

BEFORE THE NATIONAL GREEN TRIBUNAL  
WESTERN ZONE BENCH AT  
PUNE.

Original Application No.37/2022

Estevam Socorro Ribeiro .....Applicant

Versus

State of Goa &Ors. ....Respondents

**AFFIDAVIT ON BEHALF OF RESPONDENT NO.2**

MAY IT PLEASE YOU LORDSHIPS:

I Dr. Geeta S. Nagvenkar, major of age, Indian National, residing at Mapusa Goa,do hereby on solemn affirmation states and submits as under:

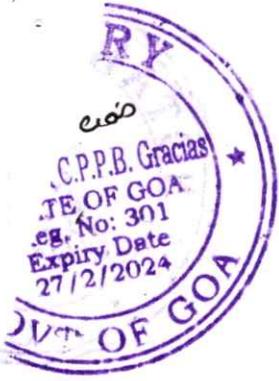
1. I say that I am the Member Secretary of Goa Coastal Zone Management Authority, and the Respondent No.2 herein joined on 22/12/2022. I state that I have been authorized to file the present

Affidavit.

2. I say that Goa Coastal Zone Management Authority has been constituted by the Ministry of Environment & Forests (MOEF), Government of India pursuant to the directions of the Hon'ble Supreme Court of India to deal, inter alia, with violation of the Coastal Regulation Zone (CRZ) Notification 2011 and implementation of the CRZ Notification.

3. I say that the office of the Respondent No.2 received Compliant/Representation dated 15.12.2021 from St. Estevam Biodiversity Management Committee, Village Panchayat Office, St.Estevam, Tiswadi Goa with regards to construction of proposed Bridge between Cumbharjua Village and St. Estevam village. I say that the RespondentNo.2 also received another Compliant/Representation from Mr.Estevam, R/o H.No 1005, Bairo Manguerial. St.Estevam, Ilhas





dated 10/01/2022 with regards to illegal construction of bridge from Chane-Kator at Cumbharjua to Vanso at St.Estevam by Goa State Infrastructure Development Corporation, the Respondent No.10.

**Annexed herewith as 'Annexure A Colly' are the copies of the Complaint dated 15/12/2021 and 10/01/2022.**

4. On receipt of the above said complaints, the Respondent No.2 conducted site Inspection, and the site was inspected by the Expert Member (GCZMA) on 03/03/2022 and submitted the report before this Authority on 07/03/2022.

**Annexed hereto as 'Annexure B' is Inspection report dated 07/03/2022 along with photographs.**

5. I say that upon perusal of the report and the Complaint, the following illegal construction resulting in violation of CRZ Notification 2011 was

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noticed.

6. I say that the details of the violations as per the Inspection Reports are indicated here below:-



Sr. No.	Name of the Party/alleged violator	Survey No./Village	Type of Construction	Distance from HTL
1.	GSIDC	66/6,7& 8 of Cumbarjua Village on eastern bank and Sy. No. 175/2,3&4 of western bank Cumbarjua Village	(i) Illegal construction of bridge.  (ii) Destruction of mangroves Illegal erection of 8 piles of bank 30 mts depth erected on both banks of River.	Within NDZ



			(iii) Illegally constructed a cement platform on the riverbank  (iv) Reclaiming of low lying area and filled with laterite stones and mud.	
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7. I say that as per the CRZ Notification 2011 the entire belt of 100mts from the High Tide Line (HTL) of river and 200mts. from the HTL from the sea is designated as the No Development Zone (NDZ) and hence no construction/development whatsoever are permissible in the said belt.
8. I say that the alleged illegal construction is highly detrimental to the Coastal ecosystem/riverine eco system. I say that further it is observed that Respondent no.10 have

not obtained any prior approval of the Respondent no.2 for the purpose of the alleged construction as required under the CRZ Notification 1991/2011.

9. I say that after receipt of the Inspection Report, the issue was discussed in the 299<sup>th</sup> GCZMA meeting held on 19/04/2022, the Authority has taken the following decision, **"The Authority deliberated on the matter at length. It is an admitted fact that prior permission of this Authority for the under-construction project was not taken by the project proponent i.e GSIDC Ltd. It is also an admitted fact that the bridge and its approaches are within an ecologically fragile area. In addition to being within the riverine NDZ, the site has mangroves and crocodile habitat as well. I say that expert members site inspection report was also perused. Considering the material available on record, the Authority resolved that it was a fit case to issue stop-work orders and accordingly the project proponent is directed to stop-work until further**



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orders”.

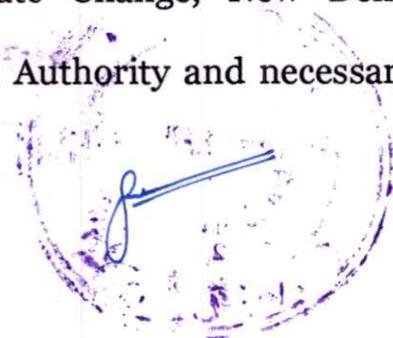
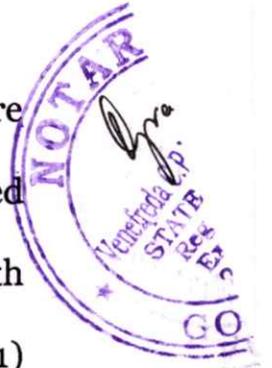
10. I say that the Respondent No.2 further directed Respondent No.10 to conduct a study with following terms of reference, and submit report: (1) Ecological assessment of the river and khazan with respect to the impact of the proposed bridge, and measures proposed to mitigate adverse effects and (2) Socio economic benefits to the farmers due to the bridge construction.

11. I say that on 27/04/2022 Respondent No.2 issued Show Cause Notice to Respondent No.10 in exercise of the powers conferred by section 5 of the Environment (Protection) Act, 1986 read with sub-rule (3) (a) of rule 4 of the Environment (Protection) Rules, 1986, delegated to the GCZMA, directing to STOP WORK with immediate effect and SHOW CAUSE as to why a direction to demolish the structures and to restore the land to its original condition should not be issued to Respondent No.10. **Annexed hereto as Annexure C is Copy of Show Cause Notice dated 27/04/2022.**



12.I say that further, Respondent No.10 is directed to ensure that no civil work of whatsoever kind and nature is carried out at said site and further, to conduct a study with following terms of reference, and submit report:(1) Ecological assessment of the river and khazan with respect to the impact of the proposed bridge, and measures proposed to mitigate adverse effects, and (2) Socio-economic benefits to the farmers due the bridge construction. Within 15 days.

13.I say that accordingly Respondent No.10 prepared EIA report and same is submitted to Respondent No.2 on 22/10/2022 which is under consideration of RespondentNo.2. Annexed hereto as Annexure D is EIA report submitted on 22/10/2022. In the meantime the 3 year term of the Authority of Respondent No.2 came to an end on 21/10/2022 and on account of which the Respondent No.2 could not deliberate and take appropriate decision in the matter. The Ministry of Environment Forest and Climate Change, New Delhi (MOEF& CC), re-constituted the Authority and necessary



reconstitution order was issued on S.O. 6071(E) dated 27/12/2022. Annexed hereto as Annexure E is Copy of the reconstitution order of GCZMA dated S.O. 6071(E) dated 27/12/2022.

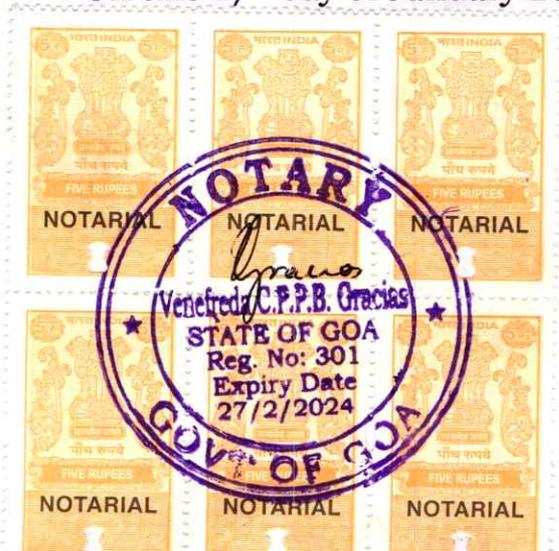
14. The reconstituted committee, held in its meeting i.e 16.01.2023 meeting of the authority further deliberated on the issue. However, could not take final decision in the matter. The next meeting of the authority is scheduled on 9/02/2023, on which date the issue will be further deliberated and appropriate decision in the regard will be taken.

15. I state that whatever has been stated herein above is based on the records available in the Office of the Respondent No.2 to which I have access and I believe the same to be true and correct.

Solemnly affirmed at Panaji-Goa.

On this 27<sup>th</sup> day of January 2023.

  
27/01/2023  
Deponent

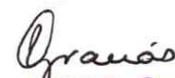


Solemnly Affirmed Before Me by  
Dr. Geeta S. Nagvenkar  
Who is identified before me by

\_\_\_\_\_ at Calangute - Goa

Sr No. 012/01/2023/P

Date: 27/01/2023

  
Venereda C.P.P.B. Gracias  
Advocate & Notary  
Bardez-Goa

# STO. ESTEVAM BIODIVERSITY MANAGEMENT COMMITTEE

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## Annexure A Colly



Village Panchayat Office, Sto. Estevam, Tiswadi Goa. 403-106  
Email: bmcstoestevam@gmail.com

Ref. No.: BMC ST EST/ 2021/ 2

Dated: 14 Dec 2021

Member Secretary  
G. C. Z. M. A.  
Inward No. 5443  
Date: 15/12/2021

The Member Secretary,  
GCZMA,  
Porvorim-Goa.

**Sub: proposed Bridge between Cumbharjua village and St Estevam village.**

*D*  
15/12

Sir,

With respect to the subject we note that work is going on the above bridge.

1. Please note that the bridge is connecting a fragile khazan ecosystem to the main district road.
2. We the villagers have not asked for this bridge and the VP St Estevam has not been consulted and not given any permission for the bridge.
3. The name of the work is bridge between Chunnem cantor and Vantsokhazan in Cumbharjua village. But actually work is going on for the bridge between Cumbharjua village and St Estevam village.
4. We strongly oppose this illegal project which will destroy the Vantsokhazan and dongri which are fragile ecosystems.
5. The project is approved by fraud and wilful misrepresentation of facts- VantsoKhazan is in St Estevam village and not in Cumbharjua village.
6. Our khazans and dongris within the khazans are biodiversity heritage sites and CRZ 1 areas and we do not want an interference in this areas. No permission is take from GCZMA.
7. Village PBR clearly shows our khazans and dongris as biodiversity heritage sits with its associated fauna etc. We want to protect our village island ecosystem and ecosensitive zones for posterity.
8. We direct you to immediately stop the work as it is solely done for the builders to open our khazans and dongris for development which is open secret known to both the villages.

Thanking you,  
*Mateus Saldanha*  
Mateus Saldanha,  
Chairperson,  
St Estevam BMC.



*Haspeck*  
*Expert member*  
*As*  
*Umebra*  
*Stevam*

Member Secretary

G. C. Z. M. A.

Inward No. 5831

Date: 10/01/2022

From,

Mr. Estevam Ribeiro

R/o. H. no. 1005, Bairro Mangueiral

St. Estevem, Ilhas Goa

Mobile no. 9822489282

*Santosh*  
*look comments*  
*from G.S.I.D.C*

*[Signature]*  
*10/01/2022*

Date: 10/01/2022

To,

The Member Secretary,

Goa Coastal Zone Management Authority,

Panjim- Goa.

**Sub: Illegal construction of bridge from Chane – Kator at Cumbharjua to Vanso at St. Estevem, by the Goa State Infrastructure Development Corporation.**

Sir,

*Adh-* This is to bring to your notice that an illegal bridge is being constructed between Survey no 175 Jua village and 65 in Cumbharjua village by the Goa State Infrastructure Development Corporation, at the above-

mentioned location. The bridge is being constructed across a tidally influenced waterbody (tributary of Mandovi River) without any permissions from the Goa Coastal Zone Management Authority

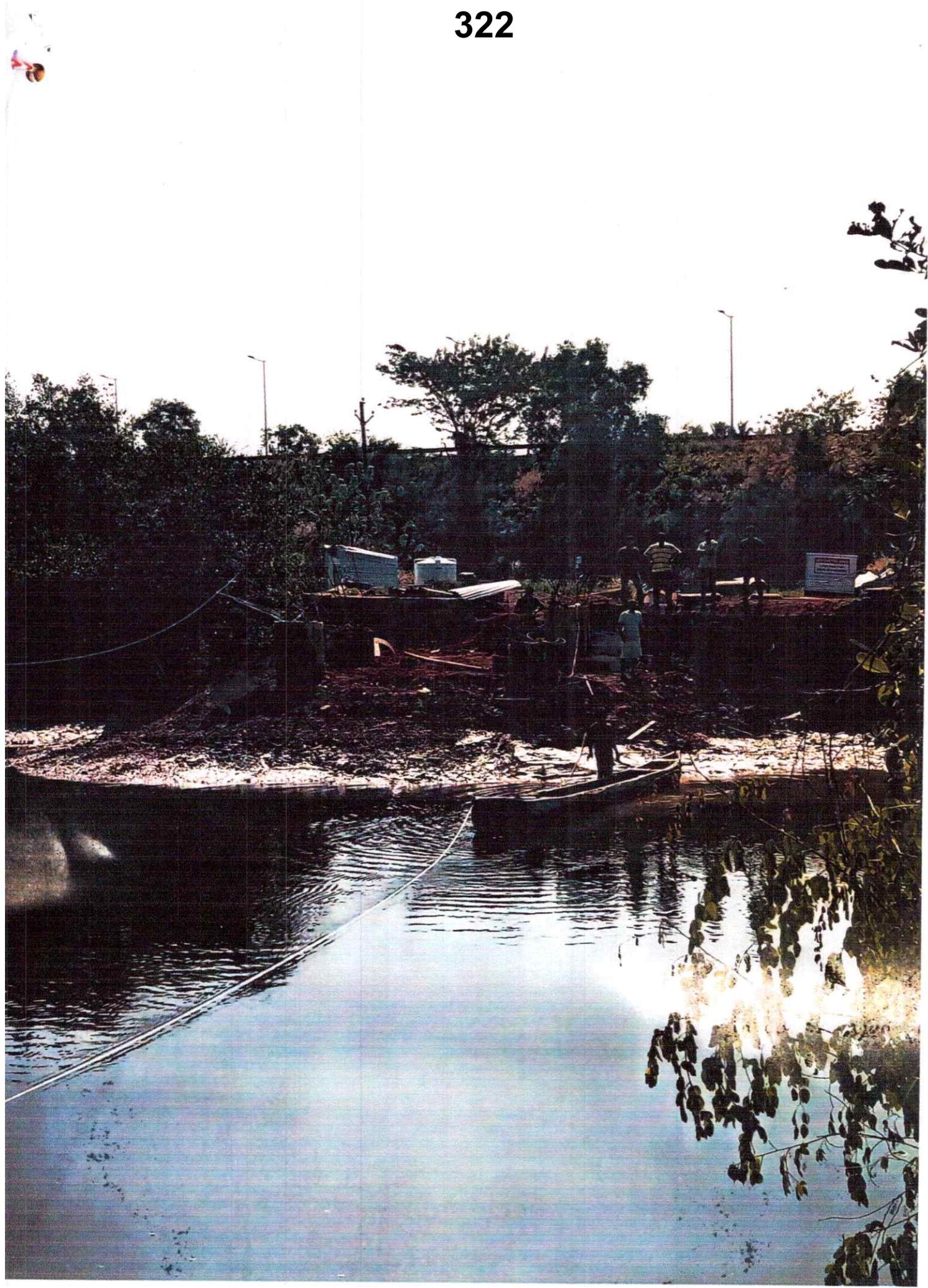
Presently mud is being dumped into the river and the work has commenced (Annexed hereto are the photographs taken on ..... )

You are requested to immediately conduct a site inspection and issue stop work notice to Goa State Infrastructure Development Corporation and take appropriate action in accordance with law.

Yours faithfully



Mr. Estevam Ribeiro



## ANNEXURE B

07 March 2022.

## INSPECTION REPORT

Re: Construction of a connecting bridge for local farmers from Chune-kator to Vanso field in village Cumbarjua being built by GSIDC.

**Introduction:**

The Office of GCZMA is in receipt of a complaint from villagers of Jua/St. Estevam with the grievance that a bridge is being constructed by the Goa State Infrastructure Development Corporation (GSIDC) in CRZ area without GCZMA permission. The site was inspected by the undersigned at request of Member Secretary GCZMA on 03 March 2022.

The inspection commenced at 14:00 hrs., and concluded at 15:00 hrs.

The GSIDC was represented at the inspection by the following:

- Mr. Vishwanath Kudchad, Dy. Manager, GSIDC.
- Ms. Shruti Naik, Asst Manager, GSIDC.

In addition to the undersigned, the GCZMA team comprised of the following:

- Ms. Bhargavi Kelkar, Engineer, GCZMA
- Mr. Vignesh Naik, Field Surveyor, GCZMA
- Ms. Siddhi Morajkar, Field Surveyor, GCZMA.

**Observations:**

1. The site in question where the bridge is under construction falls within the riverine NDZ. There exist mangroves along the banks. From our preliminary inquiries, the survey nos. are 66/6,7&8 of Cumbarjua village on eastern bank and 175/2,3&4 of St Estevam village on western bank. However, the precise survey numbers may be ascertained. The approximate GPS coordinates (eastern bank) are 15°31'11.47" N and 73°56'43.82" E.
2. The site is shown under CRZ III and 'Khazan land' in Draft CZMP Map GA 166.
3. The GSIDC Contractor has commenced construction of the bridge connecting both the banks.
4. <sup>Eight piles of 30 meters</sup> ~~Four~~ columns of 3 meters depth have been excavated and erected <sup>driven</sup> on both banks of the river. A cement platform has been constructed on one of the riverbanks. The span of the proposed bridge is about 35 metres. Jal
5. Low-lying area has been reclaimed by filling it with the laterite stones and mud.





6. The river is a crocodile habitat. A crocodile was sighted in the river at the time of the site inspection.
7. No permission from GCZMA has been obtained.
8. Since the area in question is ecologically fragile, work of such nature is detrimental and ought to have been executed with proper assessment of all risks and prior permission from GCZMA.
9. Site inspection proceedings are recorded in prescribed form and annexed to this report.

**Findings & Recommendations:**

The bridge construction work undertaken by GSIDC is in gross violation of CRZ Notification 2011 and needs to be stopped immediately. Hence, stop-work orders may be issued on priority. The GSIDC may be asked to restore the land and riverine area back to its original position.

Photographs taken during inspection are attached that would enable better appreciation of the site position.

Submitted.



Sujeetkumar Dongre,  
Expert Member, GCZMA



Sávio J.E. Correia,  
Expert Member, GCZMA



Shrirang Jambhale,  
Expert Member, GCZMA

# Photographs



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Jainilbhai

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**GOA COASTAL ZONE MANAGEMENT AUTHORITY**

C/o Department of Science, Technology and Environment (Govt. of Goa)

4<sup>th</sup> floor, Dempo Towers, Patto, Panaji Goa

www.czma.goa.gov.in

Ref.No.GCZMA/N / ILLI- (compl) / 21-22 / 80 / 188

Dated: 27/04/2022

**SHOW CAUSE NOTICE CUM STOP WORK ORDER ISSUED UNDER SECTION 5 OF THE ENVIRONMENT (PROTECTION) ACT, 1986, READ WITH RULE 4 OF THE ENVIRONMENT (PROTECTION) RULES, 1986.**

**WHEREAS**, the Goa Coastal Zone Management Authority (hereinafter referred to as 'the GCZMA' in short) has been constituted by the Ministry of Environment & Forests (MoEF), Government of India pursuant to the directions of the Hon'ble Supreme Court of India to deal, inter alia, with violation of the Coastal Regulation Zone (CRZ) Notification 2011 and implementation of the CRZ Notification.

**AND WHEREAS**, the office of the GCZMA is in receipt of Compliant /Representation dated 15.12.2021 from Sto. Estevan Biodiversity Management Committee, Village Panchayat Office, Sto Esttevam, Tiswadi Goa with regards to proposed Bridge between Cumbharjua village and St. Estevam village. Further another Compliant/Representation was made by Mr. Estevam R/o H.no 1005, Bairo Manguerial , St.Estevam, Illhas dated 10/01/2022 with regards to illegal construction of bridge from Chane -Kator at Cumbharjua to Vanso at St. Estevam by Goa State Infrastructure Development Corporation. (*Enclosed Copy of the Complaints*)

**AND WHEREAS**, The site was inspected by the Expert Member (GCZMA) on 3/3/2022 and submitted the report before this Authority on 7/03/2022.

**AND WHEREAS**, upon receipt of the Complaint, the following alleged illegal construction resulting in blatant and serious violation of CRZ Notification 2011 is noticed. The details of the violations are indicated here below:-

Sr No.	Name of the Party/alleged violator	Survey No. / Village	Type of Construction	Distance from HTL
1.	GSIDC	66/6, 7 & 8 of Cumberjua Village on eastern bank and sy no. 175/2, 3 &4 of	<ul style="list-style-type: none"> <li>• Illegal construction of bridge.</li> <li>• Destruction of mangroves</li> <li>• Illegal erection of 8 piles of 30 mts depth erected on both banks of river.</li> </ul>	Within NDZ

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		western bank Cumbarjua Village	<ul style="list-style-type: none"> <li>• Illegally constructed a cement platform on the river bank</li> <li>• Reclaiming of low lying area and filled with laterite stones and mud.</li> </ul>	
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**AND WHEREAS**, as per the CRZ Notification, 2011; the entire belt of 100 mts. from the High Tide Line (HTL) of river and 200mts. from the HTL from the sea is designated as the No Development Zone (NDZ) and hence no construction/ development whatsoever are permissible in the said belt;

**AND WHEREAS**, the alleged illegal construction is highly detrimental to the Coastal ecosystem / riverine ecosystem. Further it is observed that you have not obtained any prior approval of the GCZMA for the purpose of alleged construction as required under the CRZ Notification 1991/2011.

**AND WHEREAS**, the issue was discussed in the 299<sup>th</sup> GCZMA meeting held on 19/04/2022, the Authority decided, *“The Authority deliberated on the matter at length. It is an admitted fact that prior permission of this Authority for the under-construction project was not taken by the project proponent i.e., GSIDC Ltd. It is also an admitted fact that the bridge and its approaches are within an ecologically fragile area. In addition to being within the riverine NDZ, the site has mangroves and crocodile habitat as well. The expert members site inspection report was also perused. Considering the material available on record, the Authority resolved that it was a fit case to issue stop-work orders. Accordingly, the project proponent is directed to stop-work until further orders.*

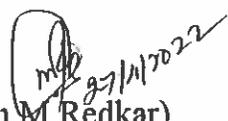
*The Authority further directed GSIDC to conduct a study with following terms of reference, and submit report: (1) Ecological assessment of the river and khazan with respect to the impact of the proposed bridge, and measures proposed to mitigate adverse effects, and (2) Socio-economic benefits to the farmers due to the bridge construction.”*

**NOW THEREFORE**, in exercise of the powers conferred by section 5 of the Environment (Protection) Act, 1986 read with sub-rule (3) (a) of rule 4 of the Environment (Protection) Rules, 1986, delegated to the GCZMA, the GCZMA hereby directs you to **STOP WORK** with immediate effect and **SHOW CAUSE** as to why a direction to demolish the structures and to restore the land to its original condition should not be issued to you. Further, you are directed to ensure that no civil work of whatsoever kind and nature is carried out at said site and further, to conduct a study with following terms of reference, and submit report: (1) Ecological assessment of the river and khazan with respect to the impact of the proposed bridge, and measures proposed to mitigate adverse effects,

(14)

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and (2) Socio-economic benefits to the farmers due to the bridge construction and submit the same to this Authority at the earliest within 15 days positively.

  
(Dasharath M Redkar)  
Member Secretary (GCZMA)

O/C

Encl: As above

To,

1. Managing Director, Goa State Infrastructure Development Corporation Limited 7<sup>th</sup> Floor, EDC House Dr.A.B.Road, Panaji

Copy to:

1. The Collector & District Magistrate (North), Office of the Collector (North), Collectorate Building, Panaji-Goa... for information and necessary action.
2. Mr. Estevam Rebeiro, r/o House No. 1005, Bairro Manguerial, St. Estevan, Ilhas.
3. St. Estevam Biodiversity Management Committee, Village Panchayat Office, Sto Esttevam, Tiswadi Goa.





Cornerstone of God's Future

Ref.: GSIDC/Engg/Works/1449/3407

21<sup>st</sup> September 2022

To

The Member Secretary,  
Goa Coastal Zone Management Authority,  
4<sup>th</sup> floor, Dempo Towers, Patto,  
Panaji Goa.  
Pin code No. 403001  
Phone: 0832-2951089.

Member Secretary

G. C. Z. M. A.

Inward No. 2242

Date: 22/09/2022

*Sanjay*  
*Place before*  
*before signature*

**Sub.: Submission of Application (Form I) and EIA report for CRZ Clearance for Construction of Bridge for Local Farmers to Cross Tributary of Mandovi/ Cumbarjua Canal for Cultivation of Fields from Chune - Kator to Vanso Fields, Village: Cumbarjua and Jua, Taluka: Tiswadi, District: North Goa, State: Goa.**

**Ref.: GCZMA letter no. GCZMA/N/IZLE-Compl/21-22/80/188 dated 27/04/2022**

Sir.

Goa State Infrastructure Development Corporation Ltd. (GSIDC) Government of Goa Undertaking is constructing a Bridge for Local Farmers to Cross Tributary of Mandovi/ Cumbarjua Canal for Cultivation of Fields from Chune - Kator to Vanso Fields. The project has started construction and completed up to pile and pile cap.

The bridge will ensure connectivity to local farmers and fulfill long-standing needs of farmers. As required application in prescribed format. EIA Report and Social Benefit Report is enclosed along with this letter.

It is requested to kindly appraise the project and grant CRZ clearance and oblige.

Thanking you

Yours faithfully

(Harish Adconkar)  
Managing Director

21.9.

# **APPLICATION FOR CRZ CLEARANCE**

**For**

**Construction of Bridge for Local Farmers to  
Cross Tributary of Mandovi/ Cumbarjua  
Canal for Cultivation of Fields from Chune -  
Kator to Vanso Fields**

**Village: Cumbarjua and Jua**

**Taluka: Tiswadi**

**District: North Goa**

**State: Goa**

**By**

**Goa State Infrastructure Development  
Corporation Ltd.**



**Prepared by**

**Aditya Environmental Services Pvt Ltd,**

**107, Hiren Light Industrial Estate, Mogul Lane,**

**Mahim, Mumbai – 400016.**

**Tel: (022) 42127500 Email: [contact@aespl.co.in](mailto:contact@aespl.co.in)**

**September 2022**

Application for CRZ Clearance for Construction of Bridge Across Tributary of Mandovi/ Cumbarjua canal for Local Farmers at part 8 & 9 of survey no. 65 of Cumbarjua village and part no.5 of survey no. 175 of Jua village, Taluka Tiswadi, District North Goa by Goa State Infrastructure Development Corporation Ltd., Panaji, Goa

### Form-I For Seeking Clearance for Project Attracting CRZ Notification

#### I. Basic information

Name of the Project	-:	Construction of Bridge Across Tributary of Mandovi/ Cumbarjua canal for Local Farmers at part no. 8 and 9 of survey no. 65 of Cumbarjua village and part no.5 of survey no. 175 of Jua village, Taluka Tiswadi, District North Goa, Goa	
Location or site alternatives under consideration	:-	Project is started construction based on demands of local farmers to access their fields. As the project is very location specific, no site alternatives are considered.	
		Location of site enclosed in <b>Annexure I</b> ; Reference coordinates are as follows:	
		North side (agriculture fields; Jua Island)	Latitude: 15°31'13.82"N Longitude: 73°56'46.02"E
		South side (towards Village Cumbarjua)	Latitude: 15°31'12.59"N Longitude: 73°56'46.32"E
Size of the project (in terms of total area)	-:	50 m length 3.5 m carriageway Arch frame bridge with two piers on both banks	
CRZ classification of the area	-:	CRZ IA (Mangrove buffer zone), CRZ III and CRZ IVB (Tributary of Mandovi/ Cumbarjua canal)	
Expected cost of the project	-:	3.4 Cr	
Contact Information	-:	Managing Director Goa State Infrastructure Development Corporation Limited 7 <sup>th</sup> Floor, 'EDC House', Dr. Atmaram Borkar Rd., Panaji, Goa Tel: (0832) - 5645769-7	

#### II. Activity

##### 1. Construction, operation or decommissioning of the Project involving actions, which will cause physical changes in the locality (topography, land use, changes in water bodies, etc.)

Sr. No.	Information/ confirmation	Checklist	Yes/ No	Details there of (with approximate quantities/ rates where possible) with source of information data
1.1	Permanent or temporary change in land use, land cover or topography including increase in intensity of land use (with respect to local land use plan)		No	Proposal is to construct bridge across tributary which will not cause any change in land use
1.2	Details of CRZ classification as per the approved Coastal Zone Management Plan?		Yes	Project activities fall under CRZ IA (Mangrove buffer zone), CRZ III and CRZ IVB (Tributary of Mandovi/ Cumbarjua canal)
1.3	Whether located in CRZ-I area?		Yes	Alignment is passing through Mangrove buffer zone
1.4	The distance from the CRZ-I areas		Yes	0m
1.5	Whether located within the hazard zone as mapped by Ministry of Environment and Forests/ National Disaster Management		No	--

Application for CRZ Clearance for Construction of Bridge Across Tributary of Mandovi/ Cumbarjua canal for Local Farmers at part 8 & 9 of survey no. 65 of Cumbarjua village and part no.5 of survey no. 175 of Jua village, Taluka Tiswadi, District North Goa by Goa State Infrastructure Development Corporation Ltd., Panaji, Goa

Sr. No.	Information/ confirmation	Checklist	Yes/ No	Details there of (with approximate quantities/ rates where possible) with source of information data
	Authority?			
1.6	Whether the area is prone to cyclone, tsunami, tidal surge, subduction, earthquake etc.?		No	No such incidence experienced in past
1.7	Whether the area is prone for saltwater ingress?		Yes	Part of bridge is in creeklet which is tidal influenced waterbody.
1.8	Clearance of existing land, vegetation and buildings?		No	Site is free of vegetation and structures
1.9	Creation of new land uses?		No	Bridge will not cause creation of new land use
1.10	Pre-construction investigations e.g. bore houses, soil testing?		Yes	As per soil/ geotechnical investigation studies carried out by B.D.Y. Geotechnical Service; strata consist of Boulder fill at the top region followed by Clayey/ Sandy strata with greyish black Basaltic rock encountered at termination level of 30.0m. hence deep foundation in the form of cast in situ pile foundation is suggested for the bridge.
1.11	Construction works?		Yes	Construction of 50 m long steel bridge having 3.5 m carriageway, arch frame bridge with two piers on both banks
1.12	Demolition works?		No	Not Envisaged
1.13	Temporary sites used for construction works or housing of construction workers?		No	Construction workers will be sourced from nearby locations. No temporary sites for housing are required
1.14	Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations and fill or excavations		Yes	Construction of bridge has started and completed up to pile and pile cap, fabrication of steel frame. Pending work involves installing pedestal, bearing, prefabricated arch structure and dirt wall
1.15	Underground works including mining or tunnelling?		No	Not envisaged
1.16	Reclamation works?		No	no reclamation envisaged.
1.17	Dredging/ reclamation/ land filling/ disposal of dredged material etc.?		No	Not required
1.18	Offshore structures?		No	Not required
1.19	Production and manufacturing processes?		No	Not required
1.20	Facilities for storage of goods or materials?		Yes	Temporary storage of construction materials, welding machines and accessories will be stored on open land besides bund on Cumbarjua side
1.21	Facilities for treatment or disposal of solid waste or liquid effluents?		Yes	Mobile toilets for sewage whereas solid waste will be segregated and stored at designated place and

Application for CRZ Clearance for Construction of Bridge Across Tributary of Mandovi/ Cumbarjua canal for Local Farmers at part 8 & 9 of survey no. 65 of Cumbarjua village and part no.5 of survey no. 175 of Jua village, Taluka Tiswadi, District North Goa by Goa State Infrastructure Development Corporation Ltd., Panaji, Goa

Sr. No.	Information/confirmation	Checklist	Yes/No	Details there of (with approximate quantities/ rates where possible) with source of information data
				disposed off according to existing local solid waste management system
1.22	Facilities for long term housing of operational workers?		No	Not required
1.23	New road, rail or sea traffic during construction or operation?		Yes	Additional road traffic to carry construction material, workers to site is envisaged during construction of bridge
1.24	New road, rail, air water borne or other transport infrastructure including new or altered routes and stations, ports, airports etc?		Yes	the bridge will create new road for local farmers to reach Jua Island for agriculture activities
1.25	Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements?		No	Not envisaged
1.26	New or diverted transmission lines or pipelines?		No	Not envisaged
1.27	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?		No	Not envisaged
1.28	Stream crossings?		Yes	The bridge is required to cross tributary of Cumbarjua canal
1.29	Abstraction or transfers of water from ground or surface waters?		No	Not envisaged but, water required for construction purpose will be sourced from the tributary/ creek
1.30	Changes in water bodies or the land surface affecting drainage or run-off?		No	Not envisaged. The bridge has only 2 piers one each on respective banks. The bridge will have soffit level at 2.5 m above HFL of the tributary.
1.31	Transport of personnel or materials for construction, operation or decommissioning?		Yes	Transport of Manpower and materials during construction phase and villagers during operation phase is envisaged
1.32	Long-term dismantling or decommissioning or restoration works?		No	Not required
1.33	Ongoing activity during decommissioning which could have an impact on the environment?		No	Not envisaged
1.34	Influx of people to an area in either temporarily or permanently?		Yes	Influx of villagers is envisaged during operation of the project.
1.35	Introduction of alien species?		No	Not envisaged
1.36	Loss of native species or genetic diversity?		No	Not envisaged
1.37	Any other actions?		No	Not envisaged

Application for CRZ Clearance for Construction of Bridge Across Tributary of Mandovi/ Cumbarjua canal for Local Farmers at part 8 & 9 of survey no. 65 of Cumbarjua village and part no.5 of survey no. 175 of Jua village, Taluka Tiswadi, District North Goa by Goa State Infrastructure Development Corporation Ltd., Panaji, Goa

**2. Use of Natural resources for construction or operation of the Project (such as land, water, materials or energy, especially any resources which are non-renewable or in short supply):**

Sr. No.	Information/ Checklist	Yes/ No	Details thereof (with approximate quantities/ rates, wherever possible) with source of information data																		
2.1	Land especially undeveloped or agricultural land (ha)	No	No agricultural land is involved in the project. GSIDC has NOC from farmer where one pier on Jua side is within agriculture field.																		
2.2	Water (expected source & competing users) unit: KLD	Yes	Water is required during construction phase. Water requirement in operation phase is not envisaged																		
2.3	Minerals (MT)	No	Not required																		
2.4	Construction material – stone, aggregates, sand/ soil (expected source – MT)	Yes	<table border="1"> <thead> <tr> <th>Material</th> <th>Quantity</th> <th>Source</th> </tr> </thead> <tbody> <tr> <td>Concrete (RMC)</td> <td>~ 400 m<sup>3</sup></td> <td>Kundaim</td> </tr> <tr> <td>TMT Steel Bars</td> <td>~ 15 T</td> <td>Chorlim</td> </tr> <tr> <td>Structural Steel</td> <td>~ 100 T</td> <td>Chorlim</td> </tr> <tr> <td>Soil for filling</td> <td>~ 1500m<sup>3</sup></td> <td>Marcel</td> </tr> <tr> <td>Hot mix</td> <td>~105 m<sup>3</sup></td> <td>Bicholim</td> </tr> </tbody> </table>	Material	Quantity	Source	Concrete (RMC)	~ 400 m <sup>3</sup>	Kundaim	TMT Steel Bars	~ 15 T	Chorlim	Structural Steel	~ 100 T	Chorlim	Soil for filling	~ 1500m <sup>3</sup>	Marcel	Hot mix	~105 m <sup>3</sup>	Bicholim
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2.5	Forests and timber (source – MT)	No	Not required																		
2.6	Energy including electricity and fuels (source, competing users) Unit: fuel (MT), energy (MW)	Yes	Power requirement is limited to streetlights (to cover 70 m distance).																		
2.7	Any other natural resources (use appropriate standard units)	No	Not required																		

**3. Use, storage, transport, handling or production of substances or materials, which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health**

Sr. No.	Information/Checklist	Yes/ No	Details thereof (with approximate quantities/ rates, wherever possible) with source of information data
3.1	Use of substances or materials, which are hazardous (as per MSIHC rules) to human health or the environment (flora, fauna and water supplies)	No	Not envisaged
3.2	Changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)	No	Not envisaged
3.3	Affect the welfare of people e.g. by changing living conditions?	Yes	The project will create easy access to agriculture fields on other side of tributary. This will lead to reduce hardship of local farmers, opens opportunities to cultivate fields other than Kharip crops. The project overall tends to bring convenience in agriculture activities
3.4	Vulnerable groups of people who	No	No residing population on Jua Island.

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Sr. No.	Information/Checklist confirmation	Yes/ No	Details thereof (with approximate quantities/ rates, wherever possible) with source of information data
	could be affected by the project e.g. hospital patients, children, the elderly etc.		Thus, vulnerable groups of people affecting due to project is less likely
3.5	Any other causes, that would affect local communities, fisherfolk, their livelihood, dwelling units of traditional local communities etc.	No	Not envisaged

#### 4. Production of solid wastes during construction or operation or decommissioning (MT/month)

Sr. No.	Information/ Checklist confirmation	Yes/ No	Details thereof (with approximate quantities/ rates, wherever possible) with source of information data
4.1	Spoil, overburden or mine wastes	No	Not envisaged
4.2	Municipal waste (domestic and or commercial wastes)	Yes	Domestic waste is generated only during construction phase which will be disposed-off as per existing waste management system. No waste will be generated in operation phase
4.3	Hazardous wastes (as per Hazardous Waste Management Rules)	Yes	Hazardous wastes generated will be given to authorized dealer.
4.4	Other industrial process wastes	No	Not envisaged
4.5	Surplus product	No	Not envisaged
4.6	Sewage sludge or other sludge from effluent treatment	Yes	Mobile toilets will be provided during pending construction phase. No effluent generation is envisaged. No effluent and sewage generation are envisaged in operation phase.
4.7	Construction or demolition wastes	No	Not envisaged
4.8	Redundant machinery or equipment	No	Not envisaged
4.9	Contaminated soils or other materials	No	Not envisaged
4.10	Agricultural wastes	No	Not envisaged
4.11	Other solid wastes	No	Not envisaged

#### 5. Release of pollutants or any hazardous, toxic or noxious substances to air (Kg/hr.)

Sr. No.	Information/Checklist confirmation	Yes/ No	Details thereof (with approximate quantities/ rates, wherever possible) with source of information data
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources	Yes	In construction phase, emissions are envisaged from DG sets, earth moving, construction machineries.

Application for CRZ Clearance for Construction of Bridge Across Tributary of Mandovi/ Cumarjua canal for Local Farmers at part 8 & 9 of survey no. 65 of Cumarjua village and part no.5 of survey no. 175 of Jua village, Taluka Tiswadi, District North Goa by Goa State Infrastructure Development Corporation Ltd., Panaji, Goa

Sr. No.	Information/Checklist confirmation	Yes/ No	Details thereof (with approximate quantities/ rates, wherever possible) with source of information data
			In operation phase, emissions are envisaged from tractor movement by local farmers.
5.2	Emissions from production processes	No	Not envisaged
5.3	Emissions from materials handling including storage or transport	No	No material handling, storage is envisaged. Transport is limited to tractor movement by local farmers
5.4	Emissions from construction activities including plant and equipment	Yes	Pending construction activities will generate dust, particulate and gaseous emissions from construction machineries, vehicle movement however pending activities will be for short duration and restricted to the construction of bridge.
5.5	Dust or odours from handling of materials including construction materials, sewage and waste	No	Not envisaged
5.6	Emissions from incineration of waste	No	Not envisaged
5.7	Emissions from burning of waste in open air (e.g. slash materials, construction debris)	No	Not envisaged
5.8	Emissions from any other sources	No	Not envisaged

#### 6. Generation of Noise and Vibration, and Emissions of Light and Heat:

Sr. No.	Information/ Checklist confirmation	Yes/ No	Details thereof (with approximate quantities/ rates, wherever possible) with source of information data
6.1	From operation of equipment e.g. engines, ventilation plant, crushers	Yes	Noise and vibrations are expected during pending construction phase from heavy earth moving machineries, D.G sets, lifting, placing and assembling of on-site prefabricated spans and other components of bridge. Noise and vibration are expected limited to tractor movement by local farmers.
6.2	From industrial or similar processes	No	Not envisaged
6.3	From construction or demolition	Yes	Noise and vibrations are expected during construction phase from heavy earth moving machineries, D.G sets, lifting, placing and assembling of on-site prefabricated spans and other components of bridge.
6.4	From blasting or piling	Yes	No blasting is required.

Application for CRZ Clearance for Construction of Bridge Across Tributary of Mandovi/ Cumbarjua canal for Local Farmers at part 8 & 9 of survey no. 65 of Cumbarjua village and part no.5 of survey no. 175 of Jua village, Taluka Tiswadi, District North Goa by Goa State Infrastructure Development Corporation Ltd., Panaji, Goa

Sr. No.	Information/confirmation	Checklist	Yes/ No	Details thereof (with approximate quantities/ rates, wherever possible) with source of information data
6.5	From construction or operational traffic		Yes	Noise and vibration during construction and operation phase
6.6	From lighting or cooling systems		No	Not envisaged
6.7	From any other sources		No	Not envisaged

**7. Risks of contamination of land or water from releases of pollutants into the ground or into sewers, surface waters, groundwater, coastal waters or the sea:**

Sr. No.	Information/confirmation	Checklist	Yes/ No	Details thereof (with approximate quantities/ rates, wherever possible) with source of information data
7.1	From handling, storage, use or spillage of hazardous materials		No	Not envisaged
7.2	From discharge of sewage or other effluents to water or the land (expected mode and place of discharge)		No	no sewage and effluent generation in operation phase of project.
7.3	By deposition of pollutants emitted to air into the land or into water		No	Fugitive dust due to construction activities, equipment/ vehicular emissions and transportation of construction materials. Suitable mitigation measures will be followed.
7.4	From any other sources		No	Not envisaged
7.5	Is there a risk of long-term build-up of pollutants in the environment from these sources?		No	Not envisaged

**8. Risk of accidents during construction or operation of the Project, which could affect human health or the environment**

Sr. No.	Information/confirmation	Checklist	Yes/ No	Details thereof (with approximate quantities/ rates, wherever possible) with source of information data
8.1	From explosions, spillages, fires etc from storage, handling, use or production of hazardous substances		No	Not envisaged
8.2	From any other causes		No	Not envisaged
8.3	Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslides, cloud burst etc.)?		Yes	The site is located in seismic Zone III. Cyclone Nisarga and Taukte in Arabian sea hit the Konkan coast in June 2020 and May 2021 respectively. The bridge is designed by taking into consideration factors as per relevant codes and standards. The proposed project site has not reported any kind of natural disasters like earthquake, Tsunami etc.

Application for CRZ Clearance for Construction of Bridge Across Tributary of Mandovi/ Cumbarjua canal for Local Farmers at part 8 & 9 of survey no. 65 of Cumbarjua village and part no.5 of survey no. 175 of Jua village, Taluka Tiswadi, District North Goa by Goa State Infrastructure Development Corporation Ltd., Panaji, Goa

**9. Factors which should be considered (such as consequential development) which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality**

Sr. No.	Information/ Checklist	Yes/ No	Details thereof (with approximate quantities/ rates, wherever possible) with source of information data
9.1	Lead to development of supporting utilities, ancillary development or development stimulated by the project which could have impact on the environment e.g.: <ul style="list-style-type: none"> <li>• Supporting infrastructure (roads, power supply, waste or wastewater treatment, etc.)</li> <li>• Housing development extractive industries supply industries</li> <li>• Other</li> </ul>	Yes	The project will have positive impact on local farmers. The bridge will create easy access to agriculture fields on other side of tributary. This will lead to reduce hardship of local farmers, opens opportunities to cultivate fields other than Kharip crops. The project overall tends to bring convenience in agriculture activities.
9.2	Lead to after-use of the site, which could have an impact on the environment	No	Not envisaged
9.3	Set a precedent for later developments	No	As the project has very limited objective to cater to local farmers to provide road access for crossing the tributary to reach agriculture fields on Jua Island and taking tractors for agriculture activities; the project will not be envisaged to set a precedent for later development.
9.4	Have cumulative effects due to proximity to other existing or planned projects with similar effects	No	Not envisaged

**(III) Environmental Sensitivity**

Sr. No.	Areas	Name/ Identity	Aerial distance (within 15km.) Proposed project location boundary
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value	Dr. Salim Ali Bird Sanctuary	~8 km (E)
2	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests	Nesting/ roosting grounds of Marsh Crocodile	~1 km
		Mangroves	~5 m (E)
		Reserve Forest at	~7 km (SE)

Application for CRZ Clearance for Construction of Bridge Across Tributary of Mandovi/ Cumbarjua canal for Local Farmers at part 8 & 9 of survey no. 65 of Cumbarjua village and part no.5 of survey no. 175 of Jua village, Taluka Tiswadi, District North Goa by Goa State Infrastructure Development Corporation Ltd., Panaji, Goa

Sr. No.	Areas	Name/ Identity	Aerial distance (within 15km.) Proposed project location boundary
		Querim	
		Reserve Forest at Querim (another patch)	~9 km (SE)
		Reserve Forest at Candepar	~11 km (SE)
		Reserve Forest at Velguem	~10 km (E)
		Reserve Forest at Sonus	~11 km (E)
		Reserve Forest at Dingnaur	~9 km (E)
		Reserve Forest at Morlem	~13 km (NE)
		Reserve Forest at Pissurle	~14 km (E)
		Reserve Forest at Kasrpal	~14 km (N)
		Mandovi Estuary	~1 km (NE)
		Zuari Estuary	~12 km (S)
		Cumbarjua canal	~0 m
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration	Cumbarjua estuary and surrounding mudflats & Mangrove vegetation by Marsh Crocodiles	~1 km
4	Inland, coastal, marine or underground waters	Cumbarjua estuary	~0 m
5	State, National boundaries	Goa-Maharashtra Boundary	~11 km (NE)
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	<b>Historical/ Famous Religious Places</b>	
		Juve/ St. Estevam Fort, St Estevam Island	~1 km (NE)
		Haat Katro Khamb, Ella, Goa	~4 km (SW)
		Ruins of Jain Temple, Cudnem	~7 km (NE)
		Lamgao Buddhist Caves, Buddhist Temple Lamgao, Bicholim	~8 km (NW)
		Shri Mahaalasa Narayani Temple, Mardol	~9 km (SE)
		Immaculate Conception Church, Panaji	~12 km (SW)
		<b>Picnic/ Recreation Places</b>	
		Devlay Hilltop, Candola	~2 km (NE)
		Crocodile Trip, Estevam	~1 km (NW)
		Vaichim Vatt, Estevam Island	~1 km (NW)
		Divar Island ferry, Chimbhel	~7 km (SW)
		Dr. Salim Ali Bird Sanctuary	~8 km (W)
		Harvalem Waterfall	~9 km (NE)
		Sonshe waterfall	~11 km (E)
		Kekdole Beach, Reis Magos	~14 km (SW)

Application for CRZ Clearance for Construction of Bridge Across Tributary of Mandovi/ Cumbarjua canal for Local Farmers at part 8 & 9 of survey no. 65 of Cumbarjua village and part no.5 of survey no. 175 of Jua village, Taluka Tiswadi, District North Goa by Goa State Infrastructure Development Corporation Ltd., Panaji, Goa

Sr. No.	Areas	Name/ Identity	Aerial distance (within 15km.) Proposed project location boundary
		Setu Sangam (Park), Bicholim	~7 km (N)
		Campal Forest Department Park, Panji	~13 km (SW)
		Bicholim Waterfall, Katarwada	~5 km (N)
		Gaja Waterfall, Talaulim	~6 km (SW)
		Chimbel Waterfall	~9 km (SW)
		Mante Waterfall, Podocem	~9 KM (NE)
7	Defense installations	None	--
8	Densely populated or built-up area	Bicholim (M Cl), population - 16986, as per census 2011	~6 km (N)
		Chimbel (CT)- population -15289, as per census 2011	~7 km (SW)
		Sanquelim (M Cl)- population - 13651, as per census 2011	~8 km (NE)
		Panji (M. Corp.+OG)- population - 70991, as per census 2011	~11 km (SW)
9	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)	<b>Hospitals/ Clinics:</b>	
		Raikar Hospital, Deul wada Marcel	~1 km (SE)
		Mashel Polyclinic, Marcel, Orgao	~1 km (SE)
		Pretty Smile Dental Clinic, Candola	~1 km (NE)
		Healing Home, Gandaulim - Marcel Rd, Carambolim	~0.6 km (NE)
		Arnica Clinic, Corlim, Goa Velha	~3 km (SW)
		Ambica clinic, Orgao	~1 km (SE)
		Garde Clinic - Maternity Centre, Orgao	~1 km (SE)
		Dr Siddhi's Diabetes & Homeopathic Clinic, Orgao, Goa	~1 km (SE)
		Sushrutzi Dr Dhulapkar's Hospital, Carambolim, Corlim, Goa	~2 km (SW)
		Dr. Anuja Anilkumar Nayak - Dental clinic Carambolim, Corlim	~3 km (SW)
		Primary Health Centre, Mangaddo, Corlim	~3 km (SW)
		Primary Health Centre, Betki	~4 km (SE)
		<b>Schools/ Colleges:</b>	
		S.S.V. Govt High School, Cumbharjua	~0.5 km (S)
		Government Primary School Madapoi, Orgao	~0.8 km (SE)
		Bhumika Day Boarding School, Marcel, Candola	~1 km (NE)
		Rose Bud Pre School And Montessori, Orgao	~1 km (SE)
		Government Higher Secondary Khandola, Candola	~1 km (NE)

Application for CRZ Clearance for Construction of Bridge Across Tributary of Mandovi/ Cumbarjua canal for Local Farmers at part 8 & 9 of survey no. 65 of Cumbarjua village and part no.5 of survey no. 175 of Jua village, Taluka Tiswadi, District North Goa by Goa State Infrastructure Development Corporation Ltd., Panaji, Goa

Sr. No.	Areas	Name/ Identity	Aerial distance (within 15km.) Proposed project location boundary
		Government College of Arts, Science & Commerce College, Khandola, Candola	~1 km (NE)
		Sharada English High School Marcela, Orgao	~1 km (SE)
		Jesus and Mary Sarvajanik High School, Carambolim	~4 km (SW)
		Government Primary School, Carambolim	~4 km (SW)
		St. Theresa High School, Palmar St Estevam, Marcela	~1 km (NE)
		Government Primary School, St Estevam, St Estevam Island	~1 km (NE)
		Shri Saraswati High School, St Estevan - School, St Estevam, St Estevam Island	~2 km (NE)
10	Areas containing important, high quality or scarce resources. (Ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)	<b>Archaeological Sites (Central Protected Monuments)</b>	
		Church of Lady of Rosary, Old Goa	~4 km (SW)
		Church of St. Augustine, Old Goa	~4 km (SW)
		Basilica of Bom Jesus, Old Goa	~4 km (SW)
		Chapel of St. Francis Xavier and connected Buildings, Old Goa	~4 km (SW)
		Largo of St. Francis Xavier, Old Goa	~4 km (SW)
		Portal remains of St. Paul's Collage, Old Goa	~3 km (SW)
		Chapel of St. Catherine, Old Goa	~4 km (SW)
		Church & Convent of St. Francis Assisi, Old Goa	~4 km (SW)
		Se Cathedral, Old Goa	~4 km (SW)
		House of Bull, Old Goa	~3 km (SW)
		Arch of Viceroy, Old Goa	~3 km (SW)
		Arch of Adil Shah's Palace, Old Goa	~3 km (SW)
		Largo of Cajetan together with other monuments, Old Goa	~3 km (SW)
		Chapel of St. Cajetan, Old Goa	~3 km (SW)
		Rock Cut Caves, Harvalem/ Arvalem	~8 km (NE)
		Safa Masjid, Ponda	~13km (SE)
		<b>Archaeological Sites (State Protected Monuments)</b>	
		Reis Magos Fort, Bardez	~14 km (SW)
		The Fortress of Khorjuve, Bardez/ Corjuem Fort, Corjuem	~10km (NW)
		Caves at Naroa, Dicholi/ Narve caves, Goa	~4 km (NW)

Application for CRZ Clearance for Construction of Bridge Across Tributary of Mandovi/ Cumbarjua canal for Local Farmers at part 8 & 9 of survey no. 65 of Cumbarjua village and part no.5 of survey no. 175 of Jua village, Taluka Tiswadi, District North Goa by Goa State Infrastructure Development Corporation Ltd., Panaji, Goa

Sr. No.	Areas	Name/ Identity	Aerial distance (within 15km.) Proposed project location boundary
		Temples of Saptakoteshwar, Dicholi/ Shree Saptakoteshwar Temple, Narve, Mayem	~3 km (NW)
		Site of Gujir, Dicholi/ Kudnem Digambar Jain Temple, Cudnem	~7 km (NE)
		Fort of Sanquelim, Dicholi/ maharaja dipaji rane's fort, Vithallapur, Sanquelim	~8 km (NE)
		Namazgah, Dicholi/ Namazgah - Mosque, Bicholim	~6 km (N)
		The Cave of Sidhanath at Tar Surla, Dicholi/ Pandavas Cave, Deulwada, Surla	~8 km (SE)
		The Mosque and Tank at Tar Surla, Dicholi/ Surla Mosque, Cotombi	~8 km (SE)
		Frontispices of Sancoale, mormugao/ Frontispiece of sancoale church, Sancoale	~13 km (SW)
		Ruins of Jain Basti, Ponda	~13 km (SE)
		Caves at Khandepar, Ponda/ Pandav Cave, Tisk, Goa	~15 km (SE)
		Cave at Ishwarbhat, Ponda/ Ishwarbhat cave, Candepar, Goa	~13 km (SE)
		Cave at Mangueshi, Ponda/ Shree Mangesh temple, Mangeshi village, Mardol	~8 km (SE)
		Shri Nagesh Temple, Ponda	~13 km (SE)
		Ruins of Brahmapuri, Tiswadi/ Shree Gomanteshwar Mandir, Brahmapuri, Oldgoa	~4 km (SW)
		Chapel of St. Xavier, Tiswadi/ Chapel of St. Francis Xavier, Ella	~3 km (SW)
		Chapel of Our Lady of Monte, Tiswadi/ Convent of Santa Monica and The Chapel of The Weeping Cross, Monte Santo, Goa Velha	~4 km (SW)
		Convent of St. Monica and Chapel, Tiswadi/ Convent of Santa Monica and The Chapel of The Weeping Cross, Monte Santo, Goa Velha	~4 km (SW)
		Ruins of College of St. Populo, Tiswadi/ Church and College of Our Lady of Pópulo, Goa Velha	~4 km (SW)
		Church of St. Peter, Tiswadi/ São Pedro Church, Goa, Velha	~5 km (SW)

Application for CRZ Clearance for Construction of Bridge Across Tributary of Mandovi/ Cumbarjua canal for Local Farmers at part 8 & 9 of survey no. 65 of Cumbarjua village and part no.5 of survey no. 175 of Jua village, Taluka Tiswadi, District North Goa by Goa State Infrastructure Development Corporation Ltd., Panaji, Goa

Sr. No.	Areas	Name/ Identity	Aerial distance (within 15km.) Proposed project location boundary
		Casa da Polvora, Tiswadi/ Mill Stones of Gun Powder Factory, Goa, Velha	~4 km (SW)
		Fort Naroa, Tiswadi/ Chapel of Our Lady of Candelária, Naroa	~2 km (NW)
		The Temple of Saptakoteshwar, Naroa, Tiswadi/ Tank of the Saptakoteshwar Temple, Naroa	~2 km (NW)
		Chapel of St. Jeronimus, Tiswadi/ Chapel of St. Jerome, Choraó, Goa	~7 km (NW)
11	Areas already subjected to pollution or environmental damage. (Those where existing legal environmental standards are exceeded)	None	--
12	Areas susceptible to natural hazard which could cause the project to present environmental problems (earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions) similar effects	No	The project will be designed by taking into consideration natural hazard factors as per relevant codes and standards. The project site has not reported any kind of natural disasters like earthquake, Tsunami etc.

Date 19<sup>th</sup> September 2022  
Place Panaji, Goa

Managing Director  
Goa State Infrastructure Development Corporation Ltd.



**Environmental Impact Assessment Report<sup>Rev.01</sup>****Construction of Bridge from Chune - Kator to Vanso Fields for Local Farmers to Cross Tributary of Mandovi/ Cumbarjua Canal, Villages Cumbarjua and Jua, Taluka Tiswadi, District North Goa, Goa**Baseline Monitoring:  
Summer 2022

by

**Goa State Infrastructure Development Corporation Ltd.**

Latitude: 15.520175  
Longitude: 73.946123  
Elevation: 6.68±4 m  
Accuracy: 9.2 m  
Azimuth: 5° (N)  
Pitch: -6.3° (0.6°)  
Time: 31-05-2022 10:38  
Note: site

**08<sup>th</sup> September 2022****Environmental Consultant: Aditya Environmental Services Pvt. Ltd., Mumbai****QCI- NABET Accredited EIA Consultant**[www.aespl.co.in](http://www.aespl.co.in)

NABET/EIA/1922/SA 0129



**Declaration by Experts contributing to the EIA report 'Construction of Bridge from Chune - Kator to Vanso Fields for Local Farmers to Cross Tributary of Mandovi/ Cumbarjua Canal, Villages Cumbarjua and Jua, Taluka Tiswadi, District North Goa, Goa' by Goa State Infrastructure Development Corporation Ltd, Government of Goa Undertaking.**

I hereby certify that I was a part of the EIA Team in the following capacity that developed the above EIA.

**EIA Coordinator:**

**Name: N. K. Shendye**

**Signature & Date: 08<sup>th</sup> September 2022**

**Period of involvement: since 25<sup>th</sup> May 2022**

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2	WP*	Rajiv Aundhe	since 30 <sup>th</sup> May 2022	
3	SHW*	Rajiv Aundhe	since 30 <sup>th</sup> May 2022	
4	SE*	Mamta Bodhale Sawak Tarapurwala (TM)	since 30 <sup>th</sup> May 2022	
5	EB*	Radhika Powar	since 30 <sup>th</sup> May 2022	
6	HG*	--	--	--
7	GEO*	--	--	--
8	AQ*	--	--	--
9	NV*	--	--	--
10	LU*	Bela Pharate	since 30 <sup>th</sup> May 2022	
11	RH*	--	--	--
12	SC*	--	--	--

**NOTE:**

(\*) Full forms of abbreviations given on Next Page

(\*\*) Tasks for each Functional Area Expert given on Next Page

Environmental Baseline sampling, monitoring and analysis for this project was carried out by in-house, environmental analytical laboratory.

**Declaration by the Head of the Accredited Consultant Organization**

I, Rajiv V. Aundhe, hereby confirm that the above-mentioned experts prepared the EIA Report 'Construction of Bridge from Chune - Kator to Vanso Fields for Local Farmers to Cross Tributary of Mandovi/ Cumbarjua Canal, Villages Cumbarjua and Jua, Taluka Tiswadi, District North Goa, Goa' by Goa State Infrastructure Development Corporation Ltd, Government of Goa Undertaking. I also confirm that I shall be fully accountable for any misleading information mentioned in this statement.

  
Name: Rajiv V. Aundhe

Designation: Director

Name of the EIA Consultant Organization: Aditya Environmental Services Pvt. Ltd.

NABET Certificate No. & Issue Date: NABET/ EIA/1922/SA 0129 dated 17<sup>th</sup> May 2021; Valid up to 1<sup>st</sup> May 2022; Validity extended up to 19<sup>th</sup> October 2022

Sr. No.	Functional Area Code	Complete Name of the Functional Areas	Tasks
1	AP	Air Pollution Prevention, Monitoring & Control	Assessing baseline ambient air quality, possible impacts and control measures
2	WP	Water Pollution Prevention, Control & Prediction of Impacts	Assessing baseline surface/ ground water quality, possible impacts and control measures
3	SHW	Solid and Hazardous Waste Management	Assessing solid/ hazardous waste generation, treatment and disposal
4	SE	Socioeconomics	Assessing baseline Socioeconomic, demographic situation, impacts and measures for upliftment
5	EB	Ecology & Biodiversity	Assessing baseline biodiversity status in study area, impacts and management plans
6	HG	Hydrology, ground Water & Water Conservation	Assessing baseline hydrogeological situation in study area, impacts and management plans
7	GEO	Geology	Assessing baseline geological situation in study area, impacts and management plans
8	AQ	Meteorology, Air Quality Modeling & Prediction	Assessing nature and scale of impacts on ambient air quality through modeling and management plans
9	NV	Noise/ Vibration	Assessing baseline ambient noise levels, possible sources, impacts and control measures
10	LU	Land Use	Assessing baseline Land use Land cover possible impacts and control measures
11	RH	Risk Assessment & Hazard Management	Assessing safety measures taken up by company modeling to assess scale of impacts, disaster management and control measures
12	SC	Soil Conservation	Assessing soil quality, scale of impacts and suggest management and control measures



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41  
9540

**Aditya Environmental Services Pvt. Ltd.**

GSTN: 27AADCA4730B1Z8 | CIN: U74999MH2001PTC132091 | UAN: MH19E0035348

**TO WHOMSOEVER IT MAY CONCERN**

This is to confirm that the EIA Report/ EMP for the project, 'Construction of Bridge from Chune - Kator to Vanso Fields for Local Farmers to Cross Tributary of Mandovi/ Cumbarjua Canal, Villages Cumbarjua and Jua, Taluka Tiswadi, District North Goa, Goa' by Goa State Infrastructure Development Corporation Ltd, Government of Goa Undertaking has been prepared by me in the capacity of EIA Coordinator. I confirm that the EIA Report prepared is based on factual data and all due diligence has been followed in preparing the same.

  
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EIA Coordinator



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I	Proposal letter and cost approval
II	NOC from Caption of Ports and Village Panchayat, Cumbarjua
III	Request letter from villagers
IV	Geo-technical investigation report
V	List of Flora and Fauna

## Explanation of Terms Used

Abbreviation	Full form
AAQ	Ambient Air Quality
AESPL	Aditya Environmental Consultant Pvt. Ltd.
BDL	Below Detectable Limit
BOD	Biological Oxygen Demand
CGWA	Central Ground Water Authority
CMD/ KLD	Cubic Meter Per Day it is exactly same as Kilo Litre per Day
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CRZ	Coastal Regulation Zone
CRS	Corrosion Resistant Steel
Distance	Distances mentioned in this report (unless specified) are measured between two nearest points and expressed as Approximate Shortest Aerial Distance
D.G. Set	Diesel Generator Set (equipment that generates electricity from diesel)
EC	Environment Clearance
EIA	Environment Impact Assessment
EMC	Environment Management Cell
EMP	Environment Management Plan
EPA	Environment Protection Act
ESZ	Eco-Sensitive Zone
GoG	Government of Goa
GSIDC	Goa State Infrastructure Development Corporation Ltd.
GSPCB	Goa State Pollution Control Board
HFL	High Flood Level
IMD	India Meteorological Department
IRC	Indian Road Congress
IS	Indian Standard
Jua island/ Jua village	Also referred as St. Evastem Island/ village
Leq	Equivalent Continuous Sound Level
dB	Decibel
LULC	Land Use Land Cover
MoEFCC	Ministry of Environment, Forest & Climate Change
MSL	Mean Sea Level
MTA	Metric Ton Per Annum
MTPD	Metric Ton Per Day
NAAQS	National Ambient Air Quality Standard
NOC	No Objection Certificate
O&M	Operation and Maintenance
PA	Protected Area
PM	Particulate Matter
PMC	Project Management Consultant
PPE	Personal Protective Equipment
Pot PTFE	Poly Tetra Fluoro Ethelene
PUC	Pollution Under control Certificate

Abbreviation	Full form
PWD	Public Works Division
SAR	Sodium Adsorption Ratio
ToR	Term of Reference
w.r.t.	With Respect To

# 1 INTRODUCTION

## 1.1 Introduction

For last 50 years, the State has made a remarkable progress in agriculture sector besides various other spheres of economic upliftment. Agriculture along with Forests in Goa is instrumental in keeping Goa green and cover nearly 65% of the total area of the State.

About 50 years ago, nearly 70% of the population was involved in agriculture as their full-time occupation. Paddy was the predominant crop of the State followed by Cashew and Coconut. Cropping pattern has changed since then and today, Goa has Cashew cultivated about 55,000 Ha with paddy covering about 31,000 Ha. Cultivation of horticultural crops is gaining importance due to better returns, lower risk and tolerance of these crops.

The State of Goa is providing assistance to agriculture at all levels to provide substantial returns to rural people. Department of Agriculture provides assistance to farmer from land preparation to the extent of marketing of produce. Its head quarter at Tonca, Panaji implements developmental programme through Zonal Agricultural Offices located in each taluka of Goa. The farmers face **tremendous shortage of manual labour**. **Dependence on machines for activities agriculture is the emerging trend**. Land holding of farmers of Goa is small and **nearly 80% of farmers own less than 1 ha. of land**. Smaller machines are preferred, and government provides financial assistance for such machines.<sup>1</sup>

Considering above challenges faced by the farmers and immense need to practice mechanisation in agriculture, GSIDC has decided to help reduce hardship of farmers by way of providing infrastructure such as bridge to cross waterways making easy to take agriculture implements/ tractors etc. to fields in short time and in hassle-free way.

One such effort is being made by constructing bridge across tributary of Cumbarjua canal/ Mandovi which will connect Chune Kantor and Vanso fields in Cumbarjua and Jua villages of Tiswadi taluka of North Goa District.

Cumbarjua and Jua are easterly villages in Tiswadi taluka of North Goa district bordering other villages in same taluka (towards west) and villages of Ponda and Bicholim talukas respectively. Cumbarjua and Jua are agriculture dominating villages having total

<sup>1</sup> Source: <https://www.agri.goa.gov.in/Overview.jsessionid=A34604759FE0CAC7D4C463F81B6536D620>

population about 9051 (4917 of Cumbarjua and 4134 of Jua as per 2011 census). Farming along with fishing is traditional occupation of locals for many decades.

The Government of Goa has submitted the proposal vide letter number Min/Power/SW/NCE/2018/1886 dated 30<sup>th</sup> May 2018 issued by Office of The Minister for Power, Social Welfare & NCE, Government of Goa. Similarly, the project has received cost approval vide letter number 4/42/2020-FIN (DMU)/156 dated 26<sup>th</sup> February 2021 by Department of Finance, Debt Management Division, Government of Goa. Kindly refer **Annexure I** (for both letters).

## **1.2 Purpose of Environmental Impact Assessment (EIA) Report**

The purpose of this Environmental Impact Assessment report is to investigate & assess the principal environmental concerns associated with construction of bridge. The report will also serve purpose of one of the essential components of application for CRZ Clearance required for this project.

## **1.3 Identification of Project & Project Proponent**

### **1.3.1 About GSIDC**

Goa State Infrastructure Development Corporation Limited herein after referred as GSIDC is a wholly owned Government Company established in 2001 under the infrastructure up-gradation programme of the Government of Goa. It is registered under the Companies Act, 1956, with the Registrar of Companies, Panaji-Goa.

- GSIDC is a Special Purpose Vehicle (SPV) for speedy implementation of all the Infrastructural Projects, envisaged by the Government like Roads, Bridges, Flyovers, Bus-Stands, Hospitals, Tourism related Projects, etc., all over the State.
- The main objective of the Company is to develop infrastructure in the state of Goa.
- The company carries out implementation of projects entrusted to it by the government through its consultant and contractors.
- For this purpose, it raises finance through budgetary support and market borrowings.
- The Corporation acts as co-ordinating agency for implementation of the projects.

### **1.3.2 Present Status**

Construction work was initiated in October 2021. Project Management Consultant (M/s. Madhav Kamat & Associates) was appointed in November 2019. Whereas Environmental

## Chapter 1 – Introduction

Consultant (Aditya Environmental Consultant Pvt. Ltd. herein after referred as AESPL) for conducting EIA studies and writing EIA report was appointed on 24<sup>th</sup> May 2022. During site visit, (by AESPL on 31<sup>st</sup> May 2022), it was observed that, casting of all 8 piles along with pile caps is completed. Reinforcement is left for dirt wall and bearing pedestals. Fabrication work of arch is completed, erection of steel is pending.

Site inspection was done by Goa Coastal Zone Management Authority on 03.02.2022 where, it was directed to obtained clearance under Coastal Regulation Zone for construction of bridge.

## 1.4 Location of the Project & Its Importance in the Region

### 1.4.1 Location of the Project

The project (construction of bridge) is located within jurisdiction of Village Panchayat Cumbarjua. Nearest railway station, Karmali (on Konkan Railway) is about 3 km to the SW of the site. The site is off the Gaundalim Marcel road, about 65 m to the N. The below figure shows the taluka map with location of villages Cumbarjua and Jua (St. Estevam).

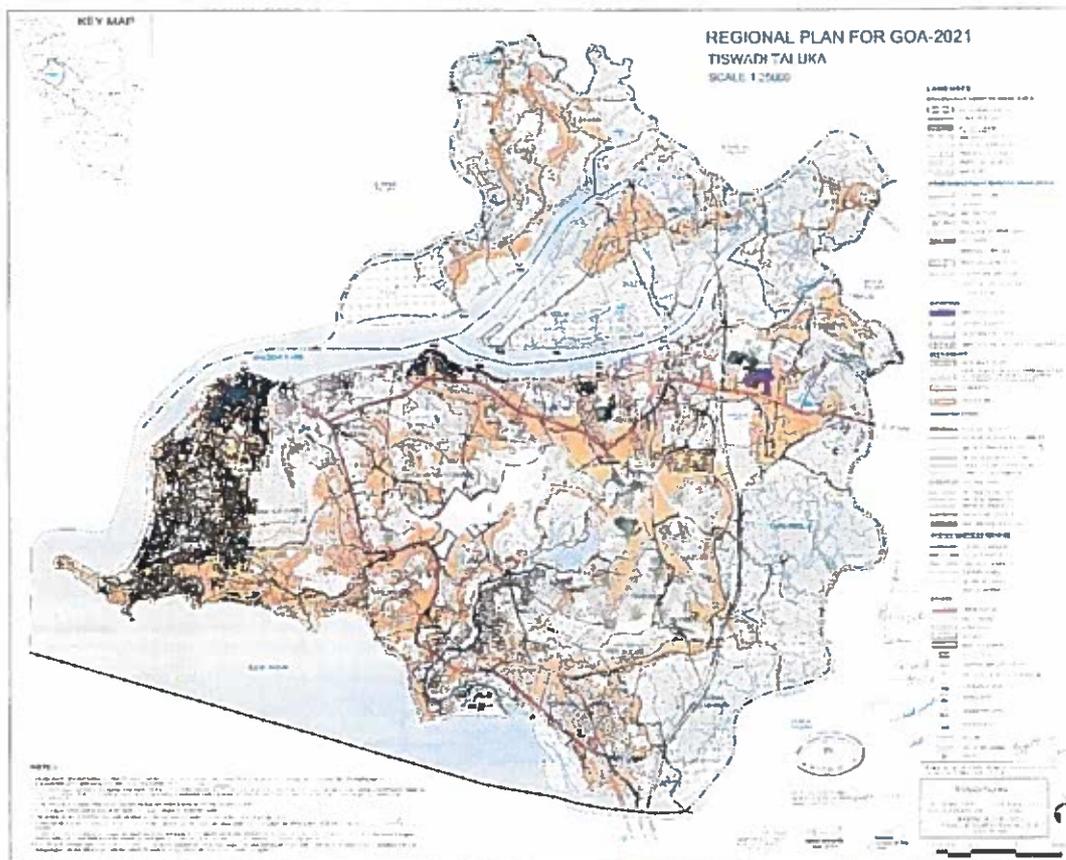


Figure 1.1: Taluka Map Showing Location of Villages Cumbarjua & Jua

#### 1.4.2 Importance of the Project to the Region

GSIDC is infrastructure developing government undertaking company, which works towards improving infrastructure in the state of Goa. The company, through various projects, always works for the upliftment of social welfare and providing better standard of living, health facilities, better ride quality, quick access to locations.

Cumbarjua and Jua are island villages having connectivity through Gadaulim Marcel road with other parts of state whereas Cumbarjua and Jua are interconnected through a bridge near Tonca Ferry Terminal. Besides road connectivity, these two villages can be access by water ways through ferry. This existing connectivity have limitations and cause encumbrances in connecting/ travel to other parts of the state especially in monsoon. Farmers of Cumbarjua have to depend on canoe to reach their fields in Jua or have to take a long detour to reach connecting bridge (near Tonca Ferry Terminal) and then walk back to respective fields. This makes the farmers cumbersome to reach their fields, they have to spend lot of time, efforts just to reach the field further, due to lack of roadway they cannot take heavy implements, equipment, tractors etc. thus, farmers have to practice traditional agriculture and get low yield as compared to input they have to pour in. construction of bridge at said location will help resolve the issue which in turn increase productivity and help local farmers to improve their standard of living.

#### 1.4.3 Regulatory Framework

The project activities such as construction of bridge does not attract EIA notification dated 14<sup>th</sup> September 2006 (and subsequent amendments) so, Environmental Clearance is not required. But, since located in CRZ area, it is covered in CRZ notification. Depending upon approval of CZMP (as per 2011 or 2019 Notification); proposal will be appraised as per CRZ Notification 2011 or CRZ Notification 2019. In both cases, the project is permissible activity but, requires prior CRZ clearance.

As per the Clause no. 3(iv)(a), 8(i)(I)(ii)(b), 8(i)(III)(A)(iii)(j) of CRZ Notification 2011, construction of bridges and roads are permissible.

As per clause no 5.1.2 CRZ-IB - The inter tidal areas, of CRZ Notification 2019, activities such as foreshore facilities like ports, harbours, jetties, wharves, quays, slipway, bridges, hover ports for coast guard, sea links, etc are permissible

Similarly, as the alignment is crossing over waterway, located within boundary of Cumbarjua VP; NOC from Caption of Ports and Village Panchayat, Cumbarjua is required respectively. Kindly refer **Annexure II** (for both NOCs).

#### **1.4.4 Scope of the EIA Study**

The scope of work has been prepared based on guidelines issued by the MoEFCC for conducting EIA studies. The scope covers the following details:

- Assessment of environmental features at and surrounding site.
- Assessment of environmental features of proposed development, it's location w.r.t. CRZ (based on Coastal Zone Management Plan map prepared by authorized agency) and conformity to permissible activities.
- Establishment of present status of land, air, noise, water, biological and socioeconomic components of the environment.
- Identification of likely impacts due to construction of bridge on environmental components during the construction, commissioning, operation and decommissioning phases.
- Study of existing operations/ activities at site.
- Assimilation of collected and generated data during the course of EIA studies.

It also includes delineation of an Environmental Management Plan (EMP) outlining measures to be implemented by GSIDC for mitigation of adverse impacts.

#### **1.5 Methodology of EIA**

Any development project is likely to impact surrounding environment. The nature and magnitude of impact on different components of the environment will depend on nature and size of the project as well as location of the project site and steps taken for mitigating environmental impact. Final net impact due to proposed project on environmental components can be evaluated through Environmental Impact Assessment (EIA) studies within study area prior to implementation of the project. The results of EIA Studies form the basis for preparation of a viable Environmental Management Plan (EMP).

The EIA Studies can be broadly divided in to three phases.

- **1<sup>st</sup> PHASE:** The first phase involves identification of significant environmental components and assessing their baseline (Pre-project or existing) status within the study area.

- **2<sup>nd</sup> PHASE:** The second phase involves identification of impacts on various identified significant environmental parameters due to proposed project. Data regarding the proposed construction activities, its design capacity, water consumption, solid/hazardous waste, sewage generation, disposal medium and topography of the study area is also taken into consideration to evaluate project related environmental features.
- **3<sup>rd</sup> PHASE:** The third phase covers the evaluation of final impacts and delineation of an Environmental Management Plan to mitigate adverse impacts on the quality of surrounding environment.

For the purpose of assessing environmental impact, study area of 7 km radius from project site was identified for the EIA study as per the CRZ Notification and was studied in summer 2022.

The EIA involved investigations to assess the impacts on different environmental components. The base line studies were carried out and the predictions made on the basis of the above are presented in the EIA report. The various facets of the work carried out are briefly reported below.

### 1.5.1 Baseline Environmental Studies

These studies include study of the environmental conditions of the site/ surrounding in summer 2022. The components covered therein are as below:

#### 1.5.1.1 Land Environment

Preliminary information pertaining to topography, land-use pattern, development pattern and landscape features within study area and location aspects of the site was collected through toposheets (OSM maps), Google Earth Imagery, and available geographical and road maps. Land Use Land Cover (LULC) map was prepared based on satellite imagery and was finalized by undertaking ground truthing using GPS. Soil characteristics were also established by collecting data at site and in nearby area.

#### 1.5.1.2 Air Environment

The preliminary information regarding topography of the study area and possible air pollution sources were collected through reconnaissance survey and review of available data and literature. Based on the information, Particulate Matter (PM<sub>10</sub>), Sulphur dioxide (SO<sub>2</sub>), Oxides of Nitrogen (NO<sub>x</sub>), and CO (Carbon Monoxide) emissions were identified

as major project related primary air pollutants, mainly due to construction activity. Baseline status of these parameters in ambient air was assessed at Cumbarjua, and data presented in the report. Meteorological data on wind speed, wind direction, temperature and relative humidity were sourced from climatological tables (IMD) and other internet sources.

#### **1.5.1.3 Noise Environment**

Noise level data was collected near the site to identify existing baseline status.

#### **1.5.1.4 Water Environment**

Reconnaissance studies conducted to know the area, project location and surrounding, identify sampling locations. Primary data collection and analysis of surface and ground water was carried out to assess its quality as baseline study.

#### **1.5.1.5 Biological Environment**

This study includes identification of species of flora and fauna by making visits at various locations in the study area. Information was also collected from secondary sources like published literature.

#### **1.5.1.6 Socio Economic Environment**

Socio-economic studies included collection of information about the population of the study area, the income profile of the local people, the standard of living, demography and the literacy rate from authorized sources like Census 2011. Primary survey was conducted in Cumbarjua and Jua villages to understand the livelihood and to understand benefit of bridge to local farmers.

### **1.5.2 Impact Assessment Matrix**

From the study of nature of activities during construction phase and after completion and with knowledge of the existing baseline/ background levels of various environmental parameters viz. Air/ Water/ Noise level/ Population density in and around the site, the nature and severity of the impact on environment was estimated.

An Impact Matrix was prepared delineating activities v/s tangible impacts, which was used for preparation of Environment Management Plan to reduce the negative impacts of the project.

**1.5.3 Environmental Management Plan**

From the identified impacts, Environmental Management Plan is prepared to outline pollution control measures to be implemented in order to ensure minimum impact on environment due to construction of bridge.

**1.6 Regulatory Scoping and Its Compliance**

The project activity (construction of bridge) does not cover under EIA Notification dated 14<sup>th</sup> September 2006 and subsequent amendments time to time. Similarly, clause no. 4.2 (procedure for clearance of permissible activities) of CRZ Notification dated 06<sup>th</sup> January 2011 and subsequent amendments time to time does not involve scoping stage. Therefore, no scoping was done for this project.

## 2 PROJECT DESCRIPTION

### 2.1 Type of Project

The proposal pertains to construction of bridge across tributary of Cumbarjua canal/ Mandovi along with necessary approaches at both ends in village Cumbarjua and Jua. This project involves creating approaches, excavation, construction of pile foundation, pile cap, placing prefabricated (in-situ) span and assembling and commissioning of bridge. The details of each component are given in subsequent paragraphs in this chapter.

Present status to be added

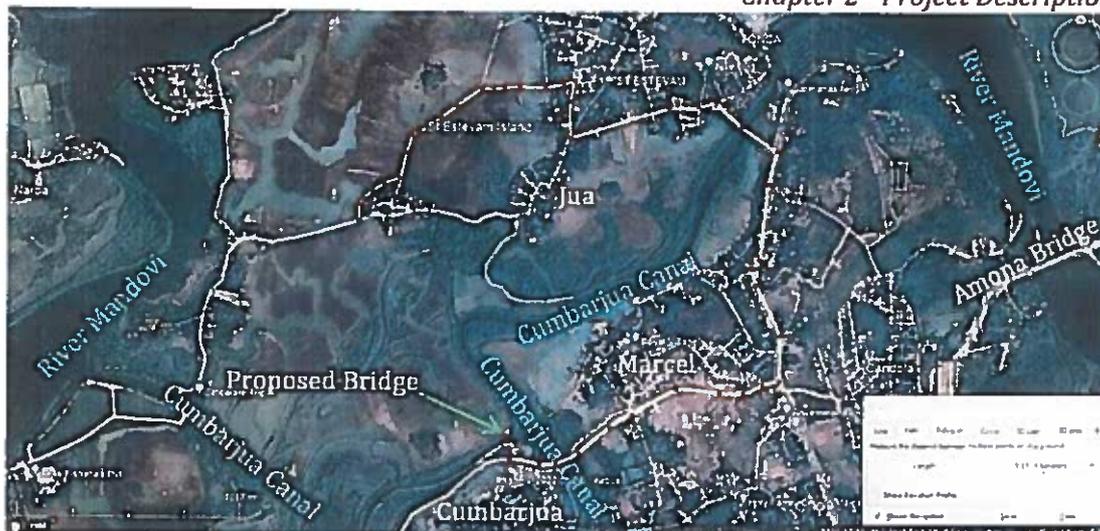
### 2.2 Need for the Project

More than 15% of the working population of Cumbarjua and Jua consists of farmers & agricultural labors. According to the 2001 village directory, the village Jua & cumbarjua has about 534.27 Ha. of agricultural land (11.94 ha irrigated & 522.33 ha unirrigated land). According to the primary survey, Cumbarjua farmers have about 40.41 Ha. of agricultural land at Jua village having a productivity order of 150 TPA. According to the 2018-19 area and production statistics for Goa, the average production of Paddy was 3.70 quintals per hectare of land. There are about 65 farmer families dependent on agriculture in Cumbarjua. They own fields Jua village on the other bank of tributary of Mandovi/ Cumbarjua Canal and has inconvenient road connectivity (detour of about 5 Km which takes up to midway to Vanso fields).

Presently, farmers are dependent on the canoe/ small boat to cross the tributary to reach their fields. This affects the farmers in two ways:

1. Farmers are not able to take heavy implements, advance agriculture machineries to their fields which are on the other side (Jua Island) of tributary. This intern jeopardises advancements and agriculture productivity.
2. Farmers also have to depend on canoe/ small boat to reach their fields and take the agriculture produce to market. This limitation and challenges make the life of farmers difficult and compel to do hardship for their livelihood.

Construction of bridge will provide local farmers easy and direct road access to fields thereby help reduce their hardship.



**Figure 2.1: Existing Road Connectivity between Cune Kantor to Vanso Fields**



**Zoom in figure 2-1**

The Socio-economic survey also reveals the need for bridge. A request letter from the villagers reads the same. This letter is available for reference in Annexure III.

The project will enable local farmers to take farming implements/ machineries to the fields and agriculture produce to market without depending on water transport. The project's overall outcomes are utilization of resources, maximising agriculture productivity and reduce hardship of local farmers, which will, in turn, improve the economy of the region.

### 2.3 Location Details

The bridge and approaches are located in part no. 8 and 9 of survey no. 65 of Cumarjua

village and part no.5 of survey no. 175 of Jua village, Taluka Tiswadi, District North Goa.

The project site and study area are covered in Open Series Map (OSM published by Survey of India) No. D43B14, D43C2, D43B15 and D43C3. General Arrangement Drawing showing alignment and other details of bridge are given in enclosed overleaf.

The reference coordinates of the site are as follows:

North side (agriculture fields; Jua Island)

Latitude: 15°31'13.82"N

Longitude: 73°56'46.02"E

South side (towards Village Cumbarjua)

Latitude: 15°31'12.59"N

Longitude: 73°56'46.32"E





Figure 2.3: Alignment of Bridge on Google Earth

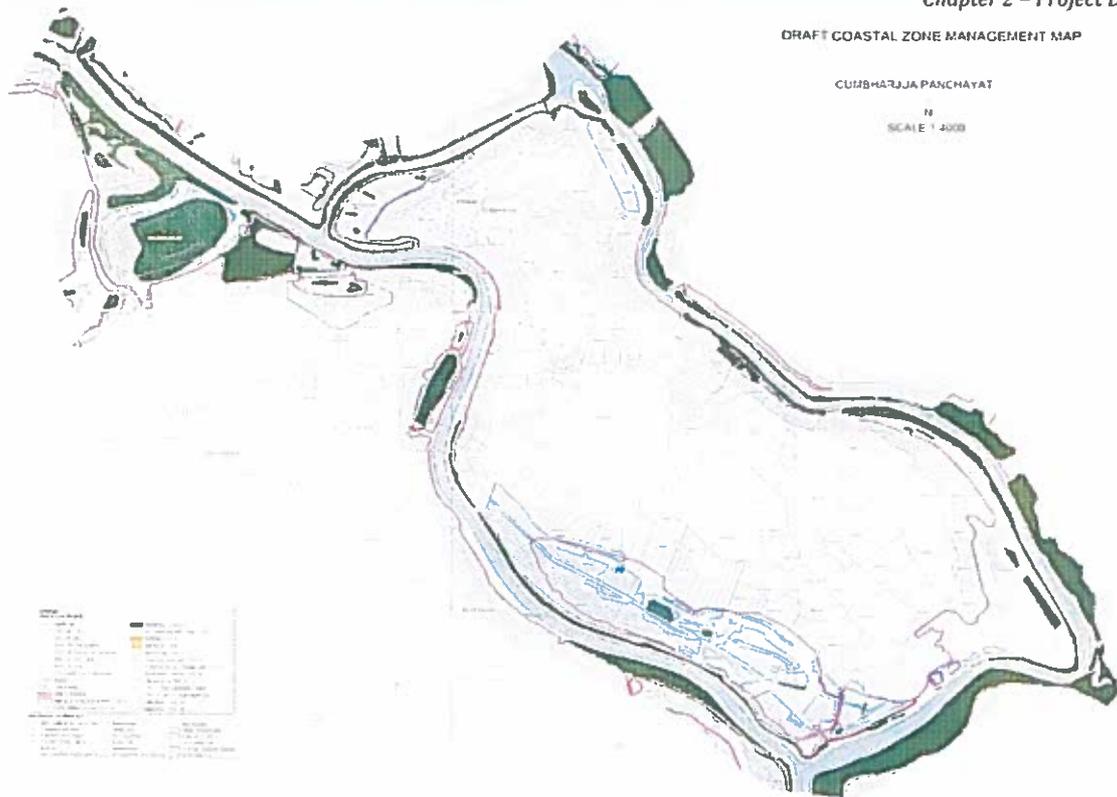


Figure 2.4: Bridge Alignment on Draft CZMP as per 2019 Notification

The project activities are superimposed on the approved CZMP. Snapshot of the same is depicted above.

According to above map, the project activities are located in CRZ IA, CRZ III and CRZ IVB. Though, it is seen in map, there were no Mangroves present at the site at the time of site visit.

#### 2.4 Design, Size/ Magnitude of The Project

Considering nature, design of the project and sub-soil strata, piles of the bridge are of deep foundation bored cast in situ in nature. Each pile having 1m diameter goes 30m below ground level till greyish black Basaltic Rock (details of sub-soil strata are given in geo-technical investigation report, kindly refer **Annexure IV**). There are 4 piles at each end (total 8) followed by pile cap (6.7m X 4.3m X 1.5m). Southern piles are on bank (within water, abutting existing bund) while northern ones are in field (outside water). There are no piles in the main channel of tributary.

The riverbed is at 6.78m and high flood level (HFL) at 8.49m; The bridge is designed such that it has soffit level 2.5m above HFT.

The bridge is designed for live load of 500 Kg/m<sup>2</sup> or one tractor load of 10 tonnes. It has in-situ prefabricated steel arch frame (in steel concrete composite) with suspenders making single span of 50m in length having single carriageway of 3.5m which will be placed on pedestal and bearing on pile cap.

In order to reduce general and long-term maintenance and to achieve durable structure, check points such as minimum concrete grade, covered reinforcement, use of corrosion resistant steel (CRS), easy access for inspection of bearing and other similar components are identified as special attention items. Magnitude of bridge is presented below:

**Table 2.1: Deasing, Magnitude of Bridge**

Sr. No.	Details	Dimensions (m)/ Specifications	No. of Units
1.	Span of bridge	50 X 5.5	1
2.	Steel tie members	50 (Length)	2
3.	Inter transverse members distance	2.5	21
4.	RCC deck slab	50 X 4.1	1
5.	Steel arch members	--	2
6.	Inter bracing distance	5	--
7.	Bracing length	2 to 3.26	7
8.	Suspenders	Variable length, maximum 6.80	18
9.	Inter suspender distance	5	--
10.	Designed to carry live load	As per IRC Class 9/R	--

## Chapter 2- Project Description

Sr. No.	Details	Dimensions (m)/ Specifications	No. of Units
11.	Designed for seismic forces	Earthquake coefficient corresponding to Zone IV with importance factor 1.2	--
12.	Designed for allowable flexural tensile stresses for concrete. The allowable flexural compressive stresses for all concrete	$F_{cr} = 0.7 \sqrt{f_{ck}} \text{ N/mm}^2$ $F_{cr} = 0.7 \sqrt{F_{ck}} \text{ N/mm}^2$	--
13.	Bridge bearings	Pot PTFE (conforming to IRC 83-part III specifications)	2
14.	Crash barrier	300 mm wide, 900 mm high	2

## 2.5 Design Standards, Codes for Bridge

The design of structural components of bridge will conform specifications laid down in the latest editions of the following Codes of Practice and Standards.

I. Standard Specifications and Codes of Practice for Road, Flyover, Bridges		
a.	Section I; I.R.C. 5 (1993)	General features of design
b.	Section II; I.R.C. 6 (2014)	Loads & stresses (4 <sup>th</sup> revision)
c.	Section III; I.R.C.21 (2000)	Cement concrete plain & reinforced (3 <sup>rd</sup> revision)
d.	Section V; I.R.C.24 (2010)	Steel road flyover bridges for permissible stress only. (Other provisions as per AASHTO Code)
e.	Section VII; I.R.C.78 (2000)	Foundation and substructure (Second revision)
f.	Section IX; I.R.C.83 (1999)	Metallic Bearings (Part-I)
g.	Section IX; I.R.C.83 (1987)	Elastomeric Bearings (Part-II)
II. Standard Specifications and Codes of Practice for Road Flyover Bridges other than mentioned above		
III. Specification for flyover Bridge works published by Ministry of Surface Transport. (Roads Wings), Government of India		
IV. Relevant provisions of IS codes of practice		
V. For items not covered in any of the above, sound Engineering practice and provisions in the GSIDC's design and provisions of relevant Codes of other nation shall be referred. In this regard decision of the GSIDC will be final and binding on construction agency.		

## 2.6 Schedule for Approval & Implementation

The forward path for approval and implementation of the proposed activities is:

Activity	Timeline
CRZ clearance	7 months
Construction of bridge (including monsoon)	9 months

Conceptual bar chart is provided in table below, time expressed in months.

**Table 2.2: Conceptual Timeline (in months) of Bridge Completion**

Sr. No.	Details of Work	1	2	3	4	5	6	7	8	9
1.	Mobilization									
2.	Foundation									
3.	Substructure									

## Chapter 2- Project Description

Sr. No.	Details of Work	1	2	3	4	5	6	7	8	9
4.	Superstructure									
5.	Finishing and Handover									

Stage/ work is already completed on ground

Stage/ work is yet to be commenced



### 2.6.1 Capital Investment for Bridge

Total capital expenditure including construction material, transport, labour, equipment and machinery, fuel, design consultancy charges, approval consultancy charges, statutory fees, administrative and other charges is estimated to be about Rs. 3.4 Crores, as below:

**Table 2.3 Capital Investment**

Sr. No.	Description	Awarded Amount (Rs.)
A	Construction of bridge for local farmers to cross river stream for cultivation of fields from Chune - Kator to Vanso Field in Village of Cumbarjua.	28,794,751.15
1	Add GST 12% on (A)	3,455,370.14
2	Minimum consultancy fee @3.50% on (1)	1,007,816.29
3	Add GST 18% on (2)	181,406.93
	<b>Sub Total</b>	<b>33,439,344.51</b>
4	Add Contingencies @3%	1,003,180.34
	<b>Sub Total</b>	<b>34,442,524.85</b>
	<b>GRAND TOTAL</b>	<b>34,442,524.85</b>
	Say	<b>34,442,525.00</b>

### 2.7 Technology, Methodology of Activities, Environmental & Safety Aspects

The details of proposed activities for construction of bridge are given below:

#### 2.7.1 Present Status

The Construction Contractor and Project Management Consultant are appointed by GSIDC, and core project team is constituted. At present, approaches and casting of all 8 pipes and pile caps are completed on site. Reinforcement is left for dirt wall and bearing pedestals. The fabrication work of arch is completed, and the only remaining activity is the erection of steel.

After completion of necessary clearances and approvals for construction of bridge, the project team will ensure availability of all necessary documents are in place and contractors have fulfilled all stipulated requirements and give "Go Ahead" to construction team.

**2.7.2 Foundation**

Foundation at south bank will be in water adjacent to existing bund so, it will be done by making Pile and Pile caps. On north bank, foundation will be done in agriculture field for which no objection is obtained from the farmers.

Excavated material will be stored at designated area not allowing it to run-off in to surrounding.

**2.7.3 Substructure**

The bridge rests on the pedestal and bearing on the pile cap.

**2.7.4 Superstructure**

Superstructure is the structure above bridge bearing. in this case it is prefabricated, arch frame steel concrete composite structure of dimensions mentioned above.

The superstructure will have transverse girder and bottom tie rests on bearing on which all above structures are placed. The cross section of superstructure from bottom to top possesses following layers. RCC deck slab of 0.2m thick followed by 0.012m thick Mastic Asphalt Waterproofing layer, then 0.05m thick layer of Dense Bitumen Macadam. A layer of Asphalt Concrete of 0.03m thick will be laid. Crash barrier on both sides of bridge will be built along with pair of arches. Following figure shows section of superstructure.

**2.7.5 Finishing and Handover**

Finishing work along with painting, checking and inspection trial runs will be taken, and it will be handed over to GSIDC for operate and maintenance.

Typical cross section, plan and elevation of bridge are given in following figures.

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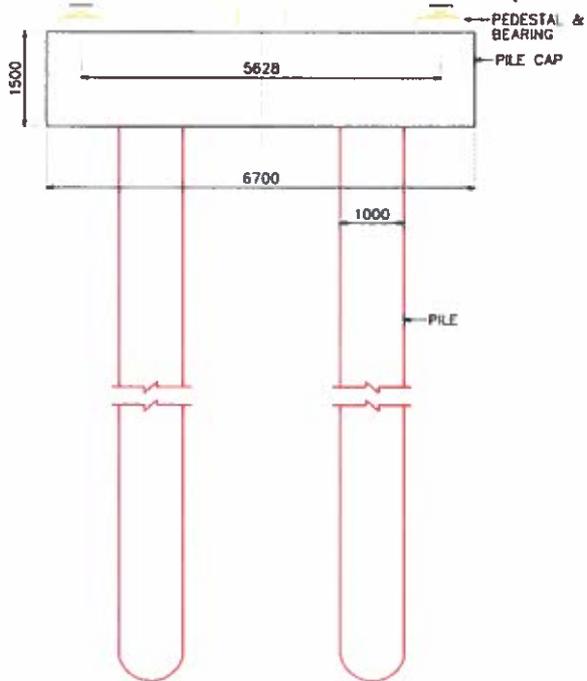


Figure 2.5: Section of Substructure

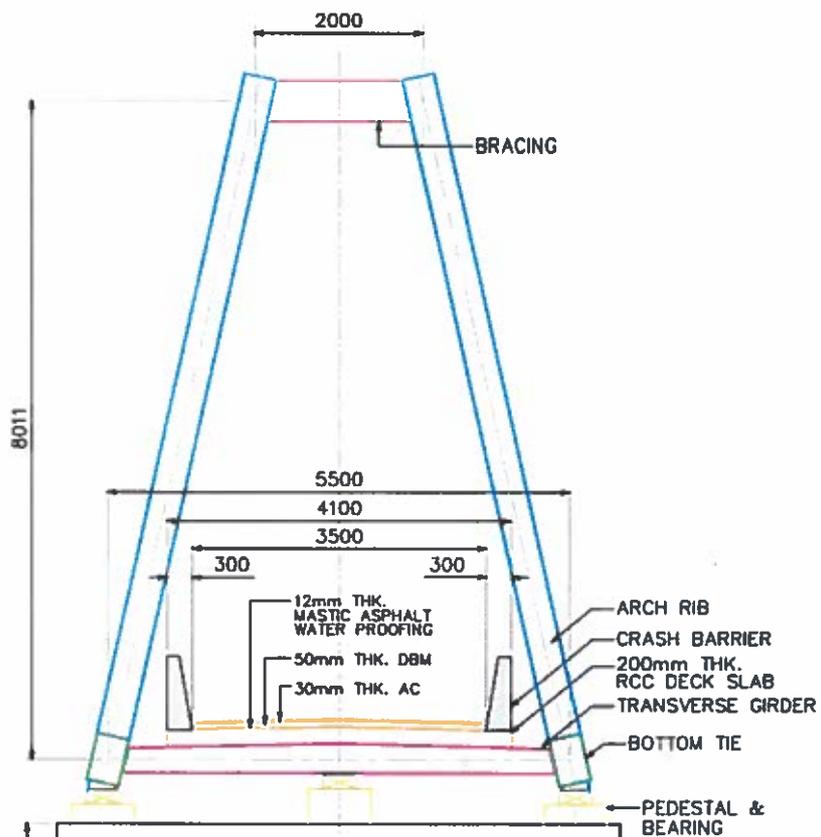
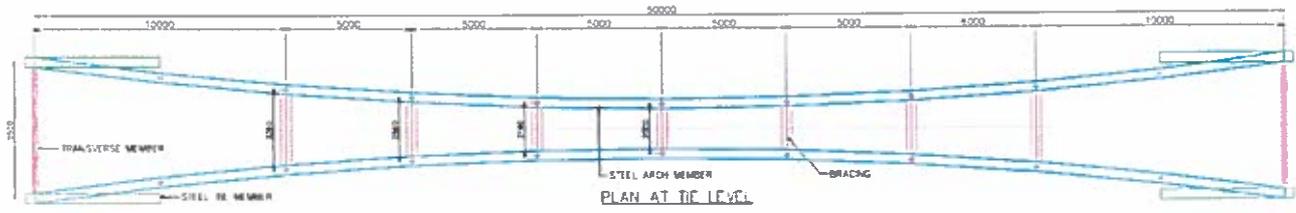
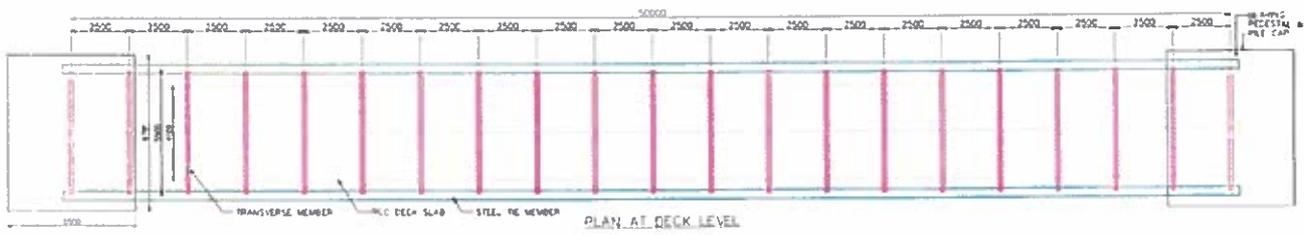


Figure 2.6: Section of Superstructure



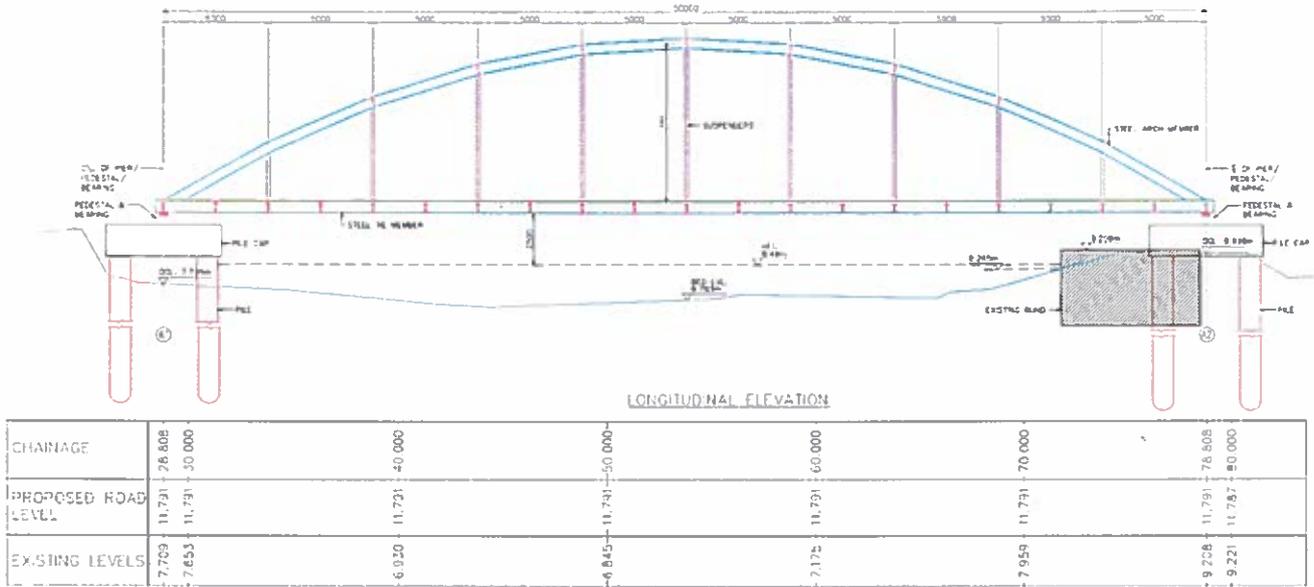


Figure 2.7: Cross section, Plan and Elevation of Bridge

## 2.8 Environmental Aspects of Project Activities

Aspects of the project envisaged as having environmental impact are as below:

- Project activities are located in III, IB and IVB classes of CRZ area
- Project activities will result in increase in turbidity which will affect the marine ecosystem temporarily
- No tree and Mangrove cutting involved
- Very low marine traffic at bridge location
- Beneficial to local farmers to cross the creek to reach their fields
- NOCs obtained from respective stakeholders
- Sufficient clearance from HFL that do not obstruct navigation of crafts underneath

## 2.9 Construction Material, Other Requirements & Sourcing

The material required is mainly civil construction material and it is proposed to obtain it from the market at the nearby city, Panaji. Sourcing locations and distances are indicated below:

**Table 2.4: Construction Material & Source Locations**

Sr. No.	Name of Material	Quantity Required	Source	Distance (km)
1.	Concrete (RMC)	Approx. 400 cum	Kundaim	10 kms
2.	TMT Steel Bars	Approx, 15 MT	Chorlim	5 kms
3.	Structural Steel	Approx. 100 MT	Chorlim	5kms
4.	Soil for filling	Approx. 1500 cum	Marcel	5 kms
5.	Hot mix	Approx 105cum	Bicholim	30 kms

## 2.10 Utilities Required During Construction Phase

Various utilities/ equipment required and respective fuel consumption for construction purpose is given in following table:

**Table 2.5: Utilities, Equipment, Fuel Consumption**

Machinery	Number	Fuel (Diesel) Required
Piling Winch Machine	01	Approx. 500 ltrs
Hydra/ Crane	01	Approx. 200 ltrs
DG set	01	Approx. 1000 ltrs
JCB/ Excavator	01	Approx. 300 ltrs

### 2.10.1 Water Requirement

Water required for project will be sourced from creek and tankers. Quantity of water required is given in following table

**Table 2.6: Project based water requirement**

Sr. No.	Use	Quantity (m <sup>3</sup> /day)
1	Drinking Purpose	0.5
2	Construction Purpose	2.5 to 3.0

### 2.10.2 Work Shift and Manpower

The work execution will be influenced by tidal conditions. Manpower required for proper execution of this project is depicted below.

**Table 2.7: Project based manpower and work-shifts**

1	Skilled Labours	5 Nos
2	Welders/ Fitters	8 Nos
3	Unskilled Labours	7 Nos

### 2.11 Solid & Hazardous Waste Generation

In the construction phase, activities include civil construction in the marine area and creation of approaches at both ends of bridge. In operation phase of the project, the bridge will be utilised to cross the creek let by local farmers. Considering the project activities that are already taken place and pending project activities, there will be merely any generation of solid and hazardous wastes.

### 3 DESCRIPTION OF THE ENVIRONMENT

The environmental baseline data covering land, ambient air, water, noise, biological and socio-economic, including marine environment, in the study area was collected by undertaking primary surveys through field visits, sampling/ monitoring, laboratory analysis, questionnaire surveys and discussions with farmers. Secondary data was collected from relevant agencies/ sources, such as census abstract, Forest Department.

Baseline study was done considering nature, location and magnitude of the project, along with MoEF&CC Guidelines.

#### 3.1 Land Environment

##### 3.1.1 Regional Setting

The study area has a rural setting, but it is also known for rice fields, tourism activities, coconut, Cashew groves, and the good standard of living of the farmers staying in Cumbarjua, Jua and other small villages in the surrounding area. The region has good connectivity by road. The climate in surrounding region is of typical coastal-hilly nature. Details of climatic conditions and agriculture are mentioned in subsequent paragraphs.

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Figure 3.1: Google Earth Image showing site & 07 km study area

4566



Figure 3.2: Bridge Alignment & Vicinity

405

### 3.1.2 Land Use Pattern

The land use land cover in study area is prepared by interpretation of latest available satellite imagery and ground truthing.

#### 3.1.2.1 Reconnaissance Survey

The study area shows distinct land use patterns – land under Cashew plantation, mangroves, paddy fields; open/ barren areas and a number of small villages spread out evenly, showing rural environment setting.

#### 3.1.2.2 LULC studies in Study Area

Satellite image procured from National Remote Sensing Centre (NRSC), Hyderabad in raw format and few pre-processing procedures (georeferencing) were adopted to bring the image to the real-world coordinate system.

An area of 07 km angular distance is generated using ArcGIS 9.3 software from the centre point of the project site. This image is further used to study the land use/ landcover of the project under consideration. Standard image interpretation elements like tone, texture, shape, size, association, shadow and pattern are useful to identify prominent LULC classes. Reconnaissance visit to the project site and surrounding has been carried out to identify the confusing and doubtful areas. Geographical coordinate of these locations was recorded using a Global Positioning System (GPS).

To achieve planimetric accuracy, the remote sensing scene was rectified with respect to SOI maps on 1:50,000 scales. The Ground Control Points (GCP) in the scene such as railway-road intersections, corners of water reservoirs, bridges etc. were identified on the image as well as on the reference map. Third order model was constructed and finally registration of image was carried out with nearest neighbourhood resampling taking map as reference and one map registration was achieved.

The below table shows details of satellite imagery. LULC map and percent distribution of Land use land cover classes is shown overleaf.

**Table 3.1: Details of Satellite Imagery**

Head	Details
Centre Coordinate of LULC map	Latitude: 15°31'13.17"N Longitude: 73°56'45.88"E
Study Area (km <sup>2</sup> )	155.03
Source Satellite	NRSC Resourcesat-2
Date of Imagery	28 <sup>th</sup> May 2022

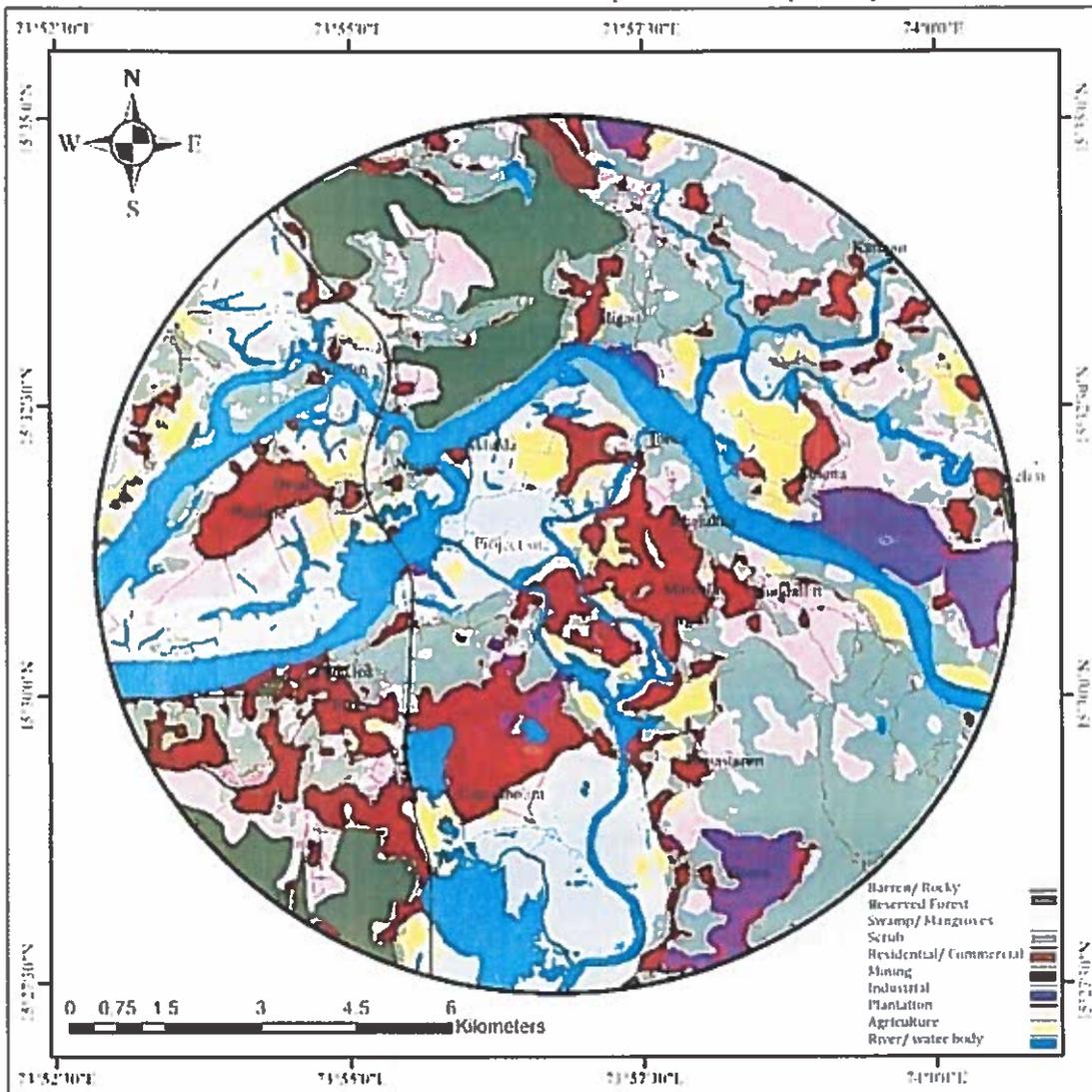


Figure 3.3 Land Use Land Cover Map of Study Area

Table 3.2: Percentage Distribution of LULC Classes within Study Area

Sr. No.	Land Use Classification/ Type	Area (km <sup>2</sup> )	Percentage
1.	Barren/ Rocky	24.72	15.95
2.	Reserved Forest	11.48	7.40
3.	Swamp/ Mangroves	17.93	11.57
4.	Scrub	39.93	25.76
5.	Residential/ Commercial	23.00	14.84
6.	Mining	0.82	0.53
7.	Industrial	5.93	3.82
8.	Plantation	0.87	0.56
9.	Agriculture	9.96	6.42
10.	River/ water body	20.39	13.15
<b>TOTAL</b>		<b>155.03</b>	<b>100.00</b>

### 3.1.3 Geology and Soil Characteristics

#### 3.1.3.1 Geology<sup>2</sup>

##### Distribution of Rock Types

North Goa district is dominantly covered by the formation of Goa Group belonging to Dharwar Super Group of Archaean to Proterozoic age. Deccan Trap of Upper Cretaceous occupies a narrow strip along the north-eastern corner to Lower Eocene age.

The Goa Group comprises of metamorphic rocks of green schist facies, and is divided into Barcem, Sanvordem, Bicholim and Vageri formation in the ascending order of superposition. The Goa Group of rocks has been intruded by granite gneiss, feldspathic gneiss, hornblende gneiss and porphyritic granite, followed by basic intrusive.

During the Sub-recent and recent times, the rocks have been subjected to lateritisation of varying thickness. Thus, laterite occurs extensively covering almost all the formations in North Goa district.

Coastal alluvium occurring along the coastal plains consists of fine to coarse sands with intercalations of sandy loam, silt and clay.

##### Structural Geology

The Goa group of rocks is disposed in a general NW–SE direction. The rock types indicate three cycles of folding. The straight coastline suggests the major fault along the west coast. Associated with this fault a number of weak planes have developed where some rivers (Terekhol, Chapora, Mandovi and Zuari) flow along. Western Ghats, which extends in NS to NNW – SSE direction represent a prominent fault zone. Even though the rock types of Goa Group have suffered considerable faulting, all the faults are not exposed on surface owing to the extensive cover of laterite.

##### Stratigraphy

The stratigraphic succession of rocks in North Goa district is given below:

**Table 3.3: Stratigraphy of North Goa District**

Age	Group	Formation	Rock Type
Quaternary			Beach Sand
Cenozoic			Laterites
Upper Cretaceous to Eocene	Deccan Trap		Basalt

<sup>2</sup> Source: Groundwater Information Booklet, North Goa District, Goa; published by Central Ground Water Board, Ministry of Water Resources, Government of India

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## Chapter 3 - Description of The Environment

Age	Group	Formation	Rock Type
Lower Proterozoic	Clospet Granite	Peridotite, Gabbro, Norite	Granite
			Pyroxenite, Peridotite, Serpentinite, Gabbro
Archaean to Lower Proterozoic	Goa Group	Vageri Formation	Carbonate-quartz-chlorite schist with Greywacke
			Bicholim Formation
		Quartz- Sericite schist	
		Banded iron formation	
		Chert and quartzite	
		Sanvordem Formation	Quartz-chlorite-biotite schist with layers of chert, iron oxide, carbonate, meta-basalt and meta gabbro
			Greywacke with conglomerate
		Barcem Formation	Quartzite
			Quartz-chlorite schist
			Meta-acid volcanics
Meta-basalt			
Archaean	Peninsular Gneissic Complex		Orthoquartzite
			Granite Gneiss, Migmatites and Granites

### 3.1.3.2 Soil Characteristics

Soils of the district can be classified into 3 types namely Laterite soil, Saline soil and Alluvial soil.

**Lateritic soil** is the major soil type in the district. It is highly porous & permeable, slightly acidic with low pH values, low in organic matter, Calcium and Phosphorus.

**Saline soil** in the district occurs in the flood plains of Zuari and Mandovi rivers in Tiswadi, Bardez and Ponda taluks. It also occurs in Pernem taluk. The soil is deep, poorly drained and less permeable. It is saline, high in pH and contains humus and organic matter.

**Alluvial soil** occurs as very thin strip along the coastline towards western part of the district. It is reddish brown to yellowish, coarse grained and confined to narrow valleys of rivers. It is well drained, acidic with low pH and organic content.<sup>3</sup>

#### Baseline Soil Characteristics

Soil quality reflects how well soil performs the functions of maintaining biodiversity, productivity, partitioning water and solute flow, filtering and buffering, nutrient cycling, and providing support for plants and other structures. Soil management has a major

<sup>3</sup> Source: Groundwater Information Booklet, North Goa District, Goa; published by Central Ground Water Board, Ministry of Water Resources, Government of India

## Chapter 3 – Description of The Environment

impact on soil quality. Representative soil samples were collected at and near site. Sampling locations were identified considering presence of land use like agriculture field and proximity to the project site. Identified locations were cleaned by removing very thin superficial layer, debris, pebbles, dried leaves etc. soil was collected by scooping 15-20cm deep and placed on impervious sheet. Colour of soil was noticed, it spread evenly and made four equal parts. Two diagonally opposite parts were discarded and remaining two mixed well to homogenised it. The steps were repeated to get 1 Kg of soil. Then it was collected in clean polythene bag, sealed and labelled. Samples were transported to laboratory and physico-chemical tests (as per IS-2720/ EPA method as applicable) were performed to know characteristics, fertility status etc.



Figure 3.4: Soil Sampling locations



Figure 3.5: Soil Sampling

Table 3.4: Soil Characteristics at and Near Site

Sr. No.	Parameter	Unit	On Site	Ramwada	Method of Analysis
1.	pH	--	5.18	5.23	IS-2720 (part 26) RA2016
2.	Colour	--	Black	Black	IS-2720 (Part 4) 1983
3.	Particle size	Clay %	18	36	IS-2720 (part 4) 2010

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Sr. No.	Parameter	Unit	On Site	Ramwada	Method of Analysis
		Silt %	37	32	
		Sand %	45	32	
4.	Texture class	--	Sandy loam	Sandy loam	IS-2720 (part 4) 2010
5.	Electrical Conductivity	μS/cm	108.4	81.9	IS 14767:2000 RA2016
6.	Moisture	%	32.6	27.5	IS-2720 (part 2) 2010
7.	Water holding capacity	%	52	48.2	IS-14765-2010
8.	Total Organic Carbon	%	0.5	0.5	IS-2720 (part 22) 2010
9.	Available Nitrogen	%	0.014	0.007	IS 9497-1980-2015
10.	Available Phosphorus	Kg/ha	11	13	IS-3025 (Part 31) 2009
11.	Available Potassium	Kg/ha	25	29	IS 9497-1980-2015
12.	Chlorides	mg/kg	382.4	98.5	EPA Method 9038:1986
13.	Sulphates	mg/kg	60.5	48.5	EPA Method 9038:1986
14.	Calcium	mg/kg	50	40	EPA Method 7000 B. 2:2007
15.	Magnesium	mg/kg	21	11	EPA Method 7000 B. 2:2007
16.	Sodium	mg/kg	11	6.0	IS 9497: 1980: 2015
17.	Iron	mg/kg	0.09	0.10	EPA Method 3050 B. 2:1996
18.	SAR	%	1.8	1.2	IS:11624-1986
19.	Chromium	mg/kg	<0.04	<0.04	EPA Method 3050 B. 2:1996
20.	Cobalt	mg/kg	<0.04	<0.04	EPA Method 3050 B. 2:1996
21.	Aluminium	mg/kg	<0.04	<0.04	EPA Method 3050 B. 2:1996
22.	Manganous	mg/kg	<0.04	<0.04	EPA Method 3050 B. 2:1996
23.	Zinc	mg/kg	<0.04	<0.04	EPA Method 3050 B. 2:1996
24.	Lead	mg/kg	<0.04	<0.04	EPA Method 3050 B. 2:1996
25.	Mercury	mg/kg	<0.04	<0.04	EPA Method 3050 B. 2:1996
26.	Nickel	mg/kg	<0.04	<0.04	EPA Method 3050 B. 2:1996
27.	Arsenic	mg/kg	<0.04	<0.04	EPA Method 3050 B. 2:1996

Standard soil classification as per Handbook of Agriculture, Indian Council of Agricultural

Research is as follows:

Table 3.5: Standard Soil Classification

No	Parameter	Classification
1.	pH	Less than 4.5 : Extremely acidic
		4.51 - 5.50 : Very strongly acidic
		5.51 - 6.50 : Moderately acidic
		6.51 - 7.30 : Neutral
		7.31 - 7.80 : Slightly alkaline
		7.81 - 8.50 : Moderately alkaline
		8.51 - 9.00 : Strongly alkaline
		9.01 and above : Very strongly alkaline
2.	Salinity Electrical conductivity (μmhos/cm) (1 ppm = 640 μmhos/cm)	Up to 1.00 : Average
		1.01 to 2.00 : Harmful to germination
		2.01 to 3.00 : Harmful to crops (sensitive to salts)
3.	Organic Carbon (%)	Up to 0.2 : Very less
		0.21 to 0.40 : Less
		0.41 to 0.50 : Medium
		0.51 to 0.80 : On an average sufficient
		0.81 to 1.00 : Sufficient
		> 1.0 : More than sufficient

## Chapter 3 – Description of The Environment

No	Parameter	Classification	
4.	Nitrogen (Kg/Ha)	Up to 50	: Very less
		51 - 100	: Less
		101 - 150	: Good
		151 - 300	: Better
		More than 300	: Sufficient
5.	Phosphorous (Kg/Ha)	Up to 15	: Very less
		16 - 30	: Less
		31 - 50	: Medium
		51 - 65	: On an average sufficient
		66 - 80	: Sufficient
		More than 80	: More than sufficient
6.	Potash (Kg/ha)	0 - 120	: Very less
		121 - 180	: Less
		181 - 240	: Medium
		241 - 300	: Average
		301 - 360	: Better
		More than 360	: More than sufficient

As per the results presented, soils at and near site are very strongly acidic, sandy loam which is the characteristic of the district. Low pH may be attributed to high precipitation in the region and lateritic in nature, sandy loam texture may impart low water holding capacity and organic matter. Fertility status of soil is poor, evident by very less Phosphorous and Potash contents; this may be because of less humus.

Sediment characteristics at proposed site are studied by analysing physico-chemical and biological parameters. The results are discussed in marine section.

### 3.2 Topography & Meteorology

The study area has undulating terrain. The area has presence of hills, mudflats, coastal plains, creeks/ streams, open/ agriculture areas. Hills in study area ranges from 70m to 170m. The project site and vicinity are in coastal plains, showing ingress of sea water during high tide due to low lying with small interconnecting creeklets/ waterways.

The meteorology of the region is influenced mainly by the coastal winds, but wind direction is influenced by presence of hills.

#### 3.2.1 Meteorology

Data on meteorological parameters are sourced from published literature of India Meteorological Department (IMD). The data station of IMD is located at Panaji (15° 29'N and 73° 49'E), the instrument is located at 18m above ground level with good exposure conditions. Surface meteorological data (Temperature, relative humidity, rainfall, wind speed and direction) is collected twice a day (12hrs. and 15hrs.) from year 1971 to 2000

called climatological normal. Monthly data of all (except wind speed and wind direction) parameters is reproduce below.

Table 3.6: Climatological Normal

Month	Atmospheric Pressure (hPa)		Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
	0830 Hrs	1730 Hrs	Max	Min	0830 Hrs	1730 Hrs	Total
January	1006.8	1003.5	34.6	17.6	77	56	0.4
February	1006.1	1002.8	35.4	18.2	78	58	0.0
March	1005.1	1001.7	35.1	20.3	79	64	0.1
April	1003.6	1000.1	34.9	22.8	75	67	4.2
May	1002.1	999.0	34.9	23.3	74	68	66.7
June	999.9	997.9	33.8	22.4	87	83	910.4
July	1000.2	998.4	30.9	22.4	90	86	942.7
August	1002.9	1000.3	30.5	22.7	91	86	595.8
September	1004.2	1001.1	31.8	22.6	90	81	219.4
October	1005.4	1002.2	34.8	21.8	85	76	123.3
November	1005.4	1002.2	35.0	19.6	75	64	27.5
December	1007.1	1003.6	34.5	18.2	71	57	2.2
Range	997.9-1007.1		17.6-35.4		56-91		2892.7

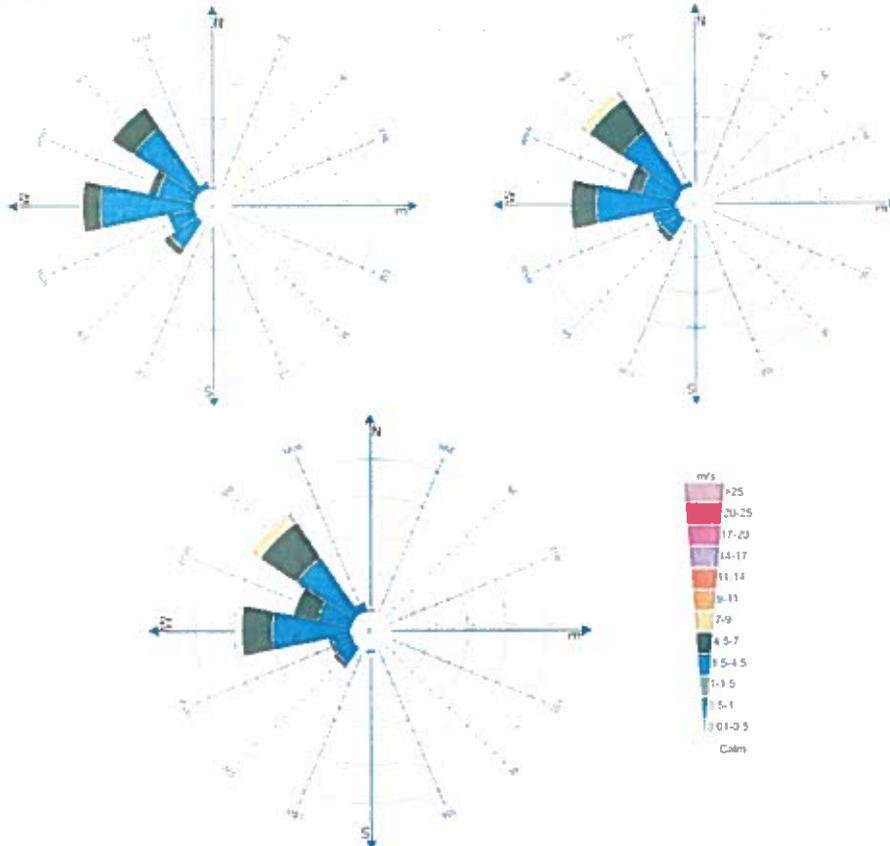


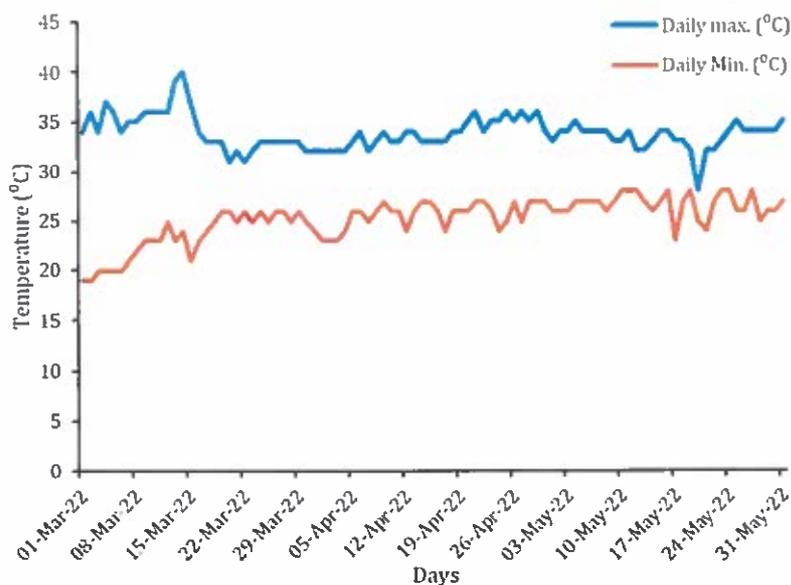
Figure 3.6 wind Rose in Summer

### 3.2.2 Temperature Profile

Being a coastal region, weather in study area remains warm & humid throughout the year. Temperature data of North Goa district and its variation in the year 2021 is given in Table and temperature profile for summer 2022 in Figure below.

**Table 3.7 Temperature Variation in North Goa District**

Months	Mean Daily Max Temp (°C)	Mean Daily Min Temp (°C)	Average Recorded Temp (°C)
January	34	21	27
February	35	21	27
March	35	23	29
April	34	23	30
May	35	24	30
June	33	23	27
July	32	23	27
August	31	24	27
September	32	24	27
October	34	22	28
November	34	22	28
December	33	20	26



**Figure 3.7 Temperature Profile of Study Area (Summer 2022)**

(Source: [www.accuweather.com](http://www.accuweather.com))

### 3.2.3 Humidity & Rainfall Profile

Being in coastal region, the climate is warm and humid with high humidity levels throughout the year (Year 2021). Based on the historical data, the highest Relative

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Humidity exceeds 98 % throughout the year while as is obvious in table below during the monsoon period (June, July and August, September) it exceeds up to 100%.

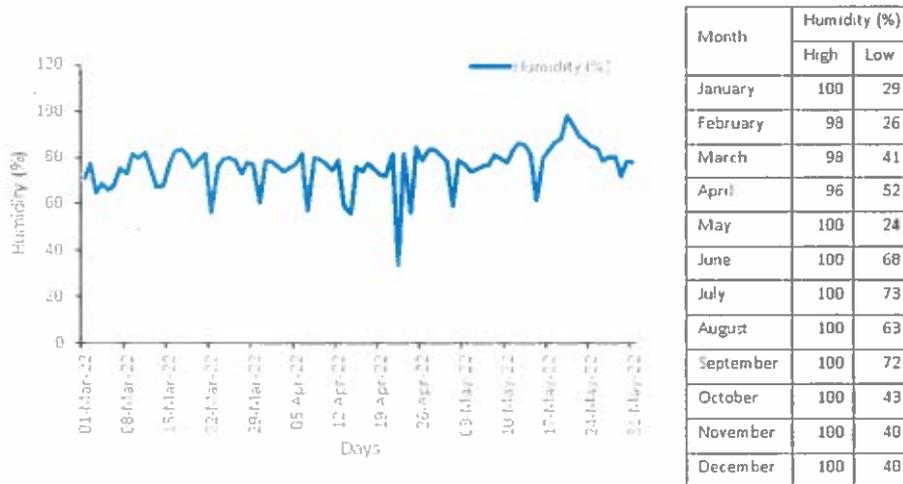


Figure 3.8 Humidity Profile of Study Area (Summer 2022)

Source: <https://www.timeanddate.com>

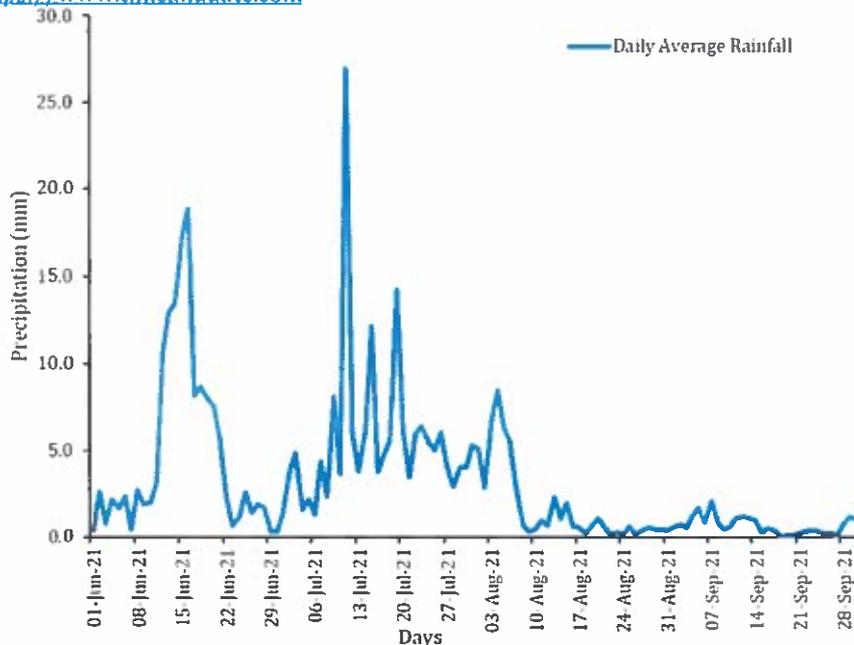


Figure 3.9 Rainfall Profile in Monsoon 2021

Source: <https://www.worldweatheronline.com/>

3.2.4 Inference

The climate being hot and humid, temperature inversion formation is less likely to happen. In monsoon season, due to heavy rains, surface water runoff is observed which goes in the river adjoining the site. Even though the region experiences heavy rains, no flood like situations are observed since the adjacent river has wide cross-sectional area that drains towards the Arabian Sea.

### 3.3 Air Environment

Ambient Air Quality Monitoring was carried out considering the scale of emissions, location, and proposed activities. Such a pragmatic approach ultimately helps in formulating Environmental Management Plan (EMP). The basic considerations for designing such a program include:

- Representative selection of sampling location (primarily guided by the topography & micrometeorology of the region)
- Adequate sampling frequency
- Inclusion of all the major pollution parameters

All these aspects were given due consideration while devising an optimal scheme for air quality monitoring for Environmental Impact Assessment (EIA) around the project site.

#### 3.3.1 Reconnaissance Study

The prime objective of this AAQ study was to establish the existing regional background levels in the vicinity of the proposed project. The sources of air pollution were identified in study area is traffic along road. Other miscellaneous sources were identified as burning of minor fuels.

The fluctuation of AAQ within the study area will be governed by overall regional emissions and micrometeorology. Overall air pollution at site found insignificant.

#### 3.3.2 AAQM Locations and Parameters Selected

AAQM sampling location was selected near the site away from large buildings/ direct emission source (such as local emission source/ heavy traffic) which may interfere in free air circulation.

PM<sub>10</sub> & PM<sub>2.5</sub> was monitored on 24 hourly bases whereas all gaseous parameters were monitored on 1/8/24 hourly basis using respirable High-Volume Sampler and standard methods prescribed by IS/ USEPA/ Air Sampling and Analysis, 3<sup>rd</sup> Edition. CO was monitored using handheld electronic meter (electro-chemical sensor).

Gaseous sample solutions kept in the icebox, particulate sample filter papers were kept in the plastic zip lock pouch and deliver to the laboratory.

**Analysis:** Analysis for selected parameters were conducted as per IS/ other suitable method as applicable. Ambient air quality monitoring location is shown in figure below.

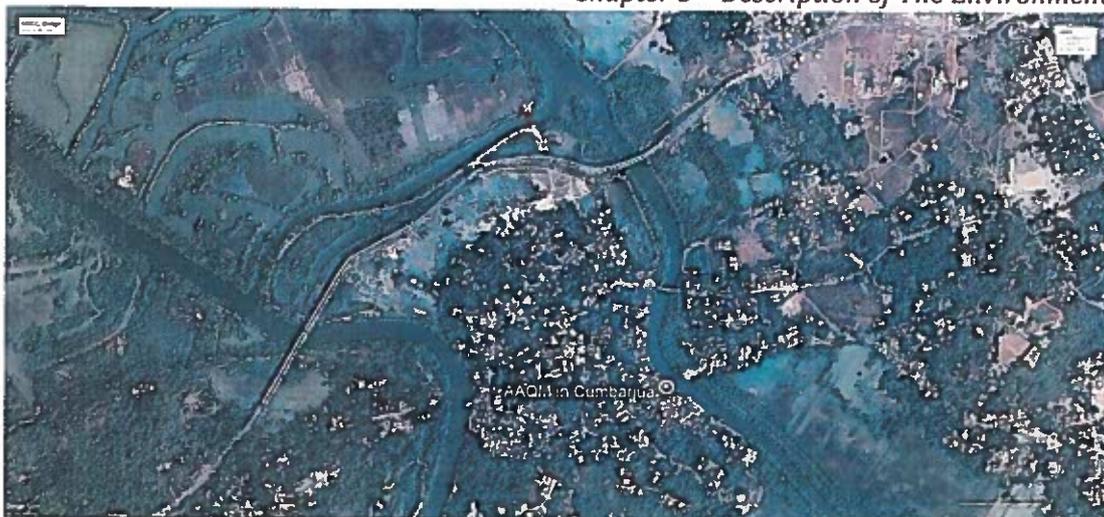


Figure 3.10 AAQM Location Map



Figure 3.11 AAQM in Cumbarjua

### 3.3.3 AAQM Results

Statistical data at sampling location, standards for relevant parameters and findings are given below. Results are compared with National Ambient Air Quality Standards (NAAQ) in respect of monitored parameters as shown in Table below. As can be seen the results, are within NAAQS standards for Residential areas.

Thus, it can be concluded that ambient air quality near site is not polluted.

Table 3.8: AAQM Monitoring Results

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Sampling Location	Parameter	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	NO <sub>x</sub>	CO
	Units	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(mg/m <sup>3</sup> )
Cumbarjua Village	Max	54.4	31.7	7.4	19.6	0.2
	Min	34.1	20.8	6.3	16.9	0.2
	Average	42.6	24.8	6.9	18.2	0.2
	98 <sup>th</sup> Percentile	53.6	31.3	7.4	19.6	0.2

Table 3.9 Relevant National Ambient Air Quality Standards (CPCB, 2009)

Pollutant	Time weighted Average	Concentration in ambient air		
		Industrial, Residential, Rural & other area	Ecologically sensitive Area Notified by Central Government	Method of measurement
Sulphur Dioxide (SO <sub>2</sub> ), µg/m <sup>3</sup>	24 Hours**	80	80	- Improved West & Gaeke - Ultraviolet fluorescence
Nitrogen Dioxide (NO <sub>2</sub> ), µg/m <sup>3</sup>	24 Hours**	80	80	- Modified Jacob & Hochheiser (Na-Arsenite) - Chemiluminescence
Carbon monoxide (CO), (mg/m <sup>3</sup> )	8 hours**	02	02	Non-Dispersive infra-Red (NDIR) spectroscopy
Particulate Matter (PM <sub>10</sub> ), µg/m <sup>3</sup>	24 Hours**	100	100	- Gravimetric - TOEM - Beta attenuation
Particulate Matter (PM <sub>2.5</sub> ), µg/m <sup>3</sup>	24 Hours**	60	60	- Gravimetric - TOEM - Beta attenuation

(\*\*) 24 hourly or 8 hourly or 1 hourly reading to be complied 98% time

Noise is caused in the study area due to traffic on Gandaulim-Marcel Road and miscellaneous noises from village.

The table below presents ambient noise level monitoring results. The data shows that the Noise levels during day and night are within standard limits specified in Schedule II of the Environment Protection Act, 1986 for residential land use.

Table 3.10: Noise Monitoring Result [Leq (dB [A])]

	Day Time (Leq)			Night Time (Leq)		
	Max	Min	Avg.	Max	Min	Avg.
Cumbarjua Village	56.2	48	52.0	45.4	41.6	43.6
Limiting Standards as per EPA Schedule II, for residential area	55			45		

**Note:** Day Time: 06.00 am to 10.00 pm, Night Time: 10.00 pm to 06.00 am

### 3.4 Water Environment

#### 3.4.1 Sewage Treatment & Disposal

Sewage disposal is done by means of septic tanks followed by soak pit connected to individual toilet blocks in well-to do houses.

### 3.4.2 Baseline Water Quality

**Location Selection:** Ground water source in majority of villages is open well, bore well. The sampling locations were chosen based on their use such as for agriculture/ Domestic.

**Sampling Collection, Precautions, Preservation & Transportation:** Two ground water (from open well in Cumbarjua and near site) samples were collected after ensuring that the well is in use and water is drawn daily for a period of an hour or two. Similarly, two surface water (one each at upstream and downstream of project site) samples were collected ensuring that while collecting sample, sediment will not be disturbed and suspended in water column, and no floating debris in water. Appropriate leak proof glass or plastic container were used for sample storage. Samples were transported in ice box. After reaching laboratory samples were kept in sample cooler (maintaining temperature uniformly between 4°C and 8°C). Samples were preserved as per IS:3025 (Part 1)-1987 RA 2019.

**Analysis:** Ground water samples were analysed for selected physico-chemical and biological parameters as per IS/ APHA method as applicable.

#### 3.4.2.1 Ground Water

Analysis results are presented in the table below. From the analysis results, it can be observed that ground water near site has Total Dissolved Solids exceeds desirable limit but within permissible limit, whereas Cumbarjua sample shows value within desirable limit. Parameters like Ammonia, Residual free Chlorine, Cadmium, Phenolic Compounds, Sulphide, Mercury exceeds desirable limit but within permissible limit. No microbial count found in 100ml of sample. It is recommended that water may be potable only after suitable treatment.

**Table 3.11 Ground Water Analysis Results**

Sr. No.	Parameter	Near Site	Cumbarjua (Ramwada)	Limits (IS 10500:2012)		Method of Analysis
				Desirable	Permissible	
1.	Colour, Hazen	<5.0	<5.0	5 Max	15 Max	IS-3025(P-4) RA2017
2.	pH@ 25°C	8.01	7.42	6.5 – 8.5	No Relaxation	IS-3025(P-11) RA2017
3.	Turbidity, NTU	<1	<1	1 Max	5 Max	IS-3025(P-10) RA2017
4.	TDS, mg/l	820	260	500 Max	2000 Max	IS-3025(P-16) RA2017
5.	NH <sub>3</sub> (as N), mg/l	< 0.56	< 0.56	0.5 Max	No Relaxation	IS-3025(P-34) RA2019

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Sr. No.	Parameter	Near Site	Cumbarjua (Ramwada)	Limits (IS 10500:2012)		Method of Analysis
				Desirable	Permissible	
6.	Boron, mg/l	<0.01	<0.01	0.5 Max	2.4 Max	IS-3025(P-57) RA2017
7.	Calcium as Ca, mg/l	38.5	46.5	75 Max	200 Max	IS-3025(P-40) RA2019
8.	Chlorides, mg/l	23.0	23.0	250 Max	1000 Max	IS-3025(P-32) RA2019
9.	Fluoride, mg/l	<0.2	<0.2	1.0 Max	1.5 Max	IS-3025(P-60) RA2019
10.	Free ResCl <sub>2</sub> , mg/l	<0.5	<0.5	0.2 Min	1.0 Min	IS-3025(P-26) RA2019
11.	Iron, mg/l	0.10	0.09	1.0 Max	No Relaxation	IS-3025(P-53) RA2019
12.	Magnesium as Mg, mg/l	24.3	1.9	30 Max	100 Max	IS-3025(P-46) RA2019
13.	Sulphate, mg/l	50.3	11.3	200 Max	400 Max	IS-3025(P-24) RA2019
14.	Alkalinity, mg/l	38.0	46.0	200 Max	600 Max	IS-3025(P-23) RA2019
15.	Hardness, mg/l	196.0	124.0	200 Max	600 Max	IS-3025(P-21) RA2019
16.	Odour	Agreeable	Agreeable	Agreeable	Agreeable	IS-3025(P-5) RA2017
17.	Aluminum, mg/l	<0.01	<0.01	0.03 Max	0.2 Max	IS-3025(P-55) RA2019
18.	Detergents, mg/l	<0.1	<0.1	0.2 Max	1.0 Max	APHA-2017(5540-C)
19.	Arsenic, mg/l	< 0.01	< 0.01	0.01 Max	No Relaxation	IS-3025(P-37) RA2019
20.	Barium, mg/l	<0.01	<0.01	0.7 Max	No Relaxation	APHA-2017(3111-D)
21.	Copper, mg/l	< 0.01	< 0.01	0.05 Max	1.5 Max	IS-3025(P-42) RA2019
22.	Manganese, mg/l	< 0.01	< 0.01	0.1 Max	0.3 Max	IS-3025(P-59) RA2019
23.	Chromium, mg/l	<0.01	<0.01	0.05 Max	No Relaxation	IS-3025(P-52) RA2019
24.	Zinc, mg/l	< 0.01	< 0.01	5 Max	15 Max	IS-3025(P-49) RA2019
25.	Cadmium, mg/l	< 0.01	< 0.01	0.003 Max	No Relaxation	IS-3025(P-41) RA2019
26.	Nitrate, mg/l	<0.5	<0.5	45 Max	No Relaxation	APHA-2017(4500NO <sub>3</sub> -B)
27.	Phenolic comp, mg/l	<0.05	<0.05	0.001Max	0.002Max	IS-3025(P-43) RA2019
28.	Selenium, mg/l	<0.01	<0.01	0.01 Max	No Relaxation	IS-3025(P-56) RA2019
29.	Sulphide, mg/l	<0.5	<0.5	0.05 Max	No Relaxation	IS-3025(P-29) RA2019
30.	Lead, mg/l	<0.01	<0.01	0.01 Max	No Relaxation	IS-3025(P-47) RA2019

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Sr. No.	Parameter	Near Site	Cumbarjua (Ramwada)	Limits (IS 10500:2012)		Method of Analysis
				Desirable	Permissible	
31.	Mercury, mg/l	<0.05	<0.05	0.001 Max	No Relaxation	IS-3025(P-48) RA2019
32.	Molybdenum, mg/l	< 0.01	< 0.01	0.07 Max	No Relaxation	APHA-2017(3111-D)
33.	Nickel, mg/l	< 0.01	< 0.01	0.02 Max	No Relaxation	IS-3025(P-54) RA2019
34.	Chloramines, mg/l	<2.0	<2.0	4.0 Max	No Relaxation	APHA-2017(4500CL-G)
35.	Mineral oil, mg/l	<0.5	<0.5	0.5 Max	No Relaxation	IS-3025(P-39) RA2019
36.	Silver, mg/l	<0.1	<0.1	0.1 Max	No Relaxation	APHA-2017 (3111-B)
37.	Cyanide, mg/l	<0.05	<0.05	0.05 Max	No Relaxation	IS-3025 (P-27) RA2019
38.	Total Coliform	Absent	Absent	Absent/100ml		IS 15185:2016
39.	E-coli	Absent	Absent	Absent/100ml		IS 15185:2016

## 3.4.2.2 Surface Water

Results of surface water samples were compared with CPCB standard of surface water quality for designated best use. Accordingly, it is revealed that, stretch of waterbody near site does not falls in any specific class but, it can be best use for navigation purpose.

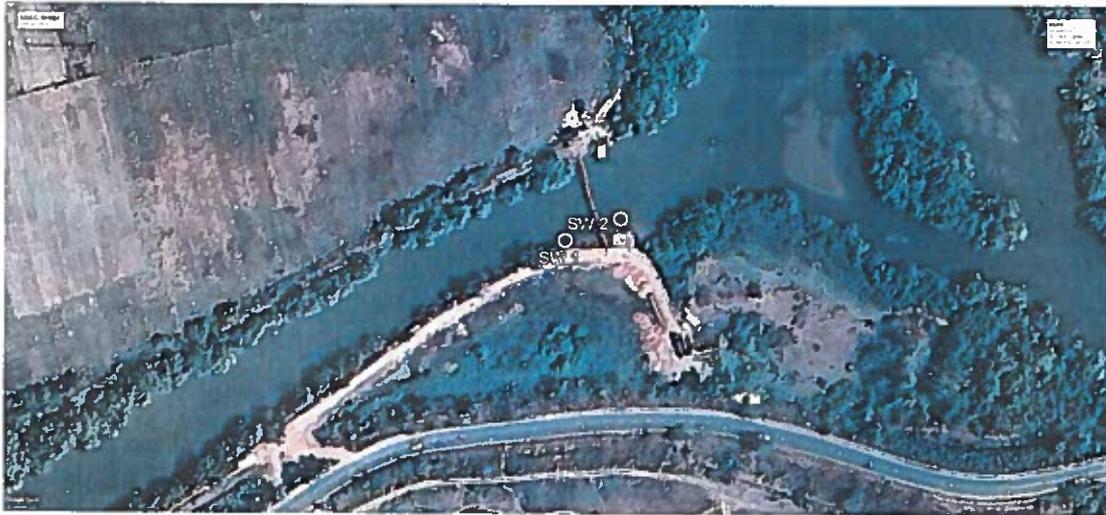


Figure 3.12: Surface Water Sampling Locations

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Table 3.12: Surface Water Analysis Results

Sr. No.	Parameter	Upstream of site	Downstream of site	Tolerance Limits for Inland Surface Waters					Method of Analysis
				Class - A	Class - B	Class - C	Class - D	Class - E	
1.	pH	7.37	7.28	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	IS-3025(P-11) RA2017
2.	Dissolved Oxygen, mg/l	6.8	6.8	6.0	5.0	4.0	4.0	--	IS-3025(P-38) RA2019
3.	Colour, Hazen units	5.0	5.0	10	300	300	--	--	IS-3025(P-4) RA2017
4.	Total Dissolved Solids, mg/l	32980	32470	500	--	1500	--	2100	IS-3025(P-16) RA2017
5.	Chlorides as Cl-, mg/l	13395.8	13495.8	250	--	600	--	600	IS-3025(P-32) RA2019
6.	Ammonia as N, mg/l	<0.5	< 0.5	--	--	--	1.2	--	IS-3025(P-34) RA2019
7.	Phosphorous	<0.2	<0.2	--	--	--	--	--	IS-3025 Part 31-RA 2014
8.	Nitrates as NO3-, mg/l	< 0.5	< 0.5	20	--	50	--	--	APHA-2017(4500NO3-E)
9.	Sodium as Na mg/l	22.5	21.0	--	--	--	--	--	IS-3025(P-45) RA2019
10.	Phenolic compound, mg/l	< 0.05	< 0.05	0.002	0.005	0.005	--	--	IS-3025(P-59) RA2019
11.	Total Suspended Solids	50	40	--	--	--	--	--	IS 3025 (Part 17) RA 2017
12.	Zinc as Zn, mg/l	< 0.01	< 0.01	15	--	15	--	--	IS-3025(P-49) RA2019
13.	Cadmium as Cd, mg/l	< 0.01	< 0.01	0.01	--	0.01	--	--	IS-3025(P-41) RA2019
14.	Lead as Pb, mg/l	< 0.01	< 0.01	0.1	--	0.1	--	--	IS-3025(P-47) RA2019
15.	Hexavalent Cr, mg/l	< 0.2	< 0.2	0.05	1.0	0.05	--	--	IS-3025(P-52) RA2019
16.	Nickel	<0.01	<0.01	--	--	--	--	--	IS-3025(P-54) RA2019
17.	Mercury (as Hg), mg/l	< 0.001	< 0.001	0.001	--	--	--	--	IS-3025 (P-48) RA2019



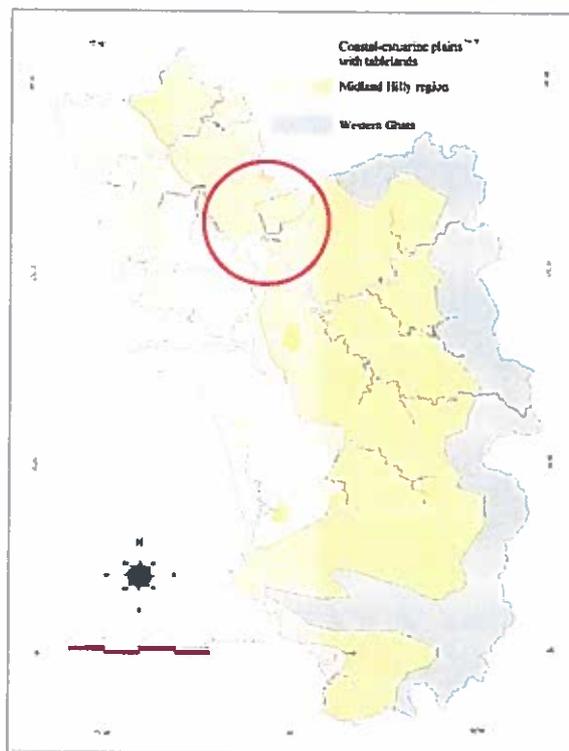
Figure 3.13: Surface Water Sampling Near Site

### 3.5 Biological Environment

#### 3.5.1 Bio-geographical Setting of North Goa District

North Goa & South Goa are the two districts of Goa state, as name indicates situated in northern & southern part of state, respectively, with major part of it falls in coastal plains. Goa has three distinct geographical regions viz. coastal plains, along western boundary, midland plateau and the hill ranges of Sahyadri, part of Western Ghats, situated along eastern boundary. Midland plateau region is the transient region between the coastal plain land agricultural belt to the west and the hilly region undulating towards to the east with most of the non-operational iron ore mines located on the hill slopes in this region.

Coastal plains are typical areas like paddy fields, river side plantations of coconut, confluence of rivers to the Arabian Sea, mudflats, mangrove thickets, sandy beaches etc. Goa's only bird sanctuary, Dr. Salim Ali Bird Sanctuary, situated at Chorao in these plains.



**Figure 3.14: Goa State Bio-Geographical Zones & Study Area**

With respect to bio-geographical zone classification of India, western belt of state (shoreline region) falls under 'Coastal-estuarine Plains with tablelands.

The Project Site falls in Western part of South Goa called as Coastal plain while study area

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encompasses of Bicholim taluka of North Goa & Tiswadi, Phonda Talukas of South Goa.

Hill ranges along the eastern border of the state provide major catchment area and gives origin to prominent rivers, offers prime habitats to wildlife, natural wealth etc. Six protected areas in Goa are situated in these hill ranges as seen from the adjoining map & none of them fall in study area.

Goa has a very large forest cover- according to 'India State of Forest Report, 2021', Forest Survey of India; forest cover in North Goa district is about 53.9% of geographical area, while for South Goa its 66.56%.

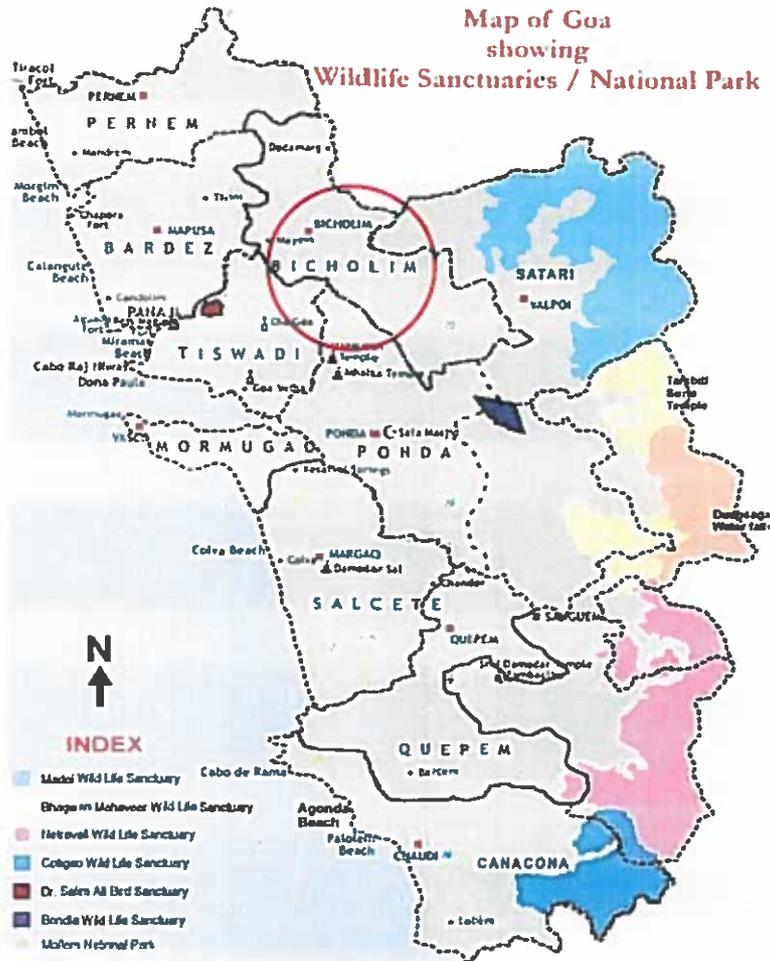
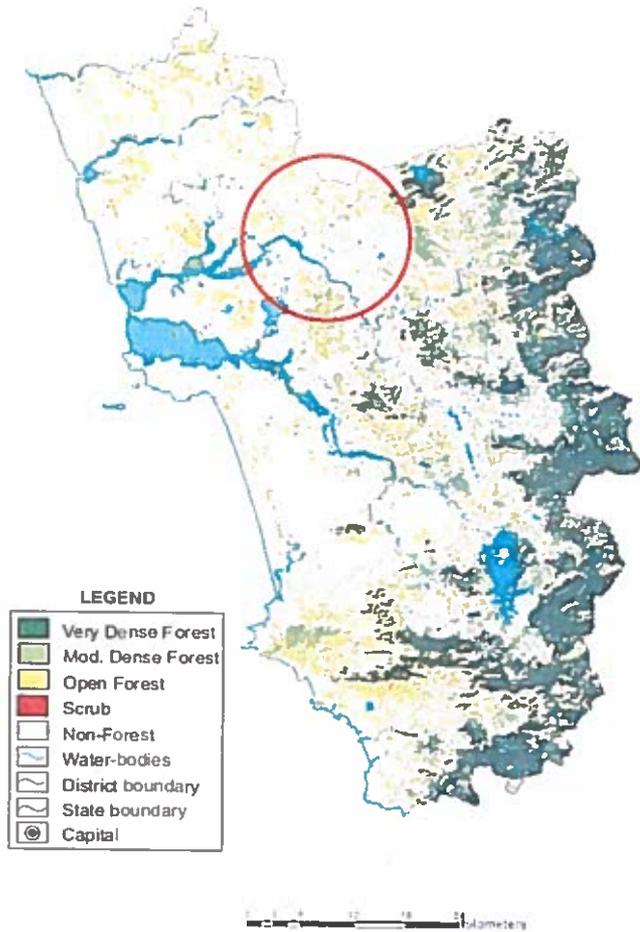


Figure 3.15: Protected Areas in Goa and Appx. Location of Study Area (Red Circle)



**Figure 3.16: Forest Cover of Goa**

According to Champion and Seth 1968, forests in Goa are classified in five types, viz. Tropical Wet Evergreen, Tropical Semi Evergreen, Tropical Moist Deciduous, Littoral & Swamp and Tropical Dry Deciduous.

Forest cover is classified in terms of canopy density classes as given below.

Class	Description
Very Dense Forest	All lands with tree canopy density of 70% and above.
Moderately Dense	Forest All lands with tree canopy density of 40% and more but less than 70%.
Open Forest	All lands with tree canopy density of 10% and more but less than 40%.
Scrub	Degraded Forest lands with canopy density less than 10%.
Non-forest	Lands not included in any of the above classes.

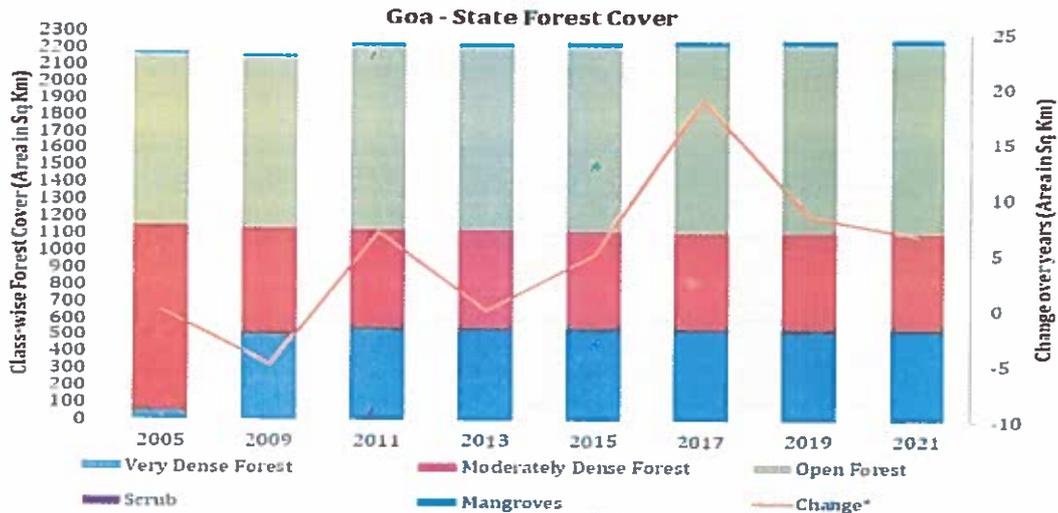


Figure 3.17: Forest Cover in Goa

(Source: India State of Forest Reports, 2003-21, Forest Survey of India)

The chain analysis through historical forest data shows that the only major change over years is that of gradual increase in Mangrove Cover.

District wise Area (km<sup>2</sup>) distribution of forest cover is presented below:

Table 3.13 District wise forest cover (Km<sup>2</sup>), 2021

District	GA**	Very Dense Forest	Moderately Dense Forest	Open Forest	Total	% of GA	Change*	Scrub	Mangrove
North Goa	1,736	127	229.77	578.95	935.72	53.9	2.81	0	20.18
South Goa	1,966	410.53	346.72	551.24	1,308	66.56	3.91	0	7.16
<b>Total</b>	<b>3,702</b>	<b>537.53</b>	<b>576.49</b>	<b>1,130.19</b>	<b>2,244.21</b>	<b>60.62</b>	<b>7</b>	<b>0</b>	<b>27</b>

Source: India State of Forest Report, 2021, Forest Survey of India

\*Change figures are based on comparison of 2021 assessment with that of 2019.

\*\*GA: Geographical Area

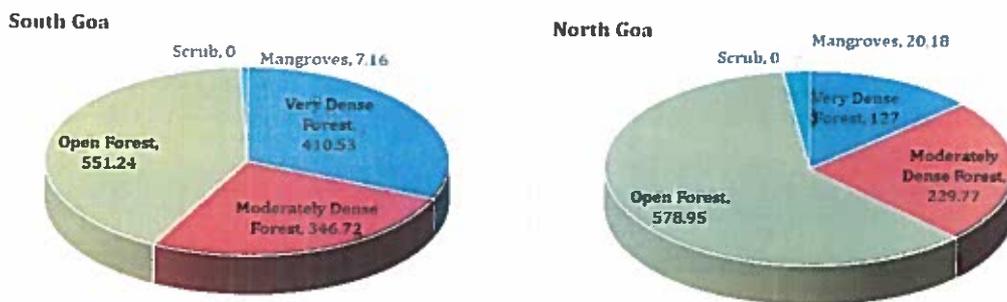


Figure 3.18 Forest Cover in Goa

(Source: India State of Forest Report, 2021, Forest Survey of India)

When compared the North Goa has more Open Forest & Mangrove cover % wrt to South Goa, though the later district hold high % of Goa state GA

**Climate:** The State owing to coastal influence, it experiences low diurnal temperature range, 2500mm annual rainfall and humidity more than 60% throughout the year. The district has 3 types of soils viz. Laterite, Saline and Alluvial; where Lateritic soil is the major soil type in the district; Saline soil occurs in the flood plains of Zuari - Mandovi rivers in Tiswadi, Bardez, Ponda and Pernem talukas; and Alluvial soil occurs as very thin strip along the coastline towards western part of the district.

These climatic and edaphic factors govern the distribution/ growth pattern of vegetation and associated wildlife.

### **3.5.2 Baseline Studies of Study Area**

Ecology & Biodiversity study pertaining to Environmental Impact Assessment Report based on primary & secondary studies was carried out within and 7 km around of project site in summer 2022.

Study area under consideration encompasses part of North Goa & South Goa Districts viz Tiswadi, Bicholim & Phonda Taluka respectively.

The toposheet study shows several distinct land features in the study area. Important landforms are cultivated fields which are generally barren in summer, mud flats often inundated with water, Kazhan lands (reclaimed areas for paddy cultivation), lakes, mangroves, hillocks covered with vegetation (scrubs, dense scrubs, mixed jungles with cashew), settlements and non-operational mines. The hillocks form undulating terrain with a maximum altitude of 374 m. Some of the noteworthy lakes with aquatic flora & avifauna diversity are Karmali and Pilar.

Species and description of habitats mentioned in this report correspond to location, time and season during which study was carried out. These habitats may harbour/ support other set of species which may be found during different seasons of the year. Thus, species list given is not comprehensive.

The study area contains several landscape elements such as rivers and canals, lakes, swamps with stunted mangroves or without significant vegetation, salt pans, mud flats, Kazhan lands, fields, luxuriant mangroves, islands (with one or more landscape elements within them), coconut groves, mining areas (non-operational), hillocks with various recognisable elements such as hard lateritic barren areas, scrub vegetation, mixed forests, cashew plantations, etc. within them. Each habitat has its own attributes which

support typical composition of flora and fauna within them. Study was carried out by visiting locations at dusk, Day and dawn, taking care that all such habitats were covered. Listing of flora and fauna was done based on actual sighting, interviewing locals, indirect evidences, Literature survey of published research works & official sites is done through internet for gathering of secondary information. To ensure maximum coverage of study area, faunal species were noted even 1.5 to 2 Km beyond study area. Occurrences of flora & fauna species in study area are presented in **Annexure V**.

Field visits, reveals presence of major cultivated plains, khazan lands, mangroves & human habitation with intermittent open scrub/ deciduous (Cashew), forming prevailing forest type in the region & each of the relevant kinds of habitats, form study region which have been described as follows.

#### **3.5.2.1 Vegetation**

The landscape elements based on vegetation type is very difficult to classify due to various reasons. The important reasons are: 1) the landscape is heterogeneous showing continuous variability in its physiognomy, 2) the natural vegetation, except in mangroves, found to be absent 3) cashew was commonly seen in vegetated areas, 4) the proportion of cashew or any other cultivated plant (teak, bamboo, pineapple, coconut etc.) in these forest areas are also uneven and 5) degradation of vegetation with mixed plantations. However, the vegetation can be generally classified into five types. They are a) Mangroves, b) Open Scrub, c) Dense Mixed forests (of moist deciduous type), 4) vegetation around and within settlements and 5) Plantations.

The Study area has a few hillocks in North-West edge of study area, majorly having dense deciduous mixed type of vegetation, mostly mixed with cashew. Cashew plantation was commonly practiced on the slopes. The vegetation near Human habitation observed is either planted or absent due to heavy civilization & cultivation.

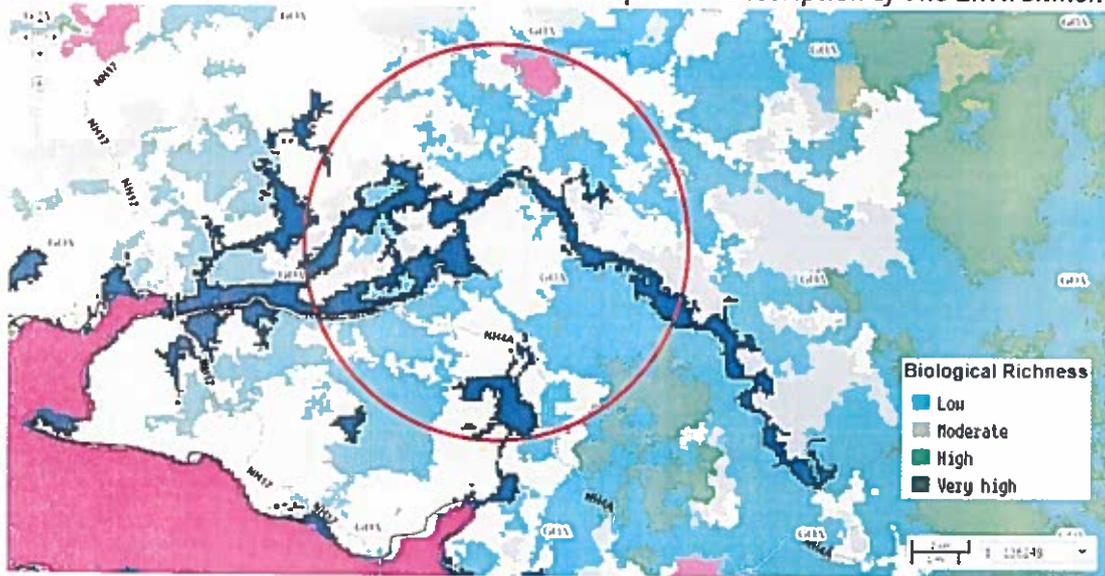


Figure 3.19: Biological richness in the study area (Source: bis.iirs.gov.in/maps)

Maps above shows the biological richness in the study area, that majority of study area is marked low with only southeast showing a patch of high richness ie, has dense mixed forest pattern

**A Mangroves:**

Mangroves are distributed along the Mandovi, the Zuari, Cumbarjua canal and Mapusa river. Mangroves at Chorao forms probably the largest patch in Goa with dense & luxuriant tree strand. This area has been declared as Salim Ali Bird Sanctuary by the Government of Goa & managed by State Forest Department. The ESZ was notified recently in 24<sup>th</sup> Feb 2015, S.O. No. 607, [23.02.2015] & distance of site from ESZ is approx. 8.91km.

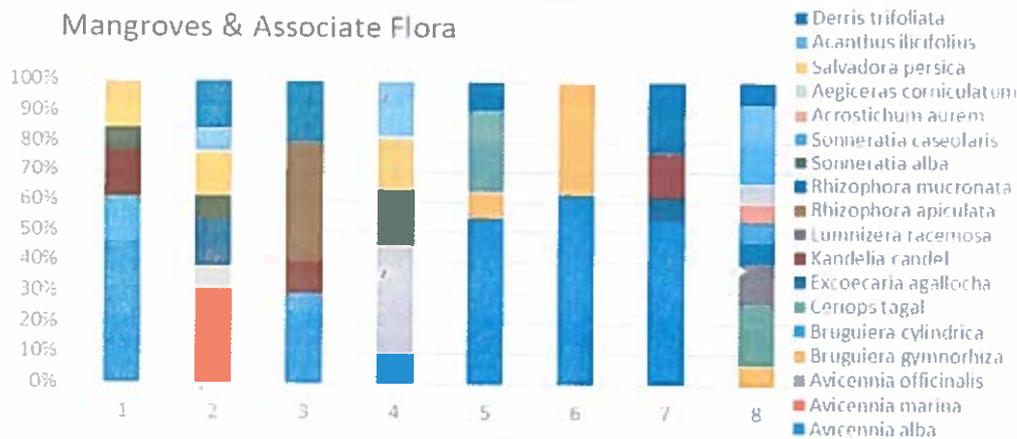


Figure 3.20: Distance from Site to ESZ Dr Salim Ali WLS, approx. 8.91 km

Mangroves were observed in patches/ fringes of various shapes throughout the water course of the study area and has diversity with respect to their composition and physiognomy. Generally, as observed mangroves were stunted on mud flats and mostly composed of *Avicennia* species, *Acanthus ilicifolius* and at times *Sonneratia* species. These patches are seen along the road networks & also along the Cumbarjua canal next to Kazhan lands, Diwar islands, Choraó etc. Presence of mangroves along the riverbank in a thin fringe is a common sight in the study area. The group-wise mangroves presence in study area is as given below.

- A. Type-Major Mangroves: *Avicennia officinalis*, *A. marina*, *Bruguiera cylindrica*, *Kandelia candel*, *Rhizophora mucronata* and *Sonneratia caseolaris*. Out of this six species *A. officinalis* is the most widely populated followed by *Rhizophora mucronata*. The species such as *B. cylindrica*, *Kandelia candel* and *S. caseolaris* are sparsely populated.
- B. Type-Minor Mangroves: *Acanthus ilicifolius*, *Excoecaria agallocha* & *Porteresia coarctata*. Among the minor mangroves *A. ilicifolius* & *E. agallocha* are moderately populated.
- C. Type-Mangrove Associates: *Acrostichum aureum*, *Clerodendrum inerme*, *Derris trifoliata*, *Ipomoea violacea*, *Porteresia coarctata*, *Sesuvium portulacastrum* & *Salvadora persica* is found occasionally growing amidst *Avicennia* spp.

Phyto-sociological study in this habitat was carried out to know Species composition of trees, shrubs, herbs and climbers at each location which are presented below.



**Fig. 3.21: Graph showing floral composition in mangrove habitat in study area**

The composition is found to be dominated by tree sp where *Avicennia* Sp forming the major flora. *Rhizophora*, Inflorescence of *Avicennia* & *Kandelia kandel* (respectively) captured during survey.



Figure 3.22: Photographic Documentation Near Site,

### B Open Scrub

The scrub vegetation was usually seen only in small pocket areas where generally hard lateritic rocks were seen. These lateritic plateaus barely support deep root system required for big tree species. Locally such areas are called as 'Maal' or 'Sada'. Variation is seen even within these scrubs depending upon the extent of lateritic rocks and soil. Open Scrub vegetation is common in some areas such as peaks of the Kundaim area, Kadamba plateau, Bambolim / Chimbil area, from Marcela to Savoiverem area, Eastern side of Mandovi river along Amona, Navelim, Mayne etc. The important plants of scrub vegetation are: *Holarrhena pubescens*, *Grewia nervosa*, *Memecylon umbellatum*, *Ziziphus rugosa*, *Capparis zeylanica*, *Ziziphus oenoplia*, *Carissa congesta*, *Acacia catechu*, *Mimosa intsia*, *Acacia pennata*. These thick scrubs are difficult to penetrate. While at in some of these scrub vegetation occasional tree elements are also seen such as *Ziziphus mauritiana*, *Strychnos nuxvomica*, *Lannea coromandelica*, *Caryota urens*, *Bombax ceiba*, *Zanthoxylum rhetsa*, *Sterculia urens*, *Carallia brachiata* etc. Cashew is commonly grown on such lands and hence it is hard to see natural thick scrub vegetation. It is observed that most of these scrubs have been degraded due to various reasons that include Cashew cultivation, mining, industry, firewood etc.

Phyto-sociological study in this habitat was carried out (figure above during open scrub land visit) to know Species composition of trees, shrubs, herbs and climbers at each location which are presented below.

Floral composition found to be dominated by shrubs followed by herbs and trees. This is typical composition in open scrub land, where tree species are often occasionally found & for number of instance Cashew plantation has overtaken the natural scrub covers.



Figure 3.23: Typical Open Scrub Land During Survey

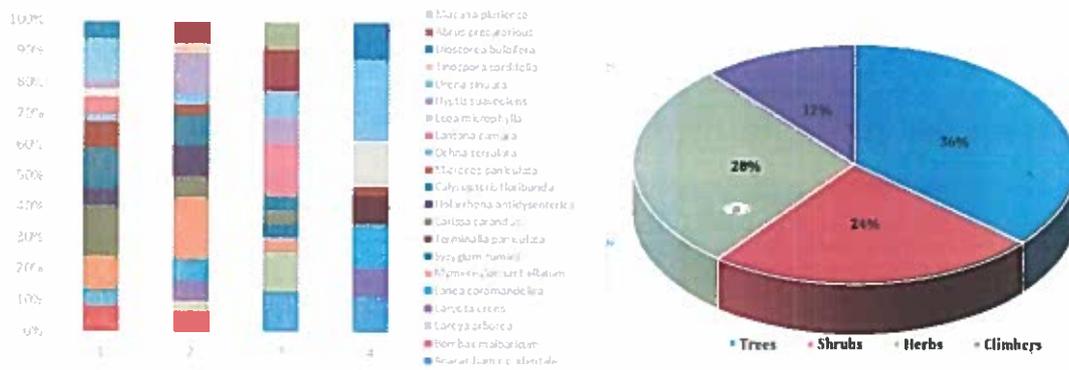


Fig. 3.24: Species Composition in Open Scrub Within Study Area

**C Mixed Forests:**

Mixed type of vegetation is seen along the hill slopes throughout and on hillocks especially between Cumbarjua canal and Mandovi river in the Cuncolem-Priol-Keri-Savoiverem belt.

This type is moist deciduous forest type and in toposheet this is mentioned as open mixed jungle or dense mixed jungle.

Our field studies show that there is not a single patch left, which shows natural strand. They have been degraded to various degrees. Only common thing is the presence of Cashew in every patch though the proportion varies. Apart from Cashew, in some areas especially in Mardol-Priol-Cuncolem belt, pineapple is extensively grown after clearing the undergrowth. In these patches, though tall and mature trees are present there are no young trees or saplings, i.e., in the event of a mature tree dying there are no young plants to fill the gap. However, these forests appear dense.

Mixed forests are mostly seen along the hill slopes and the settlements along the

periphery of these hillocks. Hence, invariably these patches have been subjected to human interference. Heterogeneity is very high in this type of forest in the study area due to different degrees of biotic interference and variations in the habitat. Some settlements such as Marcel are situated on rocky areas.

Phyto-sociological study in this habitat was carried out to know Species composition of trees, shrubs, herbs and climbers at each location which are presented below. Floral composition is found to be dominated by trees followed.



**Fig. 3.25: Species Composition in Dense Mixed Forest Within Study Area**

Floral composition found to be dominated by trees equivalently by herbs followed by shrubs and grasses.

The common natural vegetation observed were *Bombax malbaricum*, *Lanea coromandelica*, *Erythrina indica*, *Terminalia sp* & *Mymeceylon umbellatum* in tree species; *Calycopteris floribunda* in shrub sps.

**D Plantation:**

The pure plantations of coconut, cashew, mango, teak, *Acacia* etc. if are seen only in small patches. Otherwise, the plantations are part of the forests or scrub jungles depending upon the type. Pure Coconut plantations are seen especially in the settlements along the NH4A and the Mandovi banks in interior areas. In the valleys between hillocks, it is basically Arecanut and Coconut plantations (Kulagar). In the areas around Cuncoliem the pineapple plantations (as undergrowth of forest) are extensively seen. However, Cashew remains the most dominant crop throughout study region. It occupies right from lateritic rocky hillocks to well vegetated hill slopes. Between Chora and Mayem it almost gives the appearance of pure plantation though it mixes with the scrub vegetation of the rocky areas. Near Keri and in mining belts small patches of *Acacia* plantations are also seen.

Alphonso Mango & Cashew has changed the face of the livelihood in this region. Organized Plantations and the Farm Based Processing Units have guaranteed men and

women farm labourers round the year employment. In fact, the sector starves from farm labour shortage. For Cashew, Banana, Supari, Mangoes, Pineapples etc. organized plantations are better managed with fences and compounds running on solar energy, irrigation and use of organic material such as vermi-compost and other compost to maintain soil fertility. The perishable Cashew apple which is major part of Cashew Produce is used to extract Alcohol "Fenny", doesn't go waste like in Maharashtra.



Fig. 3.26: Supari Plantation in Study Area

Other cultivated crops are Coconut, Kokum, Areca nut and Jackfruit.

Phyto-sociological study in this habitat was carried out to know Species composition of trees, shrubs, herbs and climbers at each location which are presented below. Floral composition is found to be dominated by trees followed.

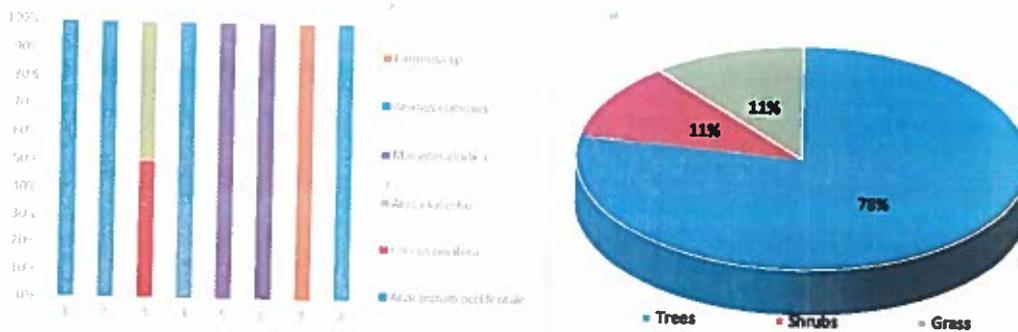


Fig. 3.27: Species Composition in Plantations Within Study Area

3.5.2.2 Agricultural Fields

Agricultural fields were observed within human settlement. Rice is the major crop seen in study area. Besides this, millets and other cereal, pluses are also taken after rice. Agriculture once upon was supplemented by plantation of species like spices, coconut, areca, mango and cashew along with livestock, but now has replaced and taken as main occupation. Once widely cultivated paddy fields now lay as open uncultivated lands.

Typically, locally known vegetables like Navalcol, tambadi bhaji, Chitki, Mirsaang etc were observed widely being cultivated.



Fig. 3.28: Paddy & Vegetable Cultivation Within Study Area

Phyto-sociological study reveals shrubs are dominated followed by herbs & trees (Fig. below). This is mainly because of dry season (no standing crop/ fields were prepared for cultivation). Species composition of trees & shrubs are presented below



Fig. 3.29: Species Composition in Agriculture Fields Within Study Area

3.5.2.3 Human Settlements

Overall, the Google Earth imagery of the study area depicts high built-up area. Number of open lands/plateaus with cultivation are seen intermittently while dense vegetation was absent in the study area

The settlements are primarily dependent on Tourism related activities & occupied by agricultural/horticultural & allied activities. The settlements appear green due to abundant avenue tree growth in and around settlements. Flora within and in ambience of settlement found to be grown from aesthetic, economic or from human benefit point of view. Faunal life observed accordingly. This also includes domesticated fauna. Settlement is dependent on biodiversity of this area like agriculture & horticulture from cashew fruits, fishing & aquacultures etc. The important among them are coconut, mango, jackfruit, kokum, ambada, teak, bamboo etc. As some settlements are linear along the foothills the vegetation of these settlements almost merge with the vegetation from the hillocks. However, Coconut is the dominant plant especially in the settlements close to NH4A.

On the Northeastern part of the study area, mining industry was observed to be dominating. The rocky plateaus and slopes are with sparse scrub vegetation or cashew plantations, though extensive barren rocky outcrops are also very common. Especially in the valleys between the hillocks and mining areas 'Kulagar' system is observed.

Floral composition is found to be dominated by grass & herbs followed by trees. This may be due to plantation of species intentionally for the purpose of beautification, shade, protection from stray/grazing animals and for food value (e.g. public garden, green belt in additional MIDC). Similarly, faunal species of interest such as cattle, domestic animals/birds were inhabited. Non-indigenous species plantation leads to cause interference to local/ indigenous biodiversity.

#### 3.5.2.4 Water Bodies:

The Study area has one of best waterway of Goa ie Cumbarjua Canal. The Mandovi – Zuari are the important rivers, and their basins cover 69% of the total geographical area of the state & are connected by a canal called Cumbarjua canal about 14 km and 11 km away from the mouths of the Mandovi and Zuari estuaries, respectively. The canal is about 17 km in length and about 0.5 km in width. It is narrow and shallow at the Mandovi end while it is appreciably wider and deeper at the Zuari end. The northern side of the canal has two narrow channels, which merge together before meeting the Mandovi estuary. The

Cumbarjua canal is an interesting example of two rivers interacting dynamically through a common channel within the estuarine region. During monsoon season the Cumbarjua canal becomes the only waterway for all the barge and boat traffic to Marmugao through the Zuari River. The fresh water flows out from Mandovi to Zuari through Cumbarjua canal during the monsoon period. This unique water body harbours Schedule I species, connects close to the river mouths consequently tidal influence is seen in the canal.



**Fig. 3.30: Common Fauna Observed in Cumbarjua Canal**

The mangrove forests are extensive along the Mandovi and Zuari estuaries, particularly in the silted up intertidal fringes of the Cumbarjua canal. The mangrove habitat findings are presented in respective sub-section above.

The Study area has Carambolim Lake & is conserved for its avifaunal attraction. A quadrilateral shaped water body surrounded by an embankment having area of 85ha with the Konkan railway line passing on the western boundary of the lake. Fishing, agriculture and grazing in surrounding area are the important land use. Nymphaeaceae flowers are commercially exploited by locals. Wild varieties of rice grow in and around the wetland; 25 varieties have so far been identified. They are a valuable potential resource for plant breeders. Many of the algae and other plants help break down pesticides. The wetland is a permanent source of water for a large area of rabi rice. This is one of the best rice-producing areas in Goa.

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The lake is under the protection of Forest Dept. providing special protection to the migratory birds arriving from Siberia and Kashmir. The moist soil surrounding the lake supports luxuriant growth of grasses, especially in the northern end. The lake is rich with a large variety of fish, insect and algae. It is important from scientific and natural history aspects.



Figure 3.31: Aquatic flora & fauna observed in during survey at Carambolim lake

List of flora and fauna observed/ reported from above habitats are presented in images below and listed in Annexure V For the purpose of listing species even if found/ reported from location, adjacent to habitat, it is included in respective habitat.

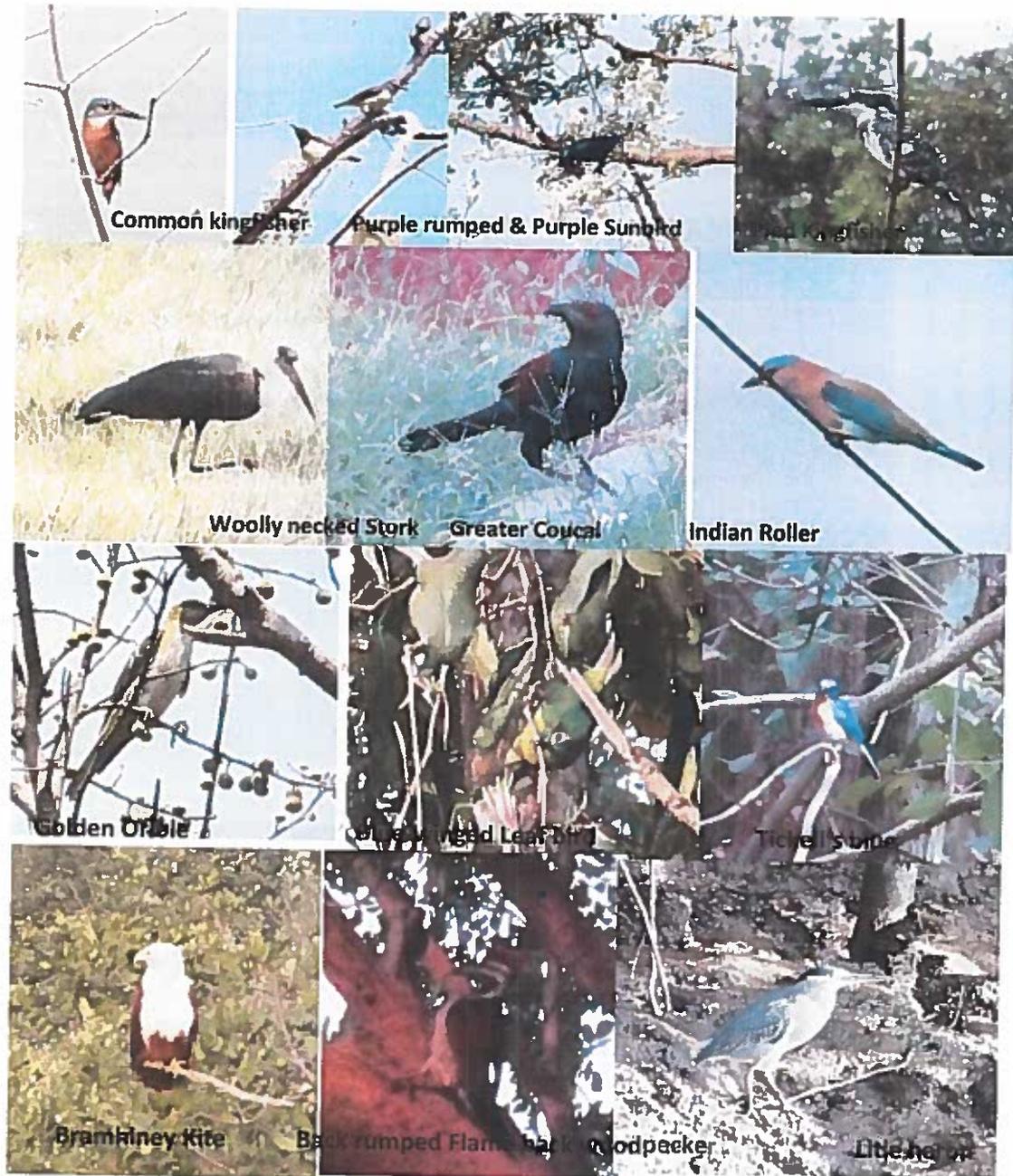


Figure 3.32: Avi-fauna Observed in Study Area



Figure 3.33: Flora Observed in Study Area

3.5.3 Baseline Studies at Site

The site is situated at one of the tributaries of Cumbarjua canal, which shall connect the Chune - Kator to Vanso fields in Cumbarjua village.

Platform like structures at both ends of the bridge were observed during site visit, and temporary support structures in the water course.

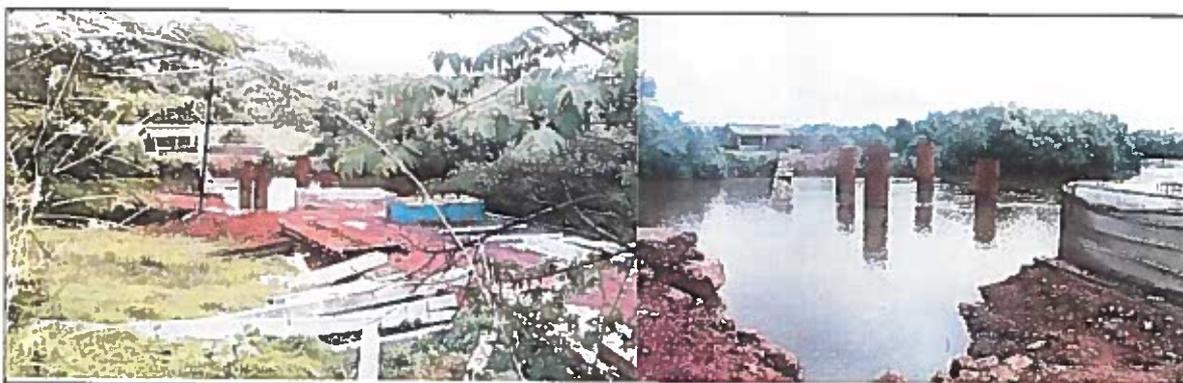


Figure 3.34: Photographic view of site

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The vicinity supports avifauna & healthy aquatic eco-system, with solitary mangroves & few nestlings. While the project location is devoid of mangroves and has solitary growth linearly present along bank & on upstream-downstream sides of the location. Locals were observed fishing in the water course.



**Figure 3.35: Mangroves on Left & Right of Bridge Location**

Across the water course, there are only fields and has no human access from the other side, since it has water channel running along all sides. The below google imagery evidently shows the inaccessibility.



**Figure 3.36: Google-Earth Imagery Showing Bridge Location & Surroundings**

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The fields have muster of peacock, the banks have Drongo's, Waterhen, Kites and number of avian species.

The site has structure as seen in below figure on bank & it is devoid of any major flora, except solitary mangrove standing at distance of aprox 20 m on left & 4 m on right of south Bank, while 11m on left & 3 m on right of north bank.

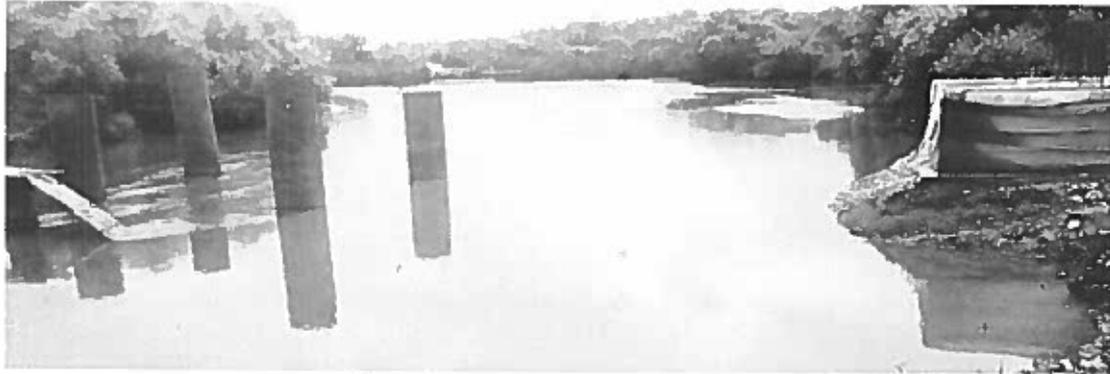


Figure 3.37: Partial View of Site

While faunal listing as per observed during survey is presented in Table & Figure below;



Figure 3.38: Fauna Observed at Site

Table 3.14: List of Fauna Observed/ Evidenced Near Site

Sr. No.	Scientific Name	Common/ Local Name	Family	Status (WPA 1972)
	<b>Birds</b>			
1.	<i>Amaurornis phoenicurus</i>	White breasted Water hen	Rallidae	Sch IV
2.	<i>Ardeola grayii</i>	Indian pond-heron	Ardeidae	Sch IV
3.	<i>Dicrurus macrocercus</i>	Black Drongo	Dicruridae	Sch IV
4.	<i>Egretta garzetta</i>	Little egret	Ardeidae	Sch IV
5.	<i>Halcyon smyrnensis</i>	White-throated Kingfisher	Alcedinidae	Sch IV
6.	<i>Haliastur indus</i>	Brahminy Kite	Accipitridae	Sch IV
7.	<i>Nectarinia zeylonica</i>	Purple rumped Sunbird	Nectariniidae	Sch IV
8.	<i>Pavo cristatus</i>	Peafowl	Phasianidae	Sch IV
9.	<i>Saxicoloides fulicatus</i>	Indian Robin	Muscicapidae	Sch IV
10.	<i>Prinia socialis</i>	Ashy Prinia	Cisticolidae	Sch IV

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Sr. No.	Scientific Name	Common/ Local Name	Family	Status (WPA 1972)
	<b>Butterflies</b>			
1.	<i>Eurema hecabe</i>	Common Grass Yellow	Pieridae	
	<b>Reptile</b>			
1.	<i>Ptyas mucosa</i>	Rat Snake	Colubridae	Sch II
2.	<i>Eutropis carinata</i>	Common Skink	Scincidae	
	<b>Mammals</b>			
1.	<i>Funambulus palmarum</i>	Three striped Squirrel	Sciuridae	
2.	<i>Rattus sp.</i>	Rat	Muridae	Sch IV

**Observations & Conclusions in Study area:**

1. Vegetables are grown alternating paddy cultivations
2. There is no 'virgin' vegetation in the area except mangroves.
3. Mangroves form prominent vegetation type though the number of species is limited.
4. Other major types of vegetation are scrubs and mixed forests. Both of them are often planted with Cashew, Mango etc.
5. Though, 3 Schedule I species were observed within study area, considering pending project activities, location, nature and magnitude of the project; preparation of species/ wildlife conservation plan is not envisaged.
6. The locals here are predominantly fishing in this dense estuarine network is for staple daily consumptions & nominal solitary selling.

Fishing & paddy, local vegetables form the lifestyle essence of the study region

Considering above the proposed project shall facilitate the to & fro activity of agricultural tools & equipment with ease, further beyond during construction temporary impacts, the proposed activity envisages negligible impact.

### 3.6 Marine Environment

#### 3.6.1 Physico-Chemical Quality

Water quality characteristics studied with conventional variables (e.g. Depth, Air temperature, Water temperature, Salinity, pH, Dissolved Oxygen, Ammoniacal nitrogen, Nitrite Nitrogen, Nitrate Nitrogen, Inorganic Phosphate) intended for EIA.

Considering pending work and its magnitude in marine environment, baseline environment was studied at 2 locations, Station 1 & 2 and supported with secondary data from 2 locations, Station 3 & 4. The locations are shown in google imagery below. Results of marine water & sediment quality are presented in tables under respective sections and observations are discussed.

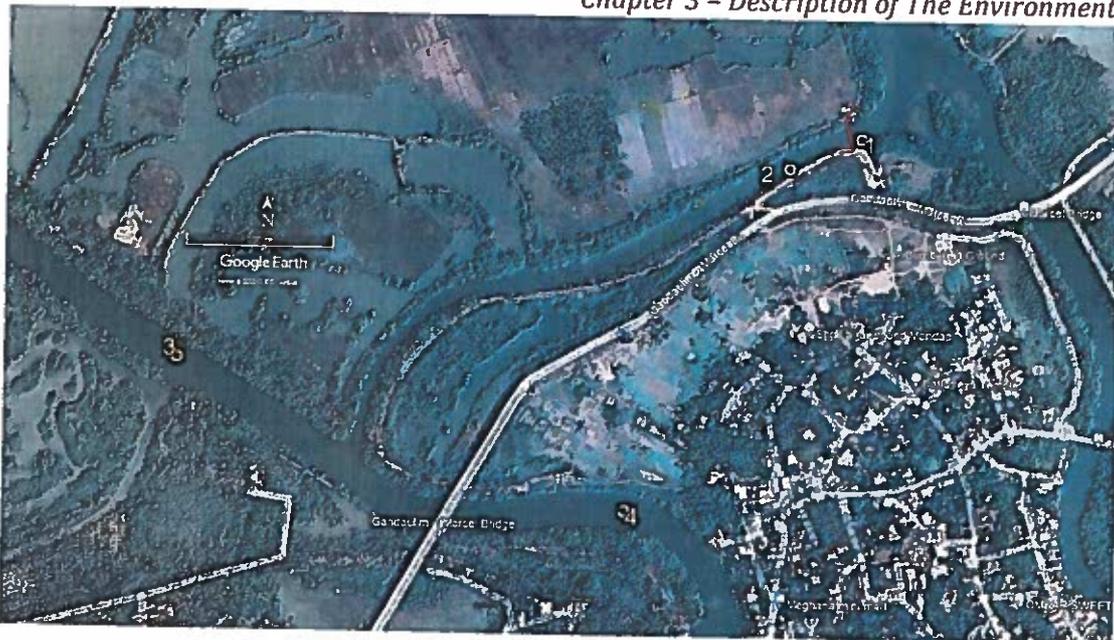


Figure 3-39 Marine Sampling Locations

The table below gives a description about the station locations and their significance

Table 3.15: Sampling Details

Subtidal Spots (water & sediment quality)	Primary (Near Site)		Secondary (Cumbarjua Canal)	
	1	2	3	4
	15°31'12.68"N 73°56'46.51"E	15°31'11.57"N 73°56'43.25"E	15°31'02.89"N 73°56'15.20"E	15°30'56.29"N 73°56'36.05"E

### 3.6.1.1 Water Quality

Marine organisms, which grow in waters of estuaries/ sea, derive their requirements from the surrounding seawater. Growth and productivity of various organisms in general, are controlled by the environmental factors such as temperature, salinity and nutrient availability in the water. Fluctuations in nutrient availability in waters affect growth rate of organisms & it is important to consider chemical composition of marine-waters along with other physico-chemical parameters.

Table 3.16: Marine Water Quality

Parameter	Level	Primary (Near Site)		Secondary (Cumbarjua Canal)	
		1	2	3	4
Water Depth (m)	Surface	1.25	2.55	3.75	3
Temperature (°C)	Surface	30	30	31	31
	Bottom	-	-	29	29
pH	Surface	7.7	7.75	7.75	7.9
	Bottom	-	-	8.1	8
Salinity (PPT)	Surface	19	19	30	30

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Parameter	Level	Primary (Near Site)		Secondary (Cumbarjua Canal)	
		1	2	3	4
	Bottom	-	-	29	28
DO mg/l	Surface	2.23	2.4	3.98	4.12
	Bottom	-	-	2.7	4.12
PO <sub>4</sub> -P (μmol/l)	Surface	0.72	0.84	1.05	0.91
	Bottom	-	-	1.39	1.63
NO <sub>3</sub> -N (μmol/l)	Surface	6.8	7.9	17.87	2.97
	Bottom	-	-	3.14	2.84
NO <sub>2</sub> -N (μmol/l)	Surface	0.27	0.33	0.4	0.45
	Bottom	-	-	0.38	0.58
NH <sub>4</sub> <sup>+</sup> -N (μmol/l)	Surface	14.2	13.7	18.4	10.69
	Bottom	-	-	4.97	6.53

Where: BDL is Below Detectable Limit and Detectable Limit is 0.01.

Water depth varied from 1.3 to 2.6 m near site & 3 to 3.8 m in Cumbarjua canal. Water temperature during collections varying in small range of 29°C to 31°C. pH varied during collections in a small range of 7.5 to 7.75 near site while varies from 7.75 to 8.1 in Cumbarjua canal with Salinity range from 19 in near site to 30 in Cumbarjua canal.

Dissolved Oxygen near site shows lower values as compared to Cumbarjua canal values, overall, the water column seems healthy.

Phosphate concentration was high in Cumbarjua than near site locations while relatively lower concentrations of Nitrite-nitrate were noted in overall observations & w.r.t. Cumbarjua.

Physico-chem values doesn't show any specific trend. The overall water quality results indicate water quality isn't under much stress or degraded.

### 3.6.1.2 Sediment Characteristics

Sediments are one of the important components of aquatic ecosystem. Sediment type and its characteristics play a major role in defining the limits of benthic fauna and its density and diversity. Sediment also acts as sink and source for chemical elements and nutrients.

**Table 3.17: Sub-tidal & Inter-tidal Sediment Quality**

Parameter (Unit)		Primary (Near Site)		Secondary (Cumbarjua Canal)	
		1	2	3	4
	pH	7.5	7.3	8.1	7.85
Texture%	Sand	37.8	39.3	52.11	77.12
	Silt	56.9	54.8	45.64	20.99
	Clay	5.3	5.9	2.24	1.89
Total Organic carbon %		0.12	0.9	0.96	0.3

pH in sediments, showed lower values at station 1 & 2 while in Cumbarjua canal values were higher at stations 3 and 4 indicating influence of influx of saline water from Mandovi estuary.

Percentage of Silt was highest, with second presence of gravel & sand presence, while clay being the lowest in percentage. Study area is largely constituting coarser sediments (sand and silt) with less clay. Organic carbon in sediments varies between 0.12 to 0.96 %.

### 3.6.1 Biological Components

Several ecological processes determine the distribution, abundance and production of organisms. In the study area, there is low activity limited to local ferry and boat traffic, that too in the Cumbarjua canal due to halt in mining activity, while in the sub-canal the only occasional activity is that of solitary local fishers.

Specific biological components of different trophic levels such as phytoplankton, Zooplankton Benthic organisms were studied to know marine ecosystem. Analysis results are presented in subsequent paragraphs.

#### 3.6.1.1 Microbiology

The results are given in table below.

**Table 3.18: Microbiology**

Parameter	Level	Primary (Near Site)		Secondary (Cumbarjua Canal)	
		1	2	3	4
TVC (c.f.u/ml)	Surface	3	3	5	4
	Bottom	-	-	4	16
TVC (c.f.u/ml)		12	14	10	46

Bacterial population in sediment is higher than water while lower wrt Cumbarjua canal.

#### 3.6.1.2 Phytoplankton

The marine health status was primarily studied through parameters like chlorophyll, cell density and generic diversity study, summarized in table below:

**Table 3.19: Phytoplankton Standing Stock**

Parameter	Water Level	Primary (Near Site)		Secondary (Cumbarjua Canal)	
		1	2	3	4
Chl-a (mg/m <sup>3</sup> )	S	4.2	3.8	2.2	3.74
	B	-	-	-	-
Cell Count (No x 10 <sup>3</sup> /L)	S	93.2	84.4	126	166.82
	B	-	-	-	-
Total Genera (No)	S	6	7	16	14
	B	-	-	-	-
Major Genera	S	<i>Thalassionema</i> sp., <i>Nitzschia</i> sp., <i>Pseudo-nitzschia</i> sp., <i>Thalassiosira</i> sp., <i>Alexandrium</i> sp., <i>Pinnularia</i> sp., <i>Ditylum</i> sp., <i>Chaetoceros</i> sp., <i>Navicula</i> sp., <i>Coscinodiscus</i> sp., <i>Cylindrotheca</i> sp.,			
	B	-	-	-	-

Phytoplankton diversity varied largely, with only predominant presented in table above.

**3.6.1.3 Zooplankton**

Secondary level biotic component of marine life was assessed through zooplankton standing stock. Zooplanktons constituted mainly Copepods, Decapoda larvae, Cumaceans Chaetognatha Lucifer sp., Polychaete larvae and Fish larvae (Chordata) with abundance of Brachyuran larvae and Euphausiids.

**Table 3.20: Zooplankton Standing Stock**

Parameter	Primary (Near Site)		Secondary (Cumbarjua Canal)	
	1	2	3	4
Biomass (ml/100m <sup>3</sup> )	4	6	29	NIL
Population Density (no x 10 <sup>3</sup> /100m <sup>3</sup> )	420	525	2500	NIL
	4	4	7	6
Major Groups	Copepoda, Decapoda Larvae, Fish larvae, Cladocerans		Copepoda, Decapoda Larvae, Polychaeta, Chaetognaths, Fish larvae, Cumacean, Lucifer	

Copepoda being the major component of standing stock & abundant in the study region.

**3.7.3.1 Macro-Benthic Composition**

Macro benthos studies showed typical benthic pattern. The faunal composition includes Polychaeta, Bivalves, Gastropoda, Crabs & Amphipoda

**Table 3.21: Benthic Fauna in Study Area**

Parameter	Primary (Near Site)		Secondary (Cumbarjua Canal)	
	1	2	3	4
Population Density (no x 10 <sup>2</sup> /m <sup>2</sup> )	0.02	0.94	1.0	3.5
Biomass (gm/ m <sup>2</sup> )	0.001	0.02	0.3	0.9
Total Groups	Polycheates, Gastropods, Crab		Polycheates, Gastropods, Bivalves, Amphipoda	

It is evident from the above that Polychaetes abundant in the system.

**Conclusions:** The results as per above discussions shows average physico-chem values along-with lower values for chlorophyll, phytoplankton, zooplankton & benthic population overall showing an average marine environment at study locations. The biota population doesn't show any specific trend.

Considering the proposed activity, the impact of same on the marine water & sediment quality is negligible.

### 3.7 Socio Economic Environment

#### 3.7.1 Project Details

Reconnaissance near site reveals that, presently Cumbarjua farmers having fields in Jua CT have to cross the tributary from Cumbarjua by ferry/boat to Jua CT to access their fields. The bridge which will fulfil long-standing demand of local farmers to access their fields. The bridge will cater to foot traffic and tractor movement.

#### 3.7.2 Study Area

The study area was distributed in 3 zones (0-2 km & 2-5 km & 5-7 km radius) for detail study. Parameters selected for baseline information on socio-economic components were demographic structure, infrastructure base in the area, economic structure, health status, and cultural attributes, socio-economic status in relation to quality of life and public awareness & public concern about the project. Relevant information was collected from randomly selected villages.

#### 3.7.3 Administrative details

Study area encompasses villages from 3 talukas of North Goa district; majority are from Tiswadi taluka. Details are presented in Table below.

**Table 3.22: Administrative details**

Sr. No	District	Taluka	No of Villages	No of Town
<b>0-2 km</b>				
1.	North Goa	Tiswadi	02	01
2.	North Goa	Ponda	0	01
<b>2-5 km</b>				
3.	North Goa	Tiswadi	5	3
4.	North Goa	Ponda	2	0
5.	North Goa	Bicholim	2	0
<b>5-7 km</b>				
6.	North Goa	Ponda	2	0
7.	North Goa	Tiswadi	5	0
8.	North Goa	Bicholim	3	0
<b>Total</b>			<b>22</b>	<b>5</b>

Source: Primary census abstract 2011, District North Goa, state Goa

## 3.7.4 Census Details

Demographic details such as number of persons per household, total area, population density, sex ratio, SC and ST population, literacy rate and employment pattern are summarized in table below.

Table 3.23: Census Details

Sr. No	Talu ka	Town/ Villag e	Name	Type	Total Househ old	Total Populat ion	Total Male	Total Fema le	0-6 Child Populati on	popul ation SC	Popul ation ST	Total Literat e	Total Illitera te	Total Work er	Main Work er	Margin al Worker	Non- Work er
<b>0-2 km</b>																	
1	Tisw adi	62672 7	Jua (CT)	Urban	1057	4134	1971	2163	332	38	84	3484	650	1455	1294	161	2679
2	Tisw adi	62672 8	Cumbarjua (CT)	Urban	1121	4917	2557	2360	426	45	686	4076	841	2171	1789	382	2746
3	Tisw adi	62671 3	Gandaulim	Rural	73	301	144	157	32	0	0	255	46	96	80	16	205
4	Ponda	62686 5	Candola (CT)	Urban	1280	5354	2742	2612	532	26	806	4353	1001	2223	1946	277	3131
<b>Sub Total</b>					<b>3531</b>	<b>14706</b>	<b>7414</b>	<b>7292</b>	<b>1322</b>	<b>109</b>	<b>1576</b>	<b>12168</b>	<b>2538</b>	<b>5945</b>	<b>5109</b>	<b>836</b>	<b>8761</b>
<b>2-5 km</b>																	
5	Ponda	62684 3	Tivrem	Rural	454	1878	960	918	156	18	123	1567	311	757	648	109	1121
6	Ponda	62684 4	Betqui	Rural	382	1707	871	836	151	80	698	1321	386	633	366	267	1074
7	Tisw adi	62672 9	Corlim (CT)	Urban	1583	6568	3386	3182	718	36	1207	5245	1323	2960	2462	498	3608
8	Tisw adi	62671 1	Malar	Rural	382	1630	813	817	119	5	77	1397	233	653	600	53	977
9	Tisw adi	62671 0	Goltim	Rural	423	1634	755	879	125	8	262	1390	244	573	563	10	1061

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Sr. No	Taluka	Town/Village	Name	Type	Total Household	Total Population	Total Male	Total Female	0-6 Child Population	population SC	Population ST	Total Literate	Total Illiterate	Total Worker	Main Worker	Margin Worker	Non-Worker
10	Tiswadi	626714	Ella	Rural	1258	5372	2702	2670	629	62	386	4272	1100	2073	1709	364	3299
11	Tiswadi	626734	Goa Velha (CT)	Urban	1055	4322	2129	2193	427	20	116	3473	849	1771	1506	265	2551
12	Tiswadi	626729	Corlim (CT)	Urban	1583	6568	3386	3182	718	36	1207	5245	1323	2960	2462	498	3608
13	Tiswadi	626718	Carambolim	Rural	1195	5179	2518	2661	491	62	2299	4079	1100	2058	1825	233	3121
14	Tiswadi	626712	Naroad	Rural	119	487	239	248	34	0	31	411	76	144	124	20	343
15	Bicholim	626758	Amone	Rural	694	2963	1482	1481	296	15	0	2437	526	1005	847	158	1958
16	Bicholim	626756	Piligao	Rural	600	2643	1295	1348	233	44	1009	2123	520	990	679	311	1653
<b>Sub Total</b>					<b>9728</b>	<b>40951</b>	<b>20536</b>	<b>20415</b>	<b>4097</b>	<b>386</b>	<b>7415</b>	<b>32960</b>	<b>7991</b>	<b>16577</b>	<b>13791</b>	<b>2786</b>	<b>24374</b>
<b>5-7 Km</b>																	
17	Ponda	626848	Boma	Rural	653	2807	1467	1340	284	8	710	2165	642	1359	1118	241	1448
18	Ponda	626847	Adcolna	Rural	385	1688	883	805	188	10	457	1288	400	677	577	100	1011
19	Tiswadi	626709	Navelim	Rural	280	1133	522	611	96	18	295	909	224	387	318	69	746
20	Tiswadi	626707	Caraim	Rural	44	202	103	99	13	0	4	181	21	68	57	11	134
21	Tiswadi	626706	Chorao	Rural	1202	5268	2604	2664	462	87	440	4235	1033	2010	1666	344	3258
22	Tiswadi	626715	Bainguinim	Rural	388	1501	754	747	162	1	10	1212	289	685	622	63	816

Sr. No	Talu ka	Town/ Villag e	Name	Type	Total Househ old	Total Populat ion	Total Male	Total Femal e	0-6 Child Populati on	popul ation SC	Popul ation ST	Total Literat e	Total Illitera te	Total Work er	Main Work er	Margin al Worker	Non- Work er
23	Tisw adi	62671 9	Azossi m	Rur al	270	1142	574	568	103	0	237	922	220	401	362	39	741
24	Bich olim	62675 2	Maem	Rur al	1728	7544	3763	3781	710	76	0	6127	1417	2878	2358	520	4666
25	Bich olim	62675 3	Vaingui nim	Rur al	156	706	347	359	58	0	1	613	93	239	188	51	467
26	Bich olim	62675 4	Aturli	Rur al	112	467	234	233	47	0	0	362	105	186	148	38	281
<b>Sub Total</b>					<b>5218</b>	<b>22458</b>	<b>11251</b>	<b>11207</b>	<b>2123</b>	<b>200</b>	<b>2154</b>	<b>18014</b>	<b>4444</b>	<b>8890</b>	<b>7414</b>	<b>1476</b>	<b>13568</b>
<b>Grand Total</b>					<b>18477</b>	<b>78115</b>	<b>39201</b>	<b>38914</b>	<b>7542</b>	<b>695</b>	<b>11145</b>	<b>63142</b>	<b>14973</b>	<b>31412</b>	<b>26314</b>	<b>5098</b>	<b>46703</b>

Source: Primary census abstract 2011, District North Goa, state Goa

**3.7.4.1 Census Structure of Study Area**

Following information is gathered and reproduces from data published in Census 2011.

- Total population of study area was 78115 out of which male 39201 (50.18%) and female 38914 (49.82%).
- Total no. of households were 18477, average occupancy 4.22 persons per household.
- Total child (below 6 years age) population was 7542 (9.65%).
- Total SC population was 695 (0.88%) & ST 11145 (14.26%).
- Sex ratio (number of females to per 1000 males) of the total population was 993.
- Overall literate population in the study area were 63143 (80.84%).
- Total worker population in the study area was 31412 (40%).
- Main workers were 26314 (34%) and marginal workers were 5098 (6%). Total non-working population was 46703 (60%).

**3.7.5 Methodology Used for the Field Survey**

In order to access and evaluate likely impacts arising out of any development projects on socio-economic environment, it is necessary to gauge the apprehensions of the people in the study areas.

**3.7.5.1 Methodology Applied for Selection of Sample & Data Collection**

The project is related to farmers who are engaged in farming activities at Jua Island and don't have proper road access/ infrastructure to cross the tributary of Cumbarjua canal/ Mandovi river to reach their farms. Purposive sampling method applied for the survey & 100% farmers were surveyed who are engaged in farming activities at Jua (65 farmers covering both, Cumbarjua and Jua). In Cumbarjua, interactions were carried out with the locals by Focus Group Discussion method. Details of consultation are given in table below. The survey included structured questions (fixed and alternative). The questionnaire mainly highlighted the parameters such as income, employment, literacy, age group to assess the standard of living of that particular region and general awareness, opinion and expectation of the respondents about the proposed project.

**Table 3.24: Level of Consultation**

Level	Type of survey format	Key participants
Individual	Farmer household survey	People including those are impacted directly
Settlement	FGD	Villagers of Cumbarjua village
Govt. office	Discussion	Gram Panchayat Sarpanch and Members

## 3.7.5.2 Site Visit

Site visit was conducted by Socio-economic team of AESPL for socio-economic studies from 19<sup>th</sup> June 2022 to 21<sup>st</sup> June 2022. Survey team carried out the survey in Cumbarjua & Jua. Different types of survey format (farmers survey & Focus group discussion) were used to record the observations, concerns, apprehensions of local farmers. Coverage of survey and farmers interacted during survey are given in subsequent tables.

Table 3.25: Socio-economic Sampling Location

Sr. No.	Sampling Location	Farmer Household covered
1.	Jua	2
2.	Cumbarjua	63
3.	Focus group discussion at Cumbarjua village	1

Source: Primary survey

Table 3.26: Persons Interacted during Survey

Sr. No.	Name	CT/ Location	Sr. No.	Name	CT/ Location
1.	Ramesh Vaman Naik	Cumbarjua	2.	Ghanshyam Wasu Naik	Cumbarjua
3.	Madhukar Ramchandra Sawant	Cumbarjua	4.	Shana Bai Kanta Amonkar	Cumbarjua
5.	Surekha Gangadhar Raikar	Cumbarjua	6.	Shubhanji Nagesh Rayker	Cumbarjua
7.	Dinesh Anant Bandudkar	Cumbarjua	8.	Subash Raykar	Cumbarjua
9.	Kashinath Janardan Phadte	Cumbarjua	10.	Sumitra Amonkar	Cumbarjua
11.	Rohit Jirrotam Desai	Cumbarjua	12.	Samiti Gavade	Cumbarjua
13.	Sanju Waman Naik	Cumbarjua	14.	Yogesh Naik	Cumbarjua
15.	Gajanan Pandurang Mopkar	Cumbarjua	16.	Virayan Desai	Cumbarjua
17.	Suhasini Kashinath Phadte	Cumbarjua	18.	Yoganand Tarai	Cumbarjua
19.	Swapnil Narhari Bhosle	Cumbarjua	20.	Ramchandra Naik	Cumbarjua
21.	Shantaram V Mopkar	Cumbarjua	22.	Surevsh koregankar	Cumbarjua
23.	Salil Ganpat Bandurkar	Cumbarjua	24.	Sujata Bhasale	Cumbarjua
25.	Saukand Vinayak Padte	Cumbarjua	26.	Ramnath Bhosle	Cumbarjua
27.	Satish Shira Morye	Cumbarjua	28.	Ashok Govind Bhosale	Cumbarjua
29.	Arun Gajanan Naik	Cumbarjua	30.	Kamal Pandurang Gavade	Cumbarjua
31.	Manohar Ramchandra Naik	Cumbarjua	32.	Laxmikant Yeso Gavade	Cumbarjua
33.	Sudha Vaman Bhosale	Cumbarjua	34.	Namita Pandurang Raikar	Cumbarjua
35.	Uday S. Bhosale	Cumbarjua	36.	Shaba Mohan Malvankar	Cumbarjua
37.	Sadanand Rajaram Bhosale	Cumbarjua	38.	Tulsidas Phadeke	Cumbarjua
39.	Diksha Damodar Bhosale	Cumbarjua	40.	Mahadev Parab	Cumbarjua
41.	Sukdu Namdev Bhosale	Cumbarjua	42.	Bharna Banddas Sawant	Cumbarjua
43.	Gurudas S. Parab	Cumbarjua	44.	Rajesh Sawant	Cumbarjua
45.	Anil Gajanan Gavale	Cumbarjua	46.	Anandibai Parolkar	Cumbarjua
47.	Kalidas Vasant Mopkar	Cumbarjua	48.	Mahesh Desai	Cumbarjua
49.	Anand Narayan Shetye	Cumbarjua	50.	Anuj Raikar	Cumbarjua
51.	Pramavati Datta Usapakar	Cumbarjua	52.	chudu Bhomaikar	Cumbarjua
53.	Ramesh Umakant Sawant	Cumbarjua	54.	Supriya Naik	Cumbarjua
55.	Uday Gajanan Shetakar	Cumbarjua	56.	Kamlawati Naik	Cumbarjua

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Sr. No.	Name	CT/ Location	Sr. No.	Name	CT/ Location
57.	Datta Aataram More	Cumbarjua	58.	Suhad Phadke	Cumbarjua
59.	Prasad Tulsidas Naik	Cumbarjua	60.	Ranjru Sawant	Cumbarjua
61.	Julie M. Parab	Cumbarjua	62.	Mahesh Sawant	Cumbarjua
63.	Suryakant Appa more	Cumbarjua	64.	Sanju Naik	Jua
65.	Sanju Waman Naik	Jua			

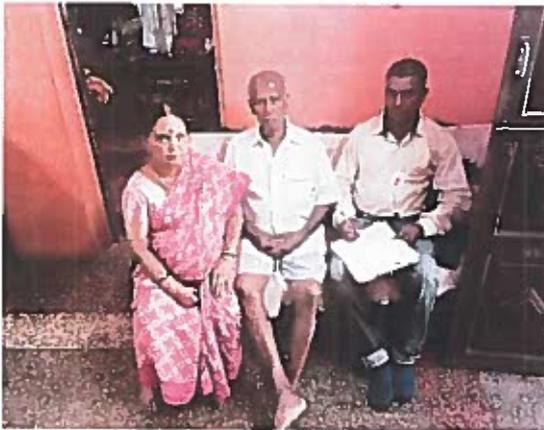
Source: Primary survey



Mr. Babulo Bhosale & Family



Mr. Devenand Raikar & Family



Mr. Kashinath Fadte & Family



Mr. Sameer Bhosale & Family



Mr. Nilam Parab



Mr. Baburao Bhosle



Mr. Lakshmikant Shetkar &amp; Family

Mr. Mahesh Sawant &amp; Family

**Figure 3.40: Glimpse of Interaction with Farmers**

### 3.7.5.3 Data Collection and Quality Assurance

Available data have been compiled to generate existing socio-economic scenario of study area. Information on socio-economic profile was collected from Primary Census Abstract CD 2011 of Goa state, other details of the surveyed area collected through survey formats.

### 3.7.6 Salient Observation of the Farmers Survey

Following details are outcome of primary survey conducted by AESPL Team:

- Total 227 people in the 65 families, 47% of the population belongs to working age group (between 16 and 45 years).

**Table 3.27: Demographic Profile of 65 Farmers Families**

Age group	0-6	7-15	16-45	46-60	Above 60
Number of people	1	6	108	55	57
Percentage	0.44	2.64	47.57	24.22	25.11

Source: Primary survey by AESPL

- 41 households are APL card holder & 24 are BPL card holder.
- All 65 families belong to Hindu religion; 57% Open, 9% ST & 34% OBC.
- 40% farmer families hold < 2.5 acre land, that means small landholders' families are more in Cumburjua. Total agricultural land of 65 families is 404100 m<sup>2</sup> (99.85 acres).

**Table 3.28: Land Holder Details**

Agriculture Land (m <sup>2</sup> )	Number of Landowner Families
10000 Above	15
5000 -10000	26
1000-4999	24
<b>Total</b>	<b>65</b>

- Literacy rate in farmer population is 88% out of which, 59% members are educated till 10<sup>th</sup> standard.

## Chapter 3 – Description of The Environment

- Out of 65 famers families, 102 (44.93%) individuals are non workers. Majority of the workers are in service/job category. Only 15 members are engaged in cultivation as a primary work. This is mainly because of poor or no road infrastructure to reach agricultural land especially when fields are surrounded by river.

Table 3.29: Current Employment Pattern In 65 Farmers Family

Occupation	Cultivation	Service/job	Business	Artist/Drama actor	Pensioner	Non-Worker
No. of people	15	55	15	11	29	102
%	6.60%	24.22%	6.60%	4.84%	12.77%	44.93%

- Discussion with farmers revealed that all 65 families are facing difficulties in farming activities due to no/ poor road access to their farm. Though they have agricultural land but due to non-availability of roadways they are unable to utilize full potential. To reach fields on Jua Island, farmers are depended on canoe/ boats or ferry service. One roadway in Jua is too long, takes unjustifiable time to reach the farms thus not suitable for the farmers.
- Farming activities are dependent on rain, during monsoon when water level rises, use of canoe/ boat is not safe and hampers transportation of tractor and labour. Increase in ferry charges makes it more difficult and non-affordable to the farmers. Owing to this, farmers are not able to earn good income from farming activities.
- Farmers are interested to practice horticulture/ double cropping but due to time consuming, high labour charges and safety issues in transportation, they are unable to do any farming activities. Resulting in unable to earn income and field remain unproductive, season by season fallow/ unproductive land is increasing making agriculture productivity of the state decrease.
- During the survey, questions related to "Construction of bridge for local farmers to cross river stream for cultivation of fields from Chune – Kator to Vanso fields in villages Cumbarjua & Jua were asked to farmers and locals. All 65 farmer families said that there is an urgent need of the bridge.
- Farmers are of the opinion that the bridge will give safe and easy road access to transport tractor, agricultural produce, farming implements, material and fertilizers which will save time, money and efforts.
- Group discussion with non-farmer population also gave positive response on bridge construction. They said that the bridge will be helpful for the farmers and locals can get rice at cheap rate due to expected increase in rice production.

## 4 ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

### 4.1 Introduction

The project has already started construction work on ground and completed 8 piles, pile caps and fabrication work of arch. As these activities are completed prior to engagement and conduct of environmental studies; Impact assessment is done only for pending activities. Pending activities are reinforcement of wall, installation of bearing pedestal and placement of fabricated arch frame. These activities will have impacts on environmental parameters like quality of sediment, water and air in surrounding due to various operations as explained in earlier chapters.

Baseline data collected and generated together with the pending project activities are considered for identifying likely impacts of the project on the environment and suitable mitigation measures suggested.

### 4.2 Identification of Impacts

Environmental impact identification is based on the type, scale and location of project activities. Environmental components that may be affected negatively and positively due to pending project activities are identified.

Following parameters are selected for impact assessment due to construction of bridge during various phases of the project.

**Table 4.1 Environmental Aspects and Impacts of Proposed Project**

Sr. No.	Step/Activity	Environmental Aspect	Impact	
			Type	Severity
1.0	Installation of pedestal bearing, Assembling/ placement of fabricated arch frame and other components of bridge at site	Fuel burning, traffic, air emission, generation of noise	Air & Noise Pollution	Temporary
		Use of water, energy and materials	Natural resource consumption	Limited
		Use of manpower	Employment	Temporary
		Waste discharge on land	Land pollution	Temporary
		Suspension of sediment in marine water	Benthic biodiversity loss and water pollution	Temporary
2.0	Erection and Commissioning	Waste Disposal	water/ land pollution	Temporary
		Use of manpower	Employment	Temporary
3.0	Operation	Socio-economic - Use of bridge by local farmers	Will fulfil long standing demand of 65 farmer families	Permanent

## Chapter 4 – Anticipated Environmental Impacts &amp; Mitigation Measures

Sr. No.	Step/Activity	Environmental Aspect	Impact	
			Type	Severity
		and tractor movement to cross the tributary		
4.0	Closure and Decommissioning	Stoppage of use of facility	Loss of income, agriculture land become fallow resulting in decrease in agriculture productivity	Permanent
		Decommissioning	water pollution	Permanent

### 4.3 Impact Identification and Mitigation Measures in Construction Phase

#### 4.3.1 Land Environment

##### 4.3.1.1 Anticipated Impacts

Pending activities in construction of bridge involves miniscule generation of solid waste in the form of packaging materials (plastic cans and drums) etc. Hazardous waste generated includes paint containers, brushes etc. Improper waste disposal will lead to unhygienic conditions and hazards to the nearby populace and marine life.

##### 4.3.1.2 Mitigation Measures

- A. Construction team will be trained for collection, segregation and storage of solid and hazardous waste at designated place. Necessary provisions (e.g. mobile toilets) will be made available at the site. Most of the work force will be sourced from Kundaim, Corlim, Panaji or nearby villages. No camp site for work force will be provided.
- B. Separate area will be earmarked for storage of solid and hazardous wastes which generates during pending activities in construction phase. After completion of construction phase, hazardous waste will be given to given to GSPCB authorized agency. Hazardous waste will be stored at designated covered place having impervious flooring. Solid waste (non-biodegradable) will be disposed off as per prevailing approved practice through authorised vender/ recyclers. Biodegradable solid waste will be composted.
- C. Waste like iron scrap will be sold to scrap dealers for recycling as far as possible.

#### 4.3.2 Air Environment

##### 4.3.2.1 Anticipated Impacts

Construction of bridge involves bringing prefabricated arch frame to site, running of D.G. set, trucks, pumps, cranes/ Hydra, water tanker, front loader, welding machinery, barge, material supply, workforce etc. which create localized temporary air emissions. Hence,

*Chapter 4 – Anticipated Environmental Impacts & Mitigation Measures*

the impact of the pending activities of construction phase of the project on air environment in study area will be insignificant.

Transportation of manpower, machinery and material for completing construction will lead to an increase in the number of vehicles plying on the Gandaulim-Marcel Road by about 3 to 4 vehicles per day. The existing road has 2 lanes with regular traffic and traffic congestion for short duration is expected at the time of material transportation, especially at the junction of approach road (to site) and Gandaulim-Marcel Road due to grade difference and double curvature during weekends. This will lead to an increase in noise levels and idling emissions. The situation may increase chances of accidents.

**4.3.2.2 Mitigation Measures**

- A. Provision of PPE (dust masks, goggles) for onsite workers.
- B. Screening of construction area, avoid idling of engines, optimizing number of trips for material and workforce transportation as far as possible.
- C. Ensure machineries are well maintained, lubricated and cleaned periodically, having valid PUC certificate
- D. Traffic Planning:
  - i. Material transporting drivers will be made aware about the situation and locational challenge and necessary guidance will be provided if required
  - ii. Drivers will be provided assistance at the junction for navigation/ turning at the entry/ exit points
  - iii. Grade difference will be made smooth and minimum to make safe and hassle-free entry/ exit through the junction
  - iv. Possibility of using underpass near junction will be explored as alternate route for small/ medium sized vehicles which will eliminate locational challenges (risk of accidents on Gandaulim-Marcel highway due to double curvature), issues related to grade difference and traffic congestion.

These arrangements will help reduce chances of accidents and traffic on Gandaulim-Marcel Highway. The proposed alternate traffic movement is depicted below.



Figure 4.1: Alternate Traffic Route

### 4.3.3 Noise & Vibration Environment

#### 4.3.3.1 Anticipated Impacts

Transportation and actual construction activities (like cutting, welding, brazing, running of D.G. set, cranes) will temporarily increase noise levels and vibrations in surrounding causing disturbance to fauna.

#### 4.3.3.2 Mitigation Measures

- A. Provision of adequate PPE (earmuffs/ ear plugs) for construction workers
- B. Screening of construction area
- C. Ensuring proper maintenance, lubrication and periodic cleaning of construction equipment/ machinery
- D. Scheduling activities to ensure that recipients are not continuously exposed to high noise for long duration

### 4.3.4 Water Environment

#### 4.3.4.1 Anticipated Impacts

Pending activities will disturb the bed resulting sediment to suspend in water column leading to temporary increase in turbidity.

#### 4.3.4.2 Mitigation Measures

- A. Temporary arrangement of safe drinking water will be provided for workers at site
- B. Sanitation provisions (mobile toilets)

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- C. Entire construction will be carried out in non-monsoon season
- D. Sea water will be used for curing purposes

**4.3.5 Ecological and Biological Environment****4.3.5.1 Anticipated Impacts**

No tree and Mangrove cutting is envisaged in pending activities of the project. These activities and vehicular movement will generate noise, vibrations and particulate matter that disturb flora and fauna temporarily and compel fauna to move away. Thus, insignificant impacts on flora and fauna are envisaged.

**4.3.5.2 Mitigation Measures**

- A. Pending activities will be carried out in non-monsoon season.

**4.3.6 Socio-Economic Environment****4.3.6.1 Anticipated Impacts**

There will be temporary employment for about 20 persons for 3 to 4 months. It will create secondary business opportunities for suppliers of construction material, fabricators, manpower suppliers, civil contractors, etc. Local labourers will be employed. possibility of accident is identified as risk/ impact on populace.

**4.3.6.2 Mitigation Measures**

- A. Local contractors and workforce having knowledge of site/ location will be engaged
- B. Adequate water supply and mobile sanitation facilities will be provided for workers
- C. Adequate PPE (helmets, safety shoes, harness, ear plugs/ muffs, dust masks and goggles) will be provided for construction workers
- D. Workforce will be trained for their duties and responsibilities towards environment protection and safety. Effective safe working practices will be encouraged which minimises environmental footprint of project and create safe working environment. Monthly refresher training will be provided. Newly joined individual will be inducted for the same.
- E. Selected workforce will be provided with first-aid training adequate necessary provisions will be made at site. Refresher first-aid training will be provided twice a year or to individual worker if joined newly in the team

*Chapter 4 – Anticipated Environmental Impacts & Mitigation Measures***4.4 Impact Identification and Mitigation Measures During Erection and Commissioning****4.4.1.1 Anticipated Impacts**

Erection and Commissioning involves installation of pedestal bearing, lifting and placing prefabricated components of bridge on Pot PTFE bearing and assembling/ tightening ancillary components, cable laying, installing lamp post etc.

These activities will generate solid waste in the form of packing material lamps, cables, etc. Unscientific disposal, if any, will create an eyesore and unhygienic conditions.

**4.4.1.2 Mitigation Measures**

- A. Suitable mitigation measures will be implemented as mentioned in section 4.3.1.2 A and B in this chapter.
- B. Additional manpower will be required for erecting and commissioning, i.e. for laying cables, electrical connections, streetlights/lamp poles, etc. This is deemed to be a positive impact as it will give rise to limited local employment for a short period.

**4.5 Impact Identification and Mitigation Measures in Operation Phase****4.5.1.1 Anticipated Impacts**

Operation phase of the project involves general inspection, maintenance of bridge, lubrication of Pot PTFE bearing etc. and use of bridge by locals to cross the tributary, movement of agriculture implements, tractor, Agri-produce. The project will fulfil the long-standing demand of 65 farmer families. This is a positive impact of the project which will benefit the local farmer community to a great extent and reduce their hardship, time and thereby increase income and partial help to boost agriculture productivity.

**4.6 Impact Identification & Mitigation Measures in De-Commissioning Phase****4.6.1.1 Anticipated Impacts**

De-commissioning phase of this project will be non-usage of bridge. This will cause poor maintenance, rusting, corrosion, weakening of structure, loss of flexural strength of Pot PTFE bearing resulting in dilapidated condition of bridge. In the long run, risk of collapsing the bridge may increase. This situation is dangerous for local farmers. Another aspect of de-commissioning of bridge will be dismantling parts of bridge and

Chapter 4 – Anticipated Environmental Impacts & Mitigation Measures  
remove sub-structure. This will pose similar impacts on water and biological environment as mentioned in section 4.3.4 and 4.3.5 respectively.

#### 4.6.1.2 Mitigation Measures

- A. Decommissioning of bridge will be properly planned and finished in a fixed time period
- B. All civil structures will be properly demolished ensuring safety
- C. Concrete rubbles will be used for filling/ levelling ex situ
- D. Iron/ steel will be sold to authorized scrap dealer
- E. Care will be taken that no demolition waste will contaminate marine environment

#### 4.6.2 Environmental Impact Matrix

Possible impacts of various construction and operation activities are identified above have been denoted below in a matrix. A rating has been devised to give severity of impacts in the following manner:

Appreciable Impact – 1

Severe Impact – 4

Significant Impact – 2

+ Sign Indicates Beneficial Impact

Major Impact – 3

- Sign Indicates Adverse Impact

Based on the importance of each environmental parameter, a value has been assigned to each parameter, which is called its weightage. Ultimately, the final assessment is made according to the impact scale discussed below.

**Table 4.2 Significance of Impact**

Sr. No.	Total Score	Significance of Impact
1.	(+) 1 to (+) 999	No significant impact on environment
2.	0	Neutral
3.	(-) 1 to (-) 999	No significant impact on environment
4.	(-) 1000 to (-) 1999	Low impact. Appropriate mitigation measures required.
5.	(-) 2000 to (-) 2999	Significant impact, Major control measures required
6.	(-) 3000 to (-) 3999	Major impact. project site/ technology to be reviewed.
7.	> (-) 4000	Not suitable; No Go for the project.

Environmental impact matrix due to the proposed project activity and with and without environmental protection measures are presented in tables below.

Table 4.3 Environmental Impact Matrix without Mitigation Measures

Sr. No.	Environmental Parameter	Weightage	Phase of Activity				Net Impact	Score
			Construction	Commissioning	Operation	De- Commissioning		
1	<b>Land Environment</b>							
A	Soil and Sediment Quality	50	-2	0	0	-1	-3	-150
2	<b>Air Environment</b>							
A	Air Quality	50	-2	0	0	-1	-3	-150
B	Noise and Vibrations	100	-2	-1	0	-1	-4	-400
3	<b>Water Environment</b>							
A	Marine Water Quality	100	-2	-1	0	-1	-4	-400
4	<b>Biological Environment</b>							
A	Aquatic Ecology	100	-2	-1	0	-1	-4	-400
5	<b>Socio Economic Environment</b>							
A	Employment	50	+1	+1	0	-1	+1	+50
B	Ease in Agricultural Operations	100	0	0	+2	-1	+1	+100
							<b>NET</b>	<b>-1350</b>

As can be seen from the impact matrix, the net impacts due to project activities without mitigation measures will be -1350. This indicates low adverse impact, and appropriate mitigation measures are required to implement.

Table 4.4 Environmental Impact Matrix with Mitigation Measures as per EMP

Sr. No.	Environmental Parameter	Weightage	Phase of Activity				Net Impact	Score
			Construction	Commissioning	Operation	De- Commissioning		
1	<b>Land Environment</b>							
A	Soil and Sediment Quality	50	-1	0	0	-1	-2	-100
2	<b>Air Environment</b>							
A	Air Quality	50	-1	0	0	-1	-2	-100
B	Noise and Vibrations	100	-1	-1	0	0	-2	-200
3	<b>Water Environment</b>							
A	Marine Water Quality	100	-1	-1	0	0	-2	-200
4	<b>Biological Environment</b>							
A	Aquatic Ecology	100	-1	-1	0	-1	-3	-300
5	<b>Socio Economic Environment</b>							
A	Employment	50	+1	+1	0	0	+2	+100
B	Ease in Agricultural Operations	100	0	0	+3	-1	+2	+200
							<b>NET</b>	<b>-600</b>

As can be seen from the impact matrix, the net impacts due to project activities with mitigation measures will be -600. This indicates insignificant adverse impact on environment.

## 5 ANALYSIS OF ALTERNATIVES (TECHNOLOGY & SITE)

### 5.1 Analysis of Alternative Sites

Project activities pertain to reinforcement of wall, installation of pedestal bearing and placement of prefabricated arch structure on bridge bearing etc. for local farmers to cross the tributary and movement of tractor, agricultural implements and agriculture produce.

Following aspects are considered to evaluate alternate site:

- The project is in accordance with basic need of local farmers, within proximity to end user
- South end of bridge is located adjacent to existing bund, same bund will be developed as approach to bund. As this is government owned land; no Rehabilitation and Resettlement is required. Northern end of bridge is located in private agriculture field for which No Objection Certificate from respective farmer is received.
- Primary socio-economic survey reveals that the farmers are unhappy due to lack of road connectivity to their fields, and it hampers their livelihood.
- Connectivity to Gandaulim-Marcel Highway
- Economy of the project and integration with existing facilities

Thus, due to the above reasons, no alternate site is considered.

### 5.2 Analysis of Alternative Technologies

Construction of bridge will take place by established standard civil construction methods as per standard code of practices. Thus, no alternate technology is evaluated.

## 6 ENVIRONMENTAL MONITORING PLAN

Based on the identified and assessed impacts as well as the baseline environmental status of the study area, an environmental monitoring program is suggested herein for implementation during various stages of the project.

### 6.1 Objective of Environmental Monitoring Program

For tracking of the effectiveness of mitigation measures and EMP at specific interval, regular monitoring of the necessary environmental parameters is required. With this in mind, an environment monitoring program is prepared with due consideration of the baseline status of the site, various components of project and the environmental attributes likely to be affected.

Major objectives of the Environmental Monitoring Program are as under:

- To comply with the statutory requirements of monitoring conditions of various permits such as CRZ Clearance, Consent to Operate and requirements of provisions under Environmental Protection Act, 1986
- Assessment of the changes in environmental conditions, if any, during construction, commissioning of the project.
- Monitoring and tracking the effectiveness of Environment Management Plan and implementation of mitigation measures planned.
- Identification of any significant adverse transformation in environmental condition to plan additional mitigation measures, if & as required.

PMC/ construction contractor will implement environment monitoring programs in line with the planned schedule. It will be ensured that the necessary requisite facilities are made available and budgetary provisions are made as and when required to ensure regular efficient environmental monitoring activities.

### 6.2 Environmental Monitoring Program

Environmental monitoring parameters and frequencies of monitoring are given in table below. In addition to environmental monitoring, project management will be ensured by quality control documentation/ maintaining records/ logs of various material and processes involved in construction phase in dedicated registers at site office. About 14 such registers are identified as under:

Table 6.1: Quality Documentation

Sr. No.	Name	Sr. No.	Name
1.	Cement Register	8.	Concrete Pour Register
2.	Cube Testing Register	9.	Steel Reinforcement Register
3.	Concrete Mix Design Register	10.	Bar Bending Schedule Register
4.	Machinery Records	11.	Flyover Bridge Alignment Register
5.	Soil Investigation Records	12.	Daily Logbook
6.	Register for Mobilization of Machinery	13.	Register of Concrete Records
7.	Acceptance Criteria Register	14.	Aggregate Register

Project Management Consultant will be the key agency to coordinate among all agencies involved viz. GSIDC, Contractors etc. by means of coordination meetings, periodic progress review meetings, reports and documentation. All the member agencies will be actively involved in this process to ensure successful planning and the execution of the project.

Table 6.2 Environment Monitoring Plan

Sr. No.	Project Phase	Environmental Component	Parameters	Frequency	Locations	Conducted by
1.	Construct ion	<b>Air Environment</b>				
		Ambient Air	PM <sub>10</sub> , PM <sub>2.5</sub> , SO <sub>2</sub> , NO <sub>x</sub> & CO	Once/Month	Near site	MoEFCC recognized Laboratory
		Active Traffic Management	Assistance to smooth traffic movement at junction (near site), exploring alternate route etc.	Continuous during construction phase	Near site	Trained professional agency
		Ambient Noise Level	Leq day and night time	Once/Month	Near site	MoEFCC recognized Laboratory
		<b>Water Environment</b>				
		Marine Water Quality	Temperature, pH, PHC, DO, suspended solids, Dissolved solids, Salinity, Microbiological parameters, Nutrients, Chlorophyll, Phytoplankton, Zooplankton	Once/month	Upstream and downstream locations	MoEFCC recognized Laboratory
		<b>Land (Sediment) Environment</b>				
	Marine Sediment Quality	Texture, C <sub>org</sub> , PHC, Macrobenthos, Pb	Once/month	Upstream and downstream locations	MoEFCC recognized Laboratory	
<b>Safety</b>						
	Safety	Supervision on General and operational safety aspects, safety and first-aid trainings	Once/month	Appropriate workforce	Professional recognised agency	
2.	Commissi oning	Ambient Noise Level	Leq	Once/month	At the Site	MoEFCC recognized Laboratory
3.	Operation Phase	General inspection of bridge	Pot PTFE bearings and other parameters as decided by project engineer	As decided by project engineer	The bridge including approaches	Authorised agency
4.	Decommi ssioning	<b>Air Environment</b>				
		Ambient Air	PM <sub>10</sub> , PM <sub>2.5</sub> , SO <sub>2</sub> , NO <sub>x</sub> & CO	Once/Month	Near site	MoEFCC recognized Laboratory
	Ambient Noise Level	Leq day and night time	Once/Month	Near site	MoEFCC recognized Laboratory	

**6.2.1 Measurement Methodologies**

Monitoring of environmental parameters shall be done as per the methods/ guidelines provided by MoEFCC/ CPCB and /or relevant Indian Standards or methods as specified by international Standards.

**6.2.2 Reporting Schedules**

The records of the monitoring program viz marine water, sediment, air, noise, safety and registers mentioned above shall be prepared, maintained and preserved properly. Records showing results of monitoring programs will be submitted as per schedule. Monitoring reports will be reviewed regularly by PMC for necessary improvement of the monitoring plan/ mitigation measures/ environmental technologies as well as for necessary actions of environmental management cell.

**Table 6.3 Reporting Schedule of CRZ Clearance Compliance**

Phase of Project	Reporting Schedule	Applicable Statute	Compliance Reporting To
Construction Commissioning Operation Decommissioning	As specified in CRZ Clearance/ GSPCB Consent to Operate	CRZ Clearance/ GSPCB Consent to Operate	a) SEIAA, Goa b) GSPCB – Regional Office c) GCZMA d) Other authorities as specified

**6.3 Budgetary Provisions for EMP**

The project cost of the proposed activities is estimated as Rs. 3.4 Crores. The PMC will make appropriate budgetary provisions, including requisite budget for environmental management. The funds will be made available at appropriate time.

## 7 ADDITIONAL STUDIES

Proposed project does not attract EIA Notification thus, public consultation is not applicable. During the duration of project, there will be no generation/ handing/ storage of hazardous chemicals, so this kind of project activity does not require Risk Assessment, HAZOP, and Heat radiation modelling studies.

Therefore, except for the studies mentioned in this document, there are no additional studies carried out.

## 8 PROJECT BENEFITS

### 8.1 Improvement in Infrastructures

The project aims to connect agriculture fields with habitation across the tributary. This road connectivity will create ease in agricultural operations, reduce hardship of local farmers in turn it will increase agriculture productivity. In future, agriculture may convert fallow to rainfed to double cropping agriculture and increases agriculture productivity of the district.

### 8.2 Employment Potential

The proposed peak manpower requirement during construction and commissioning will be 20 persons. Once commissioned, the bridge will be handed over to PWD for local farmers therefore in operation phase there is no employment potential except general inspection and maintenance of bridge.

Most of the recruitment will be done from the local area which will be the considerable benefit considering the demography of the region. Further, the indirect employment, local economic activities will also add in employment potential of the project. Thus, potential of employment will be beneficial to local people.

### 8.3 Other Tangible & Intangible Benefits

Demand of food is increasing in India as well as in foreign countries day by day. The proposed project will help in reduction in time and effort required for agriculture. Thus, it will benefit the local farmer community in earning appropriate revenue against their efforts.

## **9 ENVIRONMENTAL COST BENEFIT ANALYSIS**

All the required Environmental protection measures will be implemented appropriately to ensure compliance with the norms.

The overall project cost is estimated at 3.4 crore.

PMC will make appropriate budgetary allocation for implementation of environmental protection measures.

Implementation of project in turn will give better road connectivity and will increase ease in the livelihood of the local farmers.



## 10 ENVIRONMENT MANAGEMENT PLAN

### 10.1 Introduction

Description of the administrative aspects for ensuring mitigation measures that will be implemented and their effectiveness monitored, after approval of EIA report and grant of CRZ clearance are presented in this chapter. This Environmental Management Plan (EMP) will enable the project proponent to operate the project within acceptable levels of environmental impact and to ensure compliance with the relevant regulatory criteria.

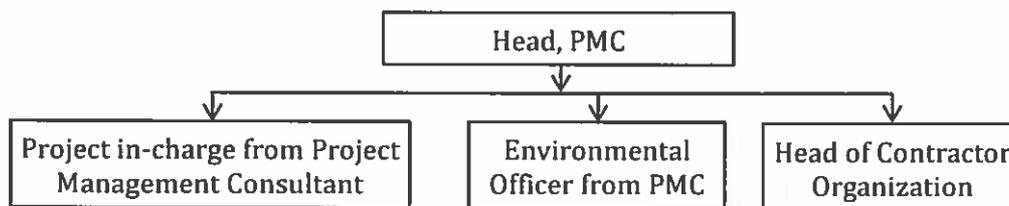
#### 10.1.1 Objective and Scope of EMP

Environment Management Plan is prepared with the objective of enlisting requirements to ensure effective mitigation of adverse impacts of project. The objectives taken into account in preparation of EMP are summarized as follows:

- a) Prevention, control and abatement of pollution of air, noise, vibration, water and sediment.
- b) Compliance with the stipulated enviro-legal requirements and standards.
- c) Delineation of the steps to be followed for effective maintenance of bridge.

### 10.2 Environment Management Cell

PMC will form an Environment Management Cell (EMC) with mandate to implement the EMP as suggested in this EIA report. The illustrative constitution of the EMC is below.



**Figure 10.1 Environment Management Cell**

As indicated in the above organogram, head of the organisation, PMC will lead the EMC and will be assisted by Project in-charge of Project Management Consulting organisation (M/s Madhav Kamat & Associates, Vasco-Da-Gama, Goa), Environmental Officer (from PMC) and Head of Contractor organisation (M/s. K.V.J. Builders & Developers Pvt. Ltd., Ernakulam Kerala).

The responsibilities of the above personnel are as follows:

*Chapter 10-Environmental Management Plan*

The Head of PMC will lead the team and direct EMC in timely manner and make budget available for implementing mitigation measures including safety aspects.

Responsible person from PMC will supervise all functions of the EMC and also act as Environmental Officer. He/ She shall be responsible for environment management works and all legal and statutory compliances, including CRZ clearance.

Project in-charge of Project Management Consulting organisation will be responsible for creating awareness /providing training w.r.t. various environmental aspects pertaining to the project such as solid waste management, water pollution prevention, operational safety, traffic management etc.

Head of Contractor organisation will look after maintenance of environmental infrastructure, sanitary provisions, transportation arrangements for waste disposal, provision of appropriate and adequate safety gears, cleanliness, lubrication, PUC of construction equipment, vehicles etc.

Standard Operating Procedures (SOPs) will be prepared by the Environmental Officer before commencement of pending work of the project. SOPs will be reviewed and approved by the head of PMC and ensured that they are understood by project in-charge and head of contractor organisation to percolate it down up to the ground zero for effective implementation. The PMC shall ensure that all necessary conditions w.r.t. environment protection (including those mentioned as mitigation measures) are incorporated in the work order/ contract agreement. The contractor shall accept them all unconditionally and deposit requisite amount (as deemed appropriate by head of PMC) to PMC as part of bank guaranty.

**10.2.1 Environmental Activities**

- Major environment protection features are solid waste management awareness. Awareness will be spread from commencement of pending work.
- Maintenance, training, awareness, provisions at site etc.

## 11 SUMMARY AND CONCLUSIONS

Goa State Infrastructure Development Corporation Limited (GSIDC) is a wholly owned Government Company established in 2001 under infrastructure up-gradation programme of Government of Goa. It is registered under the Companies Act, 1956, with the Registrar of Companies, Panaji-Goa.

Department of Agriculture, Government of Goa provides assistance to farmer at all levels even up to marketing of agricultural produce. It undertakes developmental programme through Zonal Agricultural Offices located in each taluka of Goa. But farmers face **tremendous shortage of manual labour**. The **dependence on machines for activities agriculture is the emerging trend**. The land holding of farmers of Goa is small and **nearly 80% of farmers own less than 1 ha. of land**. The smaller machines are preferred, and government provides financial assistance for such machines. Considering such challenges and immense need to practice mechanisation in agriculture, GSIDC has decided to help reduce hardship of farmers by way of providing infrastructure such as bridge to cross waterways making easy to take agriculture implements/ tractors etc. to fields in short time and in hassle-free way. One such effort is being made and started construction of bridge across tributary of Cumbarjua canal/ Mandovi, approaches and bridge are located in part no. 8 and 9 of survey no. 65 of Cumbarjua village and part no. 5 of survey no. 175 of Jua village, connecting Chune Kantor and Vanso fields, Taluka Tiswadi, District North Goa. Construction of this bridge requires prior CRZ clearance under CRZ notification. Government of Goa had submitted the proposal and it received cost approval, NOC from village panchayat, NOC from farmers (for putting piles and approach on north side) and NOC from Caption of Ports.

The bridge will have 50m length, single carriageway of 3.5m, prefabricated steel concrete composite arch frame structure on two pears. It will be designed for live load of 500 Kg/m<sup>2</sup> or one tractor load of 10 tonnes. Construction of bridge is done as per Standard Specifications and Codes of Practice for Road Flyover Bridges, respective IRC codes, IS standards etc. Conceptual timeline of the project is 9 months, cost of project is Rs. 3.4 Crores. The project does not involve Mangrove and tree cutting. Most of the raw material is sourced from nearby marketplaces The project will meet its water and energy requirement by respective existing supply systems.

There is no effluent generation, wastewater generated will be disposed-off through mobile toilets, hazardous waste will be given to GSPCB authorised agency and solid waste to authorized vendors/ recyclers.

Baseline studies has been carried out in summer 2022 to understand land use land cover, ambient air quality, water quality, soil quality, noise level, biological and socio-economic status of study area. Latest satellite imagery is processed by standard methods reveals 10 land use land classes of which scrub is dominant followed by barren/ rocky area. Rice is the main crop whereas main plantation crop is Cashew and Coconut. Soils at and near site are very strongly acidic, sandy loam, low water holding capacity and organic matter. Fertility status of soil is poor, evident by very less Phosphorous and Potash contents. AAQM reveals parameters are within the prescribed limits. Ambient Noise levels are found to be close to the standard though both day and night readings are within limit. Ground water analysis reveals that water may be potable only after suitable treatment. Species observed in the surroundings are commonly found in other parts of the region. The study area and data from Government agencies is assessed to check socio-economic status of the region. The area is rural in nature and has good sex ratio and literacy. All 65 farmer families were interacted to know existing socio-economic conditions and expectations about project. Major source of income in the area is agriculture, fishing and employment. Rice is major crop of the area and agriculture is rain fed.

Environmental impact matrix evaluation has been done for land environment, air environment, water environment, solid and hazardous waste management, biological environment socio-economic environment with & without control measures. Project activities will have insignificant negative impacts if proper mitigation measures are followed. Details impacts and mitigation measures of four phases of project namely Construction, Commissioning, Operation & Decommissioning phases are described in chapter 4.

Detailed Environmental Monitoring Program covering all four phases of project has been presented in chapter 6, along with EMP budget and schedule for compliances.

The Environment Management Plan (EMP) is prepared giving roles and responsibilities through the EMC for implementation of EMP.

The pending work of project of GSIDC will have insignificant adverse impact with due implementation of control measures as suggested. Continued vigilance with budgetary support is required from the PMC in order to implement the EMP.

## 12 DISCLOSURE OF CONSULTANT ENGAGED

<b>Name</b>	<b>Aditya Environmental Services Pvt. Ltd.</b>		
<b>Reg. Office</b>	107, Hiren Light Industrial Estate, Mogul Lane, Mahim, Mumbai - 400016		
<b>Phone No.</b>	(022) 42127500/(022) 24456473/7304794854	<b>Email id</b>	: contact@aespl.co.in
<b>Website</b>	http://www.aespl.co.in/		
<b>Laboratory</b>	Aditya Environmental Services Pvt. Ltd. P1, Commercial Complex, MIDC Colony, Rasayani, Taluka Khalapur, Dist. Raigad, Maharashtra PIN - 410222		
<b>Phone No.</b>	(02192) 252008/ (02192) 250352	<b>Email id</b>	: pglab@aespl.co.in
<b>Contacts:</b>	Goa, Pune, Ahmedabad, Delhi & Vadodara		
<b>Accreditation Obtained</b>	<ol style="list-style-type: none"> <li>1. ISO 9001:2015 Certified</li> <li>2. OHSAS 18001:2007 Certified</li> <li>3. NABL Accredited (TC-7085) for <b>Chemical Testing</b>: - Pollution &amp; Environment (Wastewater &amp; Water) and Soil &amp; Rock (Clays &amp; Soils) <b>Biological Testing</b>: - Water (Drinking, Ground, Surface &amp; Swimming pool &amp; Spa water), Pollution &amp; Environment (Sewage water)</li> </ol>		
<b>Accredited Sectors</b>	16 sectors including highways and port and harbour		
<b>Services Offered by AESPL</b>	<ul style="list-style-type: none"> <li>▶ Environmental planning studies</li> <li>▶ Policy planning studies for MoEF, CPCB, MPCB and other agencies like World Bank.</li> <li>▶ Environmental Impact Assessment (EIA) &amp; Environment Management Plan (EMP)</li> <li>▶ Risk Analysis Studies &amp; On Site/Off Site Emergency Management Plan.</li> <li>▶ Environment Health &amp; Safety audits &amp; Due Diligence audits</li> <li>▶ Effluent Treatment Treatability Studies &amp; Project Management Consultancy</li> <li>▶ Analytical Services covering entire spectrum of environmental analysis</li> <li>▶ Environmental Training and awareness</li> <li>▶ Project management consultancy for installation of effluent treatment plant</li> <li>▶ Environmental monitoring and legislation compliance services</li> <li>▶ Operation of effluent treatment plants</li> </ul>		

9/432

**Annexure I -  
Proposal Letter & Cost Approval**

C/431

Rec on 1/6/18 V-3

Code - O R - 17



Inward No	3311
Date	1/6/18
GSIDC LIMITED	

**OFFICE OF THE MINISTER FOR  
POWER, SOCIAL WELFARE & NCE  
GOVERNMENT OF GOA  
SECRETARIAT, PORVORIM GOA- 403 521**

Tel.No. 0832-2419518

Fax.0832-2419852

No.Min/Power/SW/NCE/2018 /1886

Date:-30/05/2018

**NOTE**

Please find enclosed a copy of Resolution No. 5(9) dated 21/05/2018 of the V.P Cumbarjua adopted unanimously that to undertake the work of construction of Bridge from Chune-Kator to Vanso Field in Village Panchayat Cumbarjua.

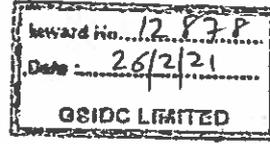
Chairman, GSIDC may kindly consider the above request and give the necessary instructions to the concerned officials to take up the above work in public interest.

**(Pandurang Madkaikar)  
Minister for  
Power, Social Welfare & NCE**

Encl. As above

**Chairman, GSIDC**

9430



GOVERNMENT OF GOA,  
DEPARTMENT OF FINANCE,  
DEBT MANAGEMENT DIVISION,  
SECRETARIAT, PORVORIM - GOA-403521

Email: - [usbud2-sect.goa@nic.in](mailto:usbud2-sect.goa@nic.in)  
Fax: -(0832)2419664

Phone:- (0832419476/2419695

No. 4/42/2020-FIN (DMU)/156

Dated: - 26/02/2021.

To,  
The Managing Director,  
M/s. Goa State Infrastructure Development Corporation Limited,  
EDC House, Panaji.

Subject: - Construction of bridge for local farmers to cross river stream for cultivation of fields from Chune-Kator to Vanso field in village of Cumberjua.

Sir,

I am directed to refer to your letter No. GSIDC/Engg/Works/5571 dated 12/01/2021 on the subject cited above and to convey herewith approval of the Government for the proposal "construction of bridge for local farmers to cross river stream for cultivation of fields from Chune Kator to Vanso field in village of Cumberjua" for an amount of Rs 2,58,36,602.00(approx).

The file bearing No. GSIDC/Engg/Works is returned herewith for your office records.

Yours faithfully,

*(Pranab G. Bhat)*  
(Pranab G. Bhat)

Under Secretary (Finance Budget -II)

Copy to :-

- 1- Guard file.
- 2- O/c.

9429

**Annexure II**  
**NOC from Captain of Ports & Village Panchayat**  
**Cumbharjua**

9428

A or 9/4/21



## Captain of Ports Department

Government of Goa

Dayanand Bandodkar Road  
Panaji - Goa - 403001, India

Phone Nos: +91(0832) 2275070/2426109 Fax: +91(0832) 2421453  
Website: [www.ports.goa.gov.in](http://www.ports.goa.gov.in) E-mail: [cpt-ports.goa@nic.in](mailto:cpt-ports.goa@nic.in)

Invoice No. 774
Date: 9/4/21
GSIDC LIMITED

Pincode: Phone Nos: +91(0832) 2420580 Fax: +91(0832) 2420582 E-mail: [captainofports@gsidc.net](mailto:captainofports@gsidc.net)

No. CP/HSO/280/1011

Dated: - 07/04/2021

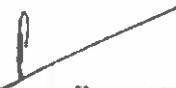
To,  
The General Manager (Civil),  
Goa State Infrastructure Development  
Corporation Limited,  
7<sup>th</sup> Floor, EDC House,  
Dr. A.B. Road,  
Panaji - Goa 403 001.

**Sub: Temporary NOC for construction of foot bridge  
for local farmers to cross river stream for  
cultivation of fields from Chune-Kator to Vanso  
field in Village Panchayat Cumbarjua.**

Sir,

With reference to your letter No GSIDC/Engg/Works/1416/6994 dated 22/03/2021, on the above subject, this is to inform you that the validity of this department NOC No CP/HSO/280/1446 dated 07/06/2019 is hereby renewed/extended for further period of one year i.e. 07/06/2022, with the same terms and conditions as stipulated in the said NOC.

Yours faithfully,

  
(Capt. James Braganza)  
Captain of Ports

9427

k on 31/7/19



**VILLAGE PANCHAYAT CUMBARJUA**  
**CUMBARJUA, TISWADI - GOA**

☎: 08322287004

Out. No. VP/ CUM / 11 / 2019-20 / 428.

Date:-29/07/2019.

To,  
 The Managing Director,  
 Goa State Infrastructure Development Corporation Ltd  
 Govt. of Goa Undertaking,  
 7<sup>th</sup> floor, EDC House, Panaji-Goa.

Inward No	6784
Date	31/7/19
<b>GSIDC LIMITED</b>	

**Sub:-Construction of Foot Bridge for Local Farmers to cross river stream for  
 cultivation of fields from Chune-Kantor to Vantso Field in V. P. Cumbarjua.**

Sir,

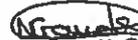
With reference to the above mentioned work, Please find enclosed herewith the N.O.C.s obtained from the Vantso Tenants Association and Chune-Cantor Tenants Association to carry out the said work.

Further, the N.O.C.s from the individual land owners will be furnished on the alignment and location of the Foot Bridge is fixed.

Thanking you,



Yours Faithfully,

  
 SMT.NISHITA N. GAUDE  
 SARPANCH.  
 VPCUMBARJUA

**CHUNE CANTOR TENANTS ASSOCIATION****KUMBHARJUA-GOA**

Date: 29/07/2019

**NO OBJECTION CERTIFICATE**

This is to certify that the Chune Cantor Tenants Association has No Objection to construct the Bridge from "CHUNE CANTOR area to" VASNUO KHAJAN BUNDH as per the convenience as per the Goa State Infrastructure Department.

This certificate is issued at the written request of the Goa State Infrastructure Department.



(CHARMAN)  
PRASAD T. Mulla  
*Prasad*

9425

**VANTSUO TENANTS ASSOCIATION****KUMBHARJUA-GOA**

Date: 29/07/2019

**NO OBJECTION CERTIFICATE**

This is to certify that the Vantsuo Tenants Association has No Objection to construct the Bridge from "VASNUO KHAJAN BUNDH area to CHUNE CANTOR" as per the convenience as per the Goa State Infrastructure Department.

This certificate is issued at the written request of the Goa State Infrastructure Department.



(CHAIRMAN)

मितीका/२७/७/१९

C/424

**ANNEXURE III**  
**Request letter from Villagers**

9423

VANTSUO TENANTS ASSOCIATION  
KUMBHARJUA-GOA

Ref. :

Ward No. 2775 Date : 02/06/2022 GSIDC LIMITED
---

Date : 02/06/2022

To  
The Chairman / M.D.  
Goa Infrastructure Development Corporation Ltd.,  
Panaji-Goa.

**Sub: Regarding the Completion work of bridge from Cumbhariua  
Village to Iua Village across the water tributary of river Mandovi**

Sir,

You are kindly aware that there is a paddy field by name ' Wadso ' which is a Khazan type of paddy field which is situated south side of village Iua.

The above paddy field is presently cultivated by 65 farmers with their respective family members. The total area is approximately 3 lakhs sq. mtrs as per the information given by local Panchayat.

That all the above farmers have their association by name " VANTSUO TENANTS ASSOCIATION, Kumbharjua-Goa " and the same is registered with the Mamlatdar of Tiswadi Taluka as per The Goa Daman and Diu Agricultural Tenancy (Discharge of Joint Responsibility of Tenants) Rules 1975.



Cont.../-

C/422

- 2 -

That the farmers of Kumbharjua have to cross the water tributary of Mandovi river from Kumbharjua to Jua village to access their field as the same is surrounded in all side by the water.

That above mentioned paddy field is a Khazan land and the farmers use the land for seasonal farming. The paddy cultivation is being done only once in a year during monsoon season.

Since there is no road approachable to the said paddy field the farmers, are compelled to hire special Ferry Boats to transport their respective tractors to the paddy field which is on the other side of the river in Jua village. It is not only difficult but very expensive also.

The existing approach road of Gaundalim bridge has bifurcated the fields. The traditional way is also blocked completely. In the circumstances the farmers of Kumbharjua village suffer as they are not able to cultivate their paddy field on account of their difficulty. They are deprived of their yield of crops.

That the farmers and their family members were making use of wooden canoes to cross the river to reach their paddy field. However due to the danger of overturning the canoes <sup>in</sup> over flowing river in monsoon, ~~it~~ is absolutely not possible to make use of traditional wooden canoes as there is every chance of canoes being tops-turvey and cause <sup>loss</sup> of human life.



Cont.../-

9421

- 3 -

There is a small bridge constructed in the year 1976 on the other side of the Kumbharjua village connecting the village Marcel of Ponda Taluka. This bridge is not at all helpful to the farmers of Kumbharjua village for cultivating their paddy field situated at the extreme south boundary of village Jua.

The proposed bridge shall fulfil the long standing demand of the farmers to make their field accessible. The bridge shall cater for pedestrian traffic and tractor movement to ~~gross~~<sup>access</sup> to the farm.

The bridge shall be exclusively used for only farming purpose ( only Kharif seasonal crop is cultivated by the farmers ). Hence the bridge will be used ~~minimally~~ thereby not disturbing the ecology and environment.

Considering the difficulties faced by the farmers and the necessities of the bridge, this association humbly request to your good self to complete the construction work of the bridge at earliest and help the farmers to cultivate their paddy fields.

Thanking You,



Yours,

*Ponda*  
2-06-2022

C/420

**ANNEXURE IV**  
**Geo-technical investigation Report**

9419

471

<b>CONTRACTOR:</b> <b>B.D.Y. GEOTECHNICAL SERVICE</b>	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)</b>
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# FINAL GEOTECHNICAL INVESTIGATION REPORT FOR FARMER'S BRIDGE AT CUMBARJUA



**CLIENT:** GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)

**CONSULTANT :** MADHAV KAMAT & ASSOCIATES

**CONTRACTOR:** KVJ BUILDERS & DEVELOPERS PVT LTD.



## B.D.Y. Geotechnical Service

Add. Room No. 365, Shri Sai Baba Adarsh Chawl No. 9, Annabhau Sathe Nagar,  
 Veer Mata Jijabai Bhosle Marg, Mankhurd, Mumbai - 400 043 (MH)  
**MOB: 9472292119, 7028684119 Email: bdygeotechnical.service@gmail.com**

<b>CONTRACTOR:</b> <b>B.D.Y. GEOTECHNICAL SERVICE</b>	<b>472</b> <b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)</b>
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C/A18

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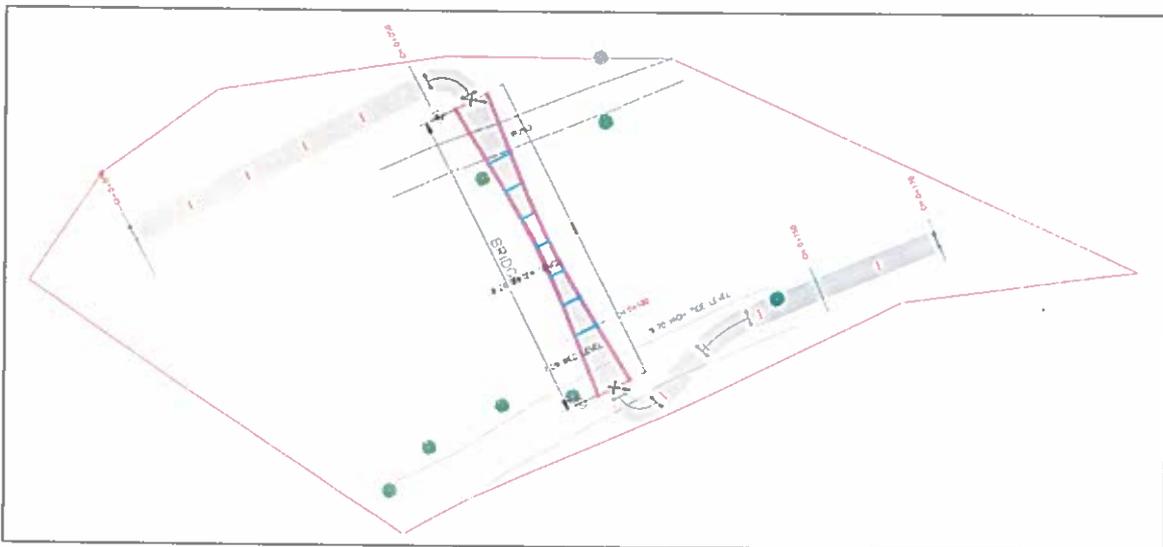
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<b>473</b>	<b>PRINCIPLE CLIENT:</b> GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)
<b>CONTRACTOR:</b> B.D.Y. GEOTECHNICAL SERVICE	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>

9417

## 1. INTRODUCTION

Goa State Infrastructure Development Corporation (GSIDC) is proposing to construct a bridge for local farmers to cross river stream for cultivation of fields from Chune - Kator to Vanso Field in Village of Cumbarjua. **M/s Madhav Kamat & Associates** is the Structural Consultant as well as Project Management Consultant for the said work. The work for the construction of the said bridge is awarded to M/s KVJ Builders & Developers Pvt. Ltd.



**Fig 1 – General Arrangement – Proposed Farmer's Bridge**

The work of geotechnical investigation for the same was entrusted to **M/s B.D.Y. GEOTECHNICAL SERVICE**. Hence, detailed geotechnical investigation was carried out to study the sub soil conditions, which comprises of **01 No. of borehole in the project area** as per the following details at the location suggested by the client.

LOCATION	BH NO	Field work		Drilling Depth
		Start	End	
Bund towards Highway side	BH – 01	19.09.21	24.09.21	30.00 m

C/416

<b>CONTRACTOR:</b> <b>B.D.Y. GEOTECHNICAL SERVICE</b>	<b>SOIL INVESTIGATION REPORT          PROPOSED FARMER'S BRIDGE          IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE          INFRASTRUCTURE          DEVELOPMENT CORP.          (GSIDC)</b>
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As per the requirement, 01 Nos. of borehole were completed at in village Cumbarjua North Goa and relevant laboratory tests were conducted on the collected soil samples of disturbed soil (SPT) & Rock samples based on the same this Investigation Report & Recommendations has been prepared.

**2. Scope of Works**

To investigate the subsurface soil conditions at proposed site 01 borehole was carried out.

The scope of investigation includes the following.

- Setting up boring rig at each location and boring 100 mm diameter bore holes through all kinds of soils.
- Drilling vertically through the rock (if encountered) using 'NX' size (76 mm) with double tube core barrel fitted with diamond studded drill bits. The boreholes were terminated at a depth 20m below existing ground level.
- Record the soil conditions encountered in the borehole.
- Standard penetration tests were conducted wherever the rock core recovery is less.
- Arranging all soil samples and rock cores in the core boxes as per the borehole logging.
- Transporting the selected soil and rock samples to laboratory for conducting specified tests.
- Analysis and interpretation of field & laboratory test data for the preparation of Geotechnical investigation report.

9415

<b>CONTRACTOR:</b> <b>B.D.Y. GEOTECHNICAL SERVICE</b>	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)</b>
--	---	---

**3. FIELD INVESTIGATION**

- **Location:** One borehole was executed as per the location suggested by Client on site, Village Cumbarjua, North Goa.
- **Period of Execution:** The fieldwork was commenced on 19.09.2021 and completed on 24.09.2021.

**3.1 Drilling in Soil / Weathered Rock:**

The field investigation boring was carried out using rotary Calyx rigs (Calyx, 8 HP, Engine) as per IS 1892-1962. The top of the bore hole is taken from the actual Ground Level at the time of boring. Water is used as drilling fluid & casing was used to support sides of borehole until sufficiently stiff strata was encountered. Following field test/sampling is carried out in the overburden.

**3.2 Standard Penetration Tests (SPT):**

Standard Penetration Tests were conducted in soil & Weathered Rock Samples at regular intervals using Standard Split Spoon Sampler driven by a 63.5 kg hammer with free fall height of 750mm as per IS 2131-1963. Standard Penetration Tests were carried out as per the provisions laid down in IS 2131-1981 in the holes & disturbed samples were collected through Split Spoon Sampler at every 1.5m interval.

A standard split spoon sampler is driven at the bottom of the hole. The penetration resistance in terms of blows for 300mm penetration of the split spoon sampler is measured as 'N' Value. The blows are imparted by a standard weight of 63.5 kg falling through a height of 750 mm. The resistance is measured for 150 mm, 300 mm and 450 mm penetrations. The resistance of first 150 mm is ignored and the resistance of next 300 mm is recorded as standard penetration value 'N'. If the sampler is driven less than 450 mm (total) then the penetration resistance is given for the last 300 mm of

<b>CONTRACTOR:</b> <b>B.D.Y. GEOTECHNICAL SERVICE</b>	<b>476</b> <b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)</b>
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9/11/14

penetration. If the penetration depth is less than 300 mm and the blows count is more than 50 then the 'N' value is considered as 'Refusal'. 'N' values were noted & the results were recorded in logs of bore holes.

### 3.3 Undisturbed samples (UDS) –

UDS were collected at specific intervals. The samples from split spoon sampler as well as Undisturbed sampler were collected in plastic bags for visual inspection and classification of strata from all the layers as recorded in log sheets of bore log.

### 3.4 Drilling in hard strata /Rock -

Once the hard stratum or rock surface is met the size of the borehole is reduced to NX size (76mm). The hard stratum or top of the rock surface is conformed, either by the refusal from standard penetration test N value or due to resistance during the drilling operation. In this hard stratum using NX core drilling with TC/Diamond studded bits carries out further work. The work is done generally as per IS 6926-1973. The maximum length of the drill (run) maintained is 1.50m. At the end of each run the drill rod string with core barrel is extracted from the borehole and core is recovered from the core barrel. The core samples were extracted from the core barrels in a manner to prevent disturbances to the core. The cores are carefully transferred to the core boxes and preserved. The core recovery percentage is recorded and also the core pieces transferred to the core box are numbered and labelled properly. Rock Quality Designation (RQD) is also recorded. The selected core samples are sent to the laboratory for conducting tests.

### 3.5 Ground water Table (GWT)

Ground water table was encountered during the Soil Investigation Works at a depth of 3.00m below Ground Level. Water table level will be highly fluctuating due to close proximity of river stream and tidal variations

<b>CONTRACTOR:</b> <b>B.D.Y. GEOTECHNICAL SERVICE</b>	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)</b>
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Details of boring with Subsoil profile, SPT values, classifications of Soil and sampling are included in the respective Bore logs & are given in APPENDIX A.

**4. LABORATORY TESTS**

The laboratory test programme was directed primarily towards the determination of engineering and index properties of soils and rocks encountered at site.

Disturbed samples in SPT split spoon and undisturbed samples in thin walled Shelby tubes were collected from the boreholes. The soil samples were visually identified and described, thereafter packed, labelled, sealed and dispatched to the laboratory. The laboratory tests were carried out as per relevant parts of Indian Standard Code of Practice. The test results are given in APPENDIX B.

**4.1 LAB TESTS ON SOIL –**

**4.1.1 Moisture Content**

Natural moisture content (NMC) of the soil samples was determined from the collected disturbed & undisturbed samples using Oven Drying Method, as per IS 2729 (Part II).

**4.1.2 Atterberg Limit Test**

The Atterberg Limits comprising liquid limit, plastic limit and plasticity index were determined on soil samples in accordance with the relevant methods described in IS:2720 (PART-V). The liquid limit has been determined using the Casagrande apparatus method. In accordance with the Standard, soil sample preparation included removal of soil particles retained on the 425µm sieve. Accordingly, where significant quantities of coarser particles are present, it should be recognized that the Atterberg Limits results are representative of the relatively fine soil fraction, and not of the complete soil sample.

<b>CONTRACTOR:</b> <b>B.D.Y. GEOTECHNICAL SERVICE</b>	<p style="text-align: center;"><b>478</b></p> <b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)</b>
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#### 4.1.3 Grain Size Distribution Analysis

**Grain size distribution analysis** by sieve analysis was conducted on selected samples to determine the Grain Size Distribution. The Sieve Analysis was carried out on soil samples in accordance with IS: 2720(Part-4) by wet sieving method. Particularly in SPT samples the quantity of soil sample available for testing is typically 100 gm. This sample quantity is considered representative of soil where grain size ranges up to 4.75 mm (Coarser sand size).

**Sedimentation analysis** was performed on soil samples in accordance with the hydrometer method described in IS: 2720 (PART-IV). The analysis provides an estimate of the particle size distribution for the fine fraction (<75µm) of a soil sample. The analysis was performed by monitoring the rate of settlement of soil particles initially suspended uniformly in distilled water. The rate of settlement, which is monitored by observing the change in fluid density with the hydrometer device, is related to the size of particles settling out of suspension. Hydrometer analysis was conducted to determine the percentage of Clay & Silt Fractions in Cohesive Soil Layers, as per IS: 2720 (Part IV).

#### 4.1.4 Specific Gravity Test

**Specific Gravity** of the Soil Grains was determined using Specific Gravity bottles as per IS: 2720 (Part III). Prior to testing, samples were ground down, if necessary, so as to pass the 2mm sieve.

#### 4.1.5 Direct Shear Test –

**Direct Shear Tests** were conducted on Sandy Samples as per IS: 2720 (Part XIII) by Direct shear box apparatus which was an un-drained test. Shearing force was applied by increasing the successive load until the failure takes place. The plane of shear failure was determined and the graph was plotted.

YAH

<b>CONTRACTOR:</b> <b>B.D.Y. GEOTECHNICAL SERVICE</b>	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)</b>
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**4.1.6 Tri-axial Compression (Unconsolidated Untrained) –**

Un drained shear strength parameters were determined for Two (2) soil samples by rapid unconsolidated-un drained (UU) tri-axial compression testing, in accordance with the methods of IS:2720 (Part 11). Testing on undisturbed samples was carried out on test 38mm & 100mm diameter specimen trimmed from thin-walled tube samples. Prior to loading, confining cell pressures were applied to test specimens in the tri-axial cell, without consolidation. During testing, no change in sample moisture content is allowed, and pore pressures were monitored.

**4.2 LAB TESTS ON ROCK –**

Tests were carried out on rock cores obtained by drilling using double tube core barrel, which were necessary to be tested in the laboratory from strength consideration. The rock samples were prepared for testing in the laboratory in accordance with IS: 9179:1979. The test results so obtained were tabulated for engineering characterization of rock samples. Water absorption, Unit Weight, Point load strength Index test and uniaxial compression test on the rock samples were conducted as per relevant Indian Standards.

**4.2.1 Unconfined Compressive Strength (UCS)**

Uniaxial compressive strength (Unconfined Compressive Strength) tests were carried out in accordance with the method suggested by IS:9143 (1979). The uniaxial compressive strength of the specimens were corrected for a height to diameter ratio of two for specimens whose height to diameter ratio was other than two using the following relationship

$$q_c \text{ (corrected)} = (q_c \times 0.889) / (0.778 + (0.222D/H))$$

Where  $q_c$  = Uncorrected Uniaxial Compressive Strength

D = Diameter of the specimen tested

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H = Height of the specimen tested

#### 4.2.2 Point Load Test

Point load Index test were performed on selected rock specimens (in case the sample length is not sufficient for UCS Test) in accordance with the method suggested by IS:8764 (1978). The tests were performed on diametrically loaded, trimmed core samples and on irregularly fractured core samples.

The results of rock test are reported in summary of rock test results as point load strength index  $Is(50)$ . Uniaxial compressive strength may be predicted by following relationship.

$$UCS / Is(50) = 22$$

Where,  $Is(50)$  = Corrected Point load strength index.

#### 4.2.3 Unit Weight, Specific Gravity & Porosity

Unit Weight, Specific Gravity & Porosity of the rock samples were determined for the selected core samples as per IS: 13030.

<b>CONTRACTOR:</b> <b>B.D.Y. GEOTECHNICAL SERVICE</b>	<b>481</b> <b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)</b>
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## 5. SUB-SURFACE CONDITION

Subsurface profile generally consists of Boulders in the top followed by Reddish Clay with Murrum followed by Greyish Sandy Clay underlain by Yellowish Clayey Silty Sand with Bouldery layer followed by Greyish Completely weathered Basaltic Rock till the extent of soil investigation. The encountered main Soil / Rock layers are described below in the borehole:

### ↓ Borehole No 01:

Soil encountered consists of **Boulders** in the top portion. Boulders were encountered mainly due to the location of Borehole being on the bund made up of Lateritic Rock. The lowermost boundary of this layer lies at 3.0m below GL. SPT N Value in this layer found to be Refusal.

This layer was underlain by Reddish Clay With Murrum. The thickness of this layer was found to be 4.0m with the lowermost boundary of this layer lies at 7.50 m below GL. SPT N Value in this layer found to be in the ranges of 20 - 22.

This layer was underlain by Greyish Sandy Clay . The thickness of this layer was found to be 11.50m with the lowermost boundary of this layer lies at 18.0 m below GL. SPT N Value in this layer found to be in the ranges of 28 - 38.

This layer was underlain by Greyish Black Boulder . The thickness of this layer was found to be 2.00m with the lowermost boundary of this layer lies at 20.0 m below GL. SPT N Value in this layer found to be refusal.

This layer was underlain by Yellowish Clayey Silty Sand. The thickness of this layer was found to be 5.50m with the lowermost boundary of this layer lies at 25.50

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<b>CONTRACTOR:</b> B.D.Y. GEOTECHNICAL SERVICE	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)
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m below GL. SPT N Value in this layer found to be in the ranges of 42 - 56. Generally, the Gravel content in the soil was found to be of the order of 0 -10%, Sand content of the order of 35 - 40% and balance Silt and Clay content. Plasticity Index of the soil was found to be 22-26% and Specific Gravity of the order of 2.55 - 2.61.

This layer was underlain by **Highly Weathered Greyish Black Basaltic Rock** till the extent of soil Investigation i.e.30.00m. The Rock is highly weathered with CR & RQD for this layer was 20 - 35% & NIL - 10% respectively. The **Unconfined Compressive Strength of Rock is found to be 56.20 MPa @ 28.50m depth.**

<b>CONTRACTOR:</b> <b>B.D.Y. GEOTECHNICAL SERVICE</b>	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE</b> <b>INFRASTRUCTURE</b> <b>DEVELOPMENT CORP.</b> <b>(GSIDC)</b>
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## 5.1 DISCUSSIONS & RECOMMENDATIONS

The proposed structure for which the Soil Investigation was undertaken, consist of a single lane Bridge (carriageway width of 3.5m) to cross the river stream.

Considering the proposed structural details & the sub soil strata obtained from the 01 no. of borehole executed in project Area, it can be seen that the strata consists of Bouldery fill at the top region followed by Clayey / Sandy Strata with Basaltic Rock encountered at termination level of 30.00m. Hence Deep Foundation in the form of Cast in Situ Pile Foundation is suggested for the proposed structure.

## 5.2 Theoretical background of various Analyses

### 5.2.1 Bearing Capacity of Foundation on Soil:

IS 6403 (1980) recommendations are used for calculation of net ultimate bearing capacity and hence safe bearing capacity

$$q_{um} = c N_c S_c d_c i_c + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W' + q (N_q - 1) S_q d_q i_q$$

Where

$c$  : Cohesion of Soil

$N_c, N_q, N_\gamma$ : bearing capacity factors, which are all function of  $\phi$ , referred from Table 1 IS 6403, PP 8

$S_c, S_\gamma, S_q$  : Shape Factor, referred from Table 2- IS 6403, PP 8

$d_c, d_\gamma, d_q$  : Depth Factor, referred from clause 5.1.2.2 of IS 6403, PP 9

$i_c, i_\gamma, i_q$  : Inclination Factor, referred from clause 5.1.2.3 of IS 6403, PP 9

$q = \gamma D_f$  :  $D_f$  - Depth of Foundation

$W'$  : Water Table Correction, referred from clause 5.1.2.4 of IS 6403, PP 9

<b>CONTRACTOR:</b> B.D.Y. GEOTECHNICAL SERVICE	<b>484</b>	<b>PRINCIPLE CLIENT:</b> GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)
	<b>SOIL INVESTIGATION REPORT PROPOSED FARMER'S BRIDGE IN VILLAGE OF CUMBARJUA</b>	

Soil Type	Descriptive Term for Compactness/Relative Density	SPT "N" Values (Blows/300mm penetration)	
Sands and Gravel	Very Loose	0 - 4	
	Loose	4 - 10	
	Medium Dense	10 - 30	
	Dense	30 - 50	
	Very Dense	> 50	
Soil Type	Descriptive Term for Consistency	SPT "N" Values (Blows/300mm penetration)	Undrained Shear Strength (KPa)
Sils and Clays	Very Soft	< 2	< 25
	Soft	2 - 4	25 - 50
	Firm	4 - 8	50 - 100
	Stiff	8 - 15	100 - 200
	Very stiff	15 - 30	200 - 400
	Hard	> 30	> 400

**General Properties of Non-Cohesive Soil (ASCE 1996)**

Soil Density Description	Relative Density "D <sub>r</sub> "	SPT Blow Count "N"	Angle of Internal Friction $\phi$	Unit Weight (lb/ft <sup>3</sup> )	
				Moist " $\gamma_m$ "	Submerged " $\gamma_{sub}$ "
Very Loose	0-15	0 - 4	< 28	< 100	< 60
Loose	16-35	5 - 10	28 - 30	95 - 125	55 - 65
Medium Dense	36-65	11 - 30	31 - 36	110 - 130	60 - 70
Dense	66-85	31 - 50	37 - 41	110 - 140	65 - 85
Very Dense	86-100	> 51	> 41	> 130	> 75

**Table 1 – Literature Review for Cohesionless Soil**

<b>CONTRACTOR:</b> <b>B.D.Y. GEOTECHNICAL SERVICE</b>	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE</b> <b>INFRASTRUCTURE</b> <b>DEVELOPMENT CORP.</b> <b>(GSIDC)</b>
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### 5.2.2 Pile Capacity in Cohesive Soil:

The Ultimate load capacity  $Q_u$  of piles, in KN, in Cohesive Soils is given by the following formula:

$$Q_u = A_p N_c c_p + \sum_{i=1}^n \alpha_i c_i A_{si}$$

The first term gives the End Bearing Resistance and the second term gives the Skin Friction Resistance. Where

- $A_p$  = cross-sectional area of pile tip, in  $m^2$ ;
- $N_c$  = bearing capacity factor, may be taken as 9;
- $c_p$  = average cohesion at pile tip, in  $kN/m^2$ ;
- $\sum_{i=1}^n$  = summation for layers 1 to  $n$  in which the pile is installed and which contribute to positive skin friction;
- $\alpha_i$  = adhesion factor for the  $i$ th layer depending on the consistency of soil, (see Note);
- $c_i$  = average cohesion for the  $i$ th layer, in  $kN/m^2$ ; and
- $A_{si}$  = surface area of pile shaft in the  $i$ th layer, in  $m^2$ .

### 5.2.3 Pile Capacity in Cohesionless Soil:

$$Q_u = A_p (1/2 D \gamma N_\gamma + P_D N_q) + \sum_{i=1}^n K_i P_{Di} \tan \delta_i A_{si}$$

- $A_p$  = cross-sectional area of pile tip, in  $m^2$ ;
- $D$  = diameter of pile shaft, in m;
- $\gamma$  = effective unit weight of the soil at pile tip, in  $kN/m^3$ ;
- $N_\gamma$  = bearing capacity factors depending upon the angle of internal friction,  $\phi$  at pile tip;
- $N_q$  = bearing capacity factors depending upon the angle of internal friction,  $\phi$  at pile tip;
- $P_D$  = effective overburden pressure at pile tip, in  $kN/m^2$  (see Note 5);
- $\sum_{i=1}^n$  = summation for layers 1 to  $n$  in which pile is installed and which contribute to positive skin friction;

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$K_i$  = coefficient of earth pressure applicable for the  $i$ th layer (see Note 3);

$P_{Di}$  = effective overburden pressure for the  $i$ th layer, in  $\text{kN/m}^2$ ;

$\delta_i$  = angle of wall friction between pile and soil for the  $i$ th layer; and

$A_{si}$  = surface area of pile shaft in the  $i$ th layer, in  $\text{m}^2$ .

#### 5.2.4 Pile Capacity in Completely Weathered Rock:

Pile foundations resting on completely weathered rock where  $N > 60$  or core recovery (CR) = 0 and Rock quality designation (RQD) = 0 (Grade V and VI) will be designed in such a way that the load from structure is transferred to the strata. Embedment length of foundation is designed to carry compressive loads through sidewall friction and by end bearing.

The shear strength of rock is estimated using correlations based on SPT N value. The allowable load carrying capacity;  $Q_a$  is estimated based on the following equation furnished in IS 2911 Part-1 Sec- II

$$Q_s = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi BL}{F_s}$$

Where,

$c_{u1}$  = Shear Strength of the rock below the base of the pile  $\text{kN/m}^2$ .

$N_c$  = Bearing capacity of factor taken as 9;

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<b>CONTRACTOR:</b> B.D.Y. GEOTECHNICAL SERVICE	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>

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## 6. GEOTECHNICAL APPRAISAL & RECOMMENDATIONS

Considering the nature of the project, we understand that the foundation needs to be designed for a Steel Bridge Project. We recommend Deep Foundations in the form of Bored Cast in Situ Piles for the proposed development with minimum depth of foundation as 30.00m below Ground level where Greyish Black Basaltic rock is encountered.

### 6.1 Recommendations for Pile Foundations (BH 1)

Pile diameter (mm)	Pile Toe Level (BGL) m	Comp. capacity (T)	Tension capacity (T)
1000	30.0	329.00	94.00

### 6.2 Foundation Protection

Following precautions shall be taken to protect concrete and reinforcement in foundations;

- Type of Cement: OPC or PPC
- Minimum Grade of Reinforced Concrete: M30
- Minimum Cement Content for spread footings: 350 kg/m<sup>3</sup>
- Maximum Water Cement Ratio: 0.45 - 0.50
- Minimum Cover to Reinforcement: 50mm (Footing)  
75mm (Piles)

For & on Behalf of



B D Y Geotechnical Service

<b><u>CONTRACTOR:</u></b> B.D.Y. GEOTECHNICAL SERVICE	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b><u>PRINCIPLE CLIENT:</u></b> GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)
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**Appendix A : BORELOGS**

<b>CONTRACTOR:</b> B.D.Y. GEOTECHNICAL SERVICE	<b>489</b>	<b>PRINCIPLE CLIENT:</b> GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)
	<b>SOIL INVESTIGATION REPORT PROPOSED FARMER'S BRIDGE IN VILLAGE OF CUMBARJUA</b>	

<b>CLIENT</b> : GOA STATE INDUSTRIAL DEVELOPMENT CORP. (GSIDC)	<b>BOREHOLE NO.:</b> BH-01
<b>PROJECT</b> : Construction of bridge for local farmers to cross river stream for cultivation of fields from Chune - Kator to Vanso Field in Village of Cumbarjua.	<b>SHEET NO.:</b> 1 of 3
<b>CONSULTANT</b> : MADHAV KAMAT & ASSOCIATES	
<b>LOCATION</b> : BUND ALONG ROADSIDE	<b>DATE</b> : 19/09/2021 TO 24/09/2021
<b>GROUND R.L.</b> : NA	<b>METHOD</b> : ROTARY DRILLING
<b>GROUND W.T.</b> : 3.00 M	<b>CASING</b> :

DEPTH (m)	R.L. (m)	LOG	STRATA DESCRIPTION	SAMPLE				BLOWS/15cm	SPT N	CORE RECOVERY (%)	ROD %	OTHER TESTS
				DEPTH (m)	TYPE	15	15					
1.00			BOULDERS LATERITIC BUND FILLING	1.50								
2.00				1.60	SPT 1	05	--	--	--	R		
3.00			REDDISH CLAY with MURRUM	3.00								
4.00				3.15	SPT 2	05	--	--	--	R		
5.00			REDDISH CLAY with MURRUM	4.50								
6.00				4.95	SPT 3	06	09	11	--	20		
7.00			REDDISH CLAY with MURRUM	6.00								
8.00				6.45	SPT 4	07	10	12	--	22		
9.00			GREYISH SANDY CLAY	7.50								
10.00				7.95	SPT 5	09	12	14	--	26		
				9.00								
				9.45	SPT 6	10	13	15	--	28		

SPT N = STANDARD PENETRATION TEST VALUE      ROD = ROCK QUALITY DESIGNATION      UDS = UNDISTURBED SOIL SAMPLE  
CR = CORE RECOVERY      DS = DISTURBED SOIL SAMPLE

REMARKS : CONTINUE TO NEXT PAGE  
**B. D. Y. GEOTECHNICAL SERVICE**

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<b>CONTRACTOR:</b> B.D.Y. GEOTECHNICAL SERVICE	<b>490</b> SOIL INVESTIGATION REPORT PROPOSED FARMER'S BRIDGE IN VILLAGE OF CUMBARJUA	<b>PRINCIPLE CLIENT:</b> GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)
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<b>CLIENT</b> : GOA STATE INDUSTRIAL DEVELOPMENT CORP. (GSIDC)	<b>BOREHOLE NO.</b> : BH-01
<b>PROJECT</b> : Construction of bridge for local farmers to cross river stream for cultivation of fields from Chune - Kator to Vanso Field in Village of Cumbarjua.	<b>SHEET NO.</b> : 2 of 3
<b>CONSULTANT</b> : MADHAV KAMAT & ASSOCIATES	

DEPTH (m.)	RL (m.)	LOG	STRATA DESCRIPTION	SAMPLE				SPT N	CORE RECOVERY (%)	ROD %	OTHER TESTS
				DEPTH (m)	TYPE	15	15				
11.00			GREYISH SANDY CLAY	10.50							
	10.95			SPT 7	12	16	18	--	34		
12.00				12.00							
	12.45		SPT 8	13	18	20	--	38			
13.00			GREYISH SANDY CLAY	13.50							
	13.95			SPT 9	06	09	14	--	23		
14.00				15.00							
	15.45		SPT 10	08	13	16	--	29			
16.00			GREYISH SANDY CLAY	16.50							
	16.95			SPT 11	11	15	18	--	33		
17.00				18.00							
	18.05	SPT 12	50	--	--	--	R				
19.00			GREYISH BLACK BOULDERS								
20.00											

SPT N = STANDARD PENETRATION TEST VALUE      ROD = ROCK QUALITY DESIGNATION      UDS = UNDISTURBED SOIL SAMPLE  
 CR = CORE RECOVERY      DS = DISTURBED SOIL SAMPLE

REMARKS : CONTINUE TO NEXT PAGE  
**B. D. Y. GEOTECHNICAL SERVICE**

<b>CONTRACTOR:</b> B.D.Y. GEOTECHNICAL SERVICE	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)
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<b>CLIENT :</b> GOA STATE INDUSTRIAL DEVELOPMENT CORP. (GSIDC)	<b>BOREHOLE NO.:</b> BH-01
<b>PROJECT :</b> Construction of bridge for local farmers to cross river stream for cultivation of fields from Chune - Kator to Vanso Field in Village of Cumbarjua.	<b>SHEET NO.:</b> 3 of 3
<b>CONSULTANT :</b> MADHAV KAMAT & ASSOCIATES	

DEPTH (m)	R.L (m)	LOG	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm				SPT N	CORE RECOVERY (%)	ROD %	OTHER TESTS
				DEPTH (m)	TYPE	15	15	15	15				
21.00			Yellowish Clayey Silty SAND	21.00									
21.45				SPT 13		16	19	23	--	42			
22.00													
22.50													
22.95			Yellowish Clayey Silty SAND	SPT 14		18	21	24	--	45			
23.00													
24.00													
24.45				SPT 15		19	26	30	--	56			
25.00													
25.50			Greyish Completely Weathered Basaltic ROCK	25.60	SPT 16	05	--	--	--	R	25	NIL	
26.00													
27.00													
28.00												20	NIL
29.00			Greyish Completely Weathered Basaltic ROCK								32	10%	
30.00													

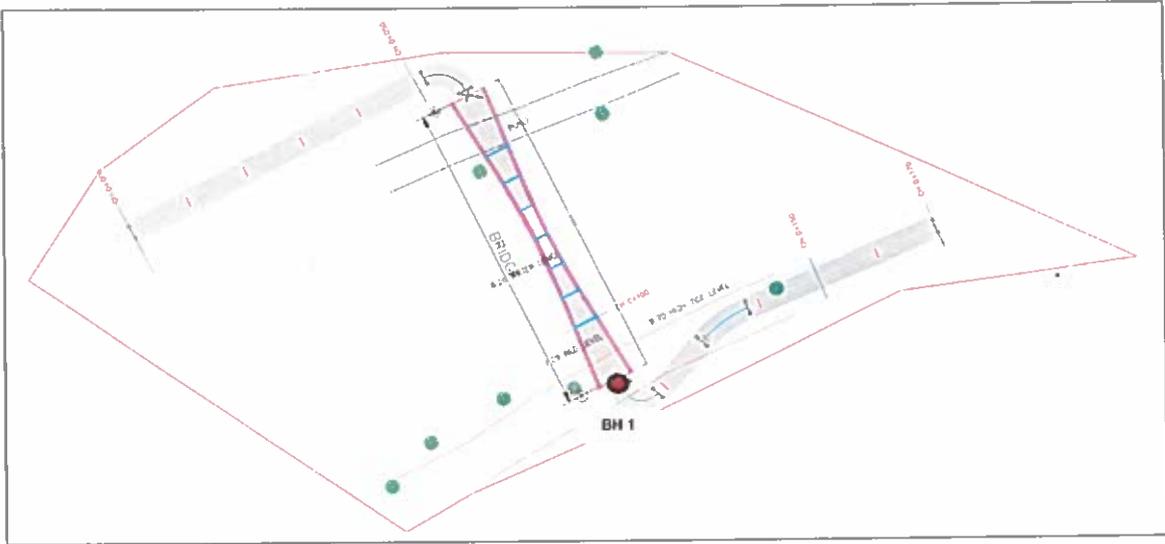
SPT N = STANDARD PENETRATION TEST VALUE      ROD = ROCK QUALITY DESIGNATION      UDS = UNDISTURBED SOIL SAMPLE  
 CR = CORE RECOVERY      DS = DISTURBED SOIL SAMPLE

REMARKS : BORE HOLE TERMINATED DEPTH AT 30.00 M BGL  
**B. D. Y. GEOTECHNICAL SERVICE**

<b>CONTRACTOR:</b> B.D.Y. GEOTECHNICAL SERVICE	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)
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**Appendix B : LOCATION PLAN**

<b>CONTRACTOR:</b> B.D.Y. GEOTECHNICAL SERVICE	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)
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<b>CONTRACTOR:</b> B.D.Y. GEOTECHNICAL SERVICE	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)
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**Appendix C : LABORATORY TEST RESULTS**

<b>CONTRACTOR:</b> <b>B.D.Y. GEOTECHNICAL SERVICE</b>	<b>495</b> <b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)</b>
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**TEST RESULTS OF SOIL SAMPLES**

**Discipline/Group** : Mechanical Soil and Rock  
**Sample ID** : 45/092 / Soil  
**Report No.** : MGS-2021-45/092 / Soil

**Client** : Goa State Infrastructure Development Corporation Limited Panaji Goa  
**Name of Work** : Soil Testing  
**Consultant** : Madhavi Kumar & Associates  
**Agency** : B.D.Y. Geotechnical Service

**Material Received** : Soil  
**Type of Sample** : DS

**U.L.R.** : IC887921000000191F  
**Date of Report** : 12-10-2021

**Source of Sample** : Cumberjua Site \*\*

Lab No	Particulars**	Grain Size Analysis %				Atterberg Limits %		Swelling Characters Index %	Shear Parameter	Consolidation	C.B.R.
		Gravel	Sand	Silt	Clay	LL	PL				
Soil Sample-1	THI-01 (4.20 - 4.95 m)	12	40	18	41	22	22	2.61	1	1	1
Soil Sample-2	EHI-01 (10.50 - 10.95 m)	9	38	53	51	25	26	2.57	1	1	1
Soil Sample-3	BHI-01 (13.50 - 13.95 m)	0	41	59	53	25	28	2.57	1	1	1
Soil Sample-4	HII-01 (16.50-16.95 m)	5	35	60	55	29	26	2.36	1	1	1
Soil Sample-5	THI-01 (21.0 - 21.45 m)	10	35	55	50	27	23	2.55	1	1	1
Soil Sample-6	HII-01 (24.0 - 24.45 m)	4	34	58	53	29	24	2.58	1	1	1
Test Method Specification		IS 2720 Part-4				IS 2720 Part-3		IS 2720 Part-40	IS 2720 Part-11 & 13	IS 2720 Part-15	IS 2720 Part-16

\*\* End of Result Sheet \*\*

**Notes:**

- The results are given only for the sample submitted by the Agency
- The test report shall not be reproduced except in full without written approval of the Laboratory
- Manglam Geotech Services is not responsible for any kind of interpretation of test results
- The results are not valid for any other purpose
- \*\* As obtained by Agency

  
**Certificate No. TC-8879**  
 Date: 10/11/2021 Page 1 / 1

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<b>CONTRACTOR:</b> <b>B.D.Y. GEOTECHNICAL SERVICE</b>	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)</b>
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**TEST RESULTS OF ROCK SAMPLES**

Discipline/Group Sample ID Report No.	* Mechanical/Soil and Rock * 46/0921/Rock * MGS-2021/46/0921/Rock	ULR # TC8879210000001192F Date of Report - 12-10-2021
Client Name of Work Consultant Agency	* Goa State Infrastructure Development Corporation Limited Panaji Goa * Rock Testing * Madhav Karnat & Associates * B.D.Y. Geotechnical Service	Source of Sample - Cumberjua Site **
Material Received Type of Sample	* Rock core and Pieces * Rock core	

Sr No.	Particulars**	Depth (m)**	UCS Soaked (Mpa)	Specific Gravity
1	Rock Sample - B111	28.5 to 30.0 m	56.2	2.81
		Test Method	IS 9143:1979	IS 1124:1974

**\*\* End of Result Sheet \*\***

**Note:**

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<b>CONTRACTOR:</b> B.D.Y. GEOTECHNICAL SERVICE	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)
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**Appendix D : PILE DESIGN CALCULATION**

<b>CONTRACTOR:</b> <b>B.D.Y. GEOTECHNICAL SERVICE</b>	<b>498</b> <b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE INFRASTRUCTURE DEVELOPMENT CORP. (GSIDC)</b>
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### Cole & Stroud Approach in Completely Weathered Rock:

As per Cole & Stroud Approach, for Soft Rock is considered as Hard Cohesive Soil for the computation of Pile Capacity.

Extrapolating the SPT data at 25.5 m depth, SPT value of  $N = 100$  is assumed for Highly weathered Basaltic Rock.

**Allowable Skin Friction Capacity  $\rightarrow q_{all} = \alpha \times C / \text{Factor of Safety}$**

Where:  $C = \text{Cohesion} = N / 1.5 = 66.6 \text{ T / m}^2$

Factor of Safety = 6.0 &  $A = \text{Adhesion Factor} = 0.9$

Allowable Skin Friction Capacity =  $0.9 \times 66.6 / 6 = 9.99 \text{ T / m}^2$

**For 1000mm Dia Piles, Allowable Skin Friction Resistance for  $3 \times D = 3.0\text{m}$  Pile Socketing**

$$= 9.99 \times \text{PI}() \times 1.0 \times 3$$

$$= 94 \text{ MT}$$

**↓ End Bearing Resistance (Rock Socketing) for typical 1000 mm Dia Piles**

**Safe load carrying capacity =  $Q_{eb} = Q_c \times N_D \times N_j \times A_p$**

Where,

$Q_c = \text{Uni-axial compressive strength of rock} = 1000 \text{ T/m}^2$

$N_D = \text{Depth factor} = 0.8 + 0.2(l_s/d) = 1.0$  for 1d rock socket

$N_j = 0.1$  to  $0.4$  (assumed as  $0.3$  for bedrock at pile tip)

$A_p = \text{Area of pile toe} = 0.785 \text{ m}^2$

$Q_{eb} = 1000 \times 1.0 \times 0.3 \times 0.785 = 235.5 \text{ MT}$

**Hence Total Pile Capacity at the mentioned Founding Level =  $94 + 235.5 = 329 \text{ MT}$**

<b>CONTRACTOR:</b> B.D.Y. GEOTECHNICAL SERVICE	<b>SOIL INVESTIGATION REPORT</b> <b>PROPOSED FARMER'S BRIDGE</b> <b>IN VILLAGE OF CUMBARJUA</b>	<b>PRINCIPLE CLIENT:</b> <b>GOA STATE</b> <b>INFRASTRUCTURE</b> <b>DEVELOPMENT CORP.</b> <b>(GSIDC)</b>
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CALCULATION OF DEPTH OF FIXITY AND LATERAL CAPACITY OF PILE			
Borehole No = BH -01			
Determination of Lateral Capacity of Pile (As per IS 2911 - Part I /Sec 2)			
Fixed Head Pile			
Diameter of pile (D) (m) =	1.00	Pile cut off level below GL (m) =	0.00
Soil Stratum Thickness below GL (m) =	25.50	Actual Length of Pile in soil LS (m) =	25.50
Rock encountered at depth below GL (m) =	25.50	Actual Length of Pile in Rock (m) =	4.50
Pile termination depth below GL (m) =	30.00	Actual Length of pile (m) =	30.00
Soil strata in general consists of Sandy Clay. And consider SPT N value as 30 - 40. So by consistency soil is Hard. as per Correlations with N values for cohesive soils from Basic and Applied Soil Mechanics by Gopal Ranjan, A.S.R. Rao. Modulus of subgrade reaction for Cohesive soil as $72.00 \times 10^3 \text{ kN/m}^3$ as per Table 4 of IS 2911 - Part I /Sec 2. The lateral capacity of pile shall be evaluated based on the effective length of pile and for maximum deflection of 10.00 mm. ( i.e. Lateral deflection of 1% of pile diameter as per clause 709.3.5.2 of IRC.78-2014)			
$Y = H (e + Zf)^3 / 12EI$			
Where			
Y Deflection of pile head	0.0100 m		
H Safe Lateral Load Pile Capacity	kN		
e Length of pile above ground level	0.00 m		
Zf Depth to point of Fixity Depends on $R = (EI/KB)^{0.25}$			
E Modulus of elasticity of concrete, $5000^* \text{sqrt}(f_{ck})$	29580.4 MN/m <sup>2</sup>		
	29580399 kN/m <sup>2</sup>		
M Grade of Concrete	35 MN/m <sup>2</sup>		
I Moment of inertia of pile cross section = $\pi D^4 / 64$	0.04909 m <sup>4</sup>		
B Diameter of pile	1.00 meter		
k1 From Table 4 of Appendix C of IS 2911, Part 1 / section 2	72.00 MN/m <sup>3</sup>		
k	14.40 MN/m <sup>3</sup>		
$R = (EI/KB)^{0.25}$	3.17		
Hence, from Fig 4 of IS 2911, Part 1 / section 2			
Zf / R	2		
Zf Depth to point of Fixity (m)	6.34 m		
Hence, $Y = H (e + Zf)^3 / 12EI$ Now $12EI = 1.74E+07 \text{ KN m}^2$ $(e + Zf)^3 = 2.55E-02 \text{ m}^3$ Hence, for $Y = 0.0100 \text{ m}$ $H = (12EI Y) / (e + Zf)^3$ $= 684.473 \text{ kN}$ $H = 69.75 \text{ Tons}$			
Consider, Allowable lateral load, Qa =	50 Tons		

**ANNEXURE V**  
**(List of Flora & Fauna)**

## List of Flora in Study Area

Sr. No.	Scientific Name	Common/ Local Name	Family
<b>Trees</b>			
1.	<i>Acacia auriculiformis</i>	Austrelian Acacia	Leguminoceae
2.	<i>Acacia catechu (L.f.) Wild</i>	Cutch Tree, Khair	Mimosaceae
3.	<i>Acacia mangium</i>	Hickory Wattle	Fabaceae
4.	<i>Achras zapota L.</i>	Chiku	Sapotaceae
5.	<i>Acrocarpus fraxinifolius</i>	Pink Cedar	Fabaceae
6.	<i>Aegle marmelos</i>	Bengal Quince	Rutaceae
7.	<i>Ailanthus exelsa</i>	Maharukh	Simaroubaceae
8.	<i>Albizia lebbek</i>	Siras	Leguminoceae
9.	<i>Albizia saman</i>	Rain Tree	Mimosaceae
10.	<i>Alstonia scholaris</i>	Satvin	Apocynaceae
11.	<i>Anacardium occidentale</i>	Kaju	Anacardiaceae
12.	<i>Areca catechu</i>	Supari	Palmae
13.	<i>Artocarpus altilis</i>	Breadfruit	Moraceae
14.	<i>Artocarpus heterophyllus</i>	Fanas	Moraceae
15.	<i>Artocarpus incisa</i>	Neer Phanas	Moraceae
16.	<i>Averrhoa bilimbi</i>	Bilimbla	Oxalidaceae
17.	<i>Azadirachta indica</i>	Neem	Meliaceae
18.	<i>Barringtonia acutangola</i>	Fresh water mangrove	Lecythidaceae
19.	<i>Bauhinia purpurea</i>	Purple Orchid Tree	Caesalpinaceae
20.	<i>Bombax ceiba</i>	Katesavar	Bombacaceae
21.	<i>Bridelia retusa</i>	Asana	Euphorbiaceae
22.	<i>Butea monosperma</i>	Palash	Fabaceae
23.	<i>Callicarpa tomentosa</i>	Velvety Beauty Berry	Verbenaceae
24.	<i>Calophyllum inophyllum</i>	Undi	Clusiaceae
25.	<i>Careya arborea</i>	Kumbhi	Lecythidaceae
26.	<i>Caryota urens</i>	Bherli mad	Palmae
27.	<i>Cassia fistula</i>	Amaltas	Leguminoceae
28.	<i>Casuarina equisetifolia</i>	Suru	Casuarinaceae
29.	<i>Citrus limon</i>	lemon tree	Rutaceae
30.	<i>Cocos nucifera</i>	Naral	Palmae
31.	<i>Delonix regia</i>	Gulmohar	Leguminoceae
32.	<i>Embelica officinalis</i>	Awala	Euphorbiaceae
33.	<i>Erythrina indica</i>	Pangara	Leguminoceae
34.	<i>Erythrina variegata</i>	Indian Coral Tree	Leguminoceae
35.	<i>Eucalyptus sp.</i>	Nilgiri	Myrtaceae
36.	<i>Ficus benghalensis</i>	Vad	Moraceae
37.	<i>Ficus exasperata</i>	Ficus with yellow fruit	Moraceae
38.	<i>Ficus glomerata</i>	Umbar	Moraceae
39.	<i>Ficus hispida</i>	Hairy Fig	Moraceae
40.	<i>Ficus racemosa</i>	Cluster Fig Tree	Moraceae
41.	<i>Ficus religiosa</i>	Pimpal	Moraceae
42.	<i>Ficus tinctoria</i>	Strangler Fig	Moraceae
43.	<i>Firmiana colorata</i>	Scarlet Sterculia, Kaushi	Sterculiaceae
44.	<i>Garcinia indica</i>	Kokam	Clusiaceae
45.	<i>Gliricidia sepium</i>	Mexican lilac	Fabaceae
46.	<i>Gmelina arborea</i>	Shivan	Verbenaceae
47.	<i>Grewia serrulata</i>	Dhaman	Tiliaceae

Sr. No.	Scientific Name	Common/ Local Name	Family
48.	<i>Grewia tiliifolia</i>	Dhaman	Tiliaceae
49.	<i>Hibiscus tiliaceus</i>		Malvaceae
50.	<i>Holoptelea integrifolia</i>	Indian Elm	Ulmaceae
51.	<i>Hopea ponga</i>	Pav, Kavshi	Dipterocarpaceae
52.	<i>Lagerstroemia lanceolata</i>	Nandi Tree	Lythraceae
53.	<i>Lannea coromandelica</i>	Medhashingi	Bignoniaceae
54.	<i>Lucena leucocephala</i>	Subabhul	Mimosaceae
55.	<i>Macaranga peltata</i>	Chandada	Euphorbiaceae
56.	<i>Magnolia champaca</i>	Golden Champa	Magnoliaceae
57.	<i>Mammea suriga</i>	Surangi	Clusiaceae
58.	<i>Mangifera indica</i>	Amba	Anacardiaceae
59.	<i>Manilkara zapota</i>	Chikoo	Sapotaceae
60.	<i>Memecylon umbellatum</i>	Anjan	Melastomaceae
61.	<i>Millingtonia hortensis</i>	Indian Cork Tree	Bignoniaceae
62.	<i>Mimusops elengi</i>	Bakul	Sapotaceae
63.	<i>Mitragyna parvifolia</i>	Kadamb	Rubiaceae
64.	<i>Morinda citrifolia</i>	Noni	Rubiaceae
65.	<i>Moringa olifera</i>	Shevga	Moringaceae
66.	<i>Moringa pterygosperma</i>	Mashing	Moringaceae
67.	<i>Musa sapientum paradisiaca</i>	Banana	Musaceae
68.	<i>Neolamarckia cadamba</i>	Kadam	Rubiaceae
69.	<i>Oroxylum indicum</i>	Indian Trumpet Flower	Bignoniaceae
70.	<i>Peltophorum pterocarpum</i>	Sonmohor	Leguminoceae
71.	<i>Plumeria rubra</i>	Chapha	Apocynaceae
72.	<i>Polyalthia longifolia</i>	Ashok	Anonaceae
73.	<i>Pongamia pinnata</i>	Karanji	Fabaceae
74.	<i>Psidium guajava</i>	Common Guava	Myrtaceae
75.	<i>Pterocarpus marsupium</i>	Bibla, Kino	Fabaceae
76.	<i>Sapindus mukorossi</i>	Soap Nut	Sapindaceae
77.	<i>Schleichera oleosa</i>	Lac tree, Kusum	Sapindaceae
78.	<i>Semecarpus anacardium</i>	Bibo	Anacardiaceae
79.	<i>Spathodea campanulata</i>	Fountain Tree	Bignoniaceae
80.	<i>Spondias pinnata</i>	Ambada	Anacardiaceae
81.	<i>Sterculia colorata</i>	Kaushi	Sterculiaceae
82.	<i>Sterculia foetida</i>	Hazel Sterculia	Sterculiaceae
83.	<i>Sterculia urens</i>	Sardol	Sterculiaceae
84.	<i>Sterculia villosa</i>		Sterculiaceae
85.	<i>Stereospermum colais</i>	Indian Snake Tree, Padal	Bignoniaceae
86.	<i>Strychnos nux-vomica</i>	Kajara	Loganiaceae
87.	<i>Syzygium jambolanum</i>	Jambhul	Myrtaceae
88.	<i>Tamarindus indica</i>	Chinch	Leguminoceae
89.	<i>Tectona grandis</i>	Sag	Verbenaceae
90.	<i>Terminalia arjuna</i>	Arjun Tree	Combretaceae
91.	<i>Terminalia belerica</i>	Behada	Combretaceae
92.	<i>Terminalia catappa</i>	Indian Almond	Combretaceae
93.	<i>Terminalia crenulata</i>	Kinjal	Combretaceae
94.	<i>Terminalia paniculata</i>	Kinjal	Combretaceae
95.	<i>Thespesia populnea</i>	Bhend	Malvaceae
96.	<i>Trema orientalis</i>	Charcoal Tree	Cannabaceae
97.	<i>Zanthoxylum rhetsa</i>	Trifal	Rutaceae

Sr. No.	Scientific Name	Common/ Local Name	Family
98.	<i>Ziziphus jujuba</i>	Bor	Rhamnaceae
99.	<i>Ziziphus mauritiana</i>	Bor	Rhamnaceae
<b>Shrubs</b>			
1.	<i>Abelmoschus esculentus</i>	Lady's finger	Malvaceae
2.	<i>Adhatoda vasica</i>	Adulsa	Acanthaceae
3.	<i>Alternanthera sp</i>	-	Amaranthaceae
4.	<i>Ananus comosus</i>	Pine apple	Bromeliaceae
5.	<i>Bauhinia racemosa</i>	Apto	Leguminoceae
6.	<i>Brassica oleraceae</i>	Navalcol	Brassicaceae
7.	<i>Calotropis gigantea</i>	Rui	Asclepiadaceae
8.	<i>Calycopteris floribunda</i>	Baguli/ Ukshi	Combretaceae
9.	<i>Capsicum frutescense</i>		Solanaceae
10.	<i>Carissa carandas</i>	Karavand	Apocynaceae
11.	<i>Crotalaria junctia</i>	Sun hemp	Fabaceae
12.	<i>Cyamopsis tetragonoloba</i>	Cluster beans	Fabaceae
13.	<i>Datura metel</i>	Dutro	Solanaceae
14.	<i>Dichrostachis cineria</i>		Leguminoceae
15.	<i>Duranta plumieri</i>	--	Verbenaceae
16.	<i>Euphorbia neriifolia</i>	Nivadung	Euphorbiaceae
17.	<i>Helicteres isora</i>	Altay	Sterculiaceae
18.	<i>Hibiscus rosasinensis</i>	China Rose	Malvaceae
19.	<i>Holarrhena antidysenterica</i>	Kuda	Apocynaceae
20.	<i>Ipomoea batatas</i>	Sweet potato	Solanaceae
21.	<i>Ixora coccinea</i>	Ixora	Rubiaceae
22.	<i>Lagerstromea flosreginae</i>	Tamhan	Lythraceae
23.	<i>Lantana camara</i>	Ghaneri	Verbenaceae
24.	<i>Melastoma sp.</i>		Melastomaceae
25.	<i>Microcos paniculata</i>	Hasale	Tiliaceae
26.	<i>Mussaenda glabrata</i>	Sarvadi	Rubiaceae
27.	<i>Nerium indicum</i>	Kanher	Apocynaceae
28.	<i>Ochna serrulata</i>	Mickey mouse plant	Ochnaceae
29.	<i>Opuntia sp.</i>	Fadya Nivdung	Euphorbiaceae
30.	<i>Pandanus odorifera+B69.</i>	Kevda	Pandanaceae
31.	<i>Raphanus sativus</i>	Raddish	Brassicaceae
32.	<i>Ricinus communis</i>	Erand	Euphorbiaceae
33.	<i>Solanum melongena</i>	Egg plant	Solanaceae
34.	<i>Solanum melongena</i>	Brinjal	Solanaceae
35.	<i>Spinachia oleracea</i>	Spinach	Amaranthaceae
36.	<i>Thevetia neriifolia</i>	Bitty	Apocynaceae
37.	<i>Vitex negundo</i>	Nigad	Verbenaceae
38.	<i>Woodfordia floribunda</i>	Dhataki	Lythraceae
<b>Herbs</b>			
1.	<i>Abutilon indicum</i>	Pettari	Malvaceae
2.	<i>Achyranthes aspera</i>	Prickly Chaff Flower	Amaranthaceae
3.	<i>Ageratum conyzoides</i>	Goat weed	Asteraceae
4.	<i>Alternanthera sessilis</i>	--	Amaranthaceae
5.	<i>Brassica juncea</i>	Mustard	Brassicaceae
6.	<i>Boerhavia diffusa</i>	Punarnava	Nyctaginaceae
7.	<i>Casia tora</i>	Taikhilo	Leguminoceae
8.	<i>Catharanthes rosious</i>	Sadafuli	Apocynaceae

Sr. No.	Scientific Name	Common/ Local Name	Family
9.	<i>Celosia argentea</i>	Red cockscomb	Amaranthaceae
10.	<i>Chromolaena odorata</i>		Asteraceae
11.	<i>Clerodendrum paniculatum</i>	--	Verbenaceae
12.	<i>Clerodendrum inerme</i>		Verbenaceae
13.	<i>Colocasia esculenta</i>	Alu	Araceae
14.	<i>Crepis sancta</i>	Sacred Hawksbeard	Asteraceae
15.	<i>Crotalaria pallida</i>	rattle pod	Fabaceae
16.	<i>Crotalaria filipes</i>	Creeping hemp, Phatphati	Fabaceae
17.	<i>Eclipta alba</i>	Maka	Asteraceae
18.	<i>Ecobolium ligustrinum</i>	Ekboli	Acanthaceae
19.	<i>Eranthemum roseum</i>	Ran aboli	Acanthaceae
20.	<i>Hemidesmus indicus</i>	Anantmul	Asclepiadaceae
21.	<i>Hyptis suaveolens</i>	Ran tulas	Lamiaceae
22.	<i>Ipomoea carnea</i>	Besharam	Convolvulaceae
23.	<i>Jatropha curcus</i>	Moghali Erund	Euphorbiaceae
24.	<i>Ocimum sanctum</i>	Tulas	Labiataeae
25.	<i>Sida rhombifolia</i>	Tupkati	Malvaceae
26.	<i>Sesuvium portulacastrum</i>		AIZOACEAE
27.	<i>Tridax procumbens</i>	Dagadi	Asteraceae
28.	<i>Urena lobata</i>	--	Malvaceae
29.	<i>Wedelia sp.</i>	Wedelia	Asteraceae
<b>Climbers/ Creepers</b>			
1.	<i>Abrus precatorious</i>	Gunja	Leguminoceae
2.	<i>Antigonon leptopus</i>	Coral vine	Polygonaceae
3.	<i>Bougainvillia spectabilis</i>	Bougainvell	Nyctaginaceae
4.	<i>Canavalia ensiformis</i>	Abai/horse bean	Fabaceae
5.	<i>Capparis zeylanica</i>	Ceylon Caper	capparaceae
6.	<i>Clitoria annua</i>	Bombay Bean	Fabaceae
7.	<i>Clitoria ternatea</i>	Butterfly Bean	Fabaceae
8.	<i>Coccinia grandis</i>	Ivy Gourd	cucurbitaceae
9.	<i>Cucumis melo</i>	Wild Musk Melon	cucurbitaceae
10.	<i>Cuscuta reflexa</i>	amarvel	Convolvulaceae
11.	<i>Gloriosa superba</i>	Glory lily	Liliaceae
12.	<i>Hemidesmus indicus</i>	Indian Sarsaparilla	Asclepiadaceae
13.	<i>Ichnocarpus frutescens</i>	Black Creeper	Apocynaceae
14.	<i>Ipomoea aquatica</i>	Water Morning Glory	Convolvulaceae
15.	<i>Ipomoea cairica</i>	Railway Glory	Convolvulaceae
16.	<i>Ipomoea carnea</i>	Hedge Glory	Convolvulaceae
17.	<i>Ipomoea mauritiana</i>	Greater Glory	Convolvulaceae
18.	<i>Ipomoea nil</i>	Blue Dawn Glory	Convolvulaceae
19.	<i>Ipomoea obscura</i>	Lesser Glory	Convolvulaceae
20.	<i>Ipomoea pes-caprae</i>	Beach Morning Glory	Convolvulaceae
21.	<i>Ipomoea quamoclit</i>	Cypress Vine	Convolvulaceae
22.	<i>Ipomoea rubriflora</i>	Scarlet Morning Glory	Convolvulaceae
23.	<i>Ipomoea sepiaria</i>	Purple Heart Glory	Convolvulaceae
24.	<i>Ipomoea violacea</i>		Convolvulaceae
25.	<i>Luffa aegyptiaca</i>	Sponge Gourd	Cucurbitaceae
26.	<i>Merremia vitifolia</i>	Grape Glory	Cucurbitaceae
27.	<i>Momordica dioica</i>	Bristle Gourd	Cucurbitaceae
28.	<i>Mucuna pluriencia</i>	Khajkuhri	Leguminoceae

Sr. No.	Scientific Name	Common/ Local Name	Family
29.	<i>Mukia maderaspatana</i>	Madras Pea Pumpkin	Cucurbitaceae
30.	<i>Operculina turpethum</i>	--	Convolvulaceae
31.	<i>Smilax microphylla</i>	N.A.	Smilacaceae
32.	<i>Tinospora cordifolia</i>	Indian Tinospora	Menispermaceae
33.	<i>Trichosanthes anguina</i>	Snake Gourd	Cucurbitaceae
34.	<i>Trichosanthes cucumerina</i>	Common Fringed-Flower Wine	Cucurbitaceae
35.	<i>Trichosanthes tricuspidata</i>	Great Fringed-Flower Vine	Cucurbitaceae
36.	<i>Vigna vexillata</i>	Indian Sweet Pea	Fabaceae
37.	<i>Trichosanthes cucumerina</i>		cucurbitaceae
38.	<i>Coccinia grandis</i>		cucurbitaceae
39.	<i>Smilax sp.</i>	sarsaparilla	Smilacaceae
<b>Grasses</b>			
1.	<i>Apluda mutica</i>	grass	Poaceae
2.	<i>Bambusa sp.</i>	Bamboo	Poaceae
3.	<i>Cynodon dactylon</i>	Durva	Poaceae
4.	<i>Dendrocalamus strictus</i>	Vet	Poaceae
5.	<i>Themeda</i>	grass	Graminae
6.	<i>Cyperus malaccensis</i>		Cyperaceae
7.	<i>Porteresia coarctata</i>		Poaceae
8.	<i>Oplismenus burmannii</i>	Wavy-Leaf Basketgrass	Poaceae
9.	<i>Eragrostis unioides</i>	Chinese Lovegrass	Poaceae
10.	<i>Arundo donax</i>	Giant Cane	Poaceae
11.	<i>Allium cepa</i>	Onion	Amaryllidaceae
12.	<i>Oryza sativa</i>	Rice	Poaceae
<b>Epiphytes</b>			
1.	<i>Dendrobium sp.</i>	Vanda	Orchidaceae
2.	<i>Loranthus sp.</i>	Bandgul	Loranthaceae
3.	<i>Rhynchostylis retusa</i>	Common Foxtail Orchid	Orchidaceae
4.	<i>Habenaria commelinifolia</i>	Long-Tailed Habenaria	Orchidaceae
5.	<i>Vanda sp.</i>	Orchid	Orchidaceae
<b>Water Hyacinth/ Wetland</b>			
1.	<i>Nymphaea pubescens</i>	Pink water lilly	Nymphaeaceae
2.	<i>Nymphaea pubescens</i>	White water lilly	Nymphaeaceae
3.	<i>Eichhornia crassipes</i>	Jal kumbhi	Pontederiaceae
4.	<i>Azolla pinnata</i>	Mosquito fern	Salviniaceae
5.	<i>Eichhornia crassipes</i>	Common water hyacinth	Pontederiaceae
6.	<i>Bacopa monnieri</i>	water hyassop	Plantaginaceae
7.	<i>Alocasia macrorrhizos</i>	Elephant ear	Araceae
8.	<i>Lemna minor</i>	common duck weed	Lemnaceae
9.	<i>Monochoria vaginalis</i>	oval leaf pond leaf	Pontederiaceae
10.	<i>Salvinia natans</i>	Floating leaf	Salviniaceae
11.	<i>Nymphoides hydrophylla</i>	Crested Floatingheart, Kumudini	Menyanthaceae
12.	<i>Pistia stratiotes</i>	Water Cabbage	
13.	<i>Nymphoides indica</i>	Water Snowflake, Kumudini	Menyanthaceae
14.	<i>Nymphaea nouchali</i>	Star Water Lily, Tambdi Salka	Menyanthaceae
15.	<i>Nymphaea pubescens</i>	Common Water Lily, Dhavi Salka	Menyanthaceae
16.	<i>Hydrocharis morsus-ranae</i>	Common frogbit	Hydrocharitaceae
<b>Mangroves</b>			
1.	<i>Avicennia alba</i>		Acanthaceae
2.	<i>Avicennia marina</i>	Grey Mangrove	Acanthaceae

Sr. No.	Scientific Name	Common/ Local Name	Family
3.	<i>Avicennia officinalis</i>	White mangrove, Tivar	Acanthaceae
4.	<i>Brugeria cylindrica</i>		Rhizophoraceae
5.	<i>Bruguiera gymnorhiza</i>	Black Mangrove	Rhizophoraceae
6.	<i>Ceriops tagal</i>	Supurred mangrove	Rhizophoraceae
7.	<i>Kandelia candel</i>		Rhizophoraceae
8.	<i>Rhizophora apiculata</i>	Stilt mangrove	rhizophoraceae
9.	<i>Rhizophora mucronata</i>	Kandal	Rhizophoraceae
10.	<i>Acanthus ilicifolius</i>	Holly Mangrove, Marandi	Acanthaceae
11.	<i>Acrostichum aurem</i>		Pteridaceae
12.	<i>Aegicerias corniculatum</i>	River black mangrove	Myrsinaceae
13.	<i>Derris trifoliata</i>	Common derris	Fabaceae
14.	<i>Excoecaria agallocha</i>	Blinding White Mangrove	Euphorbiaceae
15.	<i>Salvadora persica</i>		Saldoraceae
16.	<i>Sonneratia alba</i>	Apple Mangrove	Lythraceae
17.	<i>Sonneratia caseolaris</i>	Apple Mangrove	Lythraceae
<b>Pteridophytes</b>			
1.	<i>Adiantum raddianum</i>	Maiden Hair Fern	Pteridaceae
2.	<i>Aleuritopteris farinosa</i>	Silver Fern	Pteridaceae
3.	<i>Lygodium flexuosum</i>	Maidenhair Creeper	
4.	<i>Dryneria</i>	--	Polypodiaceae

#### List of Fauna Observed/ Reported in Study Area

Sr. No.	Scientific Name	Common/ Local Name	Family	Status (WPA 1972)
<b>Birds</b>				
1.	<i>Alcedo atthis</i>	Small blue Kingfisher	Alcedinidae	Sch IV
2.	<i>Amaurornis phoenicurus</i>	White breasted Water hen	Rallidae	Sch IV
3.	<i>Anastomus oscitans</i>	Open bill stork	Ciconiidae	Sch IV
4.	<i>Ardea alba</i>	Great Egret	Ardeidae	Sch IV
5.	<i>Ardea cinerea</i>	Grey heron	Ardeidae	Sch IV
6.	<i>Ardea intermedia</i>	Intermediate egret	Ardeidae	Sch IV
7.	<i>Ardea modesta</i>	Eastern great egret	Ardeidae	Sch IV
8.	<i>Ardea purpurea</i>	Purple heron	Ardeidae	Sch IV
9.	<i>Ardeola grayii</i>	Indian pond-heron	Ardeidae	Sch IV
10.	<i>Ardeola grayii</i>	Pond herons	Ardeidae	Sch IV
11.	<i>Bubulcus ibis</i>	Cattle Egret	Ardeidae	Sch IV
12.	<i>Oriolus oriolus</i>	Eurasian Golden Oriole	oriolidae	Sch IV
13.	<i>Ceryle rudis</i>	Pied kingfisher	Alcedinidae	Sch IV
14.	<i>Columba livia</i>	Rock pigeon	Columbidae	Sch IV
15.	<i>Copsychus saularis</i>	Magpie Robin	Muscicapidae	Sch IV
16.	<i>Coracias benghalensis</i>	Indian roller	Coraciidae	Sch IV
17.	<i>Cyornis Tickelliae</i>	Tickell's flycatcher	Muscicapidae	Sch IV
18.	<i>Dicaeidae sp</i>	Flower pecker	Dicaeidae	Sch IV
19.	<i>Dicrurus macrocercus</i>	Black Drongo	Dicruridae	Sch IV
20.	<i>Dicrurus paradiseus</i>	Racket tailed drongo	Dicruridae	Sch IV
21.	<i>Egretta garzetta</i>	Little egret	Ardeidae	Sch IV
22.	<i>Egretta gularis</i>	Western reef heron	Ardeidae	Sch IV
23.	<i>Eudynamys scolopaceus</i>	Asian Koel	Cuculidae	Sch IV
24.	<i>Fulica atra</i>	Eurasian coot	Rallidae	Sch IV
25.	<i>Gallinula chloropus</i>	Common moorhen	Rallidae	Sch IV

Sr. No.	Scientific Name	Common/ Local Name	Family	Status (WPA 1972)
26.	<i>Halcyon smyrnensis</i>	White-throated Kingfisher	Alcedinidae	Sch IV
27.	<i>Haliaeetus leucogaster</i>	White Bailed Fishing Eagle	Accipitridae	Sch IV
28.	<i>Haliastur indus</i>	Brahminy Kite	Accipitridae	Sch IV
29.	<i>Hirundo smithii</i>	Wire-tailed Swallow	Hirundinidae	
30.	<i>Ixobrychus sinensis</i>	Yellow bittern	Ardeidae	Sch IV
31.	<i>Lonchura atricapilla</i>	Black Headed Munia	Estrildidae	Sch IV
32.	<i>Megalaima viridis</i>	White-cheeked Barbet	Megalaimidae	Sch IV
33.	<i>Merops orientalis</i>	Green Beater	Meropidae	
34.	<i>Merops sp.</i>	Chestnut beater	Meropidae	
35.	<i>Metopidius indicus</i>	Bronze jacana	Jacanidae	Sch IV
36.	<i>Milvus migrans</i>	Black Kite	Accipitridae	
37.	<i>Motacilla maderaspatensis</i>	Large Pied Wagtail	Motacillidae	
38.	<i>Nectarinia zeylonica</i>	Purple rumped Sunbird	Nectariniidae	Sch IV
39.	<i>Ocyroceros griseus</i>	Malabar Grey Hornbill	Bucerotidae	Sch IV
40.	<i>Pavo cristatus</i>	Peafowl	Phasianidae	Sch I
41.	<i>Pelargopsis capensis</i>	Stork billed kingfisher	Alcedinidae	Sch IV
42.	<i>Phalacrocorax fuscicollis</i>	Cormorant	Phalacrocoracidae	Sch IV
43.	<i>Ploceus philippinus</i>	Baya	Ploceidae	Sch IV
44.	<i>Porphyrio porphyrio</i>	Purple swamphen	Rallidae	Sch IV
45.	<i>Porzana fusca</i>	Ruddy-breasted crane	Rallidae	Sch IV
46.	<i>Prinia sylvatica</i>	Jungle Warbler	Cisticolidae	
47.	<i>Pseudibis papillosa</i>	Indian Black Ibis	Threskiornithidae	Sch IV
48.	<i>Psittacula cyanocephala</i>	Plum headed Parakeet	Psittaculidae	Sch IV
49.	<i>Pycnonotus cafer</i>	Red vented Bulbul	Pycnonotidae	Sch IV
50.	<i>Pycnonotus jocosus</i>	Red whiskered Bulbul	Pycnonotidae	Sch IV
51.	<i>Saxicoloides fulicatus</i>	Indian Robin	Muscicapidae	Sch IV
52.	<i>Threskiornis melanocephalus</i>	White Ibis	Threskiornithidae	Sch IV
53.	<i>Tringa glareola</i>	Wood Sandpiper	Scolopacidae	Sch IV
54.	<i>Aegithina tiphia</i>	Common Iora	Aegithinidae	Sch IV
55.	<i>Dicrurus caerulescens</i>	Whitebellied Drongo	Dicruridae	Sch IV
56.	<i>Elanus caeruleus</i>	Black-shouldered Kite	Accipitridae	Sch IV
57.	<i>Plotus anhinga</i>	Darter	Anhingidae	Sch IV
58.	<i>Streptopelia chinensis</i>	Spotted Dove	Columbidae	Sch IV
59.	<i>Turdoides striatus</i>	Jungle Babbler	Timaliidae	Sch IV
60.	<i>Tadorna ferruginea</i>	Ruddy Shelduck	Anatidae	Sch IV
61.	<i>Plegadis falcinellus</i>	Glossy Ibis	Threskiornithidae	Sch IV
62.	<i>Cinnyris asiaticus</i>	Purple Sunbird	Nectariniidae	Sch IV
63.	<i>Centropus sinensis</i>	Greater Coucal	Cuculidae	Sch IV
64.	<i>Prinia socialis</i>	Ashy Prinia	Cisticolidae	
65.	<i>Lonchura striata</i>	White Rumped munia	Estrildidae	
66.	<i>Rhipidura albicollis</i>	White throated fantail	Rhipiduridae	
67.	<i>Calidris temminckii</i>	Teminick's stint	Scolopacidae	Sch IV
68.	<i>Ciconia episcopus</i>	Woollynecked Stort	Ciconiidae	Sch IV
69.	<i>Ciconia ciconia</i>	White Stork	Ciconiidae	Sch IV
70.	<i>Anas poecilorhyncha</i>	Spot Billed-duck	Anatidae	Sch IV
71.	<i>Sarkidiornis sylvicola</i>	Comb duck	Anatidae	Sch IV
72.	<i>Actitis hypoleucos</i>	Common Sandpiper	Scolopacidae	Sch IV
73.	<i>Gallinago stenura</i>	Pintail Snipe	Scolopacidae	Sch IV

Sr. No.	Scientific Name	Common/ Local Name	Family	Status (WPA 1972)
74.	<i>Orthotomus sutorius</i>	Common tailor bird	Cisticolidae	
75.	<i>Gallus sonneratii</i>	Grey Junglefowl	Phasianidae	Sch IV
76.	<i>Lanius schach</i>	Long tailed shrike	Laniidae	
77.	<i>Acridotheres fuscus</i>	Jungle Myna	Sturnidae	Sch IV
78.	<i>Terpsiphone paradisi</i>	Asian paradise flycatcher	Monarchidae	Sch IV
79.	<i>Dinopium benghalense</i>	Back rumped flameback	Picidae	Sch IV
80.	<i>Chloropsis cochinchinensis</i>	Blue winged leafbird	Chloropseidae	
81.	<i>Ciconia boyciana</i>	Oriental Stork	Ciconiidae	Sch IV
82.	<i>Cecropis daurica</i>	Red Rumped Swallow	Hirundinidae	
83.	<i>Halcyon pileata</i>	Black Capped Kingfisher	Alcedinidae	Sch IV
84.	<i>Butorides striata</i>	Little heron	Ardeidae	Sch IV
85.	<i>Haliaeetus leucogaster</i>	White Bellied Sea Eagle	Accipitridae	Sch I (Part III)
86.	<i>Circus aeruginosus</i>	eurasian marsh harrier	Accipitridae	Sch IV
87.	<i>Vanellus indicus</i>	Red Wattled lapwing	Charadriidae	
<b>Butterflies</b>				
1.	<i>Parantica aglea</i>	Glassy Tiger	Nymphalidae	
2.	<i>Danaus chrysippus</i>	Plain Tiger	Nymphalidae	
3.	<i>Eurema hecabe</i>	Common Grass Yellow	Pieridae	
4.	<i>Neptis hylas</i>	Common Sailor	Nymphalidae	
<b>Reptile</b>				
1.	<i>Ptyas mucosa</i>	Rat Snake	Colubridae	Sch II
2.	<i>Crocodylus palustris</i>	Crocodile	Crocodylidae	Sch I (Part II)
3.	<i>Eutropis carinata</i>	Common Skink	Scincidae	
<b>Mammals</b>				
1.	<i>Funambulus palmarum</i>	Three stripped Squirrel	Sciuridae	
2.	<i>Hystrix sp.</i>	Indian Porcupine	Hystricidae	Sch IV
3.	<i>Lepus nigricolis</i>	Black napped Hare	Leporidae	Sch IV
4.	<i>Pteropus giganteus</i>	Flying Fox	Pteropodidae	
5.	<i>Semnopithecus sp.</i>	Langur	Cercopithecidae	Sch II
6.	<i>Sus scrofa</i>	Wild Boar	Suidae	Sch III
7.	<i>Ratufa indica</i>	Indian Giant squirrel	Sciuridae	Sch II (Part I)
8.	<i>Herpestes edwardsi</i>	Common Mongoose	Herpestidae	Sch II
9.	<i>Rattus sp.</i>	Rat	Muridae	Sch IV

## **Socio-economic & Farmer Benefit Report**

on

**Construction of Bridge from Chune - Kator to Vanso Fields for Local Farmers to Cross Tributary of Mandovi/ Cumbarjua Canal, Villages Cumbarjua and Jua, at Survey Number. 65/9 and 175/5, Taluka Tiswadi, District North Goa, Goa**

by

**Goa State Infrastructure Development Corporation Ltd.**



**30<sup>th</sup> June 2022**



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## 1 Introduction

### 1.1 Background

Goa State Infrastructure Development Corporation Ltd. (hereinafter called 'GSIDC') has been constituted by the Government of Goa in year 2001, under the infrastructure up-gradation programme. Currently GSIDC is implementing several infrastructure projects such as bridges, upgradation of tourism related roads, hospitals, bus stands, village recreational centres, market complexes and few amenities which needs urgent attention and action at a fast pace. Present techno feasibility report deals with desirability of a bridge connecting Cumbarjua CT with Jua CT.

*Note: CT: Census tracts (CTs) are small, relatively stable geographic areas that usually have a population of less than 10,000 persons, based on data from the previous Census of Population Program.*

### 1.2 Salient Features & Need of The Bridge

**Location:** The proposed bridge over tributary of Cumbarjua canal falls in survey number 65/9 and 175/5 and it will connect Cumbarjua CT with Jua CT.

**Conveyance:** At present Cumbarjua farmers having fields in Jua CT have to cross water tributary from Cumbarjua by ferry/boat to Jua CT to access their fields. Proposed bridge will fulfil the long-standing demand of the farmers to access their fields. The bridge will cater to foot traffic and tractor movement.

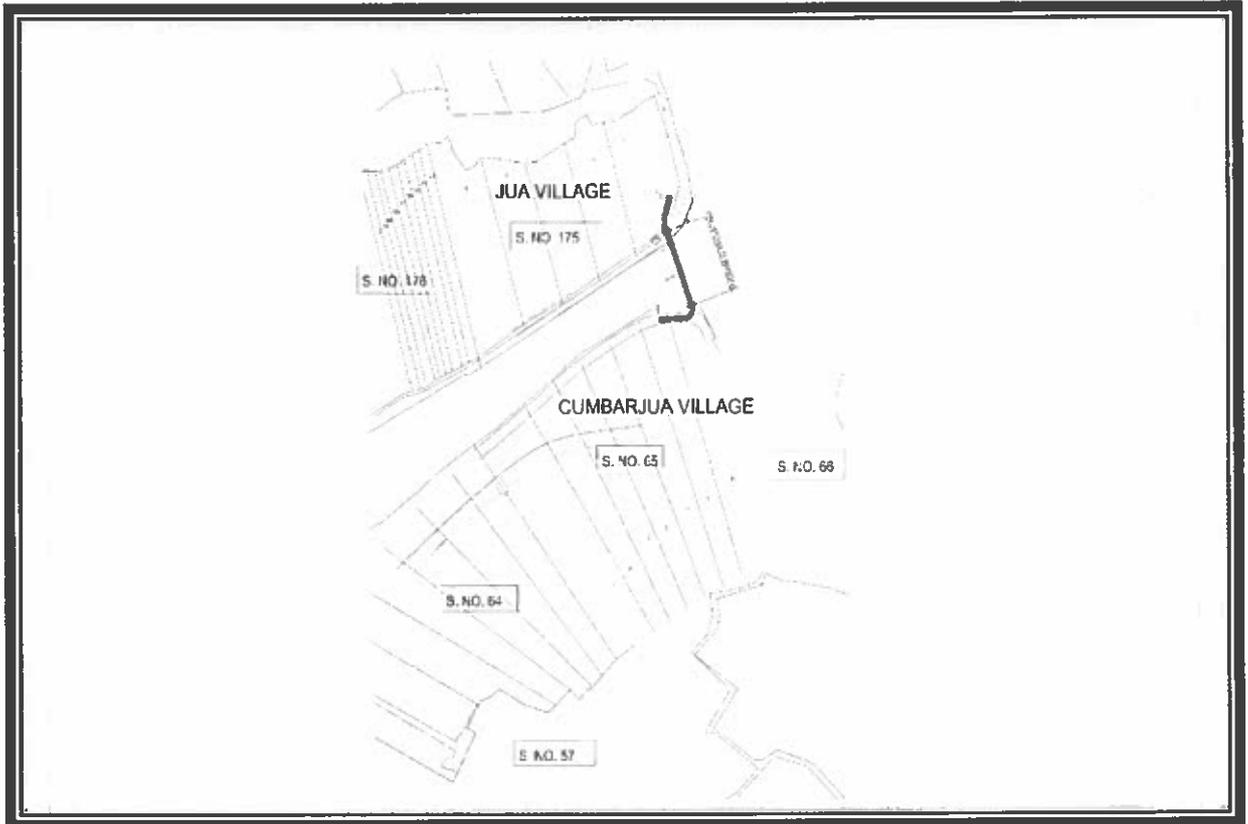


Figure 1.1 Location of Site

### 1.3 Objectives of The Study

The main objective of the present study is to carry out a socio-economic survey of 65 farmers from 2 locations (Jua & Cumbarjua) who are engaged in farming activity at Jua location & facing difficulties in farming due to water tributary in between Cumbarjua & Jua location. To reach at the agricultural field, farmers have to cross the river Mandovi by ferry/small boats which is difficult as well as expensive for them. The study will help to assess the importance of the proposed bridge in the farmers present as well as future life. To generate the necessary data and information on farmer families, to prepare an appropriate report for importance of construction of bridge for local farmers to cross river stream for cultivation of fields from Chune - Kator to Vanso field in village of Cumbarjua.

**More specifically, the objectives are:**

- a) To collect demographic and socio-economic characteristics of farmers residing adjacent to the project site

Report on Benefit of Bridge (to connect Chune - Kator to Vanso Fields) to Local Farmers of Jua & Cumbarjua, Tiswadi, North Goa, Goa by Goa State Infrastructure Development Corporation Ltd.

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- b) To determine, how the proposed development project will affect or change the lives of current or future farmers of Cumbarjua CT
- c) To understand the people's reactions towards the project
- d) To identify the needs/ problems of the farmers

## 1.4 Scope of the Study

- Have a more complete understanding of farmers of Cumbarjua location

## 1.5 Layout Of the Report

Chapter 1 has given overall details of the socio-economic community report, chapter 2 gives details about the survey methodology, sample size, percentage of HH covered etc. Chapter 3 provide all secondary source details, primary data analysis & in chapter 4, conclusion & recommendation is described. the layout of this report constitutes the following sections.

- Chapter-1 : Introduction
- Chapter-2 : Approach, Methodology and Schedule
- Chapter-3 : Socio Economic Profile of The Study Area
- Chapter-4 : Conclusion & Recommendation

## 2 Approach, Methodology and Schedule

### 2.1 Approach and Methodology

Approach and methodology mainly consist of quantitative and qualitative tools and techniques. The study was conducted in three phases.

#### 2.1.1 Phase – I: Pre-Survey Activities

Collection and review of project literature

- a) discussions with Project Implementing authorities
- b) collection of available secondary database

Rapid reconnaissance survey to familiarize field activities Following to the review and consultations, rapid preliminary field visits were conducted as part of ground truthing exercise. This is primarily observatory exercise and entails briefings by the concerned.

Scoping and other Pre survey activities

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Both the review and rapid reconnaissance survey helped in finalizing the study instruments and inception report detailing the final methodology and work plan.

### 2.1.2 Phase II: Survey Activities

1. **Farmer Survey of the focus area:** Conducting a household farmer survey is to broadly enumerate households' details
2. **Focus group discussion:** The qualitative survey includes focus group discussions and in-depth interviews with various sections of people such as knowledgeable persons, community leaders basically to elicit their expectations and suggestions towards the project
3. **Discussion with officials:** Discussion with Gram Sevak, Panchayat members, Sarpanch

### 2.1.3 Phase III: Post Survey Activities – Analysis and Reports

#### Analysis of data:

The information collected through structured interviews and questionnaires is systematically coded, validated, analyzed and tabulated. Wherever required, the observations are supported from the information collected through desk research.

### Preparation of Report:

This is the outcome of all the above activities and results in the preparation of Socio-economic report, which provide the socio- economic status of the population for the farmers survey, all 65 farmers who are engaged in farming activities are covered under the farmers survey. Sampling location details is given in Table 2.1.

**Table 2.1 Sampling Location & Household/ Population Covered**

Sr. No	Sampling Location	Sampling size/ Farmer Household covered for the Farmers survey
1	Jua	2
2	Cambarjua	63
<b>Total</b>		<b>65</b>

### 2.2 List of Team Members with Qualification

The composition of Socio-economic team is given in Table 2.2 which is responsible to carry out the socio-economic community report. Each member of the team is an expert in his field and has undertaken numerous such studies before.

**Table 2.2 List of Team Members**

Sr. No	Name	Qualification
1	Mrs. Mamta Bodhale	Masters in social work
2	Mr. Sawak Tarapurwla	Masters in social work
3	Mr. Sanjay Biranje	Master in social work

### 2.3 Desk Research

Before the site visit, desk research study including census 2011, town directory, web data reviewed by SE team.

Note: Census has been undertaken every 10 years by Ministry of Home Affairs, India. The census provides information on size, distribution and socio-economic, demographic and other characteristics of the country's population. The last census undertaken in 2011, therefore 2011 census has been considered for the study.

### 2.4 Site Visit & Data collection

Site visit was done by Mr. Sanjay Biranje between 19<sup>th</sup> June 2022 to 21<sup>st</sup> June 2022.

## 2.5 Interaction with Local Farmers

Public consultation was carried out in the form of public meeting, Farmer survey, focus group discussion and village survey with Sarpanch etc. The purpose of consultation was to get a detail information of Farmers family's socio-economic status.

Glimpse of interaction with Cumbarjua farmers are given below:



Mr. Babulo Bhosale & Family



Mr. Devenand Raikar & Family



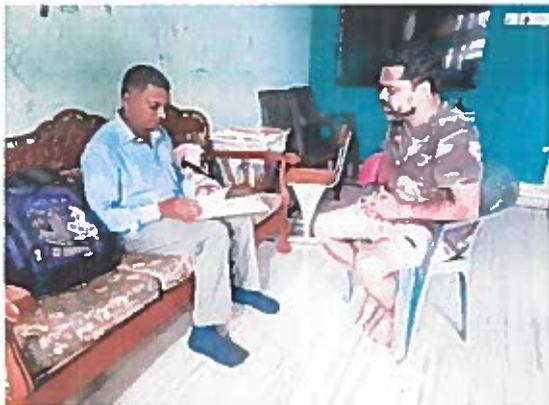
Mr. Kashinath Fadte & Family



Mr. Sameer Bhosale & Family

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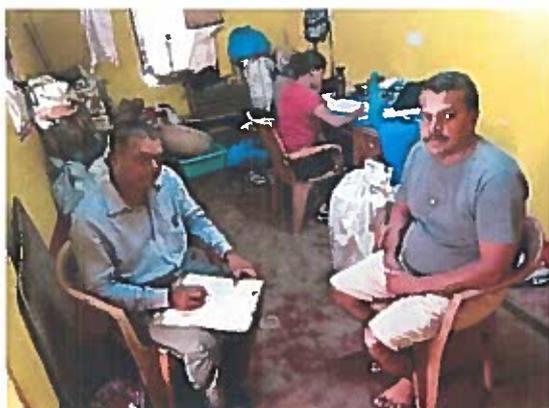
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Mr. Nilam Parab



Mr. Baburao Bhosle



Mr. Lakshmikant Shetkar & Family



Mr. Mahesh Sawant & Family

## 2.6 Objective of the public consultation

- Identification of major socio-economic information
- Understand the views and perception of the people about the proposed bridge project
- Identify the farmers issues

## 2.7 Tools for the consultation

- Farmer survey format
- Focus group discussion format
- Village leader format

## 2.8 Technique used for community consultation

- Questionnaire Survey: One to One Consultation
- Transect Walk: Along the project boundary
- Group Consultations: Social and gender group wise consultation.

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- On-site Rapid Consultation: Interaction with village elders, sarpanch, community leaders.

**Table 2.3 Level of Consultation**

Level	Type	Key Participants
Individual	Farmers survey	Farmers of Cumbarjua & Jua CT
Group	Focus group discussion	Local residents of Cumbarjua
Govt. office/ Other	Discussion/ village survey	Sarpanch

## 2.9 Overview of Information/ Data Source Used

Both qualitative and quantitative data analysis techniques were applied for the study purpose to undertake the study.

Project specific questionnaire is presented in Annexure I.

Secondary sources of qualitative data used in compiling the baseline conditions of the CTs included.

- Primary census abstract 2011 of Goa state, India
- District town handbook 2011 of Goa state, India

During the survey, farmer families' persons connected at Jua & Cumbarjua. Details are presented below.

**Table 2.4 Key Persons Interacted**

Sr. No	Name	CT/ Location
1	Ramesh Vaman Naik	Cumbarjua
2	Madhukar Ramchandra Sawant	Cumbarjua
3	Surekha Gangadhar Raikar	Cumbarjua
4	Dinesh Anant Bandudkar	Cumbarjua
5	Kashinath Janardan Phadte	Cumbarjua
6	Rohit Jirrotam Desai	Cumbarjua
7	Sanju Waman Naik	Cumbarjua
8	Gajanan Pandurang Mopkar	Cumbarjua
9	Suhasini Kashinath Phadte	Cumbarjua
10	Swapnil Narhari Bhosle	Cumbarjua
11	Shantaram V Mopkar	Cumbarjua
12	Salil Ganpat Bandurkar	Cumbarjua
13	Saukand Vinayak Padte	Cumbarjua
14	Satish Shira Morye	Cumbarjua
15	Arun Gajanan Naik	Cumbarjua
16	Manohar Ramchandra Naik	Cumbarjua
17	Ghanshyam Wasu Naik	Cumbarjua
18	Shana Bai Kanta Amonkar	Cumbarjua

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Sr. No	Name	CT/ Location
19	Shubhanji Nagesh Rayker	Cumbarjua
20	Subash Raykar	Cumbarjua
21	Sumitra Amonkar	Cumbarjua
22	Samiti Gavade	Cumbarjua
23	Yogesh Naik	Cumbarjua
24	Virayan Desai	Cumbarjua
25	Yoganand Tarai	Cumbarjua
26	Ramchandra Naik	Cumbarjua
27	Surevsh koregankar	Cumbarjua
28	Sujata Bhasale	Cumbarjua
29	Ramnath Bhosle	Cumbarjua
30	Ashok Govind Bhosale	Cumbarjua
31	Kamal Pandurang Gavade	Cumbarjua
32	Laxmikant Yeso Gavade	Cumbarjua
33	Sudha Vaman Bhosale	Cumbarjua
34	Uday S. Bhosale	Cumbarjua
35	Sadanand Rajaram Bhosale	Cumbarjua
36	Diksha Damodar Bhosale	Cumbarjua
37	Sukdu Namdev Bhosale	Cumbarjua
38	Gurudas S. Parab	Cumbarjua
39	Anil Gajanan Gavale	Cumbarjua
40	Kalidas Vasant Mopkar	Cumbarjua
41	Anand Narayan Shetye	Cumbarjua
42	Pramavati Datta Usapakar	Cumbarjua
43	Ramesh Umakant Sawant	Cumbarjua
44	Uday Gajanan Shetakar	Cumbarjua
45	Datta Aataram More	Cumbarjua
46	Prasad Tulsidas Naik	Cumbarjua
47	Julie M. Parab	Cumbarjua
48	Suryakant Appa more	Cumbarjua
49	Namita Pandurang Raikar	Cumbarjua
50	Shaba Mohan Malvankar	Cumbarjua
51	Tulsidas Phadeke	Cumbarjua
52	Mahadev Parab	Cumbarjua
53	Bharna Banddas Sawant	Cumbarjua
54	Rajesh Sawant	Cumbarjua
55	Anandibai Parolkar	Cumbarjua
56	Mahesh Desai	Cumbarjua
57	Anuj Raikar	Cumbarjua
58	chudu Bhomaikar	Cumbarjua

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Sr. No	Name	CT/ Location
59	Supriya Naik	Cumbarjua
60	Kamlawati Naik	Cumbarjua
61	Suhad Phadke	Cumbarjua
62	Ranjru Sawant	Cumbarjua
63	Mahesh Sawant	Cumbarjua
64	Sanju Naik	Jua
65	Sanju Waman Naik	Jua

Source: AESPL, Primary survey

### 3 Profile of District & Study Area

#### 3.1 Project State

##### *Goa state*

Goa is a state on the southwestern coast of India within the Konkan region, geographically separated from the Deccan highlands by the Western Ghats. It is located between the Indian states of Maharashtra to the north and Karnataka to the east and south, with the Arabian Sea forming its western coast. It is India's smallest state by area and its fourth-smallest by population.

##### *Climate & Rainfall*

Goa receives rain from the South - West monsoons. The average rainfall is 2800 mm. rainy season is spread over four months from June to September. Occasional thunder showers are experienced in May and October. Goa experiences warm and humid tropical climate. The summer temperature ranges from 24° C to 36° C. In winter, the mercury hovers between 21°C and 30°C. The average relative humidity is 75.90%.

##### *Altitude*

In Goa, the land elevation ranges from sea level to 1,022 meters. The highest point is the Wagheri Hills in Sattari taluka. The Ghat section of NH-4, rises to 650 meters MSL near Anmod.

##### *Soil*

The soils of Goa are mostly lateritic (81%). They are sandy loam to silt-loam in texture, well drained and highly acidic (5.5 to 6.5 pH). These soils have moderate organic carbon and are poor in potash. About 11% of the soils located along the seacoast and estuaries are sandy-to-sandy loams. They include the Ker lands and beach fronts. The remaining 8% of the soils are alluvial in nature. The Khazans and adjoining areas have alluvial soil with high water tables and are subject to inundation by saline water.

##### *Land Types*

**Khazan Land:** It consists of low-lying areas, of ten below sea level along the estuaries. This land is used for monsoon paddy crops followed by Rabi Vegetables, in limited areas, pisciculture is also done by regulating flow of water.

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**Ker Land:** This is flat land at low elevation above sea level and having a high-water table. Aerable, sandy to sandy loams soils fit for multiple cropping through irrigation. Rabi paddy vegetables, pulses, etc. are grown in these areas.

**Morod Land:** It refers to upland or terraced field suitable for Horticultural/Plantation crops or single rain fed crop of rice.

### ***Irrigation***

In Goa traditional sources of irrigation were storage tanks, small Diversion bandharas, natural springs and wells. For rabi paddy (vaigon) Irrigation was mostly from storage tanks located in Salcete and Bardez. The usual practice is to cultivate kharif paddy in tank bed and the water weir is closed early in September after harvest of Kharif paddy. In Ponda, Sanguem and Bicholim small kuccha "diversion" works are constructed on Nallas to irrigate paddy fields during Rabi. Considerable area under arecanut depends on various springs at higher altitudes. After Liberation of Goa, a number of Government "lift irrigation schemes" were commissioned. Irrigation wells were also opened. Further commissioning of Salaulim Irrigation Project at Sanguem and Anjunem Irrigation Project, State has added to irrigate an area of more than 10,000 ha.

### ***Important Crop of Goa***

**Fruits:** Mango, Cashew, Coconut, Banana, Pineapple, Jackfruit, Arecanut etc.

**Field crops:** Paddy, Ragi, Sugarcane, Groundnut, Cowpea etc.

**Vegetables:** Brinjal, Bhendi, Chillies, Cucumber, Pumpkin, Gourds, Musk Melons, Red amaranthus, Raddish, Knol-Khol, Cabbage, Bottle gourd, Long beans, Cluster beans etc.

**Flowers:** Jasmine, Crossandra, Dahlia, Hibiscus, Marigold, Orchids, Gerbera, Anthuriums, Gladiolus, etc.

**Spices:** Black Pepper, Nutmeg, Kokum, Turmeric, Cinnamon, etc.

**Tubers:** Colocasia, Yam, Elephant foot, Dioscorea, Sweet Potato, etc

**Rivers:** Terekhol, Mandovi, Baga, Zuari, Colval, Saleri, Mandre, Harnal, Sal, Talpona and Galjibag are the eleven rivers of Goa which are known as the lifelines of the state. Due to the extent of their drainage areas and the human attraction they hold, these main eleven rivers and their 42 tributaries are significant, not only as the source of potable water but they support also the Goan eco-systems.

Most of the prominent rivers of Goa originate in the thick forests, many of them sanctuaries, of Western Ghats and discharge into the Arabian Sea. Landscape of Goa characterized by small area is dominated by these rivers which are an intricate system of

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wetlands, tidal marshes and cultivated paddy fields interconnected by canals, inland lakes, bays, lagoons and creeks governed by regular tides. Goa is thus more intimately linked with its rivers and also more livelihood dependence on them.

### 3.2 Project district

North Goa district is one of the two districts that constitutes the state of Goa, India. The district has an area of 1,736 square kilometres (670 square miles), and is bounded by Kolhapur and Sindhudurg districts of Maharashtra state to the north and by Belgavi district of Karnataka to the east, by South Goa district to the south, and by the Arabian Sea to the west.

According to 2011 census, North Goa district have total households of 191766 respectively. Tiswadi is a taluka in North Goa district and has 42241 households. On an average in each of these places the number of family size is 4. North Goa district have total population of 818008 respectively, while Tiswadi taluka has a population of 177219. The proportion of SC population is lower in comparison to ST population in both the district & taluka. The literacy level in district is 81% and 82% at taluka. North Goa district total cultivators are 4.13 and in Tiswadi taluka it is 2.65% of total main working population. The details are given in the table below.

**Table 3.1 Demographic Profile of District & Taluka**

Description	District North Goa	Taluka Tiswadi
No of households	191766	42241
Average Household size	4.26	4.19
<b>Population</b>		
Total	818008	177219
Rural	74704	37549
Urban	117062	139670
<b>SC &amp; ST Population</b>		
SC	17606	3209
ST	56606	18785
Sex ratio (females per 1000 males)	963	966
Literacy rate	81%	82
Total Workers	40%	41%
Cultivators	4.13%	2.65%

Source: Census of India 2011, Goa state

#### 3.2.1 Demographic Profile of Study Area

Jua CT: According to the census 2011, Jua CT population was 4134 in which 1971 were males and 2163 were females. 0-6 child population was 332 which is 8% of the total

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population. Total households were 1057 with a mean family size of 3.91 members. Total SC population was 38 (0.91%) and total ST population was 84 (2.03%) of the total population. Sex ratio was 1097 females to 1000 males.

**Cumbarjua CT:** According to the census 2011, Cumbarjua CT population was 4917 in which 2577 were males and 2360 were females. 0-6 child population was 426 which is (8.66%) of the total population. Total households were 1121 with a mean family size of 4.38 members. Total SC population was 45 (0.91%) and total ST population was 686 (13.95%) of the total population. Sex ratio was 923 females to 1000 males.

**Table 3.2 Demographic Profile of Study Area**

Sr. No	Distri ct	Talu ka	Town/Vi llage	Name	TR U	Total Household	Total Population	Total Male	Total Female	0-6 Child Population	SC Populati on	ST Populati on
1	North Goa	Tisw adi	626727	Jua (CT)	Urban	1057	4134	1971	2163	332	38	84
2	North Goa	Tisw adi	626728	Cumbarju a (CT)	Urban	1121	4917	2557	2360	426	45	686
<b>Total</b>						<b>2178</b>	<b>9051</b>	<b>4528</b>	<b>4523</b>	<b>758</b>	<b>83</b>	<b>770</b>

Source: Census of India 2011, Goa state

### 3.2.2 Demographic Profile of 65 Farmers Families

According to the primary findings there were total 227 people in the 65 families, 47% of the population comes under 16-45 age group which comes under working age group. Majority of the households does not provide the Child population therefore child population comes low in the 65 families' demographic details.

**Table 3.3 Demographic Profile of 65 Farmers Families**

Age group	0-6	7-15	16-45	46-60	Above 60
Number of people	1	6	108	55	57
In %	0.44	2.64	47.57	24.22	25.11

Source: Primary survey by AESPL

### 3.2.3 Ration cards under targeted public distribution system

BPL below the poverty line: Families that have BPL cards are the ones who are living below the poverty line specified by the state government. BPL families receive 10 kg to 20 kg food grains per family per month at 50% of the economic cost. The subsidized end retail price for specified quantities of wheat, rice, sugar, and other items varies from state to state. Each state government fixes different rates per quantity.

(APL-Above poverty line) Families that have this card are the ones who are living above the poverty line as specified by the state government. APL families receive 10kg to 20 kg food grains per family per month at 100% of the economic cost. Each state government fixes a subsidized retail rate for rice, wheat, sugar, and kerosene oil for a certain quantity. According to the survey record it is observed that total 41 households are APL card holder & 24 households are BPL card holder.

**Table 3.4 APL/ BPL Cardholders**

Ration cad Type	Families
BPL	24
APL	41
<b>Total</b>	<b>65</b>

Source: Primary survey by AESPL

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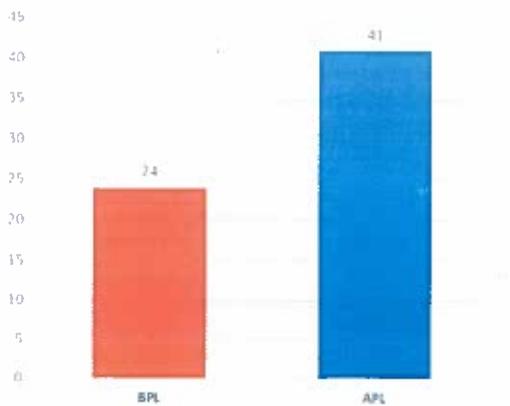


Figure 3.1 Ration card status of 65 Farmer Families

**Religion & Caste of 65 farmer families**

All 65 families belong to Hindu religion, 57% families are from general cast, 9% families are ST & 34% families are from OBC cast.

Table 3.5 Religion & Caste of 65 Farmer Families

Category	Number of farmer families	In %
Hindu religion	65	100
OBC	22	34
ST	6	9
Open/General	37	57
Total	65	100

Source: Primary survey by AESPL

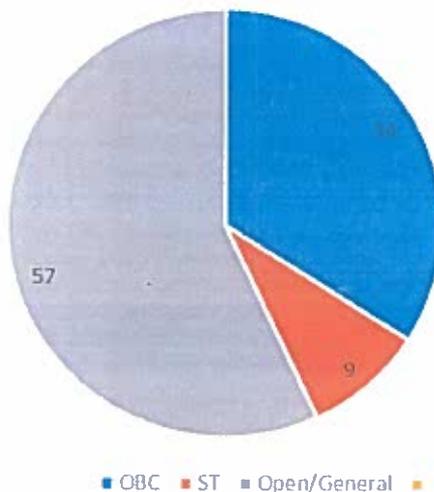


Figure 3.2 Caste of 65 Farmer Families

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### 3.2.4 Land holder details

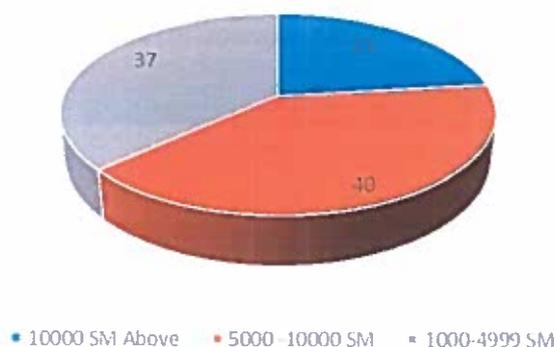
According to the primary survey 40% farmer families holds less than 2.5-acre land, that means small landholders' families are more in the Cumbarjua village. Total agricultural land of 65 farmers is 404100 sqm.

**Table 3.6 Land Holder Details**

Agriculture Land Area in SM	Number of families owns land
10000 SM Above	15
5000 -10000 SM	26
1000-4999 SM	24

Source: Primary survey by AESPL

**Number of families owns land**



**Figure 3.3 Land Holder Details**

### 3.2.5 Literacy Profile of Study Area

Literate A person aged 7 years and above who can both read and write with understanding in any language is taken as literate. Literacy rate of the population is defined as the percentage of literates in the age group seven years and above. For different age groups the percentage of literates in that age group gives the literacy rate.

- According to the census record, Jua CT literacy rate was 84.28% & illiteracy rate was 15.72%.
- According to the census record, Cumbarjua CT literacy rate was 82.90% & illiteracy rate was 17.10%.

**Table 3.7 Literacy Details Of The Study Area**

Sr. No	Name	Total Literate	Male Literate	Female Literate	Total Illiterate	Male Literate	Female Illiterate
1	Jua (CT)	3484	1656	1828	650	315	335
2	Cumbarjua (CT)	4076	2183	1893	841	374	467
<b>Total</b>		<b>7560</b>	<b>3839</b>	<b>3721</b>	<b>1491</b>	<b>689</b>	<b>802</b>

Source: Census of India 2011, Goa state

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Primary findings: According to the primary survey, literacy rate is 88% in total farmer family population. 59% of the family members are literate till 10<sup>th</sup> std.

### 3.2.6 Employment Pattern in The Study Area

In the census record, occupation profile described in 3 types of categories.

- Main worker A person who has worked for major part of the reference period (i.e. six months or more during the last one year preceding the date of enumeration) in any economically productive activity is termed as Main worker".
- Marginal worker A person who worked for less than six months of the reference period (i.e. in the last one year preceding the date of enumeration) in any economic activity is termed as „Marginal worker“.
- Non worker A person who has not worked at all in any economically productive activity during the reference period (i.e. last one year preceding the date of enumeration) is termed as Non worker.
  - Jua CT: According to the 2011 census record, total workers were 1455 (35%) of the total population. Total male workers were 1099 (26%) and female workers were 356 (9%). This data indicates female workers were lower than male workers. Main Workers were 1294 (31%) & marginal worker were 161 (4%) & non-workers were 2679 (65%) of the total population.
  - Cumbarjua CT: According to the 2011 census record, total workers were 2171 (44%) of the total population. Total male workers were 1551 (32%) and female workers were 620 (12%). This data indicates female workers were lower than male workers. Main Workers were 1789 (36%) & marginal worker were 382 (8%) & non-workers were 2746 (56%) of the total population.

**Table 3.8 Employment Pattern in The Study Areaasaa**

Sr. No	Name	Total Workers	Male Workers	Female Workers	Main Workers	Marginal Workers	Non-Workers
1	Jua (CT)	1455	1099	356	1294	161	2679
2	Cumbarjua (CT)	2171	1551	620	1789	382	2746
	<b>Total</b>	<b>3626</b>	<b>2650</b>	<b>976</b>	<b>3083</b>	<b>543</b>	<b>5425</b>

Source: Census of India 2011, Goa state

### 3.2.7 Main Worker Employment Pattern in The Study Area

According to the census 2011, main workers classified under 4 categories.

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- **Cultivator** For purposes of the Census a person is classified as cultivator if he or she is engaged in cultivation on land owned or from government or from private persons or institutions for payment in money, kind, or share.
- **Agricultural laborer** A person who works on another person's land for wages in cash or kind or share is regarded as an agricultural laborer. She/he has no risk in the cultivation, but merely works on another person's land for wages. An agricultural laborer has no right of lease or contract on land on which she/he works.
- **Household industry worker** Household industry is defined as an industry conducted by one or more members of the household at home or within the village in rural areas and only within the precincts of the house where the household lives in urban areas.
- **Other worker** A person who has been engaged in some economic activity during the last year of reference period but not as a cultivator or agricultural laborer or worker in Household Industry.

For Jua CT, the occupation classification showed that out of the total number of main workers, main workers comprise of cultivators 10 (0.78%), agricultural labourers 8 (0.62%), household industries workers 26 (2%) and other workers 1250 (96.60%).

For Cumbarjua CT, the occupation classification showed that out of the total number of main workers, main workers comprise of cultivators 173(10%), agricultural labourers 33 (2%), household industries workers 39 (2%) and other workers 1143 (86%).

**Table 3.9 Main Worker Employment Pattern**

Sr. No	Name	Cultivator			Agricultural worker			Household industry Worker			Other Workers		
		Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
1	Jua (CT)	10	7	3	8	5	3	26	19	7	1250	957	293
2	Cumbarjua (CT)	173	68	105	33	19	14	39	29	10	1544	1143	401
<b>Total</b>		<b>183</b>	<b>75</b>	<b>108</b>	<b>41</b>	<b>24</b>	<b>17</b>	<b>65</b>	<b>48</b>	<b>17</b>	<b>2794</b>	<b>2100</b>	<b>694</b>

Source: Census of India 2011, Goa state

**Table 3.10 Current Employment Pattern In 65 Farmers Family**

Cultivation	Service/job	Business	Artist/Drama actor	Pensioner	Non-Worker
15	55	15	11	29	102
6.60%	24.22%	6.60%	4.84%	12.77%	44.93%

Source: Primary findings by AESPL

### Primary Findings

- According to the primary survey, out of 65 famers families total 102 people comes under non workers which is 44.93% of total population. Majority of the workers works under service/job category. Only 15 members are engaged in cultivation as a primary work. The reason behind that no proper roadway to reach at agricultural land, farms surrounded by river, no bridge etc.

### 3.2.8 Project Demand

During the survey questions were asked to the farmers and few locals by the surveyor related to "Construction of bridge for local farmers to cross river stream for cultivation of fields from Chune - Kator to Vanso Field in Village of Cumbarjua. All 65 farmers said that there is an urgent need of the bridge because at present there is only waterway present to reach at agricultural land, ferry boats charge is high and not convenient for tractor/other farming equipment transportation, labor cost is also high due to additional cost of ferry service. Due to various difficulties in farming, they are unable to earn income from the agriculture field.

Canopy boat is use by 8-10 farmers, but it is not safe during monsoon season, due to increased level of water tributary.

Farmers said that the proposed bridge will give easy access to transport tractor, loading unloading of agricultural material and fertilizers will be safe and easy, there will be more saving due to no extra expenses on ferry for transportation of labour, tractor, other farming materials.

In the group discussion with the non-farmer population, they also gave positive view about the bridge construction. They said that the bridge will be helpful for the farmers and locals can get rice at cheap rate due to expected increase in rice production.

During the visit at Gram Panchayat Cumbarjua, Mrs. Bindi Parab (sarpanch) also told that bridge construction is necessary for the farming activities.

**Table 3.11 Town Details**

Sr. No	Town Name	Reference Year	Class	Civic Status of Town	Area (km <sup>2</sup> )	Density (Census 2011)	Rainfall (mm)	Maximum Temperature (°C)	Minimum Temperature (°C)	Railway Station Name	Bus Route Name
1	Jua (CT)	2009	VI	CT	8.3	499.9	2956.89	31.53	23.51	Carambolim	Yes
2	Cumbarjua (CT)	2009	VI	CT	2.4	2048.8	2956.89	31.53	23.51	Carambolim	Yes

Source: Town Directory 2011, state Goa

Cumbarjua is a Gram Panchayat and its current population is 5000 and households are 1500. Dominant religion in the CT is Hindu, & Others are Christiane & Muslim. 70%, population comes under general category, OBC-20%, SC-5%, and ST population is 5%.

Education facilities are in the form of Anganwadi, Primary School, Middle School- High School. Primary Health Sub Centre is present in the CT, Private Clinic also present in the CT. Major drinking water source is Tap water and the tap water is supplied by Gram Panchayat. 100% individual toilets present in the CT with addition 8 common toilets also present.

According to the Town directory 2011, both Jua & Cumbarjua falls under urban category (CT) and comes under class VI. As per area, Jua CT is bigger than Cumbarjua CT. Population density is high for Cumbarjua which is 2049 people to per sq km. The reason behind the high population density of the CT is higher population than Jua CT. Both cities have bus facility for transportation purpose.

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### 3.2.9 Production Statistics of Goa State

The Production statistics for Goa state data indicates that paddy production & total land area is decreasing year on year basis. The data clearly indicates that bridge constriction will be helpful to increase paddy production in the Goa state at some extent.

**Table 3.12 Area and Production Statistics of Goa**

Name of the Crop	2014-15		2015-16		2016-17		2017-18		2018-19	
	Area (Ha)	Total Prod (Ton)								
<b>Paddy</b>	41970	180754	41344	115068	40823	113227	38520	102997	36384	98854

Source: Government of Goa, official port

## 4 Conclusion & Recommendation

### 4.1 Key Issues Identified

After the discussion with farmers, it has been revealed that all 65 farmers are facing difficulties in farming activities due to no proper access to the farm. Though they have agricultural land but due to the non-availability of roadways it is difficult to reach at their agricultural land due to land is surrounded by Mandovi river. To reach at the agricultural land farmers are depended on waterways, and they use canopy boats, & ferry services for the same. There is one roadway in Jua village but that route is long and takes time to reach at the farm and it is not suitable for the farmers.

Farming activities depended on rainfed, during monsoon season river water level increases and the use of canopy boats is not safe for transportation, for the movement of tractor and labor ferry cost is high and not affordable to the farmers. Due to extra cost farmers are not able to earn good income from farming activities.

Farmers are interested in horticulture/double crop farming but due to the time consuming/higher charges of labor and safety issues in transportation to reach at farms they are unable to do any farming activities. Due to the difficulties for farming activities farmers are unable to earn income as well as their agricultural farm is not in use.

All 65 farmers said at present there is an urgent need of the bridge.

### 4.2 Conclusion

- 97% of farmers are small landholders, they can't afford the high expenses of transportation via ferry/boat for the farming activities. On an average two-way trip ferry cost is 4000-5000 for the transportation of tractors, labor, and other agricultural-related materials. After the bridge construction, all small landholders can have easy access to their agricultural land and there will be no additional cost for the waterway transportation. Due to the bridge, easy access More family members can go to farms and it will help to ease the farming activities.
- The land type of farmers agricultural land is Khazan type which is suitable for paddy crops followed by Rabi vegetables and pisciculture. Due to no proper access to the agricultural land, farmers of Cumbarjua are unable to take Rabi vegetables. The proposed bridge will help the small farmers to take double crops and earn a good income.

- The proposed bridge will open many ways to earn income, aquaculture is also one of the options for small landholders. Aquaculture practice will help to earn secondary income as well as farmers can provide nutrition to their family members. Farmer's family members can also engage themselves in aquaculture activities.
- Due to the proposed bridge construction, farmers can save their time /extra cost on transportation activities therefore farmers can complete their agricultural tasks on time which results in good crop production
- According to the census 2011, female cultivator was 6% of the total cultivator population at cumbarjua CT, the data indicates majority of the females were engaged in farming, the proposed bridge will definitely increase the female participation and women employment rate will increase at Cumbarjua location
- There are 24 families covered under BPL (below poverty line) category, due to the proposed bridge the BPL families can upward their life by good income generation from farming activities and their living standard can be better.
- The farming cost will decrease and production will increase, in result locals can get paddy, vegetables, fishes in their own area. Cumbarjua population growth is positive the demand of the local consumer will be fulfilled easily by the increased crop/vegetable production
- New experiments in farming seasonal fruits/vegetables can be performed by the farmer/farmers group in future, young generation can choose advance agriculture technologies and set their career in it

### 4.3 Recommendation

- Enhancing agricultural productivity is a central component of the strategy to meet the food demands of India by 2050. Achieving this target will require good type of infrastructure facilities with various types of schemes for the farmers.

The construction of the bridge will play a crucial role in the farmer's life. The proposed project of bridge construction best satisfies all the goals and issues of farming activities. The construction of the bridge is highly recommended because the bridge will definitely help in reducing expenditure on waterway transportation, increase the quality of life of the farmers by good earning from the agricultural crop/double-crop, alternative income source by aqua culture etc.

Report on Benefit of Bridge (to connect Chune - Kator to Vanso Fields) to Local Farmers of Jua & Cumbarjua, Tiswadi, North Goa, Goa by Goa State Infrastructure Development Corporation Ltd.

c/217

- Bridges should not be located in flood periodically, because in monsoon season water level increases at Mandovi river
- During bridge construction every necessary precaution should be taken to prevent the disturbance of river channel banks

### Annexure I: Survey Format

Farmer survey for construction of bridge for local farmers to cross river stream at tributary of cumbarjua canal project

Project ID	Project proponent	Project Name	Name of the Interviewer	Signature & Date
Questionnaire No:				

#### 1. Particulars Of Head Of The Family

1. Name of the Head of the family:

2. Address:

3. Religion: a) Hindu \_\_\_\_\_ b) Muslim \_\_\_\_\_ c) Christian \_\_\_\_\_ d) Jain \_\_\_\_\_  
e) Sikh \_\_\_\_\_ f) Other \_\_\_\_\_

4. Caste: a) SC b) ST c) OBC d) NT e) GEN

5. Ration card: a) APL \_\_\_\_\_ b) BPL \_\_\_\_\_

#### 2. Particulars of Family Members:

Sr. No.	Name of Family Member	Relation with Head of the Family	Sex	Age (years)	Educational Levels	Marital Status	Occupation (Main)	Occupation (Secondary)	Annual Income (Rs)
1									
2									
3									
4									
5									
6									
7									
8									

Do you own agricultural land? 1 Yes 2. No

If yes, how much agricultural land you own?

Report on Benefit of Bridge (to connect Chune - Kator to Vanso Fields) to Local Farmers of Jua & Cumbarjua, Tiswadi, North Goa, Goa by Goa State Infrastructure Development Corporation Ltd.

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Do you do farm on others farms on contract/agreement base? 1. Yes 2. No

How many of your family members primarily engaged in Cultivation?

a. 1 2 b. 2-4 c. 4-6

Type of crops cultivating in the agricultural farm

Kharif crops:

Rabi crops:

Is horticulture practiced at your agricultural farms? 1. Yes 2. No

If yes, type of horticulture crops:

In last few years what are the main difficulties faced by you related to farming activity?

**Project related questions**

What do you think, construction of bridge for local farmers to cross river stream at tributary of Cumbarjua canal between village Cumbarjua and Jua is required for you?

1. Yes 2. No

If yes, kindly explain why the bridge is required

If no, kindly explain why the bridge is not required

If the bridge constructed, what do you think what type of improvement comes in your life as a farmer?

Sign of interviewee

Sign of respondent



# भारत का राजपत्र

## The Gazette of India

सी.जी.-डी.एल.-अ.-27122022-241450  
CG-DL-E-27122022-241450

असाधारण  
EXTRAORDINARY

भाग II—खण्ड 3—उप-खण्ड (ii)  
PART II—Section 3—Sub-section (ii)

प्राधिकार से प्रकाशित  
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पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय

आदेश

नई दिल्ली, 27 दिसम्बर, 2022

का.आ. 6071(अ).—केन्द्रीय सरकार, पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) (जिसे इसमें इसके पश्चात् उक्त अधिनियम कहा गया है) की धारा 3 की उपधारा (1) और उपधारा (3) द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए, नीचे सारणी में उल्लिखित, निम्नलिखित व्यक्तियों से मिलकर बने गोवा तटीय जोन प्रबंध प्राधिकरण (जिसे इसमें इसके पश्चात् प्राधिकरण कहा गया है) का, राजपत्र में इस आदेश के प्रकाशन की तारीख से तीन वर्ष की अवधि के लिए, गठन करती है, अर्थात् :-

सारणी

क्र. सं.	गुजरात तटीय जोन प्रबंध प्राधिकरण का नाम और संपर्क ब्यौरे	पदनाम
1.	सचिव (पर्यावरण और जलवायु परिवर्तन), पोर्वोरिम, गोवा सरकार	अध्यक्ष, पदेन
2.	प्रधान मुख्य वन संरक्षक, वन विभाग, गोवा वन भवन, अल्टिनो, पणजी, गोवा	सदस्य, पदेन
3.	निदेशक, पंचायत निदेशालय, माइल्स हाई कोरपोरेट हब, पाटो, पणजी, गोवा	सदस्य, पदेन
4.	निदेशक, पर्यटन विभाग, पहला तल, पर्यटन भवन, पाटो, पणजी, गोवा-403001	सदस्य, पदेन
5.	प्रधान मुख्य इंजीनियर, जल संसाधन विभाग, प्रधान कार्यालय, अल्टिनो, पणजी, गोवा	सदस्य, पदेन

6.	मुख्य इंजीनियर, जल संसाधन विभाग, सिंचाई भवन, पुलिस स्टेशन के नजदीक, पोर्वोरिम, गोवा	सदस्य, पदेन
7.	निदेशक, मत्स्य निदेशालय, दयानन्द बन्दोडकर मार्ग, पाटो कालोनी, पणजी, गोवा	सदस्य, पदेन
8.	श्री गनेश वेलीप, सेवानिवृत्त कार्यकारी इंजीनियर, लोक निर्माण विभाग, निवासी 4707, पदमानारायण इस्टेट, जिवोतम मठ के निकट, गोगल, मारगाव, गोवा	विशेषज्ञ सदस्य
9.	श्रीमती राधा बी. राव, संरचनात्मक सलाहकार और इंजीनियरिंग संस्थान के सदस्य, निवासी एफएस-2, पहला तल, आशुतोष भवन, कुरचोरेम, गोवा	विशेषज्ञ सदस्य
10.	डॉ. दिलीप बी अरोल्कर, आचार्य और प्रधानाचार्य, नयानप्रसारक मंडल कालेज और अनुसंधान केंद्र, 11, असगांव, बरदेज, गोवा, निवासी 11टी4, कामत क्लासिक 4, कारन्जेलेम, तिसवाडी, गोवा	विशेषज्ञ सदस्य
11.	श्री सुशांत एस. नायक, मुख्य वैज्ञानिक, वैज्ञानिक और औद्योगिक अनुसंधान परिषद्, राष्ट्रीय समुद्रविज्ञान संस्थान, दोना, पोला, गोवा	विशेषज्ञ सदस्य
12.	मै. वन्यजीव और पर्यावरण के बारे में अध्ययन और जागरूकता, मकान नं. 9/17/56, श्रीनिवास, एलआईसी कार्यालय के निकट, खडपबंध, पोन्डा, गोवा	सदस्य, गैर-शासकीय संगठन;
13.	निदेशक, पर्यावरण और जलवायु परिवर्तन विभाग, गोवा सरकार, चौथा तल, डेम्पो टावर्स, पाटो, पणजी, गोवा	सदस्य सचिव।

2. प्राधिकरण का मुख्यालय गोवा स्थित पणजी में होगा।

3. प्राधिकरण की बैठक के लिए गणपूर्ति, इसके सदस्यों की कुल संख्या के एक-तिहाई से होगी।

4. पदेन सदस्य से भिन्न सदस्य को, केंद्रीय सरकार द्वारा नियत मानदंडों के अनुसार भत्ते का भुगतान किया जाएगा।

5. सदस्य, हितों के किसी भी विरोध से बचने के लिए, किसी ऐसी परियोजना के, जिसके लिए उन्होंने परामर्श सेवा प्रदान की है, अंकन की प्रक्रिया में, प्राधिकरण की किसी बैठक में से स्वयं को अलग कर सकेगा (सकेंगे)।

6. प्राधिकरण, गोवा राज्य में तटीय पर्यावरण की क्वालिटी को संरक्षित करने और सुधारने तथा तटीय विनियम जोन क्षेत्रों में पर्यावरणीय प्रदूषण के निवारण, उपशमन और नियंत्रण के प्रयोजन के लिए निम्नलिखित उपाय करेगा, अर्थात् :-

- (i) प्राधिकरण, परियोजना प्रस्ताव के अनुमोदन के लिए आवेदन प्राप्ति के पश्चात्, यदि वह अनुमोदित तटीय जोन प्रबंध योजना के अनुसरण में हैं और भारत सरकार द्वारा, यथास्थिति, संख्यांक का.आ. 19(अ), तारीख 6 जनवरी, 2011 द्वारा जारी की गई तटीय विनियम जोन की अधिसूचना, 2011 या का.आ. 37(अ), तारीख 18 जनवरी, 2019 द्वारा जारी तटीय विनियम जोन अधिसूचना, 2019 (जिसे इसमें इसके पश्चात् उक्त अधिसूचना कहा गया है) की अपेक्षाओं के भीतर है तो उसका परीक्षण करेगा और संबद्ध प्राधिकरण ऐसी परियोजना के अनुमोदन के लिए, जैसा कि उक्त अधिसूचना में विनिर्दिष्ट है, ऐसे आवेदन की प्राप्ति की तारीख से साठ दिन के भीतर सिफारिश करेगा;
- (ii) प्राधिकरण, उक्त अधिसूचना में विनिर्दिष्ट किए गए के अनुसार तटीय विनियमन जोन में सभी विकासात्मक क्रियाकलापों को विनियमित करेगा;
- (iii) प्राधिकरण, उक्त अधिसूचना के उपबंधों का प्रवर्तन और मानीटरी के लिए उत्तरदायी होगा;
- (iv) प्राधिकरण को, उक्त अधिनियम की धारा 5 के अधीन निदेश जारी किया जाएगा;
- (v) प्राधिकरण, उसके समक्ष मामले के तथ्यों को सत्यापित करने के लिए, ऐसी कार्रवाई करेगा, जैसी उक्त अधिनियम की धारा 10 के अधीन अपेक्षित है;
- (vi) प्राधिकरण, उक्त अधिनियम की धारा 19 के अधीन परिवाद फाइल करने के लिए प्राधिकृत है;

- (vii) प्राधिकरण, तटीय विनियम जोन क्षेत्रों और तटीय जोन प्रबंध योजना के वर्गीकरण में परिवर्तन या उपांतरणों के लिए गोवा राज्य सरकार से प्राप्त प्रस्तावों की परीक्षा करेगा और राष्ट्रीय तटीय जोन प्रबंध प्राधिकरण को उस पर विनिर्दिष्ट सिफारिश देगा;
- (viii) प्राधिकरण, उक्त अधिनियम या उसके अधीन बनाए गए नियमों के उपबंधों के अभिकथित अतिक्रमण के मामलों में जांच करेगा और उक्त अधिनियम तथा उसके अधीन बनाए गए नियमों के उपबंधों के अतिक्रमण या उल्लंघन को अंतर्वलित करने वाले मामलों का पुनर्विलोकन करेगा;
- (ix) प्राधिकरण, उक्त अधिसूचना के अतिक्रमण या उल्लंघन के मामलों में स्वप्रेरणा से या किसी व्यक्ति या निकाय या संगठन द्वारा किए गए परिवाद के आधार पर जांच या पुनर्विलोकन करेगा।
7. प्राधिकरण, अपने कृत्यों में पारदर्शिता बनाए रखने के प्रयोजन के लिए एक समर्पित वेबसाइट तैयार करेगा और इसके कृत्य, जिसके अंतर्गत बैठकों में कार्यसूची, बैठकों का कार्यवृत्त, प्रत्येक बैठकों में किए गए विनिश्चय, उक्त अधिसूचना के अतिक्रमण तथा उल्लंघन के मामलों में सिफारिशें और ऐसे अतिक्रमण तथा उल्लंघन पर की गई कार्रवाई और न्यायालय मामले जिसके अंतर्गत न्यायालयों के आदेश हैं और राज्य सरकार की अनुमोदित तटीय जोन प्रबंध योजना से संबंधित सूचना डालेगा।
8. प्राधिकरण, छह मास में कम से कम एक बार अपने क्रियाकलापों की रिपोर्ट राष्ट्रीय तटीय जोन प्रबंध प्राधिकरण को भेजेगा।

[फा. सं. 12-6/2005-आईए-III(भाग)]

डॉ. सुजीत कुमार बाजपेयी, संयुक्त सचिव

## MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

### ORDER

New Delhi, the 27th December, 2022

**S.O. 6071(E).**—In exercise of the powers conferred by sub-sections (1) and (3) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986) (hereinafter referred to as the said Act), the Central Government hereby constitutes the Goa Coastal Zone Management Authority (hereinafter referred to as the Authority) consisting of the following members, specified in column (2) of the table below, for a period of three years, with effect from the date of publication of this Order in the Official Gazette, namely:-

**TABLE**

Serial number	Member	Status
(1)	(2)	(3)
1.	Secretary (Environment and Climate Change), Porvorim, Government of Goa	Chairman, exofficio;
2.	Principal Chief Conservator of Forest, Forest Department, Goa Van Bhawan, Altinho, Panaji, Goa	Member, exofficio;
3.	Director, Directorate of Panchayat, Myles High Corporate Hub, Patto, Panaji, Goa	Member, exofficio;
4.	Director, Department of Tourism, 1 <sup>st</sup> Floor, Paryatan Bhavan, Patto, Panaji, Goa, 403001	Member, exofficio;
5.	Principal Chief Engineer, Water Resources Department, Head Office, Altinho Panaji, Goa	Member, exofficio;
6.	Chief Engineer, Water Resources Department, Sinchai Bhavan, Near Police Station, Porvorim, Goa	Member, exofficio;

7.	Director, Directorate of Fisheries, Dayanand Bandodkar Marg, Patto Colony, Panaji, Goa	Member, exofficio;
8.	Shri Ganesh Velip, Retired Executive Engineer Public Works Department, Residence of- 4707, Padmanarayan Estate, Near Jivotam Muth, Gogal, Margao, Goa	Member, Expert;
9.	Smt. Radha B.Rao, Structural Consultant and Member of Institution of Engineer's, Residence of- FS-2, 1 <sup>st</sup> Floor, Ashutosh Building, Curchorem, Goa	Member, Expert
10.	Dr. Dilip B. Arolkar, Professor and Principal, Dnyanprassarak Mandal's College and research Centre, 11, Assagaon, Bardez, Goa, Residence of- 11T4, Kamat Classic IV, Caranzalem, Tiswadi, Goa	Member, Expert
11	Shri Sushant S.Naik, Principal Scientist, Council of Scientific and Industrial Research-National Institute of Oceanography, Dona Paula, Goa	Member, Expert
12.	M/s Study and Awareness of Wildlife and Environment, House Number 9/17/56, Shriniwas, Near LIC Office, Khadpabandh, Ponda, Goa	Member, Non-Government Organisation ;
13.	Director, Department of Environment and Climate Change, Government of Goa, 4 <sup>th</sup> Floor, Dempo Towers, Patto, Panaji, Goa	Member Secretary

2. The Authority shall have its headquarters at Panaji, Goa.

3. The quorum for the meeting of the Authority shall be one-third of the total number of its Members.

4. A Member, other than an *exofficio* Member, shall be paid allowances as per the terms and conditions decided by the Central Government in this behalf.

5. In order to avoid any conflict of interest, the Member shall recuse himself from the meeting of the Authority, in the process of appraisal of any project, for which they have rendered consultancy service.

6. The Authority shall, for the purposes of protecting and improving the quality of the coastal environment and preventing, abating and controlling environmental pollution in the Coastal Regulation Zone areas in the State of Goa, take the following measures, namely: -

- (i) Examine after receiving the application for approval of project proposal, in accordance with the approved Coastal Zone Management Plan and within the requirements of the Coastal Regulation Zone notification, 2011 issued by the Government of India *vide* number S.O.19(E), dated the 6<sup>th</sup> January, 2011 or Coastal Regulation Zone Notification, 2019 issued *vide* number G.S.R. 37(E), dated the 18th January, 2019 (hereinafter referred to as the said notification), as the case may be, and make recommendations for approval of such project to the concerned authority, as specified in the said notification, within a period of sixty days from the date of receipt of such application;
- (ii) regulate all developmental activities in the Coastal Regulation Zone areas as specified in the said notification;
- (iii) responsible for enforcing and monitoring the provisions of the said notification;
- (iv) issue directions under section 5 of the said Act;
- (v) take such action as may be required under section 10 of the said Act, to verify the facts of the cases before it;
- (vi) file complaint under section 19 of the said Act;
- (vii) examine the proposals received from the State Government of Goa for changes or modifications in the classification of Coastal Regulation Zone areas and in the Coastal Zone Management Plan and make specific recommendations thereon, to the National Coastal Zone Management Authority;

- (viii) inquire into cases of alleged violation of the provisions of the said Act or the rules made thereunder, and review the cases involving violations or contraventions of the provisions of the said Act and the rules made thereunder; and
- (ix) inquire or review cases of violations or contraventions of the said notification *suo-moto*, or on the basis of a complaint made by any individual or body or organization;
7. The Authority shall, for the purpose of maintaining transparency in its functioning, create a dedicated website and post the information relating to its functions, including the agenda in its meetings, minutes of the meetings, decisions taken in each meeting, recommendations for matters on violations and contravention of the said notification and actions taken on such violations and contraventions, court matters including the orders of the courts and the approved Coastal Zone Management Plan of the State Government.
8. The Authority shall furnish reports of its activities at least once in six months to the National Coastal Zone Management Authority.

[F. No. 12-6/2005-IA.III(Part)]

Dr. SUJIT KUMAR BAJPAYEE, Jt. Secy.