ENVIRONMENT MANAGEMENT PLAN FOR MATHERAN PLATEAU

Prepared by **Grass Roots Research and Consultancy, Mumbai**

Project funded by the **MMR- Environment Improvement Society**

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1. INTRODUCTION

1.1 GENERAL INTRODUCTION TO ESZ AND PLATEAU

1.2 REGIONAL CONTEXT AND SETTING

1.3 ECOLOGICAL SIGNIFICANCE

1. INTRODUCTION

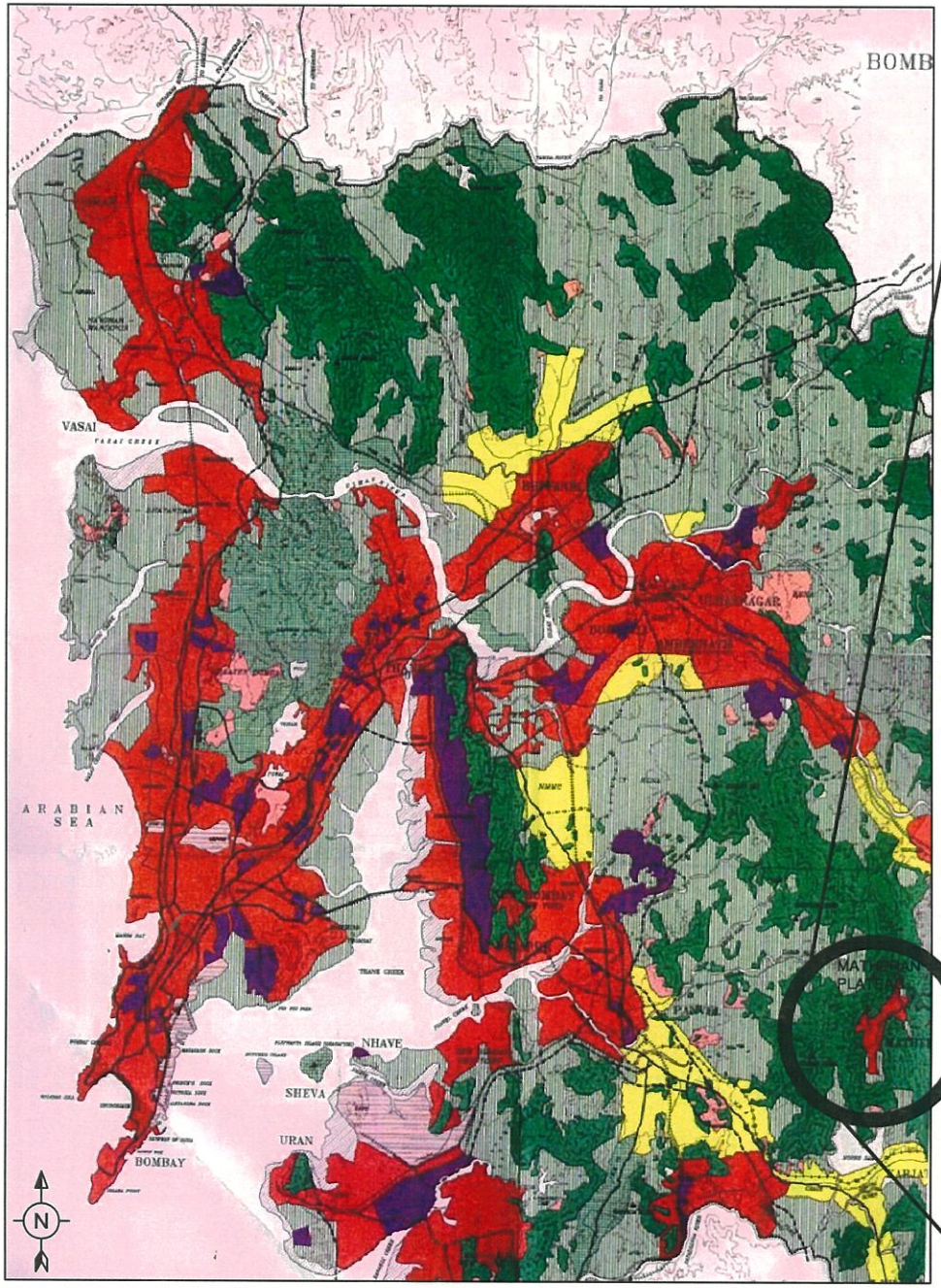
1.1 GENERAL INTRODUCTION TO ESZ AND PLATEAU

The Matheran plateau and its surrounding area in the MMRDA region, has been declared as an Eco-Sensitive Zone (ESZ), by the Government of India, vide notification No S. O. 133 (E) dated 4th February 2003. This ESZ covers an area of 214.73 sq km. with a 200 m buffer zone; thus comprising a total area of 251.56 sq km. This area falls under the jurisdiction of the Matheran Municipal Council, with its surrounding areas under the Raigad and Thane Districts.

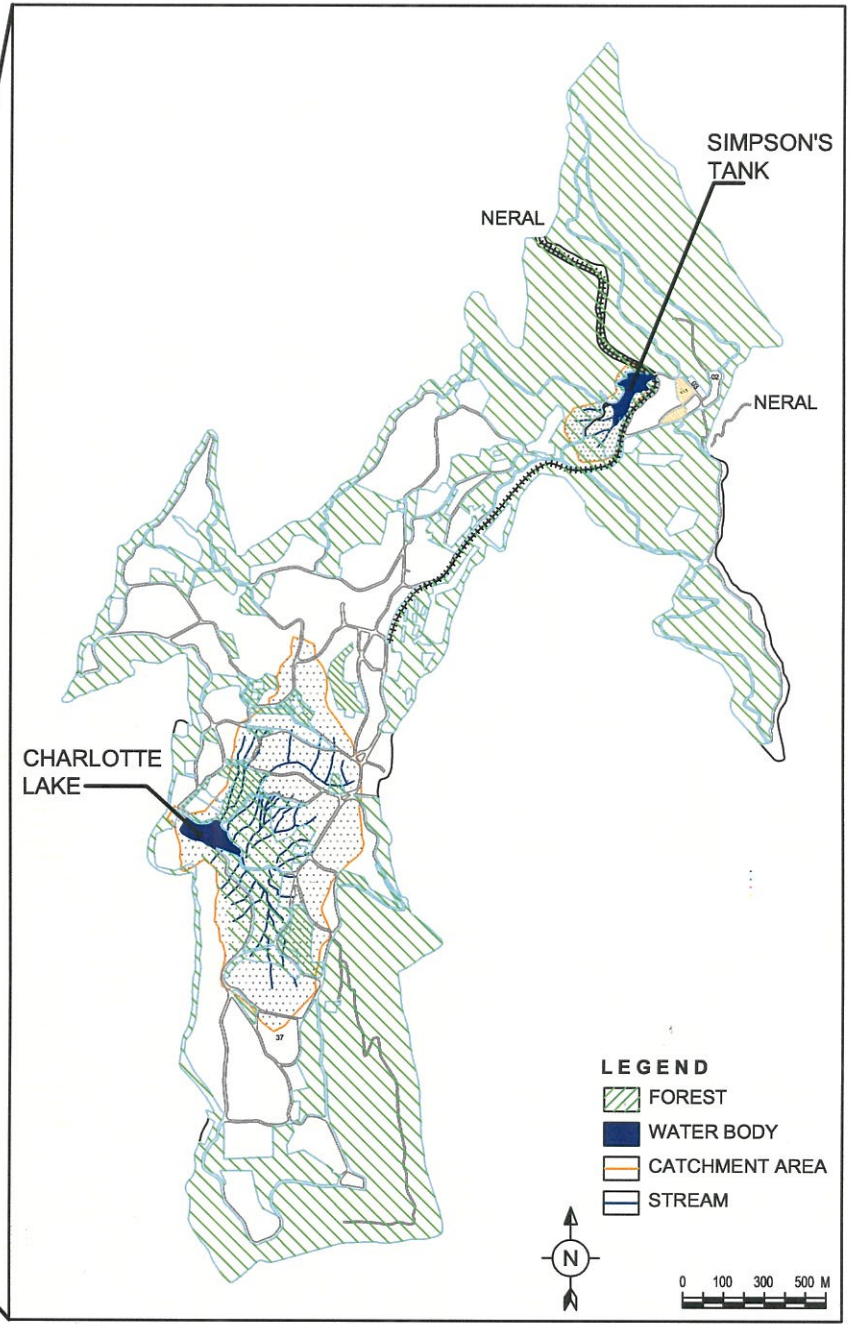
Most of the area under this ESZ has been classified as Forest Zone by the MMRDA and some areas lie under the Green Zones G1 and G2. The Matheran Plateau has been zoned as urbanisable zone (U1).

The concept of this Matheran plateau as hill station emerged during the British rule. It is a unique hill station admeasuring 7.5 sq km, located about 64 kilometers from Mumbai city, at an altitude of about 700 meters above sea level. Being extremely close to the two main cities in Maharashtra i.e. Mumbai and Pune, it is one of the two, most popular and heavily frequented, tourist destinations in the state, the other being Mahabaleshwar - Panchgani. It attracts tourist for its wonderful climate all around the year and the unique toy train ride to reach the plateau. And nevertheless, it is the only hill station in Asia where vehicles are not allowed.

Thus Matheran is a showcase of rich natural, cultural and built heritage, the planning for which, calls for a holistic approach where one has to look at the plateau along with the surrounding region, in order to evolve a sustainable plan.



REGIONAL MAP



MATHERAN LOCATION MAP WITH THE LAKES

MATHERAN ESZ & PLATEAU

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1.2 REGIONAL CONTEXT AND SETTING

The Matheran hill forms a major part of the Matheran Malang - Gad hill chain that stretches up to Malang gad in Thane and Raigad districts. It also consists of the Prabalgarh and Irshalgarh. This 30 km stretch is an outlier of the Sahyadri range that is a long chain of hills stretching from Mumbai to Goa in the south.

The Western Ghat region has a subtropical hill forest and is declared 'ecologically fragile' by the Ministry of Environment and Forest (MoEF). The plateau and the ESZ are adjacent to the Western Ghats region though isolated from it.
The highest point of ESZ is 788m (about 2580') and is located at latitude of 18 degrees 58' east and longitude of 73 degrees 18' north.

The significance of this plateau is that it is the only one in the vicinity with a Lateritic cap, available at such low altitude. The ESZ consists of a large reserve forest covering an area of about 300 sq km. This forest is one of the largest unfragmented forests in the Mumbai Metropolitan Region (MMR), forming the immediate natural region for Matheran.

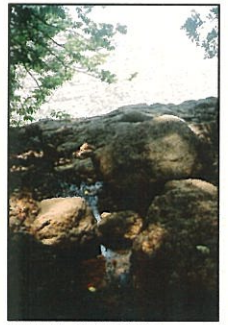
The administrative region for Matheran is Raigad district and Karjat Tehesil. The Villages surrounding the plateau are Neral, Bekare, Asal, Maldunge, Dhodani, Sondewadi, Borgaonkhurd and Warose Parf Wankhal. A large number of people from Gaothans and padas surrounding the plateau visit the plateau on a daily basis, as they are economically dependent on it.

WATERSHEDS

MORBE DAM

CHARLOTTE LAKE

MALET SPRING TANK



NALA SPRING

BLACK WATER SPRING

HARRISONS SPRING & TANK

MONKEY SPRING

REGIONAL LEVEL WATERSHED

PLATEAU LEVEL WATERSHED

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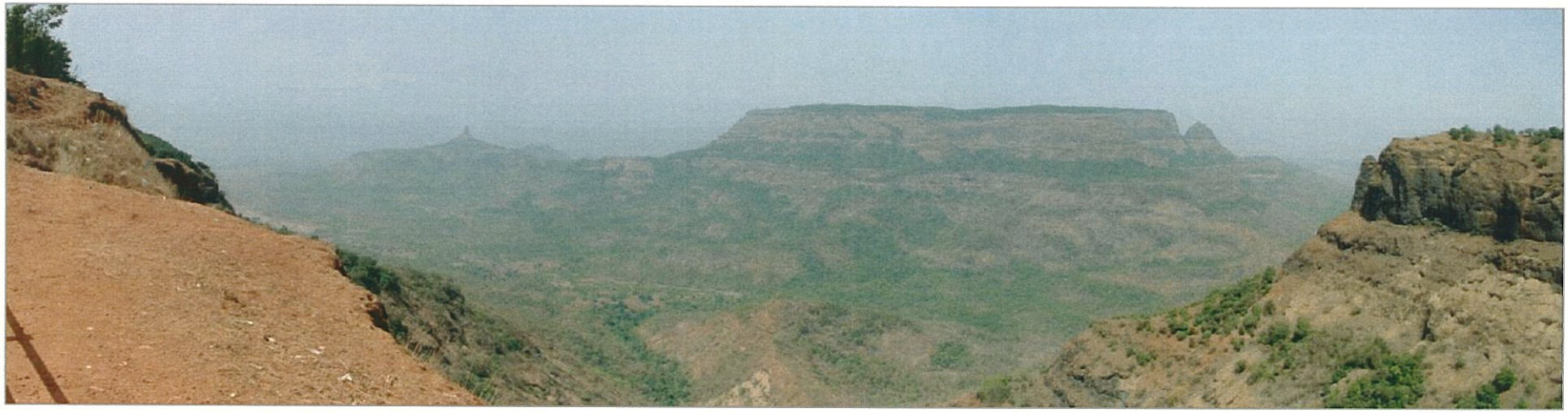
MATHERAN REGION - THE ECOSENSITIVE ZONE



HILLY AREAS AROUND MATHERAN PLATEAU

MORBE DAM

VALLEY AT THE BASE OF MATHERAN PLATEAU

LANDFORM CHARACTERISTICS OF MATHERAN PLATEAU

1.3 ECOLOGICAL SIGNIFICANCE

Matheran is nestled amidst dense forest, which covers an area of about 300sq km. It is a home for many endangered species of flora and fauna. The plateau receives high rainfall and thus has origins of many streams. Hill vegetation plays a critical role in the hydrological cycle.

Hydrology

The western slopes of the hill comprise a catchment of numerous rivers, which discharge water into Panvel creek and ultimately into the Arabian Sea. The eastern slopes form the catchment of the river Ulhas and the southern slopes the catchment of the river Dhavri that eventually meets the river Patalganga.

The Morbe Dam has been constructed on this river, with a catchment area of about 58 sq km and is projected to supply water to the needs of the fast growing development in Navi Mumbai for the next 30 years. Hence sustainable use of the watershed of the region and catchment is extremely important. Any alteration in the catchments of the dam will affect the quality and quantity of the water received. At the same time due to the inevitable development in the surrounding regions, this area is bound to be under environmental stress in the immediate future. Thus to avoid the depletion of the resources, environmental planning for the region is required.

As the plateau and hill chains within the eco-sensitive region, form the catchment areas of numerous rivers, reservoirs and tanks, it is of critical importance that they remain adequately covered with forest. This will also prevent erosion, siltation in water bodies, decrease runoff and will in turn allow for percolation and act as a water bank. Thus it is important to protect this unique and fragile ecology.

The plateau water shed is equally interesting because of the unique landform. The plateau shows a great terrain variation in a short span of 12.5 km giving it a unique undulating character, as well as, rendering every edge in a character of its own, making it interesting for tourists. Also these numbers of watersheds on the plateau serve the water bodies, streams and springs. Stream networks over the plateau also contribute to the formation of small basins, viz. Simpson Tank and Charlotte Lake basin.

Forest and vegetation

The forest ecosystem plays a major role in microclimate conditions. Local climate change may cause regional environmental problems and affect natural ecological cycles.

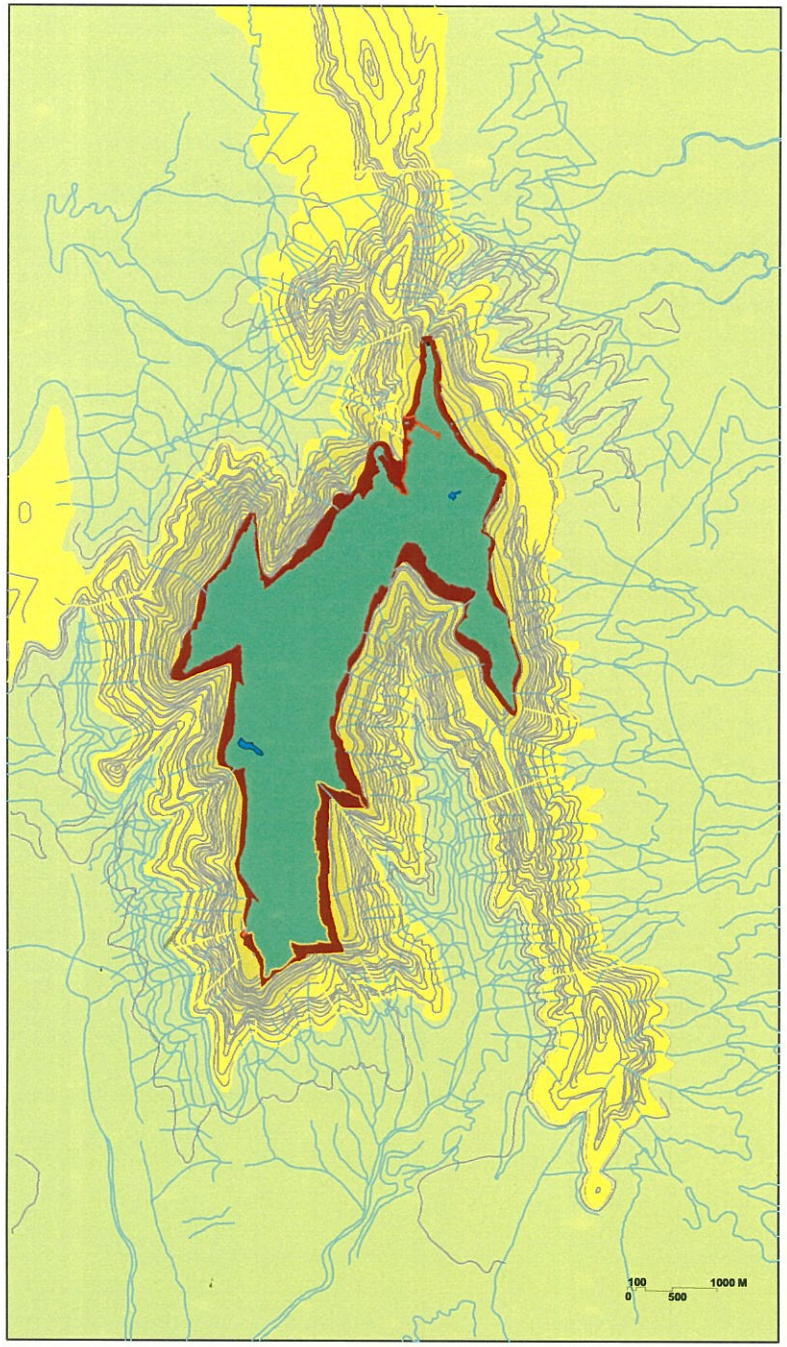
Preserving the forest cover on the plateau and the hill ranges is essential in order to prevent landslides and to mitigate and avoid the damaging impact of floods and heavy rainfall.

The forest is an important resource, for the forest produce. In addition it provides important services such as maintaining the soil fertility and soil structure, limitation of soil erosion, downstream movement of soil nutrients, cycling and storage of carbon and soil nutrients and opportunities for tourism and recreation. The crest forest on the plateau is an unsubsidized ecosystem, having no input of nutrients from outside. Thus it is important to limit the outflow of nutrients in the form of soil, sediments, leaf litter etc.

The plateau forest is representative of Western-Ghat subtropical hill forest. This type of forest is confined to Matheran plateau and terraces in the Karjat range. The forest ecosystem over the major part of Matheran plateau is quite unique. It is quite different from that in the Mahabaleshwar area. Such lofty semi-evergreen forest hardly exists anywhere else in the Sahyadri region. Another interesting feature is that the floristic composition of the forest communities in different localities varies considerably. It is a climax forest, a highly specialised ecosystem with intrinsically low resilience, which once destroyed will be impossible to restore or regenerate.

The important Matheran flora lies in the forest, on the crest of the hill, on the Western side of the Sahyadris. It has some plants, which are not seen elsewhere. Thus a number of plants are localized and endemic. They possibly illustrate the processes that must have been at work for a long time.

Thus the forest ecosystem at Matheran is unique and remarkable in many respects - its dense and lofty arboreal growth, peculiar blending of evergreen and moist deciduous species and moreover – a high percentage of endemism and almost undisturbed natural climatic climax formations.



VEGETATION MAP: MATHERAN REGION

MATHERAN REGION/ ECOSENSITIVE ZONE

RAINFALL, HUMIDITY AND RETENTION OF MOISTURE IN THE SOIL IS THE FACTOR WHICH DETERMINES THE FOREST TYPE

UNSUBSIDISED ECOSYSTEM

ECOSYSTEM HAVING NO INPUT OF NUTRIENTS FROM OUTSTDE

CREST FOREST ON PLATEAU TOP

THE CREST FOREST IS A UNIQUE CLIMAX ECOSYSTEM RANGING FROM EVERGREEN TO SEMIEVERGREEN FOREST.
PRECIPITATION/RAINFALL: ABOVE 3000MM

SUBSIDISED ECOSYSTEMS

ECOSYSTEM HAVING AN INFLOW OF NUTRIENTS FROM THE PLATEAU AND UPPER SLOPES

PLATEAU EDGE, ESCHARPMENT

STEEP ROCKY SLOPES SHOW EDGE CONDITIONS /SPARCE VEGETATION

GALLERY FOREST

MIXED SEMI EVERGREEN MOIST DECIDUOUS FOREST

LOWER SLOPES

DECIDUOUS VEGETATION

PLAINS

DECIDUOUS VEGETATION

FOR AN UNSUBSIDISED ECOSYSTEM AS THERE ARE NO INPUTS IT IS IMPORTANT TO CHECK THE OUTFLOW OF NUTRIENTS....SOIL,SEDIMENT LEAF LITTER ETC.

N

Biodiversity

Floral and faunal diversity generally go together and form an integral part of the ecosystem, and also evident by the preliminary survey, the area sustains fairly diverse and abundant animal populations.

The evergreen - semi-evergreen forest on the crest is a climax ecosystem having a complex tropic web. It is a habitat for the Indian Giant Squirrel (*Ratufa Indica*) and several other rare, endemic, endangered plants and animals. The presence of residential population of giant squirrels is a noteworthy feature of the plateau of Matheran. The giant squirrels in Matheran are locally endangered as per the study conducted by Dr. Renee Borges around 1999.

The escarpment and Lateritic rocky exposures found on the plateau are also important habitats for a number of rare/endangered plants.

Many species of endemic threatened plants are found in the Eco-sensitive Zone, especially in high biodiversity areas such as the terrace forest, escarpment, crest forest and rocky exposures. Some of the wild animals found in the area are panthers, barking deer, wild cats, and civets. The endemic species Khandala Caecilian (*Indotyphlus battersbyi*), a legless amphibian, is found only in the crest forests at Khandala, Lonavala, and the plateau forest at Matheran. The Matheran hill being isolated, like an island, many of these species could be locally endangered as a result of increasing biotic pressures.

The presence of the State Animal -The Giant Squirrel and its association with tree species like *Garcinia* and *Actinodaphne* warrants the need of the conservation of the ecosystem, while as infestation of the *Xantolis* trees with a parasite- *Loranthus obtusatus* warns against its degradation due to human intervention.

The forest here is fragmented and it is therefore essential to establish and maintain certain corridors. Steep slopes, forested areas, streams and water channels in this area are important corridors for wildlife.

IMPORTANT WILD LIFE HABITATS AND ASSOCIATIONS

- **EVERGREEN FOREST -HABITAT OF THE GIANT SQUIRREL**

  THE EVERGREEN CANOPY/ CREST FOREST IS A CLIMAX ECOSYSTEM HAVING A COMPLEX TROPHIC WEB.IT IS AN HABITAT FOR THE MALABAR GIANT SQUIRREL ENDEMIC TO THE WESTERN GHATS.
  BEING AN ARBOREAL CREATURE IT REQUIRES A CONTINUOUS TALL CANOPY FOR MOVEMENT,FEEDING AND NESTING. LARGE BUTTRESSED TREE SPECIES SUCH AS FICUS NERVOSA(LOTH) WHICH ARE FOOD PLANTS OF THE SQUIRREL ARE FOUND IN THE CREST FOREST BUT THEIR DISTRIBUTION IS NOW RESTRICTED TO A FEW EVERGREEN PATCHES.
  TREES SUCH AS MYRISTICA ATTENUATA, GARCINIA INDICA, OCHROCARPUS LONGIFOLIUS AND RARE WOODY CLIMBERS AND LIANAS SUCH AS GNETUM FOUND HERE ARE INDICATORS OF GOOD EVERGREEN FOREST.

- **WATER RESERVOIRS, PERENNIAL SPRINGS, STREAMS AND BASINS**

  PROVIDE WATER HOLES FOR A VARIETY OF MAMMALS INCLUDING PANTHERS, DEER, JUNGLE CAT, MONKEYS,SQUIRRELS AND WHICH EITHER RESIDE ON THE PLATEAU FOREST OR ARE VISITORS FROM THE GALLERY FOREST OR THE DECIDUOUS FORESTS AROUND MATHERAN

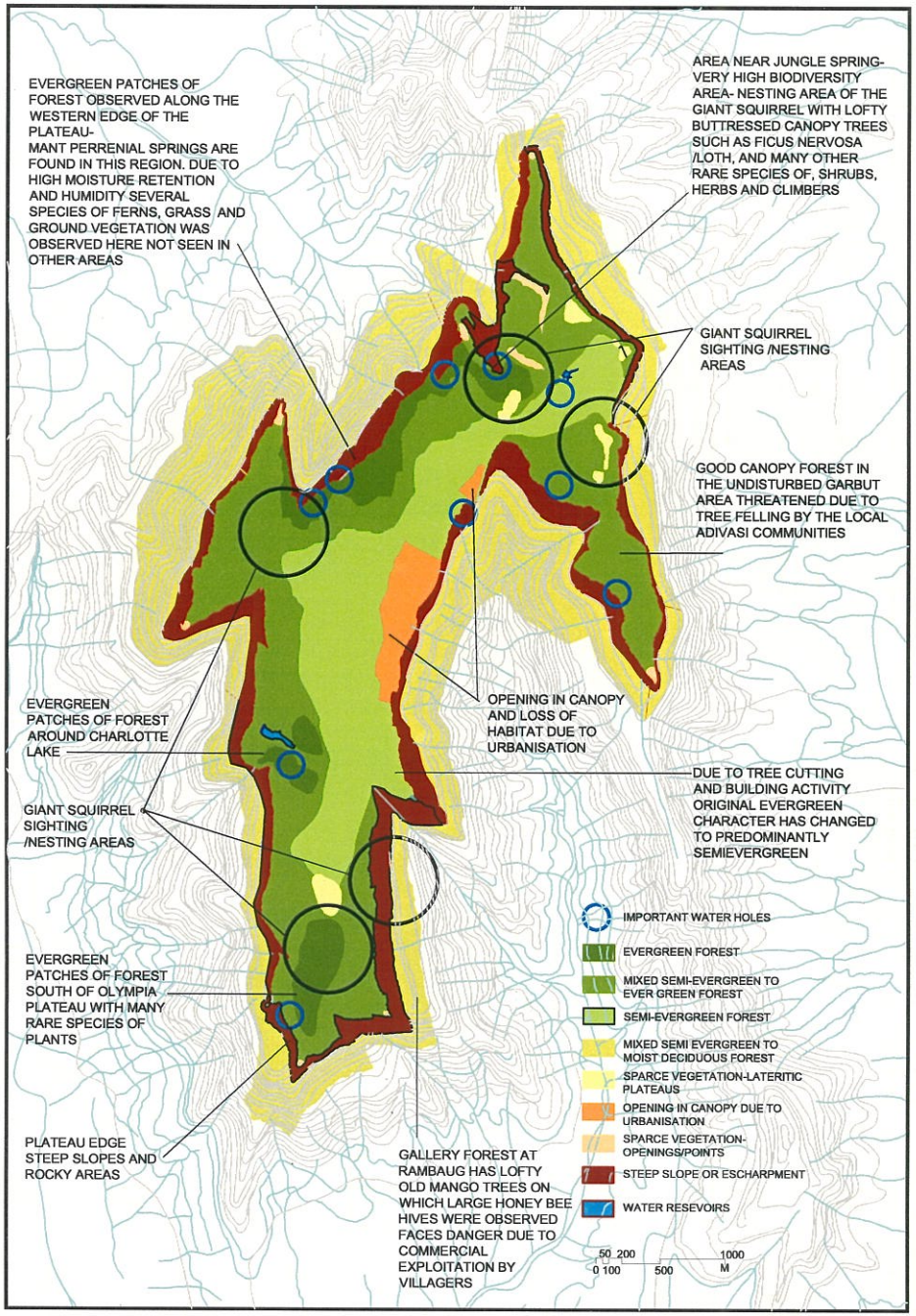
- **GALLERY FOREST**

  THE LOFTY SEMIEVERGREEN FOREST WITH A PREPONDERANCE OF MOIST DECIDUOUS SPECIES SHOWS VERY GOOD BIODIVERSITY. IT IS A HABITAT FOR MAMMALS LIKE THE GIANT SQUIRREL,PANTHERS WILD BOAR ETC

- **PLATEAU EDGE , STEEP SLOPES AND ROCKY AREAS**

  PLATEAU EDGE , STEEP SLOPES AND ROCKY AREAS ARE A HABITAT OF THE MONITOR LIZARD(GHORPAD) AS WELL AS NESTING AREAS FOR CERTAIN PREDATORY BIRDS.

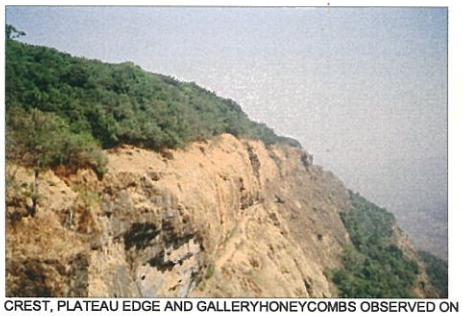
  VEGETATION OBSERVED HERE INCLUDES DECIDUOUS SPECIES LIKE,FICUS ARNOTTIANA(THE STRANGLER FIG), SHRUBS SUCH AS,WOODFORDIA FRUITICOSA (DHAYATI) AND KARVI.



ECOSYSTEM, ASSOCIATIONS AND WILDLIFE HABITATS

MANMADE WATER RESERVOIR, SIMPSONS TANK

SPRINGS AND STREAMS



CREST, PLATEAU EDGE AND GALLERYHONEYCOMBS OBSERVED ON STEEP ESCARPMENT

DECIDUOUS SPECIES -FICUS ARNOTTIANA OBSERVED ON PLATEAU EDGE

WILDLIFE HABITATS

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Geology

The geomorphologic value of the plateau is very high. The region is covered by basaltic flows of the Upper Cretaceous to lower Eocene age. The basalt is known Deccan basalt or Deccan trap. Laterite, found on the plateau of Matheran, is formed as a result of the leaching of the ferruginous rocks.

The mass of hills is composed of basaltic trap, which is impervious, overlaid with a crust of laterite, which is porous. Matheran receives very heavy rainfall and since laterite is much porous water percolates into it and a good amount of water is held into it. This water then oozes out when it comes in contact with basalt resulting in a lot of springs on the edge of the plateau.

The Lateritic plateau tops represent the original surface formation. It is indicative of the original lithology, altitude of the plateau and the rock composition. They are a significant key to the past Geology and need to be declared as areas of geological heritage.

2. ADMINISTRATIVE BOUNDARIES

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The Mumbai Metropolitan Region (M.M.R)

The Mumbai Metropolitan Region (M.M.R), geographically lies between18 deg 33' and 19 deg 31'North Latitude and between 72 deg 45' and 73 deg 28' East Longitude. It administratively comprises of various Districts, Tehesils, Talukas, Municipal Councils and Villages, totaling to a gross area of 4355 Sq. Km.

The Mumbai Metropolitan Region (M.M.R.), comprising of Mumbai city, Mumbai Suburban District, parts of Thane district and parts of Raigad district, is administratively divided into two areas, viz. the Thane district and the Raigad district.

The Thane district comprises of Thane city, Kalyan, Bhiwandi, Ulhasnagar and parts of Vasai Tehesil. These include the Vasai-Virar Municipal Council, Bhiwandi, Ulhasnagar, Panvel, Uran, New Bombay Municipal Corporation, Thane Municipal Corporation, and Kalyan-Dombivili Municipal Council.

The Raigad District comprises of the Uran Tehesil, parts of Panvel, Karjat, Khallapur Tehesils, and Pen and Panvel Tehesils. These include, the Karjat Municipal Council, Khopoli Municipal Council, Pen and Alibaug Municipal Councils.

The Matheran Plateau entirely falls in the Raigad District, whereas the Eco-Sensitive Zone is divided between Thane and Raigad districts.

The Eco-Sensitive Zone

The Eco-Sensitive Zone (ESZ), admeasuring 214.73 Sq.Mts and comprising of 89 villages, is administratively divided into Thane district and Raigad district. Further in The Raigad district, it comes under the jurisdiction of various Tehesils, viz; Panvel, Khallapur and Karjat. The ESZ includes a Buffer Zone of 200 mt width. The industrial zone at Jambhivali and the urbanisable and industrial zone at Ambernath, abut the ESZ.

The Eco-Sensitive Zone comprises of forestlands, agricultural lands and tribal areas. Zonal Master Plans, Sub-Zonal Master Plans, Tourism Master Plans, and Area Master Plans (for habitations having population of more than 5000) are proposed for this Eco-Sensitive Zone.

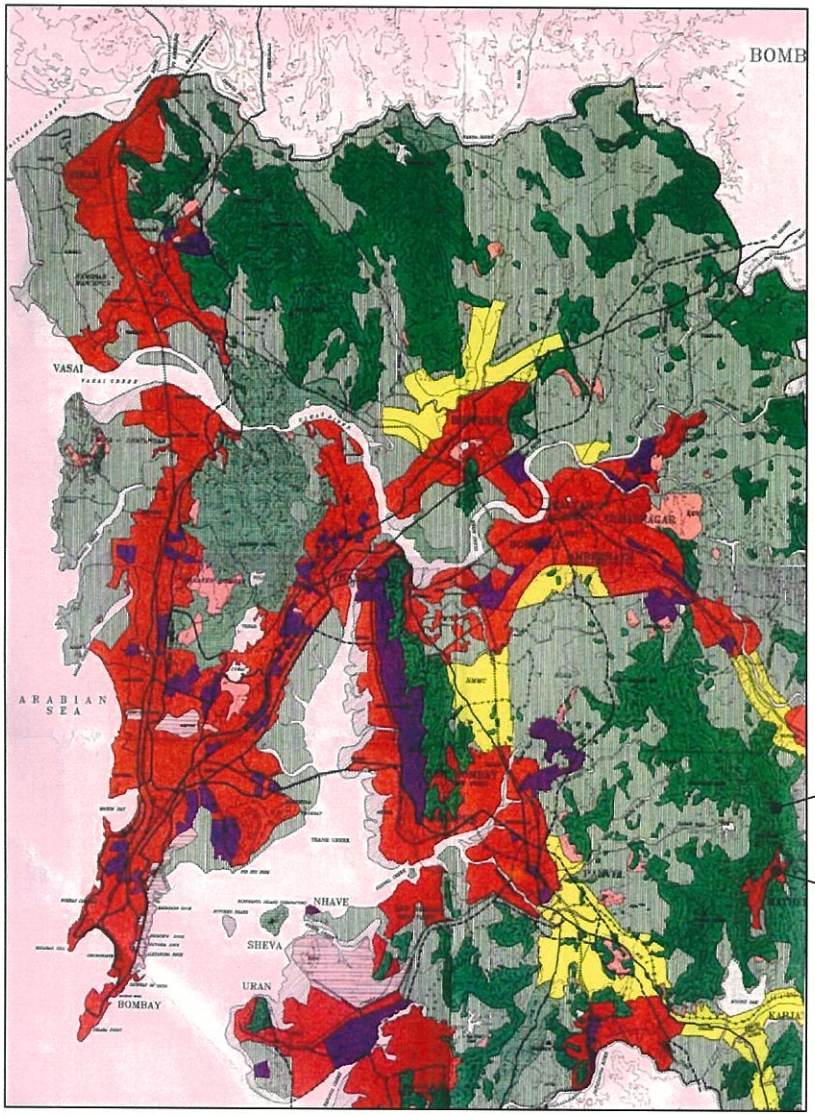
The development of the Eco-Sensitive Zone emphasizes laws governing Sustainable Development and Clean Development Mechanism (CDM) methodology. In accordance with that, non-polluting, non-hazardous small-scale and service industries, agriculture, floriculture, horticulture or agro-based industries, producing products from indigenous goods from the Eco-sensitive Zone and which do not cause any adverse environmental impact are permitted. The development of land not under Reserve Forest, Protected Forest, Acquired Forest or Forests as defined as per the Supreme Courts Order dated 12th December 1996 in the Eco-Sensitive Zone, is as per the regulations stipulated for Green Zone 1& 2, Urbanized Zone 1& 2,Gaothans & Gaothan Expansion. All developmental activities including additions, alterations, demolitions, repairs, renovations and restorations of buildings require prior approval of the Monitoring Committee and are subject to Heritage Clearance if necessary.

Within the Raigad district, the Forest Department divides the Eco-Sensitive Zone into Range, Rounds and Beats, with the head office at Alibaug. The area of Eco-Sensitive Zone under Thane district is administered directly under Thane Forest Officer.

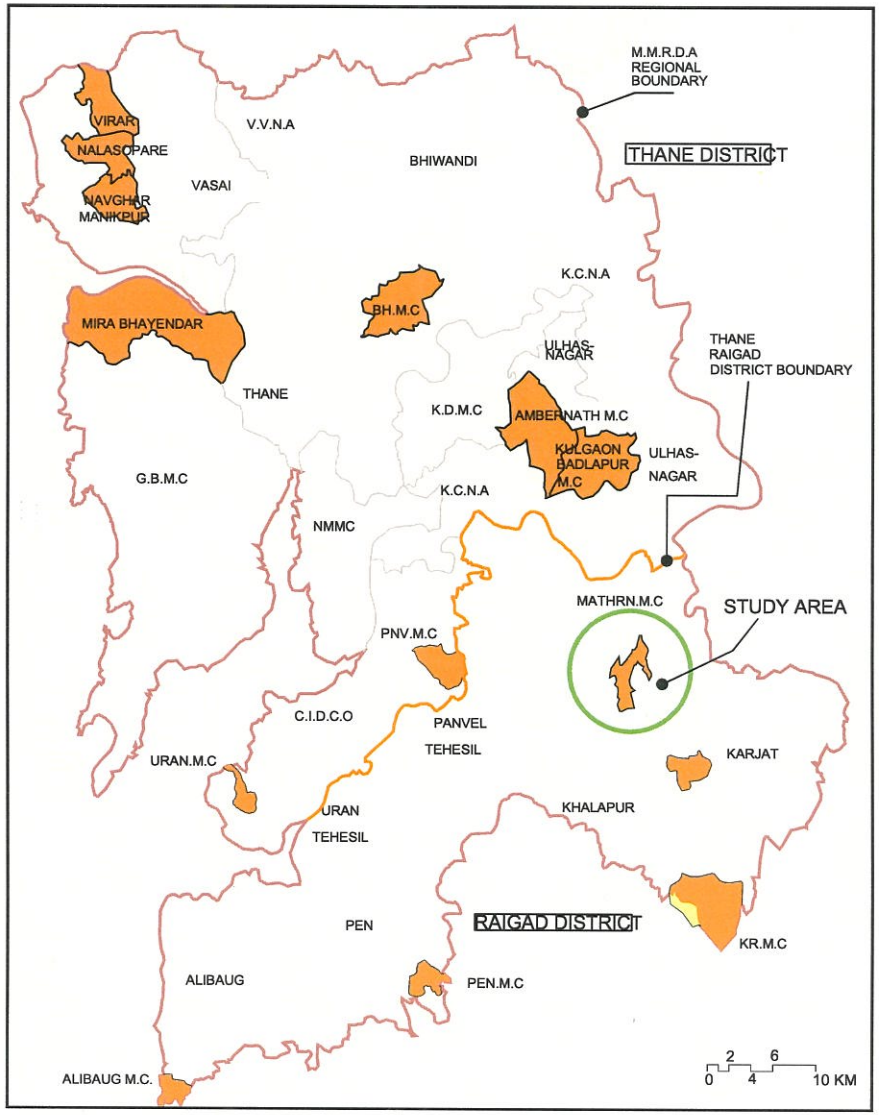
All activities in the forest (both within and outside municipal areas) are governed by the provisions of the Indian Forest Act, 1927 (16 of 1927) and Forest (Conservation) Act, 1980 (69 of 1980). All activities in the protected areas are governed by the provisions of the Wildlife (Protection) Act, 1972 (53 of 1972).

Though the Eco-Sensitive Zone is safeguarded under The Forest Act, The Forest Conservation Act, The Wildlife Protection Act and The Environment Protection Act; the desired goal and end result of conserving the Forest and its habitat remains unachieved, due to certain reasons mentioned below:

- The boundary of the Eco-Sensitive Zone as well as the Buffer Zone is haphazard and fails to follow any Geographical or Administrative guideline, as it passes randomly through farmlands and villages. This gives rise to discrepancies, slows down the implementation of directives, thereby creating opportunities for ambiguous activities and giving incorrect decisions.
- Many hilly areas of the Urbanisable Zones abutting the Eco-Sensitive Zone have not been included in the zone. Hence only a part of the contiguous hill eco-system comes under the protected zone. A Quarry Zone abutting the Eco-Sensitive Zone has also not been included.
- Presence of too many governing bodies for Eco-Sensitive Zone viz. Zilla's, Tehesils, Forest Department, Revenue Department, does not show desired effect in the implementation of law and conservation of Forest and Natural Habitat, as it lengthens the procedure for approvals and puts stress on the officials as well as the general public.
- Regarding the administrative set-up of the Forest Department, for the Eco-Sensitive Zone, the co-ordination between superior and junior staff seems quite distant, as the orders and directives have to be obtained from Alibaug. More over the area under one personnel/ Beat Officer is huge as compared to the objectives to be achieved. Thus there seems to be an obvious and urgent need for up gradation of staff to manage the forest and conserve it.
- Though the notification stipulates the development of area not under forests (Reserved or Protected) in accordance to Green Zone 1 and 2, Urbanisable Zone 1and 2, Gaothans and Gaothan expansion, there is a dire need to specify in detail the implementation, working and maintenance of the measures like Waste Recycling, Rain water Harvesting and Conservation, Soil Conservation, Habitat Conservation, Eco-Tourism in terms of quantity and quality which would strongly emphasize the concept of Eco-Development, on paper as well as in practice.
- Parameters and facilities of Clean Development Mechanism should be emphasized to sustain the Natural Heritage.
- The Eco-Sensitive Zone does not take cognizance of the tribal population that depends on the forest for their livelihood. The Forest Laws put restrictions upon exploiting natural wealth, though beneficial to maintain the ecosystem, deprives the tribals from earning their livelihood. Thus, while implementing the objective of preserving the ecosystem, it is necessary to create alternative sources of livelihood for the tribal population. Creating job opportunities with a view of preserving and conserving the natural environment would definitely be beneficial for the local population.



M.M.R.D.A REGIONAL PLAN
1996 - 2011



M.M.R.D.A ADMINISTRATIVE BOUNDARIES V/S E.S.Z

LEGEND
- ECO-SENSITIVE ZONE LINE
- THANE RAIGAD DISTRICT BOUNDARY
- MUNICIPAL COUNCILS
- MMRDA REGION BOUNDARY

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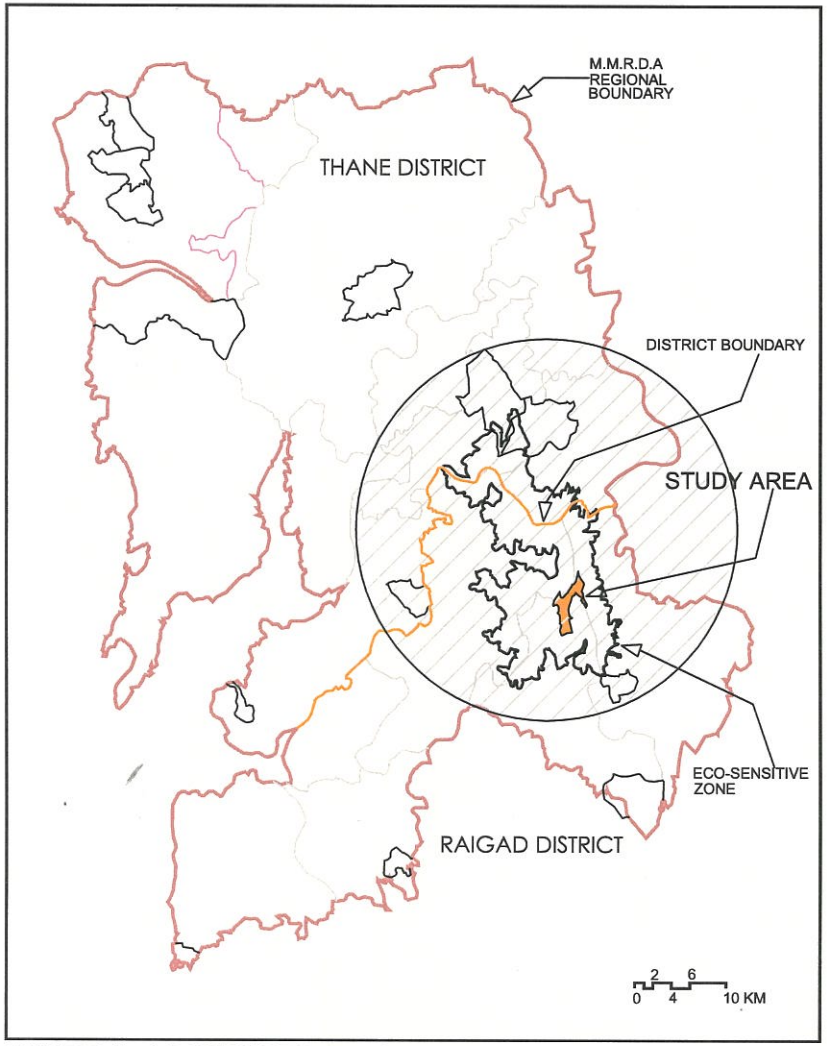
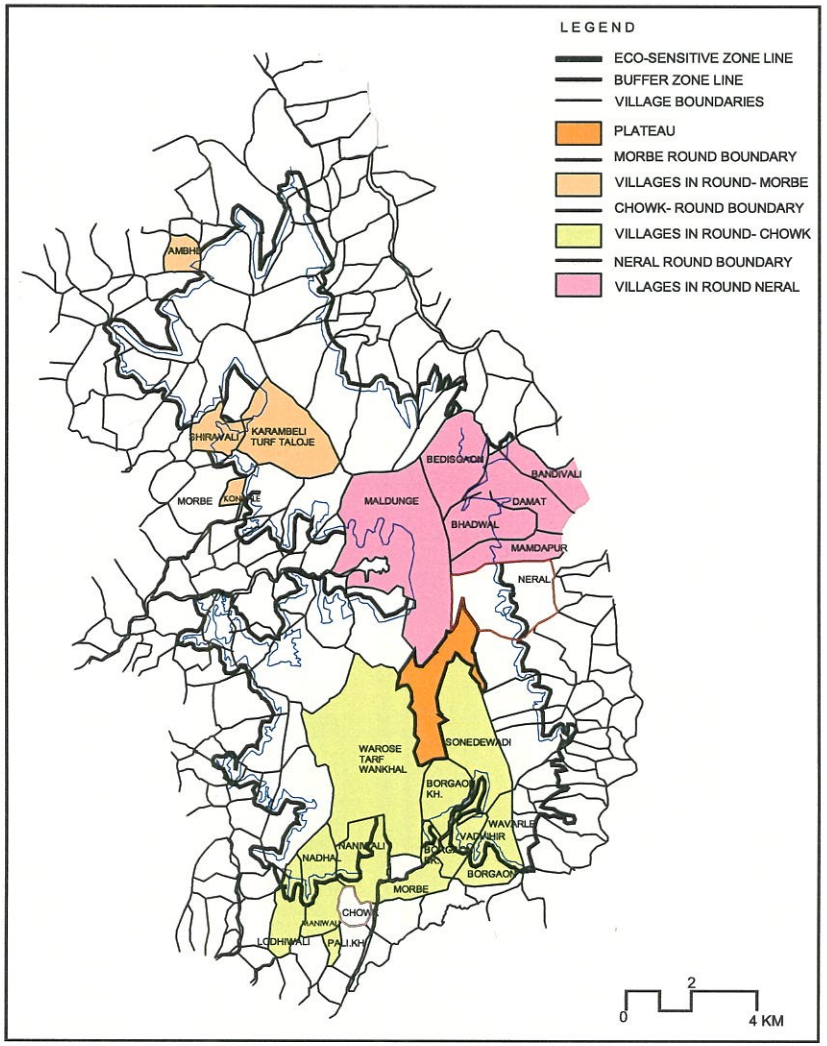
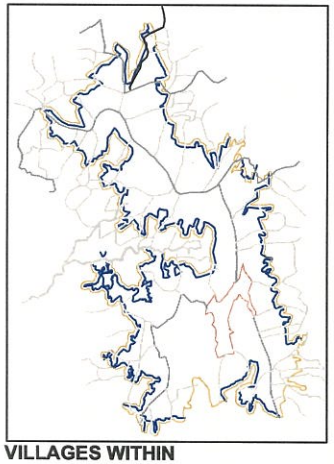


MMRDA ADMINISTRATION BOUNDARIES



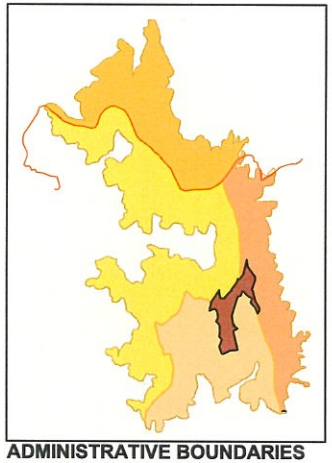
FOREST ADMINISTRATIONBOUNDARIES

MANAGEMENT CONFLICTS



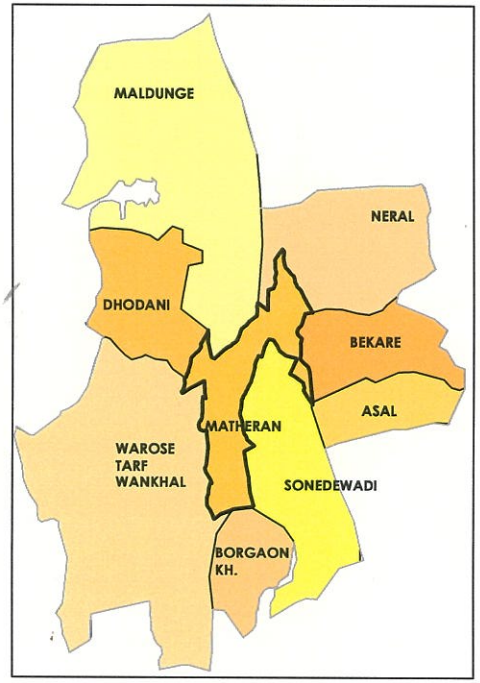
VILLAGES WITHIN ECO-SENSITIVE ZONE

- ECO-SENSITIVE ZONE LINE
- BUFFER ZONE LINE
- MATHERAN COUNCIL BOUNDARY



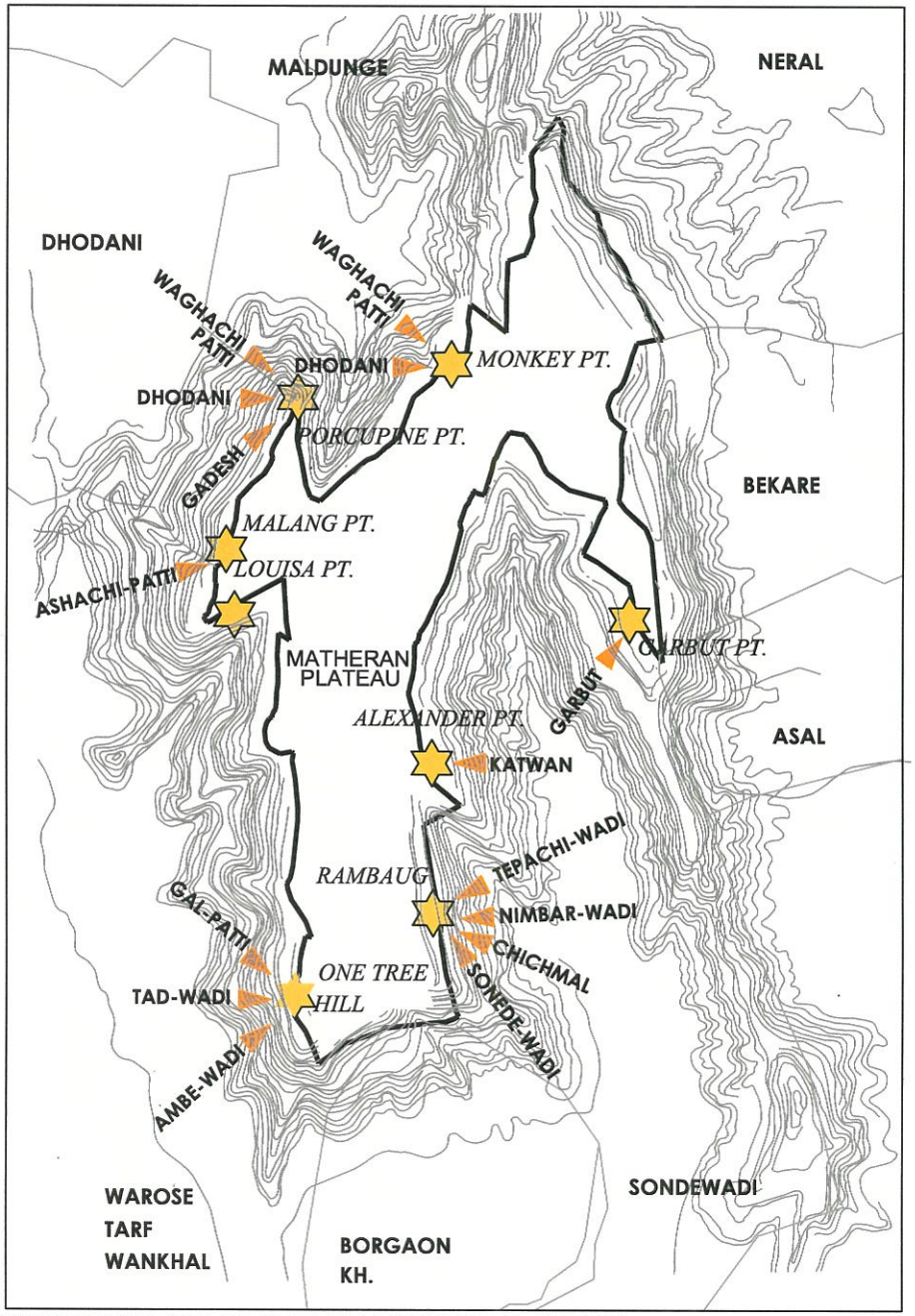
ADMINISTRATIVE BOUNDARIES WITHIN ECO-SENSITIVE ZONE

- THANE RAIGAD DISTRICT BOUNDARY
- ECO-SENSITIVE ZONE LINE
- MATHERAN COUNCIL REGION
- PANVEL TEHESIL
- KHALLAPUR TEHESIL
- KARJAT TEHESIL
- THANE DISTRICT



VILLAGES ADJACENT TO PLATEAU

0 2 4km



GAOTHANS ON SLOPE ADJOINING PLATEAU

0 1 2KM

POPULATION DATA FOR GAOTHANS ON THE SLOPES ADJOINING THE PLATEAU

- Garbut : 160
- Katwan : 180
- Tepachi-wadi : 150
- Nimbar-wadi : 140
- Chichmal : 120
- Sonde-wadi : 200
- Ambe-wadi : 350
- Tad-wadi : 225
- Gal-Patti : 150
- Ashachi-Patti : 175
- Gadesh : 160
- Dodhani : 300
- Wagahachi-Patti :200

PLATEAU CONNECTIVITY

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3. DETAIL STUDY AND ANALYSIS OF NATURAL AND MAN-MADE ELEMENTS FOR THE PLATEAU

3.1. PHYSIOGRAPHIC FEATURES

a. Landform

b. Hydrology and Water Features

c. Vegetation

d. Geology

3.2. MANMADE INFRASTRUCTURE: AGENTS OF CHANGE

a. Land use

b. Infrastructure- Water Supply, Sewage, Solid Waste Management

c. Traffic and Circulation

d. Population

3. DETAIL STUDY AND ANALYSIS OF NATURAL AND MAN-MADE ELEMENTS FOR THE PLATEAU

3.1 PHYSIOGRAPHIC FEATURES

3.1 (A) LANDFORM

The Matheran hill, with an altitude of over 700 meters (2400 feet), is isolated from surrounding hills by its sheer height. The North-south stretch of the plateau is approximately 7 km with an average width of a kilometer. The Panorama point forms the northernmost tip of the plateau, to the southeast of which lies the Garbut point. This 7sq.km area shows large variations in topography. There are few Lateritic plateaus like Mount Berry, Olympia, Rugby and Rajasthan that are remnant of original geological structure. Out of these Rugby plateau is the highest with height of 811 meters from MSL.

Weathering process has generated steep slopes around these plateaus. The Simpson tank watershed, situated in Patal temple basin, has its lowest point at 580 meters from MSL. This shows a difference of more than 200 meters in altitude within a length of 3kms.

Along the border of the plateau are escarpments. These marginal slopes are made of basalt that underlies the laterite. Terraces are formed in some parts after these escarpments.

The undulating topography has slopes ranging from below 5% to above 50%. The adjoining map indicates the gradients/ percentages of slopes on the plateau. The northern side of the plateau has steep sloping areas with slopes greater than 50%, whereas, the central and southern sides have gentler sloping areas, with slopes ranging from 0 to 20%.

The plateau is divided into three broad geomorphic units:

Laterite Tops

These represent the original surface formation. It indicates the original lithology, altitude of the plateau and the rock composition. The summits like Rugby, Olympia, Mount Berry etc. indicate a continuous Lateritic surface in the past. They are found in the interior parts of the plateau and form an arbitrary ridgeline. These are a significant key to the past Geology.

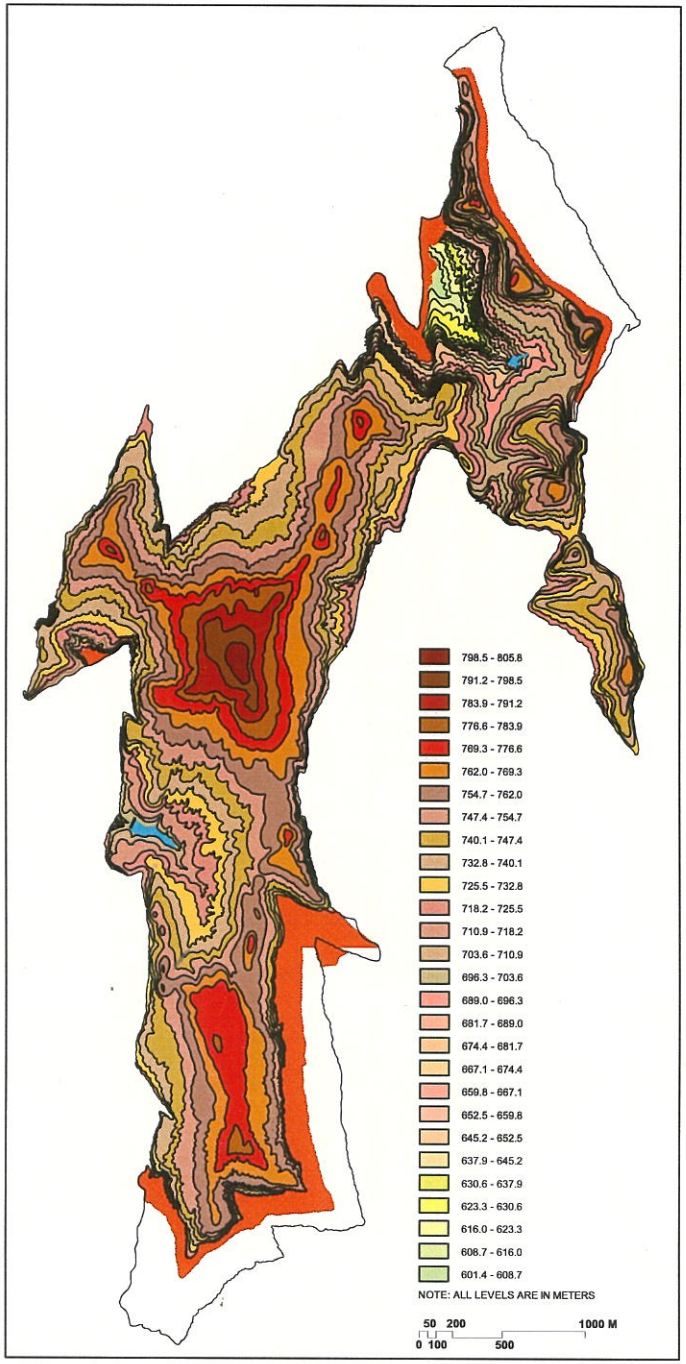
Top slopes

Large area of the plateau shows a gentle to moderate slope. In general these slopes are either facing east or west. The eastern slopes are short and steep, whereas, the western slopes are comparatively gentle and long. Short and swift steams that are active during monsoon plunge over the cliff forming waterfalls along the boundaries, further dissecting the slopes. These slopes have replaced the original surface. They are covered by soil and support the characteristic plateau top vegetation. Stream networks over the plateau form small basins. Two of these are significantly large viz. Simpson Tank and Charlotte Lake basin. Rest are poorly developed networks mostly comprising of first and second order streams.

Marginal Slopes

These are the steep slopes bordering the plateau. They are made of basalt that underlies the laterite, forming the geomorphic boundary of the plateau and separating it from the surrounding areas physiographically as well as in terms of its development.
Immediately below the slopes are Galleries or Patti's. These are supported by the wash material from the top and are covered with good vegetation.

LANDFORM FEATURES



TOPOGRAPHICAL MAP

SLOPE GRADIENT MAP

FLAT TERRAIN NEAR RUGBY

OLYMPIA PLATEAU

STEEP GRADIENT NEAR CHARLOTTE LAKE

LOUISA POINT PLATEAU

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3.1 (B) HYDROLOGY AND WATER FEATURES

The land surface is generally irregular. This has given rise to various water features such as surface streams, basins, dharas, waterfalls and springs.

The general topography of the plateau is so undulating that such a small area is divided into approximately 15 watersheds. These watersheds consist of a dense and intricate network of streams and rivulets. Watersheds of Charlotte Lake and Simpson tank are more important as they feed these water resources of the plateau. Charlotte lake watershed is gentler in slope and spread over larger area compare to Simpson tank watershed.

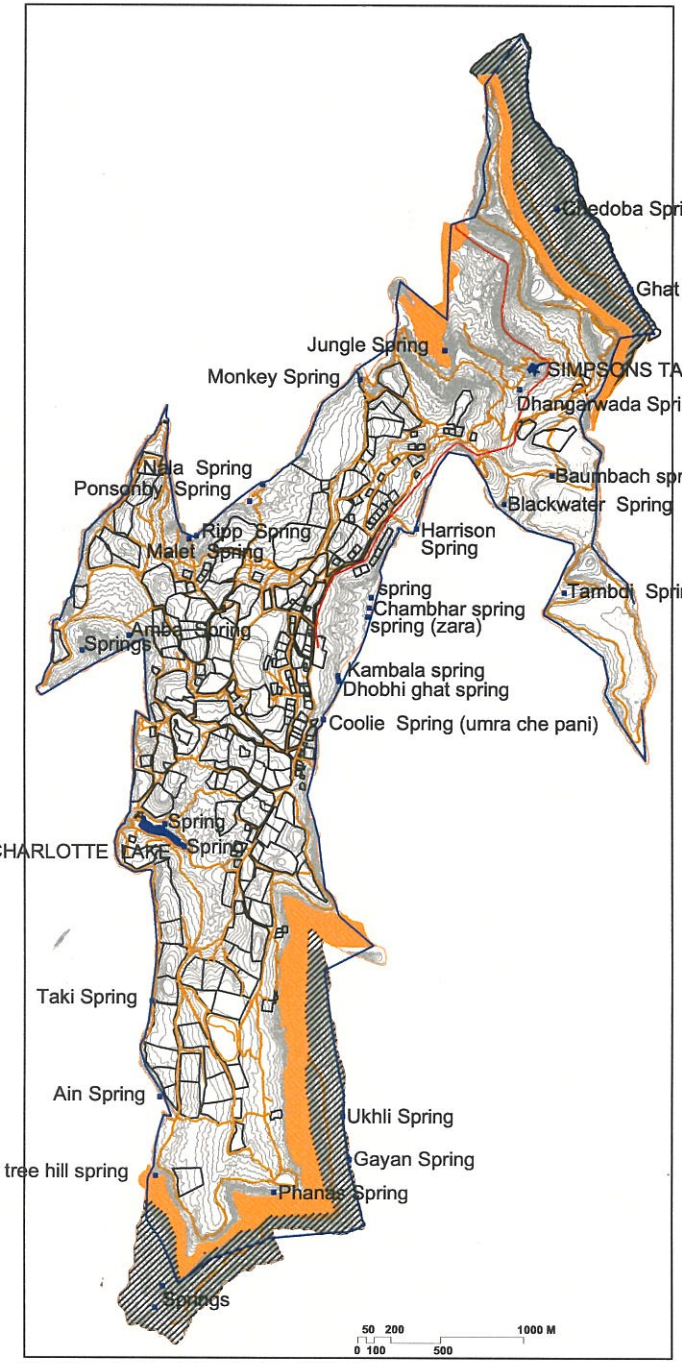
The climate, the geology, basin morphology and vegetation in the catchment are important variables that control the geo-hydrology of the plateau.

During monsoons ground water gets recharged. Existing wells on Matheran plateau indicate that the ground water level in some areas is quite high even in summer. Rate of percolation of water into the ground is also high due to the porous upper strata and large areas on the plateau being covered with forest or vegetation. High level of soil moisture has resulted in the evergreen nature of the crest top forest.

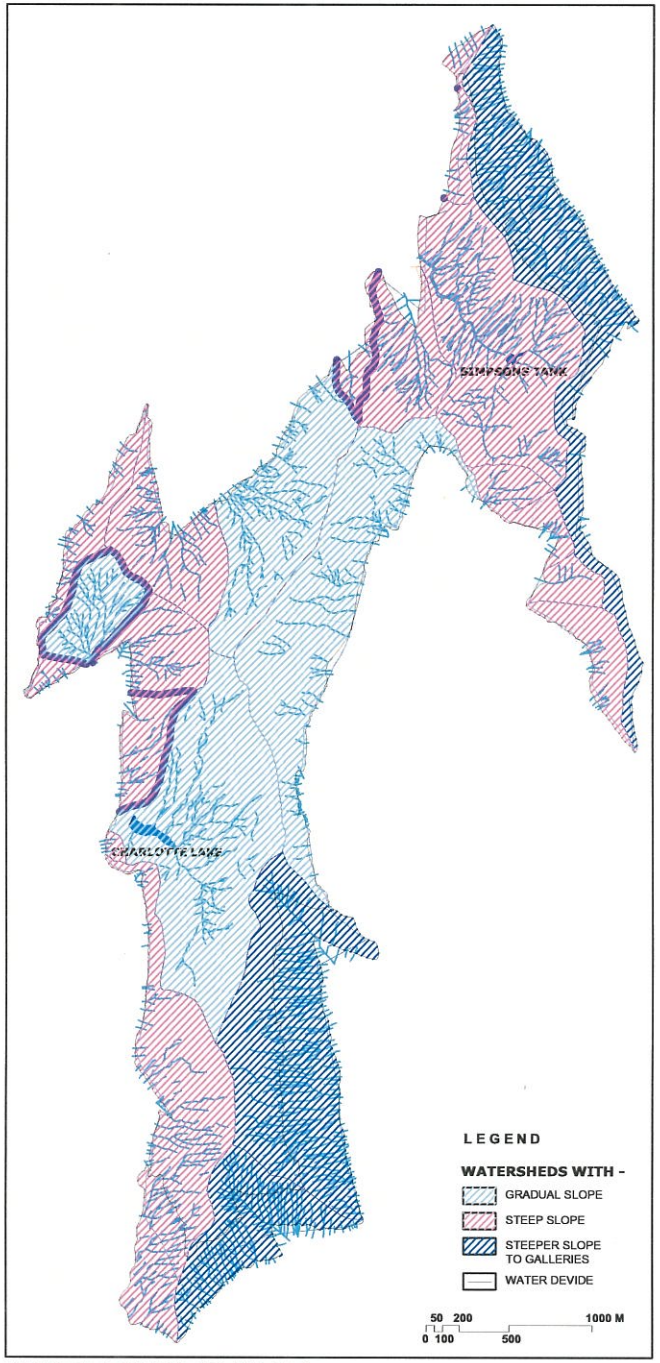
The Underlying trap (basalt rock) drains the water absorbed by the porous laterite to the edges of the plateau where springs issue out from the junction of the laterite crest and the trap. These springs are an important water resource for the plateau and the surrounding region.

Deforestation, loss of topsoil and erosion has affected ground water levels on the plateau in certain areas leading to the drying up of springs. Large paved areas and built up areas also increase surface runoff and reduce the area under natural vegetation and forest cover thus affecting ground water. Dug wells and drawing of ground water will result in reduction of soil moisture, which in turn, will increase soil erosion and affect the quality of vegetation.

On the plateau top, due to porous Lateritic terrain, water management by construction of check dams is geologically feasible only in certain areas where basalt rock is present. Therefore to augment the existing water supply on the Plateau, rainwater harvesting and recycling of water is the only solution.



WATERBODIES MAP



WATERSHED MAP

3.1 (C) VEGETATION

According to earlier records (T.Cooke, Birdwood, Maharashtra Gazetteer, B.S.I.), it is evident that Matheran vegetation is fairly rich and diverse in its seasonal and ephemeral component. Further work on the biodiversity of the ecosystem, particularly in and after rainy season will throw light on the endemic, vulnerable and threatened plant and animal species.

The type of vegetation changes with the altitude, precipitation and soil strata. Deciduous to moist deciduous vegetation is found on the lower slopes. Moist deciduous to semi-evergreen vegetation is observed on the terraces. The crest forest on the plateau top is a unique climax ecosystem ranging from semi-evergreen to evergreen with a prevalence of evergreen species. The evergreen nature is a result of high rainfall and the retention of ground water in the soil strata. The precipitation/rainfall on the plateau top is above 3000 mm.

Matheran plateau shows three main types of habitats.

Forest

The forest ecosystem of Matheran plateau is unique; for such a lofty semi evergreen forest hardly exists anywhere else in the Sahyadri region. The canopy density is variable between 40-90%. At several localities the ecosystem can be designated as a closed forest. Dominance of Memecylon umbellatum indicates a change in character of the original forest from primary to secondary growth.

The common and abundantly occurring species are *Actinodaphne anguistifolia* (Pisaa), *Memecylon umbellatum* (Anjani), *Persea macarantha* (Gulum), *Olea dioica* (Paarjambhul), *Syzygium cumini* (Jambhul), *Mangifera indica* (Amba), *Xantolis tomentosa* (Kate Kumbal), *Garcinia talboti* (Phansada) and *Glochidion hohenhackeri* (Bhoma). Such areas deserve perfect protection as fragile climax ecosystem zone as well as biodiversity hotspots.

Vegetation of Matheran exhibits such a remarkable blending of evergreen and moist deciduous tree species over large area, that dominant species are often deciduous with subdominant evergreen members and vice versa. The common towering top canopy deciduous trees are *Heterophragma quadriloculare* (Waras), *Dillenia pentagyna* (Karmal), *Terminalia bellerica* (Beheda), *Bridelia retusa* (Asana), *Lagerstroemia microcarpa* (Nana), etc. Another interesting feature evident as a result of the preliminary community study is that the floristic composition of the communities in different localities varies considerably.

Study of the biological spectrum of Matheran in relation with its hydrotherm figure (Bharucha and Ferreira) indicates decidedly its phanerophytic plant–climate with 52% phanerophytes. The regeneration of dominant species is satisfactory.

Thus The forest ecosystem at Matheran is unique and remarkable in many respects - its dense and lofty arboreal growth, peculiar blending of evergreen and moist deciduous species and last but not the least – high percentage of endemism and almost undisturbed natural climatic climax formations.

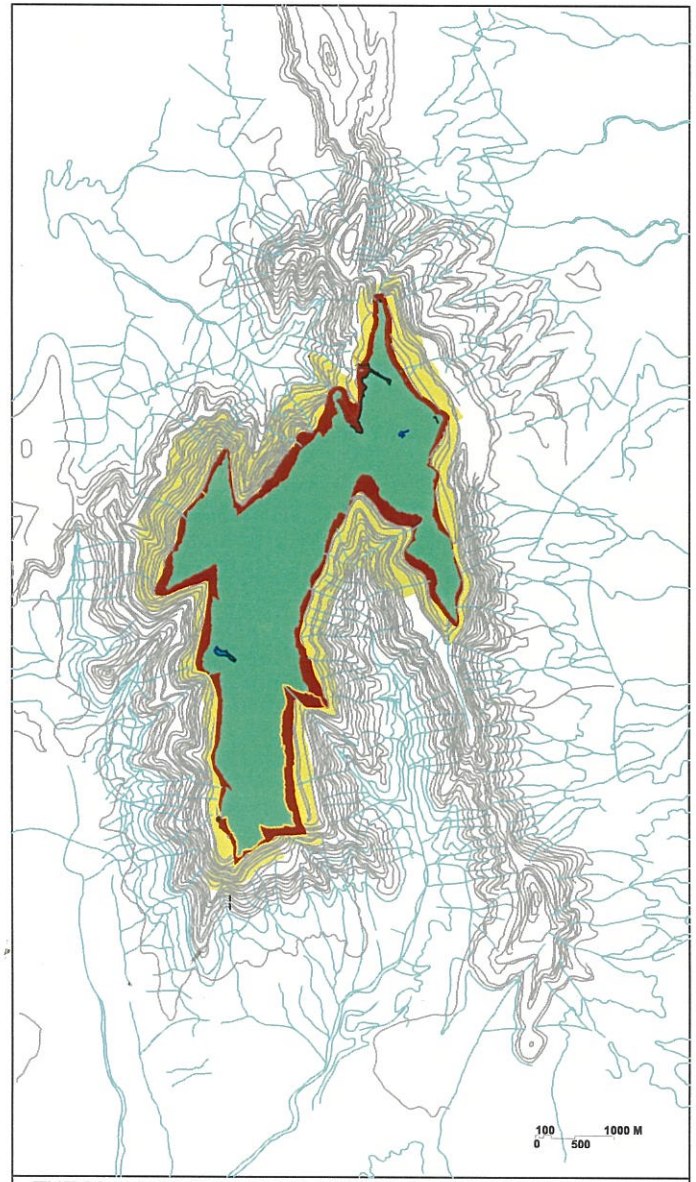
Rocky exposures or rocky outcrops

Plateaus are generally wrongly considered as barren land, are biologically very important. Even though plateaus are very poor in scrubby and tree vegetation, monsoon herbaceous found here is very rich in diversity. These are very special ecosystems as they are limited in size and number. Hence they are of great ecological significance.

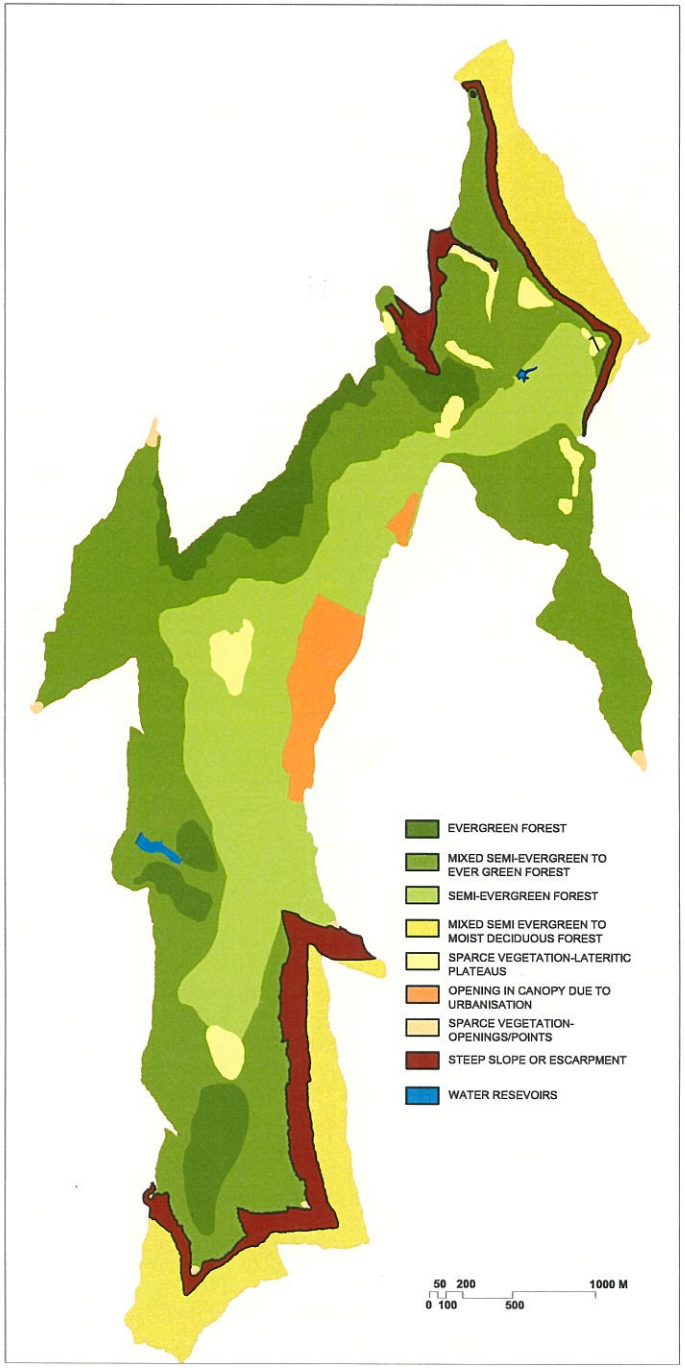
The plants that grow on these rocky outcrops are specially adapted to these unique conditions. They are capable of growing in extremely limited amounts of soil. A centimeter or less of this soil is enough to support their monsoon growth. Most of the herbs that grow on the plateau are monsoon plants. They spring out of the ground during the monsoons, grow rapidly, flower in a short spell and die. A fair proportion of these species could be endemic. Majority of plant species that grow on the plateaus are very rare, less in population and in endangered status.

Rocky escarpment

The plateau edge/ escarpment consists of steep rocky barren slopes. The vegetation found here is scrubby and sparse. Some plants, which grow on the escarpment, are specially adapted to the rocky exposed conditions found here. The escarpment thus forms an important habitat for many endemic plant species.



THE PLATEAU FOREST IS OF TROPICAL SEMI EVERGREEN TYPE WITH A PREPONDERANCE / ABUNDANCE OF EVERGREEN SPECIES OF TREES.
THE FOREST ECOSYSTEM OVER A MAJOR PART OF THE MATHERAN PLATEAU IS UNIQUE. SUCH A LOFTY SEMIEVERGREEN FOREST HARDLY EXISTS ANYWHERE ELSE IN THE SAHYADRI REGION.



EVERGREEN FOREST ON MATHERAN PLATEAU.
THE CANOPY DENSITY IS VERY MUCH VARIABLE IT SEEMS TO BE BETWEEN 40-70%.AT SEVERAL LOCALITIES THE ECOSYSTEM CAN BE DESIGNATED AS CLOSED FOREST
DOMINANCE OF MEMECYLON EDULE (ANJAN) ON MANY PARTS OFTHE PLATEAU INDICATES A CHANGE IN CHARACTER OF THE ORIGINAL FOREST FROM EVERGREEN TO SEMIEVERGREEN AS A RESULT OF TREE FELLING

FOREST TYPES

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FOREST TYPES, MATHERAN PLATEAU AND GALLERY

3.1 (D) GEOLOGY

Matheran, a part of Prabal-Malang ranges, is a plateau with laterite as a cap rock. No other peak in the vicinity has laterite at such lower altitude. The nearest occurrence of laterite is at Bhimashankar. But it exists at the crestline. In the southern Konkan, in districts like Ratnagiri and Sindhudurg, such low altitude laterite plateaus are seen. The presence of laterite has to be explained by various theories of its formation.

Warm and humid climate with excessive rainfall bring about a combination of chemical weathering processes – oxidation and leaching. Ultimately, the uppermost layer, which is exposed to this climate, gets metamorphosed to laterite. These chemical processes impact the characteristics laterite is known for. Process of leaching removes the soluble material from the original rock, making it porous. The oxidation converts the elements like Iron and aluminum into their oxides. These oxides, being insoluble in water, remain as metamorphosed product. Such a process of formation makes laterite almost inert for further processing. Therefore it remains in the landscape in form of flat cap. It provides protection for lower mass.

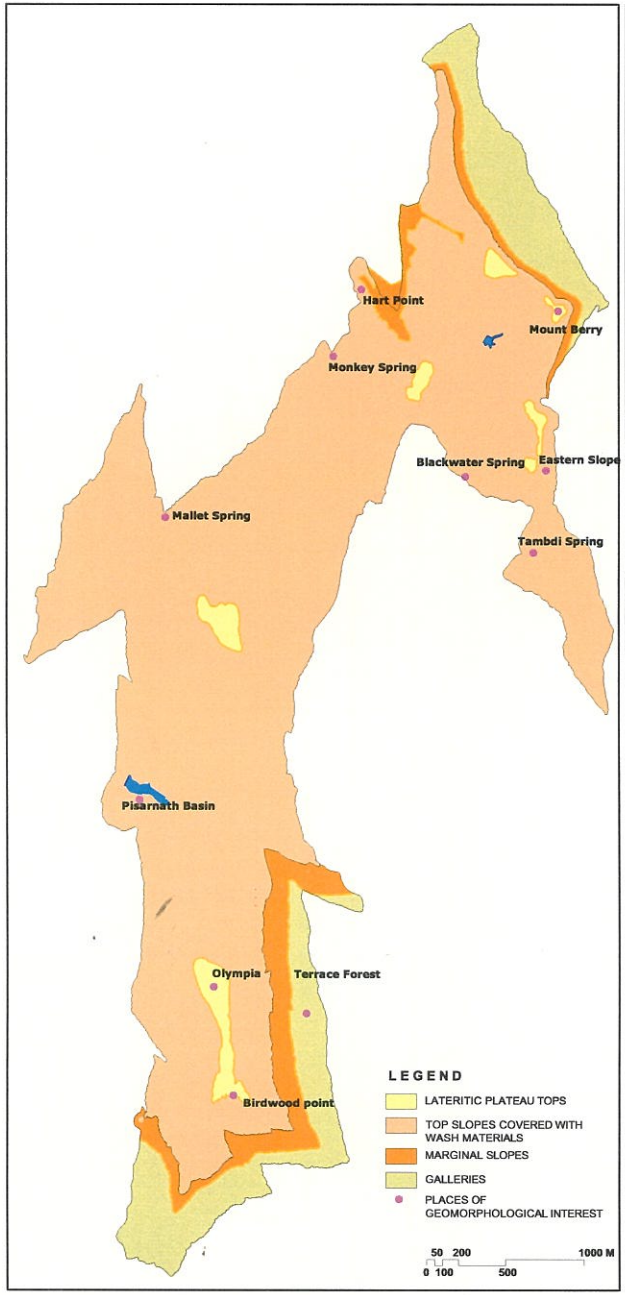
The laterite being inert remains unchanged and is thus called as Pedagogy to the landform. But over the years it undergoes disintegration along its edges. The process like spring sapping contributes to the marginal disintegration of laterite. Here the edges loose their underlying support due to the hollows and cavities carved out by springs, thereby developing the cracks parallel to the edges as the slab tilt. These cracks slowly widen and the edges collapse. These fractures are clearly visible on the Mount Berry plateau. The broken blocks and boulders roll along the slope. Such process slowly converts the plateau into gentle slopes. Over the years the cap is replaced by regolith. In Matheran such process has removed the original duricrust from large areas. The remnants of the original crust are seen in form of high plateau like Rugby, Olympia, Mount Berry, and Governor's Hill etc. Even these are undergoing marginal disintegration. It can be seen near Birdwood point on large scale. There are few patches of soil on the Olympia and Mount Berry tops. Other parts are barren. Vegetation is sparse on the plateau tops.

Original Lateritic top is now in a disintegrated form. Disintegration of laterite is very typical process, which has divided the plateau in three broad geomorphic units: Lateritic cap, top slopes and marginal slopes. Wash material and Lateritic boulders are visible on the immediate slopes. This marginal disintegration occurs due to weathering and erosion of laterite.

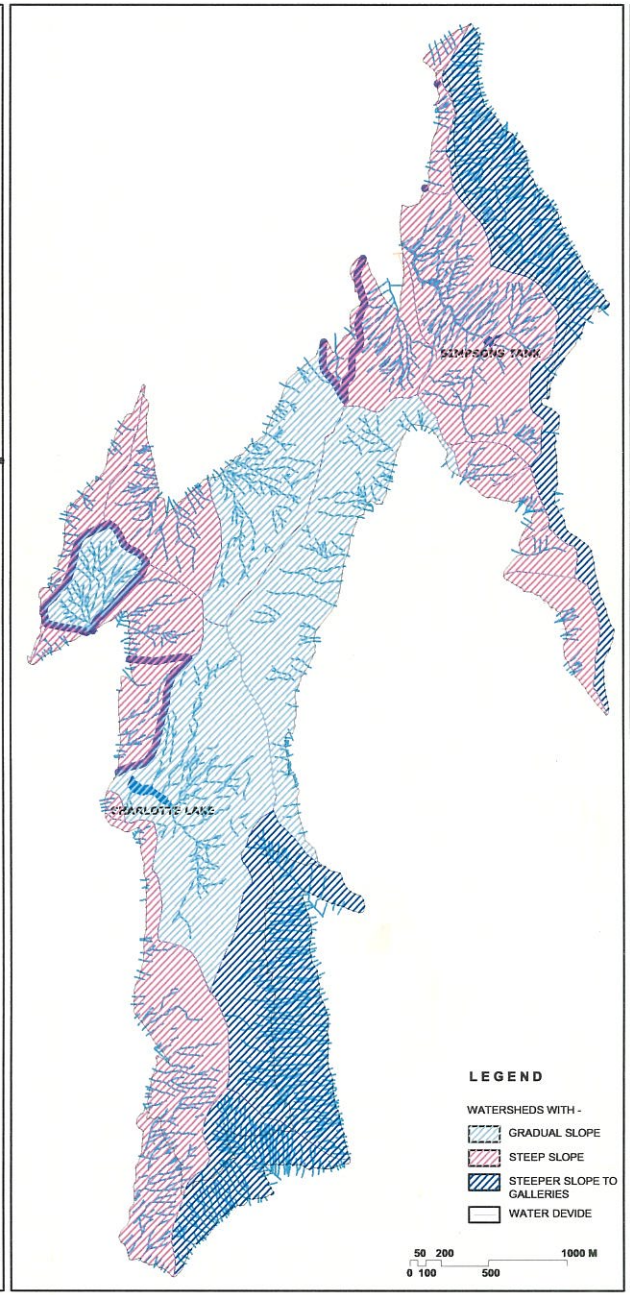
The presence of laterite has affected the lithological, hydrological and pedagogical characteristics of the plateau, which in turn, are decisive in distribution of vegetation, soil, moisture, water table, springs and drainage pattern.

The ecological study of the various components was carried out through site surveys, as well as through quadrats and transects surveys in certain critical areas and related plant and animal associations. This was done with a team of Ecologists and botanists under the guidance of Prof S.D. Mahajan (Taxonomist Msc Botany)

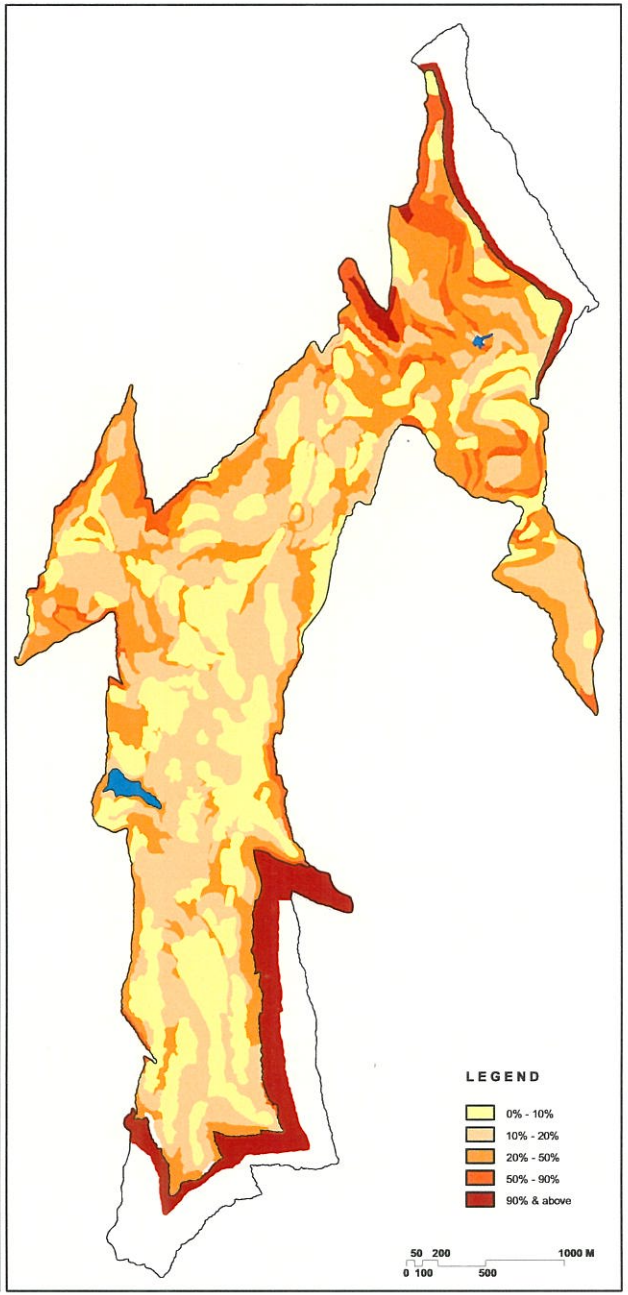
The geomorphic characteristics have been studied and mapped by Prof Surendra Thakurdesai (who has extensively studied lateritic formations as a part of his PhD) and his team of geology students.



GEOMORPHIC UNITS



WATERSHED CHARACTERISTICS



SLOPE ANALYSIS

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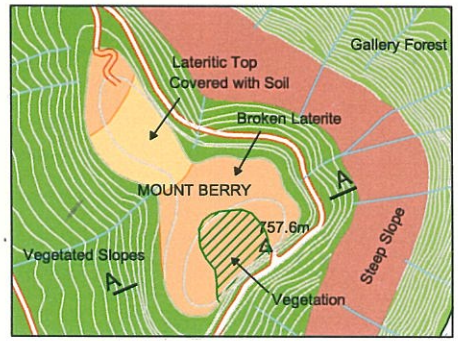
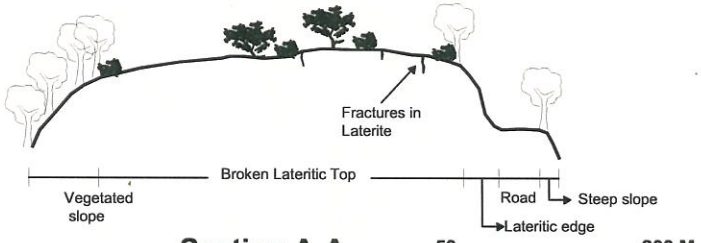
GEOMORPHIC UNITS

KEY PLAN

1- MOUNT BERRY

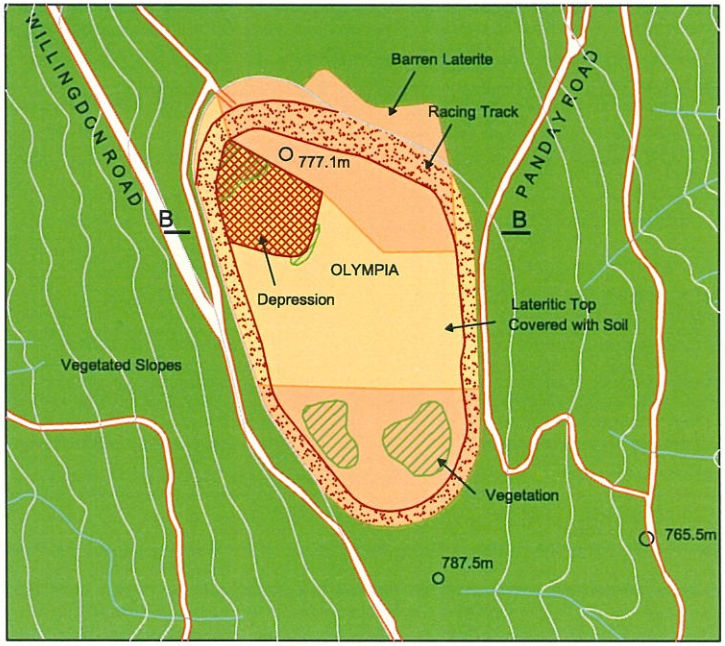


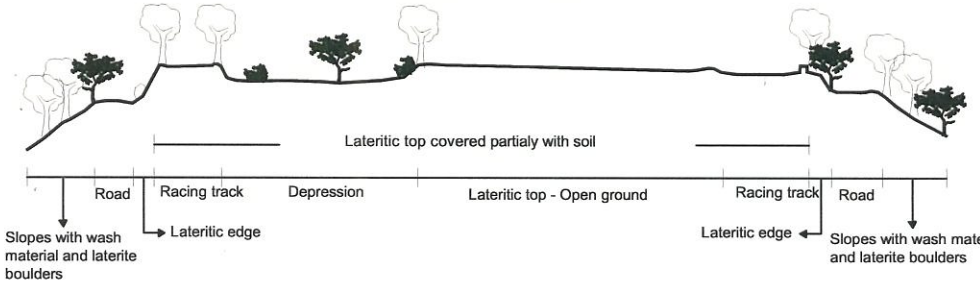


Section A-A

50 0 100 200 M

2- OLYMPIA PLATEAU





Section B-B

50 0 100 200 M

N

3.2 MANMADE INFRASTRUCTURE: AGENTS OF CHANGE

3.2 (A) LANDUSE

Most of the area that lies within the Eco-sensitive Zone has been classified as Forest Zone by the M.M.R.D.A. and some areas within the Eco-sensitive Zone come under Green Zone (G1 and G2). The Matheran plateau has been zoned as Urbanisable Zone 1.

The British developed Matheran plateau as a health resort. It was envisaged as a self sufficient, self-contained township with bungalows (i.e. staying facilities), and other amenities and facilities like hospitals, gymkhanas, post office etc.

Today the state government owns all plots on Matheran plateau, which are given on long lease to various lessees. These include trusts, companies, Matheran Municipal council (MMC), Maharashtra Tourism Development Corporation (MTDC) and private bodies/ individuals. The rest of the plateau is under the Forest Department.

The 1987-sanctioned development plan (D.P.) reveals that the hill station had about 64% land under forest and about 22% under residential zone, indicating that the forest forms the major component of the landuse followed by residential.

Another important aspect of Matheran town is its rich built heritage in the form of colonial buildings, resting amidst dense forest, regenerating a countryside ambience. These houses, which were built in the 1850's, have large plot sizes with less built up area. The rest of the area is covered by forest, which is not accounted for in the forest landuse.

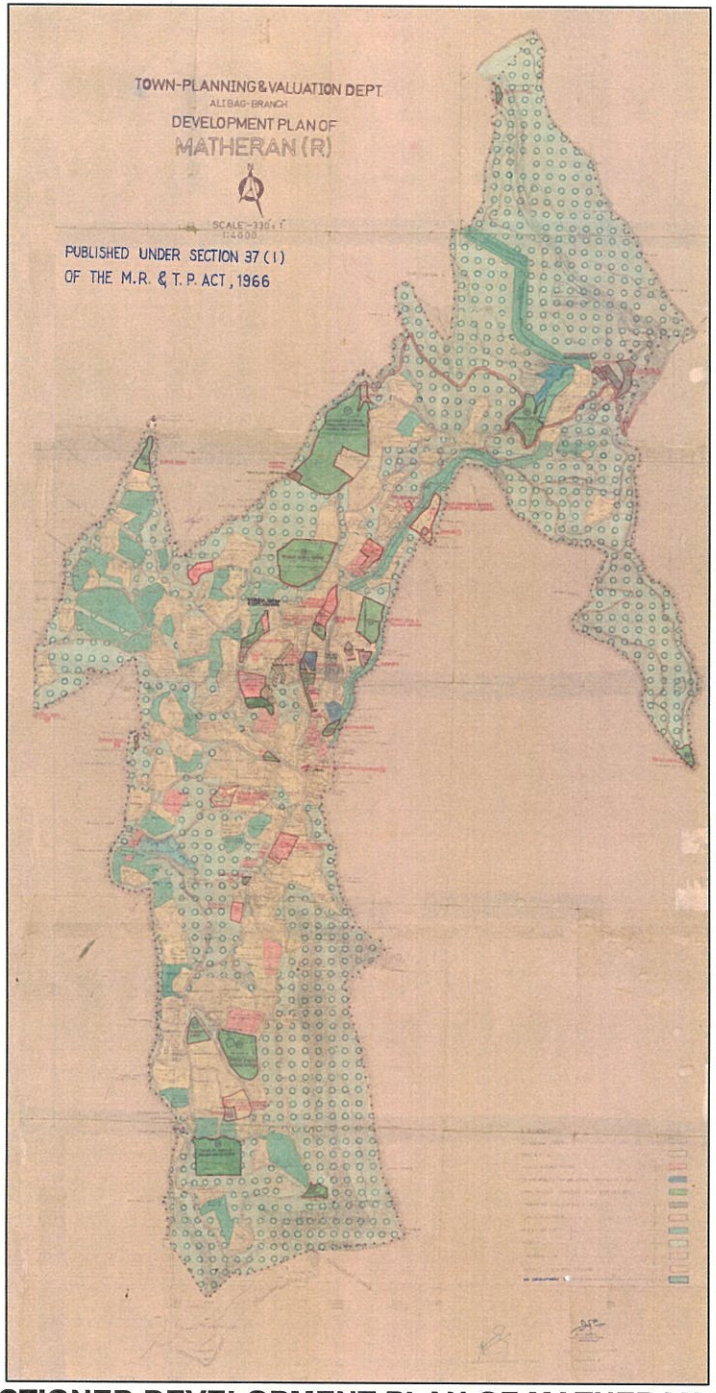
Shops and other commercial units are located only in the Bazaar area, which is a major commercial spine near the railway station, with the exception of very few shops on roads leading to popular viewing points and at the points itself. The commercial landuse is about 5.38%. Hotels form a major component in the commercial landuse.

Recreational or organized spaces contribute to about 3% of the landuse. These include the Pay master park, Madhavji park, Olympia racecourse and other playgrounds and gymkhanas. Besides these landuse, there are public utilities or amenities with public and semi public spaces, which are about 0.04% and 2.17% respectively. They are schools, religious buildings, burial grounds, one hospital and

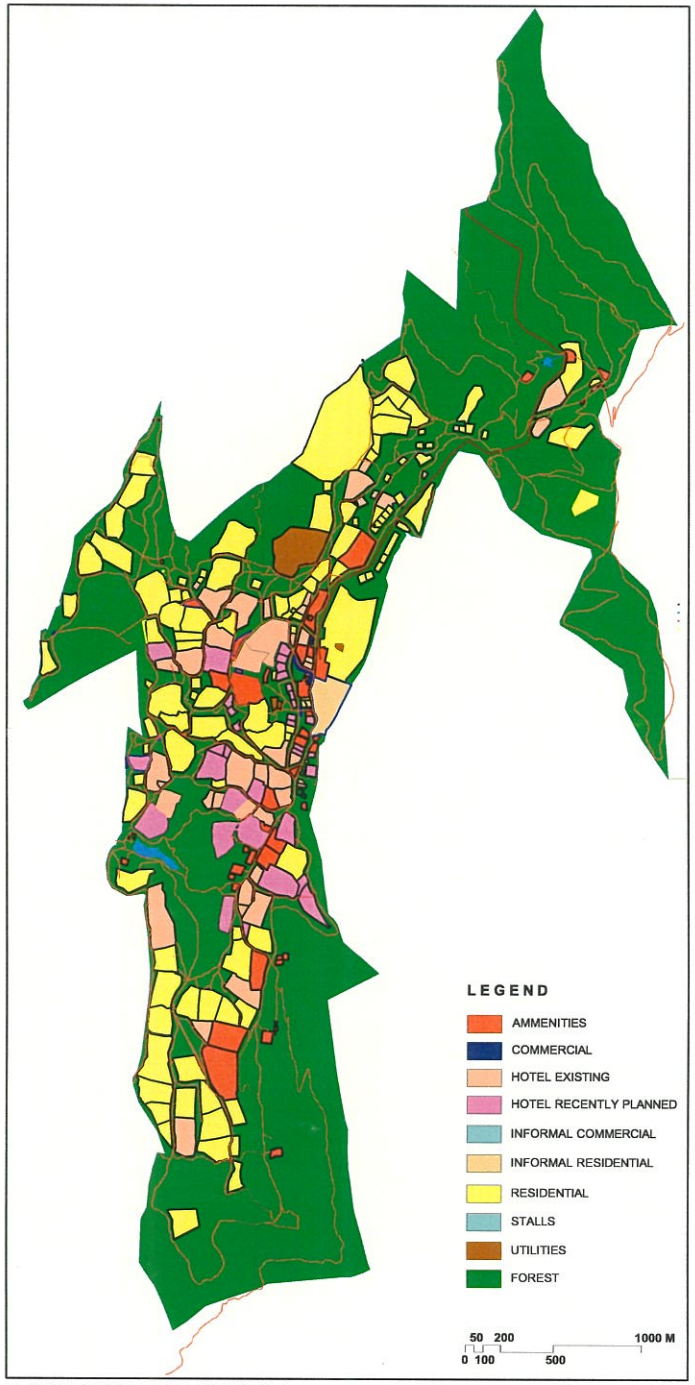
a library. Transport and communication and miscellaneous landuse are about 2% and 1.8% respectively. There are no manufacturing industries in the town. Cottage industries include units like leather goods, footwear, chikki making etc. Agriculture is not practiced in the town.

The development of the plateau as a tourist destination has led to a change in the landuse pattern. Today, many old bungalows and houses are converted into hotels or other commercial uses. The existing landuse survey (study done in Feb 2005 – June 2005) of the plateau shows that the forest is still about 68% including the gallery forest, but the commercial landuse percent on site has increased with a drop in the residential landuse. The existing hotels account to about 5.37% of landuse, with other commercial uses about 0.4%, which add to 5.41% of commercial landuse. But the recently planned hotels, converted from old bungalows or houses, contribute another 2.89% to commercial activities. Thus the commercial landuse totally sums up to about 8.31%, with a rise of about 2.93%. The land now used for residential purpose, both formal and informal contribute to about 18%, with a drop of about 4%. The percentage of amenities and utilities has relatively remained the same, it being 2.92% and 0.71% respectively.

Apart from the plateau landuse, most of the village settlements are in adjoining valleys and on slopes.



SANCTIONED DEVELOPMENT PLAN OF MATHERAN,1987

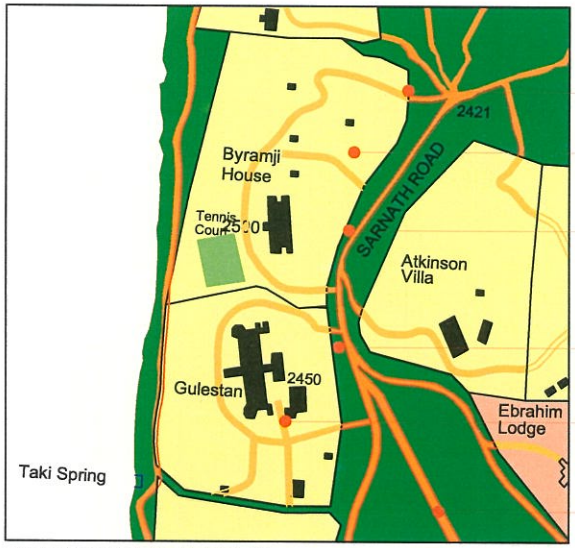


LANDUSE SURVEY

LANDUSE MAP

COMPARATIVE ANALYSIS OF PISARNATH ROAD & VICTORIA ROAD FOR VISUAL QUALITY

KEY PLAN



PRIVATE PLOT BOUNDARY

PRIVATE LAND

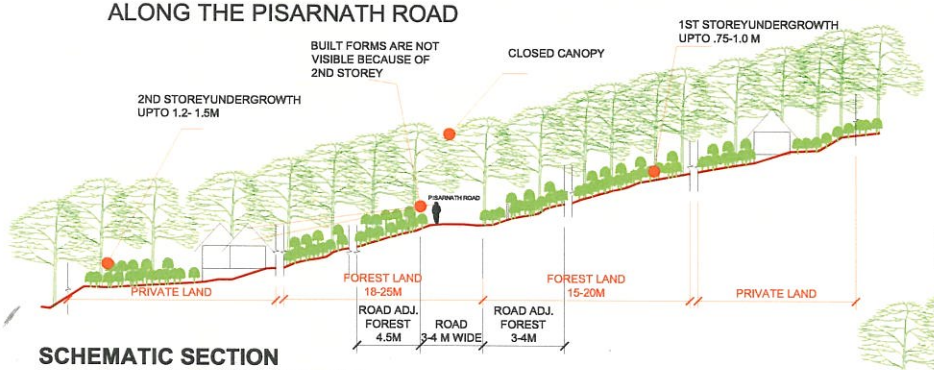
FOREST LAND

BUILT FORMS ARE NOT VISIBLE BECAUSE OF FOREST BUFFER

KACHHA PATHWAYS IN THE PRIVATE PROPERTY

LESS FREQUENTED ABOVE 3.0 M WIDE ROAD

OWNERSHIP PATTERN
ALONG THE PISARNATH ROAD

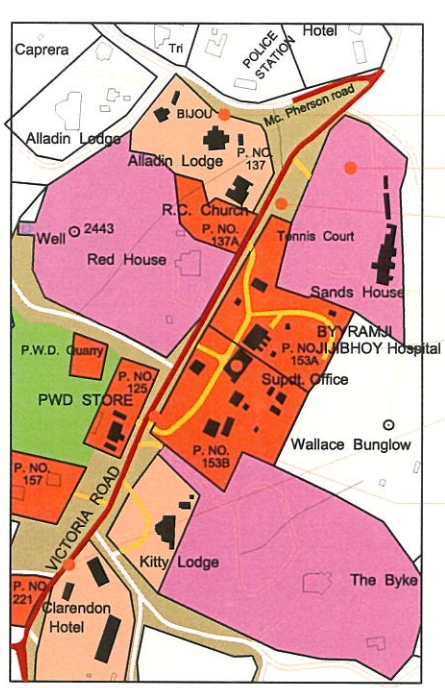


SCHEMATIC SECTION THROUGH PISARNATH ROAD

FOREST LAND THROUGH OUT THE LENGTH OF THE ROAD MAINTAINS VISUAL QUALITY & ORIGINAL CHARACTER OF PLACE.

CLOSED CANOPY OF PISARNATH ROAD

ROCKY OUTCROPS ALONG THE PATHWAY



PRIVATE PLOT BOUNDARY

PRIVATE LAND

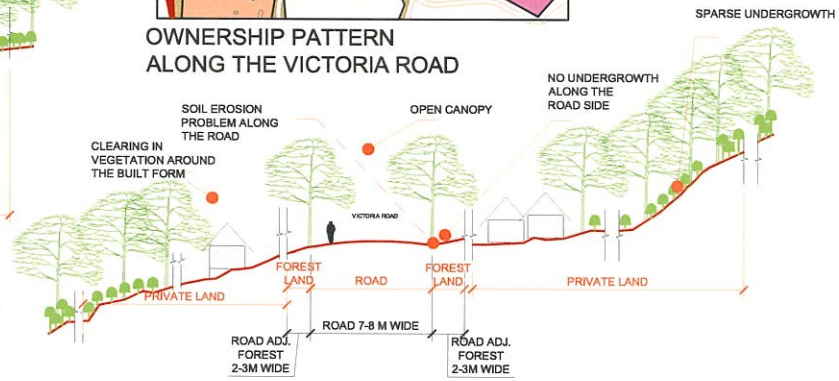
FOREST LAND 1-2M WIDE

BUILT FORMS ARE VISIBLE FROM ROAD BECAUSE OF ABSENCE OF UNDERGROWTH & SPARSE FOREST

INCREASE IN ROAD WIDTH FROM 3-4M TO 7-8M REDUCES FOREST LAND STRIP ALONG THE ROAD

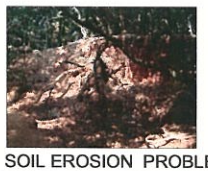
HEAVILY FREQUENTED 8-9 M ROAD

OWNERSHIP PATTERN
ALONG THE VICTORIA ROAD



SCHEMATIC SECTION THROUGH VICTORIA ROAD

VISUAL QUALITY OF FOREST & ORIGINAL CHARACTER OF PLACE ALONG THE LENGTH OF VICTORIA ROAD IS DISTURBED.



SOIL EROSION PROBLEM ALONG THE ROAD

50 200M
0 100

VISUAL QUALITY DETAIL OF ROADS

N

3.2 (B) INFRASTRUCTURE

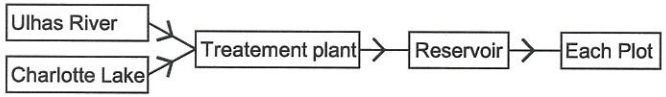
Water Supply

The two major water sources for the Matheran plateau are Ulhas River, which flows at the base of Matheran near Neral and the Charlotte Lake situated on the plateau. Water drawn from the Ulhas river is the primary source of water supply to the plateau. Alternatively, some water is pumped from Charlotte Lake for about 5-6 hours on regular days and for about 10-12 hours in the peak season. Water pumped from both these sources is treated in the filtration plant, built by the British in 1926, near Rugby plateau, which is the highest altitude on the plateau. After purification it is distributed all over the plateau. Quantity of water supplied during the non-tourist season is close to 0.8MLD and which goes up to 1.6 -2MLD during the tourist season. Ulhas River water is used throughout the year, whereas, Charlotte Lake water is used only up to February, as beyond that, water level goes down in the summer season.

The demand for water has gone up with increasing number of tourist population. Hotels are providing facilities like swimming pools, which add to the water demand. Present sources and purification capacity of filtration plant is not sufficient for the constantly increasing tourist population.

The other sources of water on the plateau are the springs that provide water for drinking as well as other domestic purposes. They are an important resource during summer when locals face water scarcity. For example, people from Galti settlement travel almost 1-1.5 km up to Black water spring for water to be used for domestic purpose.

DRINKING WATER SUPPLY FOR MATHERAN



FORMAL WATER SOURCE - ULHAS RIVER WATER IS PUMPED UP AND AFTER TREATEMENT STORED IN RESRVOIR. CHORLLOTE LAKE WATER AFTER TREATEMENT STORED IN RESERVOIR.

INFORMAL WATER SOURCE - HARRISONS SPRING, BLACK WATER SPRING, MONKEY SPRING, DHANGARWADA SPRING, MALET SPRING, KAMELA SPRING , DHOBI SPRING

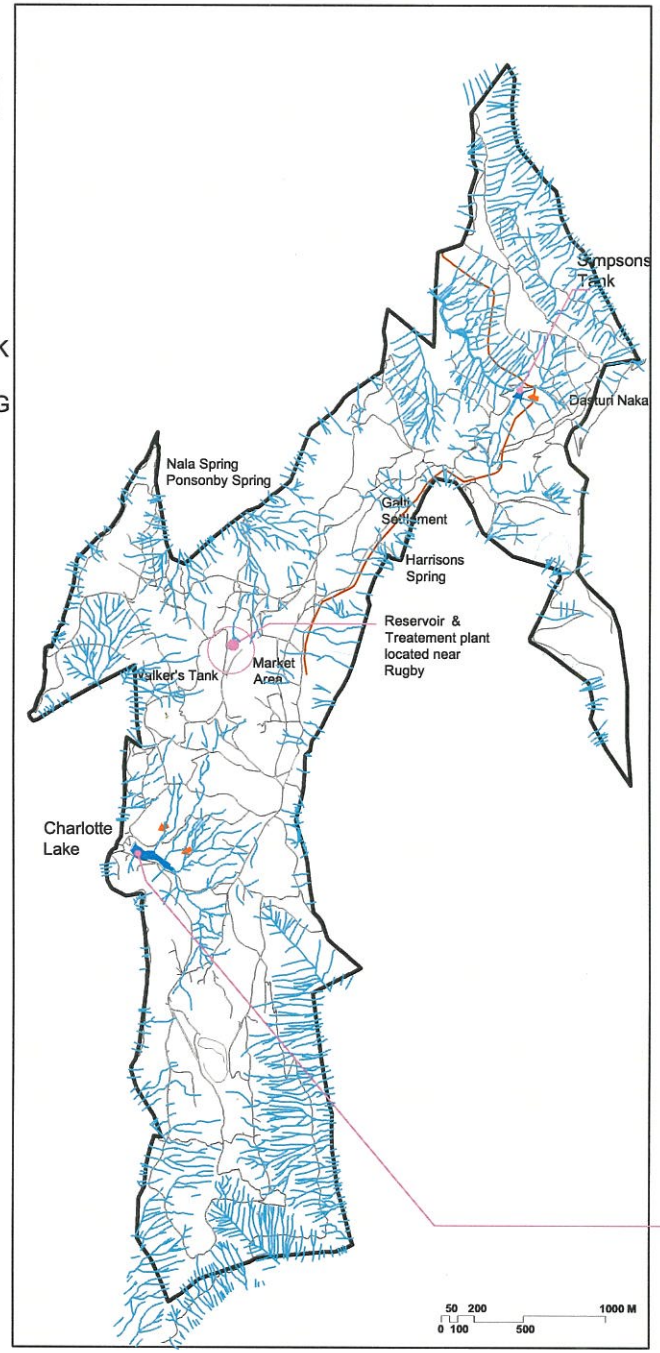
HARRISONS SPRINGS, BLACK WATER SPRING WATER IS USED BY GALTI SETTLEMENT FOR DOMESTIC PURPOSE IN SUMMER WHWN THERE IS ACUTE SHORTAGE OF PIPE WATER.

MONKEY SPRINGS WATER IS USED BY PEOPLE CARRYING HAY SATCKS FROM VILLAGE BELOW.

PROBLEMS OF DRINKING WATER SUPPLY

Entire matheran plateau is depending on charlotte lake & Ulhas river for water supply. In summer there is a acute shortage of water from Ulhas river water and at the same time water level in charlotte lake receeds drastically. In summer season demand of water is very high due to the peak tourist season.
To avoid this kind of critical condition Charlotte lake should be augumented.

Earlier water form the Simson tank was used for drinking but owing to high level of contamination has been abandoned completely.



FORMAL AND INFORMAL WATER SOURCES


FILTERATION PLANT


FILTERATION PLANT

Upgradation of Charlotte lake and protecting it's catchment area as per details in Charlotte lake.

Simson Tank can be revived it's quality and quatity in terms of holding capacity can be increased.


SIMPSONS TANK


CHARLOTTE LAKE

N

Solid waste management in Gymkhana plot

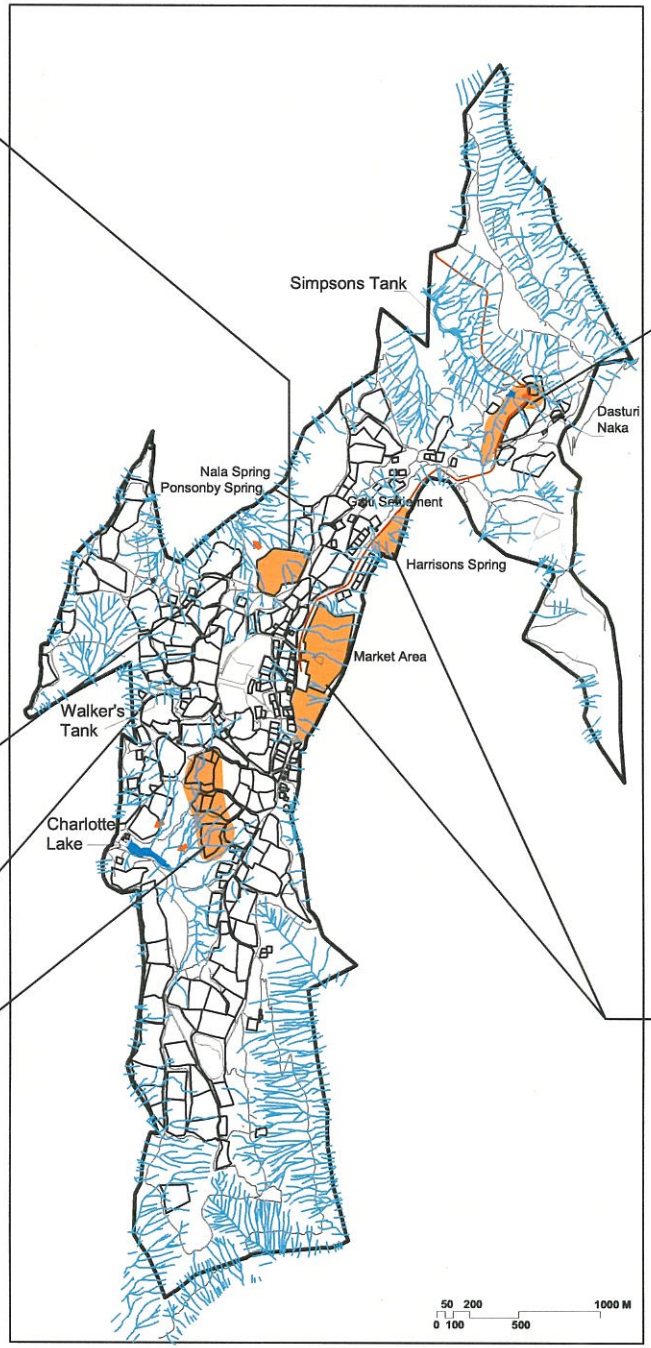
Garbage dumped on the ground

Composting on ground

Surface drain leading to Nala Spring & Ponsonby Spring may contaminate the surface water and the ground water

Walker's Tank - Used for immersing Ganesh idols

Hotels in the catchment of Charlotte Lake The untreated effluent flowing into the Lake - contaminating major water resource of the plateau



SITES OF WATER CONTAMINATION

Simpsons Tank catchment

Tank water is completely rendered as nonpotable because of many reasons detailed out in the Simpsons Tank drawings

Informal residential settlement - no drainage system - untreated sewage directly flowing in to the valley

Sewage

Providing a centralized drainage system for the entire plateau is not feasible due to the undulating topography of the plateau. Bungalows and hotels have their individual septic tanks. Very few hotels have sewage treatment plants. Outlets of these septic tanks and treatment plants are just laid into nearby streams or storm water drains on the plateau. This untreated or partially treated effluent flowing on the plateau leads to contamination of water bodies as well as ground water.

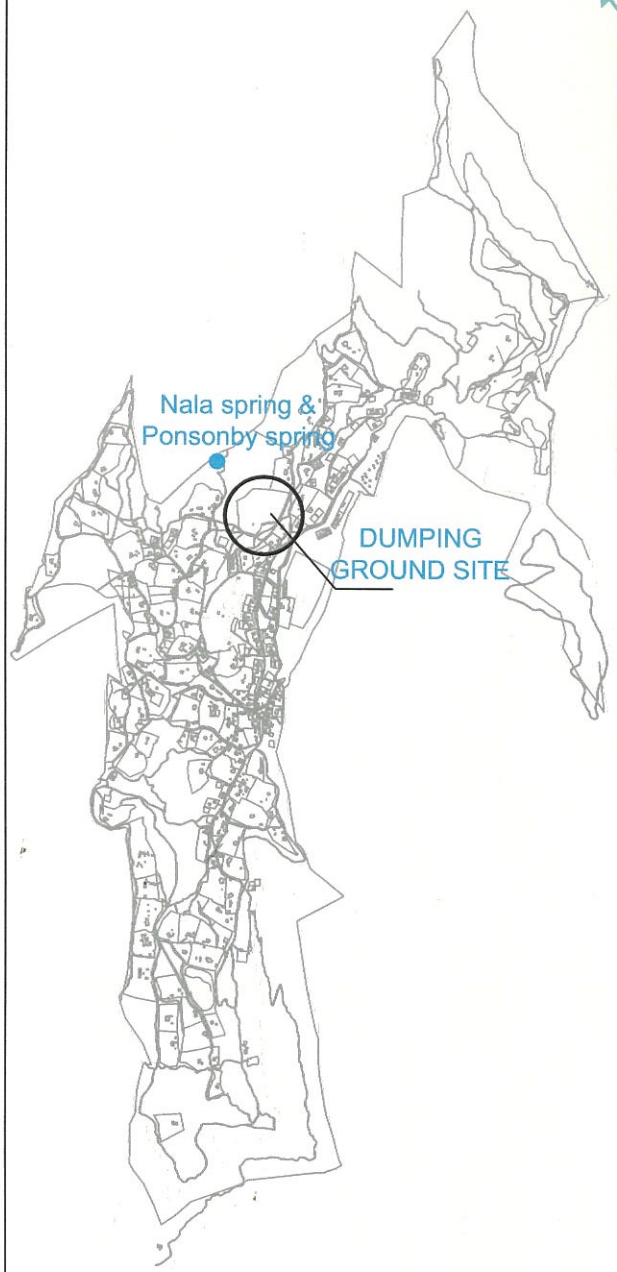
The densely populated local settlement near the Bazaar area has no proper facilities for sewage treatment and disposal. The untreated sewage flows into nallahs and open drains and it is directly released on the escarpment thereby contaminating the valley slopes. This has led to unhygienic conditions.

Solid Waste Management

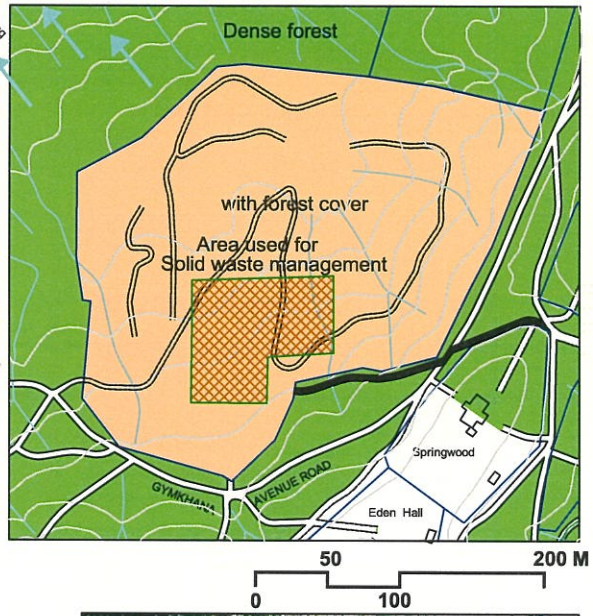
Matheran Municipal Council has taken measures for collecting solid waste, like segregating of wet and dry garbage etc. Solid waste from the plateau is collected, segregated and disposed off at the Old Gymkhana plot. Decomposition of wet garbage also takes place at the same place on the open ground. This plot is surrounded by thick forest and is located on the upstream side of Ponsonby and Nala springs. These activities lead to contamination of surface water as well as the springs. The collected garbage is scattered by stray animals like dogs and monkeys and the wind. In the informal settlement on the eastern side of the bazaar area, garbage is being disposed off in the storm water drains, nallahs and streams.

Certain positive steps have been taken such as imposing a ban on polythene bags in Matheran.

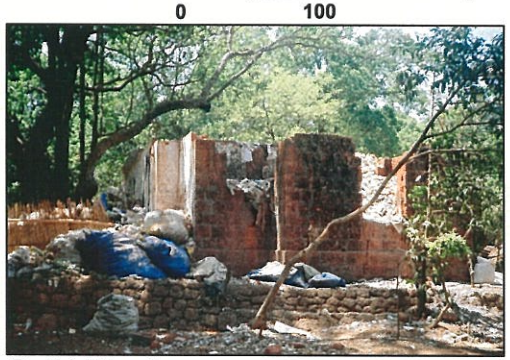
KEY PLAN



SOLID WASTE MANAGEMENT ON MATHERAN PLATEAU



Garbage dumped on the ground and stray animals



Solid Waste

Segregated -
Plastic Bags & Plastic Bottles

Burning Solid Waste

Decomposing Waste

SOLID WASTE MANAGEMENT

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3.2 (C) TRAFFIC AND CIRCULATION

Presently there are two primary modes of transport to Matheran, by road upto Dasturi naka and by train up to the bazaar area. These two modes of transport need to be upgraded considering the heavy tourist influx on the plateau. As no vehicular entry is permitted on the plateau, the only modes of transport are horses, ponies and hand rickshaws for tourist and goods carts and ponies for goods.

Vehicular road and car park

Pay and park facility for private vehicles is available at Dasturi naka on the plateau as well as within Neral town at the foothills. Increased number of private vehicles that enter Matheran has resulted in unregulated expansion of the parking area at Dasturi. Undergrowth and under storey in the forestland is being cleared each year to accommodate more private vehicles. The allotted area for parking has indiscriminately expanded to encroach upon forestland. It is essential to put some restrictions on the area to be allotted for parking on the plateau. The existing road from Neral to Dasturi carpark is being widened to allow mini buses to carry passengers and trucks for goods.

Apart from this there is a regular taxi service, which takes tourists from Neral up to Dasturi naka. Around 450 taxis are available for this service - 350 omnis and 100 fiats. From Dasturi naka tourists reach their destination, either walking or on horse or pony backs or by hand rickshaws.

The area around Dasturi naka is used for loading and unloading of goods. It is a highly unorganized area, with inadequate facilities. These goods are transported to their destinations by freight horses or by goods carts.

Mini train service

The Neral-Matheran mini train was made operational in 1907 and is still one of the engineering marvels in today's time. It is a narrow gauge, single-track train service, which takes tourists and goods from Neral station up to the bazaar area on the plateau. This train makes six trips to and six trips fro in a single day on weekends and thrice on weekdays. The journey, though very appealing, takes about 2 hours. This frequency of trains is low as compared to tourist population in the tourist season. In addition, only one compartment in the train allows goods to be carried. This goods carrying capacity is

insufficient as compared to the demand, which invariably burdens the road transport. Also the rail service is shut for 4 months during the monsoon period to avoid any mishap.

Ride horses/ ponies

Horses and ponies are the major mode of transport on the plateau. There are about 457 licensed horses and 75 ponies for the tourists. , The same routes are used by the horses, ponies and tourists, thus resulting in the intermingling of pedestrian and horse movement. These ponies are parked along the main roads at any point apart from the pony junctions. Horses trotting on mud roads raise a lot of dust causing several problems such as air pollution as well as diminished photosynthetic activity of the roadside plants. Trampling or movement by horses results in destruction of forest undergrowth, increasing soil erosion and land degradation. Trampling by horses also results in compaction of the soil and affects growth and natural regeneration. During monsoon the horse dung carried by storm water pollutes streams and reservoirs.

Freight horses

There are approximately 85 licensed freight horses that carry goods from Dasturi naka to the bazaar. But they lack basic infrastructure like stables, sufficient food and drinking water, hygiene, medical facilities etc. Presently the Simpson Tank area is being used for tethering these horses. Horses are left loose around the tank for drinking water, bathing etc. This has resulted in heavy erosion along the banks and siltation in the reservoir. There is complete degradation of undergrowth in the surrounding forest slopes that form the watershed. Malnutrition, overburden and abuse of horses cause infections. Such infected horses are often abandoned, and left to die. Their dead bodies are dumped inside the reservoir or the stream below. This has rendered the water at Simpsons Tank unfit for drinking or any other use.

Apart from the horses and ponies, goods carts and tourist carts are other modes of transport on the plateau. There are approximately 15-20 goods carts, which are pulled by 8 – 10 persons, under inhuman conditions. The tourist carts or hand rickshaws are 97 in number, each pulled by 3 persons. These are used mostly to carry tourists and their luggage.

TRANSPORTATION SYSTEM IN MATHERAN

MODE OF TRANSPORT	NUMBER	USER	OPERATING ROUTE
Train	5/day	Tourist	Around 100 are operated from Dsturi, rest from market & other places.
Taxi-Omni	350	Tourist	
Taxi-Fiat	100	Tourist	
Tempo	10-12/day	Goods	Trucks can not come as road is narrow
Horse	450	Tourist	
Pony	75	Tourist	
Pony	75	Goods	
Goods Cart	10	Goods	Carried by8-10 persons
Tourist cart	94	Tourist	Carried by 3 persons

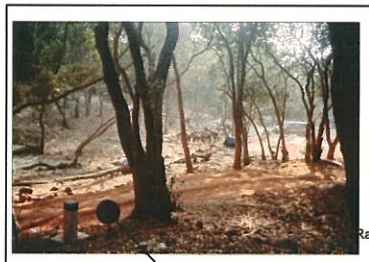
PROBLEMS RELATED TO TRANSPORTATION SYSTEM IN MATHERAN.

- Intermingling of pedestrian and horse movement.
- No seperate service road is provided for trasportation of goods from Dasturi to main Bazar area.
- Unorganised loading unloading facality.
- Everincreasing paking demand for private as well as for taxies.
- Unorgnised pony parks along the main roads.
- Soil erosion due to heavy traffic causes dust problem for pedestrians.
- Soil erosion due to heavy traffic.
- Absence of steet furniture.

Frequency of trains from Neral to Matheran is less as compared to tourist population in tourist season. Only one compartment of train allows to carry goods from Neral to Matheran.Goods carrying capacity of train is less but demand is more which burdens road transport system.Goods & tourists coming by tempos & taxies comes at Dasturi naka. From here manually or by ponies tourists & goods are distributed to their destination under complete inhuman conditions. Which leads to conjection and intermingling of pedestrian and horse movement.

HEAVILY FREQUENTED ROAD AT DASTURI NAKA





TRANSPOTATION SYSTEM IN MATHERAN

UNORGANISED LOADING UNLOADING FACALITY

Unorganized goods loading unloading activity leading to descriminate loss of precious ground cover.

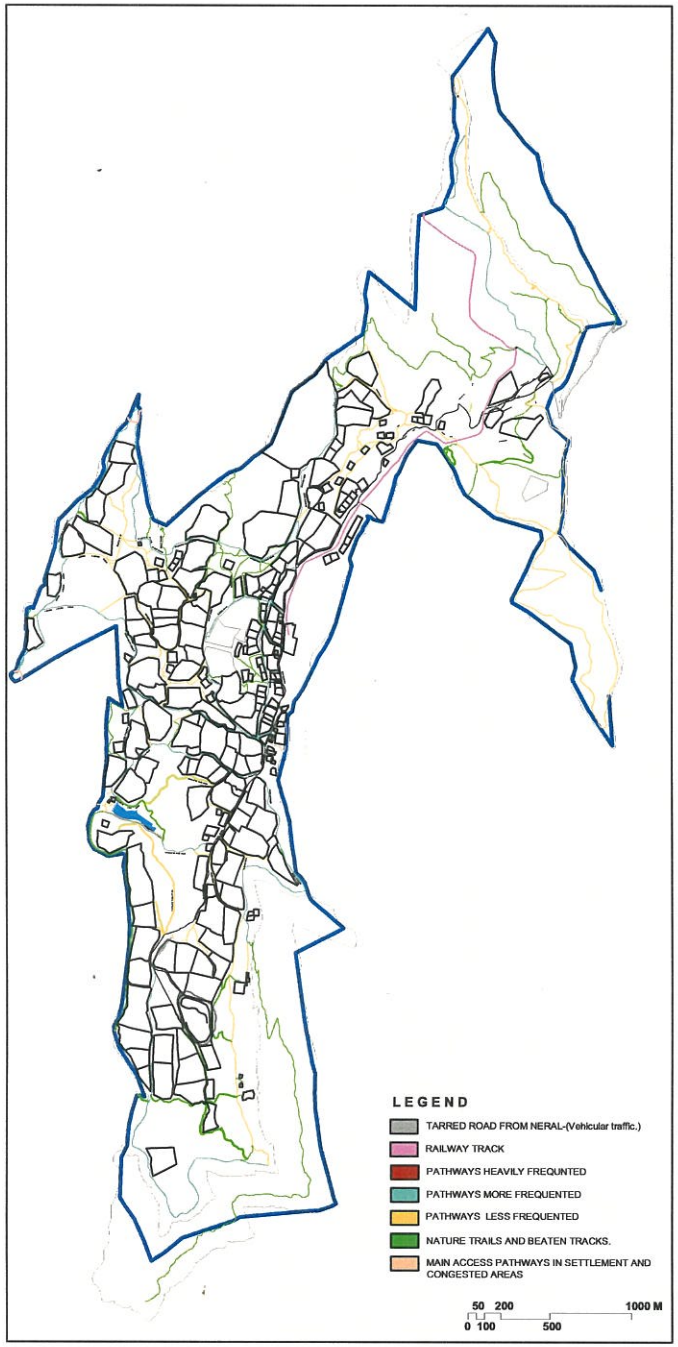
PRIVATE VEHICLES & TAXIS PARKING AREA


Ever-increasing demand for private parking & taxi parking, leading to depleting forest haphazardly.

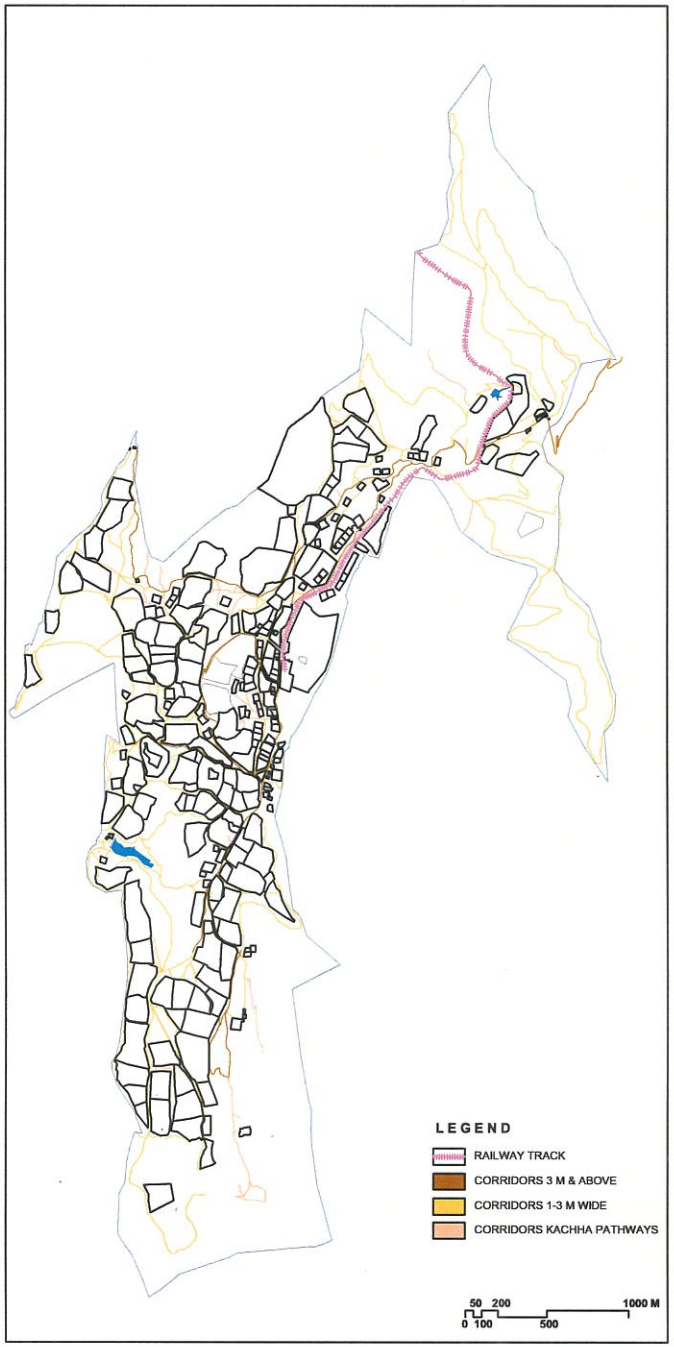
TRANSPORTATION OF GOODS


Distribution of goods under inhuman conditions.

MAJOR MOVEMENT CORRIDORS



FREQUENCY OF PATHWAYS



WIDTH OF PATHWAYS

VERY LESS FREQUNTED WIDE ROAD

HEAVILY FREQUNTED
PATHWAYS IN MARKET AREA

KACHHA PATHWAYS
AROUND OLYMPIA

N

3.2 (D) POPULATION

Tourism is an important aspect of Matheran. For any place to become a tourist attraction, it should have certain unique qualities and a potential to attract tourists, for example the presence of natural features or historical monuments or religious attractions. Matheran is known for its natural environment.

Any tourist area has two major classes of population or people residing at any one given time viz. resident population and floating population. Here the resident population is the locals of the plateau and the bungalow owners. And the floating population is mainly the tourists along with adivasis and villagers from the surrounding gaothans and padas that lie within the region.

Resident population: -

Demographic features: The Census data shows that the permanent residential population was more or less stagnant up to 1961 with an annual growth rate only between 0.12 to 0.17 %. The growth rate is on increase since 1971. This is mainly due to increase in tourism. As per the 2001 Census data the local population within the municipal limits was 5139.

Economic profile: The economy of Matheran capitalizes on its environment and is based on tourism and other dependent occupations. There is no agriculture on the plateau. Less than 1% of the population is engaged in the primary sector, which includes livestock and forestry. 9.71% of the population is engaged in the secondary sector including construction and industry. There is no industrial activity on the hill except manufacturing of handmade articles and leather-ware.
A sizable population (89.67%) is engaged in the tertiary sector - which includes trade and commerce, transport and communication- head loaders, rickshaw-walas, ghodawalas and guides. The flourishing hotel industry supports a large percentage of immigrated employees besides the local residents. *

Floating population: -

Adivasis and villagers: The adivasis and villagers from around the region come from padas and Gaothans namely Ambewadi, Tadwadi, Galpatti, Ashachipatti, Waghachipatti, Dhodani, Katwan, Nimbarwadi, Tepachiwadi, Sondewadi, Chichmal, Gadesh etc. These adivasis and villagers in the gaothans around the main plateau still depend on the natural forests on the plateau and in the region

for fuel wood and domestic consumption. Many are now employed in the tertiary sector or the hotel industry on the plateau.

Tourists: The floating population of tourists is increasing every year. Pleasant climate, unpolluted and peaceful environment and natural beauty are the main reasons why tourists visit Matheran. But, the increasing numbers of tourists visiting Matheran have put pressure on the existing infrastructure and resources. The Matheran hilltop is like an island - any internal/ external pressures on it shall lead to its destruction. There needs to be a balance between utilization of resources and conservation. The entire economy of the hill is dependent on tourism. Hence the sustainability of the hill in terms of providing long-term benefits from this industry is very essential. All stakeholders of Matheran have to be educated and made aware of this immediate need.

Most of the tourists who visit Matheran are from metropolises like Mumbai or Pune. Some of the conventional entertainment or recreational facilities available in these cities are pubs, restaurants, discos, casinos etc. An increasing number of tourists expect similar facilities to be served to them at any tourist destination. They therefore look for lodging and boarding facilities, which offer them more than just stay and accommodation. Most of the hotel industry today is catering to this tourist demand; which has disturbed the natural character of the place.

In the tourist season there is an average of 5000 odd people on the plateau at one time. Hotel records show that on peak tourist days, the number even rises to 10,000 people at one time.

4. ANALYSING THE DATA AND SETTING THE OBJECTIVES AND STRATEGIES

4. ANALYSING THE DATA AND SETTING THE OBJECTIVES AND STRATEGIES

The ecological processes are extremely dynamic through various associations between the landform, geology, hydrology, vegetation and other factors; not only on the plateau but also with the surrounding region. The focus of the study has been to identify these natural processes and their role in imparting a character to the place. A detailed study of all the natural features using the GIS analytical tools was carried out.

METHODOLOGY ADOPTED IN THE GIS ANALYSIS

Setting of values for all the natural ecosystems and natural resources was done with respect to the intact ecological infrastructure of the plateau. Ecologically intact areas were identified through the extensive ground surveys determining the impact of man-made infrastructure on the natural ecosystems. Such areas were assigned various attributes such as the watershed characteristics, vegetation pattern and density of green cover, topography etc. Through the analysis a series of maps were generated to ascertain the value of each area /zone spatially with respect to its interconnectivity in terms of the ecological values. This intrinsic interconnectivity of the natural resources was overlaid with other attributes such as the administrative boundaries etc.

The entire spatial analysis of the areas on the plateau has been done only with respect to their natural ecosystems and natural resources. **This strategy and preference is in keeping with the prime objective of this study which is to assure that the protection and preservation of ecological infrastructure become the primary consideration in all the local land use planning activities for the region.**

Given the existing administrative and political boundaries on the plateau as well as the existing institutional mechanism it was essential to then device a strategy such that the development of the plateau takes place in accordance with the environmental concerns. The enhancement of all the ecological resources of the areas gets incorporated into the planning process by default. The environmental zoning hence has been proposed to follow the administrative boundaries already existing on the plateau. In addition to the development control regulations related to the built form these zones shall have specific regulations. These regulations have been elaborated in the following chapters.

In addition to this the areas which have undergone extensive change and which require several mitigation measures have been identified and several conservation measures have been proposed for the conservation and enhancement of these areas.

With respect to the above understanding the recommendations have been divided into three major categories addressing various concerns viz:

- Recommendations for each **Ecological zone**
- Recommendations for all **Natural heritage sites**
- Recommendations and **detail conservation measures for significant locations** on the plateau

I. Ecological zoning

Firstly **four zones** have been proposed on the plateau and the gaothans around it, based on the ecological aspects of the region. This zoning follows the existing administrative divisions already in place on the plateau for feasibility/ convenience in implementation of policies, which can be directly incorporated into the existing development control regulations on the plateau.

1. **Forest Zone**
2. **Conservation Reserve Zone**
3. **Hill Slope Zone**
4. **Community reserve Zones**

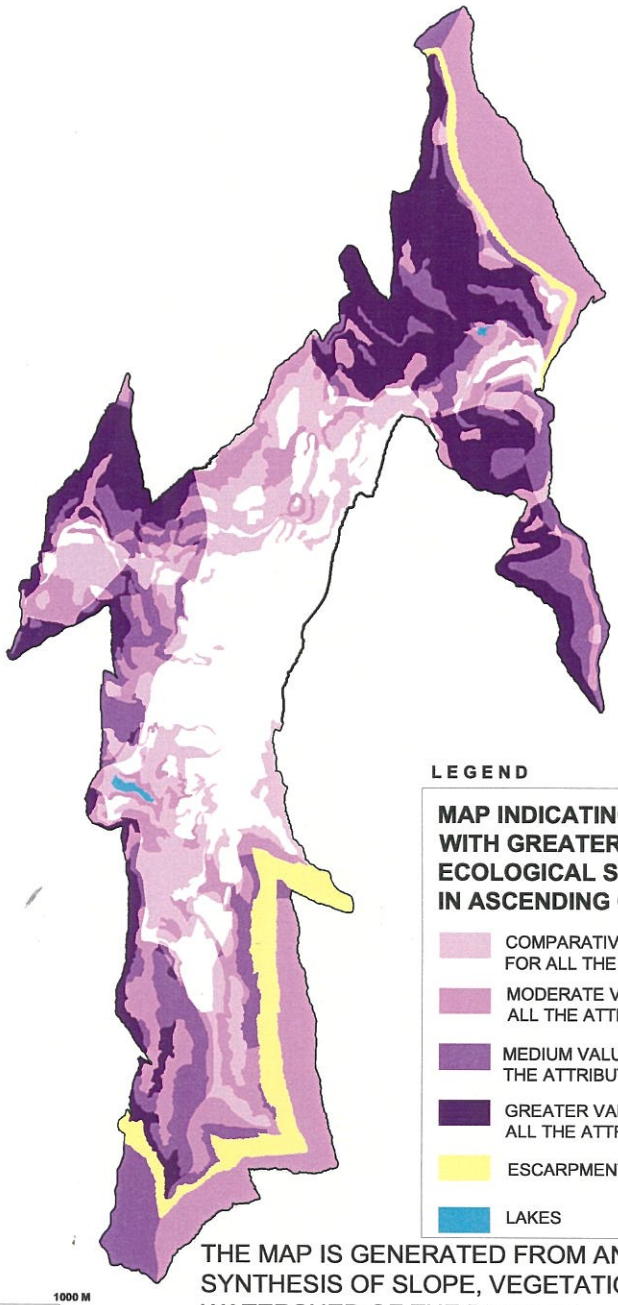
II. Natural heritage sites

In addition to these certain sites of important **natural heritage** need to be identified and demarcated. These require specific plans for their conservation.
These sites shall include sites of valuable natural heritage such as:

- **Areas of geological heritage**
- **Ecological heritage**

III. Detail conservation measures for some significant locations on the plateau

In order to conserve the important natural resources of the plateau, steps need to be taken regarding specific issues. Measures have been recommended for the management of important resources and infrastructural services, to deal with the issues at the micro level and thus minimize the impact of these on the environment.



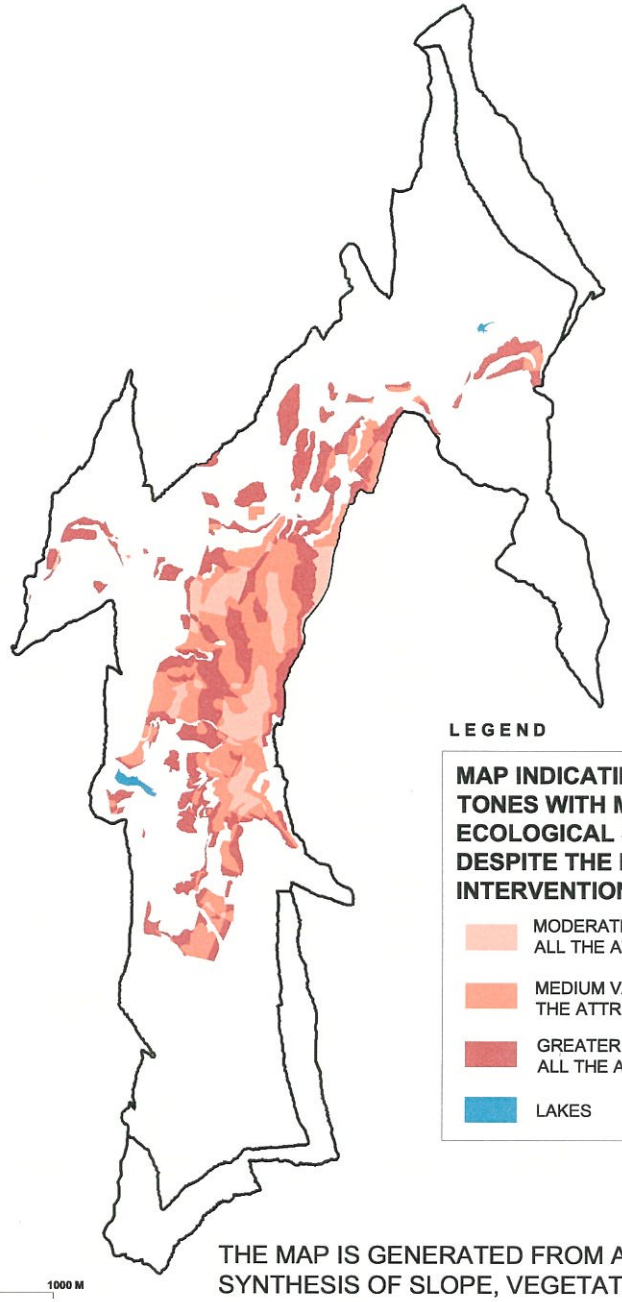
LEGEND

MAP INDICATING TONES WITH GREATER ECOLOGICAL SENSITIVITY IN ASCENDING ORDER.

- COMPARATIVELY LESS VALUE FOR ALL THE ATTRIBUTES
- MODERATE VALUE FOR ALL THE ATTRIBUTES
- MEDIUM VALUE FOR ALL THE ATTRIBUTES
- GREATER VALUE FOR ALL THE ATTRIBUTES
- ESCARPMENTS
- LAKES

50 200 1000 M
0 100 500

THE MAP IS GENERATED FROM ANALYSIS AND SYNTHESIS OF SLOPE, VEGETATION AND WATERSHED OF THE PLATEAU



LEGEND

MAP INDICATING VARIOUS TONES WITH MODERATE ECOLOGICAL SENSOTIVITY DESPITE THE HUMAN INTERVENTION.

- MODERATE VALUE FOR ALL THE ATTRIBUTES
- MEDIUM VALUE FOR ALL THE ATTRIBUTES
- GREATER VALUE FOR ALL THE ATTRIBUTES
- LAKES

50 200 1000 M
0 100 500

THE MAP IS GENERATED FROM ANALYSIS AND SYNTHESIS OF SLOPE, VEGETATION AND WATERSHED OF THE PLATEAU

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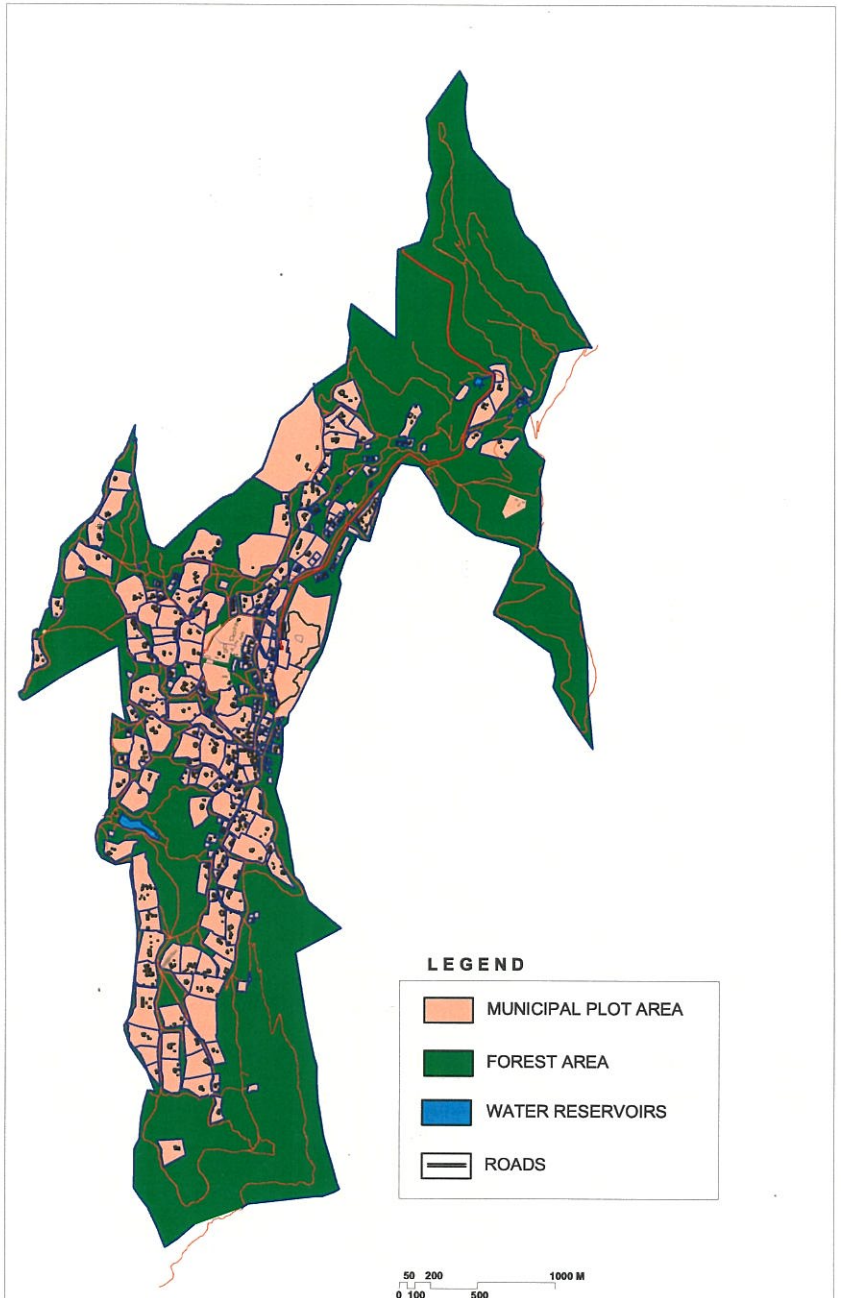
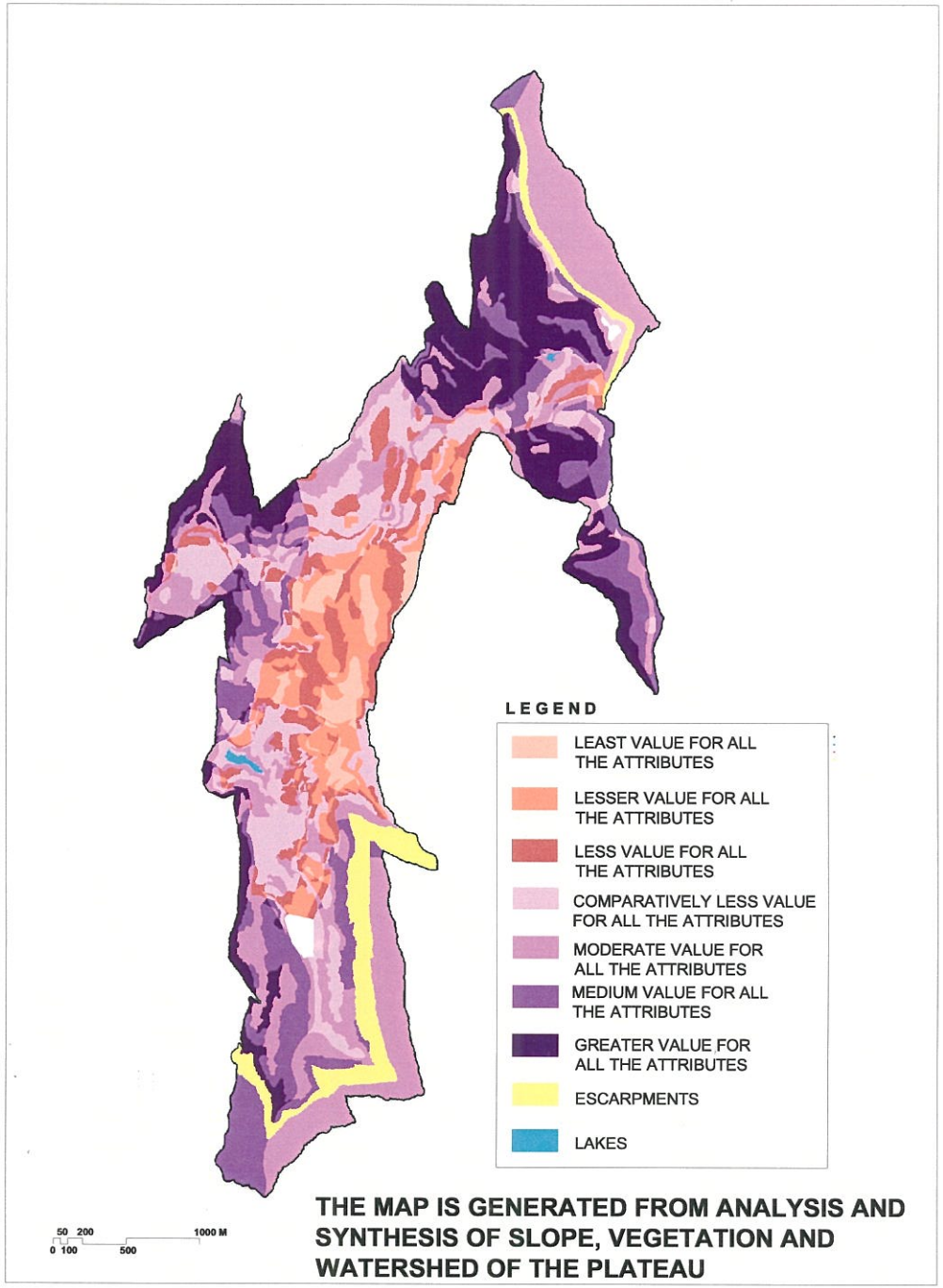


FOREST AREA AND MUNICIPAL PLOTS

AS PER MAP OF MATHERAN HILL STATION, 1903-04



THE MAP IS GENERATED FROM ANALYSIS AND SYNTHESIS OF SLOPE, VEGETATION AND WATERSHED OF THE PLATEAU

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5. INSTITUTIONAL MECHANISM

5. INSTITUTIONAL MECHANISM

The development towards the conservation of all the natural resources requires to be implemented systematically through the existing administrative setup as well as through the already available actors and agencies identified to perform respective tasks.

Institutional mechanism for the implementation and sustenance of the proposed measures has been worked out for the ecological issues identified in the study .Refer to the drawings as well as the chart for the Institutional mechanism .Phase wise implementation plan for the conservation of the natural environment would be prepared for the most critical areas hereafter.
For this purpose various tasks have been identified and the probable collaborative efforts among various actors have been identified and proposed in the following chart. Prior to this there are several measures that require to be undertaken to ensure sustainable participation amongst the stake holders and the actors and agencies.

- Creation of awareness amongst all stakeholders, actors and agencies
- Prevention of social and land tenure conflicts
- Integration of successful natural resources management strategies into economic development plans
- Setting up of an Entrepreneurship Development Cell / Training and research capacity building centre
- To conduct skill development training programmes leading to self/wage employment towards the sustainable rural development in the entire Eco-sensitive zone.

In addition to the institutional mechanism for the implementation of conservation activities and infrastructure development it is also essential to provide a framework for the overall social awareness and social uplift of the local poor through appropriate ways of community participation and the development of education centers in the region.

ACTORS/ AGENCIES ► / TASKS ▼	Central govt.	State govt.	MMC	Land records/ revenue	Central Rly.	Forest dept.	Local residents	Bunga-low owners	Hotel owners	Horse/ pony owners	MTDC	NGOs	Experts	Institutes
Demarcation of forest land		■	■	■		■								
Management of forest	■	■	■			■	■	■	■	■	■	■	■	■
Energy Plantations	■	■				■	■							
Erosion Control measures			■			■						■	■	
Management of Roads			■											
Management of Railway	■				■									
Management of Horses and Ponies			■							■		■	■	
Water management		■	■				■	■	■		■	■	■	■
Sanitation and Sewage management		■	■				■	■	■		■	■	■	■
Soild Waste management		■	■				■	■	■		■	■	■	■
Storm Water management			■			■							■	
Management of Water Bodies and Springs			■			■								
Management of Points			■			■								
Environmental Awareness												■	■	■
Master Planning for Neral Node	■	■			■						■		■	■

6. RECOMMENDATIONS

6.1. GENERAL RECOMMENDATIONS

6.2. ZONAL MASTER PLAN AND ECOLOGICAL ZONING

6.3. NATURAL HERITAGE SITES

6.4. FOREST CONSERVATION AND MANAGEMENT

a. Recommendations for Matheran Plateau and Terraces (Sub- zone)

b. Recommendations for the Matheran Ecosensitive Zone

c. Recommendations for the Lower slopes and Foothills

d. Recommendations for Gaothans and Village areas

6.5. INFRASTRUCTURE

a. Traffic Management

b. Water Management

c. Sanitation and Solid Waste Management

d. Quarrying and Mining

e. Storm Water Drainage System (Soil Erosion)

6.6. TOURISM

6. RECOMMENDATIONS

6.1 GENERAL RECOMMENDATIONS

1. The Regional Plan / Zonal Master Plan for Eco-sensitive Zone and Sub-Zonal Master Plan for the plateau shall comprise of overlay maps (showing forest cover, geology, contours, slope, hydrology-stream flows, etc.)

2. The Government of Maharashtra notification no. TPS 1896/1231/CR 123/96/UD-13 dated 26 November 1996 regarding setting up of new hill stations shall not apply to this Zone.

3. The Government of Maharashtra notification no. TPB-4302/2080/CR-215/02/UD-11 dated 21 August 2004 regarding setting up of new townships or any other similar notification shall not apply to this Zone.

4. No proposed or final amendment(s) to the Sub-Zonal Master Plan by the State Government shall apply unless it is first approved by the Ministry of Environment & Forests.

5. Not withstanding anything contained in any law, rule or regulation in force, no Transfer of Development Rights (TDR) or Development Rights Certificate (DRC) or their equivalent or such similar rights shall be generated or applied in any form or manner on any land in this Zone.

6. The draft / sanctioned Regulations of the Government of Maharashtra regarding permitting development of Information Technology in Agriculture Zone / No Development Zone shall not apply to this Zone.

7. Residential use or purpose does not include resorts, hotels, motels, clubs, institutions or lodging and boarding houses.

8. Trust properties: No transfer, sale or lease of any property belonging to a Public Charitable Trust is permissible unless accompanied by a letter of consent from the Charity Commissioner.

9. No development or user activity shall exceed the noise levels prescribed under the Environment (Protection) Act, 1986. The levels for silence zones shall be made applicable for the Eco Sensitive

Zone. No noise generating activity shall be permitted between 8 pm and 8 am. Use of loudspeakers shall be regulated as per the Rules of the Mumbai Police.

10. The Government of Maharashtra Memorandum no. TPB 4394/1504/CR 287/94/UD-11 dated 22 July 1998 being direction u/s 154 of the MRTP Act regarding installation of Display Boards on Construction sites shall be strictly followed and shall be a condition of sanction, non-compliance of which shall automatically result in revocation of permission.

11. Signage and street furniture shall be permitted only at places approved by the Monitoring Committee.

12. As per the Notification quarrying and mining activities shall be banned in the Eco-sensitive Zone and no fresh mining lease shall be granted.

6.2 ZONAL MASTER PLAN AND ECOLOGICAL ZONING

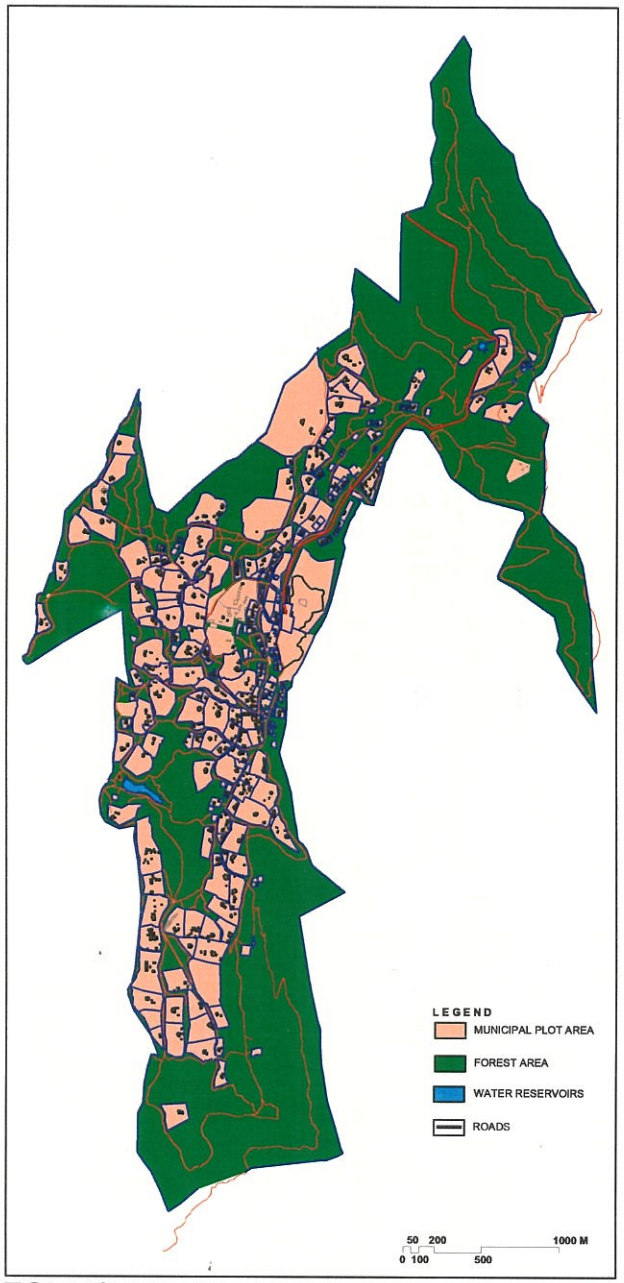
The ecological significance of the crest forest on Matheran plateau has been explained earlier. It constitutes the most important and critical part of the Eco-sensitive Zone. The zoning of Matheran plateau in the Regional Plan of the Mumbai Metropolitan Region shall be changed from Urbanisable Zone 1 (U1) to Eco-sensitive Zone as per the notification.

Through the detail surveys and data for the Matheran plateau, the zonal master plan provides separate regulations for the various environmental zones on the plateau. Four major ecological zones for the plateau are recommended. They are:

1. **Forest Zone**
2. **Conservation Reserve Zone**
3. **Hill Slope Zone**
4. **Community reserve Zones**

This type of zoning is based on the ecological aspects of the region, and has been accepted in principle, for the Master Plan, which is under the preparation for the Mahabaleshwar –Panchagani Eco-sensitive Zone.

The Sub-Zonal Master Plan map is at a scale, wherein, it is not possible to show the Zoning of small parcels of land. If the site conditions satisfy the criteria as laid down in these Regulations, then, notwithstanding the Zone shown on the Sub-Zonal Master Plan map, these Regulations shall govern the development of the land.



FOREST AREA AND MUNICIPAL PLOTS

AS PER MAP OF MATHERAN HILL STATION, 1903-04

HILL SLOPE ZONE

AREA HAVING MORE THAN 20% SLOPE SHALL BE ZONED AS HILL SLOPE ZONE.

THE ZONING OF MATHERAN PLATEAU SHALL BE CHANGED FROM URBANIZABLE ZONE (U1) TO **ECOSENSITIVE ZONE** AS PER THE NOTIFICATION.

ECOLOGICAL ZONING:
THIS BEING AN ECOSENSITIVE ZONE THERE SHALL BE DUAL ZONING, THE OTHER ZONING BEING BASED ON ECOLOGICAL CRITERIA.THIS HAS BEEN RESTRICTED TO CERTAIN AREAS THAT NEED SPECIAL ECOLOGICAL ATTENTION.

FOREST ZONE:

ALL FOREST AREAS UNDER THE CONTROL OF THE FOREST DEPARTMENT SHALL BE ZONED AS FOREST Z ONE IN THE REGIONAL PLAN.

NO DEVELOPMENT OR CONSTRUCTION OR N.A. PERMISSION SHALL BE GRANTED IN THIS ZONE EXCEPT FOR IN-SITU CONSERVATION AND RESTORATION WORK WITHOUT AFFECTING THE ECOSYSTEM AND WITH PRIOR PERMISSION UNDER THE FOREST (CONSERVATION) ACT,1980.

THIS ZONE SHALL NOT BE ENTITLED TO ANY F.A.R.

CONSERVATION RESERVE ZONE:

ALL AREAS OF ECOLOGICAL AND ENVIRONMENTAL IMPORTANCE SHALL BE ZONED AS CONSERVATION RESERVE ZONE.

THIS ZONE INCLUDES ROCKY PLATEAUS AND THEIR IDENTIFIED SLOPES, ORIGINS OF WATERFALLS, EDGES OF PLATEAUS, SMALL PLATEAUS BELOW THE MAIN PLATEAU, ORIGINS OF SPRINGS AND PERENNIAL STREAMS.
AREA HAVING FOREST COVER WITHIN MUNICIPAL PLOTS SHALL BE DEMARCATED ON SITE BY A PROPER SURVEY (SUBJECT TO GROUND TRUTHING) AND SHALL BE ZONED AS CONSERVATION RESERVE ZONE.

NO DEVELOPMENT OF THESE AREAS SHALL BE PERMITTED EXCEPT FOR IN-SITU CONSERVATION AND RESTORATION WORK.

THIS ZONE SHALL NOT BE ENTITLED TO ANY F.A.R.

ACTIVITIES SUCH AS AGRICULTURE, FLORICULTURE, HORTICULTURE, GRAZING SHALL NOT BE PERMITTED IN THIS ZONE.

HILL SLOPE ZONE:

THE HILL SLOPE ZONE COMPRISES OF ALL LANDS WITH A SLOPE OF 20 DEGREES OR MORE.

NO DEVELOPMENT OF ANY TYPE OR KIND SHALL BE PERMITTED IN THE HILL SLOPE ZONE.

WHERE PART OF THE LAND FALLS WITHIN HILL SLOPE ZONE (THE AFFECTED AREA) AND PART IN THE RESIDENTIAL ZONE/ GREEN ZONE / GAOTHAN/ GAOTHAN EXTENSION (THE UNAFFECTED LAND) DEVELOPMENT OF THE UNAFFECTED LAND MAY BE PERMITTED PROVIDED THAT THE MINIMUM AREA OF THE UNAFFECTED LAND IS 500 SQ. M. THE TOTAL F.A.R. THAT CAN BE CONSUMED ON THE PLOT SHALL BE THE MINIMUM OF THE F.A.R. OF THE PLOT AND 1.5 TIMES THE F.A.R. PERMISSIBLE ON THE UNAFFECTED LAND.

N

1. Forest Zone

This zone comprises of lands declared as forest under various Acts and Orders of the court.

As per the notification, all activities in the forest, within and outside, municipal areas shall be governed by the provisions of Indian Forest Act, 1972 (16 of 1972) and Forest Conservation Act, 1980(69 of 1980). All activities in the protected areas shall be governed by the provisions of the Wild life (protection) Act 1972. All forest areas should be properly demarcated.

By the order of the Supreme Court dated 12-12-96 in Writ Petition (civil) no 202 of 1995, forest areas on private lands shall be considered and treated as forest, and forest rules shall apply. These areas need to be demarcated on site through proper survey.

1.1 No development, construction or N.A. permission shall be granted in this Zone except only for the bona fide use of and for the Forest Department for in situ conservation and restoration work without affecting the ecosystem of the area and with prior permission under the Forest (Conservation) Act, 1980.

1.2 No diversion of forestlands for non-forest purposes shall be permitted except for Government projects when absolutely no other land is available.

1.3 This Zone shall not be entitled to any F.A.R.

2. Conservation Reserve Zone

All large properties in the Matheran Municipal council area have an area covered with forest. All the forested areas on lease properties shall be identified and marked on maps and declared as Conservation Reserve Zone so that it is not put to any other use in the future.

These areas are very essential for maintaining the ecological and environmental balance of Matheran and for maintaining the scenic beauty.

All areas of ecological and environmental importance shall be zoned as Conservation Reserve Zone.

2.1 This Zone shall include forested areas of all Plots, rocky plateaus, escarpments, gallery below Matheran plateau, 100 m. aerial distance from origins of waterfalls, 50 m. from edges of plateaus, upper valley portion and small plateaus below the main plateau.

2.2 No development of these areas shall be permitted unless for in-situ conservation work with the prior approval of the Monitoring Committee of the Matheran Eco Sensitive Zone / Ministry of Environment & Forests in consultation with the Forest Department.

2.3 Provided that only temporary structures connected with in situ conservation work may be permitted provided that temporary structure(s) do not stand for more than a year and leave no footprint when removed.

2.4 Provided further that no temporary structure(s) shall be permitted to be constructed during the monsoon period i.e. 1st June to 30th September.

2.5 This Zone shall not be entitled to any F.A.R.

2.6 Activities such as agriculture, floriculture, horticulture and grazing shall not be permitted in this Zone.

2.7 Trees shall not be planted on rocky plateaus. The only activity permitted on rocky plateaus shall be walking along identified pathways.

2.8 Retaining walls constructed for soil and moisture conservation shall be of dry stone masonry only and shall not exceed 1.2 m. from the average ground level.

3. Hill Slope Zone

All areas with a slope of 20 degrees or more shall be zoned as hill slope zones.

3.1 **No development shall be permitted in this zone.**

3.2 Not withstanding anything contained by any other law or regulation in force no development of any type or kind shall be permitted in the hill slope zone.

3.3 Where part of the land of a plot falls within Hill Slope Zone and part outside (the unaffected land), development of the unaffected land may be permitted provided that the minimum area of the unaffected land is 500 sq. m. The total F.A.R. that can be consumed on the plot shall not exceed 1.5 times the F.A.R. permissible on the unaffected land.

Sample Case :
Total land area :- 1 Hectare
Land having slope less 20° :- 0.60 ha. (unaffected land)
Land having slope 20° or more :- 0.40 ha. (affected land)
F.A.R. permissible:- 0.10
F.A.R allowable over an unaffected land
(a) 0.6 x 0.1 = 0.06 ha. (regular F.A.R.)
(b) 0.4 x 0.1 = 0.04 ha. (F.A.R. of affected land)
(c) Total = (a) + (b) = 0.1 ha. i.e. 1000 sq. m.
(d) Maximum permissible F.A.R. = 1.5 x (0.6 x 0.1) = 0.09 ha. i.e. 900 sq. m.
Maximum F.A.R. that can be consumed on the unaffected land = Minimum of (c) and (d) i.e. 0.09 ha. i.e 900 sq. m. and no F.A.R. shall be permitted to be consumed on the affected land.

4. Community Reserve Zone

Areas near/around the adivasi Gaothans shall be demarcated and zoned as community reserves. In this area energy /fuel plantation, agro forestry, use of alternative sources of fuel shall be encouraged.

4.1 Forest departments, eco development schemes, can be introduced for the benefit of villages in these sensitive areas.

4.2 Only organic agriculture for locals needs/ agro forestry shall be permitted in this Zone.

4.3 Activities such as bee keeping, grazing in restricted areas, shall be permitted in this zone.

6.3 NATURAL HERITAGE SITES

Besides the four major zones for the plateau, there are natural heritage sites, which require plans for their conservations. The state government needs to formulate and implement strict guidelines to discourage construction activities at or near these sites.

These sites shall include sites of valuable natural heritage such as:

- **Areas of geological heritage**
- **Areas of ecological heritage**

"Sites of valuable natural heritage on the plateau shall be identified. These shall include rock formations, waterfalls, pools, springs, gorges, groves, caves points, walks and rides and the like and plans for their conservation in their natural setting shall be incorporated in the Master Plans. Strict guidelines shall be drawn by the state Government to discourage construction activities at or near these sites including under the garb of providing tourist facilities. Development and construction activities shall be regulated as per the statutory provisions of the state government made in accordance with the Model Regulations for Conservation of Natural and Man-made Heritage Sites formulated by the ministry of Environment and forests"1995 and as amended from time to time. The State Government shall draw up proper plans for their conservation and preservation within one year from the date of publication of the notification."- Notification.

Sites of valuable natural heritage shall also include areas of geological heritage and ecological heritage that have been identified.

a) Origins of waterfalls:

Recent studies have shown that the origins of waterfalls are home to and repositories of a number of endemic species of flora. These areas need to be zealously guarded.

- The origins of waterfalls need to be preserved, conserved and protected. Hence no development of them and around them shall be permitted.
- The origins of waterfalls shall be zoned as Conservation Reserve Zone. In delineating the Conservation Reserve Zone around the origin of the waterfall, a circle of 100 m. aerial distance for the origin of waterfall shall be considered.

- All steps shall be taken to ensure that there is absolutely no pollution of water upstream, as this would affect the flora at the origin of the waterfall.

b) Rocky outcrops/ exposed rocky plateaus:

The Lateritic tops of the Western Ghats possess characteristic vegetation. Plateaus have grassy, ephemeral, herbaceous flora, and scrubby vegetation and generally have less tree cover. Many of these species are recorded in the "Red Data book". Botanically very little is known about them and their economic and medicinal values are still unknown to science. Plateaus of the Western Ghats of Maharashtra are Ecologically Sensitive areas and Regions of Endemism and Speciation.

Matheran is an isolated plateau. Exposed rocky Lateritic outcrops, seen at Olympia, Rugby, Mount Berry, Governor's hill, Rajasthan bungalow, etc., could be habitats of important endemic and threatened plants. Certain exposed rocky habitats in Matheran have already been destroyed or greatly disturbed due to excessive construction and inappropriate land use. This is evident on the Rugby plateau due to construction of buildings, swimming pools, flowerbeds, lawns, gardens, and at the Olympia racing ground due to trampling by horses, leveling and clearing of vegetation. Areas that are so far undisturbed need to be given complete protection. A survey needs to be carried out to assess the character of herbaceous flora and its local, regional and national importance. Measures of conservation will depend on the surveys findings.

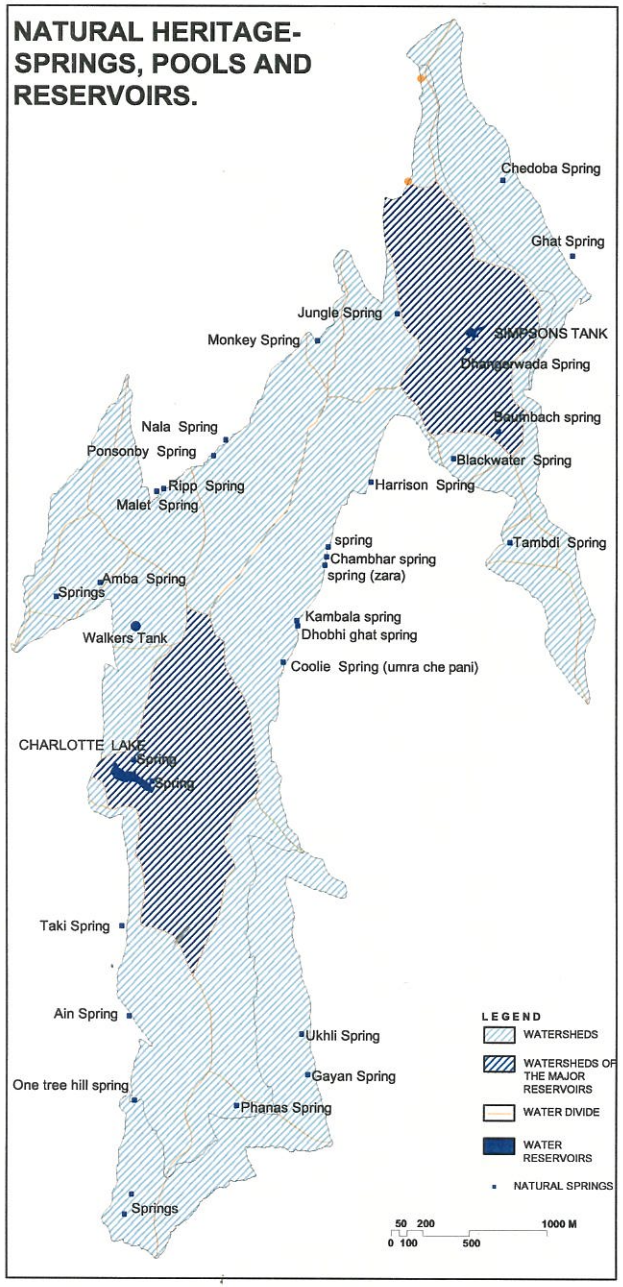
- There shall be a ban on any kind of change in land-use on these plateau tops and some of the unfortunate trends that have happened in the past shall be reversed.
- All Lateritic caps and rocky plateaus in Matheran shall be declared as areas of geological interest and shall be included in the list of sites of Natural Heritage.
- Those habitats that are so far not disturbed shall be preserved at any cost. Plateaus and their slopes shall be zoned as Conservation Reserves.
- Horse riding shall not be allowed on the undisturbed plateau tops. Walking on the plateau top shall be restricted to a few identified pathways. No other form of land use shall be permitted in these conservation reserves.
- No planting of trees shall be permitted on these rocky plateaus.
- Grazing shall be actively discouraged on these rocky plateaus.
- Quarrying shall not be permitted anywhere in this Zone.

c) Sites of Special Scientific interest and Heritage Biodiversity areas:

Certain endemic or rare plants are confined to particular localities on the plateau. These could be old growth forests, near virgin or natural forests or areas having high biodiversity. Among the reserve forest areas these areas should have special status and should not be disturbed. These areas need to be preserved/ conserved as they are important as seed banks.

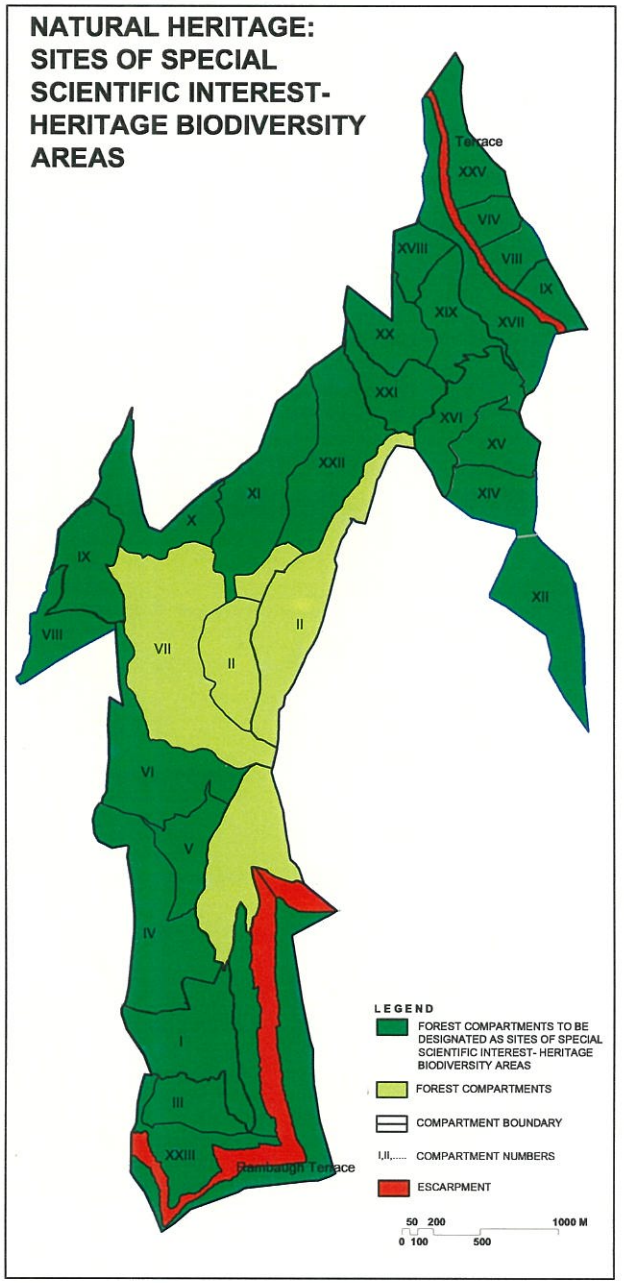
- These areas are to be designated as areas of Special Scientific Interest and shall be included in the list of sites of Natural Heritage. Forests around Simpsons tank, Vetal temple, Jungle stream, Olympia, Charlotte lake, Pisarnath temple on the Matheran plateau and Rambagh terrace shall be declared as heritage biodiversity areas and shall be included in the list of sites of natural heritage. These may be given the status of Devrais to get social and religious protection.
- Tribals, and villagers shall be educated to prevent further exploitation and tree felling in these areas.
- These areas shall be monitored regularly by the Forest Department.
- Certain areas shall be demarcated as observation plots. Quantitative surveys shall be carried out in these areas to find out the status of vegetation.

NATURAL HERITAGE- SPRINGS, POOLS AND RESERVOIRS.



NATURAL HERITAGE: ROCKY PLATEAUS, ESCARPMENT, POINTS, WATERFALLS

NATURAL HERITAGE: SITES OF SPECIAL SCIENTIFIC INTEREST- HERITAGE BIODIVERSITY AREAS



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SITES OF NATURAL HERITAGE:

SITES OF NATURAL HERITAGE SHALL INCLUDE ROCK FORMATIONS, WATERFALLS, POOLS, SPRINGS, GORGES, CAVES, POINTS, WALKS, RIDES ETC AND AREAS OF ECOLOGICAL HERITAGE AND GEOLOGICAL HERITAGE THAT HAVE BEEN IDENTIFIED. PLANS FOR THEIR CONSERVATION IN THEIR NATURAL SETTING SHALL BE INCLUDED IN THE ZONAL MASTERPLAN AND SUB ZONAL MASTERPLAN.

6.4 FOREST CONSERVATION AND MANAGEMENT

Matheran forest is a climax ecosystem that has unique biodiversity and is extremely fragile. *"The moist semi evergreen seasonal cloud forest is very typical of this area. Once lost such forest may never regenerate to its original state."* [1] Any disturbance to the forest will result in permanent damage to the fragile ecosystem of Matheran.

Certain recommendations are applicable to both the Matheran plateau (Sub-zone) as well as the Eco-sensitive Zone, as ecological boundaries do not follow revenue boundaries.
Some are specific to the lower slopes, community reserves or Gaothan areas. Where recommendations are pertaining to a specific area only, this has been mentioned.

6.4 (A) RECOMMENDATIONS FOR MATHERAN PLATEAU AND TERRACES (SUB-ZONE)

- The diversion of forestland for non-forest purposes, shall, as a rule not be permitted. There shall be absolutely no diversion of forest land under any circumstances.

- Certain lands have been disforested/ shown as disforested on the map with the Forest Department. Since the date of the gazette/ notification there has been no non-forest land use in these areas and since these areas still have good forest value, these lands shall revert back to the Forest Department.

- By order of Supreme Court dated 12-12-96 in Writ Petition (Civil) No. 202 of 1995, forest areas on private lands shall be considered and treated as forest and forest rules shall apply. These areas shall be demarcated on site through a proper survey.

- Forests around Simpson Tank, Vetal temple, Jungle stream, Charlotte Lake, Pisarnath Temple and Rambaug are rich in biodiversity and shall be protected and conserved at all costs. Observation plots shall be demarcated and studied in these areas. These forests shall also be declared as Sites of Special Scientific interest or Heritage Biodiversity Areas, to highlight their importance.

1. Reference Dr. Rachel Reuben, Honorary Secretary, BNHS, Mumbai

Management of forest areas on the Matheran plateau and terraces

- There shall be no use of forested land for any non-forest purpose excepting. any work related to conservation and management of forests and wildlife.
- Incineration of garbage and burning of leaf litter/ dried grass in forest areas shall be prohibited.
- Activities such as camping, in forest areas shall be banned.
- Horses shall not be tethered or let loose in forests.
- Topsoil shall not be removed from the forests.
- Trampling of undergrowth or vegetation in forest areas by horses and people shall be prohibited.
- Horse dung shall not be disposed off in forests.
- Movement of goats and cattle in forest areas shall be prohibited. Grazing shall not be allowed on the plateau forest. Stall-feeding for domesticated animals shall be made compulsory and adequate facilities shall be provided. Movement of goats and cattle in forest areas shall be restricted.
- Particularly degraded areas that are in need of regeneration or areas that need to be protected or are under threat shall be fenced off.
- The population of monkeys (Bonnet maquacue) on the plateau that has increased considerably shall be controlled by translocating them to other areas. Tourists and local people shall be discouraged from feeding monkeys.
- Dumping of plastic/ garbage shall not be allowed in forest areas.
- Defilement of the jungle inside/ outside the compound renders the offender liable to prosecution under section 268, 278, or 290 of the Indian penal code, 1860 or under section 117 read with section 108 of the Bombay Police Act 1951. (1959 – rules and orders of Matheran issued under the authority of Government for the guidance of lessees, visitors and others)

- Use of chemical fertilizers, pesticides and insecticides shall not be permitted in this Sub-Zone; organic substitutes shall be promoted and used.

- Commercial exploitation of forests in this Sub-Zone shall not be permitted.

- Only wood from energy plantations shall be permitted to be used as fuel wood. The Matheran Municipal Council shall procure wood from outside the Eco-sensitive Zone or from the energy plantation areas within the zone to provide wood for cremation / fuel-wood in Matheran.

- Lopping of trees for fodder shall be prohibited. Forest undergrowth / vegetation in the climax forest shall not be used as fodder for cattle.

- Ecological restoration activities shall be undertaken in areas that are already disturbed or devastated. For all ecological and environmental restoration and conservation works, suitable agencies, subject experts, authorities and N.G.O s shall be short-listed. The works should not be executed only by the Municipal Council or the Forest Department.

- Site-specific restoration measures shall be taken up depending on ground cover, natural regeneration, soil cover and soil depth. Leaf litter / compost shall be used to restore soil cover in places where topsoil has been lost due to severe erosion. Bunding shall be carried out where necessary for moisture retention. Herbs or pioneer plants shall be planted to restore ground cover and prevent erosion.

- Plantation of trees conducive to growing in degraded areas shall be carried out where natural regeneration is absent. Trees, wherever required to be planted, shall be of local, endemic and indigenous species only. Monoculture shall not be permitted.

- A seed bank of indigenous trees shall be established on the plateau for the propagation of indigenous species for plantation on the plateau. Measures shall be taken to propagate rare and endemic species. The forest department shall start a nursery of indigenous endangered and endemic plants.

- The Forest Department needs to be strengthened by providing them with horses, communication equipment, fire fighting equipment, more manpower, women guards, etc.

- Suitable hedge plantation shall be provided along roads to act as live fencing to prevent movement and encroachment in forest areas, screening off dust and encouraging natural regeneration.

Indigenous trees, herbs, shrubs, climbers that shall be used for reforestation on the plateau are listed in ***annexure-XI***
Indigenous trees, herbs, shrubs, climbers that shall be used for plantation on the terrace are listed in ***annexure- X***

Recommendations regarding trees on the plateau

- A lessee shall have no title to the trees standing on his leasehold site or to any part or produce there of.

- There shall be no felling/ pruning of trees whether on forest, Government, Revenue or private lands, without the prior permission of the State Government in case of forest land and the respective district Collector in case of state Government, Revenue and private land, as per procedure which shall be laid down by the state Government. Tree preservation orders have to be placed to prevent their removal or mutilation.

- If a tree has been cut on a property without clearance, then in addition to action under the relevant laws, not withstanding anything contained in any law, rule or regulation in force, no development permission shall be given on that property by the Appropriate Authority till an endemic tree has been planted in its place and its survival ensured for three years after plantation; planting a three year old tree shall not be considered as sufficient.

- Trees where required to be planted shall be of local endemic and indigenous species only. *See* ***annexure- XI.***

- The owner/ occupier of any property shall ensure the survival of any tree planted/ replanted for three years from the date of planting/ replanting. If the tree does not survive then another tree shall be planted in its place.

- The Matheran Municipal Council shall appoint a suitable agency to carry out a tree census within the municipal plots on the plateau. Each tree shall be numbered with permanent marking. The

number as well as species of trees in each plot shall be recorded. Rare endemic trees shall be given additional protection. Measures shall be taken for the germination and propagation of these species without delay and their distribution or plantation in other areas should be encouraged.

- Burning of trees / leaf litter / dried grass near tree trunks or in the hollow portion of trees shall not be permitted or undertaken.

- Signage / advertisements on rocks and trees shall be prohibited.

Recommendations regarding forest areas, development and landscaping within municipal plots on the plateau

- All large properties in the Matheran Municipal council area have an area covered with forest. All the forested areas on lease properties shall be identified and marked on maps and declared as Conservation Reserve Zone.

- Demarcation of Conservation Reserve zone shall be the first activity to be undertaken jointly by the Forest Department, Matheran Municipal Council and the Monitoring Committee of the ESZ.

- It shall be mandatory, except for plots within 54 acres of the bazaar area, to show all physical features within a distance of at least 300 m. from the plot boundaries on the key plan such as forest areas with an inventory of the number of trees on site, water bodies, natural drainage channels, view points, springs and structures. The site plan must incorporate or attach:
  1. Original contour plan showing alignments of the natural drainage channels.
  2. Vegetation plan-including trees, existing vegetation, pathways, terracing, retaining walls and other landscape features.
  3. At least two sections through the site, indicating land gradient, existing structures, implications of new proposals and its effects on the topography and terrain.

- A careful landscape ecology appraisal of the site will be a central element of any development/ design brief. Details including an assessment of impact of the proposed development and any appropriate measures to alleviate this shall be submitted for approval.

- Not withstanding anything contained in any law, rule or regulation in force, sub-division of any plot shall not be permitted, as it will lead to scattered development into forested lands, causing fragmentation of forested lands.

- No relaxation of regulations governing Hill Slope Zone, Conservation Reserve Zone, and areas of Natural/Geological Heritage, Sites of Special Scientific Interest/ Biological Heritage shall be permitted. Heritage regulations provide for the relaxation of other regulations to protect, preserve, conserve, restore or retain the heritage site. This should be amended. No additional buildings, whose construction may take place on areas to be declared as Conservation Reserve zones, shall be permitted.

- Scattered development within a plot is not to be allowed. The built forms should have cohesive and closely linked layouts, so as not to affect the forest cover in the plots. There shall be only one dwelling unit in each residential plot for the *bona fide* use of the owner. A small outhouse in the form of servants quarters may be permitted on the rear of the plot with plinth area not exceeding 25 sq. m. Cottages for commercial development like hotels, lodging and boarding houses, etc. shall not be permitted.

- All development, which requires the removal of trees, or any tree cutting, shall not be permitted or shall seek replacements.

- Landscaping shall be permitted only for restoring the native ecology and habitats and no exotic species shall be used / introduced.

- Natural soil, rocks, vegetation or undergrowth shall not be cleared for any purpose such as paving, creation of pathways, landscaping, etc.

- Lawns, exotic ground covers, and flowerbeds shall not be used in landscaping. There shall be no removal of natural ground cover, soil, rocks, vegetation or grass for the purpose of growing lawns.

- Hard paving shall not be permitted in Municipal limits except for walking paths which shall be of porous paving material. (E.g. laterite).

- The existing slopes shall be maintained and the topography of the land shall not be disturbed while developing the land, except where terracing is permitted under these Regulations, for soil and moisture conservation activities.

- Boundary walls shall not exceed 0.75 m. in height above which a 0.45 m. high fencing may be permitted.

- The owner of each plot shall prove the existence of a minimum of 8 trees of local, endemic and indigenous species per 100 sq. m. of plot area.

- Retaining wall constructed for soil and moisture conservation shall be of dry stone masonry only and shall not exceed 1.2 m from the average ground level.

- Agriculture, Floriculture, horticulture and grazing shall not be permitted within municipal plots.

- No development shall be permitted in a 15 m. wide belt on both sides of streams, nallahs, rivers and other watercourses, 50 m. from water bodies and 100 m. from origins of waterfalls.

(*List of indigenous plants to be used for landscaping on the plateau are mentioned in* ***annexure- XII***

Management of fuel demand in the Sub zone

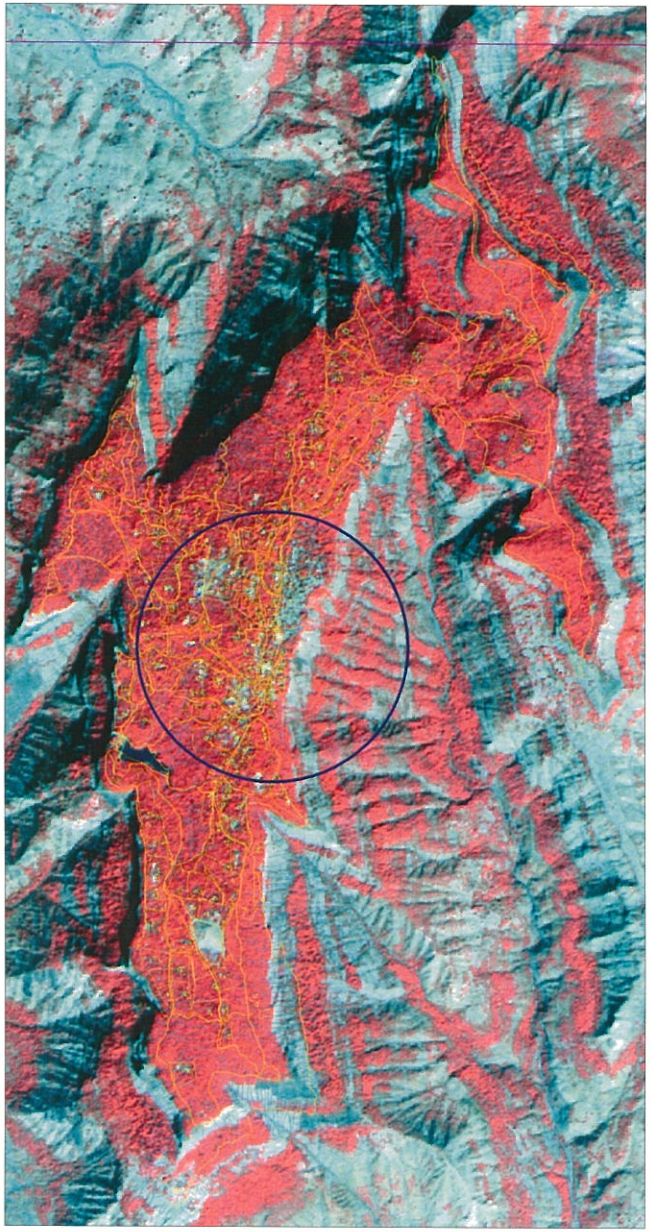
- There shall be no exploitation of the crest / terrace forest to meet fuel wood demand on the plateau.

- Wood from the energy plantation on the lower slopes could be used for fuel. But to reduce pressure on forests, alternative sources of fuel such as biogas, kerosene, L.P.G shall be encouraged.

- For cremation an alternative could be an electric cremation center. This could be constructed taking into account the rules and norms with respect to the E.S.Z. and the approval of local people. No wood from the Sub-Zone shall be used as fuel wood for cremation purposes. The Forest Department shall procure and sell wood for cremation from wood obtained either from energy plantation within the Eco-Sensitive Zone or from outside the Matheran Eco Sensitive Zone.

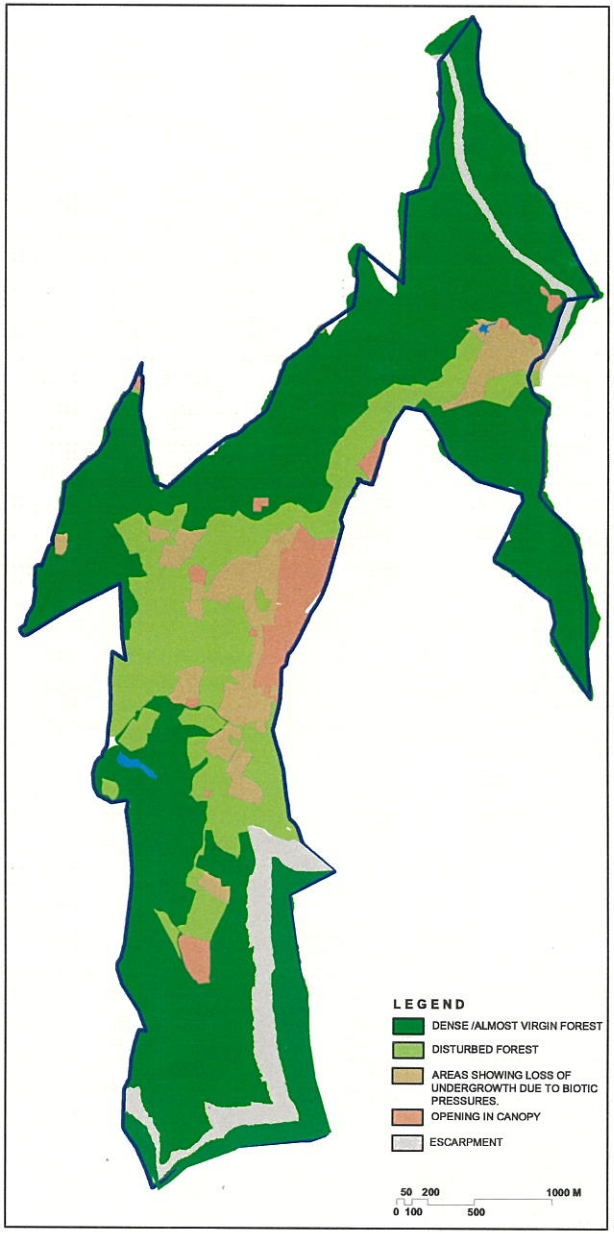
- Solar assisted water heating systems shall be mandatory.

- In the Sub-Zonal Master Plan for Matheran, reservations shall be made for installation of Kerosene Pump(s).



SATELLITE IMAGE SUPERIMPOSED WITH LANDUSE MAP SHOWING LOSS OF CANOPY COVER IN DUE TO URBANIZATION AND THE CONSTRUCTION OF LARGE HOTELS.

IMAGE:- IRS P6 Taken in February 2005



VEGETATION MAP SHOWING DISTURBED FOREST AREAS AND AREAS SHOWING LOSS OF UNDERGROWTH DUE TO INCREASING BIOTIC PRESSURES.

Note:- As per existing visual surveys between Feb 2005 to July 2005

DENSE /ALMOST VIRGIN FOREST

DISTURBED FOREST AND AREAS SHOWING LOSS OF UNDERGROWTH DUE TO BIOTIC PRESSURES.

OPENING IN CANOPY

N

6.4 (B) RECOMMENDATIONS FOR THE MATHERAN ECOSENSITIVE ZONE

Biodiversity conservation

- A detailed study lasting at least one year shall be carried out to record the flora and fauna of this Sub-Zone; to check the status of different species, to ascertain if they are locally extinct, endangered or threatened, to understand the impact of development, or if there is any change in structure / nature of forest, and the impact future developments could have. Such detailed studies about associations shall be useful for developing a long-term strategy for the conservation of these species. A detailed Environment Impact Assessment, for the plateau, terrace and the Eco Sensitive Region shall be sanctioned by the Government.

- The Master Plan, including all its components, for the Matheran Eco-Sensitive Zone shall be approved by the Ministry of Environment and Forests (M.O.E.F.) Zone, only after the relevant provisions of the Biological Diversity Act 2002 have been implemented. Further, the Master Plan, including all its components, shall be approved only after a detailed bio-assessment of the Eco-Sensitive Zone during all seasons has been carried out.

- There shall be no disturbance to the natural vegetation. Tree cutting, removal of lianas, climbers, shrubs and saplings shall be prohibited.

- Removal of dead wood unless obstructing a path, ride or road shall be prohibited.

- Removal of shrubs or undergrowth from the forests shall be prohibited.

- Collection, sale, trade of endemic plants, orchids, mosses, lichens, ferns, shall be prohibited.

- No collection of biological material like endemic plants, orchids, mosses, lichens, and ferns shall be permitted except by reputed institutions and organizations working in the field of in-situ ecological conservation and with the prior written permission of the Monitoring Committee.

- No exotic species of flora or fauna shall be introduced to the region without prior written permission of the Ministry of Environment and Forests in consultation with the Monitoring Committee, Forest Department, experts and NGO's.

- Required studies shall be undertaken and plans for the conservation and protection of threatened and endangered species shall be made. Further work needs to be undertaken during the monsoon to understand the endemic, endangered as well as the vulnerable species of the ephemeral.

Management of forest areas in the Eco-sensitive Zone

- *A specific Forest Protection Plan shall be prepared by the Maharashtra State Forest Department and necessary funds for the implementation of the protection plan shall be provided by the State Government on a priority basis.*

- The Forest Departments on the plateau and the region need to be strengthened and better equipped. Female forest guards shall be appointed to prevent female woodcutters engaged in illicit cutting and felling of trees.

- Lopping of trees in forests for fodder should be banned and they should be grown in the Community Reserves around villages.

- The felling of trees in natural forests shall be totally prohibited.

- There shall be a ban on commercial exploitation of natural forests in the Eco-sensitive region. Efforts shall be taken by the forest department to stop illicit trade in timber and forest produce, by providing education and alternative sources of income to local adivasis and villagers.

6.4 (C) RECOMMENDATIONS FOR THE LOWER SLOPES AND FOOTHILLS

Fuel wood plantations

- Energy plantations shall be taken up on priority basis, especially around those areas from where people resort to cutting the trees of Matheran forests. Villages and suitable areas in the community reserves on the lower slopes in /around Gaothans shall be identified for fuel wood plantation through JFM(Joint forest management) on the lower slopes (up to 400 m. altitude) to provide sufficient quantity of cheap firewood to the local villagers thereby removing pressure on the invaluable trees in the natural forests.

- Afforestation programmes shall involve local villagers. The energy plantation shall be managed by local village women.

- Indigenous trees shall be used for fuel wood plantation in the Eco-sensitive Zone as far as possible. Certain fast growing species like bamboo/ Casuarinas may be planted for immediate supply of fuel and other economic benefits.

- Mixed plantation shall be carried out and monoculture shall not be permitted in energy plantations.

- Sale of fuel wood except that procured from the energy plantation shall be stopped.

Indigenous trees that shall be used for energy/ fuel wood plantation are listed in ***annexure- IV***

Forest fires

- Burning of slopes shall be prohibited in the Eco-sensitive Zone.

- Fire tracing in susceptible areas is necessary and shall be given priority.

- Adequate firewatchers shall be deployed by the Forest Department for their early detection and control.

- Watch towers, with communication facilities, shall be constructed by the Forest Department for early detection of forest fires and detect illegal tree felling.

- Fire beating equipments shall be made available at areas prone to forest fires.

- Forest and/or village protection Committee shall be set up in Matheran and every village in the Matheran Eco Sensitive Zone to control forest fires. A JFM committee shall be established in the villages to control forest fires.

- Police Patils in villages should be made responsible for forest fires within their jurisdiction.

- Fire lines shall be maintained.

Soil, moisture conservation and ecological restoration

- Soil and moisture conservation, and erosion control shall be given top priority.

- Suitable slopes shall be identified to carry out soil and moisture conservation activities.

- Earth or stone bunds shall be created to prevent any further soil erosion and to slow the flow of water downhill.

- Contour trenching or creation of pits shall be carried out on suitable slopes to collect soil that is being washed down and retain moisture. These will collect organic matter and silt. When this happens trees can successfully be planted in them.

- On steep slopes vegetative barriers shall be planted along contour lines to prevent soil erosion. This work shall be carried out by the JFM committee.

- Grazing / range feeding should be restricted to only identified areas. Stall feeding as opposed to grazing / range feeding shall be encouraged, promoted and implemented. Grazing shall be managed by the JFMC.

- Wastelands shall be identified and marked on maps. Certain areas shall be fenced off for protection. Fencing should as far as possible be live fencing.

- Denuded areas in the lower slopes shall be identified. Barren areas should be used to propagate local grass species, for supply of fodder for cattle and horses. Restoration of denuded areas shall be given priority.

- Erosion control measures shall be undertaken on steep slopes by planting grass or regenerating ground cover.

- The forest department shall take up afforestation works in blank patches and degraded forest areas to increase forest cover.

- Plantation shall be carried out to provide wind protection and improve soil conditions.

- Several streams that originate on the plateau act as important corridors for wildlife. Therefore sufficient forest cover and bank vegetation shall be maintained to help in migration of animals. Streams coming down from the plateau shall be restored for the tribals to get hill stream fish to supplement their diet. Large dams and reservoirs on streams shall be prohibited.

- Encroachments shall not be allowed in the floodplains. There shall be a buffer of vegetation that will harbour biodiversity and recharge ground water.

Shrubs and trees that should be used as live fences in villages and community reserves are listed in ***annexure- VII.***
Indigenous trees that shall be used for reforestation of the lower slopes are listed in ***annexure- IX.***

Agroforestry

- Agroforestry shall be proposed in Gaothans and Community Reserves on lower slopes. 50 % of the area shall be covered by perennial tree cover. Species should be chosen to meet the food, fuel and timber needs of the villagers, provide fodder for animals in addition to improving the ecology of the area. For Agroforestry local species shall be used as far as possible. Economically useful trees and fruit trees shall be planted. Medicinal plants and herbs, fodder grasses and legumes may be

introduced. Non-edible oil seeds, and other trees and plants to provide housing and roofing materials, material for basket weaving, fodder etc. may be introduced. Minor fruit trees that yield edible fruit and vegetables, and food grains for local consumption shall also be encouraged.

- Activities such as bee–keeping may be proposed in Community Reserves.

- Mixed plantation shall be carried out and monocultures shall be avoided. Shrubs creepers and herbs shall also be integrated in the regeneration process.

- The State Government shall promote organic farming in this (and other) Eco-sensitive Zones, as it has for certain areas / districts in the State. Non-organic farming shall be prohibited in the Eco-sensitive Zone. Cash crops shall not be introduced in catchment areas of dams and reservoirs. Organic practices and biological control methods such as mulching shall be used to increase fertility of the soil for Agroforestry and growing crops for local consumption. The use of fertilizers, insecticides and pesticides shall be prohibited in this region.

Indigenous fruit trees/ other economically valuable trees/ crops are listed in ***annexure- VI.***
Fodder trees, shrubs and grasses to be planted in Community Reserves near villages are listed in ***annexure- V.***

Education and introduction of sustainable practices

- Environment education and awareness shall be immediately started in Matheran and villages in the Matheran Eco Sensitive Zone. Education and awareness programs shall be taken up by the forest department / NGO's / gram panchayat in all the village Gaothans and adivasi padas that lie within the Eco- sensitive zone.

- Local people should be educated to prevent and control forest fires.

- Use of solar cookers and non-wood fuel such as biogas shall be encouraged.

- The use of fuel-efficient chulahs should be encouraged.

- Cutting or felling of trees/ removal of climbers/ other plants from critical areas / near virgin patches of forest shall be prohibited. Strict action shall be taken against those who resort to this activity.

- Local people shall be trained and employed in-situ conservation, restoration and energy plantation.

- Gas should be provided at subsidized rates.

- NGO's and agencies shall be identified to carry out the conservation, education, social work in villages and Gaothans within the Eco-sensitive Zone.

6.4 (D) RECOMMENDATIONS FOR GAOTHANS AND VILLAGE AREAS

- Gaothan expansion may be permitted by the Monitoring Committee based on the needs and requirements of, and for the existing *bona fide* Gaothan domiciled residents only. In determining the area required for Gaothan expansion the procedure laid down by the State Government shall be followed. Under this procedure the need is first identified, the number of households requiring land is listed, the total area computed, that much land is acquired and parceled and given to each household. The practice of declaring a random area of 200-500 m. around the Gaothan for expansion shall not be followed.

6.5 INFRASTRUCTURE

6.5 (A) TRAFFIC MANAGEMENT

Presently there are two primary modes of transport to Matheran, by road up to Dasturi naka and by train into the bazaar area. These two modes of transport need to be upgraded. The goods train and the rails buses, which have been discontinued, need to be restarted.. The goods trains will reduce the number of freight horses plying from Dasturi naka into the hill station and decrease the problems they create. Rail buses will bring the tourists up in about 45 minutes from Neral.

Vehicular road and car park

- Matheran being a pedestrian resort, vehicles shall be allowed via the Neral-Matheran road only up to the parking lot at Dasturi Naka. No vehicular traffic shall be permitted within the Matheran municipal limits, except the ambulance and fire engine.

- Pollution Under Control certificate shall be mandatory for all the vehicles that ply on or through the E.S.Z. This certificate shall be checked by the police or any other suitable Authority or agency at the entrances of the E.S.Z.

- Only mini bus-service and private taxis shall be used to transport passengers to Matheran. The number of these taxis and mini buses shall be regulated.

- No private vehicles shall be permitted to park on the Matheran plateau. A suitable site shall be identified at Neral for parking facilities for private vehicles.

- The existing parking lot at Dasturi naka shall be demarcated. This area shall be fenced off and encroachment into the forest areas shall not be permitted. This area shall be used only for parking of taxis and mini buses. Before the mini-buses are permitted to ply, proper arrangements for their parking, bus stop, etc. shall be made at Dasturi and Neral.

- Battery operated vehicles shall be introduced for transport of goods on the plateau.

Goods train, passenger train and rail buses

- A goods train shall be started for direct and efficient transportation of goods from Neral to Matheran. This shall be a convenient mode to carry heavy material like gas cylinders, perishable goods etc.
- A goods train shall be started to transport goods from the loading and unloading point (next to Wadia Bungalow near Dasturi) upto Matheran railway station.
- Rail carts that operate on Petrol can also be used to transport goods and supplies from the loading and unloading point up to the bazaar area.
- During peak season / on weekends transportation of goods/ supplies upto the bazaar area by the pedestrian road shall be avoided to reduce traffic on the pedestrian road from Dasturi to the bazaar area.
- The rail bus service shall be restarted and passenger train/rail bus service shall be started from Aman Lodge station to Matheran railway station.

Roads/ paths/ trails

- Certain roads shall be reserved for pedestrians only and horse traffic shall not be permitted. *(Refer to map on page no. 89)*
- New paths, walks and trails shall not be constructed through forest area or area having forest vegetation.
- Widening of existing roads and pathways shall not be permitted.
- Roads shall be regularly compacted to prevent erosion.
- Existing roads shall be maintained using traditional methods such as WBM (Water Based Macadam) - using Laterite boulders/stones placed in three layers and compacted with soil.

- Loose soil shall not be excavated and laid on roads and pathways and other areas prone to erosion without sufficient compaction.

- To prevent sheet erosion of roads, during the monsoon, small 2-inch bunds shall be constructed to divert the water from the roads into the storm water drains.

- There shall be no sweeping or removal of leaf litter from roads, pathways, trails, viewing points and other areas prone to erosion; sweeping of roads shall be restricted to picking up horse dung and garbage. During the monsoon all roads, pathways, trails and viewing points and areas prone to erosion shall be covered with leaf litter.

- No development in terms of tarring and paving in cases of viewing points, natural paths, walks and rides shall be permitted, except in case of in-situ conservation work.

- The main road from Dasturi up to the Matheran municipal council shall be paved in laterite or concrete paver blocks in places as it is difficult to maintain due to heavy traffic. Certain portions of road that are difficult to maintain due to heavy traffic, and have severe erosion problems shall be paved in laterite stone or concrete paver blocks.

- Laterite for paving, construction and maintenance shall not be quarried from the plateau. An alternative nearby source of Laterite shall be found. The Laterite used for road making and repair work shall be of good quality and able to withstand heavy traffic and weathering. It shall be tested for crushing strength.

- In the settlement, in congested areas, paved pathways in interlocking concrete blocks may be permitted, to prevent erosion and water logging.

- Cobbled pathways using laterite boulders (Such roads exist in some parts of Matheran) may also be tried as an option as this is more economical as compared to paving with laterite blocks.

- Storm water drains shall be constructed (in laterite masonry) only along roads having continuous commercial development.

- Nature trails shall not be widened or made accessible to horses and rickshaws nor shall shops, food stalls, restaurants and the like be permitted. Only limited pruning of shrubs shall be allowed to

make them accessible. There shall be no removal of vegetation or removal of earth from the sides of these pathways or any such activity that could start the process of erosion.

- The following methods shall be used for the maintenance of various roads depending on the traffic and intensity of movement; as per the adjoining map *(Refer to map on page no. 89)*
  1. Nature trails with leaf litter
  2. Traditional WBM roads
  3. Laterite stone paving
  4. Interlocking concrete paver blocks

Horses/ ponies

- Horse traffic shall be restricted only to areas demarcated for horses. Movement of horses shall not be allowed near or in surface streams, water channels, reservoirs and water-bodies. Horses shall not be allowed in forestlands, areas covered by forests and vegetation. Certain critical areas need to be fenced off to prevent the movement of horses.

- Riding of horses in Matheran hill station shall be restricted to walking in areas and roads specified. Galloping shall be permissible only at Olympia ground. Furious riding shall be prohibited throughout the hill station.

- Horses shall be restricted to the existing major roads and shall not be permitted elsewhere. Horses shall be permitted only on M G Road, Kasturba Gandhi Road, Chowk Circus, the roads from Bazaar area to Charlotte Lake, Louisa Point and Porcupine Point, and the road from Charlotte Lake to Porcupine Point via Louisa Point. *(Refer to map on page no. 89)*

- Horses shall be tethered and stabled only at specific locations earmarked, which shall not be in forests/ near streams / water bodies. Ponies in Matheran shall be kept in the stables built at the expense of the Matheran municipality or on sites set apart by the authority and/or space given on hire to horse owners.

- The use of freight horses to carry goods from Dasturi to Matheran shall be discontinued until the required facilities and infrastructure are provided.

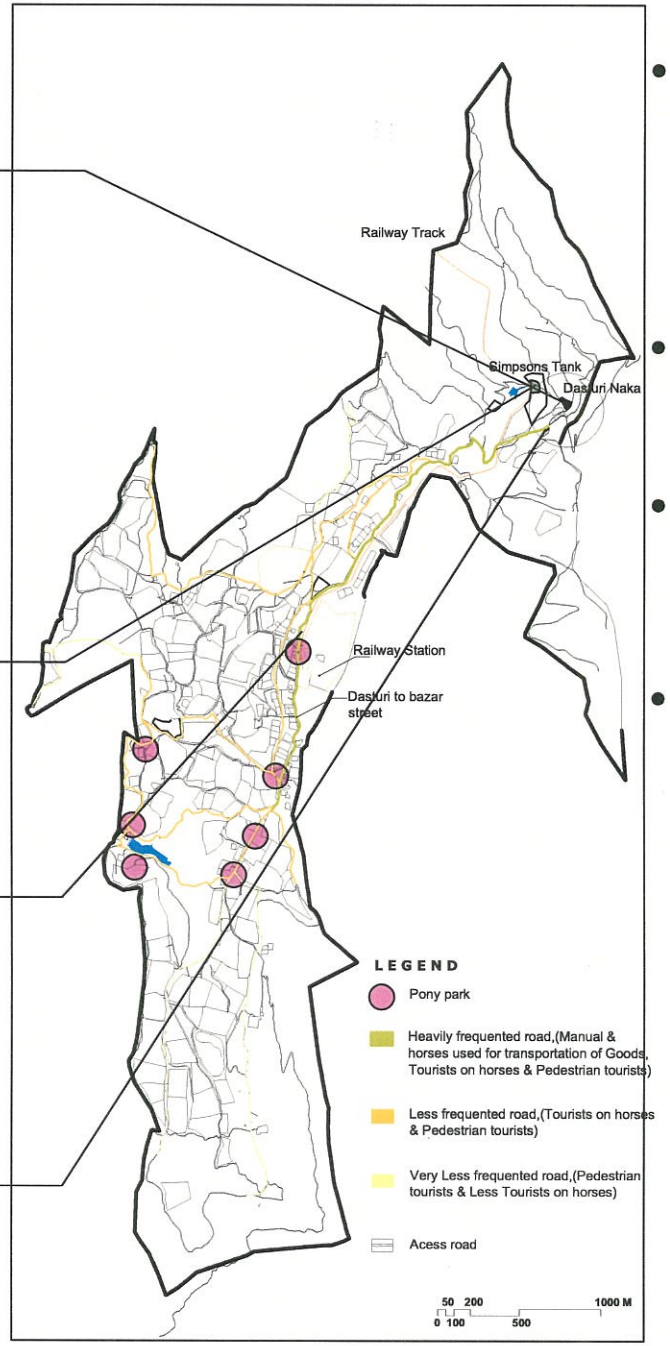
- All horses including those used for carrying goods shall have a permit / license issued after a fitness test.
- The number of riding horses for tourists shall be restricted and regulated.
- The number of pack horses shall be restricted to below 25. (Licenses permit and supervision by an appointed authority shall be mandatory).
- Periodic inspection of the horses for infections, diseases and their immunization are necessary and shall be regularly undertaken.

- **Vehicle parking** - Private vehicle parking should be restricted. Detailed survey should be carried out for minimum parking requirement. Parking site should be provided for the rest at Neral. Already some residentials are providing pay & park at Neral. This could be promoted in a organized way.

- **Goods Transportation** - Additional Railway Loop -(Refer dwg-proposal for Simsons tank dwg) With this goods can be transported upto the market (2.5 km). Seperate goods train from Goods depot to railway station can be run that is for bulk trasportation. From the market distribution will be much easier & nuisance in Simpsons watershed can be controlled. It will also stop transporting the goods on steep slope manually which is really inhuman.

- A seperate pathway along the railway track should be provided for seperate pedestrian movement from Aman lodge station to main market area.

- **Pony Parks** -A big pony(Refer dwg-proposal for Simsons tank) park near at goods depot and small pony parks along the roads,points should be designed.



- **Segregation of traffic**- Whereever is possible pedesrian and horse movemnt should be segregated by time management or by restricting entry of horses to some roads . Demarcations on roads for segrgating pedestrian and horse movement.

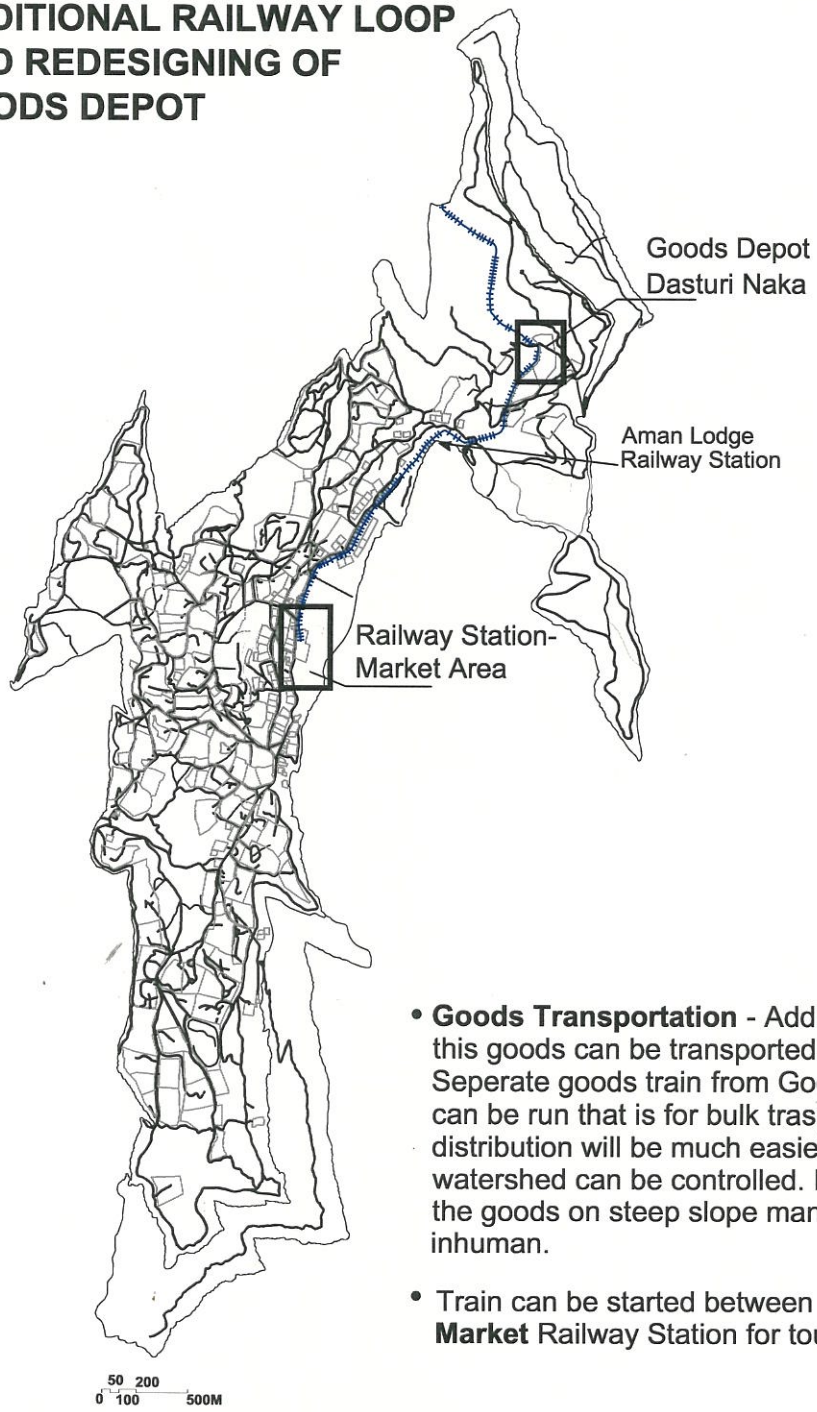
- **Signages**- For free and easy movement of tourists signages , street furniture should be provided mainly on main streets.

- Main roads to be paved and inner secondary roads should be kept with leaf litter that is to reduce soil erosion & dust pollution.

- Pony parks / Pony Stations in market area to be provided with proper facalities as in stables.

TRANSPOTATION SYSTEM IN MATHERAN

ADDITIONAL RAILWAY LOOP AND REDESIGNING OF GOODS DEPOT



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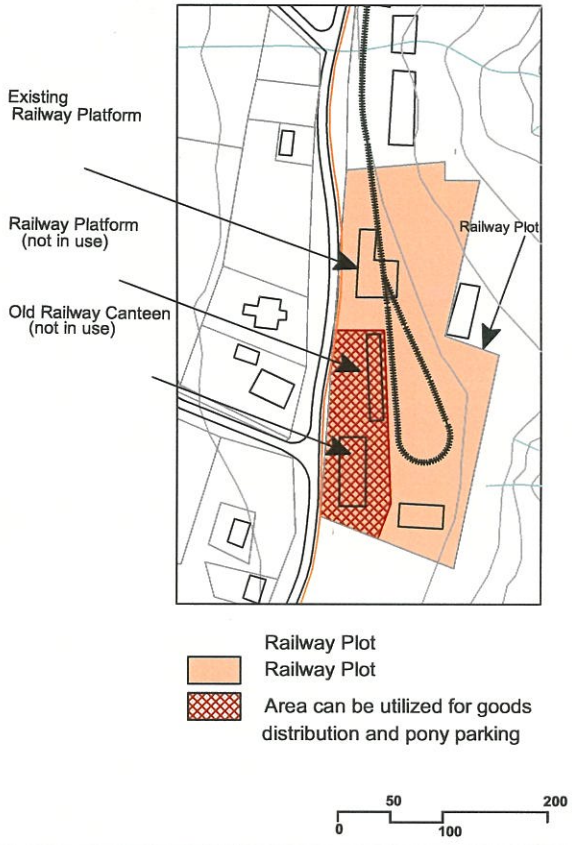
- Train can be started between **Aman Lodge** Station and **Market** Railway Station for tourists and local people

GOODS DEPOT NEAR DASTURI

RAILWAY STATION -MARKET AREA



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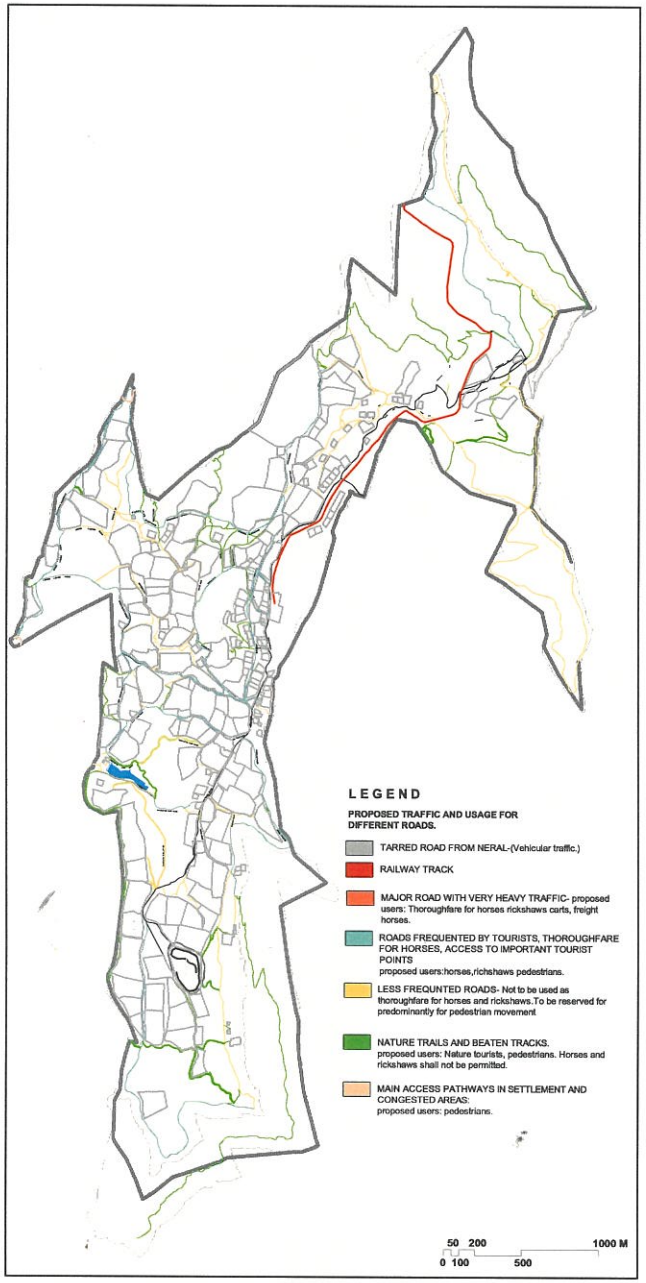
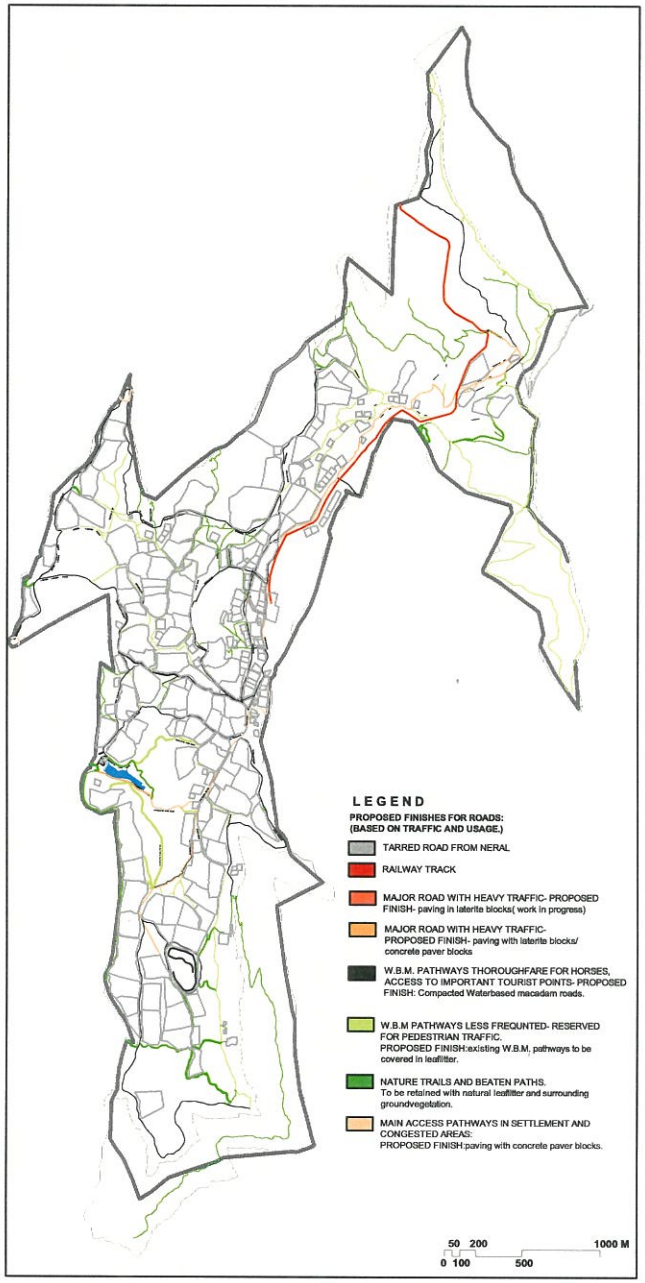


PROPOSED USAGE PATTERN FOR ROADS



PROPOSED ROAD FINISHES

N

6.5 (B) WATER MANAGEMENT

The precipitation/ rainfall on the Matheran plateau is above 3000 mm. However it still faces an acute water shortage, especially during the peak tourist seasons and the water supply needs to be augmented by pumping water from the Ulhas River. The increase in tourism has put pressure on the existing water resources and sustainable water management techniques need to be adopted.

Water Supply

- Desilting should be undertaken to increase capacity of Charlotte Lake.
- If restored and purified Simpsons Tank could be used again to supplement the water supply in Matheran.
- Filtration Plant should be upgraded for quality and quantity.
- Alternative water sources should be discovered like rainwater harvesting, recycling of sewage water, utilization of springs near settlements (e.g. Harrisons spring). While utilizing springs, care should be taken to avoid overexploitation of springs.

Ground water

Recommendations for the plateau

- No more dug wells shall be allowed on Matheran plateau.
- The use of ground water for swimming pools and allied activities shall be prohibited.
- Hard paving shall be banned in municipal areas and ground coverage area of buildings restricted to allow percolation and recharge of ground water.
- No development including tarring / paving of viewing points, natural paths, walks and rides shall be permitted except for in-situ conservation work.

- Storm water drains along roads shall be de-silted, repaired and suitably designed to reduce the velocity of storm water and allow percolation.

- Storm water, where possible, shall be directed to existing reservoirs.

- Existing check dams and reservoirs shall be desilted.

- Large dams and reservoirs shall not be permitted. Heights of existing dams shall not be increased, as it would lead to submergence of forestland.

Recommendations for the Eco sensitive-zone

- Encroachments shall not be allowed in the floodplains. There shall be a buffer of vegetation that will harbour biodiversity and recharge ground water. All floodplains should not be encroached irrespective of where they are.

- Stream restoration shall be taken up by a proper agency to increase their life and make them perennial and improve water supply after the rainy season.

- Buffer walls, where required, not exceeding the height stipulated by experts, shall be constructed.

- Stream restoration techniques shall be adopted in certain areas depending on local conditions and geology. These shall include placing of obstruction or stone embankments to reduce the velocity of water, channeling water to replenish other zones, maintaining in-stream habitats, maintaining the hyporic zone and bank vegetation.

- Gully and nallah plugging shall be undertaken and maintained in all streams.

- Soil and moisture conservation measures such as contour trenching and plantations shall be carried out on the lower slopes.

- Large dams and reservoirs shall not be permitted in this region.

Rain water harvesting

- Roof water harvesting has to be made mandatory for all commercial and public establishments and the volume of storage has to be related to the occupancy.

- Rainwater harvesting shall form a part of the development proposal and shall be shown on the plan. However, this is not mandatory for purely residential houses in Bazaar Plots. Appropriate storage shall be provided based on the soil strata, requirement of users, etc.

Solid waste management -

- Solid waste management system should be more efficient and fast.
- Care should be taken to avoid scattering of garbage by wind and by stray dogs and other animals. Natural boundary should be demarcated by hedge, shrubs and trees.
- Proper pits should be designed for composting wet garbage. Vermiculture can be added for speedy decomposition

Market Area-

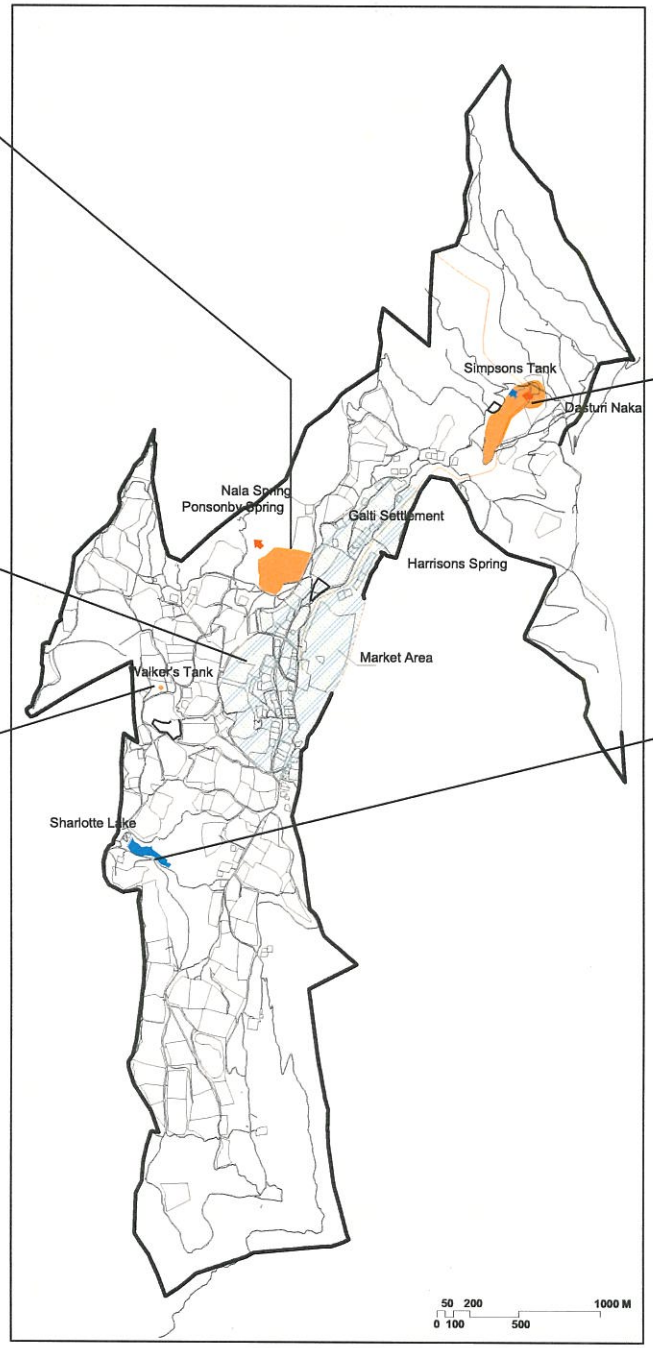
- The cetralised drainage system should be designed for entire market area

Walker's Tank -

- Temporary sedimentation pit can be provided beside the tank during Ganesh festival.

Hotels and Settlements other than market area -

- All the hotels on the plateau should have efficient sewage treatment plant
- Effluent from the treatment plant should be checked by municipal corporation time to time
- All the commercial and residential dev. should have scientifically designed sock pits



Solutions for Simpsons Tank catchment and Charlotte Lake catchment are detailed out in the respective proposal drawings

PROPOSAL TO PREVENT WATER CONTAMINATION

WATER CONTAMINATION

N

6.5 (C) SANITATION AND SOLID WASTE MANAGEMENT

The increasing number of hotels on Matheran plateau and inadequate infrastructure for sewage treatment has led to contamination of ground water reservoirs and springs due to discharge of sewage and untreated effluents. Due to the undulating topography a centralized drainage system is not feasible for the entire plateau, except for the settlement area near the Bazaar. In view of this, septic tanks have been recommended for individual bungalows and sewage treatment plants for larger hotels.
Certain measures are being taken for segregation and disposal of solid waste. These need to be improved and efficiently organized.

Sewage

- Discharge of effluents (treated or untreated), garbage disposal, accumulation of horse dung or any other activity that can cause contamination shall not be permitted in the catchment of springs and water bodies. Activities such as bathing and washing of clothes shall not be permitted at or in the vicinity of the springs.

- All bungalows, restaurants hotels motels and lodging and boarding houses with less than 20 beds shall have septic tanks that are regularly cleaned and maintained. This shall be monitored by the Maharashtra Pollution Control Board.

- All new resorts, hotels, motels, lodging and boarding houses and clubs shall have waste water treatment and recycling plants if it is not connected to an existing waste water treatment and recycling plant. Existing clubs hotels, motels, lodging and boarding houses shall install wastewater treatment and recycling plants within a period of two years from the date of publication of this Sub-Zonal Master Plan.

- All clubs, resorts, hotels, motels, and lodging and boarding houses shall install a Sewage Treatment Plant (STP) and the same shall be shown on the building plans.

- No proposal for such development should be entertained unless a STP is provided for.

- The Appropriate Authority shall grant a license to operate *inter alia* on the condition that the STP is operational, non-compliance of which would automatically result in cancellation of the license.

- Separate and independent water and electricity meters shall be installed for the STP.

- If the Appropriate Authority finds that electricity has not been used in the STP then the Authority shall inform the same in writing to the Monitoring Committee of the Matheran Eco Sensitive Zone / Ministry of Environment and Forests and the Maharashtra Pollution Control Board (M.P.C.B.).

- Existing developments shall install the STP within a period of six months.

- The M.P.C.B shall immediately investigate and report the sewage treatment facility available with each hotel, motel, lodging and boarding house, club, school hostel and institution. The report shall be made public and handed over to the Monitoring Committee of the E.S.Z. The report shall include such details as the number of rooms, number of beds, peak and average occupancy, water consumption, size and capacity of sewage treatment facility, cleaning periodicity etc. The concerned officers of the M.P.C.B. shall be prosecuted under the Environment (Protection) Act, 1986, if the report is not made available within 6 months or if there are inaccuracies or false information in the report.

- Many of the new storm water drains in the Bazaar area and settlement area are used as open gutters for sewage. This shall be immediately stopped.

- The municipal council shall provide underground drainage system of sewage from the bazaar and congested areas. This shall be collected at appropriate place(s) using methods and technologies appropriate for hill areas. Community biogas plants for sewage treatment/ Sewage treatment plants can be installed for bazaar area. This shall be accomplished in the next one year.

- In the Sub-Zonal Master Plan under preparation for Matheran reservations shall be made for Common Sewage Treatment Plant(s)

Solid Waste Management

- The local authorities shall draw up plans for the segregation of solid wastes into biodegradable and non- biodegradable components. All biodegradable waste shall be composted and all recyclable non- biodegradable waste shall be recycled. No recyclable material, such as plastics, paper metal, tetra-packs, and laminates shall form part of any landfill. The municipal council shall be responsible for collecting and segregating waste from the municipal area.

- The biodegradable materials shall be recycled preferably through composting or vermi-culture and the inorganic material may be transported from the plateau and disposed off at environmentally acceptable locations.

- A boundary should be demarcated to avoid scattering of garbage using hedge, shrub plantation etc.

- A compost pit shall be made compulsory for all bungalows and hotels unless the municipality collects biodegradable waste separately at source and composts it.

- The Municipal Council shall take immediate steps to provide dustbins and suitable place to collect wastes in the settlement and congested areas. There shall be separate bins for dry and wet wastes. Those who are seen throwing wastes outside the dustbins shall be heavily penalized by the appropriate authority.

- No burning or incineration of solid wastes shall be permitted. No dumping/incineration of wastes in forest undergrowth, nallahs, streams, valleys, pathways or storm water drains shall be permitted.

- Dumping of construction material anywhere outside the property under development shall be prohibited. This condition shall also be a condition of sanction. Non-compliance of this condition shall automatically result in revocation of sanction.
- Every lessee is required to keep his compound free from unsightly and in-sanitary accumulation and may be required by the Superintendent / Collector to remove any such accumulations.(1959 guidelines)

- There shall be a strict implementation of the ban on the use of polythene bags. The use of cloth bags by local inhabitants and tourists shall be encouraged. This shall form one of the components of the interpretation center.

- The disposal of solid waste from hospital, dispensary etc. shall be made as per the Biomedical Waste Disposal Act 2000.

- Land use such as garbage dumps, shall not be allowed in the catchment area / watersheds of important perennial springs, and water reservoirs such as Charlotte Lake and Simpsons Tank up to the ridge-line or the water divide.

- Garbage is presently being stacked, segregated and composted at the Gymkhana on the western side of the plateau. This site was found to be unsuitable as it lies in the proximity of important perennial springs and shall be relocated to a suitable location.

- The solid waste management system should be more efficient. Proper areas shall be demarcated/ pits designed for composting wet garbage. Care shall be taken to avoid scattering of garbage by wind, stray dogs and other animals.

- Dumping of clay in the forest vegetation shall be prohibited. Proper arrangements shall be made for the disposal of clay deposited in Walker's tank during the Ganesh festival.

- In the Sub-Zonal Master Plan under preparation for Matheran, reservations shall be made for:
  1. Waste segregation site(s)
  2. Composting area(s)

6.5 (E) STORM WATER DRAINAGE SYSTEM (SOIL EROSION)

The plateau forest is an unsubsidized ecosystem. In such an ecosystem there is no inflow of nutrients from outside and therefore whatever nutrients are available or already present need to be preserved. It is therefore important to arrest and prevent the outflow of soil and organic matter. Lateritic soils are shallow, the soil formation process is slow and they contain very little humus. Aggregate formation is absent and such soils are more susceptible to erosion. Soil erosion takes place due to various issues. Areas most affected are along roads, along streams and along water drains. Also steep areas are susceptible to soil erosion.

Along Roads

In Matheran there is a practice of removing topsoil from forest areas for road maintenance. This practice in the past several years has resulted in numerous ditches or borrows pits in forest areas. The practice of removing topsoil for gardening has also continued without any check. The removal of soil is hazardous to the vegetation in the affected areas. Many trees have been uprooted damaging the adjoining shrubs and climbers. The continuous heavy soil erosion has created siltation problems downhill. Thus strict measures to prevent this shall be taken.

- Quarrying for boulders/ removal of soil from along sides of roads or from any other forest area shall be banned or stopped immediately.
- To allow percolation, arrest surface flow and to hold the soil together, the roads shall be covered with leaf litter. There shall be no sweeping/ removal of leaf litter from pathways, trails, viewing points and other areas prone to erosion.
- Natural grass or groundcover shall be maintained in the forest, plateaus and viewing points. Regeneration of ground vegetation shall be encouraged to hold the soil together.
- Water based macadam roads shall be regularly repaired, maintained and compacted to prevent erosion.
- Loose soil shall not be excavated and laid on roads and pathways and other areas prone to erosion without sufficient compaction.

- Where roots of trees are exposed due to soil erosion retaining walls (in stone), shall be constructed to preserve the soil and prevent loss of canopy.

- The street edges, wherever damaged, shall be repaired and regularly maintained.

Along streams

Increase in the velocity of water results in stream erosion and undercutting of stream banks that can cause widening of channel steep gullies. This causes the collapse of stream banks and results in thinning of canopy over the stream channel. This can lead to loss of forest cover due to merging of two channels that are close to each other. It also gives rise to problems like headward cutting, which eventually adds to siltation problems downstream. Thus the velocity of water needs to be reduced.

- Any activity that can cause increase in velocity of water, such as quarrying within the streambed, shall not be allowed. Measures shall be taken to prevent and control stream erosion under the supervision of geologists, hydrologists and subject experts.

- No development shall be permitted in a 15 m. wide belt on both sides of streams, nallahs, rivers and other watercourses.

- Excavation of stream banks or widening of channels shall not be allowed.

- Activities such as tethering of horses, dumping of garbage/ construction material etc. shall be prohibited near streams.

- A stream restoration program shall be undertaken by proper agency and under the supervision of scientists, ecologists and subject experts, which will include measures to be adopted to prevent and reverse the pollution of streams.

- Any kind of domestic use shall be prohibited in or around the stream.

- Collection ponds should be provided at culverts in the stream, which reduce the velocity of water flowing and also act as silt catchers.

- Measures like chain-link bunding and bund walls in Laterite stone shall be constructed in streambeds along steep contours to reduce velocity of water and arrest silt from being washed away.

Along Water Drains

Storm water drains should be constructed bearing in mind the topography and relative slopes of the land. These should be constructed using stones like Laterite, which are porous and allow percolation. The joints should also ideally be mortar free. Any smooth surface, which allows fast velocity of water, should be totally avoided. The storm water drainage system in Matheran is in a state of disrepair. Some drains have collapsed, others have silted up and certain drains in the bazaar area have been encroached upon. The municipality is constructing new storm water drains. The base is made in Laterite stone and the sides are in brick masonry. These new storm water drains are being plastered in cement No troughs or barriers have been provided at intervals to retain the soil. The entire volume of water along with the sediment it carries is being washed downhill resulting in loss of precious soil from the plateau. The smooth uninterrupted channel also results in the increase in the velocity of water that may cause severe problems of erosion downhill. Many such new channels have been constructed in the bazaar area and settlement area. Many of these are now being used as open gutters for sewage. Certain new hotels are also discharging sewage directly into these drains. To further avoid soil erosion in storm water drains, certain simple and cost effective measures should be practiced.

- Storm drains need to be properly maintained and provided wherever necessary.
- They shall be desilted before the monsoons.
- They shall be constructed only using laterite and with pits / troughs to reduce the flow of water and collect sediment.
- Boulders, bunds or walls shall be placed in storm water drains along areas with steep slopes, to trap the fertile soil from being washed away into the valleys.
- Along areas with gradual slope, silt catchers or barriers in the form of troughs shall be provided, to arrest the soil at these points. This soil can then be used for ramming the roads.

- To obstruct the flow of soil and leaf litter from the forest areas on to roads and into storm water drains, suitable hedge plantation shall be carried out along the sides of roads and storm water drains.

- Ultimately water from drains and streams is let out into the valley. These outlet points should be located on or near basalt rock and not in forest areas to avoid soil from being washed away.

- The number of culverts shall be increased to reduce the volume and velocity of water that flows through each culvert.

Slope protection measures

Wherever natural slope was cut to maintain the street levels, the plot boundaries adjoining the street were stabilized with Laterite masonry walls. These retaining walls have been largely damaged over the years causing heavy soil erosion and uprooting of numerous trees along the street edges.

- The existing slopes shall be maintained and the topography of the land shall not be disturbed when developing the land, except where terracing is permitted under these regulations, only for soil and moisture conservation activities.

- Erosion control measures are to be undertaken on steep slopes by planting grass or regenerating ground cover, as steep slopes, if barren, will also pose a threat to the building.

- In certain places where there are landslides, slopes or the ground is unstable, stone retaining walls or gabion walls shall be constructed to retain the soil or measures like contour trenching and bunding shall be carried out.

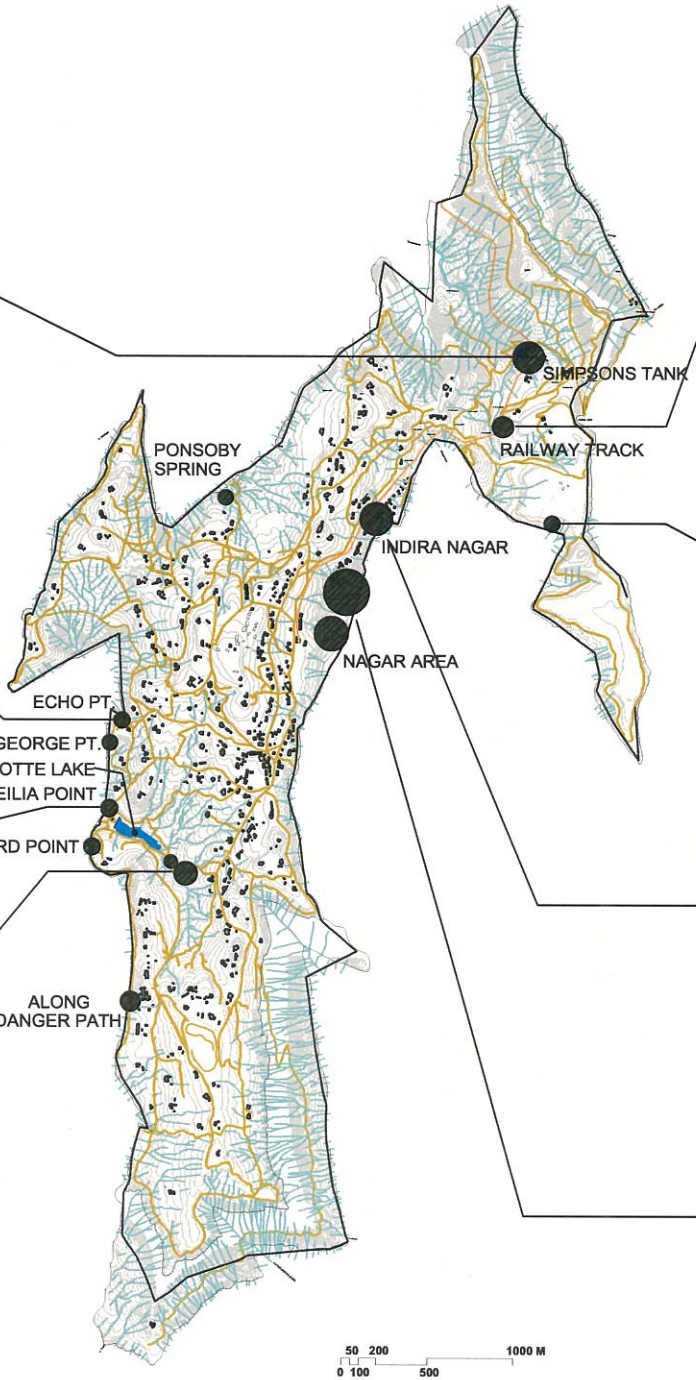
SOIL EROSION

soil erosion due to steep slope at Simpson tank area

removal of soil along roads for ramming

soil erosion along overflow of Charlotte lake at Ceilia point

headward cutting along stream bed at Charlotte lake



soil erosion along railway track

landslide along road to garbut point

soil erosion in stream bed at Indira nagar

poor condition of stream in the nagars

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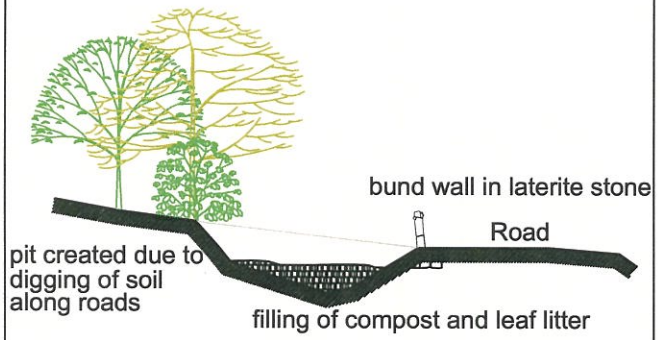
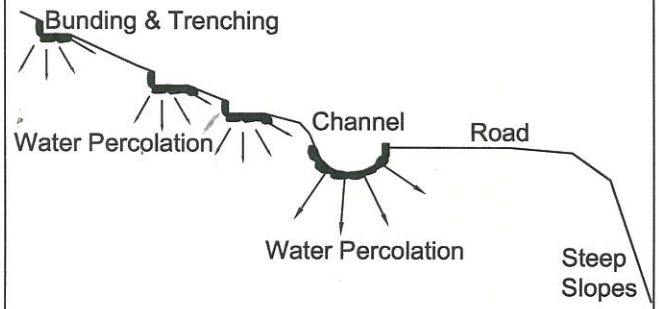
MEASURES FOR SOIL EROSION CONTROL ON THE PLATEAU

ALONG ROADS



DETAIL ALONG ROADS

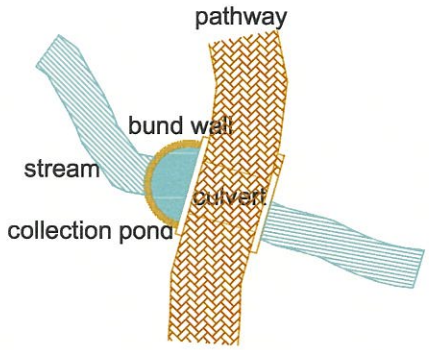
Soil along the roads is dug out for ramming the roads. This causes heavy soil erosion and uprooting of trees. Bund walls in laterite stone should be built along the road edge and the pits should be filled with compost and leaf litter, which will generate fertile manure. Plantation measures should be carried out in these sections.



DETAIL ALONG STEEP SLOPES

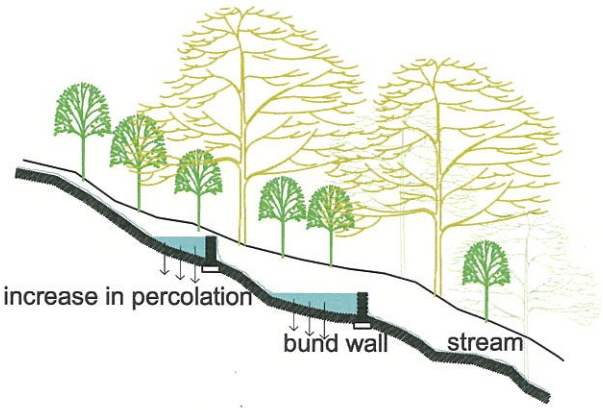
Measures like contour trenching and bunding should be carried out in areas with steep slopes to arrest soil from being washed away. This will also help in water percolation.

ALONG STREAMS



DETAIL OF COLLECTION POND AT CULVERT

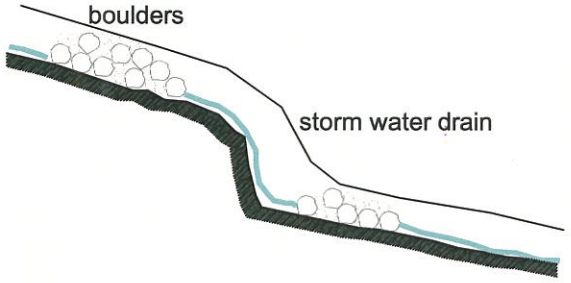
Collection ponds should be provided at culverts in streams. These ponds reduce the velocity of water flow and act as silt catchers.



DETAIL OF STREAM BUNDING

Chain link bunding and bund walls in Laterite stone shoul be constructed in stream beds along steep sloping areas. This would reduce the velocity of water, thereby decreasing soil erosion along the stream edges and arresting the silt from being washed away.

ALONG STORM WATER DRAINS



DETAIL OF BOULDER DRAIN

Boulders can be placed in storm water drains along areas with steep slopes. These act like filters which trap the fertile soil from being washed away into the valleys.

DETAIL OF SILT CATCHER ALONG DRAIN

Silt catchers should be provided along storm water drains with gradual slope. This allows the soil to settle at these points. This soil can then be used for ramming the roads.

DETAIL AT WATER OUTLET POINTS

Water from storm water drains and streams is let out into the valley at the edge of the plateau. These outlet points should be located at Basalt rock faces and not in the forest areas. Also they should be widened at the cliff edge to reduce the water velocity.

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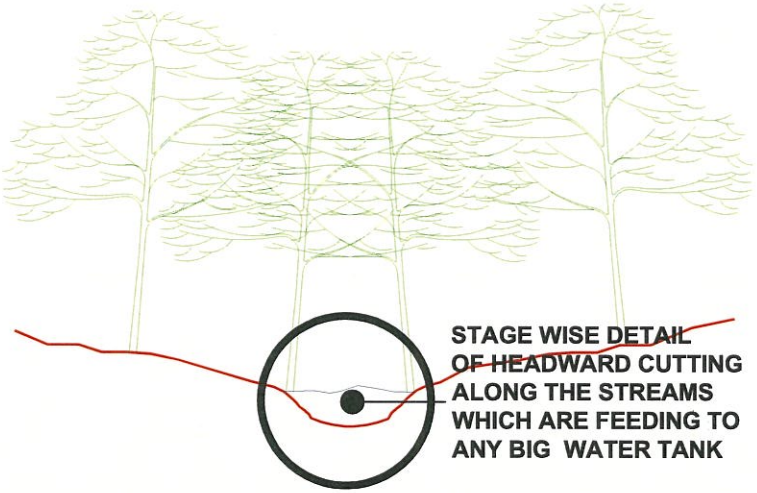
HEADWARD CUTTING

HEADWARD CUTTING LOCATION



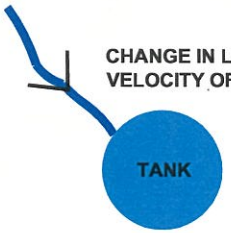
STAGE WISE DETAIL OF HEADWARD CUTTING ALONG THE STREAMS WHICH ARE FEEDING TO ANY BIG WATER TANK

KEY PLAN

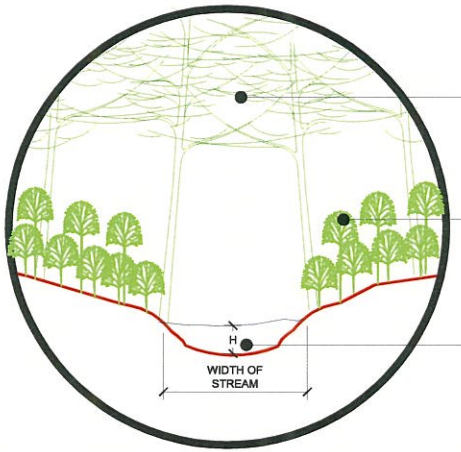
STREAM JOINING THE LAKE

SOIL EROSION ALONG THE EDGES OF STREAM

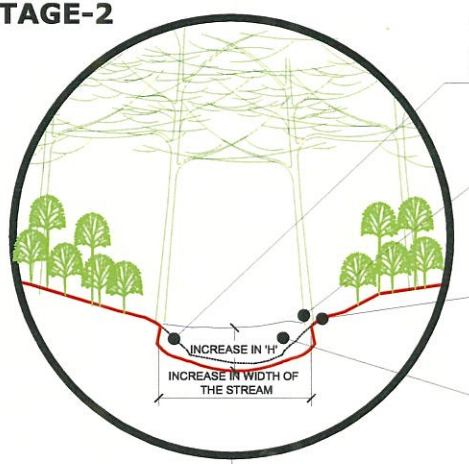
SOIL EROSION IN THE STREAM



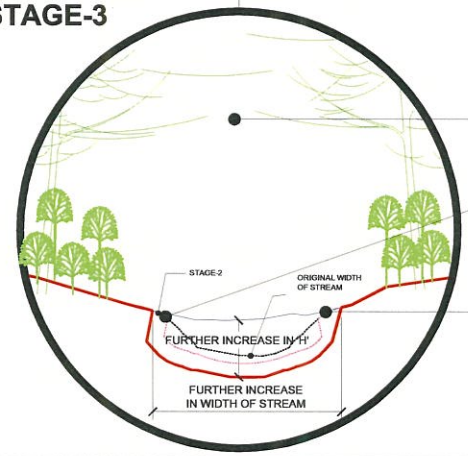
STAGE-1



STAGE-2



STAGE-3



HEADWARD CUTTING

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6.6 TOURISM

The economy of Matheran capitalizes on its environment and is based on tourism and other dependent occupations. The Matheran plateau and region present a vast scope for alternate forms of tourism, like historic, architectural and nature based. These alternate forms of tourism shall be promoted over the conventional forms.

- The ESZ notification stipulates that the State Government shall prepare the Tourism Master Plan based on Carrying Capacity study of the area. *Prima facie* the Carrying Capacity of this Sub-Zone has been exceeded and further development of this Sub-Zone needs to be controlled.

- New hotels, motels and boarding houses in the Matheran municipal area shall not be permitted until the Sub Zonal Master plan for the Matheran plateau is prepared based on the carrying capacity. Existing motels, hotels, lodging and boarding houses shall not have more than 6 rooms per acre of plot size.

- No new or expansion of existing resorts, hotels, motels, lodging and boarding houses, or clubs shall be permitted.

- Pending the approval of the Tourism Master Plan by the Ministry of Environment and forests, the use of existing heritage buildings for heritage hotels within the Matheran Municipal Council area may be permitted by the Monitoring Committee only after it is approved by the Heritage Conservation Committee.

- Bed and Breakfast type of tourist accommodation may be permitted with prior approval and sanction by and of the Maharashtra Tourism Development Corporation subject to a limit of 1 such room not exceeding 2 beds per plot.

- Tourism activities shall be as per a Tourism Master Plan with emphasis on Eco tourism, Eco-development, and Eco-education. All tourism promotion shall be based and focused on alternate forms of tourism like historic, architectural and nature based.

- Developmental activities not consistent with the eco-sensitivity and activities that are otherwise available outside this Sub-Zone, such as golf courses, go-cart tracks, airstrips, amusement parks, water parks, swimming pools, helipads and ropeways shall not be permitted.

- Interpretation centers, botanical garden, nature trails shall be set up for the orientation and education of tourists and local people.

- Efforts shall be made to modify the use of tourist area and visitor behavior by providing nature orientation for tourists. Visitor activities and practices that are particularly damaging shall be prohibited, restricted and discouraged. This can be done through educative brochures, visitor information centers etc. This will orient tourists towards more environmentally sound practices and prevent activities such as littering, wastage of water, fires etc.

- Visitors shall also be oriented towards the wilderness of Matheran and its ecological significance. Conservation of natural resources, sustainable tourism, interpretation of the natural aspects of Matheran such as its Flora and fauna and its ecological, historic and cultural importance shall be highlighted during the orientation process. This can be achieved through the nature interpretation center, guided and self guided nature trails, signage, and proper publicity of Matheran as an Eco-sensitive Zone. Local guides, hoteliers, the forest department shall contribute to modifying the visitors expectations.

- An interpretation or information center shall be set up, by restoring an existing heritage building or bungalow, to educate the local people and tourists. This would be environmentally friendly and no new construction shall be required. A suitable site shall be selected and reserved for this purpose. A reputed organization, such as B.N.H.S. or W.W.F or W.I.I., shall be consulted to design, set up and run this center with display areas and audio-visual facilities. The example of the interpretation center at Dandeli should be followed.

- Tourists shall be informed of the various forms of tourism at the interpretation center. Alternate tourism packages shall be prepared and tourists shall be encouraged to avail of them depending on the duration of their stay in the region. They shall be acquainted with these alternate forms of tourism through the audio-visual media. A short film on these forms of tourism shall be shown at the interpretation center.

- Efforts have to be made to involve the local people in income generating activities like conducting nature trails, monitoring maintenance and management of eco-tourist areas so as to gain their support for nature based tourism. For this it is essential to create awareness amongst the local people about the ecological significance of Matheran. Nature trails such as wild flower trail, medicinal plants, bird watching, and butterfly trail may be systematically arranged for tourists. Local/adivasi persons can be trained as guides.

- Many scientists, ecologists, ornithologists, visit Matheran during different seasons for field studies and nature camps. A permanent nature campsite shall be started. It shall have a research wing, library and database. It could be a center for research, documentation continued long term monitoring by ecologists and scientists. Non Government Organizations such as B.N.H.S. or W.W.F. or W.I.I. shall be involved in setting up these education and research facilities for scientists, ecologists, students and tourists and these shall be managed by the Forest Department.

- A Botanical garden shall be created to educate visitors about local flora. Only indigenous species found in the semi evergreen-evergreen forests of the region shall be grown here. Food plants of butterflies, medicinal plants, and orchid species found in Matheran and surrounding forests can be grown here.

- The Botanical garden shall be located in a degraded area. The forest park / area near Simpsons tank can be used for this purpose. A reservation shall be made for Botanical garden in the Sub-Zonal Master Plan. The Forest Department shall set it up and maintain it. Reputed institutions and organizations (B.N.H.S/ W.W.F) shall be involved in the design and setting up of this facility. Ecologists and Scientists shall be consulted. Plants shall be displayed in their natural setting. Lawns, terracing landscaping, or plantation with exotic species shall not to be allowed. There shall be no built structures allowed in this area. Existing pathways shall be converted to nature trails. The pathways shall be restored and left covered with leaf litter to prevent soil erosion.

- The forest area around Simpsons tank is degraded and shall be restored. Self-guided nature trails can be developed here. These could include information about various plant and tree species, birds, butterflies, insects etc.

- The Botanical garden shall have trained local guides as in Protected Areas.

7. MICRO LEVEL STUDY ANALYSIS AND RECOMMENDATIONS FOR SPECIFIC FEATURES AND LOCATIONS ON THE PLATEAU

7.1. WATER BODIES

a. Charlotte Lake

b. Simpsons Tank

7.2. NATURAL SPRINGS

7.3. POINTS

7. MICRO LEVEL STUDY ANALYSIS AND RECOMMENDATIONS FOR SPECIFIC FEATURES AND LOCATIONS ON THE PLATEAU

7.1 LAKES

7.1 (A) CHARLOTTE LAKE

Charlotte Lake is one of the main water resources of the Matheran Plateau. Covering a mean area of three acres; it is the only drinking water reservoir located on the plateau. It is situated next to the Pisarnath temple and is also a major tourist spot. The lake was constructed by the British by damming the Pisarnath stream to serve as the water resource for Matheran hill station. However today, with the growing water demands of the plateau and augmentation of water supply by pumping water from the Ulhas River, this lake has become a secondary source of water for the plateau.

The catchment area of the lake has been affected by various factors such as development, soil erosion etc. It is crucial to recognize the importance of this water resource of the plateau and take steps for its protection and maintenance.

Landuse in the watershed

The watershed of Charlotte Lake covers an area of about 1.25 square kilometers (*1264729 sq. m.*). The area immediately surrounding the lake is demarcated as a forest zone. Surrounding this zone are residential, commercial and amenity plots that have undergone a large amount of development, mostly by construction of hotels and lodging facilities. This has led to clearing of vegetation, degradation of the forest cover and destruction of undergrowth in the catchment area, as is quite evident from the satellite image.

The construction of several new hotels in the watershed or catchment area of the lake, with no/ inadequate sewage treatment facility, has led to the contamination of ground water and several springs that feed the reservoir. Certain hotels have laid pipes carrying sewage right upto the reservoir and sewage water is being released directly into the reservoir.

Charlotte Lake is one of the highly frequented tourist spots, having heavy pedestrian and horse traffic along the approach roads. Due to this, the roads need constant maintenance and soil used for this purpose is excavated from forest areas and road edges. This has led to soil erosion and siltation in the reservoir.

Pony stops are located along the Edward road and Charlotte lake road. Undergrowth has been cleared for this purpose. Horse dung being washed into the lake has resulted in the contamination of lake water.

Drainage pattern

Charlotte Lake is fed by several streams and springs.

Severe headward cutting and stream erosion is observed along the two major streams that feed Charlotte Lake. This has resulted in loss of canopy and forest cover in the watershed. This heavy erosion in streams has led to siltation in the reservoir and at the mouth of the streams. One of the major causes of such severe stream erosion was the P.W.D. quarry located near the mouth of the stream. The overflow of the lake has also caused soil erosion at Ceilia point.

Culverts have been provided for storm water drainage. However their number is inadequate, considering the quantity of water and large surface areas to be drained. This increases the velocity of water that is being diverted through each culvert, leading to erosion and cutting of banks.

The lack of culverts at certain crucial points and storm water drains along roads that are silted, results in large quantities of water flowing on the surface of roads during monsoons causing sheet erosion.

Vegetation

The forest cover has been disturbed and destroyed due to construction activity in the developed plots in the catchment area. In the area surrounding the Pisarnath temple and on the lower side of the dam, much of the forest has been cleared.

Clearing of the undergrowth has led to the degradation of the forest in these areas. Stream erosion is also an important factor that has affected canopy cover in this area. Along the roads soil is being taken

out for ramming the road surfaces, which is causing soil erosion along these patches and destruction of valuable undergrowth. Most of the forest in the forest zone surrounding the lake is in good condition and has good biodiversity. However these areas are sensitive and need to be protected and maintained in their natural state.

Recommendations for Charlotte Lake and its watershed

Forest area

- Forest area, in the watershed of Charlotte Lake, shall be declared as an area of Special Scientific interest and a Heritage Biodiversity area and shall be included in the list of Natural Heritage sites.
- Site-specific restoration measures shall be taken to improve the vegetation and undergrowth to prevent erosion, retain soil cover and soil moisture.
- The Forest area around Charlotte Lake shall be fenced off from roads to allow restoration of the degraded area.
- Indigenous hedge plantation shall be carried out along the roads to protect ground vegetation from dust.
- Loose soil shall not be excavated and laid on roads and pathways and other areas prone to erosion without sufficient compaction.
- Activities such as camping, in forest areas shall be banned.

Developed areas

- No development shall be permitted up to a distance of 50 m. from the maximum water level of the lake.
- All the forested areas on lease properties shall be identified and included in the Conservation Reserve Zone.
- Ecological restoration activities shall be undertaken in forested areas that are disturbed. Plantation measures of indigenous species shall be carried out in areas where the forest is completely degenerated or devastated.
- Lawns, exotic ground covers, and flowerbeds shall not be used in landscaping. There shall be no removal of natural ground cover, soil, rocks, boulders, stones, vegetation or grass for the purpose of growing lawns.
- Landscaping shall be permitted only for restoring the native ecology and habitats and no exotic species shall be used / introduced.

- Sewage treatment plants shall be made mandatory for all existing hotels / developments in the watershed. No activity that can pollute ground water such as dumping of garbage, construction material etc. shall be permitted in this area.

Undeveloped plot areas

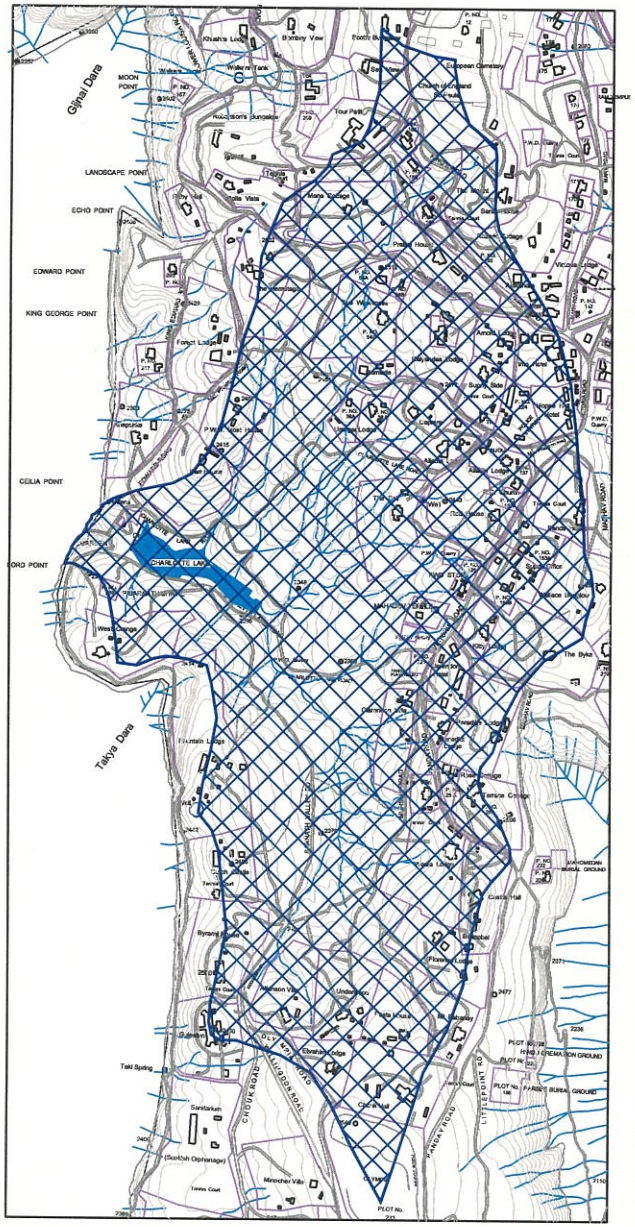
- No new development activity shall be permitted in the catchment of Charlotte Lake.
- All the forested areas on lease properties shall be identified and included in the Conservation Reserve Zone.

Conservation and restoration of natural ecology

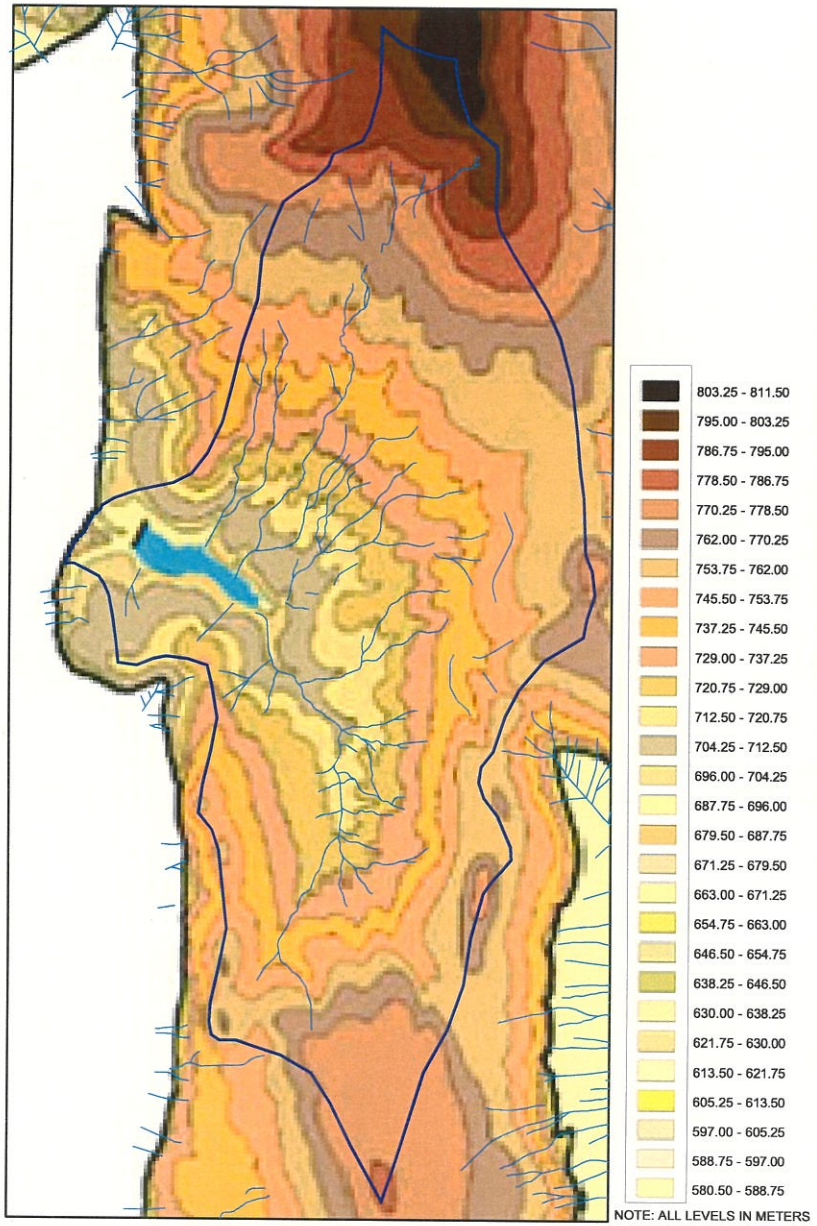
- Any activity that can cause increase in velocity of water, such as quarrying, within the streambed shall not be allowed. Measures shall be taken to prevent and control stream erosion under the supervision of geologists, hydrologists and subject experts.
- No development shall be permitted in a 15 m. wide belt on both sides of streams, rivers and other watercourses.
- Excavation of stream banks or widening of channels shall not be allowed.
- Activities such as tethering of horses, dumping of garbage/ construction material etc. shall be prohibited near streams.
- A stream restoration program shall be undertaken by proper agency and under the supervision of scientists, ecologists and subject experts, which will include measures to be adopted to prevent and reverse the pollution of streams.
- Measures shall be taken to slow down the velocity of water. Gabion walls shall be constructed at required locations to control severe erosion.
- Number of culverts shall be increased along the roads and provided with silt catchers and collection ponds to reduce velocity of water.
- Storm water drains shall be desilted and designed with silt catchers and collections ponds.
- Pitching and plantation measures shall be carried out at the overflow at Ceilia point to prevent soil erosion.
- The lake and surrounding areas shall be desilted to increase the water holding capacity.
- The lake area has been fenced off from the road. No activities such as bathing, swimming etc. shall be allowed in the reservoir and surrounding streams. Horses/ people shall not be allowed near the reservoir.
- Area at the mouth of stream can be bunded and developed as additional water storage, after proper assessment of site conditions.

- Wastewater outlets into the streams and lake shall be stopped immediately.
- The area near Pisarnath Shrine can be developed into a Botanical garden with provision of tourist facilities like seating.
- Pathways frequented by people should be paved. Horses should not be permitted on the pathway near Pisarnath shrine.
- Mud roads in the watershed shall be repaired with sufficient compaction and maintained to prevent soil from being washed into the streams and reservoir.
- A proper area shall be demarcated for pony stop on Edward road. Hedge plantation shall be carried out along the forest edge to prevent horses from trampling in the forest.
- Construction of temporary shelters and camping on forestlands shall be prohibited.

MAP OF MATHERAN PLATEAU



DEVELOPMENT IN WATERSHED OF CHARLOTTE LAKE



NOTE: ALL LEVELS IN METERS

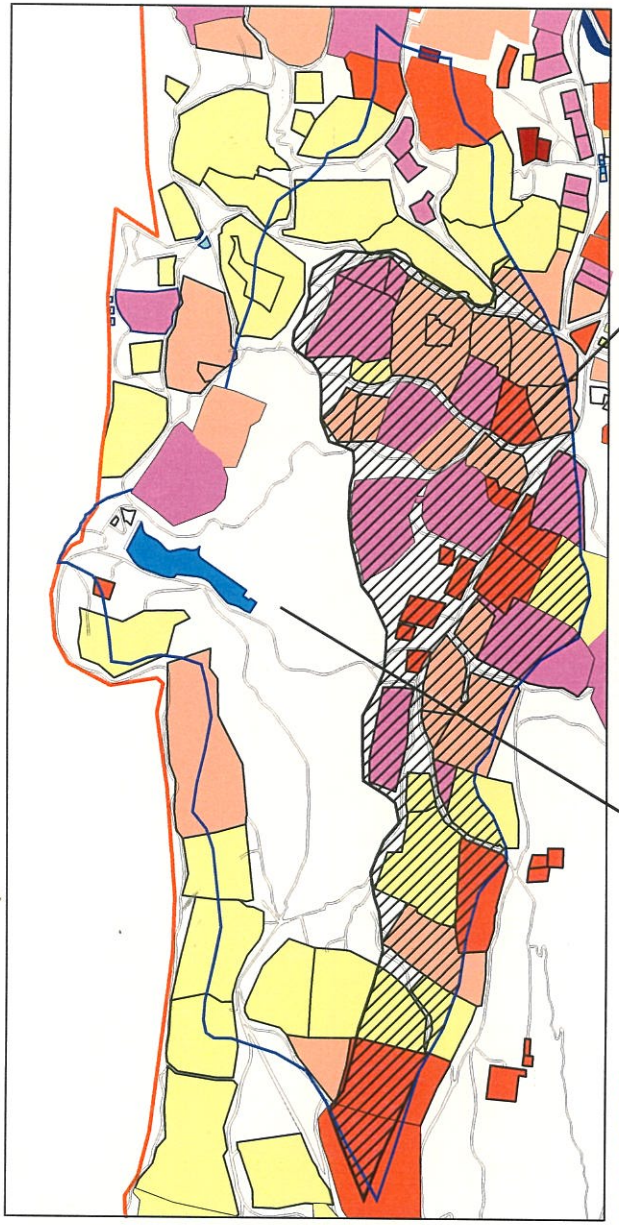
TOPOGRAPHY OF WATERSHED OF CHARLOTTE LAKE

CHARLOTTE LAKE DETAILS

N

50 200
0 100 500 M

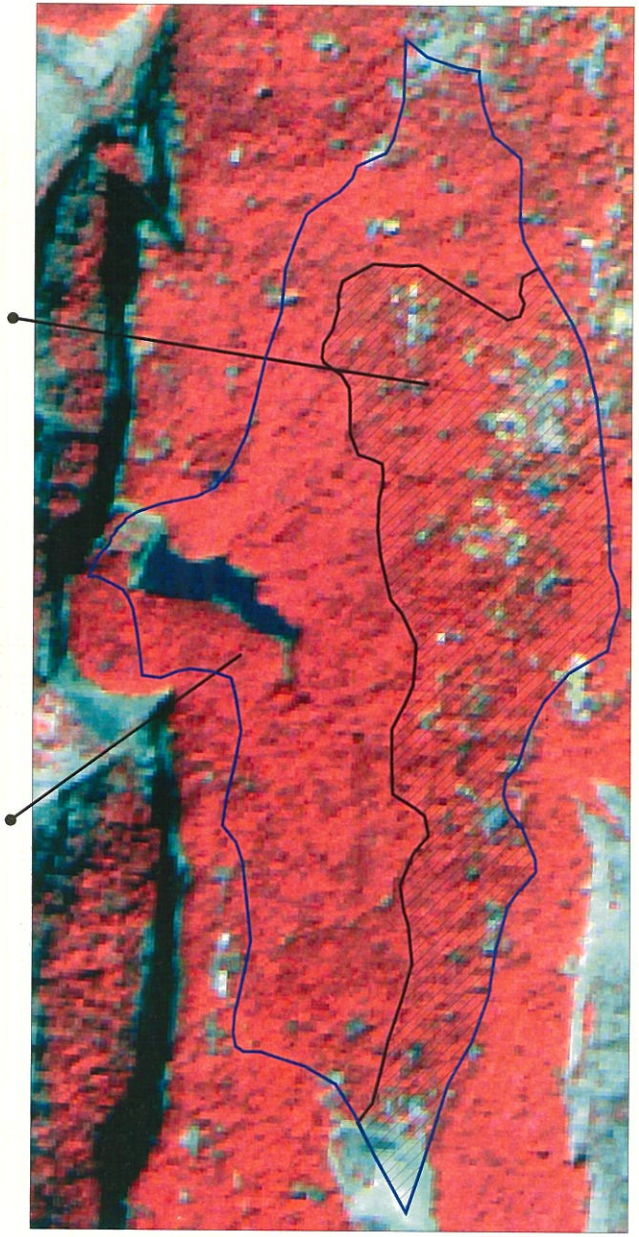
WATERSHED CHARACTERISTICS FOR CHARLOTTE LAKE



LANDUSE IN WATERSHED OF CHARLOTTE LAKE

THE **CHANGE OF LANDUSE** FROM RESIDENTIAL TO COMMERCIAL USE AND **DEVELOPMENT OF PLOTS** FOR HOTELS AND LODGES, HAS LED TO CLEARING OF FOREST AREAS AND **DEGRADATION OF FOREST COVER** BY DESTRUCTION OF UNDERGROWTH IN THE WATERSHED OF CHARLOTTE LAKE.

THE **FOREST AREA** IMMEDIATELY SURROUNDING THE LAKE IS IN GOOD CONDITION. HOWEVER IT NEEDS TO BE **PROTECTED AND MAINTAINED** TO PRESERVE IT IN ITS NATURAL STATE.



SATELITE IMAGE INDICATING VEGETATION COVER

50 200
0 100 500 M

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DEVELOPMENT PATTERN

CHARLOTTE LAKE

ROAD FREQUENTED BY TOURISTS.
HENCE HEAVY PEDESTIAN AND HORSE TRAFFIC ON ROAD

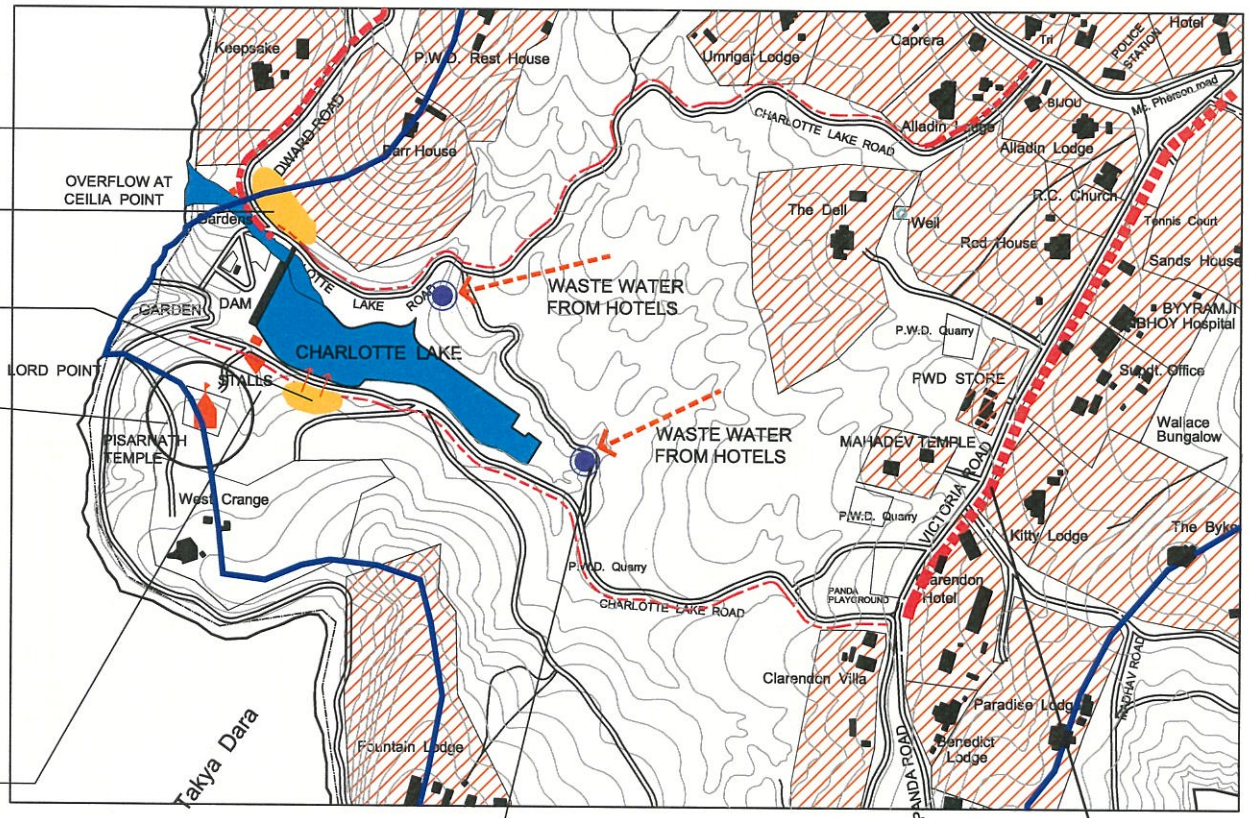
PONY STOP
LEADING TO CLEARING OF UNDERGROWTH IN THIS AREA.

PONY STOP
ALL THE DUNG GETS WASHED AWAY INTO THE LAKE LEADING TO CONTAMINATION OF LAKE WATER

PISARNATH TEMPLE–
A MAJOR TOURIST SPOT

STALLS NEXT TO TEMPLE

WASTE WATER OUTLET INTO STREAM FROM SURROUNDING HOTELS LEADING TO CONTAMINATION OF LAKE WATER



VICTORIA ROAD--
A MAJOR ROAD USED BY TOURISTS WHICH CUTS ACROSS THE WATERSHED

THE STORM WATER DRAINS ALONG THIS ROAD SHOULD BE DIRECTED TOWARDS THE LAKE

LEGEND

- LINE OF WATERSHED
- PONY STOP
- HEAVILY FREQUENTED ROADS
- MODERATELY FREQUENTED ROADS
- LESS FREQUENTED ROADS
- STALL
- DEVELOPED PLOTS

0 50 100 200 500 M

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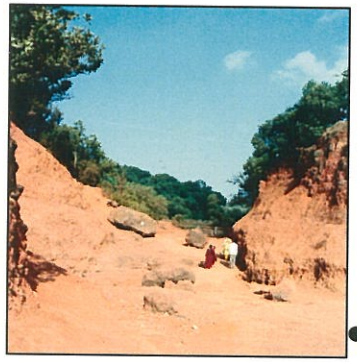
TOURISM AND DEVELOPMENT ISSUES



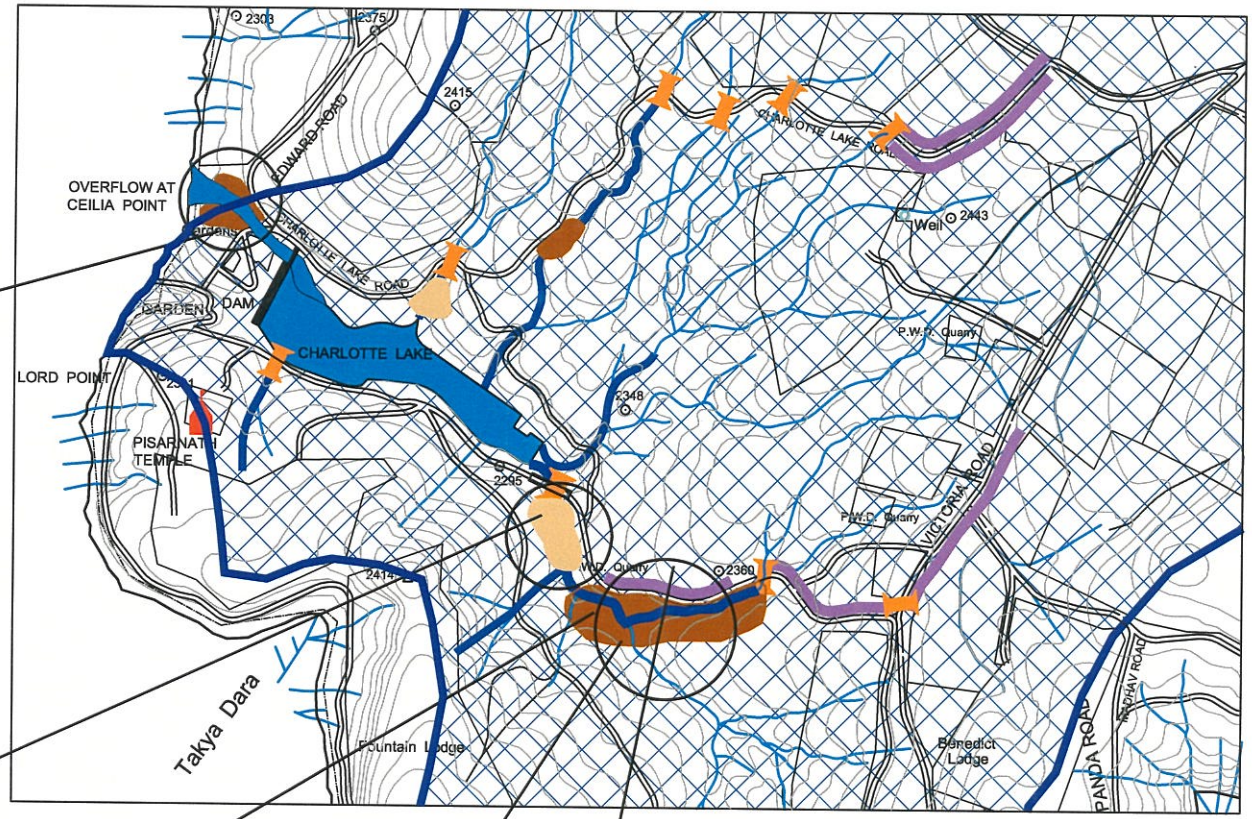
MAJOR SOIL EROSION ALONG
OVERFLOW OF LAKE AT CEILIA POINT

SILTATION IN STREAM FEEDING THE LAKE

MAJOR SOIL EROSION ALONG EDGES OF STREAM DUE TO QUARRYING ACTIVITY AND HIGH VELOCITY OF WATER

EXPOSED ROCK DUE TO HEAVY SOIL EROSION ALONG STREAM EDGE

CULVERTS NEED TO BE PROVIDED ALONG ROAD IN THIS AREA TO CARRY WATER FROM THE CATCHMENT AREA INTO THE STREAM AND PREVENT SOIL ALONG ROAD BEING WASHED AWAY



LEGEND

- LINE OF WATERSHED
- NATURAL STREAM
- MAJOR STREAM
- GUTTER
- CULVERT

DRAINAGE PATTERN IN WATERSHED

0 50 100 200 500 M

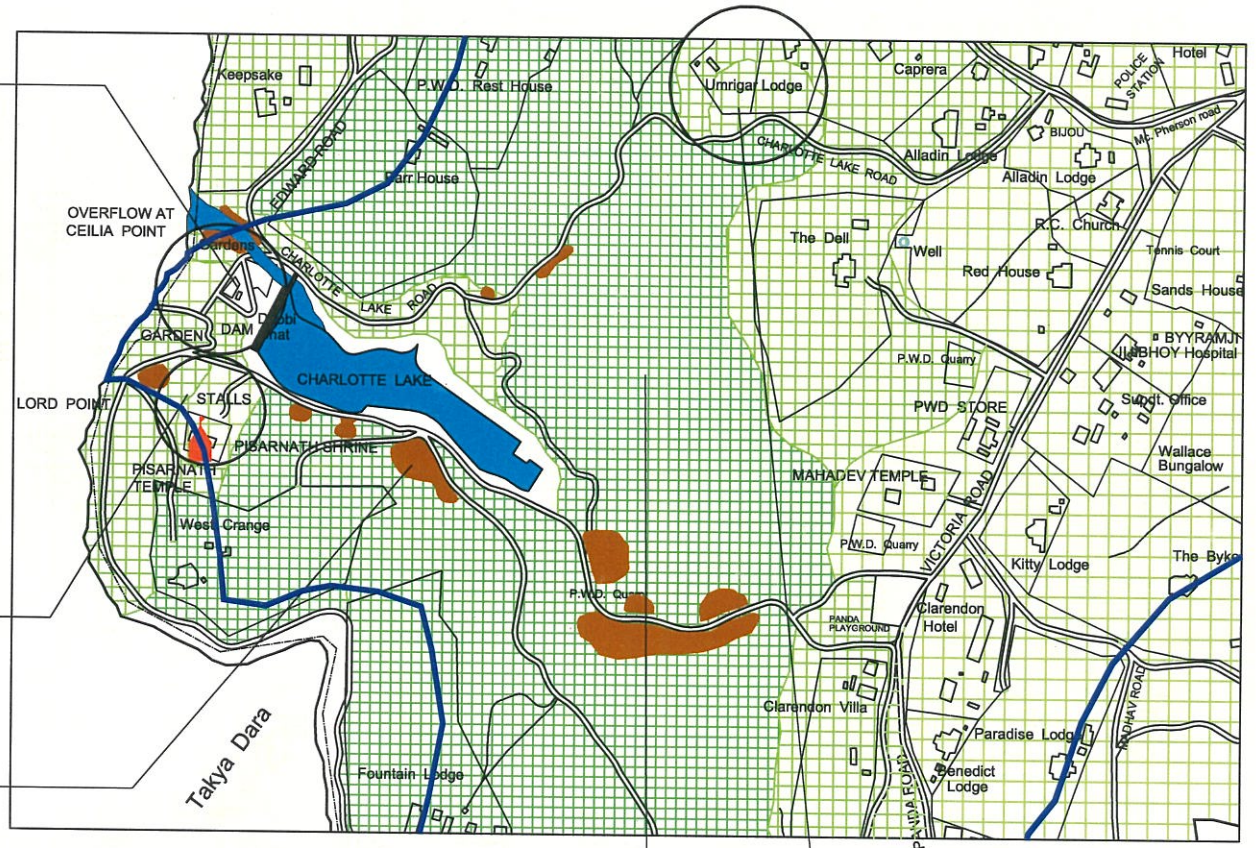
N

CLEARING OF FOREST VEGETATION ON THE DOWNSIDE OF DAM

CLEARING OF UNDERGROWTH IN FOREST AREA AROUND THE TEMPLE AND STALLS

SOIL USED FROM SURROUNDING FOREST AREA FOR RAMMING THE ROADS FREQUENTED BY TOURISTS

FOREST AREA IN GOOD CONDITION NEEDS TO BE PROTECTED AND MAINTAINED IN NATURAL STATE



LEGEND

- LINE OF WATERSHED
- SOIL EROSION
- VEGETATION WITH NO UNDERGROWTH
- GOOD VEGETATION BUT DISTURBED
- DENSE FOREST COVER

FOREST VEGETATION CLEARED FOR CONSTRUCTION ACTIVITY

0 50 100 200 500 M

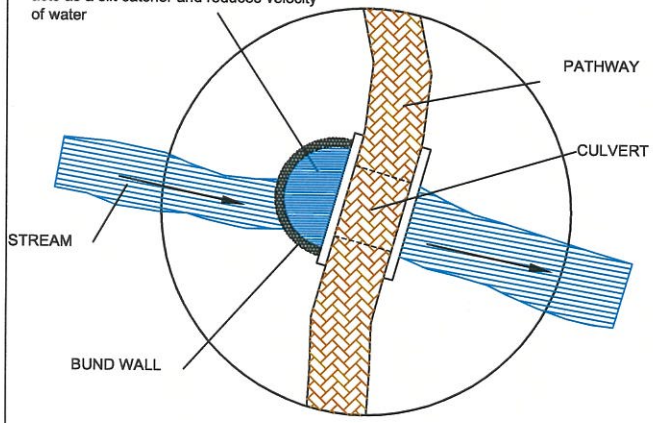
N

VEGETATION AND SOIL

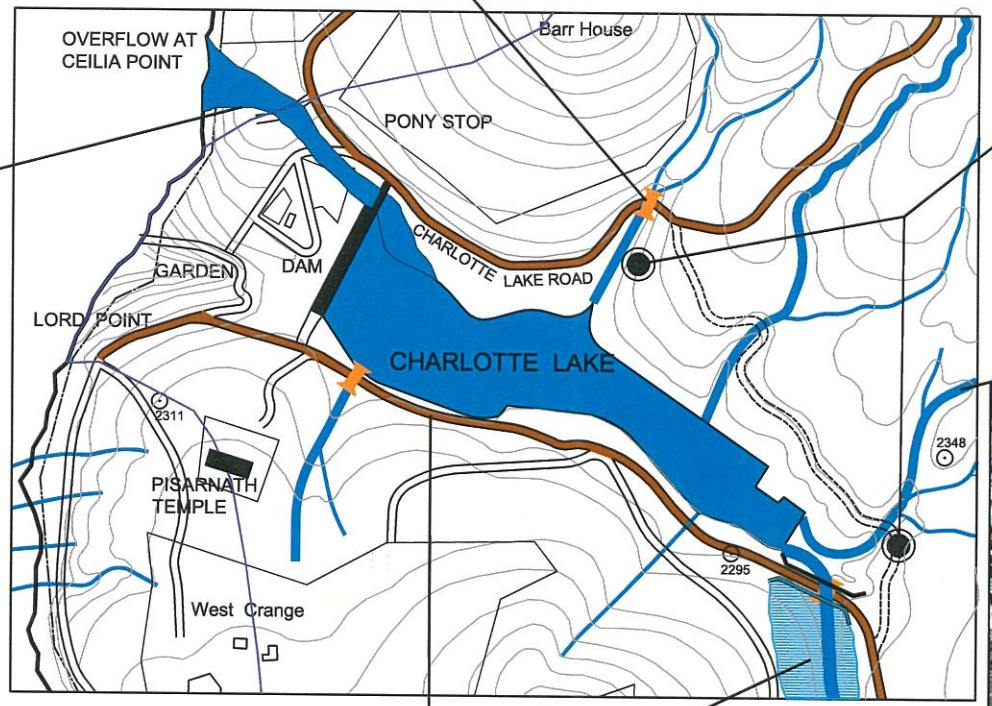
CHARLOTTE LAKE

CHARLOTTE LAKE

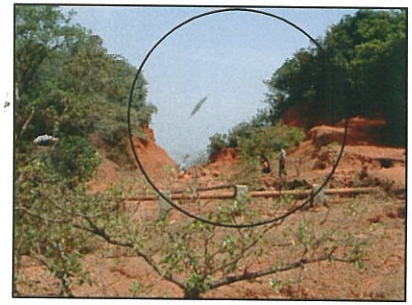
COLLECTION PONDS SHOULD BE PROVIDED AT THE CULVERTS TO CHECK VELOCITY OF WATER



DETAIL OF COLLECTION POND AT CULVERT



DISCHARGE OF WASTE WATER INTO THE LAKE SHOULD BE STOPPED IMMEDIATELY

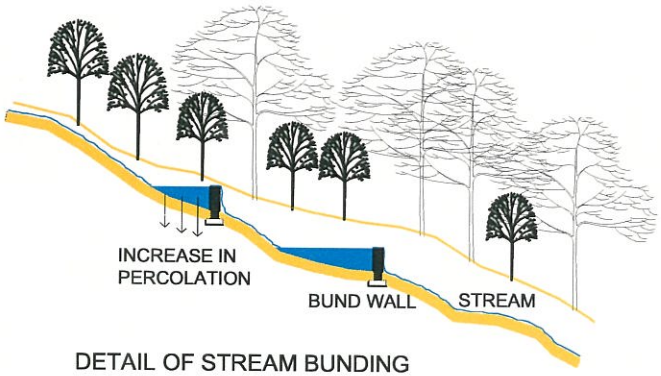


SOIL EROSION CONTROL MEASURES LIKE PITCHING AND PLANTATION TO BE CARRIED OUT AT THE OVERFLOW POINT

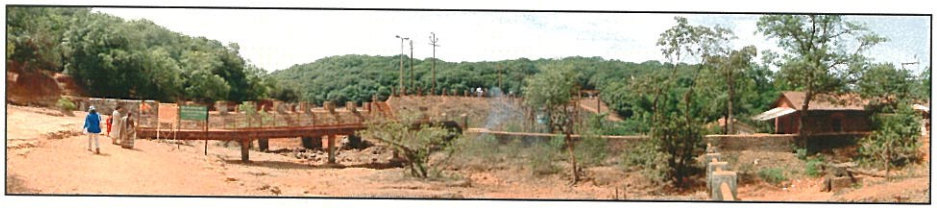
PATHWAY SHOULD BE RESTRICTED FOR PEDESTRIAN USE ONLY. THE PONY STOP NEXT TO PISARNATH TEMPLE SHOULD BE REMOVED.

BUNDING SHOULD BE CARRIED OUT ALONG STEEPER SECTIONS OF STREAMS TO REDUCE VELOCITY OF WATER FLOW AND PREVENT SOIL EROSION.

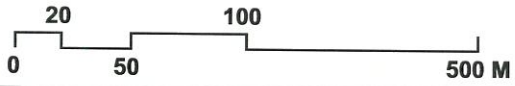
AREA AT THE MOUTH OF THE STREAM CAN BE BUNDED AND DEVELOPED AS ADDITIONAL WATER STORAGE, AFTER PROPER ASSESSMENT OF SITE CONDITIONS

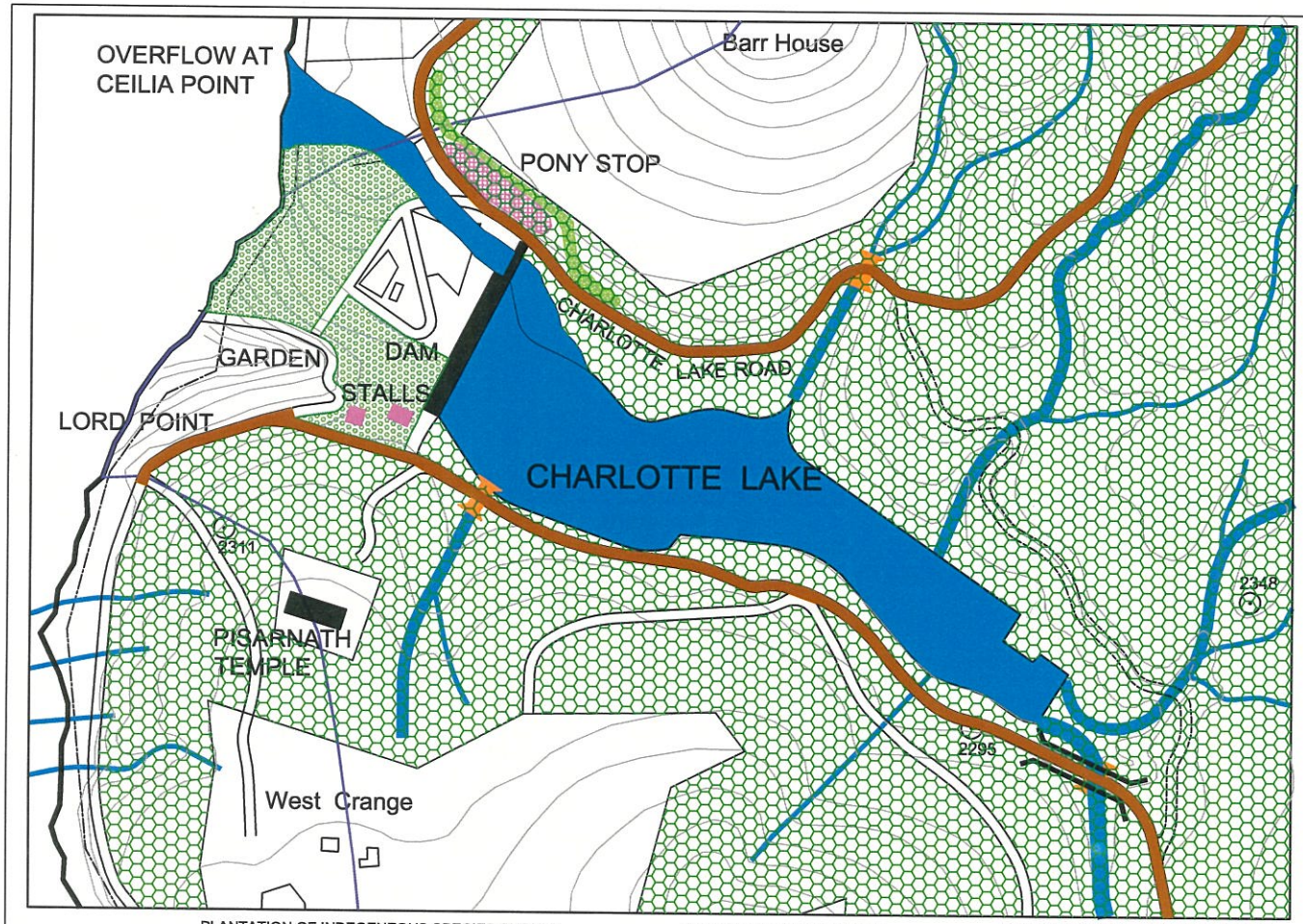


DETAIL OF STREAM BUNDING



PROPOSAL FOR CHARLOTTE LAKE





HERITAGE BIODIVERSITY ZONE

BOTANICAL GARDENS

PAVED PATHWAYS

HEDGE PLANTATION TO PREVENT HORSES FROM TRAMPLING IN THE FOREST

PLANTATION OF INDEGENEOUS SPECIES SHOULD BE CARRIED OUT ON THE DOWNSIDE OF DAM. THIS AREA CAN BE DEVELOPED INTO A BOTANICAL GARDEN WITH PROVISION FOR SEATING AREAS AND STALLS FOR TOURISTS.

RAILING AND SEATING TO BE DESIGNED ALONG THE DAM

FOREST AREA TO BE DECLARED AS A HERITAGE BIODIVERSITY ZONE.

PROPOSAL FOR CHARLOTTE LAKE

20 100

0 50 500 M

N

CHARLOTTE LAKE

7.1 (B) SIMPSONS TANK

Simpsons Tank is the second largest tank on Matheran plateau, situated on the steep gradient in Patal stream basin. The tank is created by constructing a stone bund across the valley. Initially water was being used for domestic purposes. Now the water is not potable and the storage capacity of the tank has reduced due to siltation and seepage. If restored and purified Simpsons Tank could be used to supplement the water supply on Matheran plateau.

Landuse in the watershed

The watershed of Simpsons Tank covers an area of about 0.48 square kilometers. The catchment area has heavy traffic, and includes the car-park area, horse-stand, loading and unloading activities.
The goods depot is located very close to the tank on the upstream side. Tempo and other goods vehicles download material at this place, which is then distributed by ponies and human carts to other areas of Matheran. This activity is being handled in an extremely disorganized manner. Dumped material gets easily washed into the tank. Freight horses are let loose to move through forest areas around the tank. They are being tethered on forestland or in streambeds. Trampling by freight horses has led to loss of ground cover and undergrowth. Around the tank there is a complete loss of ground cover that has resulted in severe erosion and siltation. The pathways and sloping banks around the reservoir show severe erosion due to movement of horses. Soil has been excavated from forestland in several areas and placed on roads to make them suitable for movement by horses. During monsoons all this loose soil gets washed into the reservoir. This has silted up the reservoir and greatly reduced its capacity. Streams are clogged with horse dung that gets washed into the reservoir during monsoons. Water in the reservoir is also contaminated by horses, and horsemen that bathe/swim in the reservoir including sick, infected horses that are abandoned and left to die in the area.
Next to the goods depot is Dasturi naka and the vehicle parking lot. The expansion of the car park in forestland due to increasing numbers of private vehicles coming to Matheran has led to deforestation with in the watershed. There are a few residential and commercial plots in the catchment.

Drainage pattern

The largest stream that feeds Simpsons reservoir shows severe head- ward erosion. Opening in canopy / thinning of canopy due to undercutting of banks is observed here. The Dhangarwada spring is located in this stream. The British Survey map dated 1903-04 shows a P.W.D quarry located near the culvert

where the stream crosses the Dasturi road. The streambed consists of basalt rock in places and check dams have been constructed to store water but these have been silted up.

Vegetation

The forest cover has been disturbed mainly due to loading-unloading activity and car parking in the up streamside of the tank. Tourist activity in this area is low as compared to other points. Vegetation in the down streamside, in the Patal Temple basin, is in good condition and shows good biodiversity. This area needs to be preserved in its natural state.

Recommendations for Simpsons Tank and its watershed

Infrastructure

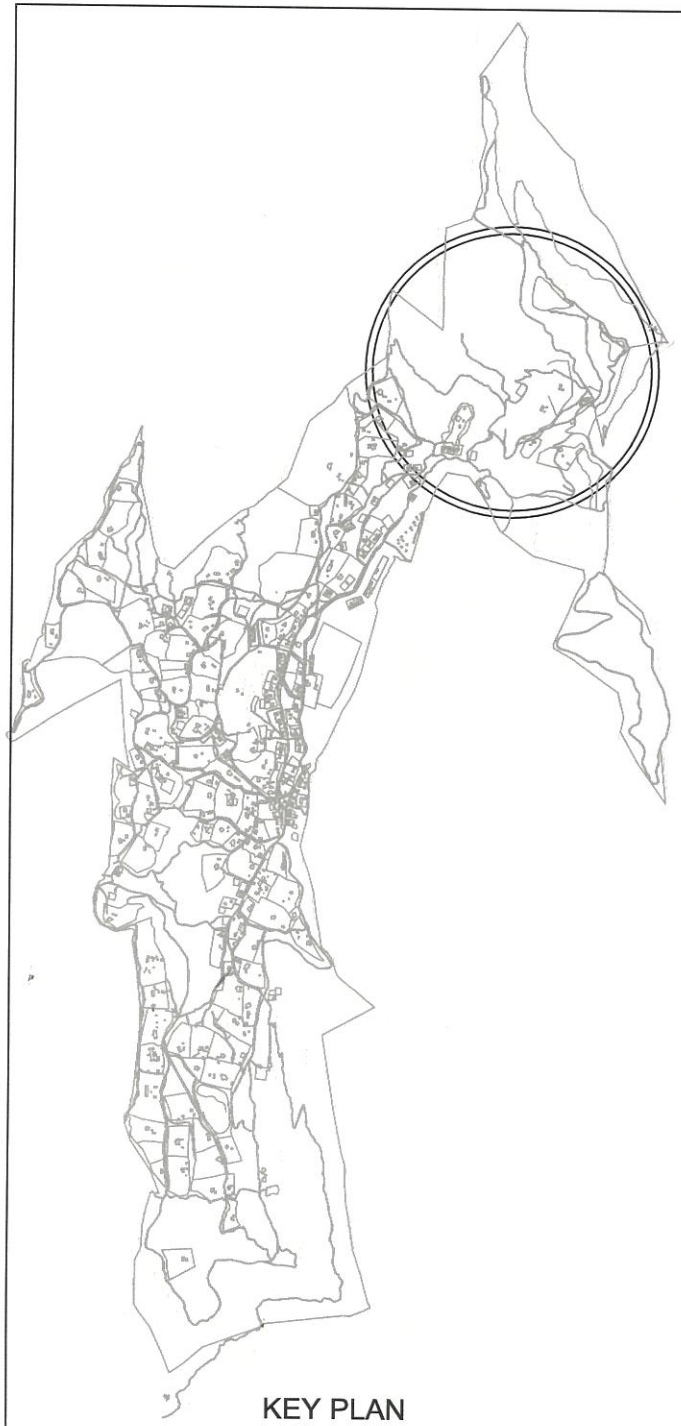
- The car park at Dasturi shall be demarcated. The car-park area shall not be allowed to expand any further. The Forest department shall reclaim the land that has been encroached upon for the car park and this shall be fenced off to prevent further encroachment.
- The bus and taxi stand shall be planned within the existing parking area, in a manner that it does not pollute the Tank or encroach upon the forestland.
- A Dasturi–Matheran station goods train shall be started to transport goods from the loading and unloading point (next to Wadia Bungalow near Dasturi) upto Matheran railway station. The number of Freight horses carrying goods from Dasturi upto Matheran bazaar area can thus be reduced. This will reduce traffic on the pedestrian road from Dasturi to the bazaar area.
- Loading and unloading at Dasturi shall be properly regulated and governed. The area shall be fenced off and demarcated to prevent encroachment into surrounding forest areas. Suitable unloading platform shall be constructed or areas demarcated for the unloading/stacking of goods. It shall be ensured that this activity does not pollute/ block/ obstruct any natural stream or water channel that feeds the reservoir.
- Proper facilities for the freight horses such as tanks for drinking water, washing, stables shall be provided at a suitable location near the loading and unloading area. Some horses are presently being tethered near an old dilapidated structure close to Simpsons Tank. This structure could be restored or converted into stables. Horses shall not be left loose in forest areas. Horses shall not be allowed to enter, drink water from/bathe near the streams and reservoirs.

- Arrangements shall be made for the disposal of pony dung from the loading and unloading area.
- The Simpsons Tank area shall be fenced off from the road / railway track. Horses shall not be allowed in this area.
- Number of horses in the catchment area shall be reduced. The number of packhorses at the goods depot shall be limited. Separate routes shall be allotted for the movement of freight horses.
- All hotels, residences in the watershed or the catchment area of the reservoir shall have proper sewage treatment facility to prevent the contamination of ground water.

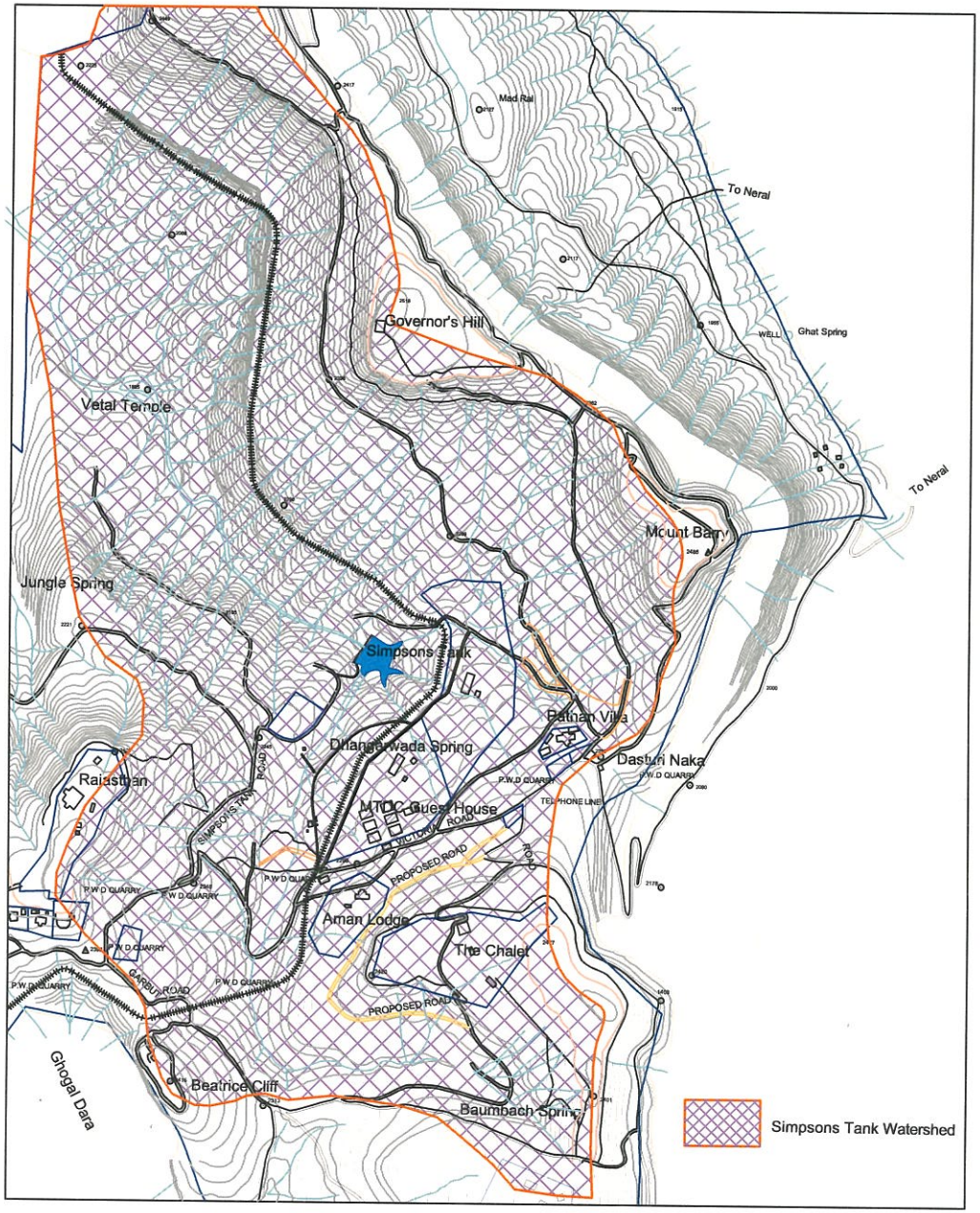
Conservation and restoration of natural ecology

- The Simpsons Tank watershed has rich biodiversity and shall be declared as a Bio-reserve.
- The forest area immediately surrounding the tank up to the railway track is very important as it acts as a buffer between the tank and the other developed areas in the vicinity of the tank. This patch of forest shall not be disturbed under any circumstances. Efforts shall be taken to maintain and restore this patch of forest cover.
- The Forest area around Simpsons Tank shall be fenced off from roads to allow restoration of the degraded area by controlling free movement of cattle, horses and tourists.
- Indigenous Hedge plantation shall be carried out along the roads to protect ground vegetation from dust.
- Erosion control and regeneration of soil in the catchment of the Tank shall be continuously undertaken and monitored.
- Plantation with indigenous species of plants shall be carried out by a proper agency. Original vegetation in the degraded areas shall be restored.
- The Tank shall be desilted regularly.
- Packhorses shall not be bathed or brought to the Tank nor shall they be abandoned and/or permitted to die in the vicinity of the Tank.
- Any activity that can cause increase in velocity of water, such as, quarrying within the streambed shall not be allowed. Measures shall be taken to prevent and control stream erosion under the supervision of geologists, hydrologists and subject experts.
- No development shall be permitted in a 15 m. wide belt on both sides of streams, rivers and other watercourses.
- Excavation of stream banks or widening of channels shall not be allowed.

- Activities such as tethering of horses, dumping of garbage/ construction material etc. shall be prohibited near streams.
- A stream restoration program shall be undertaken by proper agency and under the supervision of scientists, ecologists and subject experts, which will include measures to be adopted to prevent and reverse the pollution of streams.
- Remedial measures shall be taken to prevent further erosion in streams that feed the tank, such as the construction of gabion walls in certain critical areas.
- Check dams shall be de-silted.
- Swimming shall not be permitted in the tank.
- Mud roads in the watershed shall be repaired with sufficient compaction and maintained to prevent soil from being washed into the streams and reservoir.
- Leaf litter shall be maintained on all pathways in this area. There shall be no removal of soil from the area for the maintenance of pathways.
- Building material, such as bricks and cement that are unloaded shall not be dumped/ stacked in forest areas and in streams feeding the reservoir.
- Construction of temporary shelters and camping on forestlands shall be prohibited.
- In the Forest park area, exotic species that have been planted shall be replaced with indigenous species and the area converted into a botanical park. Restoration and enhancement schemes need to be prepared. No commercial development for tourism such as food stalls shall be permitted in this area.



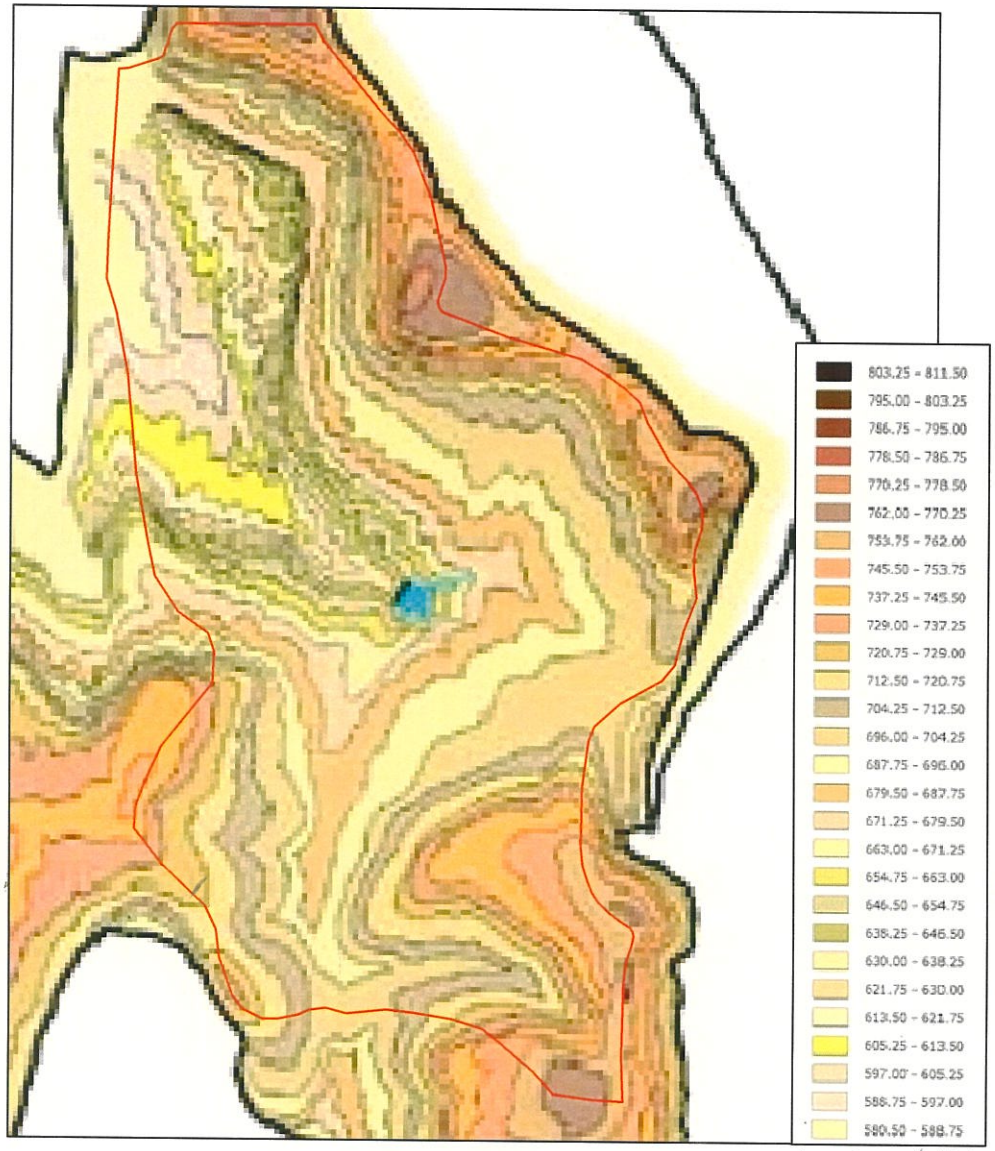
KEY PLAN



SIMPSONS TANK WATERSHED

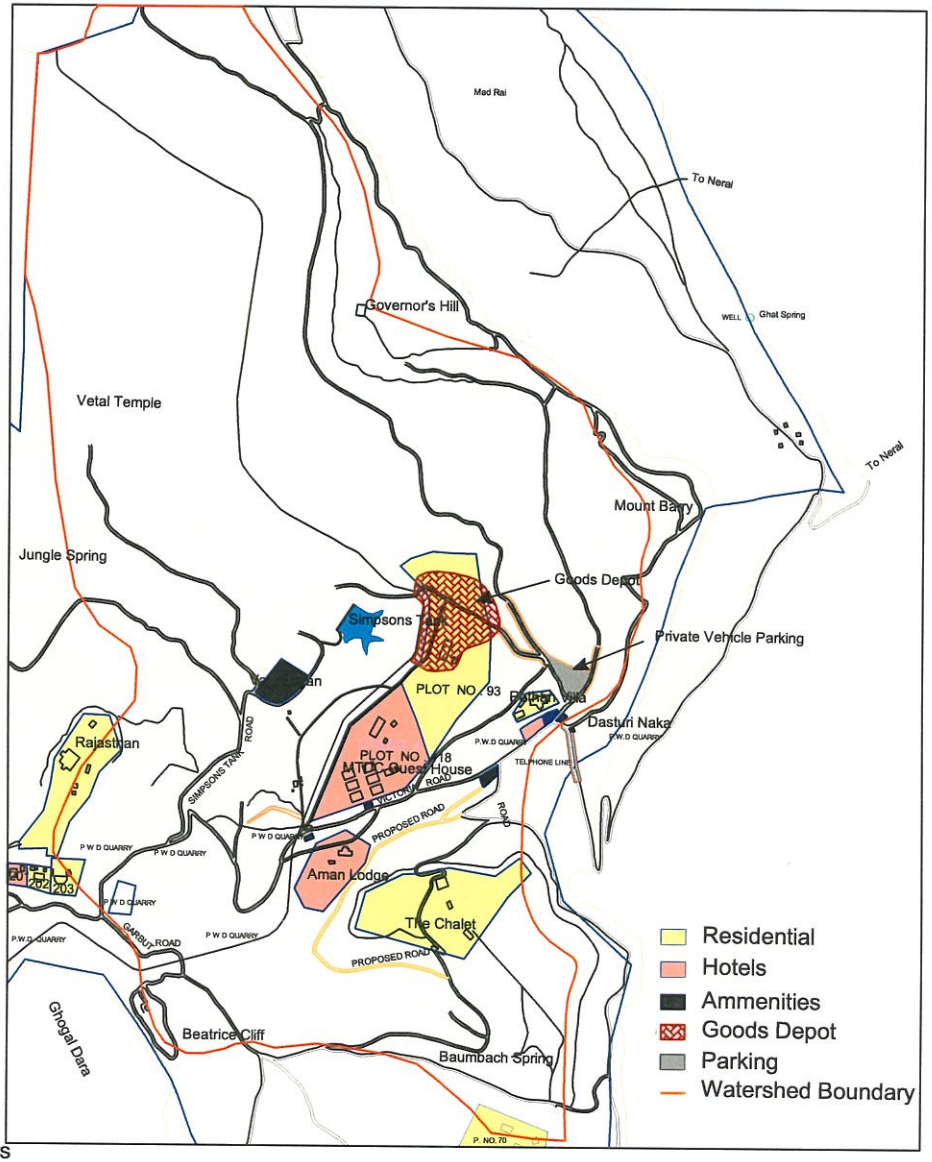
100 0 200 400 M

N



Levels are in Meters

TOPOGRAPHY OF WATERSHED OF SIMPSONS TANK



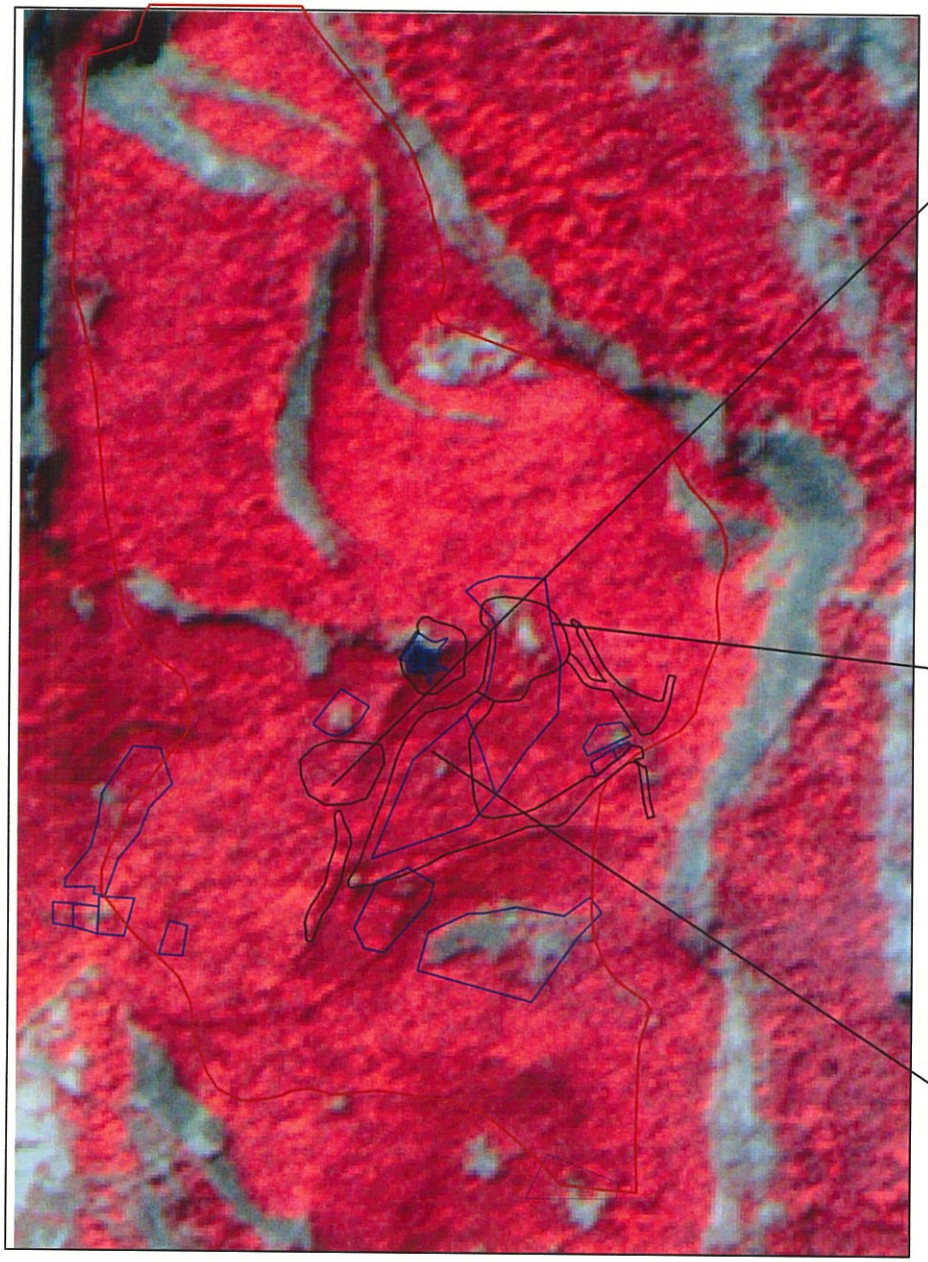
LANDUSE IN WATERSHED OF SIMPSONS TANK

100 0 200 400 M

N

SIMPSONS TANK

KEY PLAN



Ponies going for water trampling freely through the forest

Goods Depot

MTDC Guest House

Zero Ground Vegetation

SATELITE IMAGE INDICATING VEGETATION COVER

Watershed Boundary

Plot Boundaries

Vegetation Thining Areas

100 400 M

0 200

N

SIMPSONS TANK

KEY PLAN

Vanaudyan

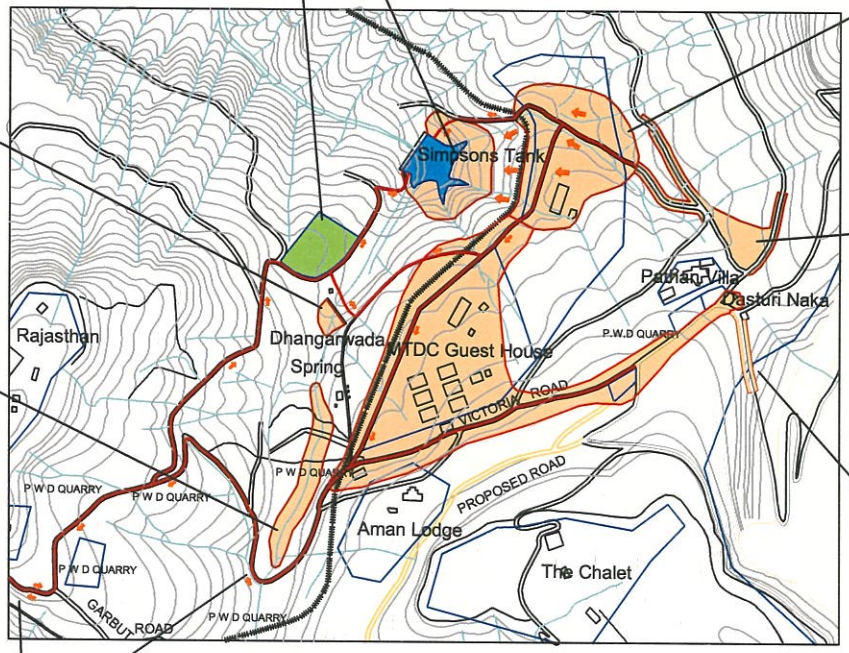
Pony at Simpsons Tank

Goods Depot

Bund
Completely filled with silt

Widening of Stream

Distribution of Goods - Causing road erosion



Distribution of goods on steep slopes - inhuman conditions

Car Park

Taxi Parking Along Road

Area under disturbance

Roads frequented by ponies

SIMPSONS TANK

N

50 200 M
0 100

SIMPSONS TANK - PROBLEMS IDENTIFIED (A)

Measure loss of vegetation along the banks

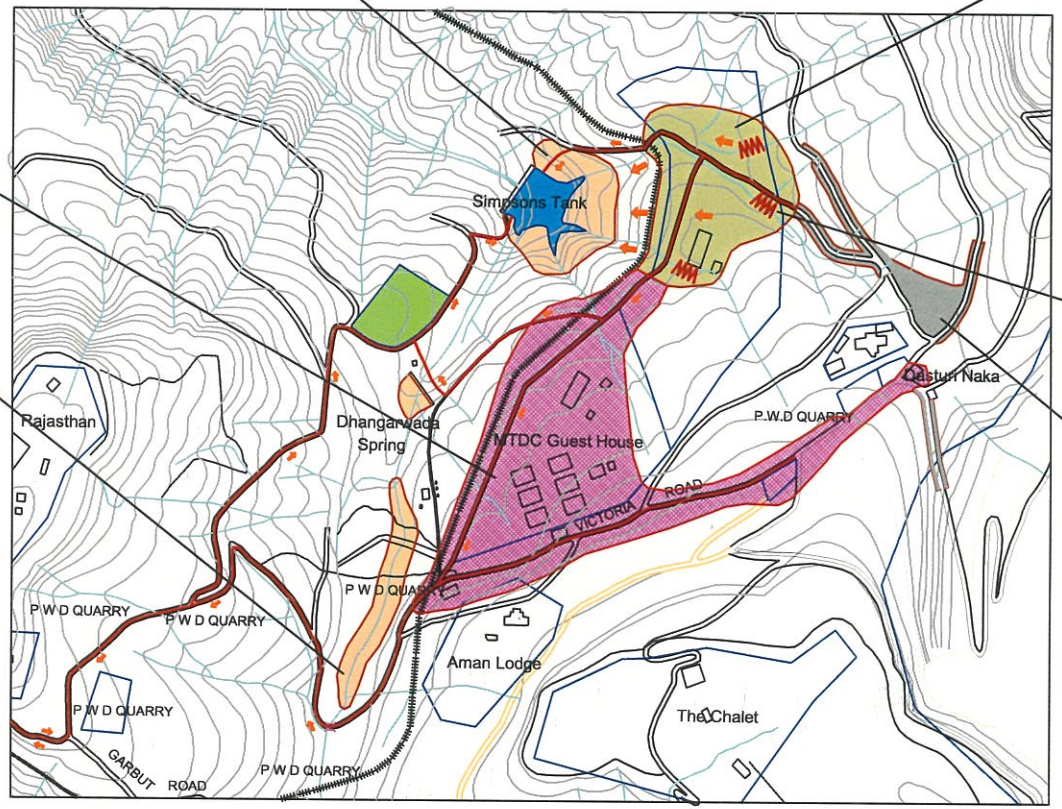
Drastic loosening of soil by pony trampling

Mud, Contaminated water & a Pony

All the debris from goods depot are directly polluting in to the main streams feeding simpsons tank

Ground vegetation is completely disturbed due to human activities and the dust from roads

A jet ejected from culvert & old exavation for quarry is tending to widening & cutting of stream



Ponies are parked in the stream bed itself. This carries all excreta in tank directly

Private vehicle parking is spreading into the forest along the roads. Peak season it goes to more than 125 vehicles at a time.

KEY PLAN

SIMPSONS TANK - PROBLEMS IDENTIFIED (B)

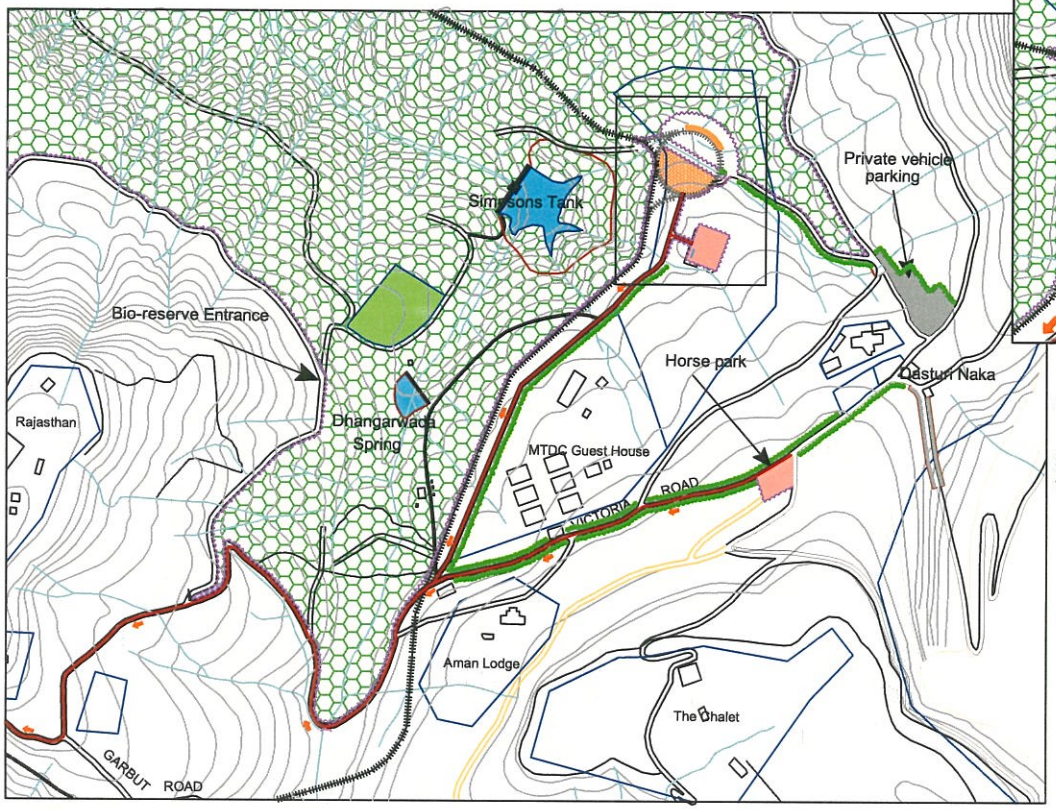
50 200 M
0 100

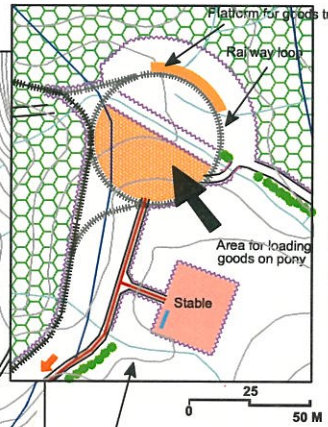
N

130

SIMPSONS TANK

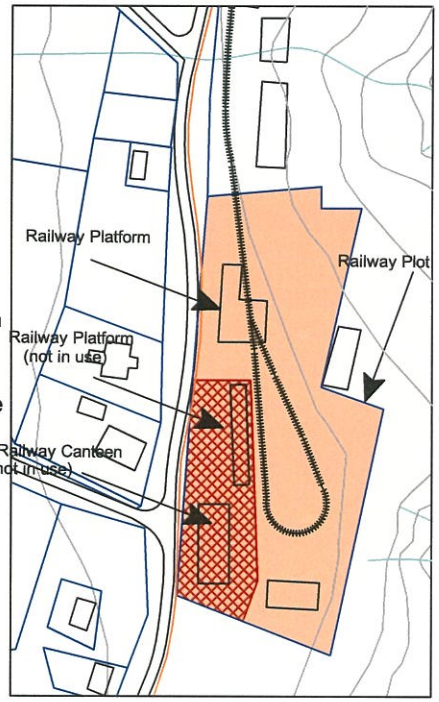
KEY PLAN





Original vegetation needs to be restored in surrounding areas outside fence

Railway Station - Market Area



Railway Plot

Area can be utilized for goods distribution and pony parking

Paths in the Bio-reserve shall be kept fully covered with leaf litter

Bio-Reserve - The area from Simpsons tank to Vetal Temple
Area is rich in biodiversity

Forest Nursery - for indigenous plants

Horse, Pony Stables - with proper facilities like water, fodder etc.
Should be fenced. Dung should be used for Gobar gas plants.

Waterbodies of Simpsons tank & Bund near vanaudyan-
Strengthening & desilting of bunds should be carried out
Capacity of the Simpsons tank can be increased
Water can be used for Stables & Nursery

Indigenus Hedge plantation - to protect ground vegetation from dust

Fencing - to restrict pony & horse movement
to protect Bio-Reserve

Pony & horse movement should be restricted to these two roads

Vehicle parking - private vehicles should be restricted to 50. Parking site should be provided for the rest at Neral. Already some residentials are providing pay & park at Neral. This could be promoted in a organized way.

Additional Railway Loop - With this goods can be transported upto the market (2.5 km). From the market distribution will be much easier & nuisance in Simpsons watershed can be controlled. It will also stop transporting the goods on steep slope manually which is really inhuman. There will also be check on the payment of coolies if it is under railways.

PROPOSAL FOR SIMPSONS TANK

0 50 100 200 M

N

SIMPSONS TANK

7.2 NATURAL SPRINGS

"Vast quantities (of water) are held back for the time and soak through the sponge-like upper stratum, i.e. Laterite and when it is prevented from further percolation by the solid bed of trap below i.e. basalt. Upon this it collects and proceeds in a more leisurely manner to find its way through the mountainsides, at levels varied according to the irregularity of trap formation. These water escapements constitute the springs that supply the station during the dry season with its drinking water. There are about 23 odd springs on the plateau. The principal ones amongst them are Malet's spring, Monkey, Ponsonby and Harrison's spring". The Hill Station of Matheran, Mrs. A. K. Oliver-1905.

Due to the unique undulating topography of the land, several watershed areas are formed on the plateau. The line joining the peaks on the plateau is called the ridgeline. These ridgelines together, result in the formation of various watersheds on the plateau. These watersheds are basically the catchment areas of the springs in which they lie. Any disturbance within the catchment area will eventually affect the spring quality and quantity. Springs emanate from percolation at higher elevations, which may or may not be under forest cover. The percolated water travels according to the features of the sub-strata. These springs are found either in streambeds or at cliff edges or from boulders within a stream or in fissures in flat rocks. The approach roads to these springs are either within a streambed or a trail in a forest or kuccha pathway or through nagars etc.

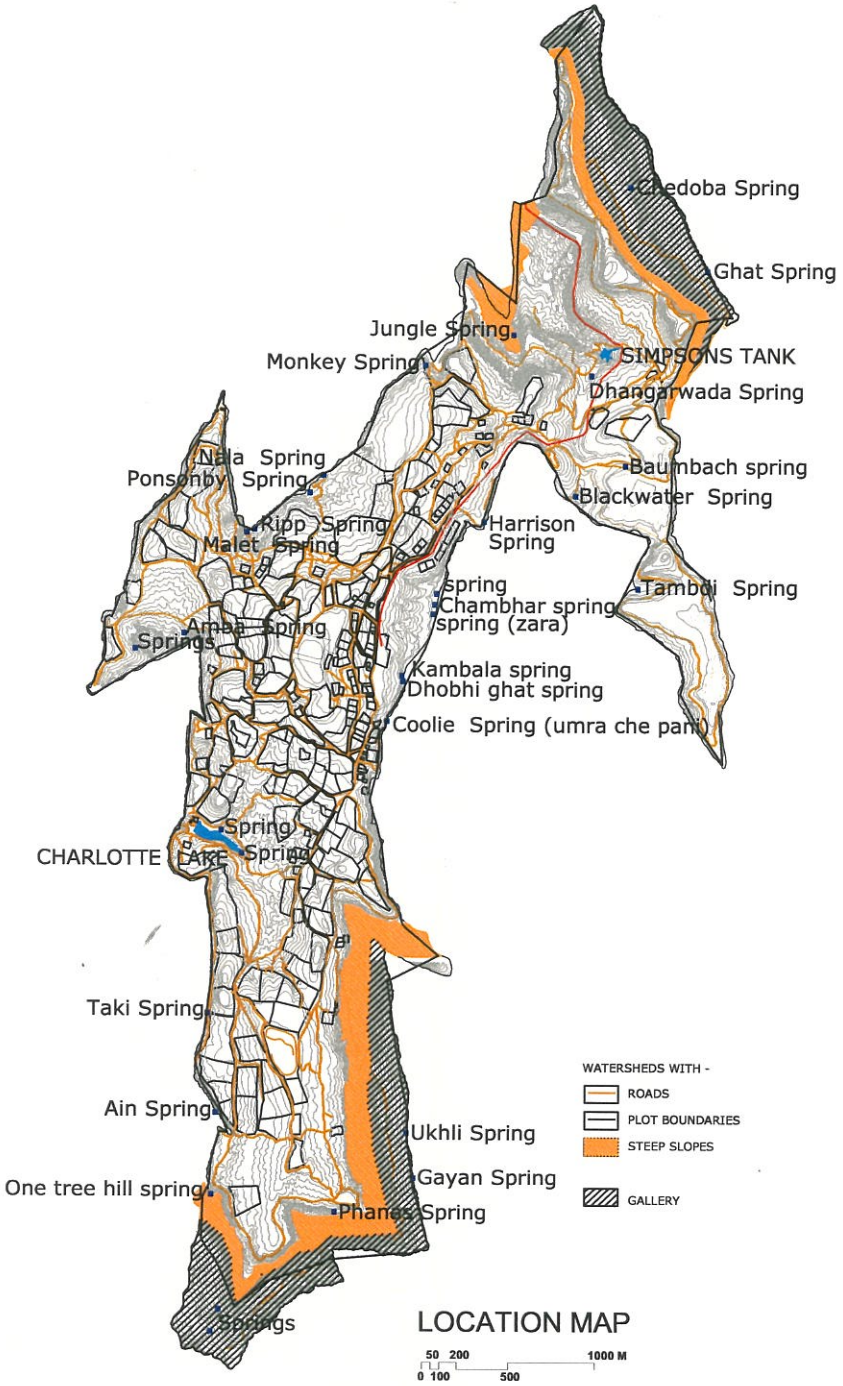
Malet spring, Nala spring, Ponsonby spring, and Monkey spring are present on the western edge of the plateau between Porcupine point and Hart point. Jungle spring is located in the Jungle stream between Hart point and Simpsons tank. The Dhangarwada spring is situated in the main stream feeding Simpsons tank. Ghat spring and Chedoba spring are on the terrace to the east of the Panorama Garbut road. Tamdi spring, Blackwater spring, Baumbach spring, are in the Garbut area. Ain spring and Taki spring are found near the plateau edge between Charlotte Lake and Belvedere point. Besides these several other springs that have not been named are shown on the British Survey map of Matheran plateau. Of these one is situated at Gijnai dara between Louisa point and Echo point. Some are situated in the terrace below Rambaug, Chauk point and One Tree Hill point. Several springs that feed the Charlotte Lake, which is the main water storage reservoir, are also found on Matheran plateau. Coolie spring, and several other springs are located on the eastern edge of the plateau in the Bazaar / settlement area.

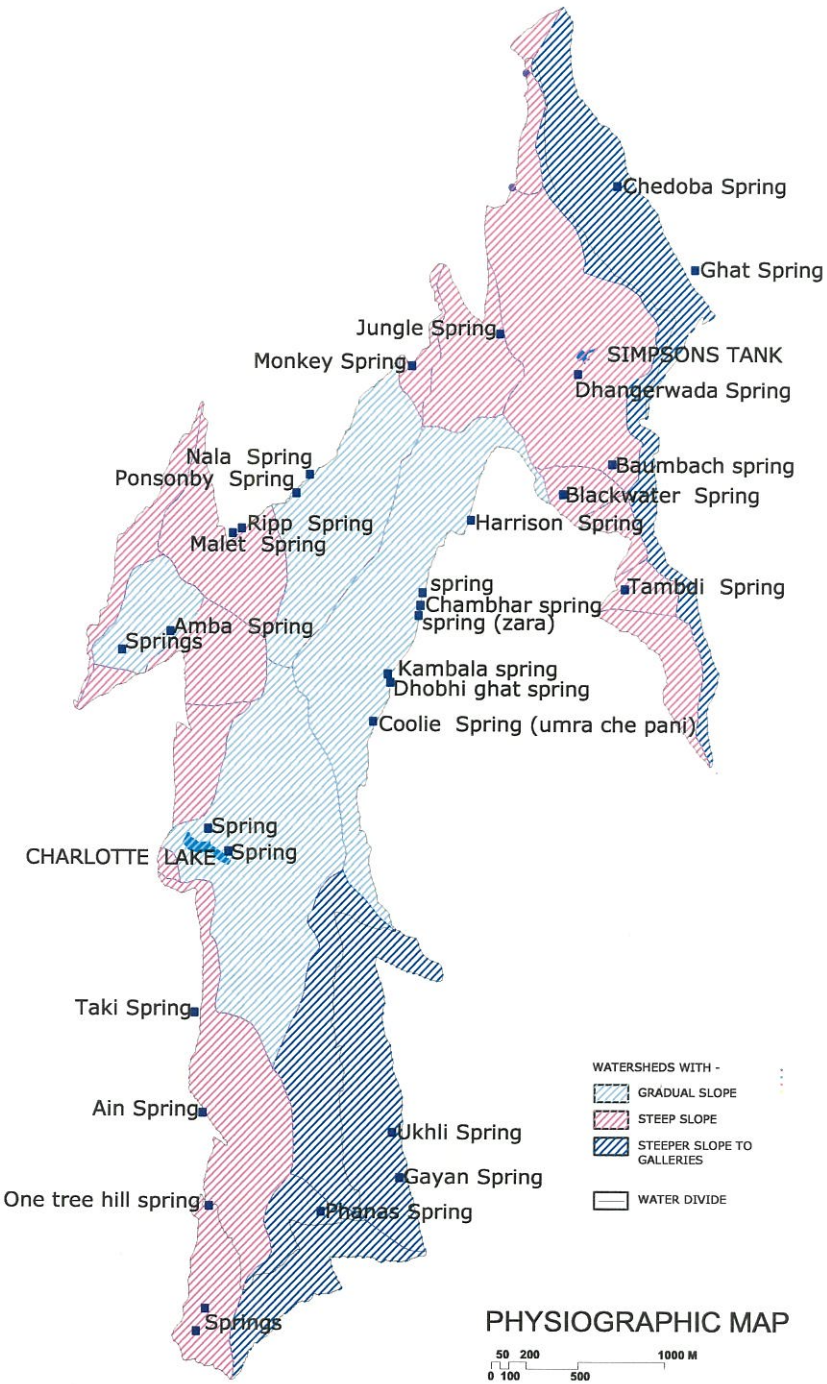
Certain springs have run dry due to excessive development or deforestation in the catchment areas. Most of the springs in the Bazaar or the settlement area are badly contaminated and have been converted to sewage flows. Several springs that feed Charlotte lake have also been affected due to insufficient/lack of sewage treatment facilities of many new hotels that have come up within the watershed. Several springs in other parts of the plateau like Garbut area and the western and southern parts of the plateau still contain pure water. Quite a few are perennial and contain water for the major part of the year. This is mainly in areas that have not been greatly affected by development where relatively large tracts of undisturbed forest exist and ground vegetation is still intact. The vegetation observed in the western parts of the plateau indicates presence of higher levels of moisture in the ground and almost all the springs here are found to be perennial. Development, construction, and land use on the plateau needs to be regulated in order to preserve these important natural resources.

Recommendations

- The Catchment areas of all natural springs shall be identified and plans for their conservation and rejuvenation shall be incorporated in the zonal master plan.-Notification.
- A detailed survey in all seasons needs to be carried out to ascertain which springs are perennial, and the duration for which they have water. Water sampling of all the springs in Matheran needs to be done to check the quality of water in order to verify its suitability for drinking and find out the level and cause of contamination.
- Site-specific measures shall be taken by proper agency for the conservation of perennial springs and rejuvenation of certain springs that have run dry. This shall be done under the supervision of ecologists, geologists, hydrologists and subject experts.
- Efforts shall be made to prevent deforestation in catchment areas. Measures shall be taken to protect and restore the natural vegetation and forest cover in the watersheds / catchment areas in the vicinity of perennial springs. Soil and moisture conservation methods to prevent erosion, regenerate ground cover and undergrowth and restore the natural vegetation or forest cover shall be undertaken.
- Activities such as garbage disposal, composting, accumulation of horse dung or any activity that can cause contamination shall not be allowed in the catchment areas near important springs.
- Certain springs in the proximity of the bazaar area, settlement and congested areas have been contaminated due to discharge of untreated effluents. Certain new hotels discharge untreated sewage directly into streams, or water-bodies or waterfalls at the plateau edge. This shall be discontinued. No untreated sewage water shall be disposed off into streams and water-bodies.

- No further development or construction activities shall be allowed in the watersheds and catchment areas near important perennial springs.
- All surface springs on the hill are the property of the Government and the right thereto in all leasehold plots is strictly reserved. (1959 regulations)
- Measures shall be taken to reverse and control contamination of springs that have so far been affected.
- All activities such as bathing, washing clothes, etc that can pollute the ground water in the proximity of springs, shall be prohibited.
- Water storage tanks at springs shall be repaired/ de-silted to augment water supply in Matheran.
- No construction shall be permitted in floodplains of streams and rivers.
- Use of spring water shall be made and encouraged to augment the water supply requirements of this Sub-Zone. Water storage tanks / troughs at springs shall be maintained for this purpose.
- Discharge of effluents (treated or untreated), garbage disposal, accumulation of horse dung or any other activity that can cause contamination shall not be permitted in the catchment of springs and water bodies. Activities such as bathing and washing of clothes shall not be permitted at or in the vicinity of the springs.
- No commercial development, construction activities, and land use such as garbage dumps, shall be allowed in the catchment area / watersheds of important perennial springs up to the ridge-line or the water divide and it needs to be more stringent on the plateau.
- Narrow ditches and water ways at higher elevations may increase percolation (and should not be artificially widened).


Chedoba Spring
Ghat Spring
Jungle Spring
Monkey Spring
SIMPSONS TANK
Dhangarwada Spring
Nala Spring
Ponsonby Spring
Baumbach spring
Blackwater Spring
Ripp Spring
Malet Spring
Harrison Spring
spring
Chambhar spring
spring (zara)
Tambdi Spring
Amba Spring
Springs
Kambala spring
Dhobhi ghat spring
Coolie Spring (umra che pani)
Spring
CHARLOTTE LAKE
Spring
Taki Spring
Ain Spring
Ukhli Spring
Gayan Spring
One tree hill spring
Phanas Spring
Springs
WATERSHEDS WITH -
ROADS
PLOT BOUNDARIES
STEEP SLOPES
GALLERY
LOCATION MAP
50 200 1000 M
0 100 500


Chedoba Spring
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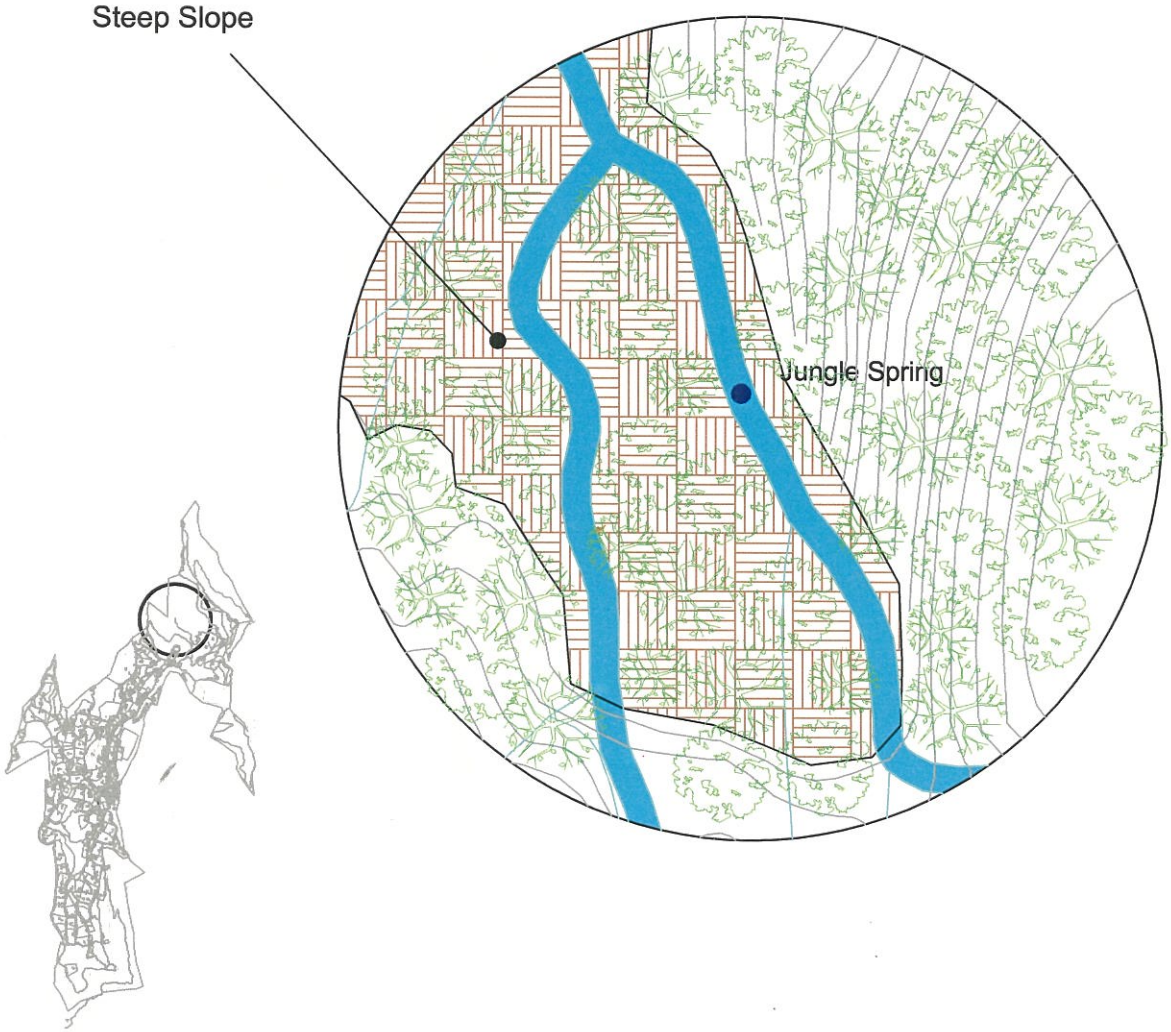
Nala Spring
Ponsonby Spring
Baumbach spring
Blackwater Spring
Ripp Spring
Malet Spring
Harrison Spring
spring
Chambhar spring
spring (zara)
Tambdi Spring
Amba Spring
Springs
Kambala spring
Dhobhi ghat spring
Coolie Spring (umra che pani)
Spring
CHARLOTTE LAKE
Spring
Taki Spring
Ain Spring
Ukhli Spring
Gayan Spring
One tree hill spring
Phanas Spring
Springs
WATERSHEDS WITH -
GRADUAL SLOPE
STEEP SLOPE
STEEPER SLOPE TO GALLERIES
WATER DIVIDE
PHYSIOGRAPHIC MAP
50 200 1000 M
0 100 500

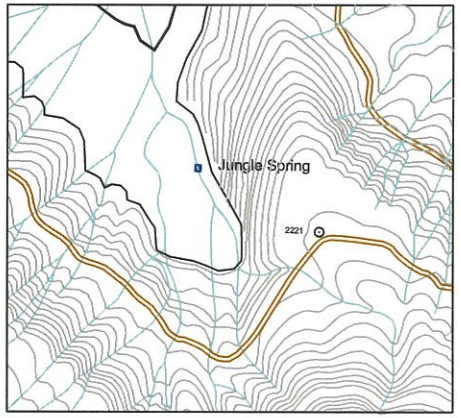
N

NAME	GEOLOGICAL		PHYSICAL				PHYSIOGRAPHIC		HYDROLOGICAL				VEG.	USES	REMARKS
	Rock Pattern	Rock Type	Approach	Closest Landmark	Landuse	Ownership	Visual attributes	Slope	Perenial/ Non Perenial	Waterflow	Potable/ Non Potable	Contamination			
Jungle	stream	basalt	footpath from from way to hart point	Hart point	forest	forest	stream bed and forest around	50-90%	perenial	steady stream	potable	none	dense	drinking	Untouched area. Shall be protected as it is.
Monkey	stream bed and boulders	basalt	footpath from monkey pt.	Monkey point	forest	forest	nice bowl carved in rock	50-90%	perenial	cascading	potable	none	good	drinking	Drinking by local people from villages below who supply fodder to matheran
Ponsonby	stream	basalt	footpath from sunset pt road	Sunset point	forest	forest	old bund in stream	50-90%	perenial	steady stream	potable	none	dense	no	A pathway up to the Monkey point can be used for nature trail
Nala	stream	basalt	footpath from sunset pt road	Sunset point	forest	forest	stream bed	50-90%	perenial	trickle	potable	none	dense	no	A pathway up to the Monkey point can be used for nature trail
Malet	stream	basalt	pathway from sunset pt road	Sunset point	forest	forest	Old tank & Pipeline indicates stream was in use for water supply, also a small well	50-90%	perenial	cascading	potable	none	dense	Only Drinking by tourist mainly	Monkeys, Giant squirrels, Honey bees spotted on the waterbody. Good water source for wildlife and valley forest. Shall be protected as it is.
Ripp	stream	basalt	pathway from sunset pt road	Sunset point	forest	forest	stream bed	50-90%	perenial	trickle	potable	none	dense	Only Drinking by tourist mainly	Untouched area. Shall be protected as it is.
Ashachi patti	cliff edge	basalt	along pathway to Ashachi patti settement	Malang point	forest and residential	forest and private	located along pathway	50-90%	non-perenial	trickle	potable	none	moderate	drinking by locals from Ashachi patti	As it is an important water source for the local settlement the spring should be protected and plantation meaures should be carried out in its catchment area on the plateau
Amba	cliff edge	basalt	along steep cliff edge	Louisa point	forest and residential	forest and private	located at base of tree at cliff edge	50-90%	perenial	trickle	potable	none	dense	drinking by locals from Ashachi patti	The forest area around the spring isin good condiion and needs to be protected. The spring should be left in its natural state
near Charlotte lake	edge of stream	laterite	not defined	Charlotte lake	forest	forest	area dirty due to contamination	20-50%	perenial	cascading	non-potable	high	dense	watersuppy to Charlotte lake	Waste water from surrounding hotels is being let out into the lake. This needs to be stopped immediately
Ain	cliff edge	basalt	along pathway	Belvedere point	residential	private	nice bowl carved in rock	20-50%	non-perenial	trickle	potable	none	dense	drinking	Situated right next to Belvedere point approach is easy and it can be developed as a tourist spot
One tree hill	stream bed and boulders	basalt	along kuccha pathway to Nirgudwadi	One tree hill point	forest and residential	forest and private	stream and boulders in area and spring at base of tree	20-50%	non-perenial	trickle	potable	none	dense	drinking by locals from Nirgudwadi	Located next to one tree hill and along a stream it has good visual qualities and can be developed into a tourist spot

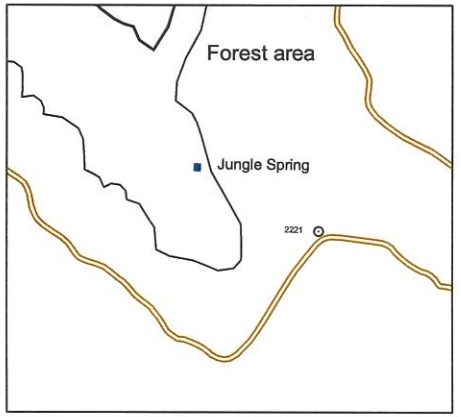
NAME	GEOLOGICAL		PHYSICAL				PHYSIOGRAPHIC		HYDROLOGICAL				VEG.	USES	REMARKS
	Rock Pattern	Rock Type	Approach	Closest Landmark	Landuse	Ownership	Visual attributes	Slope	Perenial/ Non Perenial	Waterflow	Potable/ Non Potable	Contamination			
Ukhli	cliff edge	basalt	steep kuccha pathway along steep cliff edge	located at edge of gallery forest below Rambaug point	forest	forest	stream bed and forest around	50-90%	perenial	trickle	potable	none	good	drinking by locals	illegal felling of trees in the gallery forest is leading to loss of valuable forest area. This needs to be stopped immediately
Gayan	stream bed and cliff edge	basalt	steep kuccha pathway along steep cliff edge	located at edge of gallery forest below Rambaug point	forest	forest	stream bed and forest around	50-90%	perenial	trickle	potable	none	good	drinking by locals	illegal felling of trees in the gallery forest is leading to loss of valuable forest area. This needs to be stopped immediately
Ghat	stream bed and boulders	basalt	pathway through nagar	market	informal residentia	private	stream bed	50-90%	non-perenial	trickle	non-potable	high	none	no	Waste water being disposed off into the streams which inturn affects the springs. This needs to be stopped immediately.
Chambhar pani	stream bed and boulders	basalt	pathway - Rohidas Nagar	market	informal residentia	private	stream bed	50-90%	non-perenial	trickle	non-potable	high	none	no	Waste water being disposed off into the streams which inturn affects the springs. This needs to be stopped immediately.
Zara	stream	basalt	pathway through nagar	market	informal residentia	private	stream bed	50-90%	non-perenial	trickle	non-potable	high	none	no	Waste water being disposed off into the streams which inturn affects the springs. This needs to be stopped immediately.
Kamela	cliff edge	basalt	pathway through nagar	market	informal residentia	private	stream bed	50-90%	perenial	trickle	non-potable	moderate	none	for domestic use	Water used by local people for washing and bathing.
Dhobighat	cliff edge	basalt	pathway through nagar	market	informal residentia	private	well on steep slope	50-90%	perenial	trickle	non-potable	moderate	none	for domestic use	Water used by local people for washing and bathing.
Coolie	cliff edge	basalt	pathway through nagar	market	informal residentia	private	stream bed		non-perenial	trickle	non-potable	high	none	no	Waste water being disposed off into the streams which inturn affects the springs. This needs to be stopped immediately.
Harrison	cliff edge	basalt	end of pathway in Galti village	Mayra point	residential	private	Old Bund on steep slope	50-90%	perenial	steady stream	potable	moderate	none	for domestic use	used by Galti villagers
Dhangar-wada	stream bed	surrounded by siltation in stream	footpath from Aman Lodge Station to Simpsons tank	Aman Lodge Station	forest	forest	Roads on both the side with heavy traffic	10-20%	perenial	steady stream	potable	moderate	moderate	drinking	area has seen lots of siltation and spring needs to be revived
Blackwater	flat rock	basalt	pathway from garbut road	Aman lodge station	forest	forest	flat opening near cliff	20-50%	non-perenial	steady stream	potable	moderate	good	domestic use	used by Galti villagers
Tambdi	flat rock	basalt	pathway from garbut road	Garbut point	forest	forest	flat opening near cliff	20-50%	non-perenial	trickle	potable	none	dense	drinking	located near Garbut point. It has good visual qualities and can be developed into a tourist spot

JUNGLE SPRING

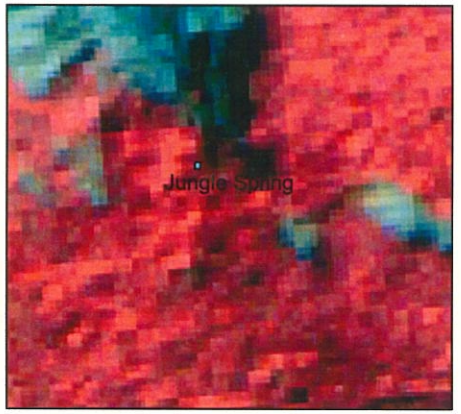




LOCATION MAP



LANDUSE



VEGETATION COVER

50 0 100 200 M

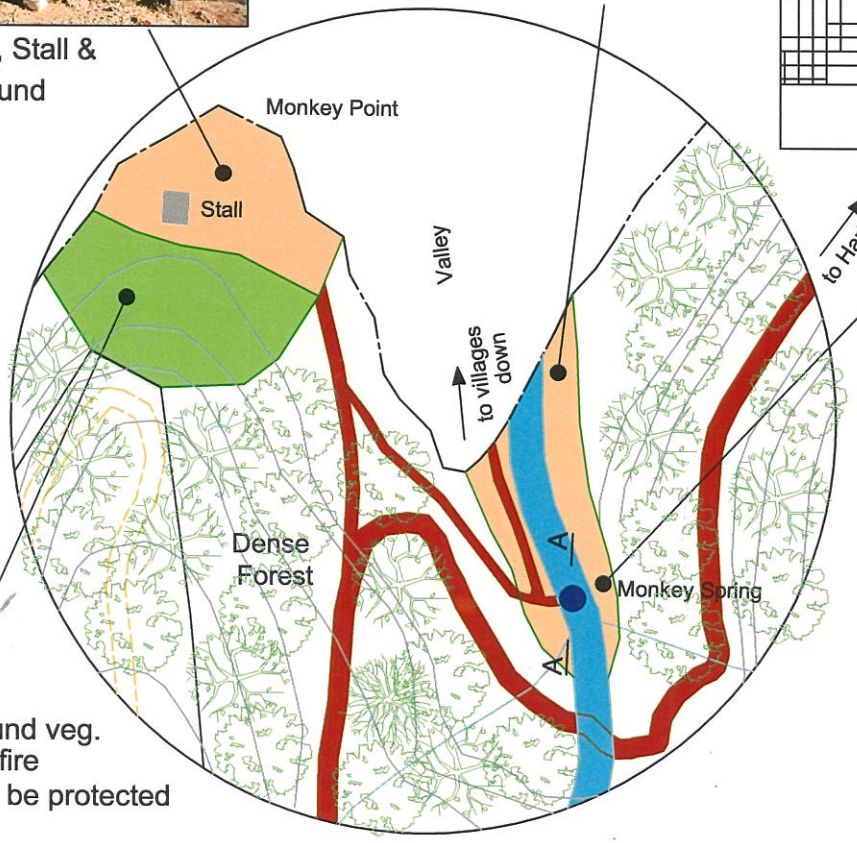
N

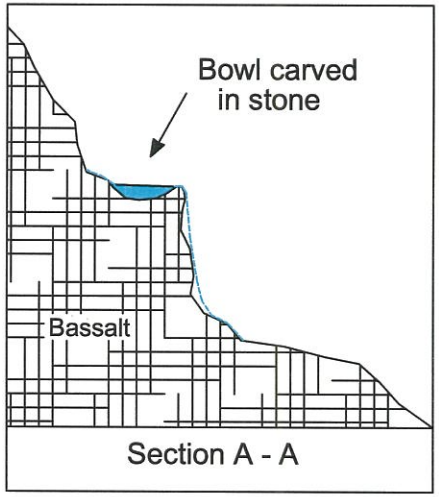
Name	Perenial/ Nonperenial	Waterflow	Potable/ Nonpotable	Level of Contamination	Vegetation	Uses
Jungle Spring	Perenial	Steady Stream	Potable	None	Dense	Only Drinking

SPRING DETAIL

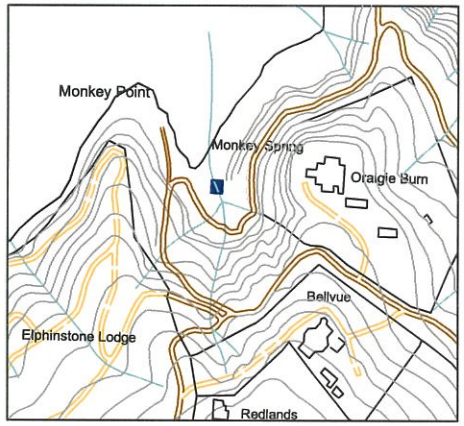
MONKEY SPRING

Monkey point, Stall & Disturbed ground vegetation

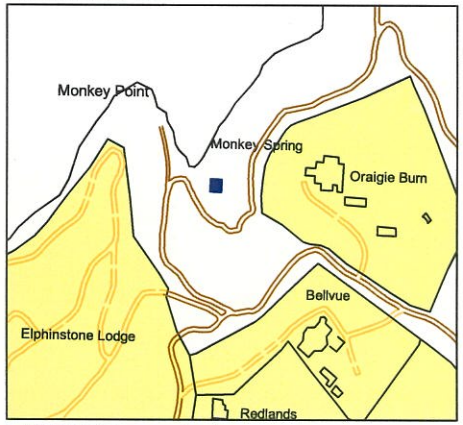




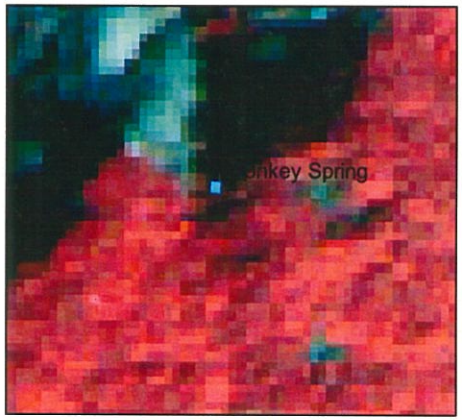
Monkey Spring



LOCATION MAP



LANDUSE



VEGETATION COVER

50 200 M
0 100

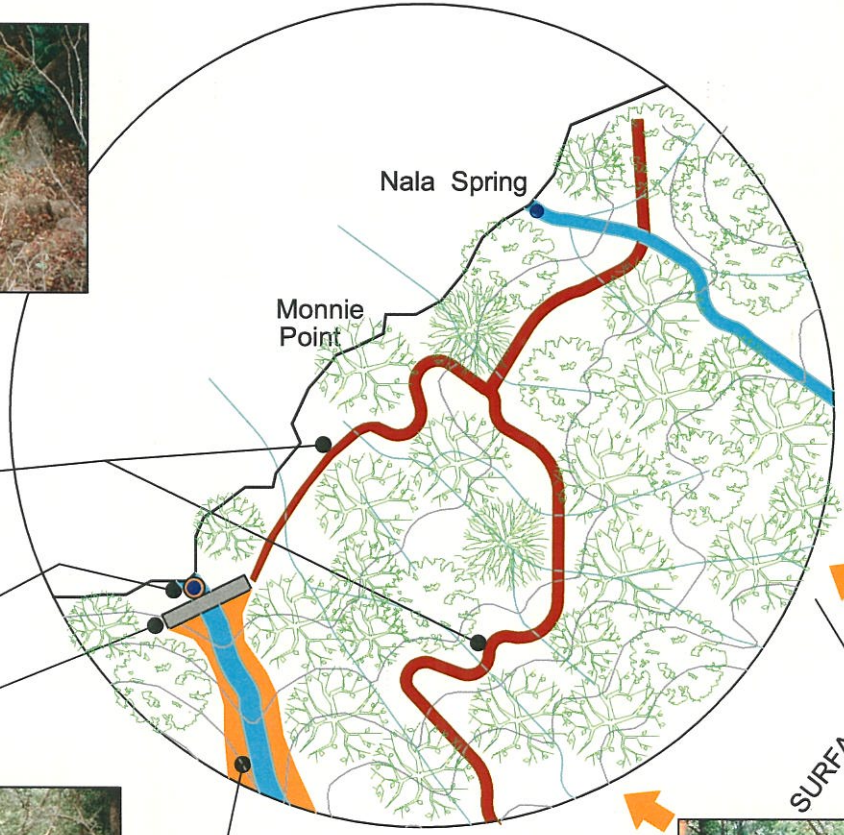
N

Name	Perenial/ Nonperenial	Waterflow	Potable/ Nonpotable	Level of Contamination	Vegetation	Uses
Monkey Spring	Perenial	Cascading	Potable	No Contamination	Good	Drinking -by local people
						from villages below
	Spring is along the pathway used by people carrying pasture from villages below.					

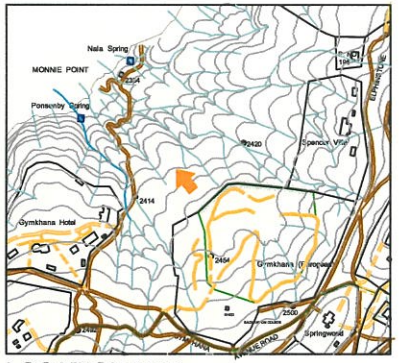
SPRING DETAIL

PONSONBY SPRING AND NALA SPRING

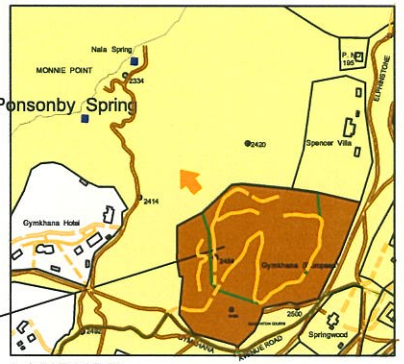
Ponsonby Spring



Nala Spring



LOCATION MAP

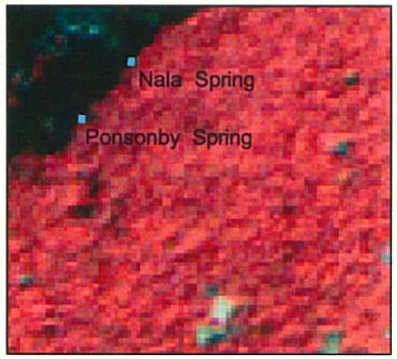


LANDUSE

SURFACE FLOW

Solid waste management plant in old Gymkhana compound. Surface flow leading to contamination of springs. Needs to be managed.

Solid waste spread on the ground



VEGETATION COVER

N

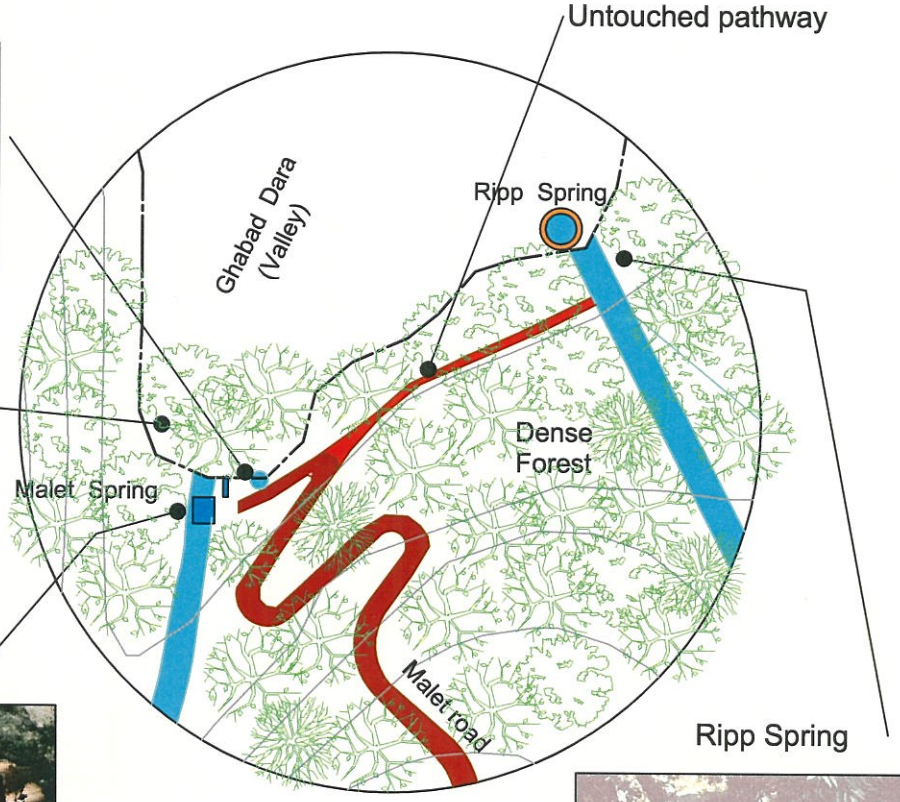
100 0 200 400 M

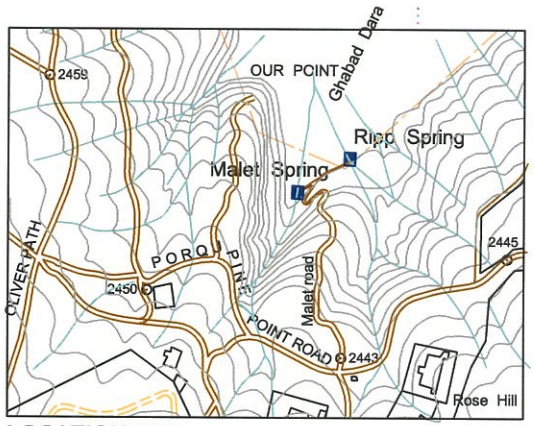
Name	Perenial/ Nonperenial	Waterflow	Potable/ Nonpotable	Level of Contamination	Vegetation	Uses
Ponsonby Spring	Perenial	Steady Stream	Potable	No Contamination	Dense	No
Nala Spring	Perenial	Trickle	Potable	No Contamination	Dense	No

SPRING DETAIL

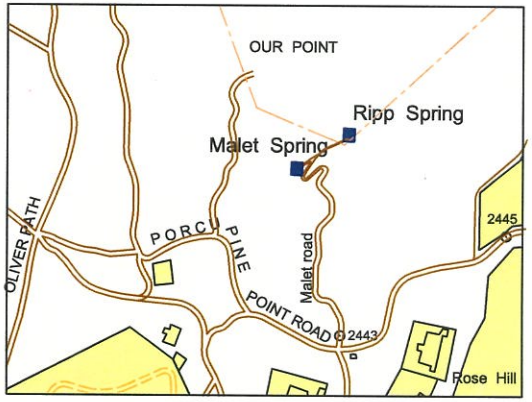
MALET SPRING AND RIPP SPRING

Perenial Well



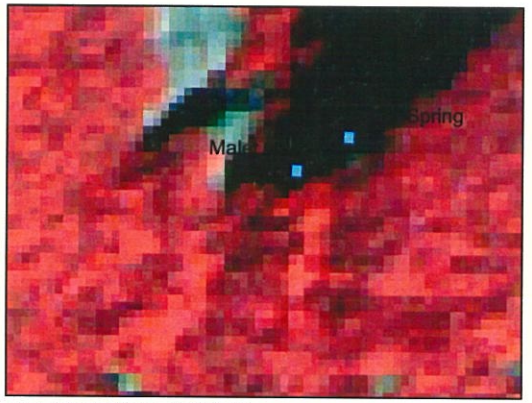


LOCATION MAP



LANDUSE

RESIDENTIAL
PRIVATE ROADS
ROADS



VEGETATION COVER

50 200 M
0 100

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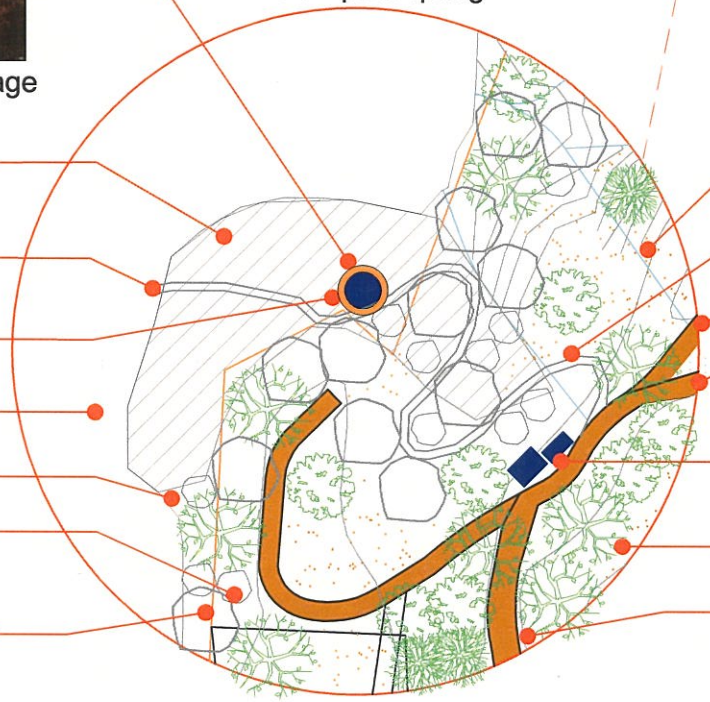
Name	Perenial/ Nonperenial	Waterflow	Potable/ Nonpotable	Level of Contamination	Vegetation	Uses
Malet Spring	Perenial	Cascading	Potable	No Contamination	Dense	Only Drinking
						By tourists mainly
	Monkeys, Giant squirrels, Honey bees spotted on the waterbody. Good water source for wildlife and					
	valley forest. Shall be protected as it is.					
Ripp Spring	Perenial	Trickle	Potable	No Contamination	Dense	No
	Untouched area. Shall be protected as it is.					

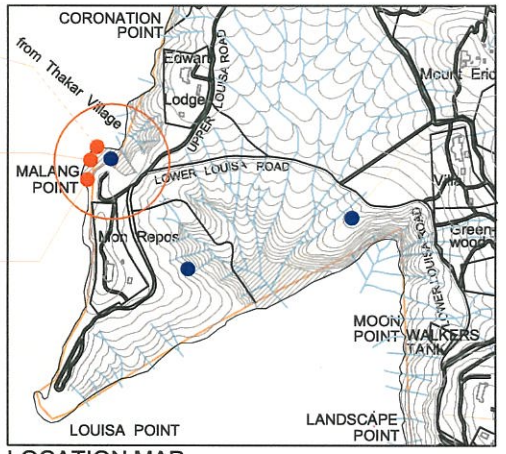
SPRING DETAIL

ASHACHI PATTI SPRING

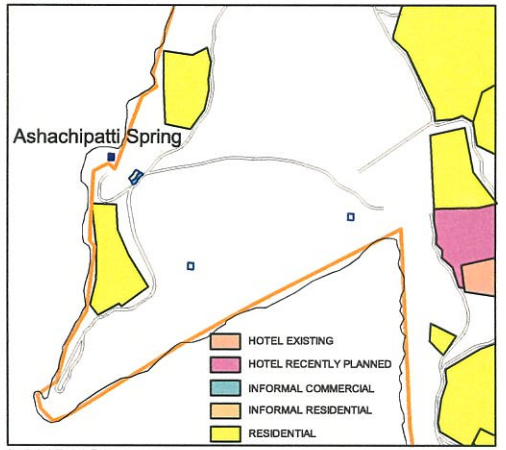
view of ashachi patti village

ashachi patti spring





LOCATION MAP



LANDUSE

VEGETATION COVER

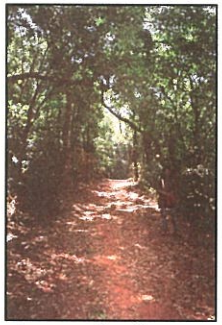
Name	Perenial/ Nonperenial	Waterflow	Potable/ Nonpotable	Level of Contamination	Vegetation	Uses
Ashachi patti Spring	Non perenial	Trickle	Potable	No Contamination	Medium	For drinking
						by locals only
	spring on the way to ashachi patti village. forest around it shall be protected since it is used by locals for					
	drinking					

SPRING DETAIL

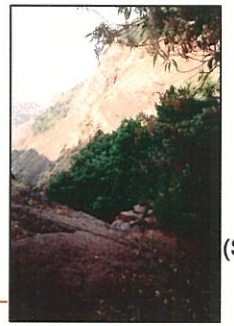
N

AMBA SPRING

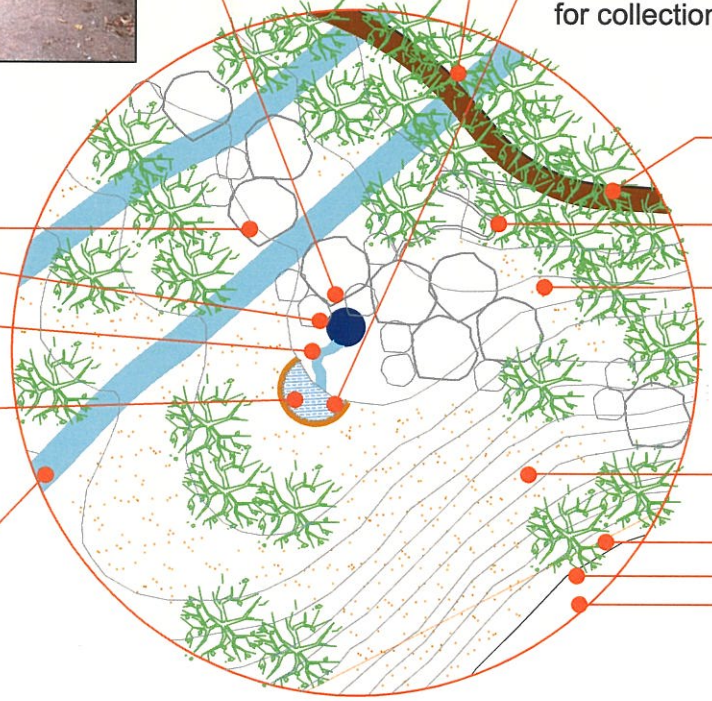
amba spring

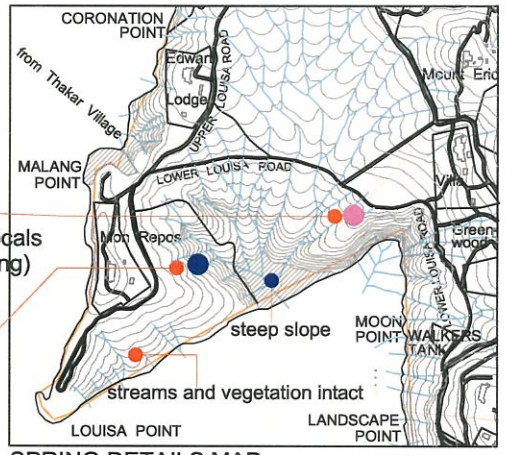


lower louisa road

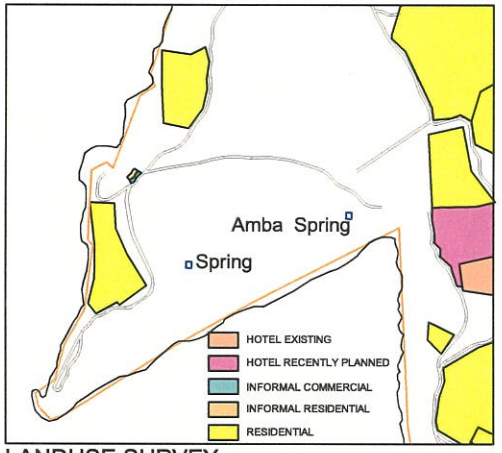


bund constructed for collection of water





SPRING DETAILS MAP



LANDUSE SURVEY

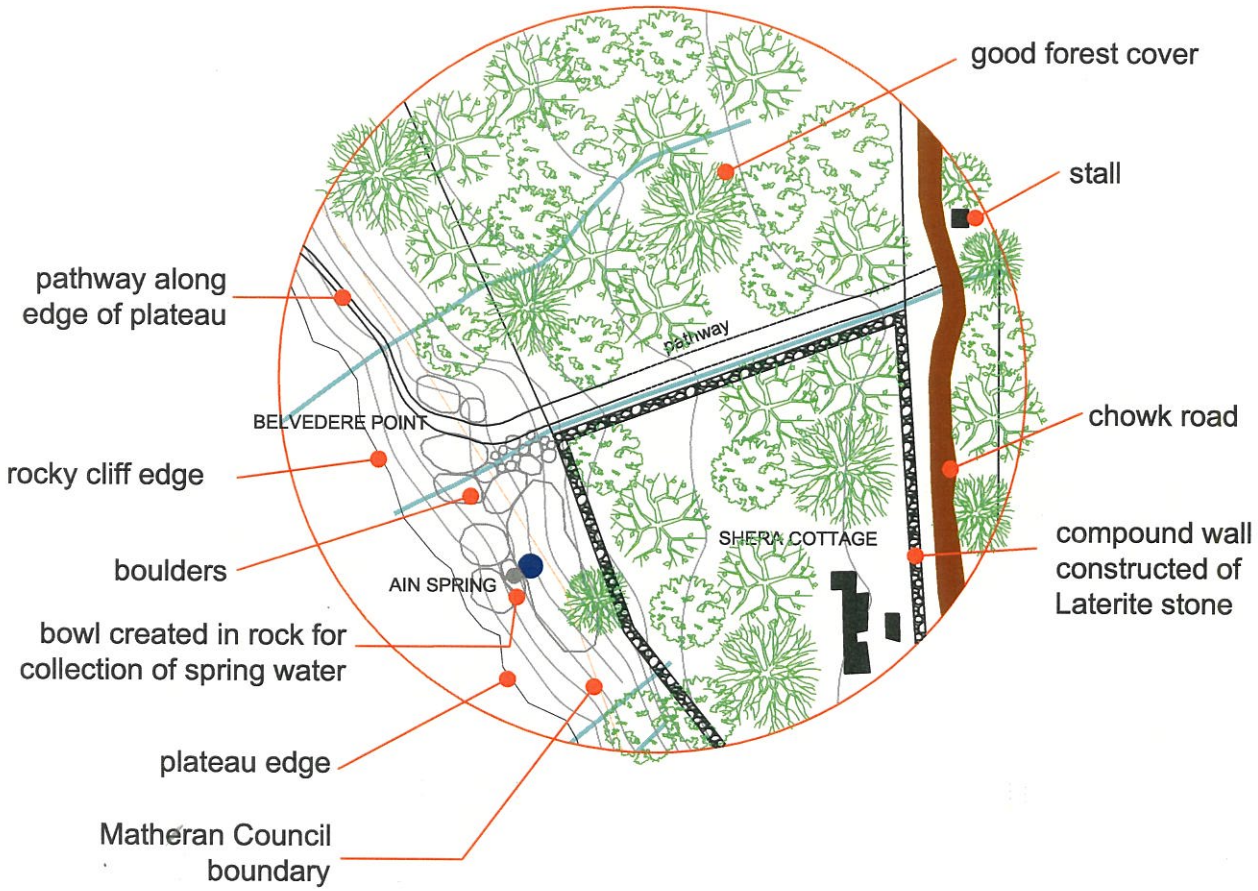
VEGETATION ANALYSIS

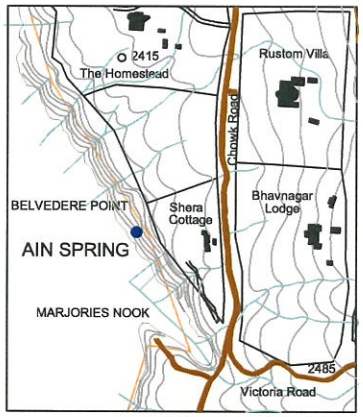
Name	Perenial/ Nonperenial	Waterflow	Potable/ Nonpotable	Level of Contamination	Vegetation	Uses
Amba Spring	Perenial	Trickle	Potable	No Contamination	Dense	For Drinking
						By locals only
	forest around to be protected. Good water source for wildlife and used by locals only on their way					
	used less frequently compared to ashachi patti spring					
Spring	Perenial	Trickle	Potable	No Contamination	Dense	For Drinking by locals
	Untouched area. Shall be protected as it is.					

SPRING DETAIL

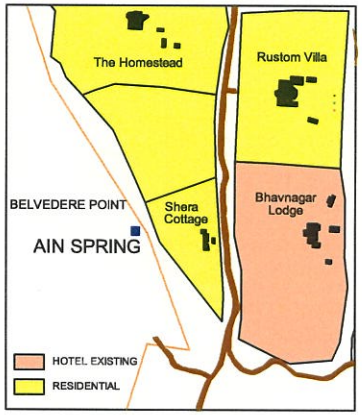
N

AIN SPRING





LOCATION MAP



LANDUSE

VEGETATION COVER

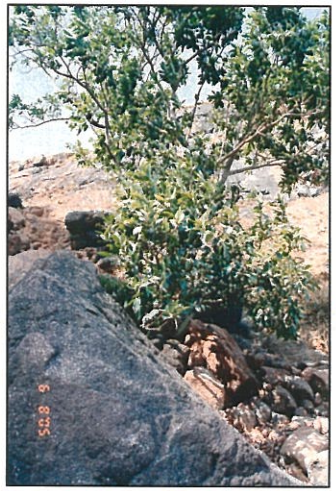
50 250 M
0 100

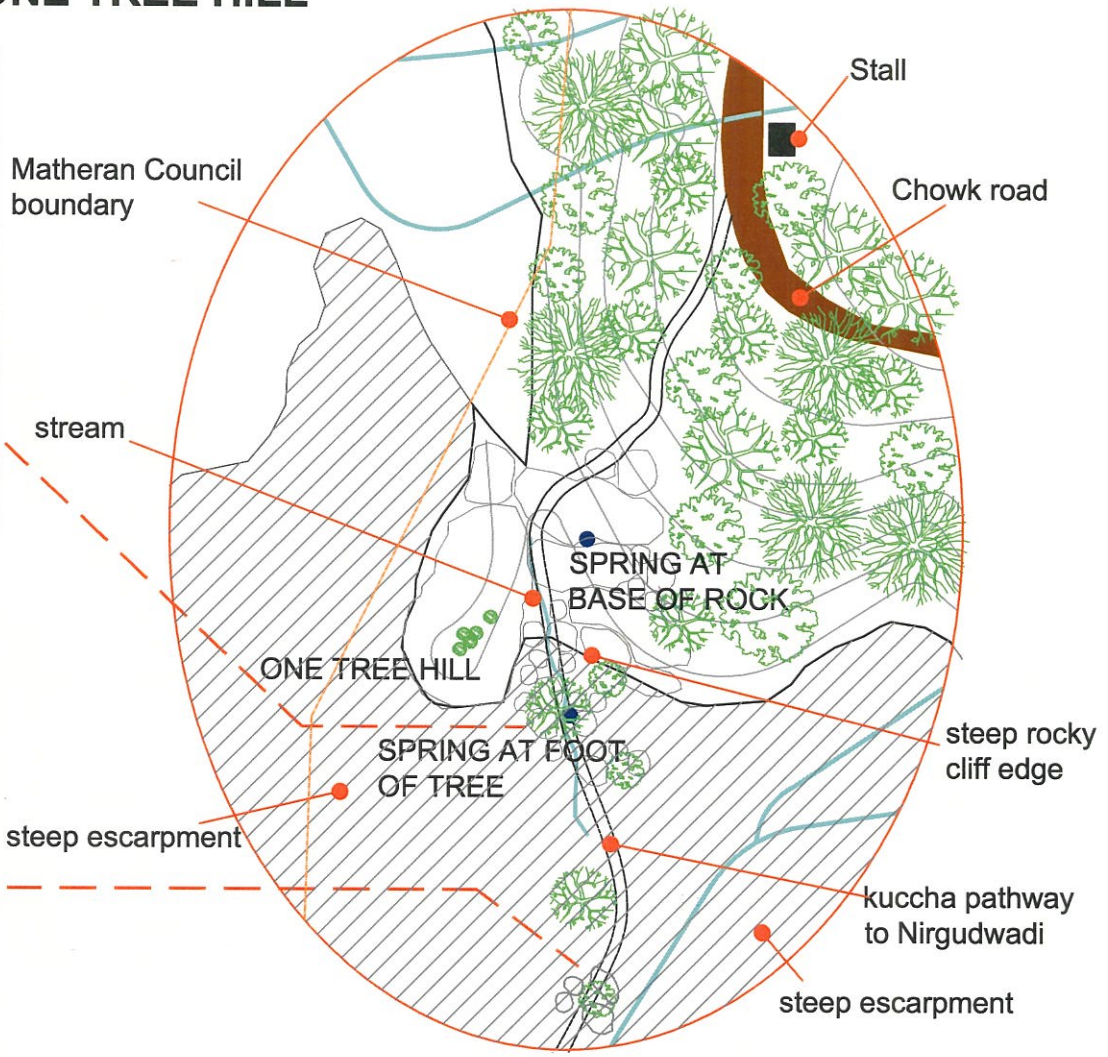
N

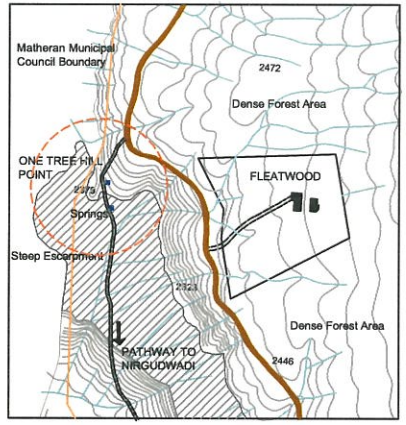
Name	Perenial/ Nonperenial	Waterflow	Potable/ Nonpotable	Level of Contamination	Vegetation	Uses
Ain Spring	Non-Perenial	Trickle	Potable	No Contamination	Dense	Drinking by locals
	Since it is next to an existing point and in good forest area it can be developed as a tourist spot to promote natural features of the area					

SPRING DETAIL

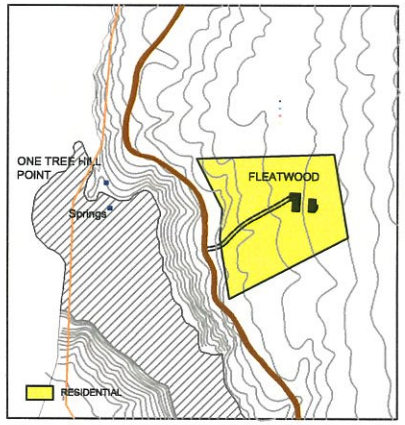
SPRINGS AT ONE TREE HILL



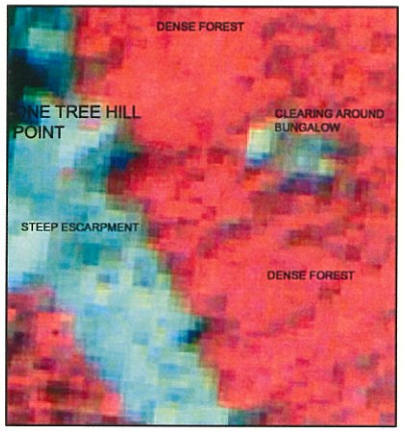




LOCATION MAP



LANDUSE



VEGETATION COVER

Name	Perenial/ Nonperenial	Waterflow	Potable/ Nonpotable	Level of Contamination	Vegetation	Uses
Springs near One Tree hill	Non-Perenial	Trickle	Potable	No Contamination	Good	Drinking by locals
	It needs to be protected as it is a water source for locals. The area has a good aesthetic quality and can be developed as a tourist spot					

SPRING DETAIL

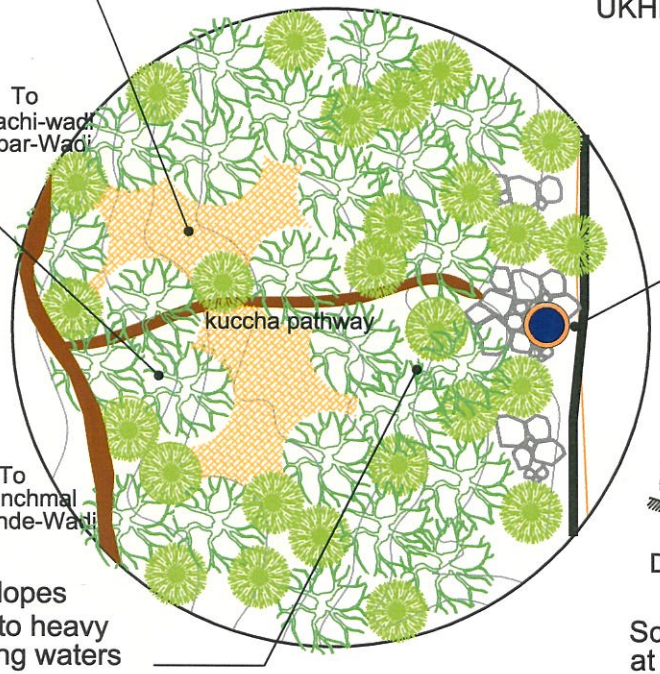
N

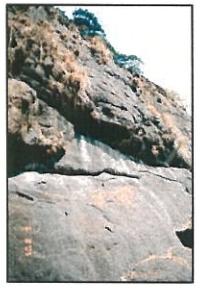
UKHLI AND GAYAN SPRINGS

Streams & Vegetation affected by tree felling. Voids created by tree felling affects the flora, fauna & bio-diversity.

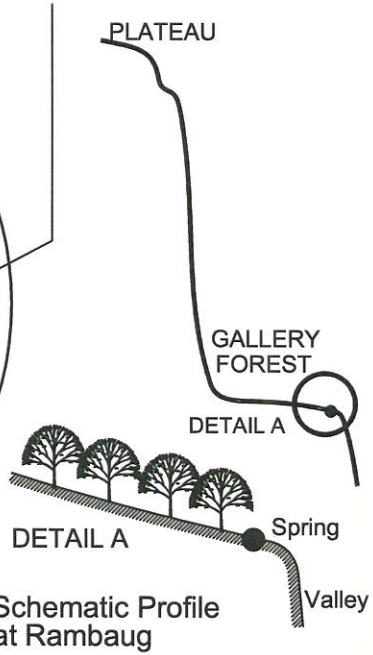
UKHLI SPRING

Vegetation of good quality showing composite forest

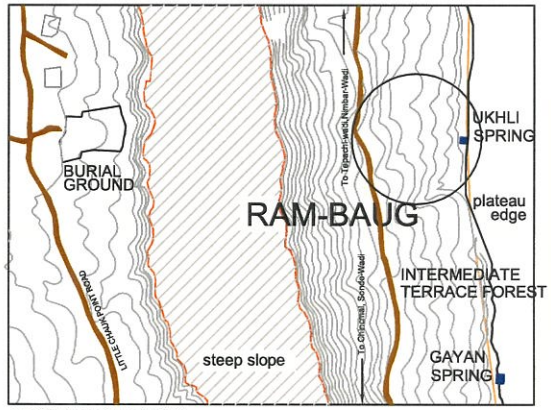




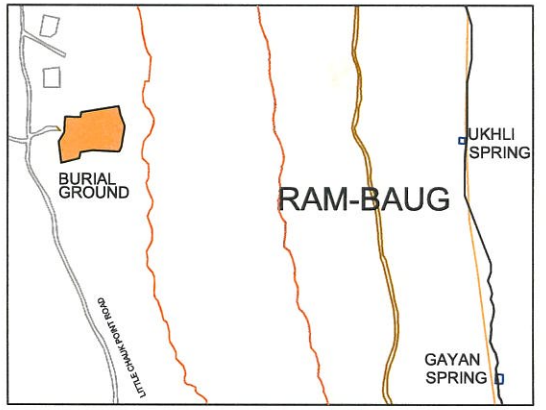
Steep Slopes leading to heavy cascading waters



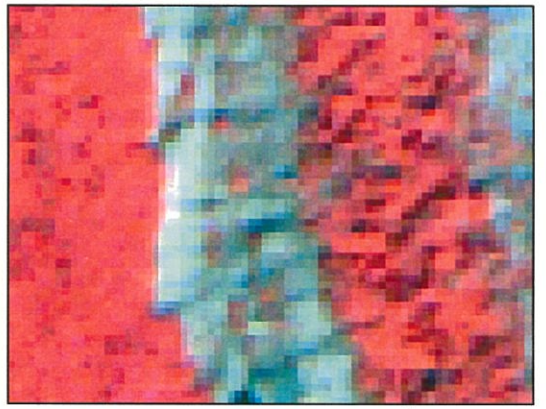
Schematic Profile at Rambaug



LOCATION MAP



LANDUSE



VEGETATION COVER

50 200 M
0 100

N

Name	Perenial/ Nonperenial	Waterflow	Potable/ Nonpotable	Level of Contamination	Vegetation	Uses
Ukhli Spring	Perenial	Trickle	Potable	No Contamination	Good	For Drinking
						by locals only
Gayan Spring	Perenial	Trickle	Potable	No Contamination	Good	For Drinking
						by locals only
	illegal felling of trees in the gallery forest is leading to loss of valuable forest area. This needs to be stopped immediately					

SPRING DETAIL

SPRINGS IN BAZAAR AREA

Paved main roads

Heavy soil erosion

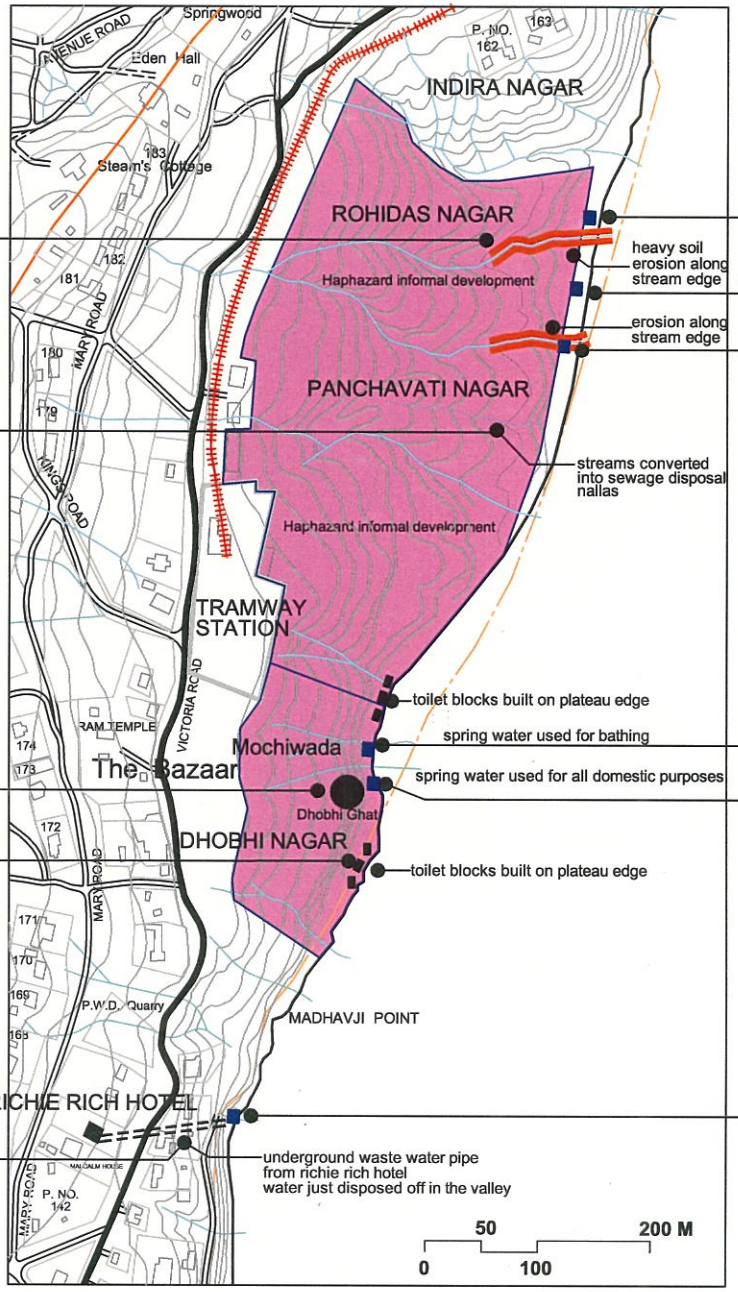
Streams converted to sewage disposal nallas

Built character in nagars with dhobhi Ghat

Drainage system

Toilet blocks on edge

Waste-water disposed in valley



SPRING LOCATION MAP & OTHER RELATED ISSUES IN BAZAAR AREA WITH ITS CHARACTER

Spring (ghat spring)

View of Ghat spring

Chambhar spring

spring (zara)

View of Chambhar pani

View of Zara

Kamela spring

View of Kamela spring

Dhobhi ghat spring

Dhobhi-Ghat spring

Coolie Spring (umra che pani)

View of Coolie spring

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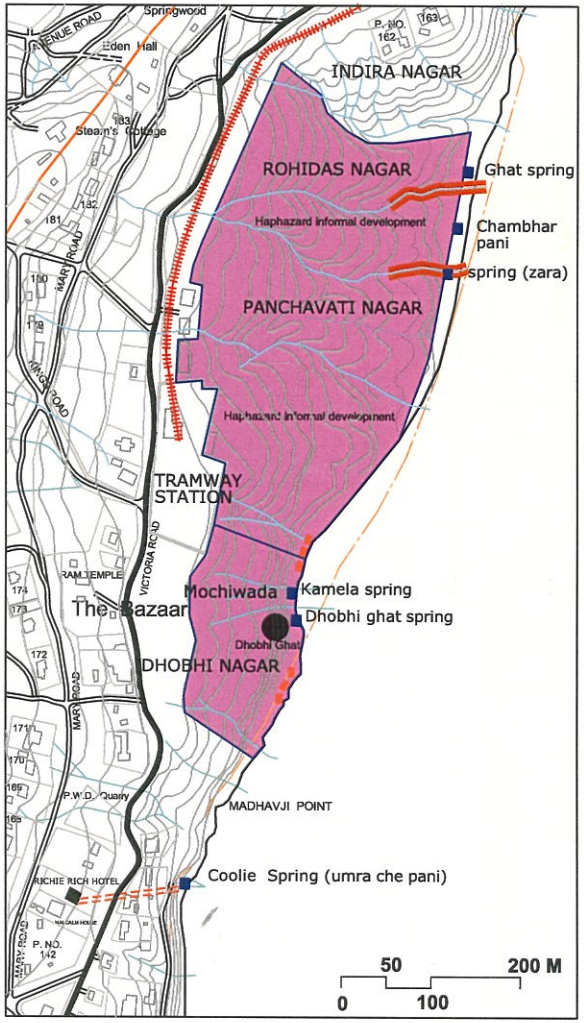
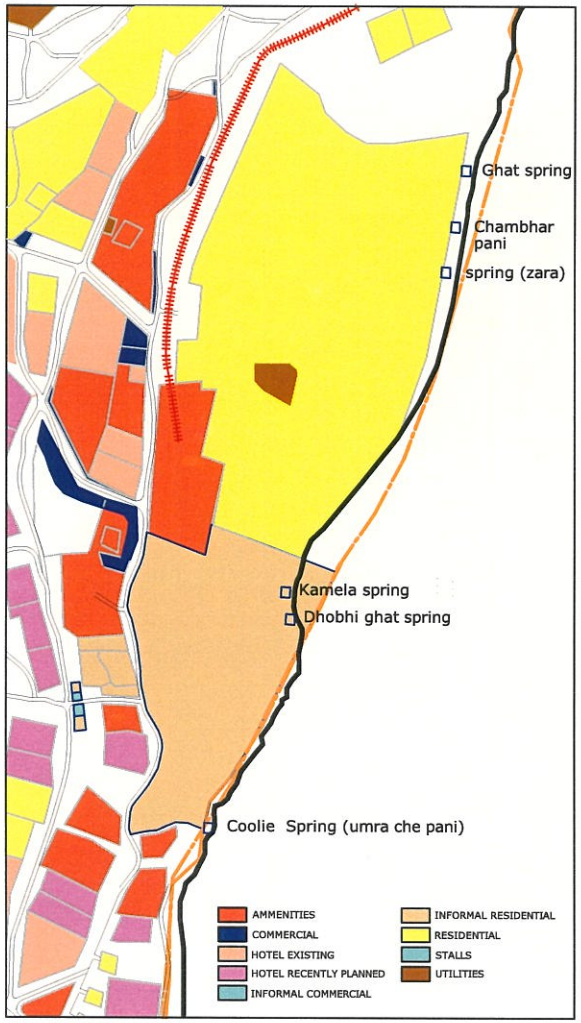
SPRING DETAIL

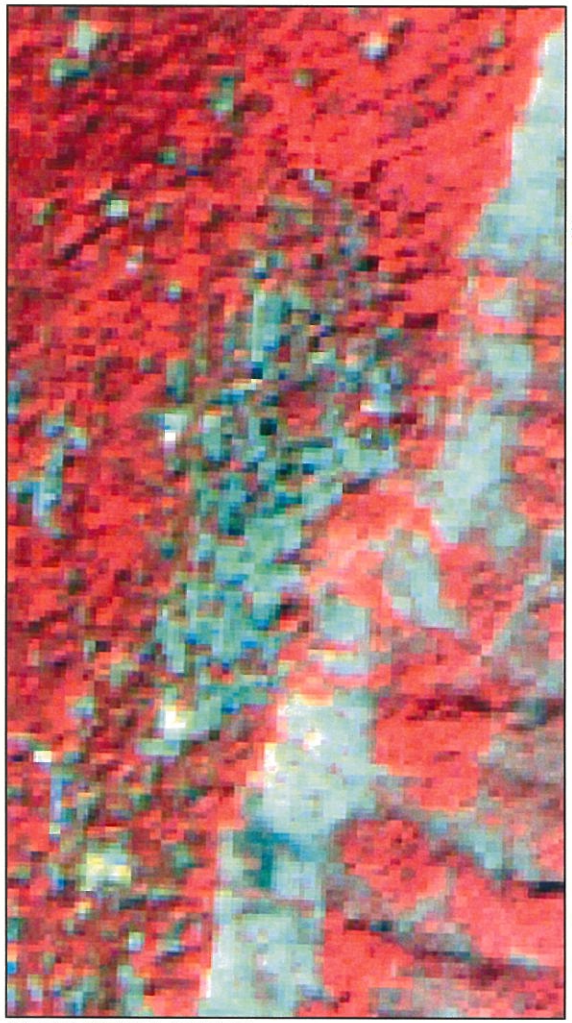
SPRINGS IN BAZAAR AREA



LOCATION MAP



LANDUSE



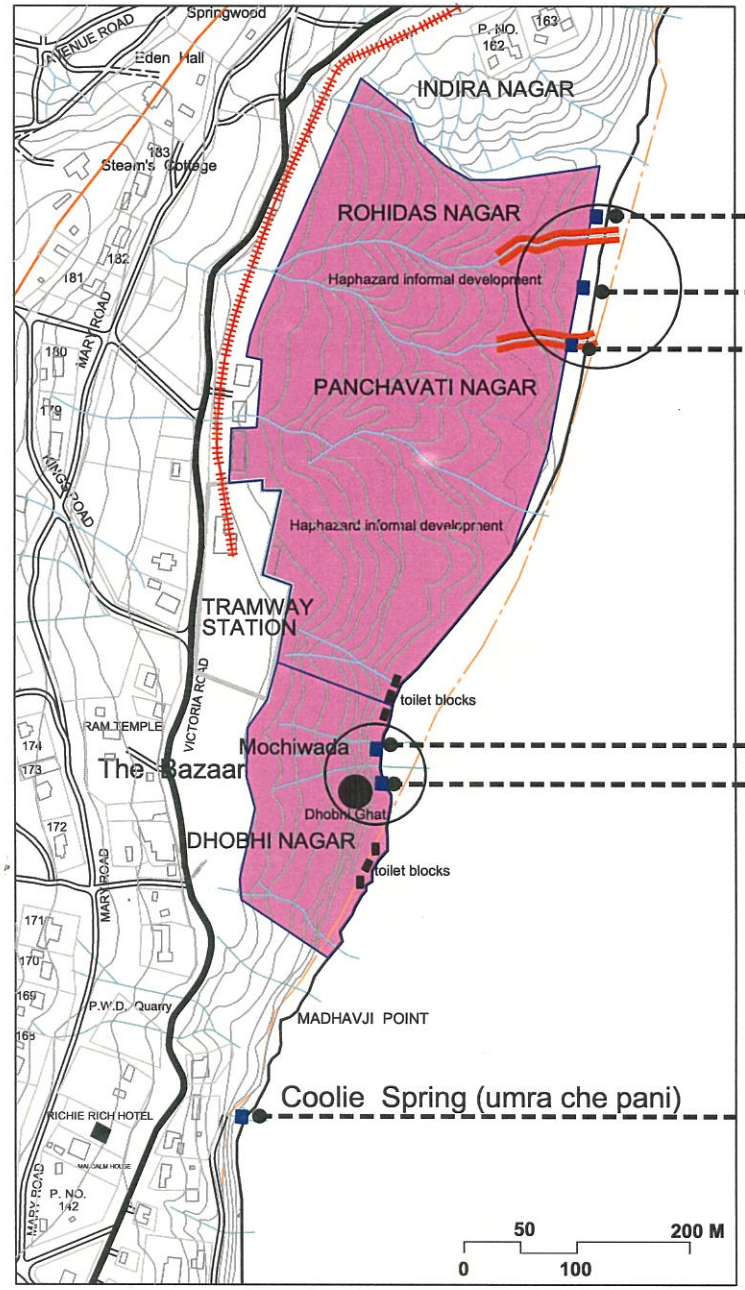
VEGETATION COVER

Name	Perenial/ Nonperenial	Waterflow	Potable/ Nonpotable	Level of Contamination	Vegetation	Uses	Remarks
Ghat Spring	Non Perenial	Trickle	Non potable	High	None	None	Waste water from the surrounding nagars and hotels is being disposed off into the streams which inturn affects the springs. This needs to be stopped immediately.
Chambhar pani	Non Perenial	Trickle	Non potable	High	None	None	
Spring (zara)	Non Perenial	Trickle	Non potable	High	None	None	
Kamela Spring	Perenial	Trickle	Non potable	Moderate	None	For domestic use	
Dhobhighat Spring	Perenial	Trickle	Non potable	Moderate	None	For domestic use	
Coolie Spring	Non Perenial	Trickle	Non potable	High	None	None	

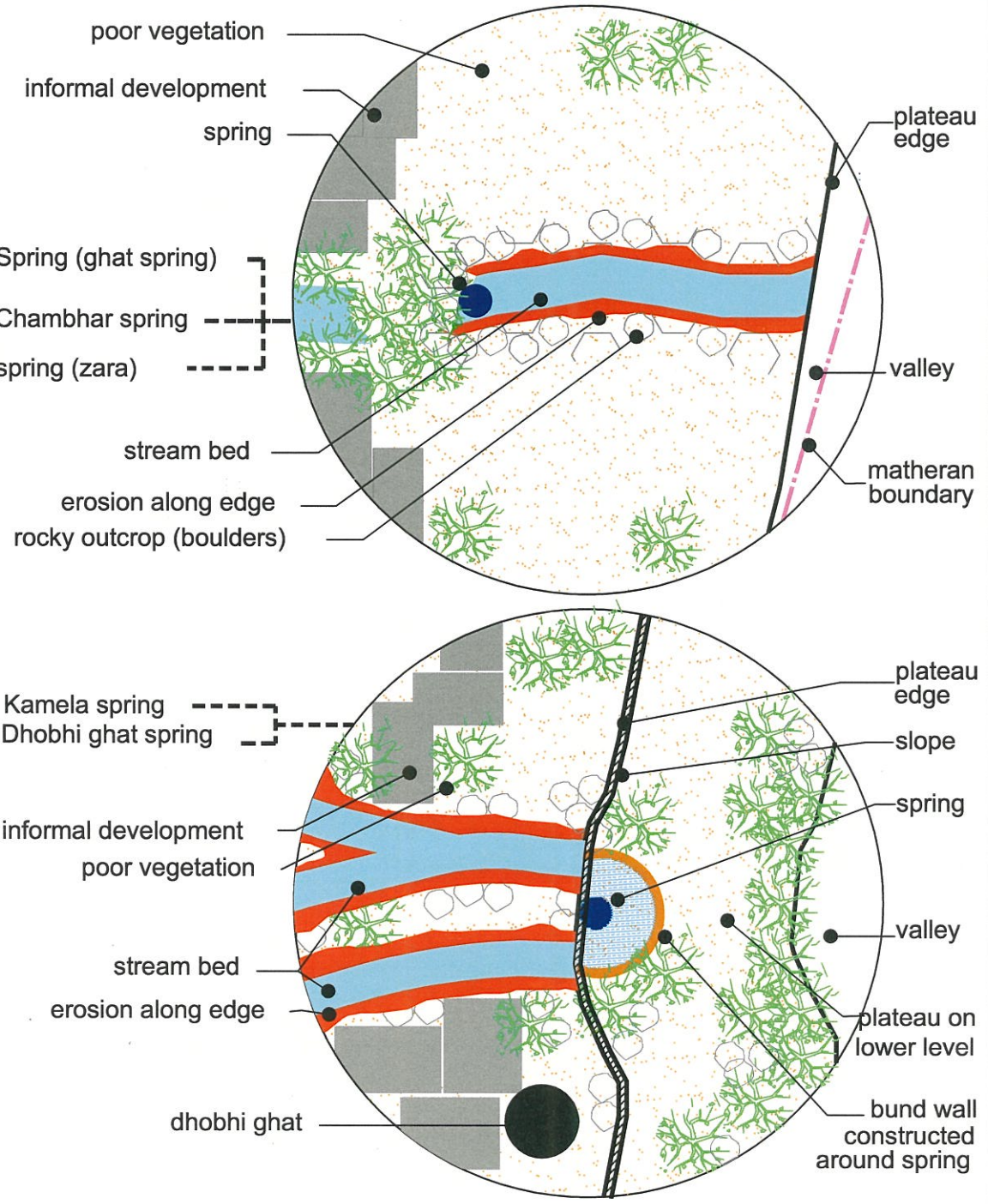
SPRING DETAIL

N

SPRINGS IN BAZAAR AREA



SPRING DETAILS MAP



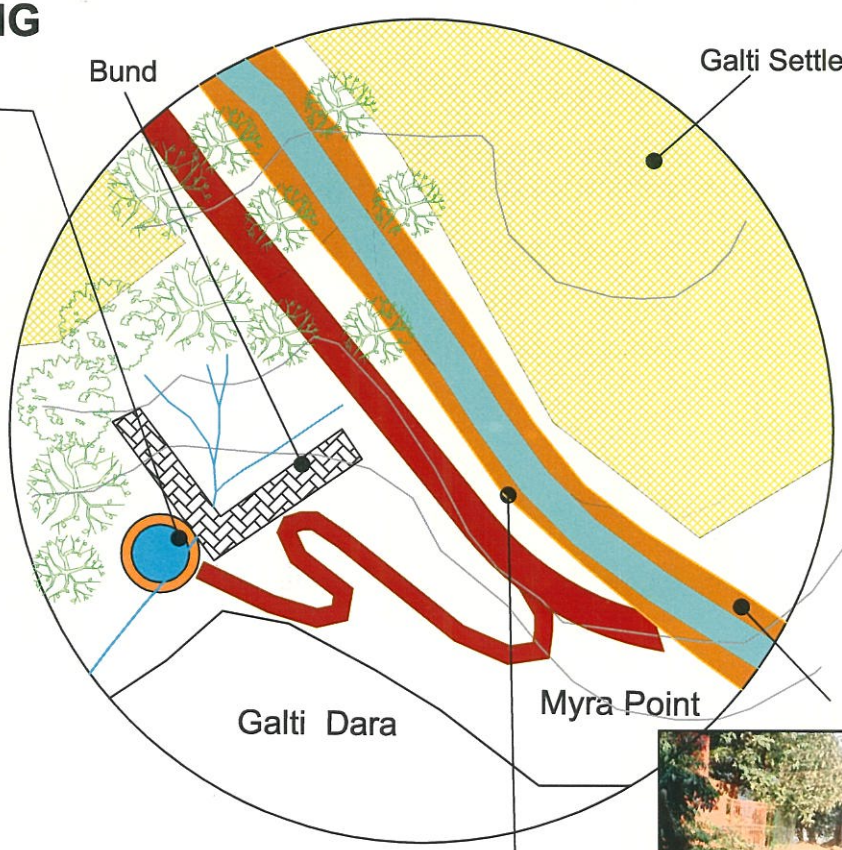
SPRING DETAIL

N

HARRISON SPRING

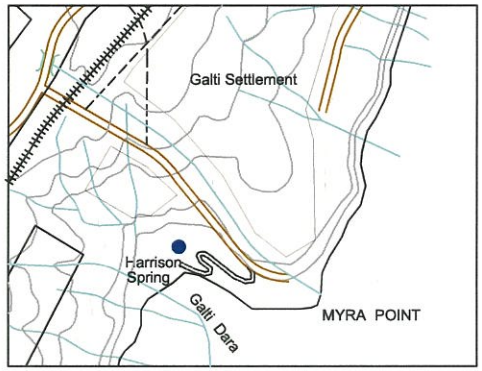
SPRING DETAIL

Harrison Spring

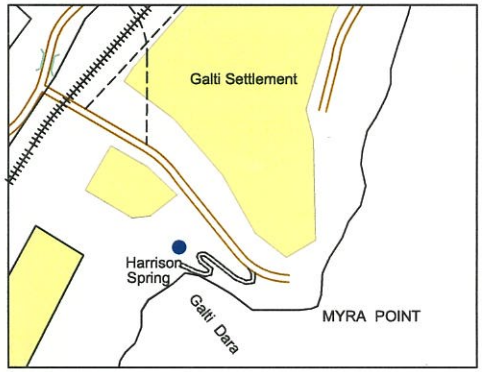


To fill one gallon it takes 15/20 minutes. Bund should be revived to solve the water problem of villagers. But commercial use, pumping or pipeline should be restricted. Washing and other activities should not be allowed on site. Water should also be allowed to flow in the valley for some part of the day.

Stream very close to settlement showing major cutting - Erosion should be checked immediately. Water can be directly transported from the culvert upto the Bassalt.

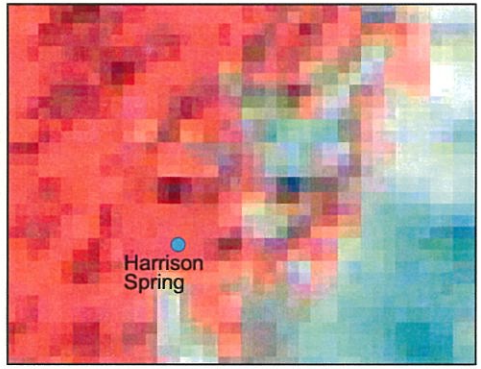


LOCATION MAP



LANDUSE

RESIDENTIAL
ROADS



VEGETATION COVER

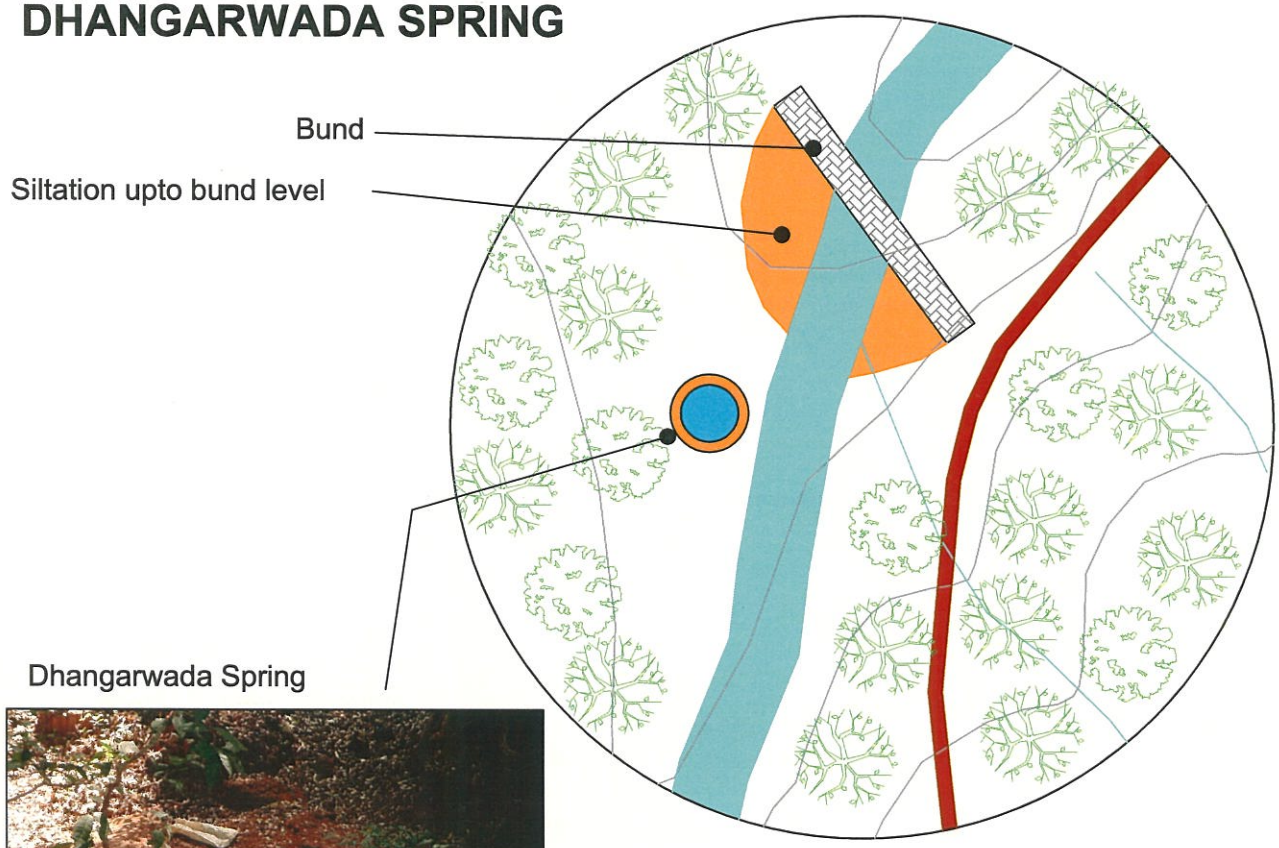
50 200 M
0 100

N

150

Name	Perenial/ Nonperenial	Waterflow	Potable/ Nonpotable	Level of Contamination	Vegetation	Uses
Harrisons Spring (Galticha Zira)	Perenial	Steady Stream	Potable	Moderate	No	Domestic
						By Galti villagers
	People from surrounding area are partially dependent on this water in summer					

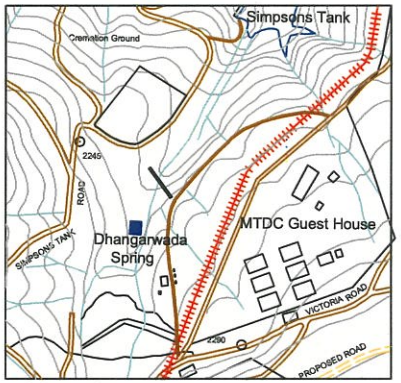
DHANGARWADA SPRING



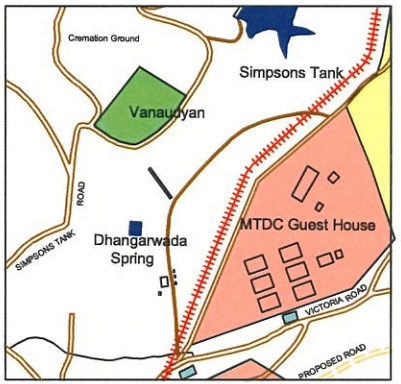
A small pit dug in silt.

Ground vegetation is heavily disturbed
This is one of the main stream feeding Simpsons tank.
Pony movement should be restricted. Area needs to be protected for regeneration of forest.

Name	Perenial/ Nonperenial	Waterflow	Potable/ Nonpotable	Level of Contamination	Vegetation	Uses
Dhangarwada Spring	Perenial	Steady Stream	Potable	Moderate	Dense	Only Drinking
						By Local people
	Spring water is used by local people, shop owners for drinking.					

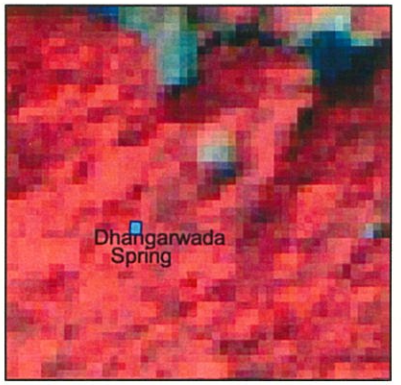


LOCATION MAP



LANDUSE

RESIDENTIAL
HOTEL
STALL
PRIVATE ROADS
ROADS



VEGETATION COVER

50 200 M
0 100

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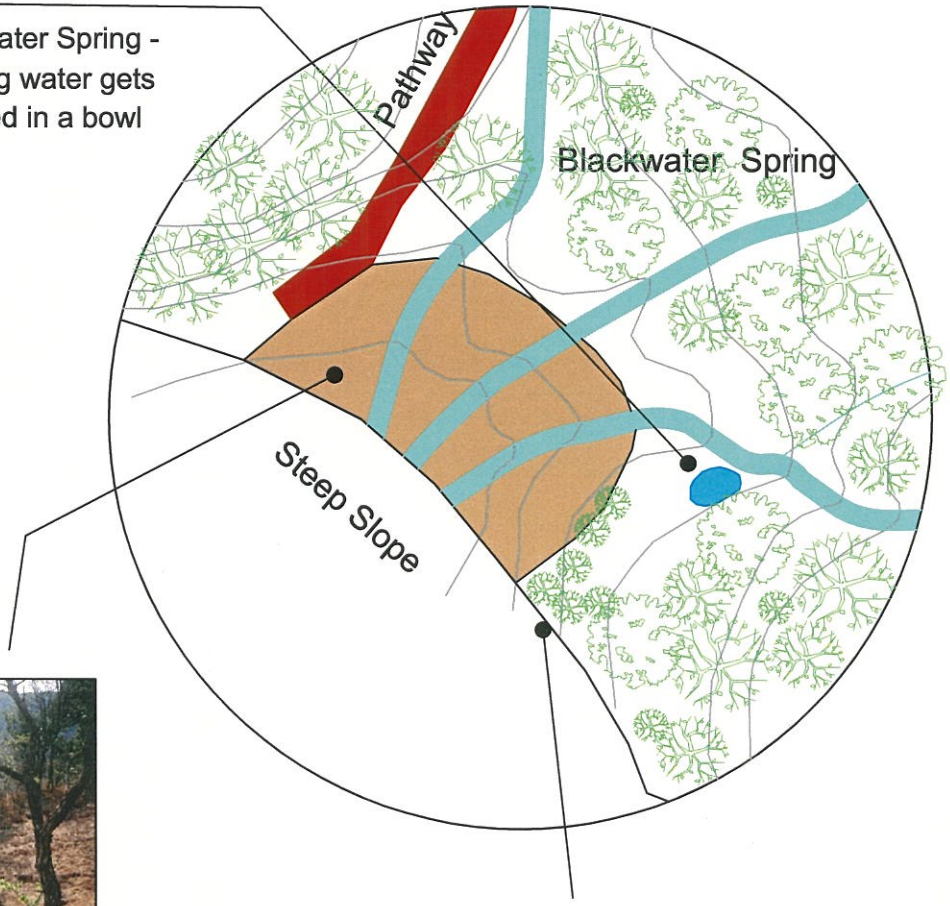
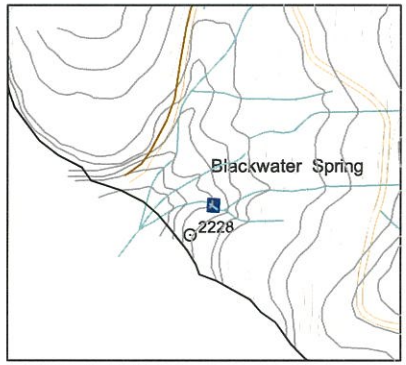
SPRING DETAIL

BLACKWATER SPRING

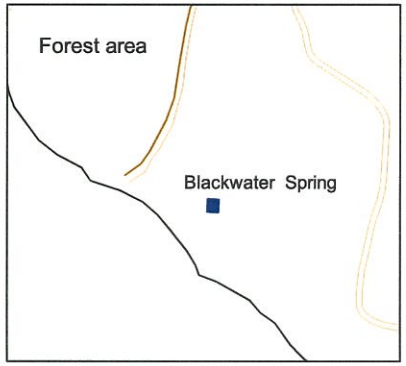
Blackwater Spring - Trickling water gets collected in a bowl



An opening of Basalt - Villagers from Galti use this opening for washing clothes



LOCATION MAP



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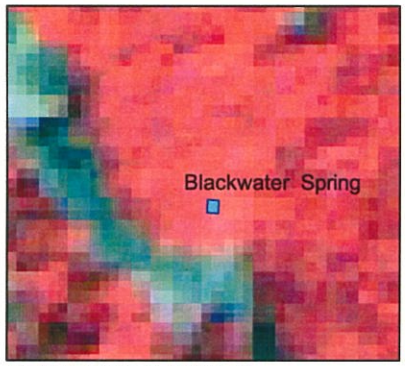


VEGETATION COVER

Name	Perenial/ Nonperenial	Waterflow	Potable/ Nonpotable	Level of Contamination	Vegetation	Uses
Blackwater Spring	Perenial	Trickle	Potable	Moderate	Good	Domestic
						By Galti villagers
	In summer people from Galti travel almost a kilometer for washing and other domestic needs					

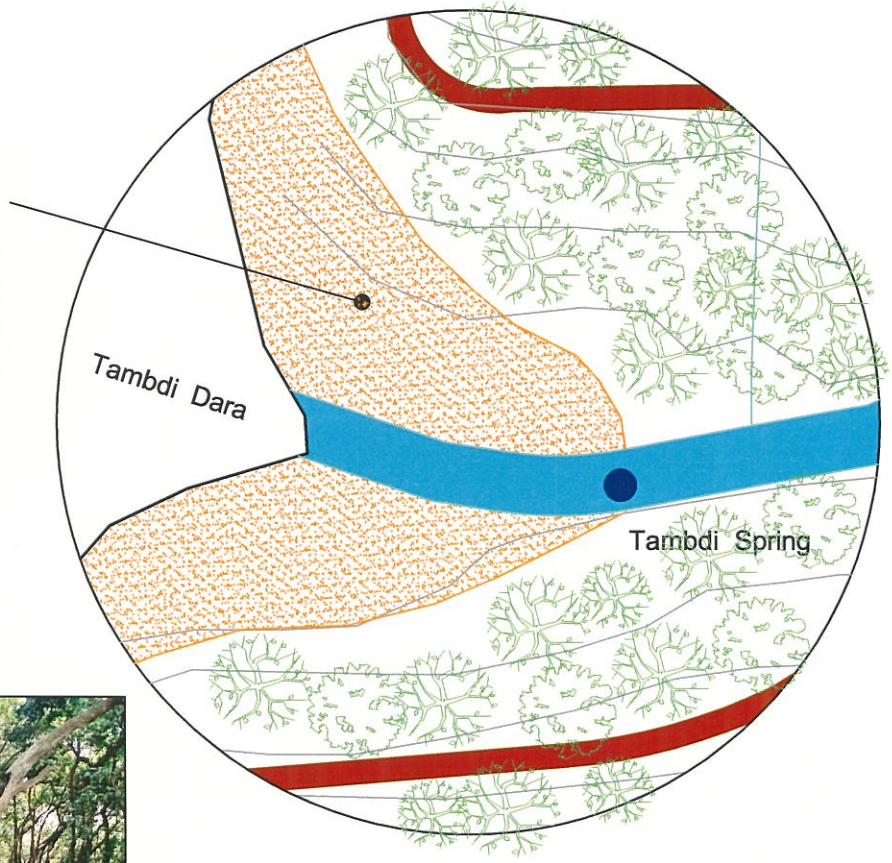
50 0 100 200 M

N

SPRING DETAIL

TAMBDI SPRING

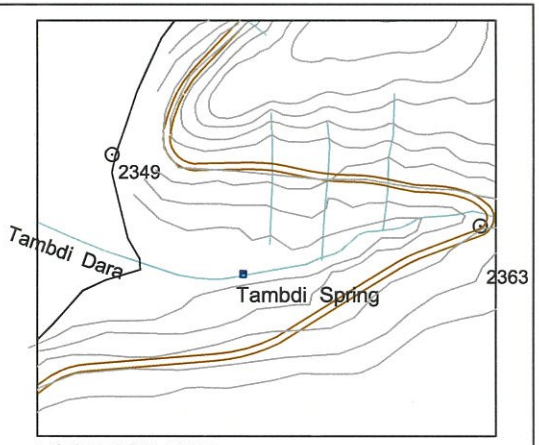
Opening around the stream bed



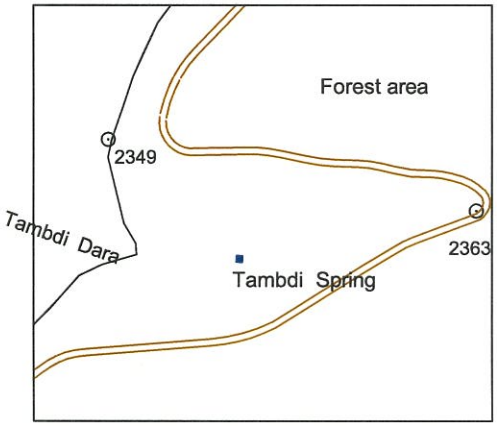
Location gives a good view of Matheran Plateau
Can be developed into a tourist spot

Intact approach roads

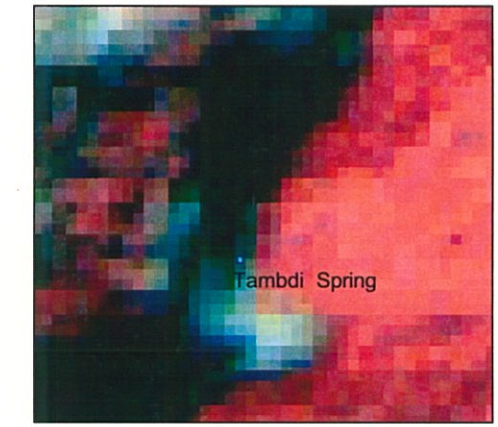
Name	Perenial/ Nonperenial	Waterflow	Potable/ Nonpotable	Level of Contamination	Vegetation	Uses
Tambdi Spring	Nonperenial	Steady Stream	Potable	None	Dense	Only Drinking
						By Local people



LOCATION MAP



LANDUSE



VEGETATION COVER

50 200 M
0 100

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SPRING DETAIL

7.3 POINTS

The Matheran Plateau, at a height of 2530 ft above mean sea level (MSL), offers a panoramic view of the surrounding landscape and geology. It exhibits natural heritage to the fullest in all forms and explores its various shades and behavior in various seasons and climates.

Matheran and the surrounding hillscapes, along with natural flora and fauna, has a great potential that can be explored for research and study as well as a get away from the urban utopia. It needs to be conserved for sustaining natural ecosystems and for further generations to come.

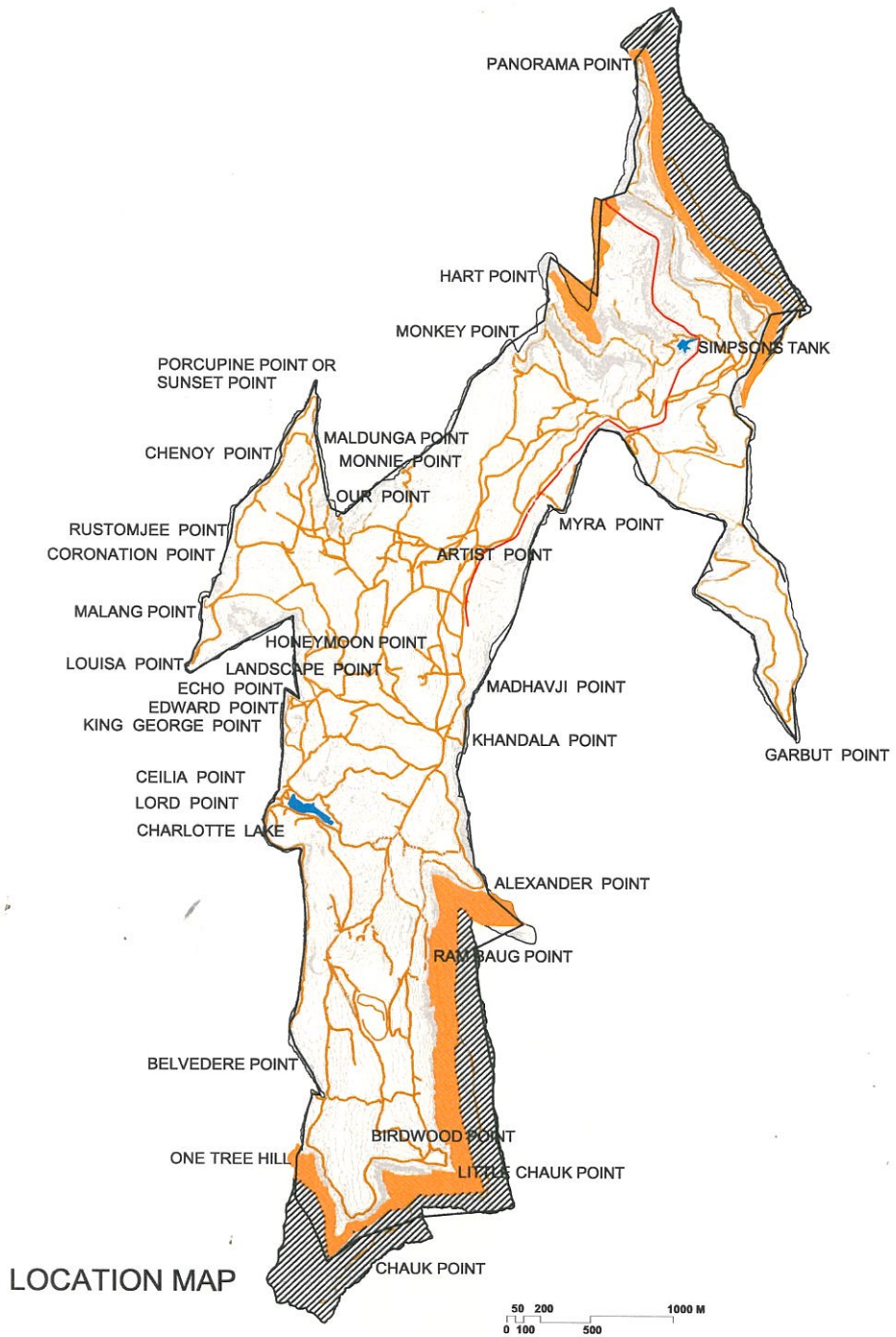
The Matheran Plateau harbors many points of tourist interest, approximately 38 in number, each unique in character in terms of its aesthetical factor eg: One Tree Hill, or the scenic view it offers eg. Sunset Point, Panorama Point, Echo Point. The points are approached by roads, pathways, trails etc. Some points like Echo Point & Porcupine Point have a conspicuous approach, while others like Rambaug Point, Beldveder Point, can be approached by narrow trails. Some are more frequented by tourists based on their location and significance. Certain Points like Garbut Point that are not so frequented still retain their natural serenity.

The Points also act as connections between the plateau and the surrounding villages situated on the hill slopes as well as on the planes below. Most of the inhabitants from these villages come to the plateau via these points for livelihood. **Rambaug Point** connects the adjoining villages or padas namely Tepachi Patti, Nimbar- Patti, Chinchmal & Sondewadi to the plateau. **One-Tree Hill** point provides access to inhabitants of Gal-Patti, Tad Wadi & Ambe Wadi. Similarly inhabitants from Ashachi Patti travel via **Louisa Point** & **Malang Point**. **Porcupine Point** and **Monkey Point** are accessed by villagers from Gadhesh, Waghachi Pati & Dodhani respectively to reach the plateau.

Understanding the above mentioned any development, beautification or up gradation done has to envisage the purpose, aesthetics and most importantly the character of the point, thereby understanding its individuality.

General recommendations for all points

- Nature trails and approach roads to points shall not be widened. Soil shall not be removed from road edges and forest areas and loose soil shall not be laid on approach roads to points and paths. Natural leaf litter forms a protective layer on the surface of roads. Leaf litter on approach pathways and trails shall not be cleared and shall be added where not present.
- Only indigenous species of trees shall be used for roadside plantations. The Municipal council shall not create avenues of exotic trees.
- Paving of points, trails and paths shall not be permitted.
- Regeneration of natural ground cover (grasses) on points and headlands shall be carried out to prevent soil erosion.
- Existing natural features such as soil, rocks, vegetation or undergrowth shall not be cleared for any purpose such as paving, creation of pathways, landscaping, etc.
- The points are a part of the natural heritage of Matheran and need to be preserved in their natural state. Measures shall be taken towards restoration of native ecology and habitats as opposed to disturbing or changing the natural landscape. Any beautification or conservation measures that need to be undertaken shall be approved by the Monitoring committee and Heritage committee.
- No temporary or permanent structures for stalls, toilet blocks, etc. shall be permitted at the points.



PROMINENT POINTS ON THE PLATEAU

POINT	ISSUES	RECOMMENDATIONS
Panorama	Surrounded by dense forest and opening covered with natural ground cover.	Area in good natural condition with good bio-diversity. Should be conserved.
Hart	Surrounded by dense forest and opening covered with natural ground cover.	Area in good natural condition with good bio-diversity. Should be conserved.
Porcupine or Sunset	Thining of vegetation in certain areas. Soil is dug from surrounding areas for roads and clearing. A large number of people visit this area for the annual Malang baba fair.	Digging of soil to be stopped and ground vegetation to be restored by spreading grass seeds.
Malang	Clearing only in the point area with good vegetation around.	Point can be developed with seating and railing in the area.
Louisa	Large clearing in the point area with railing only in certain sections.	Point can be developed with seating and railing in the area. Ground cover can be restored. The route to this point is through dense forest and has good visual quality which should be maintained.
Echo	Point frequented by large number of tourists. Major soil erosion along the path to this point due to digging from surrounding areas for ramming the road. Loss of ground cover at pony junction.	The pathway to this point should be paved. Vegetation to be restored. Point can be developed further with plantation measures and seating for the tourists.
One Tree Hill	Soil erosion at this point due to steep slope and loss of vegetation.	Vegetation to be restored. This area has good visual attributes with a stream and spring, thus has potential to be developed.
Chauk	Soil erosion at this point due to steep slopes and digging of soil leading to barren terrain.	Lateritic stone walls should be built along the roads to prevent soil erosion. Leaf litter should be allowed to collect naturally which would prevent soil erosion and form good manure.
Rambaug	Major felling of trees in the forest area is leading to loss of valuable terrace forest which is the habitat of endangered species like the Giant Squirrel.	Felling of trees should be stopped and fuel wood plantations should be carried out in the valleys for the local villagers. Afforestation measures should be taken to restore the forest vegetation.
Garbut	The point is less frequented by tourists and is in good natural condition.	Route to the point is through dense forest area which is in good natural condition. The area should be developed as a point of natural heritage.

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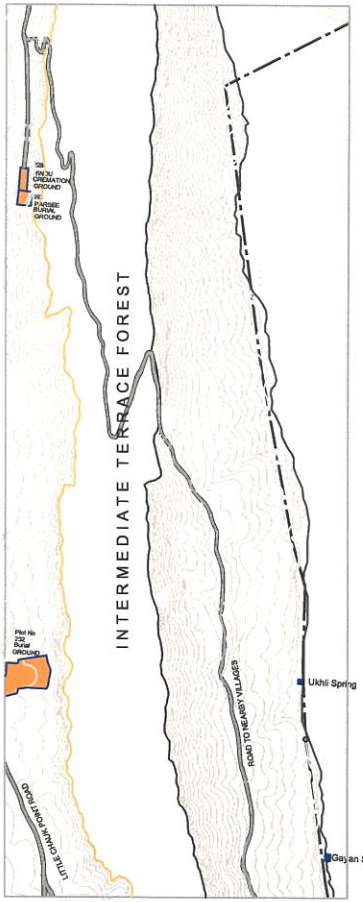
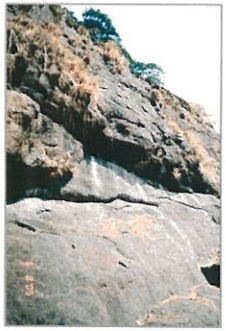


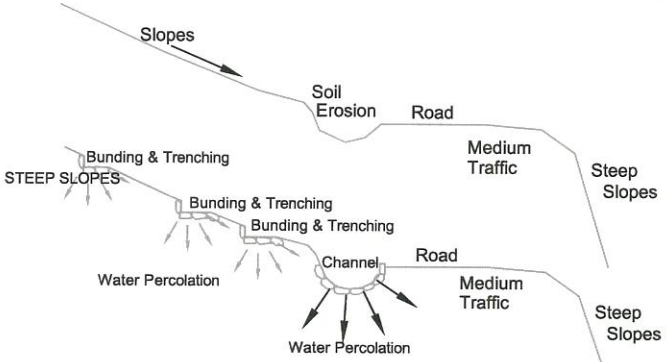
RAMBAUG
AREA CONTEXT

PLATEAU

DETAIL A



Steep Slopes
leading to heavy cascading waters



DETAIL A
RAMBAUG- Plateau Area
Suggested Modifications

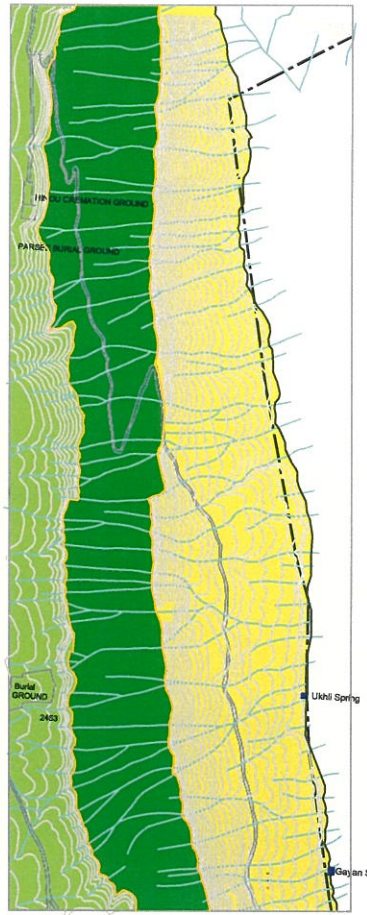
GALLERY FOREST

DETAIL B

RAMBAUG
SCHEMATIC SECTION

STEEP SLOPES

Composite forest
supporting ich bio-diversity
Giant-Squirrel Habitat
affected by TREE-FELLING.



RAMBAUG
Natural Features

EVERGREEN FOREST
MIXED SEMI-EVERGREEN TO EVER GREEN FOREST
MIXED SEMI EVERGREEN TO MOIST DECIDUOUS FOREST

Steep Slopes

Voids created by TREE-FELLING

DETAIL B
RAMBAUG- Gallery Forest

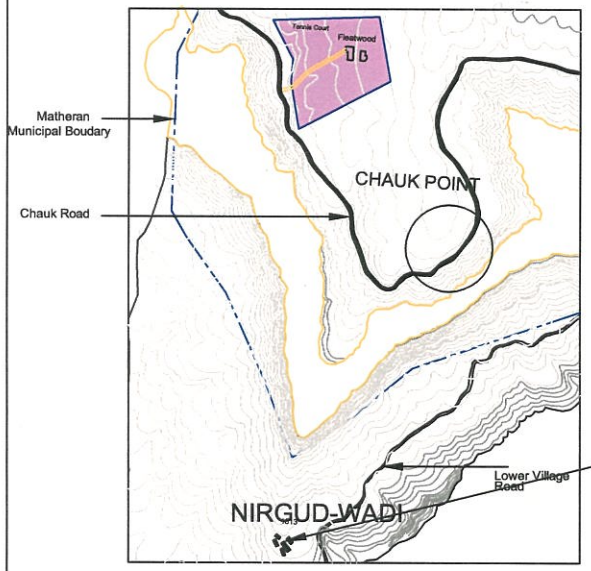
Steep Slopes

Deforestation affects flora & fauna
HABITAT OF GIANT SQUIRREL AFFECTED
Solution: Afforestation
Fuel wood plantation
Awareness amongst residing tribes

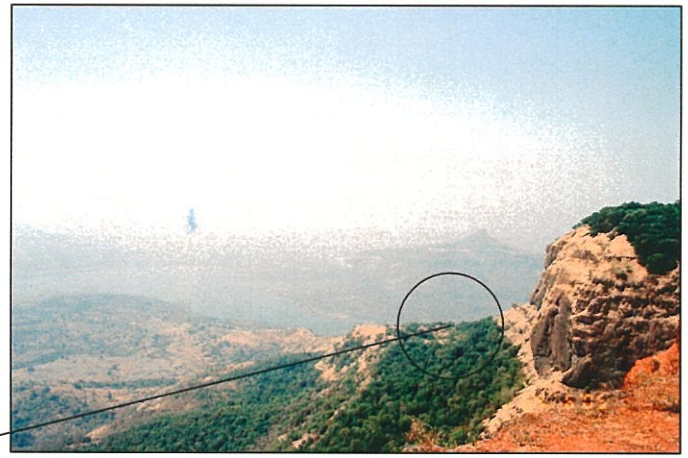
KEY PLAN

N

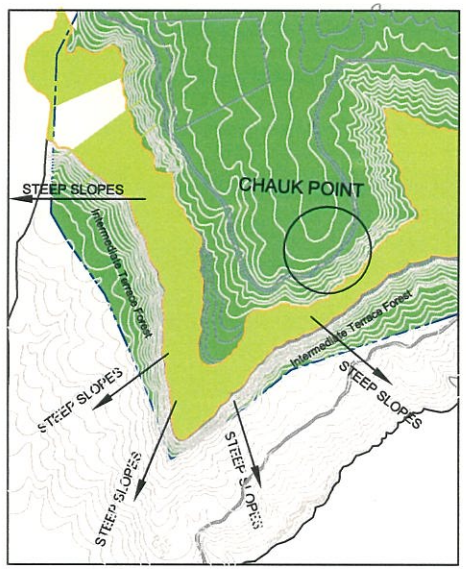
RAMBAUG POINT



CHAUK POINT
with context to sourrounding area.



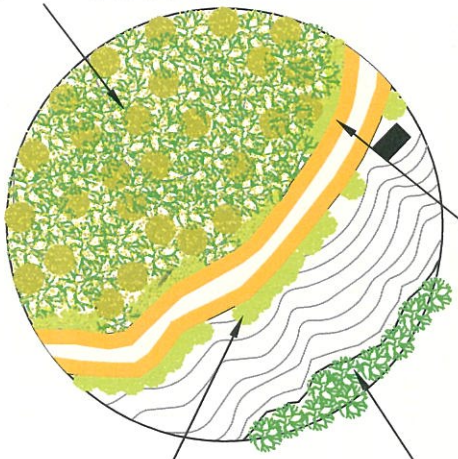
Nigrud Wadi



CHAUK POINT
Natural Features

Good Quality Forest
Good Quality Trees

Upper Composite Forest

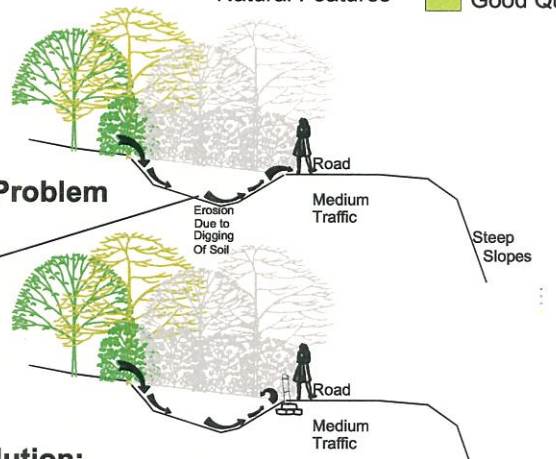


CHAUK POINT
As existing condition

Scenic view from Chauk Point

Soil Erosion along Chauk Road

Problem



Solution:

--Digging of soil should be stopped
--Allow collection of leaf litter, to naturally decompose to form rich manure
--Building of Lateritic Stone walls on the road edge shall stop the water which carries eroded earth thereby making the trench rich & conducive for undergrowth.
--Need for Trenching & Bunding Techniques.

CHAUK POINT
KEY PLAN

N

CHAUK POINT

ANNEXURES

(I) A note on the importance of Matheran forest, by. Dr. Rachel Reuben, B.N.H.S.

(II) Report on the Malabar Giant Squirrel in India

(III) List of rare endemic and threatened plants found in Matheran

(IV) List of tree species for energy plantation

(V) List of fodder trees, shrubs and grasses

(VI) List of fruit trees and economically important trees/ plants for agro-forestry

(VII) List of hedge plants for live fencing in gaothans or community reserves on the lower slopes

(VIII) List of indigenous hedge plants for live fencing on the plateau

(IX) List of indigenous trees for reforestation or plantation on the lower slopes

(X) List of indigenous trees for reforestation on terraces

(XI) List of indigenous trees for reforestation or plantation on the plateau

(XII) List of indigenous plants for landscaping on the plateau

(XIII) List of plant species/ flora observed on Matheran plateau in March-April 2005

(XIV) List of fauna observed on Matheran plateau in March-April 2005

ANNEXURE I

BOMBAY NATURAL HISTORY SOCIETY
MUMBAI

8th July 2005

A NOTE ON THE IMPORTANCE OF MATHERAN FOREST

Situated at 110 km away from Mumbai, Matheran is a small plateau in the Western Ghats, which has an area of only 20 sq. km and is at an elevation of 800 m. Forest here is moist semi- evergreen seasonal cloud forest consisting of stunted crest-lined forest. The avifauna is mainly composed of the forest-dwelling species and among mammals, Indian Giant Squirrel, Three Striped Squirrel, Tree Shrew, Civet Cat, Barking Deer, Sambar, Hanuman Langur and Bonnet Monkey occur here. Leopard too is reported from here, but it keeps to the denser valleys below.

The Indian Giant Squirrel is an endangered species, besides being the State Animal of Maharashtra. Being exclusively, a tree-dwelling mammal, continuous tree canopy is vital for its survival. Fragmentation of Matheran forests can severely threaten this endangered mammal. The Leopard too is endangered.

The area is rich in herpetofauna, especially some endemic species to Western Ghats occur here. Among the endangered reptiles, Common Monitor Lizard and Indian Rock python occur in Matheran. Also, some rare and endemic caecilians (amphibians) are found in Matheran.

The flora too is rich in medicinal plants, including some rare orchids and lilies. Many of these plants are used locally for food and medicine.

The area of Matheran municipality is 725 ha. Of which 459 ha. is Reserve Forest. Of the 163 ha. of residential area, it is estimated that at least half of it is forested and would fall under the dictionary meaning of the word 'forest'. Hence, at least around 550 ha. of the 725 ha. (i.e. at least 76%) of Matheran is forest land, with over 80% canopy cover.

The forest of Matheran is not just for the birds and butterflies, but more importantly, these forests form an important catchment area for Ulhas, Gade and Dharvi rivers that provide drinking water to the populace down below. Any degradation of the forests and pollution will cause irreversible damage to the ecosystem affecting the entire population dependent on this water resource.

The moist semi- evergreen seasonal cloud forest is very typical of this area. Once lost, such forests may never regenerate to its original state, as the red laterite soil is too impoverished to support new growth. Loss of ground cover will further leach away the soil nutrients and cause excessive siltation in water bodies situated at the base. Therefore, any "development" in Matheran that causes loss of forest cover, will result in permanent damage to this fragile ecosystem of Matheran.

Any further development should not take place unless a proper Environmental Impact Assessment (EIA) is carried out giving sufficient time to cover all seasons. The EIA should be conducted by a team biologists from a reputed institution.

It should be borne in mind that the very uniqueness of Matheran lies in its forests.

Dr Rachel Reuben
Honorary Secretary

ANNEXURE II

EXECUTIVE SUMMARY

The Malabar giant squirrel was extensively studied at Bhimashankar Wildlife Sanctuary, Pune District, Maharashtra, from the end of 1993 through 1995. The core study area was 18 hectares within the Bhimashankar sacred grove; in addition squirrels were also studied within three satellite forest patches of Choura, Hindola and Adhal which were each approximately 0.5-km^2 in area but differed from each other in vegetation composition. The squirrel density was highest in the sacred grove and in Choura whose vegetation is most similar to that of the grove and very low in the other three patches. The squirrel density in the Bhimashankar sacred grove also showed a 30% reduction from an earlier study done 10 years ago (Borges 1989b). Morecever, there was a doubling of home range size compared to the earlier study. This indicates the probable effect of habitat degradation even within the best available habitat for giant squirrels within the Bhimashankar Wildlife Sanctuary i.e. within the sacred grove, and has very serious implications for the long-term survival of the giant squirrel within the sanctuary. Squirrels were affected by fragmentation and edge effects, exhibiting greater aggression, crowding and nest parasitism at the edge of the grove particularly in an area of canopy discontinuity due to the aborted Bombay Road.

A detailed study of giant squirrel food resources revealed that lianas were an extremely important component of the diet contributing to as much as 95% of the daily squirrel diet. The need for liana conservation is stressed as lianas have hitherto been a neglected component of research and management plans in forests throughout the world.

An in-depth study of the phytochemistry of the Bhimashankar forests in relation to giant squirrel foraging revealed that condensed tannins and fibre contents of food

resources were important negative predictors of relative food consumption and were, in fact, along with the astringency of tannins, significant determinants of resource avoidance. Saponins and alkaloids were also implicated in food selection with saponins present in 66% of the tested non-consumed items. Sixty-seven percent of items containing both alkaloids and saponins were ignored by the squirrels. Cyanogenic glycosides were found to be absent in the vegetation.

The chemical variation between individual trees of two dominant species in the sacred grove, *Mangifera indica* and *Memecylon umbellatum*, was also investigated. This was in support of the intraspecific variation observed between individual trees in their utilisation by the squirrels for bark or leaves. Gross energy contents of the leaves was positively related to consumption level in *Memecylon* and in 1994 leaf and bark levels of condensed tannins were negatively related to the consumption of *Memecylon* and *Mangifera* respectively. Variation between individual trees of the same species as food resources for an arboreal herbivore such as the giant squirrel has profound management implications. Investigation of the chemical landscape matrix of a forest on such a micro-scale has rarely been undertaken.

The population biology of two dioiecious tree species that are important food resources for the giant squirrel was also studied. It was found that *Garcinia talbotii* and *Diospyros sylvatica* were also the most harvested species by the local people and had severely skewed sex ratios. The management implications of these findings are also discussed. Associated studies on the reproductive biology of three plant species are also presented and the implications of the findings for the pollination and reproductive success of the plant community at Bhimashankar are presented. These are particularly germane to giant squirrels who depend on the reproductive portions of many plants for food.

Results of the surveys for giant squirrels in different states in India revealed some general conservation concerns and some particular problems specific to the surveyed sites. The albinistic subspecies of the giant squirrel *Ratufa indica dealbata*, formerly restricted to the northern Western Ghats in the Surat Dangs of Gujarat, was found to have gone extinct owing to habitat loss and hunting pressures. The northern boundary of the giant squirrel in the Western Ghats was found to be within the Kalsubai-Harishchandragad Widlife Sanctuary in Maharashtra. In most areas, squirrels were found to be restricted to fragments which were either completely isolated or of undetermined connectivity with other patches e.g. riverine forests in the dry deciduous forests of the Satpura mountains. In many areas squirrels were restricted to small sacred groves (only a few hectares in area) surrounding temples or sacred springs as in Andhra Pradesh. In such small relict patches of old growth forests, there was limited or no evidence of natural regeneration of the vegetation which was further complicated by grazing pressures. Several populations of squirrels have disappeared from specific locations e.g. from Kawal Wildlife Sanctuary in Andhra Pradesh. A serious view needs to be taken of the regeneration potential of old growth forests as further shrinkage of patches without the prospect of successful regeneration will be deleterious to the long-term survival of giant squirrel populations in many parts of India.

As a result of the surveys conducted in this project, new areas containing giant squirrels were added to the Phansad Wildlife Sanctuary in Maharashtra. This population of giant squirrels constitutes one of the few coastal lowland forests containing giant squirrels in the country.

The results of the ground surveys of giant squirrels and their associated habitat are proposed to be incorporated into a Geographical Information System analysis which will be invaluable for planning management strategies for arboreal herbivores in a

II . THE MALABAR GIANT SQUIRREL IN INDIA

SALIENT FEATURES OF THE SURVEYS

The first year of the project was devoted to an assessment of the status of the Malabar giant squirrel in the Western Ghats, Eastern Ghats and Central India. Owing to time constraints and the vast land mass to be covered, these surveys were done only in representative areas in these three regions. It is believed, however, that the findings of these surveys have helped to elucidate some general principles and some specific problems peculiar to the giant squirrel, associated forest formations and other arboreal herbivores.

n this final report, only the most salient features of some surveys are presented statewise. Additional details are available in Annual Report 1 (1991-1992) and Annual Report 2 (1992-1993) of the Giant Squirrel Project.

METHODS

Surveys were done either on foot or by vehicle. In each State, areas were located on Forest Division or Range maps (wherever possible) and on Survey of India topographic sheets (1:50,000 scale). Forested types in this report broadly follow Champion and Seth (1968). Forest degradation is measured in the following categories: none, minimal, moderate, considerable, complete. Approximate forest patch size is measured in the following ranges: 0.5-5 km^2, 5-10 km^2, 10+ km^2. Information on canopy connectedness and patch continuity isolation is provided wherever possible.

Giant squirrel observations: The number of individuals, and nests or calls heard while walking or driving through paths in the surveyed areas were noted. Owing to time constraints, no attempt was made to census populations via line transects. All

accessible pre-existing paths were traversed on foot within the available time. If distances within an area were large and jeepable roads were available, distances between patches and approximate sizes of patches were estimated using the vehicle mileage meter. The status of the giant squirrel population was estimated in the following categories: **a) not at risk:** if the patch size was large or connected to other patches and/or hunting was not prevalent and/or no other threat seemed imminent; **b) vulnerable:** if the population is exposed to threats such as enhanced habitat destruction, hunting and the patch size is not large and is in danger of further fragmentation; **c) endangered:** if the patch is small and isolated and/or the population is subjected to threats such as hunting and further habitat degradation and is likely to go extinct if remedial measures are not taken immediately; and d) **indeterminate:** if owing to weather conditions, inaccessibility of area due to rugged terrain, lack of time etc., the information gathered about an area is insufficient to enable any conclusion. All other available information on giant squirrels was collected.

Information about other arboreal herbivores (birds and mammals) was also collected wherever possible. Local tribals were interviewed in all areas to obtain information about past habitat conditions, species previously present and reasons for their decline.

Local human population: Warli, Katkari and Mahadeo Koli tribals

Major source of livelihood: Agriculture

Local knowledge of flora and fauna: Good forests present 20-30 years ago

General threats to fauna: Hunting prevalent in all areas; wild boar and barking deer mainly hunted

Threats to habitat: Tree felling in all areas

Wildlife-human interaction: Cattle lifting and occasional injury to humans by leopard reported in Sativali Round

Recommendations: Enhanced protection to be given to the forests in Sativali, Mandvi, Maziwali, Ogada and Suryamal Rounds

RAIGAD DISTRICT

Survey period: May, June, August, September 1992

Map coordinates: 18° 05′ N –19° 10′ N; 72° 55′ E – 73° 40′ E

Surveyed areas:

I. **Alibag Forest Division:**

A. **West Karjat Range:**

(a) Matheran and adjoining forests

B. **East Karjat Range:**

(a) Ulhas valley (b) Kataldara valley

(c) Meroli rai (d) Rajmachi foot hill (e) Amba valley

C. **Alibag Range:**

(a) Alibag Round (Kankeshwar)

II. **Roha Forest Division:**

A. **Roha Range:**

(a) Sudkoli Round (Mhasadi, Titwi, Kapri) (b) Channera Round

B. **Murud Range:**

(a) Phansad Wildlife Sanctuary (b) Murud Round (Garambi)

C. **Mhasala Range:**

(a) Mhasala Round (b) Dehen

(c) Mandatane (d) Pangloli

D. **Mahad Range:**

(a) Raigad Round (b) Mahad Round (Khutil)

(c) Poladpur Round (Rankadsai, Dabhil and Lahulase foot hills)

Elevation: Matheran 755 m, Ulhas valley 200 m, Phansad Wildlife Sanctuary 300 m, Lahulase (Pratapgad foot hill) 200 m, Mhasala 100 m, forests adjoining Pratapgad 700 m

Topography: Steep western slopes of main Sahyadri range (Rajmachi. Ulhas valley. Mahad Range); small plateau on crest surrounded by steep slopes of secondary Konkan range (Matheran); low undulating hills near coast of Arabian Sea (Roha. Phansad, Mhasala) forming creeks (Mhasala and Rajpuri creek); catchment areas of Ulhas, Kundalika, Patalganga and Savitri rivers

Protected status: Kankeshwar forest under Kankeshwar Temple Trust: parts of Murud Range in Phansad Wildlife Sanctuary; rest Reserved Forests

Forest type: Coastal semi-evergreen in Phansad Wildlife Sanctuary; subtropical broad leaved evergreen hill forests in Matheran and Meroli rai; moist mixed deciduous forests elsewhere

Forest degradation: Moderate in Garambi, Sudkoli. Channera, Dehen, parts of Matheran, Meroli rai; considerable elsewhere: upper parts of Dabhil. Rankadsai. Lahulase not surveyed

Approximate patch size: Matheran (5-10 km^2); Meroli rai. Kataldara. Garambi. Dehen. Sudkoli, Channera (0.5-5 km^2 and with connected canopy); small. fragmented without connected canopies elsewhere

Dominant tree species: *Syzygium cumini, Olea dioica, Memecylon umbellatum, Mangifera indica* in Matheran, Meroli rai; *Mangifera indica, Salmalia malabarica, Terminalia tomentosa, Terminalia bellerica, Syzygium cumini* elsewhere.

Special features of vegetation: Evergreen normally upper altitude vegetation in Phansad Wildlife Sanctuary at lowland elevation near coast; isolated giant trees of species such as *Alstonia scholaris* in Amba valley; dominance of *Semecarpus anacardium* in Mhasala and Phansad.

Presence of Giant Squirrel:

Area	Sightings	Calls	Nests
Matheran	7	+	16
Kataldara	1	-	14
Meroli rai	4	-	35
Sudkoli	-	-	31
Channera	-	+	11
Garambi	-	-	19

Threats to Giant Squirrel: Hunting prevalent in all areas usually by catapult; in Meroli rai and Kataldara by slicing through nest with sickle and/or stoning animal; also by guns in Murud (Garambi) and Poladpur Rounds

Status of Giant Squirrel: Endangered in all patches owing to small size and isolation of patches, and prevalence of hunting

Associated frugivorous birds: Malabar grey hornbill in Kataldara valley and Meroli rai

Associated arboreal mammals: Bonnet macaques and hanuman langur in Matheran and Ulhas valley

Other fauna: Leopard, wild boar, barking deer and blacknaped hare reported in all areas; Indian tree shrew in Matheran

Local human population: Warli, Katkari and Mahadeo Koli tribals

Major source of livelihood: Agriculture and daily wage labour

Local knowledge of flora and fauna: Good forests present 20-30 years ago

General threats to fauna: Hunting by locals using crude methods prevalent in all areas; hunting by professionals in forests near townships of Matheran, Khandala, Alibag, Murud and Mahad

Threats to habitat: Tree felling in all areas; illicit breweries in Ulhas and Amba valleys causing deforestation; overgrazing

Wildlife-human interaction: Cattle lifting by leopard/ (tiger?) reported in Raigad Round

Recommendations: (1) The forests in Sudkoli and Channera Rounds (Mhasadi, Titwi, Kapri, Temghar (Compartment numbers 267, 269, 272-275) should definitely be included in the Phansad Wildlife Sanctuary as these contain one of the few known coastal forest populations of giant squirrels. This population has probably been isolated for a long time and is probably genetically quite distinct. This needs more investigation. Forests in Garambi nearby also contain giant squirrels, however this is an isolated patch and perhaps cannot be easily connected to the protected area of Phansad. (2) Tourist pressure on the forests of Matheran and of Khandala (Ulhas and Amba valleys, Meroli rai) in terms of commercial consumption of fuelwood by tourist establishments must be controlled. (3) Illicit breweries in Ulhas and Amba valleys should be closed. (4) Meroli rai and Kataldara forests should be given enhanced protection especially since Meroli rai was where the eminent botanist Fr. Santapau collected most of his specimens in the 1940s for his monograph on the flora of Khandala. This forest has shrunk considerably since the time of Fr. Santapau and is now reduced to a strip of nearly inaccessible forest at mid-slope level.

CONCLUSION: Owing to the confirmed extinction of the Malabar giant squirrel in the Western Ghats of Gujarat (Surat Dangs), the northernmost bounday of the squirrel in the Western Ghats was confirmed to be within the Kalsubai-Harishchandragad Sanctuary in Maharashtra. Special attention needs to be paid to this population.

As a result of this survey during which giant squirrels were found in the Sudkoli and Channera Rounds of Roha Range (Alibag Forest Division), the relevant forest compartments containing giant squirrels were added to the notified area of Phansad Wildlife Sanctuary according to the recommendations made in Annnual Report 1 of this project. The timely action taken by Mr. Indurkar (then Chief Wildlife Warden) is sincerely acknowledged.

Owing to time constraints, forests in eastern and southern Maharashtra were not surveyed. However, since it is a general fact that the natural forest cover of Maharashtra is limited and patchy, concerted effforts must be directed towards the protection of all natural forest patches from further fragmentation. The absence of giant squirrels from forested areas like Melghat Tiger Reserve needs to be further investigated as this appears to be either a biogeographic fact or a historical accident.

ANNEXURE III

LIST OF RARE ENDEMIC AND THREATENED PLANTS FOUND IN MATHERAN.

	BOTANICAL NAME
1.	*Achyranthes coynei*
2.	*Bidaria khandalense*
3.	*Canscora khandalensis*
4.	*Cassia koladensis*
5.	*Ceropegia attenuata*
6.	*Ceropegia occulata*
7.	*Chlorophytum borivlianum*
8.	*Crotolaria falians var trichocarpa*
9.	*Curcuma inodora*
10.	*Delphinium malabaricum*
11.	*Erinocarpus nimmoni*
12.	*Eriocaluon humile*
13.	*Euphorbia khandalensis*
14.	*Flemingia gracilis*
15.	*Iphigenia magnifica*
16.	*Lindernia estaminodiosa*
17.	*Pinda kokanensis*
18.	*pogonache racemosa*
19.	*Polyzygus tuberosus*
20.	*Pseudodicanthium serrafalcoides*

ANNEXURE IV

A LIST OF TREE SPECIES FOR ENERGY PLANTATION

-(To be carried out in the community reserves in/ near Gaothans in the ESZ and certain other areas identified on the lower slopes and foothills.)

BOTANICAL NAME	COMMON OR VERNACULAR NAME
1. *Acacia catechu*	Khair
2. *Acacia nilotica*	Babhul
3. *Adina cordifolia*	Hedu
4. *Bambusa arundinacea*	Kalak
5. *Bauhinia foveolata*	Chambel
6. *Bauhinia purpurea*	Kanchan
7. *Bauhinia racemosa*	Apata
8. *Bombax malabarica*	Kate savar
9. *Cassia fistula*	Bahava
10. *Casuarina equisetifolia*	Khadasherani, Suru
11. *Cordia mixa*	Bhokar
12. *Dalbergia lanceolaria*	Dandus
13. *Dalbergia paniculata*	Phanashi
14. *Dalbergia sissoo*	Shisavi
15. *Dendrocalamus strictus*	Bambu
16. *Gmelina arborea*	Shivan
17. *Grevia tilaefolia*	Dhaman
18. *Heterophragma quadriloculare*	Varas
19. *Ixora brachiata*	Gorbale
20. *Lagerstroemia microcarpa*	Nana
21. *Lagerstroemia parviflora*	Bondara
22. *Madhuca longifolia*	Moha
23. *Manilkara hexandra*	Khirani, Rayan
24. *Mitragyna parviflora*	Kalam
25. *Morinda pubescens*	Bartondi
26. *Peltophorum pterocarpum*	Peetamohor
27. *Polyalthia longofolia*	Ashoka
28. *Saccopetalum tomentosum*	Humb
29. *Schleichera oleoides*	Koshimb
30. *Sesbania grandiflora*	Hataga
31. *Sterculia foetida*	Pun
32. *Sterculia guttata*	Kukar
33. *Terminalia bellerica*	Beheda
34. *Terminalia crenulata*	Ain
35. *Terminalia paniculata*	Kinjal
36. *Trema orientalis*	Gol

ANNEXURE V

FODDER TREES SHRUBS AND GRASSES - (FORAGE AND FODDER PLANTS.) *Community reserves in/ near Gaothans in the ESZ and certain other areas identified on the lower slopes and foothills.)*

BOTANICAL NAME	COMMON OR VERNACULAR NAME
1) Alysicarpus longifolius	Shevara
2) Apluda aristata	Bhas
3) Brachiaria mutica	Pyaragrass
4) Chrysopogon montanus	Songavat
5) Cynodon dactylon	Harali
6) Desmodium laxiflorum	
7) Dicanthium annulatum	Marvel
8) Hardwickia binata	Anjan
9) Heylandia latebrosa	Godhadi
10) Indigofera glandulosa	Barbada
11) Indigofera linifolia	Pandharphali
12) Ischaemum pilosum	Kunda
13) Ischaemum rugosum	Ber
14) Iseilema laxum	Moshi
15) Medicago sativa	Vilayati Gavat
16) Ougenia oojeinensis	Tiwas/Kalapalas
17) Paracalyx scariosa	Ranghevada
18) Penisetum purpureum	Elephant Grass
19) Sehima nervosum	Pavana
20) Sehima sulcatum	Sheda
21) Sesbania aegyptica	Shewari
22) Sesbania grandiflora	Hataga
23) Stylosanthes hamata	Hamata/Stylograss
24) Tamarindus indica	Chinch

ANNEXURE VI

LIST OF FRUIT TREES AND ECONOMICALLY IMPORTANT TREES /PLANTS FOR AGROFORESTRY

To be c arried out in the / near Gaothans in the ESZ and certain other areas / community reserves in identified on the lower slopes and foothills.)

BOTANICAL NAME	COMMON OR VERNACULAR NAME
Annona squamosa	Seetaphal
Annona reticulata	Ramphal
Acacia catechu	Khair
Acacia nilotica	Babhul
Acacia concinna	Shikekai
Achras sapota	Chiku
Aegle marmelos	Bel
Albizzia procera	Kinhai
Alstonia scholaris	Satvin
Amoora rohituka	Rohitak
Anacardium occidentale	Kaju
Anogeissus latifolia	Dhavada
Areca catechu	Supari
Artocarpus heterophyllus	Phanas
Artocarpus incisa	Neerphanas
Artocarpus lakoocha	Otamb
Borassus flabellifer	Tad
Buchanania lanzan	Charoli
Butea monosperma	Palas
Calophyllum inophyllum	Undi
Carissa congesta	Karvanda
Caryota urens	Bherali maad
Cinnammomum zeylanicum	Tamalpatra
Citrus decumana	Papanas
Cocos nucifera	Naral
Cordia mixa	Bhokar
Dalbergia latifolia	Shisam
Dalbergia sissoo	Shisavi
Dillenia indica	Karmal
Diospyros melanoxylon	Tembhurni
Eliocarpus ganitrus	Rudraksha
Emblica officinalis	Avala
Erythrina indica	Pangara
Ferronia elephantum	Kavath
Ficus microcarpa	Nandruk
Garcinia indica	Kokam
Garuga pinnata	Kakad
Gmelina arborea	Shivan
Gossypium arboreum	Dev kapas
Grewia subinaequalis	Phalasa
Helicterus isora	Murudsheng

Holarrhena pubescens	Pandhara kuda
Ixora arborea	Rai kuda
Jatropha curcus	Mogali erand
Meyna spinosa syn. Vangueria spinosa	Alawi, Alu
Morinda pubescens	Bartondi
Melia composita	Limbara
Michelia champaka	Son-chapa
Moringa oleifera syn Moringa pterigosperma	Shewga
Myristica fragrans	Jayphal
Murraya koenigii	Kadhipatta
Nephelium lit-chi	Lichi
Pandanus tectorius	Kewada
Phyllanthus distichous	Ray-avala
Mangifera indica	Amba
Piper nigrum	Black pepper
Psidium guyava	Peru
Rauwolfia serpentina	Sarpagandha
Sapindus laurifolius	Ritha
Saraca asoka	Seet-ashok
Spondias mangifera	Ambada
Strychnos nux-vomica	Kajara
Syzygium cumini	Jambhul
Syzygium jambos	Jam
Tectona grandis	Sag/Sagwan
Tamarindus indica	Chinch
Terminalia arjuna	Arjun
Terminalia chebula	Hirda
Terminalia bellerica	Bhehada
Terminalia crenulata	Ain
Zanthoxylum rhetsa	Tirphal
Zizyphus jujube	Bor
Zizyphus rugosa	Toran

ANNEXURE VII

HEDGE PLANTS FOR LIVE FENCING IN GAOTHANS OR COMMUNITY RESERVES ON THE LOWER SLOPES:

BOTANICAL NAME	COMMON OR VERNACULAR NAME
1) *Acacia cocinnia*	Shikekai
2) *Acacia intsea*	Chillar
3) *Acacia pennata*	Chillar
4) *Adathoda vasica*	Adulsa
5) *Agave cantala*	Ghaypat
6) *Agave sisalna*	Ghaypat
7) *Artrabotrys odoratissimus*	Hirva chapha
8) *Arundo donax*	
9) *Asparagus racemosus*	Shatavari
10) *Bambusa vulgaris & other spp.*	Bambu
11) *Caesalpinia bonducella*	Sagargota
12) *Caesalpinia sepiaria*	Chilar
13) *Capparis horrida*	Waghati
14) *Cassia alata*	Kasavinda
15) *Caressa congesta*	Karvand
16) *Clematis gouriana*	Morvel
17) *Clerodendron flomidis*	Agnimanth
18) *Clerodendron inerme*	Koyanel
19) *Dodonea viscosa*	Jakhmi
20) *Erythrina indica*	Pangara
21) *Erythrina suberosa*	Buch pangara
22) *Euphorbia nerifolia*	Nivadung
23) *Euphorbia tirucalli*	Sher
24) *Ficus benjamina*	
25) *Ficus tsiela*	Pipari
26) *Fluggea leucopyros*	Pandharphali
27) *Gmelina asiatica*	Kali shivan
28) *Holarrhena pubescens*	Kuda
29) *Jatropha curcas*	Mogali Erand
30) *Lawsonia alba*	Mehendi
31) *Mezoneurum cucculatum*	Garingi
32) *Mimosa hamata*	Tarati
33) *Opuntia dillenii*	Phadya Nivdung
34) *Pandanus furcatus*	Kevada
35) *Prosopis spicigera*	Shami
36) *Rauwolfia canescens*	
37) *Rubus lasiocarpus*	
38) *Vallaris heynei*	Vishamogari
39) *Vitex negundo*	Nirgudi
40) *Wagatea spicata*	Wakeri
41) *Zizyphus rotundifolia*	Chanya Manya Bor

ANNEXURE VIII

INDIGENOUS HEDGE PLANTS FOR LIVE FENCING ON THE PLATEAU:

BOTANICAL NAME	COMMON OR VERNACULAR NAME
Acacia cocinnia	Shikekai
Adathoda vasica	Adulsa
Artrabotrys odoratissimus	Hirva chapha
Asparagus racemosus	Shatavari
Caesalpinia bonducella	Sagargota
Capparis horrida	Waghati
Carissa congesta	Karvand
Clematis gouriana	Morvel
Clerodendron flomidis	Agnimanth
Clerodendron infortunatum	
Gmelina asiatica	Kali shivan
Gymnosporia rothiana	Henkel
Mezoneurum cucculatum	Garingi
Rauwolfia canescens	
Rubus lasiocarpus	
Vallaris heynei	Vishamogari
Vitex negundo	Nirgudi
Wagatea spicata	Wakeri
Zizyphus rugosa	Toran

ANNEXURE IX

INDIGENOUS TREES FOR REFORESTATION OR PLANTATION ON THE LOWER SLOPES:

SLOPES
Acacia catechu
Aegle marmelos
Alangium salvifolium
Albizzia amara
Albizzia lebbeck
Anogeissus latifolius
Bambusa arundinacea
Bauhinia racemosa
Bombax ceiba
Butea monosperma
Boswellia serrata
Cassia fistula
Dalbergia paniculata
Dalbergia sissoo
Diospyros melanoxylon
Dolichandrone falcata
Erythrina indica
Erythrina suberosa
Ficus microcarpa
Ficus bengalensis
Ficus religiosa
Flacourtia indica
Holarrhena pubescens
Holoptelea integrifolia
Lagerstroemia reginae
Moringa pterigosperma
Morinda pubescens
Phoenix sylvestris
Schleichera oleosa
COMMON TO LOWER SLOPES AND TERRACES
Haldinia cordifolia
Holarrhena pubescens
Holoptelia integrifolia
Hymenodictyon obovatum
Lannea coromandelica
Macaranga peltata
Madhuca longifolia
Melia composita
Mangifera indica
Mitragyna parviflora
Morinda pubescens
Oroxylum indicum
Ougenia oojeinensis

Pterocarpus marsupium
Radermachera xylocarpa
Randia rugulosa
Sterculia urens
Spondias pinnata
Syzygium cumini
Tectona grandis
Terminalia bellirica
Terminalia crenulata
Xantolis spinosa
Xylia xylocarpa
Zizyphus oenoplia
Zizyphus xylopyrus

ANNEXURE X

INDIGENOUS TREES FOR REFORESTATION ON TERRACES:

BOTANICAL NAMES
1) Adenanthera pavonina
2) Aegle marmelos
3) Ailanthus triphysa
4) Albizzia procera
5) Anogeissus latifolius
6) Artocarpus heterophyllus
7) Artocarpus lacoocha
8) Bambusa arundinacea
9) Bauhinia foveolata
10) Bombax insigne
11) Bridelia retusa
12) Careya arborea
13) Cassia fistula
14) Cordia dichotoma
15) Dalbergia latifolia
16) Dalbergia paniculata
17) Dillenia pentagyna
18) Diospyros montana
19) Emblica officinalis
20) Eleodendron glaucum
21) Erythrina stricta
22) Erythrina suberosa
23) Ficus microcarpa
24) Ficus racemosa
25) Firmiana colorata
26) Gardenia gummifera
27) Gardenia resinifera
28) Garuga pinnata
29) Gmelina arborea
30) Grewia subinaequalis
31) Sesbania grandiflora
32) Spondias pinnata
33) Streblus asper
34) Syzygium cumini
35) Tectona grandis
36) Terminalia crenulata
37) Terminalia bellirica
38) Xantolis spinosa
39) Zizyphus mauritiana
40) Zizyphus xylopyrus
41) Zizyphus oenoplia

ANNEXURE XI

INDIGENOUS TREES FOR REFORESTATION/ PLANTATION ON THE PLATEAU.

BOTANICAL NAME
1) *Actinodaphne anguistifolia*
2) *Alseodaphne semicarpifolia*
3) *Bauhinia foveolata*
4) *Bauhinia malabarica*
5) *Bridelia retusa*
6) *Callicarpa lanata*
7) *Carallia brachiata*
8) *Careya arborea*
9) *Caryota urens*
10) *Celtis tetrandra*
11) *Canthium dicoccum*
12) *Dalbergia latifolia*
13) *Dillenia pentagyna*
14) *Diospyros sylvatica*
15) *Diospyros ebenum*
16) *Ehretia laevis*
17) *Ficus rumphii*
18) *Ficus nervosa*
19) *Ficus microcarpa*
20) *Flacourtia montana*
21) *Ficus racemosa syn Ficus glomerata*
22) *Garcinia indica*
23) *Garcinia talboti*
24) *Glochidion ellipticum*
25) *Gmelina arborea*
26) *Grewia tilifolia*
27) *Haplophragma adenophyllum*
28) *Hemigyrosa canescens*
29) *Heterophragma quadriloculare*
30) *Ixora brachiata*
31) *Knema attenuata*
32) *Kydia calycina*
33) *Lagerstroemia microcarpa*
34) *Lagerstroemia parviflora*
35) *Lagerstroemia reginae*
36) *Litsea stocksii*
37) *Maba nigrescens*
38) *Macaranga peltata*
39) *Madhuca longifolia*
40) *Mallotus philippensis*
41) *Mammea suriga*
42) *Manilkara hexandra*
43) *Memecylon umbellatum*
44) *Memecylon talbotianum*
45) *Meyna spinosa*
46) *Microcos paniculata*
47) *Mimusops elengi*

48) Mangifera indica
49) Mitragyna parviflora
50) Morinda pubescens
51) Nothapodites nimmoniana
52) Olea dioica
53) Persea macrantha
54) Randia rugulosa
55) Saccopetalum tomentosum
56) Sageraea laurifolia
57) Spondias pinnata
58) Sterculia guttata
59) Sterospermum chelenoides
60) Streblus asper
61) Strychnos nux-vomica
62) Syzygium cumini
63) Symplocos spicata var.laurifolia
64) Symplocos beddomei
65) Terminalia arjuna
66) Terminalia chebula
67) Terminalia bellirica
68) Teframeles nudiflora
69) Uvaria narum
70) Vitex altissima
71) Xantolis spinosa
72) Xylia xylocarpa
73) Zanthoxylum rhetsa
74) Ziziphus oenoplia
75) Ziziphus xylopyrus
76) Atalantia racemosa
77) Garcinia spicata
78) Ixora arborea
79) Sapium insigne
80) Trema orientalis
81) Artocarpus integrifolia

ANNEXURE XII

INDIGENOUS PLANTS FOR LANDSCAPING ON THE PLATEAU:

BOTANICAL NAME
1) *Canthium dicoccum*
2) *Dillenia pentagyna*
3) *Flacourtia montana*
4) *Bauhinia malabarica*
5) *Bridelia retusa*
6) *Callicarpa lanata*
7) *Canarium strictum*
8) *Hemigyrosa canescens*
9) *Kydia calycina*
10) *Litsea stocksii*
11) *Macaranga peltata*
12) *Madhuca longifolia*
13) *Mallotus philippensis*
14) *Mammea suriga*
15) *Manilkara hexandra*
16) *Memecylon umbellatum*
17) *Memecylon talbotianum*
18) *Mangifera indica*
19) *Mitragyna parviflora*
20) *Olea dioica*
21) *Schleichera oleosa*
22) *Spondias pinnata*
23) *Syzygium cumini*
24) *Terminalia chebula*
25) *Terminalia bellirica*
26) *Vitex altissima*
27) *Atalantia racemosa*
28) *Ixora arborea*
29) *Trema orientalis*
30) *Mimusops elengi*
Roadside plantation:
31) *Garcinia indica*
32) *Garcinia talboti*
33) *Careya arborea*
34) *Caryota urens*
35) *Actinodaphne anguistifolia*
36) *Garuga pinnata*
37) *Lagerstroemia microcarpa*
38) *Lagerstroemia parviflora*
39) *Lagerstroemia reginae*
40) *Michelia champaka*
41) *Heterophragma quadriloculare*
42) *Diospyros sylvatica*
43) *Diospyros ebenum*
44) *Sterculia guttata*
45) *Streblus asper*
46) *Artocarpus integrifolia*
47) *Garcinia spicata*

ANNEXURE XIII

Appendix I A List of Plant Species- Flora of Matheran n March-April 2005
Legend A-abundant, C-common, F-frequent, D-dried, P-planted, H-herb, S-shrub, C-clim

Sr no.	Botanical name	Common name	Habit	Occurrence
1	Actinodaphne hookeri syn-A. angustifolia	Pisā	T	C
2	Adhatoda vasica	Adulsā	S	R,P
3	Adiantum lunulatum	Hansapadi	H	F,D
4	Alseodaphne semecarpifolia	Phadgus	T	R
5	Ancistrocladus heyneanus	Hardal	C	F,D
6	Apluda mutica	Ghāgarā	H	C.D
7	Aspidopteris cordata	Burvel	C	R
8	Atalantia racemosa	Mākad limbu	T	C
9	Blumea sp	Bhāmburdā	H	C,A
10	Boehemeria scabrella		S	F
11	Bombax ceiba	Kātesāvar	T	F
12	Bridelia retusa	Asānā	T	C
13	Callicarpa lanata	Isar	T	F
14	Calycopteris floribunda	Ukshi	C	C
15	Canthium dicoccum	Tupā	T	F
16	Capparis zeylanica	Wāgati	S	R
17	Capparis pedunculosa	Kolisanā	S	F
18	Caralia brachiata	Phanashi	T	R
19	Caretia arborea	Kumbhā	T	F
20	Caryota urens	Bherali mād	T	R
21	Cassia fistula	Bahāvā,Bāvā	T	F
22	Celtis tetranda	Bhumaj	T	R
23	Chellanthus farinosa		H	R,D
24	Cocculus macrocarpus	Vatali,Pathā	C	C
25	Combretur ovalifolium	Madavel	C	C
26	Colebrookea oppositifolia	Bāmani	S	C
27	Clematis gouriana	Marvel	C	C
28	Clerodendron viscosum	Bhandiārā	S	C
29	Carvia callosa	Kāravi	S	C
30	Cedrela odorata		T	R,P
31	Derris scandens	Karanjvel	C	F
32	Dillenia pentagyna	Karmal	T	F
33	Ecobolium viride syn.I E.linneanum	Rānaboli	S	F
34	Erythrina stricta	Pāngārā	T	C
35	Ficus microcarpa syn.F.retusa	Nāndruk	T	C
36	Ficus nervosa	Loth	T	R
37	Ficus rumphii	Pāyar	T	C
38	Ficus race mosa syn.F glomerata	Umber	T	F
39	Ficus religiosa	Pimpal	T	F
40	Firmiana colorata	Kaushi,Kavas	T	R
41	Flemingea strobilifera	Kānphuti	S	C
42	Flucourtia montana	Atak,Ataki	T	C
43	Garcinia spicata	Phansādā	T	C
44	Glochidion ellipticum syn G. hohenackeri	Bhomā, Bhombā	T	C
45	Gnaphalium lento-album		H	R
46	Gnidia glauca Syn.Lasiosiphon eriocephalus	Ramethā	S	F
47	Gnetum ula	Ombali	C	F
48	Gymnopteris subcrenata		H	R

49	Gymnosporia rothiana	Henkel	S,T	F
50	Haplanthes tentaculatus		H	F
51	Hemigyrosa canescens syn.Lepisanthes tetraphylla	Karap,Ãmbã karap	T	C
52	Heterophragma quadriloculare	Vãras	T	C
53	Hippocratea grahamii	Lokhandi,Yesti	C	F
54	Holarrhena pubescens syn.H. antidysenterica	Pãndarã kudã	S	C
55	Ixora brachiata		S,T	C
56	jasminum malabaricum	Kusar	C	F
57	Knema attenuata syn. Myristica attenuata	Raktamãrã Rãnjãyaphal	T	R
58	Lagerstroemia microcarpa	Nãnã	T	F
59	Lannea coromandelica syn.odina wodier	Mol, Shemati	T	C
60	Leea indica syn.L. sambucina	Dindã	S	C
61	Flucortia indica	Tãmbat		F
62	Garcinia indica	Kokam	T	R
63	Ixora arborea syn.I parviflora	Raikudã,Lokhandi	S,T	C
64	Litsea stocksii	Pisi	T	F
65	loranthus obtusatus	Bãndgul	S	C
66	Macaranga peltata	Chãndadã	T	C
67	Mackenziea integrifolia syn.Strobil anthes perfoliatus	Wãiti	S	C,A
68	Mallotus philippensis	Kundu,Shendri	T	C,A
69	Mallotus stenanthus		S	C
70	Mammia suriga syn.Ochrocarpus longifolius	Surangi	T	R
71	Mappia foetida syn.Nothapodites nimmoniana	Ghãnerã	S,T	R
72	Memecylon umbellatum	Anjani	T	C,A
73	Meyna spinosa syn. Vangueria spinosa	Alu, Alvi	T	C,A
74	Mezeneuron cucculatum	Rãgi, Gargini	C	R
75	Murraya koenigii	Kadilimb, Kadipattã	S	F
76	Neolitsea cassia syn. Litsea zeylanica	Kirkirã	T	R
77	Pavetta indica	Pãpat	S	C
78	Piper hookeri	Rãnmiri	C	C,A
79	Pogostemon parviflorus	Pãngali	S	C
80	Rourea prainiana syn.R. santaloides	tãmbadã telyã	C	F
81	Sageraea laurifolia	Sajeri	S,T	R
82	Sapium insigne	Hurã	T	R
83	Schlechera oleosa	Koshimb, Kusum	T	F
84	Smilax zeylanica	Ghotvel	C	F
85	Sterculia guttata	Kukar	T	R
86	Strychnos minor syn.S. colubrina	Kãjrãvel, Kanal	C	R
87	Syzygium cumini	Jãmbhul	T	C,A
88	Terminalia bellirica	Behedã, Bhetã	T	F
89	Terminalia chebula	Hiradã	T	R
90	Terminalia crenulata	Ãin	T	F
91	Tinospora sinensis		C	R

92	Tragia involucrata	Khājel, Khājvel	C	R
93	Tylophora dalzelli	Pātāl garudi	C	C
94	Trema orientalis	Gol	T	F
95	Ventilago sp?	Kanvel	C	F
96	Vitex negundo	Nigadi, Nirgudi	S	C
97	Wrightia tinctoria	Kālākudā	S	C
98	Woodfordia fruticosa	Dhāyati	S	C,A
99	Xantolis tomentosa syn. Sideroxylon tomentosum	Kāte kumbal	T	C,A
100	Ziziphus rugosa	Toran	C,S	C
101	Ziziphus xylopyrus	Ghatbor	S,T	R
102	Lichens, dried mosses, dried ferns			C

ANNEXURE XIV

Appendixll

List of Fauna observed at Mathheran Plateau 14-16 April 2005

Legend- C-common R- rare

Butterflies

1Common crow	C
2Common mormon	C
3Blue mormon	R
4Common sailor	C
5Common leopard	C
6Zemon pansy	C
7Choclate pansy	C
8Common evening brown	C
9Common grass yellow	C
10Mottled emigrant	C
11Common emigrant	C
12Striped tiger	R
13Plain tiger	C
14Danaid eggfly	C
15dark blue tiger	R
16Common caster	C
17Lime butterfly	C
18Common jezebel	C
19Red pierrot	C
20Blue oakleaf	R
21Dark palm dart	R

Other insects

1Odonata	7sp
2 Orthoptera	2sp
3 Dictyoptera	1sp
4 Mantodea	1sp
5 Phasmodea	1sp
6 Isoptera	1sp
7 Hemiptera	4sp
8 Diptera	8sp
9 Hymenoptera	8sp
10 Coleoptera	1sp
11 Trichoptera	1sp
12 Moths	13sp

Birds

1 Red vented Bulbuls	C
2 Small green barbet	R
3 Shama	R
4 Hobby	R
5 Crested serpent eagle	C
6 Red whiskered bulbul	C
7 White spotted fantail flycatcher	R
8 Whitye throated ground thrush	R
9 Iora	C

Mammals

1Tree striped palm squirrel	C
2 Bonnet macaque	C
3 Giant squirrel	R
4 Jerbil	R
5 Hanuman Langur	R

ACRONYMS

BNHS	Bombay Natural History Society
DP	Development Plan
DRC	Development Rights Certificate
ESZ	Eco Sensitive Zone
FAR	Floor Area Ratio
GIS	Geographical Information System
JFM	Joint forest management
JFMC	Joint forest management committee
LPG	Liquid Petroleum Gas
MLD	Million Liters per Day
MMC	Matheran Municipal Council
MMR	Mumbai Metropolitan Region
MMRDA	Mumbai Metropolitan Regional Development Authority
MoEF	Ministry of Environment and Forest
MPCB	Maharashtra Pollution Control Board
MTDC	Maharashtra Tourism Development Corporation
PWD	Public Works Department
STP	Sewage Treatment Plant
TDR	Transfer of Development Rights
WII	Wildlife Institute of India
WWF	World Wildlife Fund

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