

**DEMARCATON OF HIGH TIDE LINE (HTL), LOW TIDE LINE (LTL)
AND COASTAL REGULATION ZONE (CRZ) MAPPING AT
1:4000 SCALE FOR THE PROPOSED FIVE STAR RESORT
AT ANJUNA VILLAGE OF BARDEZ TALUKA IN
NORTH GOA DISTRICT, GOA**

SPONSORED

by

M/s. Goa Tourism Development Corporation Limited
Panaji, Goa – 403 001.



**INSTITUTE OF REMOTE SENSING
ANNA UNIVERSITY, CHENNAI-25**

December 2018

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ABSTRACT

On the request of M/s.Goa Tourism Development Corporation Limited, Goa - 403 001, a survey was carried out to demarcate the High Tide Line(HTL),Low Tide Line(LTL) and Coastal Regulation Zone(CRZ) for Anjuna Village of Bardez Taluka in North Goa District, Goa for the proposed Five Star Resort. The satellite imagery of the study area was interpreted for geomorphic features in the vicinity of the survey site. The proposed area falls near to the Arabian Sea. The cadastral map of the area provided by the client was used as Base Map. Based on the topography; High Tide Line has been identified and traced in the field by Kinematic GPS survey. The High Tide Line is superimposed on to georeferenced cadastral map to prepare a local level HTL map. The project area boundary and the proposed development (Five Star Resort) provided by the client was superimposed on to HTL map and enclosed. The spheroidal coordinates of the High Tide Line in WGS84 system are presented in the Annexure. The satellite imagery of project site is also enclosed herewith.

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1. INTRODUCTION

The coastal zone is the area of interaction between land and sea. The coastal Zone of Goa has a very high concentration of population along with ecologically sensitive areas like mangroves. There is a spurt of developmental activities arising from huge residential colonies, new industries and tourism centers along the coast and in coastal zone. There is a need to protect the coastal environment while ensuring continuing production and development. This zone is extremely vulnerable and has to be managed judiciously striking a balance between ecological and developmental needs.

Government of India has issued a notification during February 1991 for regulating the developments along the coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by tidal action. The land between 500 meters from the High Tide Line (HTL) and the Low Tide Line (LTL) is identified as Coastal Regulation Zone (CRZ). The coastal stretches within CRZ are classified into four categories, namely, Category I (CRZ-I), Category II (CRZ-II), Category III (CRZ-III) and Category IV (CRZ-IV). The notification has also laid down regulations to regulate the various activities in the coastal zone. The Ministry of Environment and Forests, Government of India, has approved a set of CRZ maps on 1:25,000 scale prepared from SPOT satellite imagery. On these maps, zones are demarcated as CRZ I, CRZ II and CRZ III, by NCZMA.

Coastal Regulation Zone I includes the zone between High Tide Line and Low Tide Line. It also includes the areas that are ecologically sensitive and important, such as national parks/marine parks, sanctuaries, reserve forests, wildlife habitats, mangroves, corals/coral reefs, areas close to breeding and spawning grounds of fish and other marine life, areas of outstanding natural beauty/historically/heritage areas, areas rich in genetic diversity, areas likely to be inundated due to rise in sea level consequent upon global warming and such other areas as may be declared by the Central Government or the concerned authorities at the State/Union Territory level from time to time.

CRZ-II covers the areas that have already been developed up to or close to the shoreline. For this purpose, the "developed area" is referred to as that area within the municipal limits or in other legally designated urban areas which are already substantially built up and have been provided with drainage and approach roads and other infrastructural facilities, such as water supply and sewerage mains. CRZ-III covers the areas that are relatively undisturbed and those which do not belong to either Category-I or II. These include the coastal zone in the rural areas (developed and undeveloped) and also areas within municipal limits or in other legally designated urban areas which are not substantially built up. CRZ-IV refers to the coastal stretches in the Andaman and Nicobar, Lakshadweep and small islands other than those designated as CRZ-I, CRZ-II or CRZ-III.

The Ministry of Environment and Forest in the CRZ Notification, 2011 declared the following areas as CRZ and imposed with effect from the date of the notification the restrictions on the setting up and expansion of industries, operations or processes and the like in the CRZ. The areas that are defined as CRZ as per CRZ Notification, 2011 are

(i) The land area from High Tide Line (HTL) to 500mts on the landward side along the sea front.

(ii) CRZ shall apply to the land area between HTL to 100 meters 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 shall be governed by the distance up to which the tidal effects are experienced which shall be 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 shall be clearly identified and demarcated accordingly in the Coastal Zone Management Plans.

(iii) The land area falling between the hazard line and 500mts from HTL on the landward side, in case of seafront and between the hazard line and 100mts line in case of tidal influenced water body the word 'hazard line' denotes the line demarcated by Ministry of Environment and through the Survey of India taking into account tides, waves, sea level rise and shoreline changes.

(iv) Land area between HTL and Low Tide Line (LTL) which will be termed as the intertidal zone.

(v) The water and the bed area between the LTL to the territorial water limit (12 Nm) in case of sea and the water and the bed area between LTL at the bank to the LTL on the opposite side of the bank, of tidal influenced water bodies.

The Classification of the CRZ is also modified for the purpose of conserving and protecting the coastal areas and marine waters as CRZ – I, CRZ – II, CRZ – III and CRZ – IV. The CRZ – I include the areas that are ecologically sensitive and the geomorphological features which play a role in the maintaining the integrity of the coast like (a) Mangroves (b) Corals and coral reefs and associated biodiversity

(c) Sand Dunes (d) Mudflats which are biologically active (e) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas (f) Salt Marshes (g) Turtle nesting grounds (h) Horse shoe crabs habitats (i) Sea grass beds (j) Nesting grounds of birds (k) Areas or structures of archaeological importance and heritage sites and the area between Low Tide Line and High Tide Line. The CRZ-II includes areas that have been developed upto or close to the shoreline. The CRZ-III includes areas that are relatively undisturbed and those do not belong to either CRZ-I or II, which include coastal zone in the rural areas (developed and undeveloped) and also areas within municipal limits or in other legally designated urban areas, which are not substantially built up. The CRZ-IV includes the water area from the Low Tide Line to twelve nautical miles on the seaward side and the water area of the tidal influenced water body from the mouth of the water body at the sea up to the influence of tide which is measured as five parts per thousand during the driest season of the year.

The Ministry of Environment and Forest has also provided guidelines for demarcation of High Tide Line in the CRZ Notification, 2011. As per the guidelines, Cadastral (village) maps in 1:3960 or the nearest scale shall be used as the base maps. HTL and LTL will be demarcated in the cadastral map based on detailed physical verification using coastal geomorphological signatures or features in accordance with the CZM Maps approved by the Central Government. 500metre and 200metre lines shall be demarcated with respect to the HTL.

In order to facilitate classification of Coastal Regulation Zones Government of India has approved few agencies/institutions across the Country vide Lr. No. J17011/8/92-1A III, dated 10.05.1999 of Ministry of Environment and Forests. Institute of Remote Sensing, Anna University being one of them, has been carrying

out HTL and LTL mapping following the guidelines issued by Ministry of Environment and Forests, Government of India.

2. BACKGROUND OF THE STUDY

M/s. Goa Tourism Development Corporation Limited, Goa - 403 001 has requested Institute of Remote Sensing, Anna University to demarcate High Tide Line on 1:4,000 scale for the proposed project site in Anjuna Village, Goa. The project site is located near Arabian Sea. Hence this study was carried out to demarcate the HTL for Arabian Sea and setback lines near the project site.

3. STUDY AREA AND EXTENT

The aforesaid project site is located in Village Anjuna. The site is located in the Survey Nos. 206/1-H, 210/5-A, 211/4(Pt), 211/5-8 & 212/ (1, 2, 3, 4&6) of Anjuna Village, Goa. The site is situated nearer to Arabian Sea and falls within Coastal Regulation Zone.

4. NEED FOR THE STUDY

The property of M/s. Goa Tourism Development Corporation Limited, Goa - 403 001 has proximity to the Arabian Sea. It is in this context, the proposed site needs to be evaluated to assess whether the proposed site falls under regulations of CRZ Notification 2011. The objective of the present study is to examine the property of M/s. Goa Tourism Development Corporation Limited, Goa - 403 001 with reference to Coastal Regulation Zone Notification 2011. Keeping in view of the requirements of Notification, Institute of Remote Sensing, Anna University undertook the project with following agreed scope of work:

- Demarcation of HTL along the stretches of Arabian Sea near the project site by conducting field survey using DGPS survey.
- Demarcation of ecologically sensitive entities such as Mangroves, Sand dunes, Turtle breeding grounds in the vicinity of project site

5. DEMARCATION OF HTL ON THE LOCAL LEVEL MAP

5.1 Methodology adopted

The village map of Anjuna Village has been used as the base map. The Geomorphology of the Coastal Zone has been studied from the temporal medium resolution satellite data. In order to prepare the local level map on 1:4,000 scale, the site has been inspected by IRS Scientists. Based on the geomorphic units, the high tide line has been identified in the field and traced by field survey. The tide level observations were collected from the Tide Tables and were interpolated for the project area from the nearest ports to the site. The highest high tide level and lowest low tide level for the past 19 years was determined from these tide tables.

As per the definition of high tide line, "The High Tide Line means the line on the land up to which the highest water line reaches during the spring tide". There is a clear boundary between the areal spread of mudflats and vegetation usually very much apparent. This boundary line coincides with the HTL line interpreted from the satellite imagery. On the other hand LTL is defined as the seaward limit to which the waves recede during low tide. In case of inland waters such as creeks and backwaters, the CRZ guidelines indicates that the development along rivers, creeks, creek lets and backwaters has to be regulated up to a distance where the tidal effects are experienced which has to be determined based on salinity concentration of 5 parts per thousand (ppt). Insitu observations of the salinity were used to delineate the HTL for backwaters.

6. GPS SURVEYING

The Trimble 5700 (Geodetic Surveyor Series) GPS receivers were used to conduct the surveying at the project site. The survey involves three components

namely, 1. Establishing Base Station, 2. Static Survey 3. Control Survey for Village Maps and 4. Kinematic Survey for HTL Demarcation.

6.1 Establishing Base Station

The survey involves establishing one base station for Static Survey. The base stations were identified on stable locations with clear view of sky for uninterrupted access to GPS satellite signals. The control point with known elevation was used as initial reference station. The base station for the project site was established on firm ground and observed with static GPS survey from the known coordinates of the control point. The observations times were fixed based on the length of base lines to obtain highest possible accuracies.

6.2 Static Survey

The conduct of Static Survey using GPS requires two GPS receivers, one to be setup over the control point (with known co-ordinate) and another one over a reference station whose coordinates and distance from the control point are to be determined. Both these receivers must record data simultaneously. These known co-ordinates of the control point were fed and fixed for processing of the logged data to accurately determine the co-ordinates of the base stations.

6.3 Control Survey for Georeferencing Village Maps

The cadastral map pertaining to the project site was provided by the client. The hard copy cadastral map was scanned and georeferenced with the help of GPS coordinates of boundary points provided by the client and used for the preparation of local level HTL Maps.

6.4 Kinematic Survey for HTL Demarcation

Kinematic Surveying enables a very rapid survey of a number of base lines in areas where there is good satellite visibility. At least, two GPS receivers are required to perform a kinematic survey. One receiver is designated as the

reference receiver and is set up over the Base Station. All baselines are measured relative to this station. The other receivers, called rovers, are moved in succession to trace and record the HTL on ground through ground profiling.

7. DEMARCATION OF HTL


Surrogate data such as Coastal Geomorphologic features identified from the satellite imagery, indicators available on the ground and Tidal data were used to verify the HTL demarcated by Kinematic Survey.

8. CONCLUSION

1. The observed baselines were processed using TGO software. The same were plotted at large scale using the ArcGIS 9.3 software and the same was superimposed in the georeferenced cadastral map. In the cadastral map of 1:4,000 Scale, the HTL for Arabian Sea and setback lines from HTL for Arabian Sea are marked (Map enclosed).
2. The proposed Development (Five Star Resort) details fall beyond 200m buffer from HTL for Arabian Sea, but within 500m buffer from HTL for Arabian Sea.
3. There are no mangroves in the vicinity of the project site.
4. The processed HTL co-ordinates in WGS 84 system are presented in the annexure.
5. The satellite imagery of project site is presented below for reference.


DIRECTOR, IRS

Director

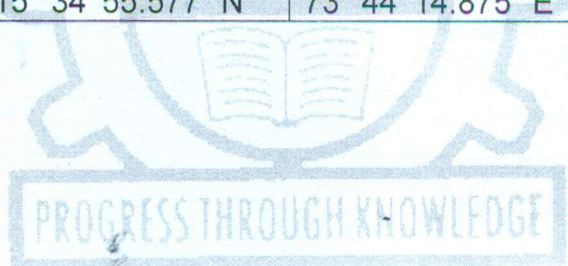

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ANNEXURE

DEMARCATIION OF HIGH TIDE LINE FOR THE PROPOSED FIVE STAR RESORT IN SURVEY NOS.206/1-H, 210/5-A, 211/4(Pt), 211/5-8 & 212/ (1, 2, 3, 4 &6) AT ANJUNA VILLAGE OF BARDEZ TALUKA IN NORTH GOA DISTRICT,GOA

CO-ORDINATES OF HTL POINTS

Point No	Latitude	Longitude	Remarks
1	15° 35' 13.795" N	73° 44' 08.669" E	HTL
2	15° 35' 12.640" N	73° 44' 09.350" E	HTL
3	15° 35' 11.451" N	73° 44' 09.269" E	HTL
4	15° 35' 10.689" N	73° 44' 10.262" E	HTL
5	15° 35' 09.515" N	73° 44' 12.141" E	HTL
6	15° 35' 06.546" N	73° 44' 13.267" E	HTL
7	15° 35' 04.000" N	73° 44' 12.935" E	HTL
8	15° 35' 03.812" N	73° 44' 13.707" E	HTL
9	15° 35' 03.120" N	73° 44' 14.460" E	HTL
10	15° 35' 00.677" N	73° 44' 13.763" E	HTL
11	15° 34' 59.176" N	73° 44' 14.039" E	HTL
12	15° 34' 57.156" N	73° 44' 15.165" E	HTL
13	15° 34' 55.577" N	73° 44' 14.875" E	HTL



[Handwritten Signature]
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GOOGLE IMAGE SHOWING THE PROJECT SITE

