CHAPTER IV
DRAINAGE SEWERAGE SYSTEM OF GUWAHATI CITY

4.1 GROWTH AND DEVELOPMENT OF DRAINAGE-SEWERAGE SYSTEM

Urbanization is considered to be the sign of development of a particular region of the modern world. Being the fast growing urban centre of the North-Eastern part of India and having the administrative, industrial and commercial hub of the entire region the city of Guwahati is experiencing the concentration of additional flow of people day by day. By observing the development of the city it is found that built-up areas have been increasing from 1911 as mentioned in the earlier chapter. With the growth of the urban centre simultaneously, the drainage sewerage system of the city is also expanding. But after the shifting of the capital from Shillong to Guwahati the pace of urbanization in Guwahati has been accelerating and along with that drainage sewerage system has developed. At present, Guwahati is one of the densely populated urban centres of the country. There is the necessity of a proper and efficient drainage sewerage system in the city. During the survey and field visit it is found that though the system is expanding, still its condition is not satisfactory. From the locational point of view, Guwahati city lies on a flat alluvial plain along with some scattered hills. But, due to fast rate of urbanization people are getting concentrated and some are engaged in transforming the hilly parts of the city to built-up area. On the other hand, with the increasing number of population, the rate of impervious surface is also increasing simultaneously resulting in reduction of the infiltration rate of the land day by day. The existing drains in the city are found to be quite inadequate and inefficient to drain out all the dischargeable waters and sewerages. As a result the city has to witness severe water logging problem specially during the rainy season.

4.2 PRESENT LAYOUT AND STATUS OF THE SYSTEM

Presently there is no sewerage system in the Guwahati city. Untreated or semi-treated sewages are disposed into the storm water drains due to lack of proper sewerage and sanitation system in the city. Guwahati being the fast growing urban center experiencing the ever increasing population pressure and urbanization process has received high volume of water discharge in the drains. The existing drains in the
city are found to be inadequate and insufficient to drain out all the dischargeable
waters. As a result, the city has to witness chronic water logging problem specially
during the rainy season and due to lack of proper sewerage system the city is facing
lots of problems related to drains and sewerage.

The city area does not present a smooth land and some topographic variations
are noticed in almost all the parts of the city. The expansion of the urban landscape
has achieved a remarkable development specially after 1947 and the present
expansion of the city is the result of the agglomeration of the urban structure
developed around a multiple nuclei. The city population is increasing spectacularly
due to socio-economic and cultural development, which makes Guwahati the urban
hub and accelerates the migration of population to the city from various parts of the
North-Eastern states in particular and from other parts of the country in general.

The phenomenal growth of population in the city has stressed the need for the
expansion of new built-up areas along with high population density in Panbazar,
Fancy bazaar, Chandmari, Athgaon, Santipur, Maligaon etc. This ever increasing
population and expansion of built-up areas have created the problem of garbage
disposal, sewerage, water logging and proper drainage in many parts of the city. Due
to lack of proper drainage facility the intensity of these problems are increasing
gradually covering new areas. Although there are a number of swamps, marshy lands,
water ponds and small streams present within the city boundary, but all these can not
be considered as adequate to absorb all the water generated from different sources of
the city. Moreover, most of the low-lying areas in the city get inundated at the time of
high floods of the Brahmaputra river, because the gradients of these small streams are
quite low and the flood water enters through these low-lying areas and adversely
affects the present drainage and the sewerage systems in the city.

The Brahmaputra and the Bharalu are the only two natural drainage systems of
the city excluding the Bonda and Khanajan rivers. The Bharalu is a small tributary of
the Brahmaputra, which runs from south-east to north-east and after attaining a sharp
bend near Fatashil hills, it flows towards north and ultimately merges into the
Brahmaputra river. In addition to this network, all the important sewerage and
drainages are directly or indirectly connected with the Brahmaputra river. The major
drainage of the city, however include the Bahini, Bharalu and Mora Bharalu (Table

(105)
4.1) and the status of different waterbodies of Guwahati along with the problems faced by these waterbodies have been shown in the table 4.2.

Table 4.1: Major drainages of Guwahati City

<table>
<thead>
<tr>
<th>Sl.no</th>
<th>Name of the drainage</th>
<th>Total length (in meters)</th>
<th>Source and mouth points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bahini</td>
<td>8300</td>
<td>From sluice gate near Bokrapara at Basistha to confluence of Bharalu at Jonali bridge point at R.G. Baruah Road</td>
</tr>
<tr>
<td>2</td>
<td>Bharalu</td>
<td>6152</td>
<td>From Nabin Nagar, R.G. Baruah RCC Bridge point to Bharalumukh at Santipur</td>
</tr>
<tr>
<td>3</td>
<td>Mora Bharalu</td>
<td>6533</td>
<td>From National Highway- 37 bypass to confluence of Bharalu at Fatasil Ambari</td>
</tr>
</tbody>
</table>

Source: Drainage Survey Map, Flood Control Department, Govt. of Assam

Table 4.2: Status of different water bodies of Guwahati City, 2011

<table>
<thead>
<tr>
<th>Sl.no</th>
<th>Name of the water bodies</th>
<th>Area (in sq.km)</th>
<th>Major problem faced</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bharalu Basin</td>
<td>42</td>
<td>Back flow during monsoon season, Large scale siltation, Dumping of waste</td>
</tr>
<tr>
<td>2</td>
<td>Deepar Beel</td>
<td>201.35</td>
<td>Earth filling, encroachment and dumping of waste</td>
</tr>
<tr>
<td>3</td>
<td>Borsoal Beel</td>
<td></td>
<td>Dumping of waste</td>
</tr>
<tr>
<td>4</td>
<td>Silsaku Beel</td>
<td>65.34</td>
<td>Encroachment, dumping of waste</td>
</tr>
<tr>
<td>5</td>
<td>Kalmoni Basin</td>
<td>66.5</td>
<td>Deforestation</td>
</tr>
</tbody>
</table>

Source: CDP, Guwahati, 2011

The Guwahati Municipal Corporation Area (GMCA) does not have any integrated sewerage system except for certain pockets in the railway colony and in the Indian Oil Corporation (IOC) Refinery establishments. Most of the individual houses have septic tanks without any collective disposal of effluents. Moreover, there is no provision for the treatment of sewage, because of which untreated sewage is released into the nearby drains and low-lying areas. Not only the domestic sewage but the industrial wastes also are disposed similarly. This results in environmental and aesthetic degradation of the city area. There are soak pits connected to individual septic tanks, which do not function well due to high sub-soil water. Table 4.3 shows
the existing sanitary facilities in GMCA area and the population served by those.

Table 4.3: Population served by sanitary facilities in Guwahati

<table>
<thead>
<tr>
<th>Sl.no</th>
<th>Sanitary facilities</th>
<th>Population served (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Septic Tanks</td>
<td>81.61</td>
</tr>
<tr>
<td>2</td>
<td>Public Conveniences</td>
<td>0.12</td>
</tr>
<tr>
<td>3</td>
<td>Low cost sanitation units</td>
<td>0.00</td>
</tr>
<tr>
<td>4</td>
<td>Others/ Open Defecation</td>
<td>18.27</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: Field survey 2011-2014 and GMDA, 2009

In the Fancy Bazar, Paltan Bazar, Uzan Bazar, Panbazar areas of Guwahati city, untreated sewage and water is discharged into storm water drains causing a grave risk to the health of sanitation workers and the citizens alike. Newer houses in the relatively more planned and organized colonies have septic tanks but most lack soak ways. The partially treated effluents are usually discharged into open road drains which flow into the natural drainage channels that pass through the city. This results in unhygienic conditions in the surrounding areas as well as pollution of ground and surface water sources. The proper sewerage system will significantly improve the overall environmental condition and reduce the risk of contagious diseases.

4.3 ONGOING AND PROPOSED EXPANSION OF THE DRAINAGE SEWERAGE SYSTEM

As revealed from topographic setting in the southern part of Guwahati city the Khasi Hills of Meghalaya are located. On the eastern side the isolated hilly areas are located. The river Brahmaputra is located on the north and the low laying areas of Dipor Beel and Rani Reserve Forest are situated on the west. Rainfall on the hilly regions around the city brings down the surface water directly towards the city. Unfortunately, due to lack of a planned and scientific drainage and sewerage system in the city the entire city environment is affected by a numbers of geo-environmental problems, among these water logging and monsoon floods are common leading to losts of life and property. A scientific and effective review of the existing drainage
and sewerage system in the city is very necessary for mitigating these ever increasing problems.

**Existing Sewerage Management System**

As per the 2001 Census, water consumption in the Guwahati City is about 122.19 MLD and generated wastewater stands at 109.97 MLD (almost 90% of total water consumption). However, Guwahati does not have an integrated planned sewerage management system. Majority of the houses in the city have septic tanks, but many of them are not maintained properly. Overflowing and dysfunctional are very common phenomena in the septic tanks. In fact, many septic tanks are now non-functional because of the high water table, and as a result, much of the untreated wastewater directly flows into the storm water drains or into the natural drainage channels. Indian Oil Corporation Refinery, Defense Service Areas, and Railway Colonies have their own sewerage systems. However, the cantonment area has only individual septic tanks with soak pits, and water from those septic tanks and soak pits is eventually disposed into the Silsako Beel which is one of the major wetlands of the city. Apart from this, in many places, wastewater has directly been discharged into drains and water bodies which are not treated prior to discharge.

Presently, the Guwahati city does not have a comprehensive drainage facility system. As a result, the city suffers from flooding and water logging particularly during the monsoon period as well as in rainy days. In addition, in absence of the proper sewerage and sanitation system in the city, untreated or semi-treated sewage is being disposed of into the storm water drains, which is escalating the flood problem. Existing storm water drainage system can be classified into three categories- Major or Main Drains, Branch Drains and Sub-branch Drains. The study area has six major drains and in addition to these major drains there are a number of branch drains, which are randomly spread over the entire city along with that there are numerous sub branch drains. Some of these drains are natural drainage courses, whereas remaining drains are man-made. Most of the sub-branch drains receive storm runoff from small catchment area (< 1km to 2 kms). Some of these drains do not have well defined outfall points as they terminate in wetlands. Storm water drains have been classified into three categories, i.e. (i) Major drain or main drain - It is mostly the natural drain which conveys the storm flows to other major natural drains. In some cases large
man-made drains functioning as main conveying channels, such as the Basistha river are also categorized as major drains. (ii) Branch drain - These are the drains which receive flows from the sub-branch drains, other branch drains and also from its own catchment. (iii) Sub-branch drain - These are the first level collector drains which have smallest sub-catchment of its own. These drains are normally located along the lanes and by-lanes of the Guwahati city and in some cases also along some of the main roads.

Rivers and major streams play a major role in the storm water drainage system of the Guwahati city. Based on the field survey and reports of different government and nongovernment agencies, an understanding is obtained about the existing condition of the storm water drainage system in the city. In the study area the major impact is because of the river Brahmaputra and three major streams, namely Bharalu, river Bahini river and Baisistha river. Based on the physiographic conditions of Guwahati all the major drains will be finally disposing all the collected storm water into the Brahmaputra river. In this case, these three major streams act as the tributaries of river Brahmaputra as these three collect almost all the major part of the surface runoff and carry it to the disposal point. Based on the above categories of drains, the major drains of Guwahati city are as follows:

i. **River Brahmaputra**

This river is flowing on the northern part of the Guwahati city. It is almost 5 kms wide along the Guwahati city, but it is narrowed down to approximately 1 km at the point where it flows on the northern part of the city. This section is further reduced to approximately 0.5 km as it reaches the Sarighat bridge across the Brahmaputra river. This sudden decrease of the channel width leads to a considerable increase in the flood level. The impact is significantly observed near the upstream of the north-eastern side of the city, i.e., near Bondajan and downstream of that point is the Bharalumukh area where the sluice gate over the Bharalu river is to be closed during high flood time.

ii. **River Baisistha and Bahini**

These two rivers originate from the hills of Meghalaya and flow north-easterly through the southern boundary of Guwahati city. Near Natun Bazar at Basistha
Chariali, the river Bahini is discontinued and the entire flow is diverted to the river Basistha. Thereafter, river Bahini continues in its natural alignment and collects run-off from the adjoining areas parallel to Beltola road and ultimately reaches confluence point of Bharalu drain and RGB open drain near Jonali with flows from the truncated catchment. The Basistha river at Bhetapara is divided into two parts. One part is directly from diversion point to Dakhingaon and other part by excavating a channel, known as Hatigaon Channel from Bhetapara to meet the first part of Dakhingaon. This drain was constructed in the year 1986-87 with an intension to relieve state capital Dispur from temporary flood and water logging. River Basistha finally discharges into Deepor beel located in the western part of the Guwahati city. Backwater is observed in Deepar Beel and it functions as a stream only during lean season, which is named as Pamohi drain. It is actually an outfall to Deepar Beel downstream of the confluence of Mora Bharalu Drain and Basistha Drain near National Highway 37. Water from Deepar Beel backflows to Pamohi drain particularly during monsoon, when the HFL exceeds the FSL of the drain. Approximate length of this drain is 6.5kms.

iii. Bharalu Drain

Bharalu drain (also called as Mora Bharalu drain) originates near Fatasil Chowk and has outfall into the Pamohi drain. Mora Bharalu collects surface runoff from Fatasil, Athgaon, Gopinath Nagar and Dhirenpara areas of the city. Bharalu was re-sectioned in the year 1986 from Fatasil Ambari Bazar to National Highway 37 to divert the flow of Bharalu through Mora Bharalu to Basistha river when the sluice gate at Bharalumukh is closed. The total length of this part is almost 6.5 kms. This natural drain all along its length has growth of vegetation and deposition of garbage makes the drain partially ineffective of its performance.

iv. Other Streams/ Drains and water bodies

Along with the above mentioned rivers and streams, there are few more drains which play a significant role in the storm water drainage system within the study area. The drains are (a) Bondajan Drain and (b) Khanajan Drain.

(a) Bondajan Drain

Bondajan is a south bank tributary of the river Brahmaputra. The drain is located in the east of Guwahati and it originates from a natural wetland called Silsako.
Almost in every summer, a vast area of the Silsako Basin is flooded during the monsoon. Backflow of water from the Brahmaputra river into the Bondajan along with diminishing of water retaining capacity of the Silsako wetland due to encroachment and dumping of solid waste is considered to be the main cause of flood in the region. Sluice gates are provided near the outfall of the drain to stop the backflow from Brahmaputra river. The gate is located at about 2 kms from the outfall point at Holigaon village near a railway crossing. The gate is presently in working condition. It has approximately 2.5 meter opening and 6 meter width at middle portion, whereas width of the drain at this location is approximately 30 meter. This creates congestion and restricts free discharge of accumulated flood in Silsako Beel to river Brahmaputra during low water levels of the Brahmaputra.

(b) Khanajan Drain

The Khanajan drain is one of the most important main drains of Guwahati city which is in the western part of the city. The main characteristics of this drain are that it acts as a balancing drain with bi-directional flow. That is, when the water level in Brahmaputra river is low, the flow of the water is from the Deepar Beel to the Brahmaputra river and when the water level in the Brahmaputra river is high the flow of the water is from the Brahmaputra river to Deepar Beel. To prevent excess backflow, there is one sluice gate bridge of 4 meters in width at approximately 0.50 km from the Brahmaputra river. The total length of the Khanajan drain is 5.9 kms. The drain originates from the Deepar Beel and passes through Khanamukh area, Dharapur Jengarbari, Garigaon area of western side of Guwahati city and meets the Brahmaputra river at Khanamukh. There is a gravel road running parallel on the right bank of the drain upto the National Highway 37. The drain is unlined in the entire stretch. However, vegetation and weeds growth along the entire stretch of the drain has caused obstruction to the natural flow and has reduced its capacity. These two drains act as the primary drains which collect the surface runoff from various parts of south Guwahati by a number of branch drains and sub-branch drains.

Along these major drains of Guwahati city, the existing branch drains are observed from which water flows to the main drains. These drains are of mainly two types, i.e. surface drains and underground drains. Most of the surface drains are
covered with RCC slabs and rest are open channels. The underground drains are of again two types, i.e. RCC Box and Pipe Conduit. Among the branch drains most of the drains are not functioning properly mainly because of the deposition of silt and garbage, improper slope and outfall, inadequate carrying capacity and irregular maintenance.

A brief description of the branch drains along with their existing status is given below:

1. **Pub-Sarania –Rajgarh Area Branch drain**
   This is one of the major covered branch drains carrying storm water from parts of Chandmari, carrying storm water from Krishna Nagar and also from the foothill of Sarania hill on the eastern side. This drain is divided into two parts, one part towards Nabin Nagar, Anil Nagar underground drain and the other reaching Lachit Nagar underground drain. The total length of this branch drain is 3700 m. Regarding the existing condition, most stretches of the drain are clogged with silt and garbage and most of the manholes are covered with bitumen surface of the road.

2. **Lachit Nagar Area Storm Drain**
   This branch drain is extending from Lachit Nagar Road to Bharalu Drainage Channel via B.T. College Road. It is a combination of pipe conduit (N.P.# Hume Pipe) and RCC Box drain. This is an underground drain which carries storm water from entire Lachit Nagar and southern part of Sarania Hill catchment area through drains meeting it at different locations. This drain starts from Lachit Nagar G.S. Road junction and terminates at river Bharalu through B.T. College Road. The approximate length of this drain is 1 km. Regarding the existing condition, this drain receives major portion of storm runoff from the Sarania Hill on its northern side. The runoff carries huge amount of silt and rotten vegetation which are ultimately deposited in the drain. This results in reduction of carrying capacity of the drain. Some of the existing manholes of the drain are broken condition.

3. **Railway Open Drain**
   This is an open RCC drain which was constructed in the year 2004 from Voltas point near Sadin office to B.Barooah over bridge. It carries storm water from parts of Nabagraha Hill, Chandmari, Krisha Nagar and Silpukhuri area. It flows
through the railway culvert below the B.Barooah over bridge and passes through Hedayatpur and ultimately outfalls at Borsola Beel through Solapara. The total length of the drain is 1324 m. The existing condition of this branch drain is that it initially was quite effective as a result of which a large area was relieved from temporary flood and water logging. But gradually, the effectiveness of the drain is reduced due to deposition of silt and debris carried by the storm water runoff from Krishna Nagar, Chandmari and Silpukhuri area. The actual area of Borsola Beel where this drain outfalls is reduced significantly due to encroachment and garbage dumping. This has reduced the water holding capacity of the wetland, which needs proper planning to restore.

4. **Drain through Khanapara reaching Silsaku Beel passing through Panjabari area**

The origin of this branch drain is at Jorabat area, i.e. the southern most part of the Guwahati city. It enters Guwahati Municipal Development Authority (GMDA) boundary near SBI Khanapara and then after passing through Veterinary College it reaches Panjanbari near the Office of Directorate of Panchayat and Rural Development. Then it crosses Panjabari road through a box culvert and finally runs through Juripar area and ultimately reaches Silsaku Beel. Storm water from Meghalaya hills contributes to this drain in Khanapara region through a box culvert in the southern part of National Highway 37.

The existing condition of this drain is that, the portion of the drain from its origin to the Office of Directorate of Panchayat and Rural Development is kutcha. From the starting point of Juripar Road to the Kabaristan the drain is RCC. After that the remaining part of this branch drain is kutcha and the course is also not well defined as it passes through the nearby low-lying areas to reach Silsako Beel. This drain carries lots of silt, mainly sand particles during storm runoff from the hills of Khanapara and Meghalaya. The deposited silt has considerably reduced the water carrying capacity of the drain. As a result, the Juripar area becomes waterlogged during heavy storm and rainy seasons. To minimize the waterlogging problem of this region the Directorate of Panchayat and Rural Development office point some water is proposed to be diverted through proposed new branch drain along Bagharbari Road.
5. **Underground drain from Ambari via parts of Gopinath Nath Bordoloi Road to Railway open drain at Ambari**

This branch drain carries storm water runoff from Ambari, Lambroad area and a part of Uzanbazar area. This drain originates from the Lamb Road area and then meets the railway culvert below B.Barooah overbridge and finally outfall at Borsola Beel. This is a RCC underground box drain. Flow through this drain is obstructed due to its sharp bends near Textile Institute and near AGP Office and also due to reduction of its section at the outfall point at the railway open drain and interception at several points by Hume pipes. Moreover, the manhole openings are for manual cleaning. Because of all these factors the drain is clogged at various points in Ambari area due to deposition of silt and wastes.

6. **R.G. Baruah Road Drain**

This is a RCC open drain extending from Zoo Narengi Tiniali to Bharalu Drain. The origin point of this drain is at Zoo Narengi Tiniali and outfall is at Bharalu main drain. This is one of the major open branch drains collecting storm water from Guwahati Refinery, Noonmati, Bamunimaidam area through railway drain running along the railway line at Bamunimaidam, Bhaskar Nagar and ultimately meeting it at Zoo Narengi Tiniali. This drain also receives water from Narikal Basti, Ambikagiri Nagar. It also receives water from some parts of Rajgarh and Chandmari area. This branch drain meets Bharau at Jonali, the meeting point of Bharalu and Bahini River. The total length of this drain is 1000 meters. The major causes of ineffectiveness of this drain are – (i) Deposition of garbages and solid wastes that reduce the carrying capacity of the drain, (ii) HFL of the drain is higher than the surrounding area causing backflow of the water during the time of heavy rain, (iii) Due to deposition of silt and inadequate opening of outlet at the outfall point the flow of the water becomes slow, (iv) Obstruction of flow is observed through the drain due to construction of low level cross structure on the drain. This causes inundation in the R.G. Baruah Road and adjacent localities during heavy shower.

7. **Chandmari Bharalu Branch Drain**

This drain covers the area of Bhaskar Nagar, Rajgarh, Nabin Nagar, parts of Pub Sarania and Anil Nagar. This drain was constructed by Town and Country Planning Department. Total length of this drain is 4954 meters. The existing condition
of this drain is not good. Its outfall is at Bharalu main drain. A sluice gate is provided at the outfall point but it is not working for last couple of years. The manholes openings are too small for manual cleaning and their conditions are also very poor. There is no lid cover in some of the manholes.

8. **Underground drain along the boundary of Nabin Nagar and Anil Nagar to Bharalu via Anil Nagar**

This branch drain carries storm water runoff mainly from Anil Nagar area. A part of the drain’s water flows towards the Chandmari Bharalu branch drain and the remaining part of the drain’s flow is diverted towards the Bharalu main drain. The total length of this drain is 1400 meters. The main reason of ineffectiveness of this drain is deposition of garbage which reduces the carrying capacity of the drain. The manhole openings are inadequate for manual cleaning. The existing sluice gate at the outfall point of the drain to Bharalu main drain is in dilapidated condition. This results in backflow of water from Bharalu main drain during the peak flow season.

9. **Kumarpara Mashkhowa Area Storm water Drain**

This drain runs from Athgaon ROB and continues along the road towards Mashkhowa vegetable market by passing through a culvert in front of Mashkhowa Masjid and ultimately passes through the Idgah Maidan to reach Bharalu main drain. Due to rapid encroachment on the stretches of the drain near the vegetable wholesale market at Mashkhowa, the drain section is reducing considerably. Dumping of garbage is another cause which hampers the free flow of storm water by this drain. The level of the adjacent KRC Road is lower than the HFL of the Bharalu main drain. On the other hand, the existing water supply pipes run across the drain at various locations which also creates obstruction to the flow.

10. **Dr. B.Baruah Road to Dr. B.K. Kakati Road underground box Drain**

This branch drain starts near the Indoor Stadium of Nehru Stadium at the junction point of Islampur road and flows towards Ulubari Chariali via Kachari Basti and ultimately falls into the river Bharalu near the Agricultural Development Office. This branch drain is functioning partially due to deposition of garbage and it has not been maintained over the years. During the rainy season and peak flow of the water the back flow from the Bharalu river takes place. It is observed that to flash out
storm water from Milanpur and Suhagpur area of Rihabari, a stretch of approximately 300 m of underground box drain is connected to this drain. But due to lack of proper maintainance of this drain the purpose has not been served.

11. **Hedyatpur Area Underground Drain**

   This branch drain was constructed by Town and Country Planning Department and it receives water mainly from Hedyatpur and Guwahati Club. This drain is 3 meters wide and 4 meters in depth. This drain starts from Guwahati Club Police Point and falls at Railway open drain below Railway overbridge. This is a RCC underground box drain and maximum portion of this drain is filled up with silt and garbage.

12. **Rupnagar Area Storm Water Drain**

   This is a road side open drain of trapezoidal section which originates from Guwahati Medical College Hospital link road and continues upto Rupnagar L.P.School. This drain was constructed to carry the storm water from Rupnagar area and to discharge it into Bharalu river. But this drain is not continuous all throughout its length.

13. **M.A. Road Drain**

   This is an underground box drain which starts from Arya Pathssala L.P. School, Rehabari and continues upto Bharalu main drain near the RCC bridge at Seraphbhatti along the M.A. Road. There is a sluice gate at the outfall point of the drain which is in damaged condition. As per the observation the alignment of the drain is good but because of the deposition of large amount of garbage and silt over a longer period of time, the depth of the drain is decreasing gradually resulting in low flow and improper functioning of the drain. Due to the small manhole openings manual cleaning cannot be done perfectly leading to the poor condition of the drain.

14. **Islampur Underground Drain**

   This branch drain originates in front of Hazi Musafirkhana and terminates near the Indore Stadium in the stretch from Dr. B. Baruah Road to Dr. B.K. Kakati Road drain. It is an underground drain. The length of the drain is 1316 meters having a width at the outfall point of 3.2 meter. This branch drain is a combination of pipe
conduit and RCC box drain. Like most of the drains of Guwahati city this drain is also obstructed by the deposition of garbage. Poor condition of the drain is observed due to lack of regular cleaning because the manholes openings are very small.

15. **Santipur Durgasarobar Area Storm Water Drain**
   This branch drain carries storm water mainly from the Durgasarobar area. The eastern part of the drain extends from Durgasarobar hill, which is intercepted by road side drain and continues till the RCC culvert in front of Military Engineering Service (MES) colony. The western part of this drain extending from Durgasarobar hill is connected by road side drain in front of Durgasarobar M.E. School and it takes a sharp turn to reach the same RCC culvert of MES colony. Both the drains are ultimately connected to the Masjid path underground drain whose outfall point is at Bharalu river through the Santipur Area Underground drain. It is observed that during the time of heavy rain the RCC culvert in front of the MES colony is not sufficient enough to pass all the storm water. Encroachment on the drain behind the M.E. School along with the deposition of garbage and silt affects the smooth functioning of the drain.

16. **Athgaon Chatribari Branch Drain**
   This is one of the major branch drains having three contributory drains, i.e. drain from Chatribari, drain from Athgaon and drain from F.A. Road and the outfall point of this drain is at Bharalu main drain. The length of this unlined drain is about 400 meters having width and depth of 3 meters each. The drain becomes narrow near Athgaon Kabarstan region because of the encroachment from both the sides. Water logging takes place in the areas of Kumarpara F.A. Road and the adjoining areas because backflow of the water from the Bharalu river takes place during monsoon, when the H.F.L. of the river exceeds the F.S.L. of the drain.

17. **Drains from Mashkhowa vegetable market to river Brahmaputra**
   This branch drain is another major drain of Guwahati city which originates near the vegetable market and receives storm water from the entire Mashkhowa residential area and falls into Brahmaputra river through a box culvert of GNB Road near Poddar Tyre shope. Like most of the drains of the city this branch drain is also encroached upon near the outlet of the drain. The size of the drain is getting small and
it becomes almost 1 meter in depth and width. Garbage deposition is the major cause leading to the obstruction of the free flow of water through this drain. Backflow of the water is common during monsoon season, when the water level of Brahmaputra flows above the F.S.L. of the drain.

18. **Lakhtokiya Chatribari Area Storm Water Drain**
   This Branch drain plays significant role in the Lakhtokiya region because this is one of the major water logging areas of Guwahati. The origin of this drain is near Paltan Bazar Fire Brigade office and outfall point is at Sarusola Beel. It is almost 665 meters in length and lined and opened up to Police Reserve, where it crosses the AT Road through a box culvert. It become underground after reaching Himatsingka petrol pump. This drain is about 2 meters in width and depth. Encroachment is observed near the outfall point of this drain and due to the absence of manholes the underground portion of this drain is not cleared after the construction.

19. **Hatigaon Drain**
   This is one of the major branch drains having a length of around 5051 meters from Basistha river near Bhetapara and it finally meets the same river at Dakhingaon. It was constructed in the year 1986-87 covering a major portion of the Guwahati city including the State Capital Dispur to relieve from water logging and flash flood during rainy periods. Initially this drain was kutch but looking the importance of the drain the Water Resource Development Department, Assam has taken the task to lining the entire drain for the smooth flowing of the water to free the area from water logging. It is observed that during monsoon the backflow of water from this branch drain to sub-branch drain is a common phenomenon.

20. **Bishnupur Area Storm Water Drain**
   This branch drain originates near the Bishnupur Bharalu bridge and outfall of this drain is at Mora Bharalu river. It is a pipe drain having a length of about 929 meters. Due to garbage dumping near the drain it is not working up to the mark.

21. **Drain from GS Road to Bahini River**
   This is another important branch drain which covers the area of Ganeshguri Chariali and Christian Basti area and carries the storm water to Bahini main
Having a length of approximately 200 meters, this drain starts at Christian Basti and its is basically an open drain.

22. **Drain of Tokobari Area**

This is an underground branch drain constructed by the Department of Town and Country Planning, Govt. of Assam. This drain receives storm water from entire Paltan Bazar and Tokobari area. The width and depth of this drain is 2 meters each. Due to lack of insufficient manholes along with their small size this drain becomes small enough to carry the water during rainy days.

23. **Drain through Ajanta Path, Beltola to Hatigaon Channel**

This is an underground branch drain having a length of about 1600 meters and 2 meters in width and depth. This drain carries storm water from Ajanta Path area of Survey and Beltola to Hatigaon branch drain. It is observed that due to smaller size of manholes along with less in numbers, it becomes difficult to clean the drain at regular interval resulting in decreasing the flowing speed of the water.

24. **Drains from Japorigag to Bahini River near Ganeshguri**

This is an important branch drain which covers mainly Japorigag, Mikirgaon and Lakhimi Gaon and some adjacent areas. It originates from the foothills of Japorigag hill and flows over the above mentioned areas and ultimately it is connected to Bahini river behind the office of the Urban Water Supply. This is a lined and rectangular shaped drain and the approximate length is 1500 meters. This drain is filled up by every rainy season with the deposition of silt and garbage carrying from different localities.

**Existing water bodies of the study area**

A number of wetlands in the form of large lakes, ponds, low-lying marshy land etc. exist at various locations in the study area. Among these the prominent wetlands are Deepar Beel, Borsola Beel, Sarusola Beel and Silsako Beel. A number of man-made surface water bodies are also available present along with the above mentioned natural water bodies. Dighali Pukhuri, Jur Pukhuri, Nagkata Pukhuri and pond near Serabbhati are the main man-made water bodies in the city. Both these natural and man-made water bodies are playing significant role with the present storm
water drainage system. These water bodies work as a temporary reservoir for the surface runoff during the monsoon period. The existing main drains directly contribute to the Brahmaputra river or to other wetlands of the city. Among the natural wetlands Deepar Beel and Silsako Beel are considered to be the most significant. These two wetlands receive most of the surface runoff of the Guwahati city.

**Proposed expansion for improvement of the drainage-sewerage system**

After doing ground survey and ground verification of the present drainage-sewerage systems of Guwahati city, it comes to notice that the existing system does not have any proper linkage among the drains. To make the city’s drainage-sewerage system an efficient and integrated one, all these drains should be connected systematically by following proper engineering guidance. Proper landuse and contour survey must be done to connect the main drains, branch drains and sub-branch drains to prepare the present layout of the proposed drainage-sewerage system of the city. Most of the existing drains are proposed to be connected with the drainage system with necessary modifications and the remaining drains will independently carry storm water from the respective catchment areas. The directions of flow of the proposed drainage systems are as per contours and relief features of the Guwahati City. In this proposed plan all the branch drains and sub-branch drains are allowed to connect to make the entire system efficient enough.

On the basis of the topographical conditions of the Guwahati city, the proposed sewerage system of the city could be divided into two parts. Each part is characterized by an independent collection, conveyance, treatment and disposal system. The main trunk routes in each part are marked along the side of existing road as per the natural slope with due consideration to railway lines, storm water drains etc. Intermediate sewage pumping stations and lift sewage pumping stations have been considered to the minimum extent possible. The sewerage treatment plants will be located in such a way that most of the major drains followed by gravity power into wet well of the TSPS in the plant and also adequate land is available for construction of these plants. Terminal pumping stations are considered as a part of the sewerage treatment plant. The sewerage treatment processes have been selected based on techno-economic feasibility and it has been decided to apply Up-Flow Anaerobic Sludge Blanket (UASB) reactor followed by Short Detention Final Polishing Unit
(FPU) for all the STPs. The treated sewerage discharge will be disposed to inland water bodies and Brahmaputra river. Sewerage Treatment Plants (STP) have been designed in such a way as to meet the discharge standards set by the regulatory body for inland water discharge. On the other hand, the treated water will be used for irrigation purpose in the agricultural and horticultural fields. It can also be used for industrial purpose, sanitary use and some domestic use after providing proper treatment to the treated waste water. The solid particles generated through the waste water are proposed to be transported for landfill or used as manure in the agricultural fields after getting dried to at least 50% moisture content at the sewerage treatment plant.

The proposed sewerage system of Guwahati city consists of the systems, such as (i) Collection system with sewers, i.e. main trunks, branch and laterals and sewer appurtenances (ii) Conveyance system (iii) Sewerage treatment plant and disposal system.

i. **Collection system of sewerage**

   The sewerage generated within the Guwahati city will be collected by means of main trunks and branch trunks. Depending on the topography the main trunks will be laid along the roads. The main trunk sewers are those where the sewers diameter is 450 mm and above. The trunks having less than 450 mm in diameter are considered as branch and lateral trunks. The properly designed main trunk sewer would carry the optimum discharge to transport the solids so that the deposits are kept to be minimum. For this technique, it is desired to achieve self-cleaning velocity minimum once in a day during peak flow of the sewers along with the expected fluctuation in discharge. The main trunks have been designed to carry the flow from the contributory areas and from the upstreams and the branch trunks joining to them.

ii. **Conveyance System**

   The city sewerage management system and its network has been designed and planned in such a way so that the number of pumping stations become minimum. To make the entire system efficient, intermediate sewerage pumping stations are also considered to be a part of the conveyance system.
iii. **Sewerage treatment plant and disposal system**

There are a number of sewerage treatment plant and disposal system which are adopted in various parts of the country depending on its characteristics. These treatment plants and disposal systems have their own merits and demerits and are mostly bio-degradable in nature. From the techno-economic point of view and to get the best feasible sewerage treatment plant the following processes have been considered for the selection of the sewerage treatment plant and disposal system. These are: (i) Waste stabilization pond, (ii) Activated Sludge Process, (iii) Extended Aeration, (iv) Trickling Filters, (v) UASB and Post treatment process with final polishing Unit and (vi) Fluidized Aerobic Bes Reactor.

Among these processes for Guwahati city the Up-flow Anaerobic Sludge Blanket (UASB), (Yan, et. al., 1989) is considered to be suitable followed by Final Polishing Unit. For this the requirement of land and energy is also taken into consideration and based on this the UASB method is more suitable for Guwahati. In this respect, the norms of the State Pollution Control Board for discharge of treated effluent into inland surface water are also taken seriously. In order to select the sewerage treatment plant site, the important points to be considered are- (i) Length of the main trunks connecting to the Sewerage Treatment Plant, (ii) Availability of proper approach road to STP site, (iii) Availability of land and related factors, (iv) Reclamation of wetland and extent of possible reclamation, (v) Distance from residential areas, public places and institutions, (vi) Proximity to the discharge point and its usage, (vii) Ultimate discharge point to be on downstream from the point of withdrawal of Public Water Supply and (viii) Prevailing wind direction.

In the proposed scheme the disposal of treated sewerage is planned to be discharged in the Brahmaputra river through gravity flow or by other means. The generated solids with moisture content of around 50% are proposed to be transported for sanitary landfill. In this process the waste water collection system has been separately considered for more effectiveness of the system. For the collection of wastewater the guidelines and parameters of CPHEEO (Central Public Health &Environment Engineering Organization) “Manual on Sewerage and Sewage Treatment” has been adopted. The flow of sanitary sewer varies from hour to hour and seasonally also, but for the effectiveness of the plant and to fulfill the purpose of
hydraulic design, the estimated peak flow is adopted. The peak factor or the ratio of maximum to average flows depends on the contributory population and the values have been recommended in the Manual of Sewerage and Sewage Treatment issued by the Ministry of Urban Development, New Delhi. This factor also varies depending upon the topography and density of population of the respective areas.