <ul style="list-style-type: none"> Extraction of sea water Desalination plant Sewage generation | <ul style="list-style-type: none"> Contamination of water due to untreated effluent discharge Increase in salinity |

| Environmental Aspects | Pre-construction/ Land Acquisition/Construction | | Operation | |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Activities | Potential Impacts | Activities | Potential Impacts |
| Impact on Air Environment | <ul style="list-style-type: none"> • Operation of vehicles and construction machinery • Fuel burning at labour camps | <ul style="list-style-type: none"> • Dust emissions due to construction activities and vehicle movement • Emissions from labour camps, vehicles, machinery and DG sets | <ul style="list-style-type: none"> • Vehicle movement • Operation stand-by generators • Operation of vessels to proposed jetty | <ul style="list-style-type: none"> • Air pollution |
| Impact on Noise Environment | <ul style="list-style-type: none"> • Operation of vehicles and construction machinery • Quarrying and transportation of material to the site. | <ul style="list-style-type: none"> • Increased noise levels from heavy machinery and increased human activities | <ul style="list-style-type: none"> • Vehicle movement • Operation stand-by generators • Operation of vessels to proposed jetty | <ul style="list-style-type: none"> • Increase in noise |
| Impact on Ecology | <ul style="list-style-type: none"> • Quarrying for fill material • Construction of road • Clearing of site and land levelling | <ul style="list-style-type: none"> • Loss of vegetation due to site clearing | <ul style="list-style-type: none"> • Landscaping and plantation | <ul style="list-style-type: none"> • Positive impact • Improved aesthetics |
| Impact on Socio-economic | <ul style="list-style-type: none"> • Construction activities • Traffic Movement • Influx of outside workers/ population | <ul style="list-style-type: none"> • Discomfort to nearby communities due to noise, air and water pollution and influx of people • Increased traffic movement | <ul style="list-style-type: none"> • Increased tourism | <p><u>Positive Impacts</u></p> <ul style="list-style-type: none"> • Increased tourists • Increased Jobs • Increased Business opportunities • Better roads • Community development programs |

9.4 Impacts during Construction Phase

The construction phase, in general, has adverse influence on all the components of environment. Most of these impacts are short lived and reversible in nature, hence proper care is must to minimize the disturbance so as to the restoration of natural and ecological services.

9.4.1 Impacts on Land and Soil

The proposed facility is planned on the land except jetty on government land. This land is devoid of any habitation and is reported to be scrub.

The anticipated impact of the project are soil contamination that may be caused from roadside litter, oil spillage from machinery, sanitation and waste disposal, spillage of hazardous chemicals etc. Any soil contamination will also impact marine water.

As the project envisaged landscaping of a large land parcel, care would be taken to maintain the present topography. Thus, limited material will be required for site preparation.

Mitigation Measures

Considering the activities and their impact on land and soil the following mitigation measures are discussed below.

- Vegetation clearance shall be confined to the minimum area required for the project.
- Re-plantation will be carried out as planned landscaping.
- All the waste has to be collected and nothing to be dumped on land or water.
- The contractor will be held responsible to clean all debris before leaving the construction site and also to make necessary arrangements with scrap dealers to sell off the waste scraps.
- The waste from labour camps and administrative activities during construction will all be disposed of at designated solid waste collection point.
- Material required for site levelling will be sourced from approve local quarry.

9.4.2 Impacts on Water Quality

Impacts on water resource are two-fold, one increased water demand and disposal of waste water.

Additional water demand due to this project is anticipated towards construction activities and drinking and maintenance water needs during operations.

During construction a total of about 2 ML water will be required. The water demand during construction will be met with ground water.

Other sources of contamination are accidental disposal of construction debris and spillage of oil and grease from the vehicles and construction machineries especially during jetty construction.

The construction activities have potential influence on the sea water within the activity area. The pile driving will cause high turbidity, removal of nutrient due to dredging, which would ultimately affect the marine flora and fauna.

No water body is observed in the study area. Natural drainage may be impacted due to the provision of the road network and hence it needs careful planning.

Mitigation Measures

In order to mitigate negative impacts on water that are expected from the projects, the following measures will be implemented:

- Bore wells, if required to source water for construction phase will be drilled after an exhaustive historical study of the region and after obtaining necessary permission and approvals from the state water board or Central Ground water Authority.
- Water cess shall also be paid to relevant authority.
- Workers shall be provided proper sanitation facilities including mobile toilets or 5 'Sulabh Shauchalayas' (community toilets).
- All the waste water will be collected and treated using soak pits and sludge from soak pits will be cleaned.
- The construction site and camp will be provided with temporary drainage.
- Avoid water stagnation/ ponding near work and camp sites to curb vector borne diseases.
- Fuel/ oil storage will be stored away from any watercourses.
- Leakage of oil wastes from oil storage and vehicles shall be avoided in order to prevent potential contamination of streams or ground water.
- Surface runoff from machine operations, oil handling areas/devices will be treated for oil separation before being discharged into the sea or river.
- Waste Oil/ grease/ lubricants are categorized by MoEF as Hazardous Wastes. All such waste will be collected and stored at a protected place and sold to a vendor authorized by TNPCB or MoEF.
- No construction activity will be undertaken during monsoon period in the sea or near coast.
- Use of silt curtains is recommended to confine areas of high turbidity during pile driving.

9.4.3 Impact of Air Quality

Air emissions due to construction activities, fuel burning, vehicle movement, machinery and DG sets are the most significant sources of air pollution during construction phase.

Air pollution can cause significant impacts on the environment, and subsequently on humans, animals, vegetation and materials. It primarily affects the respiratory, circulatory and olfactory systems in humans. In most cases, air pollution aggravates pre-existing diseases or degrades health status, making people more susceptible to other infections or the development of chronic respiratory and cardiovascular diseases.

Mitigation Measures

- Power supply from State Electricity Board shall be sourced for electrically operated construction machinery/equipment.
- The use of DG set would be limited to backup during power failure.
- Dust suppression systems (water spray) will be used near the earth handling sites, asphalt mixing sites and other excavation areas to reduce the wind-blown fugitive dust emissions.
- Earth moving equipment, such as bulldozer with a grader blade and ripper will be used for excavation work.
- Excess idling of construction equipment as well as vehicles to be prohibited.
- Vehicles and construction equipment will be fitted with internal devices i.e. catalytic converters to reduce CO and HC emissions.
- All stationary machines/ DG sets / construction equipment emitting the pollutants will be inspected weekly for maintenance and shall be fitted with exhaust pollution control devices.
- Vehicles and machineries will be regularly maintained to conform to the emission standards stipulated under Environment (Protection), Rules 1986.

- “No Objection Certificate (NoC)” for setting up of crusher, hot-mix plant and DGs will be obtained from Gujarat Pollution Control Board.
- Ensure that all vehicles must possess Pollution under Control (PUC) Certificate and shall be renewed accordingly.
- All the roads in the vicinity of project will be paved to minimize the fugitive emissions.
- If any of the road stretches are not paved due to some reason, then adequate arrangements will be made to spray water on such stretches of the road.
- The labours shall be provided with clean fuel so that they neither cut the trees for fuel wood nor burn firewood.

9.4.4 Impacts on Noise Quality

During construction phase, there could be high noise levels due to operation of various construction equipment and increased number of vehicles supplying man and material to the site. It is known that continuous exposure to high noise levels above 90 dBA affects the hearing acuity of the workers/operators or residents and hence, require mitigation planning.

Mitigation Measures

- The construction works will be carried out during the day time. The work hours should be limited depending on convenience of the local people.
- Noise levels of machineries used shall conform to relevant standards prescribed in Environment (Protection) Rules, 1986. Workers shall not be exposed to noise level more than permitted for industrial premises, i.e. 90 dBA (Leq) for 8 hours.
- Exposure of workers near the high noise levels areas can be minimized. This can be achieved by job rotation/automation, use of ear plugs, etc.
- Labour camps shall be established away from high noise generating area. Workers exposed to high noise level shall use ear plugs or ear muffs.
- Regular maintenance of all vehicles and machinery shall be made mandatory to keep noise under check.
- Nearby communities will be notified of the construction schedule and construction works shall be structured to daylight working hours.
- Any ‘High Noise Area’ shall be posted with warning signs and will have restricted access.
- Noise from air compressors could be reduced by fitting exhaust mufflers and intake mufflers.
- Chassis and engine structural vibration noise can be dealt with by isolating the engine from the chassis and by covering various sections of the engines.
- Crushers, if any, will be fitted with rock lining to act as natural sound insulator during the crushing process.
- Noise levels from the construction equipment can be reduced by fitting of exhaust mufflers and the provision of damping on the steel tool.
- Noise from the DG set should be controlled by providing an acoustic enclosure or by treating the enclosure acoustically.
- Regular monitoring and maintenance of all the equipment and DG sets shall be taken up to keep a note on noise levels and to take corrective actions.

9.4.5 Impacts on Ecology

The land requirement for the project will be met through available Government land. It is scrub land and initial site clearing will be carried out for proposed development.

It is important to mention that the area does not fall under Marine National Park or its eco-sensitive zone (refer to **Figure 3.5**). The reserve forest is also about 200 m away from the proposed site.

On the water side, pile driving may cause increase in sediment concentration, which may also reduce sunlight penetration. Disturbance from construction activities may cause displacement of fishery resources and other mobile bottom biota.

Mitigation Measures

- No construction activity will be allowed during the monsoon season within sea or near coast so as to avoid breeding period of fishes.
- Use of silt curtains is recommended to confine areas of high turbidity during pile diving.
- Areas with high fish yield or used by locals for fishing shall be avoided.

9.4.6 Impact on Social Conditions

No land acquisition is proposed for the project. Thus, no loss of land or livelihood is anticipated.

Sudden influx of labours, operations of construction machinery are believed to cause some discomfort to the locals but it will be very local and short-lived. It is important to note that habitation is more than 300 m away from the site.

Mitigation Measures

- It is proposed that existing roads will be strengthened to connect Dwarkadhish and Abhya mata Temple.
- All construction activities will be restricted during day time to avoid disturbance to the locals.
- Dust arrestor screens will be erected to contain dust emissions during construction.

9.4.7 Impact on Cultural Aspect

Beyt Island is an important archaeological site and several historical finding have been reported in this area. Thus, there are likely chances that similar chance finding may be found during construction especially during jetty construction.

Mitigation Measures

- A detailed archaeological survey is proposed along the proposed trestle and jetty.
- A chance find plan shall be prepared for the project
- Any chance find observed will be reported to ASI immediately and all work around the suspected location must cease till the clearing of chance find and approval of ASI.

9.5 Impacts during Operation Phase

9.5.1 Impact on Land and Shoreline

The coastline is fronted with rock and there are no signs of accretion or deposition. The project is planned to have a 350 m long jetty on trestle, for sustaining vessel operations only and hence no coast line changes are anticipated.

Mitigation Measures

- Regular monitoring of the coast line shall be carried out so as to assess any changes.

9.5.2 Impact on Water Quality

At present residents of Beyt use ground water to meet their daily requirements. Considering that it is an island and large ground water extraction may results in depletion of resource or salinity influx in the aquifer. Thus it is proposed to source sea water and purify it using a desalination plant. The desalinated water will be used for operation phase. A total of 0.5 MLD of fresh water will be required for the project in the ultimate stage development.

Sea water will be extracted from the appropriate depths and will be stored in an underground tank and thereafter transferred to desalination plant. It is proposed to locate intake near the Beyt Passenger jetty due to the available deep depths and water will be transported to the facility through 1 km long pipeline.

The most likely impacts on the marine water from the operation phase of the project will be due to the discharge of untreated effluent. All these may lead to odour and degradation of water quality. A sewage treatment plant is proposed to collect all waste water from the facility and only treated water conforming to discharge standards. Part of the treated water will be reused for the landscaping and only a small portion will be let out in the sea (10 KLD to 40 KLD).

Mitigation Measures

- Location of sea water intake shall be planned carefully so that it does not affect the flow and sediment pattern in the region.
- An aerated lagoon is proposed to be provided for treatment of effluent from domestic sources and the settled sludge will be dried in sludge drying beds and then used as manure for local use.
- Storm water drain shall be made to collect run off from rain but care shall be taken that it is not contaminated.
- Treated wastewater from STP will be reused for the landscaping.
- Membrane Bio Reactors (MBR) based Sewage treatment plant (STP) is proposed so as to avoid any odour problems at the site.

9.5.3 Impact on Air and Noise Quality

There is no source of air or noise pollution during operation phase except a standby DG set which may only be operated during power shortage. In addition it is proposed that power demand of the facility for lightening of the pathways will be met through solar lighting system.

However, the project may result in increased vehicular pollution and noise due to the small passenger vehicles that may be used for travelling from facility to jetty or temple.

Mitigation Measures

- All vehicles shall have a valid PUC certificate and regular maintenance shall be mandated.
- All the roads in the vicinity of the project site will be paved or black topped to minimize the entrainment of fugitive emissions.
- If any of the road stretches cannot be blacktopped or paved due to some reason, then adequate arrangements will be made to spray water on such stretches of the road.
- Noise from the DG set should be controlled by providing an acoustic enclosure or by treating the enclosure acoustically.
- Regular monitoring and maintenance of all the equipment and DG sets shall be taken up to keep a note on noise levels and to take corrective actions.

9.5.4 Impact on Socio-Economic Conditions

It is envisaged that during operation stage impacts are mostly positive in nature. Once the project is operational, the project has several benefits to the immediate affected community and society at large. The following positive impacts envisaged from the project:

- Employment generation for locals
- Development of road
- Business opportunity due to increased tourism.
- Better aesthetics and environmental quality of the area
- Development of a recreational areas
- Usage for educational purpose, i.e., Museum

9.6 Environmental Monitoring Plan

This section presents the environmental monitoring framework for the project where parameters, frequency and locations for the environmental monitoring are suggested (**Table 9.3**).

Table 9.3 Environmental Monitoring Plan

| Environmental Components | Parameters | Frequency of Monitoring | Location |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------|
| Construction Phase | | | |
| Air | PM2.5, PM10, SO2, NOx, CO, HC | 2 times a week for 24 hours | 3 - 4 |
| Surface water / Marine water | pH, DO, BOD, O&G, Salinity, Electrical Conductivity, TDS, Turbidity, Phosphates, Nitrates, Sulphates, Chlorides and heavy metals (Zinc, Lead, Cadmium, Mercury) | Once every months | 3 - 4 |
| Ground water | Monitoring as per IS : 10,500:2012 | Once every months | 3 - 4 |
| Noise | Leq (Night), Leq (day), Leq (24 hourly) | Once every month | 3 - 4 |
| Ecological Environment (Coastal) | No. of species and density: <ul style="list-style-type: none"> • Phytoplankton • Zooplankton • Benthos • Fisheries • Mangroves Invasion of new plant species and plant communities, increased habitat diversity, invasion of new species. | Once | Entire site and around the site in 5 km radius |
| Coast Line | Shore line changes/ erosion / accretion | Once a year | All along the coast line abutting site |

9.7 Environmental Management Cost

About 1% of the project cost is estimated to be earmarked for environmental management activities during construction phase. Environmental Management cost will include provision of desalination plant, effluent treatment plant and monitoring.

10.0 COST ESTIMATES AND FINANCIAL ANALYSIS

10.1 Cost Estimates

10.1.1 General

The block cost estimates prepared have been arrived based upon available site information, appropriate assumptions, and the data available with AECOM for similar projects. The site information and assumptions are subject to many factors that are beyond the control of AECOM; and AECOM thus make no representations or warranties with respect to these estimates and disclaim any responsibility for the accuracy of these estimates.

These costs estimates would enable decision making on progressing with the project. The actual capital cost shall be based on the cost quoted by the selected EPC contractor for the development of the facility and working out the other administrative expenses at the end of implementing agency.

10.1.2 Capital Cost Estimates

The capital cost of the proposed facility has been worked out as furnished below in **Table 10.1**.

Table 10.1 Block Cost Estimates

| S. No. | Item | Cost (Rs. in Crores) |
|-------------------------------------------|------------------------|----------------------------|
| 1. | Area development | 9.65 |
| 2. | Onshore infrastructure | 7.25 |
| 3. | Tourist Amenities | 3.35 |
| 4. | Sky Tower and Museum | 22.85 |
| 5. | Interior Works | 12.51 |
| 6. | Onshore Infrastructure | 13.74 |
| Subtotal | | 69.34 |
| Contingencies @10% | | 6.93 |
| Engineering and Project Management @5% | | 3.47 |
| Grand Total | | 79.74 |

10.2 FINANCIAL ANALYSIS

10.2.1 Introduction

A financial analysis for the proposed development has been carried out with the objective of assessing the return on investment.

10.2.2 Project Cost

The capital investment for development of the proposed facility is about Rs. 80 crores as given in **Table 10.1**. The capex spending for the proposed facility development has been planned for 2 years, i.e., 40% in first year and 60% in the second year.

10.2.3 O&M Cost

The O&M costs of the facility are about Rs. 2.4 crores per annum as indicated in **Table 10.2**.

Table 10.2 O&M Cost of the Facility

| Details | Qty | Rate (Rs.) | Total (Rs.) |
|------------------------------|--------|------------|-------------------|
| O&M of the facility | - | - | 12,151,015 |
| Staff | 10 | 200,000 | 2,000,000 |
| Security | 20 | 150,000 | 3,000,000 |
| Water | 60,000 | 50 | 3,000,000 |
| Elect | 72,000 | 7 | 504,000 |
| Total Expenses | | | 20,655,015 |
| Administrative Expenses @15% | | | 3,098,252 |
| Total O&M Costs | | | 23,753,267 |

10.2.4 Visitation Assumptions

The likely visitation to Beyt Dwarka for the realistic case scenario is estimated to be 5 million as detailed in Section 5.4.

- It is estimated that Park will only interest 30%-40% of the total visitation in the initial years, which will gradually increase to 85% in a span of 10 years and then remain constant for the next 10 years.
- For Museum, it is estimated that it shall attract the 30% of the persons visiting the Park.

10.2.5 Revenue

The revenue from the facility would be from the following components:

1. Entry fee to the park
2. Entry fee to the Museum
3. License fee from the vendors of food courts and shops
4. License fee from the restaurant in the Sky Tower

Based on the market survey on the visitor profile it is proposed that only a nominal fee be charged for entry and additional fee can be charged for the Museum/Sky Tower.

Entry fee to the Park & Museum is divided in to 3 categories as mentioned in **Table 10.3** . A License fee of Rs. 40,000 per year per shop will be charged from the vendors of food court and shops.

Table 10.3 Entry Fee for Park and Museum

| Group | Entry Fee | |
|-------------------------------|------------------|------------------|
| | Park | Museum |
| Kids | Free | Free |
| Youngster/Teens (12-18 years) | Rs. 10 per Entry | Rs. 10 per Entry |
| Adults | Rs. 20 per Entry | Rs. 20 per Entry |

10.2.6 Operation and Maintenance Costs

The O&M cost of the proposed facility would comprise of the maintenance of the civil infrastructure created as part of the facility, water and electricity charges, manpower expenses and other repair and maintenance costs. These costs have been worked out as 1% -3 % of the capital costs for various civil work components and based on consumption/deployment for others. The annual O&M costs of the facility work out to about Rs. 2.4 crores.

10.2.7 IRR and NPV

The financial analysis carried out based on the above assumptions indicates a project IRR of 7.17%. The NPV of the investment at discounted rate of 12% over a 20 year time horizon works out to Rs. -3.8 crores only.

10.3 Implementation Schedule

The facility is likely to have the construction time of about 18 months. The overall implementation schedule for development is shown in .

Table:10.1 Implementation Schedule

| S. No. | Item of Activity | Project Months | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------------------|---------------------------------------------------------------|----------------|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|--|--|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | | | |
| Award of Work | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Statutory Approvals | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Appointment of EIA consultant | █ | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | EIA Study | █ | █ | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Environmental and CRZ clearance | | | | | | | █ | | | | | | | | | | | | | | | | | | | | |
| 4 | Other Approvals | | | | █ | | | | | | | | | | | | | | | | | | | | | | | |
| Tendering Process | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | Pre Tender Process / Tendering Period | █ | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | Tender Evaluation, Negotiations and Award of Contract | | | | | █ | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Financial Closure | | | | █ | | | | | | | | | | | | | | | | | | | | | | | |
| Construction Activity | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | Establishment at site by Contractor | | | | | | | | █ | | | | | | | | | | | | | | | | | | | |
| 11 | Detailed Engineering by EPC Contractor | | | | | | | | | █ | | | | | | | | | | | | | | | | | | |
| 12 | Civil Works (STP/Pipelines/Desalinisation / Amphitheatre etc) | | | | | | | | | | | █ | | | | | | | | | | | | | | | | |
| 13 | Landscaping | | | | | | | | | | | | | | | | █ | | | | | | | | | | | |
| 14 | Buildings (Skytower/ Museum) | | | | | | | | | | | | | █ | | | | | | | | | | | | | | |
| 15 | Assess Roads | | | | | | | | | | | | | | █ | | | | | | | | | | | | | |
| 16 | Utilities and Fittings | | | | | | | | | | | | | | | | | █ | | | | | | | | | | |
| 17 | Commissioning | | | | | | | | | | | | | | | | | | | | | | | | | | | |



10.4 Funding Arrangement

There would be involvement of various government agencies in the development of the proposed facility at Beyt. The roles and responsibilities of the agencies involved for the development of the project are envisaged as follows:

- **Ministry of Shipping (MOS)** - To conceive the project and also partly fund the development.
- **Gujarat Maritime Board (GMB)** – To facilitate various approvals required for setting up the facility and provide land for the development.
- **Gujarat Infrastructure Development Board (GIDB)** – To act as a nodal agency for the development of the facility and coordination with the multiple agencies involved in the project.
- **Tourism Corporation of Gujarat Limited (TCGL)** –To promote and market the proposed facility so as to capture maximum tourists to visit the facility.
- **Archaeological Survey of India (ASI)** – To provide artefacts to be showcased in the Museum.
- **Marine Archaeological Centre, National Institute of Oceanography** – To provide artefacts to be showcased in the Museum.
- **State Government, District Collector** - To facilitate the approval process, provide land for facility and development of road between Main Temple and the proposed facility.

Due to involvement of multiple agencies it is therefore suggested that government agencies should be directly involved in the project development and its maintenance including financing. Considering the type of facility GIDB seems to be the most appropriate agency who could be assigned for ownership of this project.

Such projects should be treated as part of social infrastructure and financial viability should not be the only criteria on progressing further. It is therefore suggested that funding of the project may also be arranged by Government entities like MoS, MoT, Gujarat Government etc. The participation of the private sector would be limited to the managing the food stalls and souvenir shops against which they shall pay lease rentals to the GIDB. In addition the restaurant at the Sky Tower could also be leased to an agency, which shall be responsible for its furnishing, operation and maintenance.

11.0 WAY FORWARD

The proposed facility would trigger the overall development of the Beyt Island and provide a soothing effect to the persons visiting this island. Centre as well as State Governments seem to be keen to build the proposed facility.

Therefore the following action plan is recommended to expedite the process:

1. One of the state government agencies, i.e., GIDB may be entrusted with the task of development of the facility.
2. GIDB shall need to coordinate with the state government and MoS for arranging the funds.
3. The land, as marked on the layout drawings of the proposed facility, would need to be transferred to the agency so that the facility could be developed. For this purpose the help of District Collector (Devbhumi Dwarka Dist.) would be needed.
4. The following consultants would need to be appointed:
 - a. A consultant to carry out the EIA study and obtain the CRZ/environmental clearance for setting up the facility.
 - b. A project management consultant for the following activities:
 - i. Setting up prequalification criteria and obtaining prequalification proposals from the potential firms. Shortlisting of firms for issue of the tender documents.
 - ii. Assist GIDB for required approvals and permissions for various stakeholders
 - iii. Review, update and Issue of the tender documents, provide response to the queries of the bidders, tender receipt and evaluation and recommendation for award on EPC basis.
 - iv. Review and approval of the designs and other submissions of EPC contractor.
 - v. Supervision of the works of EPC contractor and project management.
 - c. A consultant for coordinating with the archaeological and other departments for getting the permanent or temporary displays in the Museum.
5. GIDB would also need to take following approvals for setting up the facility:
 - a. Environmental clearance from the state Environmental Impact Assessment authority would be needed

- b. A part of the facility to be developed in CRZ III, approval from Coastal Zone Management Authority would be needed.
- c. Consent to Establish (Air, Water, Noise) from the Gujarat state pollution control board would be needed to set up the facility
- d. No Objection/ Approval from the forest department would be needed
- e. No Objection/Approval from Archaeological Survey of India would be needed.