

Storm Water Drainage

1.1 Introduction

Kochi city is the largest urban agglomeration in Kerala situated in the coastal plains with extensive backwater system and tidal canals. Kochi CDP area consists of:

- i. Highly urbanized Kochi corporation area;
- ii. Two less urbanized municipalities; and
- iii. 13 adjoining panchayaths.

The topography of Kochi is almost flat. The average altitude towards the eastern fringes is about 7.5 m above M.S.L but towards west most part of the city is only about 1.00 m above M.S.L. Kochi is characterized by sand bars running in north – south direction with tidal canals in between. In the absence of sufficient wide drains and also because of the general flatness of the terrain, the city is facing acute drainage problems. Several preliminary studies were conducted regarding the drainage of the city, which clearly proved the inadequacy of the primary, secondary and tertiary drains either because of the size, design or maintenance level.

1.2 Climate, Rainfall, Run Off

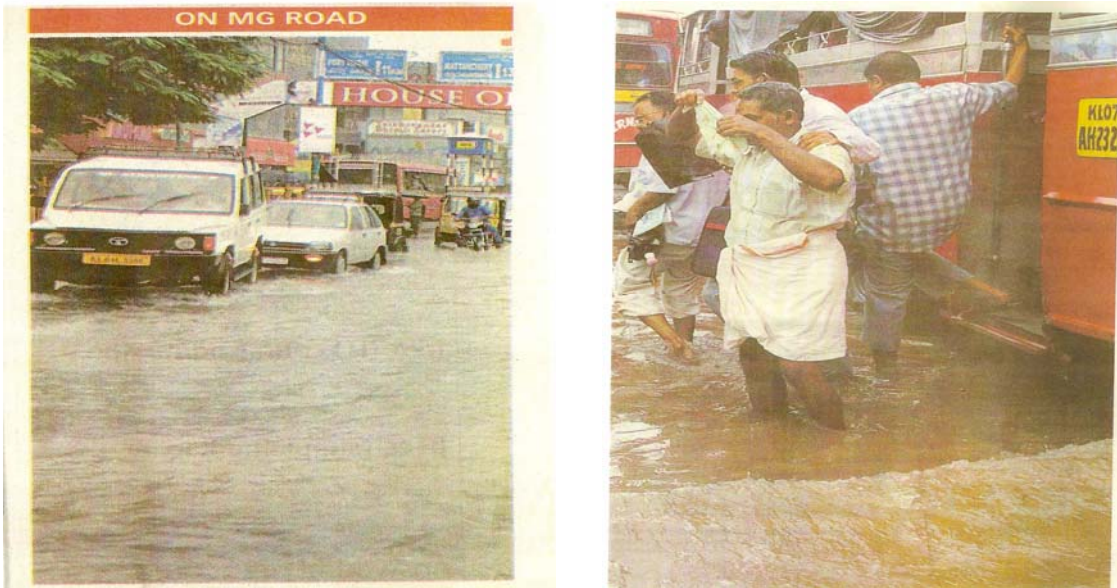
The city area falls with in the tropical climate. The average annual rainfall in the region is about 3,099 mm. The southwest monsoon yields more than 60% of the total precipitation and that of the north –east monsoon is about 25% of the total rainfall. According to hydrological records maximum recorded high tide level for rainy months of mid May to mid November works out as +0.44 m and maximum recorded low tide level is 0.155 m relative to MSL.

The recent study of the run off of the catchment and discharge efficiency of the drains in the Kathrikadavu - Pullepady area (CBD) in Kochi Corporation, it was seen that, the average efficiency of the drain is only 43.31%. Out of the 34 catchment areas studied, 12 have less than 25% efficiency and only one has 100% efficiency among the secondary, tertiary drains. The hydrological characteristics of the region make surface water drainage, an important element of urban renewal efforts.

1.3 Present Scenario

The present drainage system depends on canals as primary drainage source, secondary drains which discharge to primary canals or backwaters, the drain along road sides are the area drains with or without covering slabs. The drainage network is not based on a drainage study /plan, but done in an ad hoc and piece-meal manner. The drains are built arbitrarily without calculating run off. The area drains and drains from premises do not have silt pits to intercept silt and solids. They discharge directly into road side area drains these drains are silted to very high degree and clogged due to solid waste especially plastics. The photographs below are examples of present scenario of drainage system in Kochi.

Figure 1.6: Flooding in the City



Three levels of drainage systems can be categorized as:

1. *Primary canals* - major natural canals, which are running in north-south direction and a few natural canals, cut across the sand bars. The primary canals which convey the storm water run off to the back water system are highly degraded because of encroachments, waste dumping, silting, weed growth, low maintenance and lack of protective measures. It is found that almost all the tidal canals are in filthy conditions. This is due to the dumping of wastes into the canals and lack of facilities for cleaning them due to inaccessibility of cleaning vehicles and machines. It is very necessary that this canal and the shorelines are protected and maintained properly for better living of the people.

2. *Natural and man made secondary drains.* Natural secondary drains are the feeder drains/canals of primary canal. The man made secondary drain encompasses major roadside drains, which go beyond the level of area, drains and which link with the Primary drains (tidal canals) running in north-south direction.

3. *Area Drains.* The area drains are the drains which discharge the storm and sullage water from a neighbourhood to secondary drain. The city has large network of area drains, which act as major storm water receivers. There is no regular pattern for this and lies along small roads and bye lines. The area drains are absent in many of the areas especially in areas with urban proliferation. These drains need immediate attention. These are the primary cause for water logging in the various neighborhoods in the city. The total length of the area drain is assessed to 1229 kms. Out of this, 330 km in Kochi corporation area and 196 km in municipalities and panchayaths area requires upgradation and are proposed for inclusion in the cost projection.

The quantitative description of drainage systems is tabulated below:

Table 1.10: Canals in Kochi City

Sl.No	Description of item	Quantity (KM)	
		Kochi Corporation	Municipality & Panchayat
1	Total length of the primary canal	77	254
2	Total length of the natural and man made secondary drains	222	198
3	Total length of area drains	740	489

Source: Irrigation Division, Ernakulam, CoC, municipalities, Panchayaths.

The city is facing severe water logging problems. A number of places in the city suffer from water logging and flooding due to heavy rainfall in the monsoon. During the period of water logging, normal life and traffic movements of the city gets disrupted. Water logging in some roads persists for few hours whereas flooding in certain lowlands continues for a few days.

The main reasons for flooding in the city are:

1. Flat topography of the area;
2. Clayey nature of the subsoil in most of the area, which prevent water percolation;
3. Lack of adequate slope of the drains and subsidence of the drains;
4. Tidal effect. If the rain occurs during high tide time intruding tidal waters prevents the exits of storm water to the main canals;
5. Decreased carrying capacity of the drains due to the heavy silt deposition, discharge of solid waste in the canals and growth of vegetation;
6. Reduction of canal width due to encroachment;
7. Inadequate vent way of the existing bridges and culverts;
8. Poor condition of the existing canals resulting in over flow and flooding in adjoining area;
9. Missing links in the existing network;
10. Obstruction due to the utility lines, such as water mains, power and communication network cables etc crossing the canals and drains;
11. Lack of awareness among the people in maintaining public drains and canals;
12. Tendency of converting canals and water bodies to provide roads. etc;
13. Meandering of the primary canals which slow down the flow;
14. Irregular and inadequate maintenance of drains/canals; and
15. Inadequacy of existing cross drainage facilities;

1.4 Operation and Maintenance

The existing city drainage system lacks proper maintenance. Concerned local bodies, State Irrigation Dept.; National Highway; Southern Railways; State, P.W.D; Panchayats; and municipality in the agglomeration area are jointly responsible for operation and maintenance of the existing drainage system in the city. Better co-ordination among these agencies is essential for maintenance of the over all drainage system. Kochi corporation takes up pre-monsoon removal of water hyacinth, de-silting of major canals and secondary drains during April / May by manual cleaning. The area drains are cleared engaging sanitary workers.

1.5 Issues and Key Challenges

Analysis from the drainage sector reveals that 60% of the Kochi city area lacks proper drainage system. The existing network is inefficient, inadequate and majority of the drains are in filthy conditions. A number of identified areas in the city are frequently flooding during even moderate rains. The drainage systems empty their water and waste loads into water bodies and backwaters through the fairly flat terrain subjected to tidal effects.

Key challenges taken into consideration are:

- i. Flatness of the terrain;
- ii. High rainfall;
- iii. Tidal effect;
- iv. Non co-ordination of respective departments;
- v. Absence of Comprehensive Planning;
- vi. Absence of proper Solid waste management; and
- vii. Inadequate capacity of Cross Drainage works especially across the N-S running Railway lines.

Vision. *A Clean and flood free city space with proper drainage system.*

1.6 Strategies and Action Plan

Strategies and action plans in this proposal are framed for achieving the above vision. Probable solutions for improving primary canals.

- To be made free from siltation, encroachments, deepened, widened and side protected;
- Side roads and access facilities to be provided for maintenance, especially for using vehicle and equipments;
- As the north-south running canals cannot be effective in draining off storm water rapidly, providing intermediate outlets towards back waters are essential. These connections have to be towards west in Ernakulam area, towards east in mattanchery area, fort Kochi area and to east/west in Palluruthy area. The purpose of these is to provide multiple overflow outlets to back waters, which will considerably reduce the storm water build up in lengthy N-S canals; and
- Multiple over flow outlets. The main drains in Kochi are very long becoming deeper at out fall end, out fall end may even be much lower than the high tide level. Due to increased time of concentration, the drains get overloaded and overflow. This can be eliminated by multiple outlets at different points.

Diversion of run off

- Run off need to be diverted partly to relieve the pressure on existing drain; and
- Diversion of run off is also partially possible by interconnecting canals.

Improving existing canals

- Improving the carrying capacity of existing drains by widening & increasing slope. Many secondary drains need improvement.

Improving Cross Drainage Works

- There are a number of cases where present cross drainage works are inadequate.

Regulatory Pumping Systems

- Provision of pumping facility may have to be resorted at certain problem areas where natural flow alone cannot create rapid discharge. Pumps are more effective at drain mouths discharging to back waters. Such pumping system can be used to pump water in during summer to destroy mosquito larvae and to flush canals.

Providing Silt Pits

- Escape of silt and solid waste can be prevented, stagnation can be brought down considerably. Provisions of silt pits at all discharge end of tertiary, secondary drains to be considered.

Controlling Land Development

- Regulations to control land development is not being insisted properly.
- Formation levels of each Zone/sub zones to be fixed and land development to be regulated to ensure positive area drainage.
- The backwater reclamation to be controlled.

Sewerage System

- Drainage carrying sullage and effluent combined together can cause severe health and environmental problems. 80% of the septic tanks directly discharges the effluents by overflow to open drainage due to high water table, low permeability of soil. Segregating sullage and effluents from open drains by sewerage system has to be accorded priority.

Upgrading Solid Waste Management

- Large quantity of solid waste contaminates and stagnates the drains now. Hence a system for proper collection & management of solid waste has to be developed.

Eviction and Rehabilitation of Encroachment

- The canal is encroached in a number of places along its stretch. Removal of encroachments and providing resettlement / rehabilitation as required, to maintain the canal width.

In areas where there are no man made secondary drains of sufficient capacity, new drains are to be provided. This is particularly so in the central area of Kochi corporation. A detailed study of individual catchment area of secondary drains is required.

In the context of interlinking of the drainage network certain existing cross drainage facilities will require to be modified. These works are in the jurisdiction of various central / state agencies such as railways, National Highways etc. The modifications are generally undertaken by the concerned agencies on deposit basis. A provision is made in the project towards this expense.

Man made secondary drains and area drains need to be covered with slabs and the provisions of manhole to facilitate the cleaning/ maintenance. About 587 km of drains in the city are required to be covered.

1.7 Approach to Up-grading Drainage System

Stage - I Preparation of Master Plan -Detailed study of the existing city drainage system and

preparation of drainage master plan for upgrading .The sub components of the study will be:

- Preparation of base map of the city for drainage with contours; and
- Identification of missing links and prioritization of drain works.

Stage - II Preparation of Feasibility Report

- Review available data, maps and reports;
- Mark the drainage zones based on reports and study;
- Locate the problem areas;
- Prepare preliminary engineering proposals; and
- Prepare financial analysis based on implementation schedule.

Stage - III Detailed Engineering Studies

- Protection of both sides and provisions for desiltation before seasons;
- Construction and reconstruction of culverts; and
- Provision for fencing at identified canal-dumping area as case study.

1.8 Major canals requiring priority attention

1.8.1 Primary Canals

- Thevara-Perandoor canal and its major branches;
- Edappally thodu and its major branches;
- Rameswaram – Kalvathy canal;
- Chilavanoor puzha;
- Champakara canal;
- Changadam poku thodu;
- Karanakodam thodu;
- Ponnethuchal thodu;
- Koyithara canal;
- Railnagar thodu;
- Punchathodu;
- Valavikadavu thodu;
- Pallichal thodu;
- Pandarachal;
- Pushnithodu;
- Chitrapuzha; and
- Konothu puzha etc;

1.8.2 Natural Secondary Canals

- Kari thodu;
- Adimuri thodu;
- Karuveli thodu;
- Athirthi thodu;
- Thodu along Major road;
- Kathmbayil thodu;
- Mullassery canal;
- Market canal; and
- Seena thodu etc.

1.9 Creating Public Awareness

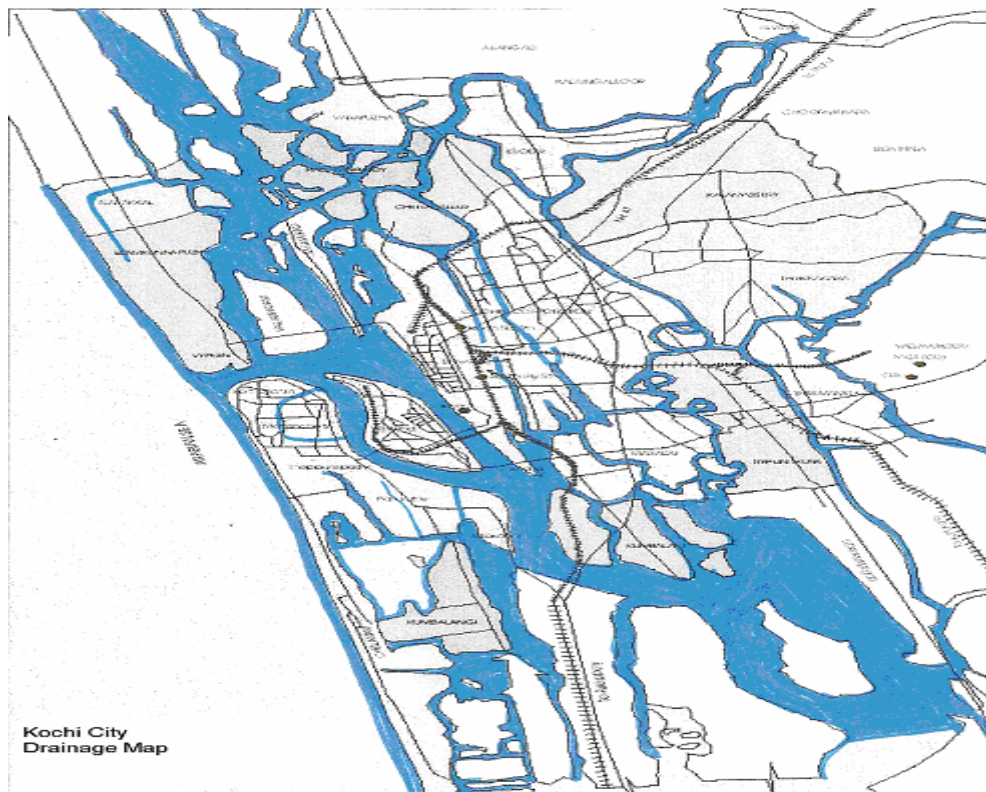
Public awareness is proposed to be created right from the primary school levels, going up to the higher community levels, encompassing the complete spectrum of urban life. The print, electronic and visual media is proposed to be utilized to ensure an enhanced level of public awareness. The propaganda schemes are proposed to be spread over a period of 5 years initially. An evaluation of this level of awareness will be scientifically done at the end of 5 years. If found desirable the propaganda will be extended beyond the 5 year period. The estimate provisions include a projection of anticipated expenses towards this media publicity.

Feasibility of ground charging the rainwater run off in the case of elevated areas of eastern sectors of Kochi agglomeration. Approximately 10% of the eastern sector of Kochi agglomeration is having elevated terrain with ground levels 3m to 6m above M.S.L It is desirable to have a separate study to ensure surface rain water in the sector. A provision is made in the project cost.

1.10 Canal Water - Quality Improvements

The Quality of water in the canals of Kochi at present is filthy and hazardous to aquatic fauna. The water is unsuitable for construction and irrigation purposes also in many of their stretches even in the rainy season. This necessitates the improvement of the quality of the water by appropriate techniques especially reducing the biological waste and chemical pollutant input and thereby increasing the dissolved oxygen. This kind of improvement in the quality of the water will facilitate the various above uses of canal water.

Figure 1.7: Outline Map Showing the Existing Canals and Drains



Cost projection, investment plan, strategy to achieve the vision & strategy for implementation are given in the section on estimate of cost.

1. Storm water drainage – Cost projection – Section - Estimate of Cost (Part 4 Table A).
2. Storm water drainage – Investment Plan – Section – Estimate of Cost (Part 4 Table B).
3. Storm water drainage – Strategy to achieve vision and goal 2006-2026 – Section – Estimate of Cost (Part 4 Table C).

List of Drains and Estimated Cost (Local body wise) is given in **Annexure 4**.

Conclusion. The strategy involves desiltation of canals, provision of side roads, provision for multiple overflow outlets, development of canal network system and regulatory pumping systems. The project involves identification of all the Primary, Secondary & Area canals and improvement of their quality to ensure proper drainage. This necessitates detailed contour survey & preparation of a drainage master plan.

The city level Steering Committee which is proposed to be set up with the collector, the Mayor and the ULB Presidents /Chairperson and the officers of the line departments will look into the aspect of coordination.

The total project is estimated to be **Rs.902 crores**.