

**HIGH TIDE LINE, LOW TIDE LINE AND COASTAL REGULATION ZONE
STATUS REPORT FOR THE PROPOSED CONSTRUCTION OF KALPASAR
DYKE & TIDAL BARRAGE UNDER KALPASAR PROJECT SCHEME ACROSS
THE GULF OF KHAMBHAT TO CREATE A FRESH WATER RESERVOIR IN
GUJARAT**

for

**National Centre for Coastal Research (NCCR)
Ministry of Earth Sciences (MoES)
Government of India, Chennai**



Prepared By



**National Centre for Sustainable Coastal Management
(Ministry of Environment, Forest & Climate Change)
Government of India**

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7	Key words	Coastal Regulation Zone, Cadastral map, Scale 1:4000, Landuse, High Tide Line (HTL), Low Tide Line (LTL), CRZ IA, CRZ IB, CRZ II, CRZ III, CRZ IVA, CRZ IVB.
8	Abstract	<p>The Kalpasar Project or the Gulf of Khambhat Development envisaged as a multi-purpose project to cater to the irrigation, drinking water, transport and energy demands of the Saurashtra region and involves construction of 60.13 km dyke across the Gulf with a flood regulator to discharge the excess water, a 16-lane roadway and 4-lane permanent way connecting the east and west bank of Gulf of Khambhat, Gujarat. In line with above, NCCR (Project Proponent) Chennai, Ministry of Earth Sciences (MoES), Government of India requested National Centre for Sustainable Coastal Management (NCSCM), Ministry of Environment, Forest & Climate Change, Government of India, Chennai to prepare project level CRZ map by demarcating the High Tide Line (HTL), Low Tide Line (LTL) and Ecological Sensitive Areas (ESAs) for the proposed project site, to obtain environmental clearances.</p> <p>The proposed project site has HTL on the River/Creek side. The proposed project activities superimposed in 1:4000 Scale CRZ map has been Prepared in accordance with the approved CZMP maps of Gujarat state as per CRZ Notification, 2011. The CRZ categories in and around the proposed project site are Mangroves - CRZ IA, Mudflat - CRZ IA, Intertidal Zone - CRZ IB, CRZ Landward of HTL - CRZ II, No Development Zone - CRZ III and Waterbody - CRZ IVB. The proposed project site falls under CRZ categories such as CRZ IA, CRZ IB, CRZ II, CRZ III, and CRZ IVB. The proposed project site falls within the Map Number GJ 92 - Revised (Sheet Number F 43 M 1/SW), Map Number GJ 93 - Revised (Sheet Number F 43 M 1/SE), Map Number GJ 94 (Sheet Number F 43 M 5/SW), Map Number GJ 95 (Sheet Number F 43 M 9/SW), Map Number GJ 96 Sheet Number (F 43 M 9/SE) of approved CZMP of Gujarat state, prepared as per CRZ Notification, 2011.</p>
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HIGH TIDE LINE, LOW TIDE LINE AND COASTAL REGULATION ZONE STATUS REPORT FOR THE PROPOSED CONSTRUCTION OF KALPASAR DYKE & TIDAL BARRAGE UNDER KALPASAR PROJECT SCHEME ACROSS THE GULF OF KHAMBHAT TO CREATE A FRESH WATER RESERVOIR IN GUJARAT

1.0 Introduction

The Kalpasar Project or the Gulf of Khambhat Development envisaged as a multi-purpose project to cater to the irrigation, drinking water, transport and energy demands of the Saurashtra region and involves construction of 60.13 km dyke across the Gulf with a flood regulator to discharge the excess water, a 16-lane roadway and 4-lane permanent way connecting the east and west bank of Gulf of Khambhat, Gujarat. The project is of high societal importance and primary to irrigation and drinking water demands of the Saurashtra and central Gujarat region. About 10.54 Lakh hectares land in 37 taluks of nine districts of Saurashtra will get irrigation benefits in addition to rejuvenation of rivers and ground water in this region. The proposed dyke will form a fresh water reservoir of 7800 million cubic meters and would receive water from four major river systems namely i.e., Sabarmati, Mahi and Dhadhar and Narmada. A 16-lane roadway and a 4-lane permanent way for rail transport are proposed to be built over the dyke which will significantly reduce the travel distance. Kalpasar Project is expected to create a sustainable region in the heart of Gujarat with enhanced development potential which includes: (1) Water management and irrigation for the water deficient areas of Saurashtra. (2) Renewable Energy generation (3) Land creation in the Gulf, due to the stabilization of the tidal variations which are common in Khambhat region, (4) Improved Connectivity between Bharuch and Bhavnagar thereby forming the “Golden Triangle” with Ahmedabad, the reduction in travel distance from 240 km to 60.13 km will also directly contribute towards the reduction in fuel consumption and emission of greenhouse gases.

In line with above, NCCR (Project Proponent) Chennai, Ministry of Earth Sciences (MoES), Government of India requested National Centre for Sustainable Coastal Management (NCSCM), Ministry of Environment, Forest & Climate Change,

Government of India, Chennai to prepare project level CRZ map by demarcating the High Tide Line (HTL), Low Tide Line (LTL) and Ecological Sensitive Areas (ESAs) for the proposed project site, to obtain environmental clearances. In this regard, NCSCM conducted a field investigation for the proposed project site to demarcate HTL and ESAs during February & September, 2023. Demarcation of the HTL, LTL, ESAs and identification of Coastal Regulation Zones (CRZ) have been carried out in 1:4000 scale to provide information on the CRZ categories with respect to the project site.

2.0 Objective

The objectives of the study are:

- Identification and demarcation of HTL and LTL for the proposed project area
- Demarcation of Ecological Sensitive Areas
- CRZ Categorization as per CRZ Notification, 2011
- Preparation of CRZ Map based on approved CZMP
- Superimposing of Project Layout Plan on the CRZ Map of 1:4000 scale

3.0 Location

The Proposed Project Site is located in Gulf of Khambhat of Gujarat State. The Project site is located within the Lat. Long $21^{\circ}51'1.896''\text{N}$ $72^{\circ}3'45.179''\text{E}$ and $21^{\circ}45'37.984''\text{N}$ $72^{\circ}39'7.815''\text{E}$ (Refer Fig.1)

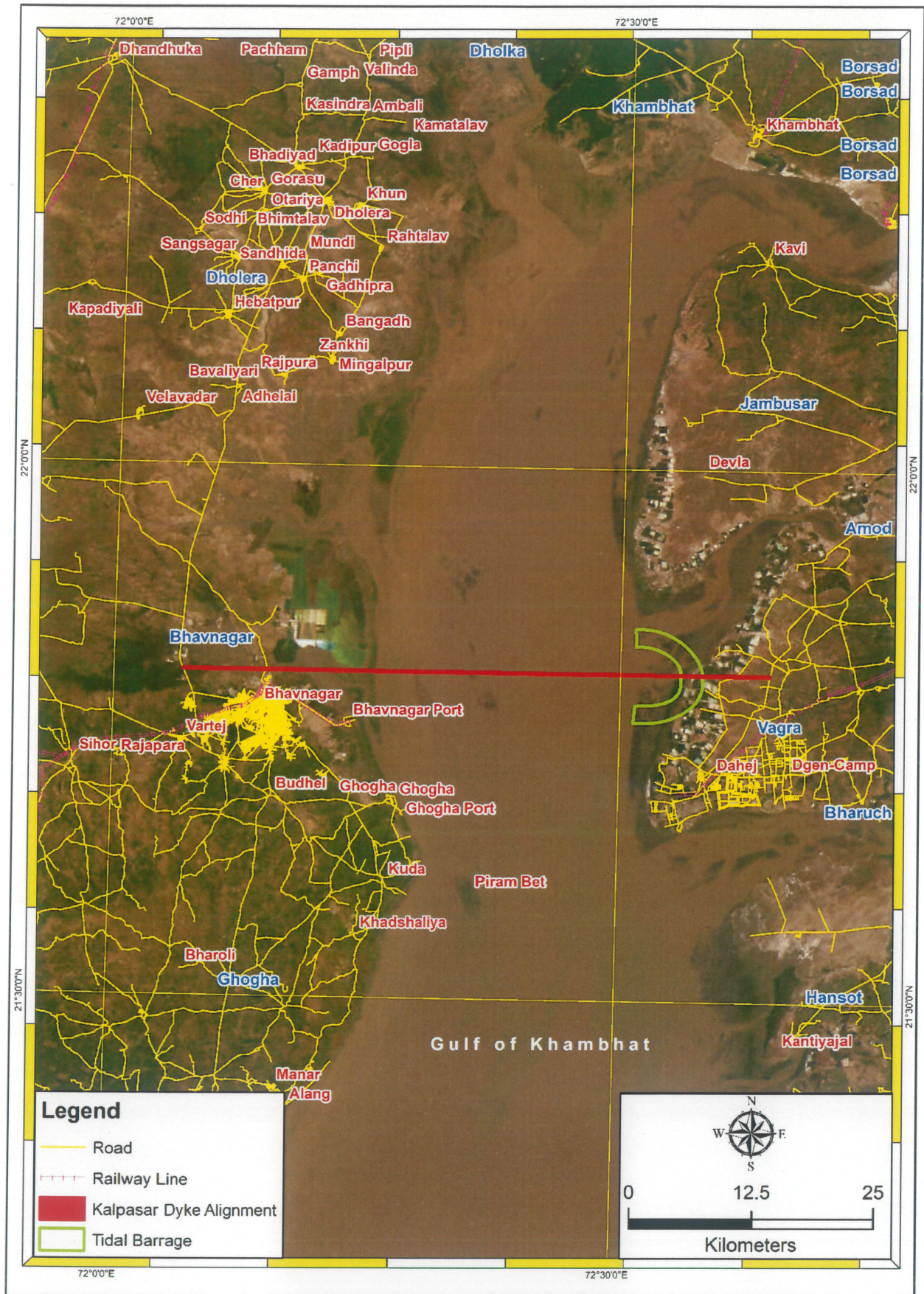


Fig. 1: Location map showing proposed project site

4.0 Approach & Methodology

The CRZ map of 1:4000 Scale is prepared to facilitate easy and accurate implementation of CRZ. Digitized Cadastral map is obtained from the Department of Environment, Government of Gujarat is used as the base map for the preparation of CRZ map. The HTL/LTL is identified following the guidelines issued by MoEF, Govt. of India.

The key elements of the approach and methodology are:

- Extraction of HTL, LTL and ESAs and preparation of CRZ map 1:4000 from the approved CZMP of Gujarat state as per CRZ Notification, 2011.
- To identify the changes in HTL, ESAs during field visit.
- Transfer the HTL, LTL and ESAs to the cadastral map with respect to the control point.
- Preparation of CRZ map.

4.1 Extraction of HTL

Extraction of HTL was carried out from the approved CZMP of Gujarat State prepared as per CRZ Notification, 2011. Extracted HTL is verified in the field based on geomorphologic features and other features such as embankments, landward boundaries of tidal flats (Moef & CC,2011). In presence of monsoon berm crest or boundary of perennial vegetation/permanent vegetation forms the HTL along the seacoast.

5.0 Data Source

In addition to the field investigation, data from various sources were used for the compilation of the final CRZ map and preparation of the CRZ report. The principal data sources include:

- Hydrographic Charts of Naval Hydrographic Office.
- Survey of India Toposheets.
- Satellite Images.
- Approved CZMP of Gujarat state as per CRZ Notification, 2011.

6.0 Tide

Tide is an important parameter that influences the position of HTL. It is also important in determining the landward extent of the reach of seawater into the land along rivers and backwaters. Tidal range data with respect to Chart Datum Pertaining to Bhavnagar (Lat. 21°45' Long. 72°15') & Luhara Point (Lat. 21°39' Long. 72°33') provided by Naval Hydrographic Office, Dehradun is given below in Table 1. (Approaches to Gulf of Khambhat, NHO Chart No. INT 7331 254, 31st July, 2019)

Table 1: Tidal range at Bhavnagar (Tidal Levels referred to Datum of Sounding)

Tide Condition	Height (m)
Mean High Water Spring (MHWS)	10.2
Mean High Water Neap (MHWN)	8.3
Mean Sea Level (MSL)	6.1
Mean Low Water Neap (MLWN)	3.5
Mean Low Water Spring (MLWS)	1.4

Table 2: Tidal range at Luhara Point (Tidal Levels referred to Datum of Sounding)

Tide Condition	Height (m)
Mean High Water Spring (MHWS)	8.8
Mean High Water Neap (MHWN)	7.0
Mean Sea Level (MSL)	5.1
Mean Low Water Neap (MLWN)	3.2
Mean Low Water Spring (MLWS)	1.4

7.0 Field Investigation

Field investigation was carried out during February & September 2023. HTL was extracted from the approved CZMP maps and were verified at the field based on geomorphologic features and other features such as embankments, landward boundaries of intertidal zone (MoEF & CC, 2011). HTL was plotted with respect to reference points identified in the field as well as located in the cadastral map. An appraisal of existing landuse/land form in the project area was also carried out. The distance and positions of HTL to control points which

was extracted from the approved CZMP were verified in the field using high precision Trimble GPS.

8.0 Coastal Landuse/Landcover

The Major land use land cover features near the proposed project site are river or creek, saltpan/aquaculture, agricultural land, settlement, industrial area, railway line and road network.

9.0 Coastal Regulation Zone and HTL

The Government of India Notification [S.O.19 (E) dated 6.1.2011] under Section 3(1) and Section 3(2)(v) of the Environment (Protection) Act, 1986 and Rule 5(3)(d) of Environment (Protection) Rules, 1986 declares 'the coastal stretches of the country and the water area upto its territorial water limit as Coastal Regulation Zone (CRZ)' (MoEF & CC, 2011). All developmental activities in the CRZ are regulated through the CRZ Notification (MoEF & CC, 2011).

The CRZ, as per CRZ Notification, 2011, consists of the following:

1. Land area from High Tide Line (HTL) to 500 m on the landward side along the sea front.
2. Land area from HTL to 100 m or width of the creek whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea and the distance up to which development along such tidal influenced water bodies is to be regulated are governed by the distance upto which the tidal effects are experienced which is determined based on salinity concentration of 5 parts per thousand (ppt) measured during the driest period of the year and distance up to which tidal effects are experienced would be clearly identified and demarcated accordingly in the Coastal Zone Management Plans (CZMPs). Tidal influenced water bodies means the water bodies influenced by tidal effects from sea, in the bays, estuaries, rivers, creeks, backwaters, lagoons, ponds connected to the sea or creeks and the like.
3. Land area between HTL and Low Tide Line (LTL) which will be termed as the intertidal zone.
5. The water and the bed area from the LTL to the territorial water limit (12 Nm) in case of

sea and the water and the bed area from LTL at the bank to the LTL on the opposite side of the bank, of tidal influenced water bodies.

According to the CRZ Notification, 2011, the tidal influenced water body has been defined as bays, estuaries, rivers, creeks, backwaters, lagoons and ponds connected to the sea or creeks and the like. The distance from the HTL shall apply to both sides of the tidal influenced water body. The CRZ Notification categorizes Coastal Regulation Zones as CRZ I, CRZ II, CRZ III and CRZ IV based on whether the area is ecologically sensitive, developed, undeveloped or water body and its bed. Ecologically sensitive and important areas and the intertidal zone constitute CRZ I. Sensitive ecosystems such as mangroves, corals, turtle nesting grounds, salt marshes, mudflats, etc., are classified as CRZ IA. Intertidal zone is CRZ IB. The areas that have already been developed up to or close to the shoreline are categorized as CRZ II. Areas that are relatively undisturbed belong to CRZ III. The water area and the bed constitute CRZ IV.

The CRZ Notification of 2011 has also defined Critical Vulnerable Coastal Areas (CVCA), which includes Sunderbans, and other identified ecological important areas including Gulf of Khambhat and Gulf of Kachchh in Gujarat. It is to prepare Integrated Management Plans (IMPs) for such CVCA keeping in view of the conservation and management of mangroves, needs of local communities such as, dispensaries, schools, public rain shelter, community toilets, bridges, roads, jetties, water supply, drainage, sewerage and the impact of sea level rise and other natural disasters. The IMPs will be prepared as per the guidelines of the MoEF & CC.

The Coastal Zone Management Plan (CZMP) prepared and approved based on the CRZ Notification, 2011 is applicable to the State of Gujarat for the approval of CRZ projects.

10.0 Coastal Regulation Zone for the Proposed Project Site

The proposed Kalpasar Dyke Alignment and Tidal Barrage is superimposed on a 1:4000 Scale CRZ map which is prepared in accordance with the approved CZMP maps of Gujarat state as per CRZ Notification, 2011 [Refer Fig. 2 (Sheet No 1 to 20)].

The CRZ categories in and around the proposed project site are Mangroves - CRZ IA, Mudflat - CRZ IA, Intertidal Zone - CRZ IB, CRZ Landward of HTL - CRZ II, No Development

Zone - CRZ III and Waterbody - CRZ IVB [Refer Fig. 2 (Sheet No 1 to 20)].

The proposed project activities fall under CRZ categories such as CRZ IA (Mangroves, Mudflat, 50 m Mangrove Buffer Zone), CRZ IB (Intertidal Zone), CRZ II, CRZ III (No Development Zone), and CRZ IVB (Waterbody) [Refer Fig. 2 (Sheet No 1 to 20)]. Part of the proposed project site falls in Critically Vulnerable Coastal Areas (CVCA) and Port Limit [Refer Fig. 2 (Sheet No 1 to 20)].

11.0 The Proposed Project Site Based on Field Survey

Based on the proposed project activities falls under CRZ categories such as CRZ IA (Mangroves, Mudflat, 50 m Mangrove Buffer Zone), CRZ IB (Intertidal Zone), CRZ II, CRZ III (No Development Zone), and CRZ IVB (Waterbody) [Refer Fig. 2 (Sheet No 1 to 20)]. And part of the proposed project site falls in Critically Vulnerable Coastal Areas (CVCA) and Port Limit [Refer Fig. 3 (Sheet No 1 to 20)]. For details for the proposed project activities falls under different CRZ Categories is given in Table 5.

The Proposed Project Site is superimposed on approved CZMP of Gujarat State and is given in Figure 4.A CRZ map covering about 7 Km radius around the proposed project site representing CRZ categories based on approved CZMP is given in Figure 5.

Table 3. Area of the proposed project activities falls under each CRZ Categories (As per approved CZMP of Gujarat, 2011)

Sheet No	Proposed Project Activities	Area in (ha)					
		CRZ - IA	50m Mangrove Buffer Zone – CRZ IA	CRZ - IB	CRZ - II	CRZ - III (No Development Zone)	CRZ - IVB
1	Tidal Barrage	524	7.61		-	-	55.71
2	Tidal Barrage	269.61	24.41	8.68	-	28.38	-
4	Kalpasar Dyke Alignment	0.94	0.49	0.08	-	0.27	-

	Tidal Barrage	117.17	38.13	18.87	-	60.44	-
5	Kalpasar Dyke Alignment	-	-	22.42	4.97	1.61	-
6	Kalpasar Dyke Alignment	-	-	59.21	5.2	-	1.38
7	Kalpasar Dyke Alignment	50.01	-	14.38	-	-	3.11
8	Kalpasar Dyke Alignment	64.58	8.6	-	-	-	2.93
9	Kalpasar Dyke Alignment	27.52	3.62	-	-	-	39.99
10	Kalpasar Dyke Alignment	-	-	-	-	-	67.51
11	Kalpasar Dyke Alignment	-	-	-	-	-	67.51
12	Kalpasar Dyke Alignment	-	-	-	-	-	67.51
13	Kalpasar Dyke Alignment	-	-	-	-	-	67.51
14	Kalpasar Dyke Alignment	-	-	-	-	-	67.51
15	Kalpasar Dyke Alignment	6.25	-	-	-	-	61.26
	Tidal Barrage	1.23	-	-	-	-	-
16	Kalpasar Dyke Alignment	20.43	4.22	0.29	-	1.29	15.58
	Tidal Barrage	411.29	48.63	20.4	-	11.01	55.36
19	Tidal Barrage	462.15	-	-	-	-	94.16
20	Tidal Barrage	301.19	-	-	-	-	6.9
Total		2256.37	135.71	144.33	10.17	103	673.93

(Note: CRZ – IA and 50m Mangrove Buffer Zone – CRZ IA are overlapping with each other)

Table 4. Area of the proposed project activities falls under Ecologically Sensitive Areas (ESAs)

Sheet No	Proposed Project Activities	Area (ha)		
		CRZ - IA		
		Mangroves	Mudflat	Salt Marsh
1	Tidal Barrage	22.69	501.31	-
2	Tidal Barrage	237.28	12.23	50.58
4	Kalpasar Dyke Alignment	0.45	-	1.39
	Tidal Barrage	79.04	-	71.33
5	Kalpasar Dyke Alignment	-	-	-
6	Kalpasar Dyke Alignment	-	-	-
7	Kalpasar Dyke Alignment	-	50.01	-
8	Kalpasar Dyke Alignment	27.44	35.97	-
9	Kalpasar Dyke Alignment	22.6	4.91	-
10	Kalpasar Dyke Alignment	-	-	-
11	Kalpasar Dyke Alignment	-	-	-
12	Kalpasar Dyke Alignment	-	-	-
13	Kalpasar Dyke Alignment	-	-	-
14	Kalpasar Dyke Alignment	-	-	-
15	Kalpasar Dyke Alignment	-	6.25	-
	Tidal Barrage	-	1.23	-
16	Kalpasar Dyke Alignment	12.63	4.4	10.29
	Tidal Barrage	108.8	255.33	87.07
19	Tidal Barrage	-	462.15	-
20	Tidal Barrage	-	301.19	-
Total		510.93	1634.98	220.66

(Note: Ecologically Sensitive Areas are overlapping with each other)

**Table 5. Area of the proposed project activities falls under each CRZ Categories
(As per field survey conducted during February & September, 2023
and CRZ Notification, 2011)**

Sheet No	Proposed Project Activities	Area in (ha)							
		CRZ - IA				CRZ - IB (Intertidal Zone)	CRZ - II	CRZ - III (No Development Zone)	CRZ - IVB (Waterbody)
		Mangroves	50m Mangrove Buffer Zone	Mudflat	Salt Marsh				
1	Tidal Barrage	30.08	8.94	493.40	-	-	-	-	55.71
2	Tidal Barrage	185.44	32.62	9.66	99.57	8.63	-	30.19	-
4	Kalpasar Dyke Alignment	0.85	0.57	0.00	1.06	-	-	0.27	-
	Tidal Barrage	67.43	35.08	-	91.72	9.76	-	59.13	-
5	Kalpasar Dyke Alignment	-	-	-	-	22.42	9.93	1.61	-
6	Kalpasar Dyke Alignment	0.66	7.88	-	-	52.11	9.48	-	0.40
7	Kalpasar Dyke Alignment	2.26	9.49	49.24	-	9.87	-	-	0.10
8	Kalpasar Dyke Alignment	25.88	23.09	37.10	-	1.30	-	-	1.76
9	Kalpasar Dyke Alignment	22.58	1.81	2.70	-	-	-	-	42.23
10	Kalpasar Dyke Alignment	-	-	-	-	-	-	-	67.51
11	Kalpasar Dyke Alignment	-	-	-	-	-	-	-	67.51
12	Kalpasar Dyke Alignment	-	-	-	-	-	-	-	67.51
13	Kalpasar Dyke Alignment	-	-	-	-	-	-	-	67.51
14	Kalpasar Dyke Alignment	-	-	-	-	-	-	-	67.51
15	Kalpasar Dyke Alignment	-	-	6.25	-	-	-	-	61.26
	Tidal Barrage	-	-	1.23	-	-	-	-	-
16	Kalpasar Dyke Alignment	12.00	4.80	6.89	8.72	-	-	1.29	15.58
	Tidal Barrage	122.88	49.19	285.18	75.79	-	-	10.46	55.02

19	Tidal Barrage	-	-	462.15	-	-	-	-	94.16
20	Tidal Barrage	-	-	301.19	-	-	-	-	6.90
Total		470.05	173.46	1654.99	276.86	104.09	19.41	102.94	670.68

12.0 SUMMARY AND CONCLUSIONS

- The proposed project site has HTL on the River/Creek side. The proposed project activities superimposed in 1:4000 Scale CRZ map has been Prepared in accordance with the approved CZMP maps of Gujarat state as per CRZ Notification, 2011 and it's shown in the Figure 2 (Sheet No 1 to 20).
- The CRZ categories in and around the proposed project site are Mangroves - CRZ IA, Mudflat - CRZ IA, Intertidal Zone - CRZ IB, CRZ Landward of HTL - CRZ II, No Development Zone - CRZ III and Waterbody - CRZ IVB
- The proposed project site falls under CRZ categories such as CRZ IA (Mangroves, Mudflat, 50 m Mangrove Buffer Zone), CRZ IB (Intertidal Zone), CRZ II, CRZ III (No Development Zone), and CRZ IVB (Waterbody)
- Part of the proposed project site falls in Critically Vulnerable Coastal Areas (CVCA) and Port Limit
- The proposed project site falls within the Map Number GJ 92 - Revised (Sheet Number F 43 M 1/SW), Map Number GJ 93 - Revised (Sheet Number F 43 M 1/SE), Map Number GJ 94 (Sheet Number F 43 M 5/SW), Map Number GJ 95 (Sheet Number F 43 M 9/SW), Map Number GJ 96 Sheet Number (F 43 M 9/SE) of approved CZMP of Gujarat state, prepared as per CRZ Notification, 2011
- The Proposed Project Site is superimposed on approved CZMP of Gujarat State and is given in Figure 3
- A CRZ map covering about 7 Km radius of the project site representing CRZ categories based on approved CZMP is given in Figure 4.

REFERENCES

MoEF, 2011. Notification No. S.O.19 (E) dated 6.1.2011, Ministry of Environment and Forest, Government of India, New Delhi.

NHO, 2019. Hydrographic Chart No INT 7331 254 - Approaches to Gulf of Khambhat. Naval Hydrographic Office, Dehra Dun, 2019.

PLATES



Plate 1: A view of creek near to Proposed Project Site



Plate 2: Another view of creek near to Proposed Project Site



Plate 3: Mudflat with Mangroves



Plate 4: Mangrove, Intertidal Zone and Saltpan