Project No: AESPL/EIA/10/CRZ/076

Environmental Impact Assessment Report

Proposed Golf Resort at

Village Tiracol, Goa

by

Leading Hotels Limited

Baseline Monitoring: Summer 2011

&

Confirmatory monitoring in February 2017

March - 2017

Environmental Consultant: Aditya Environmental Services Pvt. Ltd., Mumbai

QCI- NABET Accredited EIA Consultant

www.aespl.co.in

TO WHOMSOEVER IT MAY CONCERN

This is to confirm that we have checked the EIA report prepared by M/s Aditya Environmental Services Pvt Ltd for our proposed Golf Resort project at Village Tiracol located in Goa. We also confirm that the data/information related to our project is correct as per our understanding of the project requirements at the moment.

We also wish to state that the Material on Record submitted earlier to the SEAC/ SEIAA as part of the clearance process remains unchanged as per directive of the Honourable National Green Tribunal (NGT) vide order no. 135/2015 dated 29th Nov 2016.

We also confirm that Environmental Management Plan included as a part of EIA report, will be implemented.

Date :

Place :

For Leading Hotels Ltd

Declaration by Experts contributing to the EIA 'Proposed Golf Resort at Village Tiracol, Goa' by Leading Hotels Limited.

TO WHOMSOEVER IT MAY CONCERN

This is to confirm that the EIA/EMP for the project "Golf Resort at Village Tiracol , Goa " by M/s Leading Hotels Pvt. Ltd., Delhi, has been prepared by me in the capacity of EIA Coordinator. The Standard ToRs as prescribed by MoEFCC vide Notification dated 10th April 2015 and the additional ToRs prescribed by EAC vide No. letter no. F. No. 21-8/2016-IA-III dated, 19th January 2017 have been complied with, in preparing the EIA/EMP. A point wise compliance to the ToRs prescribed as above has been presented in Chapter 1, Sr. No. 1.5.4.

We also confirm that the EIA prepared is based on factual data and all due diligence has been followed in preparing the same.

Date : 03/02/2017

Place : Mumbai

Name: Dr Shobha Kamat

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

NABET Certificate No. & Issue Date: NABET S.N. (3) as per QCI website.

Signature & Date: 2nd March, 2017

Period of involvement: Since 2011

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Functional Area Experts:

S.N.	Functional Areas	Name of the Expert/s	Involvement (Period& Task**)	Signature & Date
1	AP*	Rajiv Aundhe	since January 2011	
2	WP*	Rajiv Aundhe	since January 2011	
3	SHW*	Rajiv Aundhe	since January 2011	
4	SE*	Anju Chawhan Bela Pharate (Team Member)	since January 2011	
5	EB*	NK Shendye	since January 2011	
6	HG*	RM Badve	since January 2011	
7	GS*	NPS Varde	since January 2011	
8	AQ*	Sudhir Verma	since January 2011	
9	NV*	Rajiv Aundhe for Noise	since January 2011	
10	LU*	Bela Pharate	since January 2011	
11	RH*	D.K. Joshi	since January 2011	

NOTE :

(*) Full forms of abbreviations given on Next Page

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

S.N.	Functional Area Code	Complete Name of the Functional Areas	Tasks
1	AP	Air Pollution Prevention, Monitoring & Control	Assessing baseline ambient air quality, stack emission, possible impacts and control measures
2	WP	Water Pollution Prevention, Control & Prediction of Impacts	Assessing baseline surface/ ground water quality, stack emission, possible impacts and control measures
3	SHW	Solid Waste and Hazardous Waste Management	Assessing solid/hazardous waste generation, treatment and disposal
4	SE	Socio-Economics	Assessing baseline Socioeconomic, demographic situation, impacts and CSR plan/ measures for upliftment
5	EB	Ecology and Biodiversity	Assessing baseline biodiversity situation in study area, impacts and Biodiversity management plans
6	HG	Hydrology, ground Water & Water Conservation	Assessing baseline hydrogeological situation in study area, impacts and management plans
7	GS	Geology & Soil	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 modelling and management plans
9	NV	Noise/ Vibration	Assessing baseline ambient noise quality, 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 meausres taken up by company modelling to assess scale of impacts, disaster management and control measures

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SOME COMMON GOLFING TERMS

Approach - The shot a player takes from the fairway to the green

Bag – The bag where a golfer carries his golf clubs, balls, tees, clothes, umbrella, cream etc.

Bag stand - a stand designed to hold a golf bag while practicing on a driving range

Birdie - Scored by a player who sinks the ball in the cup one stroke under par for that hole. For example, if a player takes four strokes to put the ball in the cup on a par five, he or she gets a birdie.

Bogey - When the number of strokes it takes to sink the ball in a hole exceeds the par by one. On a par three hole, a score of four is called a bogey, and the golfer scores one over par on that hole. A double bogey is two over par and a triple bogey is three over par.

Boundary - The edge of the course that defines the area in play.

Break - The way in which the green is sloped, so that when you put, the ball will role in that direction. For instance, if you are going to put, and someone says "The shot is going to break to the left" that means the ball is going to naturally roll to the left, so you need to aim more to the right of the hole.

Caddie - The person who carries a golfer's bag around the golf course and sometimes gives tips to the Golfer on how to play the hole.

Cart: a two or three wheeled cart pulled or pushed by a player which holds the clubs and accessories of a golfer. Nowadays electric powered four wheeled carts are available.

Cart Path : Narrow path extending from hole to hole on the golf course for motorized golf carts to enable transport players and their equipments. These are generally prepared in asphalt or concrete

Cup (or the Hole) - The round hole on each green (4 1/4" diameter). There is only one hole per green and is designated by a Pole or Flagstick inserted in the hole.

Divot - The clump of grass dug up from under the ball on fairway iron shots.

Dog Leg - Any golf hole where the fairway bends either left or right toward the green - like a dog's leg.

Drive - Term describing a golfer's first stroke from the tee box on every hole.

Drop Ball - If a ball lands in a water hazard, is lost, or needs to be repositioned in its lie on the course, the golfer takes a drop ball. From an outstretched hand, the golfer drops the ball on the course in a position no closer to the hole than where the original ball landed.

Driving Range - An area designated to hit practice shots.

Fairway - The long stretch of neatly trimmed grass that runs between the tee box and the green. The desired landing place for your tee shot

Flagstick ("Pin" or "Stick") - The pole (with flag) that stands in the cup on each green. The pin is a marker at which players shoot when approaching or aiming for the green. The flag is usually removed when players begin putting.

Fringe - The thin strip of slightly longer grass (compared to the grass on the green) that separates the surrounding rough from the green (also called Apron).

Green (or Putting Surface) - The short grassy surface where the cup (or hole) is located. Players putt from the green.

Green Fee - This term refers to the money that it costs to play the course - what the club house charges you to play.

Golf: A game in which clubs with wooden or metal heads are used to hit a small ball into a number of holes, usually 9 or 18, in succession, situated at various distances over a prescribed course having natural or artificial obstacles. The object being to get the ball into each hole in as few strokes as possible.

Handicap - A rating of each hole on the course from 1 to 18 with 1 being the most difficult and 18 the most easiest. handicap is also a measure of the difference between a player's skill (average score) and the difficulty of a course.

Hazards - Obstacles strategically placed on a golf course to make play on each hole more difficult. Sand traps, water, and trees are all considered hazards.

Hole-in-one (or Ace) - This rare score occurs when the golfer's tee shot goes into the hole. Most hole-in-one shots occur on the shorter par three holes.

Iron - a golf club with a flat faced lofted, solid metal club head, generally numbered from 1 to 9. The higher the number, The greater the loft.

Line – The expected path of the ball to the cup while putting.

Links - A term originally describing seaside golf courses, now used to describe golf courses in general.

Marker - Another term for ball marker, which is a small flat round object, or a dime (etc) in which to mark your ball with when picking it up from the ground. This is usually done on the green, to move your ball out of someone else's line of play.

Markers - These are the objects on the Tee Box which mark where you should tee off from. You always place your ball behind them, never in front of them.

Nineteenth Hole - This is another term for the clubhouse.

Obstructions - Any path, road, or foreign object on a golf course. A golfer is permitted to move a ball from an obstructed lie using a drop ball. In this instance no penalty stroke is incurred by the golfer.

Par - The number of strokes per hole it should take a player to sink the ball in the cup. Holes measuring up to 250 yards are called par threes; from 251 to 475 yards are par fours; and any hole above 475 yards is considered a par five.

Putt - This term is referred to the strokes on the green with a putter. Your "Putt shots" or putts.

Putter - The club used to hit the ball on the green.

Reading the Green - To determine which way the put will "break" or naturally roll on the green, when on a slope.

Rim - Edge around the cup.

Rough - The taller grass that lines the fairways and greens on each hole.

A Round - Playing eighteen holes of golf.

Sand Trap (or Bunker) - Sand-filled pits on fairways and next to greens that are placed as hazards on a course.

Tee - A piece of wooden or plastic material used to prop the golf ball up off the ground, usually at the beginning of the hole on your first shot. A tee may only be used when in the tee box.

Tee Box - The area at the start of each hole from where players drive the ball.

Tee Off - This is your first shot on a hole, and sometimes is used as slang to mean to play golf.

Water Hazard - A pond or stream. If a ball lands in water and is unable to be played, the golfer takes a penalty stroke.

Yardage - This usually refers to the total yardage of a hole, to determine its difficulty. It can also mean the "yards left" to the hole, etc.

LIST OF ABBREVIATIONS

Abbreviation	Full Form
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
CRZ	Coastal Regulation Zone
DSLR	Directorate of Settlements and Land Records, Goa
EIA	Environmental Impact Assessment
GCZMA	Goa Coastal Zone Management Authority
GSPCB	Goa State Pollution Control Board
HTL	High Tide Line
IGBC	Indian Green Building Council
LEED	Leadership in Energy & Environmental Design
LHL	Leading Hotels Limited
LTL	Low Tide Line
MOEF	Ministry of Environment & Forests
MSL	Mean Sea Level
MLSS	Mixed Liquor Suspended Solids
NABET	National Accreditation Board for Education & Training
NOx	Nitrogen Oxides
PWD	Public Works Department, Goa
PM10	Weight of Particulate Matter less than 10 micron/cubic meter
PM2.5	Weight of Particulate Matter less than 2.5 micron/cubic meter
QCI	Quality Council of India
WRD	Water Resources Department, Goa
SLEAC	State Level Expert Appraisal Committee
SS	Suspended Solids
SEIAA	State Environmental Impact Assessment Authority

SO2	Sulfur dioxide
TAC	Technical Assessment Committee
TSS	Total Suspended Solids
TCP	Town & Country Planning Department, Goa
USGBC	United States Green Building Council
USPGA	United States Professional Golf Association

EXECUTIVE SUMMARY

PROJECT DESCRIPTION

Introduction

The proponent intends to develop a luxury Resort in Tiracol, Pernem Taluka, North Goa and has been has been selected by the Department of Tourism, Government of Goa for establishment of a world class PGA standard 18 hole golf course. The site was found to be ideal by reputed international golf course designers for the development of PGA standard golf course and is bound to attract, not only, well known "golfers/golf tournaments" but also high end tourists which will boost tourism in Goa.

Regulatory Scoping

The site for the proposed Tiracol Resort comprises 244.6 acres land located in Tiracol, Goa at the confluence of the Tiracol River and the Arabian Sea. A part of the site is covered under the Coastal Regulation Zone (CRZ). An area of 51.9 acres (2,10,061 sqm.) lies within 200 m from the High Tide Line (HTL) in the landward direction and is a "No Development Zone (NDZ)" as per CRZ Rules. An area measuring 86 acres (3,48,079 sqm) is located between 200 m to 500 m from the HTL. The remaining area of 99 acres (4,00,695 sqm) lies beyond 500 m from the HTL and hence does not fall under the CRZ category. Another NDZ area is formed along the bank of Tiracol river (being influenced by tidal waters) between 0- 100m and admeasures 7.7 acres (31,165 sqm.).

According to the approved Coastal Zone Management Plan (CZMP) of Goa, Tiracol village falls under Coastal Regulation Zone-III (CRZ-III). As per CRZ 2011 Notification "construction of a Resort/ Hotel for tourists or visitors in between 200 to 500m of HTL" is a permissible activity as per Item 8 under "Norms for Regulation of Activities in CRZ-III zone" of CRZ 2011. As such the proponents are proposing to develop the villas and associated facilities forming part of the main hotel like entrance lobby, spa, restaurants etc within 200-500m of the HTL line, while the premium villas will be located beyond 500m.

Since the plot of the proposed resort covers an area 98.74 Ha, which is greater than 50 ha as mentioned in the Schedule of List of Projects or Activities requiring Prior Environmental Clearance of the EIA Notification of Sept., 2006, the project falls in the 8(b): "Townships and Area Development projects" category and requires a prior environmental clearance.

Proposed Development

The total land area dedicated for construction of resort is around 4,27,408 sq.m or 105.6 acres. Of this, the permissible FSI Area is 40,000 sq.m. and Gross Covered Area is 58,416 sq.m.

The Master Plan for the proposed development is evolved so that the main Golf Resort comprising Standard villas & Guest rooms are located as a cluster within 200-500m zone (from the High Tide Line) to the west of the plot (in the northern highland and headland plateau) to offer a view of the sea. The central hotel axis (spine) and spa

serves as the resort anchor with golf, pools and detached hotel suites in close proximity. Other amenities include tennis courts, pools, golf, children's and young adult clubs, an outdoor garden for functions, a spa with adjacent gardens etc. A cluster of standard resort villas will provide accommodation support to corporate and leisure guests. Resort villas will derive its architectural character from vernacular Goan architecture where traditional architectural elements will be styled in a contemporary manner. To cater to the parking requirements, 660 parking bays have been proposed covering an area of 7,319 sq.m.

Water Requirement

Around 70,000 to 80,000 cu m of water has been estimated as the requirement for the construction phase of the project and other ancillary requirements such as setting up of plant nursery, golf course irrigation requirements during dry season, etc. (construction phase is estimated to last for 36 to 40 months and thus the water requirement is estimated upwards of 100 cum/day). Peak potable water requirement worked out on the basis of maximum occupancy (during golf tournaments or conferences, or holiday periods) is 555 cmd for the resort and 95 cmd for community facilities, i.e. a total of 650 cmd. During the monsoon season, the Resort occupancy to be around 40% where the water requirement will be reduced to around 220 cmd while the provision for water for community facilities is maintained same at 95 cmd. Non potable water required will be 1900 cmd and the total water demand will be 2,550 cmd. Construction of the golf course involves filling of upto 4.69 lakh cum. Cutting will be undertaken on site for (a) rainwater harvesting water bodies (b) for building foundations and (c) for external landscaping.

Municipal Solid Waste

Domestic solid waste collection will be around 27.8 cum. per day, (biodegradable and non biodegradable waste). A Baler/compacter is suggested for use in order to reduce the overall waste volume upto 25%. Non-degradable waste will segregated. The waste (paper waste, plastic and metal scrap steel/ glasses) will be disposed off by sale through scrap dealers or will be sold to authorized vendors for recycling. The organic/biodegradable solid waste will be stored in a cold room and taken for composting in a mechanical composting unit to be located in the Garbage management centre (GMS). The compost from the same will be used for landscaping within the plot.

Power Requirements

Power supply will be drawn from Goa Electricity Department but sourced from Maharashtra side from Malewad substation which is around 9 km from the site. The maximum power demand for the Resort is 6300 kVA. The Resort shall provide for full 100% backup in case the emergency supply shut downs. 2 sets of generating plants comprising of 3x750 KVA generators (total 6) are proposed. All generators are designed to run as continuous set. The generator sets would provide sufficient capacity for maximum demand load with 2 sets as standby.

Renewable Energy

Use of renewable energy is proposed through use of Solar Water Heaters with automatic back up electrical connection during cloudy and /or rainy spells, for each

villa, Solar LED Lantern in each room, Solar Photovoltaic Power Plant (50kW) to provide power for 6 x1800W pumps for irrigation, 600 LED (14W) street/garden lights, One junction traffic light, and 3 LED display boards. A Biogas Plant (100 cum) based on kitchen /garden waste is also proposed.

The proposed fire fighting systems are designed as per NBC of India 2005.

Green Development

Census of trees in study area has been carried out by LHL and their data shows that there are about 19,000 trees within the project site. More than 90% of the proposed tree species will be local/endemic to Konkan. Proposed golf course has been designed using the latest variety of grass (*Paspalum sp*.) which responds very well to biofertilizers and biopesticides and provide a better playing surface. This grass species uses less water than other warm season grasses or Bermuda grass, and handles drought conditions very well. It also has a lower nutrient requirement.

The total investment on the project will be around INR 505 crore.

DESCRIPTION OF THE ENVIRONMENT

The plot has an undulating rolling terrain having slopes that are mostly gentle, which favor golf course landscape development. The northern periphery of the site is at an elevation overlooking the entire site (and thus would offer beautiful views of the golf greens) and the entire coast. The Central plateau offers a panoramic oceanic view and is preferred location for club house and resort. The Golf architect –IMG World have endorsed the site as being ideal for a world class Golf Course location.

The existing baseline environmental status (land, air, noise, water, biodiversity and socio-economy) was assessed within a 10 km radius and monitoring was carried out in summer 2011. Additional sampling was undertaken in summer of 2013 for baseline pesticide assessment in ground water as per directives of SEAC/ Technical Appraisal Committee (TAC) of Goa State Pollution Control Board.

Landuse and Land Cover studies

LULC study of the 10km area within the study area around the site, shows that the total cultivable area in the study zone is approximately 43.876 sq km. The main kharif crop grown in the region is rice. Some plantations, mainly of cashew, coconut and mango are also prevalent in the study zone. The Tiracol village adjacent to site and the Redi village in Maharashtra about 1.5km to North of site, are the only permanent settlements adjacent to the project site. The Tiracol Fort towards the South is a heritage site. Mining activity in the study area is mainly for the extraction of iron ore. Tata Metallics factory stands towards the North of the site but is non- functional since October 2011.

Baseline Environmental Monitoring

Soil quality has been studied at three locations and it was observed that the soil is sandy loam in texture, with a acidic PH. AAQM was done for PM10, SO2, NOx, CO at six locations and it is observed that all parameters are well within the prescribed limits of NAAQ for residential areas. Noise monitoring was carried out at six locations on the site and the readings show the noise levels to be below the standards during both day time and night time. Ground water quality has been checked at 5 locations and the results

show neutral pH values in two wells (No. 4 and No. 9) and slightly acidic nature of water in the remaining wells. Except for high Mn concentration in one well (No. 9), all parameters are well within the prescribed limits for drinking water (IS 10500) quality. Additional findings from analysis conducted in summer 2013: Results are at trace levels and much lower than the prescribed norms under IS 10500: 2012. The upper part of Tiracol plateau was previously under cultivation and also the valley portion was under coconut plantation. The pesticides detected were probably used at these sites.

Ecology and Biodiversity

A substantial portion of the site is a Lateritic Plateau with relatively shallow soil strata, poor complement of permanent vegetation; monsoonal flush vegetation chiefly comprising of grasses and shrubbery. Also, seen here are patches of Cashew (Anacardium occidentale) monoculture.

In the north-east direction of the site is a fairly open vegetated area with a good diversity of species both floral and avifaunal, besides mammals, and the lesser vertebrate groups like the amphibians, reptiles and other invertebrate fauna. It has a mix vegetation of trees, shrubs and herbaceous flora. The ground and the land strata with its umpteen low lying and ascending profiles provides numerous micro-habitats for herpetofauna, avifauna and scores of invertebrates. Also, the low lying areas in the lateritic strata allow water accumulation and subsequent establishment of aquatic ephemeral vegetation and fauna.

Due to the heavy monsoon, plants of family Cyperaceae, Poaceae, Eriocaulaceae emerge with the advance of monsoon, but were only distinguishable at morphospecies level. By the end of monsoon season, mass blooming of non-grass families (*Fabaceae, Eriocaulaceae, Lentibulariaceae, Rubiaceae*) is observed on all rocky plateaus. The site up to the cliffs in the south western direction is relatively open and covered only by ground vegetation that comprise of grasses and other ephemeral flora after the rains. The 'ephemeral flush' stage is evident on cessation of rains and before the onset of winter. Barring a few species, much of this is common and with little conservation value. However, the associated meiofauna like the ants, scorpions, araneid and non-araneid arachnids abound. Myriapods (Millipedes and Centipedes) are common.

Socio- Economic Profile

The Tiracol fort, located to the East of the site is a popular tourist destination in Goa and attracts a lot of tourists annually. Agriculture is the main occupation in the study area, and tourism related services thrive as subsidiary occupations. Tata Metallics, the Steel Unit, also used to provide employment to the nearby villagers until it shut down recently. Tiracol village, located adjacent to the site has a total population of 203. The area has a rural setting and primary occupation in the region is related to Agriculture including small coconut / cashew plantations. Literacy rate like in other parts of the State is high.

ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Construction Phase

About 1966 trees exist in the development zone of the project- of which about 56% (1101 trees) are endogenous/endemic trees for Konkan region and will be retained/transplanted as part of the development. The balance 44 % (865 trees) are acacia/cashew and other rain trees which will be removed during the development. It is proposed to develop a landscape using the Spice Route concept. More than 4,000 trees will be planted afresh on site of which more than 90% will be natural/endemic to Konkan region. This will be a part of the resort/golf course landscape development.

Cutting will be undertaken on site (a) for golf course (including rainwater harvesting bodies) (b) for building foundations and (c) for external landscaping. The total envisaged cut and fill volumes are 2,41,373 cum and 7,10,913 cum respectively. The net fill material required will be 4,69,540 cum. Construction waste consists of materials such as debris, concrete, steel/other metals, bricks, pallets, packaging/ paper products, railings, door/window casings, fixtures, tiles, furnishings, discarded containers of paints, etc. Approximately, 0.5-1 MT/ day debris will be generated. Of this, the discarded paint containers are hazardous waste and are to be disposed off through authorized parties.

As part of mitigation measures, top soil and substratum from excavated areas will be stored separately and reused, as the top cover, for landscaping and during golf course layout. Activities will be carried out during dry season. Provision of bunds/trenches, silt fences and gabions along the peripheral contours, erosion control using Geotextiles, Netted/ Rolled Erosion Control Products and sods on bare soil to establish turf, grading to ensure proper channelization of storm water, use of *Paspalum* grass species – a high TDS tolerant grass – capable of remaining green over long periods and amenable to bio pesticides/bio fertilizers. It is also draught tolerant.

Commissioning Phase

Impacts during commissioning phase will be generation of waste water and construction waste due to the use of water, power and other construction materials. Mitigative measures like: Proper training to employees in handling, segregation and reuse of construction waste under supervision etc is suggested.

Operation Phase

Contamination of soil by spilled fuel and lubricants from equipments such as DG sets, vehicles as well as due to improper storage and disposal of solid waste may occur during this phase. Golf course maintenance requires use of various chemicals such as fertilizers, weedicides and pesticides.

The proponent proposes to use *Paspalum* grass species instead of traditional Bermuda grass for fairways, tees and greens and will use of biopesticides and biofertilizers for maintaining the golf course turf grass. *Paspalum* grass responds well to use of biopesticides and biostimulants and is also tolerant to high salinity water (having 3000-6000ppm TDS). It requires low amount of water and can be watered every alternate day. It can also remain green for longer durations in adverse conditions (does not

yellow). The use of Paspalum grass thus results in substantial saving of fresh water and significant reduction in use of biofertilizers and biopesticides.

The project site is bound by the Arabian Sea on the South and South West, across the rocky premonitory along the seaward periphery of the partially rocky plateau land. The continuous forces of incoming waves lead to erosion of the presently unprotected coast. Although this is a natural phenomenon, coastal protection measures are suggested. Protection of shoreline will be achieved by adopting buffer material such as boulders, conventional concrete blocks, and tetra-pods to form "interlocking/porous" barriers in order to dissipate the power of waves and currents.

Solid waste from the Resort will consist of plastic, paper/paper products, glass, metal scrap and bio-degradable waste from kitchen and "landscape/golf course" maintenance works. Impacts are anticipated to be negligible in view of the proposed measures during operation phase like waste segregation at source, recycling, storage etc.

Following CSR activities will benefit the locals in the long run:

- Construct a Primary school for neighbouring village children.
- Construct a 25 bed Medical Centre for the Tiracol village for emergency treatments.
- Development of a Disaster Management Centre for congregation and evacuation during emergencies.

Decommissioning Phase

There will be a marginal and temporary impact on the air quality in the immediate vicinity of the resort, due to dust emissions and noise generation during the decommissioning phase. More than 90% of the proposed tree species will be local/endemic to Konkan. Decommissioning of the project will create a loss of employment opportunities. Tourism industry in the state will have a major setback. Closure of the infrastructure facilities during commissioning of the project may an adverse impact on the local populace.

Mitigation measures suggested are: Proper procedure for safe decommissioning shall be established as part of project development with training to employees. A designated procedure will be in place to ensure that workers do not suffer in this eventuality.

Environmental impact matrix evaluation

Environmental impact matrix evaluation shows that the proposed development will have minor negative impacts.

ENVIRONMENTAL MONITORING PROGRAMME

Monitoring of environmental parameters like ambient air, noise, water, soil etc. will be carried out to comply with the statutory requirements of monitoring for compliance with conditions of EC, Consent to Operate etc. and also to understand the nature and magnitude of pollution control required. Monitoring will assist in tracking the effectiveness of Environment Management Plan and implementation of mitigation measures planned. It will also identify any significant adverse transformation in environmental condition to plan additional mitigation measures; if and when required.

Measurement Methodologies

Monitoring of environmental samples shall be done as per the methods/guidelines provided by MoEF/ CPCB and /or relevant Indian Standards. Methodology of monitoring (sampling & analysis) shall be documented as SOP (standard Operating Procedure) for parameters analyzed through in house laboratory and shall be subjected to Internal audit and review.

Reporting Schedules

The records of the monitoring program shall be prepared and preserved properly. The records showing results/outcome of the monitoring programs will be submitted as per the given schedule.

Monitoring reports will be reviewed regularly by Facilities Management along with Environmental Consultant for necessary improvement of the monitoring plan/mitigation measures/environmental technologies as well as for necessary actions of Environmental Management Cell.

ADDITIONAL STUDIES

A study regarding the **Golf Tourism in India** reveals that although the IGU web site states that there are more than 200 courses in India, a cursory study indicates that out of this, only 48 courses are professionally designed and suitable for holding tournaments. Out of this, 16 are in Northern states, 17 in Southern states, 8 in the West and 7 in the East. There are 3 USPGA standard golf courses in the country yet India does not find a place currently in the US Professional Golf Circuit.

"**Scotland" as a case study for Golf Tourism** was studied and it reveals that Golfers are most attracted to Scotland by its 'traditional' image –and are willing to pay anything for a 'unique' experience and a taste of the tradition and history which Scotland brings to any visitor. Golfers tend to prefer the spectacular links courses than the inland courses and much higher revenues are recorded in these courses. Generally Golfers spend four times the amount spent on green fees on other considerations like accommodation, food and drink and travel, leisure activities.

A **Preliminary Assessment of LEED Rating** Building design simulation studies for Sustainable Site, Water Efficiency, Energy & Atmosphere, Materials & Resource and Indoor Environmental Quality have been conducted to study the implications of the architectural design aspects on the indoor and outdoor environment as well as the local micro-climate. In order to get the USPGA accreditation, the project is being developed for a Gold Rating as per the US Green Building code LEED 2012.

Traffic Analysis considering the impacts of the additional traffic generated due to the proposed project has been conducted. A detailed analysis of saturation level on road links, entry and exit efficiency of site entry and geometry at turns has been done for all links and entrances/ exits has been conducted.

A **Disaster Management Plan** has been prepared to mitigate any kind of disasters (manmade or natural) beforehand. All the line authorities are assigned with their proper role and responsibilities, which are clearly indicated in the plan. Information about actions to be taken and rehabilitation camp/ relief assistance are outlined.

PROJECT BENEFITS

The proposed Golf Resort will assist to boost tourism in Goa. Following are the anticipated highlights:

- Goa is an internationally preferred tourist destination. The proposed project will make Goa an international golfing destination, within the global tourism circuit.
- Golf tourism will uplift the image of Goa with substantial revenue multiplier effects
- It will fill a big tourism related void in Goa, which is the absence of a full size golf course, a basic need to attract high end tourists.
- Project will redefine the socio-economic profile of Pernem Taluka
- Golf resort will offer exclusive lifestyle in a natural environment
- Propagate eco-friendly concepts in architecture and design utilities
- Tiracol will be catapulted into a global destination

The project will have the following positive repercussions on socio economic and community welfare:

- Will create jobs that match the "skills/talent", available locally
- Will lead to spin-off businesses, which also are green in nature
- Will provide community service facilities, better "infrastructure/services" and
- Employment to the tiny rural settlement of Tiracol.

ENVIRONMENT MANAGEMENT PLAN

The Environmental Management Plan is prepared with the main objective of enlisting all the requirements to ensure effective mitigation of adverse impacts for all the components of the proposed project. The impacts can be minimized through engineering solutions incorporated in the design and implementation of the EMP and the proposed monitoring plan.

EMP Implementation Schedule

- Structural measures identified will be provided during the construction phase prior to commissioning of plant operation.
- Proper installation of pumps, motors will be done well before commissioning to prevent wastage & efficient use of water
- The non-structural actions will be initiated with inception of commissioning stage and will be implemented & practiced as routine throughout the project life.
- Maintenance of all pollution control equipment and devices will be done throughout the extent of operation phase.

A total budget of around INR 870 lakh (capital cost) and around INR 125 lakh as annual recurring cost for maintenance and operation has been envisaged for the implementation of the EMP.

Project proponent will, however, obtain applicable clearances and approvals from the Goa SPCB and other concerned authorities. It is also recommended that the proposed

EMP is improvised during implementation if there is any change in design or realignment (if deemed necessary).

Environmental Management Committee

Structural measures: Directors, Project Manager, Accounting Head/Manager, Site Officer & Engineers, Contractors.

Non-Structural (SOP's, studies, implementing systems etc: Directors, Site Manager, Accounting Head/Manager, Resort In-Charge, Safety & Environment Officer & Engineers, Contractors & Operators

This body will oversee, inspect, co-ordinate and implement the entire environmental aspects of the proposed development. All the members will be given specialized training to take care of operation and maintenance of environmental infrastructure, fire fighting and emergency operations. Committees will be set up during the construction as well as operation phases. This committee will meet at least once in a month and consider all issues affecting the environment. It will inspect the works frequently and take quick decisions to correct any anomaly. The Committee will meet and act as per the given schedule.

CONCLUSION

Compared to many other development options which have been tried and tested in Goa (viz. manufacturing industry, pharmaceuticals, mega-housing projects, metallurgical furnaces/foundries and the like), tourism related developments such as coastal resorts, "horticultural/plantation" retreats, marinas, and medical tourism (speciality clinics/hospitals) appear to be most compatible with Goa's landscape, socio-cultural ethos and environment friendly nature. Evidently, a golf course based resort which thrives on greenery, breathtaking landscape and breathtaking ocean/ river views as its main ingredients, is fully compatible with the project site, in the remote undeveloped and (mostly) barren corner of Tiracol region in Pernem taluka of Goa.

Unlike mega-housing projects and industries, a Golf Resort is socio-ecologically and environmentally most desirable because of its major attributes, listed below:

- Causes no demographic influx.
- Enhances the green cover of the locality.
- Creates jobs that match the "skills/talent", available locally.
- Leads to spin-off businesses, which also are green in nature.
- Fills a big tourism related void in Goa, which is the absence of a full size golf course, a basic need to attract high end tourists.
- Involves no loss of native tree cover, except for the relocation of some trees by removal and transplantation.
- Promotes harvesting of rainwater to the maximum extent possible.
- Reclaims a vast stretch of highly eroding coastal premonitory and rocky plateau and converts it into a stable and lush green ocean view landscape.
- Encourages ventures of ornamental gardening, flowering plants, lawn making and plant nurseries.
- Promotes organic manures and organic pesticides.
- Encourages highly efficient and water saving irrigation technology.

- Promotes renewable energy sources.
- Provides community service facilities, better "infrastructure/services" and
- employment to the tiny rural settlement of Tiracol.
- Makes Goa an international golfing destination, within the global tourism circuit.

Potential negative environmental impacts of the proposed project which can be effectively mitigated as explained in this Report, are listed below:

Short-term adverse impacts such as dust pollution and soil erosion during earth works for shaping of land surface and landscaping works to establish the golf course and resort building

- Temporary "air/noise" pollution during construction of resort buildings.
- Increased solid waste generation in the area.
- Increase in vehicular traffic.
- Significant water requirement for the establishment and maintenance of golf course and landscaped gardens.
- Possibility of surface/ground water pollution due to the nutrients and herbicides used to maintain the golf course and landscaped gardens.
- Generation of sewage and kitchen waste from resort "rooms/villas" and kitchens, respectively.

Significant but temporary negative impacts are most likely to occur during the construction phase. However, the said negative impacts (listed above) are mitigable "and/or" reversible, through engineering and scientific solutions incorporated in the present EMP, and in the monitoring plan. The extra soil material required for the project will be procured, after the approval of the concerned "authority", and on ascertaining that no adverse environmental impact occurs at the site of procurement of the material. The development work on the project site will be undertaken only after securing prior clearances from the Coastal Zone Management Authority, State Pollution Control Board, Town & Country Planning Department .and the local Village Panchayat.

The upcoming project is thus notable on account of the fact that there are no resettlement or relocation issues associated with this project. With the implementation of appropriate mitigation, the project will be socio economically viable and environmentally sustainable. The proposed mitigation measures for the project are sufficient. All negative impacts, during and post construction can be properly mitigated and no comprehensive, broad, diverse or irreversible adverse impacts have been identified.

In view of this, it may be concluded that proposed project presents no major environmental and ecological concerns.

1 INTRODUCTION

1.1 Purpose of Environmental Impact Assessment (EIA) Report

Environmental Impact Assessment (EIA) as the name suggests is a process of meticulous assessment of environmental impacts. It was introduced for the purpose of identifying /evaluating the potential benefits or adverse impacts of development projects on the surrounding environment consisting of land, air, water and biological factors, taking in to account environmental, economic, social, cultural and aesthetic considerations. For evaluating the impacts of the proposed activities, all activities associated with planning, design, site preparation, construction, operation and maintenance within the proposed project are included. All of these considerations help decision makers & project planners to develop proper mitigation measures at an early stage in the project.

The aim of an EIA is to ensure that potential impacts are identified and addressed. For this purpose an Environmental Impact Assessment (EIA) Report has been prepared to assess baseline environmental conditions at the site and an Environment Management Plan (EMP) has been prepared to execute the project with minimum pressure on the natural resources and negligible impacts on the environment.

The study area to be considered for the purpose of assessing the impacts on the environment has been determined as per the applicable EIA guidelines as well as the requirements of MoEF.

1.2 Identification of project & project proponent

M/s. Leading Hotels Limited has proposed to set up an 18 hole United States Professional Golfers Association (USPGA) standard Golf Course wrapping around a luxury Resort (with 185 villas & associated facilities like banquet halls, restaurants, spa and health club etc) with the aim to provide world class facilities for international tourists. This will be a Signature Golf Course designed by Colin Montgomerie, one of the world's best-known golfers and the successful Captain of Europe's triumphant 2010 Ryder Cup team, along with IMG World.

The proposed development also includes a Primary School, 25 bed Health center, a Community Centre, a Disaster Management Site (DMS) and a Garbage Management Site (GMS). In addition, various social upliftment and green measures are proposed which are given in detail under Environment Management Plan.

1.2.1 Project Proponent

Leading Hotels Ltd. is a member of an established Hospitality Development Group which has successfully owned and operated Luxury Hotel Developments across India for more than 30 years. The Company is promoted by Mr. S.K. Jatia who is the promoter of Asian Hotels (North) Limited – owners of Hyatt, Delhi. The Company earlier

developed the Hyatt Regency, Kolkata and Hyatt Regency, Mumbai and have over three decades of experience in this vertical. The Group made its beginning in 1980 in the Hospitality sector and is now a successful and highly regarded enterprise with presence in Hospitality, Real Estate and Education sectors. The Group has also developed the super luxury Four Seasons, Mumbai, owned by Magus Estates & Hotels Ltd. as well as Hyatt Regency, Pune, owned by Ascent Hotels Limited, both members of the Jatia Group.

1.2.2 Operator for the Proposed Facility

It is proposed that the management and operations of this luxury golf resort be undertaken by **Four Seasons**, a reputed Canadian hospitality management company. Currently, with around 94 hotel properties in 36 countries and more than 40 properties under development, The Company is recognized in hospitality sector as one which manages the finest hotels, resorts and residence clubs. Four seasons creates properties of enduring value having superior design and finishes and also supports them with highly personalized yet professional service by combining friendliness and efficiency.

1.2.3 Consultants to the Project

The Resort development is being undertaken through top notch Consultants and Architectural Design firms who have developed some of the milestone properties in the luxury hotel industry in the World. The list of the various Consultants on board for this project is mentioned in Chapter 12: Disclosure of Consultants Engaged.

1.3 Brief Description of Nature, Size, Location of the Project & Its Importance in the Country, Region

1.3.1 Green Nature of the Project

Leadership in Energy and Environmental Design (LEED) is a comprehensive, consensus-based building rating system developed by design and building professionals in the US in the 1990s. Ever since its inception, LEED has come up with many versions for different building types, including New Construction (NC), Existing Buildings (EB), Commercial Interiors (CI), Core and Shell (CS). There are over 300 LEED rated projects and over 2000 registered projects around the world. The latest LEED version is LEED 2012.

The Indian Green Building Council (IGBC) was founded in 2000, in partnership with the USGBC, and released LEED-India in 2006. The latest version is LEED India 2011. The Indian Green Building Councils goal is to:

- **Facilitate** positive results for the environment, occupant health and financial return
- Define “green” by providing a standard for measurement
- Prevent “green washing” (false or exaggerated claims).
- Promote whole-building, integrated design processes
- Establish market value with recognizable “brand”

- Raise consumer awareness

LEED 2012 considers a few extra requirements or credits not addressed in LEED India 2011. LEED (New Construction) is divided into 5 categories.

1. Sustainable sites
2. Water Efficiency
3. Energy and Atmosphere
4. Materials and Resource
5. Indoor Environmental Quality

The proponents have envisioned an eco-friendly project featuring sustainable resources for architecture and efficiently managed systems. In order to get the USPGA accreditation, the project is being developed for a **Gold Rating as per the US Green Building code LEED 2012.**

1.3.2 Location of the Project

The proposed project site is located in village Tiracol in Pernem Taluka of North Goa district. Tiracol village lies on the iconic northern most tip of Goa, and is one of the most scenic and serene location in Goa. Located in this picturesque surrounding is the majestic Tiracol Fort, a beautiful heritage monument built by the Portuguese, overlooking the vast expanse of the Arabian Sea as well as the meandering Tiracol River that meet each other.

1.3.3 Importance of the Project to the Country, Region

India is one of the fastest growing economies and is increasingly becoming a preferred destination for commercial and economic activities. India's tourism industry is fast developing and thriving, owing to a huge surge in both business and leisure travel by foreign and domestic tourists. Given its unique endowments of biodiversity, forests, rivers, coastline, mountains, historical places, culture, etc, India offers a tremendous growth potential to the tourism industry.

The project proponents have proposed to develop an 18 Hole PGA standard Golf Resort in Tiracol village, located in Pernem Taluka on the northern most tip of Goa, with world class amenities catering to the refined taste and preference of high end global tourists. Indian communities are also developing a real taste for the quality lifestyle that combines wonderful living standards set within a healthy and natural environment.

The game of Golf is increasing in popularity and there is an increasing demand for quality golf courses. As there are only three golf courses in India which are accreditated by USPGA, of which only one is in Western India, the proposed golf resort will be an attraction for players looking for a challenging and exciting golf game with a world class golf landscape design.

In order to address present day concerns, a green development is being contemplated by adopting newer and more appealing ways of conserving the environment as against traditional conservation practices. This will include development of the resort itself as a

LEEDS- Gold certified facility and also develop the golf course by adopting the latest environmental friendly development practices such as use of geo-textiles for erosion control, special drought resistant grass species requiring lesser water and tolerant to salinity, reuse and recycle of entire sewage water generated, maximizing rain water harvesting, recapturing of excess irrigation water by providing under drainage system, composting of biodegaradable wastes are envisaged. The villa architecture will draw from the differential architecture seen in Goa and would thus itself be a big draw for tourists. In order to have conducive development, the project envisages development facilities for the Tiracol village by way of providing water supply, providing emergency power, creation of a 25 bed Health centre and primary school.

Since the proposed site is a vacant unused land it fulfills the requirements of the project. Considering its scenic beauty a resort of international standards would redefine the way Tiracol lives and increase the overall positioning and branding of Goa as one of the leading tourist hotspots. A project of such magnitude would catapult Tiracol into a global destination.

1.3.4 Status of Key Approvals

The proposed activity i.e. construction of "Golf Resort" conforms to the existing local Development Plan. The Regional Plan (RP) 2021 for Goa was formalized with Tiracol as an Eco-Tourism zone and golf course under a Committee headed by Charles Correa. Clearance or approval of the proposed Master Plan from local regulatory body Town and Country Planning (TCP) to confirm adherence to local Development Control is also obtained by the proponent.

Permit for the provision of utilities like water supply, drainage etc will be obtained by the project proponent from the local Water Supply Department, Irrigation department respectively. Other approvals like the Fire NOC, etc. also will be procured by the project proponent before the commencement of the project.

Following is a list of NOCs obtained by the project proponent:

Table 1.1 Status of Key Approvals

S.No	Approval	Date
1	Submission to Government to earmark Tiracol as a Golf Course in the Regional Plan (RP) 2021	9th April 2009
2	RP 2021 formalized with Tiracol as Eco-Tourism zone & Golf Course under committee headed by Charles Correa	8th Nov'2010
3	Selection of LHL as Public Private Partner under LRG Scheme	27th April 2011
4	Approval of Master Plan (7,70,000 sqm) by Town & Country Planning (TCP)	17th Nov 2011
5	Issue of Conversion SANAD for 40,000 sqm by Collector	30th Dec'2011
6	Approval of Revised Master Plan (9,90,000) sqm by TCP	25th Feb'2013

S.No	Approval	Date
7	Issue of Conversion SANAD for 1,32,559 sqm by Collector	3rd May'2013
8	Grant of Environmental Clearance	12th April 2013
9	Grant of Consent to Establish	10th Feb'2014
10	Grant of CRZ from the Ministry of Environment, Forest & Climate	9th Dec'2014
11	Construction License for Experience Center	15th Jan '2015

The project proponents are required to obtain "Consent to Establish" (under Water Pollution Act (1974), Air Pollution Act (1981) and Authorization under Hazardous Waste Rules 1989/ 2008) before initiating any activity. The Goa Pollution Control Board (MPCB) has a procedure to grant a Consent/ Authorization under the above mentioned Acts/ Rules. A"Consent to Operate" needs to be taken before commissioning of the project.

The Ministry of Environment and Forests (MoEF) has stipulated general discharge standards for water effluents, and general emission standards for air and noise emissions. These standards limit the concentration and volumes of the effluents and emissions released to the atmosphere. In addition to the above, the Central Pollution Control board (CPCB) has also specified National Ambient Air Quality and Noise Standards for residential, commercial, industrial and sensitive zones for the country as a whole to be followed by the developer/ project proponent.

1.3.5 Scope of the EIA Study

The primary objective of the EIA study is to safeguard the environment during planning, design, construction and operation of the proposed project activities and associated facilities by mitigating environmental impacts envisaged during various phases of the project.

The study is designed to evaluate the proposed project activities considering environmental factors and prepare an Environment Management Plan (EMP) for the project.

Specific objectives of the EIA study are to:

- Determine the baseline environmental conditions of the project area.
- Identify, predict and assess environmental impacts that might arise during the construction and operation of the proposed resort project and activities associated with it.
- Suggest environmental impact mitigation measures and appropriate technologies to suit local conditions, keeping in mind the proximity of coastal area, in order to eliminate or reduce the negative impact on the environment (if any), as part of the Environmental Management Plan.

- Enable the project proponent to comply with environmental rules and train operating personnel to operate pollution control facilities in order to protect the environment.

The scope of work for EIA includes:

- Assessment of the present status of air, water, noise, land, biological and socio-economic components of the environment.
- Identification and quantification of impacts due to the proposed project on environmental components (during the pre-construction, construction and operation phases).
- Assessment of the identified environmental impacts.
- Preparation of Environmental Management Plan (EMP) outlining additional control technologies to be adopted for mitigation of adverse impacts, if any.
- Delineation of post-project environmental quality monitoring to be pursued by the project proponent.

1.4 Methodology of EIA

The methodology adopted for the environmental impact study consists of the following stages:

- Identification of significant environmental components and assessment of their baseline (pre-project or existing) status within the study zone. This is carried out by site visits to study geographical/ topographical features followed by a study of environmental conditions (viz. air quality, water quality, noise levels etc.) at the site.

- Prediction of impacts on various identified and significant environmental parameters due to the proposed project. Data pertaining the proposed construction activities, design capacity of the individual units, water consumption, "solid waste/sewage" generation, characteristics of disposal medium are studied to identify those activities causing environmental impacts through an environmental impact matrix.

- Evaluation of most significant impacts and delineation of an Environmental Management Plan to mitigate adverse impacts (if any) on the quality of surrounding environment.

The detailed methodology for the environmental impact study is outlined below:

1.4.1 Baseline Environmental Studies

This study includes an understanding of environmental conditions within 10 km background/ study area around the site.

Details of various components covered therein are as under:

1.4.1.1 Land Environment

It includes study of preliminary information regarding topography of the study area, location aspects of site, land-use pattern (using Satellite imagery), sub-stratum characteristics (through resistivity surveys and studying the soil investigation reports), development pattern and landscape features within the study zone (through reconnaissance survey) and review of data obtained through various primary / secondary sources.

1.4.1.2 Air Environment

Preliminary information regarding the location of the proposed project and possible air pollution sources is gathered through reconnaissance survey as well as data obtained through primary and secondary sources. Major project related primary air pollutants were identified as Respirable Particulate Matter (RSPM or PM10), Particulate Matter less than 2.5 ug/cum (PM2.5), Sulfur Dioxide (SO2), Carbon Monoxide (CO), and Oxides of Nitrogen (NOx), mainly generated due to vehicular emissions and proposed construction activities. Assessment of the baseline status of these parameters in ambient air within the impact zone was undertaken during summer season of 2011. Baseline monitoring was also carried out in February 2017 as prescribed by the EAC for one month.

Data on micro-meteorological parameters such as wind speed, wind direction, temperature and relative humidity was obtained from secondary sources.

1.4.1.3 Noise Environment

Noise level measurements were undertaken at the proposed site and in neighborhood areas to identify existing baseline status.

1.4.1.4 Water Environment

Reconnaissance studies, for identification of available water resources (ground/ surface) were carried out in the study area. Analysis of water samples were undertaken during the summer season of 2011 and also additional sampling was undertaken in summer of 2013 for baseline pesticide assessment in ground water as per directives of SEAC/ Technical Appraisal Committee (TAC) of Goa State Pollution Control Board . The sampling was an assessment for potability and possibility of use for various purposes, such as supplementing water requirement through reuse of treated water and harvesting of rain water as also to establish baseline characteristics. Further to that, baseline monitoring was carried out in February 2017 as prescribed by the EAC for one month.

1.4.1.5 Biological Environment

Assessment of the baseline status of flora and fauna in the study area was carried out through various primary and secondary sources and through field surveys .

1.4.1.6 Socioeconomic Environment

Data on demographic pattern, population density, educational facilities, employment opportunities, health status, water & sanitation and transport facilities in the study zone was collected through secondary sources such as, census records and other information available from local Government offices.

1.4.2 Impact Assessment Matrix

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

Impact Matrix was prepared delineating activities v/s tangible impacts. Environmental Management Plan was prepared for the project to reduce negative impacts of the project.

1.4.3 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 proposed operation of the plants.

1.5 Regulatory Scoping & Its Compliance

The site is bound by Arabian sea to its west and thus part of it is covered under the Coastal Regulation Zone (CRZ). An area of 51.9 acres (2,10,061 sqm.) lies within 200 m from the High Tide Line (HTL) in the landward direction and is a "No Development Zone (NDZ)" as per CRZ Rules. An area measuring 86 acres (3,48,079 sqm) is located between 200 m to 500 m from the HTL. The remaining area of 99 acres (4,00,695 sqm) lies beyond 500 m from the HTL and hence does not fall under the CRZ category. Another NDZ area is formed along the Bank of Tiracol river (being influenced by tidal waters) between 0- 100m and admeasures 7.7 acres (31,165 sqm.).

According to the approved Coastal Zone Management Plan (CZMP) of Goa, Tiracol village falls under Coastal Regulation Zone-III (CRZ-III). As per CRZ 2011 Notification "construction of a Resort/ Hotel for tourists or visitors in between 200 to 500m of HTL" is a permissible activity as per Item 8 under "Norms for Regulation of Activities in CRZ-III zone" of CRZ 2011. As such the proponents are proposing to develop the villas and associated facilities forming part of the main hotel like entrance lobby, spa, restaurants etc within 200-500m of the HTL line, while the premium villas will be located beyond 500m.

Since the plot of the proposed resort covers an area 98.74 Ha, which is greater than 50 ha as mentioned in the *Schedule of List of Projects or Activities requiring Prior Environmental Clearance* of the EIA Notification of Sept., 2006, the project falls in the 8(b): "Townships and Area Development projects" category and requires a prior environmental clearance.

1.5.1 Sequence to Environmental Clearance granted by Goa SEIAA

The project has been granted an Enviornmental Clearance by the Goa State Environmental Impact Assessment Authority (SEIAA) vide letter dtd. 12th April 2013. Following were the stages of approval:

Table 1.2 Sequence to Environmental Clearance granted by Goa –SEIAA

S.NO	AGENCY	STEPS	DATE
1	**LHL & Aditya Environment Pvt Ltd.**	31 months study	15th May '10 to 14th December'12
2	**GCZMA**	Application submission	24th Jan 2013
		Proposal approved in 81st GCZMA Meeting and forwarded to SEIAA for recommendations	21st March 2013
3	**SEAC Committee meeting**	Presentation to SEAC	
		Minutes of SEAC posted on website	4th February 2013
		Site visit by SEAC members	11th February 2013
		Part response to SEAC query raised during SEAC presentation and site visit	8th March 2013
		Final response to SEAC, SEAC presentation and site visit SEAC Project/Site observations & Recommendation to SEIAA	14th March 2013
4	**SEIAA**	Proposal approved in 9th SEIAA meeting and Environmental Clearance granted	9th April 2013 10th April 2013
5	**SEIAA clearance**		12th April 2013

1.5.2 Status of Litigations

At present, there is no court case pending for violation of the Environmental laws against the proposed project. A local NGO – Goa Foundation, filed an application (no. 135/2015) dtd. 8th January 2015, in the Hon'ble National Green Tribunal (NGT) Bench, Pune, challenging the grant of the Environmental Clearance by the Goa SEIAA.

Twenty three months later, on 29th November 2016, the Hon'ble Tribunal has passed orders in the matter without any adverse observations with regard to the environmental studies submitted by the Project Proponent – Leading Hotels Ltd, on the basis of which the said EC was granted.

*Please refer to **Annexure I** for the complete Order from the Hon'ble National Green Tribunal (NGT), Pune Bench*.

The National Green Tribunal Bench, Pune in Application 135/2015 dated 29th November 2016 has pronounced:

- EC granted to Leading Hotels Ltd –Respondent No.5 - Project Proponent, be kept in abeyance for next four months.
- Goa - SEAC has been directed to appraise the Project by considering all the material on record within next four weeks and send its recommendations to Goa - SEIAA
- Goa - SEIAA shall further appraise the Project for a decision of grant of EC within four weeks from the date of receipt of recommendations of Goa- SEAC.

1.5.3 Procedure for Environmental Clearance following the NGT Order

The proponent has now applied for appraisal of the project by the Ministry of Environment, Forests and Climate Change (MoEFCC), following the orders of the NGT. Following is the sequence of events post the NGT Judgement:

Table 1.3 Steps for EC Approval

S.NO.	STEPS	SUB-STEPS	DATE
1	National Green Tribunal Bench, Pune	Judgment of pronounced for Application No 135/2015.	29th Nov '16
2		Receipt of Certified Copy of Judgment from Hon'ble Tribunal	30th Nov'16
3	Document Submission	Application to Goa SEAC to comply with Judgement of Hon'ble Tribunal	1st Dec'16
4	Scrutiny of Documents & Response To LHL	Scheduled Meeting of SEAC committee	1st Dec'16
5		The Project Proponent was informed by Member Secretary, Goa – SEAC. Accordingly they declined to consider the Project for further appraisal.	2nd Dec'16
6	End of Committee Term	Goa-SEAC and Goa-SEIAA term ends	8th Dec'16
7	MoEFCC Notification	In absence of a duly constituted State SEIAA or SEAC, a Category 'B' project shall be considered at the Central Level as a Category 'B' project, as per clause no- 4, sub clause iii of EIA Notification 2006 dated 14th Sept'06	
8	Ministry of Environment, Forests & Climate Change	With the expiry of the Term of SEIAA & SEAC on 8th Dec'16 and in keeping with the EIA notification 2006, Project Proponent applied for appraisal of the Environmental Clearance already granted by the State authorities on 12th Apr'13	6th Dec'16
9	Document Submission & Agenda	Online submission after expiry of Goa SEAC and Goa -SEIAA i.e 8th Dec'2016. Hard Copy submission of Application along with Forms.	9th Dec'16

S.NO.	STEPS	SUB-STEPS	DATE
10		Agenda received via email	16th Dec'16
11		Documents sent to Chairman and EAC Members	17th Dec'16

1.5.4 Terms of Reference for EIA Studies

The Standard Terms of Reference [TOR] for EIA / EMP report for projects / activities requiring environment clearance under EIA Notification, 2006 was published by MoEFCC vide order dated 10th April 2015. Compliance to various TOR items as per the Standard TOR is enclosed in the Table below.

Table 1.4 Compliance to Standard ToR prescribed by MoEF

S.No.	Term of Reference	Compliance/ Companies Reply
(i.)	Examine details of land use as per Master Plan and land use around 10km radius of the project site. Analysis should be made on latest satellite imagery for land use with raw images.	Please refer to Chapter 3: Baseline Env. Monitoring, Section 3.1.5: Landuse Pattern and Secion 3.1.5.1: LULC studies for Study Area (10km radial distance from site)
(ii.)	Submit details of environmentally sensitive places, land acquisition status, rehabilitation of communities/ villages and present status of such activities	Details of environmentally sensitive places are given under Section 3.1.4, table 3.2, same are indicated on study area marked on toposheet- attached as **Annexure XI**. Land acquisition status: The land for the proposed project is purchased by the project proponent. There is no human habitation on the said project land. Hence no rehabilitation is required.
(iii.)	Examine baseline environmental quality along with projected incremental load due to the project	Monitoring was carried out to understand the baseline environmental quality during the summer of 2011. Additional sampling was undertaken in summer of 2013 for baseline pesticide assessment in ground water as per directives of SEAC/ Technical Appraisal Committee (TAC) of Goa

S.No.	Term of Reference	Compliance/ Companies Reply
		State Pollution Control Board . Further to that, confirmatory environmental monitoring was carried out in January/February 2017 as prescribed by the EAC for one month. Based on the above studies, the baseline environmental quality is described in Ch 3: Baseline Environmental Monitoring. Projected incremental load due to the project is discussed in Ch 4: Anticipated Environmental Impacts & Mitigation Measures
(iv.)	Environmental data to be considered in relation to the project development would be (a) land, (b) groundwater, (c) surface water, (d) air, (e) biodiversity, (f) noise and vibrations, (g) socio economic and health	Please refer to Ch 3: Baseline Environmental Monitoring, separate sections for each environmental parameter are mentioned.
(v.)	Submit a copy of the contour plan with slopes, drainage pattern of the surrounding area.	Copy of the contour plan is given as fig. 3.12 and Digital Elevation Model depicting the topology and elevation of 2 km radius area surrounding the site is given in Fig. 3.13.
(vi.)	Submit the details of the trees to be felled for the project	Details of the trees to be felled is given in Section 4.3.5.1. NOCs for tree cutting attached as **Annexure XVIII.**
(vii.)	Submit the present land use and permission required for any conversion such as forest, agriculture etc.	Please refer to Section 3.1.5 for landuse details. Refer to **Annexure XII** for conversion Sanad.
(viii.)	Submit roles and responsibilities of the developer etc. for compliance of environmental regulations under the provisions of the EP Act.	Please refer to Section 10.2: Responsibilities for Environmental Managment

S.No.	Term of Reference	Compliance/ Companies Reply
(ix.)	Ground water classification as per the Central Ground Water Authority.	Please refer to **Annexure XV:** CGWB Year Book for 2013-14 for Goa for Ground water classification and **Annexure XIV:** Hydrogeological and Geo-Electrical Investigations of Tericol Area, Goa for detailed study for ground water classification carried out in Summer 2011
(x.)	Examine the details of source of water, water requirement, use of treated waste water and prepare a water balance chart.	Please refer to Section 2.10.1, 2.10.2 and 2.10.3
(xi.)	Rain water harvesting proposals should be made with due safeguards for ground water quality. Maximize recycling of water and utilization of rain water. Examine details.	Please refer to Section 2.10.3.2 and 2.10.4
(xii.)	Examine soil characteristics and depth of ground water table for rain water harvesting.	Please refer to Section 3.1.6 for details of geology and soil characteristics and section 2.10.3.2 for proposed rain water harvesting scheme which mentions the depth of ground water table.
(xiii.)	Examine details of solid waste generation treatment and its disposal.	Please refer to Section 2.11: Solid Waste Management
(xiv.)	Examine and submit details of use of solar energy and alternative source of energy to reduce the fossil energy consumption.	Please refer to Section 2.7.3 for details of use of solar energy and alternative source of energy.
(xv.)	DG sets are likely to be used during construction and operational phase of the project. Emissions from DG sets must be taken into consideration while estimating the impacts on air environment. Examine and submit details.	Please refer to Section 4.3.3 for Emission Modelling study
(xvi.)	Examine rail/ road connectivity to the project site and impact on the traffic due to the proposed project. Present and future traffic and transport facilities for the region should be analysed with measures for preventing traffic congestion and providing faster trouble free system to reach different destinations in	Please refer to Section Section 7.4: Traffic Management which gives the present and future traffic and transport facilities. Measures for

S.No.	Term of Reference	Compliance/ Companies Reply
	the city.	preventing traffic congestionare also mentioned.
(xvii.)	A detailed traffic and transportation study should be made for existing and projected passenger and cargo traffic	Please refer to Section 7.4: Traffic Management which gives the detailed traffic and transportation study
xviii.)	Examine details of transport of material for construction which should include source and availability	Please refer to table 4.3: Raw Material Requirements and Source
(xix.)	Examine separately the details for construction and operation phases both for Environmental Management Plan and Environmental Monitoring Plan with cost and parameters	Details for construction and operation phases for proposed EMP are given under Section 10.2.1 and 10.2.2 respectively. Environmental Monitoring Plan for construction and operation phases are given in table 6.1. EMP costing is given in table 10.4.
(xx.)	Submit details of a comprehensive Disaster Management Plan including emergency evacuation during natural and manmade disaster.	Please refer to Section 7.5**:** Disaster Management Plan. Also refer to the drawing: Disaster Mangement Plan given as **Annexure VII.**
(xxi.)	Any further clarification on carrying out the above studies including anticipated impacts due to the project and mitigative measure, project proponent can refer to the model TOR available on the Ministry's website "http//moef.nic.in/Manual/Townships".	--

Compliance to Project specific TOR granted in the 12th meeting of Expert Appraisal Committee (Infra-2), MoEFCC, dtd. 16th Jan., 2017, are enclosed in the **Table** below:

Table 1.5 Point wise Compliance to Additional TOR

S.N.	Term of Reference	Compliance/ Companies Reply
i.	Importance and benefits of the project.	Please refer to section 2.2: Need for the Project. Also, please refer to Chapter 8: Project Benefit.
ii.	Present landuse of the proposed project site.	Please refer to Section 3.1.5: Land Use Pattern
iii.	Copy of project sanction plan.	Please refer to **Annexure IV:** for sanctioned TCP Master Plan

S.N.	Term of Reference	Compliance/ Companies Reply
iv.	Details of project configurations and built up area.	For details of project configurations and built up area, please refer to Section 2.5.
v.	Layout plan indicating road, greenbelt, drainage, sewer line, STP, solid waste handling area, rain water harvesting structure, etc. in different colour to be furnished.	Please refer to **Annexure VIII**: Utility Master Plan
vi.	Layout of parking plan indicating entry and exit points of vehicular movement as well as traffic management plan. Highlight the fire tender pathway.	Please refer to **Annexure IX:** Traffic Master Plan
vii.	Details of source of water supply alongwith permission to be submitted.	Please refer to Section 2.10.2 for details of source of water supply and **Annexure X** for Applications for supply of water to Water Resources Department (WRD), Goa and Maharashtra Jeevan Pradhikaran (MJP), Maharashtra. WRD, Goa has in-princliple agreed to the same.
viii.	Quantification of various effluent streams such as sewage, restaurant effluent, Laundry effluent etc.	Please refer to Section 2.10.1.2 for quantification of various effluent streams
ix.	Treatment scheme for effluent and its recycling mode.	Please refer to Section 2.10.3.1 for Sewage/ Effluent Treatment with Recycle Facilities
x.	Water conservation plan for golf course.	Measures for conservation of water considering golf course are given under section 2.10.4.3: Landscaping Using Water Conservation Techniques
xi.	Action plan to prevent pollution from discharge of surface runoff into water bodies.	Please refer to Section 2.10.4: Storm Water Management & Distribution
xii.	Action plan to control soil erosion.	Please refer to Section 2.9.5.4: Erosion Control and Section 4.3.1.2 for mitigation measures to control erosion.
xiii.	Details energy conservation measures to be taken (all points mentioned in the proposal such as orientation to support reduced heat gain, use of ASHRAE 90.1, use of ECBC compliant envelope measures to be supported through drawings and details in the proposal.	Energy conservation measures are given under Section 2.7.4. Sections 7.3.1.4, 7.3.3, 7.3.5.5 and 7.3.5.6 give the various methods proposed for achieving Gold Rating as per LEED 2012.
xiv.	Details of DG sets. Prediction of ground level concentration due to emissions from DG sets.	Details of DG sets are given in Ch: 2 Project Description, Section 2.7.1.4 For prediction of ground level concentration due to emissions from DG sets, please refer to Section 4.3.3: Emission Modelling study.
xv.	Details of arrangement for meeting standby power from solar energy.	Please refer to Section 2.7.3: Use of Renewable Energy

S.N.	Term of Reference	Compliance/ Companies Reply
xvi.	Details of rain water harvesting system to be furnished. Clarity on recharge pits, storage systems for rain water and use of appropriate filtration system for collected rain water to be detailed.	Please refer to Section 2.10.3.2 and 2.10.4 for details of proposed rain water harvesting system
xvii.	Calculation on sizing of solar water heating systems to be furnished.	Please refer to **Annexure VI –** Calculation on sizing of solar water heating systems
xviii.	A management plan for excavation and dewatering to ensure compliance to the CGWA guidelines and regulation.	Please refer to Section 4.3.1.2: Mitigation measures during site preparation. No excavation is envisaged beyond 3-5m. Current water table is at about 10m and hence no dewatering is envisaged.
xix.	Solid waste management plan alongwith area earmarked for solid waste management scheme.	Details of the proposed scheme for solid waste management are given in Section 2.11. Area earmarked for solid waste management is shown in Utility Master Plan attached as **Annexure VIII**.
xx.	Management and disposal plan of used cooking oil from restaurant.	Please refer to Section 2.11.3
xxi.	Management of excavated soil. Pollution control measures to be taken to control fugitive emission during construction phase including marble /stone cutting.	Please refer to Section 4.4.1.3 management of excavated soil. Please refer to Section 4.4.2.1 for pollution control measures to be taken to control fugitive emission during construction phase.
xxii.	Layout plan indicating Greenbelt alongwith area earmarked to be provided.	Please refer to **Annexure V** Green Belt Master Plan which shows various types of green areas earmarked.
xiii.	Disaster Management plan including onsite and offsite plan.	Please refer to Section 7.5**:** Disaster Management Plan of Chapter 7: Additional Studies. Also please refer to the drawing: Disaster Mangement Plan given as **Annexure VII.**

2 PROJECT DESCRIPTION

2.1 Type of Project

The Company proposes to develop a Golf Resort with 185 luxury villas and associated facilities like health club, spa, restaurants, banquets halls etc in Tiracol. The proposed development also includes a Community School, a twenty five bed Emergency Health Centre a Community Centre, a Disaster Management Site (DMS) and a Garbage Management site (GMS). The Resort would be styled in traditional Goan architecture with contemporary expressions blending perfectly with the unique scenic environment of the Tiracol site.

The proposed Golf course resort facility is planned to be a USPGA accreditated 18 hole signature course which will be LEED Gold certified resort and managed by internationally acclaimed Operator Four Seasons known for its efficient management and staff and will thus meet the expectations of the high end golfers. M/s IMG World the agency involved in developing this Golf course is exploring ways and means of getting India on the USPGA tour map and the entire site planning is being done to make this possible.

2.2 Need for the Project

2.2.1 Tourism Industry in India

Tourism is one of the World's largest industry with a growth rate exceeding 5% per annum over the past 20 years. Several countries have transformed their economies by using the tourism potential to the fullest. Tourism has the advantages of creating large scale employment of diverse kind – from the most specialized to the unskilled and generation of massive productive employment opportunity is what India needs the most.

In India, Tourism is the largest service industry with a contribution of 6.23% to the national GDP and 8.78% of the total employment. In 2011, total Foreign Tourist Arrivals (FTA) in India were 6.18 million and Foreign Exchange Earnings stood at US$ 16.691 billion (Global rank-17) up 17.6% from previous year figure of US$ 14.193 billion (5.58 million FTAs in 2010). The majority of foreign tourists come from USA and UK. Kerala, Tamil Nadu, Delhi, Uttar Pradesh and Rajasthan are the top five states to receive inbound tourists. Domestic tourism in the same year was 740 million Andhra Pradesh, Uttar Pradesh, Tamil Nadu and Maharashtra received the big share of these visitors. According to World Travel and Tourism Council, India will be a tourism hot-spot from 2009 to 2018, having the highest 10-year growth potential. Tourism revenues are expected to surge by 42% from 2007 to 2017. India's rich history and its cultural and geographical diversity make its international tourism appeal large and diverse. It presents heritage and cultural tourism along with medical, business and adventure tourism. India has one of the largest and fastest growing medical tourism sectors

2.2.2 Tourism Industry in Goa

Goa is one of the most favorite tourist destinations in India. A former colony of Portugal, Goa is famous for its excellent beaches, Portuguese churches, Hindu temples and Wildlife sanctuaries. The Basilica of Bom Jesus, Mangueshi Temple, Dudhsagar Falls and Shantadurga are famous attractions in Goa. Recently a Wax Museum (Wax World) has also opened in Old Goa housing a number of wax personalities of Indian history, culture and heritage. The Goa Carnival is a world famous event, with colorful masks and floats, drums and reverberating music and dance performances.

With the rule of the Portuguese for over 450 years and the consequential influence of the Latin culture, Goa presents a somewhat different picture to the foreign visitor than any other part of the country.

Tourism is Goa's primary industry: it handles 12% of all foreign tourist arrivals in India. Last season Goa received about 5 Lakh foreign tourists (which included arrivals through charters and Free Independent Travelers (FIT)) and about 23 Lakh Domestic tourists. The state has been experiencing a growth rate of about 17 % of foreign tourists and 3.5 to 4% of domestic tourists. An encouraging trend has been the steady rise in free independent travelers in the past few years.

2.2.3 Sports Tourism - a Growing Phenomenon in the Tourism Industry

Sport Tourism refers to travel which involves either viewing or participating in a sporting event staying apart from their usual environment. Competitive sports events like Olympics, F1 races or the like attract huge amounts of visitors. Similarly, tourists visit sports halls of fame and venues in a vacation purely for nostalgia. Recreational sporting or leisure activity such as Hiking, Trekking and/or canoeing may also induce travel.

Sports tourism is a fast growing sector of the global travel industry and equates to $600 billion a year.

Sports induced tourism does exist in India – but is limited to the sporting events principally led by cricket which draws large crowds from World over. The Commonwealth games held in Delhi were a huge success and managed to draw large crowds of both foreign and domestic tourists.

2.2.4 Golf Tourism- World scenario

Golf is a hugely popular sport around the World. Despite the global recession Golf continues to grow. Over the last 20 years, the number of registered golfers in Europe has increased from 1.5 million to 4.3 million. There are over 32,000 golf courses to choose from worldwide and according to Mintel (Leisure Intelligence 2009), approximately 56 million golfers play on them. The IAGTO (International Association of Golf Tour Operators) estimate that worldwide golf tourism is worth in the region of £10 billion. Despite its popularity there is great growth potential, with only 1% of the world population playing golf at present. As against this, in the United States, according to the USPGA (Professional Golfers Association), 27 million, or roughly 10% of its population, plays golf. The growth of the professional golf tour (PGA tour) having more than 35 major golfing events has taken golf to all corners of the globe and there are now world-class

events from St Andrews (Scotland-the World's oldest Golf Course) to Shanghai. There is also an economic benefit from golf events which bring both players and spectators –to have other tourism experiences while they are there.

Many countries in the world have developed their golf tourism product & have attracted a loyal following of visitors. The top 10 golf hotspots around the world in 2008 are as listed below:

Table 2.1 Top Ten Golfing Destination in the World

1. Portugal	6. South Africa
2. Spain	7. Scotland
3. Turkey	8. Ireland
4. Dubai	9. North Africa
5. USA	10. Thailand, Malaysia & Indonesia

Source: *Scottish Golf Tourism Market Analysis – a report to Scottish Enterprises, by SQW Consulting (2009).*

2.2.5 Golf Tourism in Asia and South East Asia

As can be seen above many Asian countries like Thailand, Malaysia and Indonesia are amongst the top ten golfing destinations in the World. Many developing countries Asia are developing Golf courses to cash in on this new opportunity in hospitality sector. **Table 2.2** below examines the scenario in top golfing destinations in Asia.

Table 2.2 Leading Golfing Destination in Asia

Country	Land Area sq. km	Number of Golf Courses
Malaysia	329,847	More than 200
Singapore	710	22
Thailand	513,120	More than 200
Indonesia	1,904,569	More than 150
Vietnam	331,210	More than 25
India	3,287,263	More than 200

Source: ** Website of Top 100 Golf Courses of the World*

As can be seen, India has a very large land area, yet it is still in infancy as far as development of golf is concerned.

In india, the Indian Golfers Union (IGU) was formed in early 1950s for developing and promoting golf in India. The National Golfers Association of India (NGAI) was established in 2004 by IGU & supported by European PGA and is the first accreditated program for Professional Golfers in India. India also boasts of a Professional Golf Tour and has also specialist Travel companies offering Golf Tours in India.

Although the IGU web site states that there are more than 200 courses in India, a cursory study indicates that out of this, only 48 courses are Professionally designed and suitable for holding tournaments. Out of this, 16 are in Northern states, 17 in Southern states, 8 in the West and 7 in the East. *(See section 7.1 for more details).*

2.2.6 Relevance of the above findings in context of this Project

Goa has a culturally diverse history and a friendly local populace which can gel well with foreign visitors. It is a small state and has about 125 beaches spread out over its 60km long coastline. Friendliness of the locals, its unique history and a diverse cultural background, its unique architecture and the security atmosphere and the understanding and respect given to privacy of foreigners has led to Goa being a preferred destination for stay by the foreign tourists. The state now has a good connectivity with the near completion of the modern airport at Dabholim, Vasco (capable of handling upto 5 million passengers) and the proposed airports at Mopa in North Goa (17 km to the SE of the proposed project site) and is also located close to the Sindhudurg airport in South Maharashtra (30km to the NE of site). Goa also is connected by sea and rail.

The above studies highlight that Golfers want a modern well designed Golf course in a unique landscape and a Professional Management set-up to be able to give them information and all support back up at the click of a hand to attract them to their golfing destinations. It is strongly felt that Goa offers all ultramodern infrastructures and a modern Golf course developed on eco friendly principles will go a long way to boost tourism and attract the high end tourists into the state.

2.2.7 Government of India Policy for Promotion of Golf Tourism

To promote golf tourism in the country the Ministry of Tourism, Govt. of India has formulated separate guidelines under the Large Revenue Generation Scheme to achieve following objectives:

- Promote India as a Golf destination for domestic and international tourists.
- Earning of additional foreign exchange through development of this niche product and thereby contributing to economic growth
- Socio economic development through employment generation, both for men and women
- Encourage creation of additional world class golf infrastructure in the country.
- Government plans to set-up an India Golf Tourism Committee a nodal body for promoting India as preferred golf destination.

It is worthwhile to mention that the Ministry of Tourism had floated an Expression of Interest for development of a World Class Golf Course in Pernem Taluka in Goa and the site at Tiracol has been selected. It has approved the project under Large Revenue Generation Scheme (LRGS) and has granted the Company a Public Private Partnership (PPP) status on 27th April, 2011. A copy of the relevant communication from the Goa Tourism Department is enclosed as **Annexure III** to this report. *(Letter from Tourism Department regarding approval of Project under Large Revenue Generation Scheme).*

2.2.8 Summary and conclusions

From the above it is summarized as follows:

- Golf is a major source of tourism revenue in certain countries like Scotland where it contributes upto half of its tourism revenue (£2.2 billion out of £4.2 billion)
- Golfers seek destinations having good quality golfing experience (golf has to be central to the trip), location in a scenic environment & a region offering wonderful tourism / leisure experience and a resort having Professional management set up (overall experience has to be hassle free)
- For every £ spent on the golf course green fees an average golfers and golf tourists spends 4 £ for other experiences/amenities like stay, leisure, travel etc.
- Golf generates massive employment directly (due to tourism opportunity and as golf caddies etc) and indirectly (for organizing other infrastructure facilities). This involves a section of the society from the uneducated to the artisans, sportsmen, professionals from catering and travel and tourism and the like. Thus, the economy benefits by way of increased revenues and employment
- Golf has thus found favour among Asia in countries like Thailand, Malaysia, Indonesia, Vietnam etc which has seen sprouting of Golf courses
- There are only about 48 major Golf courses in India, western India has only 8 – only two being of the commercial use and pay type while others are private and for Members
- Goa offers unique advantage – having high literacy, good tourist attractions, (beaches and Mountains), unique cultural mix and good connectivity
- Government of India has brought out a Policy giving measures to boost Golf related tourism
- Golf is increasing in popularity in India with a Professional Golf Tour of India formed in 2006 resulting in the country having its own annual Golf circuit – this will result in increasing Golf popularity in India
- M/s IMG World the agency involved in developing this Golf course is exploring ways and means of getting India on the USPGA tour map and the entire site planning is being done to make this possible. If this happens, Goa will experience a tourism boost which will bolster state revenues and generate massive employment alongwith development of the Pernem Taluka which is today much backward even as far as tourism is concerned

2.3 Location Details

The proposed site is located at longitude 73°41'02.05" East and latitude 15°43'33.88" North. It is bordered by Maharashtra on the North. Along the coastline, the site is connected to Sindhudurg district and the Konkan region of Maharashtra to its North. On the South is the mouth of river Tiracol, as it opens into the Arabian Sea.

The site is mostly undeveloped, and vegetated with some barren outcrops. The undulating topography mainly slopes from North-West to South-East flattening into a plateau allowing direct views of the Arabian Sea. Higher view points along the eastern side reveal views along the mangroves and estuaries (in the Maharashtra side), as well as the fishing village along the river. The soil type in Tiracol is sandy loam, offering good moisture retention and percolation rates. The mixture of loamy soil and humus has resulted in diverse range of vegetation on site. Dominant species include Coconut and Cashew and a few endemic plant species such as Anjan and Kokam. The underlying geology of site is Basaltic rocks and is found scattered all over the site.

Image 2.1 Red cliff (Western Edge of the Plot)

Image 2.2 Tiracol Sea View (to the West of site)

Image 2.3 View of Maharashtra Mangroves (from South East Corner of Plot)

Image 2.4 View of Beach Palms (in Maharashtra from NW corner of plot)

2.3.1 Site Extent

The project zone and construction zone for the proposed development is highlighted in Table below :

Table 2.3 Project Zone and Construction Zones

Survey Numbers in Tiracol village forming part of Project Zone	Survey Numbers in Tiracol village on which proposed Construction is located
2 (1-4, 10-16, 19-20, 24-36,42)	-
3 (1-23), 4 (1-7)	3 (20), 4 (1-2)
5 (1-15), 6 (1-28), 7 (1-3)	5 (2-9), 6 (1-2, 5,8,10) 7 (1-3)
8 (1-24), 9 (1-17), 10(2)	8 (1-7, 12-13, 23), 9(1-9, 12, 15-17) 10 (1-3)
11 (1-7, 11-13), 12 (1-15), 13 (1-4)	11 (1-2, 4,6),12 (1-3, 6-8), 13 (7)

2.3.2 Site Selection

As the proposal is to set up an 18 hole USPGA standard Golf Course wrapping around a luxury Resort, the site selection has been done keeping in mind the requirements of a golf course. Typical physiographical site selection criteria for a Golf Course include study of the natural opportunities and/or constraints of the site such as: Topography, Soils, Water, Vegetation, Wildlife, Site drainage, etc.

During site visits, it was observed that the plot has an undulating rolling terrain having slopes that are mostly gentle, which favor golf course landscape development. The northern periphery of the site is at an elevation overlooking the entire site (and thus would offer beautiful views of the golf greens) and the entire coast. The Central plateau offers a panoramic oceanic view and is preferred location for club house and resort. The site was approved by IMG World who have endorsed the site as being ideal for a Golf Course location. ***Annexure II*** *exhibits letter from IMG*.

The site at Tiracol, Pernem Taluka, Goa, was found to be the most suitable and appropriate for the development of an international standard 18 Hole PGA Course due to the following reasons:

- Site was identified in Development Plan for Goa for Golf Course
- The site does not include restricted land types like agricultural land, protected wetland, riparian area or any sensitive site elements.
- The site is at present vacant, barren and unused land, therefore the proposed golf course could enhance the environment by providing needed green space and recreational opportunities. Also, it will help in generating employment for locals and better amenities to Tiracol village and will bring in foreign exchange for the country and contribute to increase in GDP.
- The site has a gentle undulating terrain, vegetation in patches and natural features appropriate for the development of a golf course.
- The natural terrain topography will prevent unreasonable cut and fill. Also, the slopes can be adequately engineered and stabilized to accommodate a golf course.
- The site offers an opportunity to restore the degraded coastal premonitory, where the proposed development could result in a healthier ecosystem and a more valued community amenity.
- The area is free from any rare, protected or endangered species habitat or other asset of special significance for native vegetation and wildlife (such as migration routes and breeding areas).
- The site is secluded and has no beachfront along its entire western coastline and as such the development will not obstruct any traditional access to public land, seashore, beach or any other common recreation resource.

While on the topic of site selection, it is worthwhile to mention that the Ministry of Tourism had floated an Expression of Interest for development of a World Class Golf Course in Pernem Taluka in Goa and the site at Tiracol has been selected. It has approved the project under Large Revenue Generation Scheme (LRGS) and has granted the Company a Public Private Partnership (PPP) status on 27thApril, 2011. *A copy of the relevant communication from the Goa Tourism Department is enclosed as* ***Annexure III*** *to this report*.

2.3.3 Site Analysis and suitability for Golf Course

The GIS analysis forms an important component of the design process providing information on Slope, Elevation, Drainage Micro Climate and Existing Vegetation. GIS analysis insures that design is based on a solid understanding of the site's physical features. Views are also important, and the overlay of the site plan onto GIS view shed mapping helps inform planting and landscape design to ensure prime views are not obstructed. The Tiracol Resort sits within a tropical monsoon climate; resulting in hot and humid weather throughout the year. Average annual rainfall is of 3500mm with the heaviest monsoon rain falling between June and August. In the summer months, temperatures can vary between 20°C in winter and 33°C in summer.

2.4 Size/ Magnitude of Operation

The site for the proposed Tiracol Resort comprises 244.6 acres land located in Tiracol, Goa at the confluence of the Tiracol River and the Arabian Sea and is a unique site of outstanding scenic beauty. The hotel and spa are arranged to maximize sea views and exclusivity, and take advantage of the site's natural features such as groves of existing woodland and dramatic rocky shorelines.

The **Master Plan** for the proposed development is evolved so that, the resort comprising **Standard villas & Guest rooms** are located as a cluster within 200-500m zone (from the High Tide Line) to the west of the plot (in the northern highland & headland plateau) to offer a stunning view of the sea.

The central hotel axis (spine) and spa serves as the resort anchor with golf, pools and detached hotel suites in close proximity. A formal entry piazza introduces visitors to this first class resort. Guests can enjoy dining throughout the day while seated on a generous outdoor terrace on the axis and flanked by sensory gardens that reference the historical **Spice Trade** that brought the Portuguese to Goa.

The main axis of the resort focuses on the resort's primary feature: the sea and three public pool experiences. Other amenities include tennis courts, a quiet pool, a family pool, golf, children's and young adult clubs, an intimate outdoor garden for functions, a spa with adjacent tranquil sensory gardens and winding walks through fragrant plantings of riotous color. Each of the detached hotel suite clusters gains its identity from the spice route in which it is nestled. This arrangement and mix of luxurious gardens and intimate neighborhoods will ensure that the Four Seasons Tiracol development becomes the first class luxury resort in Goa.

The Four Seasons Premium Resort villas are proposed to be located along the highland and the midland portion in the East-West direction (on either side of the main public road) in multiple rows all along the property – to give an exclusive view of the sea (towards the west), the Tiracol river and mangroves towards the East and the Golf course greenery all around. The golf course itself wraps around the resort and entire property.

Fig 2.1 presents an analysis of the site indicating views offered from various locations**.** **Fig 2.2** presents the Master Plan for the entire development, **Fig 2.3** presents the Main resort and its components **Fig 2.4** presents locations of the Four Seasons Premium Resort Villas.

The Tiracol resort will be set in a very diverse backdrop. The designers have made every effort to blend in with the artistic style and culture of Goa such that the visitors can experience traditional Goan style in a very modern and contemporarily designed facility. This is very evident from their concept of Traditional progressing to Contemporary styling.

Amongst the highlights of the Master Plan are:

- A gorgeous and impactful sense of arrival.
- An 18 hole USPGA standard Signature Championship Golf Course designed by Colin Montgomerie, one of the world's best-known golfers and the successful Captain of Europe's triumphant 2010 Ryder Cup team, along with IMG World.
- The course would be laid out as a wrap-around of the entire development and would add very lush and green views all across converting the entire project into a green zone.
- The Club House would be developed as a unique structure sitting as a focus to the golf routing in proximity to the lake which would be used as a rain water harvesting storage. The Club House will have a parking space for 100 golf carts and a dedicated maintenance building.
- A main street will be developed within the resort on the lines of a Portuguese village serving as the spine/axis having structures developed in the classic Goan architecture.
- A very large holistic health SPA and a Yoga centre offering a spectacular ocean view will be housed including an open air health farm on cliff edge.
- Extensive banquet and meeting facilities will support a range of specialty F & B dining and exotic bars offering memorable ocean and river views
- A cluster of standard resort villas will provide accommodation support to Corporate and Leisure guests. Resort villas will also derive their overall looks based on Goan architecture.

Figure 2.1 Views Offered from various Points in the Site

Figure 2.2 Master Plan

Figure 2.3 Main Resort and its Components

Figure 2.4 The Premium Resort Villas

The Resort Arrival Lounge will be decorated in traditional Goan style giving the visitors a warm welcome and at once setting up the festive mood. The arrival lounge will be impactful, visually soothing and will have a sense of arrival, splendid aura, especially for the foreign tourists who come from concrete jungles to make them immediately fall in love with the lush green & vibrantly colored setup.

Figure 2.5 Resort Arrival

Figure 2.6 Welcome Experience

The entire resort is designed in clusters for easy navigation from one point to another. The entire northern corner is dedicated to public area & the spa is seated right in the

middle of public area. The swimming pools are strategically located amid gardens & public spaces.

Along the spine of the resort, are placed various courtyards consisting of traditional shops, small flea markets, spa, pools, gardens etc. all slowly evolving into contemporary styled shops and boutiques. The spine will simulate a Goan/Portuguese village street.

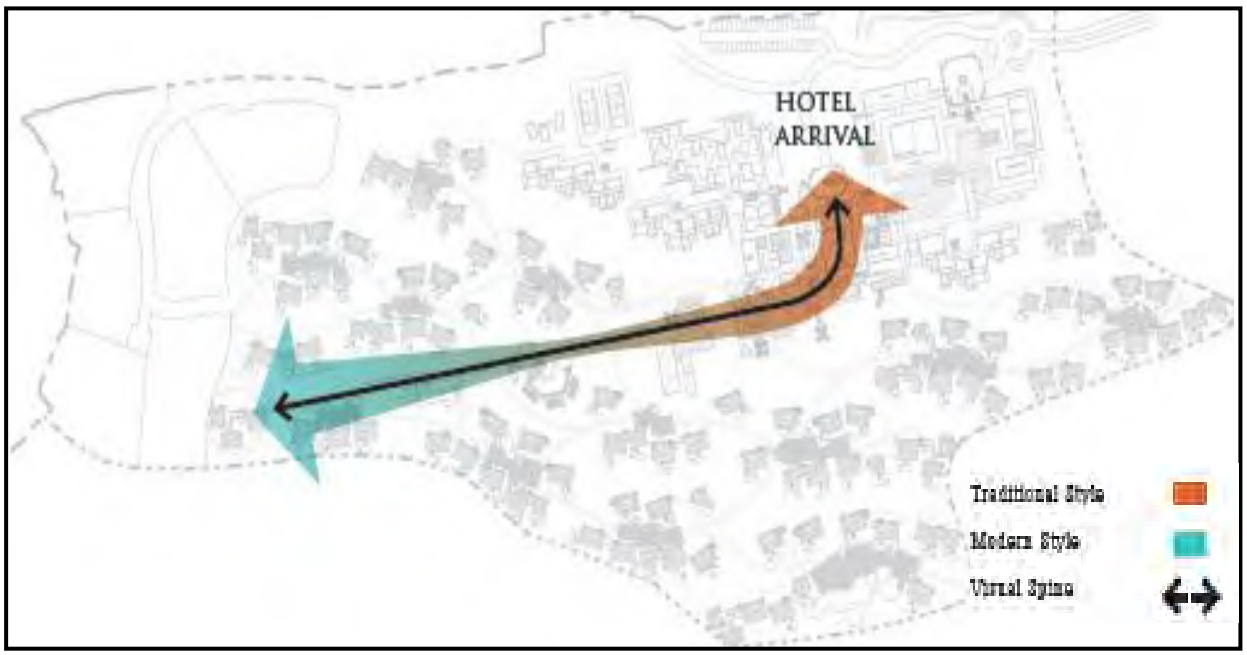


Figure 2.7 Spine Programmatic Approach: Traditional to Modern

FEATURES ALONG THE SPINE

The spine will serve as the resort anchor with golf, pools and detached hotel suites in close proximity. A formal entry piazza introduces visitors to this first class resort. Guests can enjoy dining throughout the day while seated on a generous outdoor terrace on the axis and flanked by sensory gardens that reference the historical Spice Trade that brought the Portuguese to Goa. The main axis of the resort focuses on the resort's primary feature: the sea and public pool experience.

Spa and Health Club : Amenities provided will include tennis courts, a quiet pool, a family pool, children's and young adult clubs, an intimate outdoor garden for functions, a spa with adjacent tranquil sensory gardens and winding walks through fragrant plantings of riotous color.

Figure 2.8 Spa

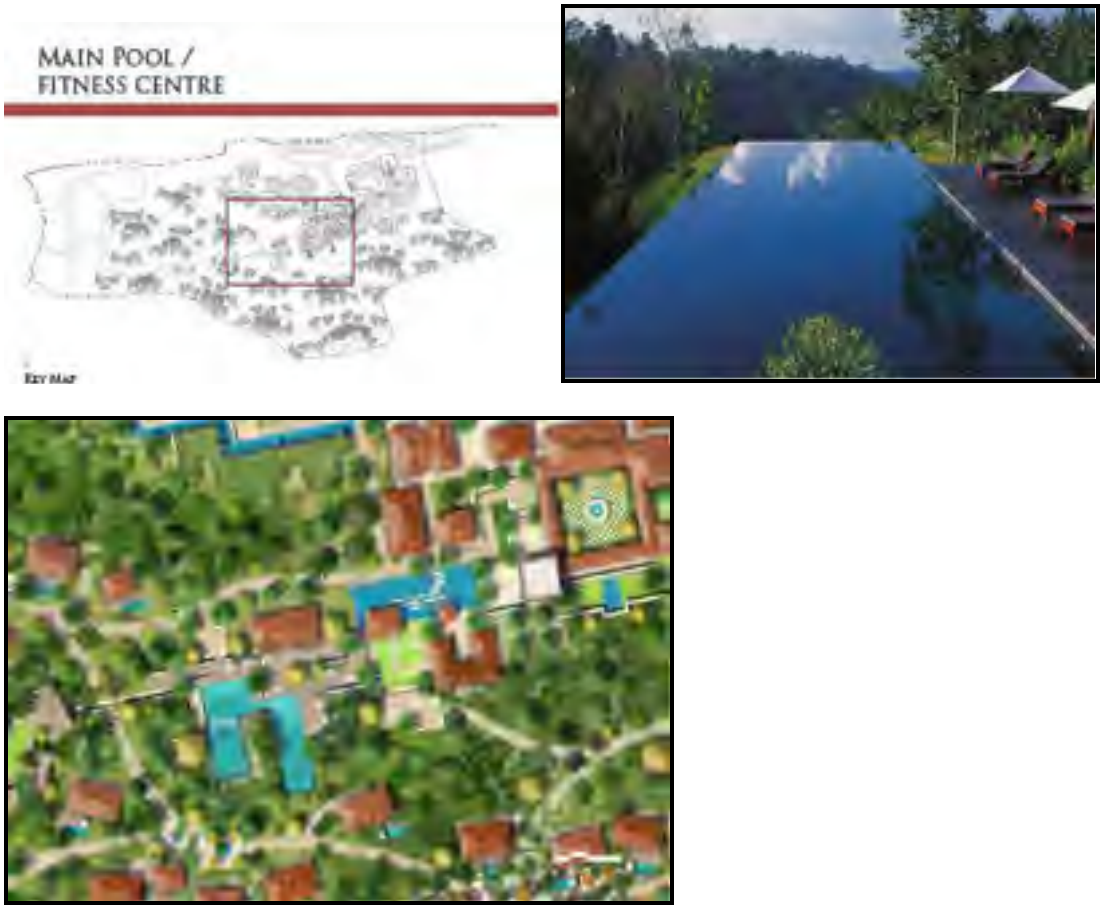


Figure 2.9 Main Pool & Fitness center

Each of the detached hotel suite clusters gains its identity from the spice route in which it is nestled. This arrangement and mix of luxurious gardens and intimate neighborhoods will ensure that the proposed Tiracol development becomes the premier luxury resort in Goa.

Figure 2.10 Guest Rooms

2.5 Project Components

2.5.1 Area Available for development

As has been mentioned part of the proposed plot is in CRZ- having Arabian sea to the west and the tidally influenced Tiracol river to the South. The description of the plot area as per CRZ norms is presented in **Table 2.4** below:

Table 2.4 Description of Area as per CRZ Norms

Sr. No.	Description	Area	
		(acre)	(sq.m)
1	Area within 200 m of HTL (NDZ)	51.9	2,10,061
2	Plot area between 200-500m of HTL	86	3,48,079
3	Area beyond 500 m of HTL (beyond CRZ)	99	4,00,695
4	Area within 100m of River Bank (NDZ)	7.7	31,165
	Total Area of the plot	244.60	9,90,000
	Permissible FSI Area	--	40,000
	Gross covered Area	--	58,416

2.5.2 Description of Areas to be developed

2.5.2.1 Resort Details

The total land area dedicated for construction of resort is around 4,27,408 sq.m or 105.6 acres. It will include:

- Lobby and Front desk
- Range of meeting and function spaces
- Food and Beverage Outlets (specialty restaurants-Cloud & Cliff)
- Fitness Centre & Spa
- Club House and Sports facilities for kids & adults with a separate Golf Club House
- Community Facilities
- Villa Cluster (Presidential & Premium Resort Villas)
- Swimming pool (main pool, and secret pool).

Swimming pools will be provided with pool side dining facilities, recreation facilities including tennis and other games, children's activity centre, landscaped gardens, lawns etc. Along with these, administration, housekeeping and laundry spaces , employee facilities and engineering service areas are proposed. Some of these facilities are described briefly below:

Villas

The golf resort will comprise of 125 standard resort villas and 60 premium resort villas.

Food and beverages outlets

Food and beverage outlets will be all-day restaurants consisting of a Beach Restaurant, Specialty Restaurants and a Sunset Beach Bar along with a lounge bar. Related support services will also be included. These facilities will support business and social dining and provide entertainment and weekend dining experiences.

Banquet and Meeting Facilities

These facilities include meeting rooms, one Board Room, etc. along with reception, sales office, kitchen, etc. The wide range of meeting and function facilities will be suited to a variety of functions such as, weddings/conferences, etc., to small meetings, seminars, training programs and team building exercises.

Fitness Centre and Spa

Fitness Centre will consist of Spa facility (separate for gents and ladies), Beauty and Barber Saloon, Gymnasium with Cardiovascular Room, Aerobics/Exercise Room, Clinic/Testing Rooms, etc.

Recreation Centre

Centres for kids and young adults along with a Dive Centre, Water Sports Centre, Tennis Pavilion and Pool Facilities.

Club House

Club House Lounge and Bar, storage facility for Golf Equipment/Golf Carts/Other Storages along with administrative and engineering services to be provided.

Community Facilities

A Disaster Management Site (DMS) space, a Garbage Management Site (GMS), Health Centre and a Community Hall have been allocated in the master plan for the resort guests and local populace/ villagers.

Back of House & Maintenance Facilities

To include facilities like chiller house, cooling tower, boiler house, DG sets, Central Golf Cart maintenance facilities.

*Please refer to **Annexure IV** for Sanctioned Plan*.

Area statement for proposed development is enclosed:

Table 2.5 Proposed Area Statement

S. no.	Description	Area (sq m)
1	Main Resort & Associated facilities:	
a	Resort villas-125 nos.	9,300
b	Lobby and Public spaces	727
c	Food and beverages areas	1,520
d	Banquet and meeting facilities	2,751

S. no.	Description	Area (sq m)
e	Administrative offices and ancillary area	466
f	Spa and fitness center	1,590
g	Sports and children activities	1,760
h	Food & beverages related services	1,226
i	Truck dock area	371
j	Housekeeping and laundry	870
k	Human resource and security	182
l	Employee facilities	1,266
m	Repairs & maintenance	904
2.	Premium resort villas (60 nos)	24,190
3.	Back of house (BOH)	
	General circulation	1,000
	Common BOH (Back of house)	1,993
4.	Community facilities	8,300
	Total Gross Floor Area	**58,416**

2.6 Architectural Features

2.6.1 Historical Context & Local Character

The recorded history of Goa stretches as far back as the 3rd Century BC, when it was a part of the Mauryan Empire. Ruled by several large dynasty by the 15th Century it was the largest trading centre of India. In 1948, the Portuguese arrived as Merchants with the intention of setting up a colony and therefore gaining control of the spice trade from other European powers. Today, the architecture of Goa is a combination of Indian, Islamic and Portuguese styles. The modern temple architecture is an amalgam of original Goan temple styles with Dravidian, Hemadpanthi, Islamic, and Portuguese architecture. This variety of styles creates a richness and individuality that makes the area truly unique. The proposed resort development will draw heavily from the architectural context to develop a highly original design that dynamically synthesis local sensibilities with global aspirations.

2.6.2 Unique Architectural Elements used in Developing the Resort

Following are the key observations which indicate the unique architectural elements in the Goan homes:

- Symmetry and order are two of the most important architectural elements of a Goan house. Most houses have a prominent entrance door through which one can directly enter the rest of the house, which usually revolves around a courtyard.

- Elongated open plans and large rooms allow for the easy passage of air. In large houses every room receives cross ventilation as the inner walls of the room open into courtyards giving a feeling of living in a perforated building.
- Goan houses generally have a symmetrical façade.
- Verandas and plinths (normally supported by pillars or side walls) create a distinct character, are protected spaces where families can rest, chat or perform chores.
- The entrance door occupies the place of honor in the facade, usually with larger proportions than the rest of the doors within the house.
- Courtyards are the nucleus of the house, sacred spaces linking air with fire and water, they help defining public and private territories.
- The roof forms are dictated by the need to provide shelter from both the sun and rain, usually made of wood with trusses and with distinct decorative expressions, containing false wood ceilings and clad in thatch or Mangalore tiles.
- Floors are often clad with elaborate patterns made with tiles imported from Europe, they have been both, workplaces and statements.
- Windows act as decorative elements, enhance the value of the exterior and interior, typically timber framed and pivoting, can be in filled with 'carepas', a highly distinctive and unique local feature.
- Dramatic and startling colour plays an important role in Goan architecture, with a colour wash, the house looks 'dressed' and therefore displays the economic well-being of the family that lives in it.

Please refer to **Image 2.5** below. The proposed resort structures will draw heavily from these architectural features.

2.6.1 Material Pallette

The choice of building and finishing materials contributes to the comfort as well as the aesthetics of the villas. In support of a green and ecological agenda, wherever practicable, materials shall be sourced locally (**Image 2.6**).

2.6.1 Landscape Design based on Spice Route Concept

The Tiracol Resort will be unique in its landscape designs based on Spice Trade of India. Goa was a key port when the Portuguese explorer Vasco de Gama navigated a maritime route around the Cape of Good Hope to India and South East Asia. The spice trade continues to be important with India currently producing 86% of the world's spices. Spice plantations still feature as a key tourist attraction for visitors to Goa.

Four Seasons Resort, Tiracol, have drawn on this story to design a unique landscape. Through the selection of different planting and materials, these spices will be represented vide rich colours, textures and fragrances. Common areas will be planted in the tradition of the spice plantation. Each of the four east west routes are identified by a key spice, Star Anise, Clove, Nutmeg or Cinnamon. The identity of the cluster of suites and the corresponding courtyard is taken from qualities of appointed spice. In this way the resort speaks to the history of the place, India's continued importance in the

seasoning of the world while highlighting the beauty of the natural Goan landscape. In addition to providing a unique identity for suites this conceptual framework aids in way finding and ensures that the hotel offers a rich, varied and exciting landscape.

Image 2.5 Architectural Elements used in Developing the Resort

Image 2.6 Material Palette for Resort

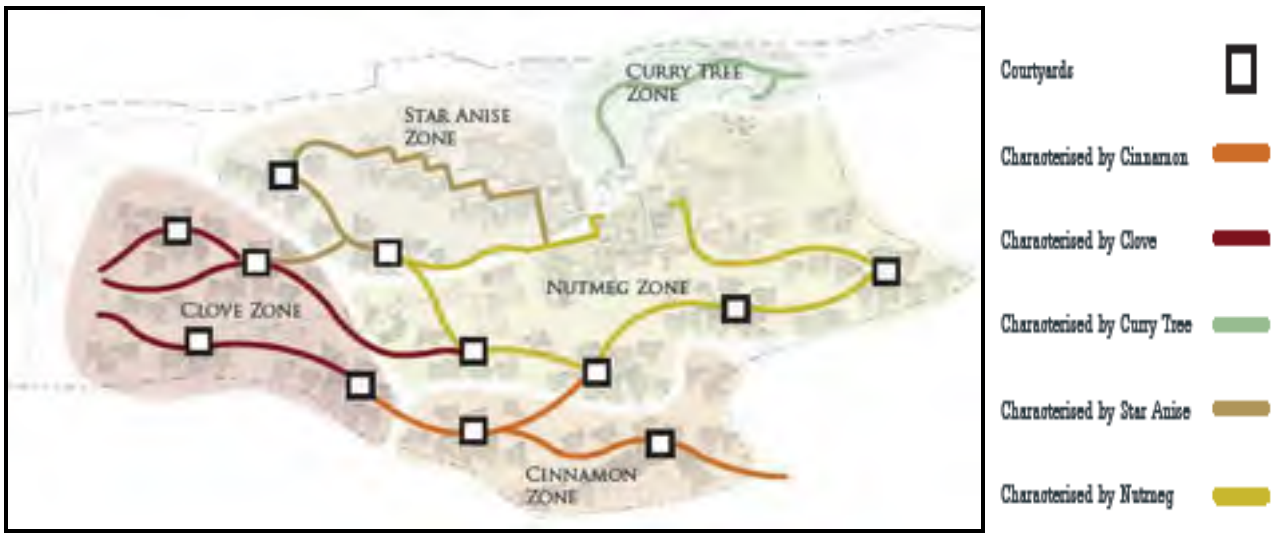


Figure 2.11 Spice Route

2.6.2 Courtyards

Every spice will be represented in courtyards. The courtyards will be styled in 3 different types -a water courtyard, sculpture courtyard botanic courtyard in each spice cluster.

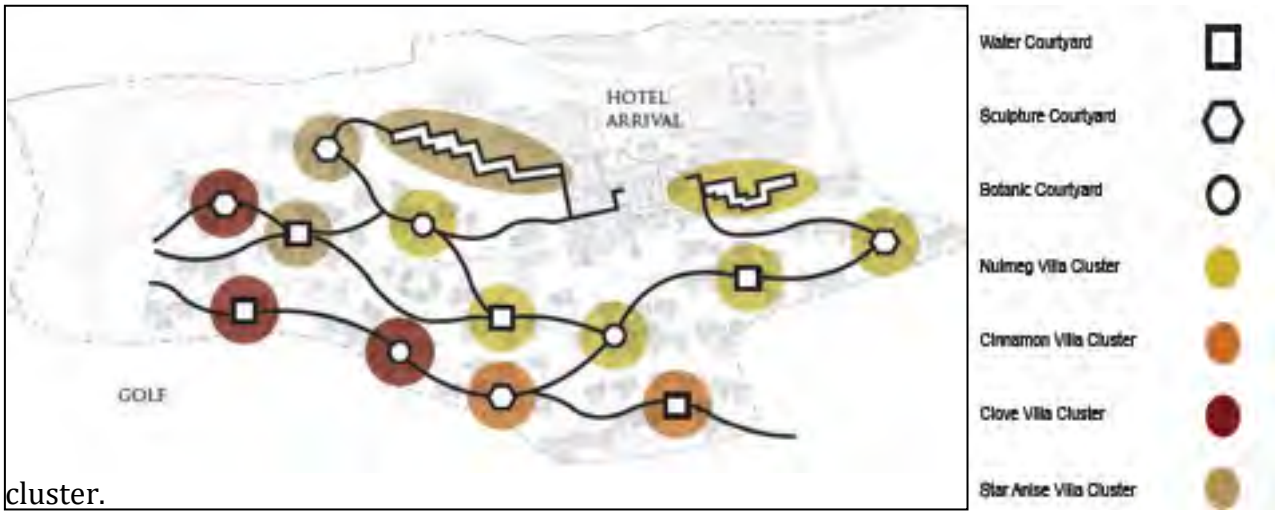


Figure 2.12 Courtyards

Figure 2.13 Typical Features:Sculpture Courtyard

Figure 2.14 Typical Features : Water Courtyard

Figure 2.15 Spice in Landscape

*Please refer to **Annexure V** for proposed Green Belt Master Plan which shows the types of green areas earmarked.*

2.7 Concept Design for Mechanical & Electrical (M&E) Services

The M&E services are divided into the following sections:

1. Electrical Systems
2. Air Conditioning and Mechanical Ventilation Systems
3. Fire Fighting and Alarm Systems
4. Food and Beverage & Laundry Systems
5. Plumbing and Sanitary Systems

The public areas of the resort are divided into Main Level and Basement Level. The basement level will consist the Back-of-House (BOH) where laundry, boilers, chillers, Transformers and MEP will be situated to cater to the Main resort and associated facilities. Central BOH will comprise of common STP, ETP and Golf Course Maintenance facilities. Basic electrical and mechanical services will be used for preliminary space planning during the master planning stage to design codes and design assumptions. A detailed design for all specifications will be carried out in design and documentation stages.

2.7.1 Electrical Systems

2.7.1.1 Resort

The maximum power demand for Resort is 6300 kVA including allocating 10% additional for future expansion and a diversity factor of 0.8. It will take electricity supply at high voltage 33 kV via the local grid's substation to the Consumer's HV (High voltage) switch room. Two nos. of 2500kVA transformers will step down the power supply in event of power failure.

2.7.1.2 Premium Resort Villa

Each Villa will take LV (Low voltage) power supply directly from the 33KV grid supplied. The total power demand for Premium Villas will be 1700 kVA.

2.7.1.3 Community Facilities

Community Facilities will take LV power supply from the authority. The total demand for community facilities shall be 250 kVA.

2.7.1.4 Emergency Power Supply

The resort shall provide for full 100% load, without the local grid power supply to tackle emergency supply shut downs.

* The Resort will have 2 sets of generating plants, each plant comprising of three (3) nos. 750 KVA generators (total 6 nos.) All generators are designed to run as continuous set. The generator sets would provide sufficient capacity for maximum demand load with 2 sets as standby.
* The Premium resort villas will have its own standby generator set within their compound. The space allocated for the generator set would be sufficient for 100% back-up load.

2.7.1.5 Fuel Supply

Four (4) underground diesel tanks of 15 kilo liters each will be provided.

Table 2.6 Power Requirement Break Up

Particulars	Power Requirement (kVA)
Village (Around 65 Families)	100
Community (School, DMS , Hospital)	250
Resort:	
1. Standard Resort Villas	715
2. Premium Resort Villas	1700
3. Public Spaces + F&B	930
4. Banquets & Meeting Spaces	136
5. Back Of House	616

Particulars	Power Requirement (kVA)
6. Golf	70
Total	**4517**

2.7.1.6 Sourcing of Power Supply

Power supply will be drawn from Goa Electricity Department but sourced from Maharashtra side from Malewad substation which is around 9 km from the site. Alternately, in case of power failure, power will be drawn from Maharashtra Grid. Sub stations will be provided at various points to distribute power.

2.7.2 Air conditioning and Mechanical Ventilation System

Air conditioning and ventilation system design shall comply with Four Seasons Standards, ASHRAE Fundamentals and ASHRAE Standard 62.1 – 2007 (IAQ), British Standards (BS) and Local Authorities Codes and Standards whichever is more stringent. The appliances used will have Energy Efficiency Rating such as **Energy Star** and other Approved Energy Labelling Schemes. Environment friendly Non-CFC refrigerants will be implemented. Single zone building such as villas, suites, residential villas and small ancillary buildings are proposed to be designed using invertor air-cooled split system or air-cooled variable refrigerant system of high efficiency with accredited energy labeling from approved institutions. Individual proprietary heat recovery system is proposed to recover heat from the air-conditioning system for heating of the hot water for the bath room.

The main lobby building which comprises of the main hotel back of the house and front of the house services supports, retails, main lobby, all day dining, convention facilities and a block of standard rooms closely linked to the main lobby building, is proposed to be designed with central water cooled chilled water system. Preliminary estimate of the water cooled central chilled water system is between 250 and 300 refrigeration ton. System will be designed with energy and water conservation in mind; such devices as variable speed drive for pumps, motors, drift eliminators for cooling towers and chemical-less water treatment system will be implemented. In addition, condensing water heat is proposed to be recovered by passing it through the heat pumps to be designed for the central hot water system at the main lobby building.

Condensate from cooling equipment will be connected to the waste water system for ease of recycling. For maintaining indoor air quality, fresh air to the conditioned space will be filtered

Ventilation system

To mitigate air pollutants from kitchen exhausts commercial grade grease filters and approved air cleaner / Activated carbon filter system will be installed to treat all kitchen exhausts before discharging to the atmosphere.

All non- air-conditioned rooms/plant rooms unless provided with natural cross ventilation openings will be provided with mechanical ventilation system.

Figure 2.16 Typical HVAC systems considered (a) Individual VRV in 7 clusters (b) Location of Chillers /Cooling Towers

2.7.3 Use of Renewable Energy

Alternate and renewable sources of power generation such as Solar Power for the resort amenities are being explored. Such sustainable practices will reduce the overall energy footprint of the resort, reduce reliability on grid connected power, create clean power and appeal to the environmentally conscious customers. It will also help the project comply with World renowned environment rating systems such as USGBC, LEED, GRIHA etc. and attain a gold rating.

Use of renewable energy is proposed by following means:

- **Solar Water Heaters** with automatic back up electrical connection during cloudy and /or rainy spells, for each villa
- **Solar Led Lantern** in each room instead of conventional chargeable lights
- **Solar Photovoltaic Power Plant** (50kW) to provide power for 6 x1800W pumps for irrigation, 600 LED (14W) street/garden lights, One junction traffic light, Three LED display boards
- **Biogas Plant (100 cum)** based on kitchen /garden waste

The external load for landscape lighting is around 430 KVA and the management are currently examining it as an alternate energy source and will implement if found feasible.

Calculation for hot water requirements from solar energy (*attached as* ***Annexure VI***) show that about 20% hot water requirement can be provided from solar and the approximate total roof area required is around 1100 sqm.

Standby power from solar: Solar PV system shall be provided for external street lighting and emergency lighting.

Table 2.7 Proposed Solar Power

Items	Watt
Driveway	900
Courtyards	18,000
Semipaved area	2,500
Pool and Decks	6,750
Buggy Parks	2,800
Gardens and Golf Course	400,000
Solar lanterns	50,000
Solar water heater	250,000
Total	**730,950**
Total KVA	**730**

2.7.4 Energy Conservation measures

Design and Envelope

- Roof, Wall, and Windows to meet ECBC Specifications
- Orientation Optimized for shading and natural wind-flow
- Shading of all exposed windows to reduce solar gains

Lighting and Controls

- Buildings to maximize day-lighting so as to reduce requirement of artificial lighting
- Lighting Power Density to meet ECBC
- Energy efficient fluorescent tube lights & CFL lamps
- Occupancy sensors & day-light sensors.

HVAC and Controls

- Variable Speed and High-COP systems to meet or exceed ECBC standards
- Natural Ventilation potential for all habitable spaces
- Exhaust-air heat recovery and air-side economizers proposed for all AHUs
- Integrated BMS to ensure thermal comfort and reduce energy use

Electrical

- Copper Bus bars in all distribution panels
- All cables will be de-rated to avoid heating during use, Copper conductor cables will be specified for sizes of 16 mm and below

- Variable frequency drives will be incorporated on motor feeders
- Power factor of the electrical system will be maintained close to unity
- An APFC is proposed to effect the power factor correction within a few cycles of deviation from the setting & also to reduce inrush currents
- The appliances used will have energy efficiency rating such as energy star and other approved energy labeling.

Table 2.8 Saving achieved through Energy Conservation Measures

Proposed Design		**% savings over conventional design**
Wall	8 inch AAC block with plaster: U value 0.64 ($W/m^{2o}K$)	1.12%
Roof	2 inch extruded polystyrene Insulation with 6-inch concrete, U value 0.55 ($W/m^{2o}K$)	3.67%
Fenestration	Double Glazed Unit U-value < 1.8 ($W/m^{2o}K$) Effective SHGC < 0.25 VLT > 40%	3.50%
Shading Devices	On all exposed windows **to reduce solar gains**	1.65%
Interior Lighting Power Density(W/m^2)	20% lower than ECBC standards	6.87%
Day lighting/Occupancy Sensors/controls	Daylit zones, corridors, mechanical/electrical rooms	0.97%
Primary HVAC system type	**Variable Speed** and High-COP systems	2.65%
Heat Recovery/Economizer	**Exhaust-air heat recovery** and air-side economizers proposed for all AHUs	5.67%

2.7.5 Fire Fighting & Alarm System

The Fire Fighting and Alarm System will comply with the Four Seasons design parameters, BS, Local Authorities Codes and Standards such as National Building Codes.

The various kinds of equipments required are:

- Automatic pumped hydrants (double pillars with hose and rack)
- Hose reel (25mm hoses/drums) and
- Sprinklers (Ordinary Hazard Group III for main building and OH I for villas) with appropriately sized pumps for 4 hours capacity
- Booster system,
- Control valves and storage tanks.
- Fire water Storage tank will have minimum effective capacity of 256 cum.

In addition to the fire-fighting system, an automatic fire alarm system comprising of detectors (smoke and heat), call points and alarm bells is proposed to be provided for the project. Computer and IT rooms shall be protected by approved FM 200 or other equivalent suppression system, Kitchen hood by approved automatic wet fire suppression system.

Fire water hydrants shall be provided on the entire resort premises. Provision of hand portable fire extinguishers shall be made. Roads for fire tender movement shall be of minimum 6m width with 12m turning radius. Assembly points are located at strategic locations.

*(Please refer drawing provided at **Annexure VII:** Disaster Management Plan)*

2.7.6 Food & Beverages and Laundry Services

The total gas supply for kitchens is estimated at 1,240,000 kCal/hr. F&B outlets will include bakery, All Day Dining, Speciality Restaurant Kitchen 1&2, Lounge Pantry, Banquet, Meeting Room Pantry etc. Total hot and cold water estimates for the kitchen is 29.7 cmd and 19.8 cmd respectively.

Estimated steam consumption for laundry is 1818 kg/hr and will be met by a boiler of 2 TPH capacity. The boiler will be operational 7 days a week for 10 hours a day. Washing capacity will be 159 kg/hr.

Table 2.9 Utility Requirements F & B and Laundry Services

Type of Outlets	Electricity				Gas Supply	Steam Consumption	Kitchen Hood / Canopy	Total Water Consumption		
	Normal		Emergency				Exhaust Air	Cold Water	Hot Water	Waste Water
	10	20	10	30						
	(kW)	(kW)	(kW)	(kW)	(KCAL / H)	(Kg/H)	(M^3/H)	(L/min)	(L/min)	(L/min)
LAUNDRY FACILITIES :										
Laundry & Valet	20	70	0	0	0	1,818	12,000	4,554	40,986	45,540
FOOD SERVICE FACILITIES :										
Bakery & Pastry	10	100	10	20	20,000	-	7,000			
Flower Prep.	1	3		3	-	-	0			
Commissary	20	30	10	30	-	-	0			
Room Service	10	15	10	0	-	-	0			
F&B storage, Cold Rooms, Ice etc.	10	30	-	30	-	-	0			
Receiving & Waste Handling	10	10	-	5	-	-	2,000			
Staff Kitchen & Servery	20	40	10	5	160,000	-	20,000	Inclusive in total below		
All Day Dining Kitchen	30	150	10	10	360,000	-	40,000			
Speciality Restaurant kitchen 1	30	80	20	5	120,000	-	25,000			
Speciality Restaurant kitchen 2	30	80	20	5	120,000	-	25,000			
Lobby Lounge Pantry	20	10	10	-	-	-	-			
Bar & Lounge Pantry	20	10	10	-	-	-	-			
Banquet & Production Kitchen	30	160	10	20	460,000	-	60,000			
Meeting Room Pantry	10	20	5	-	-	-	-			
TOTAL WATER ESTIMATE FOR KITCHENS								19800	29700	19500
Total Estimate	271	808	125	133	1,240,000	1,818	191,000	24,354	70,686	95,040

Notes / Assumptions:

LAUNDRY OPERATIONAL HOURS: 7 DAYS A WEEK 10 HOURS A DAY

1. LAUNDRY - WASHING CAPACITY = 350LBS / HR; DRYING = 60% WASHING CAPACITY
2. Average load per room is 25lbs / room
3. The estimated MEP requirements are subject to actual selection of equipment.
4. The MEP loads estimate for all the foodservice facilities will be revised once all the plan of the areas are confirmed.

2.7.7 Plumbing & Sanitary Systems

2.7.7.1 Potable Water

Potable water shall be supplied from the water treatment plant located at central BOH. The system will be designed with energy and water conservation in mind; such devices as variable speed drive for pumps, pneumatic tanks and flow limiting devices will be installed at all plumbing fixtures.

Equipment for direct water consumption such as ice making machines, coffee machines, drinking fountains/dispensers shall be complete with filter and in-line UV treatment devices. Hot water requirement for the resort & villas will be sourced from Solar Water Heater and Individual Heat Recovery Cylinder connected to the proprietary heat recovery air conditioning system. Hot water shall be stored at 65°C and water temperature set for reheat at not lower than 50°C to minimize risk of legionella bacteria. Similarly, hot water in the pipe will be recirculated for re-heat when water temperature drops to 50°C.

2.7.7.2 Internal Sanitary System

Two-pipe soil waste and waste water piping system is proposed for the project. Soil waste and waste water shall be discharged to respective inspection chambers located within 1.5m from the building for final connection to the sewerage network taking it to the STP/Grey Water Treatment Plant. Kitchen wastes shall be connected to screen chambers and proprietary grease traps prior to connection to sewer network. Laundry discharge shall be connected to dilution tank prior to discharge to the Grey water treatment system.

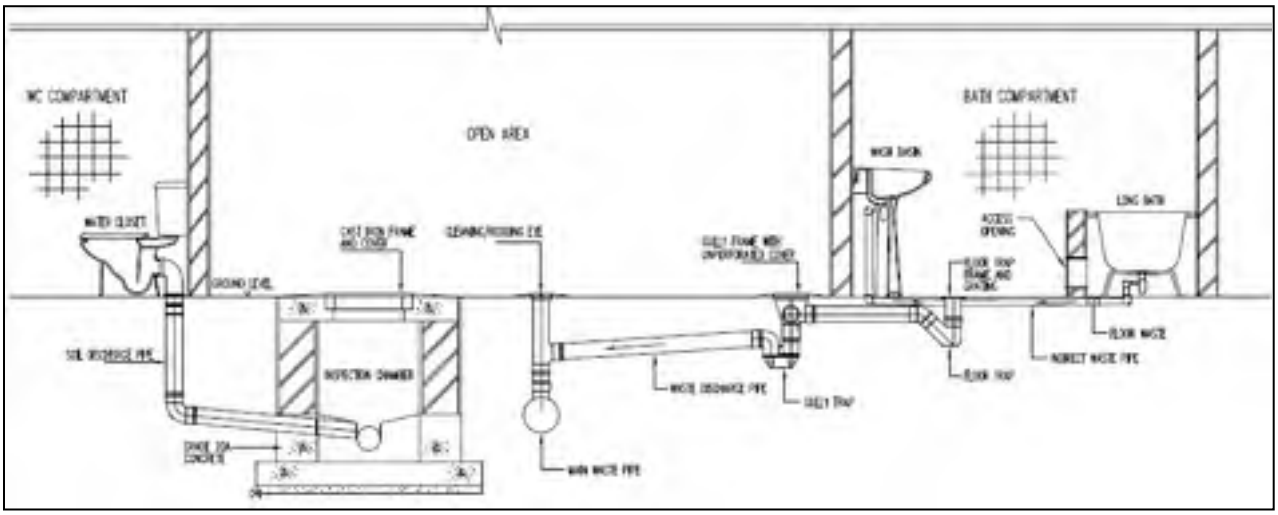


Figure 2.17 Plumbing & Sanitary Installations

*Please refer **Annexure VIII** for Utility Master Plan indicating utlities like road, greenbelt, drainage, sewer line, STP, solid waste handling area, rain water harvesting structure, etc.*

2.8 Planning for Road Network and Parking

2.8.1 Proposed Road Network

There is an expected quantum jump in traffic particularly during Golf Tournaments when the resort is expected to be at maximum occupancy. The present public road needs to be made a minimum of 10 to 15 meters wide to avoid occurrence of any traffic jams which is also in accordance with the proposed RP 2021. Internal roads leading to Resort also need to be made of similar width to avoid traffic jams on the Public Roads. Figure below presents the Circulation Diagram for access to various Resort areas. Since the site is developed on either side of the public road main access to site will be provided via a central round about providing access to villas and resort properties on either side of public road. Within the resort, outside vehicles will be provided access in certain limited areas on the fringe of the development. Electric powered Golf carts /buggies will be provided for internal movement within the resort and golfing areas to provide nonpolluting access in keeping with the green nature of the development.

Figure 2.18 Circulation Diagram for Access to Various Resort Areas

The speed limit for the Vehicles on Public roads would be 30km/hr to avoid accidents. Within the resort, the maximum speed would be 15km/hr. Some speed breakers would be provided as needed. Mirrors at blind spots and other signages used by the Traffic Department would be provided.

The present Road which leads from the Maharashtra to GOA (Tiracol) towards the Ferry Point or the bridge is as per the MORTH Standard. The internal Roads within the resort would also be as per the MORTH Standard. All Pavements should be designed to have

storm water drainages at either sides or underground cabling or pipes of power and water. Pavements thickness would depend on the material and utility of the Road. Pavements would be of Cement / Tar / Precast cement blocks.

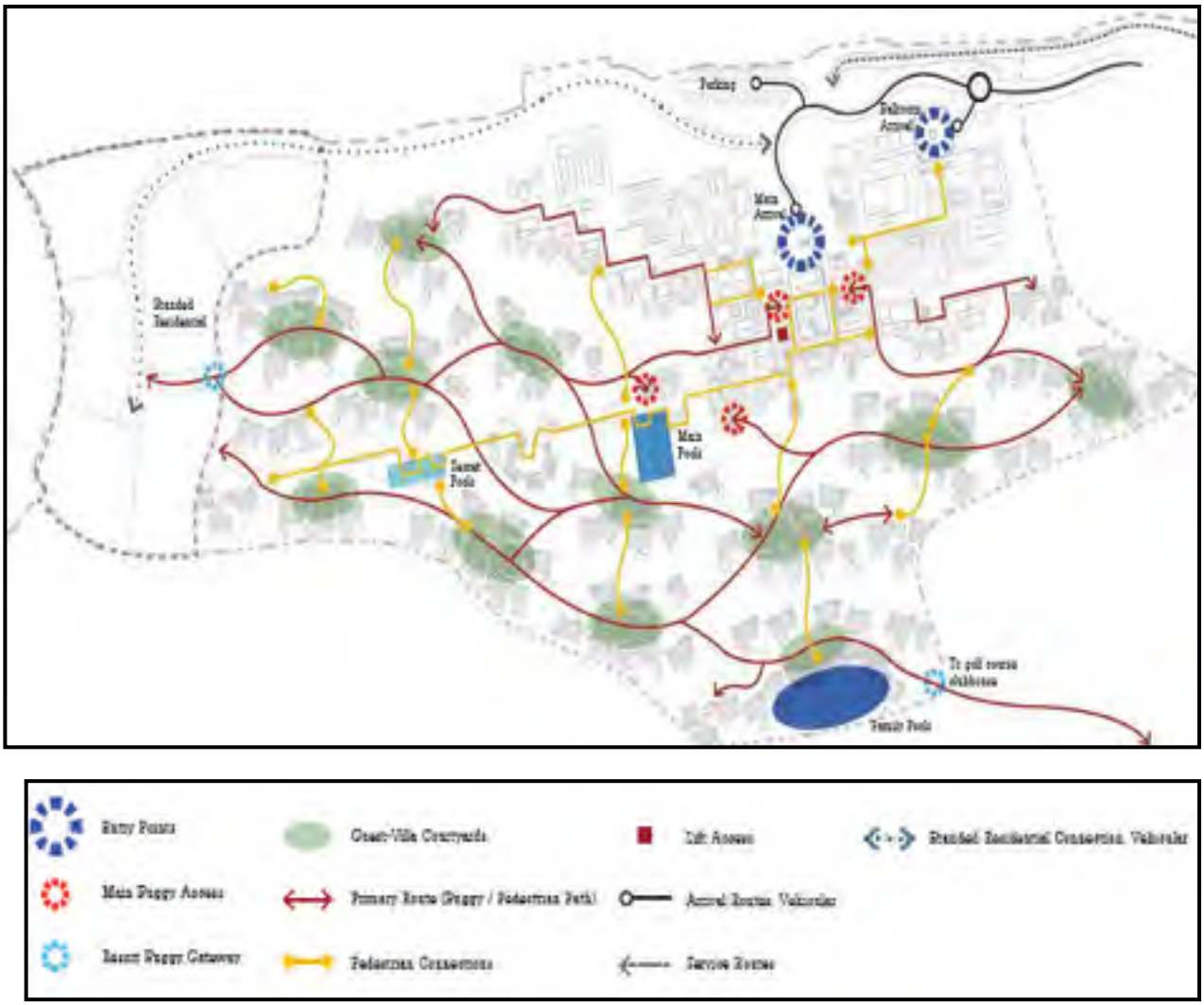


Figure 2.19 Circulation within Main Resort

2.8.2 Proposed Parking Facilities

Parking facility for guests and service vehicles has been provided within the premises exceeding local regulations. All parking bays will be provided on ground and adequate road network will be designed for smooth movement of vehicles on site.

*Please refer to **Annexure IX**: Traffic Master Plan.*

Table 2.10 Proposed Parking Facilities - Resort areas

Description	NBC/ MoEFCC Norm	Requirement as per NBC/ MoEFCC	No.of bays	Area per bay (sq.m)	Total Area (sq.m)
Car parking for Villas	1 car per 2 rooms	100	150	12.50	1,875
Car parking for Public Areas/ Banquets	1 car per 5 seats	405	250	12.50	3,125
Parking for Buses			10	60.00	600
Two Wheeler parking for staff			250	3.13	781
Total Surface Parking	**--**	**505**	**660**	**--**	**7,319**

2.9 Golf Course Design & Development

The Golf Course is being developed by M/s IMG World (a global leader in sports, media and fashion– which has developed over 25 Golf courses throughout the World) with signature design provided by Colin Montgomerie Design (CMD) (a company owned by Colin Montgomerie a top ranked Golf Player in the World). Construction and development of the Golf Course will be as per Guidelines of USPGA (United States Professional Golfers' Association).

Development and construction of the Golf Course will follow the following sequence:

2.9.1 Initial Survey and Staking

Survey and Initial Work- Survey of topography, study of surface features such as hillocks, water bodies, tress etc.

Staking -Identifying important areas of the field and colour coding the same.

2.9.2 Site Preparation involves laying of sub grade

Erosion control- installing protective cover and devices to check soil erosion and leaching.

Land clearing/Grubbing- removal and disposal of vegetation. Includes general clearing and selective clearing.

Earthwork- Includes dressing work, cut and fill, etc.

Rough Shaping- All major contours and features of the Course's sub-grade are set to shape within 15 cm (6-7 inches) of the final grade.

Lake construction- It is an important step for construction of artificial lakes with special liner materials.

Irrigation- Watering the Course during per-construction, construction and during operation phases.

Drainage- Installing a well engineered drainage pipeline system.

Hard-scaping – this includes creation of buggy paths, wooden bridges etc

2.9.3 Features Construction/Finishing

Construction of all tees, bunkers, greens and fairway catch basins.

Fine Shaping - final shaping of the entire golf course, teeing in all features and cleanup.

Sand Capping

Sodding - all bunker faces, green surrounds and steep slopes to be sodded prior to other grassing procedures.

Landscaping - planting of trees, shrubs and other plants at the same time when Sand Capping and Sodding are underway.

Grassing On approval of the sand capping, finish grassing by either sprigging or hydro-seeding. If different grass varieties are involved grassing lines shall be marked.

Grow-In - 3-4 months of grow-in period that will be deemed complete once Punch List has been completed for each hole.

Final Preparation : All equipment and materials necessary to make the Course ready for play, including maintenance equipment, benches, drinking fountains, fences, golf course accessories and civil structures (ie.: culverts, weirs, inlets, outlets, bridges and boardwalks).

2.9.4 Activities involved in Golf Course Construction

2.9.4.1 Initial Survey and Staking

It includes evaluation of the site and environmental attributes such as soil, on which Greens are to be established. Gather all maps such as topographical and soil survey maps. Survey work will include topography, archaeological study, demarcating boundary lines and original golf course centerline stakeout. Identify relevant environmental standards such as favorable growing conditions, high priority factors such as air movement, day light, drainage pattern, etc. The development standards should also meet local and state regulatory norms.

2.9.4.2 Staking

It includes identifying important areas of the field, marking and colour coding them. Control points for the centerlines at the center of each golf hole shall be staked using 2.5m to 3.0 m tall PVC or wooden poles. Each pole is clearly marked to identify the features either by painting it or by having a 60 ×60 cm flag or sign attached to signify the hole number and colour. A permanent benchmark is established for the property and used for grade changes.

Colour coding for the control points shall be as follows:

Tees – **BLACK**

Turning Points – **RED**

Greens – **GREEN**

Staking out the golf course features for both earthmoving and rough shaping also need colour coding. Colour coding of features shall be as follows:

Greens – **GREEN**

Bunkers – **YELLOW**

Lakes, Streams, Catch Basins – **BLUE**

Mounds – **RED**

Tees – **BLACK**

Contour Lines - WHITE

2.9.5 Site Preparation

2.9.5.1 Land Clearing /Grubbing

This phase will be done in stages to prevent any irreparable damages. Clearing will begin along the centerline to the perimeters of each hole. It will include removal of all trees, underbrush and weeds from the golf course corridor to an initial width of 10 m wider than the fairway edges/bunkers and mounds. There are two types of clearing:

- **General clearing:** General clearing will consist of complete removal and disposal of all trees, brush, projecting roots, stumps, pasture grass, weeds, rubbish, and other objectionable material within the designated limits of the fairways/ golf course. All decayed stumps will be removed to a depth of one meter below the original ground surface. Two weeks after clearing, a broad spectrum herbicide treatment will be applied. All stones 5 cm in diameter and larger will be removed from areas to be sand-capped, grassed and/or landscaped. This removal will be accomplished with stone pickers or rakes.
- **Selective Clearing:** Selective clearing will consist of the removal and disposal of vegetation less than 10cm in diameter, including stumps, within the area between the general clearing limits and the golf course boundary or the selective clearing limits. The Landscape Designer may however, designate certain smaller trees of exceptional value to remain or direct that certain trees larger than 10 cm be cleared.
- **Grubbing:** Grubbing will consist of the removal and disposal of all stumps, roots or other objectionable vegetation having a length exceeding 60cm and/or a diameter exceeding 8 to 10cm within the designated general clearing area. After removal of all objectionable material, all holes, ruts or depressions will be backfilled, smoothed and left in a condition to permit positive drainage.
- **Disposal of cleared material:** vegetative species & biodegradable material so cleared will be composted on site and the manure so produced will be used for gardening.
- **Protection of existing vegetation:** All plant material on the golf course site which are endogenous to Konkan will be saved. They will be protected against injury to roots and crown. No grading, trenching, pruning or storage of materials 1 meter beyond the drip-line will be permitted. Penalties will be charged for removing any tree which has not been marked.

2.9.5.2 Laying of Sub Grade

Site preparation starts with the construction of Sub-grade. A well compacted base is critical to the success of greens as it is the building block and all other features are to be developed on it. When a new green is constructed, the sub-grade is prepared during rough shaping of the greens. The fill material obtained from the excavation of the lake & foundation excavations for the villas and resort buildings will be used to shape the new green site. The contours of the sub-grade will conform to those of the proposed finished grade. It will be constructed 14 inches below the proposed finished grade and compacted sufficiently to prevent future settling which might create water-holding depressions in the sub-grade surface and putting surface. The materials above the sub-grade consist of 10 cm of gravel and 35 cm of greens-mix (compacted to 30cm). The finished sub-grade contours should ensure the rapid removal of excess surface water from all playable areas.

2.9.5.3 Earthwork

Temporary haul roads will be constructed prior to commencement of earth work. Earthworks involves excavation for lakes and villas/resort buildings and using this cut material as fillers to create golf course features as also includes removal of and stockpiling of topsoil and replacing it on fairways and roughs after shaping has taken place. It is seen that in the area between 0-200m from HTL, no top soil is available and hence only a sand capping of 30cm will be required over all fairway and rough areas.

2.9.5.4 Erosion Control

In order to minimize erosion and siltation during construction, rolled erosion control products like netted blankets or turf reinforcement mats or geotextile covers shall be used. Erosion control using Geotextiles, Netted/Rolled Erosion Control Products and sods on bare soil to establish turfGarland drains followed by series of filter bunds will be installed and provision made for addition of Polyelectrolyte so as to ensure that no sediment goes outside the site. The topsoil will be removed during the clearing and grubbing process and stockpiled and siltation control measures will be taken.

2.9.5.5 Drainage

All excavated areas will be kept smooth and well drained at all times during construction. All swales and depressions will be maintained to provide positive drainage to designated collection points.

2.9.5.6 Lakes

As seen in the Master Plan **Fig 2.21**, the project envisages creation of two rainwater harvesting bodies – one towards the central part having capacity 34,724 cum and a smaller rainwater harvesting body to the south east having a capacity of 4,900 cum both having water depth of 5m with freeboard of 1.5m. The rainwater harvesting bodies will also serve as water hazard feature on the golf course. Development of lakes will be undertaken as follows:

- ✧ Will balance between Cut and fill volumes

- ✧ Establish safe embankment fill where the existing contour level is lower than the lake top level
- ✧ Safe and suitable internal slopes
- ✧ Ensure no flooding of the village located downstream by providing over flow discharging water into the rivulet without causing flooding
- ✧ Considering the porous laterite strata below, various liner materials such as High Density Poly Ethylene (HDPE), Geosynthetic Clay liners (GCL) with Bentonite backing , Polypropylene (PP), Ethylene Propylene Diene Terpolymer (EPDM) are being studied. All liners are inert and do not pose harm to aquatic flora and fauna. Fit to hold potable water for domestic and drinking purposes and ease of installation are key factors in determining suitable liner.
- ✧ A 150mm cushion layer of silt or clay will be laid and compacted on the embankment
- ✧ Base geo-textile layer of specified thickness will be used
- ✧ Geo-membrane of thickness 0.55mm – 1.5 mm laid using weld joints
- ✧ Top protection geo textile layer of specified thickness
- ✧ Special finishes such as turf or stone pitching in the exposed surfaces
- ✧ Earthen Embankments or Berm made of filled up soil – natural/ roller compacted
- ✧ Anchor trenches for liners
- ✧ Overflow Weir with piping / pumping arrangement for usage of harvested water
- ✧ **Fig 2.20** shows the details of rainwater harvesting bodies to be constructed at site, while **Table 2.11** presents design details.

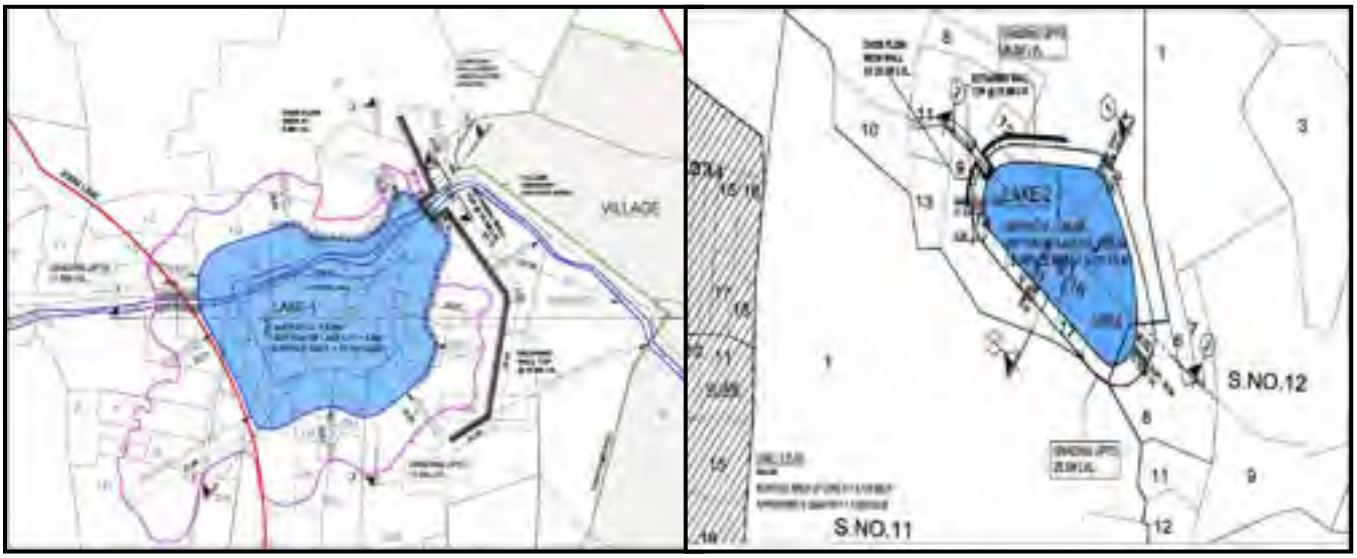


Figure 2.20 Details of Rainwater harvesting bodies (a) 1 and (b) 2

Construction steps during rainwater harvesting bodies construction are as follows:

- **Stakeout:** Prior to excavation, the top of the bank line will be accurately staked to ensure its conformity with the plans
- **Slopes:** Grassed slopes above the water level will have a gradient not greater than 3:1

- **Rainwater Harvesting bodies Compaction:** After excavation and formation, the basin will be thoroughly compacted to prevent seepage, and the surface will be left in a clean, smooth condition.

Table 2.11 Details of Proposed Lakes

S.No	Items	Water Body 1	Water Body 2
1	Volume (cum)	34,724	4900
2	Plan Area Coverage (sq.m)	11,105	3,133
3	Max Internal Slope	1V: 3H	1V: 3H
4	Water Depth (m)	5	5
5	Free Board By Grading (m)	1.5	1.5
6	Berm Contour Level (m)	11.50	26.50
7	Water Level (m)	9.80	25.0
8	Outer Perimeter (m)	425	224

- **Rainwater harvesting Lining:** will be lined to prevent seepage.
- **Siltation:** Like for any other earthwork, care will be taken to prevent siltation into the adjoining nalla. The banks will be stabilized and sodded as it nears completion.

2.9.6 Features Construction/Finishing

2.9.6.1 Fairways and Roughs

- **Fine Grading - Topsoil Cleaning- Sand Capping:** After topsoil or 30 cm sand capping is spread, all stones, roots and debris greater than 1.875 cm in diameter will be removed by stone pickers or rakes. Final surface prior to grassing must be perfectly smooth and can be achieved through the use of box-blades, Sand Pros, drag mats and/or hand raking. Soil may have to be amended to adjust the pH.
- **Drainage & Drain Tile Installation:** Storm water drainage will be designed for 100 year maximum rainfall and used for planning and installation of all drainage mainlines, catch basins, lake overflows and outfalls. A 2-3% slope is generally provided so that Surface storm drainage is rapid in order to remove excess water from the course.
- **Catch Basins :** All fairway catch basins will be drained with solid and perforated drainage pipes – the under drains will convey the water to the nearest lake so that it maybe reused for golf course irrigation again.

- **Lake Outfalls :** All drain-tile outfalls into lakes or ponds will be located so that the top of pipe is 50 cm below proposed normal water level (NWL).
- **Trunk Lines :** All trunk drainage lines will be installed at a depth of at least 0.9 meters below proposed final grade in order to avoid conflict with the installation of the irrigation system.
- **Manholes, Grates, and Inlets :** Will not be constructed from reinforced concrete or brick. Most suitable is PVC or ADS "T" fittings, with perforated stand pipes. Covers or grates can be made from metal, and fabricated locally.
- **Floating :** After fertilizer has been spread, the fairways and roughs will be floated to a perfectly smooth finished grade with no water-holding pockets. Care will be exercised that no stones or debris are dragged to the top of the finished grade.

2.9.6.2 Tees

The tee area should be large enough for heavy pedestrian traffic, must have multiple entry and exit points and must receive sufficient sunlight. The surface must be as flat as possible. It should have the top 6 inches with an amended soil and the use of subsurface drainage lines. Depending on the impermeability of the sub-grade soil, a drainage system for the teeing ground will be installed. It consists of 10 cm laterals and main line arranged in a herringbone fashion. Spacing for the laterals will be of 5m intervals. Drain lines will have a minimum slope of 1%.

2.9.6.3 Root-zone Modification

The tee turf grass must be vigorous to recover rapidly from injury. A proper root zone mix and turf grass for the teeing ground must possess these qualities: a high recuperative capacity, minimum inclination to compaction, adequate soil/water infiltration and percolation rates and a surface which readily accepts the insertion of a golf tee.

2.9.6.4 Greens

The method of construction will conform to United States Professional Golf Association's methods as per its publication, SPECIFICATIONS FOR A METHOD OF PUTTING GREEN CONSTRUCTION (2005). Greens are generally designed to be firm with high infiltration rate, well drained, resistant to compaction and capable of supporting play all round the year. Good surrounding conditions are also required such as air movement and light conditions.

Maintenance of greens includes regular trim work and is quite labor intensive. The quality of turf can hugely impact the playability, maintenance, irrigation and drainage of the greens. The selection of an acceptable Root-zone (sand/soil mix) material is critical to the overall success of the project. Generally a 250 mm depth of material is required in the putting area to provide an adequate Root-zone layer that will hold sufficient moisture for turf growth, while also draining adequately. Naturally occurring sand blended with organic matter such as Peat moss, coir fibre, rice hulls, composts and animal manures will be used in order to meet the physical requirements.

"Ringing" The Green

To prevent capillary water movement between the surrounding areas and the collars, a plastic interface will be installed to "ring" the exterior edge of the collars. The plastic will be 1mm in thickness and 60cm in width. The sheet will be staked at 3.00m intervals to ensure that it remains in place.

Under Drainage

The golf course will have underdrainage system to capture the excess irrigation water – such underdrainage will extend to lakes, streams, trunk drains, or other approved outfalls. Washed gravel of 1/4" to 3/8" diameter will be evenly spread 5cm deep in bottom of all trenches. Upon the gravel blanket will be laid perforated plastic pipes, 10cm in diameter. All pipe joints will be connected by impervious sleeves and taped. The trenches will then be filled with gravel and a 10cm gravel blanket will be spread over the entire putting surface.

Gravel Base

The entire sub-grade should be covered with a layer of clean, washed gravel or crushed stone with 6 to 10mm diameter particle size to a uniform minimum thickness of 10cm.

Greens Mixture

The greens mix will be in accordance with the specifications recommended by the United States Golf Associations' Greens Section. Greens mix will be laid evenly to the compacted minimum depth of 30 cm over the putting surface area using a small crawler-type tractor suitably equipped with a blade.

Finish Grading

Grade stakes spaced at 3 to 4m intervals, in a grid system, within the green cavity will be helpful in indicating the finished depth of the soil mixture. Finish grading of the surface root zone involves a significant amount of firming. "Footing" or trampling the surface and repeating the footing operation will result in having a uniformly firm seedbed.

Floating

The entire green area will be floated so that all contours blend into fairways, bunkers, and mounds as shown on the Greens Detail Plans. No water-holding pockets will be left.

2.9.6.5 Bunkers

Fairway /Green side Bunkers

Bunkers will follow the Golf Course Designer's size, shape, and depth. Drainage trenches will extend into the low area of each bunker lobe and will extend to lakes, streams or other approved outfalls. The trench will be 20cm in width by 30cm in depth, having a 0.5% bottom slope. Washed gravel of 6 to 10 mm diameter will be evenly spread 5cm deep in the bottom of all trenches. Upon the gravel blanket, will be laid the same type of pipe as used on greens. The portion outside the bunker will be covered with topsoil or sand capping.

Figure 2.21 Sand bunker

Table 2.12 Bunker sand Mesh Size

BUNKER SAND	
Sieve Size	% retention
16 mesh	3.91
20 mesh	5.22
30 mesh	14.59
40 mesh	26.45
50 mesh	32.50
70 mesh	14.12
100 mesh	2.86
140 mesh	0.36

Bunker Sand

Sand for the bunkers should be of a consistency and color approved by the Golf Course Designer, after testing at an approved USGA laboratory, as per above sieve analysis.The material will be stockpiled at a high point of the bunker sub-grade sufficiently away from the edges of the bunker. Sufficient sand will be placed to provide a 15 cm sand layer over the entire bunker subgrade.

Bunker Liners

The bunker sub-grade area will be lined with a bunker liner -a high-loft nonwoven geo-textile consisting of durable polyester fibers and having a permeability of no less than 6.0 cm/sec. The bunker liner color will be "Off-White" or "Tan-Buff" so to as closely as possible match the selected 'white' or 'tan' bunker sand.

2.9.6.6 Nursery Areas

Putting surface nursery area of least 500 sqm. according to normal greens specifications (USGA) as also a Fairway/Rough grass nursery area of at least 25,000 sq.m. will be constructed according to normal fairway specifications. This will be used to harvest sprigs from roughs, tees and fairways

2.9.6.7 Grassing

Seed Quality (if required)

Seed will be furnished in sealed standard containers and will have a germination rate of ninety percent (90%), and a purity of ninety-eight percent (98%). All containers will show the guaranteed percentages of germination, purity, and date of testing and will be available for inspection by the Golf Course Architect at any time during the construction.

Hydro-seeding/Mechanical seeding

Hydro seeding is a planting process which utilizes a slurry of seed, fertilizer and mulch. The slurry is transported in a tank, either truck or trailer-mounted and sprayed over prepared ground. All fairways on the golf course are hydro-seeded. Dolomite lime will be spread as determined by soil tests upon all areas to be hydro-seeded.

Hydraulic mulch will be Flexterra, a Flexible Growth Medium (FGM), as manufactured by PROFILE Products. The FGM will require no cure time and comprise of wood fiber, cross-linking hydrocolloid trackifier, co-polymer gel and crimped interlocking fibers. The FGM will be green in colour, to aid in visual metering during application. The dye will be biodegradable and will not inhibit plant growth.

Terrain	**FGM Application Rate (NSA)**
Flat soil surface	2,240 kg per a
Slopes 3:1 or less	3,360 kg per Ha
Slopes 2:1 or less	3.920 kg per Ha
Critical areas or 1:1 Slopes	*4,480 kg per Ha

After hydro-mulch has been applied and allowed to dry, the seeded area will be sprinkled with a fine spray of water to prevent runoff.

Mechanical seeding may also be resorted to using slicer or other appliances to apply correct amount of seeds.

Compacting

Immediately after seeding/sprigging, the entire area will be compacted either with a culti-packer or a roller.

Protection

Immediately after seeding/sprigging, the area will be protected against traffic or other use by erecting barricades as needed, and by placing warning signs at appropriate intervals.

Stolons

Stolons will be planted immediately after they are received on site. If it is not possible to plant within four hours, they will need to be evenly spread in a shady, cool area and kept moist until planting occurs.

Greens Planting

Greens will be sprigged with Bermuda grass. Before planting, the putting surfaces will be fumigated as recommended by manufacturer. Sprigs will be uniformly spread over the surface of the greens. The green surface must be hand watered immediately after planting, not only to provide moisture, but also to ensure soil contact that will promote establishment.

Fairways, Tees and Rough Planting

The fairways, tees and roughs will be sprigged with Platinum TE paspalum. The sprigs will be freshly harvested and be in a weed free condition upon delivery to the site. Stolons will be uniformly spread over the surface.

Sodding

All tee and green surfaces will be ringed with at least one strip of rough grass sod. All bunkers will be sodded from top of slope to bottom of slope. All steep mounds and slopes and all lake slopes will be sodded.

Application of Fertilizers

Nitrogen at no more than 2.4 kg per 100sqm per year shall be supplied with moderate levels of Phosphorus, Potassium and Iron. The fertilizer program will follow a paspalum specific strategy: light in the summer, moderate during winter. Prescription fertilization at low rates (0.06 kg of nitrogen per 100 sq m per application) on a regular monthly basis will be adequate.

Greens - 10 to 15 ton / year

Tees & Approaches - 10 to 15 ton / year

Fairways - 30 to 40 ton / year

Rough - 20 to 30 ton / year

During grow-in period 80 to 100 Ton/year

2.9.6.8 Green Initiatives in Maintenance of Turf Grass

a) Use of Paspalum Grass on Fairways, Tees and Roughs

- Paspalum maintains a 4-8 + inch root system on greens
- The grass is salinity tolerant and can sustain from 3000-6000ppm TDS water
- Requires much less amount of water than traditional grass – also can sustain watering on every alternate day , thus reducing water requirement
- The grass exhibits shiny green colour despite exposure to sunlight for long time periods and reduced water intake
- Has very high nitrogen uptake rate and utilization efficiency thus requires reduced amount of fertilizer
- It is not genetically modified
- Responds very well to organic fertilizers/biopesticides
- Paspalum has been used in India for the Mumbai Presidency Golf course and Pune Oxford Golf Course as also at Common wealth games stadium & other prestigious clubs like DLF, Gurgaon (USPGA approved) to address the issue of water scarcity with excellent results. It has also been used in other countries having tropical climate like Mauritius.

b) Use of Bio fertilizers and bio pesticides for maintaining Greens

In keeping with the overall green strategy for the proposed development, the management has been in touch with Golf Course Superintendents from Mauritius & turf grass development experts to explore ways and means to use least amounts of synthetic pesticides/weedicides and fertilizers during the maintenance of the turf grass. Some findings are given below:

Organic liquid combinations and granulated organics are applied via the fertigation system on Fairways & Roughs and Tees. Products from companies like Sustane (USA) and Terralift (UK) are used extensively on both Greens & Tees (these are granulated slow release natural fertilizers made from aerobic

composting of animal litter with C:N ratio of 5:1 and application rate of 12.5kg/100 sqm. These give a stable humus to the grass and has micronutrients like Ca, Mg in it). Also, an extensive range of foliar products from a Biological Company called Nutri-Tech Solutions of Australia are used (foliar products are nutrient products made through sea brown algae and applied through leaves- these are rich source of proteins, vitamins and micronutrients like Ca, Mg, Fe, K, P etc).

Fairways & Roughs; Sustane and Biogreen (Australia) are applied in granular programs. Biogreen is a naturally occurring high mineral analysis liquid concentrate containing Total nitrogen 5%, soluble potash (K2O) 1%, Sulfur and iron made from sea weed algae). Both Sustane and Biogreen can replace synthetic Fairway Grade products from companies like Simplot, Scotts and Lesco. By using the above organic products within the biological strategies virtually no disease pressure on tees, fairways, and roughs etc is experienced and turf grass's dependence on chemicals is reduced drastically.

To control various types of worms and bettles which may affect turf quality, three natural bio-stimulant/ plant extracts from Nutri-Tech Solutions are being contemplated which when mixed into normal organic foliar programs and applied four times per month, has resulted in dramatic reduction of insect activity. The exciting aspect of these biological programs is there environmental sustainability because the products being applied are all natural, the products are all stand alone bio-stimulants and the weekly spoon feeding is done at very nominal costs.

Drawing from these experiences, the management intends to locate suitable similar locally made traditional products for management of turfs.

c) Use of Integrated Pest Management Techniques

It is proposed to adopt Integrated Pest Management strategy. This will involve the following :

- Use biopesticides in lieu of chemical pesticides
- Use agronomic and cultivation practices to prevent the development of conditions conducive to pest attacks eg proper tilling of soil to prevent formation of some types of soil
- Use seeds/weeds which are not contaminated with pests
- Use fertilizers only in need based manner

2.9.7 Cart Paths

Cart Path locations and grades are general in nature. All engineering to establish grades all inspections of work and final approval will be done by Project Engineer.

2.9.7.1 Excavation

Excavation will extend to the depth of the proposed finished grade. All soft and yielding, organic, or other unsuitable material and the sub-grade will be compacted thoroughly and finished to a firm, smooth surface.

2.9.7.2 Width and Depth

Paths will be two and one-half meters (2 1/2m) wide and ten centimeters (10cm) deep. In the areas of the Club House, Driving Range, 1st and 10th tees and the 9th and 18th greens, all cart paths will be 3.5m in width (approx. 750m).

2.9.7.3 Finishing

Path will have a laterite finish.

2.10 Water and Wastewater Management

2.10.1 Water Requirement

2.10.1.1 Construction Phase

During the construction phase water will be required for construction activity and the daily laborers' domestic activity such as drinking; washing, etc. Around 70,000 to 80,000 cu m of water has been estimated as the requirement for the construction phase of the project and other ancillary requirements such as setting up of plant nursery, golf course irrigation requirements during dry season, etc. (construction phase is estimated to last for 36 to 40 months and thus the water requirement is estimated upwards of 100 cum/day).

2.10.1.2 Operation Phase

During operation phase water will be required for both potable and non potable purposes.

Potable Water Supply

Potable water is required by Hotel guests, recreation facilities like swimming pools, laundry, F & B, staff quarters. In addition, water will be supplied for the community facilities like Disaster Management Site (DMS), Primary school, Health Centre and for the villagers for which a provision of 95 cmd is made. Peak potable water requirement worked out on the basis of maximum occupancy (during golf tournaments or conferences, or holiday periods) and is presented in the table below for the 8 non monsoon (dry) months which works out to 555 cmd for the resort. During the monsoon season, the resort is expected to have about 40% occupancy and water requirement during monsoon will be reduced to 220 cmd while the provision for water for community facilities is maintained same at 95 cmd.

Table 2.13 Peak Potable Water Requirements for Resort & Associated Facilities

Sr. No.	Purpose	No of persons	Water required (L/capita)	Total requirement (LPD)
1.0	Resort Area			
1.1	Number of bedrooms – 140	2 persons/ bedroom	320	90,000
1.2	Staff rooms – 50 Nos.	___	136	7,000

Sr. No.	Purpose	No of persons	Water required (L/capita)	Total requirement (LPD)
1.3	Add 10% for Swimming Pool/ Spa etc	___	___	9,700
2.0	Kitchen, F&Bs - 470 seats	120 L/ seat		50,000
3.0	Laundry		LS	50,000
4.0	Guest Areas (Major load during sporting events, conferences & holidays) Banquets + Fitness Centre + Spa+ Sports & Children Facilities + Public Spaces (Maximum expected load 3,500 guests).		45	1,57,500
5.0	Premium Resort Villas			
5.1	Number of Bedrooms – 229	2 persons / bedroom	350	1,60,300
5.2	Add 15% for swimming pool Make-Up & spa etc		LS	27,000
	Total For Resort			551,500
	Total (Rounded off)			Say 555,000

From the above details, break up of water use into grey (i.e use for washbasins, showers and swimming pool etc), black water (i.e water will get polluted with organics like use in kitchen, sewage generation etc) and quantity of water consumed or used is prepared and enclosed in the table below.

Table 2.14 Break-Up of Grey & Black Water Generation from Resort (during Peak season)

Sr. No.	Head	Total Water Required (LPD)	Water Break – Up (LPD)		
			Grey	Black	Used / Lost
1.0	Resort Villas	90,000	66,500	20,000	3,500
2.0	Staff rooms	7,000	4,000	2,000	1,000
3.0	Swimming Pool for resort	9,700	8,700	0	1,000
4.0	Guest Areas	1,57,500	1,15,000	38,000	4,500
5.0	Premium Resort Villas	1,60,300	1,17,000	38,000	5,300
6.0	Swimming Pool/Spa for Premium Villas	27,000	24,000	0	3,000
7.0	Kitchen, F&B	50,000	0	50,000	0
8.0	Laundry	50,000	0	50,000	0
	TOTAL	5,51,500	3,35,200	1,98,000	18,300
	ROUNDED OFF TO	5,55,000	3,35,000	2,00,000	20,000

Overall Water Requirement (Potable and Non Potable)

Water will also be required for non potable requirements like irrigation, landscape and cooling water makeup. The peak water requirement for the proposed development is about 2550 cmd – of this non potable water required will be 1900 cmd, while potable demand is 650 cmd. The table below presents the total water requirement for potable and non potable purposes for the project and its sourcing details.

Table 2.15 Total Water Requirement – Potable + Non Potable (during Peak season)

Sr. No	Development Elements	Requirement (Cmd)
TOTAL NON POTABLE WATER REQUIREMENTS		
1.	Golf Course - Irrigation	1200
2.	Landscape- Irrigation	500
3.	Landscape- Water Features	50
4.	Cooling Water Makeup	150
5.	TOTAL non potable water requirement	1900
WATER MANAGEMENT INITIATIVES		
1.	STP Recycled – Black Water	500
2.	STP Recycled - Grey water	
3.	Under surface storage runoff	300
4.	Non potable water from public source	1100
5.	Total	1900
POTABLE WATER REQUIREMENT		
1.	Resort-Villas, Public Spaces, & All Utilities	555
2.	Community facilities like Tiracol village, Disaster Mgt Site, Primary school, Health Centre etc	95
3.	Total	650
WATER SOURCE		
1.	Water from borewell extraction	250
2.	Water from public source	400
	Total	650

2.10.2 Sourcing of Water

2.10.2.1 Construction Phase

During construction water for potable use will be sourced from PWD through water tank at Tiracol village or RO treatment provided to bore well water. Water requirement will be supplemented by creation of lakes for rain water harvesting at the site and topped up if necessary using water tankers.

2.10.2.2 Operation Phase

Public Source:

As can be seen from the above, the total (potable and non potable water requirement) from public source is 1,900 cmd. The source for this water is proposed from Water Resource Department (WRD), Goa, through a proposed pipe line which will come from Tuem. The Water Resource Department, Goa, will supply raw water from Tillari Canal via Dhargal-Tuem. The department has recently approved the laying of the required pipeline. However, this is irrigation quality water and will require treatment prior to use. Presently 85 MLD raw water is available from Tillari for Dhargal area in Pernem taluka, however it will be required to extend a 450 mm diameter raw water pipe line of 1 MLD of 25 Kms length, from Dhargal to Tiracol, for the Project to treat and consume. The figure below shows the position of the water pipeline.

The other souce for fresh water identified is the Maharashtra Jeevan Pradikaran Department, Maharashtra. This pipe line will come from Vengurla.

*Please refer to **Annexure X** for Application to Water Resources Department (WRD), Goa and Application to Maharashtra Jeevan Pradikaran Dept., Maharashtra for supply of water*. The Water Resource Department has in-principle agreed for the supply of fresh water for the project.

Figure 2.22 Water supply pipeline network existing in Pernem Taluka

2.10.3 Water Recycling Initiatives

In order to have reduced dependence on public source, the following water recycling initiatives will be implemented:

(a) Sewage/Effluent Treatment with Recycle facilities

(b) Rain Water Harvesting by Creating Lakes, Recharge of Aquifers.

(c) Landscaping using Water Conservation Techniques and low water consuming Grass.

2.10.3.1 Sewage/Effluent Treatment with Recycle Facilities

Sewage/Effluent Collection Network

The principal sources of sewage/effluent within the resort will be the toilet blocks, kitchen, laundry and floor cleaning. All the waste water from these sources will be collected through a network of underground sewerage pipes, chambers and manholes and channelized through the sewer network to the proposed Sewage Treatment Plant comprising of Black and Grey water treatment processes. The chambers and the manholes will provide access into the sewers for periodic cleaning. Ample ventilation to the sewers, to prevent formation of sulfur dioxide and hydrogen sulfide, will be provided.

Sewerage system is proposed for the project as follows

- Sewage shall be discharged to respective inspection chambers located near the buildings.
- Kitchen waste shall be connected to the screen chamber,/ sand grease traps prior to its connection to the sewerage system
- Laundry discharge shall be connected to the dilution tank prior to its discharge in to the sewage system
- Grey water (from hand wash, showers etc) will be routed separately to a grey water collection network and treated separately.

Concept -Sewage / Effluent Treatment Plants

The conceptual design for the Sewage treatment works for the project will separate the flows for grey water (from hand wash, showers and the like - i.e having low organic strength) and sewage water (from toilet blocks, kitchen etc) to reduce the amount of treatment required and the fluctuations in biological demand and surges in flow.

Grey Water

The grey water will have significantly lower chemical and biological oxygen demand, therefore to reduce the treatment loads onto the main STP a separate plant will be provided to deal with these loads.

Sewage Water

The remaining sewage water, mainly from the toilets, laundry and kitchen is to be treated in the sewage treatment plants located at the central Back of House. The treated sewage water will be used for Golf course irrigation purposes. Excess sludge will be mechanically dewatered mixed with biodegradable waste and composted.

Treatment Systems

Grey Water Treatment

Grey water has minimum chemical and biological contamination and hence a filtration system to remove hair, lint and organic matter is proposed. Filtration systems have small pore size to remove bacteria and other waterborne pathogens as well.

Two Ultrafiltration Grey Water Plants with a Total capacity of up to approximately 350m^3/day are proposed.

The system is modular and has no use of chemicals and no moving parts, also, it can be expanded easily to meet future demand. The grey water is not expected to have a high biological loading; therefore reduction in BOD is not required for this system.

The raw water for the grey water treatment system is anticipated not to exceed the following contamination loadings:

Turbidity = ≤ 50 NTU

Total Organic Carbon = ≤ 20 mg/L

Biological Oxygen demand = negligible.

The expected quality of the treated effluent will be as follows:

Turbidity = ≤ 0.1 NTU

Colloidal silica content = 98%

Bacteria and pathogen removal = 99.99% reduction, including Giardia, Cryptosporidium and Legionella

As the mineral and bacteria removal of the system is sufficient for cooling tower make up water and irrigation, no further treatment is required.

The Grey Water Treatment Scheme using Ultrafiltration is shown below:

Figure 2.23 Grey Water Treatment Using Ultrafiltration Membrane

Sewage Water treatment system

For this project a Membrane Bioreactor (MBR) system is proposed as the main sewage treatment plant. This system has the following benefits:

- Reduced land area usage
- Reduced retention time
- Reduced volume of sludge generated
- Generates high quality effluent for direct reuse

Process Description

Primary Treatment facility

The primary treatment facility consists of Collection Tank, Fine Screen and Raw Water Pump. The objective of this facility is to receive and store raw sewage, equalize fluctuation of incoming flow and its constituents, remove floating materials and screenings, and transfer raw sewage to MBR Unit.

- Collect tank stores the Raw Sewage from the Resort.
- Raw Water Pump - Sewage is pumped and transferred to MBR Tank. The pump will operate automatically according to the level inside the MBR tank.
- Fine screen - The Fine Screen is installed prior to the MBR Tank. The mesh size of the screen is 1mm. The Fine Screen removes fine substances contained in the sewage such as toilet paper, hair, etc. to prevent clogging and/or scratching of membrane. Screenings are scraped automatically and discharged into a container.

MBR (Membrane Bioreactor) facility

The key process for the Membrane Bioreactor sewage treatment plant is the membrane bioreactor process, which removes most of BOD and SS contained in sewage.

The system has two major functions. One is to remove organic matter (BOD) within sewage by activated sludge method. The activated sludge process injects oxygen into the aeration tank to make aerobic microorganism growth within the tank, and make those microorganisms oxidize and thus remove the organic content within the wastewater. The organic matter is partly oxidized to generate carbon dioxide, and partly used to grow bacteria.

The Mixed Liquor Suspended Solids (MLSS) of the MBR system is 8,000 to 12,000 mg/L, and that is why the microorganism concentration can be maintained at high level. The time required for treatment can thus be reduced to approximately 30% of the conventional system. The other function is to separate solids from liquid using a membrane filter. The process removes suspended solids (SS) within the wastewater by membrane filtering. Since the pore size of the membrane is as fine as 0.1 micrometre, not only SS but also bacteria such as coliform bacteria can be removed. In addition, since the membrane unit is installed immersed within the aeration tank, the gravity sedimentation tank required for conventional systems can be eliminated.

The MBR facility consists of aeration tank, membrane unit, filtered water pumps, and excess sludge pump. The raw sewage treated by the fine screen enters the aeration tank.

Aeration Tank - Within the aeration tank, BOD is oxidized and removed by aerobic microorganisms maintained in high concentration. After those biological treatments are completed, solids-liquid separation is performed through the membrane unit installed within the aeration tank. The filtrate is discharged as treated water by the filtered water pump. The filtered water pump is automatically operated according to the water level within the aeration tank.

Membrane Unit – The membrane unit consists of a membrane module for filtering and the air diffusing unit that feeds air for washing the surface (or backwashing) of the membrane module. The air dispersed from the air diffusing device cleans the surface of the membrane and at the same time provides oxygen required for biological treatment.

Air Blower - The air blower continuously supplies air into the aeration tank in order to scour the membrane surface and facilitate biological treatment.

Membrane washing unit - The membrane washing unit is provided for chemical washing of the membrane when the membrane is clogged. The membrane washing unit consists of a chemical solution tank, where sodium hypochlorite is dissolved and stored, and a chemical dosing pump, which feeds chemicals into the membrane. The frequency of washing is approximately once every 3 months, although it varies depending on operation conditions.

Excess Sludge Pump - The sludge generated and settled within the aeration tank is transferred by the Excess Sludge Pump to the Sludge Storage Tank. The pump is submerged inside the MBR Tank and operated manually by the operator.

The expected quality of sewage effluent and treated water for recycle is presented in Table below:

Table 2.16 Expected Quality of Raw & Treated Sewage from Black Water Treatment

Items	Unit	Raw Sewage Quality	Treated Sewage Quality
Average Daily Flow Rate	cmd	200	200
pH	-----	6 to 8	6 to8
BOD	mg/L	300	Less than 10 (target <5)
COD	Mg/L	1000	30
Suspended solids	Mg/L	300	< 5 (target < 1)
Total Nitrogen	Mg/l	80	<5 (target < 1)
Total Phosphorous	Mg/l	20	<5 (target < 1)
Total coiliforms	CFU/100ml	--	none
E-Coli	CFU/100ml	--	none
Oil/grease	Mg/L	100	5

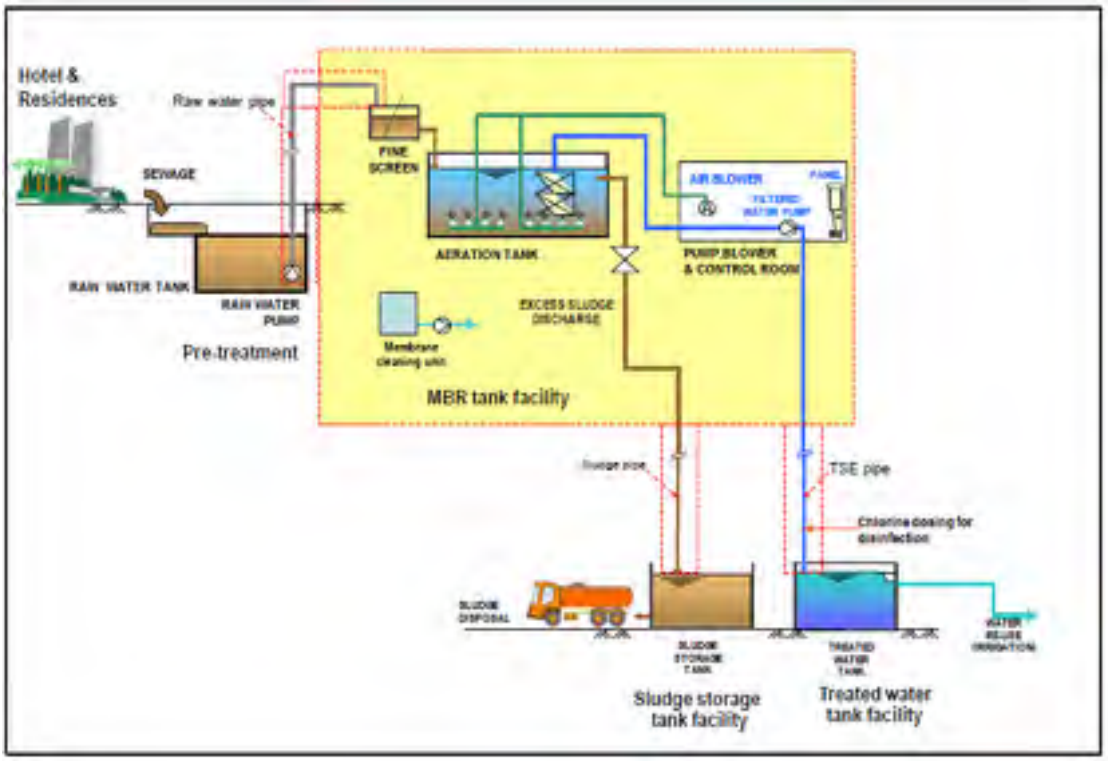


Figure 2.24 MBR Schematic Diagram

2.10.3.2 Rain Water Harvesting

The average annual rainfall in Goa is more than 3000 mm and almost 75 % of the precipitation occurs during the months of June to September. Given the pervious nature of soil, rain water percolates underground. There are aquifers around the Tiracol Village which are both confined and semi-confined in nature. Also the ground water table is found at shallow depth of less than 10m and vertically limited to less than 15 m. The porous nature of laterites on the plateau portions, enclosed within patches of soils, form a favorable condition for natural ground water recharge during rains. Besides, there is good scope for developing artificial structures for rain water harvesting so that ample quantity of rainwater can be stored and also recharged into the sub surface to maintain the ground water levels, thereby reducing the stress on potable water requirements. Table 3.14 presents rainfall data collected near the project site for the period 2006-2010 & graphical plot presented below:

Table 2.17 IMD Rainfall data, Goa

STATE	DISTRICT	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
Goa	Goa	2006	0	0	21.1	0.3	349.9	745.4	807.3	731.1	418.2	362.1	53.4	0	3289
Goa	Goa	2007	0	0	0	0	96.5	1016	761.9	1051.7	775.5	76.2	88.8	0.6	3867
Goa	Goa	2008	0	0	75.2	10.3	28.4	868.4	703.3	1048	664.1	9.5	2	5.8	3431
Goa	Goa	2009	0	0	0	0.5	4	649.2	1381.8	347.5	438.1	354.7	155.2	0	3329
Goa	Goa	2010	10.4	0	0	7.7	60.2	828.3	1281.1	811.9	497.9	312.3	186.8	12.8	4018
		Average	2	0	19	4	107	825	949	798	558	223	97	4	3587

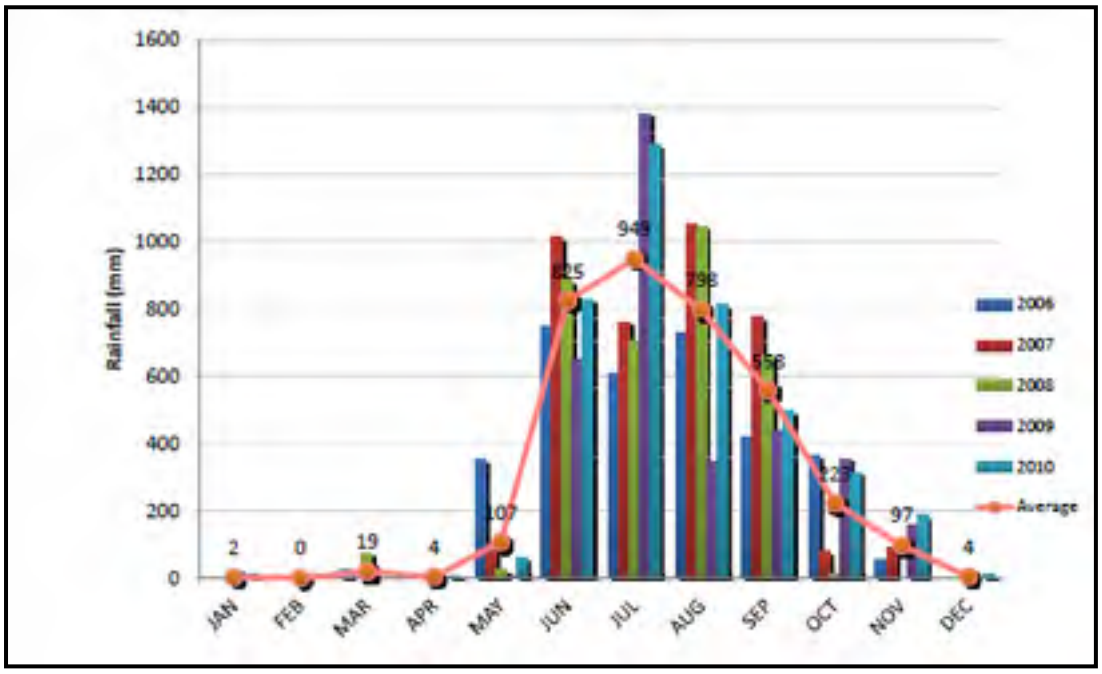


Figure 2.25 Graphical Plot of Rainfall in Goa 2006- 2010

2.10.4 Storm Water Management & Distribution

Maximum storm water will be generated in the monsoon months, i.e. from May to September. The storm water drainage of the developed area will follow the natural contours of the site and thus avoid any flooding in the resort area. There will be negligible surface water runoff in the resort area and hence storm water will mainly consist of rain water from roofs, under-surface runoff from golf course and percolated surface water. Water from roof tops (area 40,000 sqm) will be conveyed though down take pipes and led to individual collection chambers opening into a Central Collection Tank. The capacity of the central water collection tank will be around 10,000 m^3. Ground surface runoff will mostly be collected from golf course into a sedimentation chamber to a storage sump for irrigation of golf course.

Storm water for the site will be managed in two separate zones to facilitate the harvesting of rainwater during the monsoon season as required, and the recharge of groundwater. The site will be split into three drainage zones: The Premium Resort villas, resort and other landscape areas.

The catchment areas for the above zones are as follows:

- Premium Resort villas roof area - 26,000m^2
- Resort roof area - 15,000m^2
- Resort area approximately – 80,000m^2

2.10.4.1 Premium Resort Villas

Runoff from the Premium Resort villas roof areas will be discharged directly into soakaways located within each plot. These will reduce the size of drainage network elements and directly increase groundwater recharge.

The remaining runoff will be collected in roadside drains and directed towards the lake and/or to central collection raw water collection tank. During the monsoon season, an estimated 500m^3/day of rainwater will recharge groundwater aquifers.

2.10.4.2 Resort Roof & landscape area.

Runoff from the Resort rooftops, impermeable surfaces i.e. roads and landscaped areas will be diverted towards the large lake adjacent to the golf course for storage, the overflow being discharged to the existing Nullah watercourse. During the monsoon period this water will be used to offset the hotels potable water consumption entirely throughout those estimated 4 months. During the monsoon season, an estimated 1450 m^3/day of rainwater will recharge groundwater aquifers.

The maximum rain proposed to be harvested by provision of soak aways and recharge wells from roof top and paved area recharge is 235,950 cum. Since most of the area where the resort villas and Premium Resort villas are located is primarily laterite, the runoff is seen to be recharging ground water aquifers today and provision of the central raw water tank of 10,000 cum capacity will not materially impact the recharge potential in the area. The proponent is seeking approval of Ground Water Board for tapping bore wells to cater to 300 cmd water requirement during non monsoon season. Rain water harvesting from roof tops and paved areas are deemed as significantly positive steps to reduce impacts due to the project.

Establishment of Rainwater Harvesting Bodies

The Golf Course Routing Plan envisages the establishment of 2 rainwater harvesting bodies, totaling a capacity of around 40,000 Cu m. The rainwater harvesting bodies will store runoff water generated during heavy monsoon showers. The water stored will be used to supplement the requirements of both, construction and operation phases, thus resulting in substantial saving of water sourced from the public water supply. The containment of water in the rainwater harvesting bodies will be enhanced by the installation of a specialized liner material which will prevent losses due to percolation.

2.10.4.3 Landscaping Using Water Conservation Techniques

a) Use of Paspalum grass as species for Turf:

The turf grass, proposed for use on the golf course is belongs to genus **Paspalum** which has several benefits over commonly used grass species. It is most suited for cloudy climate as it does not lose its green luster in low light intensities. It is a highly draught tolerant species and can also tolerate higher salinity upto 6000 ppm. During the grow-in stages of the golf course construction, irrigation applications are required every day, but since all 18 holes are not grassed at once (typically grassing is done in groups of 3-4 holes at a time) the daily water need will be reduced substantially. Also, during monsoon the need for daily irrigation will not arise.

2.10.4.4 Water balance

Using various water conservation techniques, water balance for monsoon and non monsoon seasons is presented below:

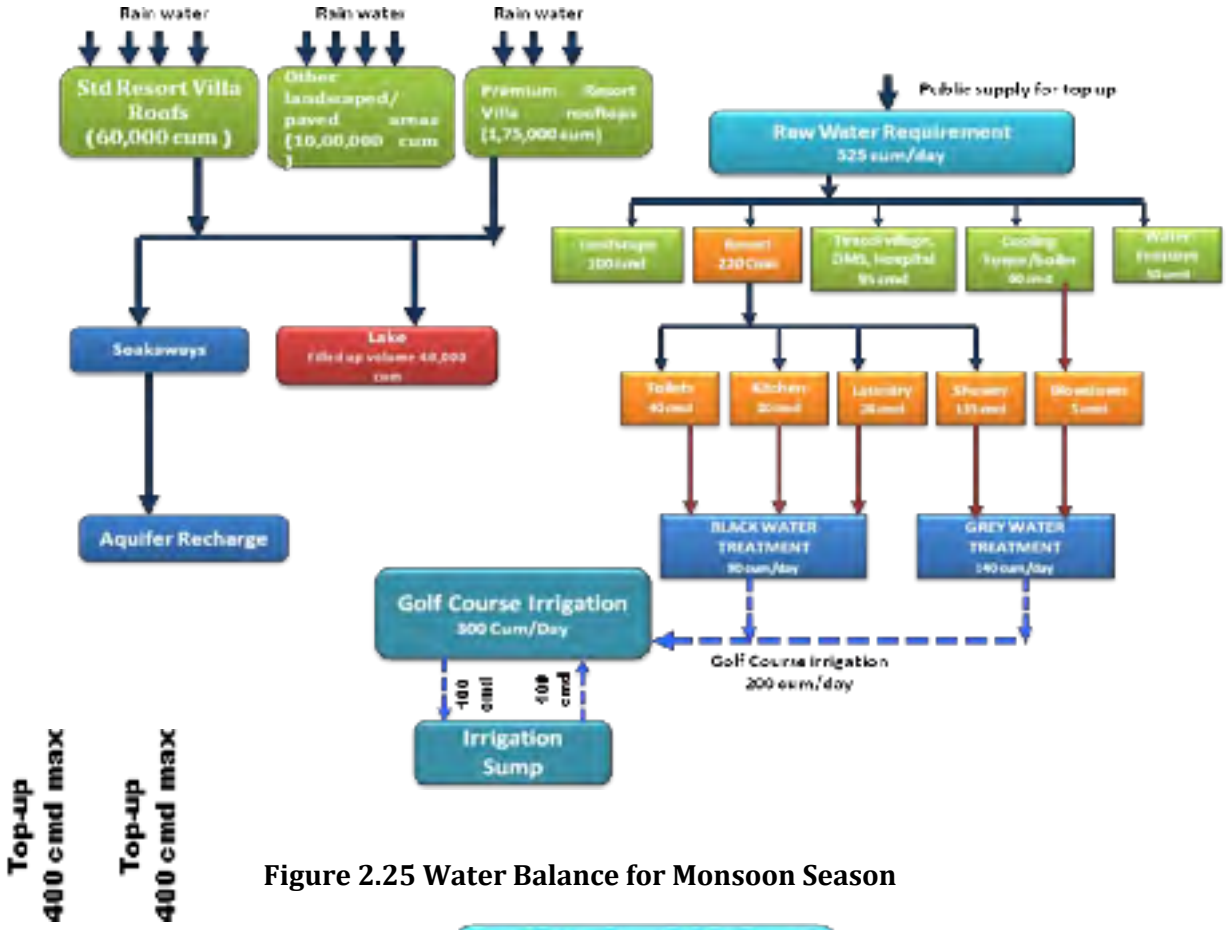


Figure 2.25 Water Balance for Monsoon Season

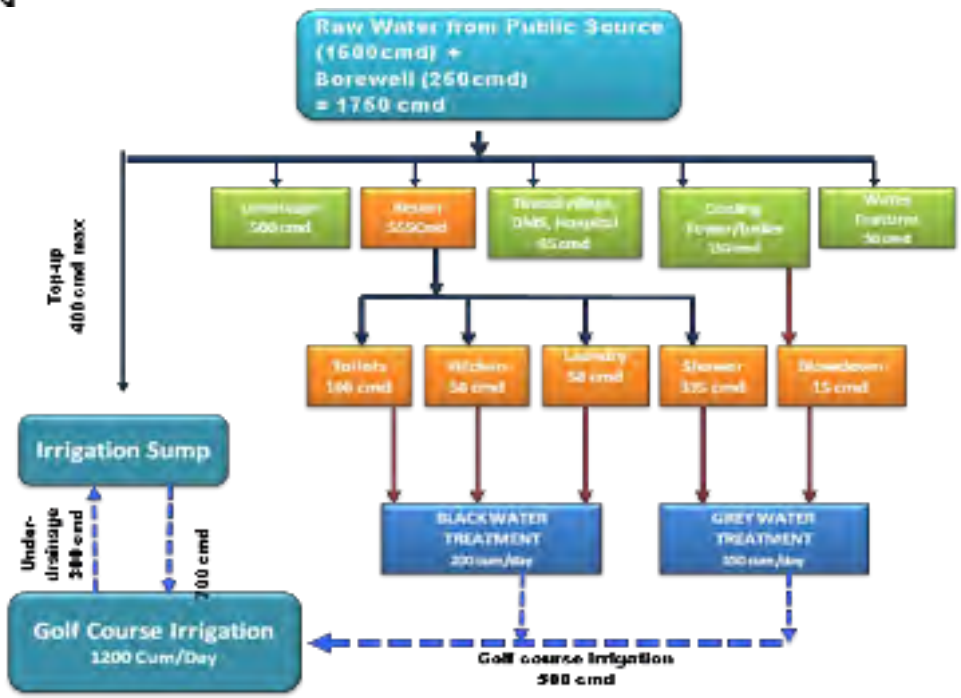


Figure 2.26 Water Balance for Non Monsoon Season

2.11 Solid Waste Management

Estimates for volumes of waste generated are based on the Standard – Waste Management in Buildings - Code of Practice (BS 5906:2005).

2.11.1 Office / Commercial Waste

Sorting Strategy

The office generally generates dry waste which can be easily separated into separate bins at each location and be collected and brought to the central waste management centre.

Quantity of Waste Generated

Based on the gross floor area and the Occupant Density, the total amount of waste generated is estimated at 2.9 m^3/ day for the office and institutional component, as shown below**.** The office area includes the Lobby/ Front desk, the Banquet/ Meeting area and community hall and school.

Table 2.18 Waste Generation in office Building

Type of Building	**OFFICE**
Area of Office	4060 m^2
Occupant Density	10 m^2 /Person
Number of Occupants	406 Persons
Waste Generated	50 L/Person/Week
	2900 L/Day
Total Volume of Waste Per day	2.9 m^3 /day
	*1305 kg/ day

**density of solid waste is considered as 450kg/cum*

Generally, office waste comprises of mostly paper and cardboard based waste, which is easily and widely recycled. Expected composition of waste stream is shown below:

Break down of Waste (Daily)		
Paper	54%	1.5 m^3
Glass	2%	0.1 m^3
Metal	2%	0.1 m^3
Plastic	11%	0.3 m^3
E Waste	0.1%	0.01 m^3
Organics & Other Waste	31%	0.9 m^3

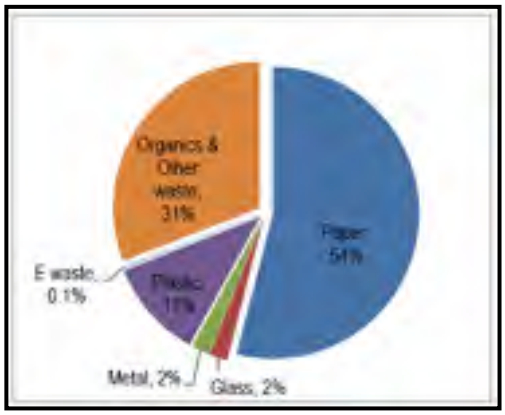


Figure 2.27 Composition of office waste

2.11.2 Resort Waste

Sorting Strategy

Waste which is generated by hotel guests in the rooms will be collected by the cleaning staff

and separated at source by them, due to the relatively small amount generated in each room. Generally in the room itself there will be little organic waste, making sorting and transporting easier. This waste is then transported directly to the waste centre.

Quantity of Waste Generated

Based on the number of bedrooms of the resort, the total amount of waste generated by the guests is estimated at 18.3 m^3 / day, as shown below**.**

Table 2.19 Waste Generation in the Resort

Type of Building	**Hotel**
No. of Hotel Rooms	369 Bedrooms
Waste Generated	350 L/bedroom/Week
Total Volume of Waste per day	18.3 m^3 / day
	*8235 kg/ day

**density of solid waste is considered as 450kg/cum*

Resort waste contains generally much higher content of organic material than commercial/office waste, at around 50%.

Break down of Waste (Daily)		
Paper	33%	6.0 m^3
Glass	5%	0.9 m^3
Metal	3%	0.5 m^3
Plastic	8%	1.5 m^3
E Waste	0.1%	0.1 m^3
Organics & Other Waste	51%	9.3 m^3

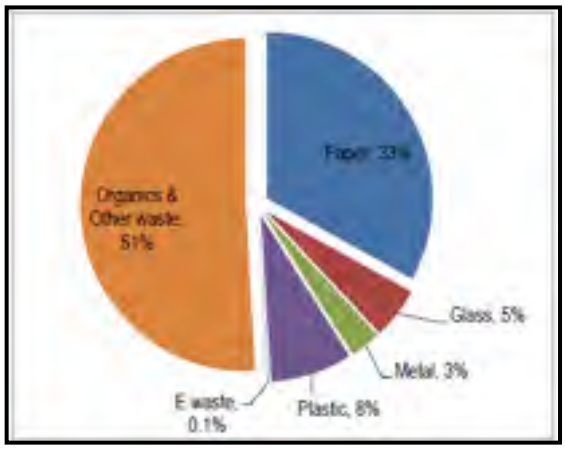


Figure 2.28 Composition of Resort Waste

Restaurant Waste:

Sorting Strategy

Solid Waste which is generated by restaurants will be collected and sorted at source by the restaurant & kitchen staff. Separate bins for compostable and non-compostable organic waste will be provided in the kitchens, as well as for recyclable materials. Staff will be trained to sort out the waste streams correctly.

Quantity of Waste Generated

Based on the number of seats in the resort, the total amount of waste generated by the restaurant guests is estimated at 1.3 m^3/ day, as shown below:

Table 2.20 Waste Generation from Restaurants

Type of Building	**Restaurant**
Number of Seating	470 Seats
Cover Density	4 Seats/Table
Waste Generated	75 L/Table/Week
Total Volume of Waste per day	1.3 m^3 / day
	585 kg/ day

**density of solid waste is considered as 450kg/cum*

Restaurant Waste contains generally much higher content of organic material than commercial/ office waste or hotel waste, at around 90%.

Break down of Waste (Daily)		
Paper	2.5%	0.03 m^3
Glass	2.5%	0.03 m^3
Metal	2.5%	0.03 m^3
Plastic	2.5%	0.03 m^3
E Waste	0%	0 m^3
Organics & Other Waste	90%	1.13 m^3

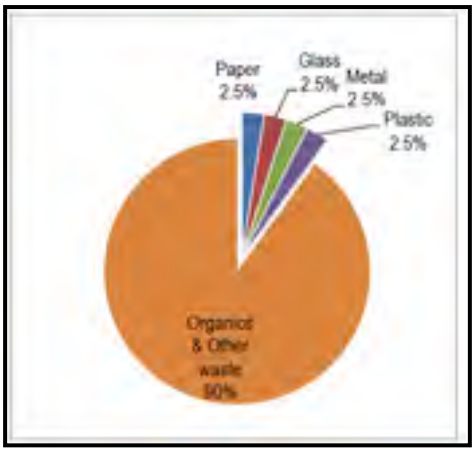


Figure 2.29 Composition Of Restaurant Waste

2.11.3 Management and disposal plan of used cooking oil from restaurant

Following are the measures for safe management and disposal of cooking oil from restaurants:

1. <u>For safety purpose</u>

- Hot cooking oil should always be allowed to cool down first before removing it from the cooking device.
- If the hot cooking oil accidently gets spilt on yourself, it can cause severe burns.
- If a small amount of cooking oil is left over in the pan, then first it should be cooled and then wiped with a paper towel. The oil should never be poured down in the kitchen drain.

2. <u>Select the right container for oil</u>

- A non-breakable and preferably plastic container should be selected for oil which works better than the glass container.

- The oil should be strained while pouring it into the container. This ensures that no small particles of food enter the cooking oil container and cause mould to grow.

3. Donate your cooking oil

- The used cooking oil if donated, will be used to make grease. The grease will be converted into clear burning Biodiesel. Biodiesel is non-toxic. Biodegradable fuel can also be used in car's engine.

4. Freeze your cooking oil

Cooking oil may also be frozen in the refrigerator. This will have two purposes:

1. It is easier to dispose off when it is solid.
2. It can be reused after it has thawed.

5. Reuse the cooking oil for another meal.

Oil can be used for cooking/ frying several times as long as it is filtered in between uses.

6. Use for making an Oil Lamp

Oil lamps are used when the power goes off.

7. Feed it to livestock occasionally

Cooking oil may be mixed with stale bread, old rice or any grain product and fed to animals.

8. Use to make soap.

9. Unwanted oil may also be used in the garden as an organic insect pest spray. One cup of unwanted oil with few table spoons of baby shampoo with little warm water may be mixed and then sprayed by a sprayer.

10. Used oil may be used in diesel vehicles with a conversion kit that allows use of (filtered) waste vegetable oil directly in the vehicle as fuel.

2.11.4 Management of Solid waste

1. Providing Baler to reduce Volume

The amount of storage required for solid waste is dependent on two variables:

1. Frequency of collection

2. Degree of compaction

Based on the projected variables the following volumes would be required for storage purposes based on solid waste removal once every second or third day.

Table 2.21 Un-compacted waste volume

Before Compaction			
Material	Storage Volume Required (M^3)		
	Collection Frequency (Day)		
	1 Day	2 Days	3 Days
Paper	9.4	18.8	28.2

Before Compaction			
Material	**Storage Volume Required (M^3)**		
	Collection Frequency (Day)		
	1 Day	**2 Days**	**3 Days**
Glass	1.3	2.6	3.9
Metal	0.8	1.6	2.4
Plastic	2.2	4.4	6.6
E Waste	0.1	0.2	0.3
Organics & Other Waste	14.0	28	42
TOTAL	**27.8**	**55.6**	**83.4**

For such developments, compaction of organic and non-recyclable waste in a large central compactor is highly recommended due to the large volumes generated. The high water content of organic waste means that it is less compressible, therefore a compaction ratio of 4:1 is a realistic expectation of a reduction in waste.

Dry recyclable waste such as metals, paper, cardboard and plastics can also be provided with a small scale compactor as these materials are much more compressible than organic waste due to their low water content and high void ratio. The volume of such materials can be reduced by 85%-90%, thus a compaction ratio of 10:1 can be assumed.

Table 2.22 Compaction Ratio

Compaction Ratio	
Paper	10.1
Plastic	10.1
Organic Material	4.1

Estimated storage volumes and the corresponding areas required are shown below based on a standard recycling bin volume of 1.1 m3.

Table 2.23 Total Waste Volumes With Varying Collection Frequencies & Compaction

Material	Before Compaction (M^3)	No. of Bales/ bins	After Compaction (M^3)	No. of Bales/ Bins
Daily Collection				
Paper	9.4	9	0.9	1
Glass	1.3	2	1.3	2
Metal	0.8	1	0.8	1
Plastic	2.2	3	0.2	1
E Waste	0.1	1	0.1	1
Organic & Other Waste	14.0	NA	3.5	NA
Total	**27.8**	**16**	**6.8**	**6**

Material	Before Compaction (M^3)	No. of Bales/ bins	After Compaction (M^3)	No. of Bales/ Bins
Collection Every Second Day				
Paper	18.8	18	1.88	2
Glass	2.5	3	2.55	2
Metal	1.6	2	1.6	2
Plastic	4.5	5	0.45	1
E Waste	0.2	1	0.2	1
Organic & Other Waste	28.1	NA	7.02	NA
Total	**55.7**	**29**	**13.7**	**9**
Collection Every Third Day				
Paper	28.3	26	2.83	3
Glass	3.8	4	3.82	4
Metal	2.4	3	2.4	3
Plastic	6.7	7	0.67	1
E Waste	0.23	1	0.23	1
Organic & Other Waste	42.1	NA	10.53	NA
Total	**83.6**	**41**	**20.49**	**12**

Thus, it can be seen that the overall waste volume will be reduced by upto 25% by the use of Baler/compacter.

2. Composting of Biodegradable Waste :

The organic/biodegradable solid waste will be stored in a cold room and taken for composting in a mechanical composting unit to be located in the Garbage management centre (GMS). A Biogas Plant (100 cum) based on kitchen /garden waste is also proposed. Patented systems such as one by Excel Industries Ltd, Mumbai are being explored for the mechanical composting unit. The system generally comprises:

Removal of all inserts/glass/plastic etc

Shredding of waste

Mixing of microbial culture /inoculums and waste

Curing in controlled moisture conditions

The block diagram showing the composting process is enclosed below.

Figure 2.30 Mechanical Composting Process

The specifications for mechanical composting, showing area required, power required are as follows:

- Input: Segregated organic waste
- Model: OWC-300
- Capacity: 125 kg per batch
- Batch time: 10-15 minutes
- Power: 13.5 HP
- Area: 3m x 4m for OWC

2.12 Air Pollution Generation

The resort in its operation phase will generate air pollution due to use of HSD in DG sets and boilers as also due to vehicular exhausts. The details of stacks and quantum of emissions expected are given below

Table 2.24 Stack and Fuel details

	Back up DG sets	**Boiler**
Total no.	6	2
Number of stacks	6	2
Stack Height above ground (m)	22	22
Capacity (KVA)	750 kVA each	2 TPH
Fuel type	HSD	HSD
Fuel consumption (kg/hr)	130	150
Temperature (^{0}C)	180	180
Velocity (m/sec)	16	6.5
Expected Emission Characteristics		
Flow rate (Nm^3/hour)	4,540	6,500
TPM (mg/Nm^3)	< 150	< 150
SO2 (gm/sec)	0.36	0.50
NOx (gm/sec)	0.14	0.19

2.13 Resort Construction Stages and Schedule of Development

Resort construction shall follow the following stages:

- Geotechnical investigation, Land survey, etc.
- Preparation of Master Plan with Golf course layout
- Detailed designing of Standard and Premium Villas and associated facilities
- Site leveling and excavation, Construction of approach roads, etc.
- Construction of resort buildings and associated facilities, construction of golf course and water features
- Finishing and furnishing, plumbing, electrical works, furniture installation, etc.
- Commissioning and handover.

As per the earlier schedule, the project was slated for completion in December 2016.

Table 2.25 Original Project Schedule

S.No	Activities	Start Date	Completion Date	Expected Approval Time
1	NOC FROM FOREST (Progressive)	20th Dec'12	19th Dec'13	12
2	MASTER PLAN FROM TCPA	5th Dec '12	1st Feb'13	2 months
3	CORRIGENDUM OF SANAD	5th Dec'12	1st Feb'13	1 month
4	NOC FOR BUILDING CONSTRUCTION	24th Dec'12	15th April'13	4 months
5	CONSENT TO ESTABLISH FROM GSPCB	1st March'12	23rd Jan'13	13 months
6	GCZMA & MoEF	1st Dec'12	23rd Jan'13	4 months
7	NOC FROM PWD	1st June '13	1st July'13	1 month
8	NOC FROM VILLAGE PANCHAYAT	1st July '13	1st Aug'13	1 month
9	NOC FROM FIRE DEPARTMENT	1st Aug'13	1st Sept'13	1 month
10	NOC FROM URBAN HEALTH DEPT	1st Aug'13	1st Sept'13	1 month
11	ENVIRONMENTAL CLEARANCE	24th Jan '13	24th Aug'13	7 months
12	CIVIL WORKS CONSTRUCTION	1st Oct'13	1st July'14	9 months
13	GOLF COURSE CONSTRUCTION	1ST Oct'13	1st Oct'15	24 months
14	MEP WORKS	1st Mar'14	1st Apr'15	12 months
15	INTERIOR WORKS	1st Sept'14	1ST Feb'16	18 months

Update:

The NOCs/ Approvals as given in sr. no. 1 to 5 above have been obtained and the balance Approvals are in progress.Thus, the project is delayed and would be completed within 36 months from the receipt of all statutory approvals.

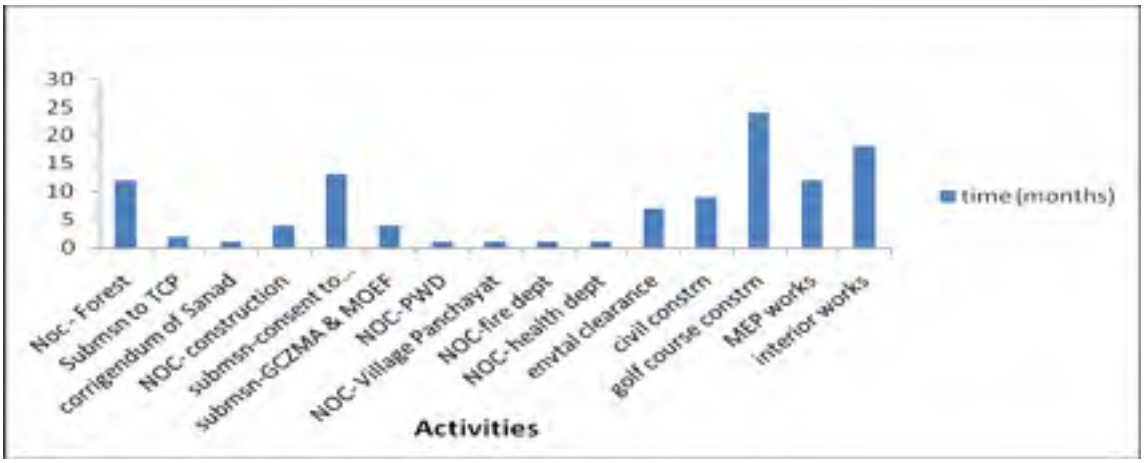


Figure 2.31 Original Project Schedule

The above figure 2.31 represents the original project schedule.

2.14 Project Cost

The total investment in the project will be about INR 505 crore, break up as under :

Table 2.26 Project Investment

Sr. No.	Head	Cost (INR Crore)
1.0	Land	110
2.0	Building	90
3.0	Plant and Machinery	95
4.0	Other fixed assets	100
5.0	Preoperative expenses, Consultancy fees, Legal expenses etc	110
	Total	**505**

3 DESCRIPTION OF THE ENVIRONMENT

The baseline data on the pre-expansion status of the terrestrial environment covering land environment, biological environment (flora & fauna) & socio-economic environment in the study area was collected by undertaking Primary surveys through field visits, monitoring and laboratory analysis. Secondary data was collected from relevant agencies, such as Raigad Town Planning, Forest Department and Directorate of Census Operations. The baseline data collected and generated, together with the relevant project activities will be considered for predicting the likely impacts of the project on the environment. Subsequently, an appropriate environmental management plan (EMP) will be presented to enable the project proponent to run the project within acceptable level of environmental impact and meet the compliance of the regulatory criteria (MOEF's Guidelines). An Environmental Impact Statement (EIS) will be ultimately made to summarize the post project status of the terrestrial environment, with the project proponent incorporating the suggested EMP measures.

For the purpose of assessing the impacts, study area of 10 km radius around project site was identified for the EIA as per MOEF guidelines. The environmental aspects were assessed through surveys, field monitoring and available existing secondary data and information. Reference to past studies and reports was also made. Each of these environmental features has been described in the following sections.

Table 3.1 Environmental Aspects

Sr. No.	Aspect	Mode of Collection	Parameters	Frequency of Collection	Source
1.0	**Land Environment**				
	Landuse	Secondary	i. LULC classification ii. DEM	Range from Oct 2008 to Jan 2011 Jan 2017	Multitemporal Satellite Images IRS P6 LISS 3and LandSat 5 and IRS P6 LISS IV from NRSA. DSLR Map Google earth
	Soil and Geology	Primary	Soil pH, moisture, water holding capacity, particle size, texture, phosphate, chloride, sulfate , organic carbon, conductivity, TKN, potassium	Sampling in summer 2011 and in February 2017 as prescribed by the EAC for one month	Field studies
	Topography and drainage	--	--	--	Contour Map
2.0	**Air Environment**				

Sr. No.	Aspect	Mode of Collection	Parameters	Frequency of Collection	Source
	Meteorology	Secondary	Temperature, rainfall, humidity, wind speed and wind direction.	2011	IMD, Panaji, Goa
	Ambient Air	Primary	SO_2, NOx, PM10, PM2.5 and CO.	Sampling in summer 2011 and in February 2017 as prescribed by the EAC for one month	Field studies
3.0	**Noise Environment**				
	Noise	Primary	Leq [dB(A)]	Sampling for 24 hours in summer 2011 and in February 2017 as prescribed by the EAC for one month	Field studies
4.0	**Water Environment**				
	Hydrogeology	Primary	Resistivity survey	One year May 2010 to May 2011	Field studies
	Ground Water	Primary	Physico chemical Parameters pH, color, turbidity, Hardness (Ca, Mg & Fe), sulfates chlorides, TDS, alkalinity, iron, manganese, calcium, copper, magnesium, mercury, cadmium, arsenic and lead. Micro Biological Parameters E.Coli, coliforms, additional parameter in summer 2013: pesticides	One sample at each location during summer 2011 and additionally in summer 2013 (as required by SEAC and TAC of GSPCB). Additionally in February 2017 as prescribed by the EAC.	Field studies
	Surface Water	Primary	TDS, Salinity, Chloride, sulfates, TSS.	One sample at each location. Once in month from Dec 2010 to Dec 2011. Additionally in	Field studies

Sr. No.	Aspect	Mode of Collection	Parameters	Frequency of Collection	Source
				February 2017 as prescribed by the EAC.	
5.0	**Biological Environment**				
	Vegetation pattern	Primary	Flora and fauna	three visits to site	Field studies
		Secondary	Flora- tree census carried out by proponent	--	
6.0	**Socio-Economic Environment**				
	Socio-economy	Secondary	Population, sex ratio, literacy rate and occupation	--	Census of India, 2011

3.1 Land Environment

3.1.1 Local Setting

The study area is located in Tiracol village of Pernem taluka in Goa. It is a small coastal village located at the North Western extremity of the state, and covering an area of 1.43 sq. km. It is the only village in Goa, which is located across the river Tiracol, at the scenic junction of the river with the Arabian Sea. Being a coastal village it is bounded on the Western side by Arabian Sea and on the Northern and Eastern side by the Maharashtra state. It is located within latitudes 15º43'13"N and 15º43'48.52"N and longitudes 73º40'32.03"E and 73º41'47.90"E. The region is shown on the Survey of India Toposheet No. 48E 10/4 in 1:25000 scale. The area being across the river mouth is not yet connected by road to the rest of Goa. Thus, the people have to depend on the ferry service to cross the river, or take the longer road route through Maharashtra to re- enter Goa.

The nearest railway station is Pernem located 11km, towards the East. Dabolim is the nearest airport at a distance of about 40 km South of site, whereas the proposed Mopa airport in Pernem is located about 17 km SE of the site.

The steel unit of Tata Metallics Ltd. lies towards the North of the site and is presently non-operational. Tiracol fort is located on the sea coast beyond the site boundary to the South. The village Tiracol is on the sea coast near the Southern boundary of the site.

The maximum length of the plot is about 1.5 km along East-West direction and about 1km along North- South direction.

The project site occupies an area of 244.6 acres (9,90,000 sq m.) The Golf course will be developed over an area of 139 acres (approx 5,62,592 sq.m) whereas the villas and associated facilities will be developed over 105.6 acres (4,27,408 sq.m).

3.1.1 Site Connectivity

The proposed project site is accessible by road, rail, air and sea.

Rail connectivity: Sawantwadi & Pernem are the nearest railway stations.

Air connectivity:-Proposed Airports of Sindhudurg and Mopa are located about 30 km NE and 17 km SE from the site, respectively. Dabolim airport is located 40km to South

Road connectivity: Nearest National Highway is NH 17- and site is connected to it by the Tiracol-Shiroda road which leads upto Tiracol Fort.

Sea connectivity: The Ferryboat jetty of Tiracol village is nearest to the site. It connects Tiracol to Querim Beach in Goa and to Arabian sea via Tiracol estuary.

Connecting Bridge- there is a proposal of Government of Goa to construct a bridge on the Tiracol river connecting Tiracol village to the rest of the state.

3.1.2 Roads and Traffic

The National Highway no.17 (NH17) is located about 16 km SE of the project site. The site is accessible by an asphalted road which further bifurcates and runs along the East and North boundaries of the plot.

The South and West edges of the site along the Arabian sea are bound by a cliff. The road traveling on the Northern edge of the plot leads further to the industrial unit of Tata Metallics located to the North of project site in Redi village of Sindhudurg district in Maharashtra. The Redi village also has two active iron ore mines in it belonging to ILPL group of Goa- which operate during non monsoon season.

Figure 3.1 Satellite image showing existing site connectivity

The Tiracol-Shiroda road is a single lane 4.5m black macadam road having very less traffic (90 cars per day and similar number of two wheelers) (please refer Chapter 3, sr. no. 3.9 for details of traffic survey carried out at site). The Querim- Dhargal road which connects site to NH17 is a 4.5 m wide road having very low traffic (maximum 15 PCU per hour) which mainly comprises village traffic and tourists visiting Tiracol Fort/ Querim beach.

Figure 3.2 Satellite image showing Alternate Access to Site

3.1.3 Regional Setting

The Mumbai- Goa National Highway no.17 (NH17) is located at about 16 km from the site and access to the site is from Shiroda- Tiracol road which leads up to the Tiracol Fort located to the South of the site just outside the plot boundary. The site is accessible by an asphalted road which further bifurcates and runs along the East and North boundary of the plot. (**Figure 3.3** presents the location of site). The South and West edge of the plot along the Arabian Sea is bound by a cliff with some rocky outcrops projecting into the sea. The site has a gently undulating terrain having a maximum altitude of about 64m from MSL. It is mostly undeveloped, unused vacant land- densely vegetated in patches with some barren lateritic outcrops. The undulating topography mainly slopes from Northwest to Southeast, flattening into a plateau overlooking the Arabian Sea. Higher view points towards the eastern side reveal a breathtaking and majestic view of the coast and the Tiracol river estuary with mangroves, as well as the fishing village along the river.

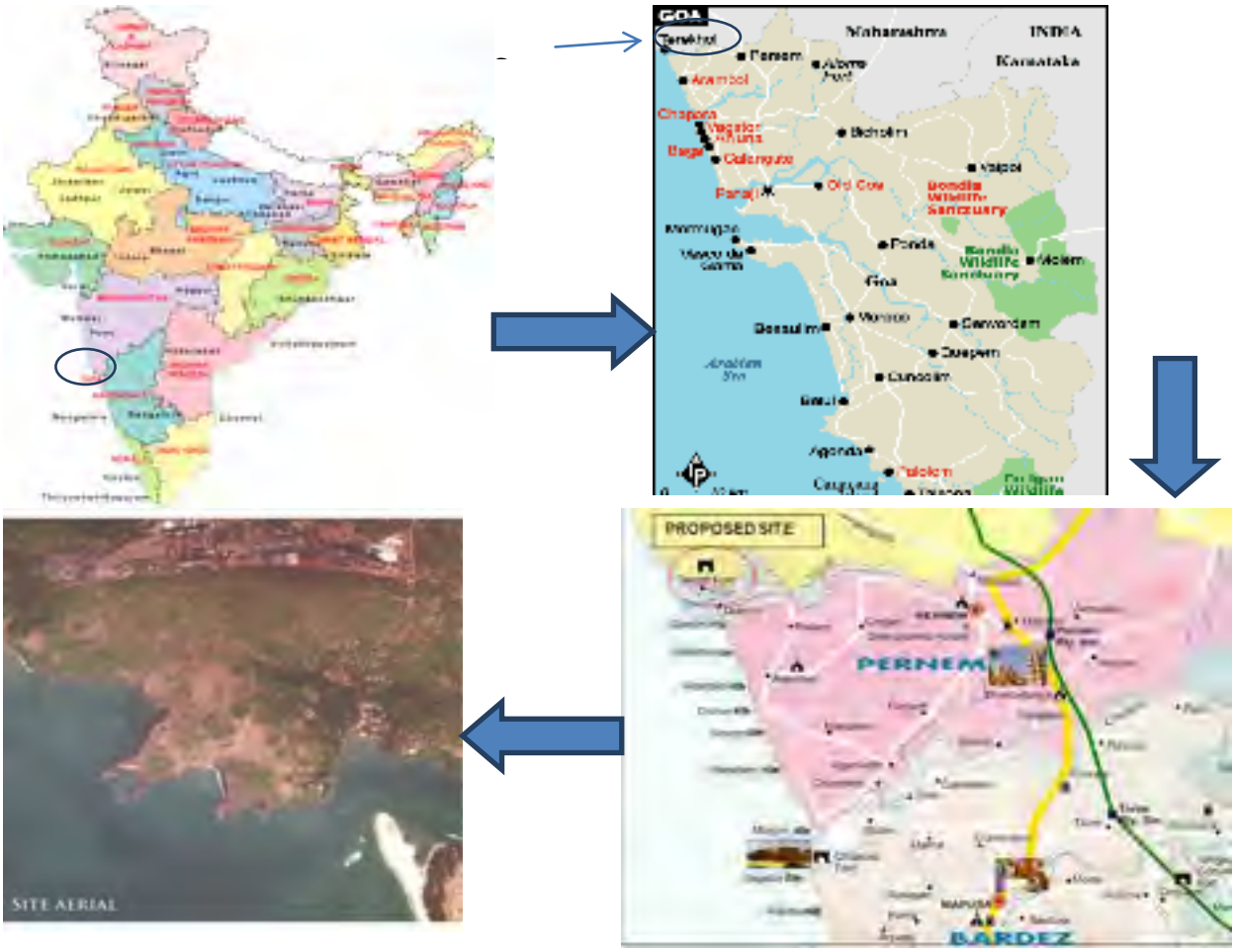


Figure 3.3 Location Map of the Site

3.1.4 Project Study Area

The following table lists out the areas within 15km of the project site which are environmentally sensitive.

Table 3.2 Environmentally Sensitive Areas in surrounding 15km area

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	ASI protected monuments (a) Tiracol Fort (b) Yashwantgad (Redi Fort)	(a) 200m distance on Tiracol plateau (b) 3km to the North in Maharashtra
2	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone,	Arabian Sea and Tiracol river- Coastal areas	The site is directly adjacent to the Arabian Sea towards west and Tiracol river on the south.

Sr. No.	Areas	Name/ Identity	Aerial distance (within 15km.) Proposed project location boundary
	biospheres, mountains, forests		
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration	Morjim beach - turtle nesting site	At about 12.7 km to the South of the site.
4	Inland, coastal, marine or underground waters	Arabian Sea and Tiracol river- Coastal areas	The site overlooks the Arabian Sea on the west and Tiracol river on the south.
5	State, National boundaries	Maharashtra State boundary	Along the northern boundary of the site.
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	Tiracol Fort	access via Tiracol jetty on the South and by road from Redi in Maharashtra to the North
7	Defense installations	No	Not applicable.
8	Densely populated or built-up area	Pernem	Located at about 13 km from the site on the south.
9	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)	New English high School, Querim, Goa. Redi Ganpati Mandir, Maharashtra	At about 1.26 km from site towards south. At about 2.83 km from site towards northwest.
10	Areas containing important, high quality or scarce resources (ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)	Iron ore mines	located at Redi in Maharashtra, approx. 1km to the North
11	Areas already subjected to pollution or environmental damage (those where existing legal environmental standards are exceeded)	No	Not applicable.
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)	Goa lies in zone III seismic region	Designing and construction will be undertaken according to requirements of seismic zone III.

Toposheet showing environmentally sensitive areas within 15km and 2km in the vicinity of the site is presented as **Annexure XI.**

3.1.5 Land Use Pattern

Land use at Tiracol site is presented in **Fig 3.4**. As can be seen, natural vegetation is seen near the valley portion, village and the northern headland portion. The plateau area is mostly covered with grass but was previously cultivated intermittently in patches for dry crops like ragi and nachni. The portion of site towards the sea cliff on the west mostly comprises wasteland with laterite top and having coastal shrubs and cashew plantation. The soil type found in Tiracol is lateritic sandy loam, offering good moisture retention

and percolation rates. The mixture of sandy loam and humus has resulted in diverse vegetation. Dominant species include coconut and cashew nut plantations with few endemic species such as *Memecylon umbellatum* (Anjan), and *Garcinia indica* (Kokum).

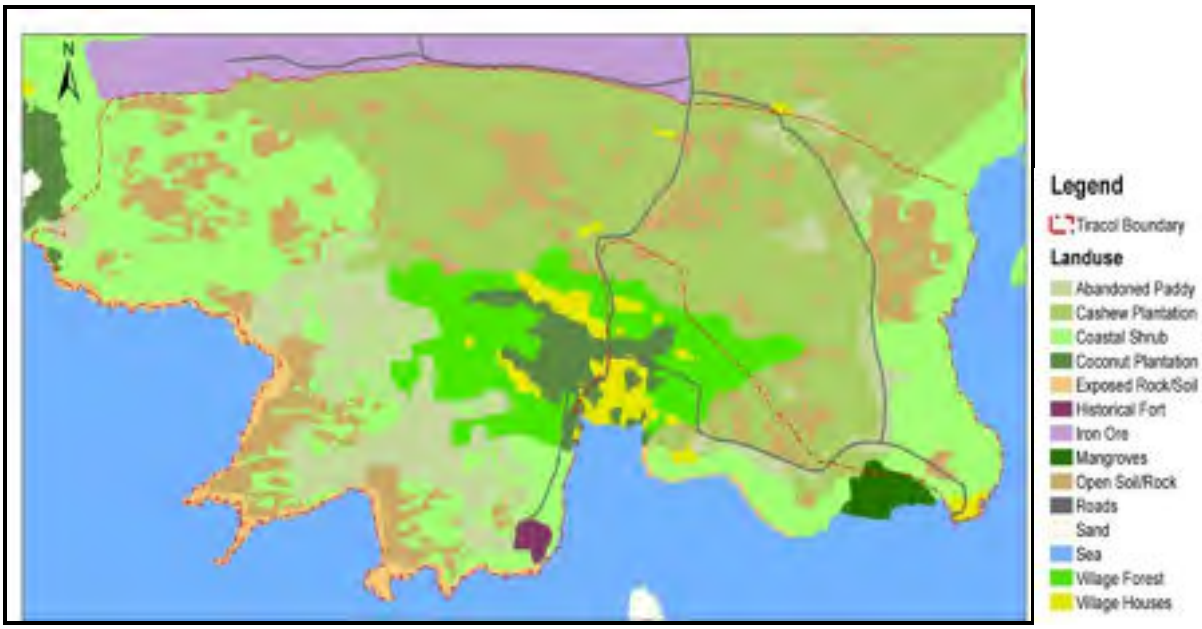


Figure 3.4 Current Land Use Of Site

*Please refer **Annexure XII** for conversion Sanad.*

3.1.5.1 LULC studies for Study Area (10km radial distance from site)

The study area includes a buffer zone of 10 Km around the central co-ordinate of the Tiracol project site falling partly in the North Goa district of state of Goa and partly in Sindhudurg district of Maharashtra. **Fig 3.5** shows geographical map of study area around the site. The land use/land cover map is shown in **Fig 3.6**.The percentage distribution of areas with different land use and land cover (LULC) classes within the total study area is presented **in Table 3.3** and **Fig 3.7.**

Figure 3.5 Geographical Map of Study area (10km)

Figure 3.6 Land Use/ Land Cover Map for Tiracol (Goa) Site

Table 3.3 Percentage Distribution of different LULC Classes within the Study Area

Class_Code	Class Name	Area(sq km)	Distribution (%)
1	Urban	0.000	0.000
2	Village	12.447	3.659
3	Industrial Area	0.146	0.043
4	Permanent Fallow	11.608	3.412
5	Kharif Rice	31.900	9.376
6	Rabi crop	0.368	0.108
7	Double Crop (Rice)	0.000	0.000
8	Plantation (Cashew Coconut and Mango)	3.110	0.914
9	Open	21.469	6.310
10	Low Density Tree Cover	45.597	13.402
11	Dense Tree Cover	45.369	13.336
12	Mangroves	1.251	0.368
13	Wildlife Sanctuaries	0.000	0.000
14	Mining Area	1.767	0.519
15	Drainage/Nallahs	0.000	0.000
16	Canals	0.000	0.000
17	River	6.345	1.865
18	Ponds	1.086	0.319
19	Heritage site	0.101	0.030
20	Sea	157.081	46.171
21	Open Wet	0.571	0.168
	Total Area	340.216	

The total cultivable area in the study zone is approximately 43.876 sq km, which includes land under permanent fallow; kharif cropped area and rabi cropped area. There is negligible cultivation of double crops within the study area. The main kharif crop grown in the region is rice. The total area under kharif cropping pattern is around 31.900 sq km as interpreted from satellite images with random validation of classified areas through actual field survey. Some plantations, mainly of cashew, coconut and mango are also prevalent in the study zone. Classes, such as urban, industrial, wild life sanctuaries, and canals are non-existent in the study area. The tiny Tiracol village & Redi village in Maharashtra about 1.5km to North of site are the only permanent settlements adjacent to the project site . The sole heritage site is the Tiracol Fort towards the South. Mining activity in the study area is mainly for the extraction of iron ore. Mining activities are stopped during the rainy season. Tata Metallics factory stands towards the North of the site but is non- functional since October 2011.

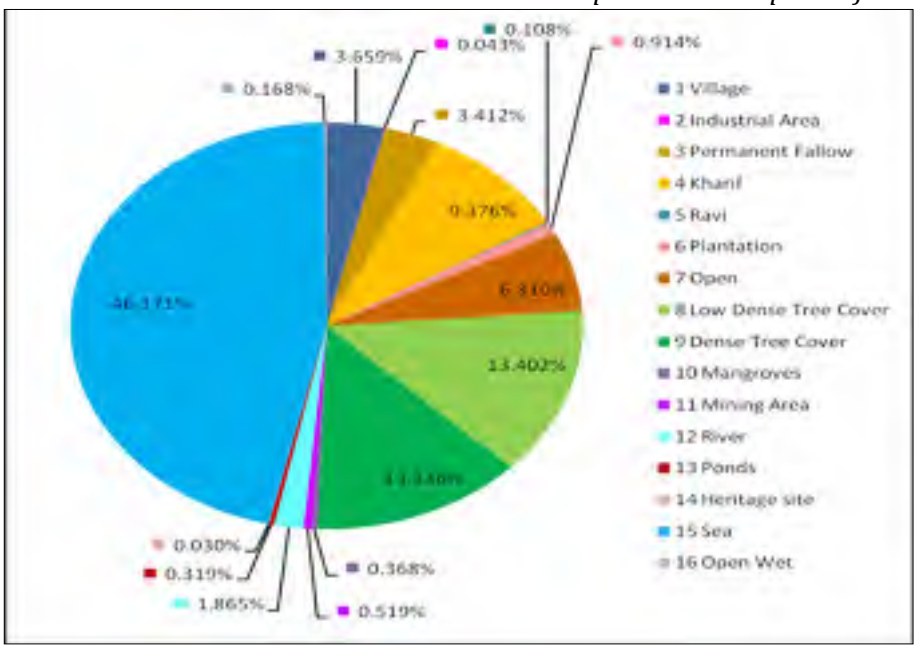


Figure 3.7 Percentage Distribution of Different LULC Classes within the Study Area

3.1.6 Geology and Soil Characteristics

3.1.6.1 Geology

The area is a part of the Goa Group of rocks and comes under Bicholim Formation. The crustal rocks of Goa are of igneous and metamorphic origin and made up of Quartz-Chlorite-Biotite Schist with layers of Chert and Iron oxides but these are often hidden below a thick weathered lateritic cap or a soil cover of varying depth. These lateritic rocks are formed due to leaching of basement rocks. Partially laterised basement rocks are exposed along the coast showing relict features as bedding and fractures. There are a few alluvial sand deposits along the Southern side of the project area.

Structurally the area is folded into anticlines and synclines having low dip. These folds are visible along the coast wherein the anticlines are represented by well terminated vertical cliffs and the syncline is represented by the wave cut platform extending in the sea. This folding has contributed to the inversion of topography seen in the area. This phenomenon is seen in the area wherein the syncline projecting into the sea is above sea level whereas the surrounding anticlines have been eroded and its place have been taken over by the sea, forming two small bays on either side of the syncline.

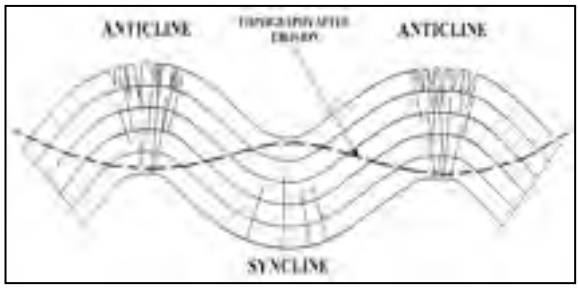


Figure 3.8 Anticline and syncline formation

3.1.7 Topology

Topographically, the area is a part of headland projecting into Arabian Sea. It can be divided into three parts –

- The Northern highland
- Headland plateau, and
- The low lying valley

The high ground has E-W trend with gentle slopes on either side. Its Western margin projects into the sea with a steeper slope forming the headland. Whereas it is intercepted on the Eastern side by another rise trending in N-S direction which itself forms a headland in the South East extremity of the village. The maximum elevation of the high ground region is 65 m above MSL. Digitized Map of Tiracol village showing surface features and topography is enclosed as **Fig 3.9.**

The plateau has a gentle North-North Western (NNW) dip and extends from SSE corner to the base of the high ground, where it grades into the low lying area situated between the plateau and the high grounds. It has a maximum elevation of 26m above MSL. On its Western margin the plateau is heavily eroded by waves, forming a number of vertical cliffs along the coast. These cliffs are progressively undercut by fresh waves resulting in further collapse and severe erosion of the rocky premonitory. It appears that over the last 45 years the sea has ingressed atleast 150 m into the land all along the length of the rocky plateau. The type of erosion occurring here is comparable to the phenomenon along the rocky coastal plateau of Anjuna (Bardez Taluka) which has also witnessed a sea ingress of atleast 200 m over the same period. Prima-facie, besides the dynamic forces of nature, the contributing factor for such excessive and rapid erosion is human mismanagement of seaside sandy patches that were converted in the past into Coconut plantations, and subsequently neglected/abandoned due to various reasons. Loss of the effective natural buffer of sandy beaches has exposed the soft laterite cliffs/plateaus to direct wave action causing progressive lateral faults/crevices and undercuts into the rocks causing huge rock collapses. The project proponent has a plan to tackle this problem and prevent further erosion through recreation of the necessary buffer between the sea and the rocky premonitory of the Tiracol site by using appropriate coastal engineering techniques and regular annual maintenance works.

The valley portion is a low lying area covering the central part of the village, and is made up of a thin layer of alluvium deposited by weathering and erosion of surrounding higher reliefs. It supports a majority of the population of Tiracol village.

Vegetation

The Northern highland has a mixed tree cover with cashew plantation. The plateau area is presently covered with grass, but was previously cultivated intermittently in patches for dry crops probably ragi. However, people have stopped agricultural activities in the past. The low lying area is surrounded by a higher topography on three sides and hence forms a natural discharge site for surrounding ground water contributing to a mixed vegetation comprising mango, coconut, bamboo, etc.

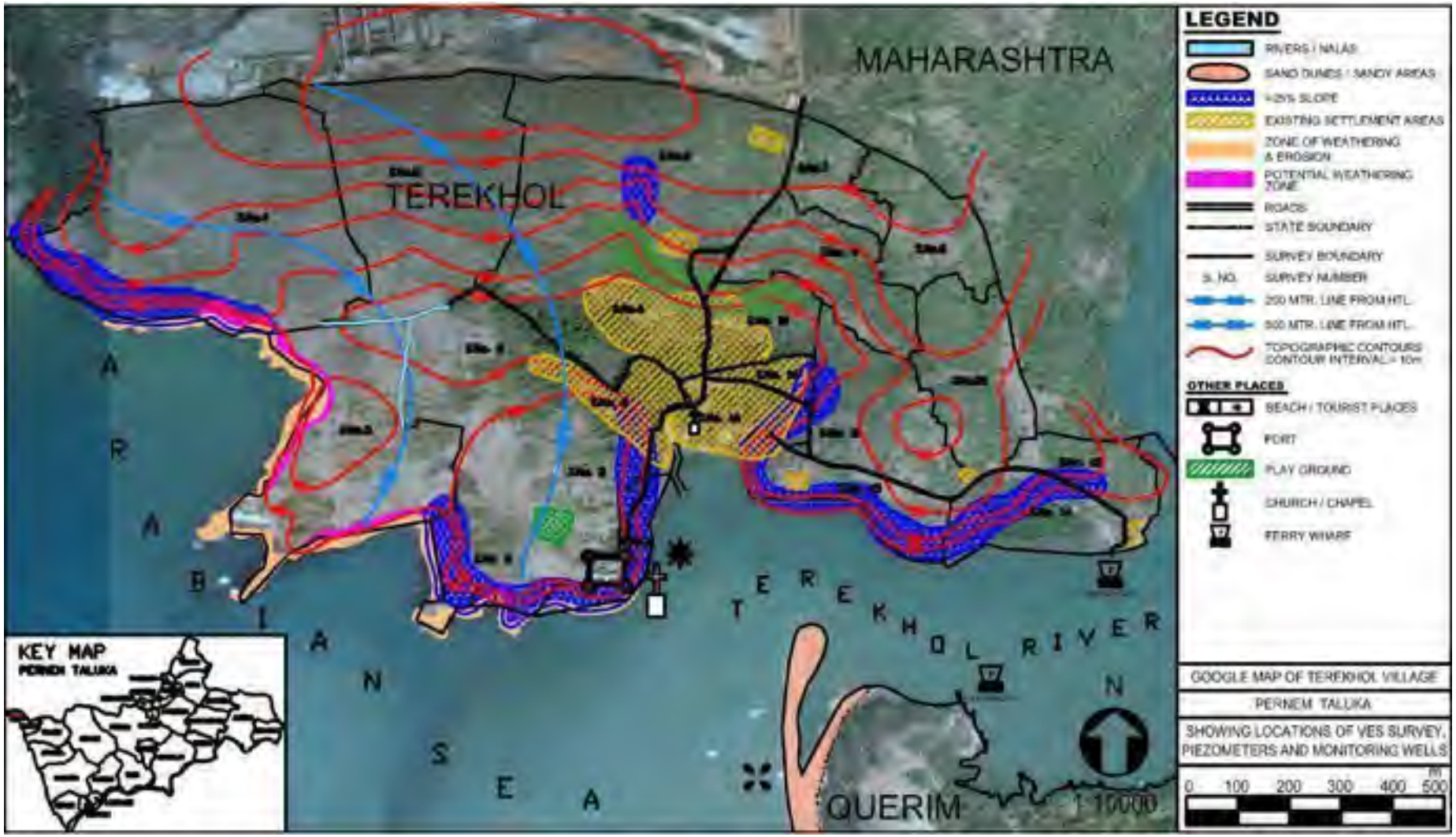


Figure 3.9 Digitized Map of Tiracol Village overlaid on Satellite image indicating various surface features

3.1.8 Geo-morphology and Soil Conditions

The South and West of the site boundary is edged with cliffs. These are formed over a period of time as a result of erosion of land and due to weathering. Sedimentary rocks such as sandstone, limestone, chalk and dolomite are most likely to form cliffs. Igneous rocks such as granite and basalt are also likely to forms cliffs. The nature of cliffs on the site under study will be evident after further study. The edge of the plot towards the South shows distinct signs of shoreline erosion over the years.

Figure 3.10 Erosion patterns observed along Tiracol shoreling

3.2 Soil Monitoring

As a part of baseline studies, soil samples were collected from the proposed site in summer 2011 to check the characteristics of soil. Additional confirmatory monitoring was carried out in February 2017 as prescribed by the EAC for one month. **Fig 3.11** shows the locations of soil sampling, chosen to represent three distinct natural landscapes on the site. Soil sampling locations are indicated in **Table 3.4** and the analytical reports are presented in **Tables 3.5** and **3.6**. It can be seen from the given data that the soil samples collected from three different locations are sandy loam in texture, with a acidic pH.

*(Soil Monitoring Reports of monitoring conducted during November 2017 are attached as **Annexure XIII**).*

Table 3.4 Soil monitoring locations

S. no.	Indicators	Location	Direction w.r.t. the site
1	S1	Near Security	On site towards East
2	S2	Towards north west	On site towards North West
3	S3	Hill top bar and restaurant	Onsite towards south east

Figure 3.11 Map Showing Soil Sampling Location

Table 3.5 Soil analysis (Summer 2011)

S. No.	Parameters	Unit	S1	S2	S3
1	pH of 20% solution	--	6.39	5.90	6.56
2	Moisture Content	%	13.00	9.56	16.52
3	Water Holding Capacity	%	62.12	61.40	73.73
4	Clay	%	7.11	6.42	10.95
5	Silt	%	13.51	14.84	20.91
6	Fine Sand	%	7.14	7.62	15.49
7	Coarse Sand	%	72.24	71.12	52.65
8	Textural class	--	Sandy Loam	Sandy Loam	Sandy Loam
9	Total Organic Carbon	%	7.5	6.75	5.25

S. No.	Parameters	Unit	S1	S2	S3
10	Chlorides	%	0.076	0.072	0.08
11	Sulfates	%	3.76	3.59	4.33
12	Phosphates	%	0.42	0.06	0.73
13	Potassium	mg/Kg	602	532	2560
14	TKN	mg/Kg	84	112	196
15	Lead	mg/Kg	17	18	12
16	Zinc	mg/Kg	23	27	11
17	Nickel	mg/Kg	40	26	59
18	Cadmium	mg/Kg	NIL	NIL	NIL
19	Mercury	mg/Kg	NIL	NIL	NIL
20	Manganese	mg/Kg	495	514	527
21	Copper	mg/Kg	12	18	2
22	Cobalt	mg/Kg	NIL	NIL	NIL
23	Sodium	mg/Kg	96	85	154
24	Chromium	mg/Kg	NIL	21	NIL
25	Iron	mg/Kg	NIL	NIL	4.29
26	Aluminum	mg/Kg	NIL	NIL	NIL

Table 3.6 Soil analysis (February 2017)

S. No.	Parameters	Unit	S1	S2	S3
	Physical Characteristics				
1	Moisture Content	%	7.9	9.2	8.4
2	Water Holding Capacity	%	11.6	8.4	11.7
3	Clay	%	2.3	2.5	3.1
4	Silt	%	19.7	10.6	11.6
5	Fine Sand	%	82.6	86.9	85.3
6	Textural class	--	Fine sand	Fine sand	Fine sand
	Chemical Characteristics				
7	pH	--	6.69	6.84	6.76
8	Conductivity	µmhos/cm	0.246	0.139	0.189
9	Sulfate	kg/Ha	56.2	87.1	63.2
10	Chloride	kg/Ha	36.3	27.4	31.8
	Fertility Status				
11	Potassium	kg/Ha	162.2	132.6	121.3
12	Total Organic Carbon	%	0.14	0.09	0.16
13	TKN	kg/Ha	3.6	2.1	2.9
14	Phosphates	kg/Ha	24.6	26.1	29.2

3.3 Topography & Meteorology

Topographically, the area is a part of headland projecting into Arabian Sea. It can be divided into three parts-

The Northern head land has E-W trend with gentle slopes on either side. Its Western margin projects into the sea with a steeper slope forming the headland. Whereas it is intercepted on the Eastern side by another rise trending in N-S direction which itself forms a headland in the South-East extremity of the village. The maximum elevation of the high ground region is 65 m above MSL

The headland plateau has a gentle North-North Western (NNW) dip and extends from SSE corner to the base of the high ground , where it grades into the low lying area situated between the plateau and the high grounds. It has a maximum elevation of 26m above MSL.

The low valley portion is a low lying area covering the central part of the village, and is made up of a thin layer of alluvium deposited by weathering and erosion of surrounding higher reliefs. It supports a majority of the population of Tiracol village.

3.3.1 Elevation Analysis

The Contour Map **Fig 3.13** shows that the total elevation changes across the site, starting at 0m and rising up to 65m. The lowest point that the current golf course routing reaches is at about 7-8m, and its highest point is at around the 65m mark. It is seen that, the vast majority of the site falls within the slope range of 0-15%. These areas are all excellent for golf, roads and development.

The following figure shows the Digital Elevation Model of an area of 2 km surrounding the proposed site for the resort. Contour levels of 2m interval are marked onto the given map. It can be seen from the map that the northern part of the site is a plateau area whereas the site slopes towards the southern and the western side.

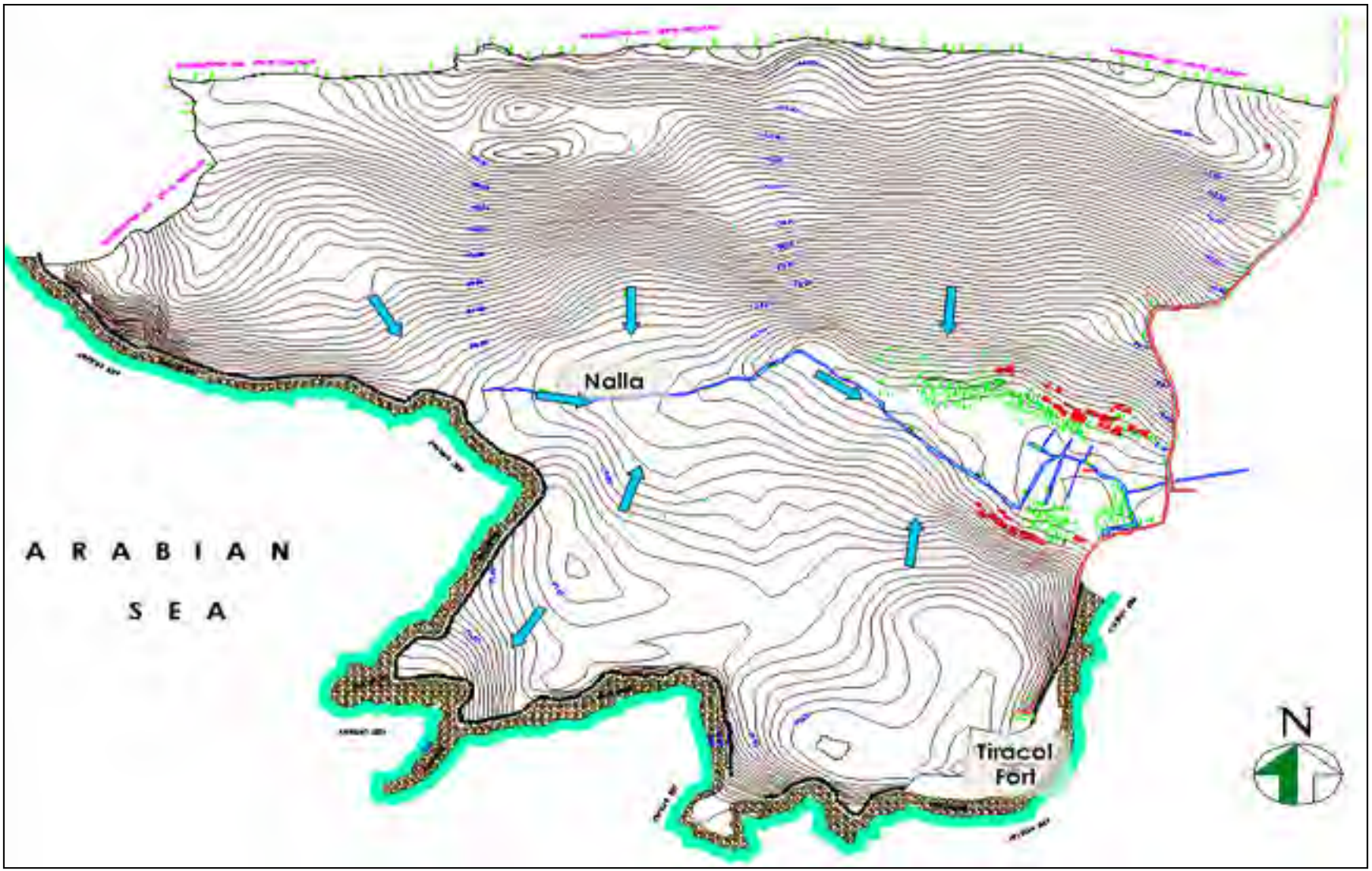


Figure 3.12 Contour Map

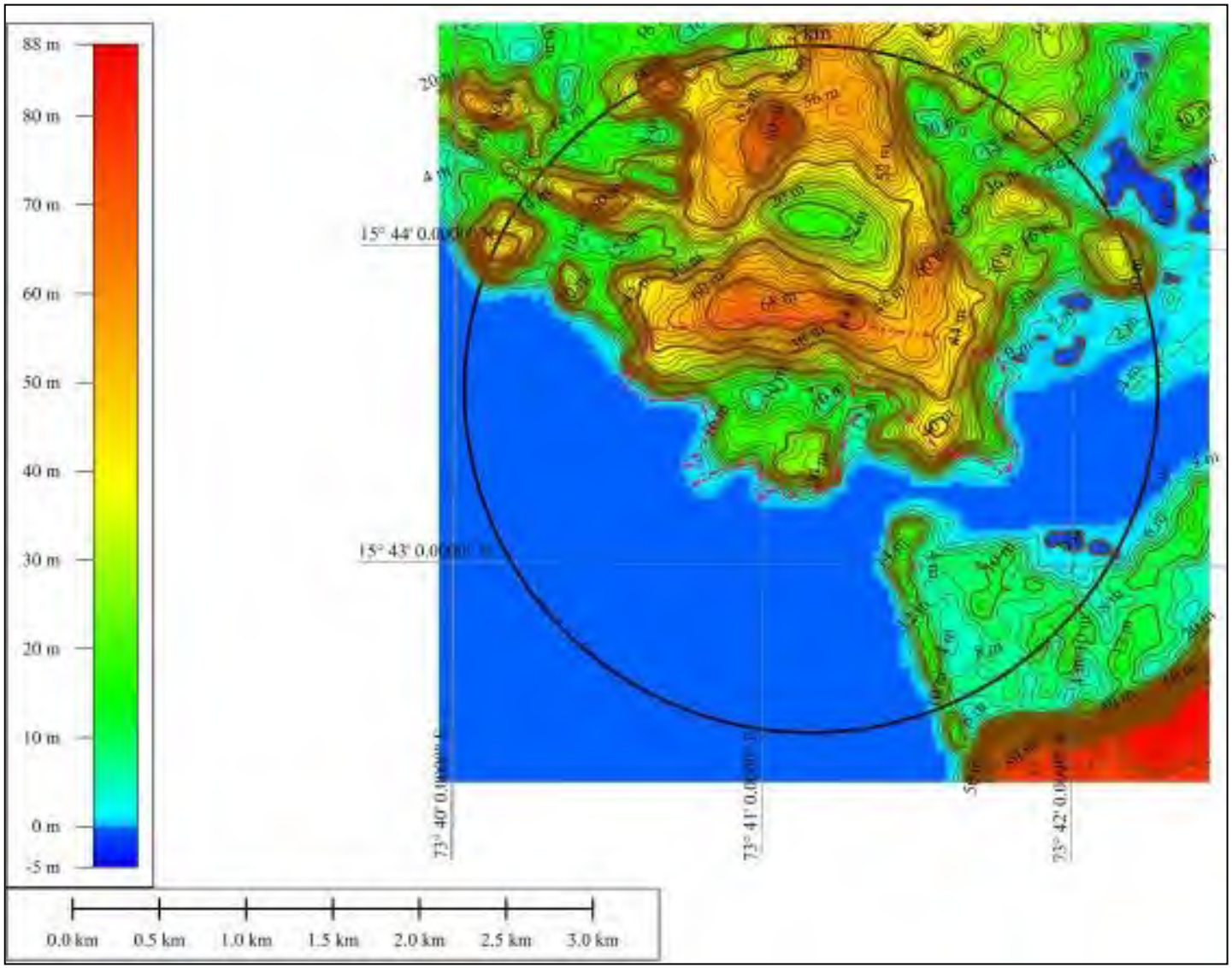


Figure 3.13 Digital Elevation Model (DEM) of Proposed Site

3.3.2 Temperature Profile

Goa has a typical tropical warm and humid climate. The diurnal range of temperature during the day is not large. It is at the minimum of 4^0 C during the monsoon season and increases to the maximum of 10°C during December and January. May is the hottest month when the mean daily temperature increases to 30°C. January is the coolest with a mean daily temperature of about 23°C. The summer season lasts from March to May while November to February is the winter period. The South-West Monsoon season spreads from June to October.

The range of temperatures during the year varies from a monthly minimum of 20ºC in December to a monthly maximum 34ºC in May (**Table 3.7**). Due to North-East monsoon, a few showers may also occur in November. Due to proximity to the Arabian Sea, humidity throughout the year is more than 60% and ranges from 80 to 90% during the monsoon period.

Table 3.7 Annual Temperature variation in Goa (2011)

Months	Temperature (ºC)	
	Minimum	Maximum
Jan	21	33
Feb	21	32
Mar	24	32
Apr	26	34
May	27	34
Jun	24	31
Jul	23	29
Aug	23	29
Sep	23	30
Oct	23	31
Nov	24	32
Dec	20	31

Note: IMD, Panaji, Goa 2011

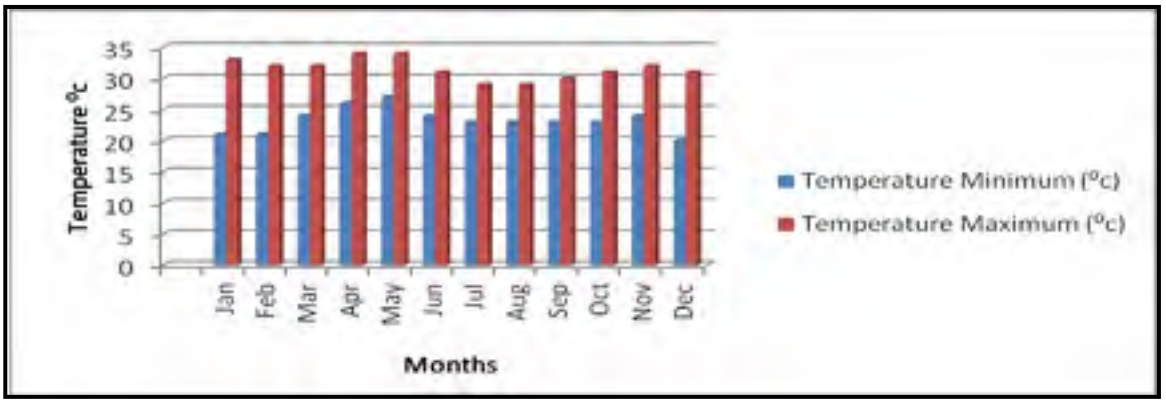


Figure 3.14 Graphical Presentation Temperature Data 2011

3.3.2.1 Rainfall

The site falls on the coast of Arabian Sea, receiving major monsoonal rainfall from June to September. With changing weather pattern, rainfall sometimes occurs even in May and up to November. The average annual rainfall recorded by Pernem Rain Guage station is 2500 mm. Climate is warm and humid and the annual temperature varies from 220 to 320. Due to proximity to the Arabian Sea, humidity throughout the year is more than 60% with it ranging from 80 to 90% during the monsoon period. Thus rainfall plays a very important role in determining the groundwater potential of the state. Replenishment of ground water is dependent upon the total annual rainfall received by the region.

Table 3.8 Annual rainfall in Goa (data for 2011)

Month	Maximum (mm)	No. of rainy days
January	0	0
February	0	0
March	0	0
April	0	0
May	0	0
June	737	17
July	1179.8	30
August	263.9	25
September	375.6	18
October	352.2	4
November	157.4	7
December	0	0

Note: IMD, Panjim, Goa 2011

The rainfall data for the year 2011 shows that the precipitation in Goa may occur from May to December with the maximum rainfall of 1180 mm in the month of July.

3.3.2.2 Wind

Wind data was collected at site by installing a micrometeorological station. Wind rose diagram gives the information regarding wind speed and direction during the monitoring period and is presented below

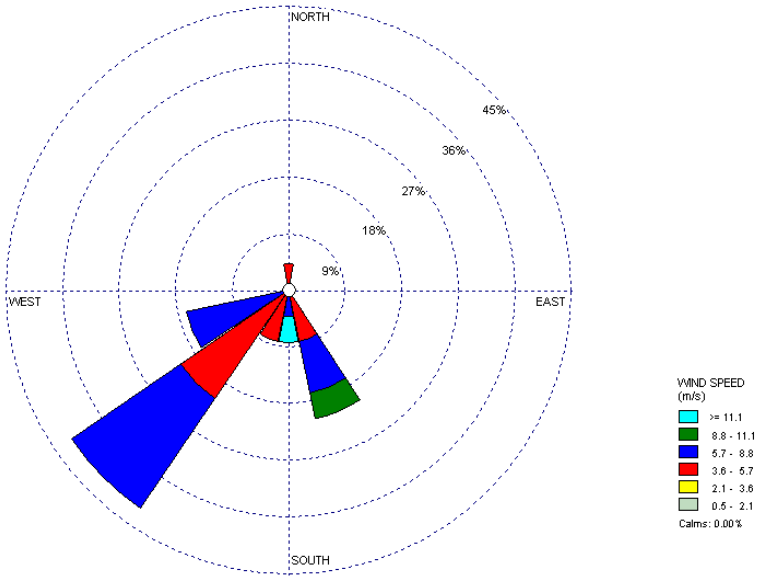


Figure 3.15 Wind rose diagram for proposed site

It is observed, from the wind rose diagram, that strong south westerly winds are observed during summer 2011 with a maximum speed of 5.7 - 8.8 m/s.

3.4 Air Environment

A methodically designed air quality monitoring program should form the basis to determine the impact assessment on air environment, which ultimately helps in formulating a sound Environmental Management Plan (EMP). The basic considerations for designing such program include:

- Representative selection of sampling locations (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 for devising an optimal scheme for Environmental Impact Assessment (EIA) around the project site.

3.4.1 Reconnaissance Study

Reconnaissance survey showed that there are no major industrial sources of air pollution – due to closure of Tata Metalics factory at Redi village. Also vehicular traffic is very low as site is far from National Highway 17 A (17 km). Only major sources of air pollution are the mines located 2km to the North of site. However, air pollution from mines comprises mostly of particulates and is highly localized along the roads. Thus, minor air pollution is caused due to use of fuel in rural households.

3.4.2 AAQM Locations and Parameters Selected

Ambient Air Quality Monitoring (AAQM) was carried out at six locations – three on the site and three in the vicinity at nearby habitations of Tiracol, Redi and Querim villages during summer season of 2011. Additional confirmatory monitoring was carried out in February 2017 as prescribed by the EAC for one month.

Fig 3.16 shows the locations of air monitoring stations. The ambient air quality monitoring results have been presented in the **Tables 3.9** and **3.10.** It can be seen that the ambient air quality is well within the limits prescribed under National Ambient Air Quality Standards (NAAQS). Most of the mines in the area are not functioning, also, the unit of Tata Metallics is completely closed down and there is no impact on the ambient air quality.

*(AAQM Reports of monitoring conducted during November 2017 are attached as **Annexure XIII**)*

Figure 3.16 Air Monitoring Location

Table 3.9 Results for Ambient Air Quality Monitoring (Summer 2011)

Location		PM 10	PM2.5	SO2	NOx	CO
		µg/m³	µg/m³	µg/m³	µg/m³	mg/m³
Reddi (A1)	Average	41.67	13.55	3.13	10.07	BDL
	98 %ile	49.37	16.4	3.14	10.53	BDL
	Max	49.6	16.51	3.15	10.56	BDL

Location		PM 10	PM2.5	SO2	NOx	CO
	Min	34.45	10.68	3.11	9.77	BDL
Querim village(A2)	Average	27.97	9.00	4.05	9.41	BDL
	98 %ile	32.85	10.26	4.66	9.41	BDL
	Max	33.14	10.34	4.68	9.41	BDL
	Min	24.68	8.25	3.16	9.41	BDL
Hillrock Restaurant(A3)	Average	42.7	20.98	3.28	13.66	BDL
	98 %ile	62.78	44.17	3.44	20.83	BDL
	Max	65.38	46.58	3.45	21.16	BDL
	Min	30.62	10.36	3.11	9.1	BDL
Near Security room (A4)	Average	54.14	17.78	4.53	15.08	BDL
	98 %ile	100.69	26.18	4.87	18.78	BDL
	Max	110.7	26.35	4.89	18.97	BDL
	Min	33.62	11.76	4.17	9.41	BDL
On site (A5)	Average	46.6	17.92	3.94	13.21	BDL
	98 %ile	58.22	21.9	4.52	22.15	BDL
	Max	58.46	22.07	4.55	23.09	BDL
	Min	12.51	13.33	3.33	9.35	BDL
Tiracol fort(A6)	Average	44.53	16.55	BDL	13.14	BDL
	98 %ile	57.05	19.16	BDL	23.85	BDL
	Max	57.36	19.21	BDL	24.69	BDL
	Min	25.07	13.48	BDL	2.82	BDL
NAAQS norms for Industrial Residential and other areas		100	60	80	80	4.00

BDL :- Below detectable limits

NAAQS :- National Ambient Air Quality Standards, published by CPCB, 2009

It can be seen from the above Table that the average values of all monitoring locations are well within the norms prescribed in the National Ambient Air Quality Standards (NAAQS) issued vide Notification dated the 18thNov., 2009, by CPCB, GOI.

Table 3.10 Results for Ambient Air Quality Monitoring (February 2017)

Location		PM 10	PM2.5	SO2	NOx	CO
		µg/m³	µg/m³	µg/m³	µg/m³	mg/m³
Reddi (A1)	Average	28.8	9.3	8.2	18.5	BDL
	98 %ile	34.1	13.6	8.7	19.6	BDL

Location		PM 10	PM2.5	SO2	NOx	CO
	Max	34.2	14	8.7	19.7	BDL
	Min	21.7	6.2	7.5	17.9	BDL
Querim village(A2)	Average	25.4	9.7	7.2	17.1	BDL
	98 %ile	29.2	13.2	8.0	17.79	BDL
	Max	29.5	13.3	8	17.8	BDL
	Min	19.2	6.8	6.5	15.8	BDL
Near Office (A3)	Average	21.7	7.7	5.9	13.1	BDL
	98 %ile	28.8	12.7	6.3	13.6	BDL
	Max	29.1	13.2	6.4	13.6	BDL
	Min	15.7	5.1	5.4	12.2	BDL
Near Security room (A4)	Average	30.3	9.5	6.2	14.2	BDL
	98 %ile	35.1	13.8	6.5	15.2	BDL
	Max	35.4	14.2	6.5	15.2	BDL
	Min	22.8	6.7	5.3	12.8	BDL
On site (A5)	Average	14.4	6.0	4.3	8.3	BDL
	98 %ile	16.5	6.7	5.1	8.9	BDL
	Max	12.3	5.1	3.6	7.5	BDL
	Min	16.4	6.6	5.0	8.9	BDL
Tiracol fort(A6)	Average	22.9	7.5	6.4	15.4	BDL
	98 %ile	26.7	8.6	7.2	16.67	BDL
	Max	26.9	8.7	7.2	16.8	BDL
	Min	18.2	5.6	5.9	14.1	BDL
NAAQS norms for Industrial Residential and other areas		100	60	80	80	4.00

BDL :- Below detectable limits
NAAQS :- National Ambient Air Quality Standards, published by CPCB, 2009

It can be seen from the above table that the average values of all monitoring locations are well within the norms prescribed in the National Ambient Air Quality Standards (NAAQS) issued vide Notification dated the 18thNov., 2009, by CPCB, GOI.

3.5 Noise Environment

Reconnaissance of site and vicinity shows that site is pristine having no industrial activity. Noise in the area is due to traffic and occasional community noise. Noise level readings were monitored at AAQM locations during summer season of 2011. Additional confirmatory monitoring was carried out in February 2017 as prescribed by the EAC for one month. **Fig 3.17** shows the locations of noise monitoring stations. **Tables 3.11 and 3.12** present the noise levels observed.

Figure 3.17 Noise Monitoring Level

Table 3.11 Noise readings at various locations (Summer 2011)

Month	Location		Noise level Leq dB(A)	
			Day time	Night Time
Mar-11	Onsite	N1	45	42
	Hill Rock Restaurant	N2	46.3	42
	Nr Security room	N3	48.5	43
	Tiracol fort	N4	45.5	41
	Querim village	N5	45.1	42
	Redi village	N6	46.2	40
Apr-11	Onsite	N1	44.2	41
	Hill Rock Restaurant	N2	45.5	42
	Nr Security room	N3	47.2	43
	Tiracol fort	N4	49.5	44
	Querim village	N5	46.6	41
	Redi village	N6	47.2	40
May-11	Onsite	N1	42.8	39
	Hill Rock Restaurant	N2	48.2	41
	Nr Security room	N3	46	43
	Tiracol fort	N4	47.7	41
	Querim village	N5	45.8	40
	Redi village	N6	46.8	40
Standard of noise level for residential area			55	45

Table 3.12 Noise readings at various locations (February 2017)

Sr. No.	Location	Noise Level dB(A)						Noise Level dB(A) (Night Time)					
		Max		Min		Avg		Max		Min		Avg	
		A1	A2	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2
1	Near office	53	49	47	45	50	47	42	40	38	36	40	38
2	Security gate	53	51	49	45	51	48	42	43	36	37	39	40
3	On site	48	44	44	40	46	42	35	36	33	34	34	35
4	Tirecol	52	54	48	46	50	50	41	42	39	40	40	41
5	Keri village	53	52	51	48	52	50	44	40	42	38	43	39
6	Reddi	63	62	55	56	59	59	56	52	50	48	53	50
	Standards	**Limits in dB (A) Leq.**											
Area Code	**Category of Area**	**Day Time**						**Night Time**					
(A)	Industrial Area	75						70					
(B)	Commercial Zone	65						55					
(C)	Residential Zne	55						45					
(D)	Silence Zone	50						40					

3.5.1.1 ***Note: A1 and A2 stand for data collected on 06/02/2017 and 13/02/2017 respectively.*****Noise Monitoring Findings**

It is seen from the above data that daytime and night time noise levels at all locations are well within the standards prescribed under the Environment (Protection) Act 1986, for day and night time, for all the locations except Reddi village.

3.6 Water Environment

3.6.1 Hydrogeology

Please refer ***Annexure XIV*** *for detaied report on "Hydrogeological and Geo-Electrical Investigations of Tericol Area, Goa". Following is a summary of the same.*

The present area is covered by Archean (crystalline and metamorphic) rocks which are capped by lateritic formations and some minor pockets of alluvial deposits mostly along the North Western corner of the study area and along the coast.

- Recent ---------- Alluvial sand, clay, beach sand
- Sub recent ---------- Laterite
- Precambrian ---------- Crystalline and associated rocks

The surface water environment in the study area is dominated by river Tiracol which flows adjacent to the site to the south and meets Arabian Sea to the West. Fresh water for public use and irrigation is sourced from Tillari Inter-State Irrigation Project, located in Dodamarg Taluka of Sindhudurg District at about 10 km towards West of the site. The area is located on the mouth of river Tiracol and forms a part of its basin. However, for domestic needs the region depends primarily on monsoonal rains to replenish its fresh ground water sources,

because of the estuarine nature of the river. Also the area is surrounded by topographically high grounds which act as groundwater divide, restricting the cross flow of ground water in the area. Because of this, very little water remains in the wells during the summer season, especially in wells situated on the slopes or near the base of the elevated area. The groundwater occurs under unconfined to semi-confined conditions in the inter-granular pore spaces of sand, gravel and pebbles which are intercalated with clays and in the voids and fractures of detrital laterites. There exists a deeper confined aquifer in the fractured basement of the plateau area.

There are two small 1st order streams which originate on the higher relief and unite in the valley portion. The upper streams are seasonal, whereas in the valley portion water is present almost throughout the year. The drainage also is largely controlled by the structure of the rocks. On the plateau region it takes the fractures in the anticlinal portion, but as it enters the valley it takes almost a sharp right turn and flow perpendicular to the axis of the folds. The stream shows a trellis pattern just before meeting the Tiracol River, thereby indicating presence of major fractures or faults in the region. A detailed hydro-geological study was conducted to ascertain the latest groundwater status of the Tiracol village area. Geo-electrical investigations were undertaken to find the depth and extent of various water bearing layers in the area.

Figure 3.18 Location of observation wells

The survey was carried out in and around the study area, covering three seasons (pre-monsoon, monsoon and post-monsoon) during 2010-2011, by establishing a network of groundwater level and quality monitoring wells. In order to monitor groundwater levels and ascertain the dynamics of groundwater flow regime, all (9) available observation wells

in the study area were used. A map showing the locations of the observation wells is depicted in **Figure 3.18.**

Table 3.13 Details of groundwater monitoring wells located in the study area.

Well No.	Owner	Latitude	Longitude	msl Elevation (m)	Well Shape	Diameter/ Diagonal (m)	Water Quality	MP Height agl (m)	Total Depth bgl(m)	Geology
1	Tiracol Fort	15⁰43'15.73"	73⁰41'11.82"	10	Square	2.17	Saline	0	8.65	Laterite
2	Kiter D'Souza	15⁰43'32.16"	73⁰41'15.86	6	Circular	2.72	Palatable	0.75	5.75	Laterite
3	Government	15⁰43'31.55"	73⁰41'14.03"	4	Square	2.72	Palatable	0.75	3.7	Laterite
4	Jose D'Souza	15⁰43'28.02"	73⁰41'13.56"	1	Circular	3.068	Palatable	0.65	5.05	Alluvial/ laterite
5	Jose D'Souza	15⁰43'26.98"	73⁰41'13.38"	5	Square	2.83	Palatable	0.43	4.67	Laterite
6	Government	15⁰43'30.22"	73⁰41'07.44"	4	Circular	4.056	Palatable	0.68	5.15	Laterite
7	Government	15⁰43'25.90"	73⁰41'19.39"	1	Square	3.383	Palatable	0.8	4.08	Laterite
8	Anton D'Souza	15⁰43'27.48"	73⁰41'21.08"	2	Square	2.464	Palatable	0.23	4.92	Laterite
9	D.C. D'Souza	15⁰43'25.32"	73⁰41'20.80"	9	Circular	2.515	Palatable	0.73	10.28	Laterite

The details of the water levels for pre-monsoon, monsoon and post monsoon periods are presented in Tables below.

Table 3.14 Details of well data collected during the pre-monsoon season

Well No.	Total Depth Bgl (M)	Depth To Water Table Bgl (M)	Water Column (m)	Height Of Water Level Above MSL (m)
1	8.65	7.3	1.35	2.7
2	5.75	5.25	0.5	-0.25
3	3.7	3.15	0.55	0.85
4	5.05	2.55	2.5	-1.55
5	4.67	4.37	0.3	-1.37
6	5.15	4.42	0.73	-1.42
7	4.08	3.9	0.18	-2.9
8	4.92	4.42	0.5	-2.42
9	10.28	9.68	0.6	-1.68

Table 3.15 Details of well data collected during the Monsoon Season

Well No.	Total Depth Bgl(M)	Depth To Water Table Bgl (m)	Water Column (m)	Height Of Water Level Above MSL (m)
1	8.65	6.02	2.63	3.98
2	5.75	3.55	2.2	1.45
3	3.7	1.7	2	2.3
4	5.05	0.65	4.4	0.35
5	4.67	2.92	1.75	0.08
6	5.15	2	3.15	1
7	4.08	2.23	1.85	-1.23
8	4.92	2.25	2.67	-0.25
9	10.28	7.33	2.95	0.67

Table 3.16 Details of well data collected during the post-monsoon season

Well No.	Total Depth Bgl (m)	Depth To Water Table Bgl (m)	Water Column (m)	Height Of Water Level Above MSL (m)
1	8.65	6.93	1.72	3.07
2	5.75	4.45	1.3	0.45
3	3.7	3.26	0.44	0.74
4	5.05	1.43	3.62	-0.43
5	4.67	3.13	1.54	-0.13
6	5.15	2.95	2.2	0.05
7	4.08	3.14	0.94	-2.14
8	4.92	3.96	0.96	-1.96
9	10.28	7.95	2.33	0.05

3.6.2 Ground Water and Flow-Net Analysis

In order to analyze the nature of the regional groundwater flow regime the flow-nets of all three seasons viz; pre-monsoon (May), monsoon (August) and post-monsoon (November) months and corresponding depth to groundwater levels below ground were prepared. The area is surrounded by topographic highs on three sides which act as the recharge area. These are depicted by the Ground water mound in plateau and high ground regions. The Tiracol River, towards the Southern boundary of the project site, acts as the groundwater discharge sink. Overall ground water flow is more or less similar throughout the year except changes in lateral extent of mound and trough and fluctuation in the water table. There exists a prominent trough near well No.7 in all three seasons, since the latter is located very close to the estuarine River, it could be the likely site for seawater intrusion during dry seasons.

The groundwater contours are closely spaced in the plateau and the high ground region, indicating lower hydraulic conductivity and high gradients, whereas the contours are moderately spaced in the low lying area causing moderate to high hydraulic conductivity and lower hydraulic gradients.

3.6.3 Chemical Analysis

Water samples were collected from 5 wells during the post monsoon season to carry out detailed chemical analysis. The results of chemical analysis for monitoring conducted during summer of 2011 are shown in **Table 3.17**. It is observed from this table that pH values for well No. 4 and well No. 9 are close to neutral and rest of the well waters are slightly acidic in nature. Except for high Mn concentration in well No. 9, all parameters are well within the prescribed limits for drinking water (IS 10500) quality.

Additional findings from analysis undertaken in summer of 2013 for baseline pesticide assessment in ground water as required by SEAC/ TAC of GSPCB in summer 2013: Results are at trace levels and much lower than the prescribed norms under IS 10500: 2012. The upper part of Tiracol plateau was previously under cultivation and also the valley portion was under coconut plantation. The pesticides detected were probably used at these sites.

The results of chemical analysis for monitoring conducted during February 2017 are shown in **Table 3.18.** *(Ground Water Monitoring Reports of monitoring conducted during November 2017 are attached as **Annexure XIII**)*. It is observed from this table that all parameters are within the desired parametrs except ammonia.

Table 3.17 Results from Chemical Analysis of Ground Water (Summer 2011)

Parameter	Unit	Norms (*)	Well 2	Well 3	Well 4	Well 6	Well 9
Colour	Hazen	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
Odour	--		None	None	None	None	None
Taste	--	Agreeable	Agreeable				
Turbidity	NTU	5	1.9	2	2.2	2.6	2.4
pH	--	6.5-8.5	6.03	6.47	7.22	6.04	7.12

Parameter	Unit	Norms (*)	Well 2	Well 3	Well 4	Well 6	Well 9
Total hardness (as CaCO3)	mg/l	300	30	31	279	35	27
Calcium as Ca++	mg/l	75	3.35	3.69	35.27	1.92	1.28
Magnesium as Mg++	mg/l	30	4.97	5.31	46.56	7.37	5.8
Dissolved Solids	mg/l	500	61	65	376	61.2	21.2
Total Iron	mg/l	0.3	BDL	0.05	0.28	0.01	BDL
Manganese as Mn	mg/l	0.1	0.03	0.05	0.08	0.05	0.27
Nitrate as NO3	mg/l	45	0.06	0.007	BDL	BDL	0.01
Sulphate as SO4	mg/l	200	BDL	0.12	89.15	0.25	0.61
Chlorides	mg/l	250	19	17	113	16.49	19
Fluorides	mg/l	1	BDL	BDL	BDL	BDL	BDL
Alkalinity	mg/l	200	4	3	7	3.5	4
Copper	mg/l	0.05	BDL	BDL	BDL	BDL	BDL
Zinc	mg/l	5	BDL	BDL	BDL	BDL	BDL
Cadmium	mg/l	0.01	BDL	BDL	BDL	BDL	BDL
Cobalt	mg/l	---	BDL	BDL	BDL	BDL	BDL
Nickel	mg/l	---	BDL	BDL	BDL	BDL	BDL
Chromium	mg/l	0.05	BDL	BDL	BDL	BDL	BDL
Lead	mg/l	0.05	BDL	BDL	BDL	BDL	BDL
Mercury	mg/l	0.001	BDL	BDL	BDL	BDL	BDL
Aluminium	mg/l	0.03	BDL	BDL	BDL	BDL	BDL

BDL – Below Detection Limit. NTU – Nephelometric Turbidity Units.
(*) Norms as per IS 10500 for drinking water (Desirable limits)

Table 3.18 Results from Chemical Analysis of Ground Water (February 2017)

Parameter	Well 1	Well 2	Well 3	Well 4	Well 5	Limits as per IS 10500:2012	
						Desirable	Permissible
Colour, Hazen	< 5	< 5	< 5	< 5	< 5	5	15
Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Taste	--	--	--	--	--	Agreeable	Agreeable
Turbidity, NTU	ND	ND	ND	ND	ND	1	5
pH	6.56	7.11	7.09	7.6.59	6.88	6.5-8.5	No relaxation
Total Hardness (as $CaCO_3$), mg/L	18	14	14	10	12	200	600
Iron (as Fe), mg/L	0.13	0.08	0.10	0.15	0.09	1.0	No relaxation
Chlorides(asCl), mg/L	16.4	20.3	16.4	18.3	22.2	250	1000
Residual free chlorine, mg/L	ND	ND	ND	ND	ND	0.2	1
Dissolved solids, mg/L	90	60	80	50	60	500	2000
Calcium (as Ca), mg/L	04	3.2	3.2	2.4	3.2	75	200
Magnesium (as Mg), mg/L	1.9	1.4	1.4	0.9	0.9	30	100
Copper (as Cu), mg/L	ND	ND	ND	ND	ND	0.05	1.5

Parameter	Well 1	Well 2	Well 3	Well 4	Well 5	Limits as per IS 10500:2012	
						Desirable	Permissible
Alkalinity, mg/L	20	24	20	22	18	200	600
Sulphate (as SO_4), mg/L	11.4	13.6	15.0	12.7	12.9	200	400
Manganese (as Mn), mg/L	ND	ND	ND	ND	ND	0.1	0.3
Nitrate (as $NaNO_3$), mg/L	ND	ND	ND	ND	ND	45	No relaxation
Fluoride (BDL as F), mg/L	ND	ND	ND	ND	ND	1	1.5
Phenolic compds (as C_6H_5OH), mg/L	ND	ND	ND	ND	ND	0.001	0.002
Mercury (as Hg), mg/L	ND	ND	ND	ND	ND	0.001	No relaxation
Cadmium (as Cd), mg/L	ND	ND	ND	ND	ND	0.003	No relaxation
Selenium (as Se), mg/L	ND	ND	ND	ND	ND	0.01	No relaxation
Arsenic (as As), mg/L	ND	ND	ND	ND	ND	0.01	No relaxation
Cyanide (as CN), mg/L	ND	ND	ND	ND	ND	0.05	No relaxation
Lead (as Pb), mg/L	ND	ND	ND	ND	ND	0.01	No relaxation
Zinc (as Zn), mg/L	ND	ND	ND	ND	ND	5	15
Anionic detergents (as MBAS), mg/L	ND	ND	ND	ND	ND	0.2	1
Chromium (as Cr), mg/L	ND	ND	ND	ND	ND	0.05	No relaxation
Aluminium (as Al), mg/L	ND	ND	ND	ND	ND	0.03	0.2
TAN, mg/L	**6.72**	**8.12**	**4.76**	**6.16**	**7.84**	0.5	No relaxation
PAH, g/L	ND	ND	ND	ND	ND	0.0001	No relaxation
Boron (as B), mg/L	ND	ND	ND	ND	ND	0.5	1
Mineral oil, (mg/l)	ND	ND	ND	ND	ND	0.5	No relaxation
Sulphide , as S^{2-} (mg/l)	ND	ND	ND	ND	ND	0.05	No relaxation
Nickel as Ni (mg/l)	ND	ND	ND	ND	ND	0.02	No relaxation
E. coli (/100ml)	Absent	Absent	Absent	Absent	Absent	Absent	No relaxation
Coliforms (/100ml)	Absent	Absent	Absent	Absent	Absent	Absent	No relaxation
Alachlor	ND	ND	ND	ND	ND	20	No Relaxation
Atrazine	ND	ND	ND	ND	ND	2	No Relaxation
Aldrin	ND	ND	ND	ND	ND	0.03	No Relaxation
Alpha HCH	ND	ND	ND	ND	ND	0.01	No Relaxation
Beta HCH	ND	ND	ND	ND	ND	0.04	No Relaxation
Butachlor	ND	ND	ND	ND	ND	125	No Relaxation
Chlorpyriphos	ND	ND	ND	ND	ND	30	No Relaxation
Delta HCH	ND	ND	ND	ND	ND	0.04	No Relaxation

Parameter	Well 1	Well 2	Well 3	Well 4	Well 5	Limits as per IS 10500:2012	
						Desirable	Permissible
2,4-Dichlorophenoxyacetic acid	ND	ND	ND	ND	ND	30	No Relaxation
DDT	ND	ND	ND	ND	ND	1	No Relaxation
Endosulphan	ND	ND	ND	ND	ND	0.4	No Relaxation
Ethion	ND	ND	ND	ND	ND	3	No Relaxation
Lindane	ND	ND	ND	ND	ND	2	No Relaxation
Isoproturon	ND	ND	ND	ND	ND	9	No Relaxation
Malathion	ND	ND	ND	ND	ND	190	No Relaxation
Methyl parathion	ND	ND	ND	ND	ND	0.3	No Relaxation
Monocrotophos	ND	ND	ND	ND	ND	1	No Relaxation
Phorate	ND	ND	ND	ND	ND	2	No Relaxation

ND – Not Detected.

3.6.4 Pumping Tests

An aquifer test is a controlled field experiment conducted in wells, to determine the hydraulic characteristics of water bearing and associated rocks (Stallman, 1971). One of the objectives of groundwater studies is to determine how much groundwater can be safely withdrawn perennially from the aquifers in the area under study. This determination involves estimation of:

- Transmissibility and storability of the aquifers.
- The lateral extent of each aquifer and the hydraulic nature of its boundaries.
- Groundwater modeling and simulation of groundwater flow and levels.
- Radius of influence around the pumping structure.
- Prediction of the movement of groundwater contaminants in the sub-surface.

There are a total of only nine wells in the Tiracol village, out of which only three were found suitable for carrying out pumping tests. In general, the owners of wells are reluctant to allow pumping of the wells due to the fear of exhaustion of water.

Table 3.19 Field data of pumping tests carried out in the study area

Well 2		Well 4		Well 9	
Time (sec)	Drawdown (mm)	Time (sec)	Drawdown (mm)	Time (sec)	Drawdown (mm)
0	0	0	0	0	0
300	80	300	30	300	20
600	160	600	70	600	40
900	220	900	120	900	60
1200	270	1200	150	1200	80
1500	320	1500	190	1500	110

Well 2		Well 4		Well 9	
1800	370	1800	240	1800	120
2100	420	2100	260	2100	120
2400	470	2400	300	2400	120
2700	510			2700	120
				3000	150
				3300	150
				3600	160
2700	510	2400	300	3600	160
3000	400	2700	300	3900	100
3300	340	3000	290	4200	80
3600	290	3300	280	4500	60
3900	230	3600	273	4800	50
4200	180	4200	260	5100	50
4500	150	4800	250	5400	40
4800	120	5700	240	5700	30
5100	80	6300	230	6000	30
5400	40	7200	220	6300	30
5700	0	8100	210	6600	20
		9000	200	6900	20
		10200	190	7200	10
		11400	180	7500	10
		12300	168	7800	10
		13500	160	8100	0
		15000	150		
		16200	141		
		17700	130		
		19500	120		
		20700	110		
		22800	100		
		24000	95		

3.6.5 Results

The values of aquifer transmissibility vary from 34 m^2/day to 256 m^2/day. The hydraulic conductivity varies largely due to the variable saturated thickness of the water bearing layers in the Tiracol village area. Based on the magnitude of aquifer hydraulic conductivity, the top willow lateritic aquifer can be classified as moderate to good yielding aquifer in the vicinity of Tiracol village. The aquifer storability values are constant for all three wells, and hence the aquifer can be classified as "semi-confined".

3.6.6 Electrical sounding data and estimation of geo-electric parameters

The Tiracol study area, forms a part of headland composed of pre-Cambrian origin rock for surface laterite and is capped with thick laterite in plateau areas. The area shows very high resistivity in the surface layer due to the presence of compact laterite on the surface. The

resistivity values decrease as the depth increases and reach a minimum for the fractured basement rock and then increase steeply for the fresh basement rock.

From site field data, the depth to the water table in the lower valley area is found to be less than 5 metres from the ground surface, which is consistent with the well data collected during the three seasons. In the upper part of the area, where the valley and the high ground meet, there is no willow aquifer. However, there exists a thin saturated zone at depths ranging from 45-55m below ground level which may be under semi-confined to unconfined conditions marked by sudden drop in resistivity as seen in the Vertical Electrical Sounding (VES) curve. On the plateau area, the corresponding drop is observed at the same depths (of 45-55m), but the drop is not as pronounced and also the resistivity is higher compared to the VES readings mentioned above. This shows that the same conducting layer is present throughout the area, but the saturation level is low and patchy in plateau area due to higher elevation compared to the valley portion, where all the ground water converges. However, at depths of 70 to 90m below surface, it appears that a confined aquifer is present throughout the area representing fractured basement rock.

3.6.7 Conclusions

The following conclusions are derived from the above study:

- The geo-electrical survey indicates that the surface laterite covers a clay layer followed by fractured and weathered meta-sediments at depths ranging from 45m to 90 m.
- The hydraulic conductivity of aquifer in the Tiracol village area, where the pumping tests have been conducted, is fairly high and the aquifer is unconfined to semi-confined in nature.
- The analysis of groundwater samples from the area shows that various parameters are well within the prescribed limits for drinking water classification, except for the high Mn content in one well. The pH of water is slightly acidic in some locations.
- Away from the village area, the plateau land within the project site, has an aquifer at depths ranging from 80m to 100m below ground surface.
- The porous nature of lateritic rocks interspersed with patches of soil, in the plateau area of the site, form favorable natural areas of rainfall recharge.
- There is a good scope for developing artificial structures for rain water harvesting, so that ample of rainwater can be collected/stored partly for needs of the proposed project and partly for ground water recharge.
- The Tiracol village is located on a low lying terrain capped by soft lateritic and alluvial sediment and hence the groundwater is available at willow depths of less than 10m and is vertically limited to less than 15m depth. The groundwater flow net analysis around the village indicates that the groundwater flows towards the center of village and partly towards the Tiracol River.

- However, it needs to be mentioned that electrical sounding studies especially in laterite capped terrain maybe affected due to problems related to inadequate electrode penetraton.

*Please refer **Annexure XIV**: Hydrogeological and Geo-Electrical Investigations of Tericol Area, Goa, Chapter 4, for classification of ground water.*

*Also refer to **Annexure XV:** Goa Ground Water Year Book 2013-14 of Goa State*, published by the Central Ground Water Board (CGWB). The report mentions that based on the surveys, the data indicated that all of the samples were in the 'desirable' limits of Drinking Water Standards.

3.6.8 Surface Water

Surface water scenario is dominated by presence of river Tiracol and Arabian Sea on the West. Drinking water for Tiracol village is supplied by operating a well and storing the water in a water tank.

Other surface water sources include four lakes, located towards the North of the project site (on Maharashtra side), description of these is as follows:

- Kanya lake (Lake 1) and Redi Lake (Lake 3) are used by the residents of Redi village.
- Kanya Lake 1 dries up in the fair season but Lake 2 is perennial.
- Gogate Lake 2 is located within the Rata Mine and is used for spraying mining roads to suppress dust pollution.
- The ILPL lake (Lake 4) water is purified and supplied to Reddi village.

Surface water sampling was carried out in these lakes during the summer of 2011. Additional confirmatory monitoring was carried out in February 2017 as prescribed by the EAC for one month. **Tables 3.20, 3.21** and **3.22** present the results of the analysis

Figure 3.19 Map showing monitoring locations of surface water samples

Table 3.20 Surface Water Analysis- Lakes in Vicinity (Summer 2011 –Round 1)

S.no	Parameters	Units	Permissible Limit		Kanya Lake 1	Tata Iron Mine Lake 2	Redi Lake 3	ILPL lake 4
			Essential	Desirable				
1	pH	--	6-8	6 to 8	7.26	6.73	6.65	6.06
2	Turbidity	NTU	5	10	4.8	2.1	1.9	0.9
3	Dissolved solids	mg/l	500	2000	4.23	887	104	776
4	TSS	mg/l			27	22	21	20
5	Chlorides	mg/l	250	1000	81.47	217.93	30.99	310.4
6	Salinity	mg/l			0.18	0.42	0.08	0.59
7	Sulphates	mg/l	200	400	59.53	37.02	2.36	37.58
8	Alkalinity	mg/l	200	600	16	18.5	2	23.5
9	Total hardness (as $CaCO_3$)	mg/l	300	600	100	132	27	156
10	Calcium as Ca^{++}	mg/l	75	200	26.8	26.8	3.2	30.97
11	Magnesium as Mg^{++}	mg/l	30	100	8.05	15.82	4.62	19.24
12	Total Iron	mg/l	0.3	1.0	0.06	0.09	0.05	BDL
13	Manganese as Mn	mg/l	0.1	0.3	0.14	0.74	0,03	0.03
14	Nitrates as NO_3	mg/l	45	No relaxation	0.05	0.05	0.03	BDL
15	Florides	mg/l	1.0	1.5	BDL	BDL	BDL	BDL
16	Phosphates as PO_4	mg/l			BDL	BDL	BDL	BDL

***BDL** – Below Detection Limit. **NTU** – Nephelometric Turbidity Units. **NS**- Not Specified*
Permissible limits as per IS 10500 for drinking water (Desirable limits)

Table 3.21 Surface Water Analysis- Lakes in Vicinity (Summer 2011 –Round 2)

Sr No	Parameters	Unit	Permissible Limit		Kanya Lake 1	Tata Iron Mine Lake 2	Redi Lake 3	ILPL lake 4
			Essential	Desirable				
1	pH	--	--	6 to 8	7.11	7.29	7.93	8.19
2	Turbidity	NTU	5	10	8.4	1.6	2.4	2.2
3	Dissolved Solids	mg/l	500	2000	788	600	57	742
4	TSS	mg/l	NS	NS	28	20	24	23

Sr No	Parameters	Unit	Permissible Limit		Kanya Lake 1	Tata Iron Mine Lake 2	Redi Lake 3	ILPL lake 4
			Essential	Desirable				
5	Chlorides	mg/l	250	1000	140.46	297.91	37.99	347.89
6	Salinity	mg/l	NS	NS	0.28	0.57	0.1	0.66
7	Sulphates	mg/l	200	400	74.38	28.58	BDL	31.39
8	Alkalinity	mg/l	200	600	14	19	9	27
9	Total hardness (as $CaCO_3$)	mg/l	300	600	146	152	28	159
10	Calcium as Ca^{++}	mg/l	75	200	39.99	33.99	4.4	31.99
11	Magnesium as Mg^{++}	mg/l	30	100	11.23	16.32	4.13	19.23
12	Total Iron	mg/l	0.3	1.0	0.16	0.05	0.02	0.02
13	Manganese as Mn	mg/l	0.1	0.3	0.03	0.03	0.03	0.03
14	Nitrate as NO_3	mg/l	45	No Relaxation	0.09	0.02	0.02	0.01
15	Fluorides	mg/l	1.0	1.5	BDL	BDL	BDL	BDL
16	Phosphate as PO_4	mg/l	NS	NS	BDL	BDL	BDL	BDL

***BDL** – Below Detection Limit. **NTU** – Nephelometric Turbidity Units. **NS** - Not Specified*
Permissible limits as per IS 10500 for drinking water (Desirable limits)

Findings: It is observed that lake water is hard in nature except for Redi Lake 3. However, three of these lakes belong to private companies and except for Rata Lake 2, dry up or have very little water during summer.

Table 3.22 Surface Water Analysis- Lakes in Vicinity (February 2017)

Parameter	Kenya Lake	Gogate Lake	Reddy lake	Limits as per IS 10500:2012	
				Desirable	Permissible
Colour, Hazen	< 5	< 5	< 5	5	15
Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Taste	--	--	--	Agreeable	Agreeable
Turbidity, NTU	ND	ND	ND	1	5
pH	6.57	6.78	7.05	6.5-8.5	No relaxation
Total Hardness (as $CaCO_3$), mg/L	100	154	108	200	600
Iron (as Fe), mg/L	0.02	0.06	0.09	1.0	No relaxation
Chlorides(asCl), mg/L	**260**	**328**	**309**	250	1000
Residual free chlorine, mg/L	ND	ND	ND	0.2	1
Dissolved solids, mg/L	360	420	370	500	2000
Calcium (as Ca), mg/L	28.8	41.6	24.8	75	200
Magnesium (as Mg), mg/L	6.72	12.0	11.0	30	100
Copper (as Cu), mg/L	ND	ND	ND	0.05	1.5

Parameter	Kenya Lake	Gogate Lake	Reddy lake	Limits as per IS 10500:2012	
				Desirable	Permissible
Alkalinity, mg/L	38	44	28	200	600
Sulphate (as SO_4), mg/L	26.8	22.2	21.6	200	400
Manganese (as Mn), mg/L	ND	ND	ND	0.1	0.3
Nitrate (as $NaNO_3$), mg/L	ND	ND	ND	45	No relaxation
Fluoride (BDL as F), mg/L	ND	ND	ND	1	1.5
Phenolic compds (as C_6H_5OH), mg/L	ND	ND	ND	0.001	0.002
Mercury (as Hg), mg/L	ND	ND	ND	0.001	No relaxation
Cadmium (as Cd), mg/L	ND	ND	ND	0.003	No relaxation
Selenium (as Se), mg/L	ND	ND	ND	0.01	No relaxation
Arsenic (as As), mg/L	ND	ND	ND	0.01	No relaxation
Cyanide (as CN), mg/L	ND	ND	ND	0.05	No relaxation
Lead (as Pb), mg/L	ND	ND	ND	0.01	No relaxation
Zinc (as Zn), mg/L	ND	ND	ND	5	15
Anionic detergents (as MBAS), mg/L	ND	ND	ND	0.2	1
Chromium (as Cr), mg/L	ND	ND	ND	0.05	No relaxation
Aluminium (as Al), mg/L	ND	ND	ND	0.03	0.2
TAN, mg/L	ND	ND	ND	0.5	No relaxation
PAH, g/L	ND	ND	ND	0.0001	No relaxation
Boron (as B), mg/L	ND	ND	ND	0.5	1
Mineral oil, (mg/l)	ND	ND	ND	0.5	No relaxation
Sulphide , as S^{2-} (mg/l)	ND	ND	ND	0.05	No relaxation
Nickel as Ni (mg/l)	ND	ND	ND	0.02	No relaxation
E. coli (/100ml)	Absent	Absent	Absent	Absent	No relaxation
Coliforms (/100ml)	Absent	Absent	Absent	Absent	No relaxation
Alachlor	ND	ND	ND	20	No Relaxation
Atrazine	ND	ND	ND	2	No Relaxation
Aldrin	ND	ND	ND	0.03	No Relaxation
Alpha HCH	ND	ND	ND	0.01	No Relaxation
Beta HCH	ND	ND	ND	0.04	No Relaxation
Butachlor	ND	ND	ND	125	No Relaxation
Chlorpyriphos	ND	ND	ND	30	No Relaxation
Delta HCH	ND	ND	ND	0.04	No Relaxation
2,4-Dichlorophenoxyacetic acid	ND	ND	ND	30	No Relaxation
DDT	ND	ND	ND	1	No Relaxation
Endosulphan	ND	ND	ND	0.4	No Relaxation
Ethion	ND	ND	ND	3	No Relaxation
Lindane	ND	ND	ND	2	No Relaxation
Isoproturon	ND	ND	ND	9	No Relaxation
Malathion	ND	ND	ND	190	No Relaxation
Methyl parathion	ND	ND	ND	0.3	No Relaxation
Monocrotophos	ND	ND	ND	1	No Relaxation
Phorate	ND	ND	ND	2	No Relaxation

ND – Not Detected

Findings: It is observed that the lake water shows presence of chlorides.

3.7 Biological Environment

*Detailed Ecology and Biodiversity Report is attached as **Annexure XVI**. Following is a summary of the same.*

3.7.1 Study Area Description

Part of Taluka Pernem forms part of study area in the state of Goa. Similarly parts of Vengurla and Sawantwadi forms part of study area in Maharashtra. The study area has five kinds of habitats, these are described as follows.

Dense Mixed Vegetation:

Southern coastal region of Maharashtra and northern coastal region of Goa has scattered hillocks. Height of these varies from 80m to150m and has wide open plateaus. Slopes of these possess dense vegetation mostly mixed with cashew. Sometimes, these dense vegetation form part of private or government forest.

Human Settlements:

Human settlements in study area are seen along the rivers, natural water ways in the valleys of hillocks described above and along sea coast. Species here found to be grown from aesthetic, economic or from human benefit point of view. Faunal life observed associated accordingly. This also includes domesticated fauna.

Open Scrub:

Open scrub found mostly on top of hillocks, where vegetation observed in the form of grasses, herbs and shrubs. These are lateritic plateaus which barely support deep root system required for big tree species. Locally such areas are called as 'Maal' or 'Sada'. Open scrub also found to be under mining activity at places like Reddy, Tiroda etc. in Maharashtra and between Pernem and Mandrem in Goa.

Agricultural Fields:

Hillocks offer a typical dendretic drainage pattern, in the valley, water find its course, leaving some area between hillock and water way. Agricultural fields were observed within these narrow strips of land along with human settlement. At some places agricultural fields were also seen in plain area near coast, particularly in Reddy and Shiroda. Rice is the major crop seen in study area. Besides this, millets and other cereal, pluses are also taken after rice. Agriculture is supplemented by plantation of species like spices, coconut, areca, mango and cashew along with livestock.

Water Bodies:

The Arabian Sea, Rivers like Tiracol etc; waterways, lakes constitute as water bodies in study area. For purpose of this study, area around salt pan, mangroves etc. are also considered in this section. Mangroves serves unique ecosystem. River Tiracol (eastuary) has mangrove vegetation about 30 ha; whereas, in Pernem Taluka under private mangroves it is about 124 ha.

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

3.7.2 General Description & Habitat Value of Site

A substantial portion of the site is a Lateritic Plateau with relatively shallow soil strata, poor complement of permanent vegetation; monsoonal flush vegetation chiefly comprising of grasses and shrubbery. Also, seen here are patches of Cashew (Anacardium occidentale) monoculture.

In the north-east direction of the site has a good diversity of species both floral and avifaunal, besides mammals, and the lesser vertebrate groups like the amphibians, reptiles and other invertebrate fauna. It has a mix vegetation of trees, shrubs and herbaceous flora. The ground and the land strata with its umpteen low lying and ascending profiles provides numerous micro-habitats for herpetofauna, avifauna and scores of invertebrates. Also, the low lying areas in the lateritic strata allow water accumulation and subsequent establishment of aquatic ephemeral vegetation and fauna.

Due to the heavy monsoon, all depressions or flat surfaces and even boulders in depressions become waterlogged during the rains. Plants of family Cyperaceae, Poaceae, Eriocaulaceae emerge with the advance of monsoon, but were only distinguishable at morphospecies level. By the end of monsoon season, mass blooming of non-grass families (*Fabaceae, Eriocaulaceae, Lentibulariaceae, Rubiaceae*) is observed on all rocky plateaus. Survey of the plateau facing the sea along the deep depressions, along the edges of the rocky plateaus and rock debris area revealed presence of stunted growth of *Memecylon umbellatum, Syzygium cumini, Catunaregam spinosa, Gnidia glauca* and associated climbers such as *Ipomoea, Argyreia, Ceropegia spp., Vigna vexilllata*.

The native flora of the region is well represented here (see inventory in **Annexure XVI**), besides agro-plots that are cultivated by the natives ensure conservation of germplasm of local cultivars. The paddy fields and the low lying areas where water accumulate forming ephemeral rain ponds and puddles are replete with hydrophytes and the Indian bull frog (*Rana tigerina*) populations that draw attention of poachers from the neighbouring talukas, the frog meat being a delicacy in Goa and still a good number of hospitality joints serving frog legs clandestinely. The common tree frog (*Polypedates sp*) is easily sighted on the lower branches of trees and shrubs with advent of monsoon season. Fossorial ants, beetles, spiders, scorpions, grasshoppers, odonata, ground nesting birds, reptiles; crevices in mud embankments and tree hollows are occupied by Mygalomorph spiders (*Chilobrachys fimbriata*). The avifaunal diversity is impressive with resident, local migrant as well as long distance migrants seen here at different times of the year.

The site up to the cliffs in the south western direction is relatively open and covered only by ground vegetation that comprise of grasses and other ephemeral flora after the rains. The 'ephemeral flush' stage is evident on cessation of rains and before the onset of winter. Barring a few species, much of this is common and with little conservation value. However,

the associated meiofauna like the ants, scorpions, araneid and non-araneid arachnids abound. Myriapods (Millipedes and Centipedes) are common and are often seen burrowing wherever soft mud is available. The ground also supports earthworms and other burrowing worms.

3.7.3 Baseline Study

Periphery of site is elevated slopping down inwards; it forms a depression in the middle portion, where Ragi/millets fields intermittently with scrub/open lateritic plateau were observed. Few more such fields were also noticed on westward slope of site. North and southeast part of site possesses dense vegetation compared to southwest. Since elevated west and south side of site is facing directly to the open sea, due to wave action, cave formations are seen.

Census of trees in study area has been carried out by LHL and their data shows that there are about 19000 trees within the project site. Survey numberwise details of trees present are as tabulated below:

Table 3.23 Results of Tree Census Conducted

Survey No.	Area (Sq. M)	Number of Trees
4	218125	3771
5	149025	5198
6	245475	5500
7	26000	208
8	44425	424
9	55725	1156
10	32950	206
11	66700	938
12	62227	1457
13	28325	150
Total	**928977**	**19008**

Source: Census survey by LHL

*List of trees in study area survey number wise are presented in **Annexure XVII:** Results of Tree Census.*

The site has mixed dense vegetation and open scrub habitats list of species observed/ reported are presented below.

Table 3.24 List of flora observed within site

Sr. No.	Scientific Name	Common/ Local Name	Family
	Trees		
1.	*Morinda citrifolia*	Noni	Rubiaceae
2.	*Acacia auriculiformis*	Australian Acacia	Leguminoceae

Sr. No.	Scientific Name	Common/ Local Name	Family
3.	*Anacardium occidentale*	Kaju	Anacardiaceae
4.	*Bridelia retusa*	Asana	Euphorbiaceae
5.	*Careya arborea*	Kumbhi	Lecythidaceae
6.	*Erythrina indica*	Pangara	Leguminoceae
7.	*Ficus benghalensis*	Vad	Moraceae
8.	*Ficus religiosa*	Pimpal	Moraceae
9.	*Garcinia indica*	Kokam	Clusiaceae
10.	*Gmelina arborea*	Shivan	Verbenaceae
11.	*Mimusops elengi*	Bakul	Sapotaceae
12.	*Sterculia colorata*	Kaushi	Sterculiaceae
13.	*Memecylon umbellatum*	Anjan	Melastomaceae
14.	*Mammea suriga*	Surangi	Clusiaceae
15.	*Mangifera indica*	Amba	Anacardiaceae
16.	*Strychnos nux-vomica*	Kajara	Loganiaceae
17.	*Syzygium jambolanum*	Jambhul	Myrtaceae
18.	*Terminalia paniculata*	Kinjal	Combretaceae
	Climbers		
19.	*Abrus precatorius*	Gunj	Leguminoceae
20.	*Mucuna sp.*	Khajkuhiri	Leguminoceae
	Herbs		
21.	*Jasminum sp.*	Jai	Oleaceae
22.	*Lea indica*	--	Leaceae
	Shrubs		
23.	*Adhatoda vasica*	Adulsa	Acanthaceae
24.	*Calycopteris floribunda*	Baguli/ Ukshi	Combretaceae
25.	*Carissa carandas*	Karavand	Apocynaceae
26.	*Holarrhena antidysenterica*	Kuda	Apocynaceae
27.	*Microcos paniculata*	Hasale	Tiliaceae
28.	*Ixora coccinea*	Ixora	Rubiaceae
29.	*Ziziphus sp.*	Bor	Rhamnaceae

Table 3.25 List of Fauna spotted within site

Sr. No.	Scientific Name	Common/ Local Name
	Birds	
1.	*Vanellus indicus*	Red Wattled lapwing
2.	*Dicrurus macrocercus*	Black Drongo

Sr. No.	Scientific Name	Common/ Local Name
3.	*Pycnonotus jocosus*	Red whiskered Bulbul
4.	*Milvus migrans*	Black Kite
5.	*Halcyon smyrnensis*	White-throated Kingfisher
6.	*Pycnonotus cafer*	Red vented Bulbul
7.	*Psittacula cyanocephala*	Plum headed Parakeet
8.	*Treron bicincta*	Orange-breasted Green Pigeon
9.	*Megalaima viridis*	White-cheeked Barbet
10.	*Saxicoloides fulicatus*	Indian Robin
11.	*Copsychus saularis*	Magpie Robin
12.	*Lonchura atricapilla*	Black Headed Munia
13.	*Merops orientalis*	Green Beeater
14.	*Eudynamys scolopaceus*	Asian Coel
	Mammal	
15.	*Pteropus giganteus*	Flying Fox
16.	*Semnopithecus sp.*	Langur
	Reptiles	
17.	*Draco sp.*	Flying Lizard

3.8 Socio Economic Environment

According to the Census Report of 2011, Goa has a total population of 1.34 million, which makes it the fourth smallest Indian State, population-wise. Goa has increasingly drawn, citizens from other States in India as well as foreigners, either for business purposes, tourism or as permanent residents. **Table 3.27** gives details of population and occupational pattern of settlements within a radius of 10 km from the proposed site.

It can be seen from the table that the totalnumber of households in the study area of 10km is 12,931 amd the total population is 54,429.

The Tiracol fort, located to the East of the site is a popular tourist destination in Goa and attracts a lot of tourists annually. Agriculture is the main occupation in the study area of 10 km, and tourism related services thrive as subsidiary occupations. Tata Metallics, a large Steel Unit, also used to provide employment to the nearby villagers until it shut down recently.

Tiracol is a medium size village located in Pernem of North Goa district, Goa with total 48 families residing. The Tiracol village has population of 205 of which 115 are males while 90 are females as per Population Census 2011. In Tiracol village population of children with age 0-6 is 15 which makes up 7.32 % of total population of village. Average Sex Ratio of Tiracol village is 783 which is lower than Goa state average of 973. Child Sex Ratio for the Tiracol as per census is 1143, higher than Goa average of 942.

Tiracol village has lower literacy rate compared to Goa. In 2011, literacy rate of Tiracol village was 86.84 % compared to 88.70 % of Goa. In Tiracol Male literacy stands at 90.74 % while female literacy rate was 81.71 %. As per constitution of India and Panchyati Raaj Act, Tiracol village is administrated by Sarpanch (Head of Village) who is elected representative of village. Table below presents the socio-economic profile of the village.

Table 3.26 Socio economic profile of village Tiracol

Sr. No.	Description	Total	Male	Female
1.	House Holds	48		
2.	Total Population	205	115	90
3.	Child (0-6)	15	7	8
4.	SC	0	0	0
5.	ST	0	0	0
6.	Literacy	86.84%	90.74%	81.71%
7.	Total Workers	103	68	35
8.	Main workers	79	0	0
9.	Marginal workers	24	12	12

Source: Census of India, 2011

Currently, the village is quite cut off, being located on the northern bank of Tiracol river. It derives water supply from a water tank which is filled from bore well supply operated and maintained by Government. There is no school in Tiracol and school children have to take ferry and go to nearest school at Querim. The village depends upon power supply from the Maharashtra grid. The village does not have a Primary Health Centre. There is a hotel (Hillrock café) located on the shore.

Community facilities are envisaged as a part of the proposed development, including a primary school, disaster management centre, community hall and a 25 bed Health Centre.

3.9 Monuments and Historical Sites

Tiracol Fort is located to the East of the project site at the mouth of river Tiracol and offers a magnificent view of the Arabian Sea in the South. The fort which dates back to the 16th century is now converted into a heritage hotel ("Hotel Tiracol Fort Heritage"). A chapel dedicated to St. Anthony is present in the courtyard of the fort.

Another fort, the Redi Fort (Yashwantgad) is located about 3 km from the site, towards the North. Redi village area, called earlier as Reddipattan, is a famous mining area located in Maharashtra, on the Goa border. Redi also has a famous Ganesh Temple.

Figure 3.20 Tiracol Fort

Table 3.27 Settlements within 10 km of Proposed Site

Name	Rural/ Urban	HH	Total Population	Population Male	Population Female	Literates	TWP	MW	CL	AL	NWP
GOA, North Goa											
Tiracol	Rural	48	205	115	90	165	103	79	4	2	102
Querim	Rural	693	3038	1591	1447	2446	1302	708	90	8	1736
Paliem	Rural	609	2776	1446	1330	2205	1065	574	53	10	1711
Corgao	Rural	1497	6639	3389	3250	5409	2451	1508	105	109	4188
Arambol (CT)	Urban	1234	5322	2780	2542	4280	1945	1527	17	9	3377
Mandrem (CT)	Urban	1882	8336	4164	4172	6811	3038	2255	42	40	5298
Parcem (CT)	Urban	1030	4627	2345	2282	3754	1600	1198	26	21	3027
MAHARASHTRA, Sindhudurg											
Sukhatanbag	Rural	176	714	348	366	624	253	236	40	14	461
Mochemad	Rural	238	972	480	492	792	450	423	199	95	522
Matond	Rural	710	2852	1404	1448	2251	1707	824	571	106	1145
Josoli	Rural	129	532	256	276	432	322	218	103	102	210
Vadakhol	Rural	90	323	174	149	258	206	75	47	20	117
Nhaichiad	Rural	102	477	254	223	356	231	211	133	4	246
Asoli	Rural	338	1293	606	687	1103	513	362	211	66	780
Sonsure	Rural	196	779	397	382	654	257	183	106	18	522
Sakhelekhol	Rural	85	326	165	161	269	109	44	5	2	217
Tank	Rural	266	948	473	475	730	287	204	53	18	661
Sagartirtha	Rural	121	440	216	224	353	156	131	1	0	284
Temb	Rural	89	389	203	186	323	120	43	9	13	269
Arawali	Rural	340	1290	642	648	1145	579	344	44	18	711
Bandh	Rural	90	345	172	173	291	88	81	2	54	257
Shiroda	Rural	508	1945	963	982	1606	697	677	76	10	1248
Parabgaon	Rural	209	800	405	395	684	260	220	22	33	540
Bagayat	Rural	149	508	271	237	429	180	96	2	0	328
Velagar	Rural	115	419	195	224	344	136	132	6	2	283
Khalchikar	Rural	217	960	495	465	819	470	447	11	4	490
Varachiker	Rural	185	799	396	403	716	288	208	4	0	511
Gandhinagar	Rural	236	898	461	437	761	310	233	97	45	588

Name	Rural/ Urban	HH	Total Population	Population Male	Population Female	Literates	TWP	MW	CL	AL	NWP
Huda	Rural	238	992	493	499	795	408	362	25	41	584
Mhartale	Rural	264	1053	543	510	824	329	296	15	76	724
Bombadojichiwadi	Rural	123	504	251	253	442	145	90	21	10	359
Sukhalbhat	Rural	209	869	427	442	716	314	264	27	6	555
Redi	Rural	160	644	354	290	550	235	125	5	1	409
Kanyale	Rural	159	642	313	329	549	191	54	1	0	451
Gavatale	Rural	196	773	410	363	616	310	175	0	2	463
		12931	**54429**	**27597**	**26832**	**44502**	**21055**	**14607**	**2173**	**959**	**33374**

**Population Data As per Census of India, 2011*

Note: TWP: Total Worker Population, MW: Main Workers, CL: Cultivators, AL: Agricultural Labourers, HH: Households, NWP: Non Working Population

4 ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

4.1 Introduction

The proposed project shall have various impacts on environmental parameters like land environment, water quality, air quality of surrounding area due to increased quantities of solid waste, hazardous waste, sewage generation, air emissions, etc.

4.2 Identification of Impacts

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

Following parameters are selected for impact assessment due to proposed activity during various phases of the project cycle:

Table 4.1 Environmental Aspects and Impacts of Proposed Project

Sr. No.	Step/Activity	Environmental Aspect	Impact	
			Type	Severity
1.	Construction of Resort and Golf Course	Air emission due to material handling, construction activities and transportation vehicles	Air Pollution	Temporary
		Use of manpower	Employment	Temporary
		Cutting of Trees	Biodiversity loss	Temporary
2.	Commissioning of onsite pollution control devices and equipments	Use of water, energy and materials	Natural resources, conservation	Temporary
		Waste Water discharge	Water Pollution	Temporary
		Construction waste disposal	Land Pollution	Temporary
3.	Operation: Usage of Resort and Golf Course by tourists	Use of water	Natural resources/ conservation	Permanent
		Air emission discharge by DG sets during power failure and vehicular pollution	Air Pollution	Temporary
		Wastewater discharge	Water Pollution	Permanent
		Waste disposal	Land Pollution	Permanent
		Use of manpower	Employment	Permanent
		Use of material, energy	Natural resources/	Permanent

Sr. No.	Step/Activity	Environmental Aspect	Impact	
			Type	Severity
		and resources	conservation	
		Noise generation	Noise Pollution	Permanent
4.0	Closure and Decommissioning: Shutting down of resort and golf course activities	Social aspect	Revenue & employment loss, loss of tourism	Permanent
		Decommissioning	Land pollution	Permanent

4.3 Impact Identification and Suggested Mitigation Measures during Construction, Commissioning, Operation and Decommissioning Phases

4.3.1 Land Environment

4.3.1.1 Impacts during Construction Phase

The site will be cleared prior to start of excavation and other construction activity. This involves removal of grass/ shrubs and leveling of land. At present, there are no permanent structures on the site; hence no demolition activity is anticipated. About 1966 trees exist in the development zone of the project- of which about 56% (1101 trees) are endogenous/endemic trees for Konkan region and will be retained/transplanted as part of the development. The balance 44 % (865 trees) are acacia/cashew and other rain trees which will be removed during the development. It is proposed to develop a landscape using the Spice Route concept. More than 4,000 trees will be planted afresh on site of which more than 90% will be natural/endemic to Konkan region. This will be a part of the resort/golf course landscape development.

While preserving trees, emphasis will be laid on preserving mature/old trees having girth larger than 30 cm. some trees will be transplanted to suitable locations in order to restore or rehabilitate degraded portions of the site. The area will have ample greenery as part of the proposed development.

Similarly, the natural drainage pattern has been considered while planning the layout and will be maintained, as far as possible, in the post-operation phase.

Excavation for foundation of buildings will involve the removal of top soil. Part of the site towards the coastline (0-200m) does not have any soil cover and is covered with laterite outcrop–no cutting will be undertaken in this area.

It is proposed to store the top soil separately and reuse it within the site in the proposed landscaped/garden areas. Cutting will be undertaken on site (a) for golf course (including lakes) (b) for building foundations and (c) for external landscaping.

The total envisaged cut and fill volumes will be as given below:

Table 4.2: Cut and Fill Volumes during Construction Phase

Development area	Cut Volume in cum	Fill Volume required cum
Golf	1,15,000	4,80,000
Resort	1,14,373	2,13,913
External Landscape	12,000	17,000
Total	**2,41,373**	**7,10,913**

The substratum removed during the cutting/excavation as also the top soil removed will be used for the filling works. The top soil removed will be reused for gardening/ landscaping. As seen above the net fill material required will be 4,69,540 cum.

It is proposed to procure the said material as shown below:

Table 4.3: Raw Material Requirements and Source

Fill Material Type	Quantity (cum)	Source
Sand	90,300	Kankavli, Maharashtra &/or artificial rock and sand
Gravel/murrum	361,240	Government approved quarries/mining overburden
Soil	18,000	Government approved quarries

Goa experiences heavy monsoon rains (>3000mm) during the period of June to October. Impacts due the project will be negative if the construction of golf course/resort is not properly planned so that major works are completed during the non monsoon season and adequate precautions are taken during monsoon season to ensure that the exposed soil does not get eroded and/or to prevent surface run off during the period.

Construction Waste

Major impact on land environment, during construction phase, will be due to the waste generated from discarded construction material/debris. Construction waste consists of materials such as debris, concrete, steel/other metals, bricks, pallets, packaging/paper products, railings, door/window casings, fixtures, tiles, furnishings, discarded containers of paints, etc. Approximately, 0.5-1 MT/ day debris will be generated. Of this, the discarded paint containers are hazardous waste and are to be disposed off through authorized parties.

Transportation of Construction materials

As has been noted roads leading to the site are small one lane road. Transport of raw materials to site through trucks may affect the traffic pattern and cause temporary traffic congestion in the vicinity of the site. It may also cause localized short-term air pollution near the site during this period.

4.3.1.2 Mitigation Measures during Construction Phase

Site Preparation

In dry weather conditions, dust nuisance is created by excavation, leveling and transportation activities. To control dust pollution, water sprinkling will be done at regular intervals and excavated materials will be kept covered at all times.

Top Soil

- Top soil and substratum from excavated areas will be stored separately and reused, as the top cover, for landscaping and during golf course layout.
- Siltation control measures will be taken
- Activities will be carried out during dry season
- Provision of bunds/trenches, silt fences and gabions along the peripheral contours
- Controlled Entry and exit of machinery from site
- The earth material will be covered with synthetic covers during heavy rains.
- In order to minimize erosion and siltation during construction, rolled erosion control products like netted blankets or turf reinforcement mats or geotextile covers shall be used.
- Erosion control to be made using Geotextiles, Netted/Rolled Erosion Control Products and sods on bare soil to establish turf
- Series of filter bunds will be installed and provision made for addition of Polyelectrolyte so as to ensure that no sediment goes outside the site.
- Grading to ensure proper channelization of storm water
- Excavated Materialwill be used as fill material

Management of Construction Waste

Resources such as sand, metal, bricks, etc. will be procured from government approved quarries and establishments.

- The major impact on the land environment during construction phase is the requirement of large quantities of construction materials as identified during EIA studies. All construction materials shall be procured from Government approved quarries and borrow areas only
- Specific areas will be demarcated on the site, for storage of this material and also for temporary collection of construction debris, prior to its disposal.
- Debris will also be generated in the form of sub-stratum removed during excavation for foundations. Use of such material will also be made for filling of areas during shaping of golf course and landscaping.
- The solid waste generated from packaging of construction material will be sorted and sold for recycle and / or reuse.
- The construction debris will be utilized for internal paving and backfilling and partly disposed off in accordance with the local policy after obtaining required permission.
- The top soil layer removed during earthwork will be stored separately and reused.

- Adequate covered facilities, such as sheds for storage of materials, will be provided for storing construction wastes

Roads and Traffic

- The raw materials required for construction will be sourced from the nearest available government approved contractors/suppliers, to prevent glut of traffic. Such vehicles shall be parked within site and not on public road leading to the site
- The transport of materials will be arranged during non peak hours.
- Proponent proposes to widen the public road leading to the site from 4.5m to 15m
- Proponent plans to have a round about on the public road, gated access to premises and adequate parking for vehicles and underpass for taking vehicles from Eastern part of plot to the Western part – these mitigation measures will go a long way to reduce impact on road traffic for general public accessing Tiracol village and Fort and hence should be implemented as planned
- The Government of Goa has plans to build a bridge, connecting Querim to Tiracol, to make commuting easy and convenient both for the villagers and resort visitors. The project proponents have offered to design the bridge so as to provide ready access to the village.

Land Topology

The project site, to a large extent, is barren, unproductive and degraded land. Soil erosion has left only sheet rock on the surface and wave action threatens to further erode the coast. The project proponents are determined to reverse this erosive trend and create a lush tropical landscape within this area.

About 1001 of the trees coming in the path of the development are endemic to Konkan. It is envisaged to save maximum number of large mature trees, by preserving in situ, while the small ones will be transplanted elsewhere.

Earthwork will be minimized through a meticulous landscaping plan. Existing drainage pattern will be maintained.

Degraded portions of the site will be restored. It is proposed to work within the norm of the existing natural land setting. About 4000 + trees are proposed to be planted – consisting of more than 90% endemic species.

Use of *Paspalum* grass species – a high TDS tolerant grass – capable of remaining green over long periods and amenable to bio pesticides/bio fertilizers. It is also draught tolerant.

Development of soft cape using the spice concept – to give an out of the world concept to the tourist is another strong positive feature of the overall development.


Figure 4.1 Development of soft cape

4.3.1.3 Impacts during Commissioning Phase

Impacts during commissioning phase will be due to:

Use of water: Water requirement for resort will be 2550 cmd. Of this, 650 cmd will be potable and will be sourced from borewells and from public source (250 cmd and 400 cmd resp.).

Similarly, electricity required (6300 kVA) will be sourced from Goa Electricity Department but sourced from Maharashtra side from Malewad substation which is around 9 km from the site. During commissioning stage the water and energy demands will be fluctuating as one by one the equipment are commissioned.

Waste water generation during operation will result in estimated 45.54 cmd of effluent from the laundry. However, during commissioning phase risks of water pollution are enhanced since the pollution control facility such as effluent treatment plant will also be under commissioning and there might be shock load to effluent treatment plant.

Waste generation: As the plant operation is yet not stabilized, there is possibility of waste batches which will need to be stored and disposed safely so as not to cause land pollution.

4.3.1.4 Mitigation Measures during Commissioning Phase

- Proper training to employees in handling of waste effluent, solid waste, hazardous waste and other chemicals by hiring trained personnel well versed in handling such chemicals.
- Personal supervision by staff to ensure that there is no shock load to sewage treatment plant. Active support from technology supplier and staff to ensure that the plant process is stabilized as soon as possible to ensure that loads to STP remain at the predicted levels.
- Have a designated procedure to ensure waste generated during commissioning is collected separately and sent to authorized waste disposal site.

4.3.1.5 Impacts during Operation Phase

Soil erosion

Possibility of soil erosion during operation phase is low as most of the land area will be developed.

Soil contamination

Contamination of soil by spilled fuel and lubricants from equipments such as DG sets, vehicles as well as due to improper storage and disposal of solid waste may occur during this phase. Golf course maintenance requires use of various chemicals such as fertilizers, weedicides and pesticides. The proponent envisage maximum use of biopesticides and biofertilizers for maintaining the golf course turf grass. Various products proposed to be used are listed in chapter 2 on development of golf course.

Proponent also proposes to use *Paspalum* grass species instead of traditional Bermuda grass for fairways, tees and greens. *Paspalum* grass responds well to use of biopesticides and biostimulants and is also tolerant to high salinity water (having 3000- 6000ppm TDS). It requires low amount of water and can be watered every alternate day. It can also remain green for longer durations in adverse conditions (does not yellow). The use of Paspalum grass thus results in substantial saving of fresh water and significant reduction in use of chemicals, fertilizers and pesticides.

Shoreline erosion

The project site is bound by the Arabian Sea on the South and South West, across the rocky premonitory along the seaward periphery of the partially rocky plateau land. The continuous forces of incoming waves lead to erosion of the presently unprotected coast. Although this is a natural phenomenon, coastal protection measures need to be taken to ensure protection of the property.

Solid Waste Generation and Disposal

Solid waste from the Resort will consist of plastic, paper/paper products, glass, metal scrap and bio-degradable waste from kitchen and "landscape/golf course" maintenance works.

Waste will be segregated scientifically and appropriate disposal techniques will be adopted as given below:

- Recyclable waste will be segregated and sold to scrap dealers
- Composting will be undertaken of biodegradabale waste
- Kitchen waste will be used to generate biogas as a supplemental fuel for cooking.
- Baler/compactor will be provided for reducing volume in case waste needs to be disposed off site
- Biomedical waste generated (soiled dressings etc 50 kg/month) from the Health Centre will be disposed off in consultation with Health Department or through Goa Medical Complex
- A dedicated Garbage Management site (GMS) will be established on site

Impact on land due to solid waste generation in operation phase is seen to be negligible in view of the above measures. If not managed properly, waste will affect the health of residents, staff and employees as well as population in the surrounding area and will also be aesthetically unpleasant.

Hazardous Waste Generation and Disposal

Used lead acid batteries from inverters, golf carts and other sources are classified as hazardous waste and will need to be safely stored and disposed off as provided by the GSPCB through Authorized recyclers. There will be separate storage area in central BOH which shall be adequately covered and provided with impervious lining.

Similarly used oil/waste oil generated from the maintenance of golf carts will need to be disposed off through GSPCB Authorized recyclers.

Estimated Quantities of waste generated are summarized below:

Table 4.4 Hazardous Waste Generation

Type	Category	Quantity	Disposal
Used Lead acid Batteries	B6, Schedule II	25 Nos/annum	GSPCB Authorised recyclers
Used Oil	5.1, Schedule I	20 KL/annum	GSPCB Authorised recyclers

4.3.1.1 Mitigation Measures during Operation Phase

Soil protection

Erosion protection measures to prevent soil erosion will be adopted. Soil contamination through fuel/ lubricant will be prevented by avoiding runoff from affected areas into natural drains. Natural fertilizers and pesticides/weedicides are proposed to be used for the golf course turf grass.

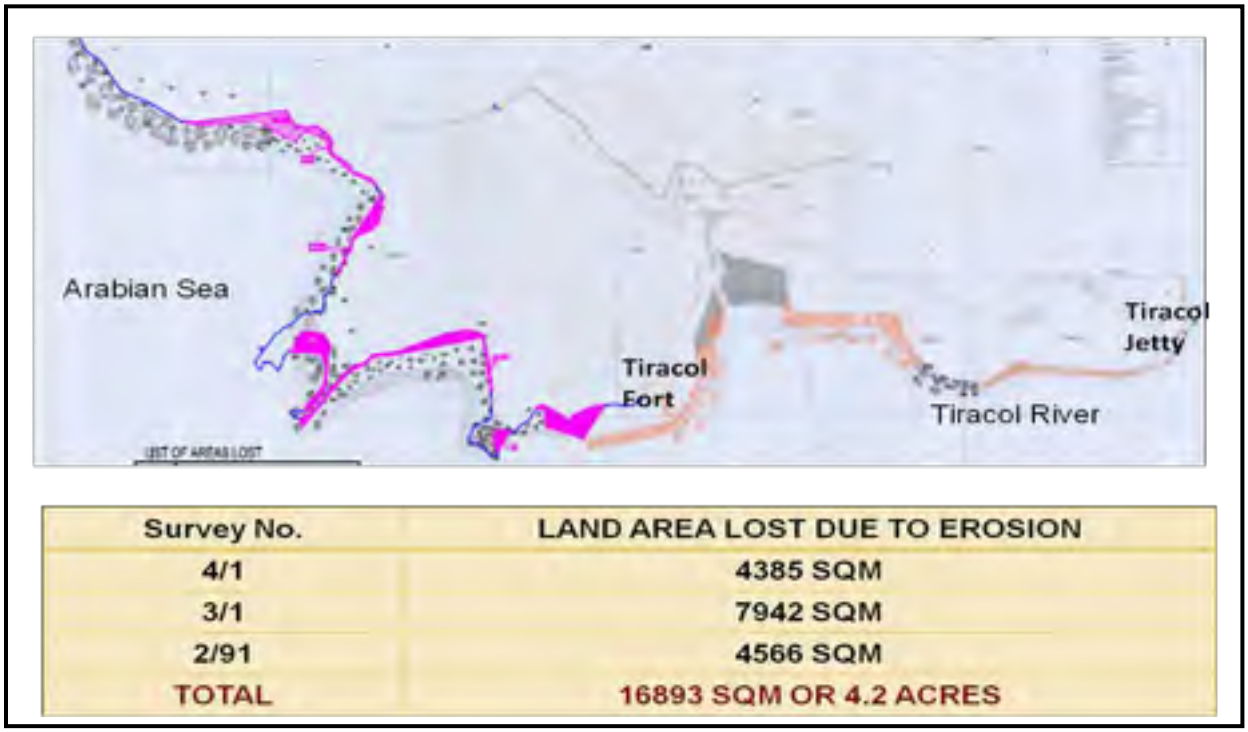
Well engineered soil erosion and sediment control plan will be adopted to prevent sedimentation of the existing *nallah*.

- Shoreline Protection
- Causes Of Beach Erosion
- Direct action of waves
- Effect of severe cyclonic storms & tides
- Reduction of sediment supply to the shore
- Rise in sea water level
- Change in shore topography
- Obstruction to littoral drift process
- Human interference such as sand mining

Extent of Erosion

Satellite imagery and revenue records have been studied for the periods of 1971 and 2011 and indicates that the site has lost large tracts of land to erosion from sea as shown in the figures below.

Protection of shoreline will be achieved by adopting buffer material such as boulders, conventional concrete blocks, and tetra-pods to form "interlocking/porous" barriers in order to dissipate the power of waves and currents.



Survey No.	LAND AREA LOST DUE TO EROSION
4/1	4385 SQM
3/1	7942 SQM
2/91	4566 SQM
TOTAL	16893 SQM OR 4.2 ACRES

Figure 4.2 Coastal Erosion Between 1971-2011

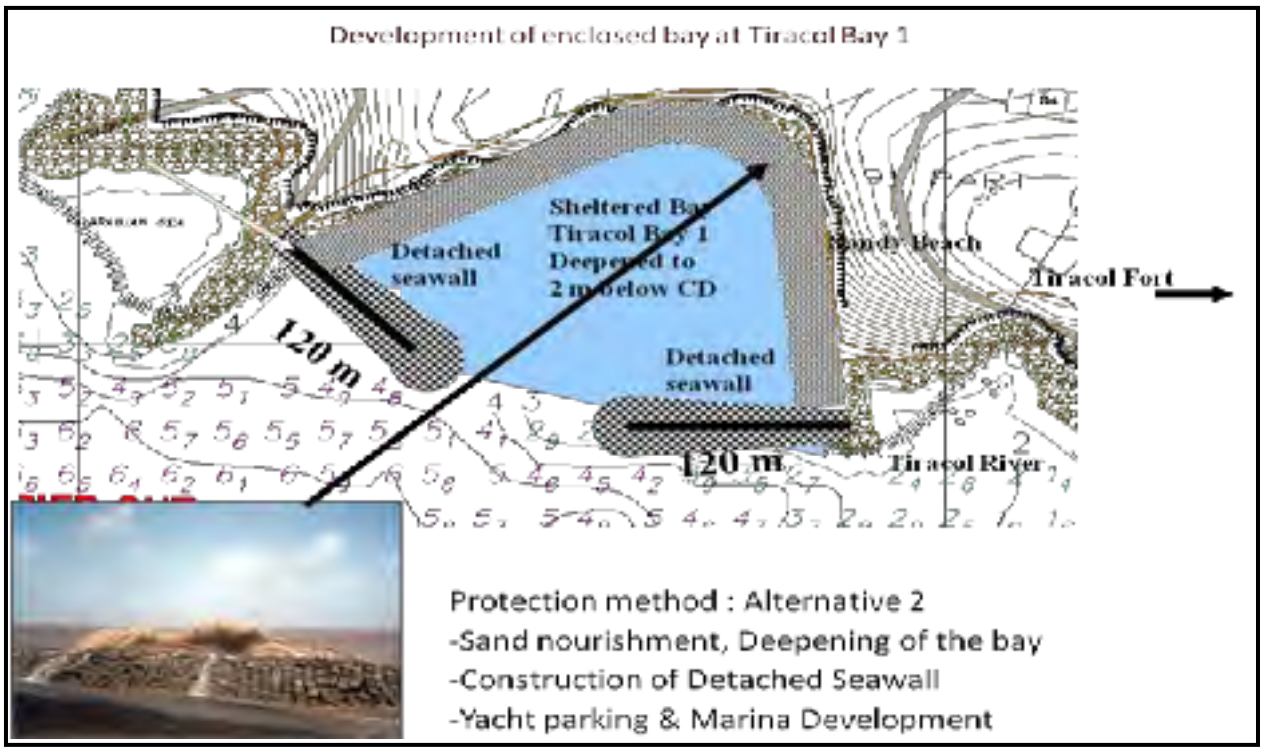


Figure 4.3 Shoreline Protection Measures

Solid Waste Management

Management of solid waste generated during the operation phase comprises its collection, segregation, treatment and safe disposal so as to cause minimal impact on the environment. This involves mandatory manual segregation of the waste, at the source, in to biodegradable (wet) and non-biodegradable components. The latter will further be separated in to recyclable and inert waste. All components will be stored separately in labeled bins and designated covered sheds. Wet waste will be stored in refrigerated condition. Recyclable material will be sold to recognized recyclers and inert waste will be disposed off, in consultation with the Municipal/ Panchayat authorities, at designated landfill sites. The biodegradable waste and garden waste will be composted in mechanical composting units. The compost from composting units will be used to manure the golf lawns and resort gardens.

Table 4.5 Proposed methodology for Solid Waste Management

Sr. No.	Waste Type	Collection and Storage	Method of Disposal
1.	Biodegradable waste	Manual collection and storage in refrigerated rooms at the ground level	Treatment in mechanical composting units provided at central BOH/Garbage Management Centre
2.	Non Degradable waste	Manual collection and storage in closed rooms at ambient temperatures.	Sorted and recyclables sold to recyclers/scrap dealers. Baler provided for compacting waste.

Biodegradable waste will be treated in mechanical composting units.

Other measures suggested:

- Dry STP sludge will be used as manure for gardening to the extent possible. Rest will be mixed with wet waste and composted.
- Spent Activated Carbon from the ACF will be given back to the supplier for regeneration and recycling
- Waste sand from the PSF will be disposed off within the site for ground leveling or as fill material for maintaining pathways.
- Spent ion exchange resins from the softening plant will be given back to the supplier.
- Used/Waste oil generated during the maintenance of vehicles (separated at the oil separator) and from "DG sets/other machinery" will be disposed off through used oil recyclers recognized by the GSPCB. Such waste needs to be stored in closed containers under covered roof and provided with impervious flooring
- Used lead-acid batteries are classified as hazardous waste and should be stored in covered roof and impervious concrete flooring and disposed off through buy-back arrangement with suppliers.
- The Biomedical Waste generated in the health center will be segregated, treated and disposed off as mandated under the Biomedical Waste (Management & Handling) Rules, 1989. This will be achieved in consultation with the local Department of Health Services & Goa Medical Complex

- The proposed Garbage Management centre will have adequate space for storage and segregation of various types of waste.

4.3.2 Air and Noise Environment

4.3.2.1 Impacts during Construction Phase

Road Construction

Ambient air quality will be affected due to fugitive dust generation during construction of roads. This will be a temporary and minor impact as lateritic soil produces comparatively low level of particulate matter and mitigation measures such as intermittent water sprinkling will be adopted till the road surfaces are asphalted.

There will be a marginal and temporary impact on the air quality in the immediate vicinity of the resort, due to increased dust emissions and noise generation. Activities such as increased heavy vehicle traffic for construction related materials to and from the site, excavation for foundations, leveling/cut & fill works, etc. may result in such impacts. Marble and stone will be factory cut and adjusted at site to site conditions. This may lead to a marginal and temporary fugitive dust emission on site.

Sources of noise pollution e.g. noise generating machinery/ equipment (dumpers, bulldozers, compressors, compactors, concrete plant, cranes, stone cutting equipment etc.) as well as heavy vehicles used for transportation, will be marginal, temporary and controllable.

4.3.2.2 Mitigation Measures during Construction Phase

Emissions from mobile sources:

- Idling of raw material delivery trucks or vehicles carrying other equipment will not be permitted, when not in active use.
- Ready mix concrete will be used for construction purposes to prevent air pollution from on-site mixing.
- Dust covers will be provided on trucks used for transportation of materials prone to fugitive dust emissions.
- Cleaning of vehicles will be carried out periodically to reduce dust and vapour emissions.

Emissions from stationary sources

- Most of the machinery related to construction will be located close to construction area for ease of handling.
- Construction areas including marble and stone cutting areas will be enclosed wherever possible.
- Machinery such as conveyers, mixers, stone cutting equipment will be screened with sheets of suitable material to reduce the spread of suspended particulate matter and to reduce noise.
- All stationary construction equipment will be located as far away as possible from existing residential pockets.

- Areas of activities such as excavation/grading and routes of delivery vehicles across patches of exposed earth, will be frequently water sprinkled to prevent dust pollution.
- Appropriate containment arrangements around bulk storage tanks and material stores will be made to prevent spillages entering watercourses.
- Equipments/machines and vehicles will always be kept in good state of repair to minimize emissions.

For mitigation of Noise Levels:

- Construction related contracts will make it obligatory to ensure that the noise levels during the operation of construction machinery will be maintained below the limits prescribed under the EP Act noise standards.
- Noise generating sources will be regularly oiled/ greased and their support platforms maintained properly so as to prevent vibratory noises.
- Workers working near high noise machinery will be provided with ear muffs/ ear plugs.
- Construction sites will be barricaded with temporary buffer walls to isolate the same from the neighboring areas.

4.3.2.3 Impacts during Operation Phase

Traffic and Transportation

The impact on road traffic during operation phase will be due to the movement of vehicles of tourists, users/residents of the Resort facilities, including Golf Course users and Villa occupiers. The impact will be particularly high during tournament periods when the golfers arrive along with their support staff and the tourists who come for watching the game. The proponent has provided greater parking space than that mandated by TCP Rules. But it is advisable to earmark separate vacant areas to tackle such a high influx during peak season. An alternative will be to identify tourist taxi operators in near vicinity of site so that night time parking demand gets reduced.

The public road leading to the site is single lane road and is the main route of communication for Tiracol village and for Tourists visiting the Fort. This will be a minor but significant impact if road traffic is not managed properly. Proponent has planned to provide round about to aid the entry into the resort area. Also, proponent has envisaged to create a under pass for the golf carts so that the East and West side of the resort can be connected to each other with out affecting traffic on main roads. The movement of users, residents, staff and visitors of the entire Golf Resort Complex will be facilitated by electric buggy-carts; this concept will make the entire zone pollution free and easily commutable.

The Government of Goa has an active proposal to construct a new bridge joining the Querim Beach side of the Tiracol river and Tiracol village to connect the latter with the rest of the State. Once this bridge becomes operational, the Resort "visitors/ users/ residents/ staff" and the people of Tiracol village will have a hassle free approach to the village, Fort and the Resort. It will also aid in traffic management.

Exhaust from kitchen and other Utilities

During the operation phase, exhaust from resort kitchens and DG set (emergency power back up arrangement) will be the only potential sources of air/noise pollution. DG sets provided will meet latest norms as per EP Act and have silencers and enclosures so that the noise doesnot affect villa residents, guests and villagers as well as avifauna of the region. Kitchen exhausts will have activated carbon filters to reduce odours.

4.3.3 Emission Modelling due to DG sets and Traffic

Following is the Emission Modelling study carried out for the project.

The schematic methodology for emission modelling is given point wise below:

1. Firstly, emission inventory was prepared using details of traffic data and emission factors. Number of vehicles were observed and then multiplied with suitable emission factor taken from the draft report on "Emission Factor Development for Indian Vehicles" by the Automotive Research Association of India (ARAI), Pune to calculate the concentration of different air pollutants including NO_x, SO_2 and PM (ARAI, 2008). Boilers and DG Sets were also studied for their stack emissions as point source.
2. After the preparation of emission inventory, meteorological data i.e. hourly wind speed, wind direction and temperature was processed using AERMET (AERMOD meteorological Pre-processor).
3. Then modelling was done through AERMOD for determining the concentration of present air quality. The output of AERMET is served as an input to AERMOD. It gave the average concentration of 24-hourly maximum and average concentration of period for pollutants over the region.
4. Here, concentration plots have been generated for TPM, NOx and SO_2 where SO_2 emission from vehicles is very negligible and it was excluded.

Emission Inventory for Vehicles and Stacks of DG Sets and Boiler

The emission inventory has been prepared for vehicles for all stacks of DG Sets and Boilers for NOx, SO_2 and PM as shown in the tables below.

Table 4.6 Emission Inventory for vehicles without project for the year 2016

Name	Length (km)	Width (m)	NOx (mg/s)	SO_2 (mg/s)	TPM (mg/s)
Tiracol Road	4	4.5	2.23	4.25	0.22
Querim Arambol Road	2.2	5	3.62	9.13	0.21

Table 4.7 Emission Inventory for vehicles with project for the year 2016

Name	Length (km)	Width (m)	NOx (mg/s)	SO_2 (mg/s)	TPM (mg/s)
Tiracol Road	4	4.5	3.21	7.42	0.30
Querim Arambol Road	2.2	5	5.15	28.35	0.30

Table 4.8 Emission Inventory for Stacks of DG Sets and Boilers for the year 2016

S.N.	Stack ID	Stack Height	Diameter (m)	Temp (°C)	Velocity (m/s)	TPM (g/s)	SO_2 (g/s)	NO_x (g/s)
	Back up DG sets							
1	DG1	22	0.1	180	16	0.189	0.36	0.14
2	DG2	22	0.1	180	16	0.189	0.36	0.14
3	DG3	22	0.1	180	16	0.189	0.36	0.14
4	DG4	22	0.1	180	16	0.189	0.36	0.14
5	DG5	22	0.1	180	16	0.189	0.36	0.14
6	DG6	22	0.1	180	16	0.189	0.36	0.14
	Boiler							
1	B1	22	0.6	180	6.5	0.27	0.5	0.19
2	B2	22	0.6	180	6.5	0.27	0.5	0.19

Results of Air Quality Modelling

Air quality modelling was carried out to make concentration plot using AERMOD for air pollutants spatially over the region. Concentrations plots have been presented for three pollutants such as NOx, SO_2 and PM for the project.

Results of NOx Concentration

The concentration of NOx in 24 hours as well as average concentration for a particular period from the ground source is plotted using AERMOD.

- As shown in **Fig. 4.4**, the maximum concentration of NOx in 24 hours period is 9.4 µg/m^3 at Tiracol road.
- **Fig. 4.5** shows the concentration of NOx for average of the period is found to be 4.0 µg/m^3 at Tiracol road.

Table 4.9 Prediction of Impact from GLC of NO_x

AAQM Location	Background value (highest) (µg/m^3)	Predicted GLC (µg/m^3)	Net impact (µg/m^3)	Norms* (µg/m^3)
A1	10.07	2.4	12.47	80
A2	9.41	2.4	11.81	80
A3	13.66	6.4	20.06	80
A4	15.08	2.4	17.48	80
A5	13.21	5.4	18.61	80
A6	13.14	4.4	17.54	80

Results of SO_2 Concentration

The concentration of SO_2 in 24 hours as well as average concentration for a particular period from the ground source is plotted using AERMOD.

- As shown in **Fig. 4.6**, the maximum concentration of SO_2 in 24 hours period is 24.3 µg/m^3 at Tiracol road.

- **Fig. 4.7** shows the concentration of SO_2 for average of the period is found to be 10.2 µg/m^3 at Tiracol road.

Table 4.10 Prediction of Impact from GLC of SO_2

AAQM Location	Background value (highest) (µg/m^3)	Predicted GLC (µg/m^3)	Net impact (µg/m^3)	Norms* (µg/m^3)
A1	3.13	6.2	9.33	80
A2	4.05	6.2	10.25	80
A3	3.28	11.4	14.68	80
A4	4.53	14.0	18.53	80
A5	3.94	6.2	10.14	80
A6	0	8.8	8.8	80

Results of TPM Concentration

The concentration of TPM in 24 hours as well as average concentration for a particular period from the ground source is plotted using AERMOD.

- As shown in **Fig. 4.8**, the maximum concentration of TPM in 24 hours period is 12.9 µg/m^3 at Tiracol road.
- **Fig. 4.9** shows the concentration of TPM for average of the period is found to be 5.4 µg/m^3 at Tiracol road.

Table 4.11 Prediction of Impact from GLC of TPM

AAQM Location	Background value (highest) (µg/m^3)	Predicted GLC (µg/m^3)	Net impact (µg/m^3)	Norms* (µg/m^3)
A1	41.67	3.3	44.97	100
A2	27.97	1.9	29.87	100
A3	42.7	6.0	48.7	100
A4	54.14	6.0	60.14	100
A5	46.6	3.3	49.9	100
A6	44.53	3.3	47.83	100

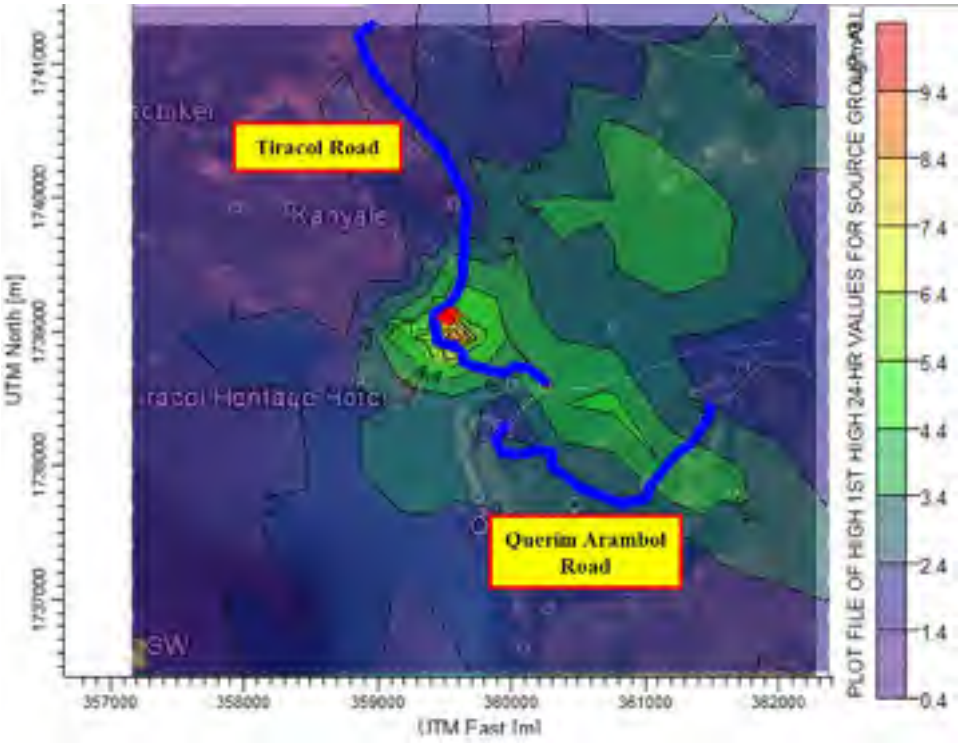


Figure 4.4 Concentration contour plots (µg/m³) for NOx for 24 hr. maximum.

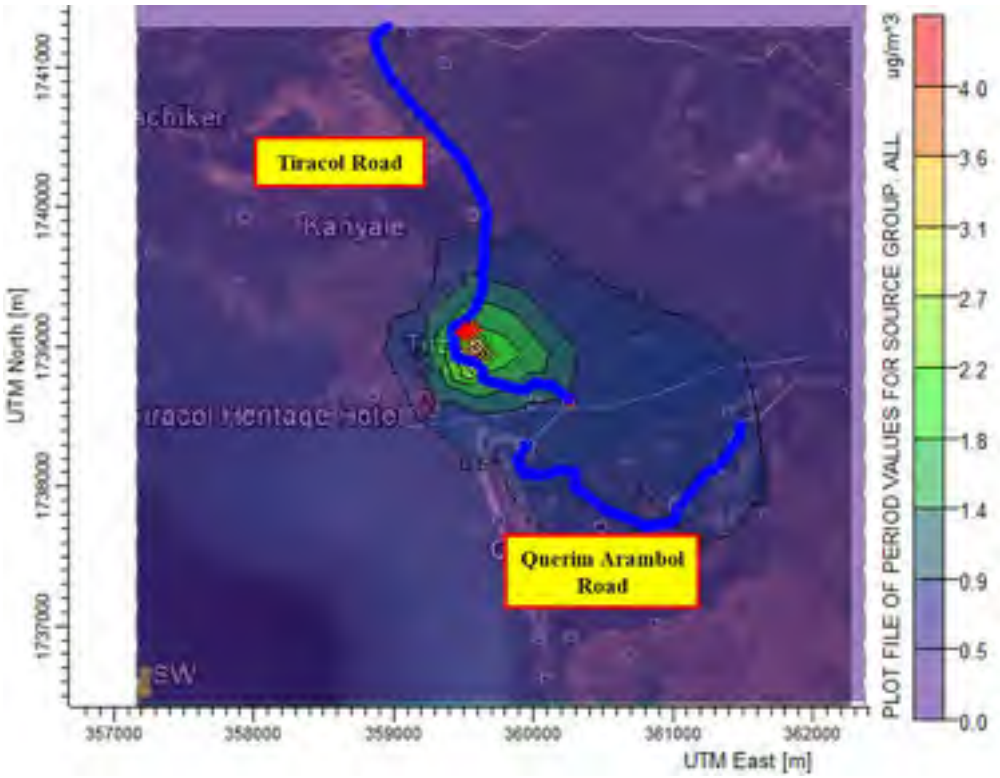


Figure 4.5 Concentration contour plots (µg/m³) for NOx for average of the period

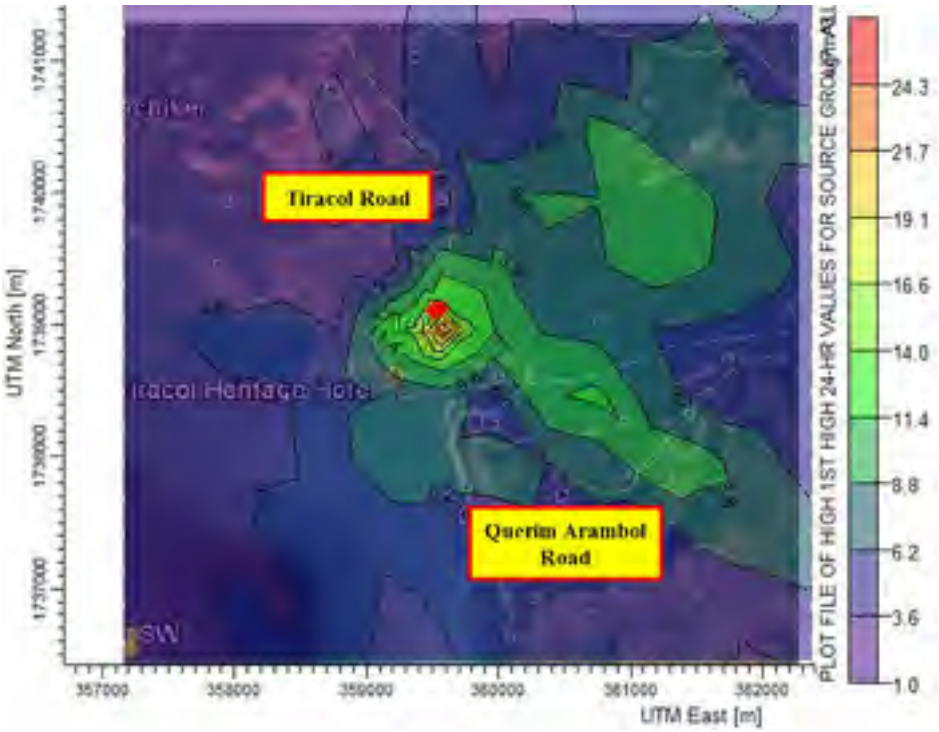


Figure 4.6 Concentration contour plots (µg/m³) for SO_2 for 24 hr. maximum.

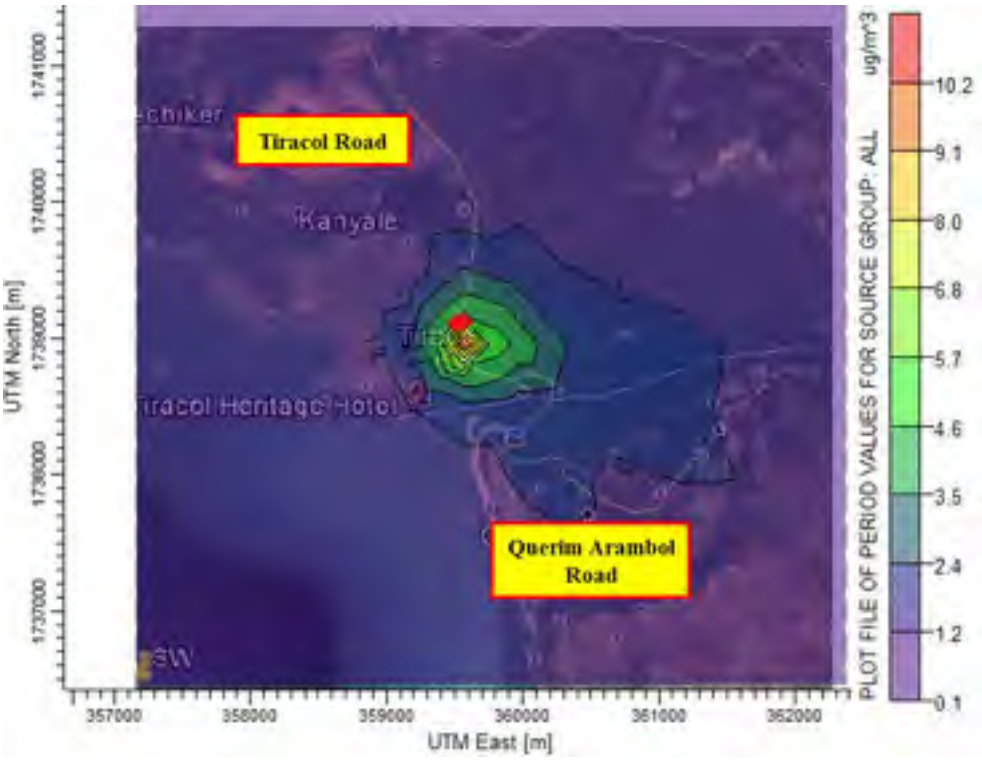


Figure 4.7 Concentration contour plots (µg/m³) for SO_2 for average of the period

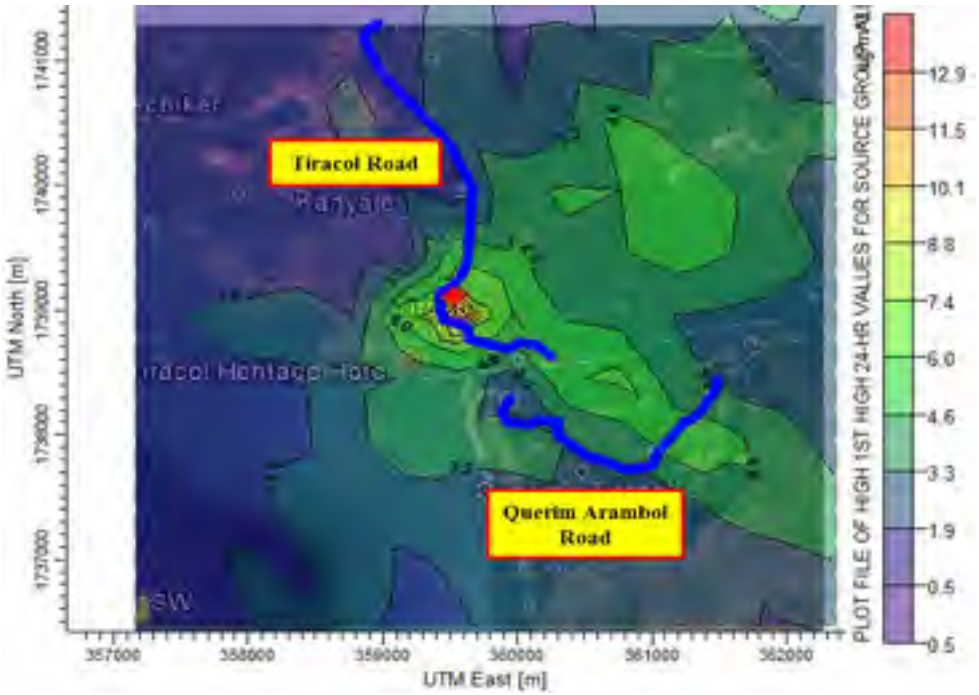


Figure 4.8 Concentration contour plots (µg/m³) for TPM for 24 hr. maximum.

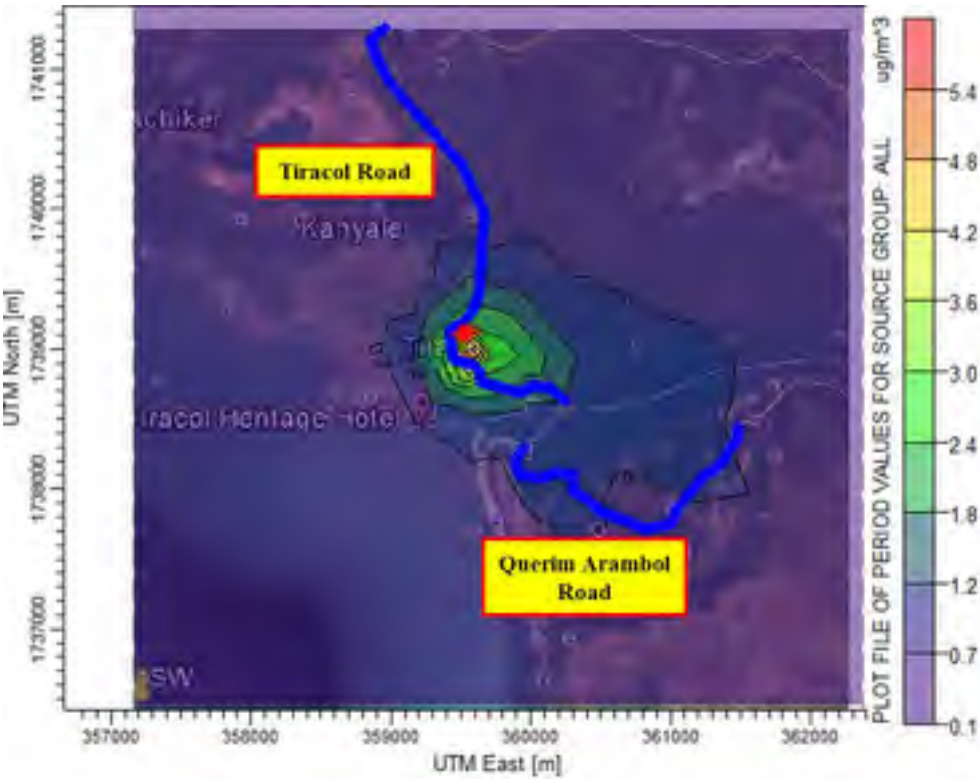


Figure 4.9 Concentration contour plots (µg/m³) for TPM for average of the period

Conclusions

In this region, vehicles used by the occupants of the resort and stack emissions from the proposed DG sets and the boilers will be the major sources of air pollution in the future.

The USEPA AERMOD air dispersion model has been used for predicting the concentration of air pollutants due to these sources.

The maximum concentration of NOx is found to be 9.4 µg/ and the average concentration of NOx is found to be 4.0 µg/m^3. The maximum concentration of SO_2 is found to be 24.3 µg/m^3 and the average concentration of SO_2 is found to be 10.2 µg/m^3. The maximum concentration of TPM is found to be 12.9 µg/m^3 and the average concentration of TPM is found to be 5.4 µg/m^3. Concentrations of the emissions were found to be more on Tiracol road as it goes adjacent to the site. Refer **tables 4.9, 4.10, 4.11** on the previous pages.

The overall concentrations of the pollutants studied are almost negligible when compared to the standards given. However, in order to reduce the level of pollutants concentration in air for future, it is suggested that some mitigation measures are undertaken.

4.3.3.1 Mitigation Measures during Operation Phase

Traffic and Transportation

A well designed traffic management plan will be adopted to regulate vehicular traffic, to and from the resort. Provision of a round about, an underpass and adequate parking areas will go a long way to reduce traffic congestion and should be provided as planned. Commuting within the resort will entirely be based on special pollution free battery operated buggies provided by the resort management.

"Entrance/exit" to the site will be maintained so as to facilitate smooth traffic flow and road side parking will be restricted.

Pollution from Exhausts

All resort kitchens will be provided with proper ventilation and exhaust vents with grease and activated carbon traps to reduce odours.

DG sets will conform to the norms specified by the Central Pollution Control Board under the Environment Protection Act and suitable acoustical enclosures will be provided. The project proponent will provide adequate preventive maintenance to ensure low emissions during operation of DG sets.

The proponent has proposed 6 DG sets of 750 KVA capacity each. The stack heights of DG sets will be maintained in accordance to the Central Pollution Control Board (CPCB) norms.

4.3.4 Water Environment

4.3.4.1 Impacts during Construction Phase

Although the Resort site is located in a high rainfall zone (>3000 mm/year), most of the precious rain water is lost through surface runoff as currently the site is bar ren and vacant. Some areas towards the West of the project site, which do not drain to the existing natural nallah, drain directly in to the Arabian Sea while towards the central portion of the site there exists a small nallah which carries rainwater from the northern highland located on the northeast corner of the plot. This nallah drains through the

Tiracol village into the Arabian sea. Hence, the project proponent intends to develop two artificial lakes to harvest rainwater and serve as water reservoirs. This will further contribute to sedimentation and erosion control, which are important design requirements of a golf resort.

The water from rainwater harvesting water bodies will be used for non-potable water applications, such as irrigation. Collecting rainwater reduces the need for runoff devices and minimizes the requirement of water to be sourced from the PWD.

Soil compaction caused by site development and the expanse of impervious surfaces, such as roads and parking lots, produce storm water runoff containing sediment and other contaminants (eg. pesticides, nutrients, vehicle fluid leaks, and mechanical equipment waste). Increased storm water runoff can overload pipes and sewers and spoil the water quality in the surrounding environment. These problems are overcome, to some extent, by creation of the lakes.

The rainwater harvesting water bodies will also help in promoting biodiversity within the project site, which is conducive for such interventions with minimal effort. Rainwater harvesting water bodies will contribute to evaporative cooling which in turn result in improvement of microclimatic conditions on the site.

Artificial Lakes and the Village Settlement

It is estimated that rainwater harvesting water body #01 will cater to a catchment area of about 89.63 acres and rainwater harvesting water body #02, to an area of about 14.00 acres. Even assuming a conservative runoff co-efficient, the actual water collection potential for Lake 1 is 432,112 Cu m (approx.), as against the rainwater harvesting water body's designed capacity of only 34,724 Cu m, thus leaving a surplus of 397,388 Cu m (approx.) which will go into the existing water way (nallah), proposed to be maintained in its natural state. Likewise, as per the estimated catchment area for rainwater harvesting water body #02, it's water collection potential is 63,130 Cu m, whereas the designed capacity of the rainwater harvesting water bodies is only about 4,900 Cu m, thus leaving a surplus of 58,230 Cu m (approx.) which will drain into the said existing water way.

Thus out of the entire water catchment potential on the site, of about 495,242 Cu m which currently runs unhindered in to the water way towards the village, only approx. 39,624 Cu m will be collected in the proposed rainwater harvesting water bodies and the balance quantity of 455,618 Cu m (approx.) will continue to flow in the water way which joins the River Tiracol. The Tiracol Village has a population of only around 200 people and presently they do not appear to make any use of the nallah water. However, even if they wish to use it in future, much more than their requirement will still be available as runoff. Therefore, it can be seen that the construction of rainwater harvesting water bodies and storage of potential rain water quantity still does not block the natural course of water flow through the Village. Apart from this, the rainwater harvesting water bodies will act as a flood control measure to the downstream areas and contribute in controlling soil erosion in the region.

Impacts due to Construction Activity

During construction activity, pollution from construction run-off is likely. Blocking of natural drains due to deposition of construction materials is a likely impact unless regular cleaning of drains is carried out. Construction of rainwater harvesting water bodies will help in solving this problem.

Impacts due to wastewater generation

Water will be required during building construction and for domestic requirement of the labour force. Maximum quantity of water required for construction works is estimated at 7m^3/day and for domestic consumption of labour colony at 3 m^3/day. The water need for construction purpose will be sourced from PWD and private tankers, whereas domestic requirement will be met from the PWD supply. The sewage generated by the temporary labour colony will be adequately treated through the conventional "Septic Tank-Soak Pit "at a safe distance from the existing settlement.

4.3.4.2 Mitigation Measures during Construction Phase

- Laborers will be housed outside the CRZ area. The proposed labour camp will be provided with adequate sanitation facilities like safe drinking water, toilets with septic tanks and soak pits (located outside the CRZ area) Temporary arrangement of drinking water will be provided for workers
- Sanitation provisions such as washrooms, toilets, dustbins for waste and other packing material brought by workers will be made available during the period and capacity will be adequate for the workers
- Construction area will be isolated and care will be taken to divert the run-off to storm water drainage, so as to prevent pollution from construction runoff. Also, subsurface work will be carried out only during non-monsoon period. A storm water management plan having limited impervious layer, will be implemented to promote infiltration.
- Precaution will be taken to ascertain that no waste materials such as cement, paint and solid material like iron rods and any other material are dumped into storm water system.No accumulation of stagnant water will be allowed within the proposed site as well as in the vicinity, to prevent breeding of mosquitoes

4.3.4.3 Impacts during Operation Phase

Impacts on natural drainage pattern and ground water

The proposed rainwater harvesting water bodies are located adjacent to the existing nallah and nallah has been considered as the overflow line. This location is also free from any Villas or Resort related building construction zone and fits in well with the golf course routing plan.

No flooding is envisaged as there is no plan for filling of low lying areas, anywhere close to the settlement. Sedimentation of the existing nallah is also unlikely as elaborate land

cover of grasses and other vegetation as well as meticulous maintenance of the same are pre-requisites for the proposed world class golf course.

Impacts on existing water resources

During operation phase, water will be sourced from the PWD for domestic purposes and supplemented by approved bore wells.

Waste water (sewage) generation from the resort area is estimated at 550 Cum/day. Waste water/ sewage generation from the proposed project activities, if not managed adequately may cause unhealthy conditions in the area through the resultant pollution of surface and ground water.

The proponent proposes to have dual plumbing whereby grey water (i.e water from washbasins/showers/swimming pools etc) and sewage water (from kitchen/ toilets/ urinals) are segregated. Grey water will be treated by ultrafiltration whereas sewage water will be treated in Membrane Filtration plant. Treated sewage water will be reused for HVAC cooling, landscaping/gardening and irrigation of golf course.

The proposed arrangements for utilizing of rain water through combination of rainwater harvesting water bodies and ground water recharge as also treatment of entire quantity of sewage generated are deemed as significant positive steps for reduction of impacts on environment.

4.3.4.4 Mitigation Measures during Operation Phase

Water Conservation

- Treated water from STP will be used for golf course irrigation, landscaping, flushing, HVAC and for fire water makeup. As can be seen from the table below, 100% of waste water will be treated and reused.
- Use of sanitary fixtures consuming low water, such as sensor operated taps and urinals.
- Dual plumbing system for urinal and WC
- Use of treated grey water (from wash basin, showers, bath etc) for flushing of back of house toilets and cooling tower

Rain Water Harvesting

- Rain water harvesting from roof tops and paved areas will be provided as under :
- Routed partly to lakes (total capacity 40,000cum) and to a concrete underground tank (10,000cum) to be located in central BOH area.
- About 250,000 cum per year water from roof tops and paved surfaces will be directed for recharging of aquifers through soakaways.
- Under drainage system will be installed to capture and re-use all golf course runoff to lakes
- No golf course run-off will be allowed to flow into the adjacent natural water sources.

Wastewater Management

- Sewage treatment plant with Membrane Bioreactor (MBR) will be provided for collection, treatment and safe disposal of sewage, based on the peak occupancy level of the resort. Mechanical drying of STP sludge will be undertaken. Treated sewage water will be reused for irrigation
- Grey water from wash basins, showers & bath tubs will be treated by Ultrafiltration and also reused for irrigation.
- In addition, the treated sewage will also be chlorinated to reduce its bacterial toxicity.
- Waste water from kitchen will be screened (to remove solids), passed through grease traps and then treated in sewage treatment plant.
- As the entire quantity of waste water generated within the resort will be treated and reused on site, it will lead to a situation of zero discharge into the surroundings.

4.3.5 Ecological & Biological Environment

There is no wild life sanctuary/national park located within study area. There is considerable agricultural area and few reserve forests patches in study area. Construction phase involves leveling, removal of bushes and minor vegetation within plot, building construction and vehicular movement will generate particulate matter, temporarily.

Particulate emissions during construction will have some impact on trees located near construction site. However, since the particulate are non-toxic in nature and emission is temporary thus no serious impacts are considered.

4.3.5.1 Impacts during Construction Phase

About 1966 trees exist in the development zone of the project- of these about 56 % (1101 trees) are endogenous/endemic trees for Konkan and they will be retained/transplanted as part of the development whereas balance 44 % (865 trees) are acacia/cashew and other rain trees which maybe cut during the development. It is proposed to develop a landscape using the Spice Route concept. More than 4000 trees will be planted newly at site. More than 90% of the trees to be planted will be local/endemic to Konkan.

While preserving trees, emphasis will be laid on preserving mature/old trees having girth larger than 30 cm. Trees will be transplanted to suitable locations in order to restore or rehabilitate degraded portions of the site. The area will have ample greenery as part of the proposed development.

4.3.5.2 Mitigation Measures during Construction Phase

Protection of Existing Trees

There are no reserved forests/ sanctuaries located within the study zone of 7km. The building layout has been planned to ensure minimum damage to the native vegetation cover. At present, about 1966 trees exist in the development path of the project.

About 1001 of these trees in the development area are endemic to Konkan region and all efforts will be made to preserve the same. The fully grown tree species which are mature will be retained or transplanted. Remaining 965 trees are common trees like acacia, cashew etc will be removed during the construction phase. To compensate the loss of these trees proposed for removal the project proponent shall undertake plantation of more than 4000 trees consisting of indigenous species. Plantation of trees will be carried out at the rate of 50 trees per hectare.

Species Recommended for Plantation:

The local topography, agro-climate, and soil profile, have been considered while selecting the tree species. Selection of species is based on their ecological value followed by aesthetic value. Trees with large canopies and leaf coverage are preferred.

Species recommended for plantation:

Table 4.12 Species selected for green belt in the outer periphery of project site

Species Name	Local Name	Type	Features	
Alstonia scholaris	Chattiyan	Tree	Quick Growing	Evergreen
Barringtonia acutangula	Indian Oak	Tree	Quick Growing	Evergreen
Barringtonia racemosa	Nevar	Tree	Quick Growing	Evergreen
Calophyllum inophyllum	Alexandrian laurel	Tree	Slow Growing	Evergreen
Garcinia indica	Kokam	Tree	Slow Growing	Evergreen
Lagerstroemia speciosa	Queen Crape Myrtle	Tree	Quick Growing	Evergreen
Mammea suriga	Suringi	Tree	Quick Growing	Evergreen
Millingtonia hortensis	Indian Corck	Tree	Quick Growing	Evergreen
Mimusops elengi	Bakuli	Tree	Quick Growing	Evergreen
Neolamarkia cadamba	Kadamb	Tree	Quick Growing	Semi-Deciduous

Table 4.13 Species selected for green belt in the inner periphery of project site

Species Name	Local Name	Type	Features	
Bauhinia purpurea	Butterfly Tree	Tree	Quick Growing	Deciduous
Bauhinia racemosa	Astha	Small Tree	Quick Growing	Deciduous
Bougainvillea spectabilis	Bougainvillea	Shrub	Quick Growing	Evergreen
Caesalpinia pulcherrima	White Gulmohor	Shrub	Quick Growing	Evergreen
Callistemon citrinus	Bottle brush	Small Tree	Slow Growing	Evergreen
Clerodendrum inerme	Kadumendi	Shrub	Quick Growing	Evergreen
Gardenia jasminoides	Anant	Tree	Quick Growing	Evergreen
Lawsonia inermis	Henna	Shrub	Quick Growing	Evergreen
Nyctanthus arbor-tristis	Parijatak	Shrub	Quick Growing	Decidous
Saraca Asoka	True Ashok	Tree	Quick Growing	Evergreen

Species Name	Local Name	Type	Features	
Tecoma stans	Tecoma	Shrub	Quick Growing	Evergreen
Thuja occidentalis	White Cedar	Tree	Quick Growing	Evergreen

Considering the permeable nature of soils on the project site, and the need to use minimum quantity of irrigation water, a high quality but draught tolerant grass species was found necessary for use on the golf course. Consequently, a versatile grass species namely, Paspalum has been recommended for the purpose. This species requires only 50 % of the water need of conventional tropical grasses.

Features of landscape design:

- Paved paths between buildings will be of minimum width so that impervious ground cover is reduced. Also, porous pathways as suggested by LEEDS are been explored.
- Stress is given to use native plants in the landscaping scheme so that it smoothly blends with the natural surroundings.
- Garden areas to form part of landscape framework with places for water bodies, water conveyance drains and water collection structures.
- Provision of drip irrigation/sprinklers to lower water requirement
- Sensors to be provided for monitoring moisture content and evapotranspiration rate to optimize water consumption
- Stepped area for containment of monsoonal water.
- Planted landforms tailored to give a majestic view of the sea.
- Use of organic manures and integrated pest control methodology.

4.3.5.3 Impacts during Operation Phase

Open areas within the resort premises will be covered with lawns, shrubs and flowering and other trees to provide good shade and a cool environment. Proposed golf course has been designed using the latest variety of grass (*Paspalum sp*.) which requires a very small quantity of chemical fertilizers and pesticides and responds very well to biofertilizers and biopesticides and provides a better playing surface. This grass species uses less water than other warm season grasses or Bermuda grass, and handles drought conditions very well. It also has a lower nutrient requirement.

The purpose of landscape planning is to protect the environment, as also to provide the much needed aesthetic excellence within the golf resort. The development aims to preserve the ecology of the site as well. After completion of the project it will lead to a more organized open space and green cover for recreation of the tourists and visitors of the resort and there will be an overall long term beneficial impact.

4.3.5.4 Mitigation Measures during Operation Phase

Landscaping and Open Areas

The site will have ample green cover as part of the proposed development. The planned area for garden, lawns, outdoor recreation and other open spaces is about 15% of the effective plot area.

All open spaces within the resort will be covered with lawns, ornamental shrubs and flowering trees to provide good shade and an aesthetically rich as well as cool environment.

Figure 4.10 Post Construction

Management of green cover on site

The purpose of landscape planning will be to conserve the environment and aim to preserve the ecology of the site as well. After completion of the project there will be more organized open spaces and ample green cover for recreation purposes. The designed landscape will also improve the aesthetics of the project environment and there will be an overall long term beneficial impact.

The Paspalum grass species proposed for use on the golf course requires less water as compared to other warm season grasses or Bermuda grass, and handles drought conditions very well. It also has a lower nutrient requirement and can tolerate upto 6000 ppm TDS.

Efforts will be made to reduce water use for irrigation by way of:

- A fully automatic irrigation system using drip/sprinkler technology.
- Watering during early morning or late evening hours.
- Water efficient landscaping.
- Use of low water consuming species.
- Grass/grid paver blocks to reduce radiant heat
- Sensors will be provided to monitor moisture and evapotranspiration rate

Integrated Pest Management (IPM)

- Use of Bio-fertilizers, Bio-Pesticides & Soil enrichers
- Biogreen, Sustane, Terralift - foliar and slow release products made from animal & plant residues
- Mechanical control of pests by placement of insect traps and regular manual de-weeding

- Application of herbal pesticides such as neem extracts on a bi-weekly basis. On the famous golf course of IL AUX CERFS, Mauritius. (used extensively in Mauritius & other tropical countries)
- Neem based pesticides: Application of 100% neem granules, just prior to the onset of turf grass stress, followed by a strategic number of sprays of combined products such as kelp, cold pressed neem oil, molasses and a bio-balancing microbial inoculant containing fungal species, which naturally predate on nematodes.
- Nutritech Solutions Use of organic fertilizers containing special microbial cultures (eg. Rhizobia and Mycorrhyza) to enhance soil fertility and plant immune system.
- Use of manure, containing in-house compost and digested biogas slurry, to supplement/reduce the application of chemical fertilizers.
- Agronomic and cultivation practices to prevent pest growth
- Use uncontaminated seeds/weeds

4.3.6 Socio-economic Environment

4.3.6.1 Impacts during Construction Phase

Increase in population

There will be a minor influx of construction workers in the site who will be staying in temporary facilities during the course of the project implementation.

Health of construction workers

Health problems may affect the workers due to continuous usage of heavy construction equipment and exposure to dust and noise. The living conditions of workers staying temporarily within the plot also need to be hygienic; failing which, the health of people on site as well as in the surroundings will be affected. The construction site may pose unforeseen hazards such as, accidents and minor mishaps. These can be controlled by following normal safety precautions and strict supervision.

Therefore provision of first-aid kits and medical dispensary with full time services of a general physician will be necessary in the proposed labour camp. Workers need to be provided with clean drinking water and water for domestic use. Hygienic living conditions need to be maintained in the labour camp with proper sewage and garbage disposal arrangements.

Employment Generation

During the construction phase, contracts will be given locally. Deployment of labour for activities such as horticulture/landscaping/construction will provide better employment opportunities for the local youth.

4.3.6.2 Mitigation Measures during Construction Phase

Provisions at the labour camp

- Accommodation to the construction workers will be planned in such a way that they do not cause any nuisance whatsoever to local residents.
- The labour camp will be located beyond the CRZ limits within the project site.
- Temporary housing facility with weather proof material will be provided for the construction workers on site. Facilities such as "fencing/gate control", and site illumination will also be provided in the camp area.
- Provision of potable water supply will be made along with sufficient number of taps.
- Adequate sanitation facility to maintain health and hygiene will be established at the camp by providing toilet blocks connected to septic tanks/soak pits.
- Additionally, provision of 'doctor on call' facility will be made.
- Fuel (kerosene) will be supplied for cooking purposes.
- All necessary precautions to avoid accumulation of water in the open will be taken. This will ensure that no breeding of mosquitoes will take place at the site. However, to control the mosquitoes and other flying insects regular spraying of biodegradable insecticides will be carried to supplement use of conventional ones.

Provisions for labour on site

- Proper hygienic working conditions & safety measures will be provided to the labourers during the construction phase.
- A construction site is a potentially risky environment. To ensure that the inhabitants are not exposed to hazards, the site will be fenced and manned at entry points.
- To keep the area clean, temporary toilets with septic tanks, and clean drinking water facility will be provided. Rest rooms for lady workers will also be provided.
- Other general cleanliness measures such as regular collection of waste and its systematic disposal at frequent intervals will be scrupulously enforced.
- Provision of crèche will be made.
- Precautions taken to prevent water logging will be taken
- Regular spraying of biodegradable insecticides and fogging will be carried out to control mosquito menace

Health

Shiroda Rural Hospital in Shiroda village of Maharashtra is located only 5 km towards the North of the Project site. Besides several well equipped medical facilities in Goa including the Goa Medical College Hospital are located within a radius a distance of ten to forty km from the project site.

A well equipped first aid room will be provided on site during construction phase. During operation phase, the workers and other supervisory staff at the site will be

offered free periodical medical check-up. Services of a general physician will be made available on-site at all times.

All the workers will be vaccinated and inoculated against communicable diseases. They will be issued health cards. Whenever any worker complains of ill health, blood test for malaria and other vector propagated diseases will be conducted and treatment given immediately. Special precaution against mosquito-borne diseases will be taken.

Safety

The safety of workers, supervisors and all those who visit or move on the site will be given utmost importance. Accidents affect the progress of work, and finally lead to escalation of costs. To avoid this situation, all safety precautions will be taken. Safety rules for all situations will be drawn and workers will be made to follow them. Use of safety gears such as helmets, shoes, and goggles will be compulsory depending on the nature of allotted works. All workers will be provided raincoats during the rainy season. Depending upon the nature of work and expected risks, all necessary safety equipments will always be available.

Health and safety of the workers for the construction project will be ensured by:

- **Safety training** and weekly tool box meetings will be conducted as required.
- Depending upon the nature of work and expected risks, all necessary safety equipments will always be available. Medical aid in case of unlikely accidents will be made available quickly.
- Provision will be made for a stand by **ambulance and paramedic** at the site.
- Use of safety equipment like **helmets, shoes, goggles, gloves, ear muffs/plugs etc**. while welding or cutting will be made compulsory. All workers will be provided raincoats during the rainy season.
- **Insurance cover** will be provided to the workers.
- Health cards will be issued to all laborers.
- Periodic health check up's of labours.

4.3.6.3 Impacts during Operation Phase

Employment Opportunities

The proposed golf resort is of international standards and will assist in generating employment opportunities. Currently the villagers of Tiracol and nearby areas derive their livelihood from agriculture, cultivation and fishing activities. The estimated direct employment from the project is 704 persons. It will result both in direct and indirect job opportunities. Employment to skilled, unskilled & semi-skilled labor (such as caddies, buggy drivers, gardeners, laundry staff, chefs, etc.) will be provided. There will be no negative impact on the demographic pattern since the resort will cater mostly to tourists and golfers who will enjoy a short stay at the site. Thus, the proposed resort construction will have a strongly positive impact on the socioeconomic environment.

Local citizens may also find employment in spin-off activities associated with the proposed project such as tour guides, caddies and taxi operators or as suppliers for essential items. leading to improvement in their economic status. Thus, the project will

improve the quality of life within the core zone and will have a long-term beneficial impact.

In addition to the above proponents propose to take up several Corporate social responsibility initiatives such as establishment of the following facilities for the benefit of local community:

- Disaster Management Centre (DMS)
- 25 bedded Health Centre
- Garbage Management Centre (GMS)
- Primary school for children
- Provision of water supply to village Tiracol
- Provision of emergency power to Tiracol village

4.3.6.4 Mitigation Measures during Operation Phase

Safety Measures during Operation Phase

During operation phase, precautions will be taken to ensure the health and safety of the local residents and the users.

The probability of natural and man-made disasters like floods, earth quakes, accidents etc. are evaluated and a "Disaster Management Plan" including arrangements for emergency evacuation prepared is enclosed in the next chapter.

Some of the precautionary measures to be taken during emergencies are:

- Fire fighting system comprising of smoke detectors and well designed hydrants will be provided in each building as per local regulations. Fire water tanks with storage capacity as recommended will be provided. Maintenance and mock trial run of these systems will be carried out regularly to ensure proper functioning during emergencies.
- Periodic inspection and maintenance of all water storage tanks will be carried out at regular intervals to prevent outbreak of waterborne diseases.
- Safe evacuation route will be earmarked for Resort occupants to ensure safe and quick evacuation during emergency.
- Adequate provisions have been made for internal roads, for smooth vehicle entry and exit.

Community Welfare

As a part of community welfare measures, it is proposed to provide the following facilitites in every Panchayat registered village home. The project budget includes a provision of around INR. 17.00 crore to create listed facilities:

- Dual line treated water connections:
- For potable use including cooking
- For bathing and washing etc.
- Metered electric power connections.

- 24 hours light and fan generator supply back up.
- The Garbage Management System (GMS) of the Resort will include the Village requirements as well.
- The sewerage system of the village homes will be connected to the Sewage Treatment Plant (STP) of the Resort.
- Internal village pathways to be paved and street furniture to be provided
- Construct a Primary school for neighbouring village children.
- Construct a 25 bedded Medical Centre which will be open to the citizens of Tiracol village for emergency treatments.
- Medical access with full time doctor and ambulance
- Development of a Disaster Management Centre for congregation and evacuation during emergencies. Dual purpose Community Center to act as Disaster Management Site (DMS). Roof top helipad for regular and emergency access
- Dedicated land Police outpost

4.3.6.5 Impacts during Decommissioning Phase

There will be a marginal and temporary impact on the air quality in the immediate vicinity of the resort, due to dust emissions and noise generation.

Decommissioning of the project will create a loss of employment opportunities.

Tourism industry in the state will have a major setback.

Closure of the infrastructure facilities during commissioning of the project may an adverse impact on the local populace.

4.3.6.6 Mitigation Measures during De Commissioning Phase

- Mitigation measure for air and noise pollution as mentioned in section 4.3.2.2 may be followed.
- Proper procedure for safe decommissioning shall be established as part of project development with training to employees
- Wastes generated will have to be identified and disposed off safely and site will not be considered shut down unless all wastes are safely disposed
- Have a designated procedure to ensure that workers do not suffer in this eventuality

4.4 Issues of Concern

In order to prepare an Environment Impact Statement, environmental concerns and issues relevant to the construction, commissioning, operation and de commissioning phases have been identified on a broad scale.

The details of activities are presented in the following table.

Table 4.14 Issues of Concern

Phase	Environmental Concern				
	Land	**Air**	**Water**	**Biological Environment**	**Socio Economy**
Construction	-Site Clearance -Provision of Labour Camp -Top soil removal	- Construction of new road -Pollution due to vehicles carrying raw materials, - Construction, dust & noise	Construction, water runoff	-Site clearance	-Provision of Labour Camp, -Employment generation
Commissioning	- Construction, and other municipal waste management	--	Waste water management	--	--
Operation	-DG set and vehicle maintenance, -Solid waste management. -Fertilizer & pesticide Mgmt	-DG set maintenance -Vehicular pollution	-Water supply, -Waste water management. - control of pollution due to fertilizer & pesticide	-Green belt provision	-Employment opportunity -Increase in economic activity. - Health, welfare community, & education facilities for Tiracol residents
Decommissioning	--	dust & noise during decommissioning work	--	--	Loss of employment opportunities. Setback to tourism industry

The impacts (both positive and negative) of each of these activities on various environmental components have been discussed further.

4.5 Environmental Impact Assessment

This section deals with the analysis of the identified impacts in terms of their nature and significance. The significance of environmental impacts has been evaluated as under:

- The spatial extent (geographic distribution),
- Duration (short term and long term),

- Magnitude (measured level of change in parameters & whether thresholds are exceeded),
- Reversibility (reversible and irreversible), and
- Spatial sensitivity (whether an impact affects a sensitive area e.g.: a Nature Reserve within the impact zone).

The following matrices assess the impacts based on their severity.

4.6 Environmental Impact Matrix

Table below presents the Impact Matrix for identified environmental parameters. The following rating scale has been devised to assess the severity of impacts:

A- High Beneficial (positive) Impact

B- Low Beneficial Impact

C- Low Adverse Impact (localized nature)

D- High Adverse (negative) Impact

(N): Indicates no conceivable (neutral) impact on the environment.

Table 4.15 Environmental Impact Matrix

Sr. No.	Environmental Parameters	Construction Phase	Commissioning Phase	Operation Phase	DeCommissioning Phase
1.0	**Air Environment**				
	Particulate Matter	C	C	-	C
	Sulfur Dioxide	-	-	-	-
	Nitrogen Dioxide	-	-	-	-
	Carbon Monoxide	-	-	-	-
2.0	**Water Environment**				
	Ground water quality/ availability	C		C	-
	Surface water quality/ availability	C		C	-
	Receiving water body	-	-	-	-
	Drainage system	-	-	-	-
3.0	**Solid waste**				
	Land Disposal	C		C	-
4.0	**Noise**				
	Ambient Noise Level	C		C	C
5.0	**Ecological Parameters**				
	Flora	B		A	-

Sr. No.	Environmental Parameters	Construction Phase	Commissioning Phase	Operation Phase	DeCommissioning Phase
	Fauna	C		-	-
	Aquatic Ecology	-	-	-	-
6.0	**Human Settlement**				
	Economic Output	A	-	A	C
	Employment Opportunity	A	A	A	B
	Occupational Health	C	-	-	C
	Infrastructure		C	B	C
7.0	**Aesthetics**				
	Topography/ Skyline	-	-	A	-
	Visual Air Quality	-	-	-	-
	Visual Water Quality	-	-	B	-

The above table shows that no significant harmful impacts, on the surrounding environment, are anticipated due to the proposed project.

This may be because the proponents are planning a LEEDS GOLD certified resort and are also taking all precautions to ensure a well planned environment friendly Golf course.

During the construction phase, there are a few parameters that need to be considered for mitigation of adverse impacts (such as air pollution/ noise levels, health hazards for labor, ground water depletion and overloading of existing local infrastructure such as roads, water supply, etc. However, the impacts of this nature will be easily controllable and of a short duration, if proper mitigation measures are taken as recommended.

The parameters which could be adversely affected during the operation phase are, noise levels, ground water table and solid waste disposal.

It can also be observed from the above table, that there will be a positive long term impact on the socio-economic status of the area due to the proposed project. This will be in terms of direct employment generation for the native population, spin-off benefit of indirect entrepreneurship opportunities (shops selling local goods/artifacts, plant nurseries, tour/travel support, taxies, opportunity as caddies etc.), improved infrastructure, and so on. Also, since the project will make use of locally available laterite building material, architectural features (viz. sloping roofs with mangalore tiles), and the like, construction activity will be consistent with the surrounding landscape and, will lead to an improved aesthetic ambience.

4.7 Conclusions

The activities with a potential negative impact on the local environment have been identified and classified stage-wise, as under

Table 4.16 Classification of Impacting Activities

Phase	Environmental Concern				
	Land	**Air**	**Water**	**Biological Environment**	**Socio-economic environment**
Construction	-Provision of labour camp -Loss of top soil, -Soil erosion, -Drainage pattern changes	-Construction/ repair of approaches to the project site -Traffic of heavy vehicles/machinery	Construction water runoff	Loss of bio-diversity (native flora/ fauna)	-Temporary employment generation. - Provision of labour camp. - increased traffic
Commissioning	-Storage/ disposal of excavated material, -Construction waste management	-Construction dust and noise.	Waste water management	--	- temporary pressure of floating labor population
Operation	-Solid/ hazardous waste management - Run off from golf course - management of possible pollution due to fertilizers & pesticides.	Additional traffic generation and vehicular pollution	-Water supply, Sewerage management and Municipal solid waste management - management of possible eutrophication & pollution due to fertilizers & pesticides respectively	--	Direct & spin-off employment generation of permanent nature - enhancement of tourism industry & activities -provision of health, community welfare & education facilities to local residents -aesthetic improvement - Increase in land prices in vicinity.
Decommissioning	--	dust emissions and noise	--	--	-loss of employment opportunities. -Setback to tourism industry

5 ANALYSIS OF ALTERNATIVES (SITE & TECHNOLOGY)

The alternatives for development of this project were classified as alternatives for site selection and alternatives for technology.

5.1 SELECTION OF SITE

Since the project site is already approved for the development of a World Class Golf Course, the site selection study alternative is not applicable for this project.

The Ministry of Tourism has selected the site at Tiracol in Pernem Taluka in Goa for the development of a World Class Golf Course. It has approved the project under Large Revenue Generation Scheme (LRGS) and has granted the Company a Public Private Partnership (PPP) status on 27th April, 2011 (*Please refer to* ***Annexure III***).

The site selection has been done keeping in mind the requirements of a golf course. Typical physiographical site selection criteria for a Golf Course include study of the natural opportunities and/or constraints of the site such as: Topography, Soils, Water, Vegetation, Wildlife, Site drainage, etc.

During site visits, it was observed that the plot has an undulating rolling terrain having slopes that are mostly gentle, which favor golf course landscape development. The northern periphery of the site is at an elevation overlooking the entire site (& thus would offer beautiful views of the golf greens) and the entire coast. The Central plateau offers a panoramic oceanic view and is preferred location for club house and resort. Before selecting the site, it was shown to various Golf architects & developers such as IMG who have endorsed the site as being ideal for a Golf Course location. (***Annexure II*** *exhibits the letter from IMG).*

The site at Tiracol, Pernem Taluka, Goa, was found to be the most suitable and appropriate for the development of an international standard 18 Hole PGA Course (*Please refer to section 2.3.2: Site Selection of this report*).

5.2 Technological alternatives

Technological alternatives for mitigating the harmful project components, if any, which may have adverse impact on the environmental conditions have been suggested here. A few activities having a negative impact are not avoidable and technological alternatives along and/ or suitable mitigative measures for such activities need to be adopted. Those activities which can be modified to reduce the impact will be considered.

The following scenarios have been studied and the impacts under each have been assessed:

5.2.1 No Project Scenario

The site is at present vacant, barren and unused land.

The site does not include restricted land types like agricultural land, protected wetland, riparian area or any sensitive site elements.

The plot has an undulating rolling terrain having slopes that are mostly gentle, which favor golf course landscape development. The northern periphery is at an elevation overlooking the entire site and the coast. The Central plateau offers a panoramic oceanic view.

The area is free from any rare, protected or endangered species habitat or other asset of special significance for native vegetation and wildlife (such as migration routes and breeding areas).

The site is secluded and has no beachfront along its entire western coastline and as such the development will not obstruct any traditional access to public land, seashore, beach or any other common recreation resource.

The site offers an opportunity to restore the degraded and high erosion prone coastal premonitory, where the proposed development could result in a healthier ecosystem and a more valued community amenity

5.2.2 Project Elements Without Change

Construction waste generation

Debris/ substratum generated if disposed unscientifically, will lead to environmental damage. Runoff from construction water may pollute surrounding surface water bodies.

Air and noise pollution from construction activity and traffic

Air and noise pollution will cause disturbance to surrounding areas

Provision of water supply

If the water requirement for the project is to be fulfilled from from public source, it would require supplying of raw water from Tillari Canal via Dhargal-Tuem by the Water Resource Department. This is irrigation quality water and will require treatment prior to use. It will also be required to extend a 450 mm diameter raw water pipe line of 1 MLD of 25 Kms length, from Dhargal to Tiracol, for the Project to treat and consume.

Sewerage

Provision of sewerage line will improve sanitation facilities and avoid contamination of ground water by infiltration

Green Belt Development

Landscape plan and green belt will improve aesthetics and act as public spaces

5.2.3 Project Elements Using Alternative Options

Construction material

The plot plan includes sufficient landscapes and open spaces intermediating with the proposed buildings. Efforts will be made to procure energy efficient materials for construction.

Conservation of top soil

Top soil removed from the site during site clearance/ excavation etc. will be stored so that it can be reused in areas where landscaping is proposed.

Construction Activity

Measures to reduce air and noise pollution during construction and operation phases need to be adopted.

Proposed project will generate job potential of both skilled and unskilled nature. Local labour may be employed for these jobs as far as possible.

Safety and health aspects of workers need to be addressed during construction and provision of hygienic conditions for labourers working on site need to be looked into. Waste management system for proposed labour camp will be provided.

Green Belt Development

Proposal for green belt management may incorporate plan for additional trees.
Plantation of trees/ grass requiring less water may be adopted for sufficient green cover required for the golf course.

Provision of water supply

In order to reduce dependence on public source, the following water recycling initiatives will be implemented:

(a) Sewage/Effluent Treatment with Recycle facilities

(b) Rain Water Harvesting by Creating Lakes, Recharge of Aquifers.

(c) Landscaping using Water Conservation Techniques and low water consuming Grass.

Water Consumption

Efficient fixtures may be used for saving water and effectively reducing water consumption for the proposed development.

Waste Water Management System

Sewage/Effluent Treatment with Recycle Facilities to be provided.

Management of solid waste

Effective measures for management of wastes generated during construction may be adopted. Waste can be segregated and reuse- recycling techniques adopted to minimize waste going out from the site to disposal sites.

Rain water harvesting

Rain water from roof tops may be harvested. Storm water runoff from roads, paved areas and green areas may also be harvested. Rainwater harvesting water bodies are proposed for reduction in runoff and assist ground water recharge.

5.3 ANALYSIS OF ALTERNATIVES

The above alternatives for development show the following benefits that can be achieved with the development of the proposed resort:

- Well planned development leading to growth in tourism potential of the state
- Improvement in employment opportunity and socio economic condition of the local populace

Benefits due to use of suggested alternatives include:

- Provision of well equipped labour camp considering health and hygiene aspects of the construction workers
- Reduction of construction wastes and probable air and noise pollution during construction phase
- Conservation of resources by incorporating the use of energy efficient materials and fixtures
- Rain water harvesting in order to conserve water

The following table gives a comparative analysis of the projects scenarios and the suggested alternatives for reducing negative impacts due to any of the project activities:

Table 5.1: Analysis of Alternatives

Project Elements/ Activities	Without Project	With Project	
		Project Elements without change	Project Elements with Alternative Options
Increase in paved and built up areas	The site is at present vacant, barren and unused land	Loss of top soil due to increase in paved and built up areas	Conservation of top soil for reuse in landscaped areas
Shoreline protection measures	degraded and high erosion prone coastal premonitory	The site offers an opportunity for shoreline treatment, where the proposed development could result in a healthier ecosystem and a more valued community amenity.	
Construction waste generation	--	Debris/ substratum generated if disposed unscientifically, will lead to environmental damage Runoff from construction water may pollute surrounding surface water bodies	Negative effects will be minimized with proper mitigation methods/ waste management techniques
Domestic solid waste management	--	Mechanism for waste disposal to be adopted	Management of biodegradable waste at site will minimize waste to be disposeto local waste treatment facility
Air and noise pollution from	--	Air and noise pollution will cause disturbance to	Pollution effects will be reduced with management of

Project Elements/ Activities	Without Project	With Project	
		Project Elements without change	**Project Elements with Alternative Options**
construction activity and traffic		surrounding areas	traffic and measures to mitigate noise and dust
Water supply	Will remain as existing	Water supply infrastructure shall improve	Treatment of Sewage/ Effluent and reuse of recycled sewage Rain Water Harvesting by creating lake Landscaping using Water Conservation Techniques and low water consuming species Use of efficient water saving fixtures and measures for reuse of treated waste water will reduce resource depletion
Ground water	--	Recharging of ground water will improve depth of ground water aquifer	Creating lakes which will collect rain water and reduce the runoff and increase ground water recharge
Sewerage	Will remain absent	Provision of sewerage line will improve sanitation facilities and avoid contamination of ground water by infiltration	--
Green Belt Development	Sparse vegetation on most of the site at present	Landscape plan and green belt will improve aesthetics and act as public spaces	Sufficient green space and recreational opportunities proposed Healthy and sustainable green cover can be achieved through use of species requiring less water
Better construction material	--	--	Energy efficient materials suggested

From the above analysis, it can be seen that by modifying some of the project elements and by adopting suitable mitigation measures, majority of the negative impacts to environment can be reduced.

6 ENVIRONMENTAL MONITORING PLAN

Based on the predicted & assessed impacts as well as the baseline environmental status of the project area, an environmental monitoring program is suggested for implementation during various stages of the project cycle.

6.1 Objective of Environmental Monitoring Program

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

Major objectives of the Environmental Monitoring Program are as under:

- To comply with the statutory requirements of monitoring for compliance with conditions of EC, Consent to operate
- Assessment of the changes in environmental conditions, if any, during the project operation/activities.
- Monitoring & tracking the effectiveness of Environment Management Plan & implementation of mitigation measures planned.
- Identification of any significant adverse transformation in environmental condition to plan additional mitigation measures; if & as required.

LHL will implement the environment monitoring programs in line with the planned schedule. The company will ensure that the necessary requisite facilities are made available and budgetary provision is made as & when required to ensure regular efficient environmental monitoring activities.

6.2 Environmental Monitoring Program

Environmental monitoring parameters and frequencies of monitoring are given below in **Table 6.1.**

Table 6.1 Environment Monitoring Plan

Sr. No	Parameters	Monitoring		Standards
		Network	Frequency	
1.	**Ambient Air Quality during Construction Phase**			
	SO_2, NO_2, PM, CO	2 stations in nearby localities near to construction sites	24 hourly continuous, once a month or as per Goa SPCB directives	National Ambient Air Quality Standards, CPCB
2.	**Stack gas analysis (DG sets & Boiler) during Construction Phase**			

Sr. No	Parameters	Monitoring		Standards
		Network	Frequency	
	SO_2, NO_2, PM	DG set stack for construction work	Once in 6 month or as per directives by Goa SPCB	EP Act norms
3.	**Source Noise Level (DG sets) during Construction Phase**			
	SO_2, NO_2, PM	DG set stack for construction work	Once in 6 month or as per directives by Goa SPCB	EP Act norms
4.	**Ambient Noise Monitoring during Operation Phase**			
	Hourly equivalent noise levels	24 hourly at 2 locations on proposed project site 1: Near closest settlement area 2: Near DG set (1.5 metre from machinery)	Once a month Once a month	IS:4954-1968 as adopted by CPCB
5.	**Water during Operation Phase**			
	Physico- chemical analysis, Bacteriological count	Grab samples during pre and post-monsoon for treated water	Diurnal and Season wise	IS: 2488 (Part 1-5) methods for sampling and testing of Industrial effluents
6.	**Ground Water during Operation Phase**			
	Physico- chemical analysis, Bacteriological count	Grab samples during pre and post-monsoon for ground water on site (existing well on site) to be taken from area within the plot where leachate/ contamination is predicted Grab samples during pre and post-monsoon for ground water in 10km distance	Diurnal and Season wise	IS: 10500 Drinking Water Standards
7.	**Waste Water during Operation Phase**			
	Oil and Grease, pH, BOD, COD, TDS, SS, other parameters, if any, as per consent conditions	Grab and composite sampling at inlet and outlet of STP for STP (Domestic/ sanitary)wastewater.	Diurnal and season wise variation	Samples for water quality should be collected and analysed as per IS : 2488 (Part 1-5) methods for sampling &testing of

Sr. No	Parameters	Monitoring		Standards
		Network	Frequency	
				sewage
8.	**Soil during Construction and Operation Phase**			
	Soil Texture, Conductivity, pH, Oil and Grease, $CaCO_3$, Ca, Mg, Fe, SO_4, PO_4, TOC, Moisture, TKN	(soil samples be collected as per BIS specifications) **Construction phase** :to be taken from area where topsoil is to be removed and reused elsewhere on plot **Operation phase** :to be taken from area within the plot where topsoil is reused from other location where leachate/ contamination is predicted	Season wise	Collected and analysed as per soil analysis reference book, M.I.Jackson and soil analysis reference book by C.A. Black

6.2.1 Measurement Methodologies

Monitoring of environmental samples shall be done as per the methods/guidelines provided by MoEF/ CPCB and /or relevant Indian Standards. Methodology of monitoring (sampling & analysis) shall be documented as SOP (standard Operating Procedure) for parameters analyzed through in house laboratory and shall be subjected to Internal audit and review.

6.2.2 Reporting Schedules

The records of the monitoring program viz water, wastewater, solid waste, air, emission, soil shall be prepared and preserved properly. The records showing results/outcome of the monitoring programs will be submitted as per the schedule below.

Monitoring reports will be reviewed regularly by Facilities Management along with Environmental Consultant for necessary improvement of the monitoring plan/mitigation measures/environmental technologies as well as for necessary actions of Environmental Management Cell.

Table 6.2 Reporting Schedule for EC Compliance

Sr. No.	Monitoring During	Reporting Schedule	Applicable Statute	Compliance Reporting To
1	Construction Phase	1st June and 1st December of each year till end of construction	EIA Notification Clause 10	a) SEIAA, Goa b) Goa PCB – Regional Office c) MOEF- Western Zone office and Monitoring

Sr. No.	Monitoring During	Reporting Schedule	Applicable Statute	Compliance Reporting To
				Cell
2	Commissioning Phase	1st June and 1st December of each year till end of construction	EIA Notification Clause 10	a) SEIAA, Goa b) Goa PCB – Regional Office c) MOEF- Western Zone office and Monitoring Cell
3	Operation Phase	1st June and 1st December of each year	EIA Notification Clause 10	a) SEIAA, Goa b) MOEF- Western Zone office & Monitoring Cell c) Goa PCB - Regional Office
		Before 10th of next Month in respect of stack/ vents, AAQ, ETP inlet/outlet, Noise levels	Combined Consent & Authorization (CC & A)	Goa PCB – Regional Office
4	Decommissioning Phase	1st June and 1st December of each year	EIA Notification Clause 10	a) SEIAA, Goa b) Goa PCB – Regional Office c) MOEF- Western Zone office and Monitoring Cell

The Company will also file returns under HW Rules (yearly), Cess Act (monthly) and annual Environmental statements &/or performance report/compliance report/audit report as per conditions of EC and CC&A and submit to Goa PCB within the stipulated timeframe.

CC&A and other statutory permission/consents must be obtained & renewed timely as per legal provision & guidelines. Similarly, all necessary report & forms will be prepared and submitted to the concern authority as per the statutory requirement of Environmental Acts/ Rules.

Reporting of accident & other requirements will be made in prescribed format well within stipulated time frame as per statutory requirements & guidelines.

7 ADDITIONAL STUDIES

7.1 Golf Tourism in India

The Indian Golfers Union (IGU) was formed in early 1950s for developing and promoting golf in India. The National Golfers Association of India (NGAI) was established in 2004 by IGU & supported by European PGA and is the first accreditated program for Professional Golfers in India. India also boasts of a Professional Golf Tour and has also specialist Travel companies offering Golf Tours in India.

Although the IGU web site states that there are more than 200 courses in India, a cursory study indicates that out of this, only 48 courses are Professionally designed and suitable for holding tournaments. Out of this, 16 are in Northern states, 17 in Southern states, 8 in the West and 7 in the East. **Table 7.1** presents a summary of the major Golf courses in India – and **Fig 7.1** shows their location. From the data presented, it is seen that:

- Golf has been in India since the nineteenth century, the first course was built in 1827 in Kolkatta and is the World's oldest course outside Great Britain the World's highest Golf course is located in India in Gulmarg
- scenic locations and historical places are preferred for locating golf courses – courses are seen located in back drop of Taj Mahal and other forts as also in the foothills of Western Ghats, Aravalis and Shivalik mountains
- there are 3 USPGA standard golf courses in the country yet India does not find a place currently in the US Professional Golf Circuit.
- there are only eight major courses in the western region of which one course in Baroda is for Members only and one in Belgaum belongs to Army.

Figure 7.1 Major Golf Courses in India

Table 7.1 Major Golf Courses in India

Sr. No	City	Name of Golf Club	Number of Holes	Yardage	Access	Par	Site detail	Other details
NORTH INDIA								
1	Agra	Agra Golf Club	9 + 9	-	Members only	72	Near Taj Mahal	Upgraded to USPGA Golf course-founded 1904
2	Jaipur	Jaipur Golf Club	18	-			Near Moti Doongri Palace & Nagarnath Fort.	
3	Jammu	Army Golf Club	18		for Army officers			
4	Kanpur	Kanpur Golf Club	9		for Army officers	36		
5	Chandigarh	Chandigarh Golf Club	18	7202	Members Only	72		Established 1966
6		Forest Hill Golf club	9 + 9		Members Only	72	Foothills of Shivalik hills near Sukhna lake	
7	Lucknow	Mauribagh Army Golf Club	18	3171/ 3052	Open to all	37/ 36		
8		Lucknow Golf Club	18	3179/ 3176		36/ 35	at Martinpura near Kalidas Marg	Established 1950
9	New Delhi	Delhi Golf Club	18	6869/ 5859		72	Located adjacent to Lal Bangla and Sanctuary for 300 birds & 200 different types of trees	Peter Thompson designed course- established 1931
10	Gurgaon	DLF Golf and Country Club	18	7204	Members Only	73	Located in back drop of Aravali ranges has 5 lakes	Arnold Palmer designed USPGA standard course. Established 1999
11	Gurgaon	Classic Golf Club	18 + 9	7114	for Members only	72 + 36	Located in back drop of Aravali ranges has 5 lakes, comprises a ridge, canyon and valley. Provides tented accommodation.	Jack Niclaus designed course

Sr. No	City	Name of Golf Club	Number of Holes	Yardage	Access	Par	Site detail	Other details
12		Golden Greens Golf & Country Club	18	7100	Members Preferred	72		Richard Hawtree with Ranjit Nanda
13	Noida	Noida Golf Course	18	6915	Members Preferred	72	Historical course located on battle ground of Delhi	Established 1989
14		Jaypee Greens	18	7343	Members Preferred	72	Longest Golf course in India	Greg Norman Designed Golf Course (2001)
15	Jaipur	Rambagh Golf and Country	18	6303	Members Preferred	70	Part of Rambagh Palace Hotel-residence of former Maharaja-overlooking two historic palaces	
16	Karnal, Ambala	Madhuban Meadow Golf club	18	5505		69	Located along both sides of the Canal on the NH-1 known as Shershah Margnor Grand trunk.	Venue for PGTI tour. Jack Nicklaus designed
SOUTH INDIA								
1	Bangalore	Bangalore Golf Club	18	6703/ 5414	Open to all	71	Located in heart of Bangalore	Founded in 1876-design by Peter Thompson
2		Prestige Golf Course	18			72	Foothills of Nandi Hills on Blore-Hyderabad road	Design by PGA design Consulting, UK
3		Nandi Hills	18	6000		70		Designed by Phil Ryan of Pacific Coast Design, Australia. Built in 2008
4	Kodihalli, Bangalore	Karnataka Golf Association	18	6786	Members Only	72		Peter Thompson designed course
5	Mysore	Eagleton The Golf Resort	18	6668	Commercial	72	on Bangalore Mysore Highway	Pacific Coast Designs, Australia

Sr. No	City	Name of Golf Club	Number of Holes	Yardage	Access	Par	Site detail	Other details
6	Hyderabad	Bolaram Golf Club	18	6434	Managed by Army	72		Established 1888
7		Boulder Hills	18	7728	Members Only	72		Peter Hardine designed course
8	Keshwapur	Rail Golf Club, Hubli, Karnataka	18			72	owned by Indian Rail	
9	Kodaikanal	Kodaikanal Golf club	18	6426	Open to all for 9 months	71	on Natural grasslands near forest areas- with tiger & other fauna	Established 1895
10	Chennai	Madras Gymkhana	18	6325	Members Preferred	70	Located within the Guindy Race Course Oval ground	Founded in 1886
11	Saidapet, Chennai	Cosmopolitan Golf Club	18	6859/ 5863	Open to all -weekdays	72	A Links course	Peter Thompson designed course Established 1873
12	Mysore	Jayachamraj Wodeyar Golf Course	18	5446	Walk ins allowed	70	Located in Chamundi foothills	Established 1905- Pacific Coast design, Australia
13	Ooty	Ootachmund Gymkhana Club	18	6074/ 5125	Open to all	70	Located at 7600 ft height- located in forest	Founded in 1896- Ross Thomson Design
14	Cochin	CIAL Golf and Country Club	18	6700	Open to all	72	Owned & operated by Cochin International Airport Ltd- has 5 water hazards. Is a links course	Founded in 1850, designed by Royal family
15	Coimbatore	Coimbatore Golf Club	18	6973	Members Only	72	More than 50 bird species	Designed by K Rajgopal in 1977
16	Coorg	Madikeri Golf Course	18	5600		72 *		Established 1890
17		Coorg Golf Links	18	6000		70		Established 1992

Sr. No	City	Name of Golf Club	Number of Holes	Yardage	Access	Par	Site detail	Other details
EASTERN INDIA								
1	Kolkatta	Royal Calcutta Golf Club	18	7195/ 6871		72	located in heart of city at Tollygunge, has number of water hazards	Established in 1829- oldest in World outside Britain
2		Tollygunge Club	18	6520/ 5686	Members only	71	located in heart of city at Tollygunge, has number of water hazards	Established in 1895
3	Dipatoli	Cockerel Golf Club	18			71		Established in 1898
4	Shillong	Shillong Golf Club	18	5873/ 5231	Open to all	70		
5	Jamshedpur	Golmuri	18	5942		70		Close to Tatanagar Airport- Founded in 1987
6	Assam	Digboi	18	6309	IOC officers Members only	72	Scenic- has a Wildlife sanctuary, ecotourism park and tea estates nearby. Has atleast 8 smaller golf courses nearby	Established in 1930
7		Kaziranga Golf resort, Jorhat	18			71	Located over two Tea estates	Has a big golf academy
WESTERN INDIA								
1	Baroda Gujarat	The Gaekwad Baroda Golf Club	12	3898	Members only			Established 1905
2	Belgaum	Infantry Institute Golf club	18	6000+	Army Officers only			
3	Mumbai	Presidency Golf Club	18	6223/ 5463	Members only	70/ 72	Located in heart in of Mumbai at Chembur	Peter Thompson designed course- built in 1927

Sr. No	City	Name of Golf Club	Number of Holes	Yardage	Access	Par	Site detail	Other details
4		Willington Golf Club	18	4510	Members only			Established 1933
5	Pune	Poona Golf Club	18	6198/ 5488	Open to all	72	Located in heart of city	
6		Aamby Valley Golf Course, Lonavala	18	7030	Members only	72	Championship Course- surrounded by Western Ghats	designed by David Hemstock & Associates, UK
7		Oxford Golf and country	18	7020	Open to all	72	surrounded by Sahyadri hills - Koregaon Park, it is horse shoe shaped	designed by Phil Ryan of Pacific Coast design, Australia
8	Ahmadabad	Kensville Golf Club & country club	18		Members only	72	Located near Lothal and 3 sanctuaries	USPGA standard

7.2 Golf Tourism Case Study – Scotland

Scotland is universally recognized as the "home of Golf" and is one of the World's premier Golf destinations. It is estimated that the Golf tourism revenue of Scotland is £ 2.2 billion against total tourism revenue of £ 4.2 billion. Golf supports more than 4,400 jobs in Scotland. There are more than 550 Golf courses in Scotland of which 70 courses bring in more than 75% of their Golfing revenues. Golf related tourism has potential to increase much more given the large number of Golf courses in existence in Scotland. This has prompted Scotland Government to undertake detailed studies on Golf tourism in the country. Two such reports include **'Scottish Golf Tourism Market Analysis' (June 2009)** by **SQW Consulting** and **'Golf Tourism in Scotland – Opportunities for Growth'** prepared by **Tourism Intelligence Scotland.** In addition**, KPMG** has published a report titled **Golf Travel Insight** in 2008. These studies have been reviewed and the key findings are presented below:

7.2.1 Key Facts of Golf Tourism:

The main influences on taking golf trips are:

- for any 'golfing holiday' the game itself is central to the trip- the quality/challenge of the course is thus the most important
- other factors include weather, ease of access, variety of golf courses to play on a trip, the welcome received at any particular club, information on things to do in the evening, facilities for washing/drying, excellent quality food, drink and accommodation, whatever the budget
- From amongst inland and links courses (coastal) Golfers tend to prefer the spectacular links courses than the inland courses. Much higher revenues are recorded in these courses.
- Golfers are most attracted to Scotland by its 'traditional' image –and are willing to pay anything for a 'unique' experience and a taste of the tradition and history which Scotland brings to any visitor

Figure 7.2 Factors Influencing Golfers Tourist Destination: Scotland Experience

7.2.2 Profile of Golf Tourists

Golf tourists are generally categorized into four different categories. Various types of golf tourists, their profile, motivation for golf and their needs as also preferred destinations for golf tours are presented below :

Type of golfer	Motivation for golf	What they need	Profile	Preferred destination for a shorter (1-4 nights) break	Preferred destination for a longer (5-14 nights) break
Golf buddies	Unrestrained socialising Leaving responsibilities behind A holiday feeling – 'beer and banter'	Great atmosphere and good golf 3 star hotel/rented house Location close to or in town Weather is a key consideration	Male Large groups Aged 40 – 70 Mid handicap Casually competitive	Scotland Ireland England	Spain Portugal USA
Luxury golfers	VIP golf Unique experience Status/image	Signature courses Challenging, links Top quality clubhouse 4/5 star hotel/golf resort Good weather is important	Male Aged 30 – 50 Low/mid handicap Competitive Golf club members	Scotland Ireland England	Portugal USA
Golfing tourists	Relaxing break Golf as part of a rounded holiday experience	9/18 hole courses Good value Scenic, enjoyable courses Lots of other attractions Good value	Male and female Couples/close friends, sometimes includes families Aged 45 – 70 Mid high/no handicap	England Scotland Ireland Wales	France Spain Portugal
Golf purists	New and challenging golf experiences Improving game Experiencing top courses	Quality, challenging courses Qualifying and Open courses, links courses, etc Clusters of courses Key factor for accommodation is proximity to courses	Male Aged 25 – 40 Low handicap Small groups Serious, competitive golfers	Scotland Ireland Wales England	Scotland Spain Portugal USA

Figure 7.3 Types and Profiles of Golfers: Study Report SQW Consulting

Main reason why Golf tourists prefer golfing destinations like Spain, Portugal to Scotland or Ireland is weather, which is immensely better in these countries.

7.2.3 On Spending Pattern of Golfers

Golf visitors from overseas tend to stay longer depending on time taken for travel to the destination (generally US visitors stay 10 days and those from further afar 12 days) playing a total of 7 rounds on one trip. Overseas golfers prefer to stay in star hotels and resorts while domestic tourists prefer the B & B hotels, Guest houses etc.

Generally Golfers spend four times the amount spent on green fees on other considerations like accommodation, food and drink and travel, leisure activities. The following graphics taken from KPMG report on Golf Travel Insights in 2008 illustrates this point. The Scottish study by SQW Consulting has also brought this out in great detail.

Figure 7.4 Split of Golf Visitors spends (*Source : KPMG, Golf Insights, 2008*)

7.2.4 Golfers Needs and Desires

Survey of Golf tourists conducted in Scotland of the Golfers needs and wants has yielded the following findings:

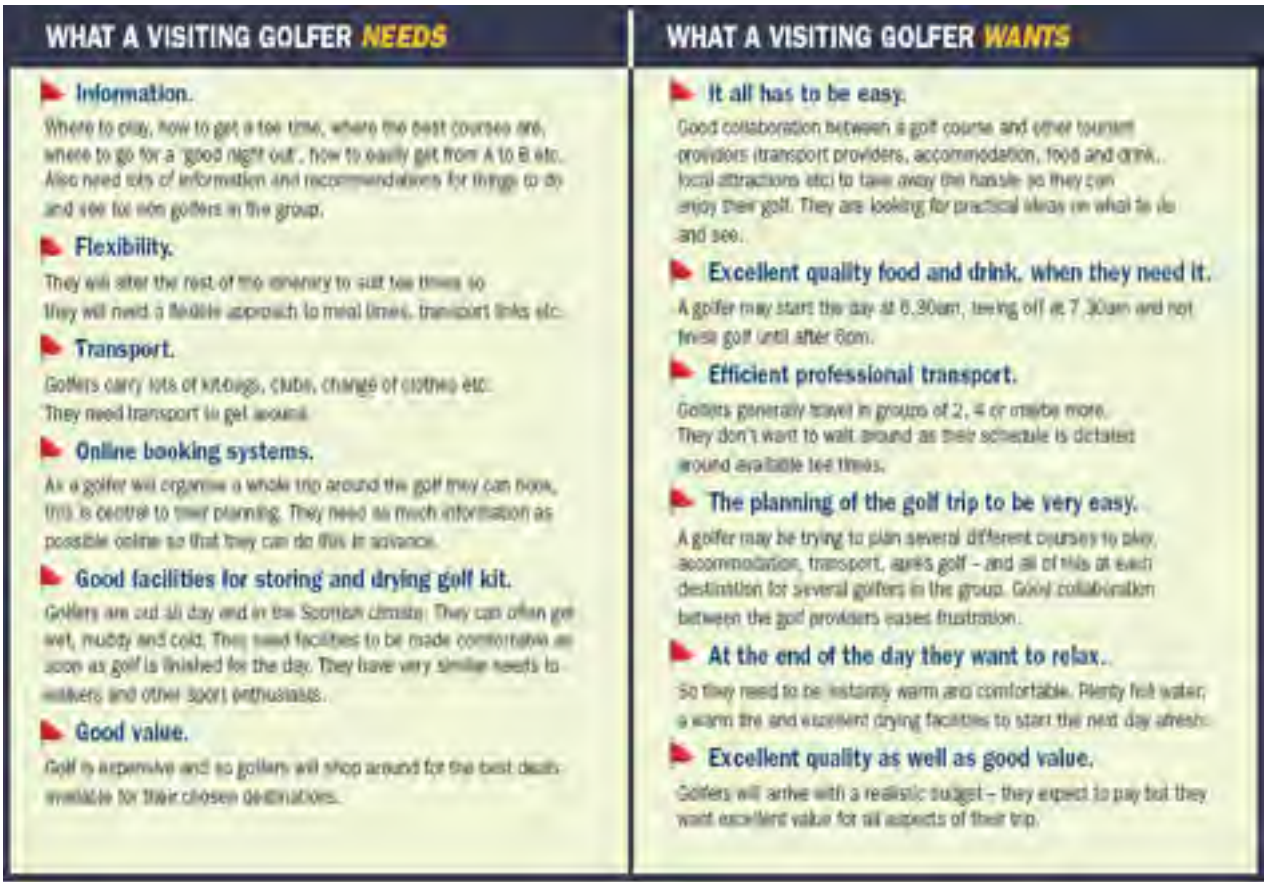


Figure 7.5 Golfers Desires and Needs: Scottish SQW Study Findings

7.3 Preliminary Assessment of Leed Rating

Detailed Report on Preliminary Assessment of Leed Rating is attached as ***Annexure XIX****. Following is a summary of the same.*

The proponents have envisioned an eco-friendly project featuring sustainable resources for architecture and efficiently managed systems. In order to get the USPGA accreditation, the project is being developed for a **Gold Rating as per the US Green Building code LEED 2012.**

LEED NC Rating system is subdivided in to 5 categories:

Table 7.2 Five Categories as per LEED NC Rating

LEED Checklist	Possible Points
Sustainable Site	13
Water Efficiency	6
Energy & Atmosphere	17
Materials & Resources	13
Indoor Environmental Quality	15

Preliminary Analysis of LEEDS Credits for Proposed Development:

7.3.1 Sustainable Sites

7.3.1.1 Site Development

The site development would demonstrate 25% improvement over existing byelaws for vegetated open space. This would mean that apart from handing over at least 15% of the site area to the local authority to be maintained as a landscaped open space, the design should allow an additional 25% over this 15% area as vegetated zone. Only native / adapted or non-invasive species would count towards the requirement of the credit. Turf grass, even species within the definitions of native / adapted would not be counted towards this credit.

Resort Softscape

The softscape of the resort will follow the Spice Route Concept as described in project description. The four directions East, West, North and South will be identified by a spice and the cluster of suites and corresponding courtyards will be authentically landscaped to exemplify the identity and traits of that particular spice. The key spices selected are Star Anise, Clove, Nutmeg and Cinnamon. In this way the resort speaks of the history of the place, India's continued importance in the seasoning of the world while highlighting the beauty of the natural Goan landscape.

Figure 7.6 Resort Softscape

It is proposed to develop a landscape using the Spice Route concept. More than 4,000 trees will be planted newly at site. More than 90% of the trees to be planted will be local/endemic to Konkan. While preserving trees, emphasis will be laid on preserving mature/old trees having girth larger than 30 cm. Trees will be transplanted to suitable locations in order to restore or rehabilitate degraded portions of the site.

Proposed golf course has been designed using the latest variety of grass (Paspalum sp.) for the fairways, tees, & greens which does not require chemical applications and provides a better playing surface. This grass species uses less water than other warm season grasses or Bermuda grass, and handles drought conditions very well. It also has a lower nutrient requirement.

7.3.1.2 Storm Water Design

- Maximizing vegetated areas to control runoff from site.
- Maximizing pervious areas through grass pavers, pervious pavers, where applicable in the design minimizes storm water runoff correspondingly.
- Considered usage of rain water harvesting pits over and above the recommendations discussed.
- The proposed lakes in the site would act as storm water collection points.

The above recommendations along with grass cover would be capable of treating a large percentage of the storm water and removal of a large percentage of TSS.

Figure 7.7 (a) Grass Pavers and (b) Interlocking Concrete Pavers

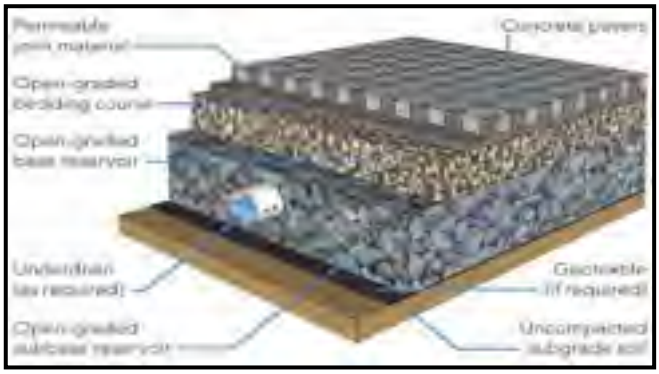


Figure 7.8 Pervious Concrete Pavers

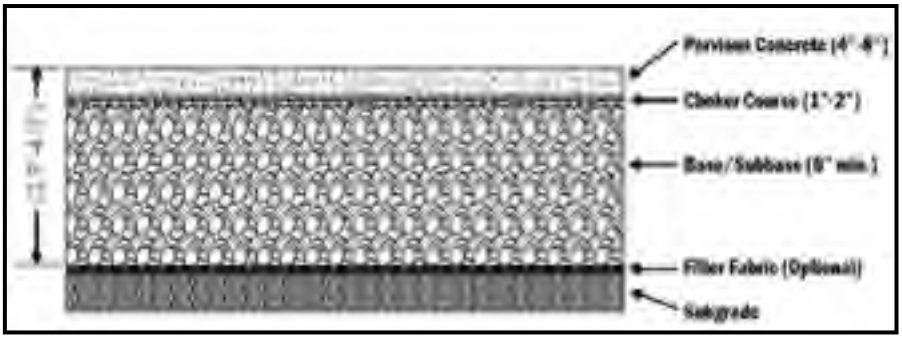


Figure 7.9 : Porous Asphalt

7.3.1.3 Rainwater Management

The project will earn the credits by management of 98%ile of the runoff through Low Impact Development and Green Infrastructure & soil erosion control measures (soil & vegetation based approach to limit runoff).

The above will be complied by harvesting roof top rain water from resort and cluster villas and channelizing the same to central raw water storage tank of 10,000 cum capacity for use in the resort or to lakes or to soakways for ground water recharge. Roof top water from premium villas and paved areas will be channelized to central raw water storage tank of 10,000 cum capacity.

7.3.1.4 Light Pollution Reduction

- Interior Lighting: All interior lighting shall comply with the interior lighting control requirements of Section 9.4.1 of the ANSI/ASHRAE/IES Standard 90.1-2010. For all spaces with luminaires with a direct line of sight to external fenestration, all interior lighting shall be automatically shutoff within 30 minutes of that space becoming vacant during hours of darkness. Exceptions for the above are lighting required for 24X7 operations, and where lighting is required to ensure safety and security.
- Signage: Signage that can be viewed from the exterior of the building shall not exceed a luminance of 200cd/m^2 during hours of darkness and 2000 cd/m^2 during hours of daylight.
- Exterior Lighting:
  - Considering that the project is located in a rural setting, the rating for uplight luminaries should not exceed U1.
  - Exterior lighting fixtures would not emit any light above the horizontal.
  - Maximum vertical luminance at the lighting boundary will not exceed 0.5 fc.

7.3.2 Water Efficiency

7.3.2.1 Landscape Water Use Reduction

- Plan landscaping to include vegetative species that are native or adapted and would not require much irrigation.
- Incorporating vegetative species that would not require permanent irrigation systems
- Irrigation control measures such as humidity sensors could be considered. Water efficient irrigation systems
- Use of drip irrigation/sprinkler system – landscaping will be planned using state of the art meteorological sensors

7.3.2.2 Minimum Fixture and Fitting Water Use Reduction

Reduce water consumption by at least 20% compared to the baseline of the project by means of using water efficient fixtures. Fixtures that would be considered in the calculation are: water closets, urinals, lavatory and sink faucets and showers.

Table 7.3 Compliance with Water flow requirements for Plumbing/Sanitary Fixtures

Water Fixture	Flow / Flush Rate
Water Closet	1.6 gpf
Urinal	1.0gpf
Lavatory Faucet	0.5 gpm @ 60 psi.
Kitchen Sink Faucet	2.2 gpm
Shower	2.5 gpm at 80 psi

Minimum performance requirements are listed below for water appliances:

- Commercial clothes washer: CEE Tier 3A
- Residential Dish washer: energy star
- Pre-rinse spray: 1.6 gpm
- Ice machine: Energy Star

7.3.2.3 Sustainable Waste Water Management

- Water saving devices like electronic controlled sensor operated water taps in wash basins in public areas and for urinals shall be provided
- Reuse building waste water on site. Treated water should conform to NSF 350 standard or the local code whichever is more stringent for its intended use.
- Both black water (sewage and kitchen waste) and grey water (hand wash, shower etc) will be collected separately and treated using MBR and Ultra filtration systems to have at least 90% reuse of wastewater.

Cooling Tower Makeup

1. Prepare a report on quality of potable water giving details on concentration on calcium, silica, chlorides, alkalinity and conductivity.
2. Install side stream filtration system of the condenser water. Monitor and report microbiological growth.
3. Control blow down with a conductivity meter.
4. Monitor and report potable water use, microbiological levels, blow down and corrosion.

5. Install drift eliminators that achieve minimum efficiencies of 0.2% for counter flow systems and 0.5% for cross flow systems. Achieve maximum number of cycles without exceeding any filtration levels or affecting the operation of the condenser water system.

Limit cooling tower cycles: The following parameters in condenser water give the maximum permissible limit:

Table 7.4 Parameters to Maintain in Condenser Water

Parameter	Maximum Level
$Caco_3$	1000 ppm
Alkalinity	1000 ppm
SiO_2	100 ppm
Cl	250 ppm
Conductivity	3500 µS/ml

Cooling water circuit will meet above requirements.

7.3.2.4 Additional Appliance and Process Water Use Reduction

Table 7.5 Reduced Water Use by various Kitchens Appliances

Kitchen Equipment		Metric Standard
Dishwasher	Under Counter	Energy Star
	Stationary Single Tank Door	Energy Star
	Single Tank Conveyor	Energy Star
	Multi-tank Conveyor	Energy Star
	Fight Machine	568 Lph and ≤ 3.78 L/100 9* dishes
Food Steamer	Batch	≤ 15 Lph per compartment including condensate cooling water
	Cook to order	≤ 57 Lph per compartment including condensate cooling water
Combination oven connection on less	Counter Tip or Stand	≤ 57 Lph including condensate cooling water
	Roll in	≤ 76 Lph including condensate cooling water
Food waste disposer	Grinder	3.78 Lpm, no-load condition; 11.4-30.3 Lpm, full load condition; 10-minitue automatic shutoff
	Scrap collector	Maximum 7.57 gpm makeup water

Kitchen Equipment		Metric Standard
	Pulper	Maximum 7.57 gpm makeup water
	Strainer Basket	No Additional Water Usage

7.3.2.5 Water Efficient Landscaping

- Native and low water consuming species shall be planted to reduce irrigation requirements.
- Overall irrigation will be reduced through high efficiency irrigation techniques including drip, micro mist or subsurface irrigation systems, where loss through evaporation could be minimized. Centralized control to monitor and schedule irrigation through sensors provides required irrigation based on environmental factors.
- Landscaping Species will be grouped based on based on their irrigation requirements which will help in controlling water use for irrigation. Monoculture will be avoided.
- Tree plantation shall be maximized to provide adequate shading and reduce evapotranspiration and reduce irrigation requirement.
- Mulching will be widely practiced to increase moisture retention in soil.

Figure 7.10 Scientific Agriculture through (a) Irrigation Sensor (b) Drip Irrigation

7.3.3 Energy and Atmosphere

A minimum of 10% improvement in the proposed building performance compared to the baseline as outlined in NSI/ASHRAE/IESNA Standard 90.1-2010, Appendix G will be made using a computer simulation model for the whole building project. These HVAC requirements will be met.

7.3.3.1 Fundamental Refrigerant Management

Reduce stratospheric ozone depletion by using CFC free refrigerants in HVAC systems.

- Use refrigerants that have an ODP=0 and GWP<50

- If it not feasible to avoid refrigerants having GWP < 50 in the project, then the ODP and GWP of all the refrigerants used in the project should conform to the following calculation: LCGWP+LCODP X 105 ≤ 100

7.3.3.2 Optimise Energy Performance

Establish an energy performance target no later than the schematic design phase. The target must be established as KBTU per square foot-year of source energy use. This target must be mapped on the same scale as the baseline and proposed buildings.

Demand Response

The project could have the following infrastructure in place to take advantage of future demand response program, if available:

- Have infrastructure in place to take advantage of future demand response programs.
- Develop a comprehensive plan of how to shed at least 10%, or 20kW, whichever is greater, of building estimated peak electricity demand during a Demand Response event, including detailed steps of available load shedding or shifting activities with responsible parties.
- Estimated load reductions for each identified measure. Peak demand is determined from EA Credit: Optimize Energy Performance.

Compliance planned: Appropriate Building Management system will be provided meeting above requirement

7.3.3.3 Renewable Energy Production

- Implement such technology to retain ownership for at least next 15 years.
- The system must be located within the utility service area as the facility claiming the use.
- Percentage of renewable energy is based on percentage of ownership of the system.
- Must meet requirements of all other on-site renewable systems.
- A 10% use of renewable energy by use of solar power is being planned to be provided.

7.3.4 Materials & Resources

7.3.4.1 Recycled Content

In compliance with the above quantities of consumables utilized in the resort and the percentage of consumed materials to be recycled will be appropriately planned and implemented.

7.3.4.2 Regional Materials

Based on the design concept and site location, recommendations are provided in the following table for a list of tentative materials that may be used in the project. It is suggested that most materials considered be available in abundance, manufactured and extracted locally in and around Goa. Also it is suggested that these materials be analyzed for recycled content in them and how rapidly renewable / harvestable they are.

Table 7.6 Indicative recommendations for MRC4 and MRC5

Sr. No	Unintended Material Use	Remarks
1	Cement	Procure makes of cement manufactured (and extracted) regionally. PPC cement with flyash content can qualify for MRc4 Recycled Content.
2	Fly Ash	If locally available, can be applied in ready mix concrete / batching plant to replace a portion of cement. Flyash is 100% post industrial.
3	Masonry Blocks	*Sand lime fly ash bricks* would be a possible option in place of cement blocks or kiln burnt bricks. Flyash is an industrial by product. Lime has much lower embodied energy compared to cement. *Extraction of lime and flyash within 400 km to be considered while short listing block suppliers. Laterite blocks* shall be considered as a walling material as this is abundantly available in Goa / Maharashtra.
4	Manufactured Sand*	Crushed natural rock deposits shall be considered as alternatives for river sand, as the river sand is depleting rapidly. Regional plants for manufactured sand to be considered.
5	Aggregate	Crushed natural rock deposits procured / extracted regionally.
6	Masonry Plaster	Lime plaster can be considered in place of cement plaster. Regional extraction shall be considered.
7	Steel	Recycled content potential shall be explored.
8	Laterite Blocks	May be considered for walling, external paving, landscape feature walls, etc. Regional extraction shall be considered while procuring.
9	Glass	Consider options with high recycled content.
10	Gypsum (for false ceiling)	Consider options with high recycled content.
11	Vitrified Tiles	Consider options with high recycled content and regionally manufactured.
12	Basalt//Granite	Shall be considered for flooring, landscape feature walls / elements. Regional extraction shall be considered while procuring
13	Insulation	Consider options with high recycled content.
14	Mangalore Tiles	Consider regional manufacture / extraction.
15	Hard Wood	Local timber can be considered for regional value. However, locally

Sr. No	Unintended Material Use	Remarks
		manufactured composite woods are better alternatives.
16	Composite Wood	Consider options with recycled content and manufactured regionally.
17	Bamboo	Available abundantly as a regional material, bamboo is also rapidly renewable (fast growing and can be harvested within 10 years). Bamboo in specific can be harvested over a span of 1 to 5 years. It can find a variety of applications like roofing systems (either stand alone or in combination with structural steel), composite wall panels, visual screens / separators, screens, furniture, lean to wall extensions for semi outdoor spaces, pergolas, gazebos, and other landscape elements.
18	Furniture	Bamboo (rapidly renewable), and composite woods (recycled content)

The project plans to fully comply with the above requirements by using crushed rock sand to supplement legally available river sand and also to use local laterite blocks for major construction works. Wherever possible local materials will be used to ensure comfort for Hotel guests and as suggested by Interior Designer.

7.3.4.3 Rapidly Renewable Materials

The intent of this credit is to reduce usage of finite or long cycle raw materials, with rapidly renewable materials that are harvested within a maximum of 10 years. These include materials such as bamboo, wood sourced from eucalyptus, birch, fabrics with high percentage of cotton / wool content, linoleum flooring (linseed oil) to name a few. The credit carries 1 point and is awarded when at least 2.5% of the total material cost of the project is from rapidly renewable source.

7.3.4.4 Low Emitting Materials – Adhesives & Sealants, Paints and Coatings

Requirement is to use architectural elements, paints and coatings and adhesives and sealants having low VOC rating. Tables below show the likely materials to be used for development which will get necessary LEEDS credits.

Table 7.7 VOC limits for adhesives and Sealants (From BDC V3 Guide)

Aerosol Adhesives	VOC Limit
General Purpose mist Spray	65% VOC's by weight
General Purpose Web Spray	55% VOC's by Weight
Special Purpose Aerosol Adhesives (all types)	70% VOC's by Weight

Table 7.8 VOC limits for Paints and Coatings (From BDC V3 Guide)

Coating Type	(g/L) Minus Water
Gloss	250

Coating Type	(g/L) Minus Water
Semi – Gloss	250
Flat	250

Table 7.9 VOC Limits for various Architectural Applications

Architectural Application	VOC Limit (g/L Less Water)	Specialty Application	VOC Limit (g/L Less Water)
Indoor Carpet Adhesives	50	PVC Welding	510
Carpet Pad Adhesives	50	CPVC Welding	490
Wood Flooring Adhesives	100	ABS Welding	325
Rubber Floor Adhesives	60	Plastic Cement Welding	250
Subfloor Adhesives	50	Adhesive Primer for Plastic	550
Ceramic Tile Adhesives	65	Contact Adhesive	80
VCT & Asphalt Adhesives	50	Special Purpose contact adhesive	250
Drywall and panel Adhesive	50	Structural Wood member adhesive	140
Cove base adhesives	50	Sheet applied rubber lining operations	850
Multipurpose construction adhesive	70	Top and trim adhesive	250
Structural glazing adhesive	100		
Substrate specific Applications	**VOC Limit (g/L Less Water)**	**Sealants**	**VOC Limit (g/L Less Water)**
Metal to metal	30	Architectural	250
Plastic Foams	50	No membrane roof	300
Porous Material (Except wood)	50	Roadway	250
Wood	30	Single-ply roof Membrane	450
Fiberglass	80	Other	420
Sealant Primers	**VOC Limit (g/L Less Water)**		
Architectural, nonporous	250		
Architectural, porous	775		
Other	750		

In the following table for a list of tentative materials that would be used in the project.

Table 7.10 Adhesives & Sealants- Indicative recommendations for IEQC4.1

Category	Suggested Material	VOC Content (g/l)
Multipurpose construction	Pidilite Fevicol SH	25
Multipurpose construction	DuPont Surface Adhesive	5
Contact Adhesive	Armaflex 520 BLV	80
architectural Sealant	Dowcorning DC 982	57.8
	Dr. Fixit Glass partition sealant	

Category	Suggested Material	VOC Content (g/l)
Vinyl Adhesive	Armstrong S 230	35
Tile Adhesive	Ardex Endura tile adhesives	30
Duct Adhesive	Fevicol AC Duct King	
Wood Adhesive	Fevicol SH	2.29
Water proofing sealers	Nina Concrete Systems: Proof Sol, Proof sol LWP, Hydrocem, Hydro Grout, Hydro guard, Neo-pol	1

Table 7.11 Paints & Coatings- Indicative recommendations for IEQC 4.2

Purpose	Suggested Materials	VOC content (g/l)
Flats	Asian paints Asian Silk Matt 30%	
	Dulux Super Smooth	13.9
	Asian: Tractor Synthetic Distemper	40-45
	Asian: Premium Emulsion	20.1
Fire Retardant Paint	Jaikamal fire retardant paints	Water based paint
Non-Flat	Asian Paints Royale	30-35
Distemper	Deco Zprime WT, Exterior Wall primer. Acrylic wall putty, Apex Ultima, Apex Weather proof. Ace Exterior Emulsion	

During the construction of the Resort as well for its maintenance, the proponents will use paint, coatings, adhesives, sealants meeting the above requirements.

7.3.5 Indoor Environmental Quality

7.3.5.1 Minimum IAQ Performance

Meet the minimum requirements of Section 4 through 7 of ASHRAE Standard 62.1-2010, Ventilation for Acceptable Indoor Air Quality.

7.3.5.2 Construction IAQ Management

- Implement a plan for erecting systems on site meet or exceed all applicable recommended control measures of the (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3).
- Prohibit operation of permanently-installed air handling equipment during construction.
- Schedule construction activities to minimize exposure of absorbent materials to VOC emissions. Complete “wet” construction procedures such as painting and sealing before storing or installing “dry” absorbent materials such as carpet or ceiling tiles.
- Protect stored on-site and installed absorptive materials from moisture damage.

Exception: if permanently installed air handling equipment operates during construction, filtration media with an MERV[1] of 8 must be installed at each return air grille and return or transfer duct inlet opening such that there is no bypass around the filtration media.

Additionally, the permanently-installed air handling equipment shall have its intended final design filtration media installed in accordance with the manufacturer's recommendations. Replace all filtration media within the permanently-installed air handling equipment immediately before occupancy and remove all temporary construction filtration.

7.3.5.3 Enhanced Indoor Air Quality Strategies

- Install permanent entryway systems at least 10 feet long in the primary direction of travel at regularly used exterior entrances. Acceptable entryway systems include permanently installed grates, grills and slotted systems that allow for cleaning underneath. The entryway should be maintained on a weekly basis.
- Sufficiently exhaust spaces where hazardous chemicals may be present (e.g. housekeeping and laundry areas, copying and printing rooms) at a minimum rate of 0.5 cfm with no air recirculation. Provide self-closing doors and deck-to-deck partitions or a hard-lid ceiling. The pressure differential with the surrounding spaces must be at least 5 Pa on average and at least 1 Pa when the doors to the rooms are closed.
- Mechanical and mixed mode ventilation: Each ventilation system that supplies outdoor air must have particle filters or air cleaning devices to filter the outdoor air before it reaches occupied spaces. These filters or devices must have a MERV 13 or higher. Clean air filtration media shall be installed in all air systems after completion of construction and before occupancy.
- For naturally ventilated spaces: Determine that natural ventilation is an effective strategy for the space, as well as the systems are as per the strategies and calculations stipulated in as per CIBSE AM10, March 2005, Natural Ventilation in non-domestic buildings.
- Improve ventilation by 30% compared to stipulations of ASHRAE 62.1 2010.

To comply with the above it is proposed to cover the courtyard and villa entrances with vines and spice trees. Also natural ventilation is planned to make the maximum use of westerly winds during the day and every premium resort villa will have an opening on top to provide easy wind circulation. Mechanical exhaust ventilation will be provided at various places where natural ventilation is not possible.

[1] MERV or Minimum Efficiency Reporting Value, is a numerical value given to filters in order to indentify its filtering abilities.

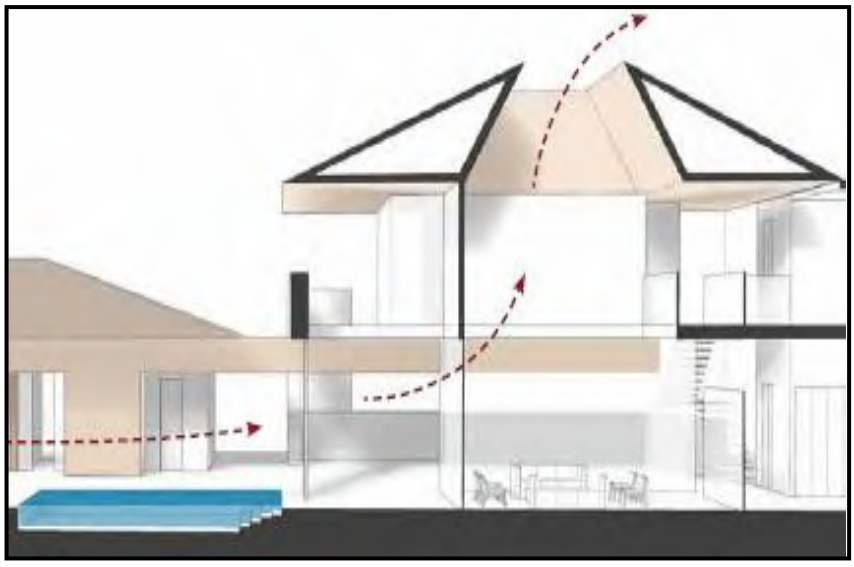


Figure 7.11 Premium Resort Villas Natural Ventilation

7.3.5.4 Outdoor Air Delivery Monitoring

Configure all monitoring equipment to generate an alarm when airflow values or CO2 levels vary by 10% or more from the design values, via either a building automation system alarm to the building operator or a visual or audible alert to the building occupants. For mechanically ventilated spaces: Monitor CO2 concentrations within all densely occupied spaces, though CO2 monitors installed between 3 and 6 feet above the floor. Provide a direct outdoor airflow measurement device to measure the minimum outdoor air intake flow, with an accuracy of plus or minus 15% of the minimum outdoor air rate, as defined by ASHRAE 62.1- for mechanical ventilation systems.

Naturally Ventilated Spaces: Monitor CO2 concentrations within all naturally ventilated spaces through CO2 monitors installed between 3 and 6 feet above the floor. To comply with the above an appropriate building management system will be implemented to monitor ventilation conditions at various points using necessary sensors)

7.3.5.5 Indoor Chemical Pollutant Source Control

- Install permanent entryway systems at least 10 feet long in the primary direction of travel at regularly used exterior entrances.
- Sufficient exhaust spaces where hazardous chemicals may be present (e.g., housekeeping and laundry areas, copying and printing rooms) at a minimum rate of 0.5 cfm with no air recirculation. Provide self-closing doors and deck-to-deck partitions or a hard-lid ceiling. The pressure differential with the surrounding spaces must be at least 5 Pa on average and at least 1 Pa when the doors to the rooms are closed.

The proposed resort is located in a pristine area free from industrial pollution. However the project is planning to make the maximum use of westerly winds during day time for cross ventilation and also to plant trees on all sides as wind breaks to obstruct polluting sources if any.

7.3.5.6 Indoor Air Quality Assessment

After construction ends, before occupancy and with all interior finishes installed, install new filtration media and perform a building flush-out by supplying a total air volume of 14,000 cubic feet of outdoor air per square foot of floor area while maintaining an internal temperature of at least 60° F and no higher than 80° F and relative humidity no higher than 60%.

To comply with the above an appropriate Building Management System will be implemented to monitor ventilation conditions at various points using sensors.

Thermal Comfort

Design HVAC systems and the building envelope to meet the requirements of ASHRAE Standard 55-2010, Thermal Comfort Conditions for Human Occupancy. Demonstrate design compliance in accordance with Section 6.2 Documentation. Provide HVAC systems and controls designed to monitor and control zone relative humidity at both occupied and unoccupied hours to 65% or less during all design load conditions.

1. For at least 50% of occupants, provide thermal comfort controls that enable adjustments to meet individual needs and preferences.
2. Operable windows may be used in lieu of controls for occupants located 20 feet inside and 10 feet to either side of the operable part of the window. The areas of operable window must meet the requirements of ASHRAE 62.1-2010. For all individual spaces and shared multi-occupant spaces, provide comfort controls that enable adjustments to meet group needs and preferences.
3. Conditions for thermal comfort are described in ASHRAE Standard 55-201004 and include the primary factors of air temperature, radiant temperature, air speed and humidity.

Exclusions:

- Guest rooms are assumed to provide adequate thermal comfort controls and are therefore not included in the credit calculations.
- Workstations that is transient in nature and/or where individual staff members spend less than 20% of their average shift may be excluded.

To comply with the above an appropriate Building Management System will be implemented to monitor ventilation conditions at various points using sensors.

Interior Lighting

Meet the requirements of Section 9.5, Building Area Method; or Section 9.6 Space-by-Space Method; of ANSI/ASHRAE/IES Standard 90.1-2010.

AND

1. For at least 90% of individual spaces provide individual lighting controls that enable occupants to adjust the lighting to suit their individual tasks and preferences, with at least three lighting levels.
2. For all shared multi-occupant spaces, provide multi-zone control systems that enable occupants to adjust the lighting to meet group needs and preferences, with at least three lighting levels or scenes (on, off, mid-level).
3. Switches or manual controls must be within the space the controlled luminaires are located and in a location that a person operating the controls can see via a direct line of sight of the luminaries being controlled.

Lighting Quality:

Incorporate at least 4 of the following interior lighting features for 90% of the regularly occupied spaces.

Hardware:

Use light fixtures with a luminance (surface brightness) of less than 12,500cd/m2straight down.

Exceptions include:

- Wall wash fixtures properly aimed at walls, as specified by manufacturer's data
- Indirect up lighting fixtures provided there is no view down into these up lights from a regularly occupied space above.
- Use light sources (lamps, LEDs, etc.) that have a CRI of 80 or higher for 95% or more of the associated connected lighting load. Lamps or fixtures specifically included in the design to
- provide colored lighting for effect are exempt.
- For 60% of the connected lighting load, use lamps that last a minimum of 24,000 hours AND for 90% of the connected lighting load, use lamps that last at least 6,000 hours, per manufacturer's data.

Design:

Provide suspended, wall-mounted, free-standing or partition-mounted indirect or direct/indirect ambient lighting for 75% of the connected lighting load.

Exclusions:

Guest rooms are assumed to provide adequate lighting controls and are therefore not included in the credit calculations. Workstations that are transient in nature and/or where individual staff members spend less than 20% of their average shift may be excluded.

State of the art energy efficient fixtures and Lighting Control System will be implemented as these are the basic requirements of a luxury resort development. Premium Resort villas will have skylight openings to allow natural light. Coutryards within Resort villas will enhance light availability

Figure 7.12 Use of Natural Daylight through Skylights & Courtyards

7.3.5.7 Performance Monitoring

Water Metering

Have in place permanently installed water meters that measure the total potable water use for the building and associated grounds. Install sub metering and separately meter the following uses if they are permanently plumbed:

1. Cooling tower with projected annual makeup water use of 54,750 cum or more. Makeup water added to the system and blow down water discarded from the system must be separately metered. A single makeup meter and a single blow down meter may record flows for multiple cooling towers.

2. Boiler with aggregate projected annual water use of 54,750 cum or more, or boiler of more than 126,082 kcal/hr. A single makeup meter may record flows for multiple boilers.

3. Landscape irrigation that is permanent and automated with either (1) an aggregate irrigated area of 450 sq.m or more (including green roofs),regardless of the projected amount of water use, or (2) projected annual water use of 54,750 cum or more

4. If reclaimed water is used for any water credit, that reclaimed water component must be provided with a meter (regardless of rate). If the reclaimed water system has a makeup water connection it shall be metered as well to facilitate the determination of the true reclaimed water component.

5. Any process water that consumes more than 547.5 cum or more per day.

6. State of the art electronic water meters will be provided for monitoring and subsequent control of water consumption

Building Level Energy Metering

Install sub meters for electricity, natural gas, chilled water, steam, fuel oil, etc. Commit to sharing the data with USGBC energy consumption data and electrical demand data acquired from energy resource meters on the project, to USGBC extending for a five year period beginning on the date the Project accepts LEED certification from the Green Building Certification Institute (GBCI) or typical occupancy. At a minimum, energy consumption must be tracked at one month intervals or in accordance with utility billing intervals.

State of the art electronic energy meters will be provided for monitoring and subsequent control of energy consumption.

7.3.5.8 Daylight & Shading Analysis

A preliminary assessment for daylight and shading measures has been done for Villa clusters in addition to Golf club, Specialty Restaurant, President's Villa and 2 Bedroom Villa. The analyses show that the fenestrations are shaded for an acceptable period. Additional recommendations for western facades are suggested for some units. Daylight assessment shows that most of the units satisfy the LEED Requirement which is attributed to the smaller floor area and larger Window to Wall Area ratio.

Analyses were carried out on typical clusters for different orientations as designed, to assess the shading performance and day lighting performance of the units.

Figure 7.13 Shadow Analysis

7.4 Traffic Management

7.4.1 Site Access

The proposed site has two separate access points. The National Highway no.17 (NH17) is located at about 16 km from the site and road access to the site is from Maharashtra side via Shiroda- Tiracol road which leads through the Tiracol village up to the Tiracol Fort located to the South of the site just outside the plot boundary.

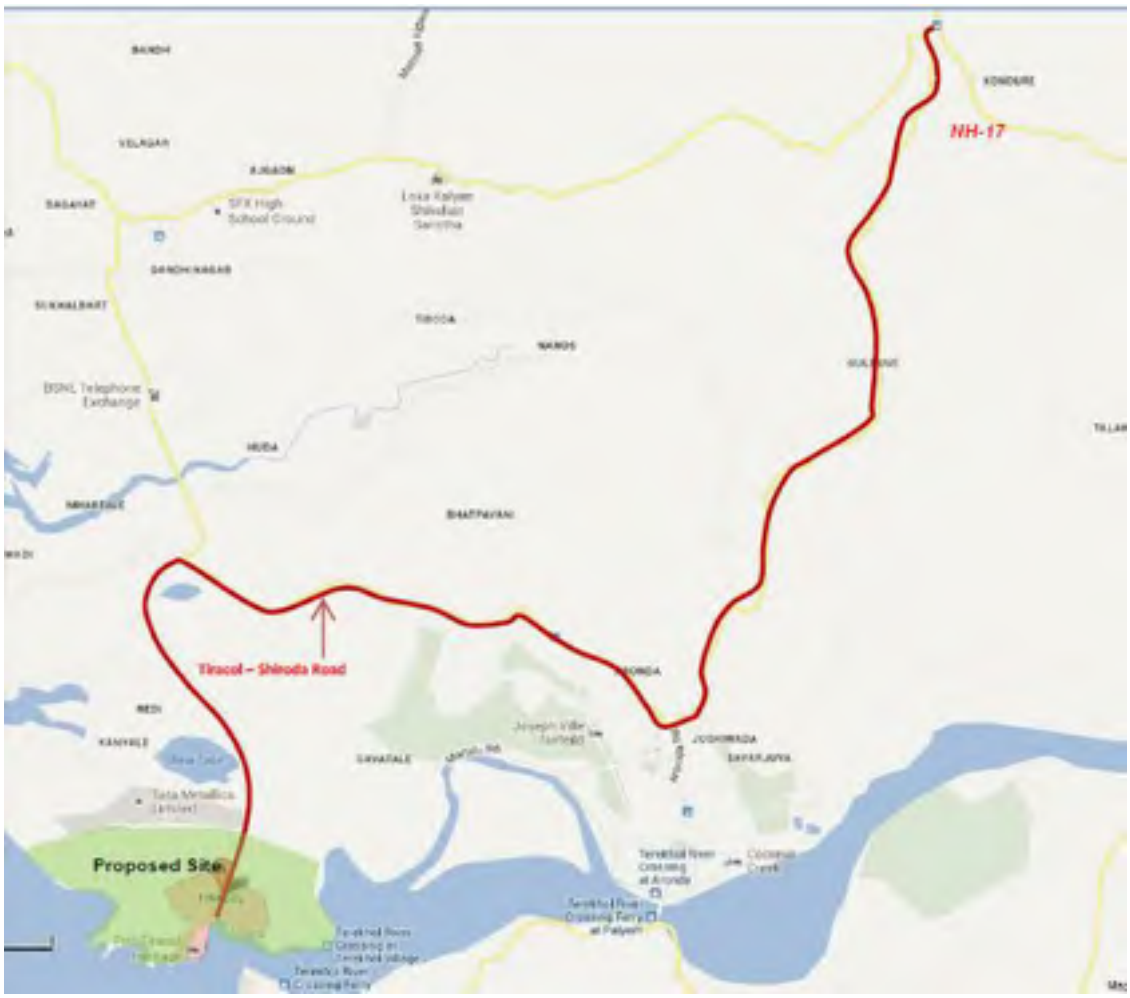


Figure 7.14 Road Connectivity to the site through Tiracol – Shiroda Road

It can also be accessed by taking a ferry from the Querim beach, located on the opposite bank of Tiracol river. The ferry service is managed by the River Navigation Department of Goa. Querim is accessed from the Goa side by Dhargal-Tuem-Querim road.

The road running from the North of the plot will serve as an access from Maharashtra. A manual counting for 30 day period was undertaken for the study.

Figure 7.15 Southern Connectivity to the site through Querim – Arambol Road

Figure 7.16 Location of Bridge at Paynem and Proposed Bridge at Tiracol

7.4.2 Existing Traffic Volumes

Existing Traffic Volume for Tiracol is presented in Table and Figure below.

Table 7.12 Tiracol – Existing Traffic Volumes September 2012 (vehicles per day)

	1st - 7th Sept	8th -15th Sept	16th -22rd Sept	23th -30th Sept
2 wheel Motor Bikes	96	85	90	89
3 wheel AutoRickshaws	20	25	27	23
4 wheel Cars	80	75	90	87
6 wheel Minibus	8	9	10	12
6 wheel tippers	7	10	8	9

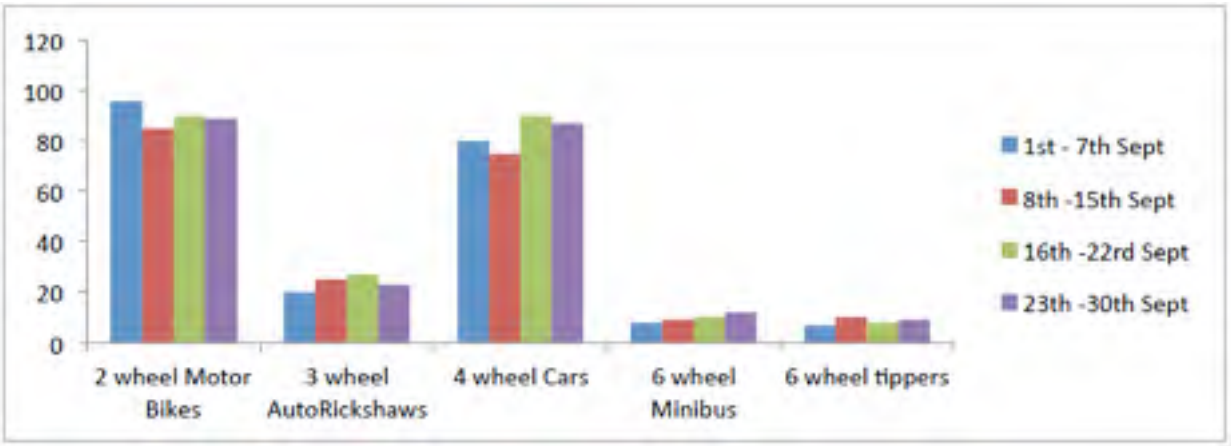


Figure 7.17 Tiracol – Existing Traffic Volumes September 2012 (vehicles per day)

7.4.3 Traffic Generation by Development

Two main functions are considered while estimating the traffic. These are core hospitality and non-core hospitality functions. Mode-wise traffic generated by each component is summarized in the table below.

Figures mentioned against serial no 1,2 & 3 is the traffic which will flow on any normal day operation of the resort. Around 177 cars, 157 two wheelers and 13 buses will arrive during a normal operational day in the resort. When resort is fully occupied around 331 cars, 157 two wheelers and 13 buses will arrive daily bringing visitor and employees to the resort.

These traffic figures will change drastically in case of tournaments. It is estimated that during golf tournaments additional 373 cars and 140 two wheelers will be added to the traffic during weekdays and around 1706 cars and 640 two wheelers during weekends. Other than these vehicles, around 15 service trucks will arrive daily. This figure will be higher during events.

Table 7.13 Total traffic generated from the Core Hospitality Functions

Sr. No.	Area of Operation	Mode-wise Distribution of Traffic		
Core Hospitality Functions		Cars	2 - wheelers	Shuttle Bus
1	Traffic Generation from Standard Resort Villa	75	0	0
2	Traffic Generation from Employees	69	157	13
3	Traffic Generation from Visitors (Restaurants)	33	0	0
4	Traffic generation from Premium Resort Villas	154	0	0
	Sub Total	**331**	**157**	**13**

Sr. No.	Area of Operation	Mode-wise Distribution of Traffic		
Non-Core Hospitality Functions		Cars	2 - wheelers	Shuttle Bus
5	Traffic Generation from Banquet	180	0	0
6	Traffic Generation from Meeting Area	84	0	0
7 a	Traffic Generation from Golf Tournaments - Weekdays	373	140	0
7 b	Traffic Generation from Golf tournaments - Weekends	1706	640	0

7.4.4 Summary and Conclusion

The proposed development will generate traffic and this report has examined the impact of the estimated traffic on the external road network. The findings of this report are as follows:

- During normal operation, resort will generate a vehicular traffic of 331 cars , 157 two wheelers and 13 shuttle buses.
- Traffic generation by the resort development when events like golf tournament or marriage occurs simultaneously. In this kind of situation traffic figures can go high.
- Around 660 car spaces are required to be planned inside the resort to meet the parking demand for normal resort operations. This will cater to the parking demand of employees, resort guest and visitors.
- To meet the parking demand during golf tournaments, parking spaces are planned outside the resort area on lands owned in Maharashtra by the Project Proponent. This land requirement may vary according to the proposed parking plan.

In conclusion, the road widths of the network proposed is adequate to cater the traffic needs of the resort. The calculated volume/capacity (V/C) ratio also indicated that the road network planned has sufficient capacity to meet the traffic requirement, both for normal day operation and also during events.

7.5 Disaster Management

7.5.1 Preliminary Hazard Analysis (PHA)

A preliminary hazard analysis has been carried out to identify major hazards associated with the functioning of the proposed project (**Table 8.4**).

Table 7.14 Hazards, Risks and Vulnerability

Hazard Component	Potential Risk	Vulnerability/ Probability
D.G. Sets	Mechanical hazards and fire hazards in: Lube oil system Cable galleries Short circuits	**Low:** The DG sets are used only in case of power failures, which are rare. The lubrication oil and diesel are stored in small quantities.
Power Trans-formers	Fire and explosion	**Low:** Transformers are always kept in the open, with proper fencing, and isolated from buildings.
Electrical Control room	Fire in cable galleries and switches. Static electricity due to improper earthing and bonding. Fire, in earthing and bonding may result in Power failure.	**Medium:** The risk may arise from low quality of insulation material bad maintenance or alterations by untrained manpower. It may also arise from voltage fluctuations.
LPG Cylinders storage	Fire and explosion due to leakage	**Low:** Probability of cylinder related fire and explosion is low.
Natural Disasters	Earthquake and cyclones may damage the electrical system, lifts, and water/sewerage lines. It may also damage the external envelop of structures.	**Low:** Goa falls in Seismic Zone III which is one of the least vulnerable zones. Goa does not have history of severe earthquakes. Goa lies on the West coast of India which is less prone to severe atmospheric changes resulting in cyclones, hurricanes, storms etc.
Topography and Drainage	Flooding/Water logging may curtail access to daily needs and transports facilities.	**Low:** The risk may arise only in the rare event of choking of natural and manmade storm water drainage system coupled with high tide and storm surge. The site is securely located at a minimum height of 40 M above MSL.
Terrorist attack, blasts etc.	Forced acquisition of building and hostage situation may result from terrorist attacks.	**Low:** The project is not a high priority target. The location is in a rural setting and not in a prime area..
Mob attack	Agitated mob attack will result in life and property damage.	**Low:** The area is residential, rural and peaceful, hence no such disturbance is likely

Hazard Component	Potential Risk	Vulnerability/ Probability
Biological Disaster	Disease outbreak, Epidemics causing deaths.	**Medium:** Goa is well connected by all means of transportation to the entire country and the outside, so the risk of biological disaster is considerable. However the State has well equipped machinery to deal with such occurrences and thus the overall risk is medium.
Others	Power failure, Water shortage,, traffic congestion, communication failure, etc.	**Low:** Such types of risks are rarely prevalent in rural Goan setting where the project is proposed. As remedial response is very quick and services are immediate, no problems of difficult nature are likely. Power failure will not affect the project seriously as stand by DG sets are provided for all essential services. With water recycling, rain harvesting and sufficient storage capacity the project will have sufficient buffer for any short term water shortage in PWD supply.In case of prolonged problem the project can avail of private water tanker supply.

7.5.2 Precautionary Measures

Precautionary measures for any disaster are to be taken by all the users/visitors of the proposed resort. Hence the measures mentioned below are to be meticulously followed by occupants of the Resort. To be well informed about such precautions a printed booklet will be kept in each resort villa/room.

Fire

The following basic precautions are recommended:

- Good house-keeping.
- Compulsory use of ashtrays while smoking.
- Prompt repair of faulty electrical appliances.
- High voltage points and instruments to be secured and labeled prominently.
- Switches and fuses to conform to correct rating of circuit.
- Welding /Cutting jobs to be carried out under strict supervision.
- Fire Rescue drills to be carried out at regular intervals.
- Elementary fire fighting training to occupants.

Earthquake

- BIS codes relevant to the project site shall be adopted for building standards
- Heavy items such as pictures and mirrors to be hanged away from beds, settees, and other sitting places.
- Overhead light and fixtures to be braced securely.
- Heavy/large objects to be stored on lower shelves.

- All breakable items such as bottled foods, "glasses/china ware", etc. shall be stored in lower level closed cabinets with latches.
- Repair defective electrical wiring and leaky gas connections. These are potential fire hazards.
- Water heaters, LPG cylinders, etc., to be secured by strapping these to wall studs and bolting to the floor.
- Weed killers, pesticides, and flammable products will be stored securely in closed cabinets with latches, in bottom shelves.
- Safe places to be identified, indoors and outdoors, for safe occupation of the occupiers during tremors. numbers (of doctors, hospitals, police, etc) to be displayed in each resort "villa/room' and also in other service areas of the resort.
- Emergency "telephone/cell"

Floods

- Sewerage and storm water systems to be checked at regular intervals for their proper functioning.
- Provision will be made to harvest most of the rain water from the proposed site. This will reduce the water shortage as well as runoff water on the site.

Cyclones

- Periodical checking of all resort buildings for structural faults, to secure loose tiles, and to carry out timely repairs, will be resorted to.
- Periodical removal of dead wood or dying trees close to the villas to be undertaken.
- Hurricane lanterns filled with kerosene, battery operated torches and enough dry cells will always be made available during emergencies.

Tsunamis

- An earthquake that lasts 20 seconds or longer in a coastal area, may cause tsunamis.
- When the shaking of the earth stops, people will be moved quickly to higher ground away from the coast. A tsunami may be coming within minutes.

Terror attack/ bomb blast

- The resort will be fully secured all around the periphery and there will be only one entry and one exit to the entire facility.
- The entry and exit points will be manned for 24 hours with specially trained security staff fully equipped with latest security gadgets including closed circuit electronic surveillance cameras/CCTVs monitoring all sensitive areas within the Resort Complex. A log book will be maintained to record the identities of all "vehicles/residents/guests/visitors" entering and leaving the Resort.
- All "persons/vehicles" entering the resort will be fully checked for explosives and weapons.

Biological Disaster

Most of the precautions to prevent a biological disaster come under the domain of government authorities. However, at personal level, hygienic practices and proper sanitation are essential criteria to be followed to prevent the spread of both, induced or natural infections. The resort management will periodically be in touch with government health authorities to prevent any such eventuality.

Other Disasters

Other disasters are rare and have not occurred in the region or their occurrence can easily be mitigated with routine precautions. Nevertheless the following precautions will be taken:

- Sufficient water will be stored, in excess of actual requirement, as a buffer stock to tackle the eventuality of temporary water supply shortage.
- Multiple communication channels will be maintained to tide over the situation of failure of telephone link "and/or" malfunction of main server.
- "Alternate/renewable" energy sources will be used to illuminate "gardens/golf course", lobbies and corridors to supplement conventional power, as also to serve as emergency power source during unexpected electricity supply failures. Such alternate power sources shall include solar power, biogas and small wind turbines.

7.5.3 Disaster Preparedness Onsite

The plan will include installation of alarms and other security related communication gadgets. The resort will prepare a Disaster Management Plan and will constitute a dedicated Disaster Management Committee/Team to implement the same when required.

Fire Alarms/Other Measures

Fire and smoke alarms will be installed in all covered places such as rooms, lobbies, halls, kitchens, offices, etc. The functioning of these fire alarms will be checked every week by the resort security staff.

- To meet the requirements, the following measures will be taken:
- Courtyard will be paved suitably to bear the load of fire engines.
- Electrical meter room will be sealed with non-combustible materials.
- The lighting in all fire escape routes will be based on independent circuits backed by DG sets.
- Underground and overhead water storage tanks having appropriate capacity will be provided for fire fighting.
- Automatic water sprinklers will be installed in all internal covered spaces.
- Fire Hydrants, Fire Hoses and Fire Extinguishers will be installed throughout the resort as mandated by the Fire Department.

- Portable fire extinguishers of dry chemical powder will be provided in the electric meter rooms and basements.

Occupational Health and Safety

The facility will have many activities such as construction, erection, testing, commissioning, operation and maintenance, where manpower, materials and machines are the basic inputs. Occupational health and safety of all the people concerned will be a major responsibility of the resort management. All statutory requirements in the above connection will be meticulously implemented. The security staff of the resort will maintain a close liaison with government authority in-charge of the Off-site Disaster Management Plan and give all collaborative support in emergency situations.

Emergency Response in the Event of Disaster

In case of emergency due to any type of disaster a quick and immediate response is essential. This response depends on the actions taken by individuals to avoid or mitigate the adverse effects of a disaster and to undertake search and rescue operations. Following are the actions which will be taken in various emergent situations.

Action in the event of Fire

Extinguishing fires: A small fire at the point of leakage will be extinguished by enveloping it with a water spray or a suitable smothering agent such as CO2 or DCP (Dry Chemical Power). Fire fighting personnel working close to un-ignited vapour clouds or close to fire, will be protected continuously by water sprays.

Response Sequence during Event of Fire

Any person noticing the fire will attempt to isolate and extinguish the fire with readily available equipment and inform or arrange to inform the Security Head in-charge regarding the:

- Location of fire
- Type of material burning
- Extent of fire
- Caller's name and phone number
- Security Personnel will:
- Sound the siren as per the Siren Code.
- Will cordon off the area and call the local fire fighting Department.
- Will direct all occupiers/guests to evacuate and assemble in designated fire shelter spaces

Actions in case of Flood/Tsunami

As stated earlier, such eventualities are not expected considering the past weather records of the entire Konkan coast encompassing the state of GOA. However, the resort

management shall take all necessary precautions in consultation with the State weather and disaster management authorities.

Biological attacks

The resort management will take all necessary precautions as suggested by the state health and intelligence agencies, in the event of any such eventuality that comes to their notice.

7.5.4 Relief and Rehabilitation

- Relief authorities at the site will:
- Encourage self-help in every activity of their day-to-day living.
- Provide assistance for identification/assessment of human and material loss.
- Provide assistance in maintenance of law and order.
- Provide assistance in maintaining sanitation standards and in disposal of waste.
- Promote cultural and recreational activities for mental health.
- Measures during Earthquake
- Relief authorities will :Conduct a week-long survey to locate quake related hazards/damages in the resort.
- Work with local emergency services and officials to help affected people and those likely to be affected.
- Provide tips for conducting earthquake drills.
- Actions to be taken to prevent impact of Cyclone
- Residents/visitors will be advised to stay tuned to weather advisories broadcast on radio or TV. Radios and TVs in Resort lobbies/restaurants etc. will also be activated for the benefit of residents/guests.
- All windows and external doors of the resort complex will be shut and appropriately secured to withstand high wind speeds.
- Extra food, which can be eaten without cooking, and surplus drinking water will be stocked for the benefit of residents/guests to tide over long power failures and damage to F&B infrastructure.
- Hurricane lanterns, torches and other emergency lights will be made available.
- All loose and unsecured materials which can fly and cause damage due to strong winds, will be removed to safe locations and/or securely fastened.
- Electrical mains will be switched off except for emergency utilities.
- The management will be continuously in touch with the State Disaster Management Authority and scrupulously follow its instructions with respect to the need for evacuation of the resort or any other eventuality.

7.5.5 Disaster Prevention

Following measures will be undertaken for prevention of disasters:

- Maintaining data base of agencies responsible for handling emergencies like Hospitals, Trauma care, State Disaster Management Agency, Police, Ambulance etc.

- Maintaining constant liaison with agencies who can forewarn of likely disasters such as IMD (India Meteorological Department), National Tsunami Warning Centre etc.
- Train staff in handling firefighting equipment
- Defining a organ gram for handling emergency situations eg. Identification of a works main controller, incident controller etc. so as to have coordinated response to attend to emergencies. Conduct mock drills at regular intervals
- Identify a emergency control centre having maps, utility drawings such as electrical, fire fighting etc.

Table 7.15 Hazard Identification

Sr. No.	Step/Activity	Hazard identification	Typical Areas /activities	Possible causes	Safety Measures Required	Risks
1.0	Construction of resort buildings and Golf Course	**Physical/ Manmade Hazards**				
		- Fall from height	- Working at ht > 2m - Formwork - Ramps - Unprotected sides and edges - Roofing - Overhead brick laying	- Untrained workers - Wearing loose clothes - No safety gear	Fall protection - guardrail - safety net/PPEs - harness - warning lines - appropriate clothes - supervision to identify hazards	Accidental injury (personal)
		- Motor vehicle crash	Ramps, excavation sites, roads	- Untrained reckless drivers	Vehicles with - service, emergency and parking brake - hooter system - windows, wipers, lights, rear window mirrors, reflectors	Accidental injury (personal)
		- Excavation accidents	foundation	- Unidentified cables & utilities	Notify prior to starting excavation Check oxygen levels Design safe access	Accidental injury (personal)
		- Electrocution	Entire site	- Temporary connections - Cables running across site	Supervision to identify hazards	Accidental injury (personal)

Sr. No.	Step/Activity	Hazard identification	Typical Areas /activities	Possible causes	Safety Measures Required	Risks
		- Struck by falling objects	Entire site	walking below loading or working equipment	Supervision Warning ribbons and signs	Accidental injury (personal)
		- Dust Generation	Entire site	excavation	Dust mask	Injury personal
		Noise exposure	Entire site	Construction & erection activities	Ear Muffs/plugs oiling and greasing Vibration dampening	Personal injury (noise induced hearing loss)
2.0	Commissioning	Electrocution	Use of Energy	Temporary connections	Tagging & Lock out Warning signs	Electrocution (personal injury)
		Noise exposure	Entire plant	Commissioning activities	Ear Muffs/plugs Oiling and greasing Vibration dampening	Personal injury (noise induced hearing loss)
3.0	Operationo of resort and Golf Course	Electrocution	Use of Energy	Temporary connections	Tagging & Lock out Warning signs	Electrocution (personal injury)
		Chemical exposure	Use & storage of chemicals & hazardous wastes	Improper handling	Safety Gear/PPE's Training	Personal injury (Chemical burn, organ damage)
				ETP/ STP/ DG failure	Regular O&M and complying recommendations	On/offsite Accident injuries
		Noise generation	Specific areas on site	Improper maintenance	Ear Muffs/plugs Preventive maintenance, oiling and greasing of equipments	Personal injury (noise induced hearing loss)
		Fire	Any part of the site	Faulty electrical appliances	Booklet on safety measures and	Personal injury, loss of inanimate

Sr. No.	Step/Activity	Hazard identification	Typical Areas /activities	Possible causes	Safety Measures Required	Risks
				Mishandling of day to day equipment/ items	Evacaultion Plan to be kept in each resort villa/room Signage to be followed Fire Rescue drills at regular intervals	objects
4.0	Closure and Decommissioning	Chemical exposure	Use & storage of chemicals & hazardous wastes	Improper handling	Safety Gear/PPE's Training	Personal injury (Chemical burn, organ damage)
		Natural Hazards				
1.0	Construction of resort buildings and Golf Course	Cyclones, Tsunami	Natural Hazard will affect areas closer to the coast	An earthquake that lasts 20 seconds or longer in a coastal area, may cause tsunamis	Safety Training to workers Workers to move to higher ground away from the coast	
2.0	Commissioning	Cyclones, Tsunami	Natural Hazard will affect areas closer to the coast	An earthquake that lasts 20 seconds or longer in a coastal area, may cause tsunamis	Periodical checking for structural faults and to carry out timely repairs Periodical removal of dead wood or dying trees close to the villas. Hurricane lanterns filled with kerosene, battery operated torches and enough dry cells will always be made available.	Loss of life and property
3.0	Operationo of resort and Golf	Cyclones, Tsunami	Any part of the site	An earthquake that lasts 20 seconds or	People will be moved quickly to higher	Loss of life and property

Sr. No.	Step/Activity	Hazard identification	Typical Areas /activities	Possible causes	Safety Measures Required	Risks
	Course			longer in a coastal area, may cause tsunamis	ground away from the coast Periodical checking of all resort buildings for structural faults and to carry out timely repairs Periodical removal of dead wood or dying trees close to the villas. Hurricane lanterns filled with kerosene, battery operated torches and enough dry cells will always be made available.	
4.0	Closure and Decommissioning	Cyclones, Tsunami	Natural Hazard will affect areas closer to the coast	An earthquake that lasts 20 seconds or longer in a coastal area, may cause tsunamis	Safety Training to workers Workers to move to higher ground away from the coast	Loss of life and property

8 PROJECT BENEFITS

8.1 Tourism

The proposed Golf Resort will assist to boost tourism in Goa. Following are the anticipated highlights:

- Goa is an internationally preferred tourist destination. The proposed project will make Goa an international golfing destination, within the global tourism circuit.
- It will fill a big tourism related void in Goa, which is the absence of a full size golf course, a basic need to attract high end tourists.
- Golf resort will offer exclusive lifestyle in natural environment
- Propagate eco-friendly concepts in architecture and design utilities

8.2 Improvement in Socio Economic Status and Community Welfare

The project will have the following posititve repecussions on socio economic and community welfare:

- Will create jobs that match the "skills/talent", available locally
- Will lead to spin-off businesses, which also are green in nature
- Will provide community service facilities, better "infrastructure/services" and
- Employment to the tiny rural settlement of Tiracol.

As a part of community welfare measures, it is proposed to:

- Construct a Primary school for neighbouring village children.
- Construct a 25 bed Medical Centre which will be open to the citizens of Tiracol village for emergency treatments.
- Development of a Disaster Management Centre for congregation and evacuation during emergencies.

8.3 Other Tangible & Intangible Benefits

Compared to many other development options which have been tried and tested in Goa (viz. manufacturing industry, pharmaceuticals, mega-housing projects, metallurgical furnaces/ foundries and the like), tourism related developments such as coastal resorts, "horticultural/ plantation" retreats, marinas, and medical tourism (speciality clinics/ hospitals) appear to be most compatible with Goa's landscape, socio-cultural ethos and environment friendly nature.

Evidently, a golf course based resort which thrives on greenery and breathtaking landscape as its main ingredients, is fully compatible with the proposed majestic ocean-view project site, in the remote undeveloped and (mostly) barren corner of Tiracol region in Pernem taluka of Goa.

Unlike mega-housing projects and industries, a Golf Resort is socio-ecologically and environmentally most desirable because of its major attributes, listed below:

- Causes no demographic influx.
- Enhances the green cover of the locality.
- Involves no loss of native tree cover, except for the relocation of some trees by removal and transplantation.
- Promotes harvesting of rainwater to the maximum extent possible.
- Reclaims a vast stretch of highly eroding coastal premonitory and rocky plateau and converts it into a stable and lush green ocean view landscape.
- High end coastal protection measures to the otherwise eroding shoreline
- Encourages ventures of ornamental gardening, flowering plants, lawn making and plant nurseries.
- Promotes organic manures
- Encourages highly efficient and water saving irrigation technology.
- Promotes renewable energy sources.

9 ENVIRONMENTAL COST BENEFIT ANALYSIS

All the required environmental protection measures will be implemented as part of the proposed development to ensure compliance with the local and national norms.

The state has a good connectivity with the near completion of the modern airport at Dabholim, Vasco (capable of handling upto 5 million passengers) and the proposed airports at Mopa in North Goa.

Goa offers all ultramodern infrastructures and a modern Golf course developed on eco friendly principles will go a long way to boost tourism and attract the high end tourists into the state. Friendliness of the locals, its unique history and a diverse cultural background, its unique architecture and the security atmosphere and the understanding and respect given to privacy of foreigners has led to Goa being a preferred destination for stay by the foreign tourists

Golf tourism will uplift the image of Goa with substantial revenue multiplier effects. Generally Golfers spend four times the amount spent on green fees on other considerations like accommodation, food and drink and travel, leisure activities. Evidently, a golf course based resort thrives on greenery and breathtaking landscape as its main ingredients, is fully compatible with the proposed majestic ocean-view project site, in the remote undeveloped and (mostly) barren corner of Tiracol region in Pernem taluka of Goa. The project will redefine the socio-economic profile of Pernem Taluka and Tiracol will be catapulted into a global destination. It will lead to spin-off businesses, which also are green in nature. Unlike mega-housing projects and industries, a Golf Resort is socio-ecologically and environmentally most desirable.

The estimated overall project cost is Rs. 505 crore. Out of this the anticipated environment protection budget (capex) is about Rs 870 lakh. This is about 1.72% of the total project cost.

Despite the project cost being Rs 505 crore, the proponent has committed to spend Rs 8.7 crore to meet statutory norms.

The treated sewage from the STP/ ETP shall be used on site for green belt development, lawn area and golf course watering thereby saving fresh water for the same.

10 ENVIRONMENTAL MANAGEMENT PLAN

10.1 Introduction

Description of the administrative aspects of ensuring the mitigative measures are implemented and their effectiveness monitored, after approval of EIA are presented in this chapter.

10.1.1 Objective & Scope of EMP

Environmental Management Plan is prepared with the main objective of enlisting all the requirements to ensure effective mitigation of adverse impacts for all the components of the proposed project. The objectives taken into account in preparation of EMP are summarized here as follows:

a) The prevention, control and abatement of pollution, i.e. air pollution, water pollution, hazardous/ non-hazardous wastes and noise pollution,

b) To comply with the stipulated enviro-legal requirements and standards,

c) To direct the steps to be followed, for effective maintenance and regulation of environmental management system.

d) To ensure the better and safe work environment through pre-meditated planning of prevention and control of hazards,

e) To direct the investments towards sustainable development by considering the cost of sewage treatment, emission control, waste disposal, social development, green belt development and health & safety in the planning stage only,

f) To account for recycling and reusing measures, proposed or required to be adopted for minimization of consumption of resources and generation of pollutants.

10.2 Responsibilities for Environment Management

Environmental pollution during construction phase will be considerably less than that when the resort will be fully operational. However, it is a good practice to develop procedures for control of pollution during entire project phase.

10.2.1 Environmental Management during Construction Phase

During construction phase, contractors as well as site-in-charge will be responsible for implementing all the mitigation measures recommended. The impact during construction phase is obviously of localized nature – restricted to the site and its immediate environment.

The following table lists the mitigation measures to be undertaken during the construction phase and the entity responsible for implementation.

Table 10.1 Mitigation Measures during Construction Phase

Sr. No.	Affected Environmental Parameters	Likely adverse impact in absence of mitigation measures	Nature of impact	Proposed Mitigation Measures	
				Action to be taken	Implementing entity
1.	Land Environment	Generation of solid waste and debris	Temporary	Construction debris will be utilized for internal paving/ backfilling. Recyclable waste will be sorted and sent for recycling through scrap dealers. Top soil removed during construction will be stored separately and reused. Adequate covered facilities will be provided for storage of waste materials. Tree plantation to start during construction phase to enhance aesthetic value and reduce erosion and run offs during monsoon. Guidelines for planting saplings of trees to be strictly followed.	Contractor and Site Civil engineer
2.	Air Quality	Traffic congestion Increase in air pollution (Increase in levels of NOx, SPM, Dust hazards) Risks of accidents	Significant but Temporary. As the area is sparsely inhabited it will not pose significant health hazard.	Construction vehicles to be parked on site Use of dust covers over construction material during transportation. Ready-mix concrete will be transported in closed containers. Sprinkling of water, on site to minimize fugitive dust emissions. Barricading of construction and dumping area will be done . Material will be brought in batches so that there is no sudden increase of traffic volume at one particular time. All stationary equipment will	Project Manager & Contractor

Sr. No.	Affected Environmental Parameters	Likely adverse impact in absence of mitigation measures	Nature of impact	Proposed Mitigation Measures	
				Action to be taken	Implementing entity
				be kept in downwind locations.	
3.	Noise Quality	Increase in noise levels causing nuisance in the locality.	Temporary. But since the property is away from the village, the effect will be insignificant	Prohibition for use of equipment emitting noise of greater than 90 dB (A) for 8 hour operation Provide workers on machinery with ear muffs/ ear plugs Provision of temporary barricading around site	Contractor and Project Manager
4.	Water Environment	Increase in turbidity and suspended solids due to soil erosion. Blocking of natural drains due to deposition of construction materials.	Significant and temporary	Construction work to be carried out before monsoon and erosion protection measures such as turfing/ pitching etc. to be undertaken. Construction materials to be stored in covered sheds. Measures to divert run-off storm water drainage and hence prevent pollution from construction materials. Cleaning of drains on regular basis to avoid blockage. No accumulation of stagnant water to be allowed.	Contractor and Project Manager
5	Biological Environment	Loss of trees and local germplasm of different species.	Significant and permanent	Plant about 4000 tree which are endemic to Konkan Total 1966 trees come in the path of proposed development – of these 1001 trees are endemic and every attempt will be made to save these trees Landscape features such as lawns are proposed in major open areas within the resort. Small shrubs and flowering trees will be planted in beds along the roads & the footpaths. Open spaces available around the Resort will be landscaped with flower beds, bushes, lawns & ornamental trees. Paved paths between buildings	Project Proponent + Landscape architect

Sr. No.	Affected Environmental Parameters	Likely adverse impact in absence of mitigation measures	Nature of impact	Proposed Mitigation Measures	
				Action to be taken	**Implementing entity**
				will be of minimum width as per the requirements so that impervious ground cover is minimized. Grass grid paver blocks to reduce radiative heat. Stress will be on soft landscape which will consist of native spices that blend with the rural native vegetation. Recommended species are: coconut, areca nut, bottle palm, flowering avenue trees, local spices and trees bearing fruits and flowers.	
6.	Social Impacts	Health and safety aspects of construction workers. Existing socio-economic conditions.	Significant and temporary	Safety training & weekly tool box meetings as per safety policy. Provision of personal protection gears such as gloves, helmets, ear muffs/plugs, etc. to all labourers. Provision of stand by ambulance. Insurance cover for all workers. Provision of a paramedic at the site. Provision of water supply and temporary sanitation facilities to laborers in labour camp. Deployment of labor for activities such as horticulture/landscaping/ construction will provide employment opportunities for local residents.	Contractor & Project Manager

10.2.2 Responsibilities for Environmental Management during Operation Phase

During the operation phase, an Environmental Management Committee will be set up and dedicated Environmental Officers will be appointed to look after tasks such as operation/ maintenance of Grey Water (wash basins/showers)/Black Water Treatment Plant (Sewage

Treatment Plant), management of solid waste, monitoring of environmental parameters, and other mandatory regulatory compliances.

A high level committee consisting of top level resort officials will be set up as listed below. This body will oversee, inspect, co-ordinate and implement the entire environmental management plan/obligations of the Resort. Tentatively the committee will comprise of the following personnel:

Structural measures: Directors, Project Manager, Accounting Head/Manager, Site Officer & Engineers, Contractors.

Non-Structural (SOP's, studies, implementing systems etc: Directors, Site Manager, Accounting Head/Manager, Resort In-Charge, Safety & Environment Officer & Engineers, Contractors & Operators.This committee will meet at least once in a month and consider all issues affecting the environment. It will inspect the works frequently and take quick decisions to correct any anomaly. The committee will meet and act as per the following schedule:

Table 10.2 Environmental Inspection Schedule

Facility	Normal Inspection	Committee Inspection	Action to be taken
Water Supply	Daily	Monthly	Leakages, quality, etc.
Sewerage	Weekly	Monthly	Cleaning, choke up removal
STP	Daily	Fortnightly	Pumps, sludge disposal monitoring results
DG set	Daily	Monthly	Exhaust, chimney cleanliness
Gardens	Daily	Monthly	Suggest improvement
Pool/ water bodies	Weekly	Monthly	Chlorination, filtration
Solid Waste	Fortnightly	Quarterly	Proper collection and disposal
Hazardous Waste	Fortnightly	Quarterly	Proper collection and disposal

The committee will address the short-comings in all the above instances and take action to take immediate remedial measures. A 'Minutes' Book' will be maintained wherein, the minutes of meetings and action taken reports will be entered and endorsed by all members of the committee. The entries in the 'Minutes' Book' will be reviewed periodically by the Director In-Charge/General Manager of the Resort.

Samples of raw and treated sewage will be analyzed daily (pH, TSS, COD) and monthly through a MoEF recognized laboratory. The results will be observed and immediate corrective steps taken to meet the prescribed standards.

All resort staff members will be given specialized training to take care of operation & maintenance, fire fighting and emergency drills. Periodically there will be refresher courses to update the preparedness and technologies. There will also be mock rehearsals and regular exercises pertaining to the operation of emergency services.

Table 10.3 Mitigation Measures during Operation Phase

Sr. No.	Affected Environmental Parameters	Likely adverse impacts in the absence of mitigation measures	Nature of Impact	Proposed Mitigation Measures	
				Action to be taken	Responsibility
1.	Land Environment	There will be a change in land use pattern.	Limited permanent impact restricted to the prescribed FAR of 10% ;	Controlled and planned development has minimum footprint for buildings and lush green cover with landscaping - The highly eroded coastal rocky plateau will be secured and enhanced with stable vegetative cover.	Planning Authority
		Increased solid waste generation which may impinge on the pristine quality of village environment and health of local residents in the surrounding area.	Limited impact. Permanent in nature but controllable.	-Waste management practices like sorting of waste at source, recycling and reuse. - Mechanical composting, of wet waste will be adopted. -Baler provided - Separate Garbage Management Centre provided	Project Proponent
2.	Air Environment	-Exhaust from kitchens and DG sets (emergency power back-up)	Minor & easily mitigable. Temporary impact.	-Kitchen will be provided with proper ventilation. -Exhaust vents will be provided with grease traps and Activated carbon filters . -DG sets will conform to the emission /noise norms specified under the EP Act	Project Proponent
3.	Water Environment	-Reduced runoff due to increased paved areas.	Positive permanent impact.	-Blockage of natural drains to be avoided. - Regular cleaning and maintenance to be carried out.	Project Proponent

Sr. No.	Affected Environmental Parameters	Likely adverse impacts in the absence of mitigation measures	Nature of Impact	Proposed Mitigation Measures	
				Action to be taken	Responsibility
		-increased demand & pressure on water resources. -Sewage generation.	-permanent negative impact which will be substantially mitigated. -permanent negative impact which will be substantially mitigated.	-Explore use of porous substrates for paved areas to divert runoff for harvesting -Roof top rain water harvesting for RWH - Grass grid paver blocks to reduce radiative heat. -Efforts will be made to reduce water use for irrigation by way of: Drip irrigation/ sprinklers, watering during early morning/ evening hours, water efficient landscaping /use of low water consuming native species and use of Palspalum grass for golf lawns. -Conservation measures inside buildings: use of sanitary fixtures consuming low water such as sensor operated taps, dual flush system for urinal and WC, use of treated sewage water for flushing, gardening, cooling towers, -Oil and grease traps and a bar screen will be provided to remove the solids, oil and grease before the waste water enters the STP. Water quality in the dug well to be monitored periodically to check its quality. Other feasible options for augmentation of water requirements such as RO treatment to be explored.	
	Biodiversity	Loss of native germplasm	Moderate mitigable	Maintenance of green cover in most scientific	

Sr. No.	Affected Environmental Parameters	Likely adverse impacts in the absence of mitigation measures	Nature of Impact	Proposed Mitigation Measures	
				Action to be taken	Responsibility
4.			negative impact	way to ensure lowest water use	
5.	Public Health and Safety	Occupational health hazards & safety.	Minor & easily controllable.	Road side plantation and its maintenance to prevent air/ noise pollution within the site. Proper parking facility. Provision of adequate road safety signage-posts/ road-crossings, etc. Fire-fighting provisions within the plot and buildings. Provisions for fire fighting: Assembly areas, fire extinguishers, diesel driven pumps with captive fire water storage, hydrants, hose boxes, hose reels, warning alarm system, automatic sprinkler systems, intelligent addressable fire alarm system, fire detection system as per NBC.	Project Proponent

10.3 Budgetary Provisions for EMP

Environment management cell will inspect the necessity & availability of the materials, technologies, services & maintenance works regularly. The cell will make appropriate budget for the purpose. Regular record review for change in financial requirement of environment management will be done and appropriate budgetary provisions will be made. Budget for environmental management will be prepared and revised regularly. The budget will include provisions for:

- Environmental Monitoring Program
- Operation & Maintenance of environmental Technologies/Equipment
- Laboratory works for Environmental management activities
- Emergency Purchase of necessary material, equipment, tools, services

- Greenbelt development
- Social & Environmental Welfare & Awareness programs/training
- Annual Environmental Audit.

LHL has made budgetary provision for the proposed project as a part of their initial planning. The same is presented below.

Table 10.4 Cost of Environment Protection Measures

Environment Protection Measures	Recurring Cost per annum (INR. lakh)	Capital Cost (INR. lakh)
Pollution Control (ETP/STP)	25	150
Environmental monitoring	10	25
Solid Waste Management	7.5	75
Hazardous Waste Management	10	10
Occupational Health	10	10
Green Belt	22.5	450
Socioeconomic/Welfare	25	50
Non Conventional Energy	15	100
Total	**125**	**870**

10.3.1 EMP Implementation Schedule

- Structural measures identified will be provided in construction phase prior to commissioning of plant operation.
- Proper installation of pumps, motors will be done well before commissioning to prevent wastage & efficient use of water
- The non-structural actions will be initiated with inception of commissioning stage and will be implemented & practiced as routine throughout the project life.
- Maintenance of all pollution control equipment and devices will be done throughout the extent of operation phase.

10.3.2 Updating of Environment Management Plan (EMP)

Implementation of EMP effectively is important but updating of EMP as and when required is the key of effecting environment management plan. Hence, it is suggested that LDL. should improve the EMP periodically which will enable effective management of environmental aspects. ISO – 14001 – 2004 system can be used as reference for continual improvement in EMP & environmental performance.

11 SUMMARY AND CONCLUSIONS

11.1 Project Summary, Major Impacts and Conclusion

The proponent intends to develop a luxury Resort and a world class PGA standard 18 hole golf course in Tiracol village, Pernem Taluka, North . The site was found to be ideal by reputed international golf course designers for the development of PGA standard golf course and is bound to attract, not only, well known "golfers/golf tournaments" but also high end tourists which will boost tourism industry in Goa. In the prevailing situation when the mining industry is facing turmoil, the state of Goa is engaging the tourism sector on a war footing and open new avenues for employment.

Compared to many other development options which have been tried and tested in Goa (viz. manufacturing industry, pharmaceuticals, mega-housing projects, metallurgical furnaces/foundries and the like), tourism related developments such as coastal resorts, "horticultural/plantation" retreats, marinas, and medical tourism (speciality clinics/hospitals) appear to be most compatible with Goa's landscape, socio-cultural ethos and environment friendly nature. Evidently, a golf course based resort which thrives on greenery and breathtaking landscape as its main ingredients, is fully compatible with the proposed majestic ocean-view project site, in the remote undeveloped and (mostly) barren corner of Tiracol region in Pernem taluka of Goa.

Unlike mega-housing projects and industries, a Golf Resort is socio-ecologically and environmentally most desirable because of its major attributes, listed below:

- Causes no demographic influx.
- Enhances the green cover of the locality.
- Creates jobs that match the "skills/talent", available locally.
- Leads to spin-off businesses, which also are green in nature.
- Fills a big tourism related void in Goa, which is the absence of a full size golf course, a basic need to attract high end tourists.
- Involves no loss of native tree cover, except for the relocation of some trees by removal and transplantation.
- Promotes harvesting of rainwater to the maximum extent possible.
- Reclaims a vast stretch of highly eroding coastal premonitory and rocky plateau and converts it into a stable and lush green ocean view landscape.
- Encourages ventures of ornamental gardening, flowering plants, lawn making and plant nurseries.
- Promotes organic manures.
- Encourages highly efficient and water saving irrigation technology.
- Promotes renewable energy sources.
- Provides community service facilities, better "infrastructure/services" and

- employment to the tiny rural settlement of Tiracol.
- Makes Goa an international golfing destination, within the global tourism circuit.

Potential negative environmental impacts of the proposed project which can be effectively mitigated as explained in this Report, are listed below:

Short-term adverse impacts such as dust pollution and soil erosion during earth works for shaping of land surface and landscaping works to establish the golf course and resort building

- Temporary "air/noise" pollution during construction of resort buildings.
- Increased solid waste generation in the area.
- More vehicular traffic.
- Significant water requirement for the establishment and maintenance of golf course and landscaped gardens.
- Possibility of surface/ground water pollution due to the nutrients and herbicides used to maintain the golf course and landscaped gardens.
- Generation of sewage and kitchen waste from resort "rooms/villas" and kitchens, respectively.

Significant but temporary negative impacts are most likely to occur during the construction phase. However, the said negative impacts (listed above) are mitigable "and/or" reversible, through engineering and scientific solutions incorporated in the present EMP, and in the monitoring plan. The extra soil material required for the project will be procured, after the approval of the concerned "authority", and on ascertaining that no adverse environmental impact occurs at the site of procurement of the material. The development work on the project site will be undertaken only after securing prior clearances from the Coastal Zone Management Authority, State Pollution Control Board, Town & Country Planning Department .and the local Village Panchayat.

11.2 Common Environmental Concerns, Facts and Mitigation Measures:

Concern 1- Loss of eco-sensitive area.

a) The project site is devoid of ecosystems such as Forest, Wetland Mangroves, Bird Sanctuaries and Animal Migration Corridor.

b) The State Government has specifically earmarked the location for eco-tourism coupled with a golf-course and as such only a very low FSI of 10% is allocated to the proposed development which further ensures development through maximum eco-conservation.

Concern 2- Loss of tree cover/ Bio-diversity.

a) About 1001 existing trees coming in the path of the development will be maintained in situ/transplanted and the greenery of the site will be enhanced by compensatory tree

planting, landscaping and golf turf development which will extend to convert the existing rocky plateau land and other barren areas into stunning green space.

b) Only 965 trees, which are common trees like cashew, acacia, etc will have to be removed.

Concern 3 - Displacement/Rehabilitation of local residents, if any.

a) no such eventuality will arise as the tiny Tiracol village is totally unaffected by the proposed development. On the contrary, the eligible local youth will be trained and employed on priority in the project, and better health, education and community facilities will be made available to the villagers.

b) The project site which was vacant and unused, has been acquired and owned by the project proponent.

Concern 4- potential of soil erosion during earthworks (cut & fill) and landscaping for golf Course and Resort Construction.

a) Major earthwork will be conducted during the dry season.

b) The peripheral contour of each elevated sub-grade will be secured by a combination of strong bunds/trenches, silt fences and gabions.

c) The entry and exit of all earthwork dumpers and machinery shall be effected only through a few designated openings, monitored round the clock.

d) In case of unexpected heavy rains, the earth material will be promptly covered with synthetic covers and kept handy on site.

e) Geotextile covers available commercially will be widely used to prevent erosion and allow proper establishment of turf grass (Paspalum) for Tees, fairways and Greens. Further, as per need and availability materials such as Netted Erosion Control Blankets, Turf Reinforcement Mats and other Rolled Erosion Control products will be used for securing turf, lawns and other plants after hydro-seeding.

f) The technique of installing sod on prepared bare soil surface will also be used to establish turf, quickly without erosion.

Concern 5- Large quantity of water required for establishment and maintenance of golf course.

a) A versatile grass species called Paspalum will be used to establish the golf turf. This grass is drought tolerant, salinity resistant and shows luxuriant growth at low levels of nutrients/pesticide applications. It is expected to reduce the irrigation water requirement by 40-50%.

b) During heavy monsoon rains (June to October) in Goa (3000 mm), the irrigation is further reduced substantially.

c) The elaborate and well designed system of water harvesting, proposed by the proponent consists of rain water collection from all roofs for ground water recharge and diversion of runoff water during rains into the lakes for storage and use. This will maintain the ground water level and provide for supplementary irrigation.

d) The proponent is also exploring the possibility of sustainable borewell water extraction on approval of the Ground Water Authority.

e) Irrigation water requirement will be rationed by its need-based use, determined by weather station data, tensiometers, neutron probes and computerized techniques such as specialized sprinkler heads and drip irrigation will be used to increase water application efficiency which n turn will reduce water requirement and run-off.

f) Treated effluent water from STP/ETP will be recycled for appropriate users such as irrigation and cooling towers.

Concern 6- Water pollution and possible toxicity due to application of fertilizers and pesticides.

a) The well established principles of Integrated Pest Management will be adopted

b) b) Only easily bio-degradable pesticides having low "persistence/residual effect" will be used.

c) Use of bio-pesticides, bio-fertilizers and manures and their quantities rationalized by need-based application determine on the basis of soil analysis.

d) The volume and flow of runoff carrying 'nutrients/bio-pesticides'. Will be controlled by efficient irrigation and 'containment/diversion/infiltration', respectively.

e) A series of structures such as, dikes, check dams, infiltration basins, trenches, grassed waterways, grass swales, roughs and lakes will be used for the said purpose of runoff control.

f) Storage and handling of 'fertillzers/bio-pesticides' formulations for their applications on the field, will be located under the roof a dedicated shed designed for the purpose. The rinsed water from this activity will be treated for safe disposal.

Concern 7- Impact on "Historical/Archeological" Site

a) The Historical Fort of Tiracol, located in the vicinity, is outside the limits of the Project site and the proposed project activity is way beyond the mandatory buffer zone, prescribed around the Fort.

11.3 Conclusion

The EIA report has thoroughly assessed all potential environmental impacts likely to be generated by the project, which are expected to be of temporary and reversible in nature.

The proposed mitigation measures for the sub-projects are sufficient. All negative impacts, envisaged during the "post-construction/operation" phase of the project, present no major environmental and ecological concerns, and hence the project is socio-economically and environmentally sustainable.

12 DISCLOSURE OF CONSULTANTS ENGAGED

ENVIRONMENTAL CONSULTANT

Name	ADITYA ENVIRONMENTAL SERVICES PVT. LTD.			
Reg. Office	107, Hiren Light Indl. Estate, Mogul Lane, Mahim, Mumbai – 400016			
Phone No.	022 42127500	**Email id**	:	adityaenviro@vsnl.com
Website	www.aespl.co.in			
Central Lab	Aditya Environmental Services pvt ltd P-1, MIDC Mohopada, P.O. Rasayani, Dist. Raigad Pin 410207			
Phone No.	02192 252008	**Email id**	:	aespvtltd@yahoo.com
Branches	Goa, Pune, Ahmedabad, Delhi & Vadodara			
Accreditation Obtained	1. 'A' Category EIA Consultancy Organization by QCI-NABET in 12 sectors. 2. Recognized by MOEF as "Environmental Laboratory" vide S.O.No. 1190 (E) dt. 01.05.2014 valid up to 30.04.2019 3. ISO 9001:2008 Certified 4. OHSAS 18001:2007 Certified			
Approved Sectors and Functional Areas	**Sector 1**	Mining of minerals including Open Cast / Underground mining		
	Sector 4	Thermal Power Plants		
	Sector 17	Pesticides industry and Pesticide specific intermediate		
	Sector 20	Petrochemical based processing		
	Sector 21	Synthetic Organic Chemicals Manufacturing Industry (SOCMI)		
	Sector 31	Industrial estates/parks/complexes/Export processing zone/Special Economic Zone (SEZ)/ Biotech parks/Leather complexes		
	Sector 32	Common Hazardous Waste Treatment Storage and Disposal Facilities (TSDF)		
	Sector 33	Ports, Harbors, Jetties, Marine Terminals, Break waters and Dredging		
	Sector 34	Highways, Railways, Transport terminals, Mass Rapid Transport Systems		
	Sector 36	Common Effluent Treatment Plants (CETPs)		
	Sector 38	Building and Construction Projects		

	Sector 39	Townships and Area Development Projects
Services Offered by AESPL	▸ Environmental planning studies ▸ Policy planning studies for MoEF, CPCB, MPCB and other agencies like World Bank. ▸ Environmental Impact Assessment (EIA) & Environment Management Plan (EMP) ▸ Risk Analysis Studies & On Site/Off Site Emergency Management Plan. ▸ Environment Health & Safety audits & Due Diligence audits ▸ Effluent Treatment Treatability Studies & Project Management Consultancy ▸ Analytical Services covering entire spectrum of environmental analysis ▸ Environmental Training and awareness ▸ Project management consultancy for installation of effluent treatment plant ▸ Environmental monitoring and legislation compliance services ▸ Operation of effluent treatment plants	

PROJECT DESIGN TEAM

Master Planner & Lead Architect	WAT&G	Singapore
Golf Course Design	Montgomerie/ IMG World	London/ Singapore
Landscape Design	AECOM	London/ Singapore
Landscape Design – Special Features	Colin Okashimo Designs	Singapore
Interior Design – Resort & Pgm Villas	HBA	Singapore
Mep Systems Design	HIDI RAE	Toronto
Mep Implementing Designer	AEON Consultants	New Delhi
Lighting Designer	PLD	Singapore
International Civil & Structure Design	WEB STRUCTURES	Singapore
Implementing Civil & Structure Design	CRN	Chennai
Kitchen & Laundry	CKP	Kuala Lumpur
Coastal Protection Design	HOV Environment	USA/ India
Environmental Sustainable Design	EDS	New Delhi

ANNEXURES