

10.3.5 PROPOSED STRATEGIES FOR RIVER

10.3.5.1 Key elements to encounter

- Urbanisation around the river
- Polluted drains contributing to the river
- Sewerage outlet in the river
- Solid waste dumping around river

The restoration and conservation of the Kolong River is an important goal for the Nagaon town. To achieve this goal, in a sustainable manner, several actions are necessary. These actions focus on addressing pollution from the major sources – raw domestic sewage and MSW – and improving the hydraulic conditions. Actions are also proposed to provide human use benefits for the citizens of Nagaon. By providing these benefits, and connecting people to an improved waterway, the stewardship of the river can be shared by all and achieve lasting conservation success.

10.3.5.2 Proposed Actions that Comprise the Restoration Solution

To remain consistent with the framework, the proposed actions which comprise the restoration of the Kolong River include:

- Sewage collection and treatment.
- Solid waste collection and management.
- Disposal location for animal carcasses.
- Removal of legacy pollution.
- Hydraulic improvement (including uptake of water from the Brahmaputra River to revive proper flow of Kolong River).
- Improving hygiene and sanitation conditions.
- Community access and benefits.
- Setting of monitoring system.

Each of these actions is described in more detail further:

• **Sewerage collection and treatment:** Presently there is no centralised sewerage collection and treatment facility in Nagaon largely because most households have either a septic tank or soak pit. A new sewerage collection system is proposed to collect all sewage and transport it to a centralised place for treatment. The system, if properly implemented, will significantly reduce pollution loads to the river. Another option which may be considered is to have multiple decentralized STPs located at strategic locations throughout the catchment area. This option will be evaluated in the Feasibility Report.

• **Solid waste collection and management:** As the Nagaon town does not have any existing solid waste collection and management plan, it is proposed to have an Integrated Solid Waste Management Plan for the catchment area, which will also cover the entire town. As the town will implement a MSW collection and management system, waste will be collected from

primary and secondary locations, and transported off-site to a disposal or reclamation facility. This system will require many years to become effective as the population learns to use and value the system over current litter and dumping practices.

• **Disposal location for animal carcasses:** Nagaon has a disposal site 8 km away from the Nagaon town which is presently used for the disposal of animal carcasses. During the primary survey, signs of disposal of carcasses in the Kolong River were not observed but are known to take place.

• **Removal of legacy pollution:** Due to current practices, there is significant pollution in the Kolong River from sewage and MSW sources. Although this pollution could be allowed to naturally attenuate following sewage and MSW source control measures described above, the restoration of the river can be significantly accelerated by removing this legacy pollution. This action would involve dredging and bank clean-up to remove this legacy pollution.

• **Hydraulic improvements:** Regular flooding of the Nagaon town due to Kolong River in the past has resulted in closer connectivity of the Kolong River with the Brahmaputra River by the water resources department. This has resulted in less flow in the Kolong River, although the river is also connected to the Misa River and Diju River. The pollution in these rivers also contributes to the pollution of the upstream stretch of the Kolong River. A morphological study for the off take at Brahmaputra River should be studied to find solutions for hydraulic improvement of Kolong River.

• **Improving hygiene and sanitation conditions:** A number of community toilet complexes are required

in gardens and playground areas along the river. Solid waste collection bins and proper washing and bathing facilities are required at ghats along the river.

• **Community access and benefits:** One of the keys to river conservation success is to provide human connections to the waterway. When these connections are established, everyone becomes a steward of the river and the restoration will be more likely to succeed. Examples of community benefits include the establishment of greenways along the

10.3.5.3 Treatment and Disposal of Septage

Some of the households in the towns are equipped with ordinary septic tanks. Under the Swachh Bharat Abhiyan, Public Health Engineering has constructed 5893 numbers of IHHL (Individual Household Latrine) in the Nagaon district to attain open defecation free status. Moreover, public toilets have also been constructed at the commercial areas.

Following remedial actions will be taken in consideration of treatment and disposal of sewage

- Sewage Treatment plant should be installed for treatment
- The discharge should be trapped by strainers before draining off to the river.
- Every individual households should be connected to sewer lines.

waterfront and points of interest to educate the community on conservation features and ecological resources.

• **Setting of monitoring systems:** An on-line system can be designed and proposed to be implemented to monitor the water flow as well as water quality of the Kolong River system. The on-line information will be used by decision makers to avoid flooding in the town.

- Every households should be recommended to have individual drainage that should be connected to soak pits or stagnated pool.
- Roadside hotels/restaurants should not be allowed to dispose untreated sewage and solid waste into the nearby drains or rivers. These establishments should be properly regulated by the concerned authority.
- Public awareness to control open defecation and understand the sanitary hygiene.
- Local administration should provide proper pucca toilets for the individuals or atleast community toilets through the IHHL scheme under Swachh Bharat Mission.

10.4 MORIKOLONG WATERBODY

10.4.1 CURRENT SCENARIO

Morikolong enjoys hot-wet summer and cool-dry winter. The temperature of these area drops to minimum of 80 C and raises up to maximum of 34.30 C. The average annual rainfall is about 1514.44 mm. June, July, August and September are the wettest months. On the other hand, December and January record the minimum rainfall. During dry season depth of the water of Morikolong remains at 2 meters but it raises up to 4 meters during monsoon. Various landuse patterns has been seen in the catchment area of Morikolong which include – agriculture, commercial area, residential area, and some area covers by bamboo and other trees. The ever-growing landuse changes have caused the shrinkage of waterbody area.

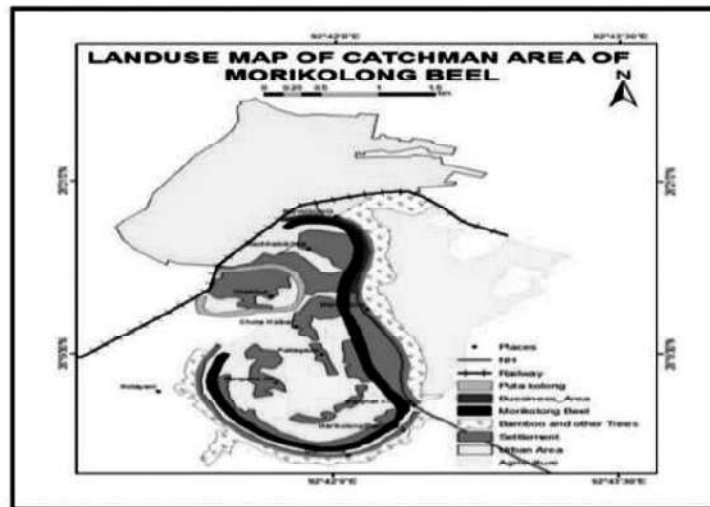


Figure 154 Mori-Kolong Catchment Landuse Map



10.4.2 BIODIVERSITY OF MORIKOLONG

Various types of flora and fauna are found in Morikolong.

Flora: Morikolong is rich in floral diversity. Some of the flora found in Morikolong is given in following table.

Table 196 Variety of Flora found along Morikolong

Sr. no.	Local name	Plant name
1	Bih Meteka	Eichornia crassipes
2	Dal Ghah	Nymeneche assamicanith
3	Boss	Acorus Calamus Linn
4	Kuhila	Aeschynomene aspera Linn
5	Jora	Alpinia galanya
6	Kola Kochu	Alocasia fornicate schott
7	Mati Kanduri	Alternanthera sessile
8	Guri Puni	Azolla Pinnata
9	Kona Simalu	Commelina benghalensis Linn
10	Keheraj	Eclipta Prostrata
11	Kalmou	Jpomoea aquatic Forsk
12	Sorupuni	Lemna Perpusilla Journey
13	Pani Meteka	Monocharia vaginalis
14	Pani Likosi	Nejas indica(will) eham
15	Bhet	Nymphaea Stellata Willd
16	Bihlongoni	Polygonaceae
17	Leheti	Renunculus sceleratus Linn

Fauna: Morikolong rich in faunal diversity include various types of aquatic birds and fishes. But due to several anthropogenic activities create threat to reduce these diversities.

Birds: The dominant aquatic birds found in Morikolong.

Table 197 Aquatic birds found along Morikolong

Local name	English name	Scientific name
Sarali Hah	Whistling Duck	Dendrosygna javanica
Samukvanga	Openbill stork	Anastomus
Bogoli	Cattle egret	Bubulcus
Dolghora	Grayheaded lapwing	Vanellus cinereous
Pani kauri	Little Cormorant	Phalacrocorax
Masruka	Kingfisher	Alcedo atthis
Dawk	White breasted waterhen	Amaurosis phoenicurus
Dolmoura	Red walted lapwing	Venellus indicus

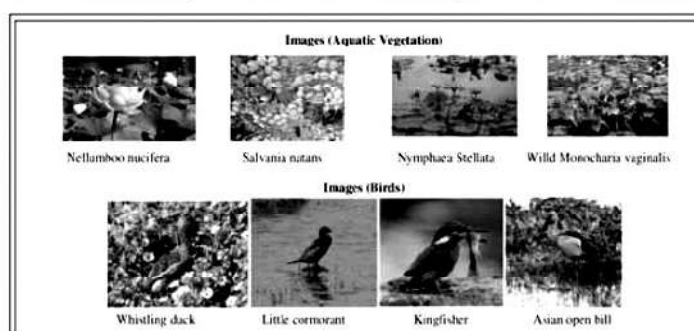


Figure 155 Aquatic Birds and Vegetation found along Morikolong

Table 198 Local names of Aquatic Birds found along Morikolong

Local name	Scientific name
Puthi	Puntius Chola
Moa	Amblypharyngodon mola
Darikona	Brachydanio rerio
Kandhuli	Notopteros
Singi	Heteropneustes
Magur	Clarius batrachus
Kawoi	Anabas testudineus
Sal	c.marulius
Soul	C.stariatus
cuchia	Monopterus cuchia
Kholihona	Colisa fasciatus
Goroi	Channa punactatus
Turi	Macrogynatus aculeatum
Patimutura	Glosogobius giuris

The Morikolong is an ideal freshwater ecosystem containing both organic and inorganic materials. Although it is a part of the Kolong river in far past but now it is an ox bow lake having no connection with the mainstream of Kolong river. The waterbody is perennial. In recent times the land use changes in surrounding areas due to manmade factors have left huge impact on the Morikolong. These land use changes and human impacts are discussed below:

Land use of an area is nothing but a representation of different physical as well as cultural elements which play an important role in the socio-economic development of a particular geographical area. Various anthropogenic activities have resulted into changes in land use and landcover pattern. The land use pattern effects the Morikolong in a various way. At present major portion of the Morikolong is under human settlement. On an average 68% of the area in the surrounding region of the Morikolong is used for residential purposes. Except it, the existing land cover is used for agriculture, plantation, and fallow land. Approximately 15% area is used for agriculture while 3% under vegetation cover and another 2% is used for fallow land. The fringe area of the Morikolong is used for paddy, jute, sugarcane, mustard and another crop production. As soon as the flood water recedes the fertile banks becomes ready for the cultivation of paddy, jute and other crops. Boro, a coarse variety of rice is normally cultivated in the areas during the winter season.

A few decades ago, most of the land is used for cultivation. The proportion of the fallow land is also very high. But due to the increasing population at an alarming rate most of the fallow and cultivated land is converted to the residential areas. From of the field study, it is revealed that most of the people are migrated from outside of Nagaon district and settled here except the local Assamese people. Thus, density of the population is increasing day by day. So, most of the vegetation cover is being destroyed for the use of the residential purposes and there by remaining only a small tract of the vegetation cover in present days. Along with the residential areas the commercial areas are also developed and now a vast portion of the land of the waterbody is used for commercial purposes. The market centres are growing day by day. Besides, some portion of the waterbody is also used for constructing various institutes like school, temple, mosque, library, club etc. Agricultural land, open spaces and the green belt is now converted to either residential or commercial purposes. Even the low-lying areas along with the banks is also being used for various construction. Bus stand, schools, junior colleges, commercial farms also cover a considerable portion of the wet land. Open spaces are mostly used by the families for vegetation production. A major portion of the waterbodies is now converting into the dumping place of the urban and domestic garbage"s. As the urbanization process of the Nagaon town is extended to the sub urban or peripheral regions the commercial activities also increase and

this altogether change the land use pattern.

The Morikolong waterbodies and its surrounding areas have experienced some problematic phenomena during recent years. These arises due to the rapid land use changes caused by the human activities. These changes have resulted some impact on the waterbodies such as:

Degradation of the water quality: The rapid increase of the residential areas leads to increase in the waste products which are often directly dumped into the waterbodies So, a large portion of the waterbody is deposited with waste products and garbage etc. Besides, some people use open defecation near the beel. In some portions, pipe and drain of the domestic toilets are open into the waterbody through which the waste products are drained into it. All these leads to the degrade the water quality and resultant water pollution.

Disappearing of the water body: Due to the more human encroachment some portion of the waterbody is disappeared. For his own benefits people construct a no. of bridges, culverts across the waterbody leading to the fragmentation of the waterbody into small segments. A decade ago, a bus stand was constructed on the waterbody by filling a considerable portion of it. All these leads to the disappearing some portion of the Morikolong waterbody.

Destruction of the bank vegetation:A few years ago, this area is under enormous green belt. But with the changing land use pattern man destroy this vegetation covers for their own purposes. The decreasing vegetation cover also have a negative impact on the environment.

Loss in aquatic biodiversity: Traditionally the Morikolong is the home of various fauna and flora. Due to more human encroachment the quality of the waterbody starts to degrade which leads to decrease aquatic floras. Extraction of the fishes from it also increasing in present day. Moreover, for their own profit the businessmen mix hybrid species of fish fauna in the waterbody. It harms the local fish species and extinction of some local species such as Darikana, Selekana, Kholihana etc. In past years, the natural calm environment of the waterbody attracts a large no of the migratory birds during autumn and winter which are now decreasing in large no due to increasing human presence and destroying the natural vegetation. There is no doubt that Morikolong has every possibility to develop a site of recreation where people can enjoy the natural beauties and refresh themselves. But the ever-increasing human activities in this region reduce this possibility very fast. Moreover, with the increasing no of commercial fisheries the local poor fishermen have to suffer as they are not allowed to catch fish. They are now compelled to change their traditional economic activities.



(Source: Changing Land Use Pattern and Human Impact On Wetland, Miss Banashree Devi)

10.4.3 ISSUES AND REQUIREMENT

10.4.3.1 Key elements to Encounter

- Degradation of water bodies
- Construction on riverbed
- Garbage dumping
- Eutrophication remediation from waterbody surface

Issues:

Several anthropogenic activities which include agricultural, industrial and construction of buildings have created tremendous pressure on waterbody environment which leads to threat upon water ecology. In this way this waterbody environment is being degraded day by day and several types of flora and fauna are extinct from the Morikolong. In the northern most part of the Morikolong mostly falls in urban environment and in this part, waterbody has been shrinkage near about 2.61 hac land from year 1987 to 2014. It is due to earth filling of Morikolong area for construction of bus stand and dumping ground for urban solid wastes. In the western most part where Kachalukhuwa village has located some people has constructed several multi storied building above the waterbody. Liquid effluents domestic sewages are throwing towards the Morikolong which may cause the degradation of waterbody environment. During winter season when water level falls down several agricultural activities has taken place in neighbouring areas of the Morikolong by the local people. These agricultural activities may also have resulted towards degradation of waterbody environment.

Requirement:

For wise use of waterbody resources, it is very important to assess the impact of socio-economic factors upon the waterbody environment in regards of management plan. For proper management of waterbody resources several Steps should be taken to protect the waterbody from encroachment and strict law should be implement for their protection to illegal encroachment. Alternative means of livelihood should be generated for the people who depend upon waterbody resources for their survival. It will reduce the exploitation of waterbody resources and killing of fish and fauna. In Morikolong large part of the area covered by water hyacinth is facing a major problem. The eradication of weeds from the waterbody on a regular basis should be taken so that it may increase nutrient status and phytoplankton productivity. This will help to increase fish productivity. Efforts should be made to educate the local people and create awareness about the importance of management and conservation of this waterbody. Successful management of waterbody resources depends upon how properly concern authorities adopt appropriate plan and in what way it should be implemented.

a. Eutrophication Remediation

Industrial effluents, run-off from agricultural fields, refuse and sewage, domestic wastes like food remnants, soaps, detergents, and sewage are dumped into lakes which break down and release nutrients in the lake. Microscopic organisms ingest these nutrients and survive on them. Following ingestion of carbonic elements, carbon dioxide is released, while some of the elements are converted into nitrates and phosphates. This is called oxidizing and uses up a lot of dissolved oxygen. The depleted levels of dissolved oxygen in water lead to a situation where other aquatic life-forms cannot survive. This process is called eutrophication.

Table 199 Effects of Eutrophication and Benefits of Removal

Effect of eutrophication	• Benefits of reducing eutrophication	• How benefits can be measured
Increased taste and odor problems in water supply	<ul style="list-style-type: none"> • Lower costs of treating water • Less need for substitute water (e.g., bottled water) 	<ul style="list-style-type: none"> • Treatment cost savings • Increased consumption of water and differential between prices of substitutes and municipal supply
Reduced visual and tactile qualities of water body	<ul style="list-style-type: none"> • Increased development around water body • Increased recreation • More diverse biota 	<ul style="list-style-type: none"> • Increased value of properties • Increased development of land • Increased expenditures on recreation • Prices for different species caught • Public WTP for improved ecosystem
Increased possibility of toxins in water	<ul style="list-style-type: none"> • Increased commercial and recreational fishing • More diverse biota • Increased water contact 	<ul style="list-style-type: none"> • Increased number and value of fish caught • Public WTP for improved ecosystem • Increased expenditures on recreation
Loss of water depth, surface area, and storage capacity	<ul style="list-style-type: none"> • Reduced need for alternative water supplies • Values of shoreline property preserved • Continued viability of fisheries • Continued viability of recreation 	<ul style="list-style-type: none"> • Avoided costs for dredging and substitute water supplies • Avoided losses in property values • Value of fish catches, which would not have taken place • Recreational expenditures which would have been lost • Public WTP for existence of lake, apart from use values



Figure 156 Eutrophication on the surface of Morikoilong

10.5 WETLANDS AROUND NAGAON TOWN

Wetlands are important to us as they remove pollution, recharge groundwater supplies, control floods, and provide home for variety of plants and animals. Wetlands include swamps, marshes, bogs, and fens. Nagaon have 3 major wetlands which surrounded by marshy lands, ponds, and low-lying areas. These wetlands are so rich in flora and fauna and plays a major role to Nagaon's environment for conserving the nature and remove harmful substances from it.

Because of increase in urbanization around these wetlands, the ecology and beauty of these wetlands are declining.

- Encroachments and unauthorized filling
- Dumping of garbage
- Lack of facilities for environmentalist, students, public and tourist to enjoy scenic beauty and learn about wetland structure, functions, and biodiversity
- Threat to the Bio- diversity
- Visual pollution
- Flooding

10.5.1 MAHRUL WETLAND

Mahrul wetland is situated in south-east of the Nagaon city. Some private recreational activities are already established around this wetland i.e Jasingfaa Aqua Tourism Resort, which is a recreational park promoting aqua based fishing and boating activity for tourists and visitors.



Figure 157 Mahrul Wetland

10.5.2 RANTHALI WETLAND

These wetlands are in the south-west of Nagaon city, a little far from the city centre. The wetlands possess good amount of aquatic plants and fish which enhance source of income and support the livelihood pattern among the village people. Almost 80% of rural people have engaged themselves with the nearby wetlands, especially for agricultural activity, fishing and grazing of animals. The place is famous for Ranthali jewelries, an authentic jewelry making art.

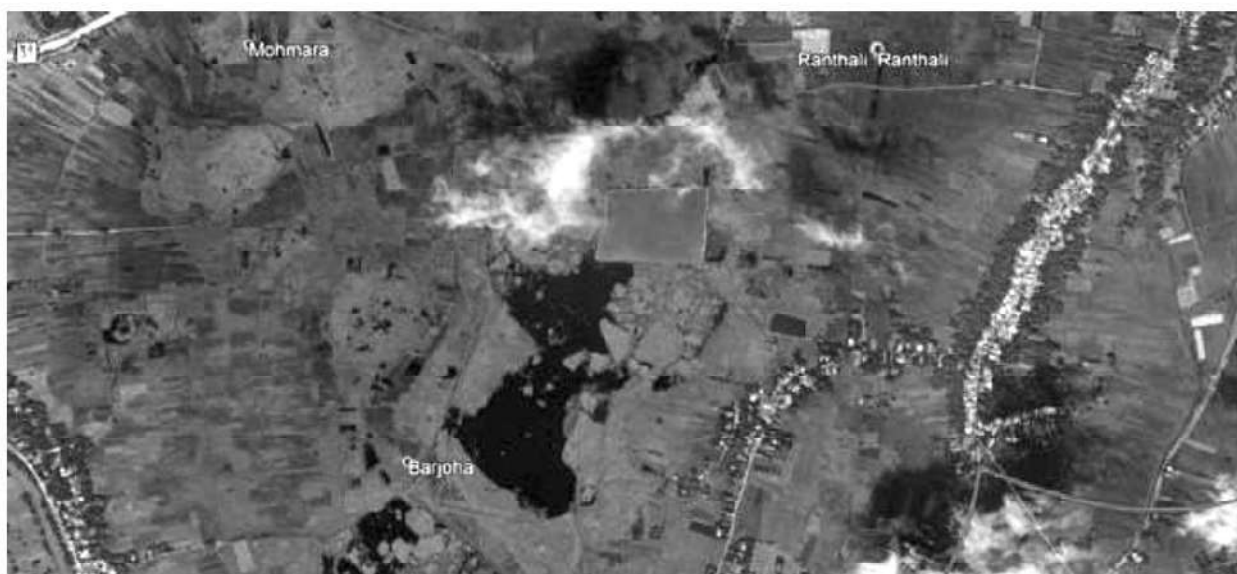


Figure 158 Ranthali Wetland

10.5.3 FAKOLI BEEL WETLAND

This wetland is on the south side of Nagaon city, this wetland some time witnesses migratory birds in season.



Figure 159 Fakoli Beel Wetland

Wetlands are indispensable for the countless benefits or “ecosystem services” that they provide freshwater supply, food and biodiversity, flood control, groundwater recharge, and climate change mitigation. These wetlands need to be conserved

- Preserve the natural environment by utilizing the land for eco-friendly development (nature trails, timber structures, creation of ponds, tree planting etc.)
- Protect wildlife by creating breeding and feeding grounds for birds
- Promote recreational activities, walkways, bird watching etc.

- Prevent public land development for unacceptable uses and from encroachments
- Conserve the area for the use of future generation.
- To enhance the natural environment of the area combining the plains, marshy lands and wetlands which is rich in scenic beauty where recreational facilities could be introduced
- To protect wetland biodiversity by preserving a preferred environment, especially for birds and butterflies
- To create opportunities for students and naturalists to learn/explore wetland plants and animal species
- To improve as a tourist attractive site with providing recreational facilities
- To maintain and preserve the wetland for flood retention purposes

10.5.4 PROPOSED STRATEGIES

10.5.4.1 Key elements to Encounter

- Degradation due to pollution
- Construction around the marshy land
- Garbage dumping
- Encroachments and unauthorized filling
- Wetland areas have been drained and reclaimed for agriculture and urban sprawl.
- Need to save the wetlands:
- To protect wetland biodiversity by preserving a preferred environment, especially for birds and butterflies
- To create opportunities for students and naturalists to learn/explore wetland plants and animal species
- To improve as a tourist attractive site with providing recreational facilities
- To maintain and preserve the wetland for flood retention purposes.
- Preserve the natural environment by utilizing the land for eco-friendly development (nature trails, timber structures, creation of ponds, tree planting etc.)
- Protect wildlife by creating breeding and feeding grounds for birds
- Promote recreational activities, walkways, bird watching etc.
- Prevent publicland development for unacceptable uses and from encroachments
- Conserve the area for the use of future generation

10.5.4.2 Restoration strategies:

a. Preserve and protect aquatic resources:

Existing, relatively intact ecosystems are the keystone for conserving biodiversity, and provide the biota and other natural materials needed for the recovery of impaired systems.

b. Restore natural structure:

Many aquatic resources in need of restoration have problems that originated with alteration of channel form or other physical characteristics, which in turn may have led to habitat degradation, changes in flow regimes and siltation. Stream channelization, ditching in wetlands, disconnection from adjacent ecosystems and shoreline modifications are examples of structural alterations that may need to be addressed in a restoration.

c. Work within the watershed and broader landscape context:

Restoration requires a design based on the entire watershed, not just the part of the waterbody that may be the most degraded site. Activities throughout the watershed can have adverse effects on the aquatic resource that is being restored. A localized restoration project may not be able to change what goes on in the whole watershed, but it can be designed to better accommodate watershed effects.

d. Address ongoing causes of degradation:

Restoration efforts are likely to fail if the sources of degradation persist. Therefore, it is essential to identify the causes of degradation and eliminate or remediate ongoing stresses wherever possible. While degradation can be caused by one direct impact, such as the filling of a wetland, much degradation is caused by the cumulative effect of numerous, indirect impacts, such as changes in surface flow caused by gradual increases in the number of impervious surfaces in the watershed. In identifying the sources of degradation, it

is important to look at upstream and up-slope activities as well as at direct impacts on the immediate project site. In some situations, it may also be necessary to consider downstream modifications such as dams and channelization.

e. Design for self-sustainability:

Perhaps the best way to ensure the long-term viability of a restored area is to minimize the need for continuous maintenance of the site, such as supplying artificial sources of water, vegetation management, or frequent repairing of damage done by high water events. High maintenance approaches not only add costs to the restoration project, but also make its long-term success dependent upon human and financial resources that may not always be available.

f. Restore native species and avoid non-native species:

Wetland's natural areas are experiencing significant problems with invasive, non-native (exotic) species, to the great detriment of our native ecosystems and the benefits. Many invasive species outcompete natives because they are expert colonizers of disturbed areas and lack natural controls.

10.5.5 WETLAND DEVELOPMENT IN NAGAON

Urban planning and design should explicitly include wetlands as natural infrastructure for nature conservation, water management (stormwater management, water supply and water treatment) and recreation. The integration of wetlands in the urban environment can deliver tangible benefits for the economy, biodiversity, and local communities.

10.5.5.1 Conservation of wetlands

- Community wetland management
- Agriculture and Silviculture
- Farming Activities in Wetlands and Buffers:
- Buffering around wetlands and marshy land



10.5.5.2 Protecting Ranthali and Mahrul Wetland

Another important waterbody in the planning area is Ranthali and Mahrul wetland, which is situated within MPA and is medium size wetlands in Nagaon region. At present, it is working as a recreational space for local people. It is proposed to provide a buffer of 50 m around this lake also. Moreover, it is important to preserve the water channels, drains, which bring

water to this wetlands as the disturbance of that will lead to water logging in certain areas and sufficient water will not reach to the lake. Thus, the primary drains bringing water to the lake are given a buffer of 50 m from the edge of the drain as per National Environment Policy.

10.5.5.3 Recreational activities around wetlands

- Bird watching
- Jogging trails around the wetland parks
- Cafes and local shops
- Leisure time fishing and angling
- Water sports activities



Nature friendly jogging track

Commercials on Wetland



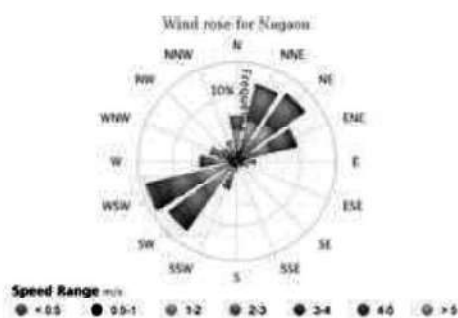
Water Sport over wetland parks

10.6 AIR QUALITY

10.6.1 WIND IN NAGAON

The wind direction of Nagaon annually is north of north-east and north-east and equally in west of south-west and south-west.

The average wind speed in Nagaon is 1.8 m/s with the maximum wind speed of around 6 m/s. The average ambient temperature remains 23.4°C, varies from 10.6°C to 35.6°C. The average relative humidity remains around 83.3%, varies from 44% to 99.8%. The station pressure varies from 975 hPa to 958 hPa, averaged around 987 hPa. Windrose of Nagaon shows that predominantly wind blow from the WSW - about 14.75% of all wind directions.



(Source: Indian climate.com)

10.6.2 AIR POLLUTION

The Air quality index of Nagaon overall is good. The air is quite clear and have very minimal impact. The SO_2 is 5, NO_2 is 13 and PM10 is 42.

Avg. CP	5	13	42
I Hi	50	50	51
I Lo	1	0	0
BP Hi	40	40	51
BP Lo	0	0	0
IP	7	16	42
Pollutant	Conct. in ug/m3	Sub index	Sub Index check
PM10 -24hrs. avg.	42	42	1
SO2 -24hrs. avg.	5	7	1
NOX -24hrs. avg.	13	16	1

(Source: pollution control board, Nagaon)

The level of air pollution concentration in residential is less than 50 ug/m^3 for particulate matter, in industrial 50-100 ug/m^3 for PM. And SO_x and NO_x is less than 50 ug/m^3 . In commercial areas the particulate matter is between 80-100 ug/m^3 .

10.7 COMMON STRATEGIES

In order to mitigate the above mentioned environmental issues, few proposals have been given, which is an effort to protect the environment of the region.

10.7.1 PROTECTION OF WATER BODIES

Water is the most precious gift of nature. Today, both surface and subsurface water in India and other South Asian cities is facing huge quantity and quality threat. Thus, it is crucial to protect the available source of water i.e. rivers, lakes, ponds, water channels etc. These waterbodies not only provide drinking water, support livelihoods and biodiversity but also control the rate of runoff and subsequently control the runoff. Nagaon Region has Three major water bodies namely, Mori Kolong, Mahrul and Ranthali beel. Considering the ecological importance of these wetland few proposals are given, which are as below.

10.7.1.1 Mori-Kolong

It becomes of utmost importance to preserve a waterbody of this much importance. In order to protect and conserve it, it is proposed to provide a buffer of 50 m around the Mori-Kolong beel. Apart from acting as a buffer zone, this area will be developed as a major recreational area for as well as surrounding regions. The water in Mori-Kolong comes from the following sources: (i) the run-off from the lake basin and direct interception by the water body; (ii) the water which is diverted by the natural dains through the channel to the lake. Therefore, it is important to conserve even the water channels, which brings water to the waterbody. A buffer needs to be given to the water channels as well.



Figure 160 Migratory Birds at Mori-Kolong

A large waterbody like Mori-Kolong attracting a large number of migrating birds from various corners of the region is itself an asset. However, this requires very careful management to see that it remains a place attractive to the migratory birds. The major problems which is faced by lakes of these kind is pollution arising out of various anthropogenic activities like free flow of untreated sewage to the waterbody, flowing of hydrocarbon elements along with the rainwater in the lake or untreated industrial effluent flowing into the waterbody. It is the general experience that development close to the lake borders with impervious cover invariably increases the phosphate content in the lake. Therefore, the following actions will be necessary to be taken by the local selfgovernment.

- Similarly, ensuring that no untreated industrial effluent/waste water reaches the lake.
- A regular system of monitoring the quality of water at the points where the storm water channel meet the lake.
- Regular census of birds and in case the coming of any particular species is going down, to enquire to the possible causes.
- To obtain the opinion of ornithologist about the status of planktons in the lake to keep a watch of algae bloom or hyacinth coverage of the water body.
- To collect the record of past incidences of death of fish with probable causes for such incident.
- The idea would be to see whether development of any kind is having any direct impact of the water quality and quantity of the feedstock for the migratory birds.
- Maintenance to see quality and safety of the areas where nests are built or where the eggs are laid.

a. Rejuvenation of waterbody by infrastructure development

The goals for conservation of Morikolong waterbody must be tailored to individual regions, specific to the problems of degradation and based on the level of dependence. This requires reconstruction of the physical conditions; chemical adjustment of both the soil and water; biological manipulation, reintroduction of native flora and fauna, etc.

b. Natures trails around waterbody

Nature trails are popular for wildlife viewing, walking, bike riding and other outdoor activities. Land managers often design and maintain trails in expansive public use areas. There is increasing interest from homeowners, business owners, wildlife enterprise entrepreneurs, schoolteachers, boy scouts, hospital personnel, parks department staff and others to develop and maintain nature trails on smaller landholdings.

Nature trails can be designed to minimize human disturbance and impacts on wildlife, plants, soils, and waterways. A well-designed trail can aid in land management, such as through simplifying timber evaluations or creating fire breaks. Properly built trails also provide opportunities to teach youngsters about wildlife, forestry, and natural resources.

To reduce impacts of trails and trail users on wildlife and plants, best trail practices are:

- Align trails along or near existing human-created edges or natural edges rather than bisecting undisturbed areas.
- Keep a trail and its zone of influence away from specific areas of known sensitive species.
- Avoid or limit access to critical habitat patches.
- Provide diverse trail experiences so that trail users are less inclined to create trails of their own.
- Use spur trails or dead-end trails to provide access to sensitive areas because these trails have less volume.
- Generally, concentrate activity along trails rather than disperse it.
- Keep trail construction impact as narrow as possible.
- Concentrate weed control at road and trail crossings, trailheads, and riparian areas

c. Water Sport Activities

Water sport activities like boating, Jet ski, riding need to be introdused for public recreational activities.



11 DISASTER MANAGEMENT

11.1 INTRODUCTION

Disaster is an undesired calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources. Disasters are usually caused by nature but in some cases, it can be caused by human actions as well. Disaster can be broadly classified into Water and Climate related, Geology related, and Accident related. India has been traditionally vulnerable to natural disasters on account of its unique geoclimatic conditions. Floods, droughts, cyclones, earthquakes and landslides have been recurrent phenomena. About 60% of the landmass is prone to earthquakes of various intensities; over 40 million hectares is prone to floods; about 8% of the total area is prone to cyclones and 68% of the area is susceptible to drought.

At the national level, the Ministry of Home Affairs is the nodal Ministry for all matters concerning disaster management. The Central Relief Commissioner (CRC) in the Ministry of Home Affairs is the nodal officer to coordinate relief operations for natural disasters. The CRC receives information relating to forecasting/warning of a natural calamity from India Meteorological Department (IMD) or from Central Water Commission of Ministry of Water Resources on a continuing basis. The Ministries/Departments/Organizations concerned with the primary and secondary functions relating to the management of disasters include India Meteorological Department, Central Water Commission, Ministry of Home Affairs, Ministry of Defense, Ministry of Finance, Ministry of Rural Development, Ministry of Urban Development, Department of Communications, Ministry of Health, Ministry of Water Resources, Ministry of Petroleum, Department of Agriculture & Cooperation, Ministry of Power, Department of Civil Supplies, Ministry of Railways, Ministry of Information and Broadcasting, Planning Commission, Cabinet Secretariat, Department of Surface Transport, Ministry of Social Justice, Department of Women and Child Development, Ministry of Environment and Forest, Department of Food.

Nagaon comes under Brahmaputra valley. The Brahmaputra valley with an average elevation from 50 to 120 m above m.s.l. represents an unique landscape comprising of a 800 km long and 130 km wide valley delimited by the low-lying valley to its south and the Karbi Anglong hills and Barail range comprising the North Cachar hills in the central part. Nagaon district has got very high reserves of Glass Sand. Thus, it can be unanimously vouchsafed that the geology of Assam depicts a rich repository of minerals with its diversified geographical structure.

11.2 CURRENT SCENARIO

River Kollong is a spill channel of river Brahmaputra having its intake point near Jakhalabandha in between Kukurakata hill and Hatimura hill. The river traverses about 199.67 Km through Nagaon district and finally outfalls into the river Brahmaputra near Chandrapur in Kamrup district. The hydrology and topography of the catchment area of the river was such that apart from receiving water from the hilly streams, the river carried the flood water from the over flooded Brahmaputra river inundating the low-lying areas of Nagaon and Morigaon district and creating havoc among the people. Even the Nagaon town was under threat due to such flooding by Kollong river. The river Kollong had become dead for a length of about 37Km upto Missa town after it was choked at the mouth due to continuous deposition of debris, water hyacinth etc. year after year. Two nos. of streams namely Missa and Diju feed Kollong at upstream of Nagaon town. Nagaon is affected by wind and cyclone, wind speed of more than 55m/s and are more vulnerable to cyclonic storms. Occasional cyclones do occur in western Assam their severity is more during monsoon.

Records of Rainfall in the district are available for eleven stations for periods ranging from forty to fifty years. The average annual rainfall in the district was 2221.15 mm in 2010. The rainfall in the district generally increases from the south towards the north. About sixty-eight per cent of the annual rainfall is received during the period of June to September, July being the rainiest month of the year. Rainfall mostly as thundershowers occurs in the pre-monsoon months of April and May and in October.

The basic objective of current Disaster Management Action Plan is to protect all the residents and the wealth of the region from all sort of untoward incidents through the following objectives:

- To prevent loss of human lives and property.
- Institutionalization of disaster management in district administration level.
- Encourage a culture of disaster preparedness.
- Vulnerability reduction and disaster mitigation through better planning process.
- Creation of best government mechanism to handle and unprecedented events.
- Instant response and effective decision making in disasters.
- Better coordination of relief and rehabilitation in the aftermath of a disaster.
- Better coordination of all line departments in disaster management.
- Regular updates of resources in and around the district.

11.2.1 FLOOD

Floods are the results of natural and physical phenomena. They are very much dependent upon the pattern of rainfall, topography of the basin and river canals configuration.

In the year 2004 three devastating waves of flood occurred and created havoc among the vulnerable population of the district. In that year, flood waters of Kopili inundated many areas in Kampur, Raha and Hojai circles. Jamuna River also inundated areas in Doboka circle of Nagaon district disrupting road communication between Doboka and Diphu. During the flood in 2004, on 8-10-04, National Highway was overtopped at Nellie. However, one RCC Bridge was badly affected on 10-10-04 morning after which vehicular traffic between Guwahati and Upper Assam was totally disrupted. In Nagaon district, road communication has been disrupted at Kampur-Baithalangshu, Kampur-Bakulguri, Kampur – Kathiatoli as the NH-37 damaged at Raha due to RCC bridge collapse. Army help has been sought for restoration. In the district about five lakh people have been affected by the flood in the year 2004.

The drainage system plays a key role during flood, at present Nagaon have total length of the existing drainage in the city is 140 km out of which 40% of the drains are lined and 60% of the drains are earthen. About 85% drains are maintained by NMB and 15% drains are maintained by APWD.

The districts that are severely flood affected are Nagaon. More than 50% of the area of these districts are flooded leading to huge socio-economic losses for the districts. The reliability and effectiveness of the embankments from the Brahmaputra flooding are generally insufficient because of structural deterioration and ongoing riverbank erosion. River erosion is resultant issue of the floods and which leads to severe land loss.

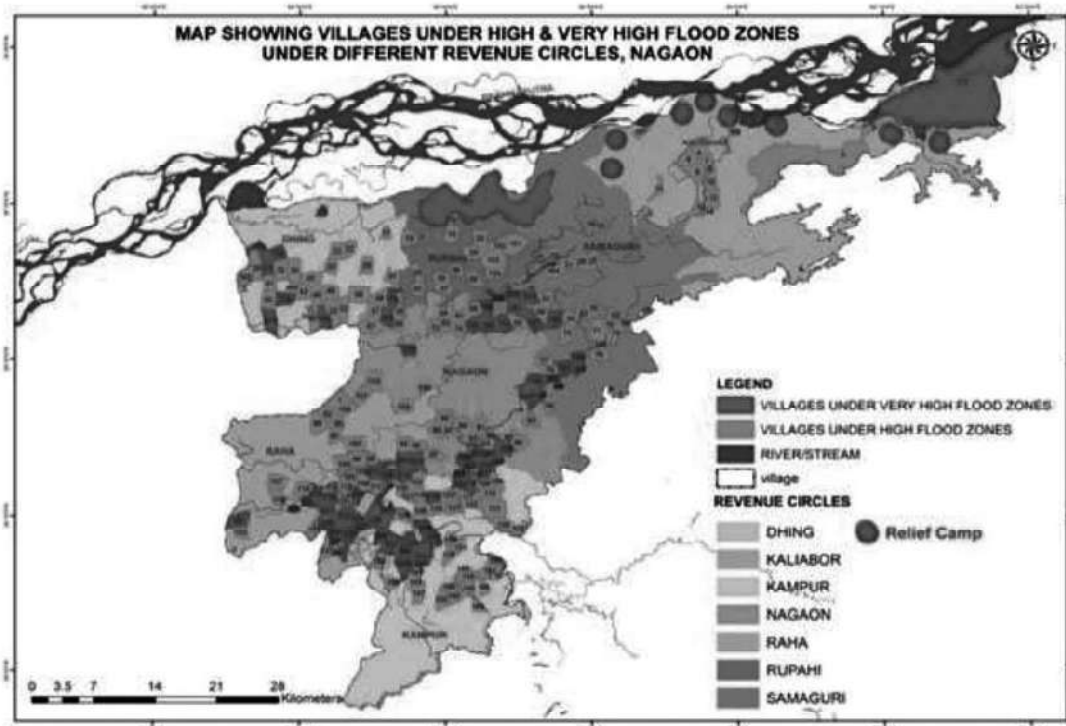


Figure 161 Village Vulnerability Map, Nagaon District

Table 200 Flood event and details

Sl. No.	Disastrous Event	Year of Occurrence	Area Affected	Name of localities	Population affected
1	Flood	2017, 2004	Nagaon town and south Nagaon,	Dhemaji, Lakhimpur, Biswanath, Kamrup Morigaon, Hojai and Ngeon District.	15000 People were affected

(Source: Assam disaster management report)

11.2.2 EARTHQUAKE

Around 58 % of the territory of India is vulnerable to earthquake, and the country has experienced 3 main earthquakes in the past few decades. The state of Gujarat has experienced a major earthquake in January 2001, Jammu & Kashmir in October 2005, and Sikkim in 2011. The major consequences of any earthquake are widespread human and material losses, excessive damage to infrastructure and services. According to the Geographical Survey of India, Seismic Zoning Map of the country, Silchar region lies in Zone-V which is said to be the most active semis zone in the Country. Like the rest of Assam, the Nagaon district has always been subject to earthquakes as it lies in the zone of seismic disturbances. The great earthquake which occurred on June 12, 1897 had its epicentre in the Shillong plateau. It had a magnitude of 8.5 Richter and was probably one of the greatest earthquakes ever recorded. The shock was felt over an area of 1,750 km² and destruction of stone buildings was almost universal in an area of 30,000 km² including Shillong, Goalpara, Gauhati, Nagaon and Sylhet area of Bangladesh. Land slips and an earth fissure was very abundant over the whole of the epicentral area. In Nagaon most of the government buildings including the Circuit House, Court building and the Deputy Commissioner's bungalow were rendered unfit for habitation. Part of the District Jail wall collapsed and the metal road along the side of the Kolong was split up with yawning fissures. The earthquake of August 15, 1950 had its epicentre at 28.5° N and 96.7° E. and had a magnitude of 8.6 Richter. The estimated area of north-eastern Assam over which extensive and heavy damage occurred was 1,900 sqmt.

Table 201 Earthquake in Nagaon

Sl. No.	Disastrous Event	Year of Occurrence	Area Affected	Name of localities
1	Earthquake	1897, 1950	Around 1750 sqmt area, Kolong river altered	All the Five circles of District

(Source: Department of Disaster Management, Nagaon)

11.2.3 DROUGHT

The southern part of Nagaon district in central Assam valley and adjoining parts of Karbi Anglong form a rain-shadow zone where annual rainfall is as low as 800-1200 mm. Water scarcity is a potential constraint for the people living in these areas. Absence of effective irrigation systems or water harvesting practices adds to the vulnerability of the people. Lumding, located centrally in this zone shows a decline in rainfall at a rate of 2.15 mm per year. As a result, water crisis might aggravate in this region in the coming years.

Table 202 Drought in Nagaon

Sl. No.	Disastrous Event	Year of Occurrence	Area Affected	Name of localities
1	Drought	2009	Nagaon District	All the circles of District

(Source: Department of Disaster Management, Nagaon)

11.2.4 RIVER EROSION

River erosion is a season specific calamity observed in certain period mostly in fixed seasonal interval. In rainy season specifically from months April to July, The Brahmaputra has unleashed its destructive force again in Assam. The sudden massive erosion caused by the river along its southern banks in Nagaon district Over 800 hectares of land at Hatimura, Baneswar, Baghjan and Kukurakata villages has been severely affected. Even the western extension of Kaziranga National Park is faced with the threat of erosion. Bank erosion prone area of the streams and Rivers of Assam are to be covered by different soil conservation measures in order to check the continuous loss of agricultural land **Gully erosion** is the main erosion problem

Table 203 River Erosion in Nagaon

Sl. No.	Disastrous Event	Year of Occurrence	Area Affected
1	River Erosion	Every consecutive year	Nagaon town,

which damages a considerable area of agricultural land annually. Gullies are the formation in the soil by the surface runoff water initiating sheet, rill and finally the gullies resulting in accountable loss of top fertile soil. Gully control structures like spillways, check dams etc. are constructed to stop further advancement of the gully heads and fingers and to improve the moisture regime in the command areas which results in increase in production from agricultural land.





Figure 162 Land Gully erosion measures



Source: Department of soil, Nagaon)

11.3 SEASONAL HAZARD ANALYSIS

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
Cyclone	x	x	x	x	x	x	x	x	x	x	x	x
Flood						↔						
Drought						↔						
Earthquake	↔											
Sunstroke	x	x	x	x	x	x	x	x	x	x	x	x
Fire		↔										
Chemical Accidents	x	x	x	x	x	x	x	x	x	x	x	x
Boat capsize						↔						
Epidemic						↔						
Accident	↔											
Lightening				↔			↔					

Figure 163 Seasonal hazard analysis

(Source: Department of Disaster Management, Nagaon)

11.4 VULNERABILITY (RISK AND HAZARDS ANALYSIS)

Table 204 Risk and hazard Analysis

Type of Hazard	Potential impact	Vulnerability	Vulnerable areas
Cyclone	NIL	-	-
Flood	Loss of crops, human lives and animals and properties damage	Communication facility, Agriculture & Horticulture. Private infrastructure- Houses, Irrigation sources, Electrical installations. Drinking water sources, Educational institutions, and Livestock.	All the Development Block areas.
Drought	Drought human life and Pets	Loss of Human lives & pets	Entire District
Earthquake	Human Lives & Structures both public & Pvt.	Loss of Human Lives & Structures both public & Pvt.	Entire District
Fire	Lives & property	Loss of Human Lives & Structures both public & Pvt.	Entire District
Chemical Accidents	Less possibility	Less possibility	Less possibility
Boat Capsize	Lives	Loss of Human lives & Pets	Inhabiting areas of river banks
Epidemic	Human lives & Pets	Loss of Human lives & Pets	Entire District
Accident	Human lives	Loss of Human lives & Pets	Alongside NH 36 & 37, Urban & Semi Urban approach roads and areas.
Lightening	Human lives	Loss of Human lives & Pets	Entire District

(Source: District Disaster Management Plan, 2020, DDMA, Nagaon)

11.4.1 INFRASTRUCTURE VULNERABILITY AGAINST HAZARDS

Table 205 Infrastructure Vulnerability against hazard

Vulnerability	Flood		Accident		Fire	
	Population	Area	Population	Area	Population	Area
Road network	15,00,000 appx.	Nagaon Sadar, Raha, Kampur, Dhing, Rupahi, Samaguri, Kaliabor Revenue Circle Areas 2800 sq k.m.	6,25,000 appx.	Along NH 36 & 37 and urban area approaching roads.	-	-
Water supply	15,00,000 appx.	Nagaon Sadar, Raha, Kampur, Dhing, Rupahi, Samaguri, Kaliabor Revenue Circle Areas 2800 sq k.m.	-	-	-	-
Hospital	50,000 appx.	All Development Block Areas	-	-	1500 appx.	Civil Hospital Nagaon,
Food stocks & supplies	15,00,000 appx.	Nagaon Sadar, Raha, Kampur, Dhing, Rupahi, Samaguri, Kaliabor Revenue Circle Areas 2800 sq k.m.	-	-	15,00,000 appx.	Nagaon Sadar, Raha, Kampur, Dhing, Rupahi, Samaguri, Kaliabor, Revenue Circle Areas 2800 sq k.m.
Communication (System)	15,00,000 appx.	Nagaon Sadar, Raha, Kampur, Dhing, Rupahi, Samaguri, Kaliabor Revenue Circle Areas 2800 sq k.m.	-	-	-	-
Embankments	15,00,000 appx.	Nagaon Sadar, Raha, Kampur, Dhing, Rupahi, Samaguri, Kaliabor Revenue Circle Areas 2800 sq k.m.	-	-	-	-
Bridges	15,00,000 appx.	Nagaon Sadar, Raha, Kampur, Dhing, Rupahi, Samaguri, Kaliabor Revenue Circle Areas 2800 sq km	-	-	-	-

(Source: District Disaster Management Plan, 2020, DDMA, Nagaon)

11.5 MITIGATION PLAN

Any disaster management plan or emergency management plan consists of four phases, namely: Mitigation, Preparedness, Response and Recovery. The mitigation component in an emergency management plan is aimed at reducing the risk, impact, effects of a disaster. Hence careful planning in the mitigation phase is important to reduce or eliminate the Longterm risk to human life, property from natural and manmade calamities. It's important to have mitigation plans led by local community, working together to identify, plan for in the event of a disaster and reduce vulnerabilities and promote long term personal and community resilience and sustainability. Mitigation plans can concentrate on both pre-disaster and post disaster efforts to reduce the impact of the disaster.

Pre-disaster Mitigation should focus on projects and interventions to address natural and man-made disaster to reduce risk to the population and property. This is mainly achieved by strengthening the resilience of National/State Infrastructures. Post-disaster Mitigation efforts are primarily designed to reduce future damage in an affected area and decrease the loss of life and property due to the incidents following the disaster. The essential steps of hazard mitigation are: -

- Hazard Identification.
- Vulnerability Analysis.
- Defining a Hazard Mitigation Strategy.
- Implementation of Hazard Mitigation Activities and projects.

The Nagaon region is more prone to Floods & Cyclone than any other natural disasters hence the disaster vulnerable area mitigation plan focuses on flood and cyclone related eventualities and how can It be mitigated and have a better preparedness. It is important to note that disaster management is an integrated task involving various government departments of region and the plan should focus on prevention, preparedness, mitigation, response, and relief measures.

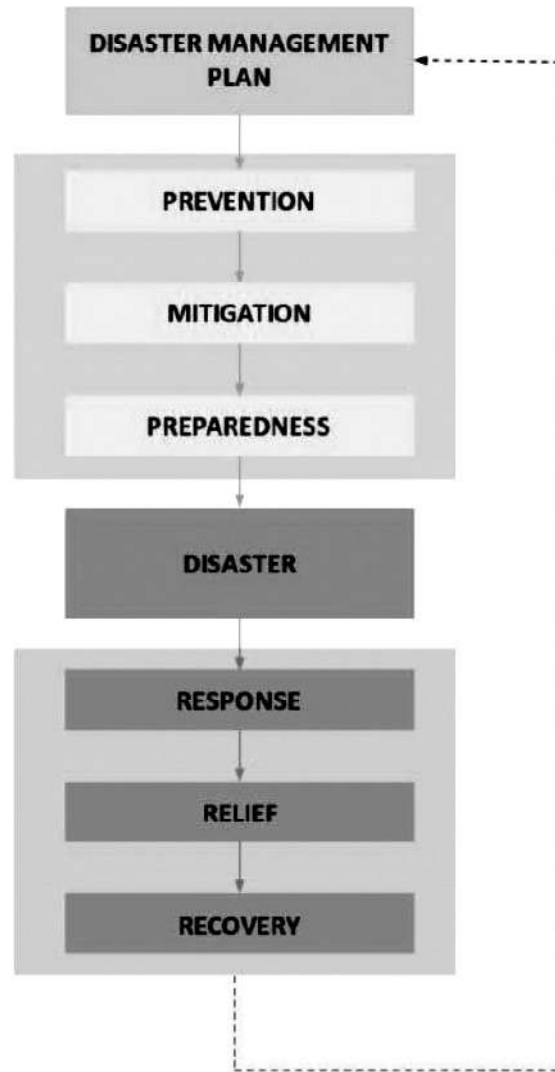


Figure 164 Disaster management plan

11.5.1 EMBANKMENTS AND VULNERABLE REACHES OF THE DISTRICT*Table 206 Embankments and Vulnerable Reaches of the District*

Dyke	Area	Length	Benefiting area
Hatimura dyke	Kaliabor Revenue Circle	3.595 km	1329 ha
Brahmaputra dyke		88.845 km	48,000 ha
Bihdubi		300 mt (dist. from dyke)	2 km
Sullung Borghuli		200 mt. (dist. from dyke)	8 km
Bogamukh		500 mt. (dist. from dyke)	2 km
Kopilli L/B dyke from Charaihagi to Tuklaitup		27.4 km	
Kollong dyke from Phulaguri to Molankata		8.6 km	-
Extension along R/B of Kollong River from Phulaguri to Haibargaon		16.2 km	-
Embankment along R/B of Nonoi & Haria from Tulshimukh to Hariaghat :		9.5 km	-
F/E along L/B of Nonoi from Ramuni to Doboka PWD Road		8.5 km	-
NTP Dyke on both bank of river Kollong:		6.2 km	-

11.5.2 PREVENTION PLAN

As part of prevention of the said natural disasters, the following measures can be adopted by concerned government departments to avoid and minimize the impacts of natural disasters.

- The Public Works Department should monitor the major water bodies like rivers,
- streams, lakes for constant flow of water, rising levels, and identify potential areas along the water bodies which need additional embankment or revetments, and these works should be implemented on priority before the onset of the season.
- Power and Communication should carry out through inspection of power lines, communication lines for defects and rectify them. Trees and branches which may damage power and communication lines should be trimmed or removed.
- Health department should ensure that the primary and community health centers are equipped with medicines and medical staff. Preventive vaccines for epidemics should be stocked in adequate quantity. Chlorination of drinking water should be ensured to avoid the outbreak of epidemics in the event of cyclones and floods.
- The Department of Disaster Management is the nodal agency in the Nagaon Region and has already handled several flood and cyclone situation in the region. From this experience, it should be able to identify the low lying and vulnerable areas and the population of such places must be warned to be alert and to be ready to move to the cyclone shelters or to safer areas or to the relief camps in case of warning of disaster.
- The Department of Civil Supplies & Consumer Affairs should decide for creation of buffer stock of food grains by making required withdrawal from the Food Corporation of India. Also, adequate quantities of Kerosene and diesel should be procured and made available through the Fair Price Shops.
- Department of Agriculture should take steps to publicize precautionary measures to be taken to save the standing crops in the vulnerable areas. Farmers should be encouraged to have platforms in their fields to stock the crops. Desilting of public and private irrigation channels should be ensured for quick drainage of paddy fields.
- Fisheries & Fishermen Welfare Department shall alert all the coastal villages and hamlets about the impending natural calamity and advice the fishermen not to venture into sea till normalcy is restored.
- Department of School Education shall keep all schools ready for accommodating the evacuees

and keep the Central Kitchens to function around the clock with in charge of the centres. NCC and NSS students shall also be grouped to send them for relief works.

- Transport Department should keep ready the list of sufficient numbers of earthmoving vehicles, transportation vehicles such as trucks, tractors, tippers, poclains, mini buses etc. Further, all the listed vehicles allocated in connection with calamity has to be kept in roadworthy condition for using them in emergency.
- Fire Services Department shall keep available sufficient number of rescue materials, like life jackets, buoys, ladders and ropes.
- Department of Animal Husbandry & Animal Welfare should store fodder, cattle feed, poultry food etc. and also carry out the inoculation of animals against epidemics. The Key Village Units should harbor stray cattle with shelters.
- Local Bodies shall make arrangements for availability of Generators and pump sets at short notice. For areas with waterlogging Local bodies should clear the L & U type drains which normally clog due to plastic materials and silt.
- The Police Department shall set up a Search & Rescue Team which shall contain at least 20 Police Personnel for each jurisdiction of the Superintendent of Police.
- Similarly, the Fire Services Department shall set up Search & Rescue Team consisting of at least 6 members of each Fire Service Station.

11.5.3 MITIGATION AND PREPAREDNESS PLAN

Pre- disaster planning consists of activities such as disaster mitigation and disaster preparedness. Disaster mitigation focuses on the hazard that causes the disaster and tries to eliminate or drastically reduce its direct effects. The best example of mitigation is the construction of embankments and construction of proper drainage system in flood prone areas to avoid floods. The other example includes retrofitting of weak buildings to make them earthquake resistant. And preparedness focuses on plans to respond to a disaster threat or occurrence. It takes into account an estimation of emergency needs and identifies the resources to meet the needs. The first objective of the preparedness is to reduce the disaster impact through appropriate actions and improve the capacity of those who are likely to be affected most. The second is to ensure that ongoing development continues to improve the capacities and capabilities of the system to strengthen preparedness efforts at community level. Finally, it guides reconstruction so as to ensure reduction in vulnerability. The best example of preparedness activities are the development of community awareness and sensitization system through community education and administrative preparedness by way of stockpiling of supplies, developing emergency plans for rescue and relief.

For a successful mitigation plan it is necessary to

identify short-, medium- and long-term mitigation measures for various hazards for structural and non-structural risks and damages. Mitigation measures should focus to reduce both the effect of the disaster and the vulnerable conditions to it, in order to reduce the scale of a future disaster and its impacts. Mitigation measures should also focus at reducing physical, economic and social vulnerability of the region at the event of the disaster. Cyclone mitigation and preparedness largely hinges on the preparedness of the community. The following steps can be taken to reduce the risk in the unfortunate event of the said natural disasters.

- Restore Communication networks
- The task force in association with Search & Rescue Teams of Police and Fire should thoroughly search the affected area for survivors and injured.
- In case of heavy flooding and inundation, vehicular access may be restricted, and hence suitable rafts/boats should be used to rescue and evacuate the people affected by the floods.
- The waterlogged in low lying residential areas should be pumped out and the pumped-out water could be let through the nearest natural drain or canal. Also, fire engines can be deployed to pump out water from affected areas during emergencies.

Table 207 Institutional Framework for Disaster Management

Type of Sector	Sub-sector	Mitigation measures	Responsible Deptt.	Time Frame
Infrastructure Development	Road	Repair/ Restoration of vulnerable points on Roads before onset of monsoon	PWD / DRDA	During Normal time and immediately
	Embankment	Repair of vulnerable points in river/ canal Embankment during free flood period.	Water Resource / Irrigation / Minor Irrigation.	During Normal time and immediately
	Bridge	Repair/ Restoration of vulnerable points on bridge before onset of	PWD, NH	During Normal time.
	Safe shelters	Ensuring proper maintenance of shelter places, with drinking water and sanitation facility	COs, BDOs, PWD (Buildings), Inspector of Schools	During Normal period.
	Communication	Ensure maintenance and proper functioning of electronic communication system	BSNL	Round the year
	Drinking water and sanitation	Immediate Response for repair/ replacement of tube wells / Pipe water	PHE / Health department.	During Normal time and immediately
	Power	Immediate response for repair of electric line and supply	PWD (Elctl)/ ASEB Diphu	Round the year.
Health / Animal Husbandry	Vaccination	Adequate stock piling of vaccines should be ensured for vaccination before	CMO, DVO, NGOs.	During Normal time and immediately
	Training	Training programme of common people should be programmed for health care, sanitation and first aid from village level to district	CMO, DVO, NGOs.	During normal period.
Livelihood Sector	Awareness	Creating awareness among general public during normal time to insured human life.	Leading NGOs.	During Normal Time.
	Agriculture	Alternating cropping pattern/flood resistance crops/ Crop Insurance /Technical Guidance to the cultivators/ Technical assistance, use of	Dy. Director Agriculture.	During Normal time and immediately after disaster.
Insurance	IEC activities	By way of IEC activities through walling posters, street play, village task force/ volunteers	Agril Dept. /CBO/ NGOs	During normal period.
	Livelihood and Life	By way of IEC activities through walling posters, street play, village task force/volunteers	By leading NGOs/ CBOs	During normal period.
Planning and Response	Relief/ Rehabilitation, Preparedness, Awareness	<ul style="list-style-type: none"> Regular updation of departmental contingency plan. Community awareness and involvement of NGOs Regular conduct of mock-drill. Co-ordination among diff. agencies and sharing of information. 	Line departments, NGOs, CBOs.	During normal time.

(Source: District Disaster Management Plan, 2020, DDMA, Nagaon)

- Any breach in rivers, streams or natural drains should be protected with adequate sand bags or creation of temporary embankments to avoid further damage to property and human life.
- In case of heavy storms, power supply to areas which are in the primary path of the storm can be disconnected to avoid hazards due to breakage of power lines. Provisions should be made to provide generators for temporary power supply to storm affected areas.
- Relief camps should be opened in appropriate locations where a large number of people are affected.

11.5.4 RESPONSE PLAN

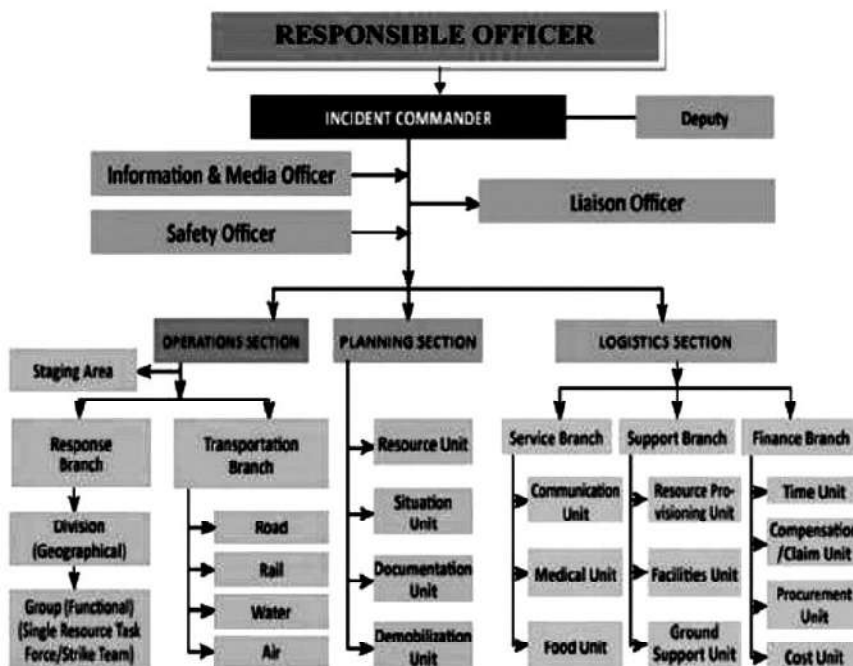
Response measures are those taken immediately prior to and following disaster impact. It is important to have clear organization structures with established line of authority within the government mechanism to handle the response plan in case of natural calamities. The plan should detail out the various phases from early warning to rehabilitation and the roles that agencies play in reaching the vulnerable and affected to identified disaster support infrastructure located in the Nagaon Region. Response plans include formation of functional teams and providing plans for transportation, evacuation, search and rescue, and rehabilitation. They are supported by supervisory zone-based teams assuring food, shelter, water, medicine to the vulnerable in order to uphold physical and psychological health. Survey and assessment should be the part of response activity.

Coordinated IEC activities should be initiated well in advance.

- Mock drill of preparedness should be carried out twice in a year. The mock rehearsal should start from the Control Room. This will help in finding out the preparedness level for the district level functionaries.
- Make separate plan of operation and list of required materials, tools machineries for each kind of disaster.
- Train the rescue forces with the equipment and specialize them for the different types of disaster

by the experts.

- Train the Panchayat leaders / village volunteers/ Villagers for helping the affected people for the disaster of their concern.
- Half yearly review the stock of men, materials and machineries of all lined departments.
- Approach to NDMA and ASDMA for any kind of assistance to the line departments for up-keepment of their machineries and strengthening the resources.
- Warning system through Police Control Room (24x7) DDIPR/AIR/DIO.
- The Incident Command Officer shall organize regular coordination meeting with all DM Committee Members, Head of office, Public leaders, NGO and senior citizen in consultation with the Chairman.
- The Incident Command Officer will liaise with all Head of office, NGO, Public Leaders and other organizations to keep their machineries and manpower in readiness to face occurrence of any type of natural disaster.
- The Incident Command Officer shall keep record of all parameter which might
- Indicate occurrence of any type of natural disaster and intimate the concerned higher
- Authority in weekly / daily basis.
- The RRTs (Medical & Police) will be alerted by the Incident Command Officer.



Aims of disaster response:

The overall aims of disaster response are:

- To ensure the survival of the maximum possible number of victims, keeping them in the best possible health in the circumstances.
- To re-establish self-sufficiency and essential services as quickly as possible for all population groups, with special attention to those whose needs are greatest: the most vulnerable and underprivileged.
- To repair or replace damaged infrastructure and regenerate viable economic activities. To do this in a manner that contributes to long term development goals and reduces vulnerability to any future recurrence of potentially damaging hazards.
- In situations of civil or international conflict, the aim is to protect and assist the civilian population, in close collaboration with National and International agencies.
- In cases involving population displacements (due to any type of disaster) the aim is to find durable solutions as quickly as possible, while ensuring protection and assistance as necessary in the meantime.

Disaster Response Activities:

Warning refers to information concerning the nature of the danger and imminent disaster threats. Warnings must be rapidly disseminated to government officials, institutions and the population at large in the areas at immediate risk so that appropriate actions may be

taken, namely, either to evacuate or secure property and prevent further damage. The warning could be disseminated via radio, television, the written press, telephone and PA system, VHF equipments and cell phone.

Search & Rescue (SAR):

is the process of identifying the location of disaster victims that may be trapped or isolated and bringing them to safety and medical attention. In the aftermath of Cyclone and Floods, SAR usually includes locating stranded flood victims, who may be threatened by rising water, and either bringing them to safety or providing them with food and first aid until they can be evacuated or returned to their homes. In the aftermath of Earthquake or Landslide, SAR normally focuses on locating people who are trapped and/ or injured in collapsed buildings.

Evacuation and Shelter Management:

Evacuation involves the relocation of a population from zones at risk of an imminent disaster to a safer location. The primary concern is the protection of life of the community and immediate treatment of those who may be injured. For evacuation to work there must be: * A timely and accurate warning system, * Clear identification of escape routes, * Designated shelter places for refugees with proper shelter management policy. District Disaster Management Authority has Identified places like Schools, Colleges, Community Halls and Places of Worship in the district to be used as Temporary shelter places.

11.5.5 RELIEF PLAN**During the Disaster.**

- Disseminate the warning of disaster from DDR&IC to all concerned destination in single attempt by using mass sms, announcement through radio, through mass voice mail and ask the people who are likely to be affected, to take shelter in safer places.
- Immediate deploy the forces to clear the route of search & rescue and also to clear the traffic from the route of rescue.
- Command to the forces, NGO, SHG & volunteers to rush immediately to the affected area for search and rescue with all pre-enlisted tools and equipment for disaster.
- During the time of occurrence of disaster, the

Nodal Officer shall liaise with all Head of office, Public Leaders and other organizations and initiate prompt measures to prevent loss of human lives and property damage.

- The Nodal Officer shall initiate immediate necessary measure for evacuations, organize Search and Rescue teams with consultation with the concerned Member which have been entrusted to this work.
- If necessary, the Nodal Officer will initiate setting up of Relief Camp for the affected people in a safer place and ensure proper supply of safe drinking water, electricity, medical facilities and rations etc. with the help of concerned departments to the relief camp.

Post Disaster:

- A Post- disaster evaluation should be done after the withdrawal of relief and rehabilitation activities in order to assess
- The nature of state intervention and support,
- Suitability of the organizational structure,
- Institutional Arrangements,
- Adequacy of Operating Procedures,
- Monitoring mechanism,
- Information tools,
- Equipments,
- Communication System, etc.

The impact studies on the aforesaid operations for long term preventive and mitigation efforts are to be

11.5.6 RECOVERY

Rehabilitation and reconstruction comes under recovery phase immediately after relief and rescue operation of the disaster. This post disaster phase continues until the life of the affected people comes to normal. This phase mainly covers damage assessment, disposal of debris, disbursement of assistance for houses, formulation of assistance packages, monitoring and review, cases of non-starters, rejected cases, no occupancy of houses, relocation, town planning and development plans, awareness and capacity building, housing insurance, grievance redresses and social rehabilitation etc.

In the unfortunate event of a natural calamity like a cyclone or flood its important focus on the methods and activities to restore lifeline support physical infrastructure like adequate water supply, power and communication networks, accessibility to the site. These must be the described in the disaster management plan- relief & recovery part. In the river side of the Nagaon the communities are depended on the specific infrastructure for their livelihood, and these should be identified and methods to restore them in short/medium/long term have to be identified and respective funding reequipments have to be made available and followed by speedy decision-making process.

In the District, the Nodal agency plays direct and active role in relief. The Deputy Commissioner office either directly or through assistance will inform to the nearest police stations, WT stations, administrative officers, and nodal agencies at Circle, Sub-Divisional and Dist. HQ by quickest means. For

undertaken.

Evaluation exercises may be undertaken to understand the perceptions about disaster response in terms of

- Adequacy of training
- Alert and warning system,
- Control Room functions,
- Communication plans,
- Security,
- Containment,
- Recovery procedures,
- Monitoring.

timely assistance to the people affected by natural disasters it is necessary to have correct assessment of extend of damage to crops, public & private properties and loss of human lives and livestock. The emergency relief measures and relief measures in the aftermath of a disaster is generally carried out in compliance with Calamity Relief Fund Norms by Deputy Commissioner.

The task force is responsible for collecting the extend of the damages with respect to number of houses damaged, loss of human lives, number of persons injured, information about individual families, their income, property and assets. The zonal officer has to prepare a report on the same to be sent to the Deputy Commissioner. The mentioned assessment is to be carried out on priority basis so that the Nodal Department in the district Region which is the Department of Disaster Management can extend relief assistance in time in order to mitigate the effect of the natural disaster.

Post Disaster Reconstruction and Rehabilitation:

Post disaster reconstruction and rehabilitation should pay attention to the following activities for speedy recovery in disaster hit areas. The contribution of both government as well as affected people is significant to deal with all the issues properly

- Damage assessment
- Disposal of debris
- Disbursement of assistance for houses
- Formulation of assistance packages
- Monitoring and review
- Cases of non-starters, rejected cases, non-

occupancy of houses

- Relocation
- Town planning and development plans
- Reconstruction as Housing Replacement Policy
- Awareness and capacity building
- Housing insurance
- Grievance redress.

Administrative Relief:

The district is the primary level with requisite resources to respond to any natural calamity, through the issue of essential commodities, group assistance to the affected people, damage assessment and administering appropriate rehabilitation and restoration measures. The district level relief committee review the relief measures. When a disaster is apprehended, the entire machinery of the district, including the officers of technical and other departments, swings into action and maintains almost continuous contact with each village in the disaster threatened area.

Reconstruction of Houses/Roads Damaged / Destroyed: PWD (Roads) and PWD (Buildings) division

Pre & Post Disaster: - As PWD (Roads) Nagaon Divn and PWD (Buildings) Divn is an executive authority wherein all construction/ improvement works are executed through an agency or contractor, the restoration/ re-construction works during Pre & Post disaster period will be carried out as per existing APWD norms / specification and procedures as

current in the state.

Military Assistance:

If the district administration feels that the situation is beyond its control then immediate military assistance could be sought for carrying out the relief and rehabilitation operations including construction. Military carries out temporary construction works for road clearance, construction of emergency bridges, shelter places, camps, distribution of relief materials etc.

Medical Care:

Specialized Medical Care may be required to help the affected population. Preventive medicine may have to be taken to prevent outbreak of diseases. Vaccination after the disaster is very much important to prevent any disease to spread.

Outside Assistance:

During disaster situations, considerable relief flows in from outside, thus there is an immediate need to co-ordinate the relief flow so that the maximum coverage is achieved and there is no duplication of work in the same area. Again the outside relief should be monitored so that the necessary items are made available.

Special Relief:

Along with compensation packages, essential items may have to be distributed to the affected population to provide for temporary sustenance.

11.6 CITY DISASTER MITIGATION PLAN

The points mentioned above should be part of a larger city or region level disaster management plan. The Disaster Management Act, 2005 has brought a change from Response & Relief oriented approach to proactive and comprehensive approach. This has encouraged many Indian cities to develop and formulate a City Disaster Management Plan, the same should be worked for Nagaon MPA as well to enable it to be better prepared in the case of natural disasters in the future. As part of the Master Plan 2045 the authority feels there is a need for a CDMP for the planning area covering the following general principles: -

- Risk & Hazard Assessment
- Planning
- Organization

- Resource Utilization
- Need for Specialist
- Training

Generally, the CDMP prepared for the planning area should include sectoral plans covering the following aspects of disaster & emergency management: -

- Overall Preparedness
- Rehabilitation
- Emergency Response
- Prevention
- Mitigation
- Recovery
- Reconstruction
- Capacity Building Plans

11.6.1 STANDARD OPERATING PROCEDURES OF THE LINE DEPARTMENTS

Table 208 Institutional Framework for Disaster Management

Departments	Normal time activities	On receiving the warning	Post disaster
Revenue and Disaster Management Department	Mapping and accountability of disaster-prone areas and its 'entities	Assigning the work, coordinate task with different dept. and shifting people from disaster prone areas	Rescue operation, managing funds and segregate affected and non-affected areas
Police Department	Details of Data, contacts, and control rooms	Evacuating public from disaster prone area	Arrange law and order in disaster prone areas and coordinate with rescue team
Health Department:	Advance arrangement of lie saving medicine, vaccine and medical tools and training with DMT	Will ensure all the facilities at the hospitals and clinics activate staffs and mobile health units and organise local doctors and facilities.	Provide first aid and shifting people and focus on mobile medical facilities.
Public Health Engineering Department	Setting up control room and operating it, arrangement of drinking water facilities	Organise the team to check source of drinking water and standby arrangement for trucks and make available of chlorine tablets	Implement the alternative contingency plan to provide drinking water
Agriculture Department	Details of agriculture products and maintain departmental equipments such as diesel generators, dumpers, generator, cutters, tree cutters, ladders, ropes, flood lights, shovels, axes, hammers	assign the work to his subordinate officers and staff and ensure availabilities of resources	Will deploy the resources and manpower available to manage the disaster
Public Works Department	PWD inspects all the building, public infrastructure and to strictly observe the rules during the constructions regarding earthquake and cyclone proof materials.	Coordinate between control rooms and ensure all the staff to be on site	Provide resources, check resource availability
Forest Department	Details of veterinary centres, artificial insemination centres, veterinary dispensary, veterinary colleges buildings, vehicles, mobile dispensaries and equipment	To assign the work to be done by the subordinate officers and staff and to arrange for wireless, telephones, manpower, forest guard in advance to disseminate information	To carry out the duty assigned for search and rescue work. and engage the resources and manpower available to manage the disaster

12 SPATIAL STRATEGY AND LANDUSE PLANNING

12.1 APPROACH TO URBAN PLANNING

The objective of preparing a Master Plan for the Nagaon is to integrate the functions of NMB as a cohesive entity with the rest of the planning area. The region excluding NMB is largely depends on the core municipal area to sustain. NMB provides the necessary impetus and drive for the development of conurbation and rural area. Development of the Nagaon is critical for development of the entire northern district of Assam as it carries the Spiritual, Heritage and Cultural importance. Therefore, it is required to understand the issues of the area surrounding the Nagaon city so that the entire NMPA is fully integrated. Urban planning refers to the rational and judicious approach of allocating available land resources to different land using activities and for different functions consistent with the overall development vision / goal of a particular region. The main objectives of land use planning area.

1. To promote efficient utilization and disposition of land ensure the highest and best use of land.
2. To promote desirable pattern of land uses to prevent wasteful development.
3. To preserve areas of ecological, aesthetic, historical and cultural significance.

In the chapter, it details out the visions, goals & planning concepts adopted for the preparation of GIS Based Master Plan for Nagaon Planning Area-2045. It then presents the guiding principles and strategies adopted for various sectors and the applications of planning theories & techniques. Later on, in the chapter it elaborates the Land use policies & growth centre models adopted. The chapter concludes a detailed explanation of the concept plan for the planning area prepared based on the strategies to achieve the overall visions & goals.

12.2 EMERGING CONCERNS AND ISSUES

However, though its strategic location, Nagaon as a whole is lagging behind the rest of the country. Flood and water logging are the main reasons that the region has not been able to come up to a certain standard of all-round development, particularly in the countryside. Apart from that, there are many other issues affecting the growth of the region, such as, weak infrastructure, and exhausted and congested CBD area, narrow accessible carriage ways encroached by unorganised parking stretches in the city core area. Following are the main emerging concerns and issues in the project area:

- Flood and Water Logging- Flood and water logging have been a major concern for the region. During the last almost six decades, this problem has devastated the urban and rural economy of the region in a big way. Water level of the Kolong River, inadequate drainage system, informal settlements, and lack of solid waste management are the main reasons for flooding and water logging in the region.
- Flowing river like Kolong would have low pollution level; however, the river in the project area is polluted because of the raw sewage directly discharged into the river without any treatments. In addition, a vast portion of the municipal waste flows directly into the

river through its tributary rivers including Morikolong waterbody. Due to lack of efficient solid waste disposal mechanisms, people have a tendency to throw plastics and other garbage into the open drainage, which leads to clogged drains.

- Existing quality of roads and transport infrastructure in the region is extremely poor; on top of that, the encroachment on the roads has narrowed the streets, which is causing the traffic chaos. The collector roads and streets of markets and narrow and lack of sufficient parking area. All these are creating traffic congestions and parking problems in and around the city area.
- Neither artificial nor natural drains have the capacity to carry the storm water effectively. Additionally, untreated wastewater from residential, commercial, and industrial activities is discharged into the underground and open drains. Inadequate run-off of rainwater, as there is no storm water drain system.
- Haphazard Development- throughout the region, especially in market areas number of illegal constructions, encroachments on the pedestrian pathways and wetland, and violation of Byelaws have led to imbalanced built-open relationship.

12.3 VISION, GOAL AND OBJECTIVES

The Nagaon GIS Based Master Plan - 2045 is initiated with the aim of achieving a better economic growth, better infrastructure facilities, and higher quality of life for the planning area while keeping the heritage, culture and form of the city intact and preserving the environment of the area. To achieve these, it is essential to set out goals and adopt the planning concepts and guiding principles so as to ensure maximum benefits and least adverse effects. The discontinues & non-homogenous geographical profile of the planning area which is a historical accident has thrown several challenges towards ensuring continuity and proper planned development. Despite this limitation, through forethoughts & reasonable approach to the situation desired results could be achieved. This section elaborates the vision statement, goals that are formulated to achieve the goals and the planning concepts, which will guide to achieve the same.

12.3.1 VISION

The Vision for the planning area perceived around the following core ideas:

1. Preserving the historical past, maintaining the liability of the present, and transforming our future through the implementation of the highest quality planning, to enhance the level of infrastructure service to all people of Nagaon Region.
2. Plan and implement the future by guiding the physical and economic development of Nagaon town while enhancing the quality of life for all through a comprehensive range of planning to promote the cultural, built and natural heritage in a sustainable manner.
3. Expand urban infrastructure to encourage appropriately compact, connected, and synchronized development by unlocking the potential of urbanization for better economic, social, and environmental outcomes at the heart of the government's economic strategy.

12.3.2 GOALS

Aspire to be Vibrant and Sustainable Urban entity for the Northeast India which is Socially Beneficial; Regionally Contextual; Environmentally Sustainable; Financially Viable; Institutionally Executable; and Politically Acceptable.

12.3.3 OBJECTIVES TO ACHIEVE THE VISION

1. To generate higher service facilities for attracting various developmental activities, investors, and industrial houses.
2. To generate facilities and activities to support small investors, informal sectors and slum inhabitants and rural migrants.
3. To improve the Transport Network system for faster communication and high standard linkages between the Growth Centers and their rural hinterlands.
4. To transform the whole region to a pollution free zone with conservation of biodiversity and environment.
5. To manage the natural and human resources for followed development.
6. To frame land policies and development proposals for eradicating bottlenecks for future development.
7. To provide decent housing for all sections of people living in the region.
8. To formulate a Disaster Management Policies to tackle natural hazards.
9. To provide high levels of physical and social infrastructure ensuring safe drinking water, improved sanitation, well distributed education, health, recreation and cultural facilities.
10. To convert the region to a learning and cultural centre for the state as well as nation.
11. To transform the region to a hub of tourism through preserving and promoting the rich cultural heritage and aesthetics of tea gardens, with high standard facilities and convenience.
12. To design an effective development control mechanism with a high value of public serviceability.
13. To reenergize the institutional and administrative system to manage future urban

12.4 PLANNING THEORIES

The planning is based on order of settlement, level of urbanization, planning area morphology it's evident that the growth over the last few decades are spearheaded due to certain factors like spatial organization of the several urban functions of commerce, production, education, and much more. One of the most important forces determining where

certain activities or growth is focused within a city deals with the price of land. Thus, it is important to understand different urban models developed over the course of time. The different planning theories are explained in the following section to understand which theoretical model suits best for the planning area.

12.4.1 CONCENTRIC ZONE MODEL

The Concentric Zone model is a model of the internal structure of cities in which social groups are spatially arranged in a series of rings. The concentric zone model was resulted from a study of Chicago in the 1920's by Ernest Burgess. This model is also known as Bull's eye Model. The idea behind this model is that the city grows outward from a central area in a series of rings. The size of the rings may vary, but the order always remains the same. Under this model, five concentric functional zones are recognized. At the center was the CBD (1). The zone of transition (2) was characterized by residential deterioration and encroachment by business and light manufacturing. The zone of independent workers' homes (3) was primarily occupied by the blue collar (wage-earners, manual laborers) labor force. The zone of better residences (4) consisted mainly of the middle-class. Finally, the commuters' zone (5) was the suburban ring, consisting mostly of white-collar workers who could afford to live further from the CBD. This model was dynamic. As the city grow, the inner zones encroached on the outer ones.

Disadvantages:

- This model was developed for American cities and had limited applicability elsewhere.
- The model does not take into account any physical barriers and gentrification - which may occur in the cities.
- It does not address local urban politics and forces of globalization.

12.4.2 SECTOR MODEL

In the late 1930s, Homer Hoyt's sector model was published, partly as an answer to the drawbacks of Burgess' concentric zone model. This model was based both on urban land-use pattern and on demography. Hoyt accepted the existence of business district at the core but suggested that various groups expand outward from the city centre along railroads, highways and other transportation arteries. As technology dealing with transportation and communication was improving, growth alone created more of a pie-shaped urban structure. Hoyt discovered that land rent (for residential, commercial, or industrial) could remain consistent all the way from the CBD to the city's outer edge.

Based on the above observation, Hoyt theorized the following:

- Cities tend to grow in wedge-shaped patterns—or sectors—emanating from the core business district and centered on major transportation routes.
- Higher levels of access meant higher land values; therefore, many commercial activities would be carried on in the central business districts, but manufacturing units would be developed in a wedge surrounding transportation routes.
- Residential areas would grow in a wedge-shaped pattern with a sector of low-income housing bordering manufacturing/ industrial sectors (traffic, noise and pollution would make these areas least desirable), while middle- and high-income households would be located as far away as possible from manufacturing industrial units.

Disadvantages:

- The theory is based on nineteenth century transport and does not make allowances for private cars that enable commuting from cheaper land outside city boundaries. This occurred in Calgary in the 1930's when many near-slums were established outside the city but close to the termini of the streetcar lines. These are now incorporated into the city boundary but are pockets of low-cost housing in medium cost areas.
- No reference is given to out-of-town development.

12.4.3 MULTIPLE NUCLEI MODEL

In the 1940s, Chauncy Harris and Edward Ullman, arguing that neither of the earlier models adequately reflected city structure, proposed the multiple nuclei model. This model was based on the notion the CBD was losing its dominant position and primacy as the nucleus of the urban area. Several of the urban regions would have their own subsidiary but competing "nuclei." As manufacturing cities became modern cities and modern cities became increasingly complex, these models became less and less accurate.

Today, there are urban realms, components of giant conurbations (connected urban areas) that function separately in certain ways but are linked together in a greater metropolitan sphere. In the early postwar period (1950s), rapid population diffusion to the outer suburbs created distant nuclei, but also reduced the volume and level, of interaction between the central city and these emerging suburban cities. By the 1970s, outer cities were becoming increasingly independent of the CBD to which these former suburbs had once been closely tied. Regional shopping centers (e.g., malls) in the suburban zone were becoming the new CBDs of the outer nuclei.

Advantages:

The advantages of this model lie in its multi nuclei approach - many sources give slight variants on the model shown in the diagram, since the model is rather flexible and adapts to local situations (the exact positions of the nuclei are not important but only the basic trends) so it can be modified to match the city under consideration.

Disadvantages:

- Negligence of height of buildings.
- Non-existence of abrupt divisions between zones.
- Each zone displays a significant degree of internal heterogeneity and not homogeneity.
- Unawareness of inertia forces.
- No consideration of influence of physical relief and government policy.
- The concepts may not be totally applicable to oriental cities with different cultural, economic, and political backgrounds.

12.4.4 URBAN REALM MODEL

Vance's urban realms model is an extension of the multiple-nuclei model and is based on the San Francisco Bay area but has been applied to other US cities. The key feature is the emergence of large self-sufficient urban areas, each focused on a center independent of the traditional downtown and central city. The area, shape and other characteristics of each realm depends upon the following several factors:

1. The terrain – mountains and rivers and other barriers will help to determine the extent and shape of a region.
2. The size of the metropolis – a larger metropolis may have more and larger realms.
3. The amount of economic activity within each realm – a determinant of the area it can serve and hence its size.
4. The transport infrastructure available within each realm – an easily accessible economic core increases the area of influence and thus size of each realm.

Transport infrastructure between realms – e.g. circumferential links (such as freeways) and airports such that people no longer have to travel to the CBD and its central realm in order to travel to other realms and to another metropolis. If a realm can become more important in this manner, then it may increase in importance. E.g. West Los Angeles is within easy reach of the LAX airport (along the freeway) but to travel by train residents have to travel to the CBD (by bus or car).

Advantages:

- If the city is successful, it can accommodate a large and growing population easily due to its automobile dependence.
- Each realm has its own economic strength, so overall the metropolis can be an economic powerhouse and can become some self-sufficient.

Disadvantages:

If a model fails, then the city displays a large amount of urban sprawl. Urban sprawl is the uncontrolled expansion of urban areas. Urban areas will expand into previously rural areas.

12.4.5 CENTRAL PLACE THEORY

Central Place Theory (CPT) is an attempt to explain the spatial arrangement, size, and number of settlements. The theory was originally published in 1933 by a German geographer Walter Christaller who studied the settlement patterns in southern Germany. In the flat landscape of southern Germany Christaller noticed that towns of a certain size were roughly equidistant. By examining and defining the functions of the settlement structure and the size of the hinterland he found it possible to model the pattern of settlement locations using geometric shapes.

Advantages:

- The theory helps us understand the organization from a theoretical perspective and the spatial distribution.
- Important in Policy Making.

Disadvantages:

- The theory doesn't incorporate the temporal aspect in the development of central places.
- The theory is good for agricultural regions but not industrial or postindustrial regions.

12.4.6 A MODEL BEST SUITED FOR NAGAON

After studying above mentioned theory, following analysis has been conducted.

It is evident that concentric zone model is not suitable for Nagaon as it was developed mostly for American cities and does not take into consideration any physical barrier or gentrification. Similarly, Sectoral model is also not applicable to NMPA as there is no allowances for private cars while considering the transportation sector. Additionally, it doesn't include any reference for the development which occurs immediately after town, which is the scenario in almost all Indian cities. In the case of urban realm model, if a model fails, then the city will start developing large amount of urban sprawl. This can't be applicable to Nagaon due to the absence of contiguous mass of land. Additionally, in today's context, a city should focus less urban sprawl as a city can't afford to lose its agricultural area. Central place theory is also not applicable to NMPS as it is good for agricultural regions.

Multiple Nuclei Model is best suited for Nagaon as it has a unique character of non-contiguous land mass. Additionally, the city has already developed a character where the application of this theory will become inevitable. The Major issues of the city can be solved with Multiple Nuclei Model.

Some of the issues include, the high-level congestion in the core town, increasing urban sprawl and decreasing agricultural land, haphazard development inside the planning area. Additionally, this model is flexible and can fit according to the local condition of a city/town. The other major reasons to adopt the Multi Nuclei Model in Nagaon region are listed below.

- Nagaon region possess flat terrain.
- Nagaon region is a noncontiguous settlement pattern paves the opportunity to develop the decentralization model.
- The administrative boundaries (noncontiguous settlement pattern) itself create the ways to decentralize the core activities from Central Business District.
- Nagaon is the region, which have Assam's most rich heritage, culture, and tradition.
- Multi Nuclei model allows the even distribution of resources allocations.

12.5 GUIDING PRINCIPLES

The principles below further articulate the vision and are to guide planning of the proposed NMPA to achieve the foreseen vision.

12.5.1 TRANSIT ORIENTED DEVELOPMENT (TOD)

Transit oriented development is a mixed-use development integrating planning and implementations of transport and land use. Mixed-use developments include residential, commercial space and office space, or a combination of the same. Generally, mixed-use development is within easy access to transit corridors. Development within easy accessibility to the transit corridors encourages residents and workers to use public transit more often over private vehicles.

12.5.2 URBAN RURAL CONTINUUM

Rural Urban Continuum is essentially the gradual change observed in terms of intensity of development from core city areas towards the peripheral area. The nature of settlement structure helps to understand the rural-urban dichotomy or continuity. In the initial stage, the change can be seen in form of changes in agricultural land use, in terms of high commercialization of agriculture activities. In the later stage, the change can be seen in occupational structure of the rural areas, in terms of when the rural population starts responding to possible employment opportunities in the surrounding urban areas. As time passes, the range of private enterprises would widen to include almost every type of enterprises sectors. Public transport would be the means of commutation, houses would be improved and better furnished; however, the basic amenities such as water supply, sewage disposal and drainage may not show any improvement. In the third and the last stage, changes in urban land use would be observed.

12.5.3 MULTIPLE NUCLEI CONCEPT

Population of metropolitan area will grow along with a growth of the metropolitan area, and so the demand for the infrastructure too will grow. By creating, multiple nuclei centers will help reduce the burden of providing sufficient infrastructure from the metropolitan area. These nuclei centers can be identified based on the physical demarcation and accumulation of cluster of activities. They would not be the absolute population accumulation in a particular area but the service population with different size.

12.5.4 URBAN GROWTH BOUNDARY

Urban growth boundary circumscribes the possible urbanizable and developable area. Local governments would use the boundary as a guide to zoning and land use decisions. The local or regional government does not support development for a specified period beyond an officially adopted and mapped line. Growth is supported inside the boundary with utilities and development-friendly policies. Growth is discouraged outside the growth boundary. The purpose of providing urban growth boundary is to synchronize existing urban growth with the provision of infrastructure needed to accommodate future growth, and to promote compact and contiguous development patterns that can be effectively served by public services; as well as to preserve open space, agricultural land, and environmentally sensitive areas that are not currently suitable for urban development.

12.5.5 PERI URBAN DEVELOPMENT

UNDP (1996) defines peri urban as an activity that produces processes and markets food and other products, applying intensive production methods and reusing natural resources and urban wastes to yield a diversity of crops and livestock. Peri urban in addition can also involve animal husbandry, aquaculture, agro-forestry, and horticulture.

12.5.6 PROVISION OF SOCIO-PHYSICAL AMENITIES

URDPFI guidelines will be base line for foreseeing the socio-physical amenities requirement for the horizon year 2045.

12.6 CONCEPTUAL PLAN DEVELOPMENT

To achieve the vision and goals set for the planning area it is critical to have a concept, which illustrates the long-term direction guided by planning principles.

Several considerations were taken into account while formulating the concept for the planning area, which are listed below.

Socio-demographic Projections

- Current Growth Trends
- Level of Urbanisation
- Stakeholder Meeting Suggestions
- Suggestions from various government organisation, NGOs etc.
- Existing Physical & Social Infrastructure
- Existing Land Use Analysis & Land Availability for Future Development
- Economy of planning area
- Govt. Policies & Future Projects

Based on the various analysis and exploration the nodal points are identified for the projected year 2045. The figure 161 reveals that the identification of growth centers, growth points and location for the Multi Modal Transit Centres in Nagaon region. They are detailed in the table 209.

Table 209 Details of Development Centers and Nodal Points

Multi Nuclei Model		
<i>Nagaon Planning Area- 2045</i>		
Sr.No.	Development Centre	Nodal Point
1.	Growth Centre	Simaluguri Gaon Maz Pathari Gaon
2.	Growth Point	Jamuguri Gaon
3.	Transit Hub	Siale Khowa Gaon

The planning area currently accommodates 2.9 lakhs of population with a gross density of 20 persons per hectare and this population is projected to grow to almost 4.6 Lakhs by 2045. The planning area have certain inherited nodes like the Institutional area, Industrial area, Municipal areas & its outgrowth, and the rural hinterlands. For ease of planning, the Nagaon Planning Area is divided into three zones as mentioned at next page.

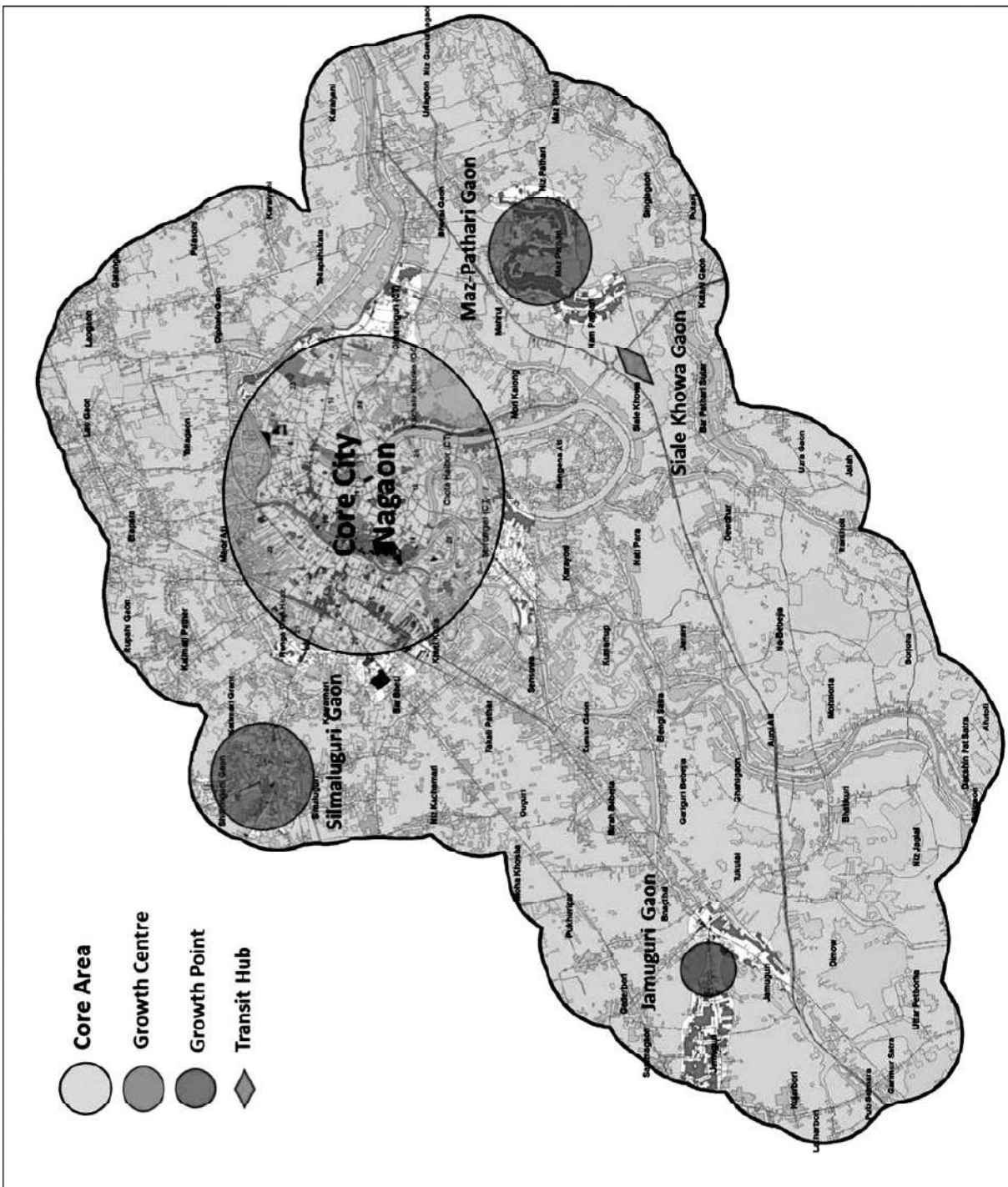


Figure 165 Concept Plan for Nagaon Masie, Plan Area - 2045

12.6.1 CONURBATION AREA

Conurbation area is a continuous urban area comprising of towns and their outgrowths merged with each other due to physical expansion and population growth. In the case of Nagaon, conurbation area includes Nagaon Municipality, 3 Census Towns (Morongial, Chhota Haibor and Dimoruguri) and 1 Outgrowth area (Kachalu khowa). The continuous development has occurred up to Bar Bheti and Khuti Katia Village due to existence of SH-3 on western side of Nagaon. The continuous development also has occurred due to State highway 47 in Rangga gair huzz village in northern part of Nagaon. This area is also well connected through NH Bypass. The villages included in the conurbation area are listed below.

Table 210 Proposed Conurbation Area 2045

Proposed Conurbation Area - 2045				
S. No.	NMB Area	OGs	CTs	Villages
1	Nagaon 22 wards	Kachalukhowa	Morongial	Rangga gari Huzz
2	-	-	Dimoruguri	Bar Bheti
3	-	-	Chhota Haibor	Khuti Katia
	1	1	3	3
Total no. of villages covered within Conurbation Area				3

(Source: Consultant compilation)

12.6.2 EXISTING LAND USE OF CONURBATION AREA

The various industries, the educational and health sectors, trade and commerce and transportation sector are responsible for the city's function. Nagaon has been observed to be a multi-functional town having characters of trade and commerce cum industries cum tea farming.

The existing land use pattern of the conurbation area shows the dominance of residential area. It can be observed that a considerable area is under Public-Semi Public use as this land use consists of the administrative and government buildings, educational institutions, medical institutions, social amenities, and public utilities being part of this land use. The maximum developed area is on the Northern side of planning area towards the Nagaon town. There is a dense network of roads within the market area. But outside that there are only some radial roads connecting various communes and the nearby state of Assam. Commercial areas are mainly located in city centre Town and along the major transportation corridors. The area for Recreational Use is practically negligible, since there are few green spaces, parks and gardens. There is a portion of area under agricultural also. The existing land use area on new conurbation area is 19.44 sq.km.

12.6.3 RURAL AREA AND GROWTH CENTERS

The formation mainly happens when the CBD gets saturated with developmental activities and there is hardly any room for further development. Thus, it demonstrates the complex nature of urban areas. In the light of this, two growth centres and one growth points are identified in Nagaon Planning Area since there is a dire need to decentralize the commercial/public semi-public activities towards outskirts of the urban area. Two Growth centres are proposed in Simalguri and Maz-Pathri. While the growth points are proposed in Jamaguri .

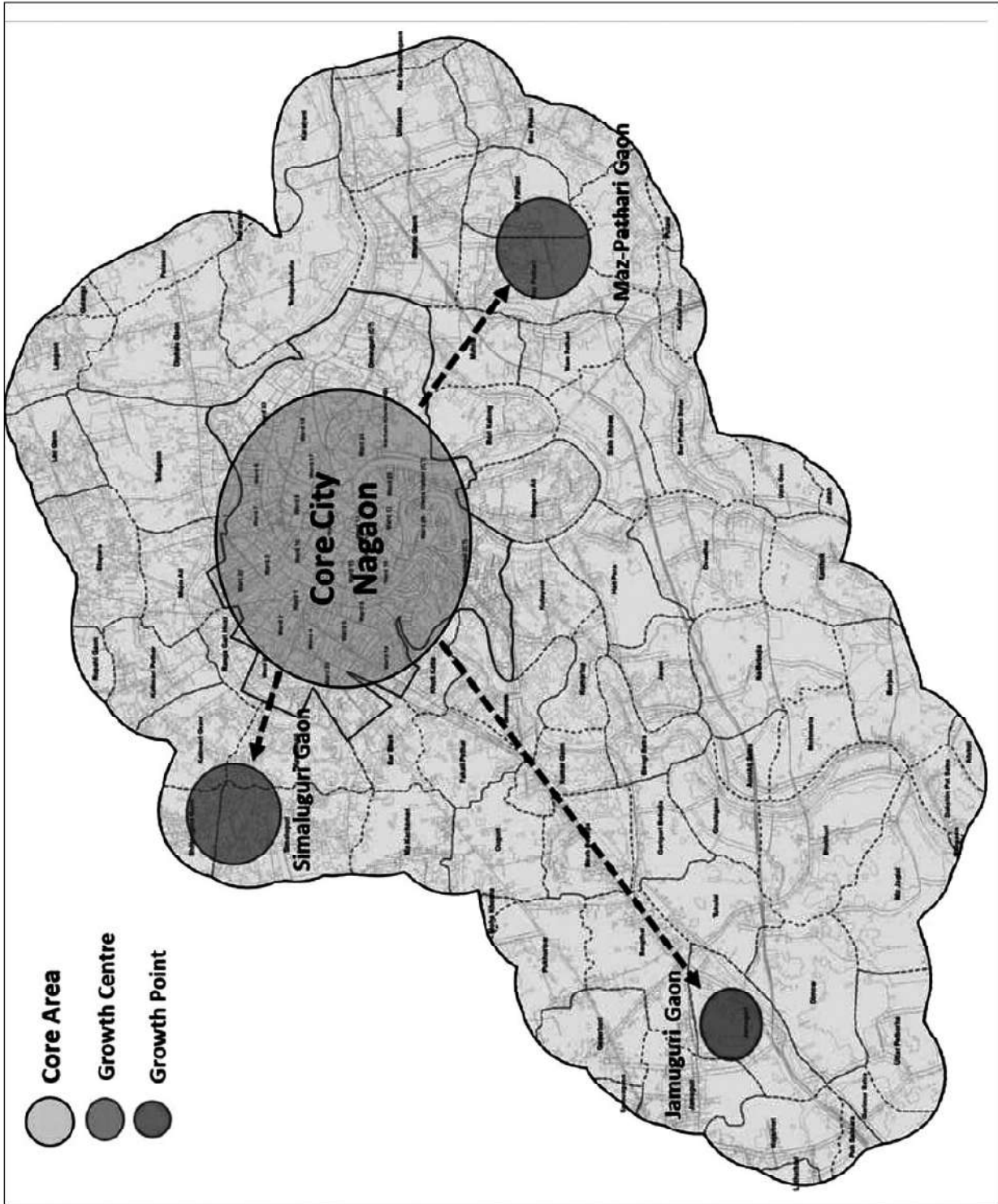


Figure 166 Concept: Plan for Nagaon Planning Area 2045

12.6.3.1 Maz-Pathari Growth Centre

Maz-Pathari located in the Southern side of planning area which has very fertile chunks of agricultural land, also the location of Maz-Pathari is very prominent, many new developments, service and manufacturing industries have come up in recent years. The Asian highway 1, is passing through this village which create mixed use potential. The canal road also passing through the village area, along which residential use can be seen. Thus, Maz-Pathari villages are proposed as an Industrial cum commercial growth centre. Other reasons stating the potential of Maz-pathari commune to be developed as a growth centre are mentioned below:

- Maz Pathari is 4 km from Nagaon town and situated at Asian highway. It is very near to Maharul wetland of Nagaon, a recreational area which is existing at Dimaroguri. This village have huge potential as it has plain areas along the highways, hence there is huge scope for Industrial development cum commercial for upcoming settlements.
- Since Maz Pathari village have large area to support the industrial activity like medium and large-scale industries. Also, this village have highways which help in transportation of raw material, goods, and finish products.
- Maz Pathari have natural drain along which there is road. A ribbon development can be witnessed along this drain which is residential use.
- Since the NMPA is Non-contiguous area, it is essential to focus on Maz Pathari center as self-sustainable development to the extent which will decongest the Nagaon town.
- Moreover, Fakoli Beel is situated in the southern part of the village which presently witnesses migratory birds in winter season. This tourism scope near village will accelerate the scope of Maz Pathari to function self-sufficiently.
- The proposal of Wetland Park and district level park facilities in Maharul wetlands and amusement park will pull the population from the nearby region which will further strengthen the development.
- Maz Pathari will have the economic development impact due to proposed outer ring road and Asian Highway.

12.6.3.2 Simaluguri Gaon Growth Centre

- Simaluguri is situated around 4 km from Nagaon town via SH 47 and situated in between Nagaon and Dhing.
- Development of Simaluguri as Multi Nuclei / Self sustainable center may reduce the traffic flow to Nagaon town.
- The presence of already existing industries, Haiborgaon market area and SH 47 which will attract a greater number of industrial and commercial development to this town.
- Apart from this, Simaluguri is also situated in the major location, as the SH 47 is connected to the major tourist place i.e., Borduwa Sattrā, which have major impact on the cultural development in Nagaon town.
- Existing Residential, schools, public spaces and commercial zones adds into the growth of Simaluguri Town.

12.6.4 GROWTH POINTS

The selected points will produce self-sustaining growth. In Nagaon Planning Area, one major growth points have been identified that is Jamaguri.

12.6.4.1 Jamuguri Growth point

Jamuguri Growth Point which is located in southern west part of Nagaon town have potential of large flat terrain around it. It is growing area with small manufacturing units and large residential pockets. This village is situated near the SH 3. It's close proximity to the proposed special tourism zone enables this area with great potential to grow as a growth point attracting investments and being a node for services for the surrounding areas.

12.7 RATIONAL FOR THE CONTIGUOUS URBAN DEVELOPABLE AREA

In addition to the regional connectivity of the NMPA with the rest of the seven sister states and the country, existing settlement pattern and urban growth in and around the Nagaon city, location of eco-sensitive areas and existing land use have to be taken into consideration while developing concept plan for the proposed NMPA.

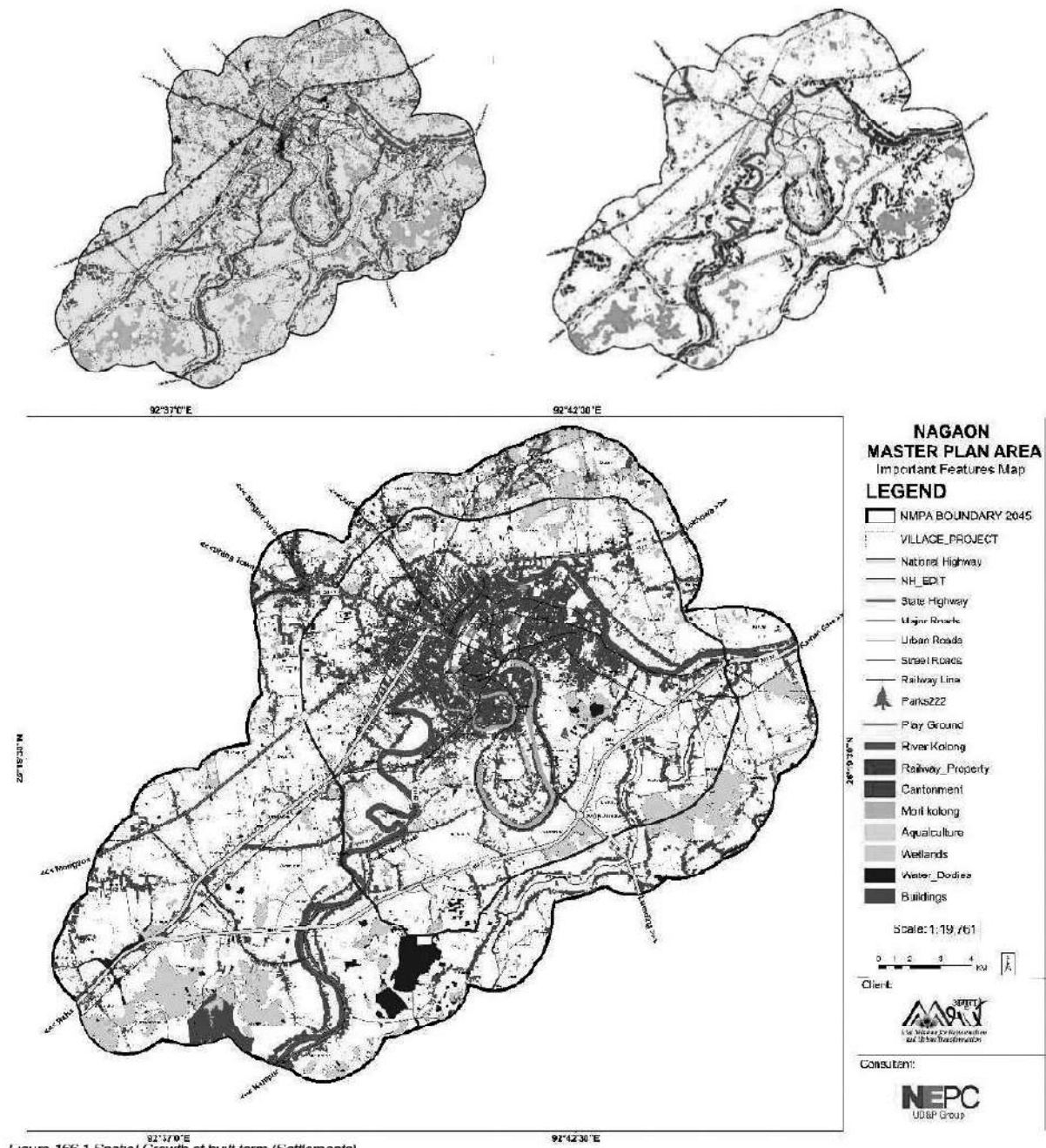


Figure 166.1 Spatial Growth of built form (Settlements)

12.7.1 TRANSPORTATION AXIS AND GROWTH PATTERN:

Strategic location of the Nagaon city makes it the regional centre of the Lower Assam region. Number of nation highways that are spread across the Assam State; connect Nagaon with the other states of northeast, as well as to the remaining India. In fact, over the last two decades, visibly urban growth has been observed along the transport axis. In addition, potential of tourist places and the cultural have influenced the growth pattern of the region. Every tourist spot is connected to major highways in Nagaon. Hence, road network, rail network and location of airport is taken in the consideration while developing the alternatives for the Contiguous Urban Developable Area. Road connectivity has enhanced the urban development of NMB and its surrounding areas. There has been visible growth observed in the East-West direction along the Asian highway, towards south along NH 36, in the south-west towards Guwahati along NH-37 and towards Borduwa and Dihing along SH 47. Numbers of new urban centers have gradually emerged along these transportation corridors. In fact, number of urban areas has increased to 4 in 2011 (including Dimoruguri outgrowth). The maximum growth in the urban centres has been observed in the areas situated on the North along SH 3 and south along Asian Highway. 2 NMB area, especially in Bharbheti, Kuti Katia.

12.7.2 ECO-SENSITIVE AREA AND EXISTING LAND USE:

Other than the urban centres, pattern of the rural settlements in the region is also taken in the consideration, along with the existing economic nodes and eco-sensitive areas. Eco sensitive area, such as forest, wetlands, and waterbodies have also taken in the consideration while developing the alternatives for the Contiguous Urban Developable Area. In the context of Nagaon whole river tributary system and wetlands need to be taken care of. Those areas are restricted and eco-friendly zones and land uses are proposed.

12.8 ALTERNATIVES FOR CONTIGUOUS URBAN DEVELOPABLE AREA

Overlaying the existing development pattern with the transportation axis, layer of eco-sensitive areas, and with the existing land use pattern in the region, following options were worked out. Here, presented all the alternatives were discussed with the Govt. officials. Recommendations and objections suggested by the authority have later incorporated in the final concept plan. In addition, three gross density alternatives were also developed to exercise the proposed urban developable area. As per URDPFI guidelines, ideal density for urban developable area in plain region should be 100-150 pph (person per hectare). Considering this guideline, the urban developable area should be comprised around between 37 sq.km to 40 sq.km. All presented alternatives were discussed with the authority, and the alternative-1 was finalized after weighting pros and cons of each of them.

Table 211 Considered Gross Density for Developable Area

2045 Population	4,63,221
Alternative-1: 90 pph Density	
Req. Area (sq.km)	51.58
Alternative-2: 100 pph Density	
Req. Area (sq.km)	46.42
Alternative-3: 125 pph Density	
Req. Area (sq.km)	37.13
Alternative-4: 150 pph Density	
Req. Area (sq.km)	30.94
NMPA Arc (sq.km)	148
Gross Density (pph)	31.36
URDPFI Guideline Recommended Density	100-150

12.9 GUIDELINES AND CRITERIA CONSIDERATION

All the above considerations would ensure in the future NMPA a planned spatial structure of the urban settlements and their functional interdependency with each other. Proper zonation and prioritizing the fragile ecology area with least development activities in terms of extensive usage of land including recreational and low-density zone would ensure a balance between developable and open spaces. The transportation axis in the area is also a major consideration, which will help facilitate the region in improving inter and intra connectivity. The final concept plan for the urbanization area of the NMPA hereby have been conceptualized with the approach that other towns around NMB would be developed as Growth Centre and Growth Point within the NMPA. Under AMRUT mission, 148 sq.km of the proposed NMPA with 116.11 sq.km of the contiguous urban developable area has been selected for Master Plan 2045.

Table 212 Existing Land Use Distribution

Sr. No.	Landuse Type	Area (Sq Km)	Percentage of Developed Area (%)	Percentage of Planning Area (%)
1	Residential	25	79	16.89
2	Commercial	0.88	2	0.59
3	Industrial	0.47	1	0.32
4	Mixed	0.119	3	0.08
5	Public and Semi Public	1.83	5	1.24
6	Public Utilities	0.027	0.0	0.02
7	Recreational	0.09	0.0	0.06
8	Transportation	3.16	10	2.14
	Total (Developed Land)	31.57	100	21.34
9	Vacant	15.23		10.29
10	Agricultural	72.9		49.26
12	Forest	13.57		9.17
13	Waterbody	14.41		9.74
	Total (Undeveloped Land)	116.11		78.45
	Grand Total	148.00		100

Out of total NMPA area, 116.11 sq.km area is the Contiguous Urban Developable Area, which is around 78.45% of the total NMPA area. Out of total Urban Developable Area, 21.34% area is non-developable area that comprise wastelands, waterbodies, nallas, forest, and defense land, while rest of the 59.54% (88.12 sq.km) area is available for urban development. Hence, overall, 120 sq.km of land is available for development under Nagaon Planning Area 2045 out of 148 sq.km identified region.

12.9.1 CRITERIA TAKEN IN CONSIDERATION FOR PROPOSED LAND USE DISTRIBUTION

URDPFI guidelines for the land use distribution (within urban developable area) are taken in consideration for the land use distributions in the NMPA. Apart from the URDPFI guidelines, residential area requirement for housing provision based on the 1.2 FSI (Floor Space Index) and commercial and industrial area requirement based on the employment projection are also taken into the considerations.

12.9.2 GUIDELINES FOR LAND USE DISTRIBUTION

Following table presented the recommendation for land use distribution within the urban developable area by URDPFI Guidelines. The table also show the proposed land use distribution within the proposed urban developable area.

Table 213 Guidelines for Land Use Distribution

Land use Categories	Recommended share of Land Use (in percentage of Developed Area)
Residential	43-48
Commercial / Mixed Use	4-6
Manufacturing/ Industries	7-9
Public and Semi-Public	6-8
Open Space Zone/ Recreation	12-14
Transportation & Communications	10-12
Agriculture, Water Bodies and Special Areas	Balanced
Total	100

(Source: URDPFI Guidelines)

12.9.2.1 Residential Area Requirement Based on Housing Demand

As per the housing projection (refer chapter - 5), the NMPA would be required total 62282 housing by 2045. Based on the consideration of 200 sq.mt/housing unit and 1.5 FSI (Floor Space Index), with 25% circulations, and 50% ground coverage, around 15.57 sq.km of additional residential land is required to accommodate the 62.2 thousand new houses within the urban developable area of the proposed NMPA. Overall, 40.57 sq.km of land will be required for residential settlement in the Planning Area 2045.

Table 214 Residential Area Requirement Based on Housing Demand

Criteria	Year 2045
Total No. of Houses Required	62282
Area Per Housing Unit (sq. meter)	200
Total Residential Unit Area (on sq. meter)	12456400
Assumed Additional 25% Circulation Area Required per unit	
Total Gross Area (Total Residential Plot/Area) (sq.mt)	15570500
Allowed FSI / Average FSI as per DCR	1.5
Net Area Residential Requirement at Plot Level	10380333
Required Residential Area (sq.km)	10.38
Required Residential Area (ha)	1038
Assumed Allowed (as per GDCR) 50% is Ground Coverage for road and other circulation at city level	
Gross Residential Land Requirement (NMPA Level) (sq.mt)	15570500
Required Total Gross Residential Area in NMPA (sq.km)	15.57
Required Residential Area (ha)	1557

12.9.3 CRITERIA TAKEN IN CONSIDERATION FOR LAND USE PROPOSALS

Based on the land suitability and potential analysis, existing land use pattern, and existing situation following criteria were considered while developing land use proposals for the NMPA, especially within the contiguous urban developable area:

- As the region is blessed with number of the wetlands and eco-sensitive area, the area surrounding them should be kept conserve and no or low intensity development should be allowed. No-development buffer varying from 9 meter to 30 meter should be kept surrounding wetland and waterbodies.
- As far as possible low intensity of residential development should be considered in the area that is in the close proximity of the eco- sensitive areas.
- Based on the existing land use pattern, high intensity of mixed use development along the major roads should be considered.
- Transport zone or transport related activities should be kept nearby transport facilities such as Asian Highway.
- Road network should be designed to have a proper road circulation throughout the Master Plan area, with road hierarchy to provide free movement and to reduce congestion from the existing roads.

12.10 PROPOSED LAND USE PLAN

The total project area includes NMB, Existing NDA Area and additional area added to make Nagaon Master Plan Area. Area other than settlements and developmental activities, such as open land (waste land, open / vacant land), wet lands (used for recreational development), Tree covers can be foreseen based on development potential, feasibility, suitability, and consultation with stakeholders.

12.10.1 PROPOSED LAND USE DISTRIBUTION

Based on the above mentioned all the criteria, below mentioned land use distribution has proposed. The proposed land use map allocate 29.90% for residential, 8.7% land for commercial and mixed use development, 6.01% land for industrial development, 3.29% for public and Semi Public, and 6.37% land for open space and recreational purposes. The Master Plan also proposed 23.41% area for the urban agriculture outside the developable area.

Table 215 Existing and Proposed Land Use Distribution - 2045

Existing - 2020					Proposed - 2045		
Sr. No.	Landuse Category	Area (Sq Km)	% age of Developed Area	% age of Planning Area	Area (Sq Km)	% age of Developed Area	% age of Planning Area
1	Residential	25	79	16.89	44.25	47.52	29.90
2	Commercial	0.88	2	0.59	2.64	2.84	1.78
3	Industrial	0.47	1	0.32	8.9	9.56	6.01
4	Mixed	0.119	3	0.08	10.24	11.00	6.92
5	Public and Semi Public	1.85	5	1.26	4.86	5.22	3.29
9	Recreational	0.09	0.0	0.06	9.43	10.13	6.37
7	Transportation	3.16	10	2.14	12.79	13.74	8.64
Total (Developed Land)		31.57	100	21.34	93.11	100	62.91
8	Vacant	15.23		10.29	0		0
9	Agricultural	72.9		49.26	34.64		23.41
10	Vegetation	13.57		9.17	5.84		3.95
11	Waterbody	14.41		9.74	14.41		9.74
Total (Undeveloped Land)		116.11		78.45	54.89		37.09
Grand Total		148.00		100	148.00		100

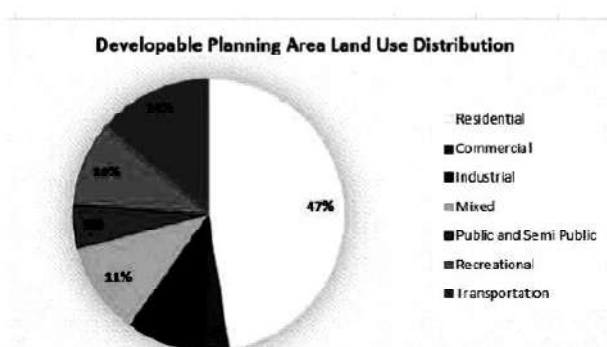


Figure 169 Nagaon Developed Planning Area Proposed Land Use Distribution



Figure 167 Total Planning Area Proposed Land Use Distribution

12.10.1.1 Residential Use

For the projected residential population of 4,63,221 persons, the total area required by 2045 for urban development is forecasted to be 9147 hectares, out of which 4425 hectares (47.52% of the developed area) are earmarked for residential development against 2500 hectares available at present. The dedicated area for affordable housing for economical weaker sections is separately identified in the proposed land use plan 2045.

12.10.1.2 Commercial Use

Commercial use has been increased to 264 hectares for the projected year 2045 from the existing 88 hectares contributing about 2.84 % and 1.78% of the developed area and the total planning area respectively. As the population increases the demand for commercial area increases, hence commercial areas has been planned at the major junction nodes.

12.10.1.3 Mixed Use

Mixed use has been increased to 1024 hectares for the projected year 2045 from the existing 119 hectares contributing about 11.00 % and 6.92% of the developed area and the total planning area respectively. As the population increases the demand for mixed use area increases, hence mixed use areas has been planned along all the higher level roads.

12.10.1.4 Industrial Use

Industrial use has been increased to 890 hectares for the projected year 2045 from the existing 47 hectares contributing about 9.56 % and 6.01 % of the developed area and the total planning area respectively.

12.10.1.5 Public and Semi-Public Use

Public and Semi-Public Use has been increased to 486 hectares for the projected year 2045 from the existing 183 hectares contributing about 5.22 % and 3.29 % of the developed area and the total planning area respectively.

12.10.1.6 Recreational Use

Recreational use has been increased to 943 hectares for the projected year 2045 from the existing 9 hectares.

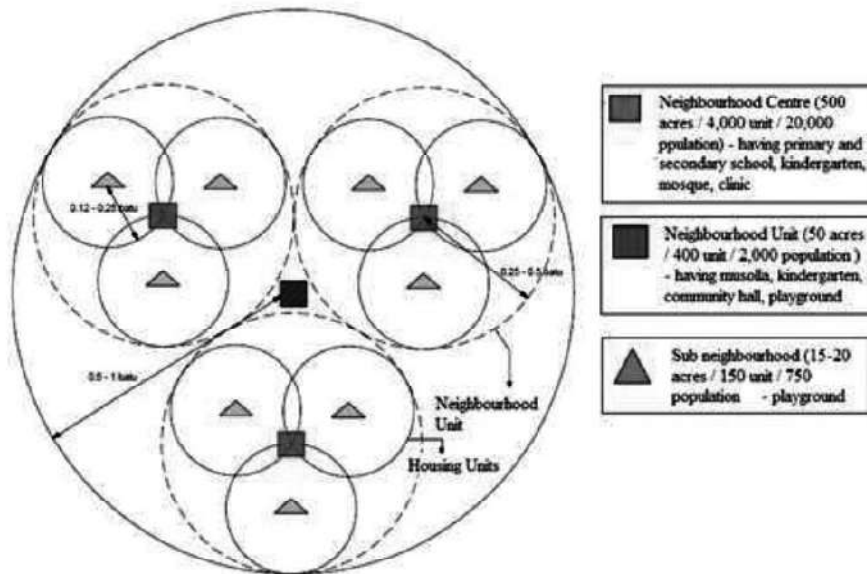
12.10.1.7 Transportation Use

Area under Transportation use has been increased to 1279 hectares for the projected year 2045 from the existing 316 hectares.

12.11 FACILITY CENTRE

Based on the hierarchy of order of settlements, facilities are planned. The following are the levels based on hierarchy:

- City level
- To facilitate higher order planning, city level facilities are provided.
- Neighborhood/ Planning Unit
- Neighborhood into 2 levels
- Level I-- 10000-11999
- Level II- 12000-15000
- Housing Area Level/neighborhood level
- Grouped to form Housing Area with an average population of 5000 population.



Higher order facilities as general hospital, intermediate hospital, college, integrated schools, and school for handicapped, socio-cultural and recreational club, fire and police stations are provided at the master plan level. Nursery and primary schools, dispensaries, Electricity Sub Station, Garbage transfer station are provided at the Neighborhood.

Table 216 Details of Neighbourhood Centres (10 Hectares for 10000 to 12,000 population)

Sr. No.	Facilities	No.	Area per Unit (ha)	Total Area (ha)
1	High Secondary School	1	1.6	1.6
2	Dispensary	1	0.1	0.1
3	Community Hall cum Library	1	0.2	0.2
4	Community Room	2	0.1	0.2
5	Primary School with Playfield	2	0.4	0.8
6	Middle School with play field	1	0.5	0.5
7	Electric Sub Station	1	0.05	0.05
8	Local shopping including Service Centre	1	0.45	0.45
9	Neighbourhood Park	1	0.75	0.75
10	Neighbourhood Play Area	1	0.75	0.75
11	Three wheeler cum Taxi Stand	1	0.05	0.05
12	Religious Building	1	0.05	0.05
	Sub Total -A		100	5.5
13	Transportation and Communication			2.5
	Grand Total			8.0

Table 217 Details of Neighbourhood Centres Provisions (10 Hectares for 12001 to 15,000 population)

Sr. No.	Facilities	No.	Area per Unit (ha)	Total Area (ha)
1	High Secondary School	1	1.6	1.6
2	Dispensary	1	0.1	0.1
3	Community Hall cum Library	1	0.2	0.2
4	Community Room	2	0.1	0.2
5	Primary School with Playfield	2	0.4	0.8
6	Middle School with play field	1	0.5	0.5
7	Electric Sub Station	1	0.05	0.05
8	Local shopping including Service Centre	1	0.45	0.45
9	Neighbourhood Park	1	0.75	0.75
10	Neighbourhood Play Area	1	0.75	0.75
11	Three wheeler cum Taxi Stand	1	0.05	0.05
12	Religious Building	1	0.05	0.05
	Sub Total -A		100	5.50
13	Housing Area			2.00
	Sub Total -B			7.50
14	Transportation and Communication			2.50
	Grand Total			10.00

12.12 ZONING REGULATIONS

In order to promote public health, safety and the general social welfare of the community, it is necessary to apply reasonable limitation on the use of land and buildings. This is to ensure that the most appropriate economical and healthy development of the city takes place in accordance with the land use plan. For this purpose, the City is divided into a number of use zones, such as residential, commercial, industrial, public and semi-public, etc. Each zone has its own regulations as the same set of regulations cannot be applied to the entire town.

Zoning protects residential area from the harmful invasions of commercial and industrial uses and at the same time promotes the orderly development of industrial and commercial areas. By regulation the spacing of buildings, adequate light, air, protection from fire etc. can be provided. It prevents overcrowding in buildings and land thus ensures adequate facilities and services.

Zoning is not retrospective. It does not prohibit the uses of land and buildings that are lawfully established prior to the coming into effect of the zoning regulations. If these uses are contrary to the newly proposed uses, they are termed as non-conforming uses and are gradually eliminated over years without inflicting unreasonable hardship upon the property owners.

The zoning regulations and their enforcement are a major tool in keeping the land uses pattern of the Comprehensive Master Plan. It has been stated that the consultants have adopted the UDPFI guidelines with minor modification. However while detailing out the use permissibility, etc in various categories all care has been taken to integrate:

- "Assam Town and Country Planning ACT, 1959" and amendments;
- UDPFI Guidelines.

This formulated guideline may adopt other provision of the regulation towards intensity of development and built form guidelines, etc.

1. In the Nagaon Master Planning Area (NMPA), various use zones namely Residential, Commercial, Industrial, Public and Semi- Public, Utilities and Services, Recreational, Transportation, Agricultural, Water bodies and Special Areas having their location as indicated in the Comprehensive Master Plan shall be regulated and guided. Except or otherwise provided, no structure or land here inafter shall be erected, recreated or altered unless its use is in conformity with the following regulations.
2. All existing places of worship, temples, churches, mosques, burial and cremation ground etc. shall be exempted from being treated as nonconforming uses, provided that continuance of such uses are not detrimental to the locality as decided by the Authority from time to time.
3. All non-conforming uses of land and buildings shall be discontinued by the owner and the modified uses shall be made to conform to the land use of the development plan in force within six months of the Regulations coming in force.

12.12.1 PROPOSED RESIDENTIAL ZONE (R)

Residential Zone is pure residential area in which major commercial and industrial activities are not allowed, however some for day-to-day needs of shopping uses should be allowed. In addition, a comprehensive range of community facilities, including schools, medical facilities, neighborhood retail and open space are allowed. Total 44.24 sq.km (47.52%) of area is earmarked for Residential Zone in the proposed land use plan.

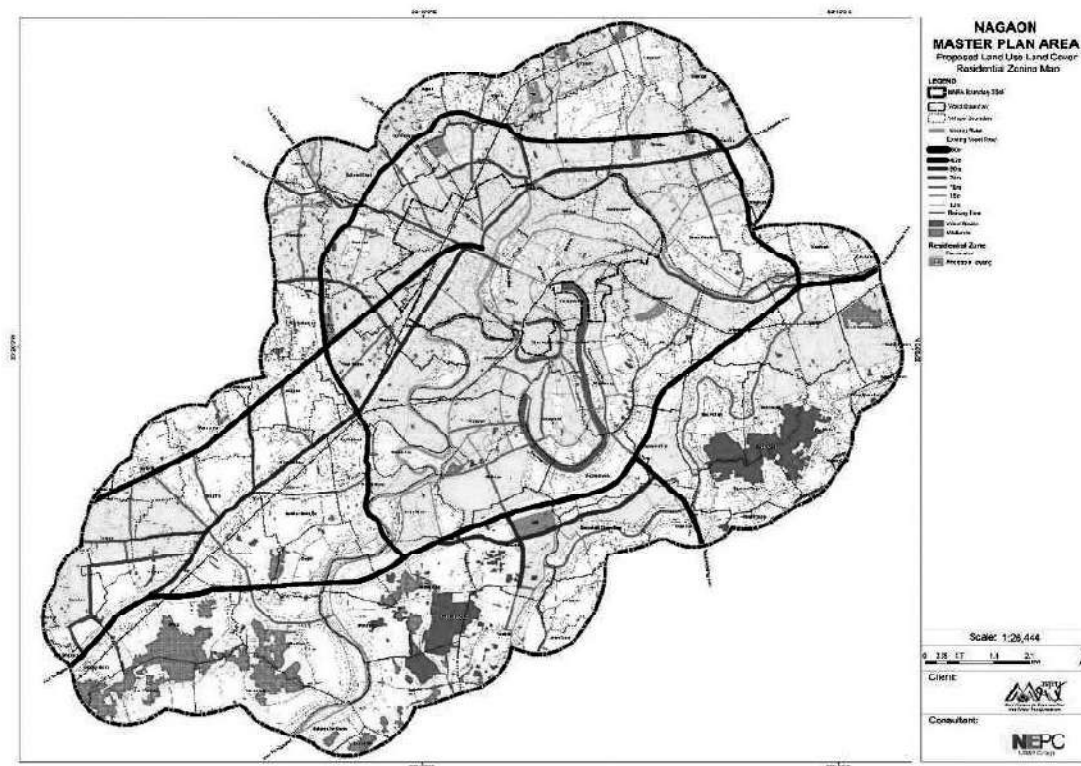


Figure 170 Proposed Residential Zone Map, NMP 2045

As conurbation area will be facing the higher pressure of development, ample residential area is proposed in order to accommodate the future expansion which will take place in the future. Higher intensity residential development is allowed in this zone. No other than residential uses are allowed in this zone; however, housing will be developed with a comprehensive range of community facilities, including schools, medical facilities, neighborhood retail and open space.

Permissible Uses: Fuel filling station, Bank, Hospital, Shopping centre/ Commercial centre, Restaurant/ Café, Retail vegetable Market, Primary and Secondary School; ground larger than 5 ha; religious building on Plot larger than 1000 sq m; Auto Repair workshop; Veterinary Hospital; Public Facility Infrastructure/Utility Buildings; and apartment and clusters thereof; Row-house, Villa/Bungalow; ground smaller than 5 ha; Housing for EWS; Dharmashala; Old- Age Home; Maternity Home, Nursing Home, Kindergarten, Day-care, Dispensary, Veterinary Clinic, Health-club, religious building on plot smaller than 1000sqm, Community Hall, Neighbourhood centre/Civic centre.

Regulated Uses: Cemeteries/ Burial Ground, Broadcasting towers and line-of-site relay devices for telephonic, radio or television communications. The following uses and structures shall be permitted as ancillary uses to the main use of the building provided their name, location and size (if applicable) is indicated in the site plan submitted for approval. Part of a residence may be permitted for use as professional office for advocates, chartered accountants, architects, doctors, engineers or the like, or as a small scale home based workshop subject to the following conditions: 1) it is not located in a multi-storey apartment; 2) the number of employees do not exceed 10; 3) it does not involve installation and use of heavy machinery, and does not create.

12.12.2 PROPOSED COMMERCIAL ZONE (C)

Total 2.64 (2.84%) sq.km of area has earmarked in the proposed land use plan as Commercial Zone for commercial land uses. This zone allows a range of commercial uses including retail shops, offices, small-scale warehouses, and the hospitality industry that includes hotels and entertainment venues.

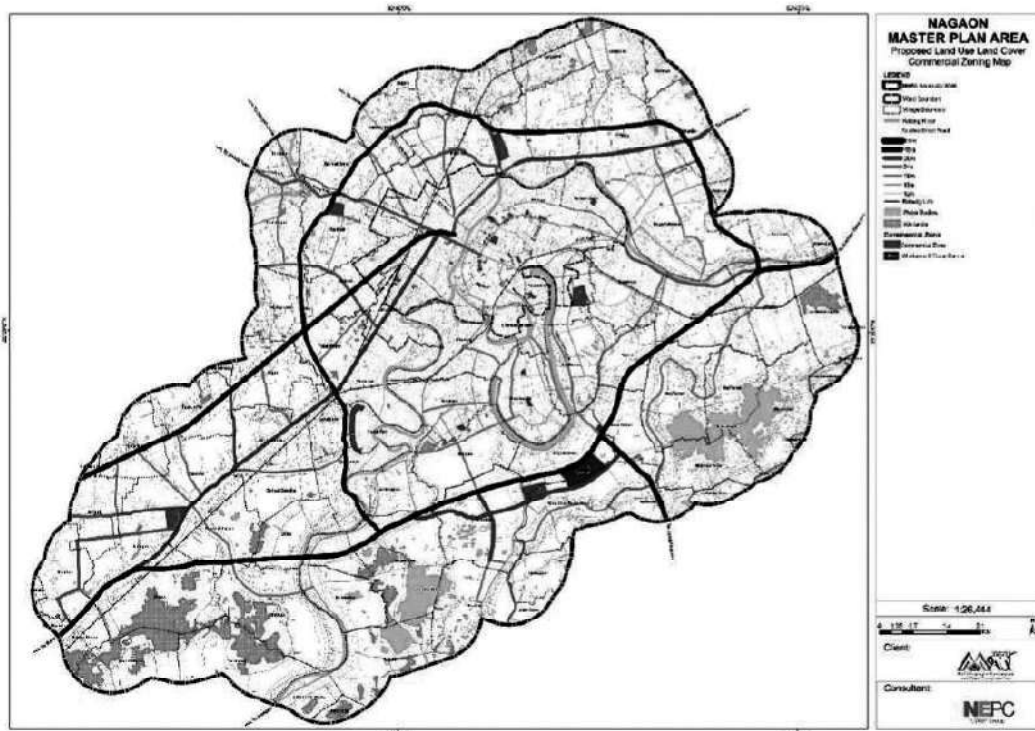


Figure 171 Proposed Commercial Zone Map, NMP 2045

Existing industrial activities will be allowed to continue as non-confirming use but no new industrial related activities would be allowed in the earmarked commercial zone.

Retail Space:

- Neighborhood and Community Level Retail Space- will be located near residential area that will include kiosks, shops, and community markets; where day-to-day needs of consumers, particularly food shopping and convenience goods will be accommodated.
- District and City Level- Larger commercial center and intermediate commercial centres, which includes the prime retail space represented by malls and high quality shopping space.

Office Space:

Offices space will be required primarily for the indirect employment generated because of direct employment in the base industries and economic sectors. The following sectors will require office space:

- Transport and Storage
- Construction and Infrastructure
- Public Administration
- Utility Companies and Institutional bodies
- Banking and financial services
- IT based company and tele communication

It is assumed that the wholesale, retail sectors, banking and financial sectors will operate out of their own premises.

Permissible Uses: Convention and Exhibition Centre; Sports Complex; Auditorium; Integrated Multimodal Passenger Transport Hub; Dormitories; Museum; Super specialty Hospital Residential Multi-storey Apartments; Serviced Apartments, Petrol/CNG/L PG Pump and all uses like Multi-level Parking; Office Complex, Retail Mall, Cinema Hall; Commercial Complex, Restaurants, Food Plazas and Food Streets; Other Retail; Public/ Govt Institutional Buildings, Training Centre; Art Gallery; Diagnostic/Radiology Centre; Hospital C and D; Health/Welfare Centre; Place of Worship larger than 1000 sqm; Public Facility/Infrastructure/ Utility Buildings; Petrol/CNG/LPG Pump Restaurants, Food Plazas and Food Streets; Neighbourhood Retail Shop; Community Hall; Health Club; Dispensary; Place of Worship smaller than 1000 sqm;

Regulated Uses: The following uses should be permitted subject to approval of a special permit on a case-by-case basis: Cemeteries/ Burial Ground, Broadcasting towers and line-of-site relay devices for telephonic, radio or television communications.

The following uses and structures shall be permitted as ancillary uses to the main use of the building provided their name, location and size (if applicable) is indicated in the site plan submitted for approval. Part of a residence may be permitted for use as professional office for advocates, chartered accountants, architects, doctors, engineers or the like, or as a small scale home based workshop subject to the following conditions:

- it is not located in a multi-storey apartment
- the number of employees do not exceed 10
- it does not involve installation and use of heavy machinery, and does not create noise, vibration, fume or dust;
- separate means of access and a designated parking area for staff and visitors is provided and marked on the site plan submitted for approval.

Devices for generation of non- conventional energy, such as solar panels, wind power. Servant quarters or lodging facilities for caretaker/security personnel NDA can grant special permission in height, FAR, Ground Coverage for Special Buildings (Star Hotels, Hospitals, institutions/government/semi government institution etc.) which have special privileges (under various Government Policies issued time to time) (in reference to Township, Special Regulations for hospitals, Special Regulations for Hotels).

12.12.3 MIXED USE ZONE (MU)

Total 10.24 sq.km area is earmarked as Mixed Use Land Use in the PLU. Further, this land use is classified into two zones viz Mixed Use-1 and Mixed Use-2.

12.12.3.1 Mixed Use-1 (MU 1)

Total 7.24 sq.km of area is proposed under this land use zone. Part of it is located along the part of NH 27 that is passing on the North of NMB area. 100 meter of influence area on both sides of the highway is proposed as a Mixed Use -1 zone.

Another earmarked 100 meter influence area on both side of SH-3, Old NH (part of the highway going towards Raha out side ring road) and 45mt Ring Road is also proposed as a Mixed Use-1 zone. In the proposed Mixed Use-1 zone 80% of the FSI will be available for commercial/institutional/ PSP purposes, while the rest of the 20% FSI will be for residential purpose. Existing industrial allowed as non-confirming use but no new industrial activities will be permitted.

12.12.3.2 Mixed Use-2 (MU 2)

Total 3 sq.km of area is proposed in the NMPA as a Mixed Use-2 where 40% area will be available for commercial/institutional/ PSP purposes, while the rest of the 60% will be for residential purpose. If for any reason, the 40% area allotted for commercial development will not fully or partly developed for commercial activities then the area can be used for residential purpose; however, if the residential area is not fully developed then allotted residential area cannot be used for commercial purpose. Locations of the Mixed Use Zone-2 is as per the Proposed Land Use Map. However, Existing industrial allowed but no new industrial activities will be permitted.

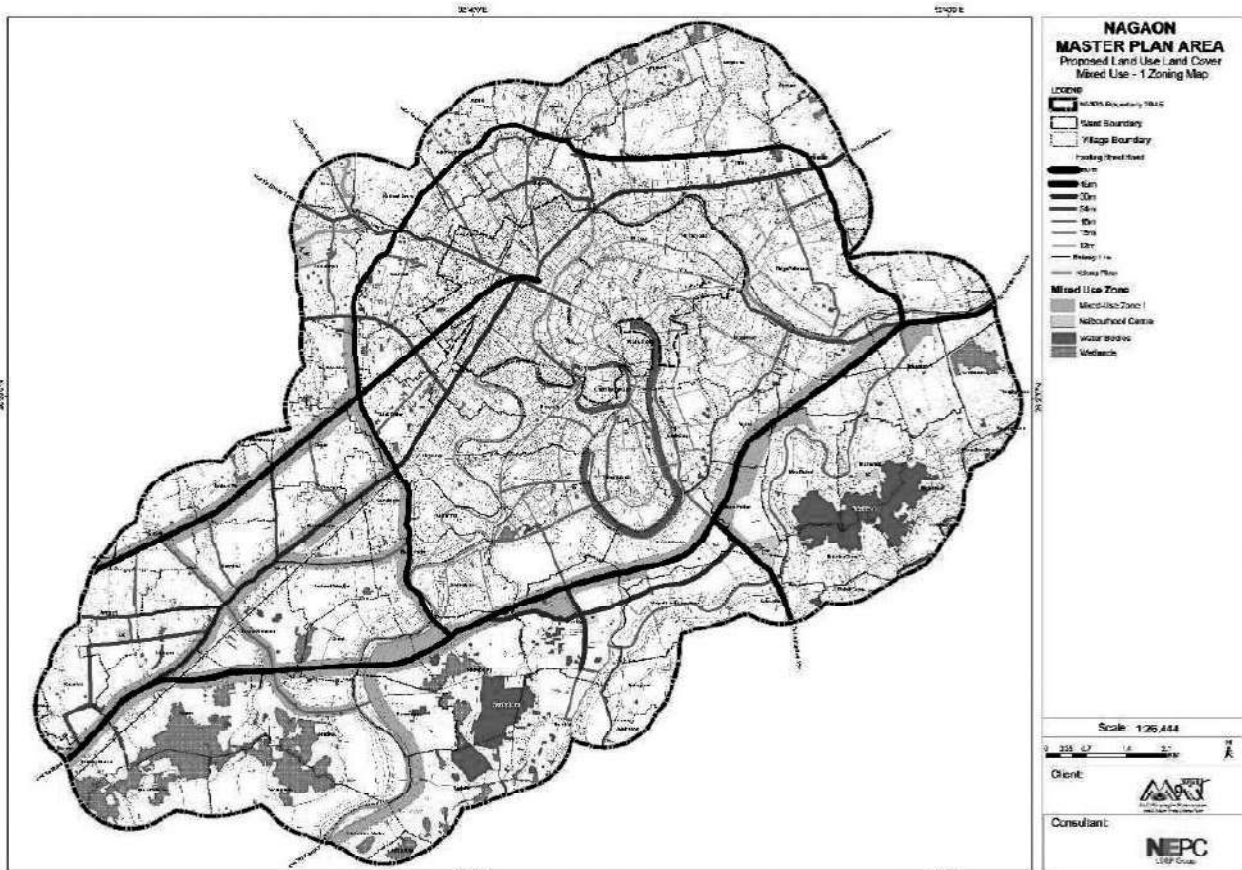


Figure 172 Proposed Mixed Use-1 Zone Map, NMP 2045

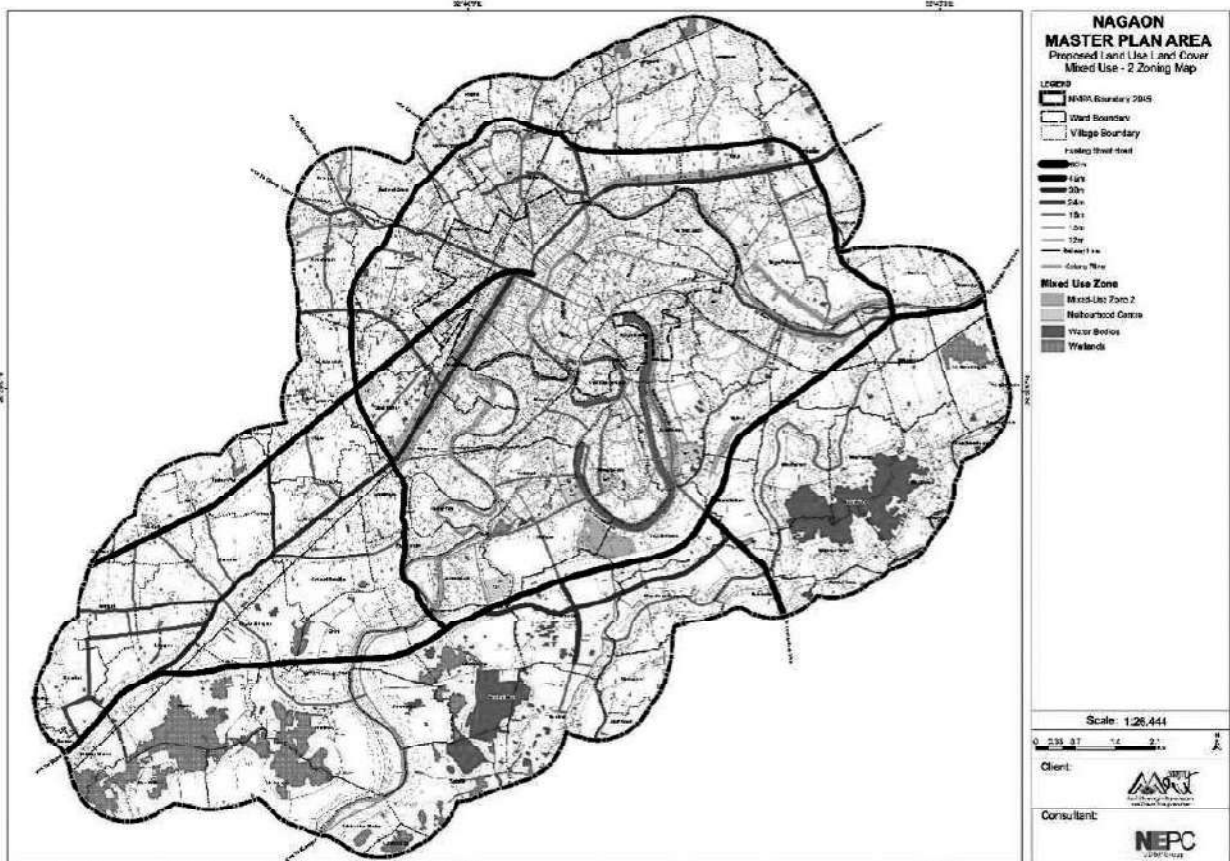


Figure 173 Proposed Mixed Land Use-2 Zone Map, NMP 2045

Permissible Uses:

Fuel filling station, Bank, Hospital, Shopping centre/ Commercial centre, Restaurant/Café, Retail vegetable Market, Primary and Secondary School; ground larger than 5 ha; religious building on Plot larger than 1000 sq. m.; Auto Repair workshop; Veterinary Hospital; Public Facility Infrastructure/Utility Buildings; and apartment and clusters thereof; Row-house, Villa/Bungalow; ground smaller than 5 ha;

Housing for EWS; Dharmashala; Old- Age Home; Maternity Home, Nursing Home, Kindergarten, Day-care, Dispensary, Veterinary Clinic, Health-club, religious building on plot smaller than 1000sqm, Community Hall, Neighbourhood centre/Civic centre .

Convention and Exhibition Centre; Sports Complex; Auditorium; Integrated Multimodal Passenger Transport Hub; Dormitories; Museum; Super specialty Hospital Residential Multi-storey Apartments; Serviced Apartments, Petrol/CNG/L PG Pump and all uses like Multi-level Parking; Office Complex, Retail Mall, Cinema Hall; Commercial Complex, Restaurants, Food Plazas and Food Streets; Other Retail; Public/ Govt Institutional Buildings, Training Centre; Art Gallery; Diagnostic/Radiology Centre; Hospital C and D; Health/ Welfare Centre; Place of Worship larger than 1000 sqm; Public Facility/Infrastructure/ Utility Buildings; Petrol/ CNG/LPG Pump Restaurants, Food Plazas and Food Streets; Neighbourhood Retail Shop; Community Hall; Health Club; Dispensary; Place of Worship smaller than 1000 sqm;

Regulated Uses: The following uses should be permitted subject to approval of a special permit on a case-by-case basis: Cemeteries/ Burial Ground, Broadcasting towers and line-of-site relay devices for telephonic, radio or television communications.

The following uses and structures shall be permitted as ancillary uses to the main use of the building provided their name, location and size (if applicable) is indicated in the site plan submitted for approval. Part of a residence may be permitted for use as professional office for advocates, chartered accountants, architects, doctors, engineers or the like, or as a small scale home based workshop subject to the following conditions:

- it is not located in a multi-storey apartment
- the number of employees do not exceed 10
- it does not involve installation and use of heavy machinery, and does not create noise, vibration, fume or dust;
- separate means of access and a designated parking area for staff and visitors is provided and marked on the site plan submitted for approval.

Devices for generation of non- conventional energy, such as solar panels, wind power. Servant quarters or lodging facilities for caretaker/security personnel NDA can grant special permission in height, FAR, Ground Coverage for Special Buildings (Star Hotels, Hospitals, institutions/government/semi government institution etc.) which have special privileges (under various Government Policies issued time to time) (in reference to Township, Special Regulations for hospitals, Special Regulations for Hotels).

12.12.4 PUBLIC AND SEMI-PUBLIC ZONE (PSP)

Nagaon is home for many educational and health institutes like Nowgaon Collage, A.D.P Colleges, Nagaon Girls Colleges, it is considered a favorite destination among students in the middle part of Assam. This has led to many educational and health institutes being established within the planning area leading to an increase in percentage of land falling under the public and semi-public category against the prescribed limit of URDPFI guidelines for PSP land use.

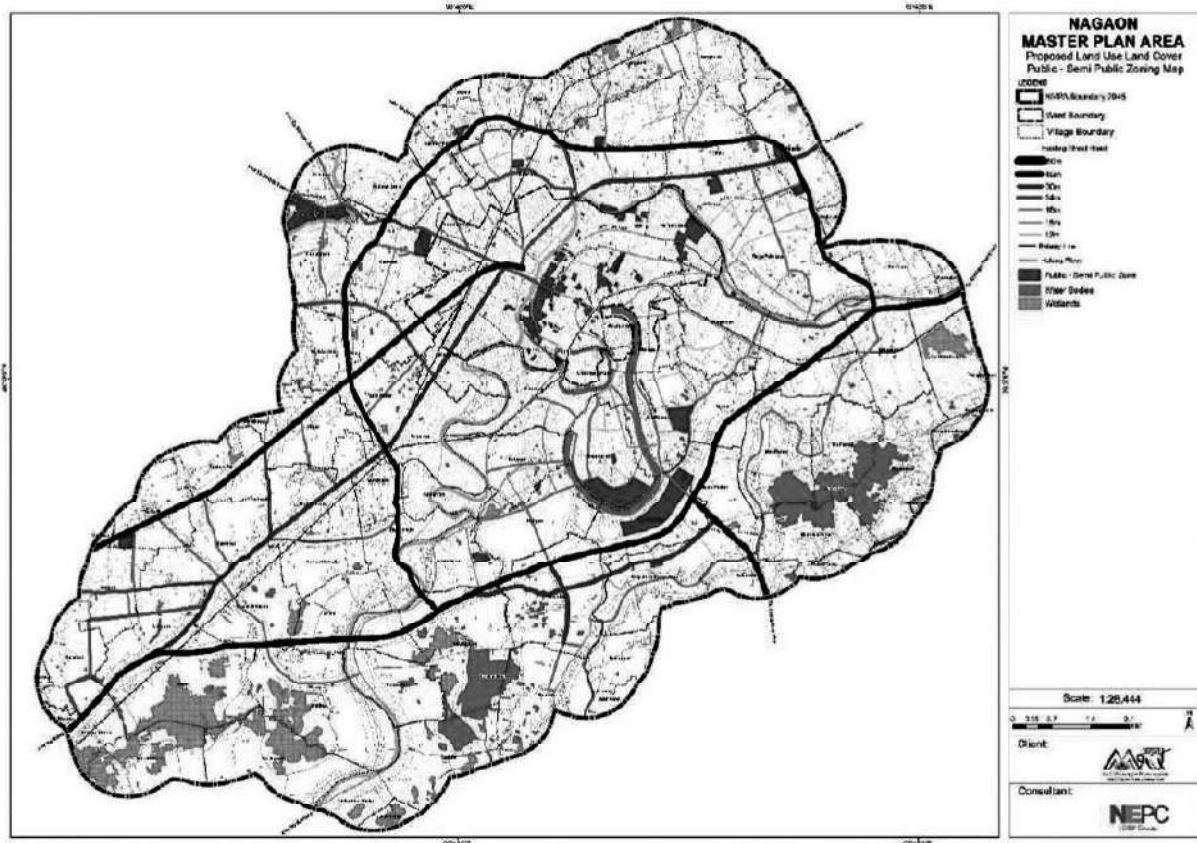


Figure 174 Proposed Public & Semi-Public Zone Map, NMP 2045

Total 4.85 sq.km of area is earmarked as a Public and Semi-Public zone in the proposed land use map. Health, Educational, Cultural, Government Buildings, sports and open space facilities will be allowed in this zone.

Permissible Uses: Government offices, Central, State, Local and Semi Government Public Undertaking Government Offices, Defence Court, Universities, Specialized Education Institutes, Polytechnic Colleges, Schools, Nurseries, Kinder gardens, Research and Development Centres, Social and Welfare centres, Railway passenger terminals, Public utility buildings, Local municipality facilities, Uses incidental to government offices and for their uses, Monuments, Radio transmission and Wireless stations, Telecommunication centres, Telephone exchange, Hospitals, Health centres, Nursing homes, Dispensaries, Clinics.

Regulated Uses: Residential flat and residential plot for staff employees, hostel, water supply installations, Sewage Disposal Works, Service Stations, Railway stations / Yards, Bus / Truck terminal, Burial Grounds, Cremation grounds, Cemeteries / graveyards, warehouses/ storage godowns, helipads, commercial use/ centres, other uses and activities.

12.12.5 INDUSTRIAL ZONE (I)

To create a conducive environment for development Industrial Zone is created. Total 8.9 sq.km of the Industrial land use zone has demarcated in the proposed land use plan. The distribution of the main industrial zones is shown in the map. Only industrial activities are allowed in the demarcated industrial land use in the PLU map. In addition, small workshops and businesses can be allowed on the edge of the main industrial. However, existing land uses within the proposed industrial zone will allow as non-confirming use until redevelopment of such land parcels.

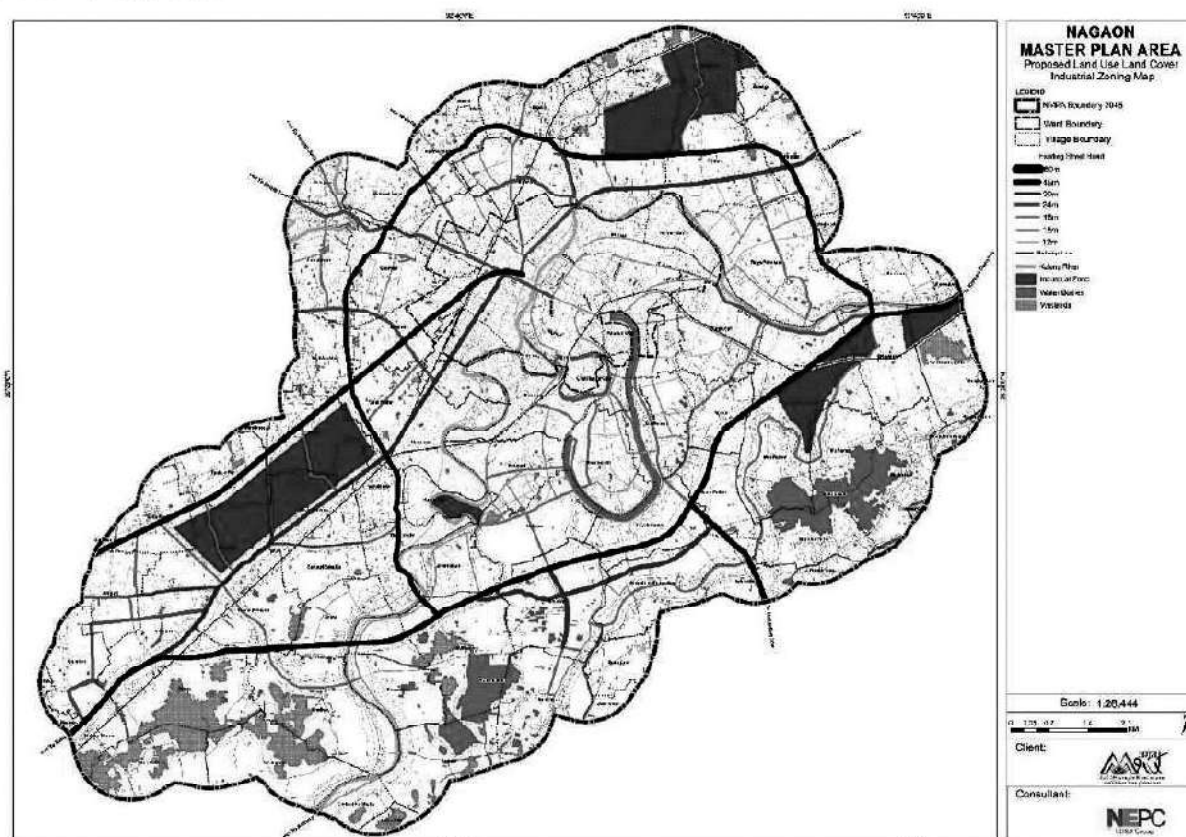


Figure 175 Proposed Industrial Zone Map, NMP 2045

Permissible Uses: Truck terminal; and Industrial Convenience Centre; Fuel filling station; Auto repair workshop; Fire Station; Solid Waste Segregation Facility; Public Facility/ Infrastructure/Utility Building; Industrial building, utility, workshop; Café/Restaurant/ Canteen; Bank; Warehouse/Godown/Storage Facility; Dormitories/workers housing.

Regulated Uses: The following uses may be permitted subject to approval of a special permit on a case-by-case basis:

- Broadcasting towers and line-of-site relay devices for telephonic, radio or television communications
The following uses and structures shall be permitted as ancillary uses to the main use of the building provided their name, location and size (if applicable) is indicated in the site plan submitted for approval:
- Devices for generation of non- conventional energy, such as solar panels, wind power
- Lodging facilities for caretaker/security personnel

NDA can grant special permission in height, FAR, Ground Coverage for Special Buildings (Star Hotels, Hospitals, institutions/government/semi government institution etc.) which have special privileges (under various Government Policies issued time to time) (in reference to Township, Special Regulations for Hospitals, Special Regulations for Hotels). NDA can grant special permission for residential use within the industrial zone provided that adjacent industries are non polluting.