ENHANCING THE IDENTITY OF LONAR CRATER BULDHANA, MAHARASHTRA

MASTER OF LANDSCAPE ARCHITECTURE

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Declaration

I Shruti Hippalgaonkar, Scholar No. 2014MLA002 hereby declare that the thesis entitled **ENHANCING THE IDENTITY OF LONAR CRATER** submitted by me in partial fulfilment for the award of Master of Landscape Architecture, in School of Planning and Architecture Bhopal, India, is a record of bonafide work carried out by me. The matter embodied in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.

[19/5/2016]

Shruti Hippalgaonkar

Certificate

This is to certify that the declaration of Shruti Hippalgaonkar is true to the best of my knowledge and that the student has worked for one semester in preparing this thesis.

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A DESIGN THESIS

Submitted

In partial fulfilment of the requirements for the award

Of the degree of

MASTER OF LANDSCAPE ARCHITECTURE

By

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ABSTRACT

Landscapes matter to people. They shape national, regional and local identities, affect quality of life and provide the arena within which development and conservation takes place. (Appleton, 1975; Scott, 2002)

Lonar is one of Maharashtra's best-kept secrets. For all of its rareness, surprisingly few have heard of Lonar Lake apart from locals, researchers and occasional trekkers. Most tourists come to nearby Aurangabad to visit the Ajanta and Ellora UNESCO World Heritage Sites, but never make it as far as Lonar. It is tragic that the lake which holds together a unique ecosystem, and has aided human civilization in its quest for understanding the mysteries of the universe, is in desperate need of intervention. The opportunity of exploring lonar crater, so that I can attempt to enhance its identity through Landscape Design emerged. To connect tangible & intangible aspects of Lonar town (urban area) to the crater as a whole, and to analyze the prospects and problems of the same at the Dhar stream-as a sample.

This design thesis is an attempt to enrich the quality of its uniqueness through landscape design; and to bring it on the tourism map of Maharashtra and also to conserve its ecology & geology.

1.0 Introduction to Lonar Crater:

About Lonar Crater:

Home to the Earth's only hyper-velocity impact crater in basaltic rock has its genesis nearly 50,000 years ago, when a 2 million-ton meteorite impacted the earth to create a depression 1.83 kilometers in diameter and 150 meters deep. A series of low hills surround the basin which has an oval shape. Over time, the jungle took over, and a perennial stream transformed the base into a tranquil, green locale. The first European to visit the lake was British officer, J.E. Alexander in 1823.

History:

The lake was first mentioned in ancient scriptures such as the Skanda Purana, the Padma Puran and the Aaina-i-Akbari. Buldhana district in Maharashtra, where the lake is located, was once part of Ashoka's empire and then of Satavahana's. The Chalukyas and Rashtrakutas also ruled this area. During the period of the Mughals, Yadavas, Nizam and the British, trade prospered in this area. Several temples found on the periphery of the Lake are known as Yadava temples and also as Hemadpanti temples.

Religious setting:

Legends about a local demon and inexplicable properties of the water have made this lake a religious draw. Lonar Lake is also an archeological goldmine with more than 20 temples dating back to the 11th century dotting its crater. Numerous temples surround the lake, most of which stand in ruins today, except for the temple of Daitya Sudan at the centre of the Lonar town, which was built in honor of Vishnu's victory over the giant Lonasura. It is a fine example of early Hindu architecture. Kamalja Devi Temple is located beside the lake and also features carved images; Gomukh Temple is located along the rim of the crater. A perennial stream emerges from here and pilgrims visiting the temple bathe in the stream. It is also called Sita Nahani temple and Dhara, Shankar Ganesh temple, partially submerged and noted for

rectangular Shiva, Ram Gaya temple are the other temples found inside the crater.

Local & International Anthrall:

The Lonar Lake is an exceptional 'bowl of biodiversity' and a wildlife sanctuary. It is land locked with extraordinary water qualities, and has no inlets, outlets nor does the water seep into the ground. It is fed by underground streams that are now dehydrating due to human folly. The remarkable shape, size and samples of celestial leftovers have lent uniqueness to this crater. These exceptional traits have attracted constant attention of ecologists, geologists and astronomers from the across the globe. It has been the subject of several scientific studies on various aspects of crater ecosystem, yet it is seemingly unknown to the general public.

Current Challenges:

It is evident that urbanization coupled with ever increasing population has led to an indiscriminate invasion of human activities in Lonar and this has created a constant threat to the ecosystem and its remarkable biodiversity. The lake also happens to be a captive water body; hence the concentration of chemicals has been on the rise and has caused irreversible pollution.

1.1 Need of intervention:

Landscapes matter to people. They shape national, regional and local identities, affect quality of life and provide the arena within which development and conservation takes place. (Appleton, 1975; Scott, 2002)

Lonar is one of Maharashtra's best-kept secrets. For all of its rareness, surprisingly few have heard of Lonar Lake apart from locals, researchers and occasional trekkers. Most tourists come to nearby Aurangabad to visit the Ajanta and Ellora UNESCO World Heritage Sites, but never make it as far as Lonar. It is tragic that the lake which holds together a unique ecosystem, and has aided human civilization in its quest for understanding the mysteries of the universe, *is in desperate need of intervention*.

Also my curiosity and urge to learn and understand the tangible & intangible aspects of crater encouraged me even more. The opportunity of exploring lonar crater, so that I can attempt to enhance its identity through Landscape Design emerged.

1.2 Aim:

To enhance the identity of Lonar Crater.

1.3 Objectives:

a) To study the occurrence of lonar crater in historical, archaeological, scientific and cultural context.
b) To understand the cultural practices related to lonar crater.
c) To study the existing landscape of lonar crater.
d) To identify the pertinent landscape issues that play a role in the identity of the place.
e) To device a design, management and protection plan.

1.4 Scope:

Lonar is a place of cultural and tourism importance. Keeping that in mind the scope is to explore the cultural landscape elements and their conservation and also to propose landscape protection, management plan for Lonar crater which will then further enhance the existing landscape, the future developments, etc. which will in a way emboss or carve the identity of the place to promote tourism, research, and other such activities for the betterment.

1.5 Limitations:

To connect tangible & intangible aspects of Lonar town (urban area) to the crater as a whole, and to analyze the prospects and problems of the same at the Dhar stream- as a sample.

1.6 Methodology:

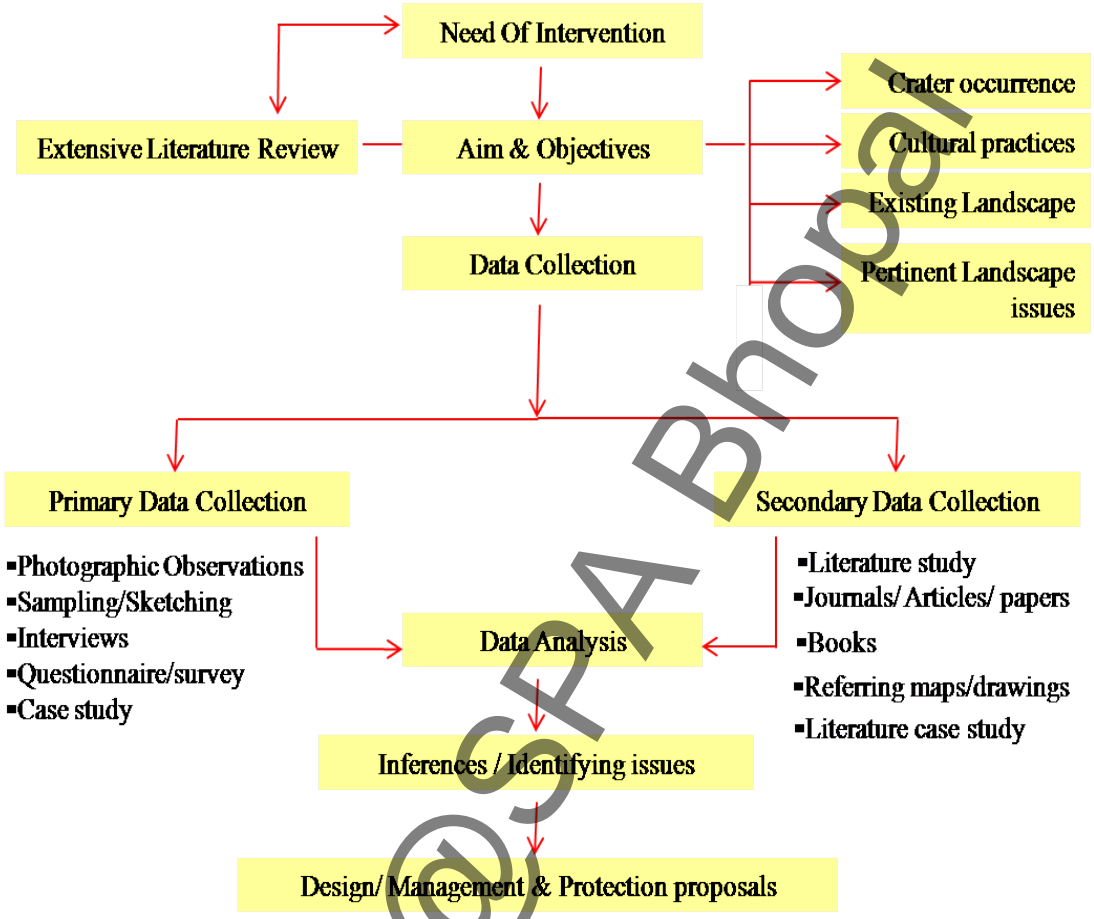


Figure 1. 1 Methodology

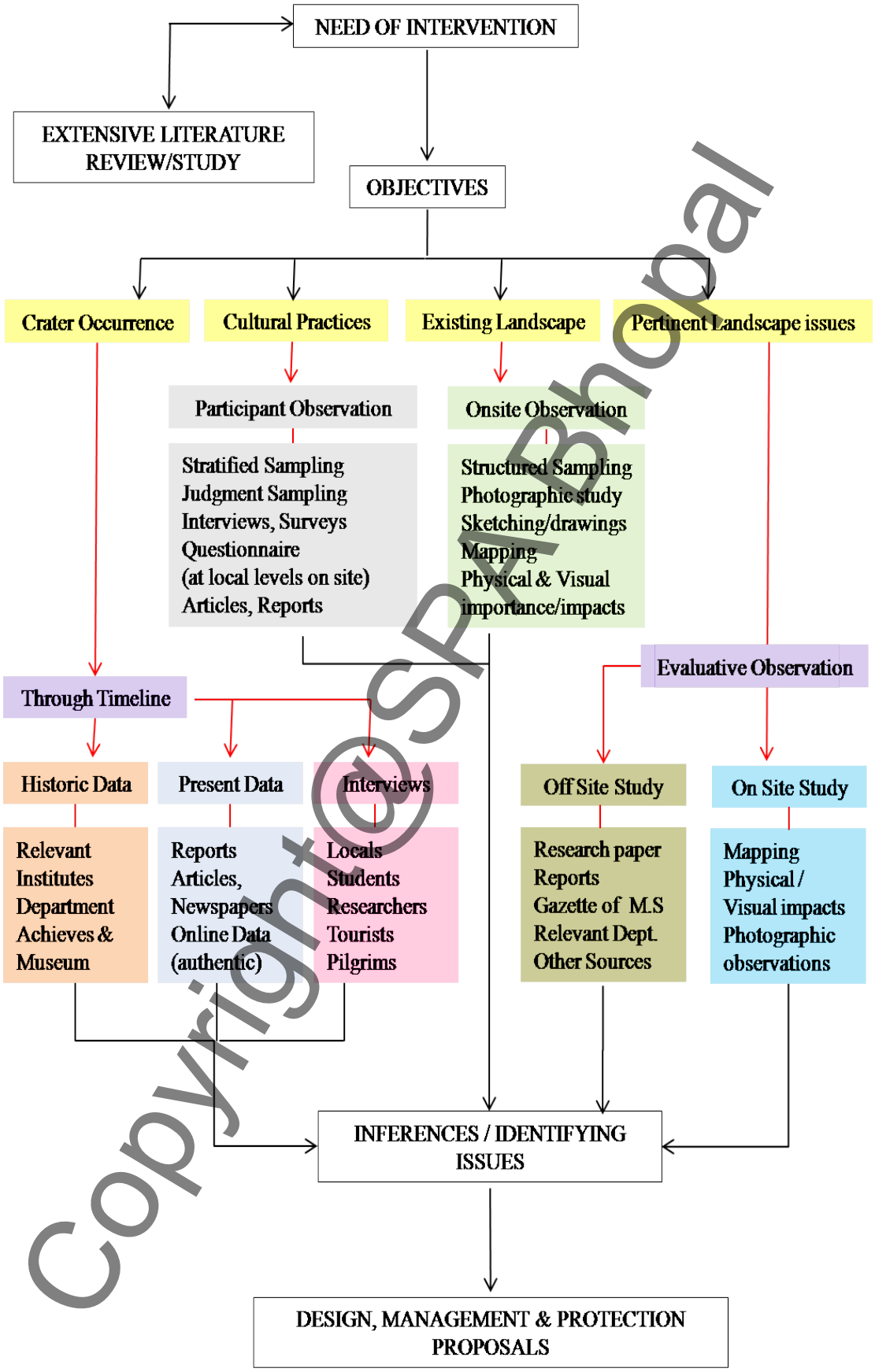


Figure 1. 2 Detailed methodology adopted

2.0 Definitions:

i. Landscape: is an area, as perceived by people, the character of which is the result of the action and interaction of natural and/or human factors. (Council of Europe, 2000)

ii. Identity means the quality of being – identical, or sameness (idem). (Identity is not Imagination – Jerry van Eyck : Topos magazine)

iii. Landscape Identity defined as 'the perceived uniqueness of a place'.

iv. Enhancement Intensify, increase, or further improve the quality, value, or extent of. (Oxford dictionary). Enhancement may take many forms, including improved land management or restoration of historic landscapes, habitats and other valued features; enrichment of impoverished agricultural landscapes; measures to improve and conserve the attractiveness of towns and creation of new landscapes. Through such measures enhancement can make a real contribution to sustainable development and the overall quality of the environment.

2.1 Perception on Landscape Identity:

Landscape identity is a social and personal construction (Haartsen et al., 2000) in which the biophysical features of the area are components. Landscape identity changes under the influence of changing contexts: the balance of power among stakeholders may shift, their aims can change, new players step up to the line, and new functions become important. (Palang et al. 2007; Saugeres, 2002) People and landscape are in constant interaction or as Turner (2006, p. 387) puts it: ''today's landscape is a form of active material culture that has both shaped people and has been shaped by them''. The identity of people is shaped through interaction with many environments, such as social class, religion, ethnicity and gender (Paasi, 2002), but also in interaction with the physical world.

Existential Identity: is that people derive from landscape in that region.Thus, when discussing existential identity, not only the objects in and the features of the physical environment are issues but also the associations, memories and symbolic meanings attached to the physical landscape (the social and cultural environment) (Schama, 1995).

Spatial Identity: people ascribe identity to their environment, or - they characterize the landscape.

Cultural Landscape Identity: the community valuing generally known landmarks, or stories about certain places in the landscape. Cultural landscape identity thus is not an aggregation of personally perceived landscape qualities, but rather a matter of human consensus. Cultural landscape identity may be characterized by signs in the landscape, care for the landscape, or a common memory of events, victories and religious features.

Toponyms are the classic signs of cultural landscape identity, often because they refer to historical events.

Place identity is related to a smaller area in the landscape and refers particularly to striking, unique or historical objects that make a certain place 'eye-catching'.

Landscape Identity = Landscape Quality (Nota Landscape 1992). It describes landscape identity as: ''. . . the ecological and historical features of an area that distinguish the area from other areas.

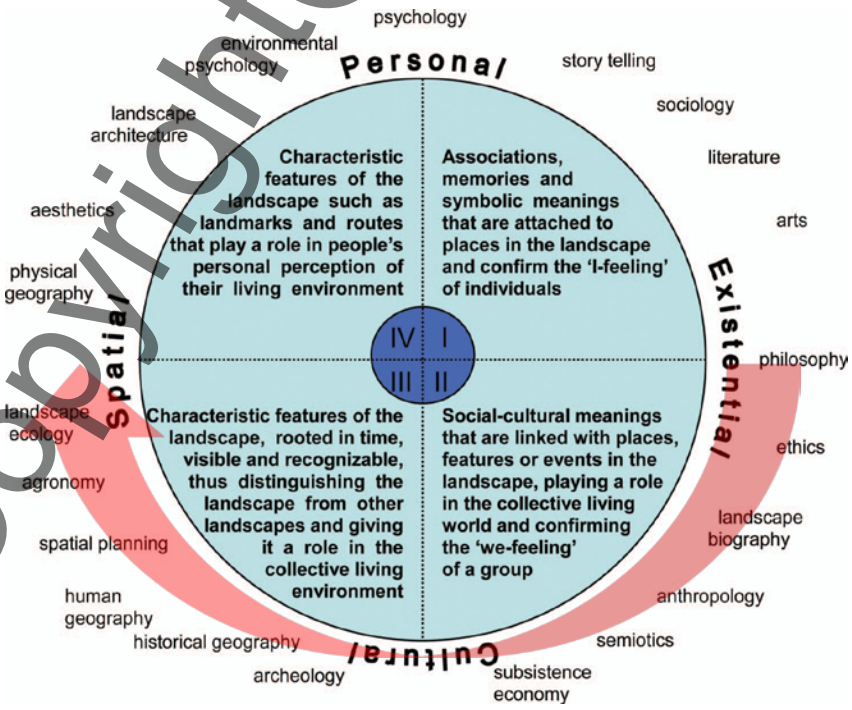


Figure 2. 1 Landscape Identity circle

2.1.1 The Personal-Existential Landscape Identity:

Concept: Places can be special to certain people because their biography is linked to these places (e.g. Korpela & Hartig, 1996; Pretty et al., 2003; Wiborg, 2004). Every human being has his/her own life-world, composed of sites with a personal meaning; this is what is called personal-existential identity of a landscape. The personal significance of a landscape lies in the association and memories attached to sites within it.

- Distinctiveness: A place enable a person to distinguish himself/herself from others: I am from Vienna or from the islands of Friesland. In this way a place acts as a social category and thus place identification can be seen as synonymous with social identification-social aspect.
- Continuity: The physical environment makes it possible to trace personal history. Two types of continuity can be distinguished: place-referent and place-congruent. Place-referent refers to specific places that have emotional significance for a person and that forms a part of personal history. Place-congruent refers to the characteristics of the places that are generic and transferable from one place to another.
- Self-esteem: This refers to a positive evaluation of an individual or a group with which one identifies.
- Self-efficacy: This aspect is related to the function or use of an area.

2.1.2 The Cultural–Existential Landscape Identity:

Concept: A place can help individuals to sense the 'we' that mutually connects them by means of envisaged images of a collective future (Stewart et al., 2004; Yorgason, 2002). This is called the cultural–existential identity of a landscape (quadrant II in Figure 1). Places used by the local population for celebratory, commemorative or, recreational activities and events, as well as landmarks and places of significance with which the region can be associated may be part of the cultural–existential

landscape identity. Cultural–existential landscape identity is the area of anthropology, landscape biography and semiotics, but ethics and philosophy are also involved, and economy too in as far as subsistence is concerned.

2.1.3 The Cultural–Spatial Landscape Identity:

Concept: Cultural–spatial landscape identity (quadrant III in Figure 1) can be characterized by those features that distinguish one region from another (Antrop, 2000; Ministry of Agriculture, 1992). The focus is on features that can principally be perceived in the landscape by everyone, such as spatial composition, land use, wildlife, vegetation and minerals, the colours, forms and patterns, and the use of building materials, etc. Implementation of the concept has led to classifications of areas on the basis of a limited range of features such as geomorphology, archaeology, genesis, historical architecture and scale features. Cultural–spatial identity is the area of spatial planning, human geography and agronomy, with such disciplines as landscape ecology and historical geography/ archaeology providing additional substantiation.

2.1.4 The Personal-Spatial Landscape Identity:

Concept: It refers to the features and parts of the landscape that are important for an individual concerning the recognisability of an area and his/her means of orientation within it. These features can be perceived by everyone, but which are not of equal importance to everybody. Kevin Lynch (1960) found that paths, boundaries, districts, nodes and landmarks are five elements that contribute to people's orientation. Kaplan and Kaplan (1989), who researched landscape preferences including those of 'legibility' and 'coherence'. According to their use of the terms a legible landscape is one that can be explored extensively without getting lost; a coherent landscape consists of patterns resulting from several similar and repeating parts thus facilitating human comprehension. The experience shows that people

often orientate themselves within a landscape by keeping large elements in sight (mountains water or in town – towers/squares) and using smaller elements for way-finding. (Coeterier, 1996)

2.2 Landscape Character Assessment:

Landscape reflects the relationship between people and place, and the part it plays in forming the setting to our everyday lives. It is a product of the interaction of the natural and cultural components of our environment, and how they are understood and experienced by people. This Approach to Landscape Character Assessment follows a well-established process developed over many years. By setting down a robust, auditable and transparent baseline Landscape Character Assessment not only helps us to understand our landscapes, it also assists in informing judgments and decisions concerning the management of change.

Our landscapes are extremely important to us; they are part of our cultural heritage. With sympathetic planning, design and management they offer an opportunity to provide a more harmonious link between man and the natural world, for the benefit of both. *Sensitive, informed, and integrated approaches should help us all to conserve, enhance, restore and regenerate landscapes that are attractive, diverse and publically valued, showing that environmental, social and economic benefits can go hand in hand*.

In particular, Landscape Character Assessment can help in processes which:

• identify what environmental and cultural features are present in a locality;

• monitor change in the environment;

• understand a location's sensitivity to development and change;

• inform the conditions for any development and change.

2.2.1 Landscape Character Assessment Overview/Guidelines:

- Site Information & Character Summary

- Key Characteristics and distinctive features of the site/region

- Descriptive overview

i. Topography
ii. Geology and soil
iii. Watercourses
iv. Landscape elements
v. Land cover
vi. Distinctive features of the landscape
vii. 'Condition' of the landscape
viii. Biodiversity
ix. Historic and cultural significance
x. Settlement pattern
xi. Built heritage

- Forces for change in Landscape

i. Change in Landscape & Cultural responses
ii. Change in Land use
iii. Current Land use trends
iv. Managing the change

- Evaluation

i. Visual and Sensory perception
ii. Recreational opportunities
iii. Making Sense of the place
iv. Threats & opportunities

- Guidelines, and proposals

2.2.2 Yardley Ridge as a sample of Landscape Character Assessment:

Location

A southern extension of the Yardley Whittle wood Ridge that largely lies in neighboring Northampton shire, this area runs along the northern boundary of Milton Keynes Council's administrative area.

Character Summary

This is a marked plateau landscape with Salcey Forest and Yardley Chase, both forming major wooded features on the skyline. The area can be divided into two sub areas:

a) *Yardley Chase Fringe* – a narrow strip of land on the northern edge of the authority forming an apron of land and foreground to the heavily wooded Yardley Chase and Salcey Forest to the north which together provide the impression of continuous woodland cover on the skyline.

b) *Hanslope Plateau* – a wider and more open plateau landscape containing a number of large but generally disconnected woods. The area contains arable, pasture and the village of Hanslope.

Key Characteristics

i. *Yardley Chase Fringe*

• Gently undulating plateau landscape

• Large to medium scale mixed woodlands linking with the extensive woods of Yardley Chase and Salcey Forest

• Large arable fields and clipped hedges

• Extensive views to the south

• Minimal isolated settlement

ii. *Hanslope Plateau*

• Gently undulating plateau landscape

• Isolated large mixed woodlands

• Large arable fields and clipped hedges

• Areas of pasture and smaller fields closer to the settlements

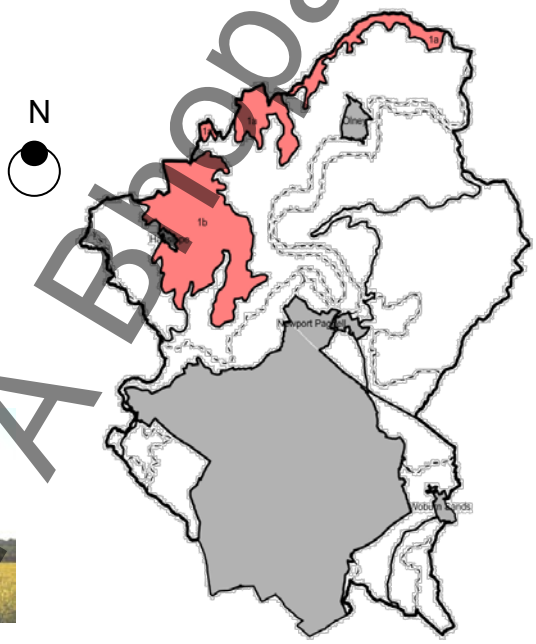
• Extensive views towards Milton Keynes and the river valleys of the Ouse and Tove.

iii. *Distinctive features*

• Hanslope Park

• Hanslope church spire

• M1 corridor



Yardley Ridge Map

Topography

The character area comprises the edge of a much larger prominent ridgeline and plateau that continues over the County boundary in Northampton shire running in a south-west, north-east direction. The ridgeline forms the watershed between the Rivers Ouse to the South and Nene to the north. The Hanslope Plateau sub area is a more obvious plateau landform within the Milton Keynes Council administrative area and forms the watershed between the Ouse and the Tove.

Open Landscape Character of Hanslope area

Geology and Soils

The underlying geology of this character area, which has helped to create the distinctive ridgeline and plateau present today, is Jurassic Oolitic limestone. This limestone is more porous than some of the surrounding geology and aquifers can be found under parts of the ridgeline. Glacial activity subsequently eroded and smoothed out the original limestone ridgeline and left behind substantial, irregular deposits of boulder clay on top of the base rock. These deposits are most substantial over the Hanslope Plateau sub area. The soils that overlay this geology can be variable but most have a high clay content.

Degree of Slope

Along Yardley Chase Fringe the ridge falls north to south towards the Ouse Valley at an average of 1 in 30 with localized steeper slopes of around 1 in 14. The Hanslope Plateau has gentler slopes of 1 in 50, falling from its centre towards its eastern, western and southern edges. There are more localized slopes of around 1 in 15 or steeper, particularly around streams and springs.

Altitude Range

The Yardley Chase Fringe sub area maintains a height of between 90-115 m. The Hanslope Plateau sub area maintains a similar altitude range but has a higher point of approximately 122m near Long Street.

Land cover and land use

The majority of the land use is arable with both large to medium arable fields. There are smaller areas of pasture often near settlements or on remnant ridge and furrow. There is a relatively high proportion of woodlands in the area. Within the Yardley Chase Fringe these link with the extensive woodlands to the north however on the Hanslope Plateau, there is limited connectedness between them.

Hydrology

The character area forms part of a major watershed between the River Ouse and the River Nene in Northampton shire, to the north of Milton Keynes.
Many streams and springs have their source at or close to the edge of the character area and flow down to the River Ouse to the south and east and to the Tove to the west. Throughout the character area there are many ponds and a number of small reservoirs associated with different farms.

Biodiversity

The woods are mainly ancient/semi-natural in origin e.g. Great Wood, Lindford Wood, Gayhurst Wood and Stokepark Wood however they contain a number of areas of replanted conifers. The local Wildlife Trust manages Linford Wood as a nature reserve and Yardley Chase, although predominantly in Northampton shire, is designated as a SSSI for its wide variety of semi-natural habitats. Within the Yardley Chase Fringe the poorer calcareous soils support a number of species rich hedges including a high proportion of Viburnum lantana. There has been an increase in number of birds of prey including Red Kite, Raven and Buzzard which is also related to the adjacent wooded areas to the north.

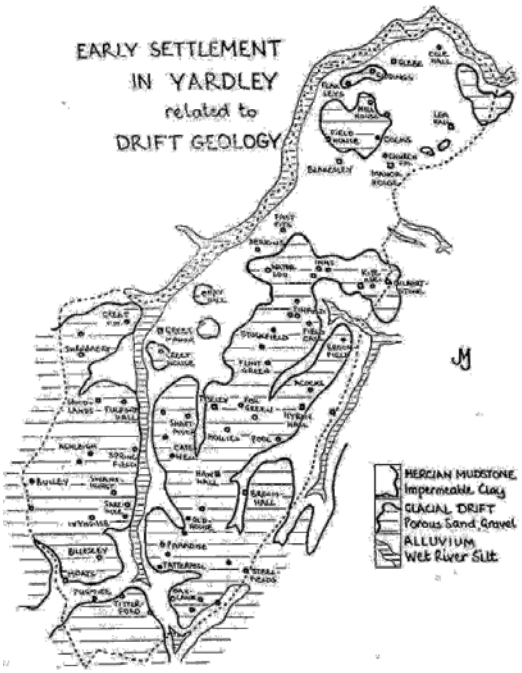
Field Pattern

The conversion of the woodland to arable through asserting was taking place by the between the 15th -17th centuries including a number of areas between the remnant woodlands on the Hanslope Plateau .Other locally stoking patterns include areas of early pre 18th century irregular enclosure e.g. around Ravensden, 18th and 19th century parliamentary enclosures with straighter boundaries and private 19th century enclosures around Hanslope where the pattern is still relatively intact although 20th century amalgamations have created some prairie fields to the Yardley Chase Fringe. There are a number of large mature field oaks close to Yardley Chase and hedgerow oaks

around Hanslope village. Hedges are variable being stronger to the minor roads but typically poorer within field boundaries.

Settlement and Built form

Settlement within Yardley Chase Fringe is very sparse and consists of a few isolated traditional farms. This pattern is similar over much of the Hanslope Plateau with the exception of Hanslope village and the associated Long Street. This large village has a mixed character with an attractive village core including a number of vernacular buildings, but also a number of 20th century residential estates which detract from the local character. St James Parish church (Grade 1 listed) has a prominent tower and the tallest spire in Buckinghamshire, which creates a majestic landmark throughout the character area and further beyond. The small hamlet of Tathall End includes a number of limestone cottages with bridges that cross a contained stream that flows south to the River Ouse.



Early Settlement in Yardley

Pictures showing the landscape character of the Yardley ridge area.

Historical and Cultural significance

Yardley Chase in neighboring Northamptonshire was once part of a much more extensive medieval royal hunting forest and at this time the woodland cover would have been more extensive over the whole plateau. The Doomsday Book and archaeological excavations have shown that pig grazing for panage i.e. eating acorns, in Hanslope parish was common in the area in the medieval period also indicating more extensive woodland cover at the time. A Royal Hunting Lodge was located at Grafton Regis in neighboring Northamptonshire. Hanslope Park, the only notable parkland in the area, was visited by Humphry Repton in 1791. Plans and sketches for the park were produced in one of his 'Red Books' in 1792 for the owner Edward Watts Esq although it is debatable how many of theses ideas were implemented. The Park is now occupied by the Foreign & Commonwealth Office (Technical Security Department of the Secret Intelligence Service). There are a number of ancillary office buildings, radio masts and security fencing, which disrupt the historic parkland, which is generally in a poor condition, although a few specimen trees, shelterbelts and copses remain.

Visual and Sensory perception

The areas fringing the Yardley Chase have a remote character emphasized by the restricted public access and the sombre horizon of woodland. Much of the area is tranquil accessed only by a number of minor roads and lanes. The M1 however occupies a central swath on the Hanslope Plateau, bringing local visual, noise and lighting intrusion. There are some distant panoramic views to the south towards the built edge of Milton Keynes and Wolverton while to the east across the Ouse and the west across the Tove there are more open

views over the rural valley landscapes. Recent and continuing built development at Hanslope Park is locally intrusive in the otherwise open landscape and the lighting of this development causes some additional visual intrusion at night.

Evaluation

1a Yardley Chase Fringe

STRENGTH OF CHARACTER	WEAK	MODERATE	STRONG
Impact of landform*	Insignificant	Apparent	**Prominent**
Impact of landcover*	Insignificant	Apparent	**Prominent**
Historic pattern*	Insignificant	Apparent	**Prominent**
Visibility from outside	**Widely visible**	Locally visible	Concealed
Sense of enclosure	Open/exposed	**Partial**	Contained/confined
Tranquillity	Discordant	Moderate	**Tranquil**
Distinctiveness/rarity	Frequent	Unusual	**Rare**
Totals * *Prime condition categories if tie*	1	1	5
CONDITION	**POOR**	**MODERATE**	**GOOD**
Landcover Change	Widespread	**Localised**	Insignificant
Age Structure of Tree Cover*	Overmature	Mature	**Mixed**
Extent of semi-natural habitat survival*	Relic	Scattered	**Widespread**
Management of semi-natural habitats	Poor	**Not obvious**	Good
Survival of cultural pattern (fields and hedges)	Declining/Relic	**Interrupted**	Intact
Impact of built development*	High	Moderate	**Low**
Visual unity	Incoherent	Coherent	**Unified**
* *Prime condition categories if tie*			
Totals * *Prime robustness categories if tie*		3	4

MATRIX			
Good	Strengthen and reinforce	Conserve and strengthen	Safeguard and manage
Moderate	Improve and reinforce	Improve and conserve	Conserve and restore
Poor	Reconstruct	Improve and restore	Restore condition to maintain character
	Weak	Moderate	Strong

Condition

Strength of Character

Landscape Strategy = Safeguard and Manage

Sensitivity
Ecological – High
Cultural – Moderate
Visual – Low
Tranquillity – Moderate

Table 2. 1 Evaluation sheet for Yardley fringe

1b Hanslope Plateau

STRENGTH OF CHARACTER	WEAK	MODERATE	STRONG
Impact of landform*	Insignificant	Apparent	**Prominent**
Impact of landcover*	Insignificant	**Apparent**	Prominent
Historic pattern*	Insignificant	**Apparent**	Prominent
Visibility from outside	Widely visible	**Locally visible**	Concealed
Sense of enclosure	**Open**/exposed	Partial	Contained/confined
Tranquillity	Discordant	**Moderate**	Tranquil
Distinctiveness/rarity	**Frequent**	Unusual	Rare
Totals ** Prime condition categories if tie*	2	4	1
CONDITION	**POOR**	**MODERATE**	**GOOD**
Landcover Change	**Widespread**	Localised	Insignificant
Age Structure of Tree Cover*	Overmature	Mature	**Mixed**
Extent of semi-natural habitat survival*	Relic	**Scattered**	Widespread
Management of semi-natural habitats	Poor	**Not obvious**	Good
Survival of cultural pattern (fields and hedges)	**Declining/Relic**	Interrupted	Intact
Impact of built development*	High	**Moderate**	Low
Visual unity	Incoherent	**Coherent**	Unified
** Prime condition categories if tie*			
Totals ** Prime robustness categories if tie*	2	4	1

MATRIX				
Condition	Good	Strengthen and reinforce	Conserve and strengthen	Safeguard and manage
	Moderate	Improve and reinforce	Improve and conserve	Conserve and restore
	Poor	Reconstruct	Improve and restore	Restore condition to maintain character
		Weak	Moderate	Strong
		Strength of Character		

Landscape Strategy = Improve and Conserve

Sensitivity

Ecological – Mainly High with some Very Low
Cultural – Mainly Moderate with some Low
Visual – Mainly Low with some Moderate
Tranquillity – Mainly Moderate with some Very Low

Table 2. 2 Evaluation sheet for Hanslope plateau

Guidelines:

• Encourage progressive conversion of conifer plantations within existing woodlands to indigenous native broadleaved tree and shrub species and local provenance stock.

• Protect and seek to extend the network of medium to large scale woodlands in the arable landscape providing enhanced linkage of ancient woodland habitats utilizing ancient hedge and field boundaries to locate the most appropriate location for wood restoration and expansion. New woods should also frame important views and emphasize landform patterns.

• Manage existing broadleaved woodland to maximize diversity and continuity through a range of measures including high forest, coppice, coppice with standards and wood pasture.

• Encourage the protection and restoration of boundary hedges by coppicing, laying and gapping up to improve the network of linkages between habitats.

• Promote the introduction of new hedges following either roads, rights of way, historic boundaries and/or routes that visually emphasize the character of the landscape.

• Encourage the planting of individual hedgerow trees to provide replacement for mature and over mature stock.

• Promote the creation of new ponds and the retention / enhancement for wildlife of existing ponds.

• Encourage the provision of uncropped or grass field margins to link areas of wildlife importance and /or existing and proposed rights of way.

• Identify locations on more marginal arable land where reversion from arable to species rich grassland can be encouraged particularly where adjacent to similar existing habitats.

• Promote the continued use of the area for quiet informal recreation.

• Support initiatives by agencies in Northamptonshire e.g. River Nene Regional Park for the enhanced management and access to Yardley Chase and Salcey Forest.

• Extend interpretation of the historic heritage of the area including Roman remains and medieval hunting forests.

• Identify and retain key viewpoints from slopes into adjacent landscapes and protect from the impact of adverse development on these views.

Yardley Chase Fringe:

• Identify improved public access arrangements by foot and horse into Yardley Chase to enable enhanced links and circular routes through the area. Ensure the routes provide a range of experiences including vistas, viewpoints and enclosure.

Hanslope Plateau:

• Develop a strategy to visually integrate Hanslope Park into the plateau landscape. To include proposals for the conservation and restoration of the historic parkland in conjunction with and related to additional screening of the modern buildings and boundary features.

• Develop a strategy to visually integrate the M1 into the landscape through additional woodland planting offsite and the management of the onsite highway planting.

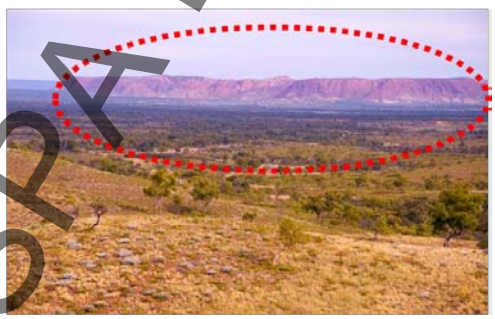
• Retain the identity of the villages and their vernacular character. Promote sympathetic improvement to village entrances and fringes screening local eyesores and framing local landmarks e.g. churches.

3.0 **Case Study Selection Criteria:**

- Craters very similar to that of Lonar crater – its physical & visual appearance.
- Crater having temples/ similar structures, a water body and the settlement around the crater – the setting.
- Despite having different geographic conditions, how the intangible context could be related.
- Comparative study for socio-cultural practices, environment, geology, history, etc and their interrelation which give them that identity.
- Focus on the pertinent landscape feature, issues, similarities & differences.
- Provide an understanding of how a place is experienced, perceived and valued by people.
- Identify the key characteristics that together create sense of place and the unique character of an area.

3.1 **Introduction to Case studies**

i. Tnorala Conservation Reserve (Gosse Bluff) is of considerable scientific and Aboriginal cultural importance and thought to be one of the best documented and most significant comet impact craters in the world. The scientific values of the Reserve are related to the formation of the crater, the unique geology of the area and, to a lesser extent, to the vegetation of the area. The tourist and recreational values of Tnorala are related to its impressive size and significance as a comet impact crater and the Aboriginal belief associated with its formation. The remote location of Tnorala and its attractive setting also adds to its appeal as a tourist destination. The area contains high education and interpretation values.



ii. Ramgarh Ring Structure, Rajasthan is a meteor crater located near Ramgarh village, Mangrol, Baran district, Rajasthan, India. Several glass resembling rock samples have been collected and being investigated upon. It has an outer diameter of approx. 4 km and a rim height of approx. 250 m above the surroundings, is formed on the extensively flat sedimentary terrain. It was first visited in 1869 by Mallet of Geological Survey of India. The crater is visible from a distance of 40 to 50 kms, as it is located on a circular hill, and forms a part of drainage of small river named Parvathi river.

3.2 **Tnorala Conservation Reserve, Australia (Gosee Buff)**

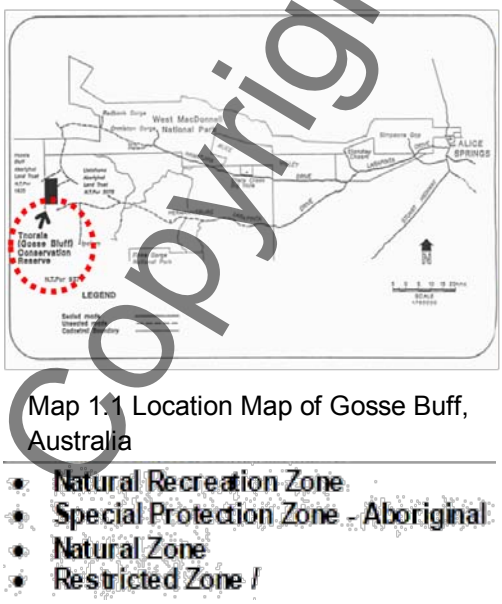
Location

i. The 4,759 hectare Reserve is located 160 kilometers west of Alice Springs and 50 kilometers west of Hermannsburg. It is bordered by Haasts Bluff Aboriginal Land Trust to the west and the Ltalaltuma Aboriginal Land to the north, east and south.

ii. On 8 September 1872 Ernest Giles in search of a suitable route to Western Australia came across Tnorala. He named the area Gosse's Range after Henry Gosse (the brother of the famous explorer William Christie Gosse). The name was later changed to Gosse's Bluff Range then shortened to Gosse Bluff. The Western Aranda traditional custodians prefer the name Tnorala.

iii. On 23 October 1969 Tnorala w as proclaimed a Reserve under the *Crown Lands Act on account of* its scientific importance. The area remained a Reserve until October 1990 w hen title was transferred to the traditional custodians of the area.

iv. The area contains high education and interpretation values. The comet impact crater, its Aboriginal cultural values and the wildlife found in the area are aspects with considerable potential for education and interpretation.



Map 1.1 Location Map of Gosse Buff, Australia

Topography/ Landform/ Soil

i. The rings of hills which comprise Tnorala are all that remain of the original crater. The hills stand about 180 meters above the level of the surrounding plain and 250 meters above the internal Plain. It is estimated that the bolides which caused the impact structure was probably a comet of low density (1,3 tons/cu. meter and high velocity (40 kilometers/second) with a diameter of about 600 meters.

ii. The energy release on impact has been estimated in the order of 33,000 megatons of TNT (about one million times more powerful than the Hiroshima bomb).

iii. The massive compressive forces of the comet upturned sedimentary formations near the focus of impact. Erosion over the past 130 million years has left only the more resistant sandstone formations forming upstanding relics of the crater core. Satellite images of the area indicate that the original crater was some 20 kilometers in diameter.

iv. Soil: The landforms within the Reserve are comprised of Lithosols, Red earths, Alluvial and Red calcareous soils. Coarse textured red lithosols with a moderate erosion hazard are found in the outer ring of hills that make up the crater.

Hydrology

There are natural dendritic drainage channels within the crater which drain surface water, from the crater after rain to seasonal creeks which lie to the north and east of the Reserve. No study has been undertaken on the groundwater resources of the area; however, they are thought to be limited. Waterholes within the Reserve are important cultural sites to the traditional custodians and act as a refuge for native wildlife. These resources may require special protection.

Vegetation

i. There are known to be at least four rare species of plants found within the Reserve; these include *Comesperma viscidulum (national significance), Red-berried Stick-plant (Spartothamnella puberula)*(regional significance) and Desert Grass Tree (*Xanthorrhoea thorntonii) (regional significance).*

ii. Other plants of significance in the Reserve include a significant stand of Hill Mulga (*Acacia macdonnelliensis) on the northern rim of the crater which requires special fire protection and the* Woolly Mat-rush (*Lomandra lencocephala) which is uncommon to the Northern Territory.*

Fauna

i. The Reserve is know n to contain a diverse assemblage of birds, including the Painted Firetail, the Rainbow Bee-eater, the Spotted Bowerbird and the Yellow -throated Miner.

ii. Mammals found within the Reserve include the Euro, Gould's Wattled Bat and the Little Cave Eptesicus (a small bat). There are a number of reptile species of significance including the Central Netted Dragon, the longnosed Dragon and Gould's Goanna.

Historic / Cultural/ Religious values

i. Special Protection zone: The purpose of this zone is to protect key Aboriginal cultural values of the Reserve including culturally significant sites. Public accesses to these areas are not be encouraged and facilities are not be provided.

ii. Restricted zone: The purpose of this zone is to protect sensitive Aboriginal cultural values, sacred sites and prevent access to culturally restricted areas of the Reserve. The areas are Mt Pyroclast in the south west corner of the Reserve and a similar rocky knoll on the North West boundary. These areas will be totally out of bounds to visitors and Park Rangers w ill only have very limited service access. Park Rangers

will be required to gain permission (except in an emergency) for access to these areas.

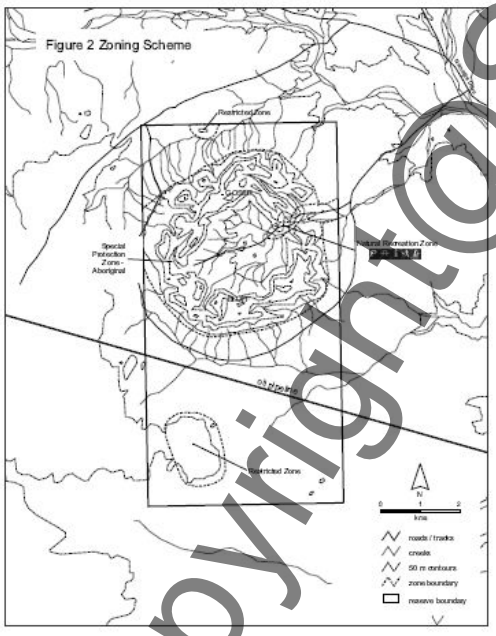
iii. Beliefs: The site is known as Tnorala to the Western Arrernte Aboriginal people, and is a sacred place. A Western Arrernte story attributes its origins to a cosmic impact: in the Dreamtime a group of celestial women were dancing as stars in the Milky Way. One of the women grew tired and placed her baby in a wooden basket. As the women continued dancing, the basket fell and plunged into the earth. The baby fell to the earth and forced the rocks upward, forming the circular mountain range. The baby's parents, the evening and morning star, continue to search for their baby to this day. The turna can be seen in the sky as the constellation Corona Australis.

Picture 3. 1 The interpretation of aboriginal culture tribes of Tnorala reserve

Evaluation

- Natural Recreation Zone
- Special Protection Zone - Aboriginal
- Natural Zone
- Restricted Zone /

The zoning scheme outlined has been prepared to help regulate visitor activities and developments within defined areas. This is to ensure that visitor use of an area is compatible with the traditional custodians' wishes of how the area should be managed and the overall need to conserve the Reserve's cultural and natural resources. Public access within any of the zones may be restricted if it is shown to be having a deleterious effect on the natural values of an area. Access may also be restricted if sites of Aboriginal significance are being adversely affected. All developments on the Reserve will be low-key and will cause a minimum of interference to the Reserve's cultural values and natural values.



Map 3. 1 Zoning scheme of Gosse buff reserve

Picture 3. 2 Aboriginal cultures

Evaluation

Management Zone	Purpose	Management Strategy	Access	Facilities	Appropriate Uses
Natural Recreation Zone	To provide an area where visitor facilities and any living area can be sited with minimal impact on the environment	To concentrate use in an area which can be managed to keep impacts within acceptable limits	Controled vehicle access along unsealed track to day-use area. Elsewhere by foot.	Unsealed 2WD track, traffic counter, park furniture, shade, interpretations shelter, pit toilet, interpretations and information signs	Aboriginal cultural appreciation, day-use picnicking, photography, short walks.
Special Protection Zone - Aboriginal	To protect the key Aboriginal values including culturaly significant sites.	To control and restrict visitor access in order to minimise impacts to Aboriginal cultural resources.	Visitor access by foot, (preferably with Aboriginal guides).	Unsealed service tracks.	Nature & cultural appreciation, walking (preferably with Aboriginal guides).
Natural Zone	To protect key natural values including stands of Grass Trees and Hill Mulga. To minimise human impact on the environment and maintain the majority of the Reserve in as natural a state as practicable.	To restrict visitor access and rationalise service access. Fire management will assist in maintaining a natural character.	Visitor access will not be promoted. Only necessary vehicular access for management purposes. Tracks to be rationalised and rehabilitated.	Unsealed service tracks.	Limited nature appreciation, walking, photography.
Restricted Zone	To protect very sensitive Aboriginal cultural values and sacred sites.	Prohibit visitor access. Allow limited service access to Park Rangers with approval of the Local Management Committee.	Visitors strictly prohibited. Necessary management access only with prior approval of the Local Management Committee.	None.	Traditional Aboriginal use only.

STRENGTH OF CHARACTER	WEAK	MODERATE	STRONG
Impact of landform*	Insignificant	Apparent	**Prominent**
Impact of landcover*	Insignificant	Apparent	**Prominent**
Historic pattern*	Insignificant	Apparent	**Prominent**
Visibility from outside	**Widely visible**	Locally visible	Concealed
Sense of enclosure	Open/exposed	**Partial**	Contained/confined
Tranquillity	Discordant	Moderate	**Tranquil**
Distinctiveness/rarity	Frequent	Unusual	**Rare**
Totals ** Prime condition categories if tie*	1	1	5
CONDITION	**POOR**	**MODERATE**	**GOOD**
Landcover Change	Widespread	**Localised**	Insignificant
Age Structure of Tree Cover*	Overmature	Mature	**Mixed**
Extent of semi-natural habitat survival	Relic	Scattered	**Widespread**
Management of semi-natural habitats	Poor	**Not obvious**	Good
Survival of cultural pattern (fields and hedges)	Declining/Relic	**Interrupted**	Intact
Impact of built development*	High	Moderate	**Low**
Visual unity	Incoherent	Coherent	**Unified**
** Prime condition categories if tie*			
Totals ** Prime robustness categories if tie*		3	4

MATRIX

Condition	Weak	Moderate	Strong
Good	Strengthen and reinforce	Conserve and strengthen	Safeguard and manage
Moderate	Improve and reinforce	Improve and conserve	Conserve and restore
Poor	Reconstruct	Improve and restore	Restore condition to maintain character

Strength of Character

Landscape Strategy = Safeguard and Manage

Sensitivity
Ecological – High
Cultural – Moderate
Visual – Low
Tranquillity – Moderate

Table 3. 1 Evaluation sheet of Gosse Buff reserve

3.3 **Ramgarh Ring Structure, Rajasthan, India**

Location

i. An isolated hill of annular shape, forming an almost complete circle approximately 3 km in radius at the location defined by the latitude 25°20'N, longitude 76°37'30"E. This feature lies in eastern Rajasthan almost on the boundary with Madhya Pradesh.

ii. It lies in Baran district of Rajasthan. Approx. 115 kilometers north-east of Kota via NH 76.

iii. The circular structure covers an area of 16 sq. km. The outer and inner diameter is 4 km and 2 km respectively; average radius is about 3 km, and depth to diameter ratio is 0.05 (Ahmad et al., 1974). The height of the rim is 200 m and the highest point is 240 m from the surrounding area.

iv. The circular structure was described in the Astronaut's Guide as an impact crater with a ring of hills and a small central peak from the Landsat Image (Grieve et al., 1988).

v. A multi-disciplinary approach is proposed to conclusively resolve the origin and age of the Ramgarh Astrobleme and possibly raise it to make an important contribution to the Earth's cratering history.

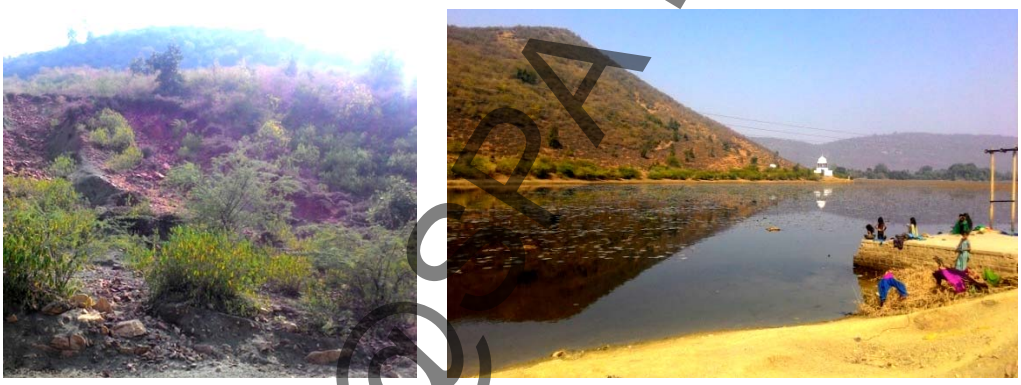
- Portable Water
- Built Heritage
- Religious draw
- Natural Landscape

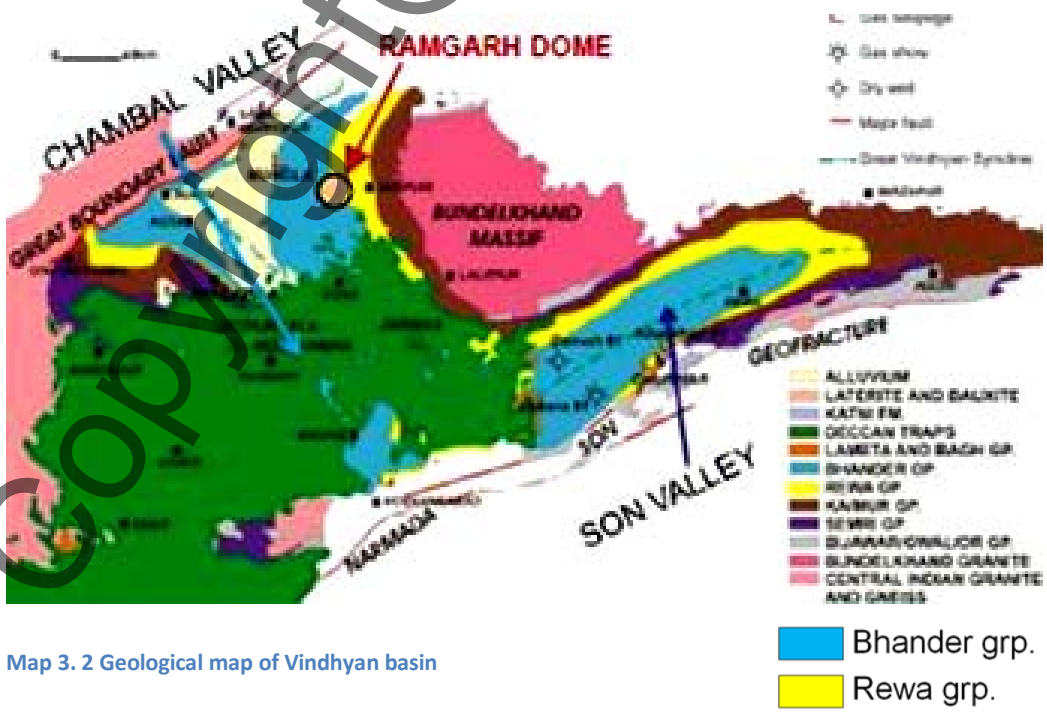
Location Map of Ramgarh ring structure, Rajasthan, India

Topography/ Landform/ Soil

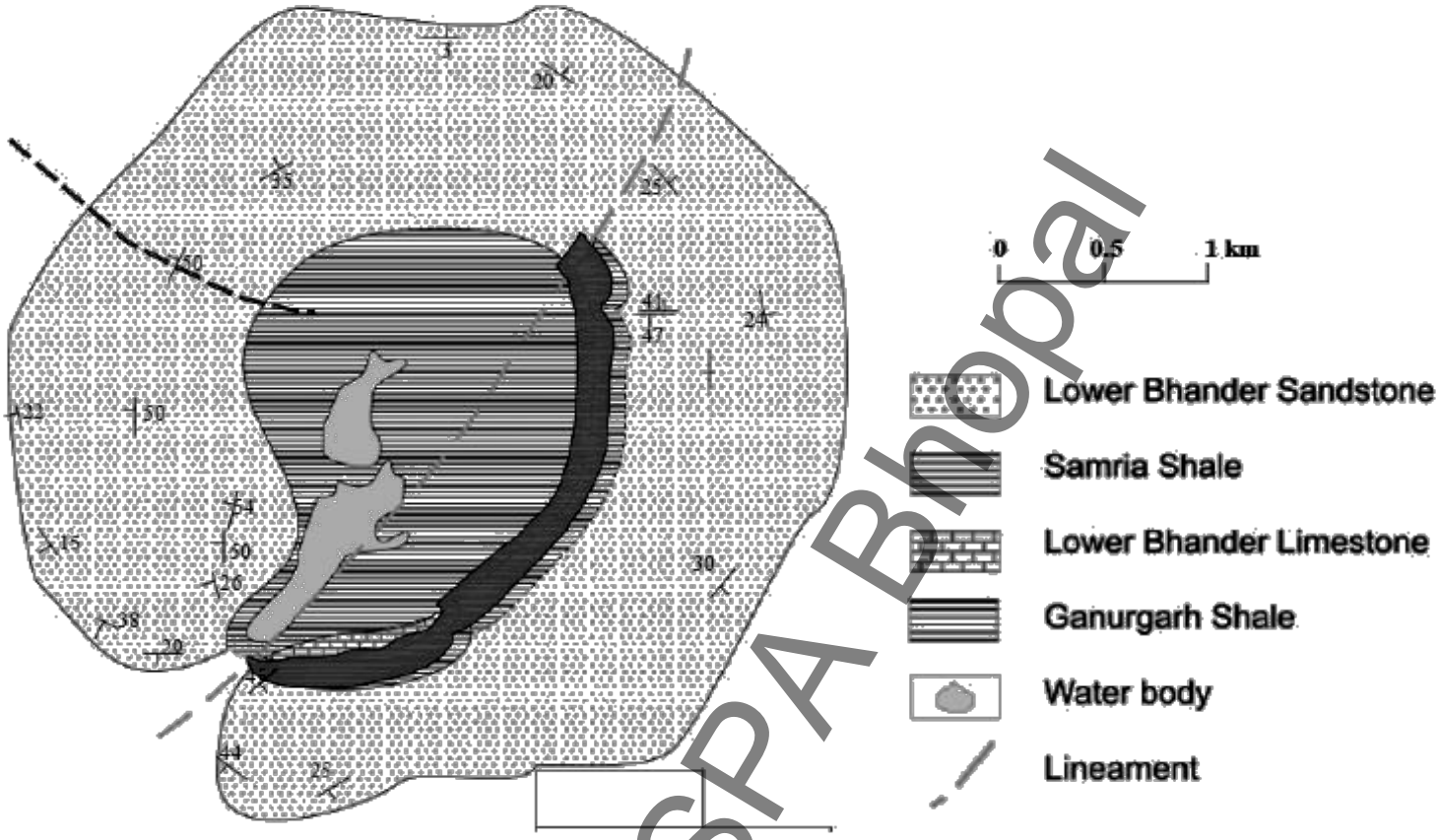
i. Its occurrence in a comparatively flat country of Sirbu shale has made it conspicuous. It displays conspicuous depression and prominent topography in an otherwise alluvial flat country.

ii. It is a prominent oblong landform characterized by a peripheral almost circular ridge and central depression. Ramgarh domal structure exposes the Govindgarh Sandstone in axial portion followed by Ganurgarh Shale in the centre, Lakheri Limestone, Samria Shale and Bundi Hill Sandstone occurring as girdle or ring.





Map 3. 2 Geological map of Vindhyan basin



Map 3. 3 Geological map of Ramgarh ring structure

Hydrology

i. The central crater water body fed by the monsoons every year. Never go dry.
ii. The crater rim or walls have kund or pond are also fed by monsoons.
iii. Low ground water potential.

Vegetation

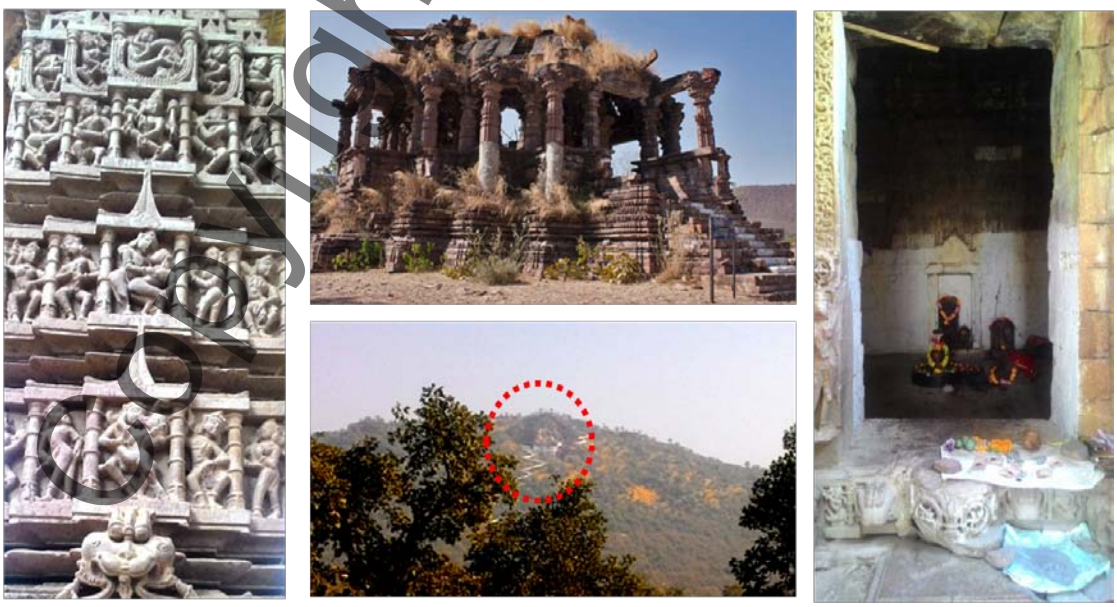
i. On crater rim: Dhogada (local name) tree & shrubs - fuel for burning.
ii. At the base of the rim: Chola (local name) tree.
iii. Other common identified plant species : Dakni bool (English babul), Date palms.
iv. Lotus in the water body of the crater.

Fauna

i. The birds in and around the crater parrots, peacocks, sparrows, koyal. Egrets, kingfisher, eagles, etc.
ii. Mammals found within the crater include the Monkeys, Wild Pigs, and Deer.

Historic / Cultural/ Religious values

i. Temples dedicated to tantric tradition of Shavism – noteworthy example of Nagara style temple.
ii. Built in 10th centuary by Raja Malaya Verma of Nag dynasty of Malwa – as a memorial for victory over his enemies and tribute to Lord Shiva.
iii. Later in 1162 AD. renovated by Raja Trisha Verma.
iv. Also has Mata mandir – 950 years old which was said to be naturally formed and later the stairway with 750 steps was constructed by the raja and now maintained by the government.
v. There were a group of five temples – which were then destroyed by the emperor Aurangzeb.
vi. Lord Shiva and Poornima & Kashna Mata are worshipped by the local people.
vii. No other religious or existential beliefs among the locals.



Picture 3. 2 Important religious sites visited in the crater

Evaluation

Picture 3. 3 Schematic section through the crater

The areas character emphasized by the existential topography of the crater. Dominant feature in otherwise plain landform.

i. Portable water used for domestic purposes.
ii. Area accessed by minor road. Not easy accessible from nearby towns.
iii. Sparse settlements observed. Vast open croplands.
iv. Inside the crater restricted accessibility.
v. Visually compact tree cover (dense feeling) from distance, but actually not that compact.

Picture 3. 4 Pictorial essay of Ramgarh Ring structure, Rajasthan

Evaluation

STRENGTH OF CHARACTER	WEAK	MODERATE	STRONG
Impact of landform*	Insignificant	Apparent	**Prominent**
Impact of landcover*	Insignificant	**Apparent**	Prominent
Historic pattern*	Insignificant	**Apparent**	Prominent
Visibility from outside	Widely visible	**Locally visible**	Concealed
Sense of enclosure	**Open/exposed**	Partial	Contained/confined
Tranquillity	Discordant	**Moderate**	Tranquil
Distinctiveness/rarity	**Frequent**	Unusual	Rare
Totals * *Prime condition categories if tie*	2	4	1
CONDITION	**POOR**	**MODERATE**	**GOOD**
Landcover Change	**Widespread**	Localised	Insignificant
Age Structure of Tree Cover*	Overmature	Mature	**Mixed**
Extent of semi-natural habitat survival*	Relic	**Scattered**	Widespread
Management of semi-natural habitats	Poor	**Not obvious**	Good
Survival of cultural pattern (fields and hedges)	**Declining/Relic**	Interrupted	Intact
Impact of built development*	High	**Moderate**	Low
Visual unity	Incoherent	**Coherent**	Unified
* *Prime condition categories if tie*			
Totals * *Prime robustness categories if tie*	2	4	1

MATRIX				
Condition	Good	Strengthen and reinforce	Conserve and strengthen	Safeguard and manage
	Moderate	Improve and reinforce	Improve and conserve	Conserve and restore
	Poor	Reconstruct	Improve and restore	Restore condition to maintain character
		Weak	Moderate	Strong
		Strength of Character		

Landscape Strategy = Improve and Conserve

Sensitivity
Ecological – Mainly High with some Very Low
Cultural – Mainly Moderate with some Low
Visual – Mainly Low with some Moderate
Tranquillity – Mainly Moderate with some Very Low

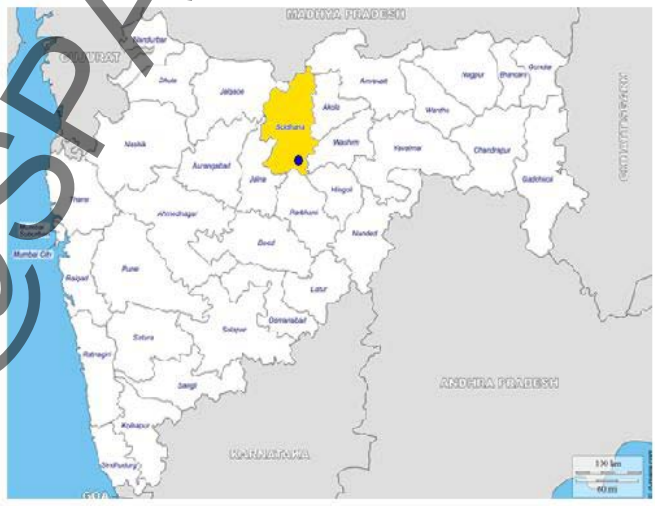
Table 3. 2 Evaluation sheet of Ramgarh ring structure

4.0 **Site introduction:**

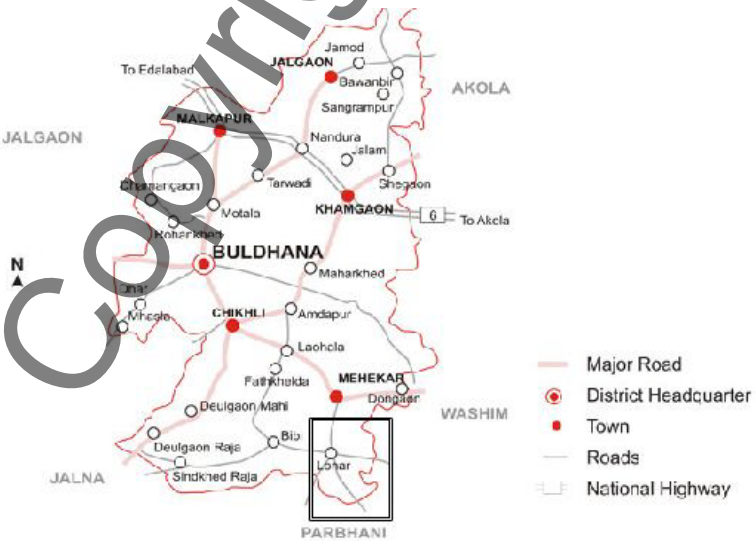
Home to the Earth's only hyper-velocity impact crater in basaltic rock, has its genesis nearly 50,000 years ago, when a 2 million-ton meteorite impacted the earth to create a depression 1.83 kilometers in diameter and 150 meters deep. A series of low hills surround the basin which has an oval shape. Over time, the jungle took over, and a perennial stream transformed the base into a tranquil, green locale. The first European to visit the lake was British officer, J.E. Alexander in 1823

Altitude of lonar: 563m MSL.
Latitude: N 19 degree 58'
Longitude: E 76 degree 31'

Map 4. 1 Map of India



Map 4. 2 Map of Maharashtra



Map 4. 3 Map of Buldhana district

4.1 **Climate:** *(Meteorological department)*

Rainfall- The area has an average annual rainfall of 720 mm – 835 mm. Most of the precipitation is received during the monsoon period from June to September.

Humidity- Except during the monsoon season the relative humidity is high. The air is generally dry over the district. The relative humidity is 25% to 30% in summer which is the driest part of the year.

Temperature- The area is hot & dry. The day temperature in summer reaches up to 45ºC and the lowest in winter is about 7ºC.

4.2 **Regional Setting:**

Lonar village is the headquarter of Lonar taluka in Buldhana district of Maharashtra of which Risod taluka is at east. Mehkar is to north, Sindhkedraja at its west.

Lonar is acessible from Mehkar, Risod and Jalna by road the respective distances from them being 24 kms., 28 kms., and 86 kms.

4.3 **Formation of crater (theories):**

1. Any solid substance which is circular or cylindrical speedly fall on solid surface, it cracks in all sides; in case of Lonar crater, there are no cracks or broken rocks on the rim or inner sides.

2. Broken stone micro Brehia are formed 300 meters deep under the Brine water, now if due to perpendicular directional metorite impact 300 m. deep rocks are broken, then due to the stroke around the crater rocks must be broken too; but in case of Lonar crater this phenomenon is absent.

3. There must be conical hill formation in case of volcanic basalt flow, but here no conical hill present. The porous stones found on the rim and inside walls float on water.

4. In the base of the crater nearly 150 meters deep there are hot water springs - which are only due to volcanic activity. Midicot & Blodford suggests at the center the volcanic blast was unsuccessful so the lava had not come outside.

The all above points indicate that there was not great blast during the formation of the crater.

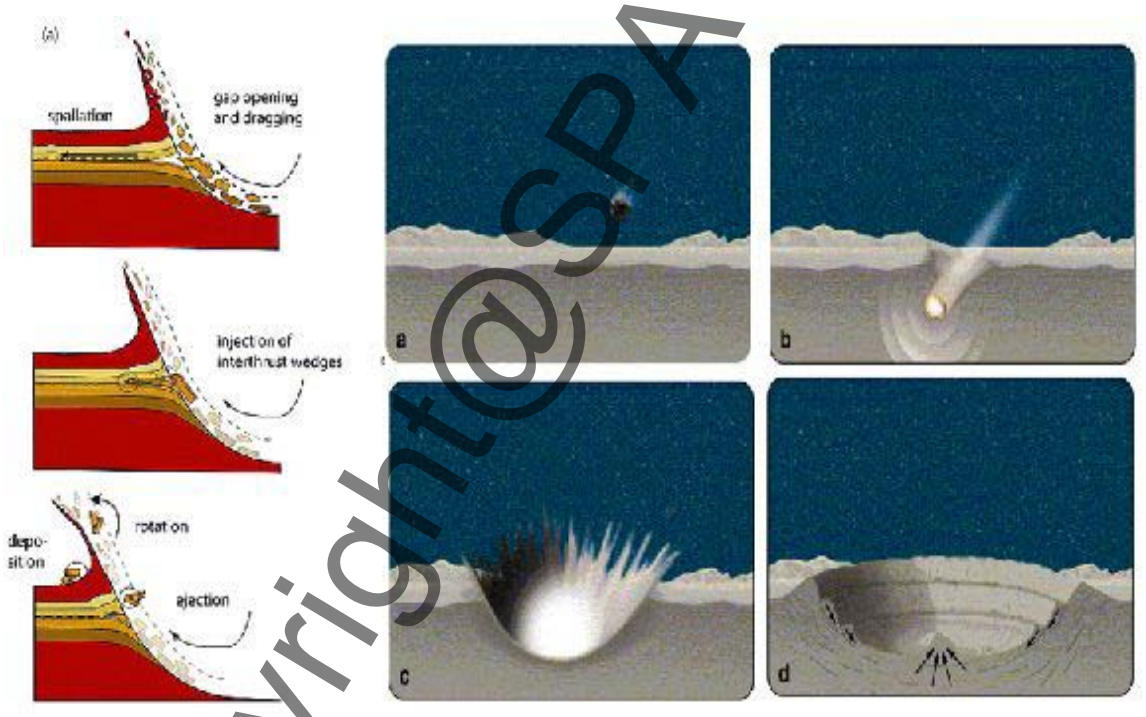
Impact cratering is a dominant surface modification process in the solar system, yet aspects of cratering mechanics remain poorly understood. Information about high strain-rate rock deformation and ejecta emplacement processes
are recorded in the geology of impact structures. However, due to the high erosion rates on Earth, few craters have retained a complete record of the cratering process. Lonar Crater, India, is a young, well-preserved simple crater formed in the Deccan trap basalts, making it a rare analog for impact structures observed on the basaltic surfaces of other terrestrial planets and the Moon.

Lonar crater walls:

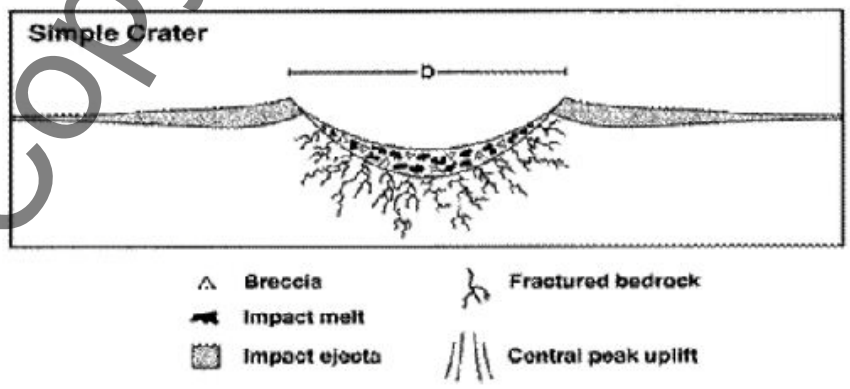
Because of the small size of the crater, rock and shock deformation features in the crater rim-fold and ejecta are limited. Microfaulting in the crater wall is difficult to observe because of the homogeneous nature of the target rock and preexisting jointing and flow banding. The strain from the rim-fold was primarily accommodated along contacts between Deccan flows.

Ejecta blanket:

Assuming that the ejecta thickness profile at Lonar has not been altered significantly by erosion or human activities, the Lonar profile is remarkably similar to lobate, rampart-terminated ejecta blankets observed around fresh craters on Mars (solid gray line).



Picture 4. 1 Formation of crater



Picture 4. 2 Formation of a simple crater

4.4 **Historical & Religious settings:**

The lake was first mentioned in ancient scriptures such as the Skanda Purana, the Padma Puran and the Aaina-i-Akbari.

Buldhana district in Maharashtra, where the lake is located, was once part of Ashoka's empire and then of Satavahana's. The Chalukyas and Rashtrakutas also ruled this area.

During the period of the Mughals, Yadavas, Nizam and the British, trade prospered in this area. Several temples found on the periphery of the Lake are known as Yadava temples and also as Hemadpanti temples.

RULERS OF LONAR

i) up to 1294 Hindu Jain Boudha
ii) 1294 – 1313 Muslim
iii) 1316 – 1318 Hindu empire
iv) 1318 – 1595 Muslim
v) 1595 – 1724 Mogal
vi) 1725 – 1853 Nizamof Hydrabad Maratha
vii) 1853 – 1947 England Government

From 1853 onwards Lonar came under British rule. Colonel Mackenzie made a systematic and detailed study of the crater.

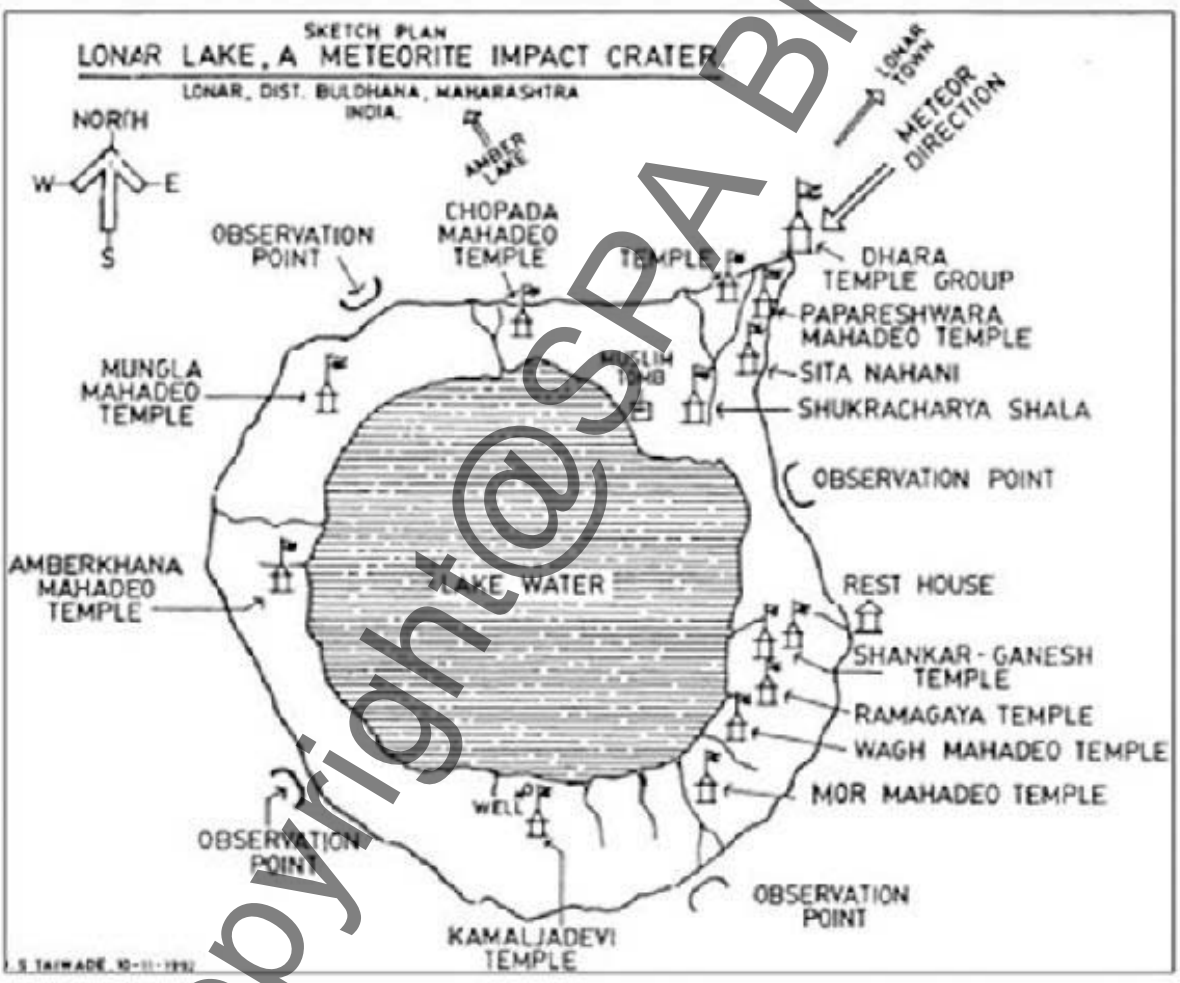
Legends about a local demon and inexplicable properties of the water have made this lake a religious draw.

Lonar Lake is also an archeological goldmine with more than 20 temples dating back to the 11th century dotting its crater.

Numerous temples surround the lake, most of which stand in ruins today, except for the temple of Daitya Sudan at the centre of the Lonar town, which

was built in honor of Vishnu's victory over the giant Lonasura. It is a fine example of early Hindu architecture.

Kamalja Devi Temple is located beside the lake and also features carved images, Gomukh Temple is located along the rim of the crater. A perennial stream emerges from here and pilgrims visiting the temple bathe in the stream. It is also called Sita Nahani temple and Dhara.



Map 4. 4 Schematic map showing the temple locations around the crater

Before the explosion, Lonar was called ‘ Madhumati nagar ’.

About the name Lonar: Some say ‘Lonar’, the name of the nearby village that is akin to the English word ‘lunar’, as if early Indians had the requisite knowledge that the crater was created by moon rock. While others say, Lonar is named after the demon, Lonasura, and is ringed by fascinating temples.

Legends about a local demon and inexplicable properties of the water have made this lake a religious draw.

Apart from the temples, it is believed and said that the rishis also visited this placed and stayed and prayed to Lord Brahma Godess Asara.

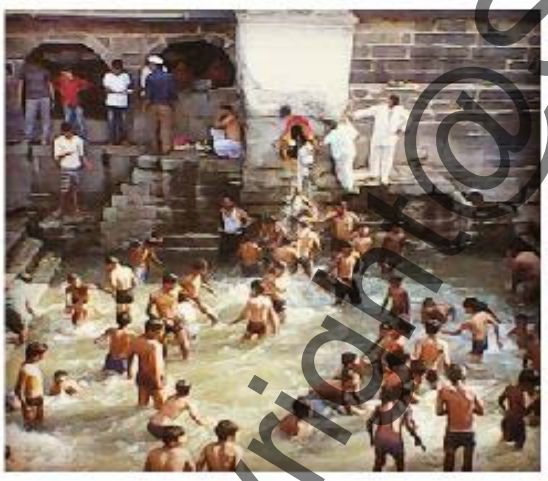
- There are altogether thirty two temples, seventeen monuments, thirteen kunds and four incriptions at lonar. Of these, twenty seven temples, three monuments, seven kunds are located inside the crater.
- Since 1906 the Archeological survey of India has protected 19 temples in lonar in and out of the crater.
- The four temples existing outside the crater which are under protection are:

1. Dharam Shala / Anna chatra
2. Square kund - east side of town known as Lambi bharav
3. Gomukha / Dhar
4. Daitya Sudhan temple

Gomukha or Dhar of Lonar:

From the Sita nahani temple down to lake extends a ravine which is the only break in the continuity of the circular walls of the crater. The head / source of the ravine bifurcates to the western branch that the spring is located from which the water is led through a gomukha into a small kund or square tank in which hindu pilgrims take bath promiscuously. The water is supposed to the holy Ganga water. According to latest Studies shows that the water of the Dhar traced from 18 kilometers south side of lonar under Purna river.





Picture 4. 3 Gomukha & Sita nahani temple complex

Gomukh temple at the rim from where a perennial stream emerges.

Considered as a holy bathe, properties and the pressure of water fall cures skin diseases.

Pilgrim visit - once a year in the month of June

Daitya sudhan temple, Lonar:

One of the best remaining examples in berar of these old mediaeval temple is that at Lonar. It is a Vaishnava shrine and receives its name from the connection with the story of the demon Lavanasura or Lonasura who used to dwell in the crater close by, and who was eventually slain by Vishnu in his incarnation of Daitya sudhan.

The temple is from the Chalunkya dynasty, built in 11th century.

The temple measures 105 feet long & 85 feet wide. It faces east side and is built of black stone, profusely carved. The shrine is made of 85% of iron on the black basalt rock. The temple complex seems to be not completed. The temple is now under the Archeological survey of India.

Picture 4. 4 Daitya sudhan temple complex

4.5 **Topography of Lonar crater:**

Altitude of lonar: 563m MSL.

Elevation : 150m (deep - base of hill to its top)

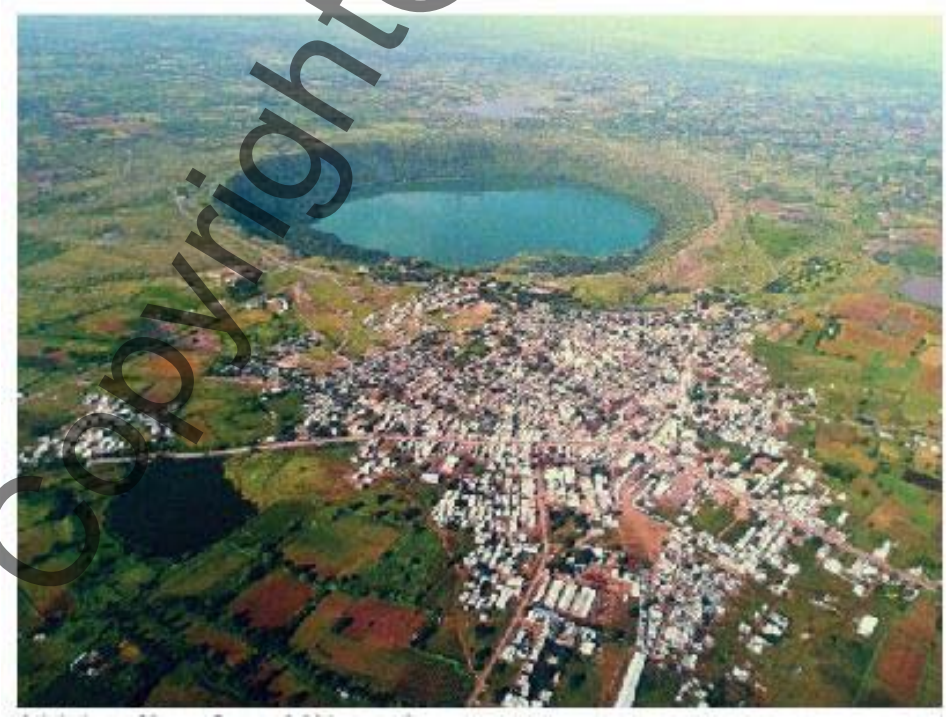
The country surrounding Lonar lake forms a rolling upland at average elevation of about 600 mt. with a few dome shaped residual hills rising to a height of 700 mt.

Geologically speaking the lake lies in region which for hundreds of kilometers around consist entirely of a bedded flow of basalt of Deccan trap which are three hundred meters or more deep.

The lake proper lies, in a nearly circular depression surrounded on all sides by steeply rising escarpment to an even height of about 150 .. above the lake level.

The `scrap' rim of the lake forms a continuation of the plateau surface through gentle outwards slopes except at the south and south west in which directions the plateau slope, down through steeper slopes; towards the valley of River Purna.

In fact one does not recognize the existence of lake until one comes right up to the edge of the crater rim folds.



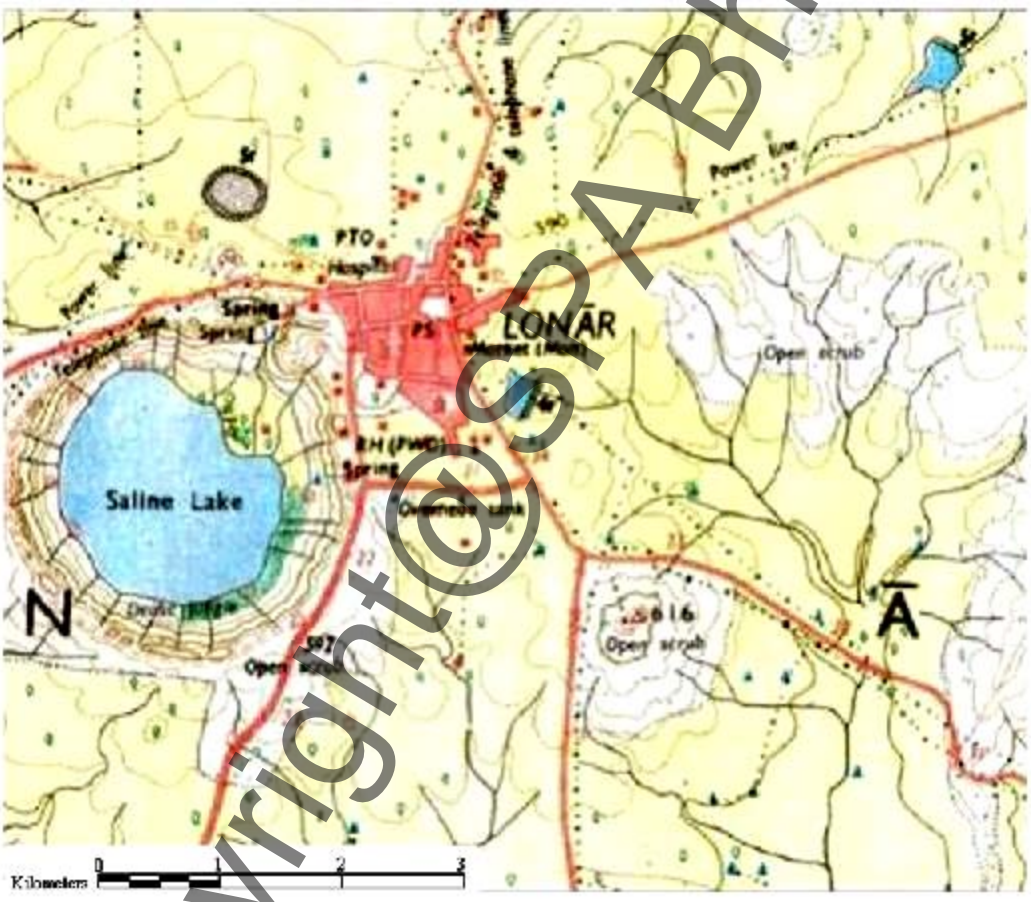
Picture 4. 5 Arial view of Lonar crater & Urban setting

4.6 **Toposheet and Land use of Lonar:**

The area surrounding the crater is all agriculture and scrub land.

The Lonar town is located on the north-east of the crater, which is a mix land use of residential and commercial use.

The flourishing tourism in present scenario demand for more commercial land use.



Map 4. 5 Toposheet Lonar

Local & International Anthrall at Lonar:

The Lonar crater has become both scientifically as well as religiously very important site.

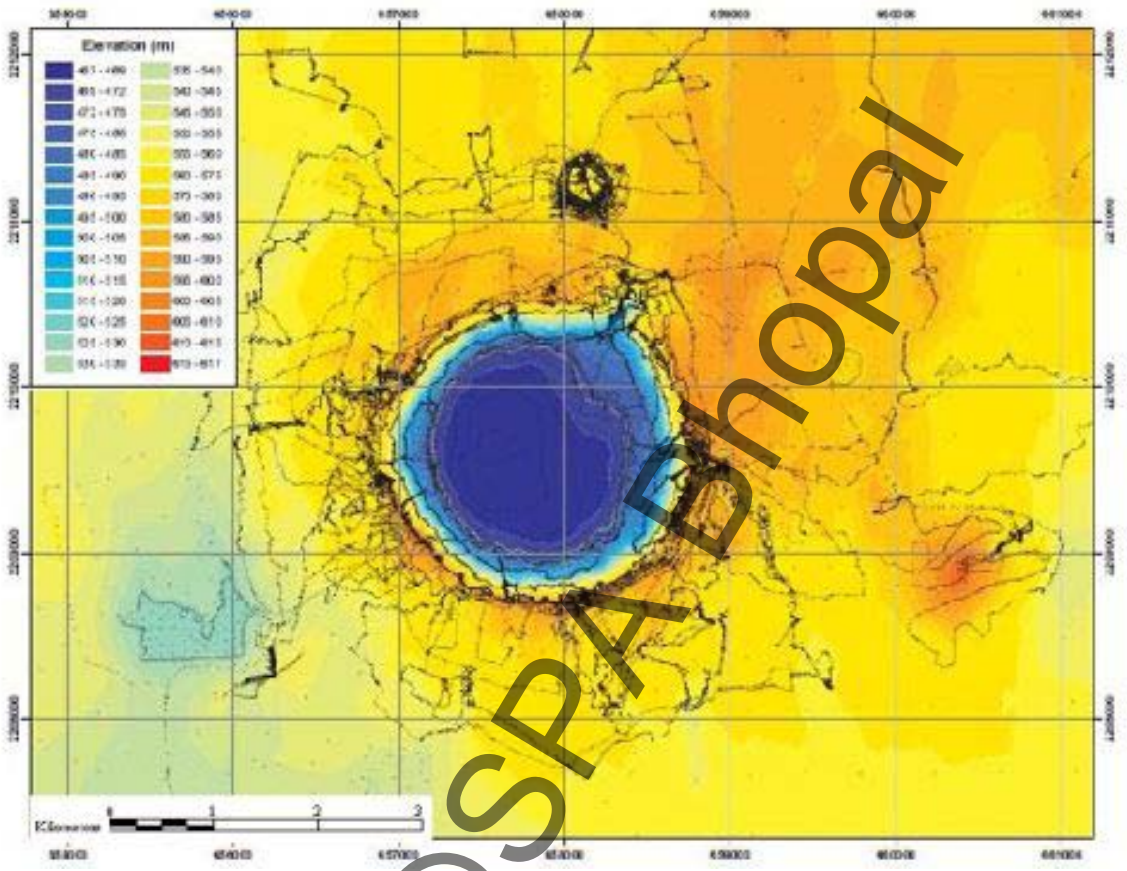
The Lonar Lake is an exceptional 'bowl of biodiversity' and a wildlife sanctuary. It is land locked with extraordinary water qualities, and has no

inlets, outlets nor does the water seep into the ground. It is fed by underground streams that are now dehydrating due to human folly.

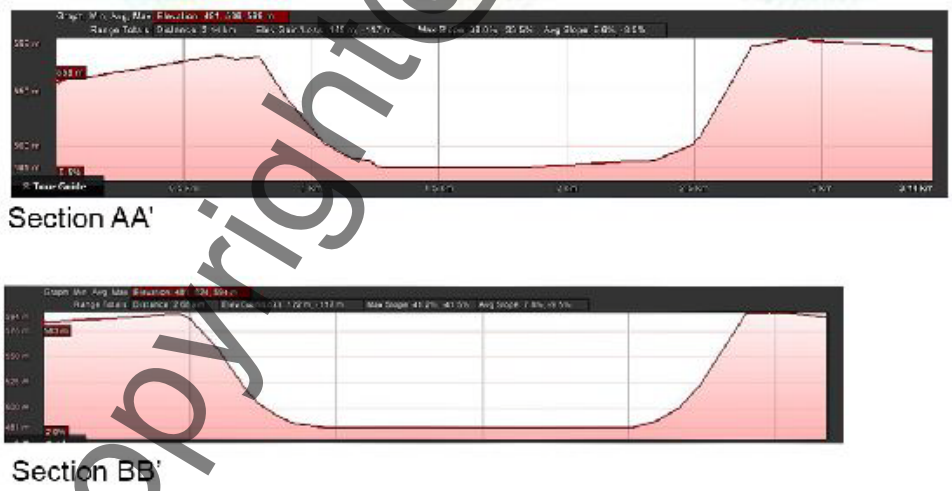
The remarkable shape, size and samples of celestial leftovers have lent uniqueness to this crater.

These exceptional traits have attracted constant attention of ecologists, geologists and astronomers from the across the globe. It has been the subject of several scientific studies on various aspects of crater ecosystem, yet it is seemingly unknown to the general public.

4.7 **Slope analysis of Lonar:**



Map 4. 6 Slope Analyses



Picture 4. 6 Schematic Sections through the crater

The slopes of the crater are steep and descend to an average depth of 450 feet as measured from crater crest to rim. The slope of the crater hill / rim is very steep. 28 degree - 30 degree slope exposed to rock bed beneath.

Not recommended for design proposal / interventions. The slope on ejecta

blanket is gradual of about 2 degree - 6 degree.

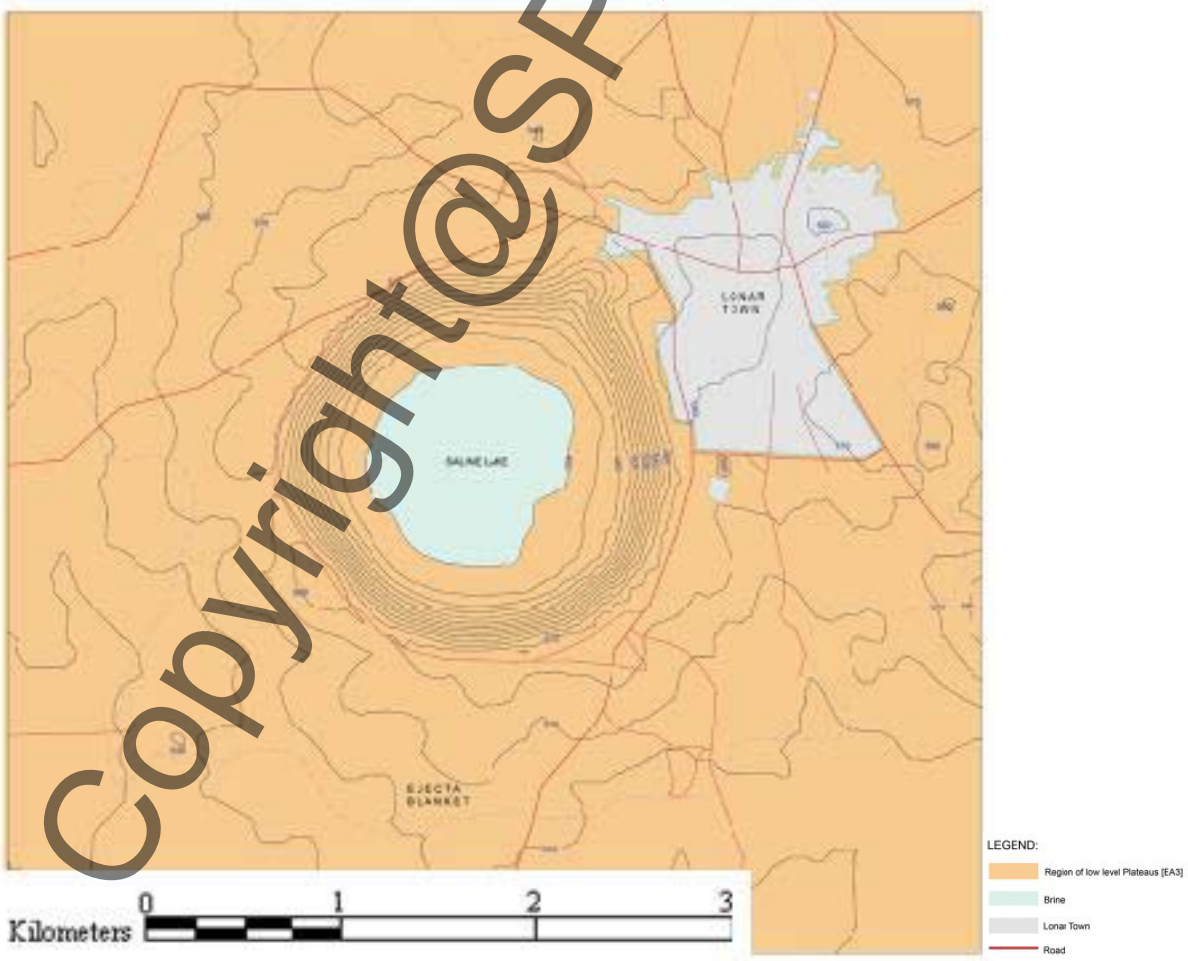
There are seasonal / monsoon streams formed on the ejecta blanket, if the monsoon is as expected yearly.

4.8 **Geomorphology of Lonar:** *(Metrology department)*

Several consequent streams cut the walls of the depression and flow into the lake. About two dozens of streams can be identified of which only two streams are perennial.

Hence erosion due to in-ward flowing streams is confined to monsoon periods only when these carry water. But certain amount of deposition was caused due to the perennial streams, which gave rise to alluvial deposition at north-eastern side of crater.

It reveals: stream incursion, enlargement of crater by erosion, sedimentation in lake. These factors dictate the age of the crater to be around 50,000 years.



Map 4. 7 Geomorphology of Lonar

Magnetic effect at Lonar:

The Earth magnetic equator is 80 deg. north of equator and has an approx. angle of 110 deg. to equator.
Around Lonar crater in 10 km. radius there are high magnetic dust and rocks under earth.
The magnetic effect here changes the direction of the compass magnetic needle by 15 deg.

4.9 **Geology of Lonar:** *(Geology of Lonar Crater, India (Adam C. Maloof, Sarah T. Stewart, Benjamin P. Weiss, Samuel A. Soule, Nicholas L. Swanson-Hysell, Karin L. Louzada, Ian Garrick-Bethell3, and Pascale M. Poussart)*

Lonar Lake lies within the only known extraterrestrial impact crater found within the great Deccan Traps basaltic formation of India. The presence of plagioclase that has been either converted into maskelynite or contains planar deformation features has confirmed the impact origin of this crater.

The crater has an oval shape. The meteorite impact came from the east, at an angle of 35 to 40 degrees.

The geological features of the Lonar crater have been divided into five distinguishable zones, exhibiting distinct geomorphic characteristics. The five zones are:

i) The outermost ejecta blanket

ii) The crater rim

iii) The slopes of the crater

iv) The crater basin, excluding lake

v) The crater lake

Portions of the ejecta blanket are overlain by aerodynamically and rotationally sculpted glassy impact spherules, in particular in the eastern and western rim, as well as in the depression north of the crater known as Little Lonar.

The emplacement of the continuous ejecta blanket can be likened to a radial groundhugging debris flow, based on the preserved thickness distribution of the ejecta, the efficient exchange of clasts between the ejecta flow and the underlying histosol, and the lack of sorting and stratifi cation in the bulk of the ejecta. The ejecta profile is thickened at the distal edge and similar to fluidized ejecta structures observed on Mars.

(1) The crater is not composed of volcanic rock, and

(2) There is an abundance of iron meteorite fragments strewn around the crater rim and adjacent plains.

The mineralogy of the Deccan trap tholeiitic flood basalts is predominantly plagioclase (labradorite) and pyroxene (augite and pigeonite). The absence of quartz means that it is difficult to classify the shock level in these basalts, particularly at low to moderate shock levels (i.e., ~2–20 GPa), where shock-produced glasses are absent or rare.

Observations:

1. Medium grained dark grey, hard, massive, non prophyric and non viscular types form predominant scarpt at upper part of the slope.
2. Fine grained, high viscular purplish grey trap.
3. Medium grained, highly weathered trap of greenish-brown colour resembles to weathered sandstone - granite.

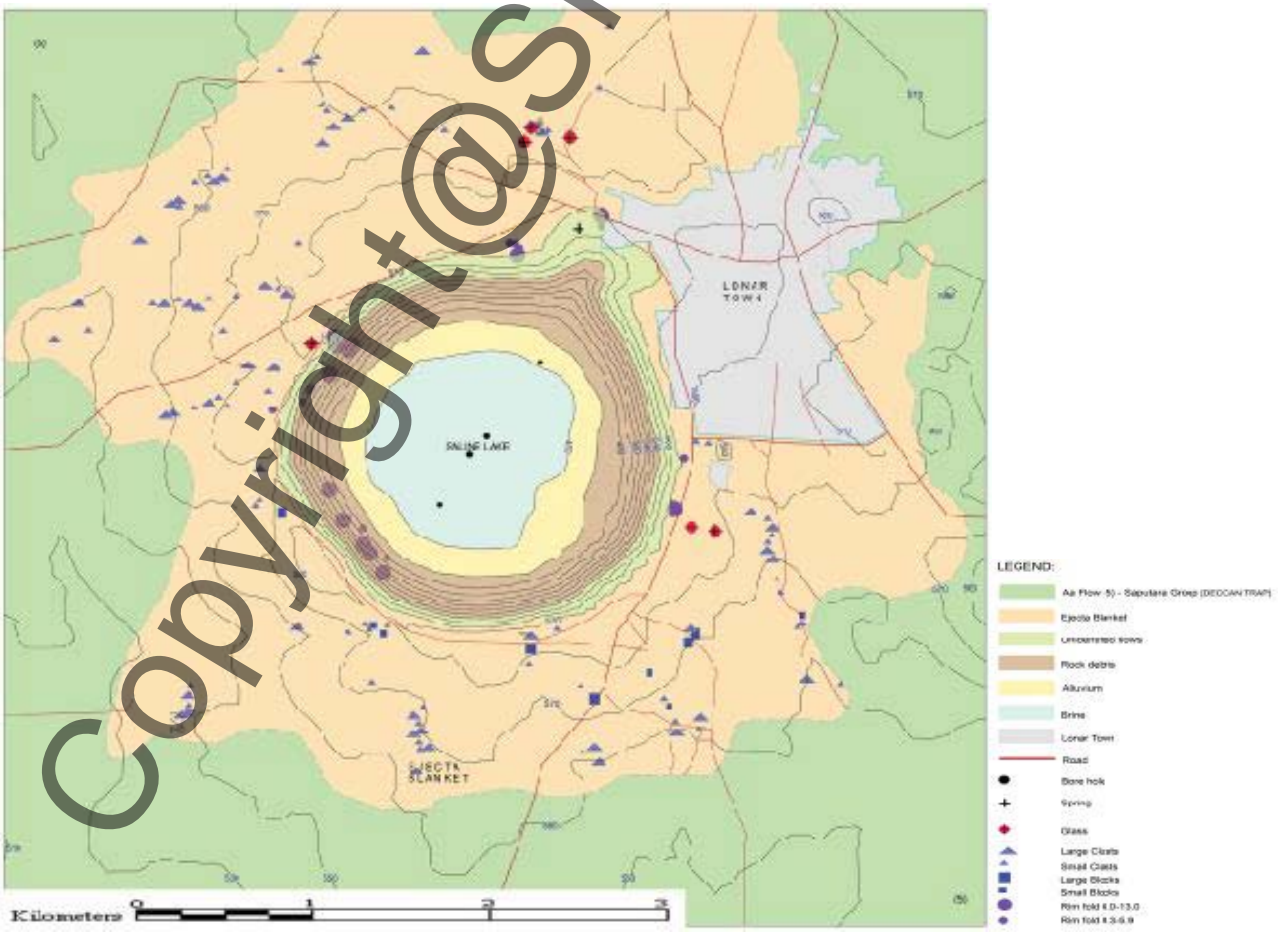
In general, hard, resistant, non viscular trap is about 30 m. thick and other highly weathered types of rocks underlying the resistant layer. Different types of rocks reveal halocystaline with maximum of 5-10% of glass. But texture of rock is typical basaltic.

The rocks within the depression show fracturing caused by crushing or shattering.

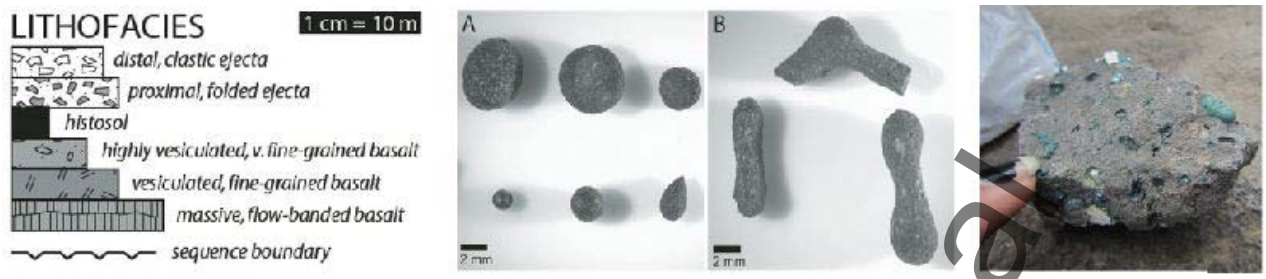
The geophysical investigations show that lake brine, sediments, rocks, vegetation do not show any anomalous concentration of nickel or cobalt or other such elements.

Seismic data indicates the presence of two zones overlying the hard trap:

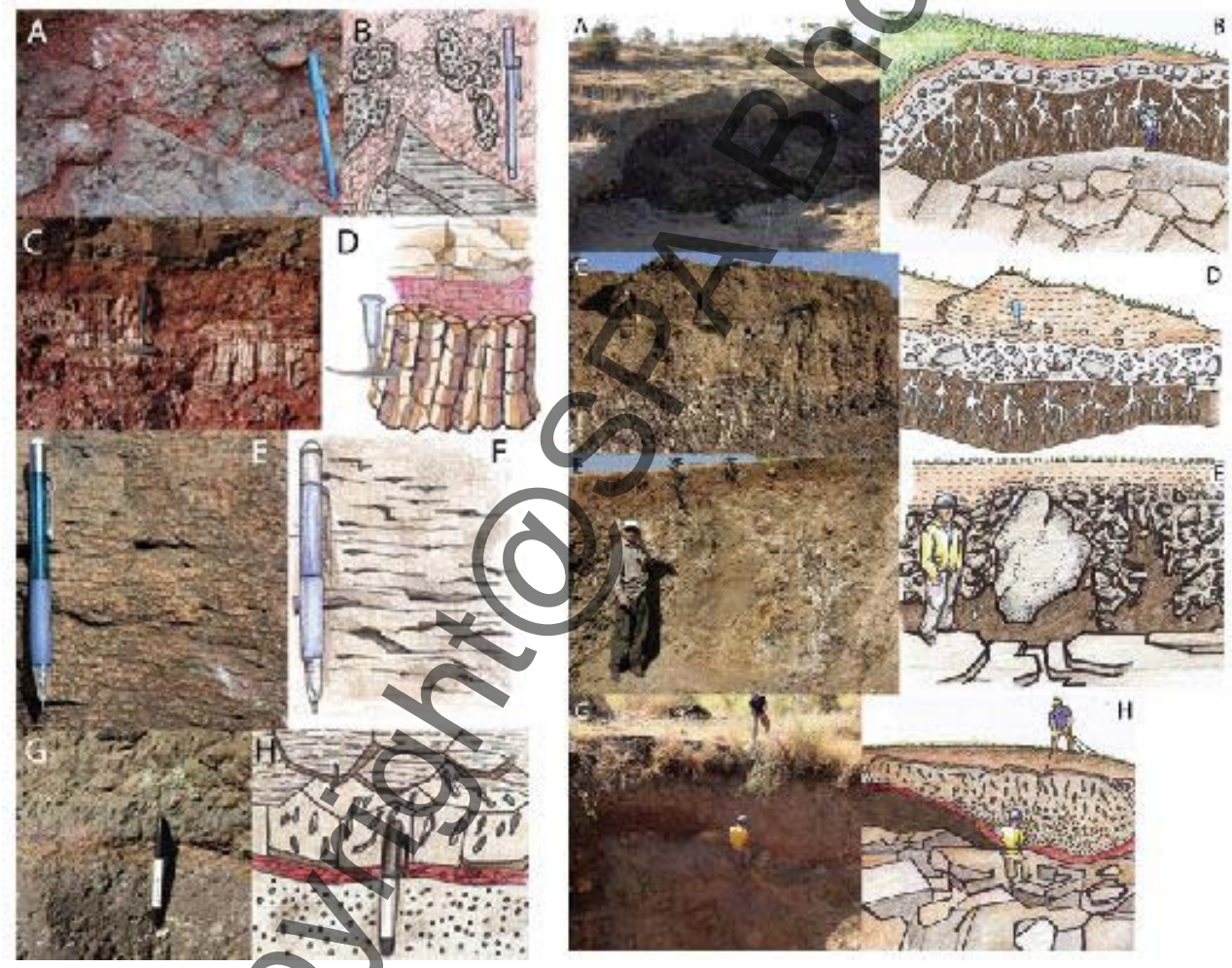
1. An upper 70 m. thick zone presumably constituting lake silt and highly weathered trap.
2. Lower 101 m. thick zone that might be made up of less weathered highly fractured trap.



Map 4. 8 Geology of Lonar



Picture 4. 7 Types of rocks found in Lonar crater



Picture 4. 8 Geological strata section at the crater

4.10 **Hydrology of Lonar:** *(*The drainage systems developing on the hydgologically active impact crater, lonar, India. G. Komatsu, P. S. Kumar, K. Goto, Y. Sekine, C. Giri, and T. Matsui*)*

At the present-day Lonar, rich and diverse hydro-logical processes are observed in and around the crater. The most notable hydrological feature is the perennial Lonar Lake (Lonar Sarovar) (1.2 km diameter) on the crater floor, and this Crater Lake has been the center of attention for the vast majority of research efforts in the past. Lonar Lake has no stream outlet.

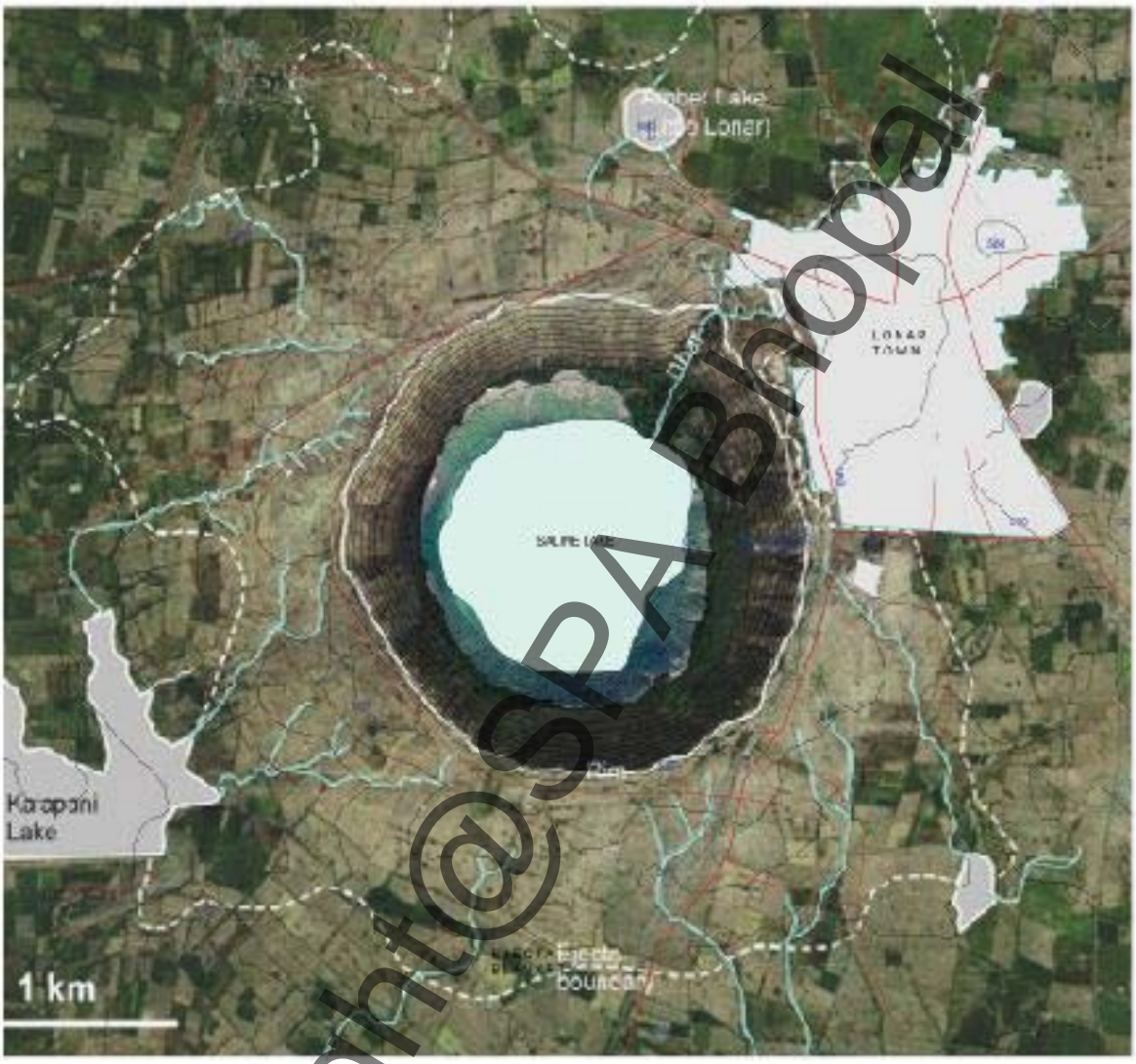
The lake level fluctuation linked to the monsoonal climate, it is reasonable to assume that precipitation in the catchment area including the Lake Surface and evaporation from the lake are the main drivers for controlling the lake level under the today's climatic condition.

The Dhar valley that is incised in the northeast segment of the rim, gullies developing along the inner rim walls, and channels on the ejecta blanket are not only the conduits for water transport but also a crucial component in processes of degradation of the crater, transport of sediment, and eventual deposition.

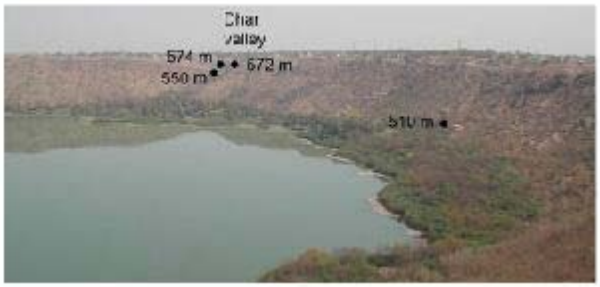
Groundwater emergence along the inner rim walls: Lonar Crater does not have incoming perennial surface flow from the surrounding plains. Lonar Lake directly receives precipitation in its surface and runoff along the inner rim walls, during the rainy season. The only drainage currently connecting the inner crater and the surrounding plains is the Dhar valley incised in the northeast segment of the raised rim. However, the valley conveys surface flow from the surrounding catchment only during the rains. The groundwater contribution is important for infilling during the rainy season and for maintenance of the lake during the dry season. There are springs that are active even during dry sea-sons. Two such springs are located near the head of the Dhar valley (at Gomukh Temple and Paphareshwar Temple), and another in the mid valley.

The groundwater discharge is observed as springs on the inner rim walls corresponding to the layers of weathered vesicular basalt, which occur above massive basalt layers. This observation indicates that groundwater movement

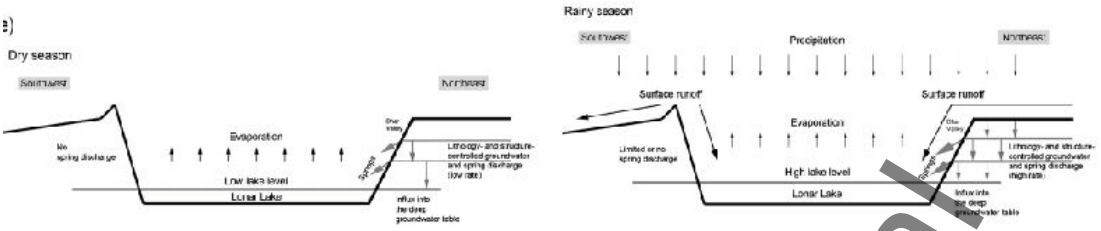
is lithologically controlled: it passes preferentially through permeable vesicular basalt (aquifer) but is hindered in less permeable massive basalt.



Map 4. 9 Hydrology of Lonar crater



Picture 4. 9 Approximate positions and elevations of springs along the inner rim walls.



Picture 4. 10 Water levels in the crater during monsoons & post-monsoons

The hydrological balance of Lonar Lake:

The hydrological balance of Lonar Lake has not been fully understood, but a hypothesis can be made based on observations. It is certain that that the monsoon precipitation in the catchment area including the lake surface is important, and the lake level increases during the monsoon by collecting both surface and groundwater entering the lake. The groundwater contribution should include not only the one emerging through springs on the surface but also the one reaching a deep water table at the level of the lake owing to the interconnectivity of the aquifers. During the dry season, the lake continuously receives groundwater input, but the evaporation from the lake exceeds the input, making the lake level to drop.

Modification landforms:

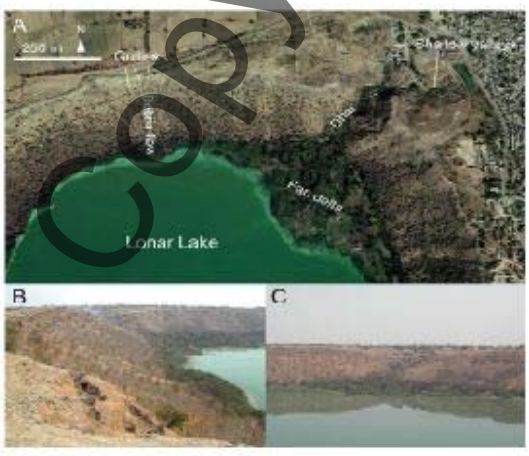
The inner rim walls are steep , and slumped blocks in contact with the inner rim walls by normal faults indicate the wall instability in some sections. The drainages inside the crater rim collect rainfall or spring water, transport water and eroded sediment down to the crater floor, in the lake. The inner rim walls are characterized by the presence of gullies and mass wasting features such as debris flows (Fig. below).

Similar to other impact craters, the gullies were formed by runoff from the rain, which enhances downward mass movement.

The transported debris forms small fans or shore terraces down in the lake. The fan positioned in front of the Dhar valley (Fig. below) accumulates sediment orig-inated from the incised rim and the surrounding plains distributing to the northeast direction outside the crater. The river valley feeder system entering a body of water transports a large quantity of coarse-grained sediment, and the fan formed in this kind of setting is called Gilbert-type delta, a type of fan delta frequently developing in front of a steep mountain front bordering with a standing body of water. The Dhar valley and the fan delta is a sediment transport system moving eroded materials from the surrounding plains and the crater rim to the crater basin floor.

Ejecta blanket:

A series of shallow channels are identified on the ejecta blanket of Lonar (Fig. 3). These channels originate, in general, near the rim crest and extend radially away from the crater center. A close inspection of one of such channels on the western ejecta found that it begins as a network of shallow ra-vines, some of which originate just below the rim crest at an elevation of approximately 580–590 m. The ravine heads coincide with a topographic saddle on the rim, which is about 6–7 m lower than the adjacent rim crests. These ravines expose ejecta-comprising basaltic clasts up to meter scale. The mid-section of the channel is single thread with occasional braiding and relatively straight, and the channel ends in a dammed Kalapani Lake at 545–550 m. The channel is ephemeral in nature, carrying water during the rain. The channels probably resulted from surface runoff, and its erosion contrib-utes to the removal of the ejecta.



Picture 4. 11 The Dhar spring and crater water level

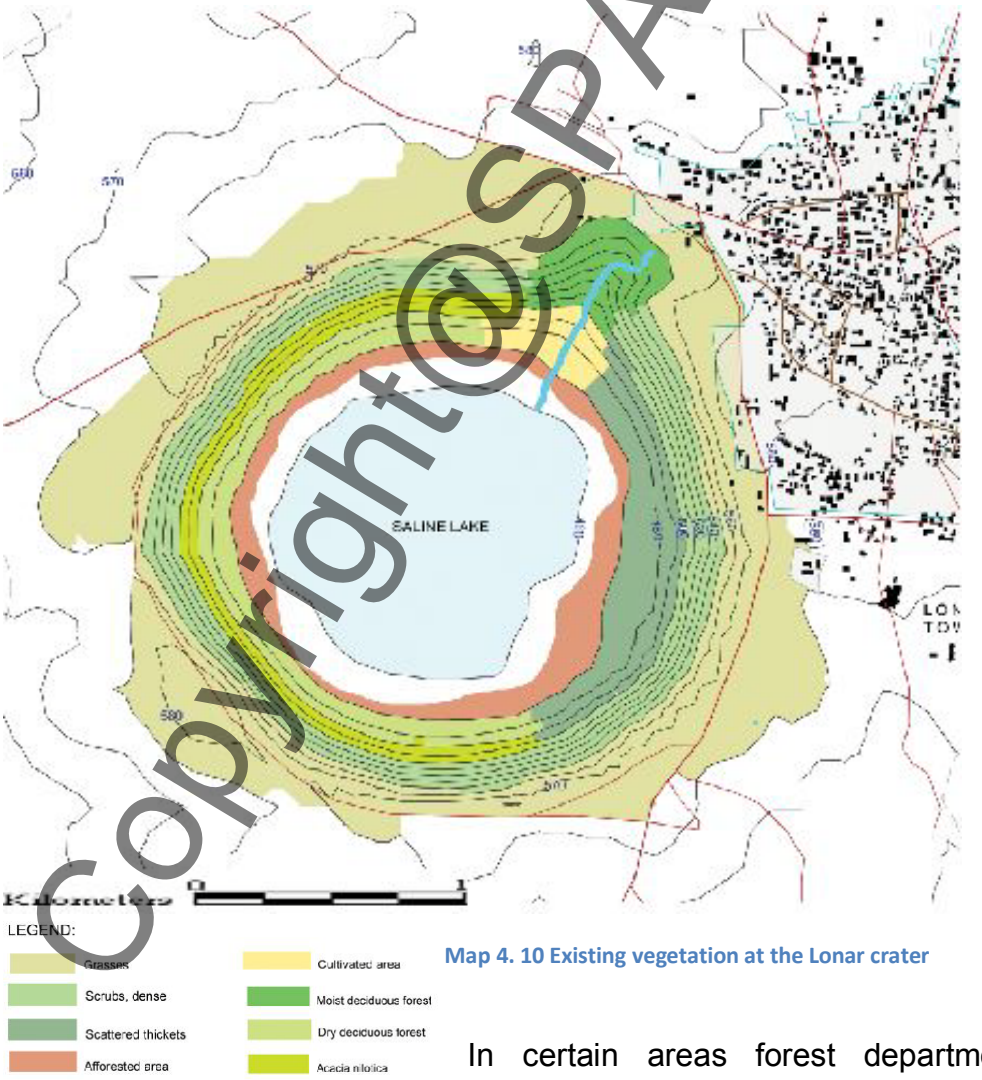
4.11 **Vegetation of Lonar:** *(Lonar – The Unique Indian Meteorite Crater in Basaltic Rock(Author: Mr. S. T. Bugdane - M.A, B.Sc, B.Ed)*

FLORA:

Some reference in British periods shows that initially this place was wooded and during the course of time illicit tree cutting took place for burning to produce salts for commercial purposes.

The vegetation around the lake where soil is extremely saline only a belt of acacia nilotica survives. During the last few years water level has kept increasing, as a result of that thick belt of Acacia is reducing.

Some parts is wooded which comes under mix type of forest - dry deciduous & moist deciduous forest types. The forest is open type. Tectona grandis dominates in this type.



Map 4. 10 Existing vegetation at the Lonar crater

In certain areas forest department had undertaken the afforestation programme without any consideration of the local

floristic composition. Planted trees - Azadirachta indica, Erythrina indica, Butea monosperma, Tectona grandis. Hence these species now dominate the vegetation of the crater.

Along the stream Dhar, where the vegetation is different and dense in nature. Vegetation comes under moist deciduous forest type.

The soil where alluvial in nature, cultivation took place. Cultivating Bananas & Papaya were done, but now a ban on cultivation in the alluvial fan has been put by the Ministry of forest department for obvious reasons.

Up till now a total of 237 species of plants belonging to 153 genera representing 70 families have been identified by the experts, out of which there are 126 herbs, 30 shrubs, 5 undershrubs, 19 climbers, 57 trees.

Existing flora & fauna list of lonar crater:

FLORA OF THE REGION :

Ranunculaceae

Clematis tribola - ranjui, ranjai

Annonaceae

Annona recticulata - ramphal

Annona squamosa - sitaphal

Menispermaceae

Coculus hirsutus L - vasanvel

Monospora cordifolia

Menispermum cordifolium - gulvel

Papaveraceae

Argemone maxicana - pivla dhotra

Brassicaceae

Brassica juncea - mohari (mustard seeds)

Cleomaceae

Cleome viscosa - tilwan

Capparaceae

Cadaba fruticosa

Polygalaceae

Polygala arvensis

Portulacaceae

Portulaca oleraceal - gholuchi bhaji

Malvaceae

Abutilon indicum - mudra, shikka

Bombyx micranthus

Glossypium herbaceum L - kapus (cotton)

Hibiscus caesius - ran ambadi

Thespesia populnea - bhendicha zad, parapimpal

Bombaceae

Bombax ceiba - kate savari

Terculiaceae

Helicteres isora L - murud sheng

Rutaceae

Citrus limon - limbu (lemon tree)

Murraya koenigil - kadhi patta (curry leaves)

Meliaceae

Azadirachta indica - neem

Rhamnaceae

Ziziphus mauritiana - bor

Sapindaceae

Sapindus laurifolius - ritha

Dodonaea viscosa - vilayati mendi

Anacardiaceae

Mangifera indica - amna (mango)

Combretaceae

Anogeissus latifolia - dawda

Terminalia arjuna - arjun sadada, kahu

Myrtaceae

Pisidium guajana - peru

Syzgium cumini - jamun

Caesalpiniaceae

Dalbergia sisso - shisam

Bahunia racemosa - apta

Bahunia purpurea - kanchan

Delonix regia - gulmohar

Hardwickia binata - anjan

Tarmarindus indica - chinch (imli)

Mimosaceae

Acacia chundra / catechu - khair

Acacia nilotica / arabica - babul

Albizia lebbeck - shiris

Punicaceae

Punica granatum - dalim (pomogranate)

Caricaceae

Carica papaya - papai (papaya)

Combretaceae

Anogeissus latifolia - dawda

Terminalia arjuna - arjun sadada, kahu

Oleaceae

Jasminum officinale - chameli

Nyctanthes arbortristis - parijata

Lamiaceae

Vitex negunda - nirgudi

Tectona grandis - sagwan (teak)

Santalaceae

Santalum album - chandan

Moraceae

Ficus religiosa - pimpal (pipal)

Casuarinaceae

Casuarina equisetifolia - morpankhi

Herbs : common name (other language)

Ranbhang

Khadakshepu

Muki

Rankanda

Ranmirchi

Kandyasher

Rantulas

Lajalu

Grasses : common name (other language)

Kusali

Gondal

Pavanya

Marvel

Taral

Bhol gavat

FAUNA :

Inspite of it being a brackish water lake one can find wide range of migratory birds in the vicinity of lake In the habitat such as lake, surrounding dense forest, cultivated areas, etc, we can observe different types of birds specially those which feed on saline water organisms as well as sweet water living in dry or moderate areas.

Nearly 75 species of birds have been identified and 17 species of mammals. Hence keeping in mind the wide variety of habitat and bird species, Lonar has a potential to become a bird sanctuary.

FAUNA OF THE REGION: common name

Monkeys
Rabbits
Squirrels
Signature Spiders
Funnal Spiders
Varanus
Honey bees
Musk-shrew
Palm Squirrels
Black naped hare
Indian langoor
Fruit bats
Indian false vampire
Insect eating bats
Barking deer
Mangoose
Snakes

4.12 **Ecology values of Lonar:**

The ecological values include flora, fauna, econiches as well as the specific ecological parameters responsible for their emergence, these are:-

1. Relative seclusion of the crater basin.
2. Higher humidity levels in the basin.
3. Higher ground water levels in the basin.
4. Perennial sweet water springs.
5. Perennial salt water reservoir.
6. Dry deciduous ecosystem around crater.
7. Dry bushy vegetation on the rim and slopes.
8. Salt tolerant vegetation along the lake shore.
9. Sandy silty shoreline.
10. Microbial world of the crater lake.
11. Natural landscape features like streams, steep slopes, etc.

4.13 **Threats & Problems of Lonar:**

Detail account of environmental conditions of the lake reveals that it has very fragile ecosystems. Little changes in any component may sweep away this rare piece of ecosystem. Hence it has become a necessity to evaluate and understand the possible problems and threats to this unique ecosystem.

1. **Land use**: Various land owners are -

a) Forest department- area around the crater and the rim.

b) Revenue department - certain area around the lake.

c) Private - for cultivation- divided among 66 persons occupying 21.26 hectare land.

d) Central government - fringes i.e. steep slopes of crater, saline lake body.

e) Archeological survey of India - area around historical monuments.

The main issue in different land uses is the cultivated field area, because it causes growing human interference in this area. It leads to cattle grazing excessive and illicit tree cutting etc. The use of pesticides and fertilizers are becoming day by day hazardous to saline water lake. These chemicals dissolve in rainwater and get mixed with the saline water.

2. **Encroachment**: The area around crater i.e. raised rim and part of the ejecta as well as area around some archeological sites are becoming parts of interest. So many people have made encroachment on the land of forest department and government causing the damage to national monuments.

3. **Rise in water levels**: In recent years rise in the water level of lake is creating alarming situation. It has been observed that rise in water level is associated with the artificial lakes for irrigation purposes which are been constructed in the vicinity. Eutophication in lake may give rise to other life forms; perhaps it may cause threat to one of the rare pattern of the life in the world.

4. **Deforestation**: continuous wood cutting is disturbing the symbiotic relationship among various elements of nature. There may be possibility of endangered species. It may affect the flora - fauna interrelationship.

5. **Afforestation**: During recent years, forest department has undertaken afforestation programme, but lack of consideration of character of vegetation has resulted into dominance of some species introduced. This may result in extinction of original composition of vegetation that had developed over years.

6. **Tourism**: Lack of sensitivity and awareness amongst people regarding this outstanding feature cause severe problem. Major tourism is because of religious and historical importance of the lake. Dumping of inorganic materials / non biodegradable materials around the temples and in the vicinity of the lake - causing environmental pollutions. Out of all tourist population 40% come for leisure and tracking on site and the rest of 60% for religious purposes - pilgrims. According to the Maharashtra tourism board the pilgrim population visiting the place at the time of June is around 2500 to 3500. So the issues are to be taken care of for environmental up gradation of Lonar crater.

4.14 **Conclusions / Inferences:**

1.) This is a very small attempt made to explore and enhance the various characters of the crater and surroundings, considering the present scenario - a policy and guideline for regional development is required.

2.) Considering the fact that the site is scientifically, astronomically and has religious importance a possible sustainable design intervention to explore these aspects by the tourists and the researchers could be zoned while keeping in mind the environmental and geological importance of the site.

3.) Management guideline for tourism development.

4.) Demarcation of buffer zone along SH-171 - which ensures protection and also acts as a screening landscape.

5.) Eco-sensitive zone marking - protecting the valley lines, acting shock absorbers to protect the area by regulating and managing the activities around the site. Minimizing the negative impact on the fragile geology.

6.) No development on ejecta blanket.

7.) Restriction of vehicular movements around the crater.

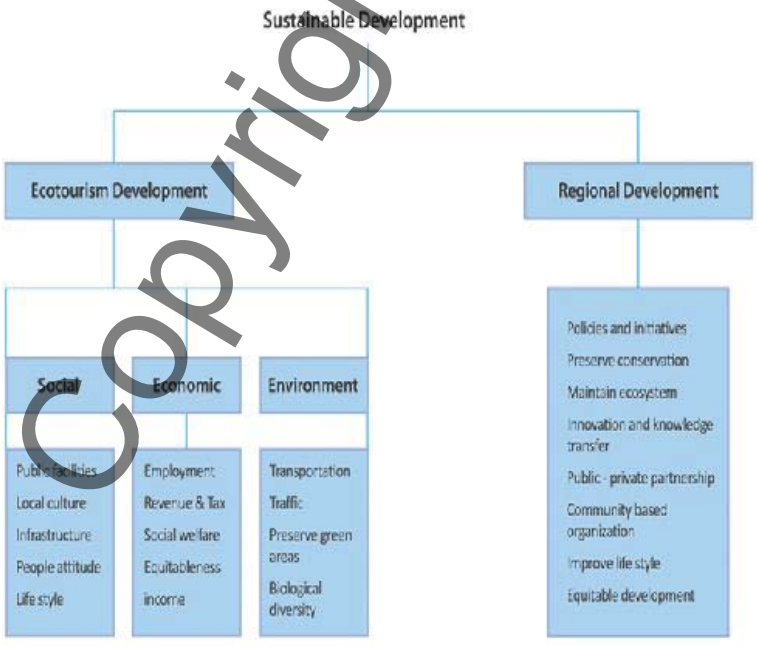
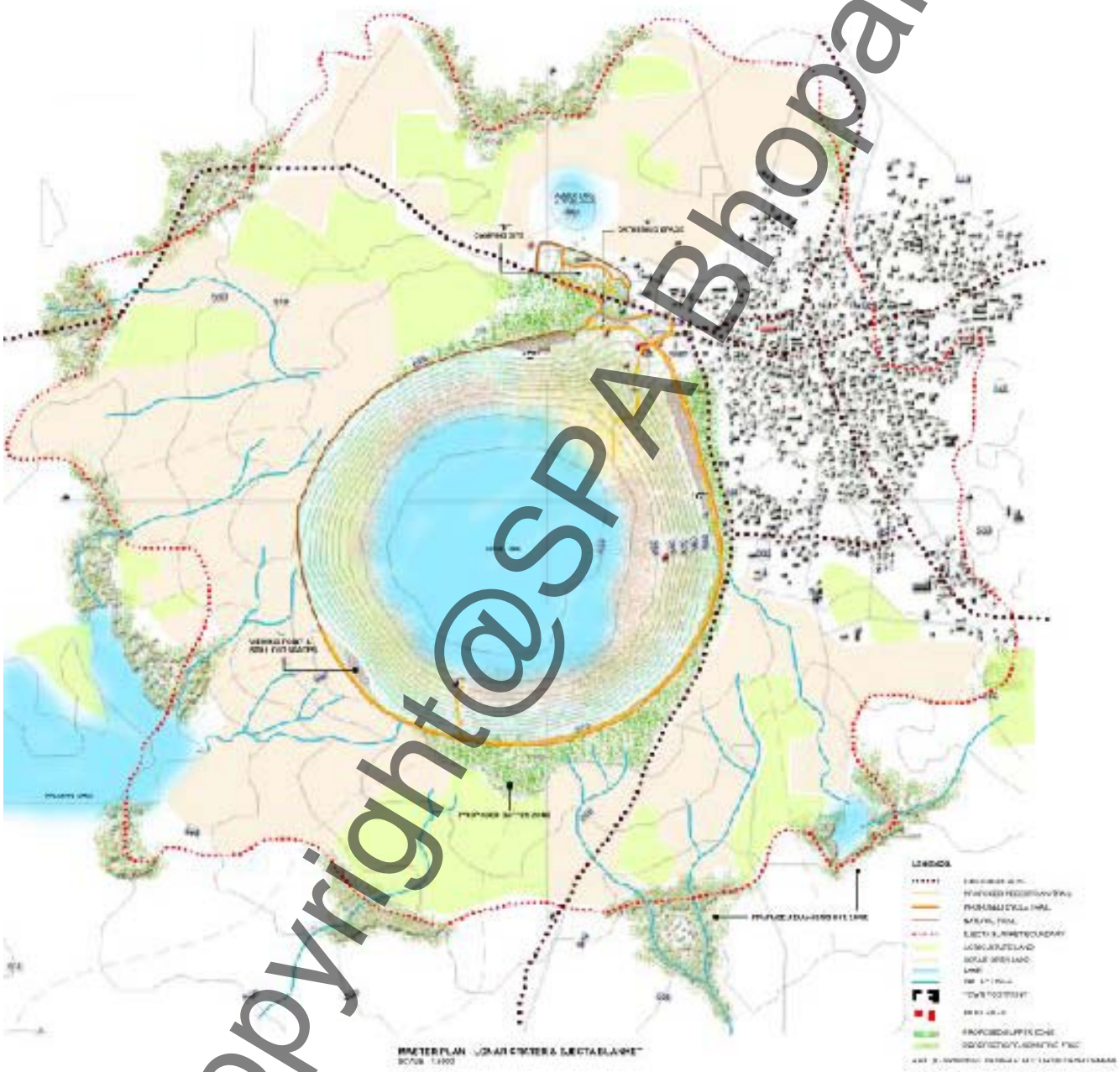


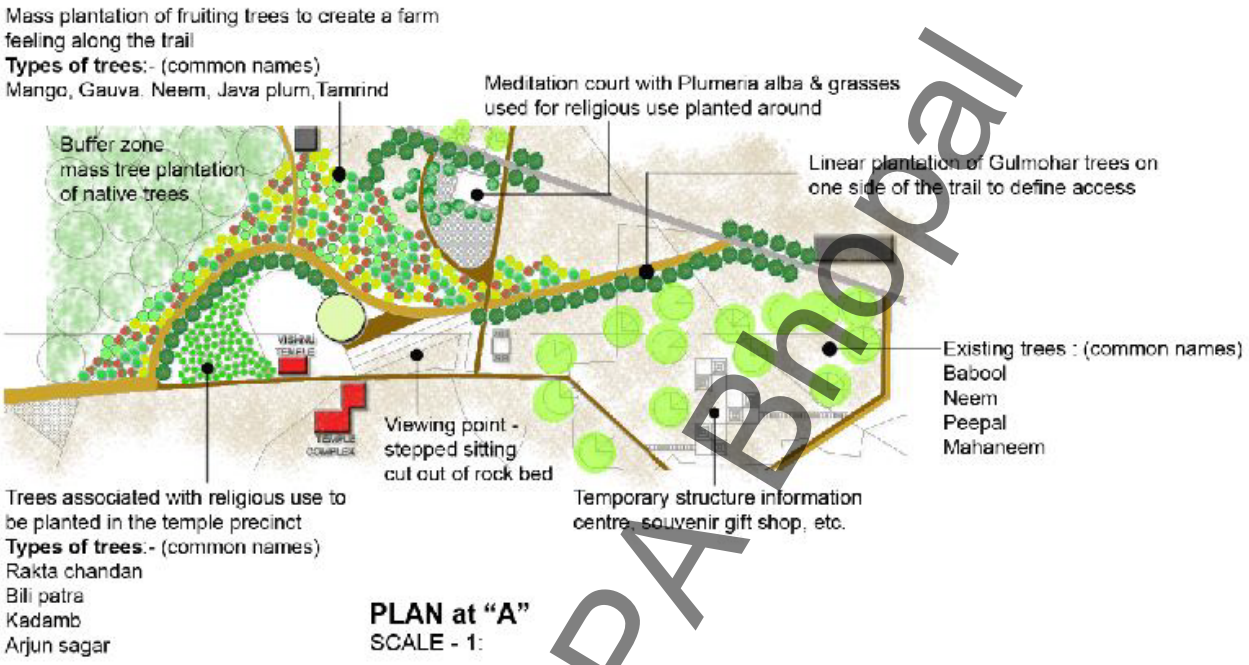
Table 4. 1 Sustainable development

5.0 **Design proposals:**



Map 5. 1 Mater plan for Lonar Crater

5.1 **Proposed tourism development - space "A" for gathering & meditation:**



Landscape design guidelines:

1. Features of environmental, cultural or heritage significance have been preserved.

2. Environmentally significant functions have been maintained.

3. Individual trees have been protected.

4. Rehabilitation and landscaped areas have been determined.

5. Buffer zones have been delineated.

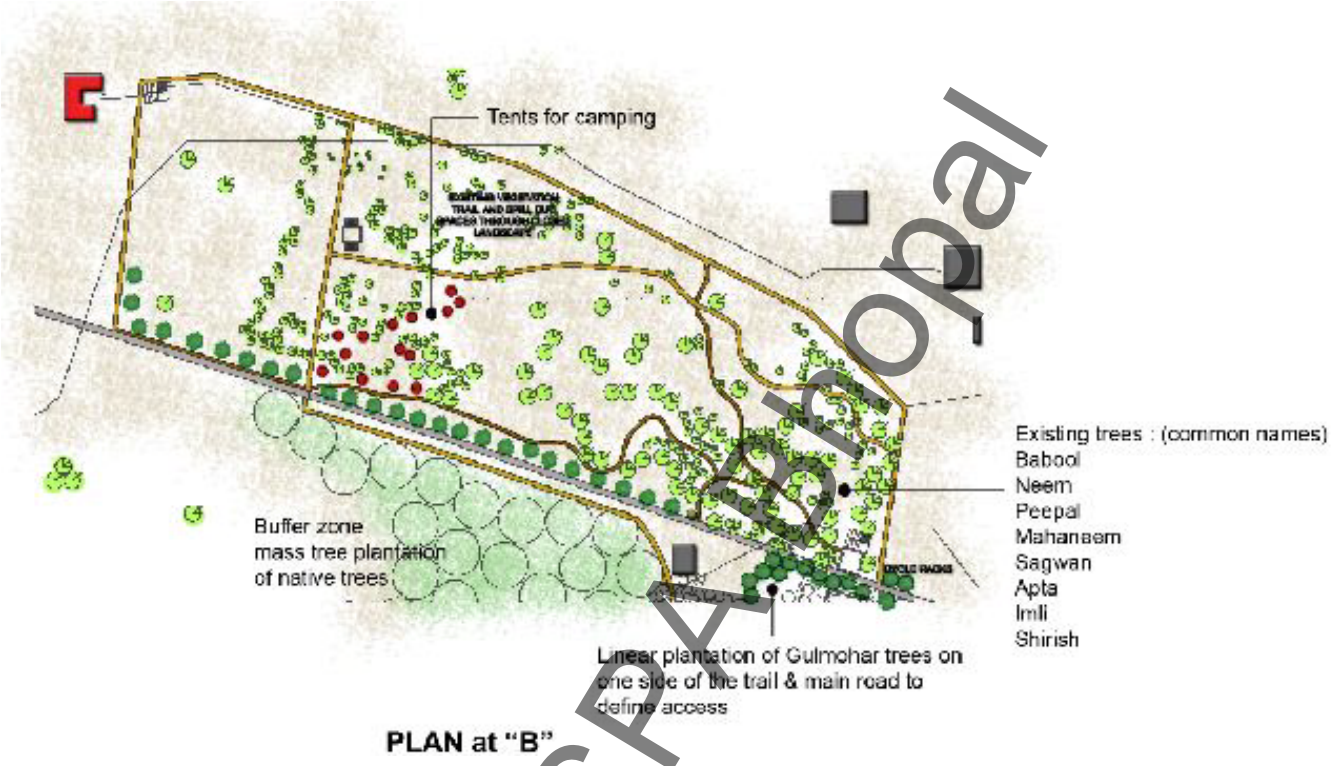
6. Park and open space provisions, including active/passive embellishments have been derived.

Viewing point with sitting

Structures for Information centre, souvenir shop, etc.

Structures for bathing area & similar closed structure for toilets

5.2 **Proposed tourism development - space “B” camping site:**



PLAN at “B”

Landscape management guidelines for camping site :

1. Wilderness conservation in ecologically sensitive landscapes.

2. Local community participation and benefit-sharing.

3. Sound environmental design and use of locally produced and sustainable materials.

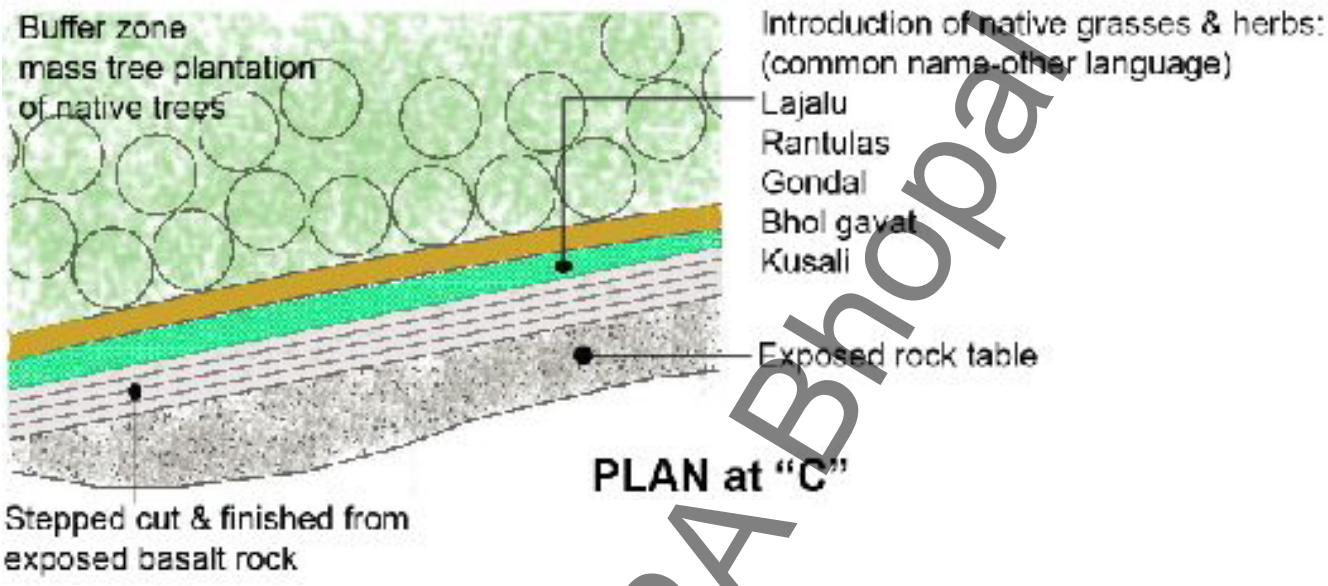
4. Conservation education and training.

5. Capacity building of local communities in planning, providing and managing tourism facilities.

Portable tents to be used for camping in the designated landscape area

Experience in a forest camping site

5.3 **Proposed tourism development - space "C" viewing points & spill over spaces:**



Stepped cut out of exposed basaltic rocks

Exposed basalt rock table for tourists for camping & viewing

5.4 **Buffer zone:**

1. A buffer zone is demarcated to ensure protection, promotion, sustainable development of the crater.

2. There are two types of buffer zones as per M.O.E.F guidelines i.e.:
   (a) Traditional use zone,
   (b) Forest buffer zone

3. The buffer zone proposed for lonar crater is a forest type - dense vegetation, it acts as a shock absorber for the region.

4. It buffers the State highway 171 from the crater rim - so that minimum or no impact is caused to the otherwise sensitive landscape & ecology of the crater.

5. The vegetation to be planted in the buffer zone will be all native trees of dry deciduous type.

Management guidelines:

- The conditions and structure of the vegetation and landscape of the buffer zone should preferably be as similar as possible to that of the conservation area, as if the buffer zone is an extension of the core zone;
- An ecosystem approach should be followed as much as possible, whereby the buffer zone could be an extension of the ecosystem or could have a corridor function for migrating species (e.g. Project Elephant in India);
- The biological diversity of the buffer zone (number of local species) should be as high as possible. This also means that LEISA and adapted agriculture is preferable to modern large-scale agriculture and cash crops;
- Buffer zone activities should not have a negative impact on the soil and water conditions.

Large plantations of exotic species such as eucalyptus and pines should be avoided;

- In order to avoid abrupt changes, utilization of buffer zones should be as

close as possible to the traditional uses (and only if the traditional uses are sustainable);

- Possibility of extending the conservation area;

- When developing and managing buffer zones, specifics on flora and fauna should be taken into account (species, migration, pests, crop raiders, species that are endangered, vulnerable, rare etc., distribution, mineral licks etc.).

-Different species require different interventions;

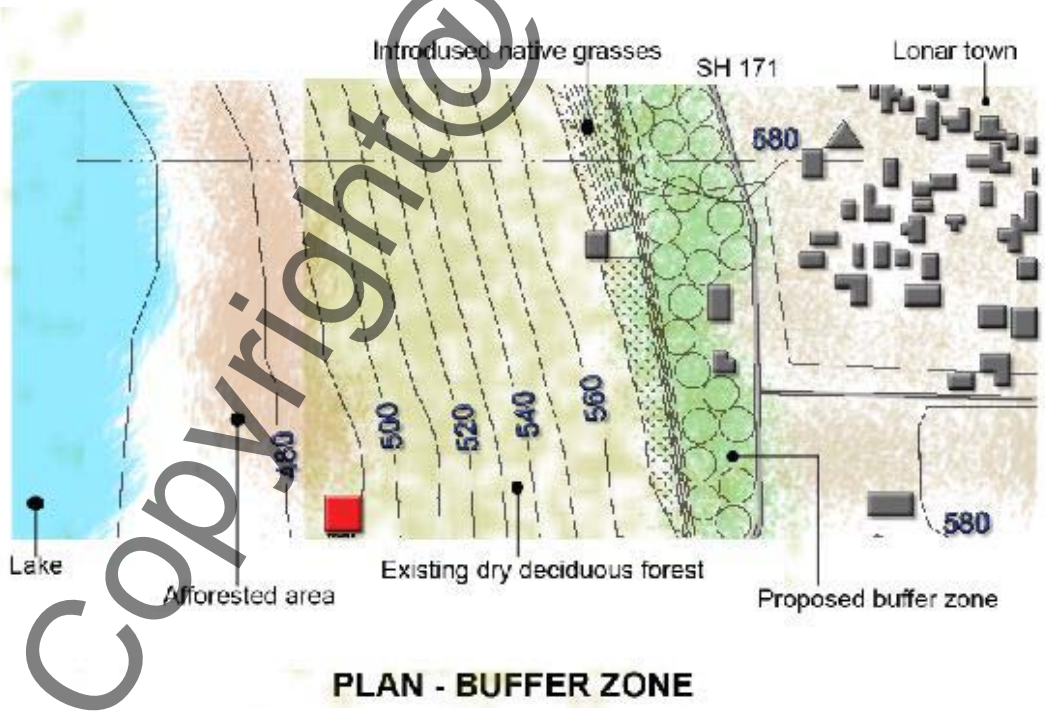
- Sensitive areas must be recognized.

- The ownership of buffer zone management should be at the lowest level possible, unless the law determines otherwise (in Ghana for instance forests are seen as strategic natural resources and therefore managed from the central level)

- High population pressure;

- The buffer zone (not the forest enterprises) has a low biodiversity and is completely cultivated;

- The buffer zone concept could only be applied in a limited area.



PLAN - BUFFER ZONE

5.5 **Eco-sensitive zone:**

1. The ecosystems which include not only forested hill ranges but also their streams, escarpments, platues, rugged crests, etc. are specialized ecosystem with their own distinctive abiotic variabilies (geology, geomorphology, hydrology, climate)

2. These have a strong bearing on biological diversity and uniqueness of the ecosystems, communities, species, genetic variability. These biotic and abiotic components of ecosystems contribute towards giving “hot spot” status.

3. An ecosensitive zone is demarcated to ensure protection, enhancement of the valley lines and the ejecta blanket of the region.

4. It is proposed to prevent ecological damages as well.

5. The eco-sensitive zone proposed for lonar crater is a thick vegetation of native trees which will in due course of period form a boundary along the ejecta blanket hence protecting & enhancing the landscape character of the region.

Management guidelines:

- The conditions and structure of the vegetation and landscape of the eco-sensitive zone preferably is similar as possible to that of the region i.e native vegetation.
- The intension is to protect the valley lines and the ejecta blanket.
- Construction, mining, development activities in the zone are strictly prohibited.
- No promotion of tourism activity in the zone.
- The geology and Topography of the area to be disturbed.
- Identification of any sensitive area in the zone is necessary for further protection.
- The zone should not be impacted by any pollution or encroachments.

- Restriction on the use of natural resources of the eco-sensitive zone is must.
- No commercialization.
- The zone could act as a distinctive eco niche.
- Provide safe and easy access for pedestrians, cyclists, cars and buses supported by appropriately planning of the circulation pattern for the region.
- Avoiding the fragmentation of the natural landscapes if any. Instead merge the natural with the designed eco-sensitive zone as far as possible.
- Managing the risk where it has the potential to directly impact upon the water resources or humans using these resources.

PLAN - ECO-SENSETIVE ZONE

5.6 **General management guidelines for the crater:**

Built Form and Development:

— Restrict development of a nature that is inconsistent with the vision and purpose of the area.

— Ensure that built form is of a high design standard and quality appropriate to the context of its location.

Protection of Water Resources:

— Seek to maintain a detailed understanding of the water quality and ensure uses and activities do not contribute to water quality decline.

— Manage risk where it has the potential to directly impact upon the water resources or humans using these resources.

Access and Traffic Management:

— Maintain and improve access to the Crater Lakes Area for visitors and the local community.

— Retain a logical hierarchy of access appropriate to the desired character and activities of each precinct.

— Provide safe and easy access for pedestrians, cyclists, cars and buses supported by appropriately located car parks.

— Consider the establishment of a tourist bus loop to provide access and connect the town, the Crater Complex and the precincts.

Geological Value:

— The geological value of the Crater Lakes Heritage Area should be retained and be visible in any developments undertaken within the area.

— Areas, which are significant in a geological sense, should be highlighted and interpreted clearly to visitors.

— No work should be undertaken in the Lakes area which damages in any physical way the remnant geological elements, particularly the craters, lakes and blow-holes.

Natural Landscape Value:

— The remnant native vegetation which remains within the Crater Lakes area should be carefully protected and retained intact.

— Full identification, delineation and assessment of biodiversity of such areas should be undertaken.

— Identify on site important areas of natural landscape for interpretation by visitors.

Managing Activities:

— Review existing activities and assess impact on the physical, cultural and social aspects on the study area.

Bibliography

Websites:

- http://www.downtoearth.org.in
- http://www.natgeotraveller.in
- http://indiatoday.intoday.in
- http://www.thehindu.com
- https://en.wikipedia.org
- http://www.maharashtratourism.gov.in
- http://meteoritics.org

Research paper:

- Geochemical identification of impactor for Lonar crater, India (Saumitra Misra, Horton E. Newsom, M. Shyam Prasad, John W. Geissman, Anand Dube, and Debashish Sengupta)
- Geology of Lonar Crater, India (Adam C. Maloof, Sarah T. Stewart, Benjamin P. Weiss, Samuel A. Soule, Nicholas L. Swanson-Hysell, Karin L. Louzada, Ian Garrick-Bethell3, and Pascale M. Poussart)
- Tnorala conservation reserve (GOSSE BLUFF) Plan of management March 1997, amended May 2007 parks
- World Heritage scanned nomination copy – Vredefort dome, South Africa
  Date of inscription: 15th July 2005 File Name: 1162.pdf
- Landscape Character Assessment – guidance for England & Scotland
- Milton Keynes Landscape Character Assessment – Area 1 Yardley Ridge
- Tnorala conservation reserve (Gosse bluff) plan of management – march 1997 (amended may 2007)

Bibliography

- Ramgarh magnetic anomaly in the chambal valley sector of vindhyan basin: a possible meteorite impact structure and its implications in hydrocarbon exploration - Jitendra Kumar*, M.S.Negi, Rajesh Sharma, D.Saha, Sanjive Mayor & Manoj Asthana
- Geochemistry of glassy rocks from Ramgarh Structure, India. – (S. Misra, D. Panda, D. Ray, H. Newsom, A. Dube and M. S. Sisodia, SAEES, University of KwaZulu-Natal, Durban, South Africa)

Book:

- Lonar – The Unique Indian Meteorite Crater in Basaltic Rock (Author: Mr. S. T. Bugdane - M.A, B.Sc, B.Ed)
- Guidelines for Landscape & Visual Impact Assessment – third edition (The Landscape Institute; Institute of Environmental management & assessment)