REPORT ON

FLOOD MITIGATION KOCHI

Market canal in 1950

present kochi

IRRIGATION DEPARTMENT
ERNAKULAM

2021

ACKNOWLEDGEMENT

I respectfully appreciate and thank Sri. Roshy Augustine , Minister of Water Resources, Kerala, for the leadership and valuable suggestions given throughout this project work.

I sincerely express deep sense of gratitude to Sri. TK Jose (IAS) Additional Chief Secretary (Home & Water Resources) as the success and outcome of this project were possible by his leadership, guidance and support which also included interactive weekly reviews. Our team is incredibly privileged to have got this all along the project preparation. It required a lot of effort from each individual involved in this project with me and I would like to thank them.

I am also thankful to **Sri. Alex Varghese, Chief Engineer, Irrigation and Administration, for providing us with all support which made us finish this project duly.**

I also deeply appreciate and thank Sri. M Anilkumar, Mayor Kochi Corporation, Sri. TJ Vinod ,MLA Ernakulam and all the Councilors for presenting such excellent support and guidance, despite having a busy schedule .

I am thankful to get consistent encouragement and support from my team members which helped us to complete the project work. I submit this project with great humility and utmost regard.

Er. BAJI CHANDRAN R
Superintending Engineer
Minor Irrigation Central
Circle Ernakulam

EXECUTIVE SUMMARY

This report is a study of the canal systems in Kochi city of Ernakulam District. Here we identified 39 main canals which passes through the Kochi corporation .These canals mainly functions as the storm water drainage of the city which takes the storm water from the small drains to the back waters. Here the ground level is almost same or below the mean sea level and hence the tidal variations also affects the flow of water into the back waters.The study was conducted by a team of irrigation engineers from the field study collection of datas including history of each canals, made maps of the canal network,analysed the present position of the canals and presented here for easy identification of problems and solutions. Earlier the canals were used for transportation and proper drainage was not a problem since not much hindrances were present in the canals. This study reveals that waste water including septic tank drainages are opened into the canal. Public is using this canals for waste dumping at various portions even though this is a punishable offence under water conservation act. Another important change noticed is the unauthorized encroachments and covering the canals with RCC slabs which will reduce its capacity and cleaning of the deposited silts in the future made difficult. Present position of the canals are shown with the help of a line diagram from start to end including obstructing structures such as small culverts ,silted up portions ,waste dumped areas etc. for each canal. The complete reinstatement of the canal system to its original state involves a huge amount. Apart from cleaning of the existing canals the kayal mouth to which the water drains into are silted up, dredging and clearing of these area is absolute necessary .The encroachments and covering slabs and including siltation reduced the holding capacity of the canal system which in turn causes flooding in the Kochi city.

All the canals in Western kochi were navigable in early days and now they are covered with RCC slabs and silted up. Instances like entire vanishing of a canal stretch of about 400mt is identified at Kazhuthumuttam in Rameswaram canal of Thoppumpady. Another instance is the encroachment at Kumaranasan nagar in Punchathodu was regularised by revenue department and fixed the boundary into the canal and 6meter wide water course is shrunken to about 2meters of width. There are other instances also for legalizing encroachments which in turn reduces the water holding capacities of the canal system .The concerned departments has to re-look into this matters and start re capturing the waterways which were converted in the past .If this scenario continues even the present conditions of the canal system will disappear in near future and the flooding of the city during rainy season is inevitable. The revamping of canal system could be achieved with the co- operation of various government agencies and public. Cleaning and desilting and removal of obstuctions and encroachments are the basic requirement. Merging of different government schemes and utilizing funds like CSR of organizations etc will make the revamping and maintaining the canal system cost effective

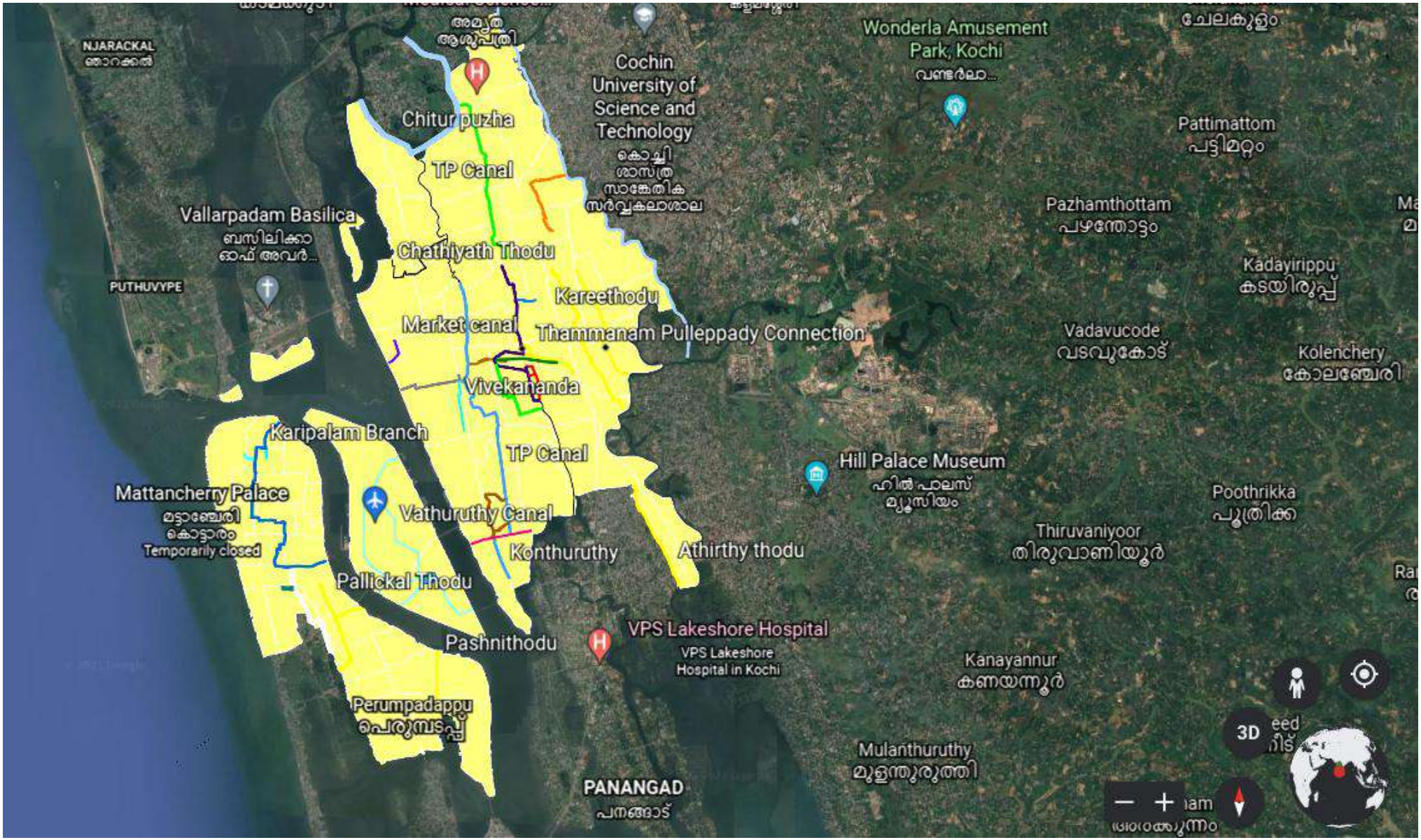
I N D E X

CHAPTER 1 INTRODUCTION

Introduction:

Kochi is one of the fastest growing second-tier metros in India forming part of Ernakulam district in Kerala. In fact , Kochi is the economic and financial capital of Kerala. Kochi is a renowned spice trading centre on the Arabian Sea coast since the 14th century, popularly referred to as the *'Queen of Arabian sea*'. Kochi is also a growing centre of information technology, tourism and international trade and is in fact the commercial hub of Kerala. Kochi has a diverse, multicultural, and secular community consisting of a mix of people from all parts of Kerala and most parts of India.The city retains its distinct colonial heritage and a blend of tradition and modernity.

Geographically the city is situated between Northern Latitude 9°54'07.2"N and 10°01'52.4"N and eastern longitude 76°14'23.8"E and 76°19'35.3"E. Kochi city extends over an area of 94.88 sq km with high population density 7139/km2. In fact it is the most densely populated city corporation in our State.



Aerial view of Thodus in Kochi

CHAPTER 2 CANAL SYSTEM IN KOCHI CITY CORPORATION

Kochi City had a well defined canal system . Owing to its proximity to sea, the canals were subjected to regular tidal inflow and outflow which kept the water in the canals naturally clean . However the urbanisation and need for road development paved way to diminishing canals and water bodies . As a result of urban encroachment of habitate and to increasing urbanization needs, decreasing trend in the width of canal which led to reduction in its water carrying capacity is being observed. Many open canals in the past are constructed concrete drains. As a part of road development, many unscientific constructions were done across these canals. The bed of many natural canals were concreted thus making infiltration of flood water through canal bed impossible.

Kochi city can be divided into Central and West Kochi.

Central Kochi

Major canals passing in Central Kochi are TP canal, Changadampokku, Karanakkodam, Mullassery, Edappallythodu and other tributaries. All major and minor canals paly an important role in Kochi town area. Since the land area is at MSL, all the drainage systems can contribute to flood. Due to perpetual encroachment and siltation, the holding capacity of entire drainage system has been reduced which results in flooding in the urban areas. Frequent increase in encroachments and other illegal constructions will create uncontrollable situations which can often lead to flood management failure. Most of the navigable canal systems used for transportation in the past are now subjected to reduction in width. About 10% of the water-spread area of Chilavannoorkayal has been reclaimed and this led to a crucial situation in the city to control flood. Some of the other identified important points are –

1. TP canal has been divided into two at chainage 4512m by constructing a small culvert by Indian railway for the railway track and now this culvert is fully clogged with waste and blocked the continuity.
2. The canal Changadampokku, was named in such a way to represent it as a navigable drain. But now it is narrowed down to 1.5m from Kaloor Metro Station to Keerthinagar (approx 1.5km). Karanakkodam thodu and Changadampokku were in a single stream and broken at Kaloor Metro Station. To balance the drainage water system, the recently mentioned canals must be connected properly.

One of the major problems identified in the city is that the effluent from railway marshalling yard is disposed directly to the drainage system without making any effluent treatment and thereby polluting water in the nearby area. Marshalling yard drain which is connected to Karanakkodam leading to Chilavannoor are also thereby polluted and

the ecosystem surrounding this is disturbed. Major problems identified are elaborated in the sections.

West Kochi

Major thodus are Calvathy canal, Manthra canal, Rameswaram canal, Pandarachira thodu, Pashnithodu, Pallichal thodu.

Earlier all the above said canals were well-maintained and navigable. Due to urbanisation, many of these canals were encroached for forming new roads. As water transport lost its shine, these canals were neglected and became points of deposition of liquid and solid wastes. Presently this is the main cause of oxygen depletion in the canals, which led to deterioration of the water quality. This has badly affected the marine flora and fauna. All the canals are at sea level and natural flow is sluggish or non- existent in non-rainy days. Tidal oscillation alone infuses some life into the system. But intervention by bunds, loss of depth by siltation and bottlenecks created in the channel by civil structures and dumping of solid waste isolate the canals into stagnant wet patches.

The tidal canals in this region do not any more carry out the natural functions expected of them because of the solid and liquid wastes ending up in these canals and due to vast encroachments that are continuously happening. If the tidal water is allowed to sweep past the canals, they will remain clean and lively all through the year.

Due to lack of proper waste management system in the city, the canals have become places of waste deposition. In many places in the city limits , sewage from nearby housing colonies are seen directly discharging into the canals. The canals which were carrying clean water in the past are now carrying putrid water. Apart from deteriorating water quality, the waste deposition is also a major factor causing blockage to free flow. The clogged canals and road drains are unable to effect speedy drainage of storm water which causes flash flooding in Kochi city.

HYDROLOGY OF TIDAL EFFECTS ON WEST KOCHI AREA

Tidal difference occurs approximately every eight hours. The water flows from south most Vembanadkayal and back. Since the Calvathy canal is the first opening from outer sea mouth the water gushes out first and gushes in every eight hours during the tidal differences. This was working fine earlier, keeping the waters clean and navigable, even in the 1970s. But now it is not possible due to these blocks and missing links.

The entire water from Muvattupuzha River basin and a part of Meenachil river is draining to the Vembanadkayal and finally to the Arabian sea. A major portion of this flows through Aroorbridge and reaches Arabian sea at Fort Kochi, where it merges with a part of Periyar River basin also. During Monsoon, the water level in the kayal is on the rising and flow of water from the west Kochi canals is minimum. Even thoughAndhakaranazhiwill also be opened at that time, the incoming storm water is not drained completely.On the otherhand,in dry seasons the Thanneermukkam bund and Thottappallyspilways are closed which prevent

the free flow of water into the sea. Also the time of travel of water around the mainland through Aroorbridge is higher compared to the flow from backwaters through Rameswaram and Calavthycanals.This increases the importance of the canal system.

Small kayals in the western side of Aroor bridge arePandarachirakayal, Kalatharakayal, Kochuchirakalkayal, Kannamalykayal, Kumbalanghikayal, Anjitharakayal, Kallancherykayal, Perumpadupukayal, Velluthulykayal, Ezupunnakayal, Chakarathode, Vijayan canal uptoChellaanam.

All these backwaters of these lakes and canals will be associated with the tidal differences happening every 8 hours approximately.This tidal flow helps in washing away all the waste and stagnant waters early.

Now these lakes are nearing stagnancy because the water flow to these kayals is coming through Aroorbridge and Pashnithodu, which is only 10m wide.

Now the water has to travel from Fort Cochin port mouth via Willington island, to reach Aroor bridge, approximately 30km. Fisher men have been complaining about the polluted waters and stagnancy of lakes for years. This happens because of the highly saline water about 44 ppt entering the canals and to lakes. Salinity of these lakes is very less because by the time the water reaches Aroor, Kannamaly, Chelanam, the tidal difference happens, as it occurs every eight hours. Moreover a new construction is in progress right at the mouth of Calvathy canal causing reduction to the width of the canal at the mouth. This is definitely going to have a great impact on the in-flow and out-flow of water.

Changes in climatic conditions:

Kerala has been receiving excess rainfall for the past few years. The percentage of excess being 23.34% in the year 2018, 12.72% in 2019 and 9% in 2020. Due to global climatic changes, Kerala coast is now getting prone to cyclonic storms also. The heavy rains received in a short duration is found to cause inundation in the Kochi city area. Experts have evidences of phenomenon like cloud bursting happening in and around Kochi which also contribute to release of large amount of storm water in a relatively smaller area causing flooding situation.

Prominent areas of flooding:

The major areas subjected to flash flooding in Kochi city are KSRTC Bus stand area, South railway station, Karshaka road, P&T colony area, Kammattipadam, Judges Avenue, Panampilly Nagar ,Kaloor KSEB substation etc.

CHAPTER 3 WATER CONSERVATION ACT

THE KERALA IRRIGATION AND WATER CONSERVATION ACT, 2003(1) & ORDINANCE NO. 27 OF 2017, THE KERALA IRRIGATION AND WATER CONSERVATION (AMENDMENT) ORDINANCE 2017

An Act to consolidate and amend the laws relating to construction of irrigation works, conservation and distribution of water for the purpose of irrigation and levy of betterment contribution and water cess on lands benefited by irrigation works in the State of Kerala and to provide for involvement of farmers in water utilization system and for matters connected therewith or incidental thereto.

a) Irrigation work includes all drainage works such as canals, channels, escape channels from a canal or channel, reservoirs or tanks, dams, weirs, embankments, sluices, groynes, field channels, and other works for the protection or benefit of agricultural lands or for the reclamation or dewatering of kole lands, kayal lands, kari lands or such other lands. Water course means a river, stream, springs, channel, lake or any natural collection of water other than in a private land and includes any tributary or branch of any river, stream, springs or channel.

b) Consequences of construction of Irrigation works : - Where the government construct an irrigation work for utilizing the water in a water course - No person or agency shall , without the sanction of the Government or such authority as may be authorized by the Government in that behalf, do anything which obstructs, interferes with , diminishes or is likely to obstruct , interfere with or diminish, the flow of water in such water course.

c) Safeguards for Irrigation works :

1. No encroachment shall be allowed in the irrigation land . No person shall occupy any irrigation land for cultivation or for any other purpose and the irrigation officer shall take all necessary steps to remove encroachments on such lands.
2. No person shall let out any industrial effluent or domestic effluent to nay water course without proper treatment.
3. No person shall deposit rubbish or filth or excreta in any distributary system or water course or allow to flow waste water into it or pollute the water in any other way.

d) Interference with functioning of cross drainage works :

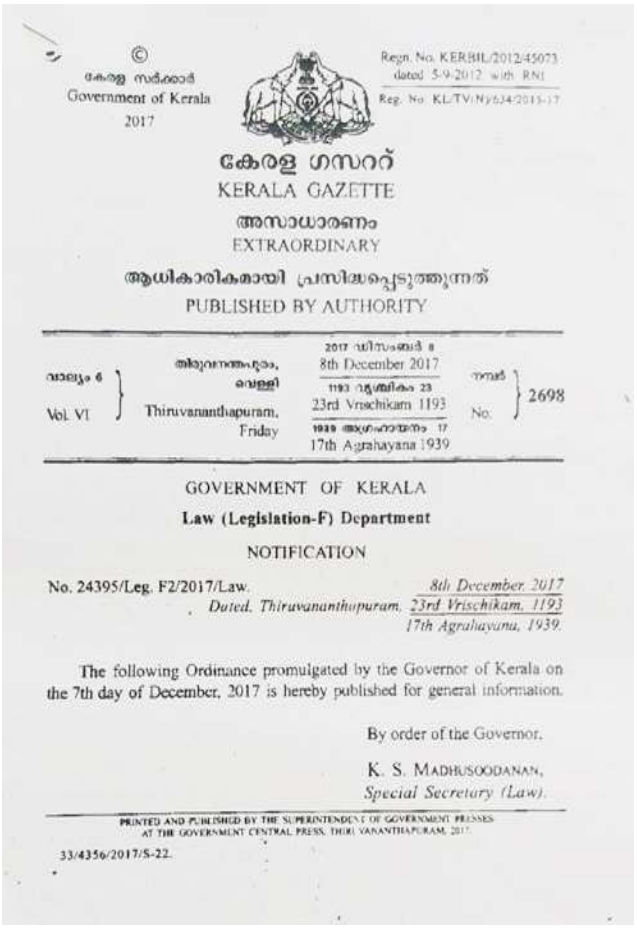
1. No person shall except with the written permission of the Irrigation Officer, Obstruct the proper functioning of the various cross drainage works, such as culverts, aqueducts, super passages, siphons, weirs and allied works constructed by or with the aid of Government for the safety of canals or channels.

PENALTIES

1. Whoever without proper authority –injures, alters, enlarges, or obstructs any irrigation work or interferes with, increases or

diminishes supply of water from any irrigation work, or destroys, defaces, removes or alters any level marked or water gauge or any other mark or sign fixed in an irrigation work shall, on conviction, be punished with imprisonment for a term which may extend to one year or with fine which may extend to five thousand rupees or with both.

2. Whoever deposits rubbish or filth or excreta in any distributary system or water course or allow to flow waste water into it or pollute the water in any other way, shall, on conviction, be punished with imprisonment for a term which may extend to three years or with fine which may extend to two lakhs, or with both.



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Government of Kerala
2017

Regn. No. KERBIL/2012/45073 dated 5-9-2012 with RNI
Reg. No. KL/TV(N)/634/2015-17

കേരള ഗസറ്റ്
KERALA GAZETTE
അസാധാരണം
EXTRAORDINARY
ആധികാരികമായി പ്രസിദ്ധപ്പെടുത്തുന്നത്
PUBLISHED BY AUTHORITY

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GOVERNMENT OF KERALA

Law (Legislation-F) Department

NOTIFICATION

No. 24395/Leg. F2/2017/Law. *Dated, Thiruvananthapuram, 8th December 2017 / 23rd Vrischikam 1193 / 17th Agrahayana 1939.*

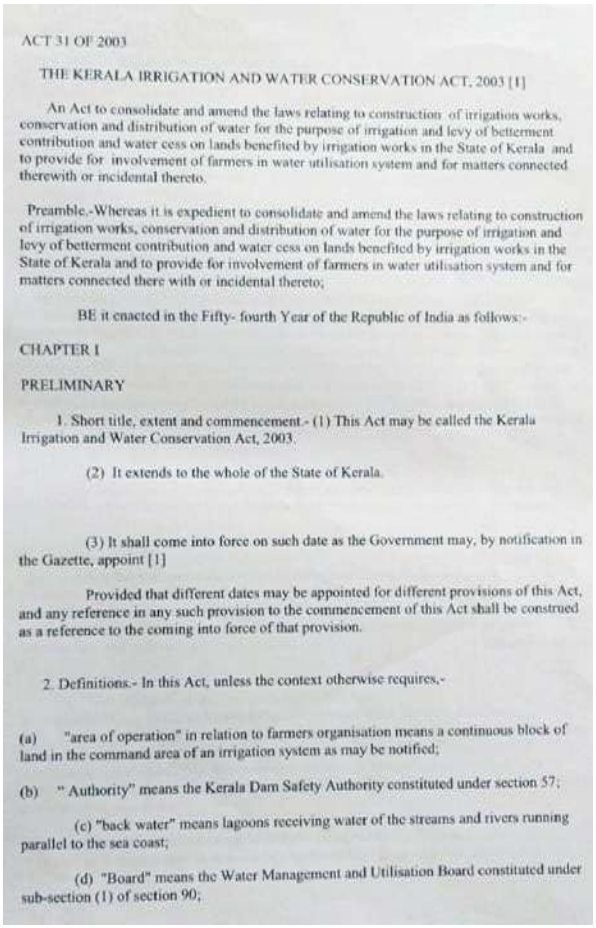
The following Ordinance promulgated by the Governor of Kerala on the 7th day of December, 2017 is hereby published for general information.

By order of the Governor,

K. S. MADHUSOODANAN,
Special Secretary (Law).

PRINTED AND PUBLISHED BY THE SUPERINTENDENT OF GOVERNMENT PRESSES AT THE GOVERNMENT CENTRAL PRESS, THIRUVANANTHAPURAM, 2017.

33/4356/2017/S-22.



ACT 31 OF 2003

THE KERALA IRRIGATION AND WATER CONSERVATION ACT, 2003 [1]

An Act to consolidate and amend the laws relating to construction of irrigation works, conservation and distribution of water for the purpose of irrigation and levy of betterment contribution and water cess on lands benefited by irrigation works in the State of Kerala and to provide for involvement of farmers in water utilisation system and for matters connected therewith or incidental thereto.

Preamble.-Whereas it is expedient to consolidate and amend the laws relating to construction of irrigation works, conservation and distribution of water for the purpose of irrigation and levy of betterment contribution and water cess on lands benefited by irrigation works in the State of Kerala and to provide for involvement of farmers in water utilisation system and for matters connected there with or incidental thereto;

BE it enacted in the Fifty- fourth Year of the Republic of India as follows:-

CHAPTER I

PRELIMINARY

1. Short title, extent and commencement.- (1) This Act may be called the Kerala Irrigation and Water Conservation Act, 2003.

(2) It extends to the whole of the State of Kerala.

(3) It shall come into force on such date as the Government may, by notification in the Gazette, appoint [1]

Provided that different dates may be appointed for different provisions of this Act, and any reference in any such provision to the commencement of this Act shall be construed as a reference to the coming into force of that provision.

2. Definitions.- In this Act, unless the context otherwise requires,-

(a) "area of operation" in relation to farmers organisation means a continuous block of land in the command area of an irrigation system as may be notified;

(b) " Authority" means the Kerala Dam Safety Authority constituted under section 57;

(c) "back water" means lagoons receiving water of the streams and rivers running parallel to the sea coast;

(d) "Board" means the Water Management and Utilisation Board constituted under sub-section (1) of section 90;

CHAPTER 4 OPERATION BREAKTHROUGH

Operation Breakthrough 2019:

The flagship programme 'Operation Breakthrough' was launched in Kochi City by the Hon' Chief Minister following the flash flooding which happened during October 2019. During the incessant rains on October 20 and 21st 2019, the major roads in Kochi city such as MG road, Shanmugham road, Banerjee road, Bypass road along with prominent locations like South Railway Station, North Railway Station, KSRTC bus stand premises etc were fully flooded and normal public life was disrupted. Several polling booths of bye election held on these dates had to be shifted. Following these incidents, Hon. Chief Minister decided to implement Operation Breakthrough Project and to formulate projects to avoid such a situation in future. Division wise study was carried out in all the 74 divisions in Kochi Corporation by teams constituted of technical personnel from Kochi Corporation LSGD wing, PWD, Irrigation, GCDA etc to assess the causes and remedies to avoid such a flooding situation in future. Technical committee of Operation Breakthrough comprising of Executive Engineers from all major work execution departments such as PWD, Irrigation,LSGD, GCDA etc in the district prioritised the remedies suggested by various teams and arranged the prioritised works under Phase 1 of the Project on a war footing basis.

The Phase 2 of Operation Breakthrough Program was led by Irrigation department under the Chairmanship of Sri. Baji Chandran R, the then Executive Engineer, Minor Irrigation Division, Ernakulam. In Phase 2 , the desilting and rejuvenation major canals and Kayal mouths in the city were taken up . After the completion of Phase 1 and Phase 2 of Operation Breakthrough program, much relief was observed in the flooding situation in Kochi. The areas which are still subjected to flooding include the KSRTC bus station and South railway station area where the renovation work of Mullassery canal is yet to be taken up. The details of each work in Phase 2 Operation Breakthrough are explained below.

1. **Desilting of Thevara Kayal mouth**

While assessing the reasons for flooding in the South west portions of Kochi city, the extremely silted Thevara Kayal mouth was identified as a major cause. The runoff water from Kadavanthra, Panapilly Nagar, Thevara and Kochu Kadavanthra areas drain to Kayal through Thevara-Perandoor canal and Koithara canal through Thevara Kayal mouth.

Due to tidal inflow and outflow, the Thevara Kayal mouth was fully silted up and blocked. Due to this, the flood water which should drain through this Kayal mouth used to flow back through Thevara- Perandoor Canal and after traversing 12.5 km exits into Kayal through its northern mouth. The Thevara-Perandoor canal is unable to accommodate this excess flood water, thus causing flooding. After desilting ThevaraKayal mouth, the water from the

southern reaches of Thevara- Perandoor canal and Koithara canal can drain off to Kayal quickly. This Project is expected to be a solution to flooding in Kadavantra, Panampilly Nagar and Thevara areas. The work is completed and water flow is restored in the canal.

2. Renovation of Koithara Canal

Koithara canal is a major canal which starts from Thevara- Perandoor canal near Panampilly Nagar and passes through Koithara area and finally merges to Thevara canal. Due to construction of a Railway Overbridge in Koithara, free water flow through this canal was blocked for over 30 years.

For the construction of Ernakulam –Alappuzha Rail overbridge, an existing culvert was brought beneath the waterway and about 72cm thick concrete slab was casted over this to form roadway. As a result, this canal was fully blocked. Also a pile cap forming part of Rail Overbridge was constructed across this canal, thus worsening the condition of this canal. During rains, the adjacent areas of canal get completely submerged. The Project was envisaged to open up the blocked canal.

Provsions were included in the Project to clear the vegetation blocking water flow in canal, desilt and clean the canal and to clear the deposited concrete debris in the canal and to demolish and reconstruct the blocked culvert. As the blockage is removed, water flow is restored in the canal. The water through this canal reaches Kayal mouth through Thevara Canal.

3. Karanakodamthodu renovation

Karanakodamthodu is a major drainage canal in Central area of Kochi city starting from area near Kaloor Metro rail station to Chilavannoor lake through rail yard. Before construction of Metro station, this thodu was connected to Changadampokku thodu. This thodu and Changadampokku thodu was together known as Chilavannoor thodu. Due to extreme siltation in this canal, flooding was caused in Kaloor

Stadium, Thammanam, Katrikadavu areas. The desilting work iscompleted now. Visible positive differences are observed due to opening up of this canal.

4**. Changadampokkuthodu**

The significance of Changadampokku thodu caught attention when the KSEB sub-station area at Kaloor was submerged in the floods and the city was plunged into darkness during the flooding in October 2019. 4km long Changadampokku thodu drains into Kayal through Perandoor river near Amrita Hospital. As the name indicates, this thodu was once the mode of conveyance by Changadams and was about 16m wide. The thodu was earlier a continuation of Karanakodam thodu and this connectivity was broken during the construction of Kaloor Metro station. The width of the thodu got reduced to 2m near KSEB premises. Approx 200m length of slab is covered with slabs in this area. The obstructions in this canal causes flooding in Sub-station area. As the width is less, the chances of getting obstructed are high. KSEB authorities have been intimated to remove the cover slabs and widen this thodu in their compound, but no action has been taken so far. However, the canal is desilted through Operation Breakthrough.

At the portion of Rail line crossing at Elamakkara,

the flow was almost fully blocked by old concrete pipes and remnants of earthen bund and damaged concrete piles used in the construction of rail bridge. As part of Operation Breakthrough the obstructions in this canal were cleared including the mouth portion. The work is completed and there is evident increase in water flow through the thodu.

5. Renovation of Edapallythodu

Another important identified Project is the rejuvenation of Edapallythodu between Muttarriver and Champakara canal. The canal flowing along the eastern boundary of Kochi Corporation will drain off significant amount of

rain water to Kayal through Muttarriver. The removal of obstructions in the 10 km stretch of canal and restoration of smooth water flow will help to relieve flooding in eastern area.

6. **Removal of blockage in Ambanattuchira thodu**

The Ambanattuchira thodu (Ponneth Chaal) is a major waterbody in Chilavannoor area . This water body was heavily silted . Approx 1.1 km long heavily silted reach upto Kayal mouth was

desilted under Phase 2 of Operation Breakthrough ensuring smooth unobstructed flow through the thodu.

PROJECTS YET TO BE TAKEN UP

1. Mullassery Canal renovation

The worst flood affected area in Kochi Corporation i.e the area near KSRTC bus stand is a natural depression and hence the runoff water from a large area gets collected in this area thus causing flooding . Presently, the flood water accumulating in this location tends to flow towards Kayal mouth through the already overloaded Perandoor canal . This causes flooding in the area along the banks of Perandoor canal . Effecting natural drainage by gravity to the nearest outlet is the most viable solution for preventing flooding up of water in KSRTC/South Railway station area. Modifying the existing raised bed of Mullassery canal near KSRTC bus station area and by effecting proper gradient towards Kayal , flooding in this area can be avoided. This Project is estimated to cost Rs.10 crores.

2. Thevara- Perandoor Canal

About 12.5 km long Perandoor canal starts from Thevara Canal and drains into Kayal through Chittur river near Perandoor. At the middle stretch of this canal near CBI quarters, the canal is passing through 3 pipe culverts of 1m dia. As this portion is completely blocked , flooding is experienced in nearby areas.Kochi Corporation is executing the rejuvenation work of TP Canal under AMRUT Scheme. Operation Breakthrough has not undertaken any works connected to this canal.

Kochi Corporation is concreting the bed of many natural canals and has been covering it with concrete slabs under AMRUT Scheme. Presently, a similar work is being carried out in Changadampokkuthodu near Ammu Sahib road. These type of works will cause flooding in adjacent areas. This is also a clear violation of Central Water Commission orders. Such works undertaken by Corporation need to be controlled.

Renovation of m ajor streams like Kareethodu near Byepass Vennala and Puncha thodu in Kathrikadavu being taken up under Phase3 of Operation Breakthrough Project.

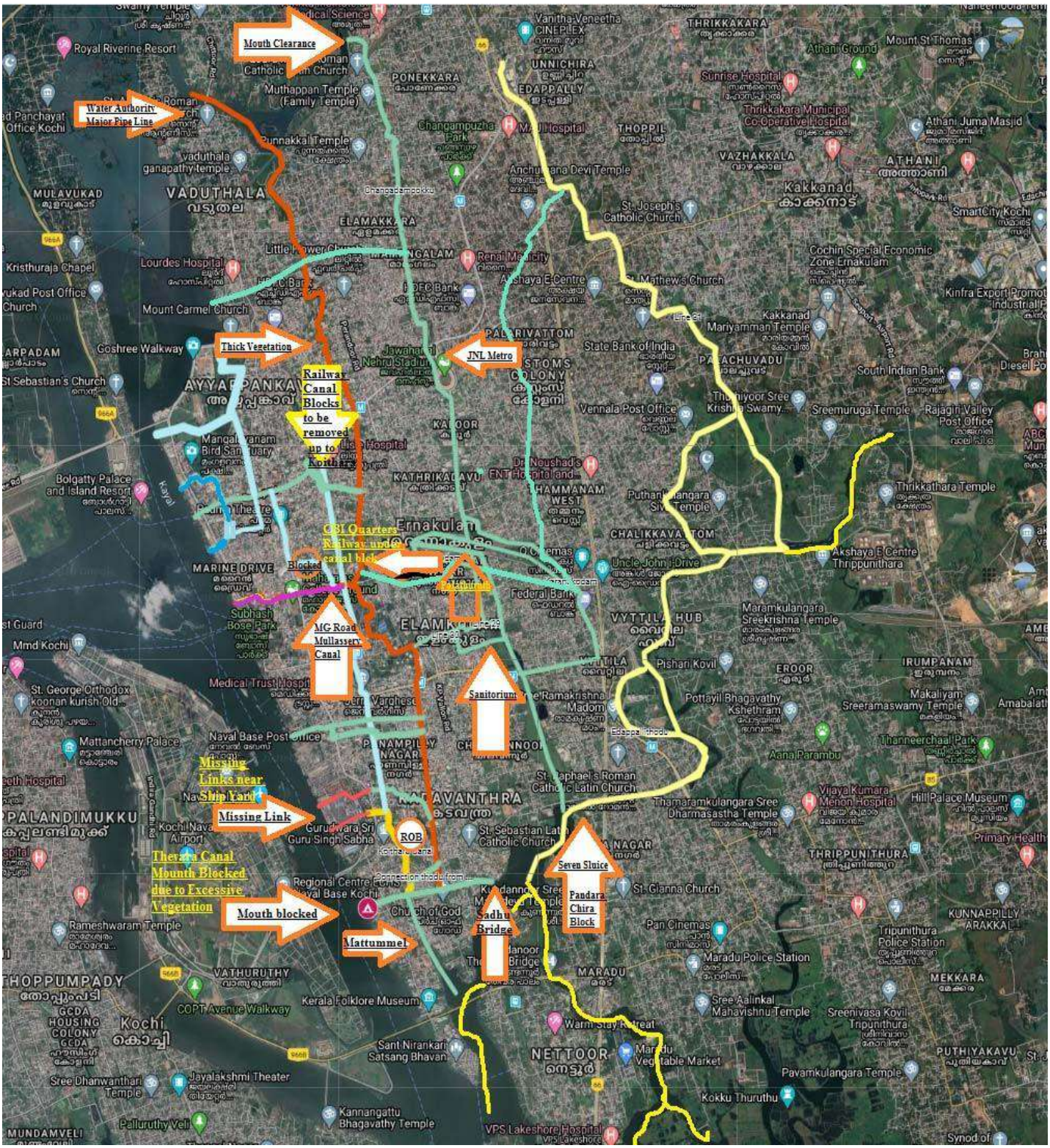
Operation Break Through has been a success as the places which has been identified and worked upon have not faced any issues unlike the last year. If the roadside drainages are properly maintained and at some particular place eg. Judges Avenue the drainages are rearranged then it will be a relief the existing identified issues.

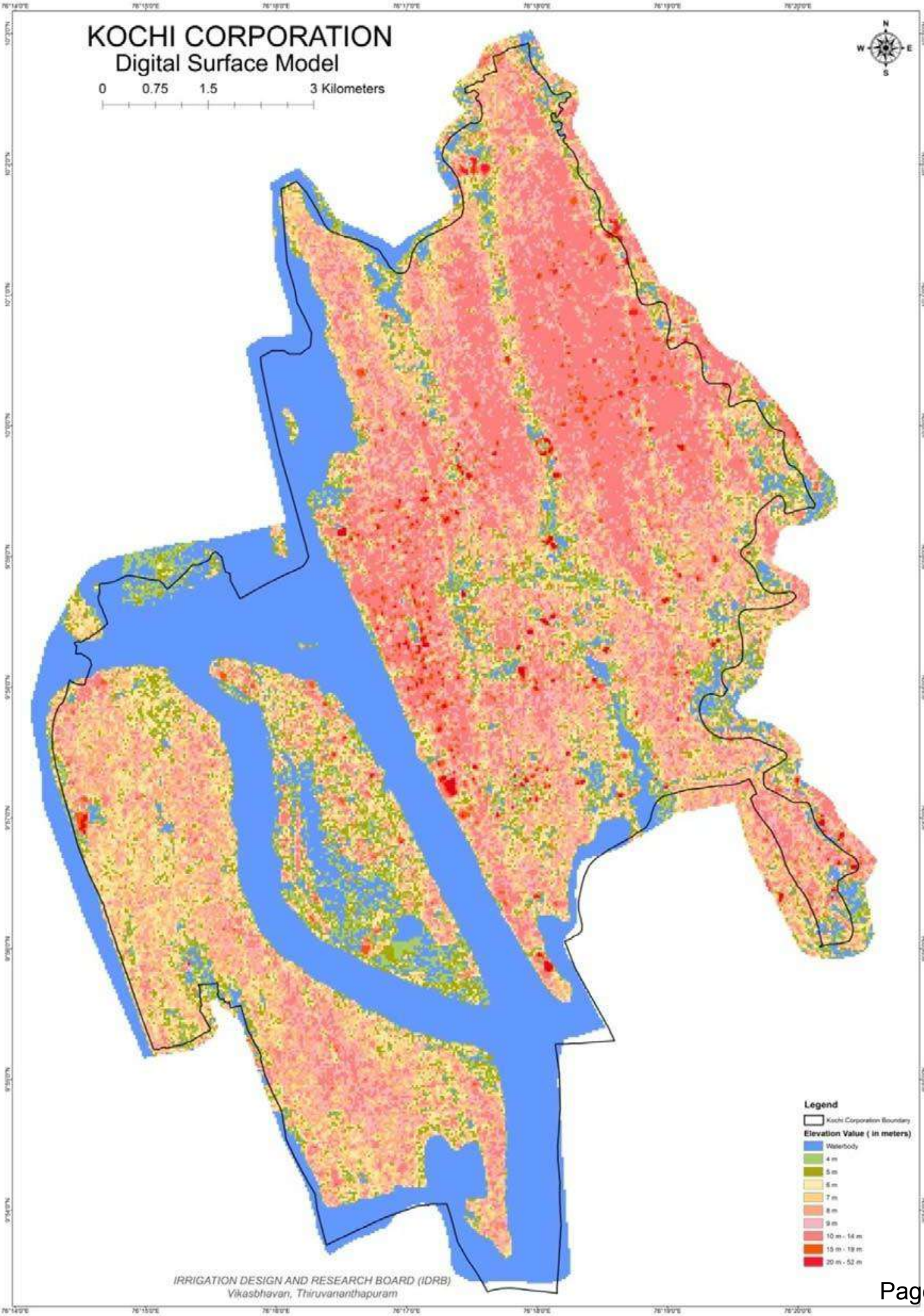
On completion of Projects such as Rejuvenation of Mullassery canal under Phase3, the Mission undertaken by Government is expected to finish successfully.

This Mission could be accomplished under the leadership of Irrigation department with the whole hearted cooperation of officials under Irrigation, PWD, GCDA and LSGD wings. All steps have been taken under Operation Breakthrough to

ensure that in the upcoming rainy season rain water reaches Kayal. The Mission was finished successfully in 30 days by the full support of Monitoring Committee (Appointed by Hon'ble High Court), MPs, MLAs and Corporation Council members.

The Mission started by Hon. Chief Minister, Kerala under the leadership of Hon District Collector Sri.S.Suhas IAS is being successfully completed through Irrigation department. Rs 25 crores fund has been allotted for this Mission under Phase 1 and 2 through Disaster Management Authority by Kerala State Govt.




KOCHI CORPORATION
Digital Surface Model
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Elevation Value (in meters)
Waterbody
4 m
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7 m
8 m
9 m
10 m - 14 m
15 m - 19 m
20 m - 52 m
IRRIGATION DESIGN AND RESEARCH BOARD (IDRB)
Vikasbhavan, Thiruvananthapuram

CHAPTER 5 CANAL REPORTS

THEVARA - PERANDOOR (TP) CANAL

KOCHI

FLOOD MITIGATION

In-charge: Er.Yesodadevi N, | Executive Engineer | MI Division Ernakulam

IRRIGATION DEPARTMENT
ERNAKULAM

THEVARA – PERANDOOR CANAL (TP CANAL)

EXECUTIVE SUMMARY

Thevara - Perandoor Canal also known as TP Canal is the Major Drainage of Kochi Corporation. It is a primary Drainage Artery of Kochi and the most important Canal out of all the 18 Tidal Canals in Kochi. It is a Man-made Canal to drain out Storm Water as well as Drainage Water from Kochi Corporation. It starts from Thevara Canal near Thevara and runs through the centre of Kochi Corporation ie. Panampilly Nagar, Kadavanthra, KSRTC, Kaloor and drains to Perandoor Kayal near Elamakkara/Ponekkara. The length of TP Canal is about 9950m. The width of canal is 15m at starting but reduced to 6m-7m in many locations and at the exit the width is 20m-30m. The width of TP Canal is only 1.2m in the midway for a length of 81m. The Storm Water as well as drainage water is flowing through TP Canal thus preventing the Corporation areas from flooding. The area of Kochi Corporation is 94.88km2 and is divided into 74 Wards for better administration. The TP Canal passes through about 14 Wards in Kochi Corporation and runs through the heart of the City. The catchment area of TP Canal is about 30 sq.km and Storm / Drainage water reaches TP Canal even from a distance of 1.5km on both sides of Canal. The catchment area of TP Canal is about 30% of total area of Kochi Corporation. The TP Canal formed years back is heavily silted up and the water carrying capacity of canal is reduced considerably.

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The rapid increase in population and urbanization has degraded the quality of this sensitive backwater lagoon environment. The backwater system has played an important role in the socio – economic and cultural history of central Kerala. It has significant importance in fish production and providing breeding and nursery grounds for fishes. Considerable changes occurred to the geomorphology of this sensitive backwater system through dredging and channelization. The estuary receives substantial quantities of effluent from industry and also enormous amount of organic and sewage waste. As a result of urbanization, the low lying areas of Kochi Corporation are being inundated in a continuous rain of about half an hour. The continuous rain happened during October 2019 inundated more than 80% of Corporation areas for about 24 Hrs. This occurred due to the low carrying capacity of various Canals in Kochi Corporation. The TP Canal also played a vital role in worsening the drainage of Kochi Corporation. The different types of structures constructed across canal, pipe lines, encroachments, wastes are obstructing the normal/flood flow of water. Most of the house drainages/sewage is draining into the canal thus making canal water dark grey. The encroachments have to be evicted and the width of the canal has to be reinstated. The canal can be brought to its original shape only after removing the obstruction, encroachments and also by preventing garbage disposal into the canal.

1.1 PRESENT SCENARIO

1.1.1 Critical Scenario

- Anamthuruthy Sluice is obstructing the normal flow of water to Thevara Canal.
- Koyithara Canal discharging its storm / drainage water into TP Canal. It increases the load on TP canal and has to be addressed.
- The storm / drainage water from MG Road also find its way to TP Canal through Panampilly Nagar and Ravipuram area. As a result, the entire area of Panampilly Nagar & Ravipuram is getting flooded and necessary measures are to be taken to divert water from MG Road area.
- In the mid-way Mullassery Canal joins with TP Canal at Chainage 4100m. As there is reverse slope in Mullassery Canal, the water that has to be drained through Mullassery Canal is flowing into TP Canal increasing water load in TP Canal at the critical reach. The storm / drainage water through Mullassery Canal to TP Canal should be reduced and to be kept minimum. It is creating flood like situation in KSRTC and South Railway Station area.
- The Branch Canal from Marshalling Yard / Kammattippadom area meets TP Canal near Mullassery Canal Junction. The Canal Mouth is being encroached on right side and Petroleum / Gas Pipe Lines (BPCL/IOCL) are laid in Canal and filled with earth making the width of canal to about 1/5th of its original width.
- High Pressure KWA Pipe Lines are crossing TP Canal near culvert leading to Kammattippadom area. These pipe lines are laid just above the bed level of
- Canal. These pipes obstruct the flow of water to a great extent and contribute to flood like situation even for a small intensity rain in and around Ernakulam South Railway Station / KSRTC.
- The main obstruction for free flow of water through the Canal is at the Railway Crossing portion. The TP Canal at Ch.4512m is crossing the Ernakulam - Kottayam railway line (Triangular Junction) with a mere width of 1.2m. The length of railway track crossing is 81m with a width of 1.2m. The width of canal on U/S and D/S side of railway track is about 6m. The 360 degree turn of water to cross railway track is the major cause of flooding in Ernakulam City during heavy rain. The railway line virtually divides the canal into two parts. The flow in this part is completely blocked. The railway culvert is not sufficiently wide enough to have continuous flow of the canal. Only an underpass is joining the 2 parts of the canal. The Canal is split into two by Ernakulam – Kottayam railway track.
- The low lying Cross Drainage Works between Pulleppady Bridge and Chirakkal Sastha Road Bridge is inundating the areas in and around Kaloor for small intensity rain. The Foot Bridges and Culverts constructed by LSGIs and Private Parties are a major concern for the free flow of water through Canal. The Canal width is reduced and converted into bund road from Pulleppady Bridge to Kaloor Chirakkal Sastha Bridge.
- The reach between Chirakkal Sastha Bridge and Perandoor Bridge is having an average width of 6m to 25m and there is no Canal Bund Road running parallel to the canal. The water carrying capacity of the canal is less and considerable silt and debris is deposited in canal bed. Garbage & Effluent discharge from Individual House Hold premises, Villas, Convention Centres and Commercial Establishments is seen to have diverted into TP Canal making water Dark Grey. The Canal is seen to have encroached by Individuals and Commercial Establishments making it into a narrow strip at certain locations.
- The Depth on Mouth of TP Canal where the Canal meets Chitturpuzha is very less. Considerable silt and debris are deposited on mouth of canal and it prevents
- discharge of City Storm Water into Kayal/Puzha, There are 3 Railway Bridge situated on mouth of TP Canal. The girder of one bridge is low and flood water touched the bottom of girder during 2018 flood. The deposition of silt and debris on mouth of canal creates Afflux and City area will get flooded even for a small intensity rain. There are some damaged remains of concrete structures which also obstructs the normal flow of water. The Water Flushing Mechanism of TP Canal is possible only after the removal of Delta on mouth of TP Canal.

1.1.2 General Scenario

- The TP canal is now totally degraded, primarily due to unregulated solid waste dumping and untreated sewage inflows at numerous locations along its course through the urban space. It is a chief repository of urban liquid and solid waste. Since it is running through the most urbanized parts of Kochi its quality indirectly reflects the civic sense and social attitude of the people living here.
- The width of Thevara-Perandoor Canal (TP Canal) is reduced in most of the reaches due to encroachments at many locations. The boundary structures like compound wall, toilets etc. are constructed in the canal. At some locations, canal is encroached as a part of beautification reducing canal width to a great extent thereby leading to clogging and hindering free flow of water. There are reports about the spread of contagious diseases in the nearby areas of this canal.
- The once pure water is now stagnant, silted and putrid. Water is almost anoxic in many regions due to the inflow of domestic sewage from the nearby areas through which canal flows. At present, the TP canal contains no fish at all. Levels of siltation make the canal virtually non-flowing thereby contributing to the infiltration of contaminated water into ground water regions. It is also contaminating the water in the nearby wells.
- It is observed that man-made constructions and cross structures at many places are obstructing the flow through the canal. The low lying bridges in terms of clear span and height are great obstructions to the free flow of flood water to the Kayal. The above structures reduce the flow through canal and thus flooding occurs in Kochi Corporation Area mainly at South Railway Station and KSRTC Bus Stand. A large number of encroachments are seen along both sides of the canal which act not only as sources of contamination but result in decreasing the width of the canal, thereby leading to clogging and hindering free flow of water.

The TP Canal bed is filled with bio degradable and non-bio degradable wastes and sufficient quantity of silt is deposited on bed. The depth of silt to be removed is about 0.6m-0.8m considering the safety of constructed structures on both sides of canal.

2.0 Study Report

The Physical Characteristics mainly Water Carrying Capacity and Behavior of TP Canal are studied in detail and represented as follows. For this purpose the Length and Width of TP Canal is kept constant and Depth of water that the Canal has to carry is calculated by taking into account of Storm Water, Drainage Water and Effluent Water. The intensity of rain in the Catchment area of Canal is taken as 1cm which is minimum according to the present climatic conditions. It is also assumed that high tide water enters Canal and rainfall intensity of 1cm occurs simultaneously with effluent discharge from the surrounding areas of TP Canal.

TP Canal - Water Carrying Capacity			
Length of Canal	9950m		
Width of Canal	15m	Assumed	
Depth of Canal	**To be Calculated at the end**		
Catchment area	9.95km*3km	29.85	km^2
	9950m*3000m	29850000	m^2
Intensity of Rainfall (Assumed)	1cm	0.01	m
Total Volume of Water after Rainfall	9950m*3000m*0.01m	298500	m^3
		0.3	Mm^3
Entry of Water due to Tidal Effect			
Length of Canal	9950m		
Width of Canal	15m		
Depth of Tidal Water	0.9m		
Total Volume of Water after High Tide	9950m*15m*0.9m	134325	m^3
		0.134	Mm^3
Effluent Discharge (Assumed)	10% of Tidal Water	0.0134	Mm^3
Total Volume of Water to be carried by TP Canal	0.3+0.134+0.0134	0.4474	Mm^3
Minimum Depth of Water that Canal should carry	**0.4474*106/9950*15**	**2.99765494**	**m**
		3	**m**

From the above table it is clear that the water depth of Canal should be 3m (Minimum). There should be sufficient Vertical and Horizontal clearance to the CD Works constructed across Canal. The Canal should have a Free Board of at least 2m to carry severe flood discharge during high intensity rain.

The Canal is divided into 4 reaches for the purpose of survey work namely;

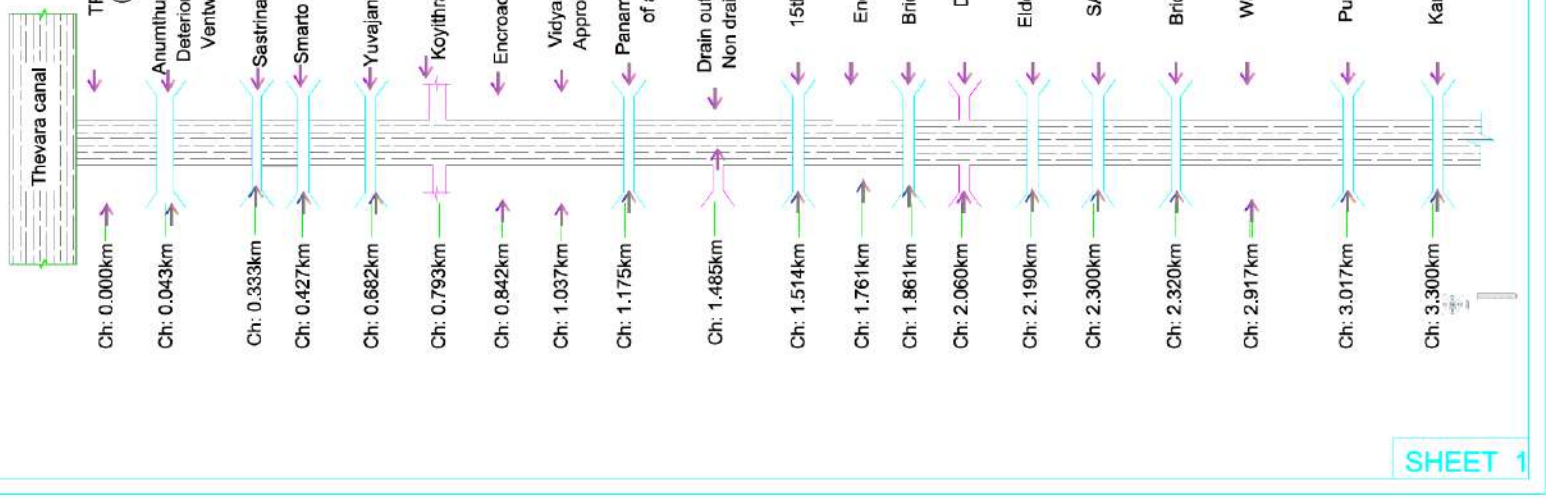
Reach I, Reach II, Reach III and Reach IV

- Reach I Starts From Ch. 0 to 2320m
  From Thevara Canal Mouth to Bridge at Kadavanthara near GCDA),
- Reach II Starts From Ch.2320m to 5000m
  (From Kadavanthara Bridge near GCDA to Pulleppady Bridge),
- Reach III Starts From Ch.5000m to 6400m
  (From Pulleppady Bridge to Sastha Temple Road Bridge)
- Reach IV starts from Ch.6400m to 9950m
  (From Chirakkal Sastha Temple Road Bridge to Perandoor Kayal Mouth).

The field survey was conducted on 2nd July 2021 by Minor Irrigation Department, Ernakulam District Officials. The Schematic Diagram of TP Canal and the Salient Features of each reach are represented in the following pages. The observations and immediate measures to be taken on Short Term and Long Term basis are also explained in this report.

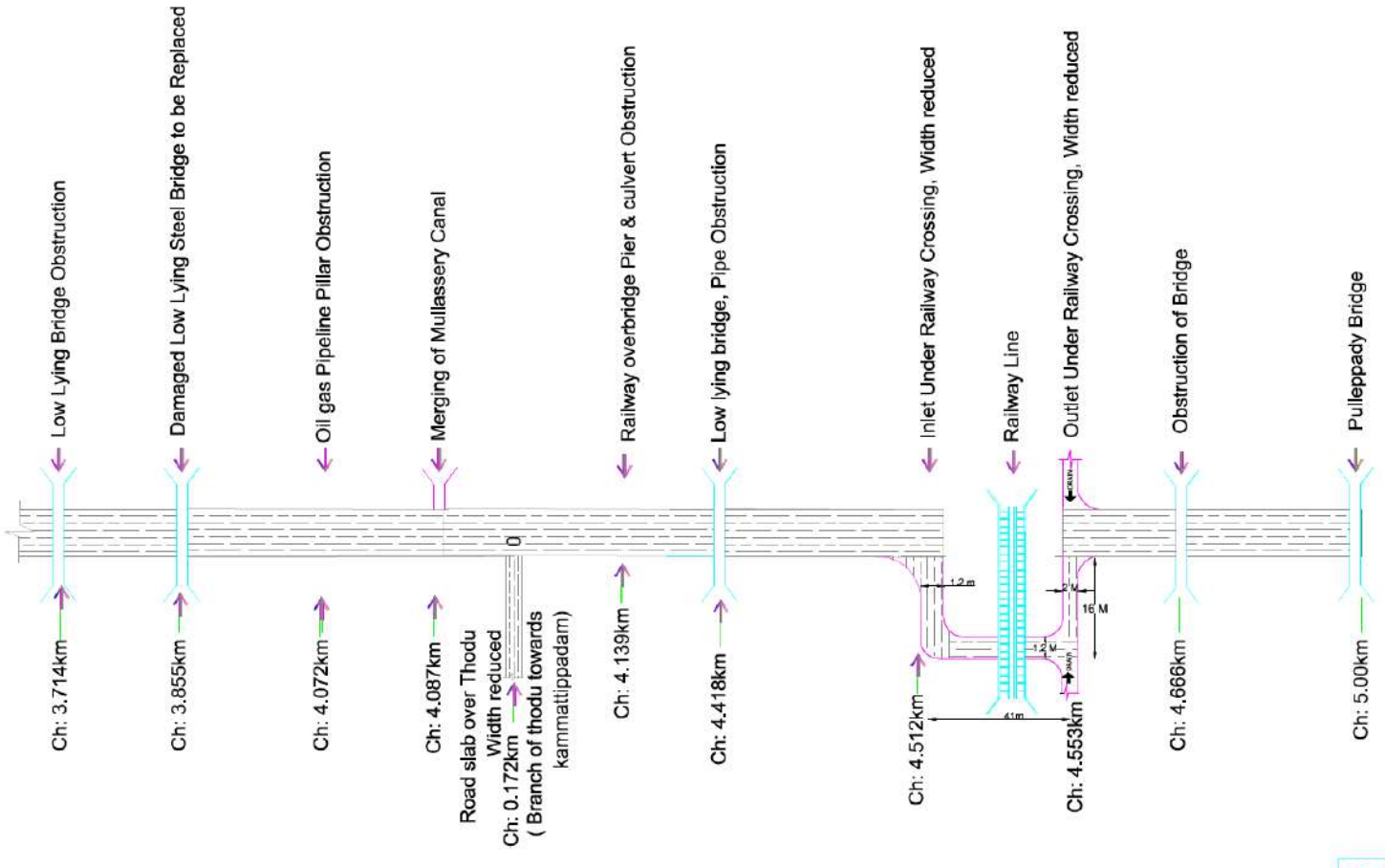
2.1 SCHEMATIC DIAGRAM

LINE SKETCH OF TEVARA PERANDUR CANAL - (FROM CHAINAGE 0.000km to 3.300 km)

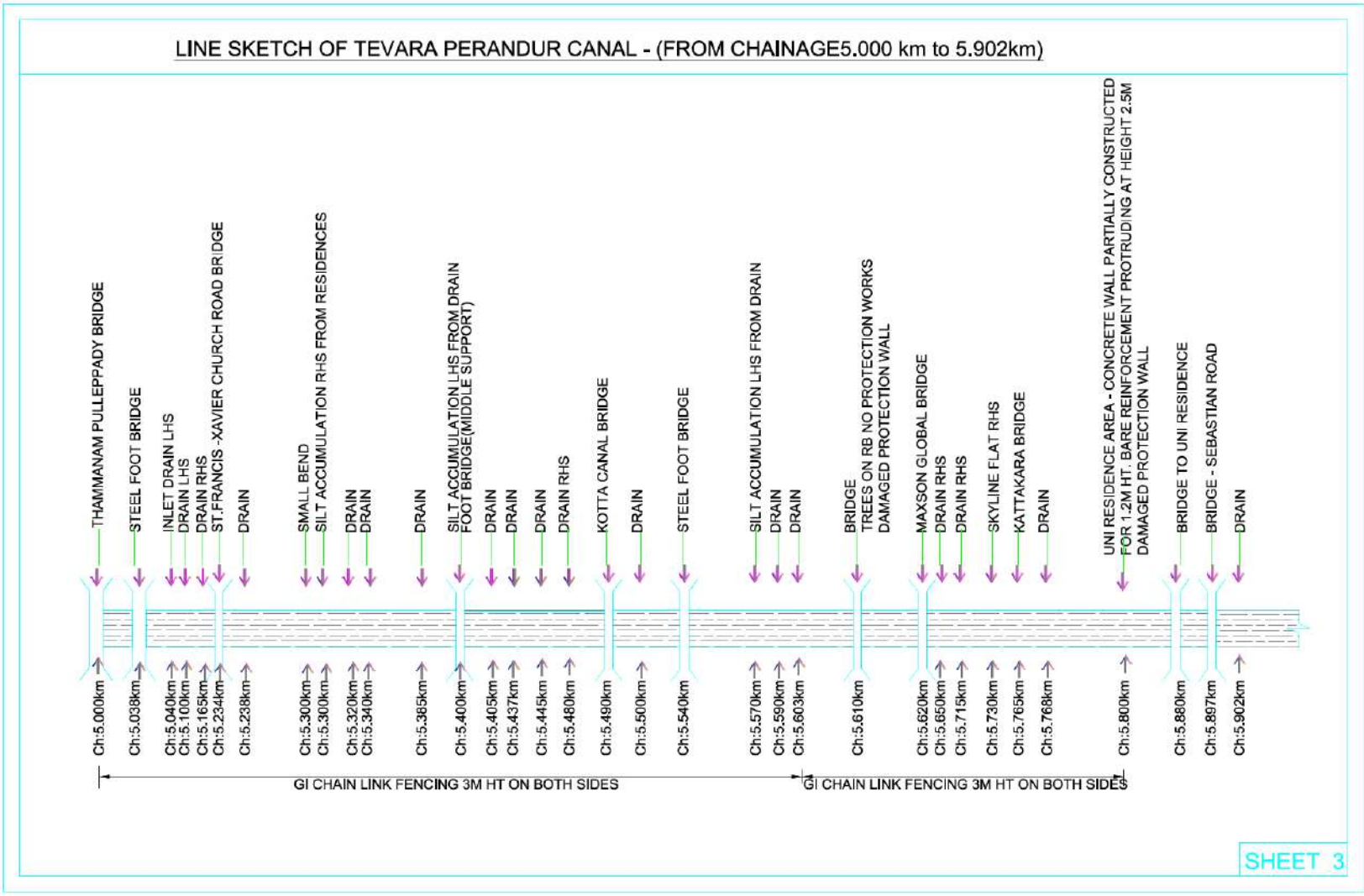


SHEET 2

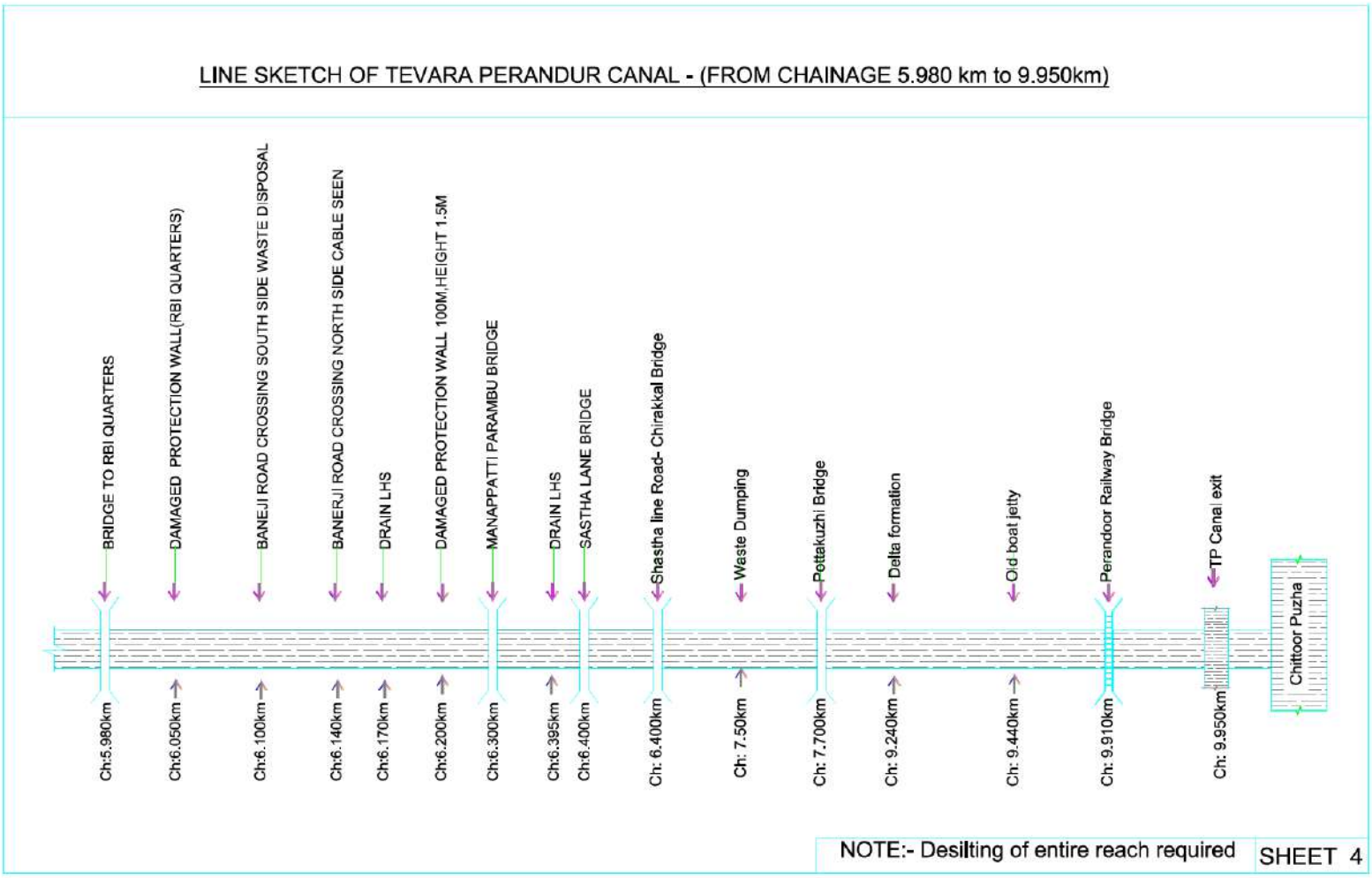
LINE SKETCH OF TEVARA PERANDUR CANAL - (FROM CHAINAGE 3.714 km to 5.000 km)



SHEET 3


LINE SKETCH OF TEVARA PERANDUR CANAL - (FROM CHAINAGE5.000 km to 5.902km)
THAMMANAM PULLEPPADY BRIDGE
STEEL FOOT BRIDGE
INLET DRAIN LHS
DRAIN LHS
DRAIN RHS
ST.FRANCIS -XAVIER CHURCH ROAD BRIDGE
DRAIN
SMALL BEND
SILT ACCUMULATION RHS FROM RESIDENCES
DRAIN
DRAIN
DRAIN
SILT ACCUMULATION LHS FROM DRAIN
FOOT BRIDGE(MIDDLE SUPPORT)
DRAIN
DRAIN
DRAIN
DRAIN RHS
KOTTA CANAL BRIDGE
DRAIN
STEEL FOOT BRIDGE
SILT ACCUMULATION LHS FROM DRAIN
DRAIN
DRAIN
BRIDGE
TREES ON RB NO PROTECTION WORKS
DAMAGED PROTECTION WALL
MAXSON GLOBAL BRIDGE
DRAIN RHS
DRAIN RHS
SKYLINE FLAT RHS
KATTAKARA BRIDGE
DRAIN
UNI RESIDENCE AREA - CONCRETE WALL PARTIALLY CONSTRUCTED
FOR 1.2M HT. BARE REINFORCEMENT PROTRUDING AT HEIGHT 2.5M
DAMAGED PROTECTION WALL
BRIDGE TO UNI RESIDENCE
BRIDGE - SEBASTIAN ROAD
DRAIN
Ch:5.000km
Ch:5.038km
Ch:5.040km
Ch:5.100km
Ch:5.165km
Ch:5.234km
Ch:5.238km
Ch:5.300km
Ch:5.300km
Ch:5.320km
Ch:5.340km
Ch:5.385km
Ch:5.400km
Ch:5.405km
Ch:5.437km
Ch:5.445km
Ch:5.480km
Ch:5.490km
Ch:5.500km
Ch:5.540km
Ch:5.570km
Ch:5.590km
Ch:5.603km
Ch:5.610km
Ch:5.620km
Ch:5.650km
Ch:5.715km
Ch:5.730km
Ch:5.765km
Ch:5.768km
Ch:5.800km
Ch:5.880km
Ch:5.897km
Ch:5.902km
GI CHAIN LINK FENCING 3M HT ON BOTH SIDES
GI CHAIN LINK FENCING 3M HT ON BOTH SIDES
SHEET 3

SHEET 4


LINE SKETCH OF TEVARA PERANDUR CANAL - (FROM CHAINAGE 5.980 km to 9.950km)
BRIDGE TO RBI QUARTERS
DAMAGED PROTECTION WALL(RBI QUARTERS)
BANERJI ROAD CROSSING SOUTH SIDE WASTE DISPOSAL
BANERJI ROAD CROSSING NORTH SIDE CABLE SEEN
DRAIN LHS
DAMAGED PROTECTION WALL 100M,HEIGHT 1.5M
MANAPPATTI PARAMBU BRIDGE
DRAIN LHS
SASTHA LANE BRIDGE
Shastha line Road- Chirakkal Bridge
Waste Dumping
Pottakuzhi Bridge
Delta formation
Old boat jetty
Perandoor Railway Bridge
TP Canal exit
Chittoor Puzha
Ch:5.980km
Ch:6.050km
Ch:6.100km
Ch:6.140km
Ch:6.170km
Ch:6.200km
Ch:6.300km
Ch:6.395km
Ch:6.400km
Ch: 6.400km
Ch: 7.50km
Ch: 7.700km
Ch: 9.240km
Ch: 9.440km
Ch: 9.910km
Ch: 9.950km
NOTE:- Desilting of entire reach required
SHEET 4

2.2 REACH I - FROM CH. 0 TO 2320M (FROM THEVARA CANAL MOUTH TO BRIDGE AT KADAVANTHARA NEAR GCDA)

The length of this reach is 2320m with a varying width of 15m to 10m. The average depth of water at the time of field survey was 0.8m (2nd July 2021) and the silt deposited is about 0.8m from existing bed level.

TP Canal - Starting Point

Anamthuruthy Sluice – To be Demolished and Bridge to be Reconstructed as Single Span

Reach Between Thevara Canal and Anammthuruthy Bridge
Average Width - 12m

The starting point of TP canal is situated on mouth of Theavara Canal which drains water into Thevara Kayal. It is situated near Anamthuruthy in Kochi Corporation. Anamthuruthy Road Bridge is crossing TP Canal which is located 43m U/S of Thevara Canal mouth. The discarded and damaged remains of sluice are obstructing the flow of water to a great extent. The sluice was constructed about 60 years ago to regulate salt water intrusion into the interior areas of Kochi Corporation. The sluice became unserviceable due to ill maintenance and by conversion of land in and around sluice. The necessity of the sluice is subsidized by conversion of wet lands into dry land and by urban culture. Thus the sluice got replaced by Anamthuruthy Bridge which runs across TP Canal. The remains of existing sluice below normal water level were not dismantled properly and the structure beneath water is obstructing the flow of water during flood times. This structure creates upward pressure on
U/S side of TP Canal and as a result, Heart of Corporation areas got inundated during Flood and High Tide times that may occur simultaneously. The sluice has to be dismantled fully to pave the way to discharge storm/drain water into the Kayal. The damaged Sluice and Anamthuruthy Bridge with starting point of TP Canal is shown in Fig.1. It is seen that some branches of trees are grown into the canal which obstructs the natural flow of water and the same has to be trimmed and waterway should be cleared off any obstructions as early as possible. From the satellite image it is seen that a narrow strip of land is obstructing the free flow of water into Thevara Canal which is also the present situation. This obstruction also has to be cleared to discharge storm/flood water. The average width of TP Canal from Ch. 0 to 333m is about 15m. The following works are proposed in this reach.

- Clearing light, thick and thorny jungle
- Trimming branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Eviction of encroachment which is visible on both sides of canal
- 6 Major drains (storm water) and small pipe drains discharging effluent into TP canal which have to be relocated
- Dismantling of Old sluice which is obstructing the natural flow of water
- Re-construction of Anamthuruthy Bridge

- **Reach Between Anamthuruthy Bridge and Sasthrinagar Bridge**

Average Width - 15m

The second Cross Drainage Work is Sasthrinagar Bridge located near Chainage 333m. The structure constructed is a box culvert with 3 vents. The culvert is having sufficient length, width and depth to pass storm/flood water. The Canal on U/S and D/S sides of Sasthrinagar is having sufficient width and depth to carry rain water. There is a single span Steel Foot Over Bridge at Ch.427m which does not obstruct the regular flow of water during normal times. The average width of canal is about 12m which is less compared to previous reach. It is seen that private properties are situated on both sides of canal. The protective structures like compound wall are constructed along both sides of canal without any offset as per building rule. It has to be surveyed and canal has to be brought back to its original shape. There are some small drains and pipe outlets in this reach which discharge storm/effluent water into TP Canal. The depth of water at the time of field survey was about 1m and silt
deposited was about 0.8m. These are illustrated in Fig.2. The following works are proposed in this reach.

- Clearing light, thick and thorny jungle
- Trimming branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Eviction of encroachment which is visible on both sides of canal
- 8 major drains (storm water) and small pipe drains discharging effluent into TP canal which have to be relocated

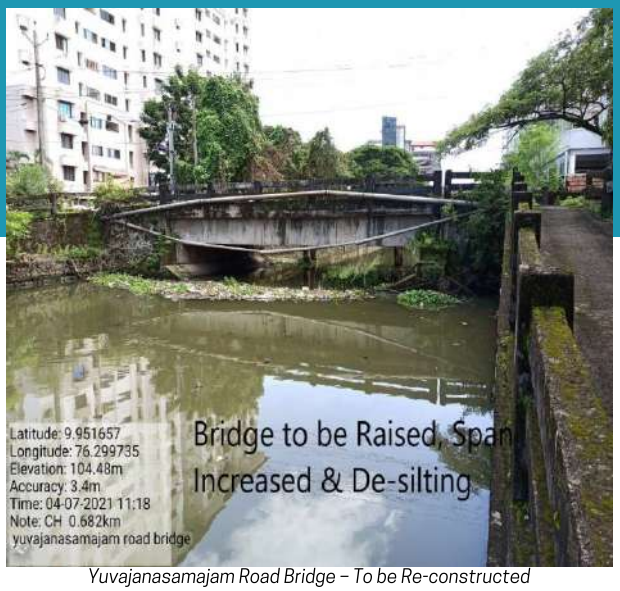
Sasthrinagar Bridge

Anamthuruthy Bridge to Sasthrinagar Bridge thru Smart Road Foot Bridge

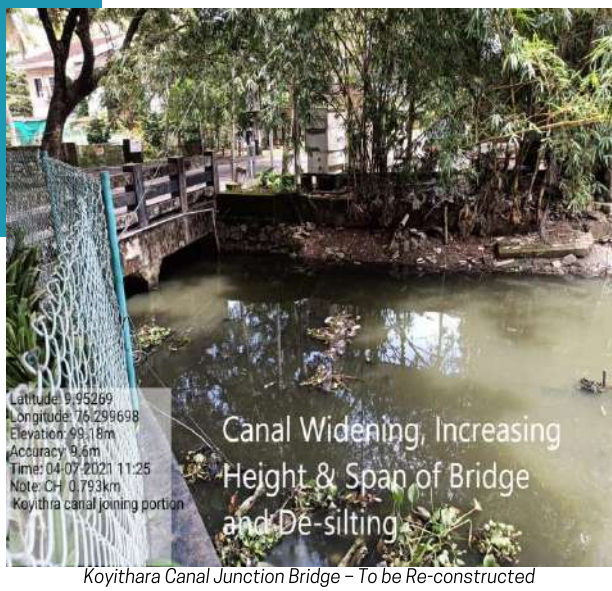
Reach Between Sasthrinagar Bridge and Smart Road Foot Bridge

Average Width - 15m

- The works proposed in this reach are
- Clearing light, thick and thorny jungle
- Trimming branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Eviction of encroachment which is visible on both sides of canal
- 8 major drains (storm water) and small pipe drains discharging effluent into TP canal which have to be relocated



Yuvajanasamajam Road Bridge – To be Re-constructed



Koyithara Canal Junction Bridge – To be Re-constructed

☒ Reach Between Smart Road Foot Bridge and Yuvajanasamajam Road Bridge

Average Width - 15m

The abutments of Yuvajanasamajam Road Bridge are situated in TP Canal reducing canal width marginally. The vertical clearance of the bridge with respect to water level is about 1m which is less compared to the flood point of view. So the bridge has to be reconstructed with sufficient Horizontal and Vertical clearance. Koyithara Canal which joins with TP Canal at Ch.793m. The bridge across Koyithara Canal also has to be re-constructed with sufficient vertical and horizontal clearance. The features are shown in Fig.3

The following works are proposed in this reach

- Clearing light, thick and thorny jungle
- Trimming branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Eviction of encroachment which is visible on both sides of canal
- Span and Height (Horizontal & Vertical clearance) of Yuvajanasamajam Bridge to be increased
- 8 major drains (storm water) and small pipe drains discharging effluent into TP canal which have to be relocated

☒ Reach Between Yuvajanasamajam Road Bridge and Koyithara Canal Jn.

Average Width - 15m

The following works have to be carried out in this reach

- Clearing light, thick and thorny jungle
- Trimming branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Eviction of encroachment which is visible on both sides of canal
- Span and Height (Horizontal & Vertical clearance) of Koyithara Jn Bridge to be increased
- 8 major drains (storm water) and small pipe drains discharging effluent into TP canal which have to be relocated

The aim of re-construction of Koyithara Canal Bridge is to reduce water load of TP Canal during peak monsoon season. Thus the storm water collected in Koyithara Canal will not flow into TP Canal and a part of TP Canal water will pass through Koyithara Canal reducing the water pressure of TP Canal.

☒ Reach Between Koyithara Canal Junction Bridge and Vidya Nagar Bridge

Average Width - 15m

The abutments of Vidya Nagar Road Bridge are situated in TP Canal reducing canal width marginally. The vertical clearance of the bridge with respect to water level is about 1m which is less compared to the flood point of view. So the bridge has to be reconstructed with sufficient Horizontal and Vertical clearance. The view from Koyithara Canal Junction shows that there is large scale encroachment on both sides of canal. The encroachment has to be evicted and TP Canal has to be brought back to its original shape. The features are shown in Fig.4.

Koyithara Canal Junction View – Encroachments to be evicted

Vidya Nagar Road Bridge – To be Re-constructed

The following works are proposed in this reach

- Clearing light, thick and thorny jungle
- Trimming branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Eviction of encroachment which is visible on both sides of canal
- Span and Height (Vertical & Horizontal clearance) of Vidya Nagar Bridge to be increased
- 6 major drains (storm water) and small pipe drains discharging effluent into TP canal which have to be relocated

Reach Between Vidya Nagar Bridge and Panampilly Nagar Link Road Bridge

Average Width - 15m

The abutments of Panampilly Nagar Link Road Bridge are situated in TP Canal reducing canal width marginally. The vertical clearance of the bridge with respect to water level is about 0.7m which is less compared to the flood point of view. So the bridge has to be reconstructed with sufficient Horizontal and Vertical clearance. The view from Koyithara Canal Junction shows that there is large scale encroachment on both sides of canal. The encroachment has to be evicted and TP Canal has to be brought back to its original shape. The features are shown in Fig.5.

Panampilly Nagar Link Road Bridge View – Encroachments to be evicted

Panampilly Nagar Link Road Bridge – To be Re-constructed

The following works are proposed in this reach

- Clearing light, thick and thorny jungle
- Trimming branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Eviction of encroachment which is visible on both sides of canal
- Span and Height (Vertical and Horizontal clearance) of Panampilly Nagar Link Road Bridge to be increased
- 6 major drains (storm water) and small pipe drains discharging effluent into TP canal which have to be relocated

Reach Between Panampilly Nagar Link Road Bridge to 15th Cross Road Bridge upto Foot Bridge under construction

Average Width - 15m

The abutments of 15th Cross Road Bridge are situated in TP Canal reducing canal width marginally. The vertical clearance of the bridge with respect to water level is about 1m which is less compared to the flood point of view. The storm water from M G Road is getting discharged into TP Canal by means of a leading channel from that area. The leading channel is completely covered with slabs and filled with debris. It creates flood like situation in Panampilly Nagar and Ravipuram area. A Petty Para arrangement is being made by Kochi Corporation to drain out excess water from Panampilly Nagar area to TP Canal. The storm water from MG Road has to be diverted directly into Kayal near Shipyard area so that the water load of TP Canal can be minimized. The Bridge has to be reconstructed with sufficient Horizontal and Vertical clearance. The view from 15th Cross Bridge shows that there is large scale encroachment on both sides of canal. The encroachment has to be evicted and TP Canal has to be brought back to its original shape. The features are shown in Fig.6.

Branch Canal to TP Canal from MG Road – To be Re-aligne

LIG Colony Thodu – Covered with Concrete Slabs – To be opened

15th Cross Road Bridge View – To be Re-constructed

Branch Thodu Jn. from MG Road – Petty Para arrangement – To be diverted

The works proposed are as follows.

- Clearing light, thick and thorny jungle
- Trimming branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Leading Channel diversion into Kayal to discharge storm water from MG Road
- Encroachment is visible on both sides of canal reducing canal width
- Span and height (vertical clearance) of 15th Cross Road Bridge to be increased
- Re-alignment of Leading Channel to TP Canal from M G Road
- 6 major drains (storm water) and small pipe drains discharging effluent into TP canal which have to be relocated

    - **Reach Between Foot Bridge under construction 1st Cross Road Bridge**

Average Width - 15m

The abutments of 1st Cross Road Bridge are situated in TP Canal reducing canal width marginally. The vertical clearance of the bridge with respect to water level is about 1m which is less compared to the flood point of view. So the bridge has to be reconstructed with sufficient Horizontal and Vertical clearance. The view from 1st Cross Road Bridge shows that there are a large number of trees/branches grown into TP Canal. The leaves and branches falling from trees obstruct the natural flow of water and it has to be cleared by trimming/cutting branches/trees. The features are shown in Fig.7. The following works are proposed in this reach.

- Clearing light, thick and thorny jungle
- Trimming / Cutting branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Eviction of Encroachment
- Span and Height (Vertical & Horizontal clearance) of 1st Cross Road Bridge to be increased
- 6 major drains (storm water) and small pipe drains discharging effluent into TP canal which have to be relocated

Trees / Branches to be Pruned

1st Cross Road Bridge View –To be Re-constructed

The works proposed are as follows.

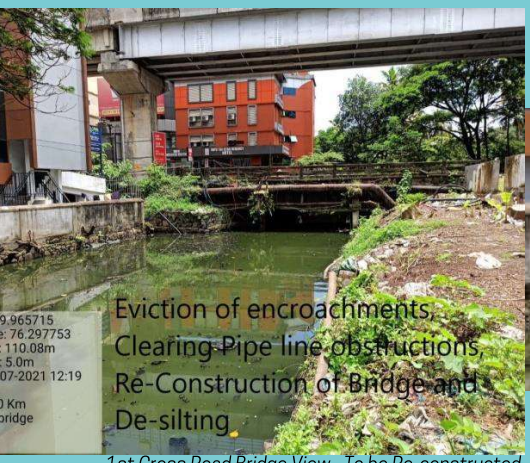
- Clearing light, thick and thorny jungle
- Trimming branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Leading Channel diversion into Kayal to discharge storm water from MG Road
- Encroachment is visible on both sides of canal reducing canal width
- Span and height (vertical clearance) of 15th Cross Road Bridge to be increased
- Re-alignment of Leading Channel to TP Canal from M G Road
- 6 major drains (storm water) and small pipe drains discharging effluent into TP canal which have to be relocated

    - **Reach Between Foot Bridge under construction 1st Cross Road Bridge**

Average Width - 15m

The abutments of 1st Cross Road Bridge are situated in TP Canal reducing canal width marginally. The vertical clearance of the bridge with respect to water level is about 1m which is less compared to the flood point of view. So the bridge has to be reconstructed with sufficient Horizontal and Vertical clearance. The view from 1st Cross Road Bridge shows that there are a large number of trees/branches grown into TP Canal. The leaves and branches falling from trees obstruct the natural flow of water and it has to be cleared by trimming/cutting branches/trees. The features are shown in Fig.7. The following works are proposed in this reach.

- Clearing light, thick and thorny jungle
- Trimming / Cutting branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Eviction of Encroachment
- Span and Height (Vertical & Horizontal clearance) of 1st Cross Road Bridge to be increased
- 6 major drains (storm water) and small pipe drains discharging effluent into TP canal which have to be relocated



1st Cross Road Bridge View –To be Re-constructed

Trees / Branches to be Pruned

Reach Between 1st Cross Road Bridge and SA Road Bridge

Average Width - 15m

- The horizontal and vertical clearance of Bridge on SA Road is very less and it has to be re-constructed to pave the way for smooth discharge of storm water through canal. The Figure 8 shows that there is large scale encroachment on both sides of canal and trees are grown on the banks preventing natural flow of water. It has to be removed as early as possible. The cables, KWA pipe lines and ducts also have to be shifted during the re-construction of SA Road Bridge. The U/S and D/S of SA Road Bridge is shown in Fig.8.

The following works are proposed in this reach

- Clearing light, thick and thorny jungle
- Trimming branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Eviction encroachment which is visible on both sides of canal
- Span and Height (vertical clearance) of Bridge on SA road to be increased
- 6 major drains (storm water) and small pipe drains discharging effluent into TP canal which have to be relocated

2.3 REACH II - FROM CH.2320M TO 5000M (FROM KADAVANTHARA BRIDGE NEAR GCDA TO PULLEPPADY BRIDGE)

The length of this reach is 2680m with a varying width of 15m to 7m excluding the railway track crossing reach which is having a reduced width of 1.2m. The average depth of water at the time of field survey was 0.5m (2nd July 2021) and the silt deposited is about 0.8m from existing bed level.

Reach Between Bridge on SA Road near GCDA and Purushu Menon Road Bridge
Average Width - 12m

The canal reach in this location is seen to have large scale encroachments. Most of the Government funded establishments like GCDA, Indoor Stadium, HPCL, IOCL and Kadavanthara Market is situated on banks of canal. The compound walls of these establishments are situated in the canal with their effluent discharge directly into the canal. The direct discharge of effluent into TP Canal should be strictly prohibited by installing local Sewage Treatment Plants. The Garbage from Kadavanthara Fish / Meat / Vegetable Market is getting directly discharged into TP Canal which should be prevented at any cost. This reach should be made accessible by providing canal road on right side of TP Canal. It is also seen that the horizontal/vertical clearance of Purushu Menon Road Bridge is less and has to be re-constructed in order to discharge storm water without any hindrance during flood times. These are shown in Fig.9 above. The following works are proposed in this reach

- Clearing light, thick and thorny jungle
- Trimming branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Making Canal Bund Road on RHS
- Eviction of encroachment which is visible on both sides of canal
- Re-construction of Purushu Menon Road Bridge
- 8 major drains (storm water) and small pipe drains discharging effluent into TP canal and have to be relocated
- Install local Sewage Treatment Plants

Kadavanthara Market – Waste dumping & Eviction of Encroachments

Purushu Menon Road Bridge – To Be Re-constructed

BPCL Effluent Outlet – To be Closed

Encroachments to be Evicted

Encroachment – To be Evicted / Rehabilitated

Karshaka Road Bridge – Waste Dumping – Install STP

☒ **Reach Between Purushu Menon Road Bridge and Karshaka Road Bridge**

Average Width - 12m

The canal reach in this location is seen to have large scale encroachments. A large number of dwellings are seen on banks of canal. Toilet waste and household discharges are seen to get directly discharged into Canal. The direct discharge of effluent into TP Canal should be strictly prohibited by installing local Sewage Treatment Plants. This reach should be made accessible by providing canal road on right side of TP Canal. The above reach is shown in Fig.10. The following works are proposed in this reach.

- Clearing light, thick and thorny jungle,
- Trimming and cutting away trees & branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Making Canal Bund Road on RHS
- Eviction of encroachment which is visible on both sides of canal
- 6 major drains (storm water) and small pipe drains discharging effluent into TP canal and have to be relocated
- Install local Sewage Treatment Plants

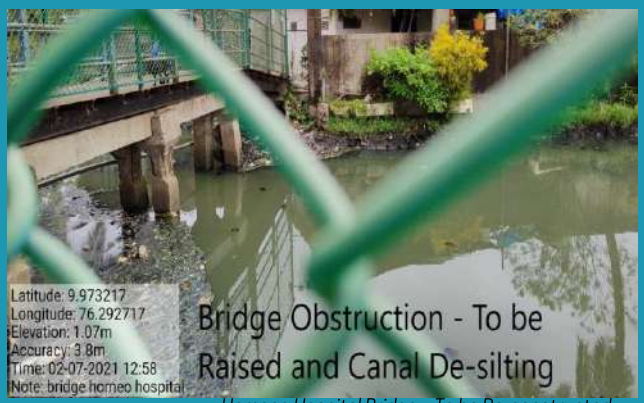
☒ Reach Between Karshaka Road Bridge and Bridge near Homoeo Hospital

Average Width - 8m

The canal reach in this location is seen to have large scale encroachments. A large number of dwellings (Snehanagar & Kareethala Colony) are seen on banks of canal. Toilet waste and household discharges are seen to get directly discharged into Canal. The direct discharge of effluent into TP Canal should be strictly prohibited by installing local Sewage Treatment Plants. These colonies have to be rehabilitated and canal should be developed into its full width. This reach should be made accessible by providing canal road on right side of TP Canal. It is also seen that the horizontal/vertical clearance of Homoeo Bridge is less and has to be re-constructed in order to discharge storm water without any hindrance during flood times. The above reach is shown in Fig.11. The following works are proposed in this reach.

- Clearing light, thick and thorny jungle
- Trimming and cutting away trees & branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Making Canal Bund Road on RHS
- Eviction of Encroachment is which is visible on both sides of canal. Snehanagar and Kareethala Colony situated on right side of TP Canal – To be rehabilitated
- 10 major drains (storm water) and small pipe drains discharging effluent into TP canal
- Install local Sewage Treatment Plants.

Encroachment & Discharge of Toilet / Household Waste – To be Evicted / Rehabilitated



Homoeo Hospital Bridge – To be Re-constructed

Steel Bridge – To be Re-constructed

Encroachment & Discharge of Toilet / Household Waste – To be Evicted / Rehabilitated

☒ Reach Between Bridge near Homoeo Hospital and Steel Bridge near Udaya Colony

Average Width - 12m

The canal reach in this location is seen to have large scale encroachments. A large number of dwellings (Udayanagar Colony) are seen on banks of canal. Toilet waste and household discharges are seen to get directly discharged into Canal. The direct discharge of effluent into TP Canal should be strictly prohibited by installing local Sewage Treatment Plants. These colonies have to be rehabilitated and canal should be developed into its full width. This reach should be made accessible by providing canal road on right side of TP Canal. It is also seen that the horizontal/vertical clearance of Steel Bridge is less and has to be re-constructed in order to discharge storm water without any hindrance during flood times. The above reach is shown in Fig.12. The following works are proposed in this reach.

- Clearing light, thick and thorny jungle
- Trimming and cutting away trees & branches of trees
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Making Canal Bund Road on RHS
- Eviction of encroachment which is visible on both sides of canal. Udayanagar Colony situated on right side of TP Canal and has to be rehabilitated
- 10 major drains (storm water) and small pipe drains discharging effluent into TP canal
- Install local Sewage Treatment Plants

AL Jacob Flyover Pier / Culvert Obstruction – To be Removed / Re-constructed

Mullassery Canal Junction Bridge – To Be Re-constructed

Pipe Line Pier Obstruction – To be Re-located

Branch Canal – Mouth to be Widened

☒ Reach Between Steel Bridge near Udaya Colony and Mullassery Canal Junction Bridge
Average Width - 7m

This reach of TP Canal is heavily silted up due to CD Works and cross structures constructed unscientifically. The pipe line supporting piers of BPCL are lying in canal which obstructs the flow of water marginally. The culvert at the junction of Mullassery Canal is also obstructing the flow of water and the culvert has to be re-constructed urgently. Mullassery Canal joins with TP Canal near Chainage 4100m. As there is reverse slope in Mullassery Canal, the water that has to be drained through Mullassery Canal is flowing into TP Canal increasing water load in TP Canal at the critical reach. The storm / drainage water through Mullassery Canal to TP Canal should be reduced and to be kept minimum. It is creating flood like situation in KSRTC and South Railway Station area. The flood water in TP Canal has to be Pumped into Mullasssery Canal to avoid Suburban Flooding till the completion of Wide Open Canal in Railway Crossing at Ch.4512m, On the U/S Side the culvert below AL Jacob Flyover is also obstructing the normal flow of water. This culvert also has to be reconstructed urgently to have sufficient horizontal and vertical clearance. One of the piers of AL Jacob Flyover is projecting into the canal which also obstructs the flow of water during flood times. A branch canal from Kammattippadom area is also leading into TP Canal near Mullassery Canal Junction. The size of Branch Canal is very much reduced and it has to be brought back to its original shape and size. This reach should be made accessible by providing canal road on right side of TP Canal. These features are shown in Fig13 and the works to be carried out are described below.

- Clearing light, thick and thorny jungle
- Trimming and cutting away trees & branches of trees
- De-silting and removal of debris
- Shifting cables, ducts and pipes
- Eviction of encroachment which is visible on both sides of canal
- Development of Canal Bund Road on RHS
- High pressure Oil/Gas pipe lines crossing TP Canal in different levels. Low lying pipe lines have to be shifted up and Piers to be relocated
- Re-Construction of Mullassery Canal Junction Bridge
- Widening mouth of Branch Canal
- 8 major drains (storm water) and small pipe drains discharging effluent into TP canal which have to be relocated.
- Install local Sewage Treatment Plants

☒ Reach Between Mullassery Canal Junction and Culvert below A L Jacob Fly over
Average Width - 7m

- Clearing light, thick and thorny jungle
- Trimming and cutting away trees & branches of trees
- De-silting and removal of debris
- Shifting cables, ducts and pipes
- Eviction of encroachment which is visible on both sides of canal
- 4 major drains (storm water) and small pipe drains discharging effluent into TP canal and have to be relocated
- The bottom slab of culvert is obstructing the flow of water. It has to be reconstructed to higher level.
- One pier of AL Jacob Fly Over is constructed inside the canal and obstructing the smooth flow of water

☒ Reach between Culvert below A L Jacob Fly Over and Kammattippadom Culvert upto Railway Crossing

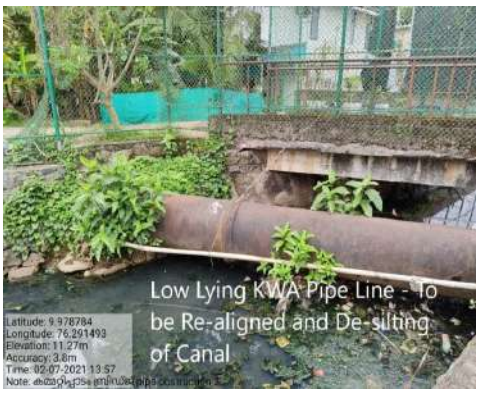
Average Width - 7m

This reach is having 2 Nos of low lying CD Works which has to be re-constructed to make use of full capacity of Canal. There are 3 Nos of High Pressure KWA Pipe Lines lying on bed of canal. One pipe line is lying above canal bed and clearly obstructs the flow of water. These pipe lines have to be shifted urgently to prevent flooding of KSRTC and South Railway Station. It is illustrated in Fig.14.

The following works are proposed in this reach

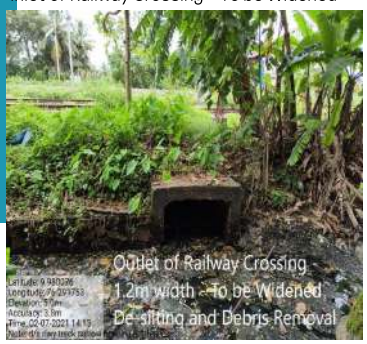
- De-silting and removal of debris
- Shifting cables, ducts and pipes
- 4 major drains (storm water) and small pipe drains discharging effluent into TP canal and have to be relocated
- The bottom slab of culvert is obstructing the flow of water during flood. It has to be reconstructed to higher level.
- 3 Nos of high capacity KWA pipe lines are obstructing the flow of water and has to be shifted.
- Install local Sewage Treatment Plants

KWA Pipe Line to be Shifted and CD Works to be Re-constructed

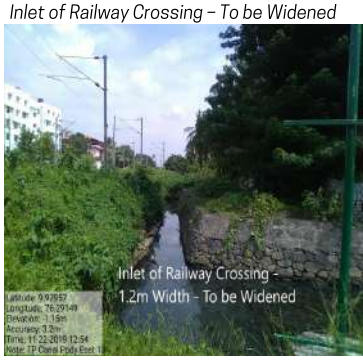


KWA Pipe Line to be Shifted

Inlet of Railway Crossing – To be Widened



Inlet of Railway Crossing – To be Widened



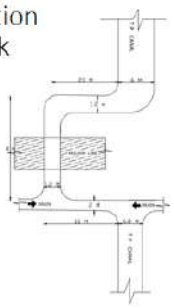
☒ Railway crossing

Average Width - 1.2m

The main obstruction for free flow of water through this canal is at the Railway crossing portion. The canal at Ch.4.512km is crossing the Ernakulam - Kottayam railway line (Triangular Junction) with a mere width of 1.2m. The length of railway track crossing is 81m with a width of 1.2m. The width of canal on U/S and D/S side of railway track is about 6m. The 360 degree turn of water to cross railway track is the major cause of flooding in Ernakulam City during heavy rain. The railway line virtually divides the canal into two parts. The flow in this part is completely blocked. The railway culvert is not sufficiently wide enough to have continuous flow of the canal. Only an underpass is joining the 2 parts of the canal. The Canal is split into two by Ernakulam – Kottayam railway track. The Canal has to be constructed straight instead of existing route which is taking a 360 degree turn for a length of 81m. the straight length of canal is only 41m and can be constructed with advanced construction technologies like Push Through method, this is the major cause of flooding in Kochi Corporation. The South Railway Station, KSRTC and surrounding areas face flood like situation every year during monsoon season. This can be prevented by making canal to its full width as in U/S and D/S and by avoiding sharp bends. The construction has to be done in co-ordination with Railway Authorities and Railway Traffic has to be regulated during construction season. These are illustrated in Fig 15 & Fig.16 and the works to be carried out are described below.

- Clearing light, thick and thorny jungle.
- De-silting and removal of debris
- Shifting of cables, pipes and ducts
- TP Canal is crossing 4 Lane Main Railway track with sharp bends. The canal is taking 360 degree turn to cross railway track and joins with original canal. The width of canal is only 1.2m. TP Canal is taking a U Turn to cover a length of 41m. The existing box culvert has to be replaced and canal has to be made straight across railway track to discharge flood water.
- Construction of New Canal by Push Through Technique for a length of 41m.
- 4 Major Drains discharging storm/effluent water into TP Canal – To be relocated and re-constructed scientifically.
- Install Sewage Treatment Plants

Schematic diagram of the obstruction at Railway track crossing



Incoming Drain to TP Canal @ Railway Crossing

De-silting of Canal

Foot Bridge to be Re-constructed

☒ Reach between Railway crossing D/S and Pulleppady Road Bridge

Average Width - 7m

The reach from Railway Crossing to Pulleppady Bridge is having sufficient width and depth for the free flow of water except at Foot Bridge location immediately D/S of railway tracks. Some ducted cables and pipe lines are also seen to obstruct the flood flow of water. Thse have to be relocated to higher level during renovation of TP Canal. The FB has to be reconstructed to clear off steps leading into canal. The features of this reach are shown in Fig.17 and the works to be carried out are as follows.

- Clearing light, thick and thorny jungle
- De-silting and removal of debris
- Shifting of cables, ducts and pipes
- Eviction of encroachment which is visible on both sides of canal
- 7 major drains (storm water) and small pipe drains discharging effluent into TP canal – To be relocated
- The bottom slab and abutment of Foot Bridge is obstructing the flow of water during flood. It has to be reconstructed to higher level.
- Install local Sewage Treatment Plants

2.4 REACH III - FROM CH.5000M TO 6400M (FROM PULLEPPADY BRIDGE TO CHIRAKKAL SASTHA ROAD BRIDGE AT KALOOR)

The length of this reach is 1400m with a varying width of 7m to 5m. The average depth of water at the time of field survey was 0.7m (2nd July 2021) and the silt deposited is about 0.8m from existing bed level.

Foot Bridge to be Re-constructed

De-silting of Canal and Tree to be cut

Reach between Pulleppady Road Bridge and Kotta Canal Bridge

Average Width – 6.5m

The reach is having an average width of 6.5m and Canal Bund Road is seen to have formed by filling canal upto Bridge at Kaloor in Banerji Road. The water carrying capacity of the canal is less and considerable silt and debris is deposited in canal bed. The low lying foot bridges and bridges in this reach have to be reconstructed to make use of full capacity of canal. The Cross Drainage Works like Culvert and Foot Bridge constructed by private parties / agencies also have to be reconstructed at their own cost. The reach is shown in Fig.18.

The following works have to be carried out in this reach

- Clearing light, thick and thorny jungle
- Trimming and cutting away trees & branches of trees
- De-silting and removal of debris
- Shifting of cables, pipes and ducts
- Eviction of encroachment which is visible on both sides of canal
- Re-construction of Culverts and CD Works constructed by private parties at their own cost
- Construction of Canal side wall
- 12 major drains (storm water) and small pipe drains discharging effluent into TP canal – To be relocated
- Installing local Sewage Treatment Plants
- 2 low lying steel and concrete foot bridges to be elevated, lengthened and reconstructed

Reach between Kotta Canal Bridge and Sebastian Road Bridge

Average Width – 6.5m

The reach is having an average width of 6.5m and Canal Bund Road is seen to have formed by filling canal upto Bridge at Kaloor in Banerji Road. The water carrying capacity of the canal is less and considerable silt and debris is deposited in canal bed. The Cross Drainage Works like Culvert and Foot Bridge constructed by private parties / agencies also have to be reconstructed at their own cost. The reach is shown in Fig.19.

The works proposed in this reach are

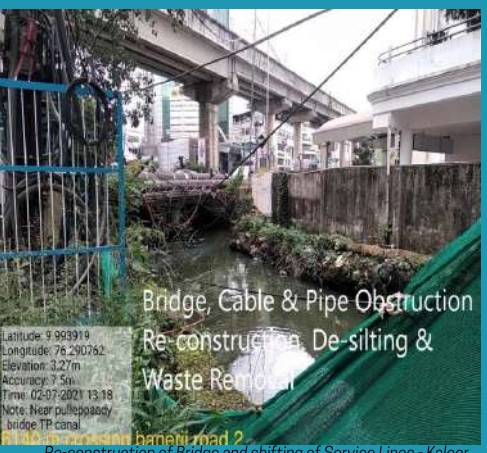
- Clearing light, thick and thorny jungle
- Trimming and cutting away trees & branches of trees
- De-silting and removal of debris
- Shifting of cables, pipes and ducts
- Eviction of encroachment is visible on both sides of canal
- Re-construction of Culverts and CD Works constructed by private parties at their own cost
- 8 major drains (storm water) and small pipe drains discharging effluent into TP canal - To be relocated
- Re-construction / Construction of damaged protection wall

Encroachment – To be evicted

De-silting of Canal and Tree to be cut

Damaged Retaining Wall – To be Re-constructed – Kaloor

Re-construction of Bridge and shifting of Service Lines



Re-construction of Bridge and shifting of Service Lines - Kaloor

Damaged Retaining Wall – To be Re-constructed - Kaloor

☒ Reach between Sebastian Road Bridge and Banerjee Road Bridge

Average Width – 5m

The reach is having an average width of 5m and Canal Bund Road is seen to have formed by filling canal upto Bridge at Kaloor in Banerji Road. The water carrying capacity of the canal is less and considerable silt and debris is deposited in canal bed. The Cross Drainage Works like Culvert and Foot Bridge constructed by private parties / agencies also have to be reconstructed at their own cost. There are two culverts that need reconstruction, RBI Quarters Bridge and Banerji Road Bridge to have sufficient vertical and horizontal clearance. The reach is shown in Fig.20. The works proposed in this reach are as follows.

- Clearing light, thick and thorny jungle
- Trimming and cutting away trees & branches of trees
- De-silting and removal of debris
- Shifting of KSEB, BSNL cables and KWA pipe lines
- Eviction of Encroachment which is visible on both sides of canal
- Re-construction of Culverts and CD Works constructed by private parties at their own cost
- Construction of Canal side wall
- 11 major drains (storm water) and small pipe drains discharging effluent into TP canal – To be relocated
- 2 Nos. of culvert to be reconstructed to have sufficient vertical and horizontal clearance to the canal (RBI Bridge & Banerji Road Bridge)
- Install Sewage Treatment Plants

Manappattiparambu Bridge – To be Elevated

De-silting of Canal and Tree to be cut

☒ Reach between Banerjee Road Bridge and Sastha Lane Bridge

Average Width – 5m

The reach is having an average width of 5m and Canal Bund Road is seen to have formed by filling canal upto Bridge at Kaloor in Sastha Road. The water carrying capacity of the canal is less and considerable silt and debris is deposited in canal bed. The Cross Drainage Works like Culvert and Foot Bridge constructed by private parties / agencies also have to be reconstructed at their own cost. There is a culvert that needs reconstruction, Manappattiparmbu Bridge which is not having sufficient vertical clearance to pass flood water through canal, The reach is shown in Fig.21. The works proposed in this reach are as follows.

- Clearing light, thick and thorny jungle
- Trimming and cutting away trees & branches of trees
- De-silting and removal of debris
- Shifting of KSEB, BSNL cables and KWA pipe lines
- Eviction of encroachment which is visible on both sides of canal
- Construction of Canal side wall
- 7 major drains (storm water) and small pipe drains discharging effluent into TP canal which have to be relocated
- 1 No. of culvert to be reconstructed to have sufficient vertical and horizontal clearance to the canal
- Install local Sewage Treatment Plants

2.3 REACH II - FROM CH.2320M TO 5000M (FROM KADAVANTHARA BRIDGE NEAR GCDA TO PULLEPPADY BRIDGE)

The length of this reach is 3550m with a varying width of 6m to 25m. The average depth of water at the time of field survey was 1m (2nd July 2021) and the silt deposited is about 0.8m from existing bed level.

☒ Reach between Sastha Road Bridge and Pottakuzhi Bridge

Average Width – 6.5m

The reach is having an average width of 6.5m and there is no Canal Bund Road parallel to the canal. The formation of Canal bund road is necessary for regular inspection of the canal. The water carrying capacity of the canal is less and considerable silt and debris is deposited in canal bed. Garbage & Effluent discharge from house hold premises and commercial establishments is seen to have diverted into TP Canal making canal water Dark Grey. There should be strict action to be taken against the people/firms contaminating water bodies thus affecting public health and hygiene. The encroachment by Individuals, Commercial Establishments, Corporate Convention Centres and Educational Institutions
converted TP Canal into a non-flow water body. The area is almost dead and Amphibious Organisms are striving for Oxygen throughout the day in this reach. On observation the quality of water in this reach is very bad and the colour of water is dark grey. The reach is shown in Fig.22.

The following works are proposed in this reach

- Clearing light, thick and thorny jungle
- Trimming and cutting away trees & branches of trees
- Removal of water hyacinth
- De-silting and removal of debris
- Shifting of KSEB, BSNL cables and KWA pipe lines
- Eviction of encroachment which is visible on both sides of canal
- Shifting of KWA pipe supports in Canal
- 9 major drains (storm water) and small pipe drains discharging effluent into TP canal
- Install Sewage Treatment Plants

Pottakuzhi Bridge – Waste Dumping to be Banned

Encroachment to be Evicted and Waste Water Discharge to be Banned

2.3 REACH II - FROM CH.2320M TO 5000M (FROM KADAVANTHARA BRIDGE NEAR GCDA TO PULLEPPADY BRIDGE)

Pottakuzhi Bridge – Waste Dumping to be Banned

Encroachment and Waste Water Discharge – To be Banned

☒ Reach between Pottakuzhi Bridge and Old Boat Jetty

Average Width – 15m

The reach is having an average width of 15m and there is no Canal Bund Road parallel to the canal. The water carrying capacity of the canal is less and considerable silt and debris is deposited in canal bed. The formation of Canal bund road is necessary for regular inspection of the canal. Garbage & Effluent discharge from house hold premises and commercial establishments is seen to have diverted into TP Canal making canal water Dark Grey. There should be strict action to be taken against the people/firms contaminating water bodies thus affecting public health and hygiene. Large scale encroachment is visible on both sides of Canal thus reducing the width marginally. The encroachment by Individuals, Commercial Establishments, Corporate Convention Centres and Educational Institutions converted TP Canal into a non-flow water body. The area is almost dead and Amphibious Organisms are striving for Oxygen throughout the day in this reach. On observation the quality of water in this reach is very bad and the colour of water is dark grey. The reach is shown in Fig.23.

The following works are necessary in this reach to clear off the obstructions in canal

- Clearing light, thick and thorny jungle
- Trimming and cutting away trees & branches of trees
- Removal of water hyacinth
- De-silting and removal of debris
- Removal of delta formation
- Canal bund road formation
- Shifting of KSEB, BSNL cables and KWA pipe lines
- Eviction of encroachment that is visible on both sides of Canal
- 12 major drains (storm water) and small pipe drains discharging effluent into TP canal and have to be relocated
- Install Sewage Treatment Plants

Encroachment and Waste Water Discharge – To be Rehabilitated

Water Hyacinth – To be removed

Swamippadi – Delta Formation to be Removed

Encroachment and Waste Discharge from Villas to be Banned

☒ Reach between Old Boat Jetty and Perandoor Canal Mouth / Chittoor Puzha

Average Width – 25m

The reach is having an average width of 25m with no major obstructions except delta formation at some locations. The water carrying capacity of the canal is less and considerable silt and debris is deposited in canal bed. Garbage & Effluent discharge from house hold premises and commercial establishments is seen to have diverted into TP Canal making canal water Dark Grey. There should be strict action to be taken against the people/firms contaminating water bodies thus affecting public health and hygiene. The canal is seen to have encroached by Individuals and Commercial establishments making canal into a narrow strip at certain locations. It is also seen that deltas are being formed in tail end which also prevents flow of water to a great extent.

The depth on mouth of TP Canal where the Canal meets Chitturpuzha is very less. Considerable silt and debris are deposited on mouth of canal and it prevents discharge of City Storm Water into Kayal/Puzha, There are 3 Railway Bridge situated on mouth of TP Canal. The girder of one bridge (1st Bridge on U/S) is low lying and flood water touched the bottom of girder during 2018 flood. The deposition of silt and debris on mouth of canal creates Afflux and City area will get flooded even for a small intensity rain. There are some damaged remains of concrete structures which also obstructs the normal flow of water. The Water Flushing Mechanism of TP Canal is possible only after the removal of Delta on mouth of TP Canal. This reach is shown in Fig.24. The following works have to be carried out in this reach to clear dark grey water in TP Canal.

Railway Bridge to be Raised and Removal of Deposited Silt

- Clearing light, thick and thorny jungle
- Trimming and cutting away trees & branches of trees
- Removal of water hyacinth and delta
- De-silting and removal of debris
- Shifting of KSEB, BSNL cables and KWA pipe lines
- Canal Bund road formation
- Removal of concrete remains of old structure in mouth of canal
- Railway bridge vertical clearance has to be increased
- Eviction of encroachment which is visible on both sides of canal
- 12 major drains (storm water) and small pipe drains discharging effluent into TP canal – To be relocated
- Install Sewage Treatment Plants

3.0 RECOMMENDATIONS

In the light of our investigation and survey of Thevara Perandoor canal, we put forward the following recommendations for its restoration.
The water load of TP Canal has to be reduced by diverting water through Branch Canals & Leading Channels and other Critical Activities that has to be done on war footing are described below.

3.1 CRITICAL ACTIVITIES

Sl.No.	Description	Activity / Works to be Executed
1	Anamthuruthy Sluice	Demolish old remains of Sluice from bed and sides of Canal
2	Koyithara Canal	De-silt and increase discharge through Koyithara Canal by renovating Canal & CD Works and by Pumping Out
3	Panampilly Nagar Area	Storm Water from M G Road should be directly diverted into Kayal instead of passing through Ravipuram and Panampilly Nagar. Petty & Para arrangement should be made functional soon
4	Mullassery Canal Junction	Excess water in TP Canal should be pumped into Mullassery Canal
5	Mullassery Canal Junction	Mouth of Branch Canal should be widened to avoid flooding in Kammattippadom area
6	Kammattippadom Culvert	Shift high capacity KWA pipe lines from bed of Canal
7	Railway Crossing	TP Canal should be made straight for a length of 41m
8	Pulleppady to Kaloor	Re-construct all low lying CD Works
9	Kaloor to Perandoor	Re-construct all low lying CD Works. Removal of Delta and Silt deposit on mouth of TP Canal to avoid Afflux. Eviction of large scale encroachments

The structures that obstruct the normal flow of water is identified and our suggestions are appended in this report. The list of Structures that has to be Re-constructed / Shifted is as follows.

3.2 STRUCTURES TO BE RE-CONSTRUCTED / SHIFTED

Thevara Perandoor Canal			
Sl.No.	Major Obstruction / Bridges to be Reconstructed	Chainage	Remarks
	Main Obstruction		
1	Railway Crossing	4512m	Canal Width reduced to 1.2m from 6m for a length of 81m
2	KWA Pipe Lines (3 Nos - High Capacity)	4418m	Lying on bed of Canal. To be shifted
	Other Obstructions - CD Works		
	Road Bridges	13	
	Foot Bridges	5	
1	Anamthuruthy Sluice	43m	Remains of Old Sluice - To be Demolished
2	Yuvajanasamajam Bridge	682m	Canal Width - 10m. To be 15m minimum
3	Koyithara Canal Bridge	793m	Canal Vertical Clearance - 0.30m. To be 2m minimum
4	Panampilly Nagar Link Road Bridge	1175m	Canal Width - 6m. To be 15m minimum
5	15th Cross Bridge	2190m	Canal Width - 8m. To be 15m minimum
6	SA Road Bridge	2300m	Canal Vertical Clearance - 0.60m. To be 2m minimum
7	Kadavanthara Market Bridge	3017m	Canal Vertical Clearance - 0.60m. To be 2m minimum
8	Homeo Hospital Bridge (FB)	3714m	Canal Vertical Clearance - 0.60m. To be 2m minimum
9	Steel Bridge (FB)	3855m	Canal Vertical Clearance - 0.60m. To be 2m minimum
10	Mullassery Canal Junction Bridge	4087m	Canal Vertical Clearance - 0.30m. To be 2m minimum

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3	Koyithara Canal Bridge	793m	Canal Vertical Clearance - 0.30m. To be 2m minimum
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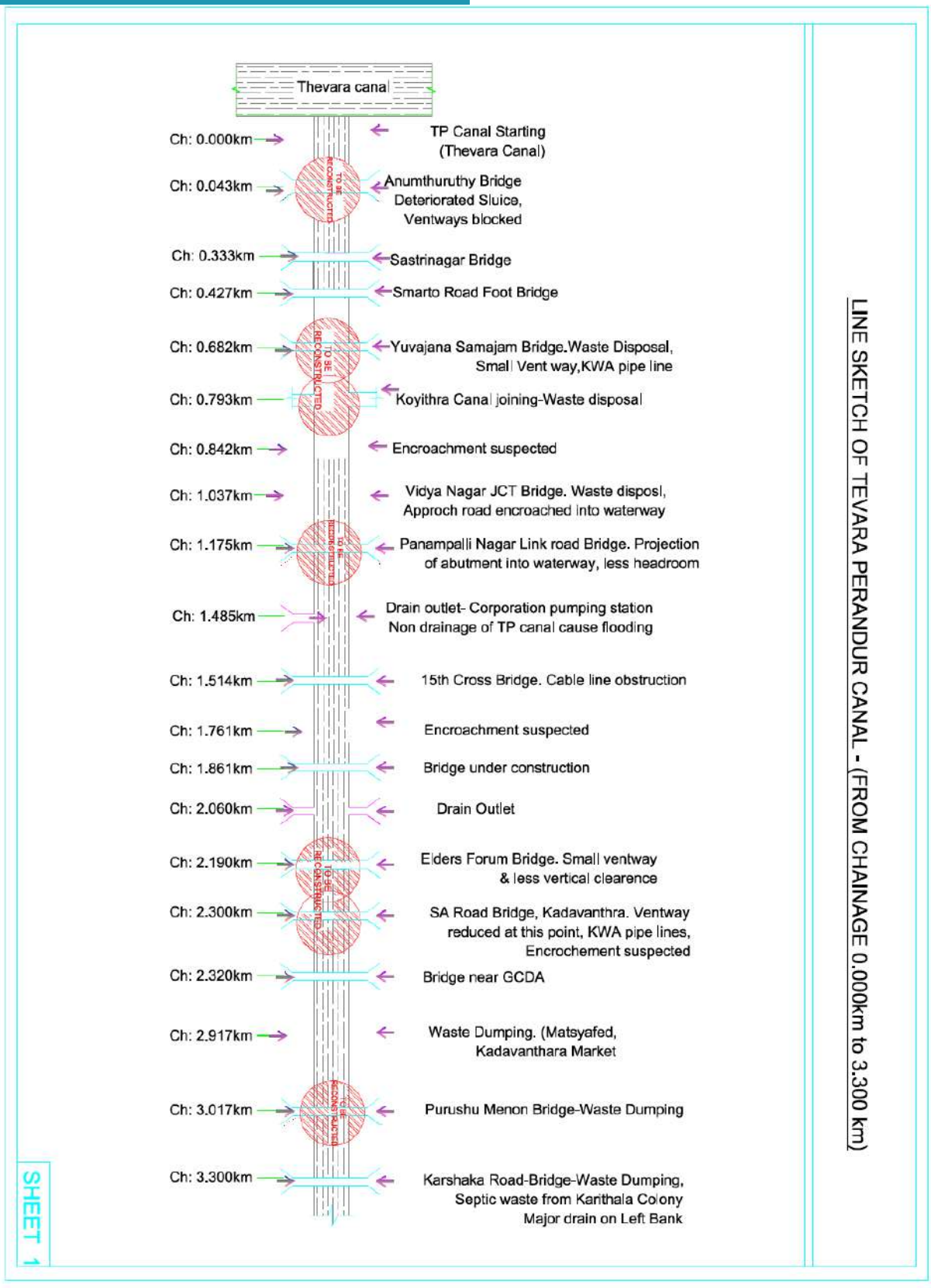
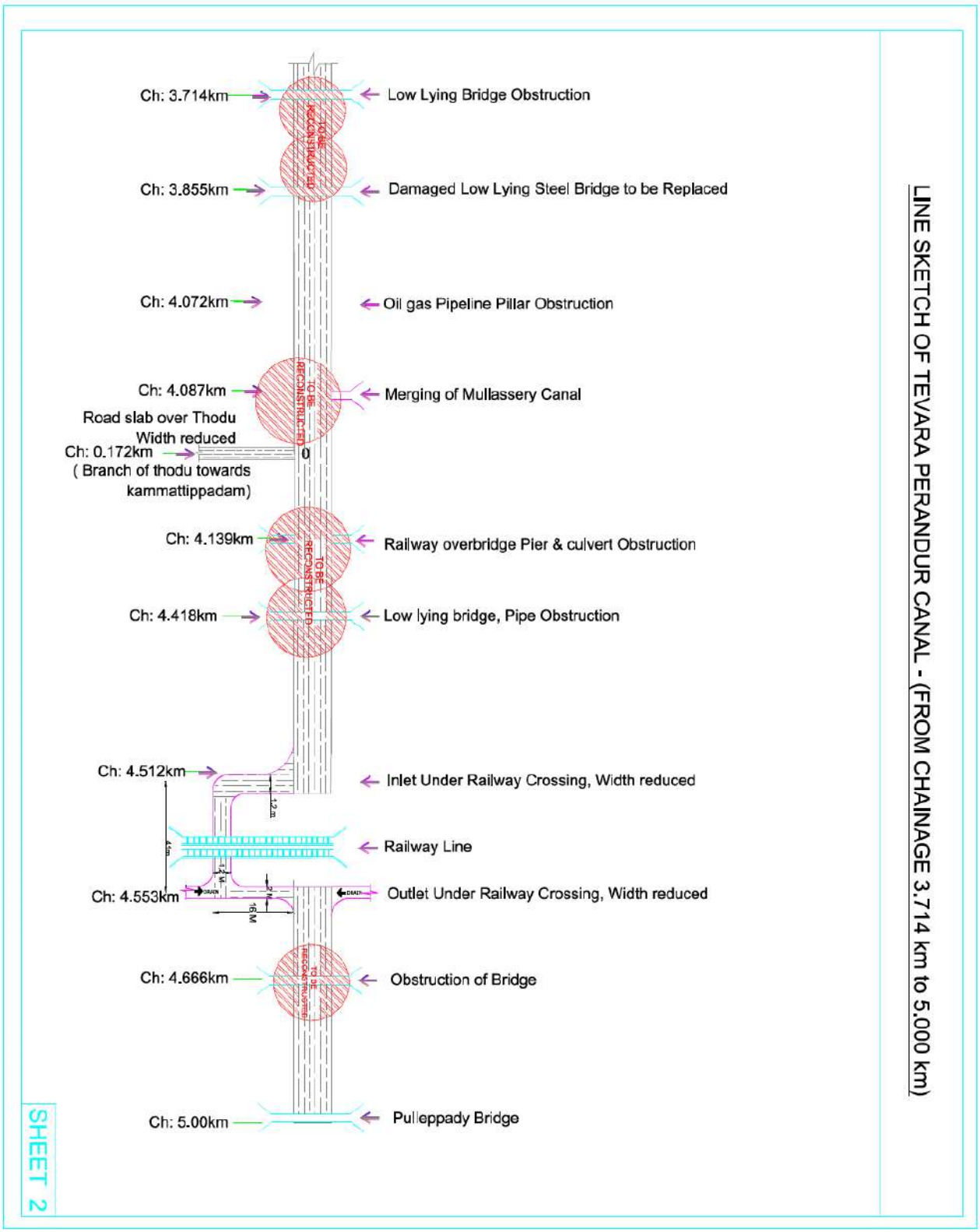
10	Mullassery Canal Junction Bridge	4087m	Canal Vertical Clearance - 0.30m. To be 2m minimum
11	AL Jacob Flyover Bridge (Below Fly over)	4139m	Canal Vertical Clearance - 0.30m. To be 2m minimum
12	Kammattippadom Bridge	4418m	Canal Vertical Clearance - 0.30m. To be 2m minimum
13	Kammattippadom FB	4418m	Canal Vertical Clearance - 0.30m. To be 2m minimum
14	Concrete FB	4666m	Canal Width - 6m. To be 8m minimum
15	Concrete FB	5400m	Canal Vertical Clearance - 0.30m. To be 2m minimum
16	RBI Bridge	5610m	Canal Width - 5m. To be 8m minimum
17	Banerji Road Bridge	6100m	Canal Vertical Clearance - 0.60m. To be 2m minimum
18	Manappattiparambu Bridge	6300m	Canal Vertical Clearance - 0.60m. To be 2m minimum

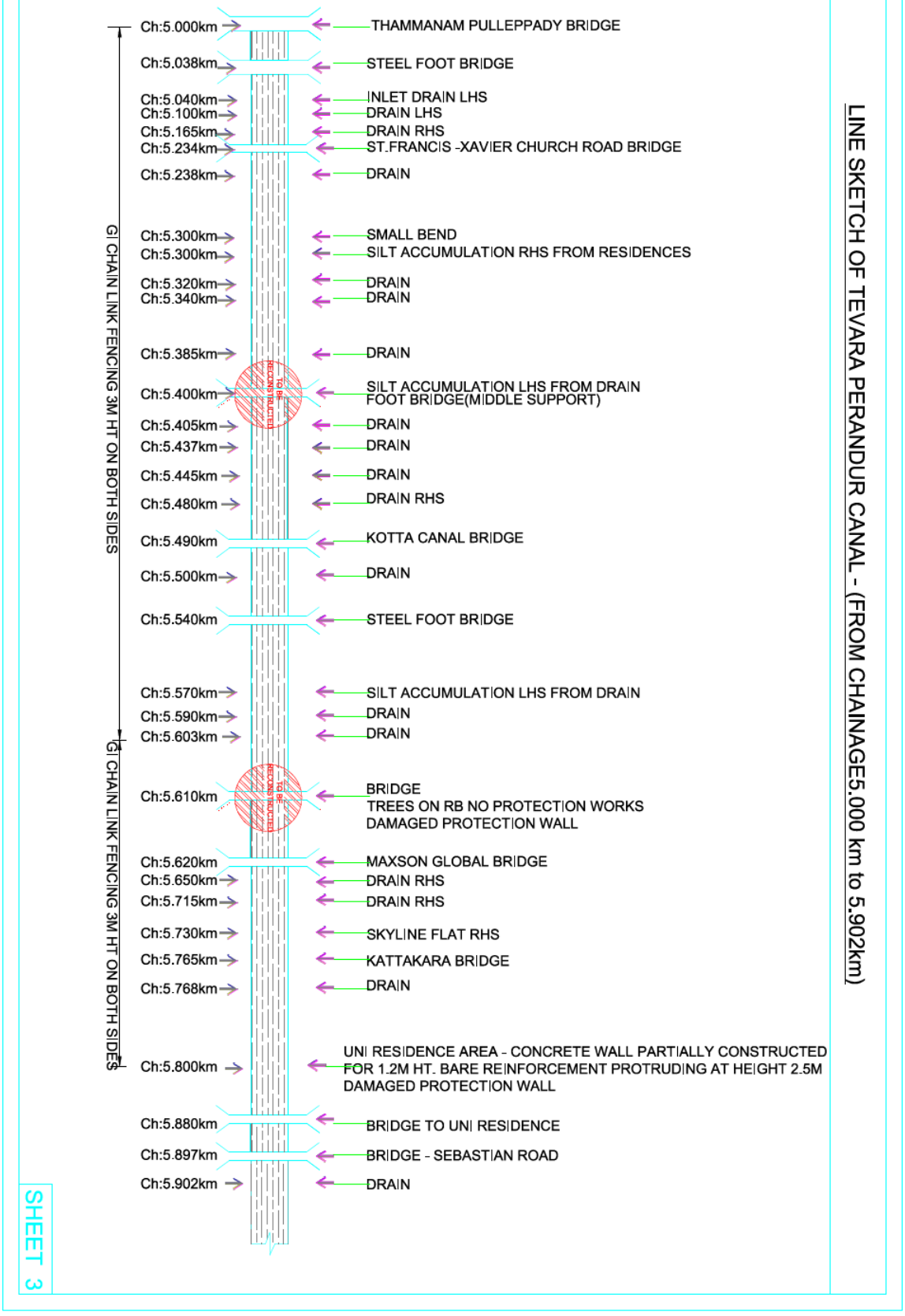
Sheet 1


Thevara canal
Ch: 0.000km
TP Canal Starting
(Thevara Canal)
Ch: 0.043km
TO BE RECONSTRUCTED
Anumthuruthy Bridge
Deteriorated Sluice,
Ventways blocked
Ch: 0.333km
Sastrinagar Bridge
Ch: 0.427km
Smarto Road Foot Bridge
Ch: 0.682km
TO BE RECONSTRUCTED
Yuvajana Samajam Bridge.Waste Disposal,
Small Vent way,KWA pipe line
Ch: 0.793km
Koyithra Canal joining-Waste disposal
Ch: 0.842km
Encroachment suspected
Ch: 1.037km
Vidya Nagar JCT Bridge. Waste disposl,
Approch road encroached into waterway
Ch: 1.175km
TO BE RECONSTRUCTED
Panampalli Nagar Link road Bridge. Projection
of abutment into waterway, less headroom
Ch: 1.485km
Drain outlet- Corporation pumping station
Non drainage of TP canal cause flooding
Ch: 1.514km
15th Cross Bridge. Cable line obstruction
Ch: 1.761km
Encroachment suspected
Ch: 1.861km
Bridge under construction
Ch: 2.060km
Drain Outlet
Ch: 2.190km
TO BE RECONSTRUCTED
Elders Forum Bridge. Small ventway
& less vertical clearence
Ch: 2.300km
TO BE RECONSTRUCTED
SA Road Bridge, Kadavanthra. Ventway
reduced at this point, KWA pipe lines,
Encrochement suspected
Ch: 2.320km
Bridge near GCDA
Ch: 2.917km
Waste Dumping. (Matsyafed,
Kadavanthara Market
Ch: 3.017km
TO BE RECONSTRUCTED
Purushu Menon Bridge-Waste Dumping
Ch: 3.300km
Karshaka Road-Bridge-Waste Dumping,
Septic waste from Karithala Colony
Major drain on Left Bank
SHEET 1
LINE SKETCH OF TEVARA PERANDUR CANAL - (FROM CHAINAGE 0.000km to 3.300 km)

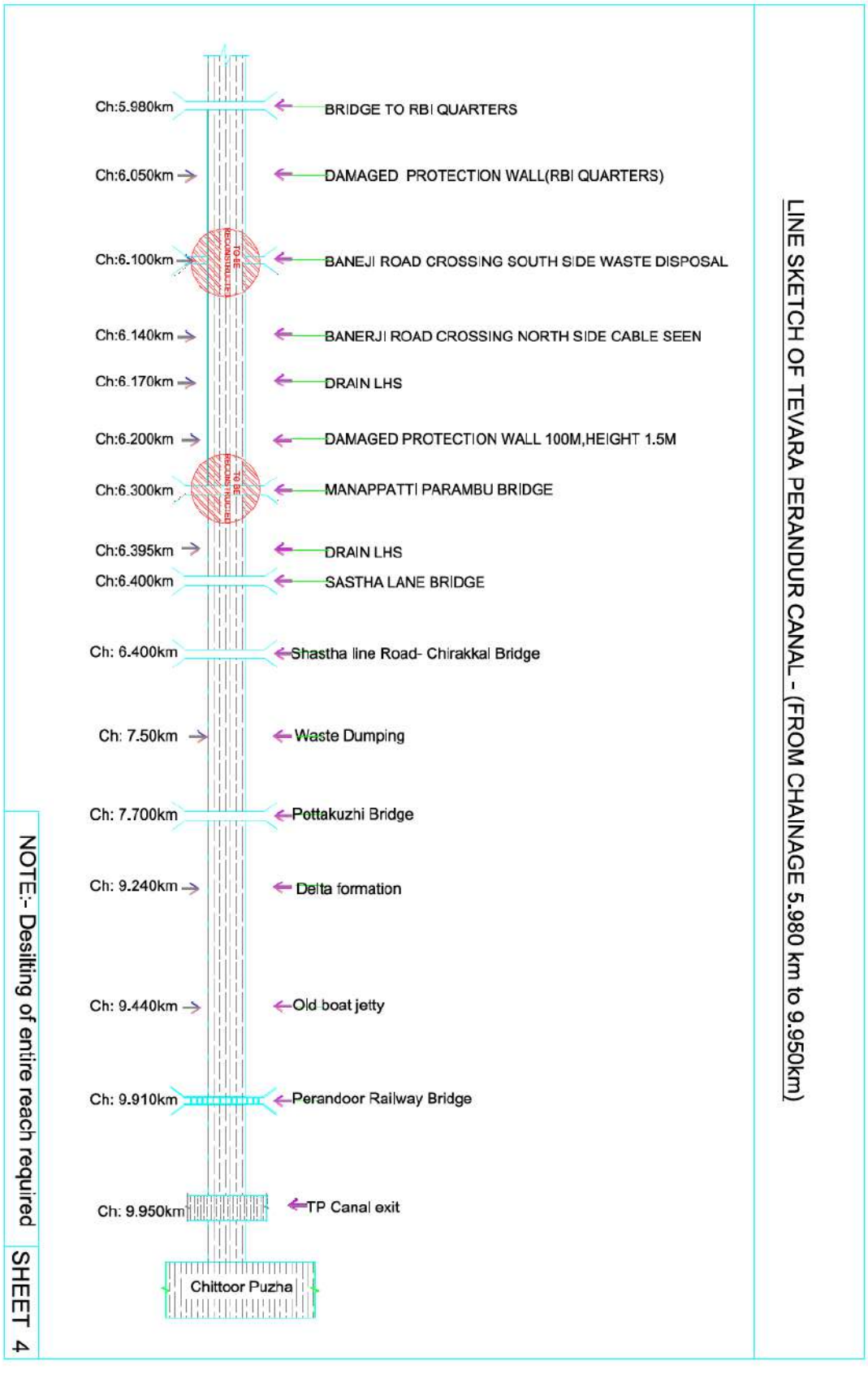
Sheet 2


LINE SKETCH OF TEVARA PERANDUR CANAL - (FROM CHAINAGE 3.714 km to 5.000 km)
Ch: 3.714km
Low Lying Bridge Obstruction
Ch: 3.855km
Damaged Low Lying Steel Bridge to be Replaced
Ch: 4.072km
Oil gas Pipeline Pillar Obstruction
Ch: 4.087km
Merging of Mullassery Canal
Road slab over Thodu
Width reduced
Ch: 0.172km
(Branch of thodu towards
kammattippadam)
Ch: 4.139km
Railway overbridge Pier & culvert Obstruction
Ch: 4.418km
Low lying bridge, Pipe Obstruction
Ch: 4.512km
Inlet Under Railway Crossing, Width reduced
Railway Line
Ch: 4.553km
Outlet Under Railway Crossing, Width reduced
Ch: 4.666km
Obstruction of Bridge
Ch: 5.00km
Pulleppady Bridge
SHEET 2

Sheet 3


LINE SKETCH OF TEVARA PERANDUR CANAL - (FROM CHAINAGE5.000 km to 5.902km)
Ch:5.000km
THAMMANAM PULLEPPADY BRIDGE
Ch:5.038km
STEEL FOOT BRIDGE
Ch:5.040km
INLET DRAIN LHS
Ch:5.100km
DRAIN LHS
Ch:5.165km
DRAIN RHS
Ch:5.234km
ST.FRANCIS -XAVIER CHURCH ROAD BRIDGE
Ch:5.238km
DRAIN
GI CHAIN LINK FENCING 3M HT ON BOTH SIDES
Ch:5.300km
SMALL BEND
Ch:5.300km
SILT ACCUMULATION RHS FROM RESIDENCES
Ch:5.320km
DRAIN
Ch:5.340km
DRAIN
Ch:5.385km
DRAIN
TO BE RECONSTRUCTED
Ch:5.400km
SILT ACCUMULATION LHS FROM DRAIN
FOOT BRIDGE(MIDDLE SUPPORT)
Ch:5.405km
DRAIN
Ch:5.437km
DRAIN
Ch:5.445km
DRAIN
Ch:5.480km
DRAIN RHS
Ch:5.490km
KOTTA CANAL BRIDGE
Ch:5.500km
DRAIN
Ch:5.540km
STEEL FOOT BRIDGE
Ch:5.570km
SILT ACCUMULATION LHS FROM DRAIN
Ch:5.590km
DRAIN
Ch:5.603km
DRAIN
GI CHAIN LINK FENCING 3M HT ON BOTH SIDES
TO BE RECONSTRUCTED
Ch:5.610km
BRIDGE
TREES ON RB NO PROTECTION WORKS
DAMAGED PROTECTION WALL
Ch:5.620km
MAXSON GLOBAL BRIDGE
Ch:5.650km
DRAIN RHS
Ch:5.715km
DRAIN RHS
Ch:5.730km
SKYLINE FLAT RHS
Ch:5.765km
KATTAKARA BRIDGE
Ch:5.768km
DRAIN
Ch:5.800km
UNI RESIDENCE AREA - CONCRETE WALL PARTIALLY CONSTRUCTED
FOR 1.2M HT. BARE REINFORCEMENT PROTRUDING AT HEIGHT 2.5M
DAMAGED PROTECTION WALL
Ch:5.880km
BRIDGE TO UNI RESIDENCE
Ch:5.897km
BRIDGE - SEBASTIAN ROAD
Ch:5.902km
DRAIN
SHEET 3

Sheet 4


LINE SKETCH OF TEVARA PERANDUR CANAL - (FROM CHAINAGE 5.980 km to 9.950km)
Ch:5.980km
BRIDGE TO RBI QUARTERS
Ch:6.050km
DAMAGED PROTECTION WALL(RBI QUARTERS)
Ch:6.100km
TO BE RECONSTRUCTED
BANEJI ROAD CROSSING SOUTH SIDE WASTE DISPOSAL
Ch:6.140km
BANERJI ROAD CROSSING NORTH SIDE CABLE SEEN
Ch:6.170km
DRAIN LHS
Ch:6.200km
DAMAGED PROTECTION WALL 100M,HEIGHT 1.5M
Ch:6.300km
TO BE RECONSTRUCTED
MANAPPATTI PARAMBU BRIDGE
Ch:6.395km
DRAIN LHS
Ch:6.400km
SASTHA LANE BRIDGE
Ch: 6.400km
Shastha line Road- Chirakkal Bridge
Ch: 7.50km
Waste Dumping
Ch: 7.700km
Pottakuzhi Bridge
Ch: 9.240km
Delta formation
Ch: 9.440km
Old boat jetty
Ch: 9.910km
Perandoor Railway Bridge
Ch: 9.950km
TP Canal exit
Chittoor Puzha
NOTE:- Desilting of entire reach required
SHEET 4

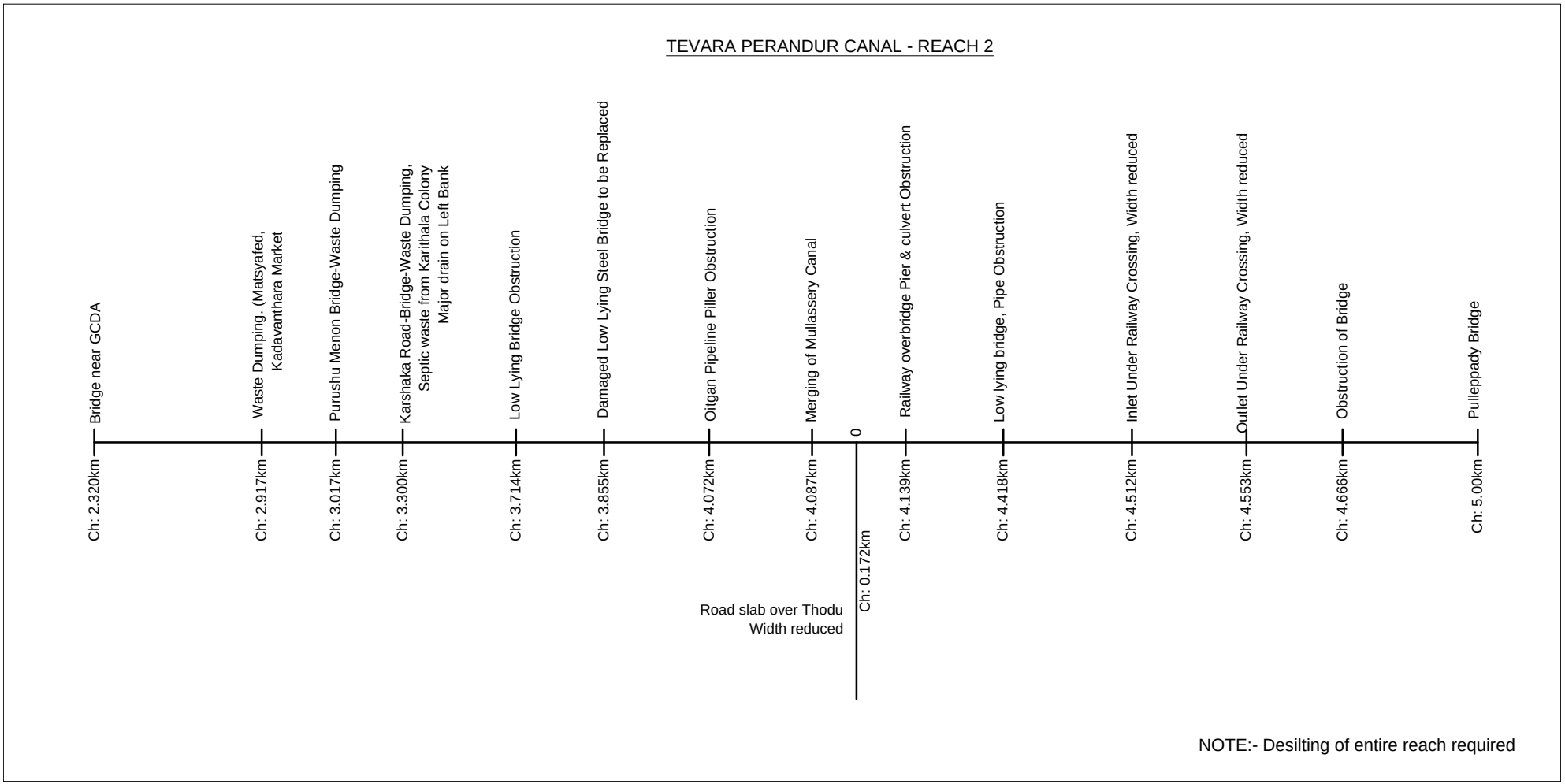
4.0 CONCLUSION

Based on our study, Thevara-Perandoor Canal is classified into 4 Categories as shown below.

Reach I	Semi Critical
Reach II	Extremely Critical
Reach III	Critical
Reach IV	Critical

The classification of the reach is according to the present status of Canal like Storm/Effluent Water flow, Silt/Garbage deposit and Blockage no the normal water flow. The reach with Extremely Critical condition has to be attended as early as possible. The remaining reaches also have to be attended on priority basis. Emphasis should be given to clear off obstructions in Reach II & Reach III and to Straighten Canal below Ernakulam-Kottayam Railway Track.

The Thevara-Perandoor Canal (TP Canal) can be brought back to its original shape by carrying out the above works on war footing. Thus the flooding of Kochi Corporation can be effectively managed by the District Administration and Corporation Authorities.


TEVARA PERANDUR CANAL - REACH 2
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Bridge near GCDA
Ch: 2.917km
Waste Dumping. (Matsyafed, Kadavanthara Market
Ch: 3.017km
Purushu Menon Bridge-Waste Dumping
Ch: 3.300km
Karshaka Road-Bridge-Waste Dumping, Septic waste from Karithala Colony Major drain on Left Bank
Ch: 3.714km
Low Lying Bridge Obstruction
Ch: 3.855km
Damaged Low Lying Steel Bridge to be Replaced
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Oitgan Pipeline Piller Obstruction
Ch: 4.087km
Merging of Mullassery Canal
0
Ch: 0.172km
Road slab over Thodu Width reduced
Ch: 4.139km
Railway overbridge Pier & culvert Obstruction
Ch: 4.418km
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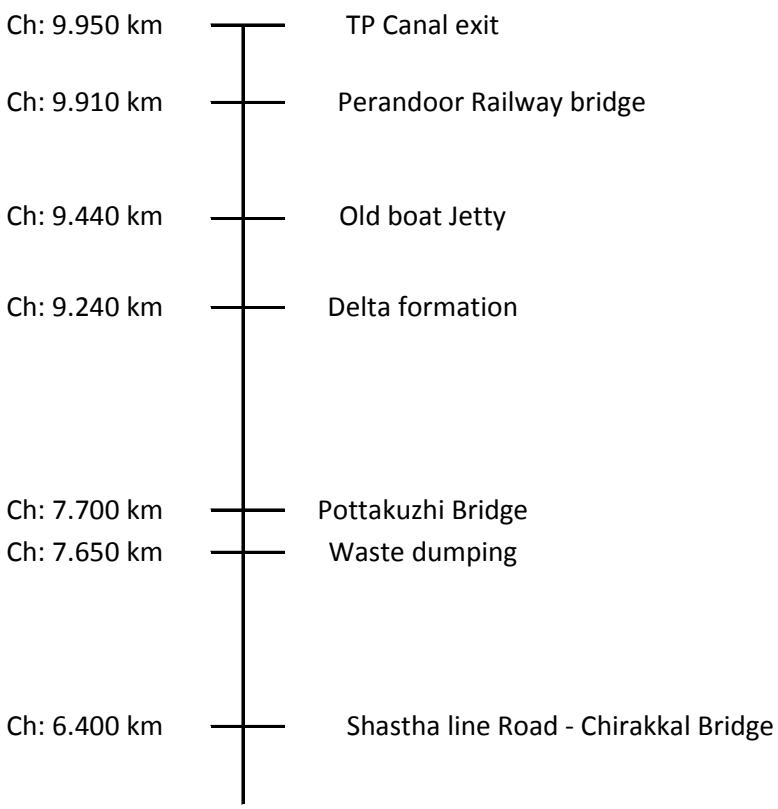
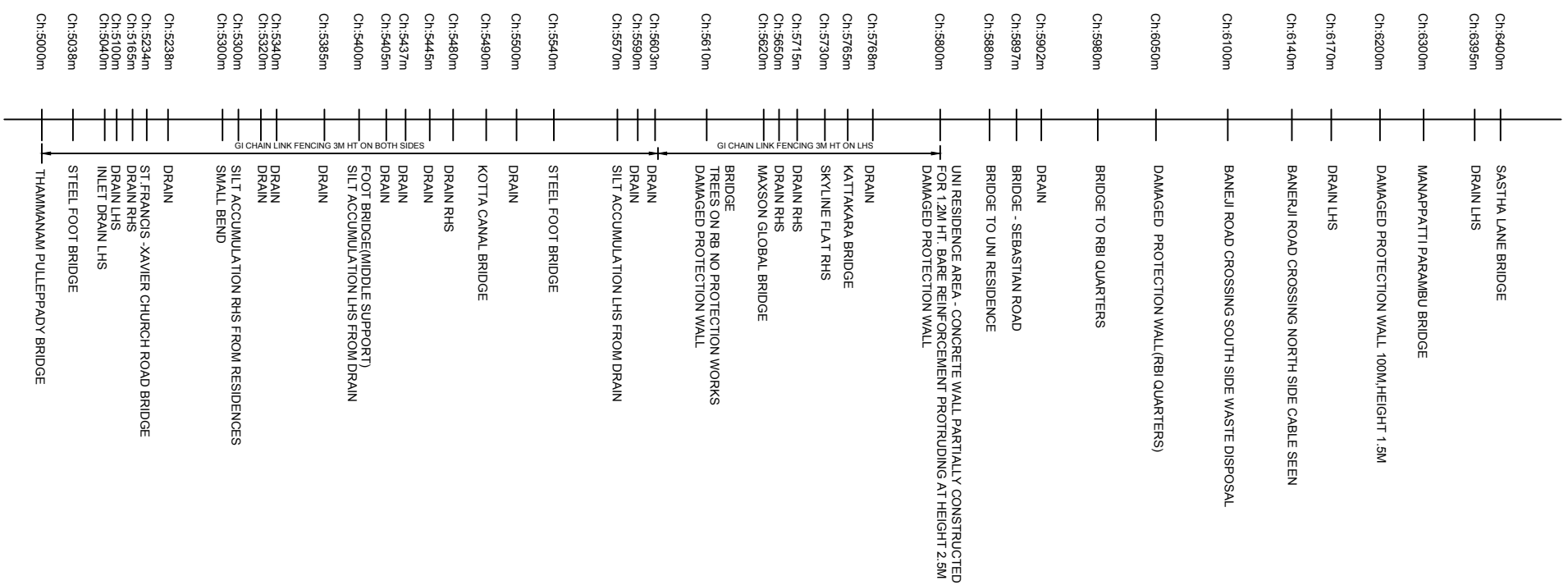
Ch: 4.553km
Outlet Under Railway Crossing, Width reduced
Ch: 4.666km
Obstruction of Bridge
Ch: 5.00km
Pulleppady Bridge
NOTE:- Desilting of entire reach required

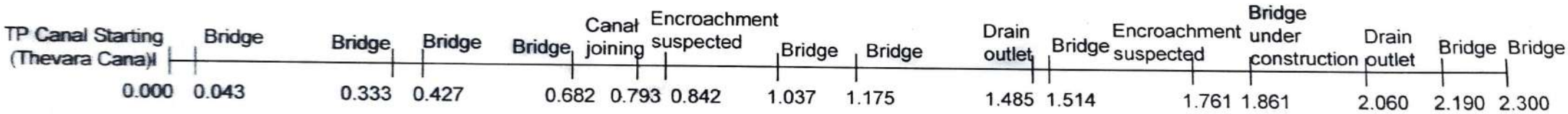
LAYOUT OF THEVARA-PERANDOOR CANAL - IVth REACH (Ch: 6.400 km to 9.950 km)



LAYOUT OF THEVARA-PERANDOOR CANAL : IIIRD REACH (CH:5000 TO 6400M)



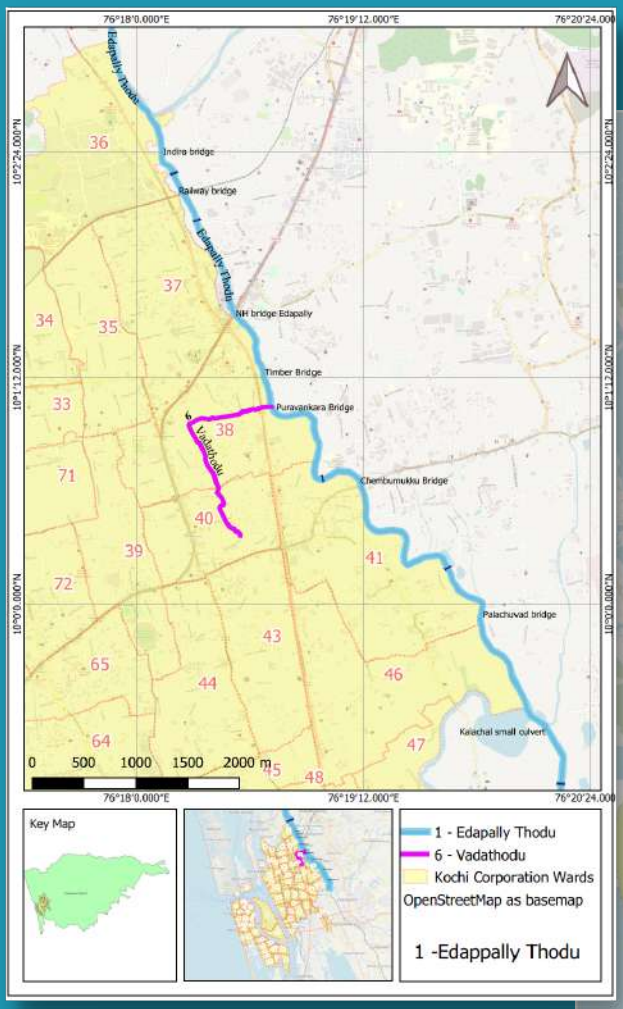
THEVARA PERANDOOR CANAL FIRST REACH- 0.000 km to 2.300 kms



CHAINAGE IN kms

EDAPPALLY THODU

KOCHI
FLOOD MITIGATION



In-charge: Er.Sandhya T, | Executive Engineer | Irrigation Division, Ernakulam

IRRIGATION DEPARTMENT
ERNAKULAM

EDAPPALLYTHODU.

INTRODUCTION

Edappallythodu in Ernakulam also known as "THUKILANKUTHIA THODU" , form the boundary of Kochi Corporation at the eastern side. Thisthodustarting from champakkara canal near Eroor bridge,flows through Eroor, Vennala, Palachuvadu, pipeline, Edappally, Muttar and joins Periyar at Edamula. Thetranversinglength of 10.20km through the west side of KalamasseryMuncipalilty east side of Cochin Corporation, west side of Thrikkakkara Municipality and north side of ThripunithuraMunicipality. The canal was used by the Royal family and ancient people for the transportation of goods and people.Earlier famous Edappally market situated adjacent to thisthodu.Since the flow of water through the thodu is not smooth ,flooding is observed at the banks of the thodu causing damages to the crops on the side of the thodu.If the flow is reestablished this problem can be solved and the land can be used effectively for agricultural purpose. Although the thodu was the main means of transportation of"Kettuvallam" in olden times, the width of thodu is seen reduced to 13m to 18m at major portions now a days. Accordingly the depth of the thodu is also considerably reduced due to the deposition of silt with the passage of time coupled with lack of proper maintenance.

Several small water bodies of the locality were joined manually to form the so called "Edappillythodu" as seen today. There is no access to the bund portion except at the road crossing areas. Thus disposal of waste happens only at the bridge portion. The dumping of waste to the water body from the bridge can be put to an end by fencing the bridge portion on either side.

The thodu has been cleaned by Kochi Corporation recently and therefore there is no visible obstruction for the flow . However at some stretches of the thodu, the trees are seen over hanging into the water body which is a major cause for accumulation of dumped waste & may cause obstruction of flow. Therefore trees along the side of the thodu, which raises such issues, have to be cleared off.

CONT...

9 bridges and 3private culverts and a metro sky bridge exists within the entire stretch of thodu.Paruthelithodu, Vadathodu, Kadamakkerythodu, Kallikuzhywaterbody and Kalachal are water sources connected to Edappallythodu.

There is no doubt in the fact that there is encroachment in the width of thodu on either side, as is made clear from the picture of conveyance of Kettuvallam during ancient time to that of the present width of 13.50 – 18 m.Edappallythodu being connected to two main water bodies on either side, experience drastic low tide, high tide and therefore the central portion of the thodu is seen to be almost stagnant. The desiltation of the thodu not only facilitates the flow of water through the canal but also puts forward an opportunity to convey passengers and goods at minimum cost and least pollution status.

Because of its alignment through the outskirts of Cochin city, it also acts as a drainage canal. Since the canal discharges at Muttar in the Edamula Branch of Periyar , this can be connected to Udyogamandal Canal. Thus we can connect the two fertilizer plants of FACT, ieUdyogamandal&Ambalamedu.

SITE PHOTOS

Starting point of Edapally thodu From Periyar- CH 0.00

(a) Chainage 0.00: Starting point of Edapally thodu

Chainage 36: Culvert have less vertical clearence, reconstruction of existing bridge is essential

(b) Chainage 36: Muttar kadavu Bridge culvert

Chainage 1000: Covered with vegetation on both banks,Disposal of waste and silt deposition

(c) Chainage 1000: Railway Bridge

SITE PHOTOS

(d) Chainage 1500: Chambokadav Bridge

Chainage 1500: Disposal of waste,Covered with vegetation on both banks,Water is polluted and appears to beoily in appearance.

(e) Chainage 2360: Lulu Private Bridge

Chainage 2360: Fully covered with hyacinth & Silt deposited

SITE PHOTOS

Chainage 2500: KWA pipe located over the beam of old bridge which is a major obstruction, fully covered with hyacinth, silt deposition and waste disposal

(f) Chainage 2500: NH bridge Edapally

SITE PHOTOS

(g) Chainage 2850: Marotty chodu palam

Chainage 2850: Trees grown to the bank of thodu,the disposal of waste is noticed

(h) Chainage 3230 : Timber Bridge

1" water line pipe laid across the thodu is found to obstruct the flow ,deposition of silt is noticed.

SITE PHOTOS

Chainage 3230 : Side protection wall is seen collapsed into the water body obstructing the water flow.

(i) Chainage 3230 : Drain joining to Edapally thodu

(j) Chainage 3230 : Pipe Line Road

Chainage 3230 : Covered with vegetation on both banks, accumulation of silt

SITE PHOTOS

Chainage 5100: Unauthorized waste disposal in between the bridges

(k) Chainage 5100: Chembumukku Bridge

(l) Chainage 6560: Kallikuzhy Paramada

Chainage6560: Fullycovered with hyacinth and water weeds.

SITE PHOTOS

Chainage7200: Vegetation on both banks, accumulated with floating wastes and is covered with hyacinth.

(m) Chainage7200: Palachuvad bridge

(n) Chainage9200: Kalachal small culvert

Chainage9200: Small culvert across the thodu

(o) Chainage10200: Edapally thodu outlet point

SHORT TERM MEASURES:

- Obstruction to free flow of water due to KWA pipe laid across the thodu near Edappally bridge which should be realigned to avoid accumulation of solid waste and to ensure free flow of water.
- Waste deposition in the thodu from outside near railway bridge, Chambakadavu bridge, NH Edappally bridge, Marottychodupalam, Timber bridge, Pipe line, Chembumukku bridge to be controlled by implementing proper waste management methods and enforcing stringent measures.
- In some stretches the trees are seen over fallen into the water body may cause obstruction to the flow of water. It has to be uprooted.

LONG TERM MEASURES:

- 1)The entire stretch of the thodu should be desilted to maintain the flow of water with respect to the lines and level of Periyar&Chambakara canal which facilitates the flow of water.
- 2)Also provide fencing to both bank of thodu near bridges and culverts which prevent unauthorized waste disposal.

SWOT ANALYSIS

Strength:

- The thodu can be connected to almost all waterbodies of Ernakulam district

Weakness:

- Low level bridges to be reconstructed

Opportunities:

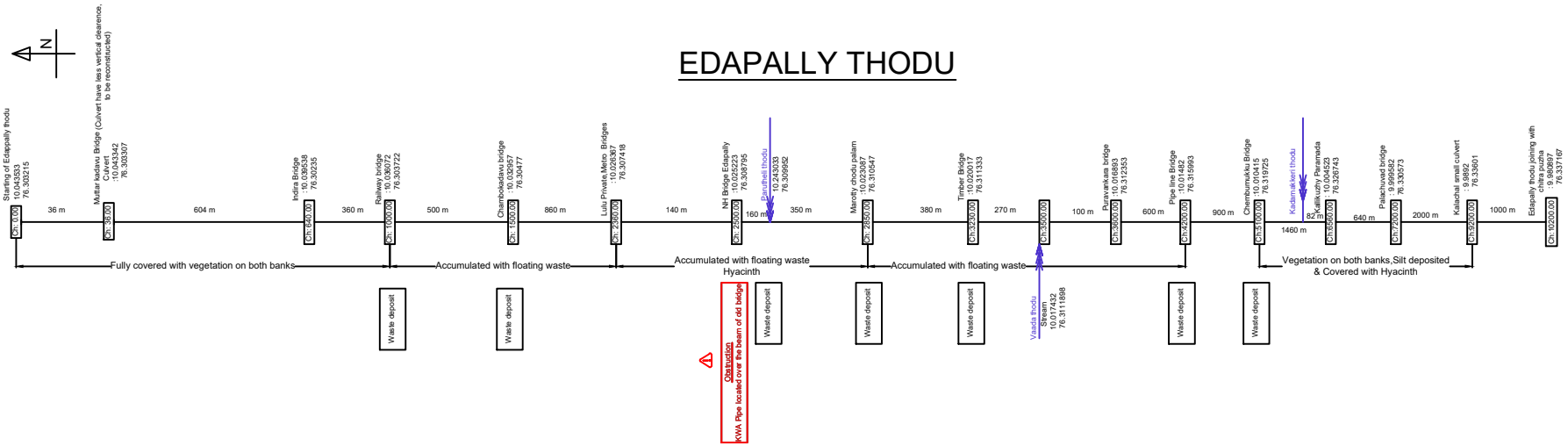
- Tourism potential is very high.
- It can be a part of NWIII connecting Chambakara canal &Chithrapuzha there by Kadambrayar.
- It can be made as a navigable canal connecting Periyar and Chambakkara canal thereby facilitates barge operations.
- Complete rejuvenation of Edappallythodu undertaken by KUWRTS aided by KIFB.
- Also walkable distance to Edappally church, Amirta hospital Lulu Metro station

Threats:

- Minimal width of the thodu in some stretches.
- KWA pipe laid across the thodu near NH Edappallybridge should be realigned.

SALIENT FEATURE OF EDAPPALLYTHODU

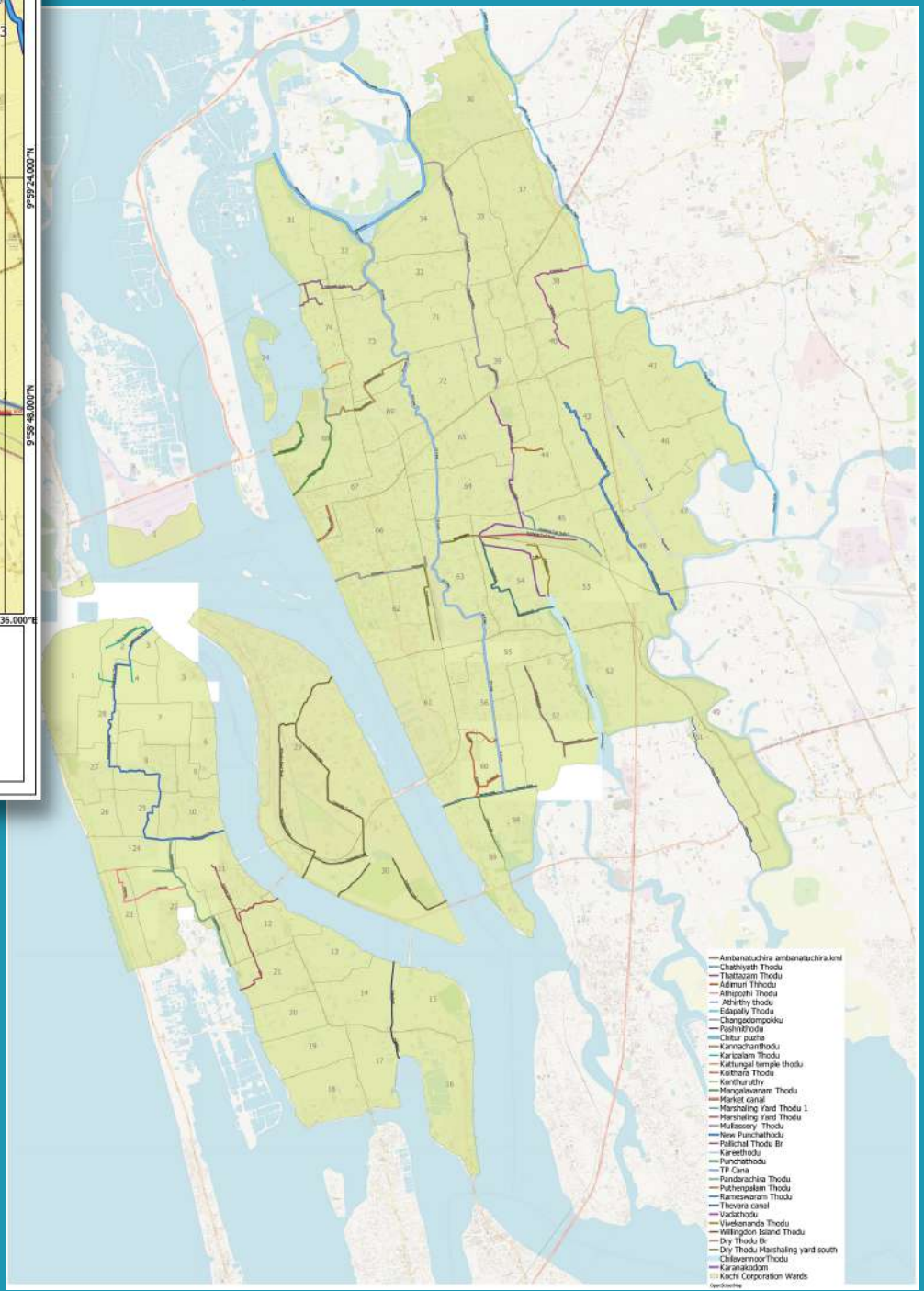
Location	Mutar, Edappally, Pipe line, Palachuvadu, Vennala, and Eroor
Village	Edappally North & South, Vazhakkala, Nadama.
Place	Mutar, Edappally, pipe line, Palachuvadu, Vennala, and Eroor.
Panchayath/Muncipality/Corporation	KalamasseryMuncipality, Cochin Corporation, Thrikkakkara Muncipality
Taluk	Kanayannoor
District	Ernakulam
Area Beneficiaries	West side of KalamasseryMuncipality, East side of Cochin corporation, West side of Thrikkakkara municipality, North side of ThrippornithuraMuncipality.
Starting Point	From Periyar – Muttar branch
Ending Point	Chithrapuzha – Chambakkara canal near Eroor.
Length	10200 m
Width	Varying from 13.5 m to 18m
Crossing	9 bridges and 3 Private culverts


N
EDAPALLY THODU
Starting of Edapally thodu
10.043533
76.303215
Ch: 0.000
36 m
Muttar kadavu Bridge (Culvert have less vertical clearence, to be reconstructed)
Ch: 36.80
10.043342
76.303307
604 m
Indira Bridge
10.039538
76.30255
Ch: 640.00
360 m
Railway bridge
10.038072
76.303722
Ch: 1000.00
500 m
Chambolodom bridge
10.032957
76.30477
Ch: 1500.00
860 m
Lulu Private,Metro Bridges
10.026387
76.307418
Ch: 2360.00
140 m
NH Bridge Edapally
10.025223
76.308795
Ch: 2500.00
160 m
Panthel thodu
10.243033
76.309952
350 m
Marotty thodu palam
10.023087
76.310547
Ch: 2850.00
380 m
Timber Bridge
10.020017
76.311333
Ch:3230.00
270 m
Ch:3500.00
100 m
Puravankara bridge
10.016583
76.312383
Ch:3600.00
600 m
Pipe line Bridge
10.01482
76.315993
Ch:4200.00
900 m
Chembumukku Bridge
10.010415
76.319725
Ch:5100.00
Kadamakkeri thodu
82 m
Kalikuzhy Paramada
10.004523
76.326743
Ch:5560.00
640 m
Palachuvad bridge
9.999582
76.330573
Ch:7.200.00
2000 m
Kallichal small culvert
9.9892
76.33601
Ch:9200.00
1000 m
Edapally thodu joining with chitra puzha
9.980897
76.337167
Ch: 10200.00
1460 m
Fully covered with vegetation on both banks
Accumulated with floating waste
Accumulated with floating waste
Hyacinth
Accumulated with floating waste
Vegetation on both banks,Silt deposited
& Covered with Hyacinth
Waste deposit
Waste deposit
Waste deposit
Waste deposit
Waste deposit
Waste deposit
Waste deposit
Obstruction
KWA Pipe located over the beam of old bridge
Vaiala thodu
Stream
10.017143
76.311898

KARANAKODAM THODU

KOCHI
FLOOD MITIGATION

In-charge: Er.Noorjahan A.A, | Executive Engineer | IIP Division, Angamaly



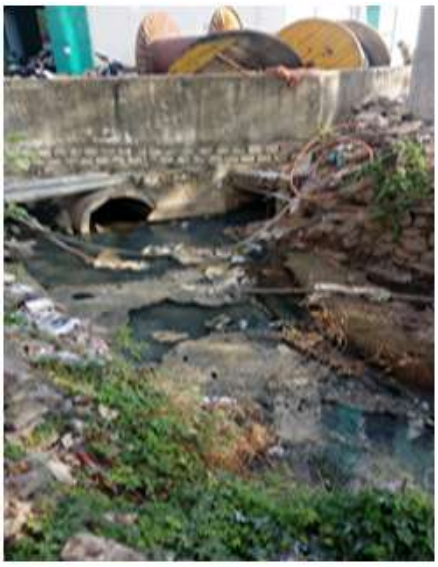
IRRIGATION DEPARTMENT
ERNAKULAM

KARANAKODAM THODU

INTRODUCTION

Karanamkodamthodu is a part of Chilavannoor canal and it starts from western side of JLN Metro station traversing towards South and ends atElamkulam, where the water drains in to Chilavannoorkayal. The parent Chilavannoor Canal originate fromChilavannoorkayal, and terminates at Chittoor Puzha , near Amritha Institute of Medical Science(AIMS) Edappally . Earlier people depended thisthodu to reach Edappally from Thripunithura and was used for the transportation of goods also.

The thodu was originally traversing through the stadium premises and was shifted to the boundary of the stadium during its construction. Now this thodu is seenseparated into two at the Banerjee road near JLN Metro Station. The thodu towards north is Changadampokuthodu and towards south isKaranakodamthodu.



PRESENT SCENARIO

The Karanakodamthodu passes through Karanakodam ,Palathuruthu , Rail Nagar and Elamkulam. The total length of the Karanakodam thodu is 4.77Km with starting width of 4m near at JLN Stadium,Kaloor. The average width of thodu is 8.5m.The width variation were noted at various stretches with Apartment and building plot compound walls constructed abutting the thodu. Cross structures not having sufficient clearance for flow of water have beennoticed. Many drains are emptying into this thodu.

Starting point -Near JLN Stadium before and after cleaning(OBT)

The connectivity to the Chittoor puzha via Changadampokkuthodu is seen blocked. There is a difference in bed levels of Karanamkodam and Changadampokku thodus. At the starting point 2 nos of pipes are also seen connected from the other side of the road to Karanakodam thodu.

Karanakodam is the discharge point of the entire Railway Marshalling yard . The hazardous effluents from the yard is getting flushed to the thodu without any treatment and polluting the water course and other connected thodus to Karanakodam. This contributes to the poor water quality of the surrounding area and warrants immediate intervention.The Karanakodam was highly silted up, covered with water weeds and waste and polluted and has been included in the Operation Break Through 2020 and was desilted.

Near joining point of Adimurithodu before and after cleaning.(OBT)

before and after cleaning.(OBT)

Near joining point of Adimurithodubefore andaftercleaning.(OBT)

PROBLEMS IDENTIFIED

Near Jln Metro Station At Ch 0 M

At the starting of the JLN metro station from where the Karanakodam – thodu started, it is noticed that the 2 pipes from the other side of the Banerjee road are connected to this thodu . Also utility service pipelines and cables are improperly laid across it. Theportion from JLN Metro station to Karnakodam stretch runs abutting to the JLN Stadium compound boundary after which it runs parallel to the stadium link road. The bridges and pipelines constructed without adequate vertical clearance across the thodu cause obstruction to the smooth flow of water through the thodu.

The Adimurythodu is joining to this near the Sreekrishna catering building at Stadium link road and foot over bridge here needs to be reconstructed as it is devoid of sufficient vertical clearance. The KWA ,KSEB and BSNL pipelines across theculverts near Kent Apartment and Skyline apartments are crossing the thodu without adequate vertical clearance.

At Ch :995m Culvert At Adimuri Thodu Junction

The thodu crosses the ThammanamPulleppady road at Ch 2039m and flows towards Railway Marshalling yard. A connection thodu from the north side of the Marshalling yard to Karanakodamis seen completely blocked at the downstream of this bridge.

Near the railway marshalling yard, the thodu has been deviated along the boundary of the yard by the Railways .In this course along the Rail nagararea,a railway bridge is crossing the thodu and at the downstream of the Railway crossing ,Punchathodu is starting at Ch 3116m. Also a drain connecting to TP canal is also seen joning here. There are two culverts viz Panorama residency culvert and Rail nagar No.1 culvert in this area. The thodu regains the original course near Rail nagar main bridge(ch. 3884) joining the thodu from Marshalling yard and proceeds southward to Chettichira and finally drains to ChilavannoorKayal. Also at Ch 3986 m, at the south end of Marshalling Yard, Puthenpalamthodu starts from this and joins ChilavannoorKayal. Water weeds is seen noticed along this stretch of thodu. At Ch 4006m, a box culvert from Marshalling yard joins the Karanakodam, but heavily silted up ,covered with vegetationand blocked.

At Ch :3394m Near Panorama Residency

At Ch 3884m -Near Rail Nagar Bridge

At Ch: 4006 M -Rail Nagar Area

The culverts in the V.V.Road (ch. 4068m) and St. Sebastian Road(ch. 4155m) have very low vertical clearance and a narrower water way and need to be reconstructed .The area has been subjected to flooding during heavy rains. There is an iron bridge at Ch 4408m at the downstream of Railnagararea .Waste accumulation and presence of water weeds,improperly aligned cable have been noticed here which causes hindrances to the uninterrupted flow of water.

At Ch: 4068m-V.V.Road Culvert

At Ch 4155m -St Sebastian Road

At Ch :4408m-Iron Foot Bridge

The thodu crosses the Subhash Chandra Bose road (ch. 4650) and joins Chilavannoor Kayal. The vertical clearance and waterway of this bridge is not adequate and coupled with the presence of water weeds are obstructing the flow and the bridge has to be reconstructed .

At Ch:4650m -Subhash Chandra Bose Road

Many domestic sewer lines and corporation drains are emptying in this water course. Apart from this ,the major share of the pollution can be attributed to the Railway Marshalling yard. The hazardous waste from the Railway marshalling yard is getting flushed to Karanakodamthodu without any treatment. All the connecting thodus of the Karanakodam is adversely affected by this untreated effluent . The Punchathodu, Puthenpalamthodu , and a drain connecting to TPCanal is joining the theKaranakodam in the Marashalling yard periphery itself .The connection of Karanakodam along the north side of the yard is highly contaminated and almost stagnant.

OBSTRUCTIONS IDENTIFIED

1. At the starting point (Ch 0m) near JLN Metro station, pipelines and cables obstructing free flow of water.
2. Culvert at Ch 995 m at the junction of Adimurithodu without adequate vertical clearance.Cable to be realigned.
3. Servicelines across culverts at Ch 1205m(near Kent Apartments) ,Ch 1598m(near Skyline Apartments), Panorama culvert(Ch 3394m) not having sufficient vertical clearance .
4. Water weeds accumulated near Rail nagar main bridge.(Ch 3884m).
5. Connection from Marshalling Yard (Ch 4006m)fully blocked.
6. Culvert at Ch 4068m in V.V.Road not having adequate horizontal vent way and vertical clearance and also service lines across culvert have so sufficient vertical clearance.
7. Culvert at Ch 4155m in St.Sebastian Road not having adequate horizontal vent way and vertical clearance and also service lines across culvert have so sufficient vertical clearance.
8. Waste accumulation and water weeds beneath the Iron Foot bridge at Ch 4408m .
9. Culvert at Ch 4650m at Subhash Chandra Bose Roadnot having adequate horizontal vent way and vertical clearance. Pillars of KWA Pipe obstructing flow.

REMEDIAL MEASURES

The significant intervention shall be made to ensure that no untreated effluent from marshalling yard is discharged to the Karanakodamthodu. Railways must be addressed regarding this and must be instructed to install ETP in the yard. Also the connection between Changadampokkuthodu andKaranamkodamthodu has to be re-established to achieveuninterrupted flow and to mitigate flooding.

A.STRUCTURES TO BE RECONSTRUCTED

1. C ulvert at Adimurithodu Junction
2. Culvert at V.V.Road
3. Culvert at St.Sebastian Road
4. Bridge at Subhash Chandra bose Road.

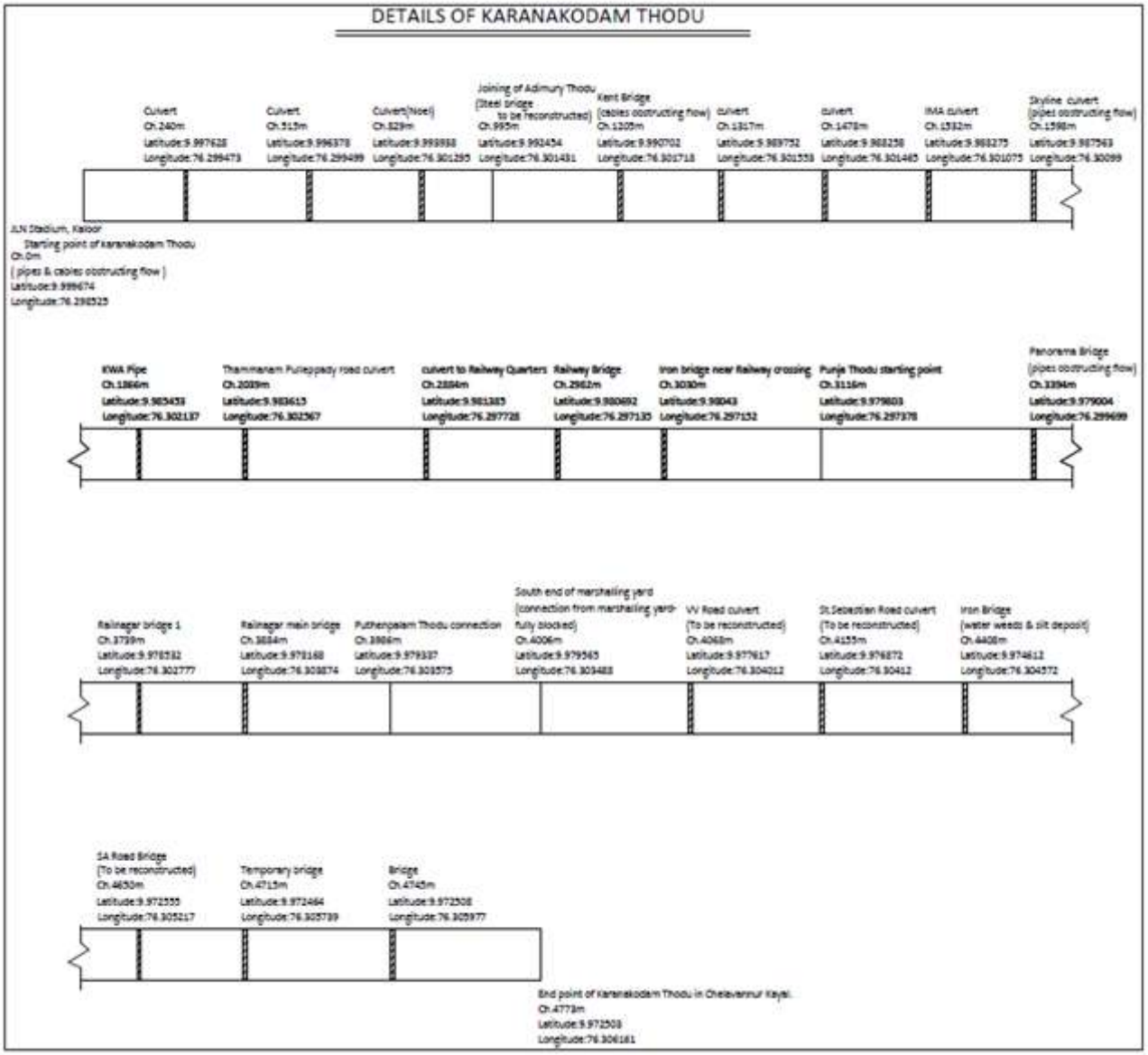
B. SERVICE LINES TO BE REPLACED

1. KWA Pipe lines andcables of KSEB and BSNL -
2. Starting point -Near Metro Station
3. Culvert near Kent Apartment.
4. Culvert near Sky line imperial apartment
5. Culvert near Panorama Residency
6. Culvert at V.V.Road .
7. Culvert at St. Sebastian road
8. At Iron foot bridge
9. Subhash Chandra Bose Road crossing.

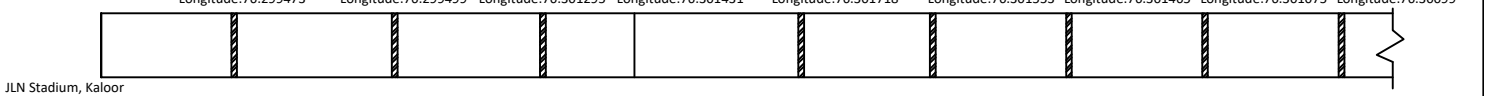
CONCLUSION

The periodical desilting of thodu and its connections ,providing cross structures with adequate horizontal waterway and vertical clearance ,realignment of service lines with sufficient head room will help to ensure the uninterrupted flow through the thodu. Stringent measures should be taken to arrest pollution of thodu from the the Railway Marshalling yard .The mouth of the Chilavannoor lake has to be dredged to receive the flood waters from the Karanamkodamthodu and the associated connections. The thodu is of varying width and abuttinghigh rise buildings on both its sides and it is necessary to get the boundaries of the thodu demarcated.

SCHEMATIC DIAGRAM



DETAILS OF KARANAKODAM THODU



JLN Stadium, Kaloor
Starting point of karanakodam Thodu
Ch.0m
(pipes & cables obstructing flow)
Latitude:9.999674
Longitude:76.298525

Culvert
Ch.240m
Latitude:9.997628
Longitude:76.299473

Culvert
Ch.515m
Latitude:9.996378
Longitude:76.299499

Culvert(Noel)
Ch.829m
Latitude:9.993938
Longitude:76.301295

Joining of Adimury Thodu
(Steel bridge to be reconstructed)
Ch.995m
Latitude:9.992454
Longitude:76.301431

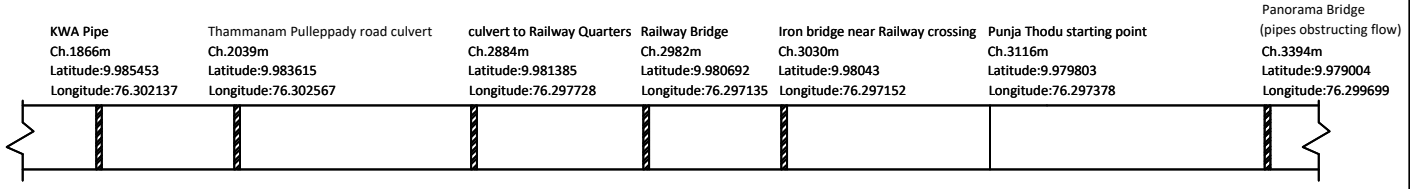
Kent Bridge
(cables obstructing flow)
Ch.1205m
Latitude:9.990702
Longitude:76.301718

culvert
Ch.1317m
Latitude:9.989752
Longitude:76.301553

culvert
Ch.1478m
Latitude:9.988258
Longitude:76.301465

IMA culvert
Ch.1532m
Latitude:9.988275
Longitude:76.301075

Skyline culvert
(pipes obstructing flow)
Ch.1598m
Latitude:9.987563
Longitude:76.30099



KWA Pipe
Ch.1866m
Latitude:9.985453
Longitude:76.302137

Thammanam Pulleppady road culvert
Ch.2039m
Latitude:9.983615
Longitude:76.302567

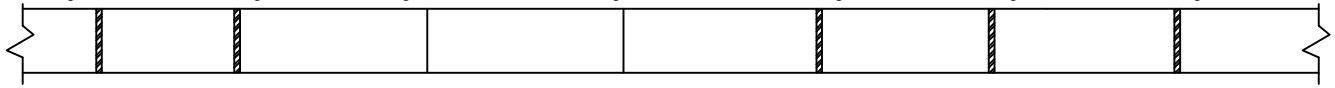
culvert to Railway Quarters
Ch.2884m
Latitude:9.981385
Longitude:76.297728

Railway Bridge
Ch.2982m
Latitude:9.980692
Longitude:76.297135

Iron bridge near Railway crossing
Ch.3030m
Latitude:9.98043
Longitude:76.297152

Punja Thodu starting point
Ch.3116m
Latitude:9.979803
Longitude:76.297378

Panorama Bridge
(pipes obstructing flow)
Ch.3394m
Latitude:9.979004
Longitude:76.299699



Railnagar bridge 1
Ch.3739m
Latitude:9.978532
Longitude:76.302777

Railnagar main bridge
Ch.3884m
Latitude:9.978168
Longitude:76.303874

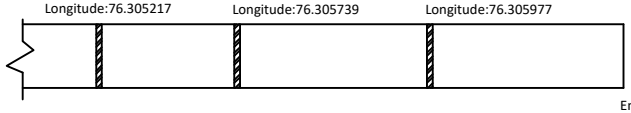
Puthenpalam Thodu connection
Ch.3986m
Latitude:9.979337
Longitude:76.303575

South end of marshalling yard
(connection from marshalling yard-fully blocked)
Ch.4006m
Latitude:9.979565
Longitude:76.303488

VV Road culvert
(To be reconstructed)
Ch.4068m
Latitude:9.977617
Longitude:76.304012

St.Sebastian Road culvert
(To be reconstructed)
Ch.4155m
Latitude:9.976872
Longitude:76.30412

Iron Bridge
(water weeds & silt deposit)
Ch.4408m
Latitude:9.974612
Longitude:76.304572



SA Road Bridge
(To be reconstructed)
Ch.4650m
Latitude:9.972555
Longitude:76.305217

Temporary bridge
Ch.4715m
Latitude:9.972464
Longitude:76.305739

Bridge
Ch.4745m
Latitude:9.972508
Longitude:76.305977

End point of Karanakodam Thodu in Chelavannur Kayal.
Ch.4773m
Latitude:9.972503
Longitude:76.306161

ADIMURITHODU

KOCHI
FLOOD MITIGATION

In-charge: Er.Jisha A, | Technical Asst. | IIP Division, Angamaly

IRRIGATION DEPARTMENT
ERNAKULAM

ADIMURITHODU

INTRODUCTION

Adimurythoduruns parallel to Adimuri road ,crosses South Janatha Road and joins Karanakodamthodu on the west side of the Stadium link road.It starts from junction of Adimury road and Pipe line road. This is the flushing point of the area between South of Palarivattom and Shantipuramjunction. The corporation drains from Palarivattom and Thammanam along Pipe line road are also ending in Adimurythodu .

PRESENT SCENARIO

This thoduhas499 m length and an average width of 2.5m .The starting portion of this thodu is completely covered for a length of 40m and is being used as a road.The width of this portion is 2.7m .

There are many culverts in this for facilitating access to the plots and buildings on the side of thodu..It crosses the South Janatha road and traverses towards stadium linkroad and joins Karanakodam thodu. The thodu isseen covered for a length of 36m on the east side of the culvert at Stadium link road and encroachments are noticed in this portion. In the starting portion of thodu,a drain from St Martin road is joining and the width at the transition portion of the thodu after covered portion is reduces.The drains from Santhipuram junction and South Janatha road reachAdimurithodu.The width of the thoduwas reduced during the construction of road.

PROBLEMS IDENTIFIED

During heavy rains , the area gets water logged .Eventhough the annual desilting is being carried out in the thodu,the obstructions in the covered portionscannot be identified and cleared diligently. The drop beam of the culvert at Ch 249 m leads to the reducedvertical clearance . The culvert at Ch 338m is having insufficient vertical and horizontal clearance.causing flooding. The waters from Adimurithodu get interrupted also in Stadium link road culvert at Ch 452 m due to the inadequate waterway.The haphazardly placed cables and utility service lines in the culverts are making the situationmore worse.The culverts, the covered portions and the improperly laid cables are causing obstruction to the smooth flow of water.

Due to this blockade, water logging in the area along the side of the thodu occurs .The drainage from Shanthipuram area gets critically affected .During heavy rains,almost 20 houses in Shanthipuram colony faces the ill effects of this.

REMEDIAL MEASURES

The cross structures without sufficient vertical and horizontal clearance have to be reconstructed. The covered portions shall be made open. Theavgwidth of the thodu must be made 3.5 m to receive the flood waters.The utility service lines must be properly aligned.

STRUCTURES TO BE RECONSTRUCTED

a. Culvert at Ch 338m
b. Culvert at Ch 249m
c. Culvert at Ch452m in Stadium link road.

SERVICE LINES TO BE REPLACED

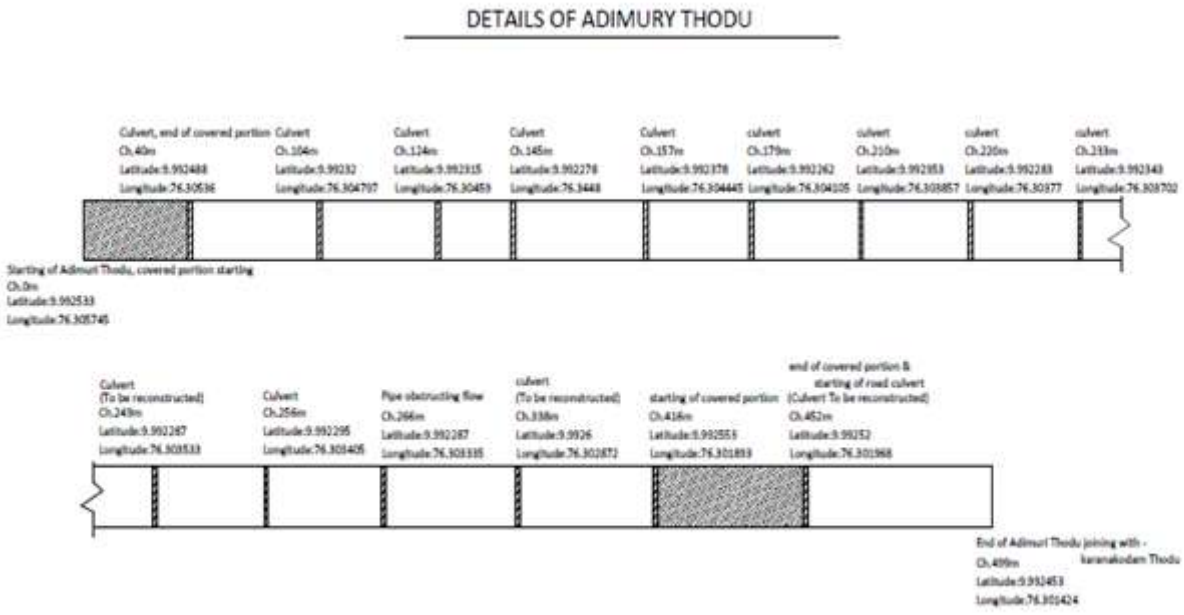
KWA Pipe lines and cables of KSEB and BSNL -

- At Ch 467 m- Stadium link road culvert.
- Between culverts at Ch. 256m and Ch 266m Culvert in Adimury road.

CONCLUSION

Adimurithodu caters to the drainage of a large area and has to be properly maintained with sufficient width and depth and The covered portions must be made open so as to make the flood mitigation easier.It has to be ensured that all cross structures are having adequate horizontal and vertical clearance. The boundaries of the thodu has to be demarcated to regain the original course of the thodu.

SCHEMATIC DIAGRAM



DETAILS OF ADIMURY THODU

Culvert, end of covered portion
Ch.40m
Latitude:9.992488
Longitude:76.30536

Culvert
Ch.104m
Latitude:9.99232
Longitude:76.304797

Culvert
Ch.124m
Latitude:9.992315
Longitude:76.30459

Culvert
Ch.145m
Latitude:9.992278
Longitude:76.3448

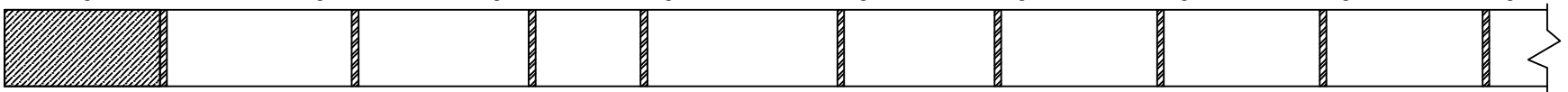
Culvert
Ch.157m
Latitude:9.992378
Longitude:76.304445

culvert
Ch.179m
Latitude:9.992262
Longitude:76.304105

culvert
Ch.210m
Latitude:9.992353
Longitude:76.303857

culvert
Ch.220m
Latitude:9.992283
Longitude:76.30377

culvert
Ch.233m
Latitude:9.992343
Longitude:76.303702



Starting of Adimuri Thodu, covered portion starting
Ch.0m
Latitude:9.992533
Longitude:76.305745

Culvert
** To be reconstructed
Ch.249m
Latitude:9.992287
Longitude:76.303533

Culvert
Ch.256m
Latitude:9.992295
Longitude:76.303405

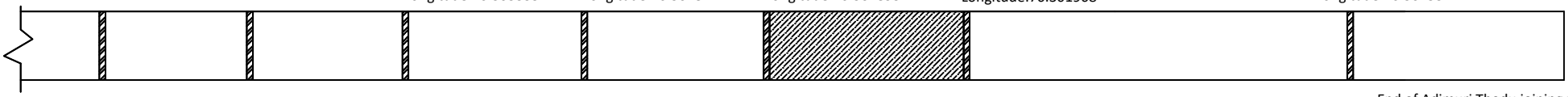
Pipe obstructing flow
Ch.266m
Latitude:9.992287
Longitude:76.303335

culvert
** To be reconstructed
Ch.338m
Latitude:9.9926
Longitude:76.302872

starting of covered portion
Ch.416m
Latitude:9.992553
Longitude:76.301893

end of covered portion & starting of road culvert
Ch.452m
Latitude:9.99252
Longitude:76.301968

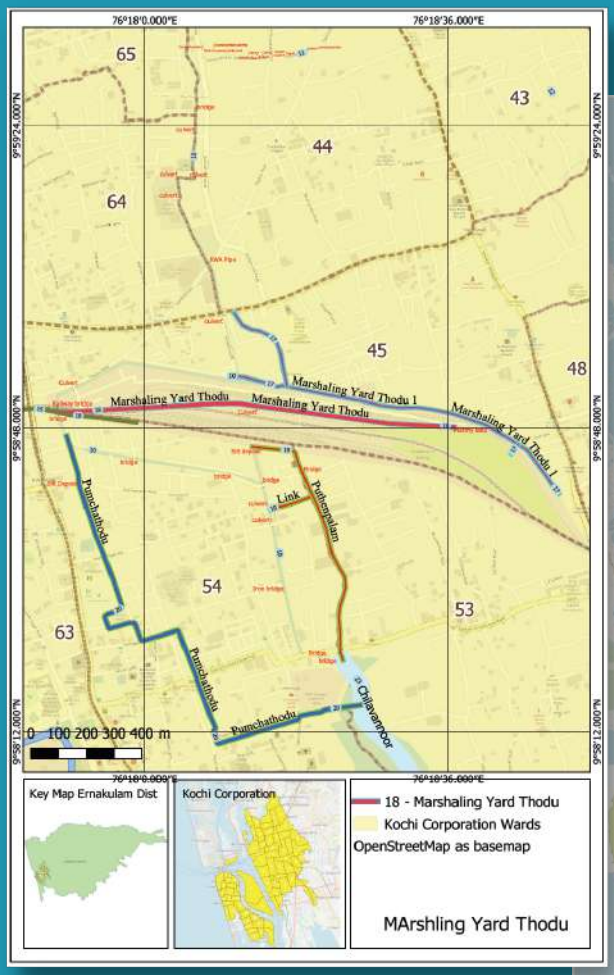
end of road culvert
**pipe obstructing flow
Ch.467m
Latitude:9.992471
Longitude:76.301537



End of Adimuri Thodu joining with karanakodam Thodu
Ch.499m
Latitude:9.992453
Longitude:76.301424

MARSHALLING YARD THODU

KOCHI
FLOOD MITIGATION



In-charge: Er.Jisha A, | Technical Asst. | IIP Division, Angamaly

IRRIGATION DEPARTMENT
ERNAKULAM

MARSHALLING YARD THODU

INITIAL STUDY REPORT

Railway marshalling yard is situated at the Karanakodam region and during the construction of yard , the original course of Karanakodam thodu was deviated at the down stream of ThammnamPulleppadybridge..The drainage of the marshalling yard is through two inter connected thodus- one inside the yard in the south side and other thodu along the northern boundary of the yard. The eastern side of the yard is a marshy land fully covered with vegetation Both thodus originate from the marshy area and are connected to Karanakodam.

PRESENT SCENARIO

Marshalling yard thodu (S)

Marshalling yardSouththodu starts from the marshy area in the south side of Railway Marshalling yard and proceeds west towards Railway bridge crossing in Karanakodam thodu. It was constructed to contain the water logging of the marshalling yard. Now the connection to Karanakodamis seen completely blocked.

The length of this thodu is 1.451km and has an average width of 2.5m There is a box culvertof 270 m length(approx) at Ch 719 of this thodu proceeding southward and joining Karanakodam thodu at Rail nagar area.. The flow from either sides of this box culvertis directed towards it. .The connection of the thodu to the Kranakodamnear the Railway crossing is fully blocked. Now the whole thodu is fully covered with thick vegetation and most parts of it are inaccessible. The box culvert joining theKaranakodam at the south end of Marshalling yard is not functional as it is fully silted up and blocked.The effluent from the yard is getting discharged to this thodu without any treatment.

Starting Point –Marshy Area -South East Portion Of Yard

BOX CULVERT – BOTH ENDS

AT CH 1451 -WEST END OF YARD – NEAR RAILWAY CROSSING.

PROBLEMS IDENTIFIED

The untreated effluent from the yard is getting discharged to this thodu. Also, corporation drains are flushing into thisthodu. The thodu is silted up, covered with thick vegetation and inaccessible at many stretches. Most of the part ,the flow is stagnated and contaminated. The residences along the northern boundary of the yard issubjected to water logging during heavy rains.The marshalling yard is draining to the Kranakodam thodu and the untreated effluent from yard , discharging to Karanakodam is badly affecting the water quality of the surrounding area. Besides this,other thodusconnected toKaranakodam are affected. Also the storm water in this yard reaches the Karanakodamthodu along the Railnagar area and leads to water logging during heavy rains.

REMEDIAL MEASURES

Installation of Effluent treatment plant –Railways must be addressed and instructed to install ETP in the yard. Strict measures should be taken to arrest the untreated effluent discharge from the yard to the thodus.
Desilting and Removal of vegetation in thodu.-The entire length of both the thodus must be cleaned and desilted so as to make the flow uninterrupted . The box culvert from the marshalling yard to the Karanakodam has to be desilted and cleared of vegetation.

The reestablishment of flow in both thodu by desilting can mitigate the water logging in the adjacent plots in the boundary of the yard .

REMEDIAL MEASURES

Installation of Effluent treatment plant –Railways must be addressed and instructed to install ETP in the yard. Strict measures should be taken to arrest the untreated effluent discharge from the yard to the thodus.
Desilting and Removal of vegetation in thodu.-The entire length of both the thodus must be cleaned and desilted so as to make the flow uninterrupted . The box culvert from the marshalling yard to the Karanakodam has to be desilted and cleared of vegetation.

The reestablishment of flow in both thodu by desilting can mitigate the water logging in the adjacent plots in the boundary of the yard .

CONCLUSION

The unchecked hazardous effluent discharge from the yard to the Karanakodamhas adversely affected the water quality of the surrounding area .As many water courses are connected to the Karanakodam, the pollution is effected in these thodusalso. Stringent directions should be given to Railways to install ETP in yard and to arrest further pollution to the water courses. Thetwo thodus in the Marshalling yard have to be desilted so that the flow can be regained .

MARSHALLING YARD THODU (N)

Marshalling yardNorth side thodu starts from the marshy area in the northeast side of yard ,flows along the northern boundary of the yard and joins Karanakodamat the downstream of ThammanamPulleppady bridge .The thodu is of788 m length .The width is varying with an average width of 1.5m at the initial stretches,butit increases to 8m near Karanakodam., It is like an open drain initially and at Ch 80m ,aculvert is constructed to connect it to other side of the marshy region.The drains from Anjumuri area is emptying in this thodu .The thodu is thickly vegetated and has a meagre flow .After Ch 360m, thodu widens and corporation drains are joining the thodu here. At Ch 680m a connection thodu fromdownstream of ThammanamPulleppadybridge,also joins and flow towards Karanakodam.

CH 28M -STARTING POINT

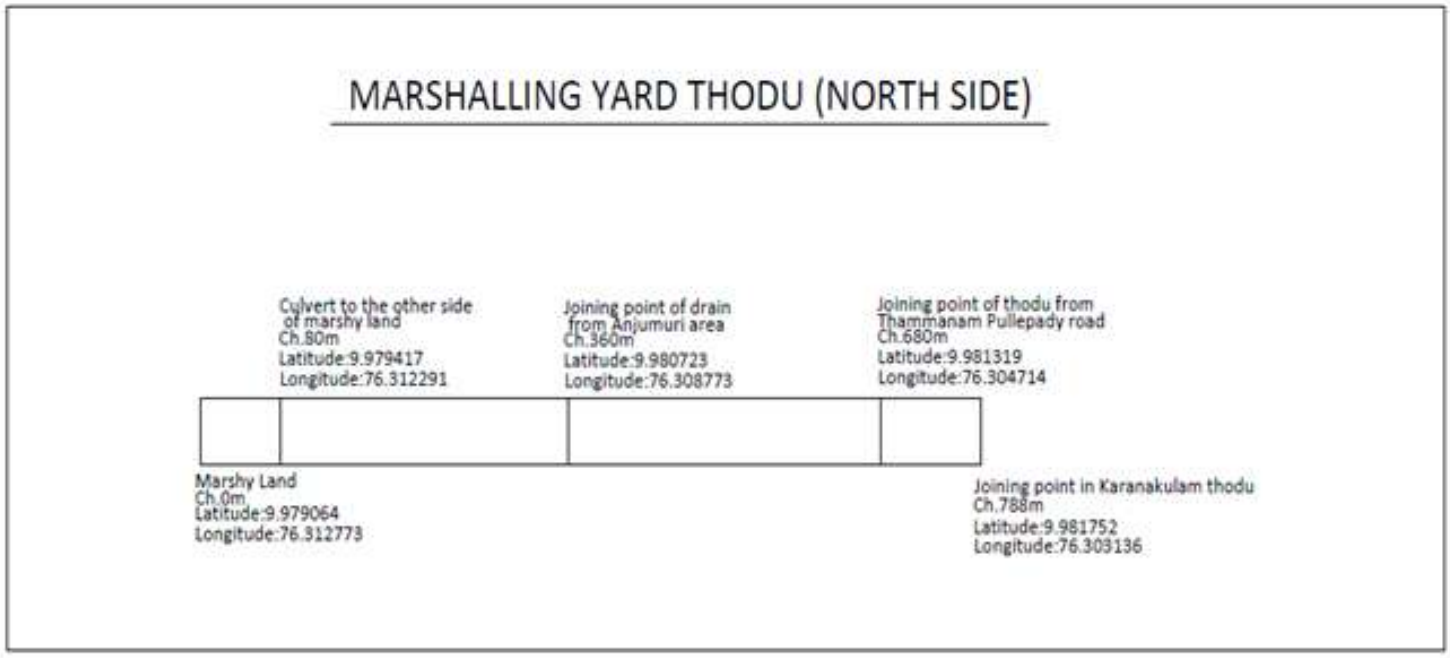
CH :80M -CULVERT TO OTHER SIDE OF MARSHY REGION

CH :360 M

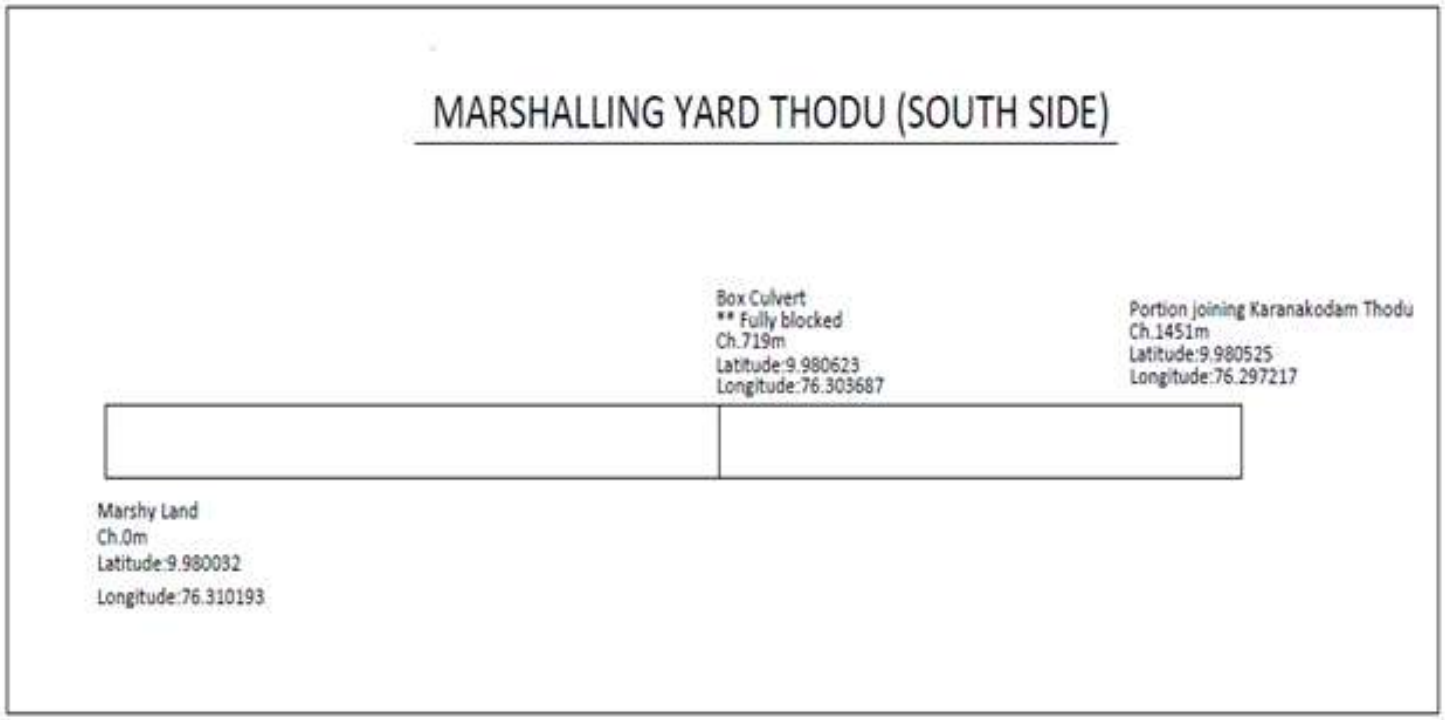
CH 748M -NEAR KARANAKODAM THODU

SCHEMATIC DIAGRAM

Marshalling yard thodu (N)



Marshalling yard thodu (S)



DETAILS OF MARSHALLING YARD THODU

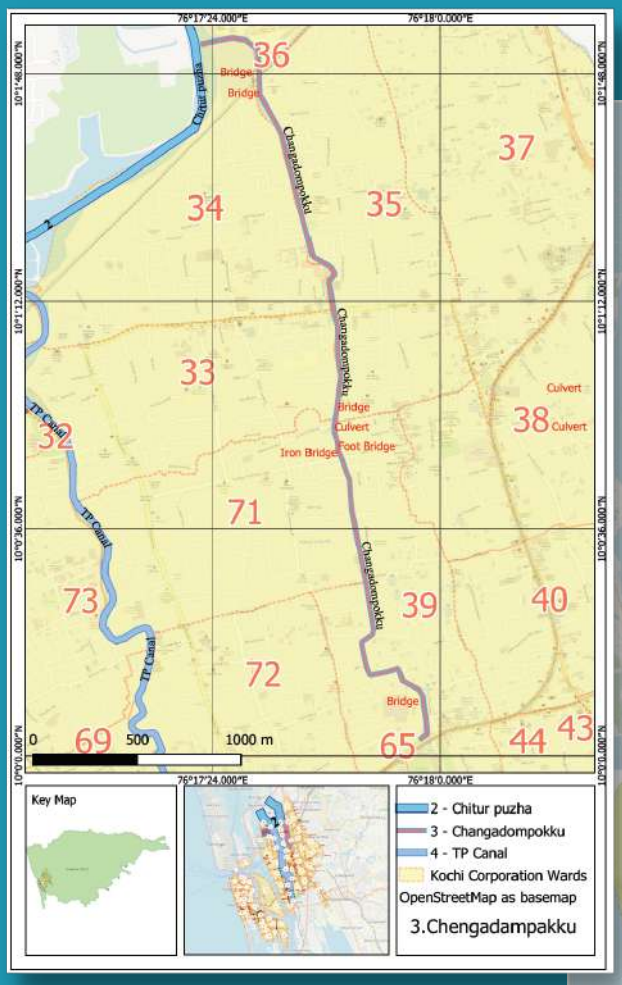
Box Culvert to Karanakodam thodu
** Fully blocked
Ch.719m
Latitude:9.980623
Longitude:76.303687

West end of marshalling yard thodu
Portion joining Karanakodam Thodu
Ch.1451m
Latitude:9.980525
Longitude:76.297217

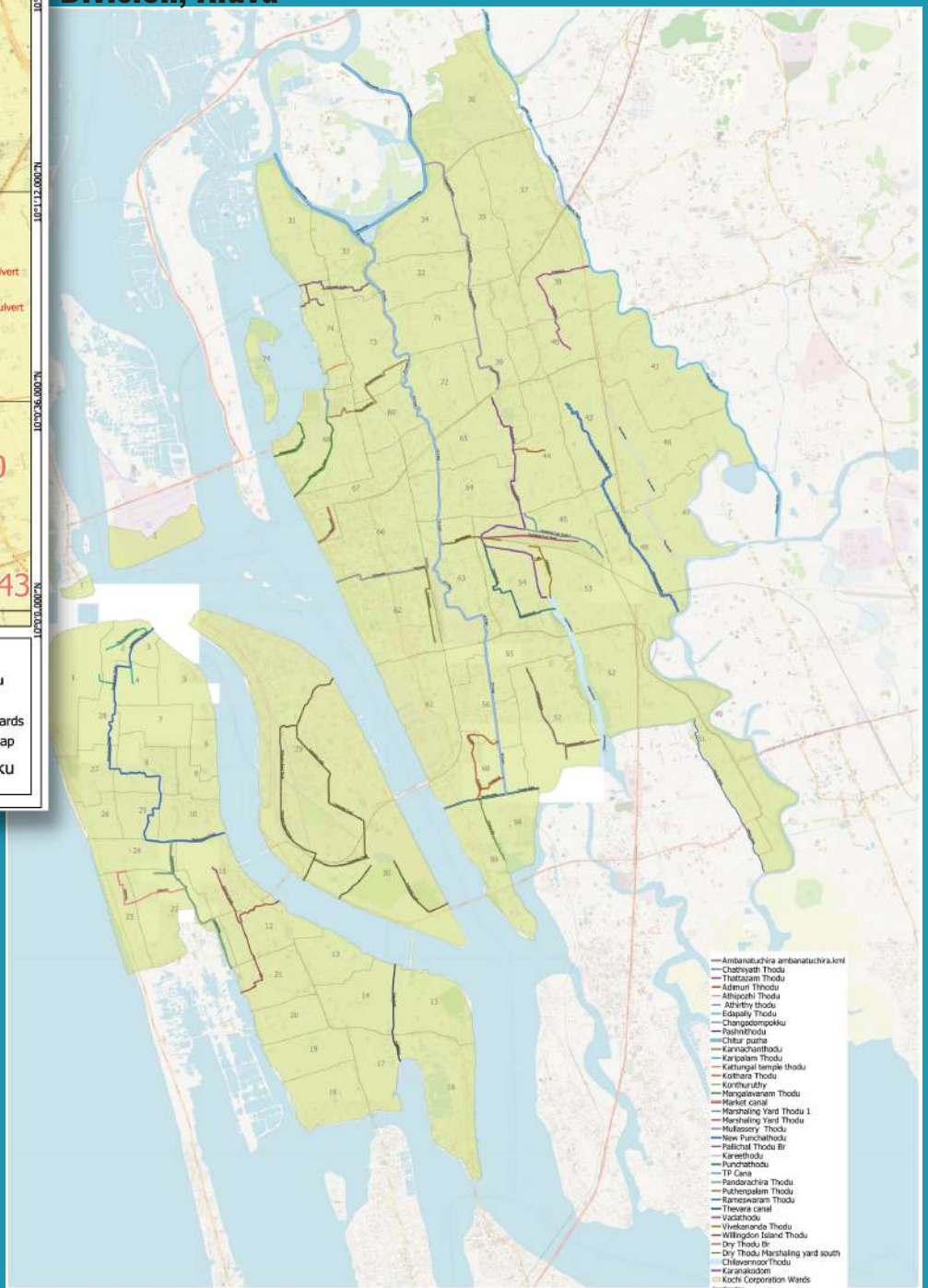
Marshy Land starting point of thodu (east side of marshalling yard)
Ch.0m
Latitude:9.980032
Longitude:76.310193

CHANGADAMPOKKU THODU

KOCHI
FLOOD MITIGATION



In-charge: Er.Rajan E. A, | Executive Engineer | PVIP Division, Aluva



IRRIGATION DEPARTMENT
ERNAKULAM

CHANGADOMPOKKU THODU

INTRODUCTION

Kochi city lies almost par with the Sea level and hence the drainage in Kochi deserves much importance as well as more sensitive also. The average altitude of Kochi ranges from +7.50m to +1.00m above MSL from east to west. A number of main and secondary canals criss - cross the area, some were used for transportation in the past and now subjected to severe environmental degradation due to waste dumping. The canals are exhausted withdrastic reduction in water carrying capacity due to rampant encroachment.

1. HISTORY

The major canals which acts as artery to the Kochi city viz. Thevara -perandoor canal, Edappallythodu, lies in north west direction. The Changadampokku thodu and Karanakkodam thodu connecting Perandoor Puzha and Chilavannoor Kayal flows in between them have a total length of 9 Km. This 9 km thodu was early known as Chillavanoor thodu. The family of Kochi Maharaja used this water way to travel from Thripunithara to Kodungallur via Chittor puzha.

As the name of thodu implies, large wooden rafts " Changadams " was plying through this canal in ancient years for conveying materials from Perandoor river.The elderly folks in the city recount stories in this regard,but due to the rampantencroachments and unscientific developments of different agencies, the course of canal was changed drastically to a shadow, once it had.

The connectivity of two canals were lostin the devcelopments happened at Kaloor . Now , the thodu from KSEB sub station Kaloor to Perandoor puzha is named as Changadampokku thodu (4.10 km) and rest from JLN metro station to Chilavannoor kayal is known as Karanakodam thodu.

Chengadampokku thodu passes through the boundaries of Divisions 39,70,71,35,34,33 of Kochi Municipalcorporation.This thodu facilitate drainage of water from the northern part of Kochi Corporation to Perandoor puzha.The width of the thodu at Jawaharlal Nehru Stadium is 2.70m and it varies up to 2.4m at certain stretches before Keerthi Nagar, and gains an average width of 14.00m near Edappally Raghavan Pillai Road.

2. PROBLEMS

The flood affected regions during the high intensity rain occurred on Oct 21st , 2019 (19cm rainfall) are ascertained from the discussion made with the residents are the following.

KSEB sub station , Kallamparambil road, George Eden road, Tagore st., Nalukandam lane, Ammu sahib colony, NPS road, Pottakuzhi Mamangalam road, Karukappilly lane, Vellakkadaparambu lane, South Keerthi Nagar, Keerthi nagar ,South Bhavans road, Edappally Raghavan road, Rajeev nagar, Karama road , Mulakkil ,Mercy lane,Prashanthi lane,Makkaparambu lane .

Flood threat regions adjacent to the thodu and that are mostly affected are KSEB substation compound, National Public School road and Pottakuzhi - Mamangalam road.

3. REASONS

The vast area of marshy land once available at the Sub station area, JLN stadium and on either sides of the thodu was vanished as part of development. These areas were act as flood absorbing pockets and the run off from high intensity rain could not be drained easily to the Perandoor river through the Changadampokkuthodu for a distanceof 4km due to the impediments, discussedbelow. If the rain is occurred during spring tide the recession of flood water will take more time, naturally the low lying area will easily get inundated.

3.1 LOST CONNECTIVITY BETWEEN KARANAKODAM AND CHANGADOMPOKKU THODU

The catchment area of the Chengadampokkuthodu is about 9.50 Sq. Km. The run off from the entire area has to be drained to the Perandoor lake through the Changadampokku thodu. The canals, Changadampokku & Karanakkodam were the north and south part of a single canal having flow in either direction due to tidal variation. During the construction of JLN stadium, the alignment of Karanakkodam thodu was shifted towards west direction, adjacent to the VIP road. The connectivity of the two canals were lost, near KSEB sub station Kaloor.The water from drains parallel to the Banerjee road from east and west direction and the drains from Vasanth Nagar and Kollamparambu road empties in to the Changadampokku thodu at KSEB compound. The entire quantity of water has to be drained through the Changadampokku thodu .

Last year (2020) Kochi Metro Rail Limited (KMRL) has laid two pipes of 900mm dia to connect the Karanakkodam and Changadompokku Thodu. But this was not effective and during May 2021 rains ,the sub station compound was flooded again and flooding was controlled by pumping the water to Karanakodom thodu .

Choked leading drain outside the entrance of substation that supposed to lead water from Changadompokku to Karanakodam

3.2SHARP DEVIATIONS DUE TO CHANGE IN ALIGNMENT AND ENCROACHMENT

The thodu have four numbers of sharp deviations with in 350m between Ch. 265mand ch.615m .The width of thodu reduced to 2.40 m between Greenz Villa and Comrade Nagar. Frequent deposit of silt is formed at these turnings.

Rear side of substation

U/s of George Eden Road

D/s of George Eden Road

3.3UTILITY PIPES CROSSING THODU

The utility pipes belongs to KSEB/ KWA/ BSNL etc.crossing the drain at different locations obstructing the free flow of water, especially during flood season. The pipes laying through the water surface of the thodu has to be lifted, leaving a clear headroom to accommodate flood water. The following locations are prone to flooding due to the obstruction of utility pipes.

Bhagyadhara culvert

Keerthi nagar Culvert

Bhagyadhara culvert 1

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Bhagyadhara culvert 1

Keerthi nagar Culvert

Edapally Raghavan Pillai road culvert

3.4 EXISTING CULVERTS HAVING NO HEAD ROOM AND VENT WAY

Ventway of the thodu is narrowed at the existing culverts viz. Keerthy Nagar culvert, Slabs laid across the thodu for private entry at Brush lane, Elamakkara railway bridge etc., which causes accumulation of wastes and finally blocking the flow of water.

Private entry at Brush lane

Keerthi nagar Culvert

Elamakkara Railway Bridge

3.5 ENCROACHMENTS

Encroachments of the thodu is suspected at several locations.There is a drastic reduction in water carrying capacity of thodu due to rampant encroachment . Slabs are constructed indiscriminately by the public over the thodu at several locations belongs to their premises without enough head room and utility pipes crossing under the slabs. It will be a bottle neck to the cleaning process. There are eight private entries across the thodu within 200m at Brush lane.

Keerthi Nagar

Brush Lane

3.6 CONVERSION OF THODU TO ROAD

The present practice of the LSGD wing to convert the thodu to road by covering with concrete slab. This will accelerate clogging of drain, which will prevent the free flow of water. Future cleaning of thodu will be cumbersome on account of this. The concreting of bed of natural thodu is not advisable.Nearly 400m of thodu has converted to covered concrete thodu between ch.350 m and Ch.1045m. Concreting the natural bed of thodu will prevent the seepage of water through ground thus increasing the risk of flooding.

60m covered thodu at Comrade nagar

350m covered thodu (Amruth Project)from comrade nagar to Pottakuzhi Mamangalam road

3.7 DISPOSAL OF WASTE WATER TO THE NATURAL DRAIN

The catchment area of this thodu is densely populated and hence the thodu is subjected to variety of pollutants such as municipal sewage, organic , plastic wastes etc. The thodu is observed to receive household sewage along its entire length. Stringent measures need to be taken to prevent discharge of such wastes and sewage to the thodu .

Comrade Nagar

4. REMEDIES PROPOSED AS LONG TERM AND SHORT TERM MEASURE.

Long term measure

- Connectivity to the two canals, Changadampokku & Karanakkodam shall be restored by constructing a drain having a minimum width of 4.00 m from the sub station compound by crossing Banerjee road adjacent to the Metro station so as to facilitate the flow in either direction.
- The thodu has to be rejuvenated to its original shape after demarcating boundaries and evicting encroachments. The width of thodu upto ch.1700m (BTS road) varies from 2.4m to 4.5m . The average runoff during a 10cm rainfall upto ch.1700m is about 8.7m3 /sec. Hence the minimum inside width required from ch.0m to 1700m is 7m. The present carrying capacity of the thodu is insufficient and has to be increased by eviction/ acquisition of land. By increasing the width , sharp deviations will be streamlined .
- Reconstruct the existing culverts having no head room and vent way .
- Private entries at Brush lane across the thodu to each plot shall be removed and form road/foot path along the right bund of the thodu for their entry to their plot .Guidelines shall be formed for constructions along and across the thodu and shall be strictly complied.
- All covered thodu portions shall be opened as the concreting the bed of natural thodu is not recommended.
- Provide high capacity pumps with shutter arrangements to drain out flood water to the lake so as to combat the tidal variations, ensuring its periodic maintenance.
- Inter linking of parallel canals by widening the existing natural stream for easy drainage.
- The rivers & lakes encompassing the main lands have to be desilted regularly in order to accommodate the flood water.Water storage capacity of puzha receiving thodu (Perendoor canal and Chittor puzha) shall be increased by desilting so as to reduce the travelling time of runoff water to kayal and to reduce the tidal inflow of water towards the thodu.

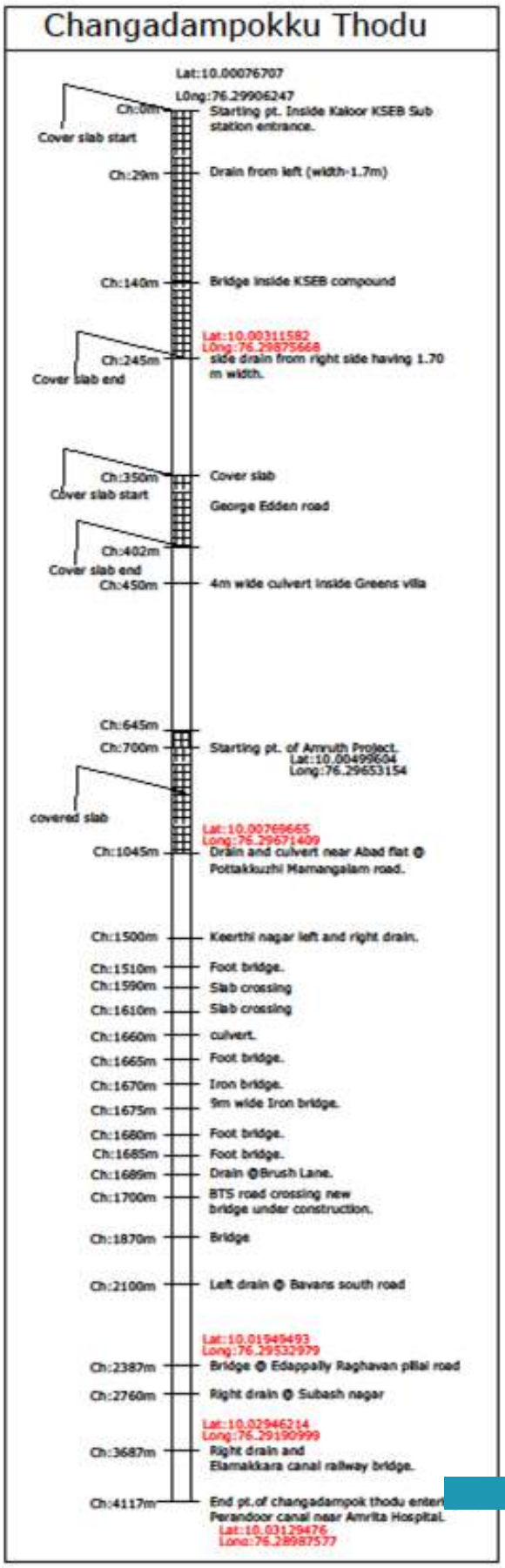
Short term measure

- Periodic desilting and cleaning of Changadampokkuthodu at the entire stretch to drain the flood water more effectively.
- Corporation shall not encourage the conversion of natural thodu to concrete thodus
- Remove the pipe lines of KWA,KSEB & BSNL which passes through the water surface of the canal.

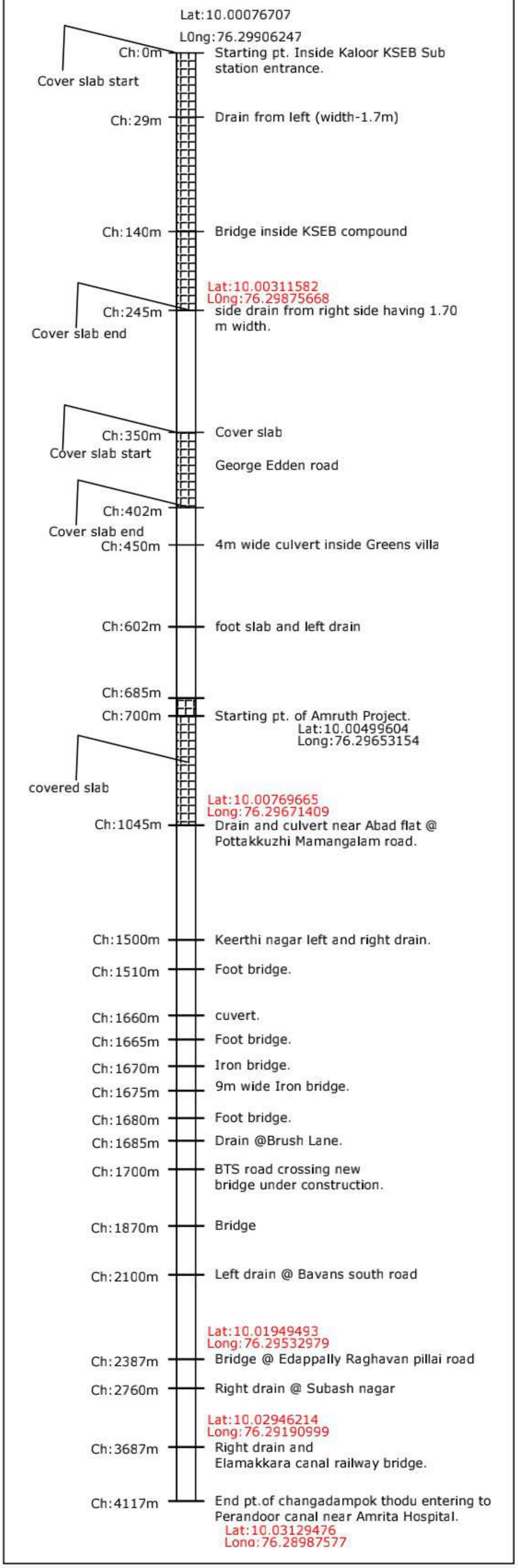
5. CONCLUSION/ RECOMMENDATIONS

A detailed study on waterlogging is essential to formulate long term strategies based on properhydrological study. A scientific study of discharge of drains emptying in to the thodu and the run off data of the catchment area at different rainfall intensity has to be arrived and the carrying capacity of the thodu has to be redesigned and to maintain proper section by evicting the encroachment if any or acquisition of land. The velocity of flow can be increased by engaging high capacity pumpsespecially during flash flood. Dumping of waste and disposal of waste water from houses directly to the thodu lead to environmental degradation posing threat to public health. Properawareness has to be given to the public to curb this menace.

6. Schematic Diagram

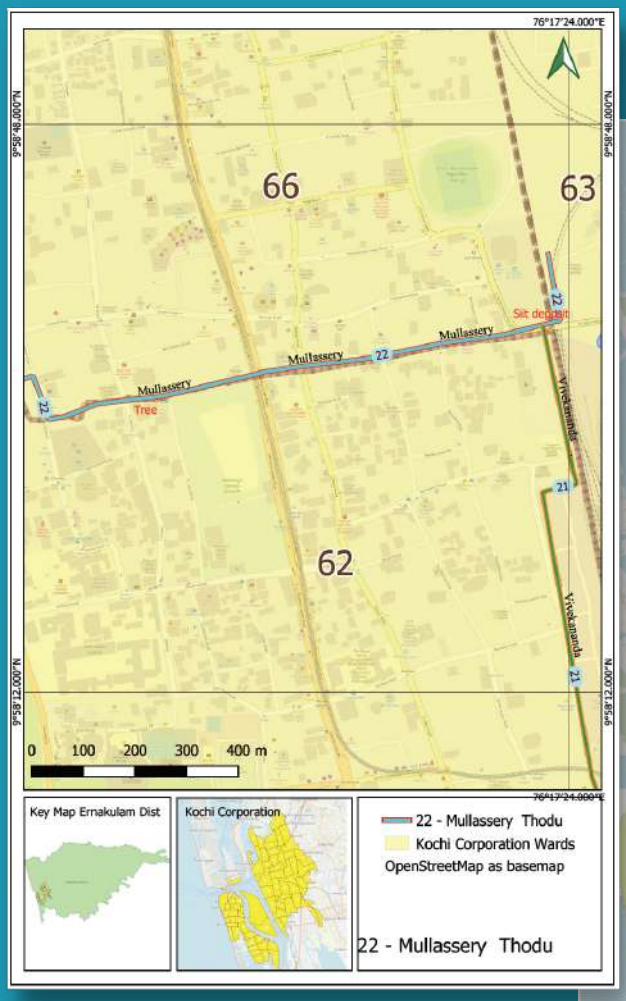


Changadampokku Thodu



MULLASSERY THODU

KOCHI
FLOOD MITIGATION



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IRRIGATION DEPARTMENT
ERNAKULAM

MULLASSERY CANAL

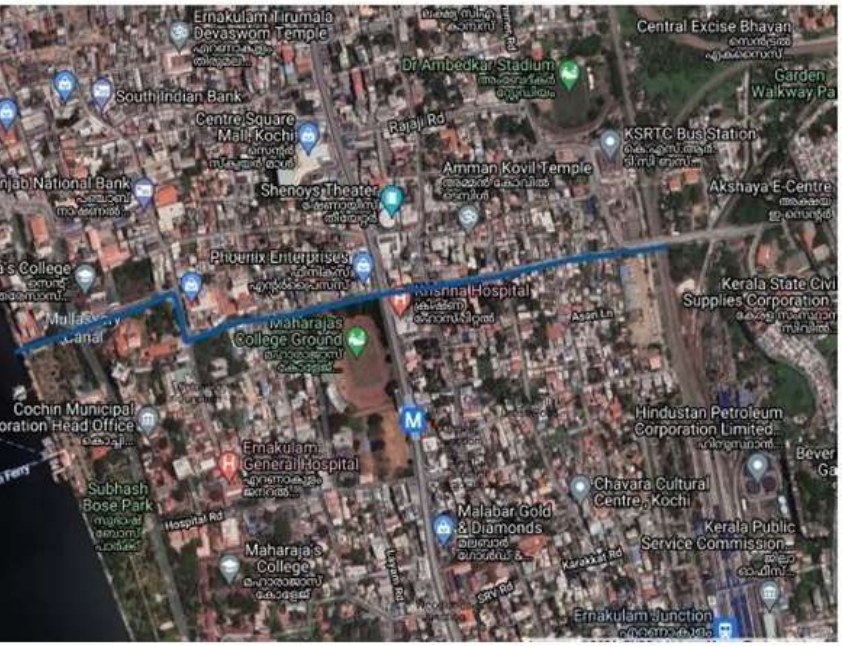
BRIEF OVERVIEW

Mullassery Canal is a 1.4 km long waterbody passing through prime commercial area of Kochi city in east-west direction. It starts from Perandoor Canal near KSRTC bus station, Ernakulam and discharges into Kayal near Childrens' park at Marine drive. The canal has been widely exploited for sake of urban development . The width of the canal is varying from 3m at its initial stretch to 12m at its mouth near Kayal.Most portions of the canal are covered by concrete slabs and are being used as roadway, parking space, access to commercial establishments/residences etc. Only approx 600m stretch of canal near its mouth at Kayal is in open condition presently. Many shops are seen perched right on top of canal along the A K Seshadri road. The canal starts from Perandoor canal near A L Jacob Railway over bridge and traverses towards west along Mullassery Canal road and afterwards crossing major roads such as Chittoor road , MG road, TD road , Market road, Park Avenue road and discharges into Kayal near Marinedrive.

SALIENT FEATURES OF MULLASSERY CANAL:

Starting point	From Perandoor Canal near KSRTC bus station/ South Railway Station,Ernakulam
Direction	**East- West**
End point	**At Kayal near Childrens' park near Marinedrive**
Length	**Approx 1.4km (Covered portion in initial reach -800m, Open portion near end at Kayal - 600m)**
Width	**varying from 1.5m to 12m**

MULLASSERY CANAL - LOCATION MAP



MULLASSERY CANAL- SATELLITE VIEW

PROBLEMS IDENTIFIED

Runoff water from a large drainage area in central area of Ernakulam city gets accumulated in the naturally low lying area near KSRTC bus station. Moreover, this is a junction point of Perandoor Canal, Mullassery canal, branch of Karanakodam thodu, Vivekananda thodu and KSRTC thodu. The water accumulating in this area has to exit to Kayal through the following three exit points. Respective distances of following exit points from KSRTC bus station is given in brackets.

1. Mouth of Mullassery Canal at Kayal near Childrens' Park, Marine drive(1.4 km)
2. Southern Mouth of Perandoor Canal near Thevara Kayal (5.14 km)
3. Through Karanakodam thodu near Mouth at Chilavannoor Lake near Tank Bund road (4.7 km)

As the mouth of Mullassery Canal is the nearest outlet to Kayal from KSRTC bus station area, this canal is expected to relieve the low lying area near KSRTC bus station from flooding by discharging the rainwater runoff in this area through its nearest outlet . However , the bed of Mullassery canal in its initial reach near Swami Vivekananda road is found to be approx 1.1 m above the bed at its starting point near rail line. Also the present bed slope of the Mullassery canal in the initial reach of 337m is found to be towards east side i.e. towards KSRTC bus station and hence this results in accumulation of flood water in the bus station and South Railway station premises during rainy season. This also results in increased discharge into Perandoor canal thereby causing flooding in Kammattipadam area and along the stretch of Perandoor canal .

The existing pumping mechanism at the starting point of Mullasssery canal near KSRTC bus station has not proven effective in preventing flooding in this area.

Heavy accumulation of wastes is observed in the area where Perandoor canal crosses rail line near KSRTC bus station. The clogged rail culvert aggravates the flooding problem in this area.

Most reaches of Mullassery canal are covered by concrete slabs. Hence entry of rainwater runoff from adjacent streets into the canal is found to be minimal. The runoff water from streets get collected in the low lying area near KSRTC bus station causing waterlogging and also increasing the load on Perandoor canal which is incapable of receiving this excess drainage.

Many shops are seen constructed over the covered portion of Mullassery canal along A K Seshadri road completely blocking entry of runoff rain water from adjacent areas into the canal.

The open reach of thodu from TD road at ch 800m upto end at Kayal is found to be silted up .

The site sketch of the canal showing prominent landmarks and features at various chainages along the canal and the longitudinal section of the canal is as follows.

SITE PHOTOS

STARTING POINT OF MULLASSERY CANAL NEAR KSRTC BUS STATION

OBSTRUCTED RAIL CULVERT NEAR STARTING POINT OF MULLASSERY CANAL

COVERED MULLASSERY CANAL ALONG MULLASSERY CANAL ROAD

COMMERCIAL/RESIDENTIAL BUILDINGS ALONG MULLASSERY CANAL ROAD

SHOPS BUILT OVER MULLASSERY CANAL ALONG A K SESHADRI ROAD

OPEN CANAL STARTING NEAR TD ROAD

MULLASSERY CANAL NEAR MARKET ROAD- EAST SIDE

MULLASSERY CANAL NEAR MARKET ROAD- WEST SIDE

REGULATOR NEAR ST. TERESAS COLLEGE

MULLASSERY CANAL NEAR KAYAL MOUTH

PROPOSED SOLUTION:

- Effecting natural drainage by gravity to the nearest outlet is the most viable solution for preventing flooding up of water in KSRTC/South Railway station area. Modifying the existing raised bed of Mullassery canal near KSRTC bus station area and by effecting proper gradient towards Kayal , flooding in this area can be avoided.
- The whole length of canal covered by slabs i.e the initial 810 m reach from KSRTC bus stand upto TD road needs to be reconstructed. To effect unobstructed flow of water, the bed level of Mullassery canal has to be lowered at least to the bed level of adjacent Perandoor canal . For effecting this, bed of Mullassery canal has to be lowered by an average depth of 1.25m . The width of the canal also has to be at least 4m . In the reaches where the existing width is less, the canal has to be widened to accommodate discharge.
- The open canal portion from TD road to Kayal (approx 600m) needs to be desilted for effecting speedy drainage.
- The rail culvert connecting Perandoor Canal to Mullassery canal needs to be regularly kept free of obstruction as this is a juncture point of many water bodies and drains .
- All illegal constructions along the full reach of canal blocking the flow of runoff water along road into the canal have to be removed.

CHALLENGES IN WORK EXECUTION:

MULLASSERY CANAL NEAR CHILDREN'S PARK

- ➢ Major slope correction issues are observed in the initial stretch of Mullassery canal for a length of approx 810m from KSRTC bus station to TD road . It is proposed to demolish and reconstruct the canal in this stretch for an approx length of 810m. Presently the canal is covered by cover slabs and the area above canal also forms part of roadway. Mullassery canal road is used by KSRTC buses as connection between bus station and bus garage area. The road along Mullassery canal serves as an important and busy connecting link from KSRTC bus station area to major roads like Chittoor road, MG road etc. There are colony of various types of commercial establishments along Mullassery canal road, the access to which are made directly from the presently covered up stretch of Mullassery canal . While demolishing the existing bed and side walls of the canal for slope correction, the access to these commercial establishments will be lost . Cooperation from stakeholders in this regard will probably be challenging.

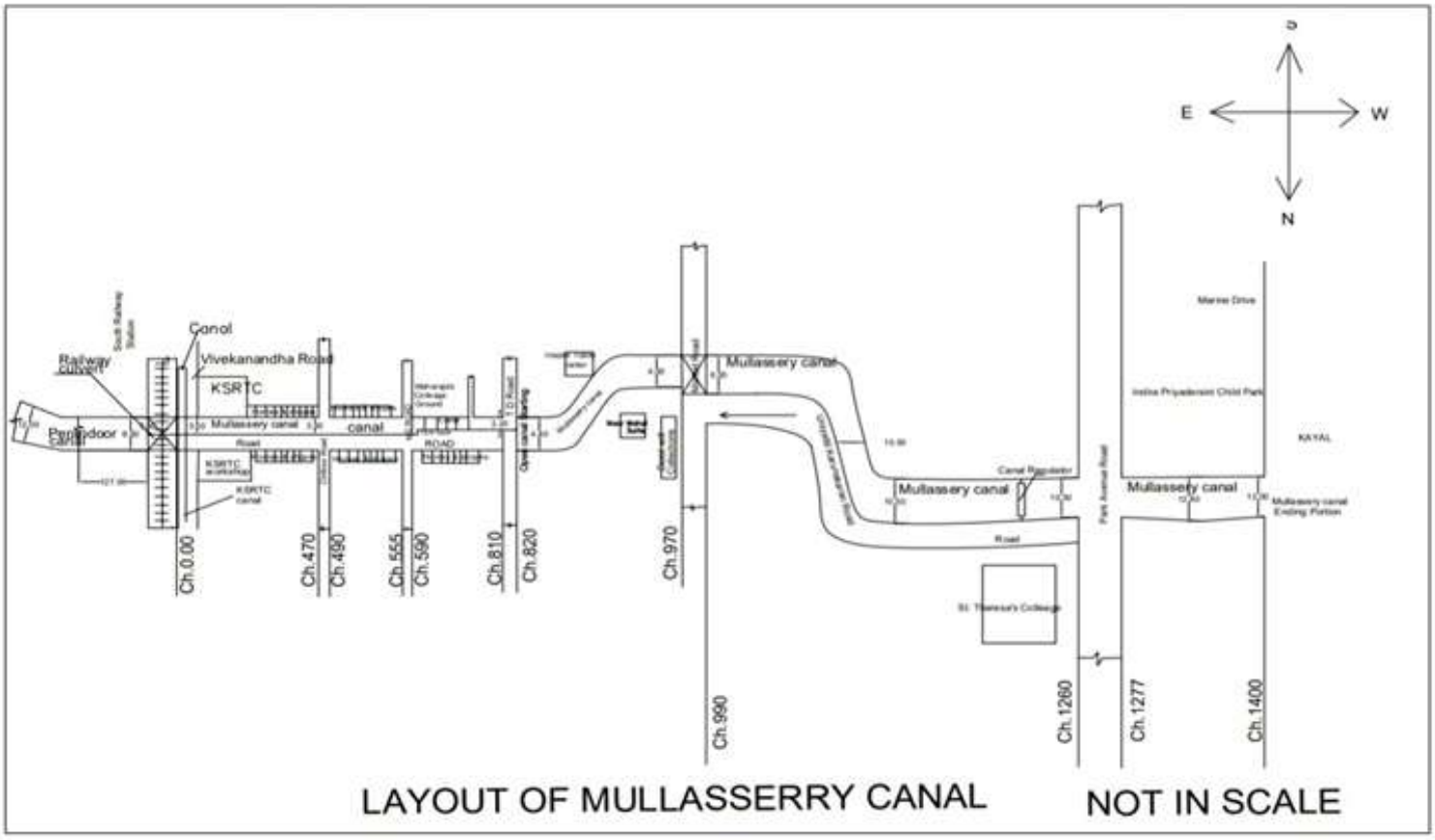
- ➢ To protect the commercial buildings and its compound walls built near the canal,sheet piling of sides along the length of canal is required which will be expensive but unavoidable.

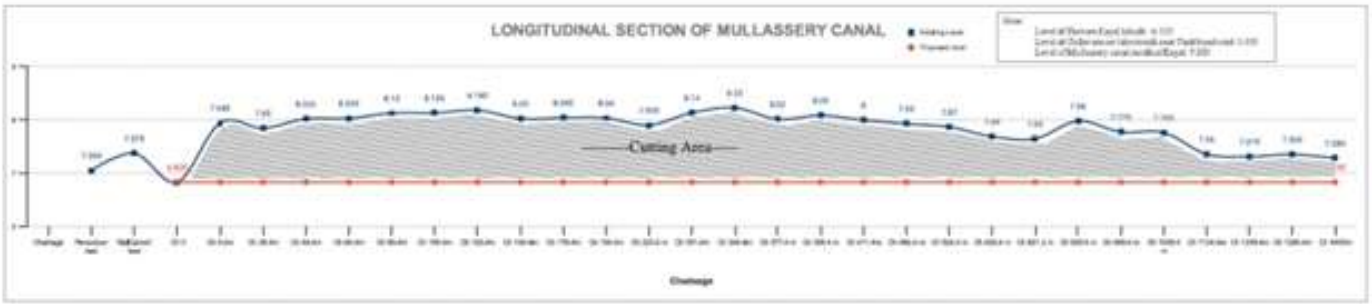
- ➢ Several shops are seen built over the covered slabs of Mullassery canal at various stretches especially along A K Seshadri road, thus blocking the entry of runoff water from roads into the canal resulting in waterlogging during rains. These shops will have to be removed for effecting proper drainage through the canal. Social impact of such action needs to be pondered.

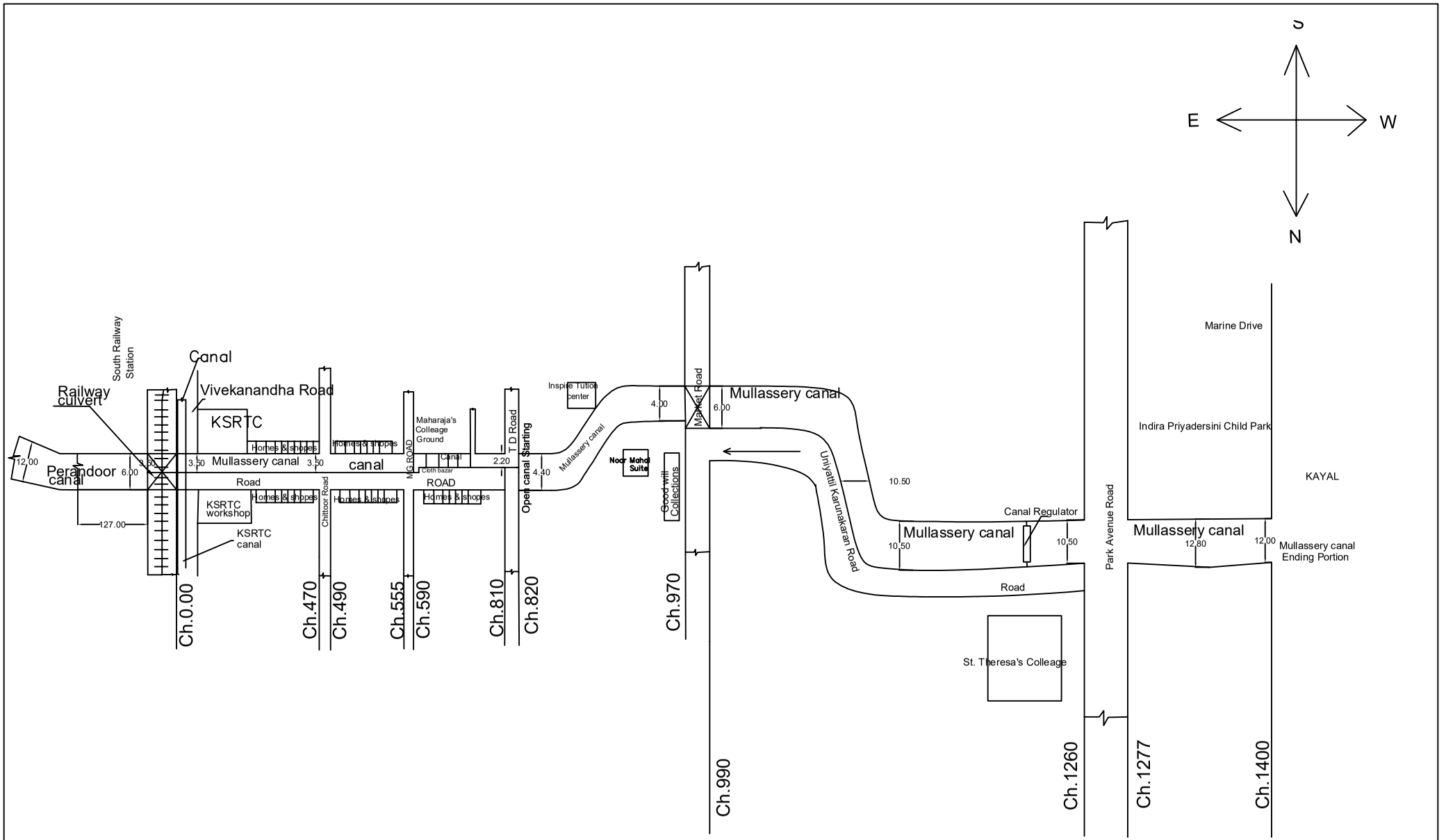
- ➢ To effect proper bed slope along the canal , reconstruction of canal is required to be carried out along and across major busy roads such as Chittoor road,MG road, TD road and Mullassery canal road near KSRTC stand. Traffic along these roads will have to interrupted for executing the work.

- ➢ The total expected cost for the renovation works are found to be 1000Lakhs.

LAYOUT OF MULLASSERY CANAL:





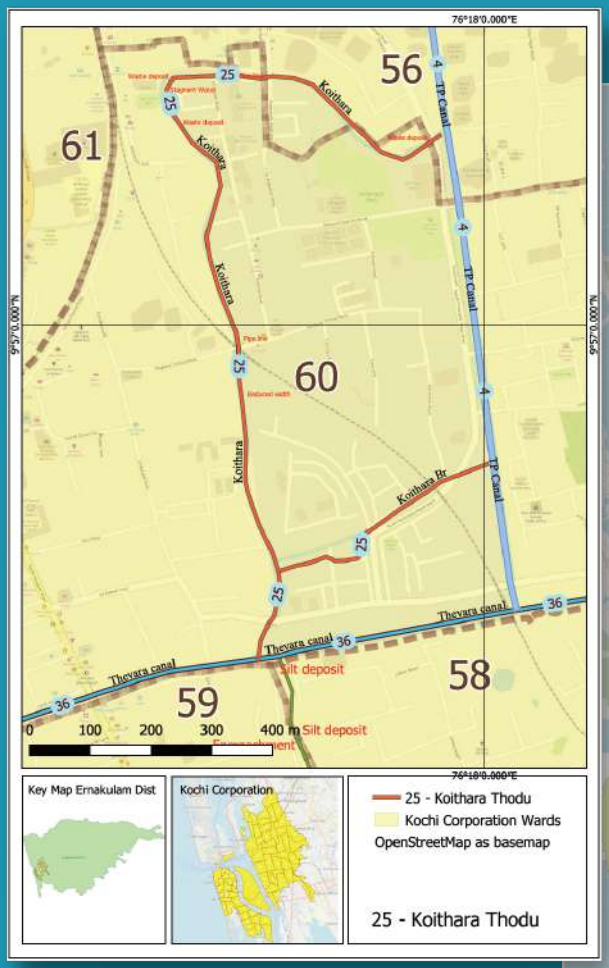


LAYOUT OF MULLASSERRY CANAL

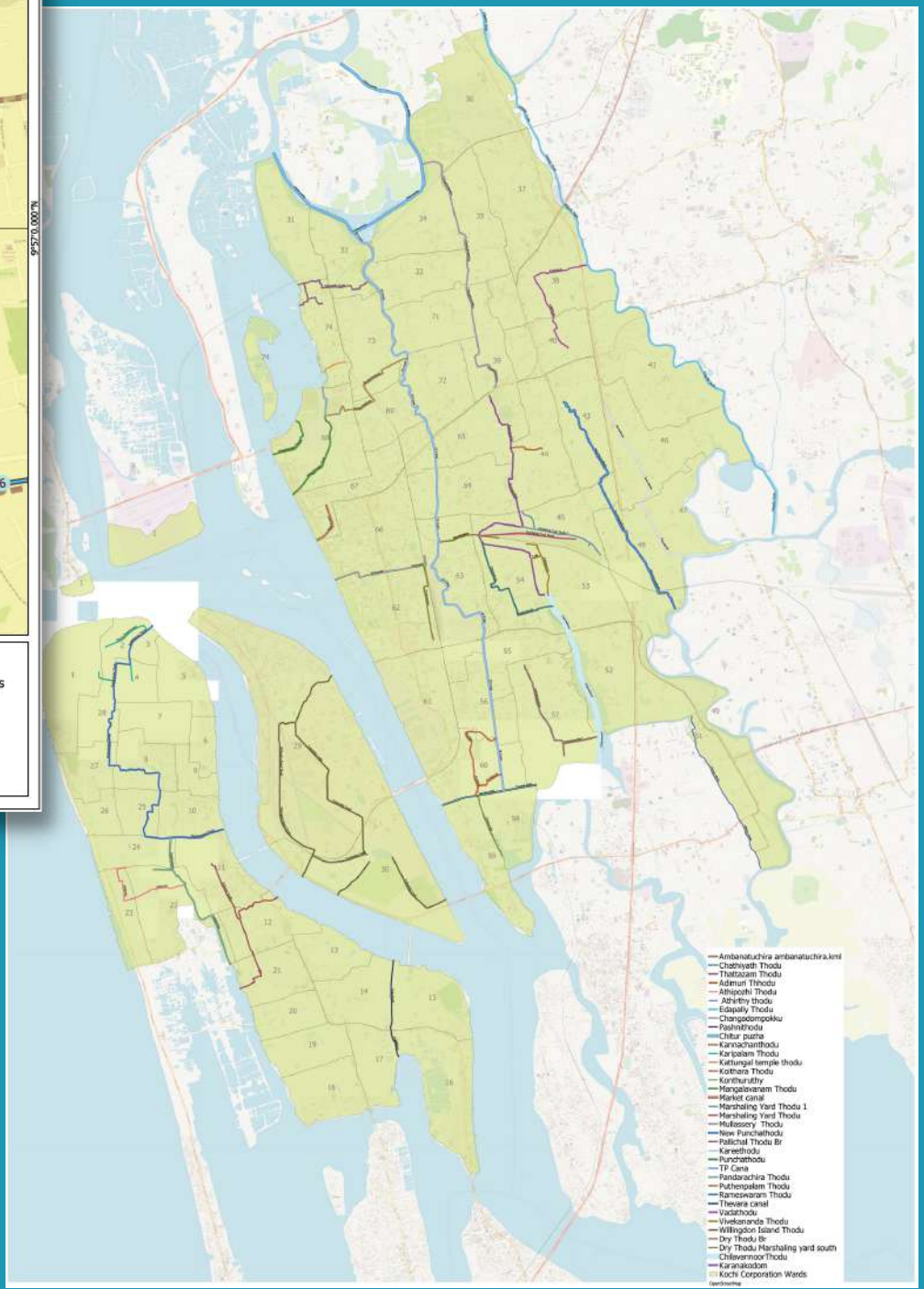
NOT IN SCALE

KOITHARA THODU

KOCHI
FLOOD MITIGATION



In-charge: Er.Dhanya K. | Asst. Executive Engineer | MI Sub Division Ernakulam



IRRIGATION DEPARTMENT
ERNAKULAM

KOITHARA CANAL

INITIAL STUDY REPORT

Koithara canal is a major canal passing through Panampilly Nagar in Kochi Corporation. The canal is 1.55 km long with an average width of 8m. It starts from Perandoor canal near Panampilly Nagar and discharges into Thevara canal. The width of canal varies from 3.5 m to 12m. The canal has four road crossings along its course which includes the Shihab Thangal road, road in front of IOC (Panampilly Nagar Park Ave), Varghese Thittayil road and Anamthuruth road.

There are housing colonies and other residential buildings situated on the banks of the canal. Waste water pipes from the houses of colonies are discharged directly in to the canal. The accumulation of organic and plastic has made the canal polluted. The width of canal reduces considerably at certain locations. It is seen that pipes and cables are laid across the canal in front of IOC, Varghese Thittayil Road culvert and Ananthuruth road culvert. This causes accumulation of waste materials at these locations and creates obstruction to the free flow of water.

A link canal starts from Ch. 1380 m of Koithara canal and discharges into Perandoor canal near KSEB substation. The link canal is having a length of 388m and width varying from 2.5m and 2m. The link canal is also having heavy silt deposit and the outlet of the canal towards Perandoor Canal is covered with thick vegetation.

SALIENT FEATURES

SALIENT FEATURES OF KOITHARA CANAL

STARTING POINT	Perandoor Canal near Panampilly Nagar.
ENDING POINT	Thevara Canal
LENGTH	1550m
WIDTH	Varying from 12 m to 3.5 m
CROSSINGS	4

SALIENT FEATURES OF KOITHARA LINK CANAL

STARTING POINT	Koithara Canal near Kasthurba Nagar.
ENDING POINT	Perandoor Canal
LENGTH	388m
WIDTH	Varying from 2.5 m to 2m
CROSSINGS	4

Koithara Canal near Varghese Thittayil Road

Koithara Canal near IOC

PROBLEMS IDENTIFIED

- Obstruction to free flow of water due to pipes/cables laid across the canal near culverts at Varghese Thittayil road and near culvert at Anamthuruth bridge.
- Pipes/cables laid across canal near bridge in front of IOC might cause obstruction to the free flow of water when the water level rises during continuous heavy rain.
- Reduced width of canal at some locations
- Discharge of waste water directly from the houses and disposal of solid wastes causing extreme poor water quality and unhealthy situation in the premises
- Link canal also heavily silted up and the outlet towards Perandoor Canal covered with thick vegetation
- Cables laid across the link canal near substation road causing hindrance to free flow of water

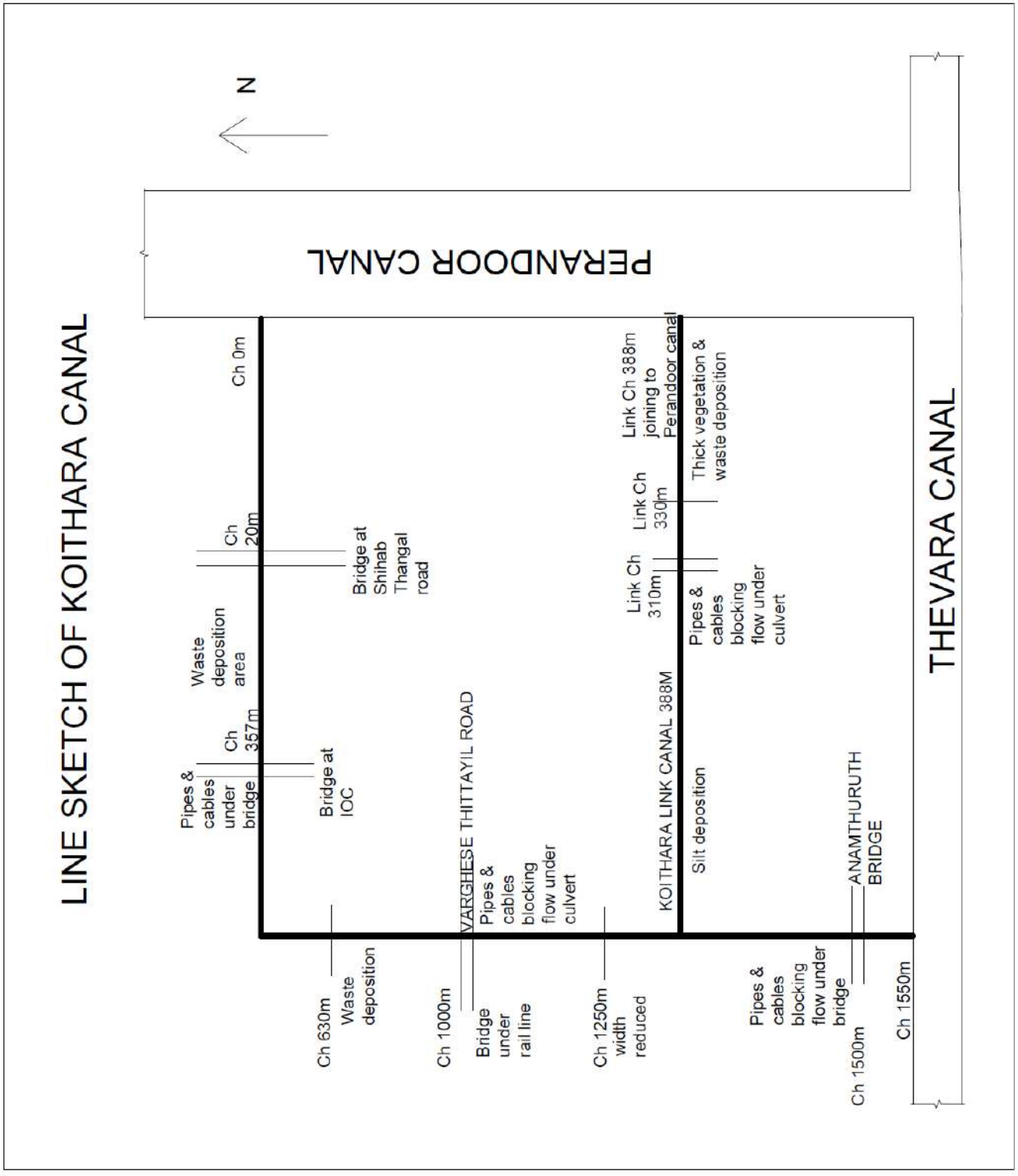
Koithara Link Canal

Outlet of Koithara Link Canal to Perandoor Canal

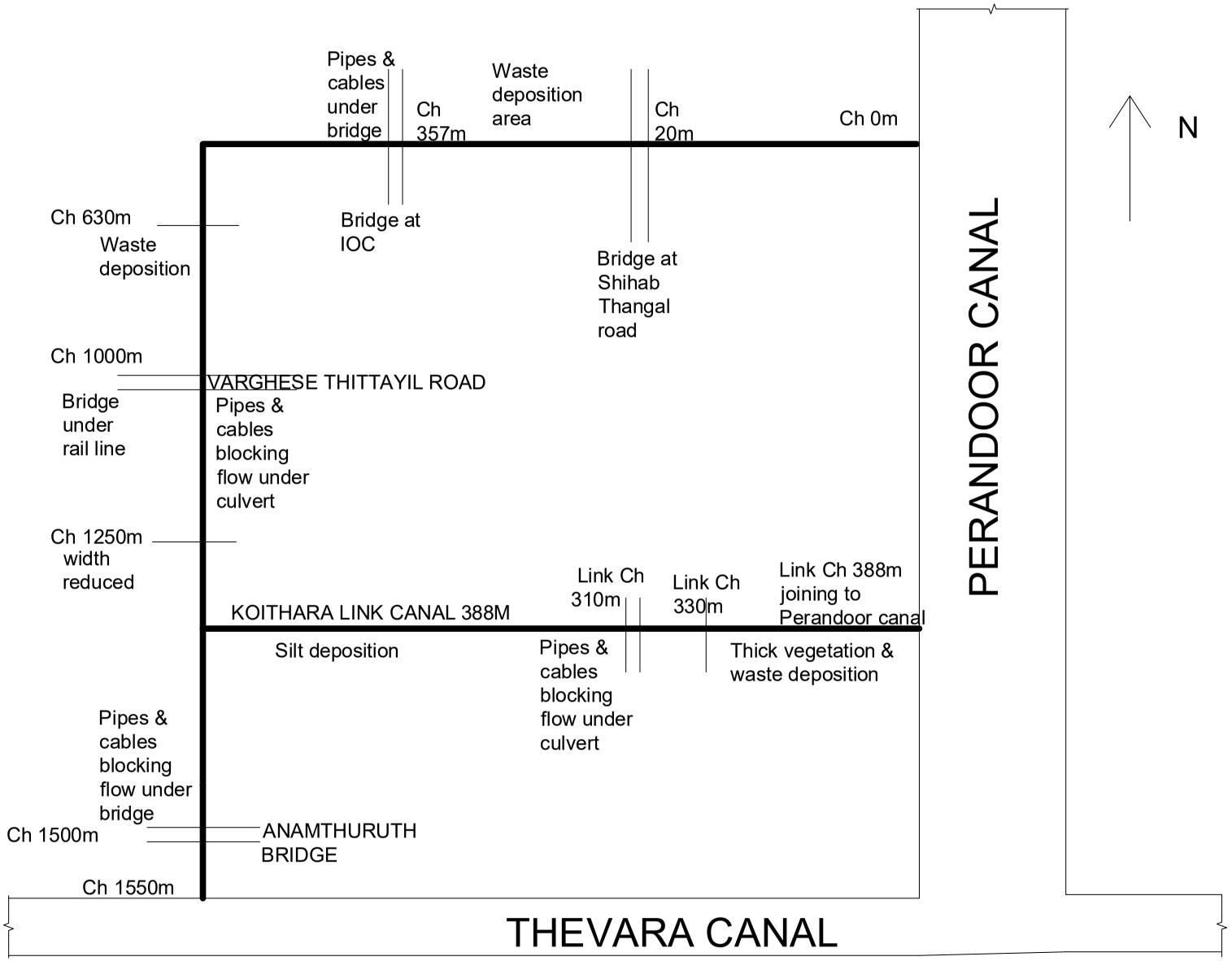
REMEDIAL MEASURES

The pipes /cables under the culverts are to be realigned to avoid accumulation of solid waste and to ensure free flow of water. Regular cleaning of the canal and its link is essential. Waste deposition in the canal has to be controlled by implementing proper waste management methods and enforcing stringent measures. Discharge of wastewater directly to the canal is also to be prevented to enhance the quality of water. Surveillance cameras shall be installed near the culvert under the railway line in Varghese Thittayil road, near IOC Panampillty Nagar, near Annamthuruth Bridge and selected locations near housing colonies.

LINE SKETCH

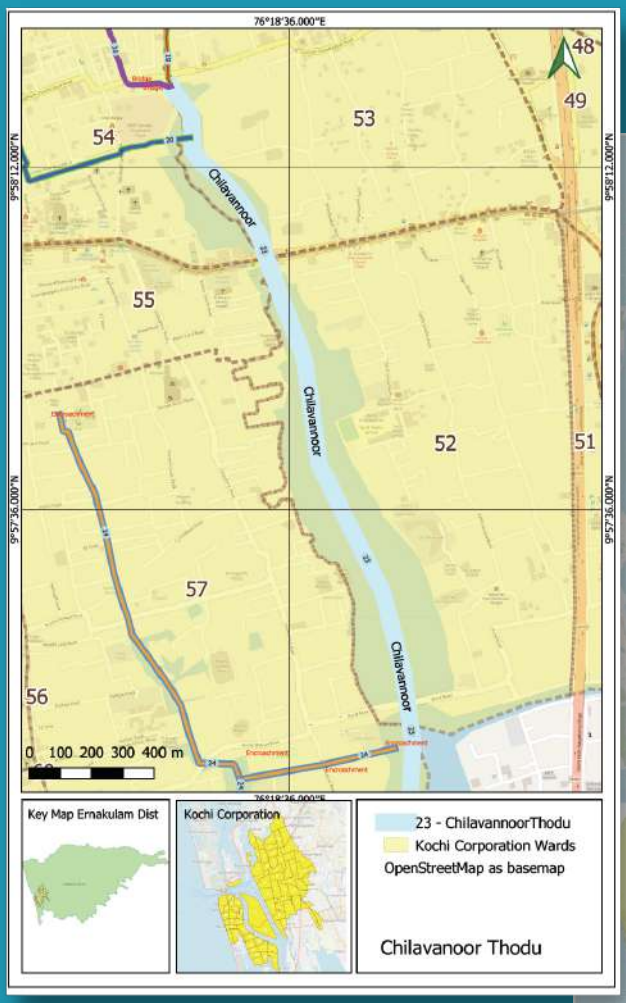

LINE SKETCH OF KOITHARA CANAL
N
PERANDOOR CANAL
THEVARA CANAL
Ch 0m
Ch 20m
Waste deposition area
Bridge at Shihab Thangal road
Pipes & cables under bridge
Ch 357m
Bridge at IOC
VARGHESE THITTAYIL ROAD
Ch 630m
Waste deposition
Ch 1000m
Bridge under rail line
Pipes & cables blocking flow under culvert
Ch 1250m
width reduced
KOITHARA LINK CANAL 388M
Link Ch 310m
Link Ch 330m
Link Ch 388m joining to Perandoor canal
Silt deposition
Pipes & cables blocking flow under culvert
Thick vegetation & waste deposition
Pipes & cables blocking flow under bridge
Ch 1500m
ANAMTHURUTH BRIDGE
Ch 1550m

LINE SKETCH OF KOITHARA CANAL

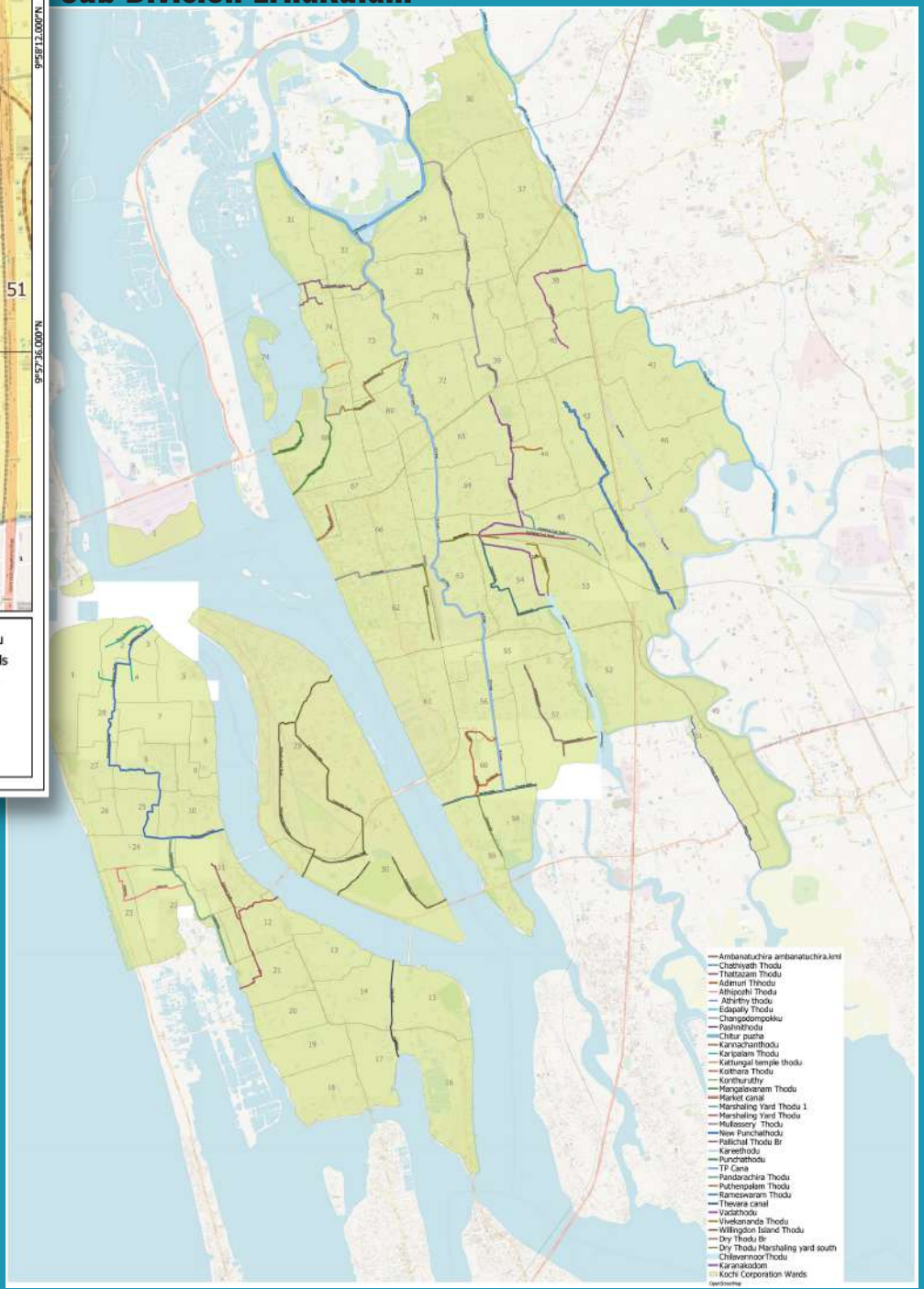


CHILAVANNOOR KAYAL

KOCHI
FLOOD MITIGATION



In-charge: Er.Dhanya K. | Asst. Executive Engineer | MI Sub Division Ernakulam



IRRIGATION DEPARTMENT
ERNAKULAM

CHILAVANNOOR LAKE

CHILAVANNOOR LAKE - GOOGLE MAP

INITIAL STUDY REPORT

Chilavannoor lake is a prominent waterbody located near Chilavannoor in the heart of the Kochi city. It is a part of the Vembanad backwaters. The GPS coordinates of the lake is 9.967189, 76.309145 .The Chilavannoor Lake extends from Subash Chandra Bose road towards south uptoChilavannoor bridge on Tank bund road . Near its starting point at Subash Chandra Bose road , two major thodus viz. Rail nagarthodu and Karanakodamthodu discharges into the Chilavannoor lake . Apart from this, two minor thodus STP thodu on western bank and Ambelipadamthodu on eastern bank also discharges into this lake. Elamkulam bridge is located at 660m downstream of this starting point. Two link thodus are found to be joining this lake near Elamkulam bridge. Those are SA road thodu on north -east side of Elamkulam bridge and ATS thodu on south-east side of Elamkulam bridge. During site inspection, it is observed that two small thodus -one to the north of Blue lagoon apartments and the otheralong Water Land road also joins to the lake on its western bank side .The Chilavannoor lake is heavily silted due to lack of proper maintenance . Hence the water carrying capacity of the lake has reduced immensely.

SALIENT FEATURES OF CHILAVANNOOR LAKE:

Start point	Near Subash Chandra Bose road bridge
Length	2.2 km
Width	Varying from 35m to 260m
Outlet	Near Chilavannoor bridge on Tank Bund road
No. of crossings/bridges	2
Water spread area between Subash Chandra bose road and Chilavannoor bridges	Approx 36 Ha

LINK THODUS CONNECTING TO CHILAVANNOOR LAKE:

Sl no	Name of link thodu	Latitude, Longitude	Chainage of Chilavannoor lake at which Link thodu is joining
1	Rail Nagar thodu	9.972742, 76.306448	Ch 0m
2	Karanakodam thodu	9.972510, 76.306084	Ch20m , western bank
3	Ambelipadam thodu	9.972328, 76.307108	Ch 60m, eastern bank
4	STP thodu	9.970857, 76.306794	Ch 225m, western bank
5	Panchavadi thodu	9.969691, 76.308740	Ch 465m , eastern bank
6	SA road thodu	9.967606, 76.309554	Ch 660m, eastern bank
7	ATS Thodu	9.967254, 76.309614	Ch 695m, eastern bank
8	Thodu to north of Blue Lagoon apartments	9.964962, 76.309004	Ch 960m, western bank
9	Water Land road thodu	9.962776, 76.309052	Ch 1205m, western bank

PROBLEMS IDENTIFIED DURING SITE INSPECTION

Waterlogging is experienced inmany areas along the banks during high tide periods especially in Panchavadi residential area along eastern bank, near Sewage treatment Plant area on western bank, near Gateway apartments on western bank etc.

Water hyacinth near Elamkulam bridge (ch 660m)

CHAINAGE 660M ELAMKULAM BRIDGE

Outlet of SA road thodu on north-east side of Elamkulam bridge

- The portion of lake under Elamkulam bridge is heavily silted up causing obstruction to flow. This needs to be cleared.
- Water hyacinth also obstructs flow in the portion near to Elamkulam bridge.
- A link thodu joins to lake at the north-east side of SA road near Elamkulam bridge. The outlet of this thodu is blocked with thick vegetation causing obstruction to flow.

CHAINAGE 695M

Outlet of ATS road thodu on south-east side of Elamkulam bridge

- At the south-east side of Elamkulam bridge a link thodu joins to lake near ATS vehicle service centre. The outlet of this link thodu is also completely blocked by thick vegetation.
- Delta formation is observed in lake near the south-east side of Elamkulam bridge

Apart from rains, during high tide periods the banks of Chilavannoor lake is facing waterlogging problems. The streets adjacent to banks such as Sunoroo church road and near Gateway apartments on the western bank get waterlogged during high tide period and water will recede only during low tide periods. As the Chilavannnoor lake is heavily silted up, water carrying capacity has decreased. Desiltation of lake will help to enhance the water carrying capacity and will reduce the chances of waterlogging in adjacent streets along banks.

CHAINAGE 695M

Chilavannoor lake- Remnants of old sluice under Tank bund road Chilavannoor bridge

- Remnants of old concrete sluice is observed under Chilavannoor bridge on Tank Bund road causing obstruction to flow.

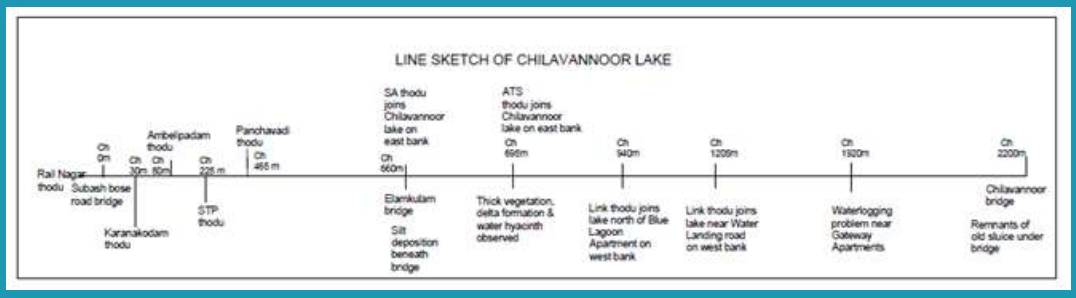
WATER CARRYING CAPACITY OF CHILAVANNOOR LAKE:

Water spread area of Chilavannoor lake = approx 36 Ha= 360000 m2
Average water holding depth = 3m
Water carrying capacity = 360000 x 3
= 1080000 m3

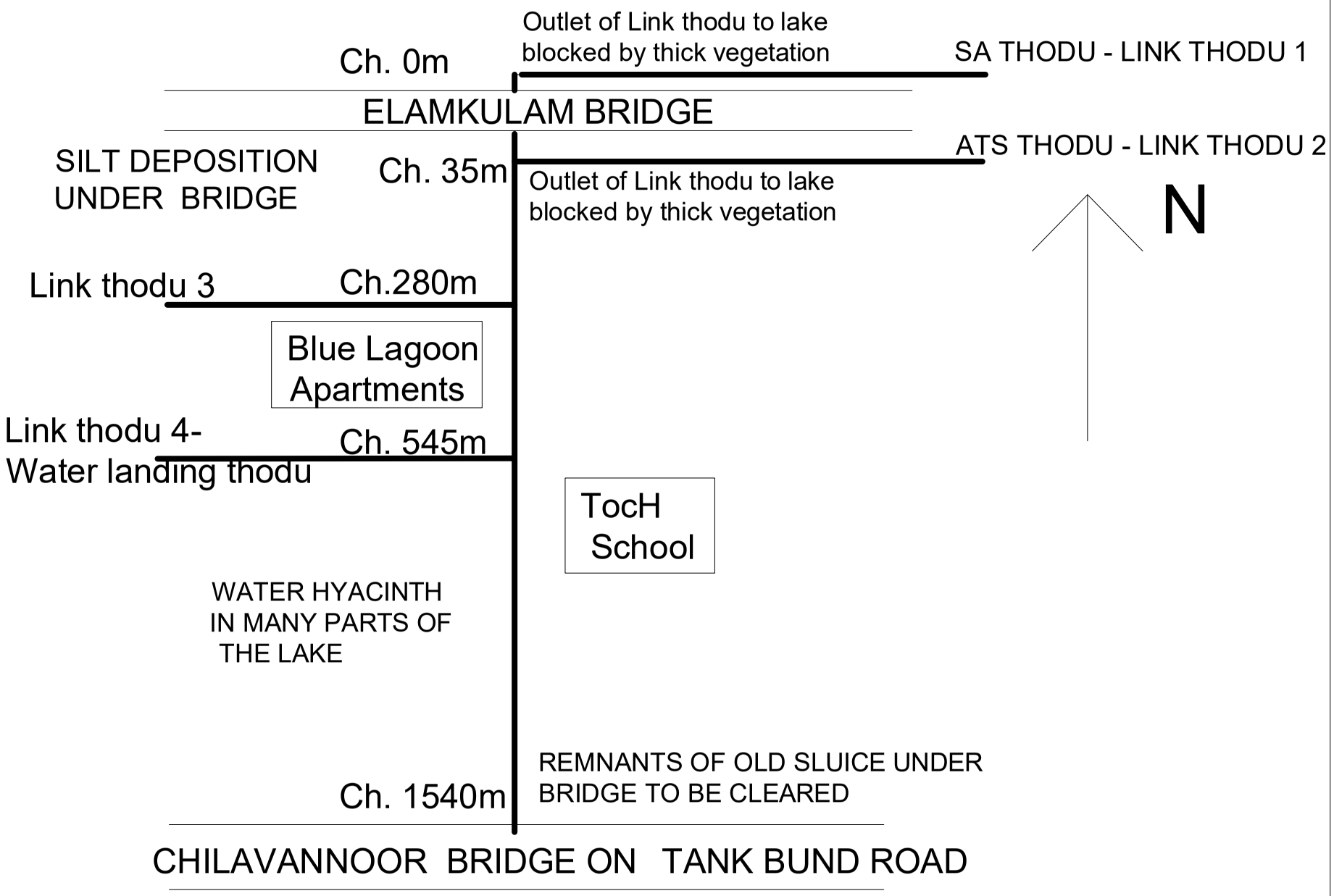
REMEDIAL MEASURES:

The obstructions under Elamkulam bridge and Chilavannoor bridge needs to be cleared to ensure free flow of water. The remnants of bund for formation of cycle track along western bank of Chilavannoor lake under Padmasarovaram project between Elamkulam bridge and Subash Chandra Bose bridge needs to be cleared.Desiltation of lake to be done to improve its water carrying capacity and also to effect speedy outflow. Waterlogging is experienced in certain areas adjacent to the lake especially near Gateway apartments on western bank even during high tide periods. A regulating mechanism can be provided at the outlet of the lake at Chilavannoor Tank bund road for regulating the inflow and outflow. Also the outlets of linkthodus to the lake are to be cleared to ensure speedy drainage of storm water.

LINE SKETCH



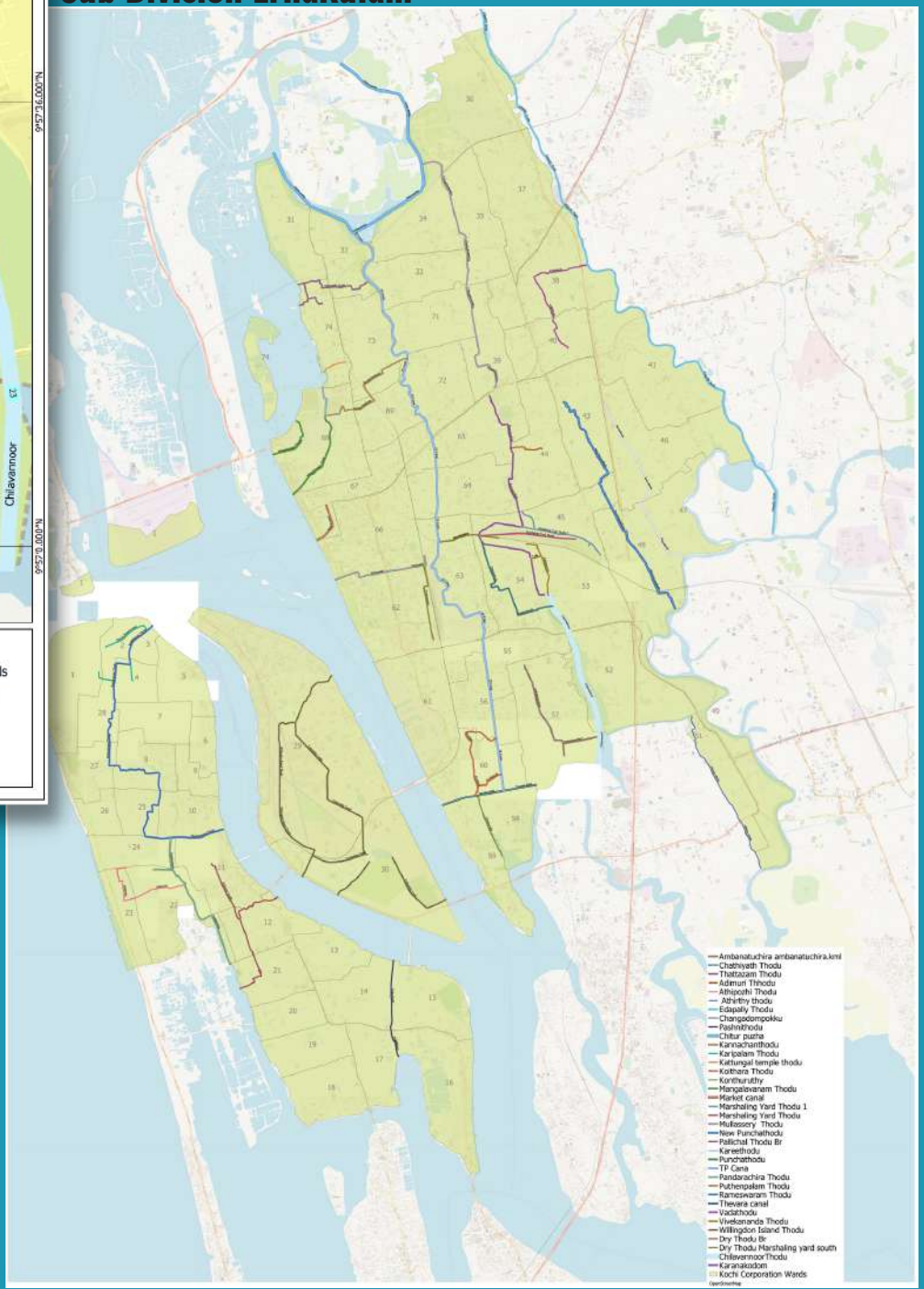
LINE SKETCH OF CHILAVANNOOR LAKE



AMBANATTUCHIRA

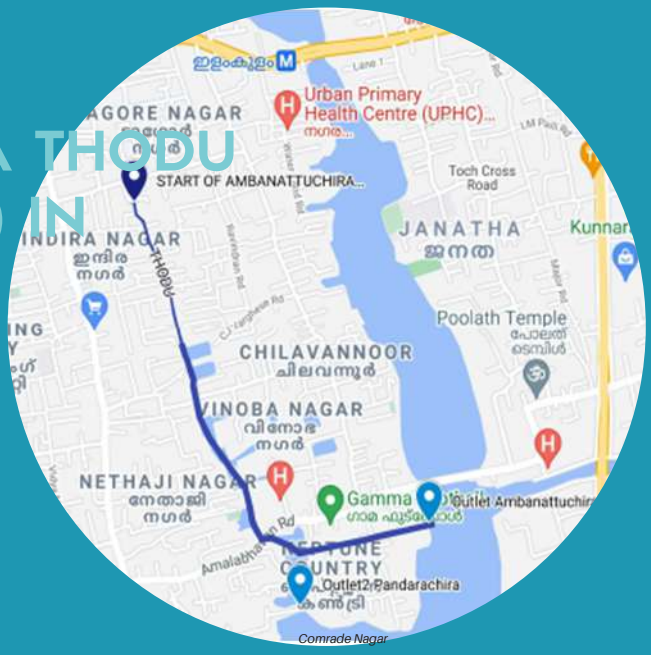
KOCHI
FLOOD MITIGATION

In-charge: Er.Dhanya K. | Asst. Executive Engineer | MI Sub Division Ernakulam



IRRIGATION DEPARTMENT
ERNAKULAM

AMBANATTUCHIRA THODU (PONNETH CHAAL) IN CHILAVANNOOR



Google Map- Ambanattuchira thodu

INITIAL STUDY REPORT

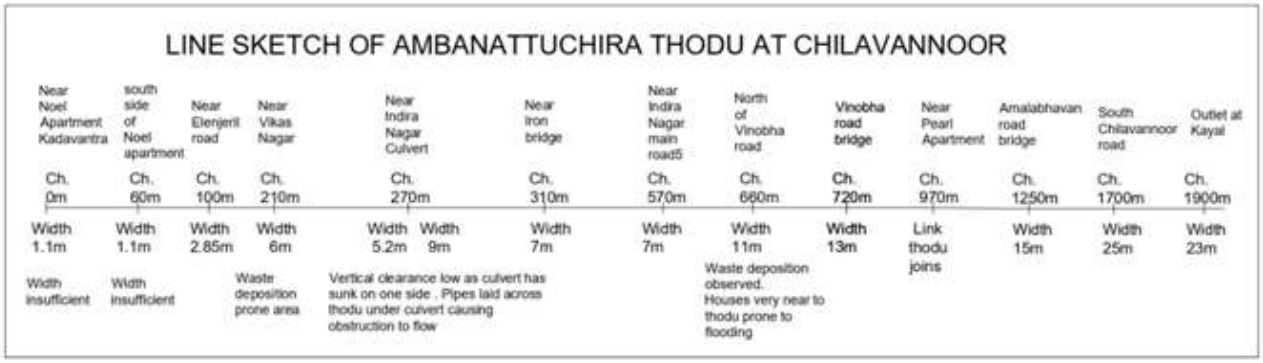
The Ambanattuchira thodu is a major natural waterbody passing through the Chilavannoor area in Kochi Corporation.. The entire storm water from an approximate area of 1.2 sq km, confined between KP Vallom road on west , Chilavannoor road on East, Sahodaran Ayyappan road on North and Pandarachira road on South, is drained off through this thodu . The thodu discharges into Champakara canal at Ambanattuchira in the East near South Chilavannoor road. The thodu has another outlet to Kayal at Pandarachira road in the south. The drainage basin of this thodu is included under division no. 55 and 57 of Kochi Corporation.

The thodu starts from the west side of NOEL apartments, Kadavanthra and is having a length of 1.9 km upto the outlet point at Ambanattuchira. There are 7 crossings across the thodu along its course including one iron bridge at Indira Nagar and the Pandarachira road at the second outlet. The other road crossings include Elenjeril road, Indira Nagar, Vinobha road, Amalabhavan road and South Chilavannoor road. The roadside drains from KP Vallom road and Ponneth temple road drains off to this thodu at its starting point.

The width of thodu at the starting point is only 1.1m. Behind the NOEL apartments the thodu is having a bend towards the East direction and then again takes a 90o bend towards Elanjeril Road and flows towards South. At the Elanjeril road crossing the thodu is having a width of 2.85 m and the vertical clearance beneath the Elanjeril road crossing seems to be negligible. The portion of the thodu from its inlet upto the north side of Vinobha road is locally known as Ponneth Chal whereas the portion to the south side is known as Kochappilly thodu. One natural link thodu starting from Kochappilly road is joining Ambanattuchira thodu near Pearls Garden Apartment, Chilavannoor.

SALIENT FEATURES OF AMBANATTUCHIRA THODU:

Start point	Near Noel Apartments, Kadavanthra
Outlet 1	Ambanattuchira in the East
Outlet 2	Pandarachira in the South
Length	1.9 km upto outlet at Ambanattuchira
Width	Varying from 1.1m to 25m
No. of crossings/bridges	7



PROBLEMS IDENTIFIED DURING SITE INSPECTION:

Chainage 0m Near Noel Apartments

The width of the thodu at its starting portion is only 1.1 m and hence the thodu seems to have insufficient carrying capacity to accommodate the entire storm water discharge, which causes flooding in adjacent residential areas. The width of thodu from Ch 0m to 80m is very narrow (avg 1m) and passes in between compound walls which makes the thodu prone to waste deposition and also makes the thodu cleaning process tedious.

Starting Point of the Thodu near NOEL Apartment, Kadavantra

Reach behind NOEL Apartment- Insufficient width and passing between compound walls

Near Elanjeril Road (ch. 100m)- Passing in between compound walls

Culvert with negligiblevertical clearance at Ch 100m Elenjeril road

Chainage 100m Near Elenjeril road

- The culvert on Elenjeril road is not having sufficient vent depth and hence during high tide periods the water level is observed to be above the bottom level of culvert deck slab, thus causing obstruction to free flow of water.
- The thodu on upstream and downstream side of this culvert passes in between compound walls in thickly populated residential area, which makes it prone to waste deposition .
- Due to waste deposition, the quality of water in the initial reaches of thodu is observed to be poor causing unhealthy situation in its premises.

Ch 210m , Vikas Nagar

Waste accumulation in thodu is observed in this reach near Vikas nagar. Quality of water in this reach is also very poor.

Ch 210m near Vikas Nagar- Waste deposition observed

Culvert near YMCA, Indira Nagar (ch 270m)

Waste deposition in thodu near Indira Nagar (ch 270m)

Ch. 270m Near YMCA, IndiraNagar

- The culvert across thodu near YMCA, Indira nagar is not having sufficient height of vent and hence wastes tend to accumulatenear this culvert causing blockage to flow. One side of the culvert is observed to have sunk reducing the available vertical clearance.In addition, there are pipes seen laid across the thodu under the culvert deck slab.
- This culvertwhich provides access to YMCA, and reported to be constructed by private party needs to be reconstructed with sufficient vent height so as to ensure free flow during tidal inflow and outflow.
- The pipes laid across the thodu below the culvert deck slab is to be realigned to ensure free flow of water.
- Accumulation of waste is observed in the initial reaches at Elenjeril road , Indira Nagar area (especially near YMCA and iron bridge) and Vikas Nagar .
- Elenjeril road, Ponneth temple road and Indira Nagar, Raveendran road are the flood affected areas along this thodu. Apart from rains, during high tide periods also, these areas are affected by waterlogging. Due to reduced width in this reach , the carrying capacity of the thodu is very less and hence results in overflowing of thodu during high tide periods.When rain and high tide occurs simultaneously, storm water cannot drain off thus causing flooding in these areas. During low tide period only, the flood water will drain off to Kayal..
- In the initial reach of approximately 580m, on both sides of the thodu there exists compound walls of residential buildings, which makes the thodu cleaning difficult.

Houses located immediate close to the banks of the thodu (ch 660m) upstream of Vinobha Nagar Bridge

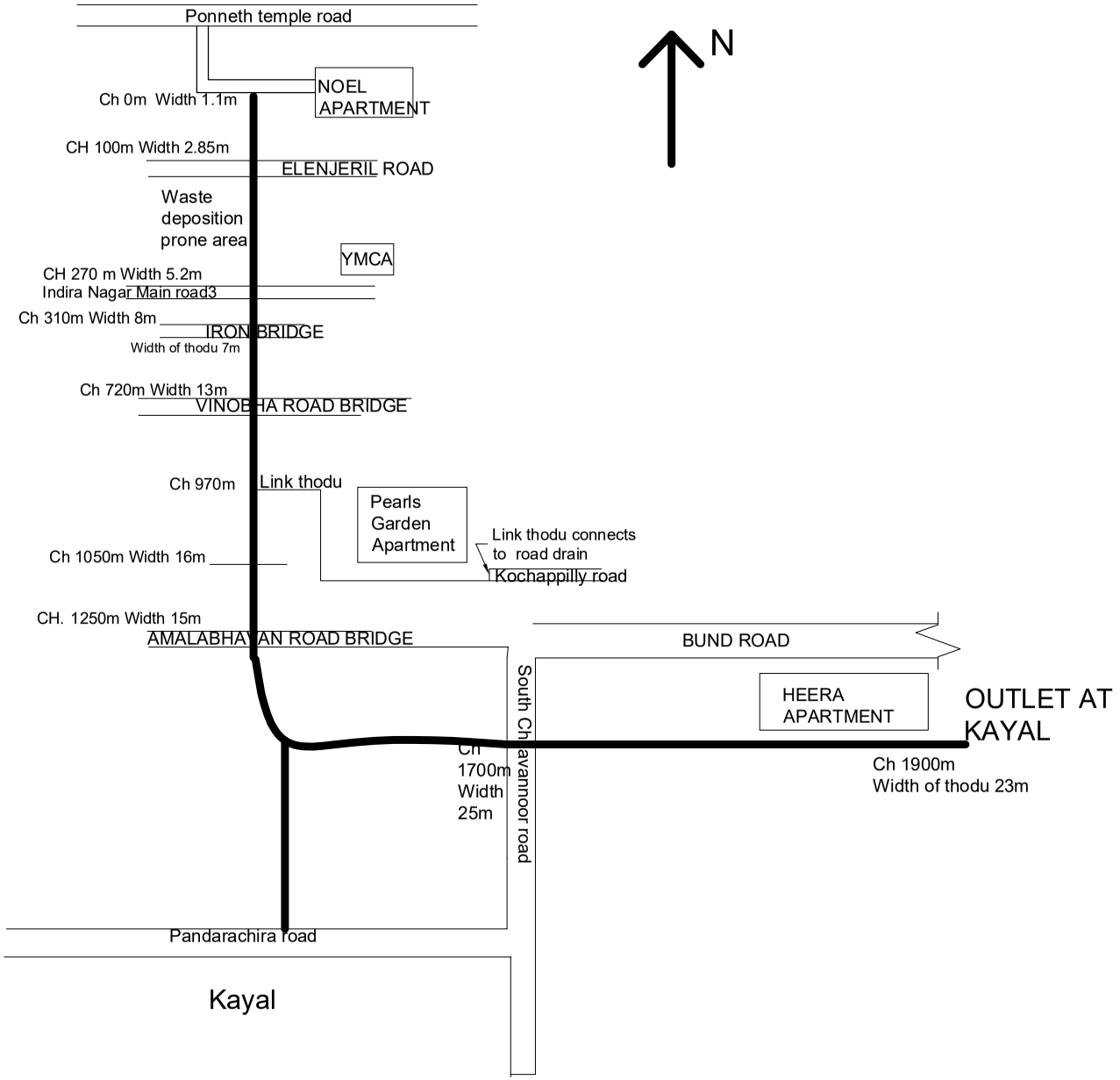
Ch 660m North side of Vinobha Nagar road

- Some houses situated immediate close to banks of the thodu on north side of Vinobha road bridge is affected by flooding during rainy season as well as on high tide. Waste deposition is also observed in this area.
- Reach of thodu from Ch 720m (Vinobha road) to Ch 1900m (Outlet at Kayal near Ambanattuchira)
- No flooding problem is reported in the wider reaches of thodu towards the south of Vinobha road bridge.

REMEDIAL MEASURES:

Flooding is usually reported in the initial reaches of thodu of considerably reduced width. As the thodu passes through thickly populated residential area, regular cleaning of the thodu is essential for removal of deposited silt and wastes. Implementation of regulating sluices at the two outlets of this thodu – at Ambanattuchira and at Pandarachira road will help to regulate the inflow and outflow. The damaged sluice at Pandarachira road is being reconstructed presently. Waste deposition in the thodu has to be controlled by implementing proper waste management methods and enforcing stringent measures.The culverts blocking flow near Elenjeril road and Indira nagar near YMCA needs to be reconstructed with sufficient vertical clearance so as to ensure smooth inflow and outflow.

LINE SKETCH OF AMBANATTUCHIRA THODU AT CHILAVANNOOR



THEVARA CANAL

KOCHI
FLOOD MITIGATION

In-charge: Er.Chithra P. Bai | Asst. Engineer | Irrigation Section Chambakkara

IRRIGATION DEPARTMENT
ERNAKULAM

THEVARA CANAL

Starting point of Thevara canal, ch: 0m

INTRODUCTION

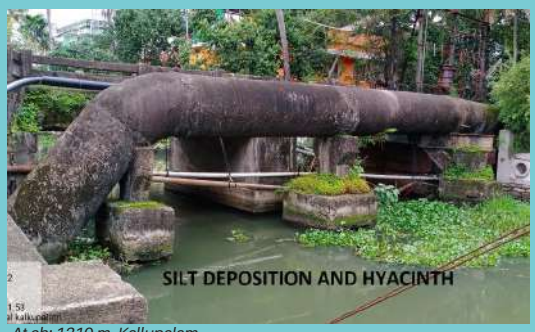
Kochi is a land of canals and backwater. The Canals Network in Kochi is very much intertwined with rivers and backwaters. Most of the traditional areas and heritage zones are connected by such canal system. Thevara canal is one of the canal in this network. It is starting from vembanadu kayal and ends at Chilavannur kayal. Thevara canal having length of 1.40 Km and average width of 20m. The average depth of canal is 1.30m. Thevara canal passes through the ward numbers of 58, 60 and 57 of Kochi Corporation. Koithara canal, Konthuruthy thodu and Thevara perandoor canal are connected to Thevara canal. Also there is an another small connecting thodu At ch; 1000m, having a length of 291m and average width of 2m and average depth of 1m. Through Thevara canal water from these canals can reach into backwater.

Near Thevara market, ch: 215 m

HISTORY

Thevara canal is a navigable canal. This canal passes through Thevara market and Koithara. In ancient times this canal used for transporting goods, and it connects the places Thevara, Fort Kochi and Mattancheri to Kundannur, Nettoor, Thrippunithura and Maradu.

End point of Thevara canal, ch: 1400m



At ch: 1310 m, Kallupalam

CROSS STRUCTURES

There are three bridges across Thevara canal. Thevara bridge is crossing at ch:215m, railway bridge is at ch: 930m and the Kallupalam is at ch: 1310m.


Railway bridge


Thevara bridge

Kallipalam bridge

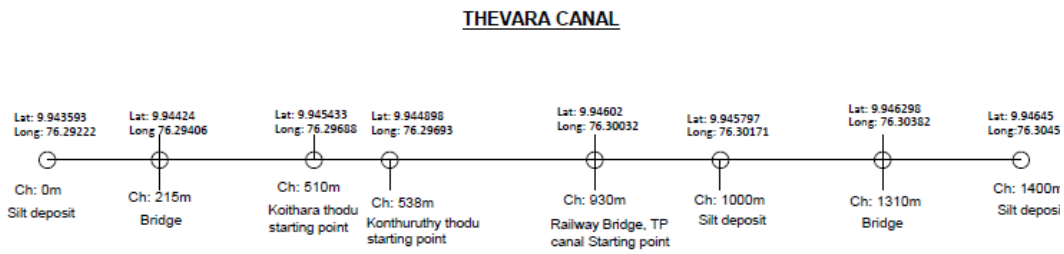
PROBLEMS

- At chainage 0m, the main obstruction is the silt deposition in the canal and its mouth.
- From ch: 0m to 930m silt is deposited and at ch: 930m vegetation is there.
- At ch; 1000m, there is a small connecting thodu of having length 291m. From length 160m to 291m this thodu is covered with slabs. Before the slab covering, Silt deposition is there.
- The obstructions found at the ch: 1310m, Near Kallupalam is water authority pipe crossings. Also presence of water hyacinth and silt deposition is there.
- At the end point, ch: 1400m delta formation and vegetation is the main obstruction.

REMEDIAL MEASURES

- Desilting of Thevara canal mouth portion is the main solution to ensure easy flow towards the backwater. Also, desilting of Thevara canal is essential. Removal of vegetation and water hyacinth from the canal will leads to easy flow of water through the canal and also towards the backwater.

LINE SKETCH



CONCLUSION

During heavy rains the excess water from TP canal, Koithara canal and Konthuruthy thodu will flow towards Thevara Canal. About 30% of water from corporation area is entering to the Thevara Canal. At the same time, if high tide is existing the water will not flow towards the backwater and it may lead to flood up. To avoid this, desilting of canal mouth portion is essential. Desilting of entire length of Thevara canal is also needed. Through this, the surplus water entering in to the canal can easily flow towards backwater (Vembanadu Kayal). At the last end of Thevara canal there is a delta formation, it is like a narrow island. To ensure free flow of water through this end removal of this delta formation is essential.
In OBT Second phase, desilting of Thevara canal mouth portion has been done. The delta formed at the mouth has removed. Through this work, it helped to reduce the chances of flooding.

THEVARA CANAL- OBT WORK PHOTOS

Before OBT Work

LOCATION – MOUTH PORTION OF THEVARA CANAL, VEMBANADU KAYAL

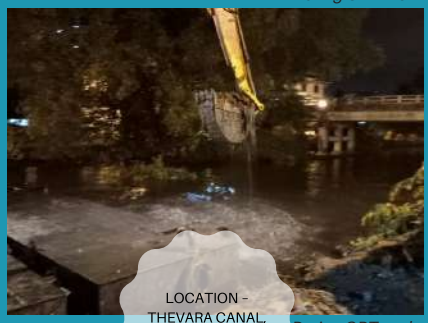
Before OBT Work

During OBT Work

During OBT work

LOCATION – STARTING POINT OF THEVARA CANAL, NEAR THEVARA MARKET

During OBT work



LOCATION – THEVARA CANAL, NEAR THEVARA BRIDGE

During OBT work

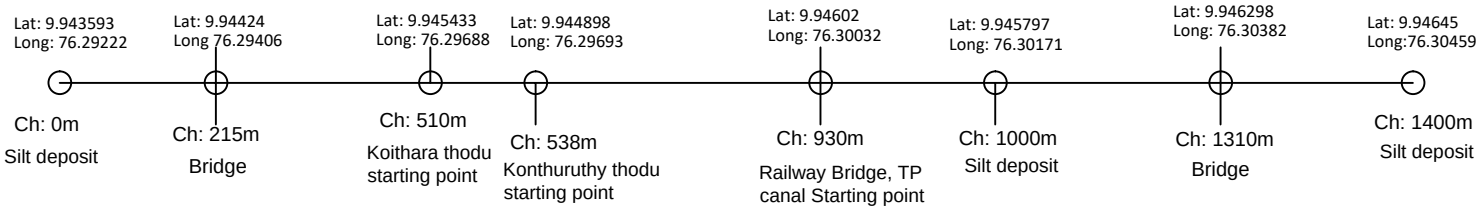
After OBT Work

LOCATION – MOUTH OF THEVARA CANAL, VEMBANADU KAYAL

OBT SITES

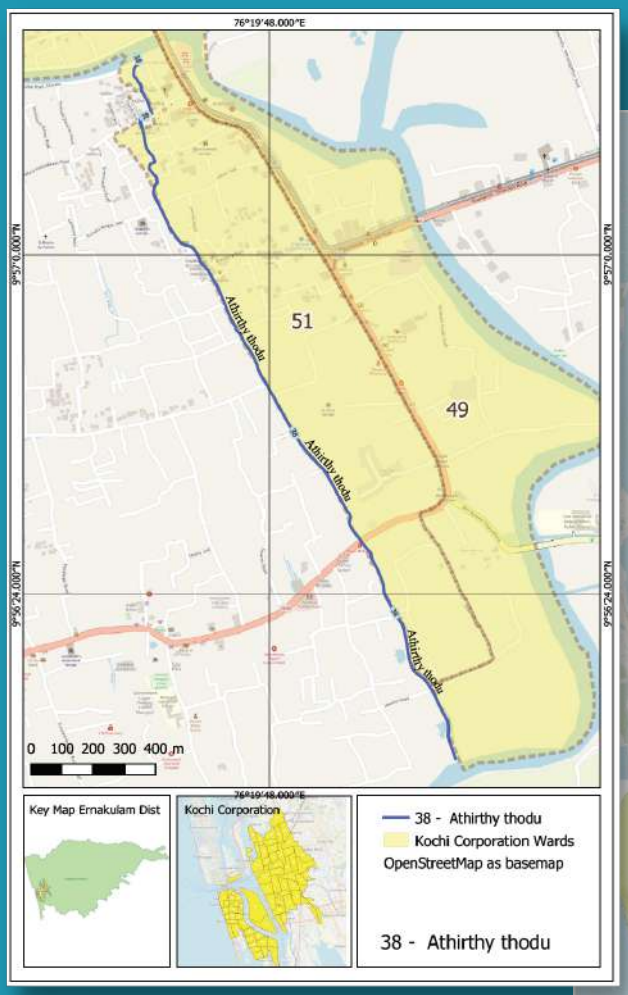
During OBT work

THEVARA CANAL



ATHIRTHI THODU

KOCHI
FLOOD MITIGATION



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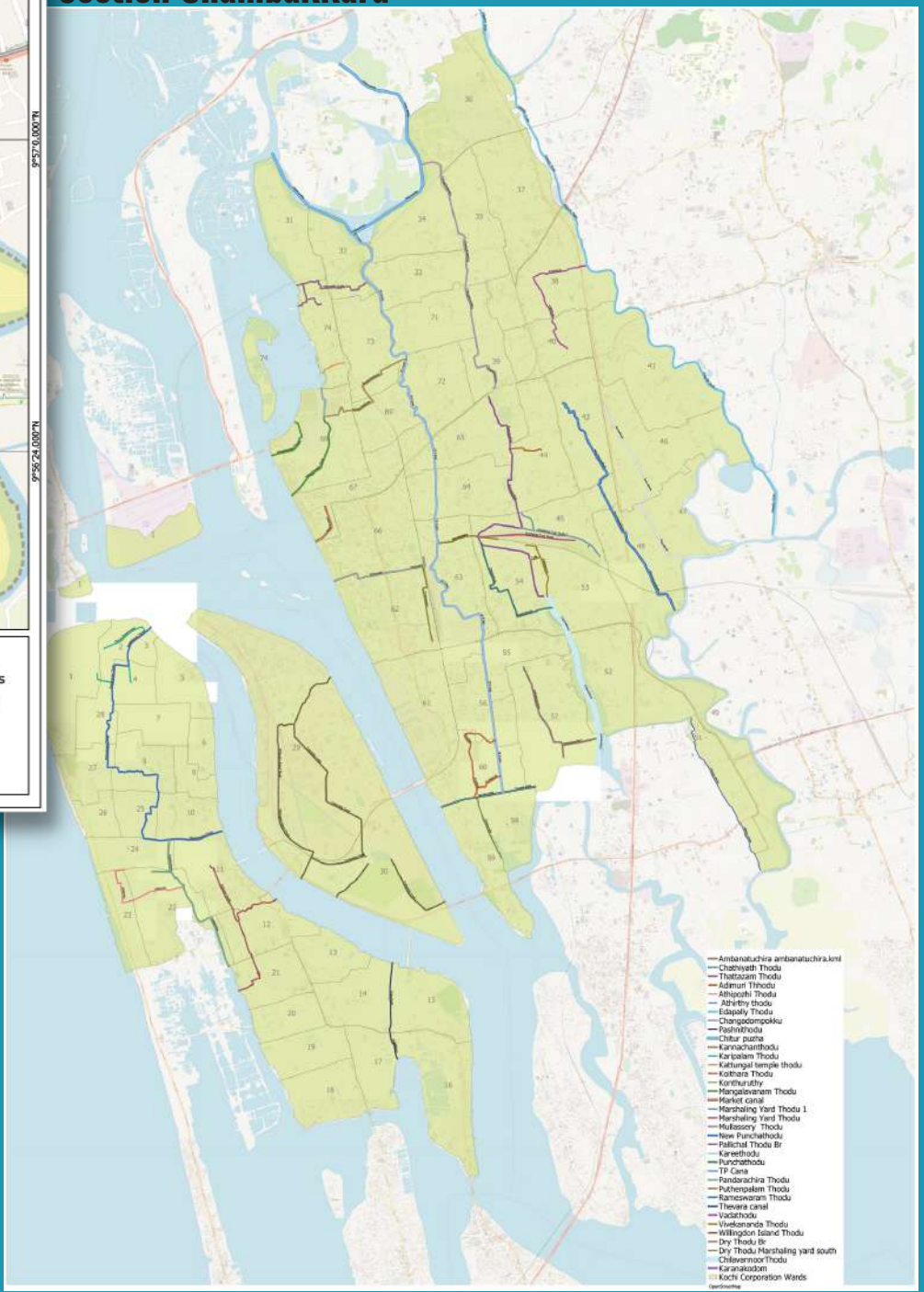


IRRIGATION DEPARTMENT
ERNAKULAM

ATHIRTHI THODU

INTRODUCTION

Kochi is a land of canals and backwater. The Canals Network in Kochi is very much intertwined with rivers and backwaters. Most of the traditional areas and heritage zones are connected by such canal system. Athirthi thodu is one of this network. It is starting from Poonithura river and ends at Champakkara canal. Athirthi thodu having length of 2.60 Km and average width of 2m. The average depth of canal is 1.20m. As the name indicates this thodu is passing through the boundaries of Kochin corporation and Maradu Mucipality. From starting point thodu passes through 50th division and ward number 20 of Maradu Muncipality. After Kundannoor petta road crossing thodu passing through division 51 and 10th and 5th ward of Muncipality. Ayni thodu is one connecting thodu and join at chainage 1440m in to this thodu.

Athirthi thodu at ch: 63m, Slab covering, poonithur

At ch: 351m, Poonithura

Poonithura, slab covering starting point at ch: 0m,

At ch: 807m, Kalathara Junction

At ch: 2080m, Thuruthy Temple road

At ch: 818m, Vikram Sarabhai Road

At ch: 1440 m, Ayni thodu joinig

End point of Athirthi Thodu, ch: 2600m

HISTORY

Athirthi thodu was a navigable thodu. This thodu connects poonithura river to Champakkara canal. In ancient times this thodu used for transporting goods.

At Champakkara Kannadilladu road Athirthi thodu is completely covered.

CROSS STRUCTURES

In Athirthi thodu, there are many cross slabs constructed across the thodu. And the cross road over the thodu are kundannoor- petta road, Kolathery Road, Thuruthy Temple road, Champakkara Kannadilladu road and champakkara canal road (Dhaivika road).

Kolathery road

Thuruthy Temple road, Bottom of Culvert

PROBLEMS

The main problems in the thodu are encroachments, silt deposition and sewage waste. Also, throughtout the length most of its length covered with slabs.

- At chainage 0m, silt deposition in the canal.
- At ch: 63m, encroachment is there and one slab is constructed towards private property.
- At ch; 250m, thodu is covered with slabs for a length of 90m. from ch: 0m to 250m its width is 5m. Due to slab covering, width from ch: 250m to 340m is reduced to 2m.
- At ch; 351m, thodu, pipe outlet is there. Then thodu is in open condition.
- Reaching to the ch; 807m, kundannoor- petta road is crossing, here box culvert is provided. Box culvert has no sufficient clearance and also cables are passing it obstruct free flow of water.
- From ch: 818m to 1160m, there is so many cross slabs are constructed for Private use.
- From ch: 1160m to 1830m thodu is completely covered with slab for a length of 100m. it is along with Vikram sarabhai road and continuous to kolathery road.
- After 1830m again thodu is open condition and here width reduced to 1.5m. Silt deposition is there and sewage waste is entering through the pipe outlet.
- At ch; 2080m, Thuruthy Temple road is crossing, and there no sufficient clearance at this culvert.
- From ch; 2080m to the end point, ch: 2600m, the entire length of thodu is covered with slabs and encroachment is there.

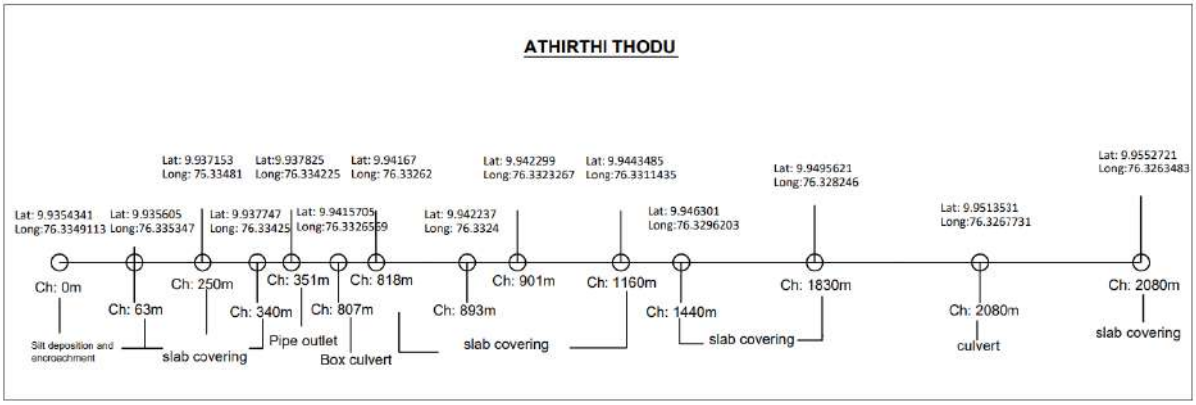
REMEDIAL MEASURES

- Eviction of encroached area is essential.
- The deposited silt should be removed. And prevent the pipe outlet provided towards thodu. For the smooth desilting process, the covered slabs need to be removed.
- The culverts provided at the kundannoor- petta road and at Thuruthy Temple road are need to reconstruct with sufficient clearance. Also, the cables passing through kundannoor- petta road should be realigned.

CONCLUSION

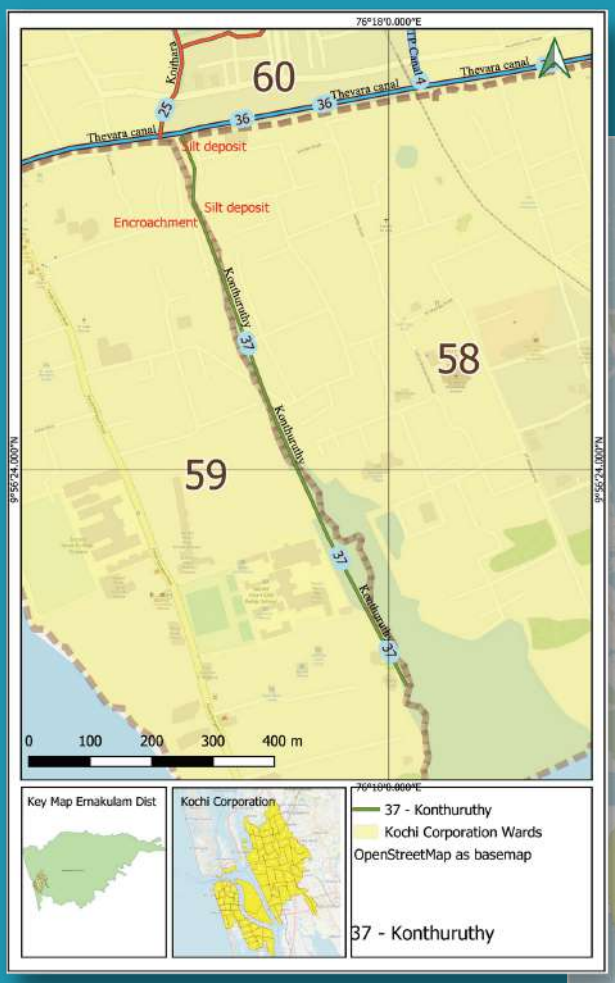
Athirthi thodu is sharing the boundaries of Kochi corporation and Maradu Muncipality. Out of its total length, 50% of this thodu is covered with slabs. The width of thodu is reducing from 5m to 1.5m. This because of the Encroachment and for making road. Towards the end point the thodu is in between the residential area and also completely covered with slabs. There is silt deposition and sewage outlets are there. To ensure smooth flow through the thodu, it is important to open the covered portions of thodu and eviction of encroached area.

SCHEMATIC DRAWING



KONTHURUTHY THODU

KOCHI
FLOOD MITIGATION



In-charge: Er.Chithra P. Bai | Asst. Engineer | Irrigation Section Chambakkara

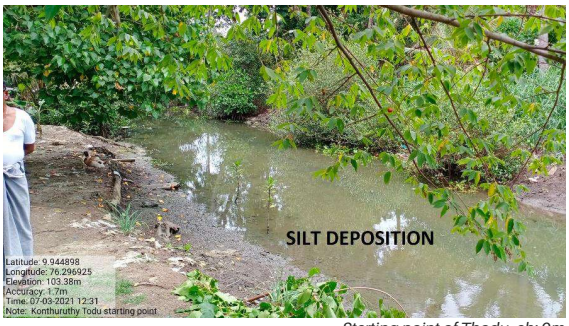
IRRIGATION DEPARTMENT
ERNAKULAM

KONTHURUTHY THODU

INTRODUCTION

Kochi is a land of canals and backwater. The Canal Network in Kochi is very much intertwined with rivers and backwaters. Most of the traditional areas and heritage zones are connected by such canal system. Konthuruthy thodu is one of the canal in this network. Konthuruthy thodu starts from Thevara canal of ch: 538m and ends at Vembanadu kayal. Konthuruthy thodu having length of 980m and the average width of thodu is 5m. The average depth of water is 50cm.

SITE PHOTOS



Starting point of Thodu, ch: 0m

At ch: 50m

At ch: 107m Near Konthuruthy road

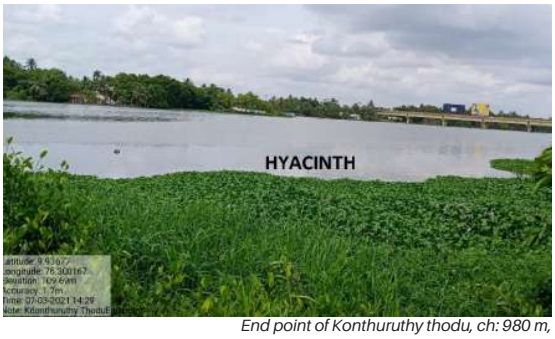
At ch: 134m, Konthuruthy road

At ch: 134m, Thodu is visible after Konthuruthy roa

At ch: 244m, Konthuruthy colony

At ch: 464m, Kazeeba bridge

At ch: 699m near Sacred heart CMI public school



End point of Konthuruthy thodu, ch: 980 m,

HISTORY

In ancient times it was a navigable thodu. and it connects the places Thevara, Fort Kochi and Mattancheri to Kundannur, Nettoor, Thrippunithura and Maradu.
Konthuruthy thodu having length of 980m and the The average depth of water is 50cm. The original width of thodu is 31m. Now the average width of thodu is reduced to 5m. Encroachment along the thodu is the main reason and a colony of 178 residents are living. Related to this encroachment, there is a case (WP(C)NO.1812/2016) existing in the Hon'ble HIGH COURT.

CROSS STRUCTURES

There is Konthuruthy road is crossing at ch:134m and there is a pipe culvert is provided. Another Kazeeba bridge is existing at ch: 464m.

Konthuruthy Road across the thodu

Kazeeba Bridge

PROBLEMS

- The main obstructions in the thodu are silt deposition, waste and encroachment.
- From the chainage 0m to 107m, its width is 5m. This portion is almost silted up and waste deposition is also there.

- Konthuruthy road is crossing at ch: 134m and there is a pipe culvert is provided. Here thodu is not visible. it affects the natural flow of water.
- Thodu is visible after Konthuruthy road, and here width is again reduced to 2.5m, due to the encroachment. waste and silt deposition is here.

Portion of thodu after konthuruthy road

- Another Kazeeba bridge is existing across the thodu at ch: 464m, here width is increased to 5m. There no sufficient vertical clearance for the bridge. Waste and silt deposition is also there.

Encroachment and silt deposition

- Reaching towards the end portion, At ch: 699m there is a delta formation and thick vegetation there It should be removed for the free flow of water.

Delta formation

REMEDIAL MEASURES

Short term

1. **D**esilting of thodu
2. Removal of delta formation at the end portion

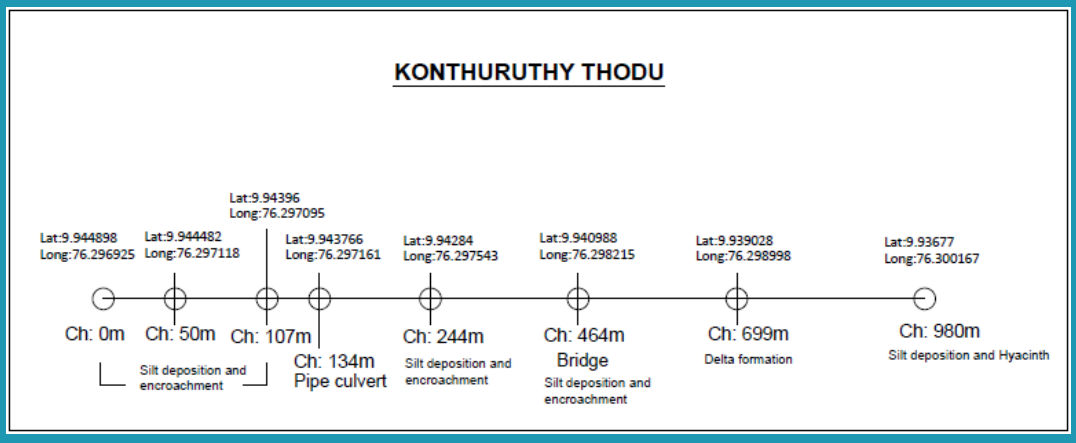
Longterm

1. Eviction of encroached area is essential and regaining its original width
2. Remove the pipe culvert provided under the thodu and construct a culver across the thodu.
3. Demolish the Kazeeba bridge and reconstrut it with sufficient vertical clearance

CONCLUSION

The main problem of Konthuruthy thodu is the Encroachment. Due to this width of thodu is reduced. The pipe culvert at the konthuruthy road is also affects the flow of water. During heavy rains the excess water from TP canal and Koithara canal will flow towards Thevara Canal. About 30% of water from corporation area is entering to the Thevara Canal. At the same time, if high tide is existing the water will not flow towards the backwater. Konthuruthy Thodu is one of the connecting thodu of Thevara canal, so it may lead to flood up in Konthuruthy Thodu. To avoid this problem, water carrying capacity of thodu should increase by regaining its actual width. For regaining the actual width, process of eviction is must. And also provide a bridge in place of pipe culvert. Towards last end there is a delta formation, it is like a narrow island. To ensure free flow of water through this thodu, desiltation of thodu and removal of delta is essential.

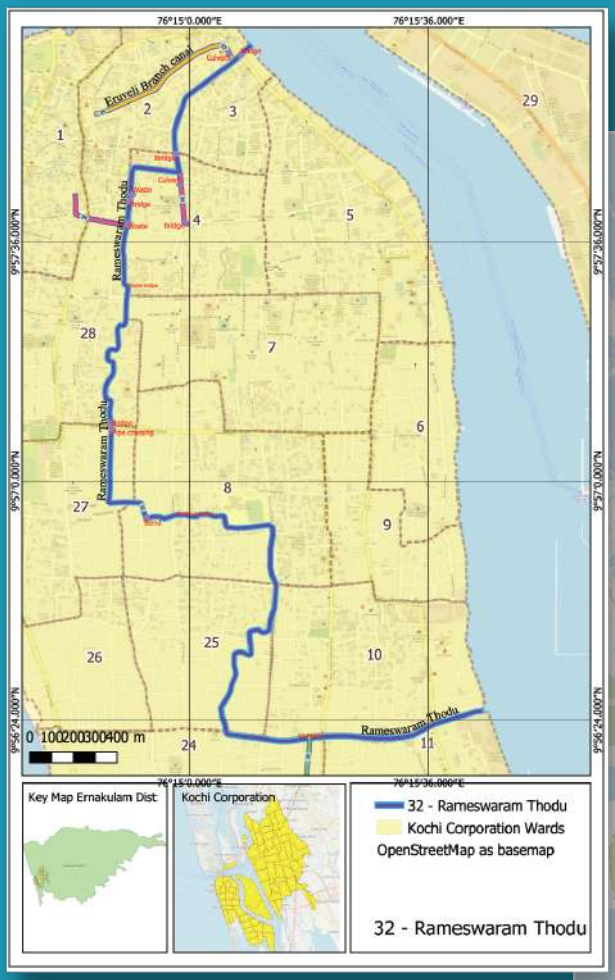
LINE SKETCH



RAMESWARAM | MANTHARA |CALVATHY CANAL

KOCHI

FLOOD MITIGATION



In-charge: Er.Kumari Sindhu S, | Asst. Executive Engineer | MI Sub Division Aluva

IRRIGATION DEPARTMENT
ERNAKULAM

BOUNDARYCANAL (RAMESWARAM – MANTHRA – KALVATHY AND ITS BRANCHES)

INTRODUCTION

Kochi is the commercial capital of Kerala,came it is being in 1967 as a result of the merging of the nonbearing towns. Kochi,today become largest and most important city in Kerala. Kochi known as the queen of Arabian sea is also the second most important city of the western coast of India. Kochi has many distinctive attractions of its own.Kochi is a tourist paradise with sparkling blue lagoon, green – blanketed islands and vast backwaters. Kochi has one of the finest natural harbours in the world.

This canal is one of the important land mark of Kochi. This is a manmade canal constructed by Portuguese for sailing boats. It starts from Vembanad Lake near Cochin Fisheries Harbour at Karuvelippady in Thoppumpady and meets the Vembanad Lake, where the Periyar merges with Arabian Sea near Fort Kochi Boat Jetty at Kalvathy.For centuries the canal and a natural tank inKalvathy wasa hub of international traders in Kochi.This waterway was the major mode of transport for spices and other trade goods from Fort Kochi to different places until 1970 and later was used by fishermen to access the lake to bring in their catch for the day. The Rameswaram canal and its allied canal systems had been a hub of international trade in Kochi for centuries. However, the development of road and rail traffic facilities pushed canal transport systems to a humble backseat and urbanization inched its way further east.

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SALIENT FEATURES OF RAMESWARAM CANAL

Starting Point	from Cochin Fisheries harbour and passes through Fortcochi Ending
Ending Point	Manthra Bridge
Length	3711m
width	Varying from 10m to 4.50m
depth	from 3m to 1.20m with respect to GL
Road Crossings	14Nos

Starting point of Boundary canal

SALIENT FEATURES OF MANTHRA CANAL

Starting Point	from Ch:3711 to Ch:5117m
Ending Point	Ch: 5117m
Length	1406m
width	Varying from 6m to 12m
depth	from 1.2m to 2m with respect to GL
Road Crossings	5Nos

End point of Boundary canal

SALIENT FEATURES OF CALVATHY CANAL

Starting Point	from Ch:5117m
Ending Point	:Ch: 5850m kayal near Fort kochi-boat jetty
Length	733m
width	8.50m to 16m
depth	from 1.6m to 1.9m with respect to GL
Road Crossings	2Nos

PROBLEMS IDENTIFIED

Existing Bridge/culvert without free board and narrow vent way

The vent way of the canal is narrow and without sufficient free board at existing bridges/ culverts , it causes accumulation of waste and finally blocking the flow of water at various chainage. Reconstruction of Bridge/ culvert with adequate free board and span is needed at Ch.1032m, Ch.1190m, Ch.1217m, Ch.1758m, Ch.2200m, Ch.2873m, Ch.4632m Ch.4777m, Ch.5189m and Ch.5424m and ch.175m of Kareepalam branch canal.

In ward No.25,at Ch. 1032m – Santo Gopalan Road cross canal width 7.50m, culvert span 5.50m

In Ward No. 25, at Ch. 1190m – Loretto Anglo Indian School Road cross, Canal width 6.50m and culvert span 4.50m

In Ward No. 25,at Ch.1217m- Sharp bend with culvert

In Ward No.8, at Ch. 1758m Mother Theresa Road cross – culvert without free board and KWA pipe line crossing below water level

In Ward No.8, at ch.2200m- Damaged Foot bridge near A .A. Kochunni Master Memorial Park, which is not in use.

In Ward No.8,at Ch. 2873m Pandikudy Bridge , Beam soffit touching the water and KWA pipe line with additional two pillars

In Ward No. 25,at Ch.1217m- Sharp bend with culvert

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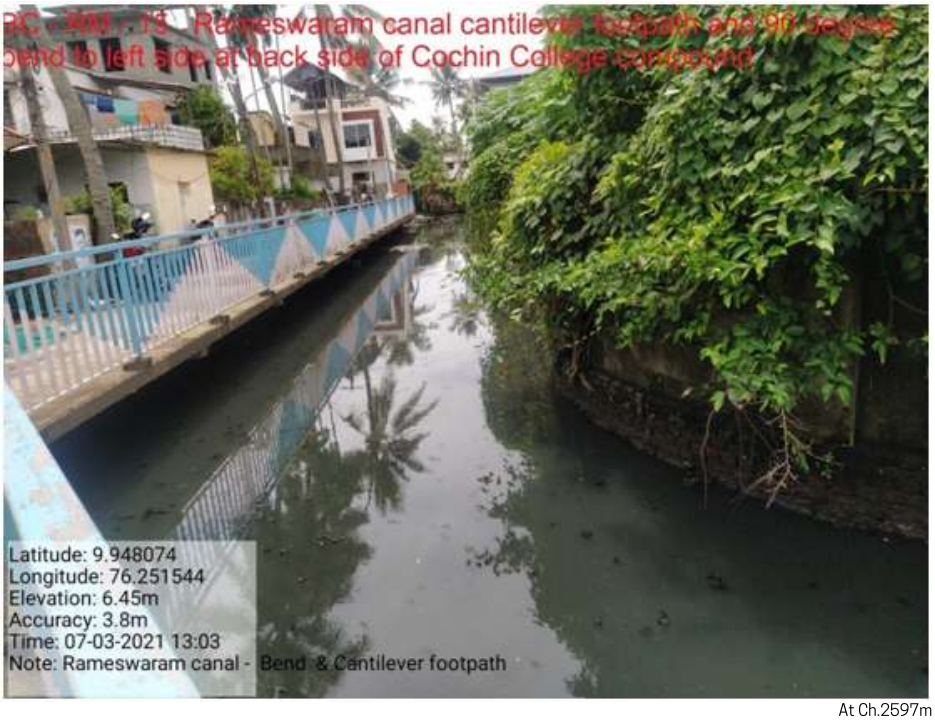
In Ward No.28, at Ch. 4632m. Kuriplavu Bridge- width reduced to 3.20m from 5.60m

In Ward No.28, at Ch. 4777m. Adhikarivalappu Bridge- canal width 9.70m, bridge span 5.15m

In Ward No.4, at Ch. 5189m. Pullupalam -canal width 17.40m, bridge span 10.90m

In Ward No.2, at Ch. 5427m. Foot Bridge- canal width 13.00m, bridge span 9.00m

In Ward No.4, KWA pipeline to be shifted and bridge to be reconstructed due to damaged condition at ch.175m. Of Kareepalam Branch Canal



At Ch.2597m

UTILITY PIPES CROSSING THE CANAL

The utility pipes belongings to Kerala Water Authority, BSNL etc. crossing the canal at different locations with additional pillars and without sufficient free board, obstructs the flow of water especially during flood season. These pipe lines through the water surface of the canal have to be lifted and fixed to the culvert parapet. Following locations such as ch.467m, ch.1190m, ch.1658m, ch.1758m, ch.1935m, ch.2379, ch.2732m, ch.2873, are prone to flooding due to the obstructions of utility pipes.

FOOT BRIDGE/CULVERT WITH SHORT INTERVEL

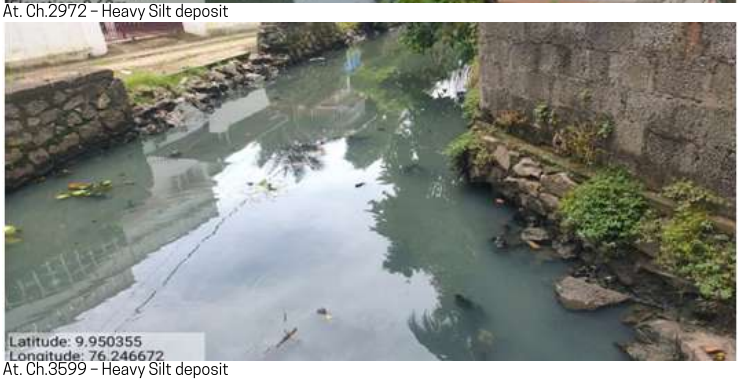
Individuals construct Foot bridge/culvert without sufficient free board at less than 10m interval instead of forming bund road to enter their property. This also leads to blockage during rainy season.

DESILTING, CLEARING JUNGLE AND PRUNING OF TREES

Main reason for flood during the rainy season is silting up the canal, overgrowth of vegetations in sides of canal, fallen down of overhanging trees to the canal. Periodical cleaning is required in Rameswaram canal for increasing the depth of flow and removing the obstructions. Desilting work already arranged by s Cochin Corporation from Manthra bridge to Fort Kochi(Kalvathy canal) including three branches and the work is ongoing.

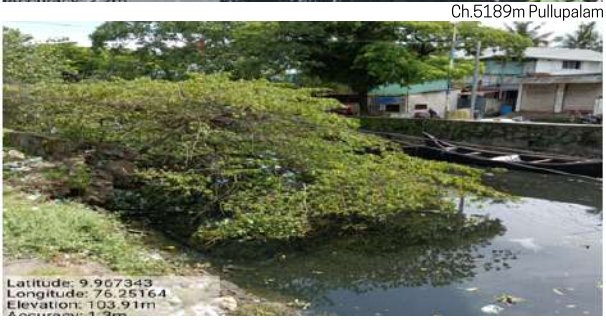
At.ch.1335 m Back side KWA Pumping station

At. Ch.2972 – Heavy Silt deposit



At. Ch.3599 – Heavy Silt deposit

Ch.5189m Pullupalam



At end portion of Kalavthy canal near Fort Kochi Boat Jetty

DISPOSAL OF SOLID WASTE AND WASTE WATER INTO NATURAL DRAIN

Disposal of solid waste into the canal causes pollution of waterbody due to waste accumulated the flow of the canal has been reduced drastically. The catchment area of the canal is densely populated and hence the canal is subjected to variety of pollutants such as municipal sewage, organic, plastic waste, etc. Waste pipe lines from houses is given directly in to the canal also causes pollution of water. Stringent measures need to be taken to prevent discharge of such waste and sewerage to canal.

In Ward No.8, at Ch. 1758m Mother Theresa Road cross – culvert
In Ward No.8, at.ch. 2100m of Rameswaram canal at Statue Road crossing waste accumulation identified

In Ward No.8,at Ch.2379m-of Rameswaram canal crosses M.A. Ragavan road heavy waste accumulation

In Ward No.8, at Koovappadam branch thodu joins to Rameswaram canal near ch.2392m

In Ward No.28, at Ch. 4390m of Zebra palam ,Waste Deposited

Koovappadam branch canal starting point ch.0.00m

The Boundary canal has 4 branches namely Koovappadam branch, Kuriplavu Branch, Kareeppalam Branch and Eruvely Branch.

Koovappadam branch canal visible from Cochin College Junction, upstream portion of the canal is fully covered with slab, having length of 161m, starting width 2.6m and ending width 6m joins near ch:2392m of Rameswaram canal.

In Ward No.8,at Ch. 2873m Pandikudy Bridge , Waste deposited

In Ward No.28, at Ch. 4777m.Adhikarivalappu Bridge- Waste deposited

Koovappadam branch canal joins to Rameswaram canal near ch.2392m

Another branch known as Kuriplavu branch canal having a length of 580m, width varies from 2.50 to 7.10m which joins Manthra canal at ch:4632m. From ch:160 to 238m the canal is fully covered with slab.


Koovappadam branch canal joins to Rameswaram canal near ch.2392m


Kuruplavu branch canal starts at ch:0m at PattalamMarket road

Kuruplavu branch canal ends at ch:4632m of Manthra canal


Eruveli branch canal starts at ch:0m near Govt. Hospital campus, Fort Kochi


In Ward No.28, at Ch. 4390m of Zebra palam ,Waste Deposited

The Eruveli branch canal joins at ch. 5737m ofKalvathy canal having length 780m width varies from 9m to 10m.

Kareeppalam branch canal starts from Kareeppalam bridge having a length of 235m and width varies from 4.50m to 8.70m, joins the Kalvathy canal at ch.5117m


Karippalam branch starting point at Karippalam bridge


Karippalam branch canal joins to Kalvathy canal at ch.5117m

MORE PROBLEMS IDENTIFIED

Boundary canal begins and ends at Vembanad Kayal . But during high and low tide, water does not flow through the canals. This happens because the bed level of the canal has silted up significantly over the years as result of not desilting the thodu. If it is to be deepened according to the present bed level, there is a chance that the side walls might collapse, because both the sides of the canal have walls. In various reaches, it's even difficult to reach the canal due to these sidewalls. But in the past, this canal was a route for several houseboats for trading. Then this canal would have been at least 15m wide back then. But now it has been reduced to 4m in many places. Moreover, sewage waste is also being discharged directly into this canal at many places. A number of bridges with reduced widths and clearance has been built close to each other. These bridges were constructed either by government agency or private people according to their own needs and wishes.

It is necessary to desilting the mouth of Kayal from which the thodu starts and ends which must be lower than the bed level of the thodu for the easy inflow and out flow of the thodu.

NEW CONSTRUCTIONS COMING UP OBSTRUCTING FLOW

1. Coast guard is constructing a berth in front of the Calvathy canal mouth near Fort Kochi Boat Jetty. This is even dangerous for the ships coming in, as there is a good chance for accidents to occur and also prevents tidal flow into the canal system and its outflow. This is definitely going to have a great impact on the inflow and outflow of water. To have a proper inflow and outflow there should not be any sort of obstruction at the mouth of the canal.So there is aprobability of reverse flow of water and it may cause flood up on either side of thodu.

2. The dock they are building near old Harbour bridge at Willingdon Island also obstructs the free flow of low tide and high tide. These two constructions are obstructing the flow of water.

REMEDIAL MEASURES

For avoiding blockage / flood during rainy season the following measures are required. Cleaning of canal, encroachment eviction, widening of canal at narrow places and maintaining same cross -section, reconsruction of culvert with sufficient span and free board, replacing the KWA pipe lines to parapet, forming side roads and removingunnecessary culverts/FB constructed by individuals, removing waste pipe line/soil pipe from house hold directly discharging into the canal etc.

Short term

1.Cleaning of canal including clearing jungle&tree pruning for improving the flow of water.
2.Replacing the KWA pipe lines to parapet
3.Removing all waste lines directly to the canal including sewage waste strictly.

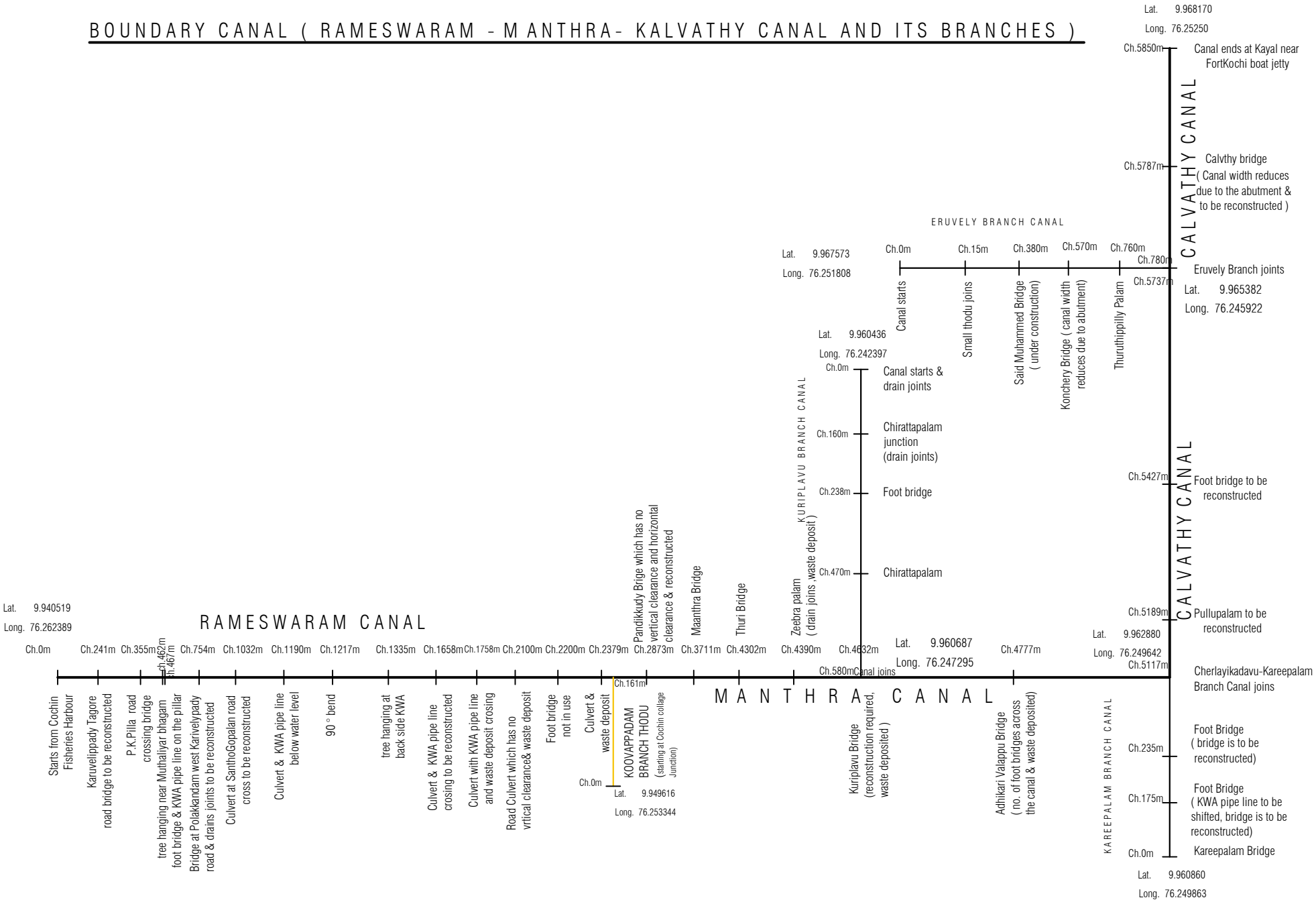
Longterm

1.Reconstruction of the bridges/culverts which causing obstruction.
2.Widening of canal at narrow places and maintaining same cross –section.
3. Removingunnecessary culverts/FB constructed by individuals.
4.Desilting of the thodu and mouth of Kayal at starting portion and end portion, for improving the easy flow of water and storage capacity of the thodu.
5. In the starting portion, near Cochin fisheries Harbour, the width of the thodu is 12m. Gradually it is decreased to 4 to 7m for an approximate length of 4.00km. During the rainy season, it is expected that that the water enters in to the thodu from the catchment area of 800 Hectare. If the precipitation of storm is 10cm/day. Then the discharge through canal is about 19m^3/s. For this discharge, the required width of the thodu is 12m for the easy flow water. Hence it is necessary to maintain width of the thodu from 4m to 10m is 12m.

CONCLUSION

The proposals for ensuring the free flow of water through the canal will revive the entire canal system. This will definitely control the flooding of the area during rainy season .The mosquito menace will be controlled due to the tidal water flow. Tourism sector will also be benefitted with the revamped clean canal. Hence the proposal will help to improve the overall living conditions of the entire West Kochi.

BOUNDARY CANAL (RAMESWARAM - MANTHRA- KALVATHY CANAL AND ITS BRANCHES)

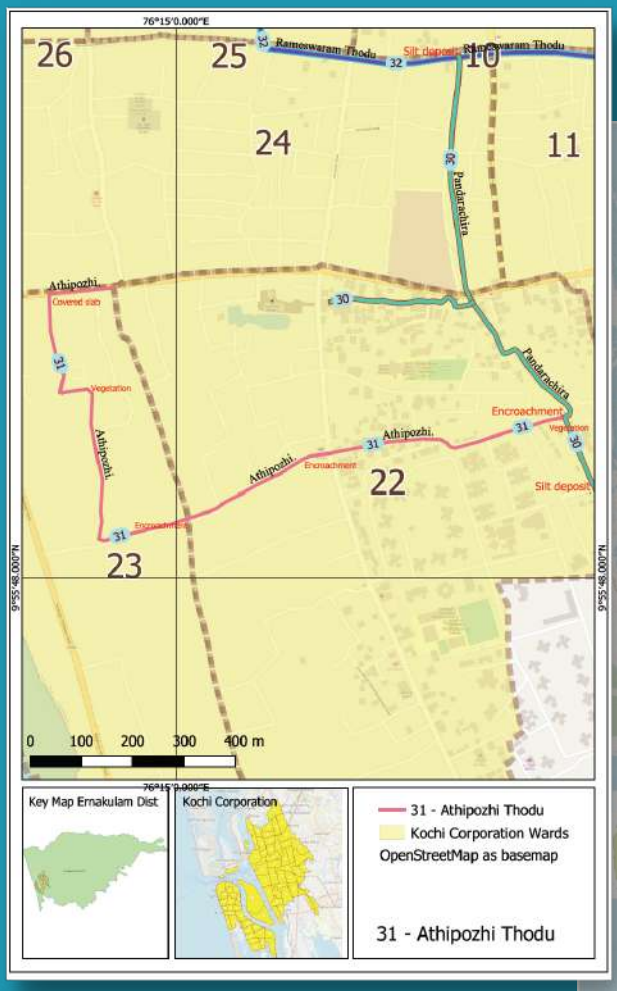


KUMARI SINDHU .S

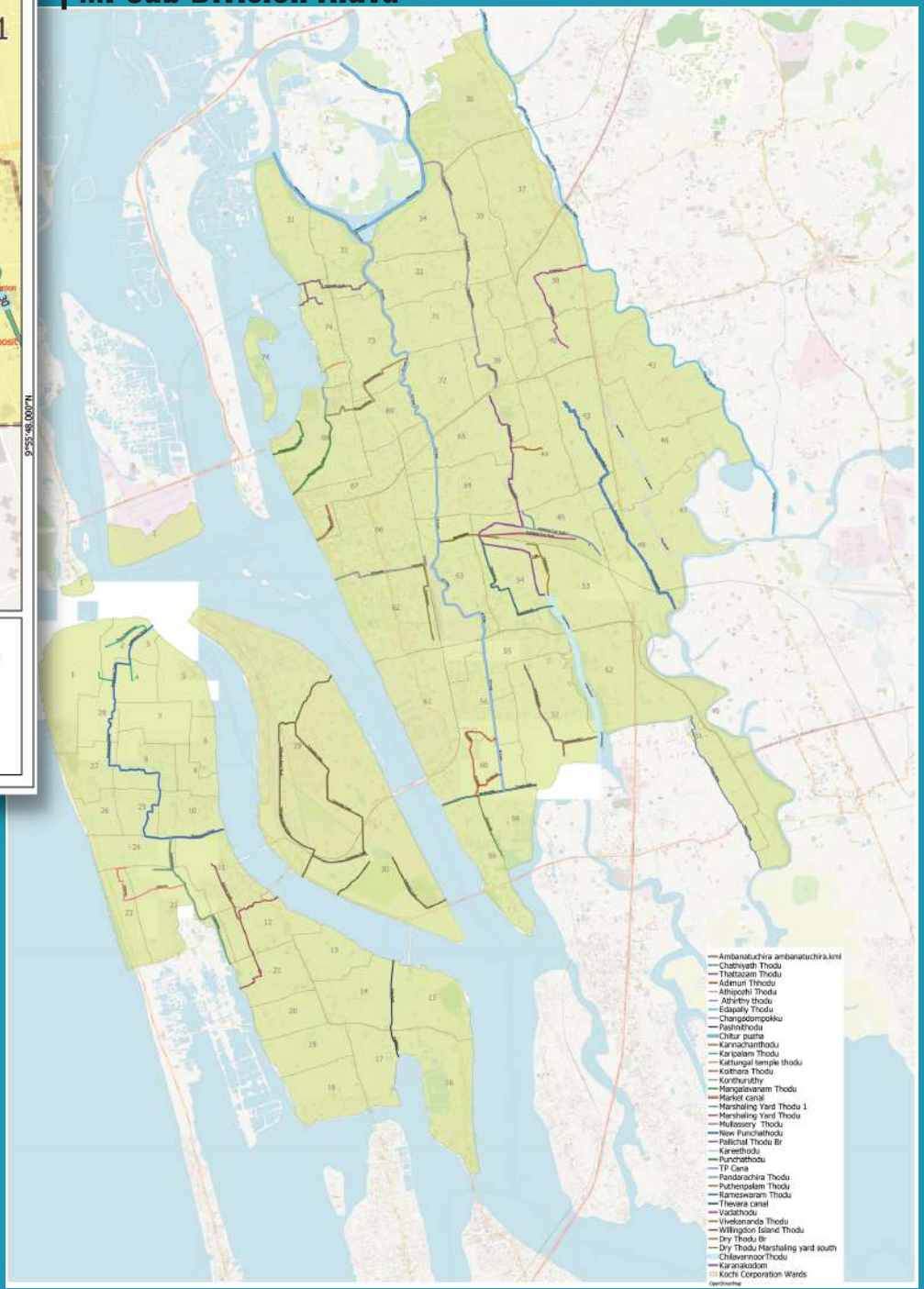
ASSISTANT EXECUTIVE ENGINEER

ATHIPOZHI THODU

KOCHI
FLOOD MITIGATION



In-charge: Er.Kumari Sindhu S, | Asst. Executive Engineer | MI Sub Division Aluva



IRRIGATION DEPARTMENT
ERNAKULAM

ATHIPOZHI THODU

INITIAL STUDY REPORT

Athippozhi Thodu is a natural thodu starts near Aryad –Athipozhi Road in Mundanveli, is globally located at Lattitude N 9.935212 . Longitude E 76.24891,and passes behind the Customs quarters and meets at Pandarachira thodu near Santhom Colony located at Lattitude N 9.932828, Longitude E 76.256842. It is a branch of pandarachira thodu.A no.of drains joining the thodu at starting point (Ch:0), Ch:178m, Ch:675m, Ch:907m, Ch;1250m, Ch:1550m etc. The sea water entered through the drain joints near Saudi at ch:178m and the water is flowing through this thodu .At present, the thoduis under encroached condition at some portions ,thus reducing its size significantly. Now a days, fishing is also not possible as the canal flow is obstructed by foot bridges made by individuals, waste deposits, waste water from households, sewage discharge etc.

This thodu is approximately 1.630km long and and 1.50m wide from starting and ending width is 10.00m. From ch: 124m to 378m (254m length) the thodu is covered with slab.

SALIENT FEATURES

Starting Point	Near Aryad –Atipozhi Road in Mundanveli
Ending Point	Pandarachira Thodu near Santhom Colony.
Length	1630m.
width	Varies from 1.5m to 10m
Crossing	5

PROBLEMS IDENTIFIED

Athipozhi Thodu -Starting Point -Near Aryad –Atipozhi Road in Mundanveli

Athipozhi Thodu -Ending Point:- Pandarachira Thodu near Santhom Colony

a) Disposal of solid waste into natural drain

Disposal of solid waste into the thodu causes pollution of waterbody due to waste accumulated the flow of the thodu has been reduced drastically.This problem is seen near chainages at 845m and at 1450m.The catchment area of the thodu is densely populated and hence the thodu is subjected to variety of pollutants such as municipal sewage, organic, plastic waste, etc.

Athipozhi Thodu -Waste deposited – ch.845m

Athipozhi Thodu -Waste deposited – at ch. 1450m- Near Customs Quarters

Athipozhi Thodu -Waste deposited – at ch. 1450m- Near Santhom colony ch.1600

Athipozhi Thodu -Reduced width of the thodu- Near Santhom colony road at ch.1550m

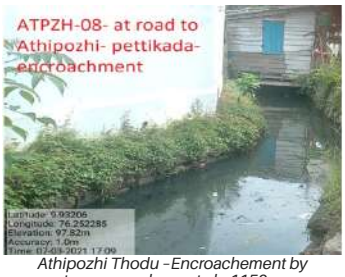
b) Reduced width of Thodu

The culvert constructed across the canal with projecting abutments causes the reduction in width of the thodu at ch.1550m which causes blockages of the thodu and reduces the easy drainage of water.

c) Encroachment.

Encroachment over the thodu by some temporary shops at ch. 907, ch. 1150, ch.1170. These sheds has to be demolished immediately and encroachment has to be evicted strictly with the help of Revenue authorities and Police.

Athipozhi Thodu –Encroachement by temporary shops at ch. 907m

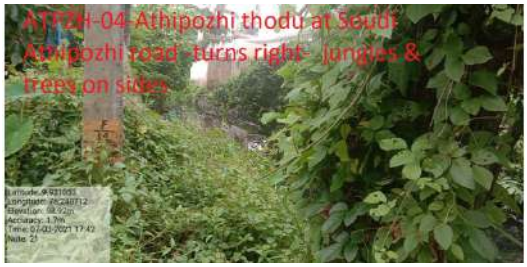


Athipozhi Thodu –Encroachement by temporary shops at ch. 1150m

Athipozhi Thodu –Encroachement by temporary shops at ch. 1170m

d) Presense of thick vegetation

Thodu is covered with thick vegetation which obstruct free flow of water. Root growth especially from nearby trees caused drainage failure on the thodu.



Athipozhi Thodu – Thick vegetation and jungle at ch. 624m

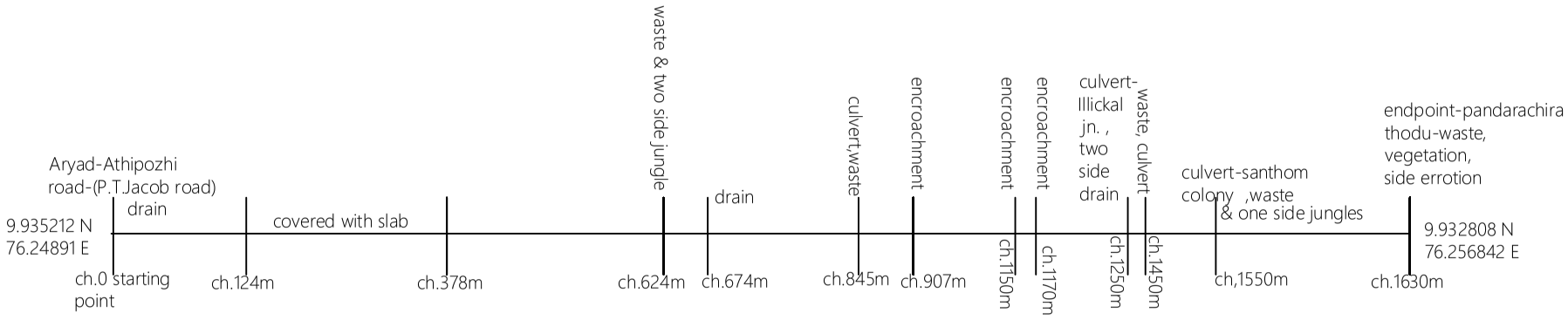
Athipozhi Thodu – Thick vegetation and jungle at ch:860m

REMEDIAL MEASURES

For avoiding blockage / flood during rainy season the following measures are required. Cleaning of thodu including deepening, Clearing vegetation , encroachment eviction, widening of thodu at narrow places and maintaining same cross -section, reconstruction of culvert with sufficient span and free board, removing waste pipe line/soil pipe from house hold directly discharging into the thodu etc.

LINE SKETCH

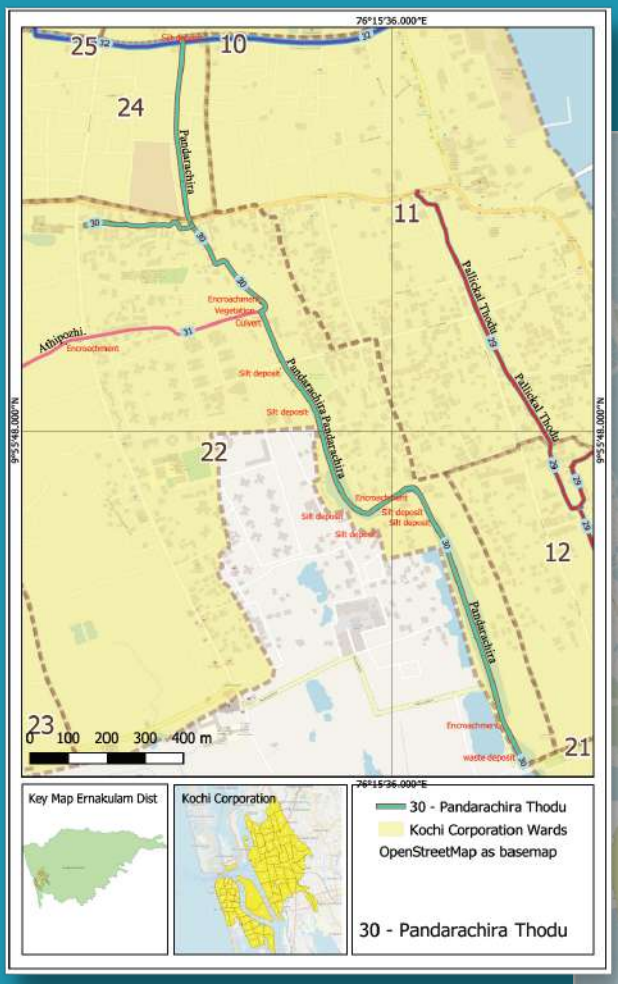
Aryad-Athipozhi road-(PT Jacob road)
9.935212 N
76.24891 E
ch.0 Starting point
drain
ch.124m
covered with slab
ch.378m
waste & two side jungle
ch.624m
drain
ch.674m
culvert,waste
ch.845m
encroachment
ch.907m
encroachment
ch.1150m
encroachment
ch.1170m
culvert-Illickal jn., two side drain
ch.1250m
waste, culvert
ch.1450m
culvert-santhom colony ,waste & one side jungles
ch.1550m
endpoint-pandarachira thodu-waste, vegetation, side erroton
9.932808 N
76.256842 E
ch.1630m



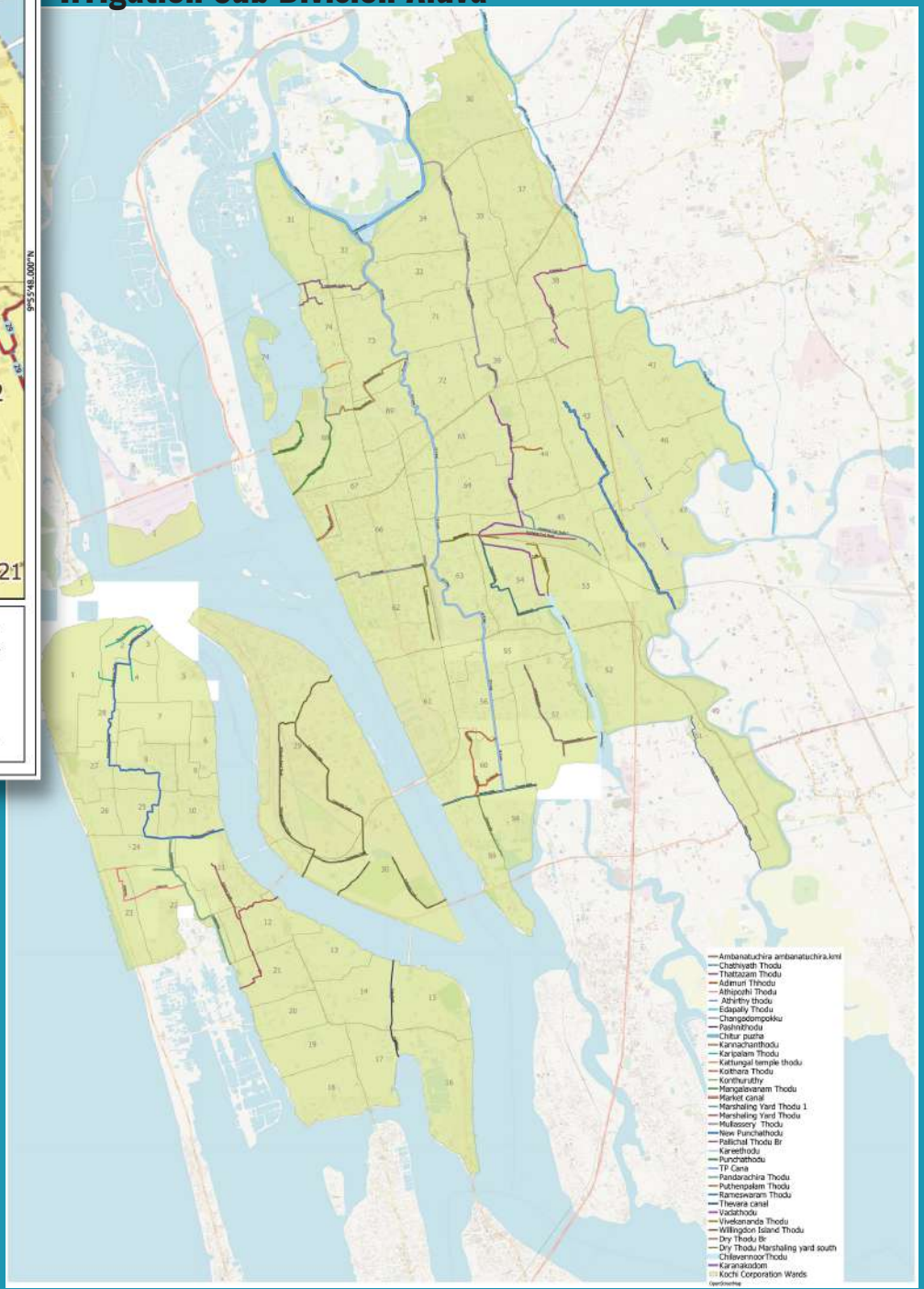
ATHIPOZHI THODU

PANDARACHIRA THODU

KOCHI
FLOOD MITIGATION



In-charge: Er.Praveen Lal G. | Asst. Exe. Engineer | Addl. Irrigation Sub Division Aluva



IRRIGATION DEPARTMENT
ERNAKULAM

PANDARACHIRA THODU

INTRODUCTION

Kochi is located on the southwest coast of India at 9°58′N 76°13′E, with a corporation limit area of 94.88 km2. Over the years, the city has expanded considerably outside the corporation. The city straddles the backwaters, encompassing the northern end of a peninsula, several islands and a portion of the mainland. To the west lies the Laccadive Sea, and to the east is the urbanised region in the rest of the mainland area. Much of Kochi lies at sea level, with a coastline of 48 km.

The current metropolitan limits of Kochi include the mainland Ernakulam.Fort Kochi, the suburbs of Edapally, Kalamassery, Aluva and Kakkanad to the northeast; Tripunithura to the southeast; and a group of islands closely scattered in the Vembanad Lake. Called the "Queen of the Arabian Sea", Kochi was an important spice trading centre on the west coast of India from the 14th century onward, and maintained a trade network with Arab merchants from the pre-Islamic era.

Kochi city lies almost par with the Sea level and hence the drainage in parts of WesternKochi deserves much importance as well as more sensitive also . The average altitude of Kochi ranges from+7.50mto+1.00m above MSL from east to west.A number of main and secondary canals criss - cross the area,some were used for transportation in the past and now subjected to severe environmental degradation due to waste dumping . The canals are exhausted with drastic reduction in water carrying capacity due to rampant encroachment.

HISTORY

Pandarachira thodu is situated near Palluruthy in Kochi taluk of Ernakulam district. The thodu passes through divisions 22 & 24 of Kochi Municipal corporation. This thodu facilitate drainage of water to Chirakal river and Rameswaram canal and viceversa.The thodu is 2.9371km long and consists of three branches namely Kazhuthumuttu thodu, Athipuzha thodu and Pandara parambu thodu which flows to the Rameswaram canal at East & Chirakal river at the west side. The branches of Pandarachirathodu Athipuzhathodu is 1.63Km long with average width of 4m which starts from Thoppumpady Chellanam Road (Aryad Athipuzha cross road) and meets Pandarachirathodu near Ch.787.50m near Santhom Colony. Another branch is Kazhuthumuttu thodu which is 520m is long meets at Ch.478.50m of Pandarachirathodu near Kazhuthumuttu junction. Another branch is Pandaraparambu thodu which has got a length of 400m, 1.20m average width meets at 633.5m chainage of Pandarachira thodu The thodu starts from Rameswaram canal near Polakandam market and ends in Chirakkal river near the fish farm owned by GCDA. The Pandarachirathodu divides at Ch:0.4785km of the main Pandarachirathodu and the branch continues for a length of 0.520km towards the south side.. The family of Kochi Maharaja used this waterway to travel from Thripunithara to Perumpadappu, Mundamveli, Karuvelipady, Chullikal, Chellanam and other areas in Western kochi..This project was envisaged by the Kochi Maharaja for the betterment of the people in west kochi near Chirakkal, Mundamvely, Kazhuthumuttu, Perumbadappu and Palluruthy areas.The Kochi Maharaja used to visit the Pandarachirathodu area with the Samoothiri from Kozhikode and used to rest in the NALUKETTU at Pallichalbridge.The Maharaja used to take rest at Pallichal and his entire itenirary was taken care of by the Vadakumthodu and Pallivathukkal family residing in Pallichal.He would spend time with the people there and used to visit the Azhakiyakavu temple for darsana of goddessBhadra at Palluruthy.The Maharaja would participate in the PULAVANIBHAM near the premises of the temple,.People used to come for PULAVANIBHAM near the temple premises to sell materials made up of coconut palm trees,bamboo, arecanut,cadjanetc which was made in there home itself.These materials were also transported to Ernakulam and places like Kollam Chenganaserry,Alleppey etc. This thodu was earlier used for transporting goods to places like Mattanchery, Mundamveli, Kattiparambu, Perumpadappu Kannamaly and chellanam in west Kochi also. They also used to transport materials like sand,bricks,stones,lime etc in big country boats.

Lot of boats used to stay anchored near the banks of the Pashnithodu, and the people used to make food and stay in the boat yard for quite some time.Then they travelled to Pandarachirathodu which leads to the Rameshwaram canal ending in the Vembanadkayal itself. There was a connection to pandarachira from pashnithodu from the east side through the perumpadappukayal. Transportation of goods was done mostly through these three thodus viz Pashnithodu, pallichalthodu and Pandarachirathodu which was interconnected leading to the Rameshwaram canal. The lands adjoining the Pandarachirathodu was highly fertile and agriculture was vastly done in this area. About 600 acres of agricultural land was well maintained in earlier times from chirakkal to Kazhuthumuttu area. The Pandarachirathodu itself was a manmade thodu constructed to irrigate these agricultural lands. In 1965 the Irrigation Department built side protection walls using rubble to protect the Pandarachirathodu.Later in 1980, Greater Cochin Development Authority (GCDA) took up these lands to build a mini city. But the project didn't come out well. The land owned by GCDAwas left out for a long time and these land was filled up with mangroves. Later on some portion of these lands were sold to private parties and as a result agriculture in that land came to an end and the left over land was turned into a barren land. People living in and around Pandarachirathodu moved to different places making use of the side bund road along the thodu. People also moved to different places through the thodu using country boats. The boats were rented for different purposes like marriage functions etc. near the starting point of Pandarachira thodu.

The elderly folks in the city, recount stories in this regard,but due to the rampant encroachments and unscientific developments of different agencies and people on the banks of the Pandarachirathodu,the course of canal has changed drastically to a shadow,once it had.

PROBLEMS & REASONS

a) Silt accumulation:-

The main problem faced in this thodu and the areas in the vicinity is flooding during the monsoon season.The main reason for this is silting up of the thodu. Periodical cleaning is not done since long,hence the depth of flow is reduced considerably. Waste dumping also has lessened the quality of water in the thodu.The main problem for flooding up of water is due to blockage of flow of water in the upstream of Pandarachirathodu at the starting point itself because the thodu is covered up by slab and between Ch.490.5m and 952.1m where there is vast encroachment, waste dumping and since long no cleaning has been done.Silt is accumulated for the entire length of 3.3371km including the branches. A delta formation has taken place at Ch.1422.1m which needs urgent attention and has to be removed. In monsoon season the recession of flood water will take more time and naturally the low lying area will easily get inundated. This portion of silt accumulation has to be cut and cleaned to facilitate easy flow of water from the thodu to the Rameswaram Canal and Chirakal river

b) Disposal of waste water and solid waste into the natural drain:-

Waste pipes from houses is given directly in to the thodu which also causes pollution of the waterbody.due to the waste accumulated the flow of the thodu has been reduced drastically . This problem is seen near Chainages 920m, 790m etc.The thodu starts with a width of 2m and reduces to 1.5m @Ch:470m, then the width increases to 5m upto Ch:478.50m. In this 478.5m stretch we could find a lot of waste dumped into the thodu from houses. Water gets blocked at Ch.478.5m where the height of the culvert is insufficient and needs to be reconstructed. Near Ch. 633.5 the thodu has two 90 degree bends where massive quantity of waste has been deposited. This has to be removed at warfooting. At this chainage the Pandaraparambu branch thodu meets the main thodu. This branch is also accumulated with waste in different stretches which also has to be removed urgently. Near Ch.787.5m where the Athipuzha branch thodu meets the main thodu a large quantity of waste is deposited. Near Ch.952.1m for a stretch of 40m, Ch.1422.1m, 1597.1m 2412.1m etc large quantity of waste has been deposited. It needs urgent attention. The catchment area of this thodu is densely populated and hence the thodu is subjected to variety of pollutants such as municipal sewage, organic , plastic wastes etc.The Pandarachira thodu at the starting portion for 186 m might also have waste pipes connected, but those are not visible because most of the length of thodu is covered by concrete slabs.

The thodu is observed to receive household sewage along its entire length.The people residing nearby the thodu is also facing health hazards due to the heavy pollution of the thodu.Stringent measures need to be taken to prevent discharge of such wastes and sewage to the thodu.

c) Blockage in small drains:-

There are 9 small drains joining the Pallichalthodu at the left side and about 12 number of small drains joining at the right bank. Moreover small PWD drains also connects to the main Pandarachirathodu. The surface runoff as well as waste water flows into the main thodu also. The other drains connecting at different points to the main and branch thodu are also clogged with waste and needs thorugh cleaning to make easy flow of water through the drains in to the main thodu.These channels would act as flood absorbing pockets and the run off from high intensity rain could not be drained easily now.

d) Reduced width of Thodu

The width of thodu is reduced at different points which causes blockages of the thodu and reduces the easy drainage of water to the Chirakal river.In the main Pandarachirathodu at Ch:0.00m the width of thodu is 2m, the width reduces to 1.5m at Ch 378m,means the thodu reduces further. This portion of thodu continues for a length of 100.5m,which finally reduces the discharge drastically. Widening of thodu in this stretch of thodu is inevitable and should be intervened urgently. The width of thodu reduces from Ch.501.50m ie from 8m to 5.5m upto Ch.633.5m which finally reduces the discharge drastically for a length of 132m. At Ch.112.5m the thodu has got 40m width. But this reduces to 12.4m at Ch.937.5m. That is for 187.6m length of thodu the width reduces gradually (27.6m). Near Santhom Colony the thodu has got 18m width at Ch.1422.1m. But at Ch.1502.10m the width of thodu reduces to only 23m and further it reduces to 8m at Ch.1637.10m. Near Neerul Iman Masjid the thodu has got 20m width only at Ch.2277.10m. But at the end Ch.2417.10m the width of thodu is 57m. As the width of thodu reduces the area of cross section of flow get reduced and drainage of water becomes blocked and wont serve the entire purpose intended.

e) Encroachment:-

Encroachments of the thodu is suspected from Ch:726.5m upto Ch.787.50m where there are two sharp 90 degree bends. This encroachment continues upto Ch.937.50m where the existing width of thodu 18.4m reduces to 12.4m and in order to facilitate the water flow there is only two pipes of 1.5m dia installed which is very much insufficient for the existing width of 12.4m. The encroachment is further found from Ch.937.50m to 1125.1m and from 1552.1m to 1597.1m. Towards the end portion near Ch.2277.10m and Ch.2237.1m the encroachment is visible where the public has constructed houses into the thodu and planted small trees also. These encroachments has to be evicted strictly with the help of higher authorities and police.

f) Existing culverts having no head room and vent way

Ventway of the thodu is narrowed at the existing culverts which causes accumulation of wastes and finally blocking the flow of water near Ch.478.50m and Ch.937.5m.

At Ch.478.5m – The height of the Culvert is not sufficient for free flow of water . This old culver has to be demolished and we have proposed reconstruction of this culvert with adequate height.

At Ch.937.50m – The existing width of thodu (18.4m) reduces to 12.4m and in order to facilitate the water flow there is only two pipes of 1.5m dia installed which is very much insufficient for the free flow of water. The area of cross section for free flow of water is reduced to 3.53m2 where we need about 22.32m2 area. We have now proposed to remove the existing RCC pipes and to construct a new culvert with sufficient width of flow which will bring in a massive impact and improve the continuous flow of Pandarachira thodu. Another pipe culvert is given at Ch.410m of Pandarachira branch thodu with a diameter of 30cm which is insufficient for smooth flow of water. A new culvert is proposed at this location with sufficient headroom and ventway. This work shall be done very urgently.

g) Utility pipes crossing drains

The utility pipes belongs to KSEB/KWA/BSNL etc. crossing the drain at different locations obstruct the free flow of water, especially during flood season. The pipes laid through the water surface of the thodu has to be lifted, leaving a clear headroom to accommodate flood water. The following locations are prone to flooding due to the obstruction of utility pipes

At Ch.478.5m near Kazhuthumuttu the thodu joins the culvert where there is huge pipe of KWA which has to be lifted up to facilitate the free flow of water.

At Ch.490.5m near Kazhuthumuttu, there is a small culvert across which a small water supply pipe passes which has to be lifted up to facilitate the free flow of water.

h) Conversion of thodu to road

The Pandarachirathodu is covered up with slab for a length of 186m from the starting point ie from Polakandam market in Ramavarma Canal. The thodu is covered and cleaning has not been done since years and the waste materials and silt is laying as such in the thodu which needs urgent attention.

The present practice of converting the thodu to road by covering with concrete slab has to be stopped. This will accelerate clogging of drain, which will prevent the free flow of water. Future cleaning of thodu will be cumbersome on account of this. The concreting of bed of natural thodu is not at all advisable. Concreting the natural bed of thodu will prevent the seepage of water through ground thus increasing the risk of flooding.

REMEDIES ARE PROPOSED

Long term measure

- The thodu has to be rejuvenated to its original shape after demarcating boundaries and evicting encroachments . The carrying capacity of the thodu has to be redesigned to maintain proper section based on run off data by eviction/ acquisition of land.
- Provide high capacity pumps with shutter arrangements to drain out flood water to the lake so as to combat the tidal variations, ensuring its periodical maintenance.
- Interlinking of parallel canals by widening the existing natural stream for easy drainage.
- The rivers & lakes encompassing the main lands have to be desilted regularly in order to accommodate the flood water. Water storage capacity of thodu shall be increased by desilting
- Fencing to be done on the boundaries of the thodu on both the banks for a minimum height of 4m in order to prevent dumping of waste in to the thodu.

- At Ch.478.5m – The height of the Culvert is not sufficient for free flow of water . This old culver has to be demolished and we have proposed reconstruction of this culvert with adequate height.
- At Ch.937.50m – The existing width of thodu (18.4m) reduces to 12.4m and in order to facilitate the water flow there is only two pipes of 1.5m dia installed which is very much insufficient for the free flow of water. The area of cross section for free flow of water is reduced to 3.53m2 where we need about 22.32m2 area. We have now proposed to remove the existing RCC pipes and to construct a new culvert with sufficient width of flow which will bring in a massive impact and improve the continuous flow of Pandarachira thodu. This work shall be done very urgently
- At Ch.410m (Pandarachira branch thodu) In order to facilitate the flow of water through the branch thodu a pipe culvert of 30cm dia is installed at Ch.410m near Parippu junction at the road crossing which is insufficient. Instead a new proposal is given to construct a culvert with sufficient head room and ventway.

Short term measure

1. Desilting and cleaning of Pandarachirathodu and its branch at the entire stretch to drain the flood water more effectively.
2. Corporation shall not encourage the conversion of natural thodu to concrete thodus at any of the reaches of the thodu
3. Blocking the waste pipes from different companies and houses shall be given immediate emphasis.
4. A tree of large girth at left bank of thodu near Ch.937.5m has to be cut to widen the waterway.

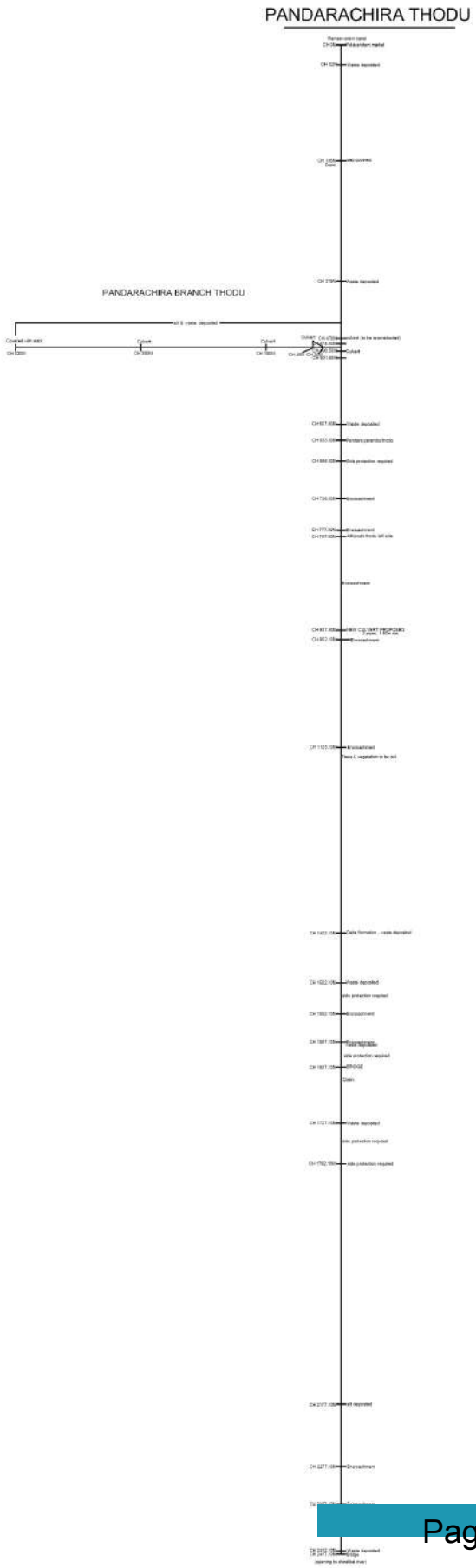
BENEFITS OF SHORT TERM MEASURE

Implementation of short term measure doesn't guarantee the redressal of all problems, unless the long term measures are implemented. But can reduce the intensity of waterlogging to a certain extent.

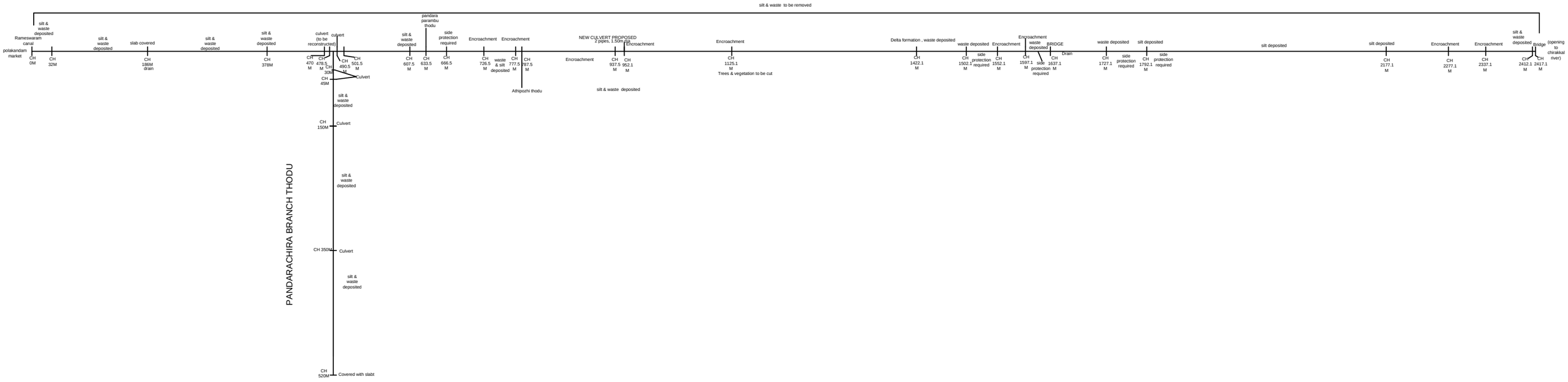
CONCLUSION/RECOMMENDATIONS

A detailed study on waterlogging is essential to formulate longterm strategies based on proper hydrological study. A scientific study of discharge of drains emptying in to the thodu and the run off data of the catchment area at different rainfall intensity has to be arrived and the carrying capacity of the thodu has to be redesigned and to maintain proper section by evicting the encroachment if any or acquisition of land. The velocity of flow can be increased by engaging highcapacity pumps especially during flash flood. Dumping of waste and disposal of waste water from houses directly to the thodu lead to environmental degradation posing threat to public health. Proper awareness has to be given to the public to curb this menace.

It is observed that the width of the Pandarachira thodu is reduced to 1.5m at the starting point from 55m at the end point. Also the total length of the thodu including the branches is 2.937Km. Out of this 0.3Km of length of the thodu is covered with slab. The width of the thodu is considerably reduced at most of the places. As per the discharge calculation of the Pandarachira thodu taking into consideration rainfall of 10Cms and other factors the discharge expected through the thodu during heavy rain is 2.528m3/S. Now the area of cross section required for the thodu during heavy rainfall to contain the maximum run off is 4.213m2. We can see at different locations of the thodu encroachment has occurred to a considerable level which reduces the area of cross section of the thodu which is insufficient to take care of the storm water. Encroachment should be evicted and the area of cross section of the Pandarachira thodu should be retained to the suggested new cross sectional area.



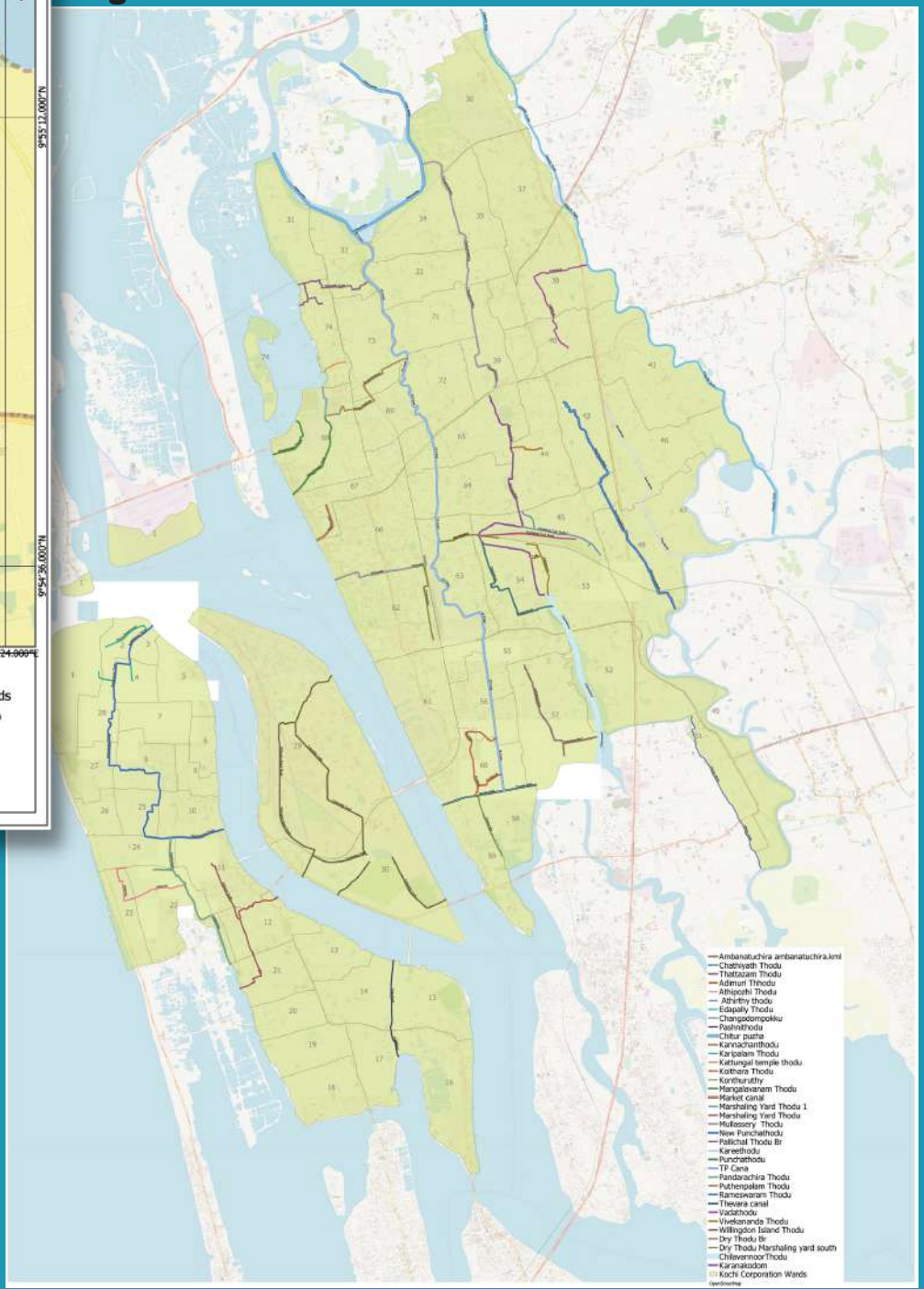
PANDARACHIRA THODU



PASHNITHODU

KOCHI
FLOOD MITIGATION

In-charge: Er.Praveen Lal G. | Asst. Exe. Engineer | Addl. Irrigation Sub Division Aluva



IRRIGATION DEPARTMENT
ERNAKULAM

PASHNITHODU

INTRODUCTION

Kochi is located on the southwest coast of India at 9°58′N 76°13′E, with a corporation limit area of 94.88 km2. Over the years, the city has expanded considerably outside the corporation.The city straddles the backwaters, encompassing the northern end of a peninsula, several islands and a portion of the mainland. To the west lies the Laccadive Sea, and to the east is the urbanised region in the rest of the mainland area. Much of Kochi lies at sea level, with a coastline of 48 km.

The current metropolitan limits of Kochi include the mainland Ernakulam, Fort Kochi, the suburbs of Edapally, Kalamassery, Aluva and Kakkanad to the northeast; Tripunithura to the southeast; and a group of islands closely scattered in the Vembanad Lake. Called the "Queen of the Arabian Sea", Kochi was an important spice trading centre on the west coast of India from the 14th century onward, and maintained a trade network with Arab merchants from the pre-Islamic era.

Kochi city lies almost par with the Sea level and hence the drainage in parts of Western Kochi deserves much importance as well as more sensitive also . The average altitude of Kochi ranges from+7.50mto+1.00m above MSL from east to west.A number of main and secondary canals criss - cross the area,some were used for transportation in the past and now subjected to severe environmental degradation due to wastedumping . The canals are exhausted with drastic reduction in water carrying capacity due to rampant encroachment.

HISTORY

Pashnithodu is situated near Edakochi in Kochi taluk of Ernakulam district. The thodu passes through the Divisions 13,14,15&17 of Kochi Municipal corporation. This thodu facilitate drainage of water to VembanaduKayal from the Perumbadappukayal and viceversa.The thodu is 1.447Km long with an average width of 15m which flows according to the tidal variations in kayal either to vembanadkayal or PerumpadappuKayal.The thodu starts from karunakaran road starting point near Perumpadappukayal and ends in Vembanatukayal near the Kanangattu Bridgein. The family of Kochi Maharaja used this waterway to travel fromThripunithara toPerumpadappu,Mundamveli and other areas in West kochi..During the first world war there was poverty in western kochi and the people living in the vicinity of Pashnithodu found it very difficult to make a living. Inorder to create employment and to facilititate livelihood of the people the Kochi Maharaja decided to make pashnithodu by engaging the people residing nearby the thodu thereby giving them work and money for daily bread. The name of thodu" PASHNI" itself implies the meaning poverty .The Pashnithodu could thus alleviate poverty to a greater extent in those days.Earlier the people had to travel long circulating the Aroor area to transport goods and other items in boats(Kettuvallam) to Ernakulam.By cutting the new thodu the distance of travel through the kayal could be cut down to the bare minimum.This project was envisaged by the Kochi Maharaja for the betterment of the people. This thodu was earlier used for transporting goods to places like Mattanchery, Mundamveli, Kattiparambu, Perumpadappu, Kannamaly and chellanam in west Kochi.The people used to make woven mats made of coconut palm trees,bamboo,arecanut,cadjan etc and transport these materials to Ernakulam and places like Kollam Chenganaserry, Alleppey etc.They also used to transport materials like sand, bricks, stones,lime etc in kettuvallam. There was big companies in the banks of Pashnithodu in the northern side of the thodu which produced immense quantity of ropes from coir and other coir products and transported these things to the southern part of Kerala.Even now we can see the dilapidated building of sahakaranasangam on the left bank of the thodu. Lot of boats used to stay anchored near the banks of the thodu, and the people used to make food and stay in the boat yard for quite some time.At present a Bridge has been constructed at Ch:392m called the Pashnithodu bridge,which helps people to travel from the southern area of the state to west Kochi.

The elderly folks in the city, recount stories in this regard,but due to the rampant encroachments and unscientific developments of different agencies, the course of canal has changed drastically to a shadow,once it had.

PROBLEMS & REASONS

a) Silt accumulation:-

The main problem faced in this thodu and the areas in the vicinity is flooding during the monsoon season.The main reason for this is silting up of the thodu. Periodical cleaning is not done since long,hence the depth of flow is reduced considerably. Waste dumping also has lessened the quality of water in the thodu.The main problem for flooding up of water is due to blockage of flow of water in the upstream of Pashnithodu in the PerumpadappuKayal.Silt is accumulated for a length of 1km in the upstream for a width of 20m and depth of 2m. In monsoon season the recession of flood water will take more time and naturally the low lying area will easily get inundated. This portion of silt accumulation has to be cut and cleaned to facilitate easy flow of water from the thodu to the perumpadappukayal and viceversa

b) Disposal of waste water and solid waste into the natural drain:-

Waste pipes from houses is given directly in to the thodu which also causes pollution of the waterbody.due to the waste accumulated the flow of the thodu has been reduced drastically.The catchment area of this thodu is densely populated and hence the thodu is subjected to variety of pollutants such as municipal sewage, organic , plastic wastes etc. The thodu is observed to receive household sewage along its entire length.Some seafood companies also operate on the left bank of the thodu. Amida Peeling shed is situated at Ch:467m of the thodu,Trity exports company is situated at Ch: 1247m on the left bank.Another Company named TSS peeling company is also situated on the left bank which also drains out waste water into the thodu.These companies are letting out solid as well as liquid wastes to the natural drain.The people residing nearby the thodu is also facing health hazards due to the heavy pollution of the thodu.Stringent measures need to be taken to prevent discharge of such wastes and sewage to the thodu .

c) Blockage in small drains:-

There are 6 small drains joining the Pashnithodu at the left side and about 4 number of small drains joining at the right bank.Thses drains are also clogged with waste and needs thorugh cleaning to make easy flow of water through the drains in to the main thodu.These channels would act as flood absorbing pockets and the run off from high intensity rain could not be drained easily now.

d) Encroachment

Encroachments of the thodu is suspected in between locations Ch:271mand Ch:296m.The width of thodu is seen decreasing to 12 m from 18 m in this area.These encroachments has to be evicted strictly with the help of higher authorities and police.

REMEDIES ARE PROPOSED

Long term measure

- The thodu has to be rejuvenated to its original shape after demarcating boundaries and evicting encroachments . The carrying capacity of the thodu has to be redesigned to maintain proper section based on run off data by eviction/ acquisition of land
- Provide high capacity pumps with shutter arrangements to drain out flood water to the lake so as to combat the tidal variations, ensuring its periodic maintenance.
- Interlinking of parallel canals by widening the existing natural stream for easy drainage.
- The rivers & lakes encompassing the main lands have to be desilted regularly in order to accommodate the flood water. Water storage capacity of thodu shall be increased by desilting
- Fencing to be done on the boundaries of the thodu on both the banks for a minimum height of 4m in order to prevent dumping of waste in to the thodu.
- Urgent construction of protection walls at required places (near Ch:1400mR/B,nearCh: 380m R/B,near Ch:1150m R/B)

Short term measure

- Desilting and cleaning of Pashnithodu at the entire stretch to drain the flood water more effectively.
- Desilting and cleaning of upstream stretch of pashnithodu in Perumpadappukayal for a length of 1km,20m width and depth of 2m at the entire stretch to drain the flood water more effectively.
- Corporation shall not encourage the conversion of natural thodu to concrete thodus at any of the reaches of the thodu
- Blocking the waste pipes from different companies and houses shall be given immediate emphasis.

BENEFITS OF SHORT TERM MEASURE

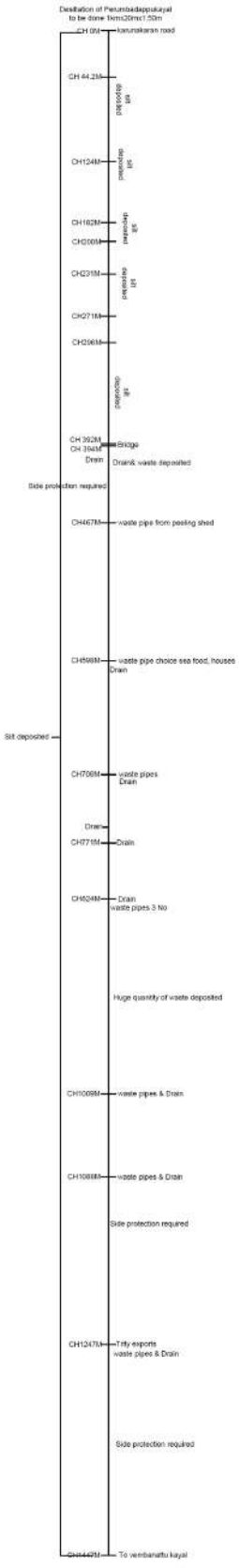
Implementation of short term measure doesn't guarantee the redressal of all problems, unless the long term measures are implemented. But can reduce the intensity of water logging to ascertain extent.

CONCLUSION/RECOMMENDATIONS

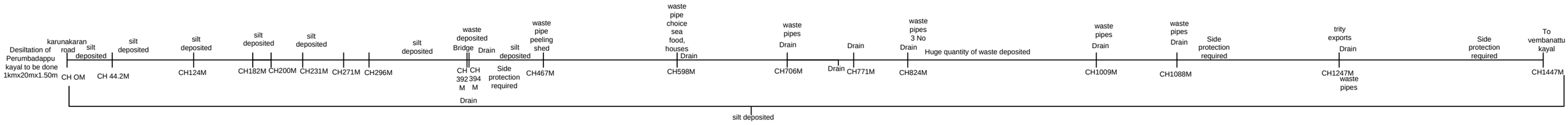
A detailed study on waterlogging is essential to formulate longterm strategies based on proper hydrological study. A scientific study of discharge of drains emptying in to the thoduand the run off data of the catchmentarea at different rainfall intensity has to be arrived andthe carrying capacity of the thodu has to be redesigned and to maintain proper section by evicting the encroachment if any or acquisition of land. The velocity of flow can be increased by engaging high capacity pumps especially during flash flood. Dumping of waste and disposal of waste water from houses directly to the thodu lead to environmental degradation posing threat to public health. Proper awareness has to be given to the public to curb this menace.

It is proposed to construct a drain from the Kumbalangi vazhi junction towards the Pashnithodu for a length of 400m to get rid of the flooding in the flood stricken areas in Ward 17. It is also proposed to construct a new drain from Eranatt Temple premises which will pass through Ward 17 along the side of the National High way to facilitate easy drainage of flood water from Eranatt Temple area to Pashnithodu.

PASHNITHODU



PASHNITHODU



WILLINGTON ISLAND THODU

KOCHI
FLOOD MITIGATION

In-charge: Er.Praveen Lal G. | Asst. Exe. Engineer | Addl. Irrigation Sub Division Aluva

IRRIGATION DEPARTMENT
ERNAKULAM

WIILINGDON ISLAND THODU

INTRODUCTION

Kochi is located on the southwest coast of India at 9°58′N 76°13′E, with a corporation limit area of 94.88 km2. Over the years, the city has expanded considerably outside the corporation. The city straddles the backwaters, encompassing the northern end of a peninsula, several islands and a portion of the mainland. To the west lies the Laccadive Sea, and to the east is the urbanised region in the rest of the mainland area. Much of Kochi lies at sea level, with a coastline of 48 km.

The current metropolitan limits of Kochi include the mainland Ernakulam.Fort Kochi, the suburbs of Edapally, Kalamassery, Aluva and Kakkanad to the northeast; Tripunithura to the southeast; and a group of islands closely scattered in the Vembanad Lake. Called the "Queen of the Arabian Sea", Kochi was an important spice trading centre on the west coast of India from the 14th century onward, and maintained a trade network with Arab merchants from the pre-Islamic era.

Kochi city lies almost par with the Sea level and hence the drainage in parts of Kochi including Willingdon Island deserves much importance as well as more sensitive also . The average altitude of Kochi ranges from+7.50mto+1.00m above MSL from east to west.A number of main and secondary canals criss - cross the area,some were used for transportation in the past and now subjected to severe environmental degradation due to waste dumping . The canals are exhausted with drastic reduction in water carrying capacity due to rampant encroachment. The idea of developing a new port in Kochi was first felt by Sir Robert Bristow, who was appointed by Lord Willingdon, then-the Governor of Madras Presidency, to create a new modern port on the West coast of India at Kochi. Cochin is a major port in India, and Willingdon Island is a landmark. The Island is connected to the mainland by Venduruthy Bridge, which has road and railway links. There are two railway stations on the Island - the Mattancherry Halt and the Cochin Harbour Terminus. The headquarters of the Southern Naval Command of the Indian Navy is located on the island. Cochin shipyard is also located near this island. It is also a major tourist center. Willingdon Island is also home to several hotels and offices of clearing agents. The Island thodu starts from Vembanatt kayal near the BOT bridge at Thoppumpady and passes through Vathuruthy and flows along the Willingdon Island main road at the side of the Naval Airport and it ends near the Willingdon Island jetty into the Kollam Kottappuram waterway at the East. The length of the Island thodu is 3.82 Km. with an average width of 8.50Km. A branch of this thodu also passes through the Naval base Airport campus starting from Vathuruthy and ending near Willingdon Island jetty. The length of this branch of Island thodu is 2.480Km. Apart from Island thodu Mattanchery channel and Vathuruthy channel also passes through the Vathuruthy area. Vathuruthy channel has got 2 reaches. The length of the first reach is 1.24Km and average width 16m and the length of the second reach is 0.82Km with average width 10m. The total length of Vathuruthy channel is 2.06Km. The length of the Mattanchery channel is 0.655Km and with average width 10m.

HISTORY

The island was created during the construction of modern port in 1936, with the soil dredged out while deepening the Vembanad Lake to accommodate the new port. It was named after The 1st Earl of Willingdon, the Viceroy of India at the time, who commissioned the project.[3] Robert Bristow, the chief protagonist and engineer for the project, owned the first building on the island.The first liner, which belonged to the Bibby Line, arrived at the island on 9 March 1935. A port hostel, called Malabar Hotel, was built for passengers who wished to rest on the island. All the pre-planned basic port structure was completed in 1939, just in time for the Second World War. A deep wharf, a rail bridge and a road bridge to the mainland provided valuable infrastructure for the local war effort. A naval works was also constructed on the adjacent Venduruthy Island to the south, where, by the end of the war, they were busily constructing landing craft for the presumed invasion of Japan. In 1940 a passenger jetty and customs house were built adjoining the hotel, together with a passenger platform and rail siding. The Royal Air Force quickly found use for this flat expanse of conveniently located virgin territory, and constructed a large aerodrome. The artificial island thus became a thriving military base. The Malabar Hotel provided quarters for all the wartime staff and the building gained a new administrative block next door to it. Taken over from the RAF by the Royal Navy on 1st October 1942, and recommissioned as HMS Garuda. It was a Royal Navy Aircraft repair yard with a capacity of 180 aircraft. Decommissioned on 1 April 1946. A new post office, an open-air swimming-bath between the hotel and offices, and a branch bank adjoining both, completed the amenities.

Control of the transport hub was transferred from the British Empire to India in 1947, when the latter gained independence.[3] During its short colonial tenure the island had handled at most one million tons of freight, by 1960 this had almost doubled.[3] The island aerodrome was extensively developed and became the city's modern military-cum-civilian airport. When Kochi got an international Airport at Nedumbassery,[5] 25 km north-east of the city, the civilian enclave of the Island airport was shut down. The airport continued as the naval air station INS Garuda. The remaining space on the island was quickly utilized in the 1950s, and far from being an unnatural appendage of the picturesque and ancient city, the isle, left behind by the British so soon after its completion, became the commercial heart of the ancient metropolis of Cochin. Apart from these, the Island has a dry dock, a fire station, tank farms, a hospital[7] and places of worship. The Port Health Organisation functions on the Island and it works towards the prevention of entry of Quarantinable diseases.[8] Cochin Chamber of Commerce and Industries is strategically placed here, as is the Government of India Tourist Information Office in the vicinity of the airport. This island is a hub of international trade. A number of port offices, branches of national and international banks, travel agencies, souvenir shops, and warehouses. Employees of the Cochin Port and Custom House live on the island. For the benefit of these families and those on the Naval Base, there are five schools and a Kindergarten. Three of these schools belong to the Kendriya Vidyalaya groups of schools. The Island thodu was mainly constructed along the boundary of the Naval base Airport in Willingdon Island which was intended to protect the naval base area and also to prevent encroachment and attach into the naval base compound. This thodu acted as a channel to drain off all the run off from the small drains from different parts of the Island into the Vembanatt kayal. There is small regulator at the boundary of Naval base where the Island thodu crosses the main road and railway line near Vathuruthy. This was installed basically to control the flow of water during flood. The Vathuruthy channel starts near Alexander Parambithara bridge at the East side of Vembanatt kayal and it connects to a small water body near Vathuruthy . From there the Vathuruthy channel flows towards the West and joins the main Island thodu. The Mattanchery channel also starts from the Vathuruthy area towards the West and crosses the highway and ends in the Vembanatt kayal

.The Kochi Maharaja used to visit the Vathuruthy area and travelled through the Vathuruthy channel and Mattanchery channel which had a width of 40m and crossed the Vembanatt kayal to reach Palluruthy through the Pallichal thodu and Kochi Maharaja used to rest in the Nalukettu at Pallichal bridge.The Maharaja used to take rest at Pallichal and his entire itenirary was taken care of by the Vadakumthodu and Pallivathukkal family residing in Pallichal.He would spend time with the people there and used to visit the Azhakiyakavu temple for darsana of goddessBhadra at Palluruthy.The Maharaja would participate in the Pulavanibham near the premises of the temple,.People used to come for Pulavanibham near the temple premises to sell materials made up ofcoconut palm trees,bamboo, arecanut,cadjanetc which was made in there home itself. These materials were also transported to Ernakulam and places like Kollam Chenganaserry,Alleppey etc.

This Vathuruthy channel and Mattanchery channel was earlier used as a means for transporting people and materials to places like Mattanchery, Mundamveli, Kattiparambu, Perumpadappu Kannamaly and chellanam in west Kochi also. They also used to transport materials like sand,bricks,stones,lime etc in big country boats. Later in 1985, the Cochin Port Authority filled up the Vathuruthy channel and Mattanchery channel at most of the places and made the main road from Thevara to Willingdon Island upto Mattanchery halt. As a result the width of the said channels was reduced considerably which hindered easy flow of water through the thodu which also reduced trade through these channels in the future. The drainages from the Naval base were earlier connected to the Vathuruthy channel which facilitated easy drainage of stormwater.

The elderly folks in the city,recount stories in this regard,but due to the rampant encroachments and unscientific developments of different agencies and people on the banks of the Island thodu,the course of canal has changed drastically to a shadow,once it had.

PROBLEMS & REASONS

a) <u>Silt accumulation:-</u>

The main problem faced in the Island thodu, Vathuruthy channel and Mattanchery channel and the areas in the vicinity is flooding during the monsoon season.The main reason for this is silting up of the thodu. Periodical cleaning is not done since long,hence th e depth of flow is reduced considerably. Waste dumping also has lessened the quality of water in the thodu..Silt is accumulated for the entire length of 9.015km of Island thodu including the Vathruthy channel and Mattanchery channel. In monsoon season the recession of flood water will take more time and naturally the low lying area will easily get inundated. This portion of silt accumulation has to be cut and cleaned to facilitate easy flow of water from the thodu to the Vembanadukayal and Thevara kayal.

b) Disposal of waste water and solid waste into the natural drain:-

Waste is accumulated in the thodu at the Malabar Gate portion at Ch.3.28Km and at Ch.3.1Km which also causes pollution of the waterbody.Vegetation is grown in the Island thodu in between the reaches Ch.20m to ch.370m and between Ch.425m upto Ch.2600m. Due to the waste and vegetation accumulated the flow of the thodu has been reduced drastically . This problem is seen near Chainages 100m & 350m of Vathuruthy channel. The catchment area of this thodu is not densely populated and the thodu is subjected to variety of pollutants such as, organic , plastic wastes etc.

The Vathuruthy channel is observed to receive household waste along some of the portions in the entire length where there are some houses. The people residing nearby the Vathuruthy channel is also facing health hazards due to the pollution of the thodu.Stringent measures need to be taken to prevent discharge of such wastes and sewage to the thodu .

c) Blockage in small drains:-

There are 7 small drains joining the Island thodu The surface runoff as well as waste water flows into the main thodu through the small drains.The other drains connecting at different points to the Island thodu and Vathuruthy channel are also clogged with waste and needs thorugh cleaning to make easy flow of water through the drains in to the main thodu.These channels would act as flood absorbing pockets and the run off from high intensity rain could not be drained easily now.

d) Reduced width of Thodu

The width of the Island thodu is reduced at different points which causes blockages of the thodu and reduces the easy drainage of water to the Vembanatt kayal & Thevara kayal. At the exit point of the Island thodu there is about 15m width. After the Malabar Gate point the width reduces considerably to 5m. At the starting point of the Island thodu is 3m which increases to 15m at Ch.425m. But the width decreases further to 5m from Ch.612m upto Ch.700m. The width of the thodu further decreases to 3m from Ch.700m to Ch.2790m. The width of the Vathuruthy channel is 20m at the starting point and further reduces to 8m to 6m at Ch.820m. The width of the Mattanchery channel is 8m at the starting point and further increases to 12m at ch.655m.

As the width of thodu reduces the area of cross section of flow get reduced and drainage of water becomes blocked and wont serve the entire purpose intended.

e) Encroachment:-

Encroachments of the Island thodu is suspected in the southern part between locations Ch:2600m and 2790m. The naval base Authority has covered th entire thodu with Aluminium sheets and has formed a boundary wall. Now the thodu is occupied by the Naval base authority for a length of 190m and width 5m. Encroachments is also suspected in between locations Ch:720m and 820m of Vathuruthy channel where the width reduces considerably. These encroachments has to be demolished immediately and encroachment has to be evicted. strictly with the help of higher authorities and police.

f) Existing culverts having no head room and vent way

Ventway of the thodu is narrowed at the existing railway culvert near Vathuruthy junction which causes accumulation of wastes and finally blocking the flow of water near Ch.350m, The existing culvert at this chainages has to be demolished and new culverts with sufficient vent way and head room has to be rebuilt.

g) Utility pipes crossing drains

The utility pipes of KWA is crossing the Island thodu at Ch350m at Vathuruthy at railway crossing which obstructs the free flow of water, especially during flood season. The pipes laid through the water surface of the thodu has to be lifted, leaving a clear headroom to accommodate flood water. The following locations are prone to flooding due to the obstruction of utility pipes

h) Conversion of thodu to road

The branches of the Island thodu is entirely covered up with slab for some length at the North side of the Naval base near the Ayyappa temple.. From this we can study that cleaning has not been done since years and the waste materials and silt is laying as such in the thodu which needs urgent attention.

The present practice of converting the thodu to road by covering with concrete slab has to be stopped. This will accelerate clogging of drain, which will prevent the free flow of water. Future cleaning of thodu will be cumbersome on account of this. The concreting of bed of natural thodu is not at all advisable. Concreting the natural bed of thodu will prevent the seepage of water through ground thus increasing the risk of flooding

REMEDIES ARE PROPOSED

Long term measure

- The thodu has to be rejuvenated to its original shape after demarcating boundaries and evicting encroachments . The carrying capacity of the thodu has to be redesigned to maintain proper section based on run off data by eviction/ acquisition of land.
- Provide high capacity pumps with shutter arrangements to drain out flood water to the lake so as to combat the tidal variations, ensuring its periodical maintenance.
- Interlinking of parallel canals by widening the existing natural stream for easy drainage.
- The rivers & lakes encompassing the main lands have to be desilted regularly in order to accommodate the flood water. Water storage capacity of thodu shall be increased by desilting
- Fencing to be done on the boundaries of the thodu on both the banks for a minimum height of 4minorder to prevent dumping of waste in to the thodu.

Short term measure

- Desilting , clearing weeds and cleaning of Island thodu, Vathuruthy Channel and Mattanchery channel and its branch at the entire stretch to drain the flood water more effectively.
- Corporation shall not encourage the conversion of natural thodu to concrete thods at any of the reaches of the thodu
- Blocking the waste pipes from different houses shall be given immediate emphasis near Vathuruthy channel
- The KWA pipe crossing the Island thodu at Ch.350.m has to be lifted up so as to provide clearance for easy flow of water.

BENEFITS OF SHORT TERM MEASURE

Implementation of short term measure doesn't guarantee the redressal of all problems, unless the long term measures are implemented. But can reduce the intensity of waterlogging to a certain extent.

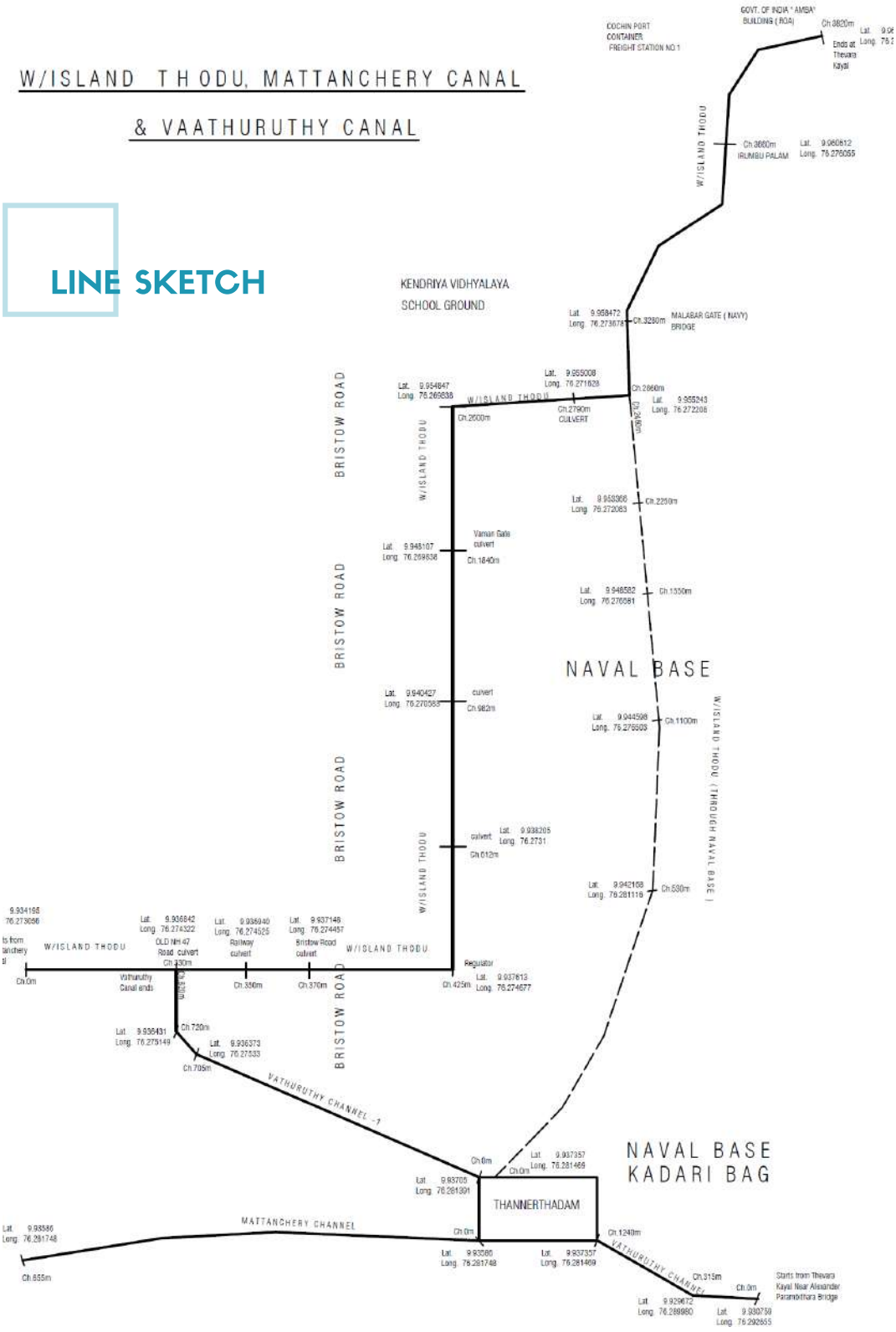
CONCLUSION/RECOMMENDATIONS

A detailed study on waterlogging is essential to formulate longterm strategies based on proper hydrological study. A scientific study of discharge of drains emptying in to the thodu and the run off data of the catchment area at different rainfall intensity has to be arrived and the carrying capacity of the thodu has to be redesigned and to maintain proper section by evicting the encroachment if any or acquisition of land. The velocity of flow can be increased by engaging highcapacity pumps especially during flash flood. Dumping of waste and disposal of waste water from houses directly to the thodu lead to environmental degradation posing threat to public health. Proper awareness has to be given to the public to curb this menace.

It is observed that the width of the Island thodu is reduced to 3m at the starting point from 15m at the end point. Also the total length of the thodu including the branches is 3.82Km. The width of the thodu is considerably reduced at most of the places. As per the discharge calculation of the Island thodu taking into consideration rainfall of 10Cms and other factor the discharge expected through the thodu during heavy rain is 2.897m3/S. Now the area of cross section required for the thodu during heavy rainfall to contain the maximum run off is 4.828m2. We can see at different locations of the thodu encroachment has occurred to a considerable level which reduces the area of cross section of the thodu which is insufficient to take care of the storm water. Encroachment should be evicted and the area of cross section of the Island thodu should be retained to the suggested new cross sectional area.

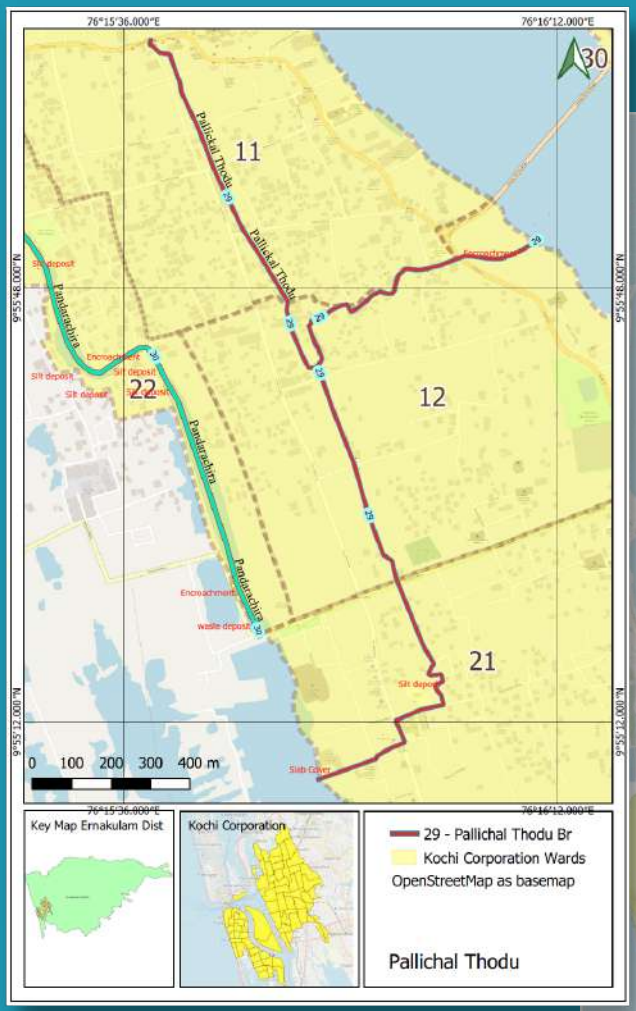
W/ISLAND THODU, MATTANCHERY CANAL & VAATHURUTHY CANAL

LINE SKETCH



PALLICHAL THODU

KOCHI
FLOOD MITIGATION



In-charge: Er.Praveen Lal G. | Asst. Exe. Engineer | Addl. Irrigation Sub Division Aluva

IRRIGATION DEPARTMENT
ERNAKULAM

PALLICHAL THODU

INTRODUCTION

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The current metropolitan limits of Kochi include the mainland Ernakulam.Fort Kochi, the suburbs of Edapally, Kalamassery, Aluva and Kakkanad to the northeast; Tripunithura to the southeast; and a group of islands closely scattered in the Vembanad Lake. Called the "Queen of the Arabian Sea", Kochi was an important spice trading centre on the west coast of India from the 14th century onward, and maintained a trade network with Arab merchants from the pre-Islamic era.

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Cochin is a major port in India, and Willingdon Island is a landmark. The Island is connected to the mainland by Venduruthy Bridge, which has road and railway links. There are two railway stations on the Island - the Mattancherry Halt and the Cochin Harbour Terminus. The headquarters of the Southern Naval Command of the Indian Navy is located on the island. Cochin shipyard is also located near this island. It is also a major tourist center. Willingdon Island is also home to several hotels and offices of clearing agents.

HISTORY

Pallichalthodu is situated near Thoppumpady BOT bridge in Kochi taluk of Ernakulam district. The thodu passes through divisions 11,12&21 of Kochi Municipal corporation. This thodu facilitate drainage of water to Vembanadu Kayal from the Chirakal river and viceversa.The thodu is 2.9845km long (comprising of main canal of length 2.2445km(average width of 4m) and a branch canal of length 0.74km with an average width of 1.80m) which flows according to the tidal variations in kayal either to vembabanadkayal or Chirakal river. The thodu starts from Chirakal river near St alosius school and ends in Vembanatukayal near the Thoppumpady BOT Bridge. The Pallichalthodu divides at Ch:1.4165km of the main Pallichalthodu and the branch continues for a length of 0.74km towards the west side.The Pallichal thodu branch ends at Rosario junction in the Kazhuthumuttu road which leads to Fortkochi. The family of Kochi Maharaja used this waterway to travel from Thripunithara to Perumpadappu, Mundamveli, Karuvelipady, Chulikal and other areas in Westernkochi..This project was envisaged by the Kochi Maharaja for the betterment of the people in west kochi near Palluruthy and thoppumpady areas.The Kochi Maharaja used to visit the Pallichalthodu area with the Samoothiri from Kozhikode and used to rest in the NALUKETTU at Pallichalbridge.The Maharaja used to take rest at Pallichal and his entire itenirary was taken care of by the Vadakumthodu and Pallivathukkal family residing in Pallichal.He would spend time with the people there and used to visit the Azhakiyakavu temple for darsana of goddessBhadra at Palluruthy.The Maharaja would participate in the PULAVANIBHAM near the premises of the temple,.People used to come for PULAVANIBHAM near the temple premises to sell materials made up ofcoconut palm trees,bamboo, arecanut,cadjanetc which was made in there home itself.These materials were also transported to Ernakulam and places like Kollam Chenganaserry,Alleppey etc.

This thodu was earlier used for transporting goods to places like Mattanchery, Mundamveli, Kattiparambu, Perumpadappu Kannamaly and chellanam in west Kochi also. They also used to transport materials like sand,bricks,stones,lime etc in big country boats.

There were big companies in the banks of Pallichalthoduin the northern side of the thodu which produced immense quantity of ropes from coir and other coir products and transported these materials to the southern part of Kerala.The banks of Pallichal towards the northern side also had timber merchants,sawing timber and selling to different areas in kochi and other parts of Kerala.Lot of boats used to stay anchored near the banks of the thodu, and the people used to make food and stay in the boat yard for quite some time.Pallichalthodu was also used to travel from the VembanatKayal to Pandarachira at the west side which leads to the Rameshwaram canal ending in the Vembanadkayal itself.There was a connection to pandarachira from pashnithodu also from the east side through the perumpadappukayal. Transportation of goods was done mostly through these three thodus viz Pashnithodu, pallichalthodu and Pandarachirathodu which was interconnected leading to the Rameshwaram canal. At present a Bridge has been constructed at Ch:2.0245km called the highway bridge,which helps people to travel from the southern area of the state to west Kochi and central part of Kochi.

The elderly folks in the city,recount stories in this regard,but due to the rampant encroachments and unscientific developments of different agencies and people on the banks of the Pallichalthodu,the course of canal has changed drastically to a shadow,once it had.

PROBLEMS & REASONS

a) Silt accumulation:-

The main problem faced in this thodu and the areas in the vicinity is flooding during the monsoon season.The main reason for this is silting up of the thodu. Periodical cleaning is not done since long,hence the depth of flow is reduced considerably. Waste dumping also has lessened the quality of water in the thodu.The main problem for flooding up of water is due to blockage of flow of water in the upstream of Pallithodu at the starting point itself because the thodu is covered up by slab and since long no cleaning has been done.Silt is accumulated for the entire length of 2.9845km including the branch thodu. In monsoon season the recession of flood water will take more time and naturally the low lying area will easily get inundated. This portion of silt accumulation has to be cut and cleaned to facilitate easy flow of water from the thodu to the Vembanadukayal and Chirakal river viceversa.

b) Disposal of waste water and solid waste into the natural drain:-

Waste pipes from houses is given directly in to the thodu which also causes pollution of the waterbody.due to the waste accumulated the flow of the thodu has been reduced drastically . This problem is seen near Chainages 1167.50m , 1168.50m , 1299.50m, 1383.50m, 1391.50m, etc.The thodu starts with a width of 2m and reducs to 1.50 m @Ch:1167.50m,then the width increases to 12m upto Ch:1299.50m(131m).In this 131m stretch we could find a lot of waste dumped,and waste pipes given directly into the thodu from houses.Near ch 1719.50 there exist a market (near the BOT bridge)from where immense quantity of market waste is deposited in to the thodu and that's the critical point where cleaning is immediately required.Severe pollution is happening at this point. The catchment area of this thodu is densely populated and hence the thodu is subjected to variety of pollutants such as municipal sewage, organic , plastic wastes etc.The Pallichal branch thodu might also have waste pipes connected, but those are not visible because most of the length of thodu is covered by concrete slabs.

The thodu is observed to receive household sewage along its entire length.The people residing nearby the thodu is also facing health hazards due to the heavy pollution of the thodu.Stringent measures need to be taken to prevent discharge of such wastes and sewage to the thodu .

c) Blockage in small drains:-

There are 6 small drains joining thePallichalthodu at the left side and about 9 number of small drains joining at the right bank. Moreover small PWD drains also connects to the main Pallichalthodu and branch thodu The surface runoff as well as waste water flows into the main thodualso.The other drains connecting at different points to the main and branch thodu are also clogged with waste and needs thorugh cleaning to make easy flow of water through the drains in to the main thodu.These channels would act as flood absorbing pockets and the run off from high intensity rain could not be drained easily now..

d) Reduced width of Thodu

The width of thodu is reduced at different points which causes blockages of the thodu and reduces the easy drainage of water to the Chirakalriver.In the main Pallichalthodu at Ch:0.00m the width of thodu is 2m, the width reduces to 0.60m at Ch 225m,means the thodureduces to a small drain.This small drain continues for a length of 241m,which finally reduces the discharge drastically.Widening of thodu in this 241 m length of thodu is inevitable and should be intervened urgently.For the next 701.50 m the width of thodu maintains the width 1m -1.50m and at Ch 1167.50m theres a sudden widening of thodu to 12m.That means this 12m width need to be there until the starting point of the thodu.Thethodu is having 12 m width only for the next 132m ie between Ch 1167.5 to ch 1299.50.The thodu again reduces to a width of 7 m for 92 m and again reduces to 1.50 m.At Ch 1661.50m the width again reaches 3m and increases gradually finally at the end point the ewidth maintained is 7m.As the width of thodu reduces the area of cross section of flow get reduced and drainage of water becomes blocked and wont serve the entire purpose intended. Similarly in the Pallichal Left Branch Thodu at the starting point the width of the thodu is 1 m which is not sufficient enough to drain away the waste water. At the exit point this thodu has got 2m width.

e) Encroachment:-

Encroachments of the thodu is suspected in the southern part between locations Ch:540m and Ch1167.50m. The width of thodu is seen decreasing to 12 m from 1 m in this area. Encroachments is also suspected in between locations Ch:1416.50m and Ch:1646.50m. At Ch:2174.50m two small sheds have been erected into the thodu which cover ups about 5m width of th e thodu. These sheds has to be demolished immediately and encroachment has to be evicted. At this chainage abutments of an old bridge made up of randon rubble masonry is protruding into the thodu which covers ups almost 3m width of the thodu. These structure has to be demolished immediately . These encroachments has to be evicted strictly with the help of higher authorities and police.

f) Existing culverts having no head room and vent way

Ventway of the thodu is narrowed at the existing culverts which causes accumulation of wastes and finally blocking the flow of water near Ch.1938.50m, Ch.2004.5m, Ch.2009.50m and 2174.50m

At Ch.1938.5 – the width of the Culvert is only 3m which blocks the flow of water.

At Ch.2004.50m – the beam of the Culvert is very deep and this causes hindrance for free flow of water in the thodu.

At Ch.2009.50m – the beam of the Culvert is very deep and this causes hindrance for free flow of water in the thodu.

At Ch.2174.50m - At this chainage abutments of an old bridge made up of randon rubble masonry is protruding into the thodu which covers ups almost 3m width of the thodu

The existing culverts at these chainages has to be demolished and new culverts with sufficient vent way and head room has to be rebuilt.

In between Ch.1661.5m and 1938.5m (277m) the number culverts have been built for access to individual houses. These culverts can block water in the thodu during the time of flood and incessant rains.It would be better to increase the height of the culvert and can be taken as a long term measure.

g) Utility pipes crossing drains

The utility pipes belongs to KSEB/ KWA/ BSNL etc. crossing the drain at different locations obstruct the free flow of water, especially during flood season. The pipes laid through the water surface of the thodu has to be lifted, leaving a clear headroom to accommodate flood water. The following locations are prone to flooding due to the obstruction of utility pipes.

At Ch.2036.5m bridge at NH Crossing near BOT bridge

h) Conversion of thodu to road

The Pallichalthodu is entirely covered up with slab for the starting length of 466m. In the second stretch at Ch:622 to Ch:884.50m (262.50m) the Pallichalthodu is also entirely covered with slab. The branch thodu is also covered up with concrete slabs from Ch:0m to Ch:626m. So we can see that out of 2.9845Km stretch of the entire thodu 1.3545Km length of thodu is covered by slab. This is almost 45% of the total length of the thodu. From this we can find that almost half portion of the thodu is covered and cleaning has not been done since years and the waste materials and silt is laying as such in the thodu which needs urgent attention.

Near Pyary junction in the Pallichal branch thodu, M sand and water tanks has been stacked on top of the covered slab. This is not at all acceptable. The present practice of converting the thodu to road by covering with concrete slab has to be stopped. This will accelerate clogging of drain, which will prevent the free flow of water. Future cleaning of thodu will be cumbersome on account of this. The concreting of bed of natural thodu is not at all advisable. Concreting the natural bed of thodu will prevent the seepage of water through ground thus increasing the risk of flooding

REMEDIES ARE PROPOSED

Long term measure

1. The thodu has to be rejuvenated to its original shape after demarcating boundaries and evicting encroachments . The carrying capacity of the thodu has to be redesigned to maintain proper section based on run off data by eviction/ acquisition of land.
2. Provide high capacity pumps with shutter arrangements to drain out flood water to the lake so as to combat the tidal variations, ensuring its periodical maintenance.
3. Interlinking of parallel canals by widening the existing natural stream for easy drainage.
4. The rivers & lakes encompassing the main lands have to be desilted regularly in order to accommodate the flood water. Water storage capacity of thodu shall be increased by desilting
5. Fencing to be done on the boundaries of the thodu on both the banks for a minimum height of 4minorder to prevent dumping of waste in to the thodu.
6. Reconstruction of new culvert at Ch.2004.5m to provide vent way and headroom for water flow.
7. Reconstruction of new culvert at Ch.2009.5m to provide vent way and headroom for water flow.
8. Construction of a sluice at the bellmouth at Ch.2244.5m with shutter arrangements to control flood waters.

Short term measure

1. Desilting and cleaning of Pallichalthodu and its branch at the entire stretch to drain the flood water more effectively.
2. Corporation shall not encourage the conversion of natural thodu to concrete thods at any of the reaches of the thodu
3. Blocking the waste pipes from different companies and houses shall be given immediate emphasis.
4. Demolishing of existing abutment made of RR Masonry at Ch.2174.5m protruding into the thodu
5. A banyan tree of large girth at right bank of thodu near Ch.2174.5m has to be cut to widen the waterway.

BENEFITS OF SHORT TERM MEASURE

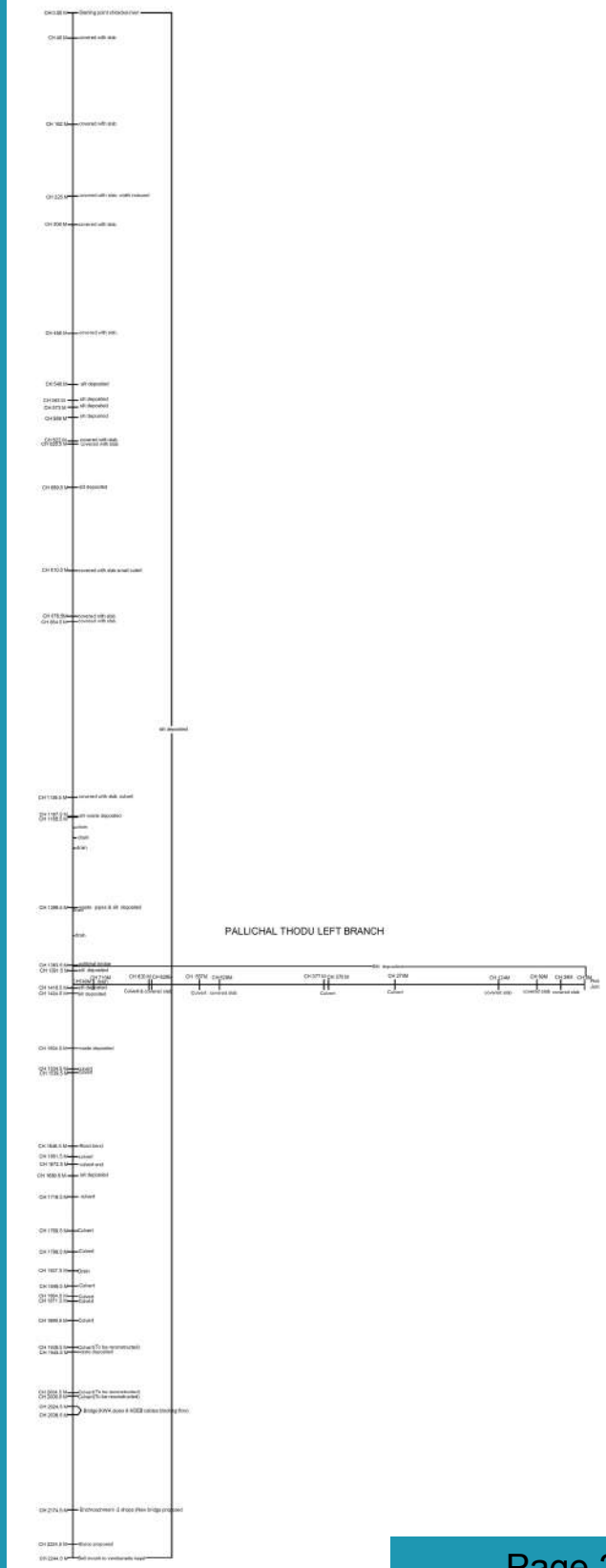
Implementation of short term measure doesn't guarantee the redressal of all problems, unless the long term measures are implemented. But can reduce the intensity of waterlogging to a certain extent.

CONCLUSION/ RECOMMENDATIONS

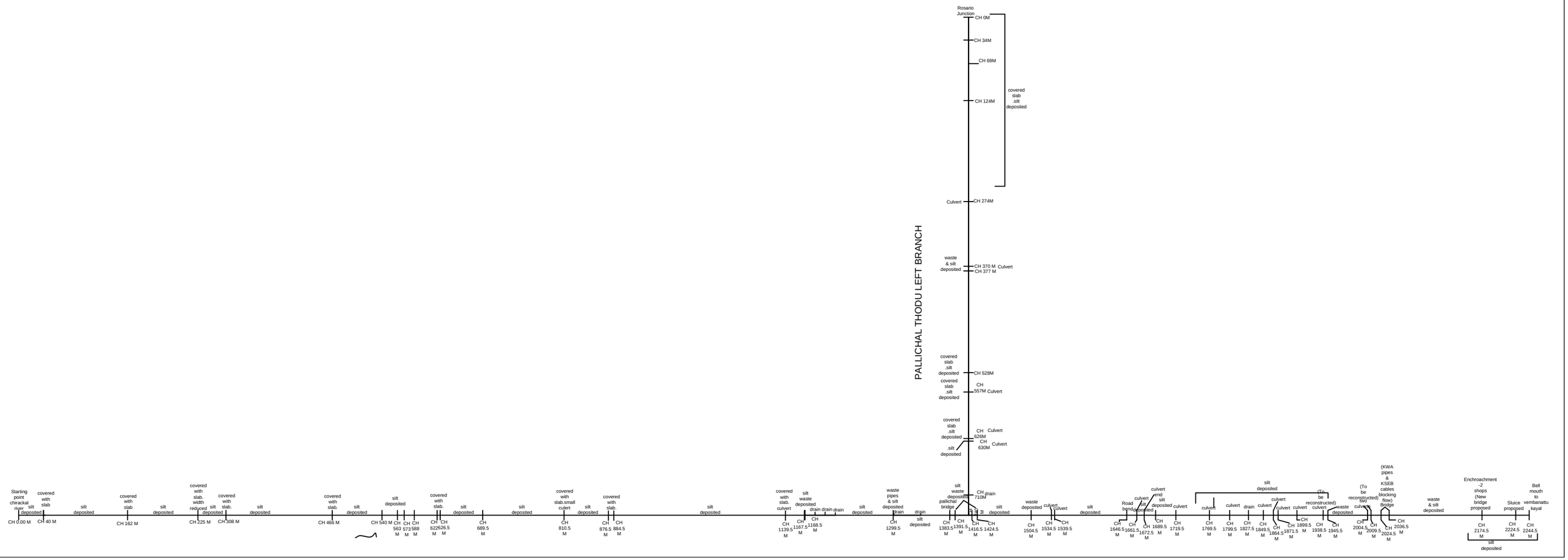
A detailed study on waterlogging is essential to formulate longterm strategies based on proper hydrological study. A scientific study of discharge of drains emptying in to the thodu and the run off data of the catchment area at different rainfall intensity has to be arrived and the carrying capacity of the thodu has to be redesigned and to maintain proper section by evicting the encroachment if any or acquisition of land. The velocity of flow can be increased by engaging highcapacity pumps especially during flash flood. Dumping of waste and disposal of waste water from houses directly to the thodu lead to environmental degradation posing threat to public health. Proper awareness has to be given to the public to curb this menace.

It is observed that the width of the Pallichal thodu is reduced to 0.6m at the starting point from 7m at the end point. Also the total length of the thodu including the branches is 2.984Km. Out of this 1.86Km of length of the thodu is covered with slab. The width of the thodu is considerably reduced at most of the places. As per the discharge calculation of the Pallichal thodu taking into consideration rainfall of 10Cms and other factor the discharge expected through the thodu during heavy rain is 2.015m3/S. Now the area of cross section required for the thodu during heavy rainfall to contain the maximum run off is 3.358m2. We can see at different locations of the thodu encroachment has occurred to a considerable level which reduces the area of cross section of the thodu which is insufficient to take care of the storm water. Encroachment should be evicted and the area of cross section of the Pallichal thodu should be retained to the suggested new cross sectional area.

PALLICHAL THODU

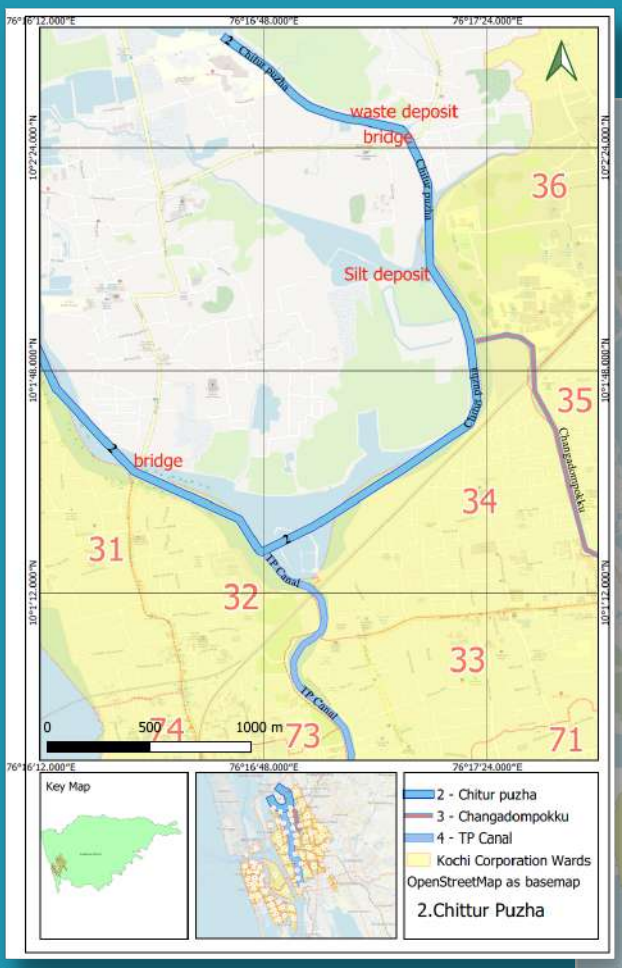


PALLICHAL THODU



CHITTOORPUZHA

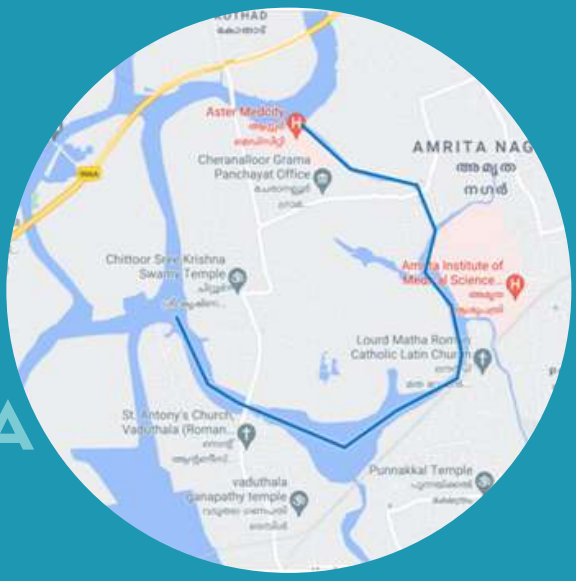
KOCHI
FLOOD MITIGATION



In-charge: Er.Resia P.K. | Personal Asst. | MICC Ernakulam

IRRIGATION DEPARTMENT
ERNAKULAM

CHITTOORPUZHA



INITIAL STUDY REPORT

The Chittoorpuzha is a waterbody encircling the island of Chittoor, branching out from the Periyarriver beside Aster Medcity and ending near Vaduthala boat jetty. It is a waterbody interconnecting parts of the estuary, and the water is saline for most part of the year. Two of the highly polluted tidal canals of the Kochi city, Thevara-Perandoor canal and Changadompokkuthodu, end up in Chittoorpuzha. This means that the entire waste of the northern half of the Corporation of Kochi, which comes to about 25 sq. km., is brought to this waterbody. Hence the study of this puzha is crucial for the flood mitigation study of the city.

As can be seen, the starting point of the Chittoorpuzha is beside Aster Medcity. It branches out from Periyar, encircles the island of Chittoor, and joins back with Periyar in the IWAI waterway, near Vaduthala boat jetty. The total length comes to about 5.5km. The width varies greatly along the length, from about 15m to about 350m at the outlet of TP canal. There are 2 bridges crossing over Chittoorpuzha, namely Edayakkunnambridge and Chittoor-Vaduthala bridge.

PROBLEMS FACED

Ch : 0m

Chittoorpuzha emerges from the Periyar river, beside Aster Medcity.

Ch : 500m to 1600m

This stretch of the Chittoorpuzha is generally narrow. Moreover, this stretch has many fishing nets installed, trees fallen into the water and sudden variations in width and siltation at some points, causing even more obstruction to the waterflow.

Ch : 1750m to 1950m

On preliminary inspection, heavy siltation has been observed at a few metres away from the Changadampokku thodu outlet behind Amrutha Hospital, approximately over a length of 200m

Sudden decrease in width

Siltation beneath Edayakkunnam bridge

Ch : 2130m

Outlet of Changadampokku thodu. Here, desiltation has already been done to an extent, however it can be further deepened for a smooth flow of water.

Ch : 3350m to 3850m

Heavy siltation has been observed near the outlet of TP canal, over a length of approximately 500m. Here, the river width is nearly 500m, therefore approximately 0.25sq.km. of area needs to be desilted here. There are also deltas / thuruthus formed in this area.

SITE PHOTOS

Tree fallen into the water body

Waste disposed

Delta formed in the water body

Ch : 1750m to 1950m

On preliminary inspection, heavy siltation has been observed at a few metres away from the Changadampokku thodu outlet behind Amrutha Hospital, approximately over a length of 200m.

Ch : 2130m

Outlet of Changadampokku thodu. Here, desiltation has already been done to an extent, however it can be further deepened for a smooth flow of water.

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Heavy siltation has been observed near the outlet of TP canal, over a length of approximately 500m. Here, the river width is nearly 500m, therefore approximately 0.25sq.km. of area needs to be desilted here. There are also deltas / thuruthus formed in this area.

Thuruthu formed near outlet of TP Canal

SITE PHOTOS

Ch : 3700m

Outlet of TP canal. Heavy siltation and debris can be seen beneath the Perandoor railway bridge. This considerably obstruct the outflow of water from TP canal to Chittoorpuzha.

Debris beneath Perandoor railway bridge

Ch : 4700m

The old bridge connecting Chittoor and Vaduthala has not yet been demolished. The piers of the bridge, along with approach roads is a huge obstruction to the water flow.

Old Chittoor-Vaduthala Bridge not Demolished

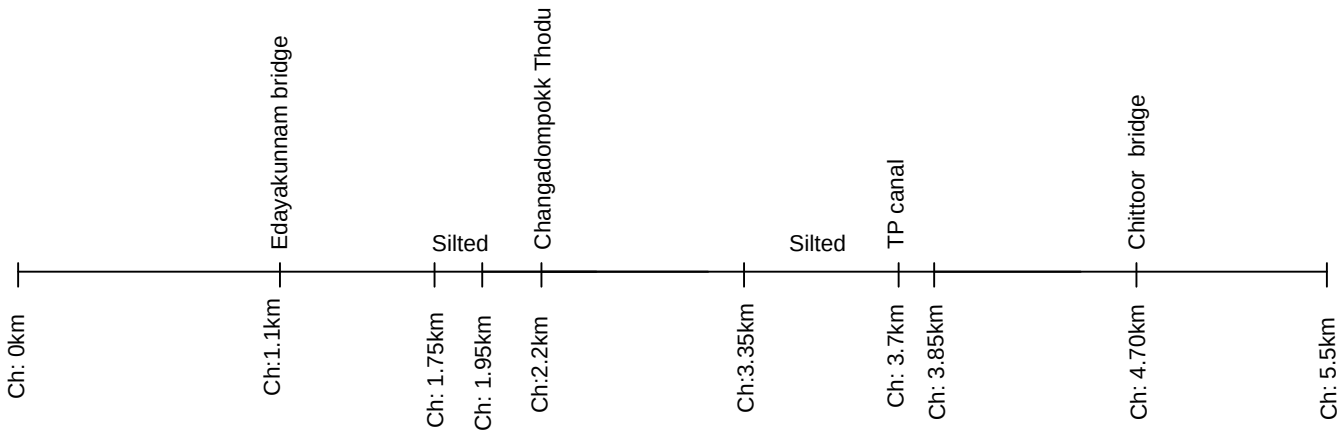
Ch : 5500m

Chittoorpuzha ends; joins Periyar in the IWAI waterway:
Solid waste disposal, waste-water outlets and fishing nets were observed at many areas along the river.

REMEDIAL MEASURES TO BE TAKEN UP

1. Desiltation is to be done at various regions of the Chittoorpuzha, especially at the outlet of TP canal and nearby areas, and the area behind Amrutha Hospital.
2. Obstacles in Chittoorpuzha between Amrutha hospital and Aster Medcity are to be removed for free discharge.
3. Action is to be taken to demolish the old bridge connecting Chittoor and Vaduthala.
4. Action is to be taken to ensure that waste disposal into the puzha is prohibited.
5. Action is to be taken to identify encroachments along the sides, and take steps for eviction of the same.

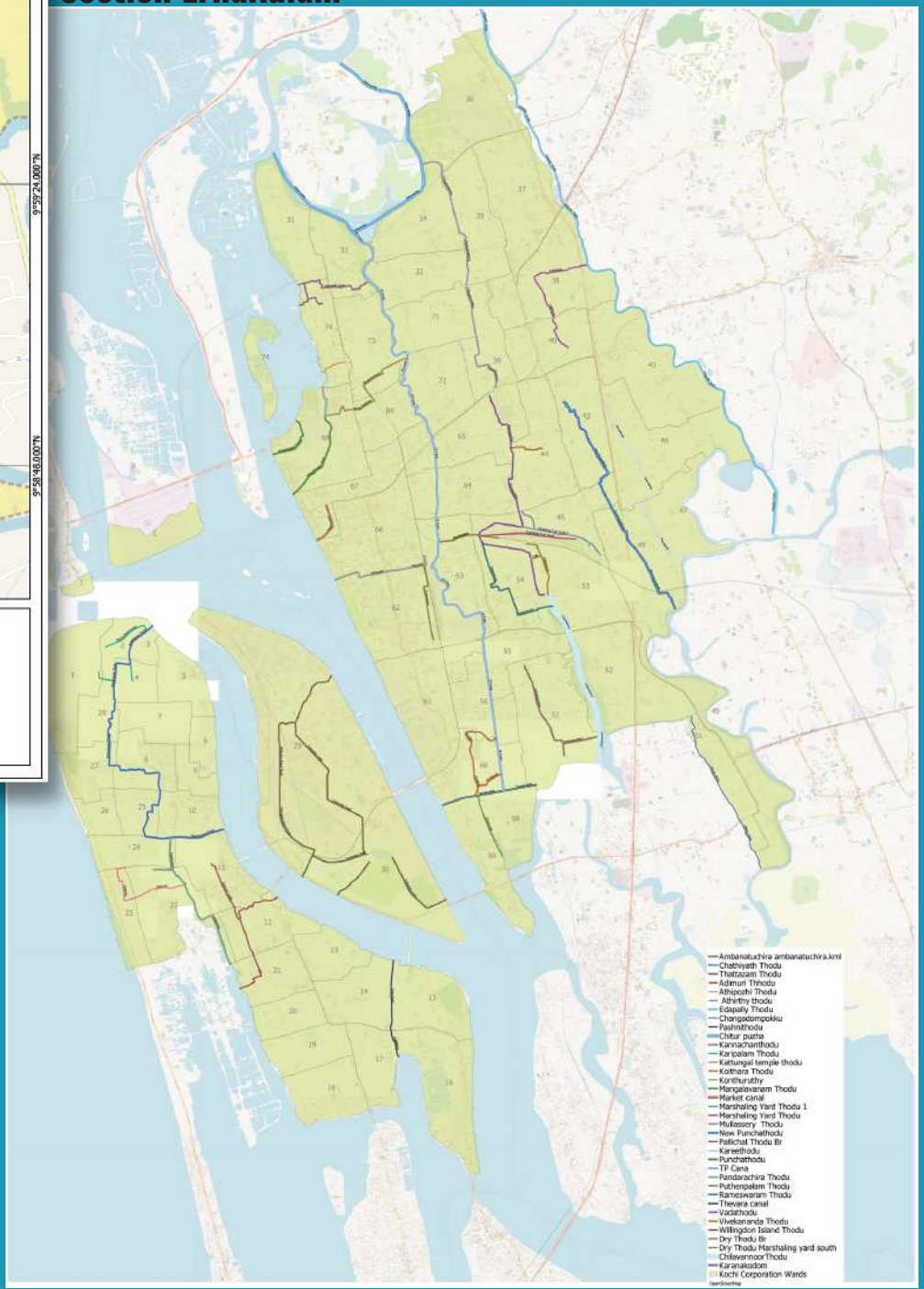
Chitoor Puzha



KAREETHODU

KOCHI
FLOOD MITIGATION

In-charge: Er.Haroon Rashid | Asst. Engineer | Canal Section Ernakulam



IRRIGATION DEPARTMENT
ERNAKULAM

KAREETHODU

INITIAL STUDY REPORT

areethodu is a natural Thodu , which originates from Palarivattom near Medical centre , is globallylocated a Latitude N 9.998738Longitude E 76.31427 passes passes through near Eranakulam Medical Center, Chakkaraparampu,Pulluparambu, Kaniyaveli, Mannarkkara and Mambraand ends in KaniyampuzhaKayal , located at Latitude N 9.97761Longitude E 76.32493. Kareethodu is one of the main canal in Cochin Corporation. At present the thodu is encroached condition at some places , thus reducing its sizesignificantly.The flow of the thodu is obstructed by low laying foot bridges made by Individuals , waste deposits, waste water from households,sewage discharge etc...

The thodu is approximately 2.93 km long and 2.00m wide from starting and end width 10.00m. There is a DR r/wall in the middle of thodu from ch.75 to ch.105m in parallel of thodu and covered this portion with RCC cover slab. Thethodu is silted up at several places. Silt accumilated from ch. 1640 to ch. 1750 m and from ch. 2910 to ch. 2930 m .It is understood that an estimate is prepared by Kochi Corporation for the deepening of Kareethodu in full length.

CONT...

KDue to the dumping of wastes free flow through this canal is obstructed and causes stagnation of dirty water and flooding which leads to unhealthy condition and epidemic. The tidal effects also affect the flow of water in the canal. During rainy season the flood water cannot discharge immediately at high tide period and the nearby houses are being flooded up. The flood water entered into the houses located on the banks of the canal. Now it is observed that the canal has become a waste dumping yard at several places and water flow has been obstructed. As a result the canal has become breeding place of mosquitoes which in turn causes epidemics such as Malaria, various viral infections etc. in nearby areas. Flow is obstructed at several locations. Various organic, inorganic and plastic wastes are freely dumped in to this canal causing hindrance to the free flow of water. Dumping of waste is a serious problem to be tackled. As a remedial measure, the foul and chocking materials in the canal have to be removed for the free flow of water and protect the canal from dumping the waste and flooding up of the canal. So paramount importance to realign, deepen and protection of side of the canal is absolutely essential. There are numerous foot bridges being constructed across this thodu for road connectivity. Theses low lying foot bridges are also obstruct the flow of water.

For improving the thodu there were already reconstructed recently two bridges at Mannarakkara and Kaniyavely. Due to this construction the flood water problems could be resolved in that area. At present a new reconstruction work of existing bridge is going on at Pulluparambu. Besides this another work is going to tender procedure for the reconstruction of existing bridge at Mambra .

1.ENCROACHMENT

Some areas are seen that encroached on conducting the survey on the thodu.The details of encroachment can be ascertained only after conducting survey by the Revanue department.

2.SIDE PROTECTION

The sides off the thodu are seen presently protected all mostlength. Wherever the protection works are seen partially damaged and it should be rectified by dismantling and reconstructed.

3.DEEPENING

The thodu has need to be deepened for the proper flow of water in the rainy season

4. PROBLEM WITH WASTES

The residents of slums and houses situated near by dispose off their waste as well as septic tank waste in to the thodu.This shall be removed by the proposed deepening.

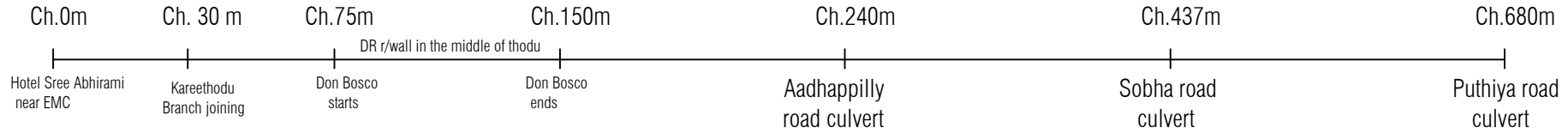
5. CULVERT & BLOCKS

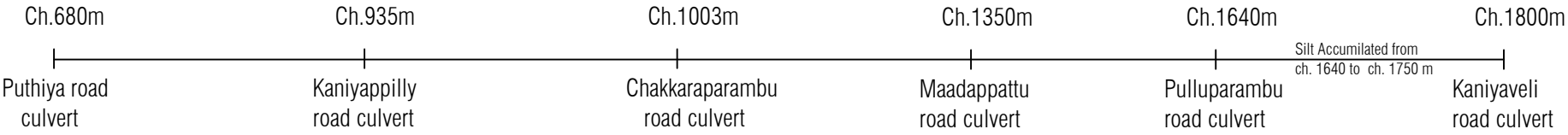
In this thode11 numbers of main culverts . Several no. of KWA pipe lines are crossing across the thodu along with the culvert.

K A R E E T H O D U

Lat. 9.998738

Long. 76.31427

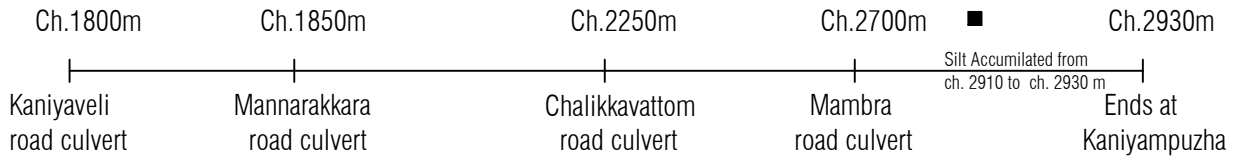




Lat. 9.97761

KSEB TOWER (UNDER CONSTRUCTION)

Long. 76.32493

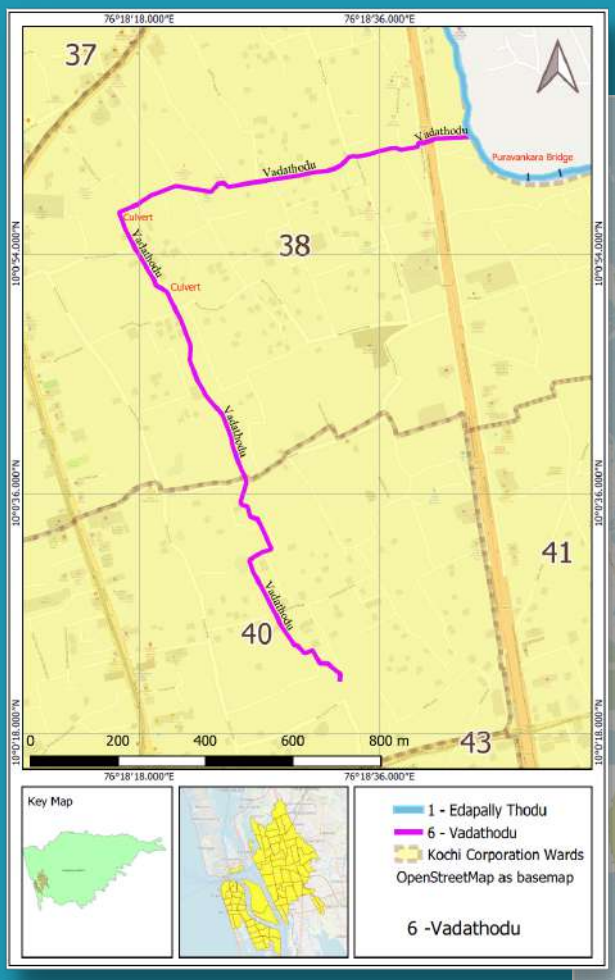


HAROON RASHEED
ASSISTANT ENGINEER

NOTE :- PIPE LINES & CABLES ARE PASSING THROUGH UNDER SIDE OF ALMOST CULVERTS

VADATHODU

KOCHI
FLOOD MITIGATION



In-charge: Er.Haroon Rasheed | Asst. Engineer | Canal Section Ernakulam

IRRIGATION DEPARTMENT | ERNAKULAM

VADATHODU

INITIAL STUDY REPORT

This is the main drainage in the southern part of Edappally area in Cochin Corporation. It has a length of 2.20km and width varies from 1.5m to 3.30m. The main purpose of this thodu is drainage of water. There are a number o smaller drains discharging in to this thodu. The thodu is silted up at several places .This results in stagnation of water .And practically this thode is not for much use because it is silted up. Moreover this thodu is filled with aquatic plants and grasess at some places.

Proper maintanance and clearing of the canal are required as a corrective measure along with cleaning the silt and debris. The drainage outlets are urgently need to remove which is coming from houses to the thodu have also to be cleaned by removing blockages and easy flow of water. Deepening the thode throughout the whole length is inevitable for maintaining smooth flow

ENCROACHMENTS AND COVERED AREA:-

Some areas are seen encroached on conducting survey on this thodu.The details of encroachments can be ascertained only after conducting the demarkation survey by revenue department.

SIDE PROTECTION

The sides off the thodu are seen presently protected all most all length.wherever the protection works are seen partially damaged and it should be rectified by dismantling and reconstructed..

DEEPENING

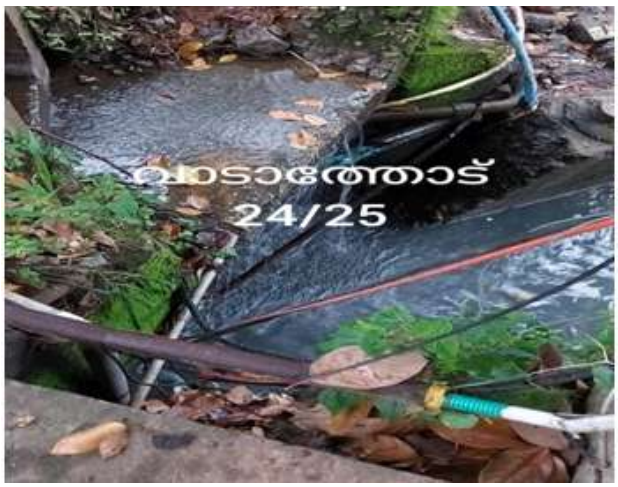
The thodu has need to be deepened for the proper low of water in the rainy season

PROBLEMS WITH HOUSEHOLD WASTE/SEPTIC TANK WASTE

The residents of slums and houses situated near by dispose off their waste as well as septic tank waste in to the thodu.This shall be removed by the proposed deepening

CULVERTS AND BLOCKS

In this thode 5 numbers of main culverts and 1 NH crossing culvert in this thode.The entry point of the NH culvert were seen a main blockage noted during the survey.

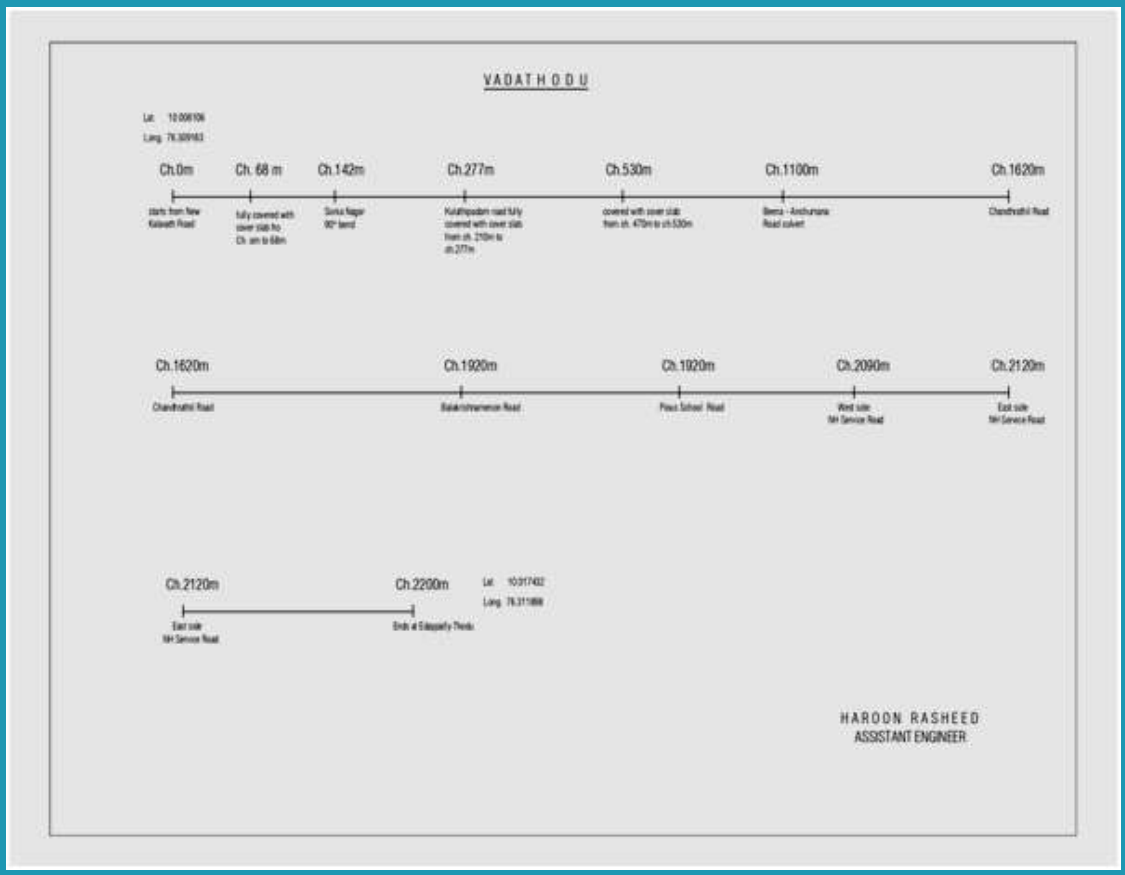


AQUATIC WEEDS

Some area of the canal filled with debris and water grass were partially obstructed the flow of water.

Due to the presnce the above grass considerable depth reductions were noticed during the survey. For removing this shall be included in the deepening works.

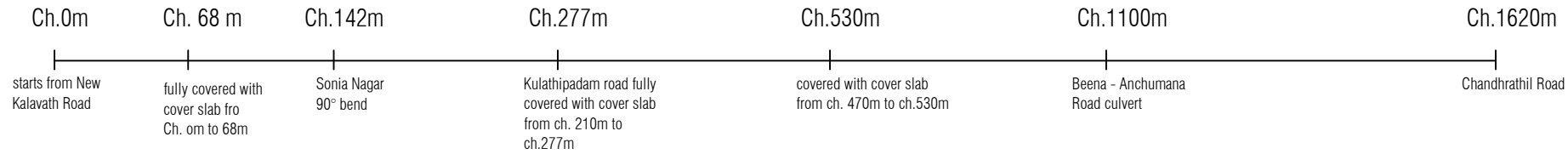
LINE SKETCH

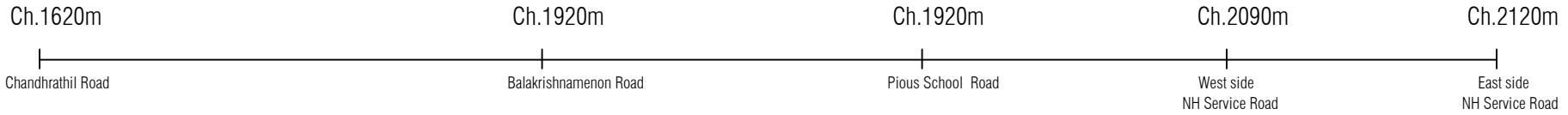


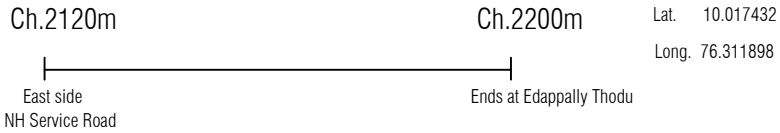
V A D A T H O D U

Lat. 10.006106

Long. 76.309163







Lat. 10.017432

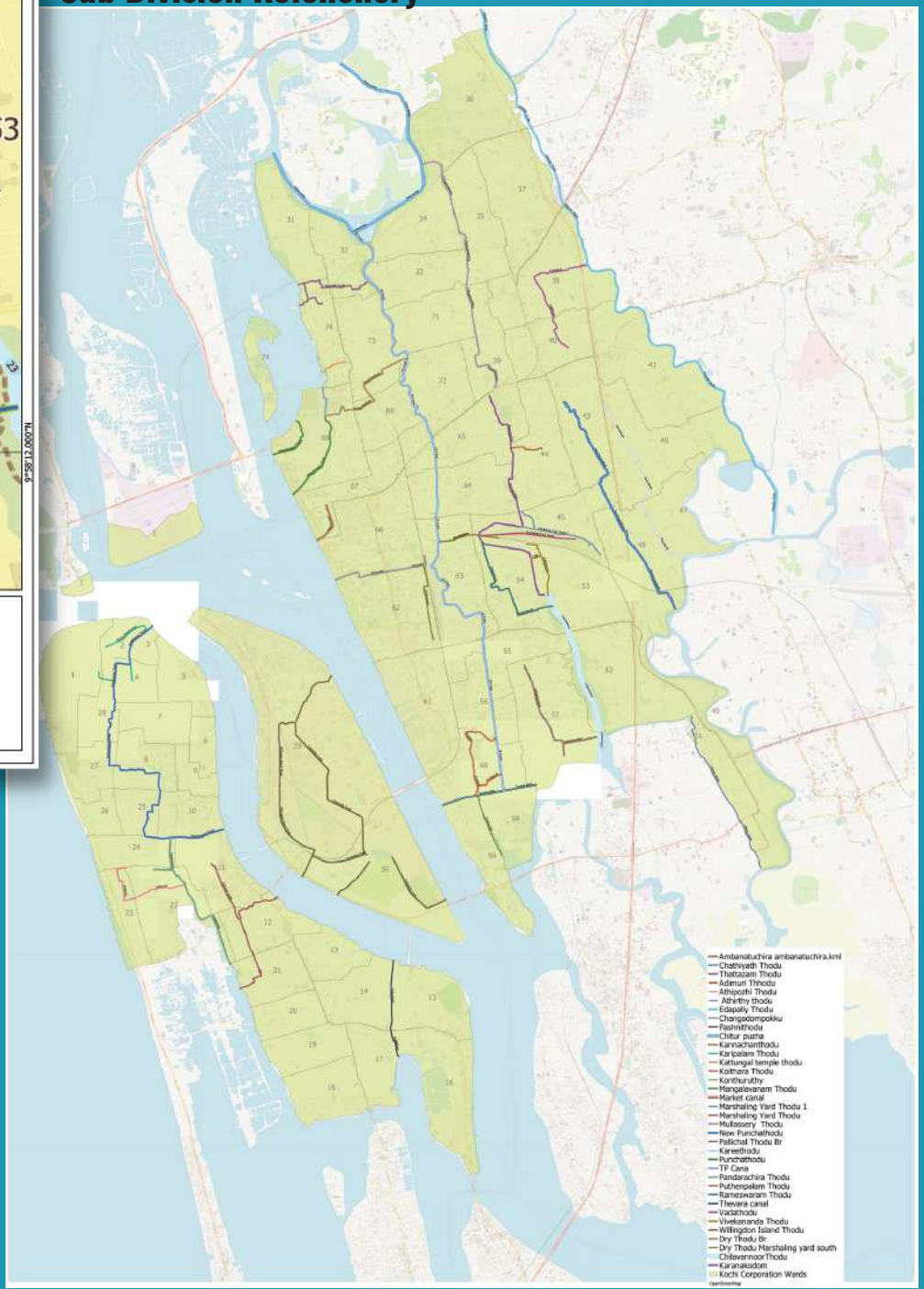
Long. 76.311898

H A R O O N R A S H E E D
ASSISTANT ENGINEER

PUNCHATHODU

KOCHI
FLOOD MITIGATION

In-charge: Er.Shiny Joseph | Asst. Exe. Engineer | PVIP Sub Division Kolenchery



IRRIGATION DEPARTMENT
ERNAKULAM

PUNJATHODU

INTRODUCTION

Punja thodu is located in Elamkulam village of Kanayannor Taluk in Ernakulam District. Both the banks of the thodu were paddy fields in the past. It used to be a drain for the exit of water from these paddy fields. Salt water intrusion during high tide led to destruction of paddy cultivation here. After that, these fields remained as marshy lands and were purchased by Housing board. During 1960-65 these lands were sold after being divided into plots. For the construction of roads many stretches of thodu got filled up and were converted to drains. Jawaharnagar was formed this way. As the roads were constructed for development, water drainage ways got closed. Since this thodu was located in between paddy fields it was included in the title deed of land owners dwelling on both banks. Afterwards coconut, banana etc. was cultivated inside thodu and was systematically converted to normal land. Subsequently boundary walls were also erected. This way the width of thodu kept on decreasing. This thodu which originally had width in the range of 10 to14metres has now been converted to a narrow drain.

Initially some small thodus from Kammatipadam and thodu from the side of Fr. Immanuel road also joined with Punja thodu. Now all these thodus are filled up and drains were constructed to drain out the storm water. The drain along Father Immanuel road joined with drain from pipeline road and crosses railway line through pipes which are completely blocked causing flooding in that area. A sump has to be constructed at this portion and jetting to be done to open up the pipelines. Another thodu was constructed from TP canal to Karnakkodam thodu by BPCL along the side of railway line. To this thodu the water through pipeline is discharged. The flow through dry thodu is blocked by the culvert and cross pipes.

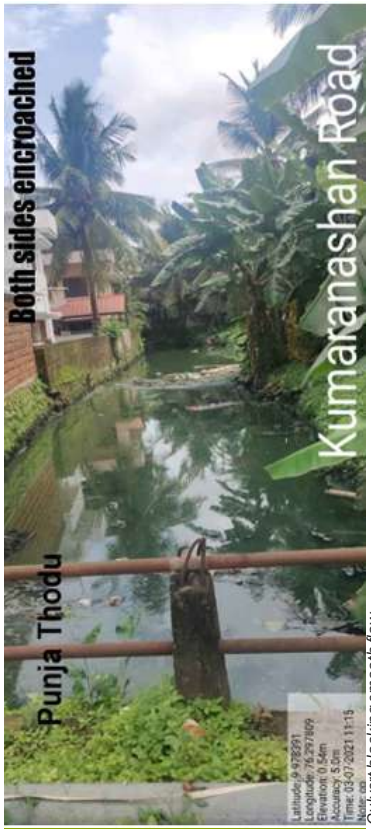
PRESENT CONDITION

Punchathodu starts from the south side of karnakodam thodu, flows through Kumaranasan Nagar, Jawaharnagar, alongside KWA sewage treatment plant and joins Chilavannor kayal. The thodu has a width of 3 metres in the starting. After 800 metres the width gets reduced to 0.60 metre and continues like that for 200 metres. Width again increases to 2.5/3.0 metres. The width of thodu is 4.0 metres near chilavannor kayal.

Presently water from Jawaharnagar flows towards north direction and drains into Karnakodam thodu. The waste water from drainage along Bhattathirippad road flows into Punja thodu at Ch 1/100 and flows towards Chilavannor Kayal. At Ch 1/760 a thodu from Muttathil lane join the Pumja thodu. At chainage 1/910 a thodu from Paalathuruth joins Punja thodu. The thodu has to be reconstructed between chainage 0/810 and 1/100 for the continuous flow from beginning to end.

Presently as the width of punja thodu is reduced to 3 metres, the mouth of Punja thodu is very much silted up. Hence the encroachment at the starting point should be immediately cleared and removal of slit is very much required.

Punja thodu starting- lesser width and encroachments



Culvert blocking smooth flow

At Ch:0/220 the present culvert obstruct the flow and at upstream, walls are constructed encroaching the thodu. Since the thodu is included in the title deeds of the land owners residing along the sides of the the thodu the boundaries while demarcating by the village authorities fall inside the thodu . And people used to remit land tax for the thodu portion as well .Similar cases are noticed between Ch: 0/00- 0/400 .

MAIN PROBLEMS

Approach road constructed encroaching thodu for flats

At ch: 0/450 approach road to some flats namely SFS and Casino is constructed encroaching thodu . The width of approach road is 7 m whereas the width of the thodu is 2.50 m .

Cross slab across thodu

Between Ch: 0/600 to 0/780 slabs are seen constructed across the thodu as entrance to the houses which hindered the cleaning of thodu .

At Ch: 0/780 hyacinth is seen for a length of 20 m where stagnation of flow is observed , indicating that there is no tidal flow at this portion . And compound wall is newly constructed at this location encroaching into the thodu.

Both sides encroached by erecting walls, also thodu full of hyacinth

Water stagnation and overflow

From Ch:0/810 – 0/920 the thodu is covered with slab , Ch: 0/920 – 0/940 inside houses and from Ch: 0/940 – 1/100 the thodu is reduced to a drainage with C/S 60cm x90 cm. Water stagnation can be seen here during rains. All the wastes, organic and inorganic got silted up here causing hazardous situation. Since the drains are covered with slabs, it is not able to carry out the cleaning properly.

Thodu covered with slabs

Thodu inside house covered by slabs

Encroachment by SBI building

At the end of the covered slab portion there is a road crossing of width 9 metre, which has to be reconstructed as a box culvert.

After crossing the Subash Chandra Bose road at Ch:1/230 , SBI building has made some constructions encroaching the thodu.

At Ch: 1/760 thodu from Muttathil Lane is drained into Punjathodu.

Between Ch: 1/790 and 1/910a walkway is constructed (old is gold road) by the corporation , encroaching the thodu.

Old is Gold road

At Ch: 1/910 the present culvert across FathimaMatha church road is obstructing the flow of water ,while waste dumping is also noticed near the culvert . The sewage pipe of KWA is laid across the thodu without sufficient vertical clearance . Here a thodu from palathuruthu also drains into punja thodu increasing the quantity of water and may cause flooding near culvert. The crossing pipes are to be removed and culvert is to be reconstructed.

Thodu blocked by culvert and pipelines

The thodu flows also through the side of KWA sewage treatment plant compound and then merges with ChilavannoorKayal .

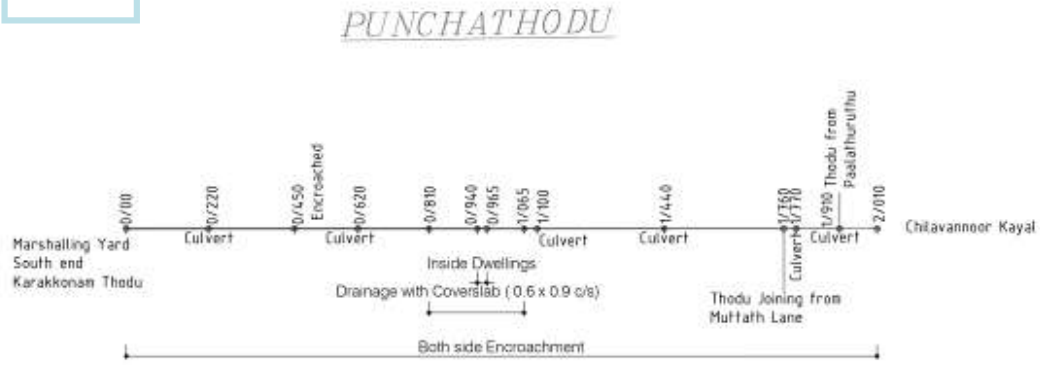
SOLUTIONS

1. All the encroachments has to be cleared and the thodu has to be widened to its original width as per
2. records. For this the boundaries of the thodu has to be demarcated.
3. The thodu between chainage 810-1100 has to be immediately reconstructed and box culvert has to be
4. constructed at chainage 1110 for crossing the road.
5. All the deposited silt has to be cleared.
6. Two culverts has to be reconstructed at ch. 1/770 and 1/910.
7. The culvert at the end of dry thodu has to be reconstructed.
8. All the pipe crossings, cables etc. under culvert has to be cleared.
9. Road has to be constructed on the bank for inspection.
10. All the access slabs constructed across the thodu has to demolished.

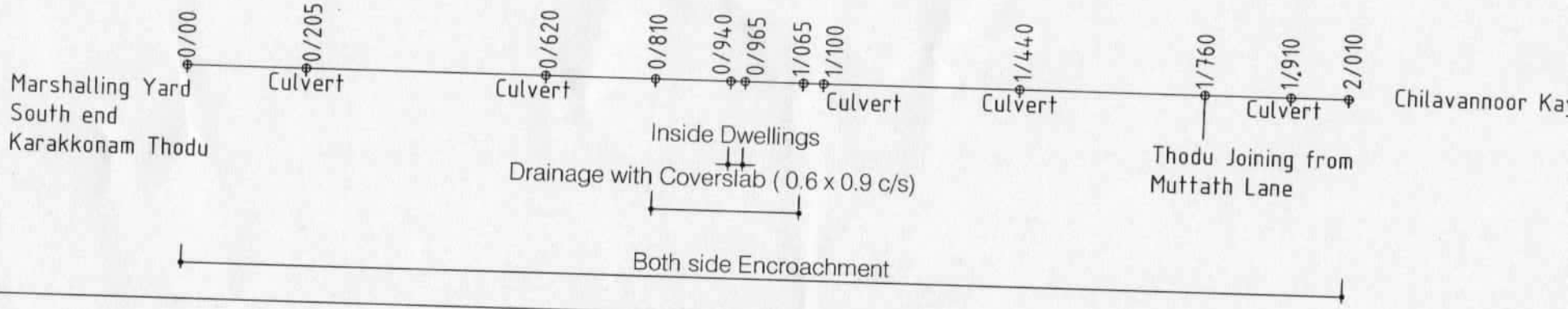
CONCLUSION

It is very essential to clear the encroachments and to restore the original width of Punja thodu. All the obstructions across the thodu has to be cleared to ensure the smooth flow of water. By this way it is possible to mitigate the floods in the areas around Punja thodu.

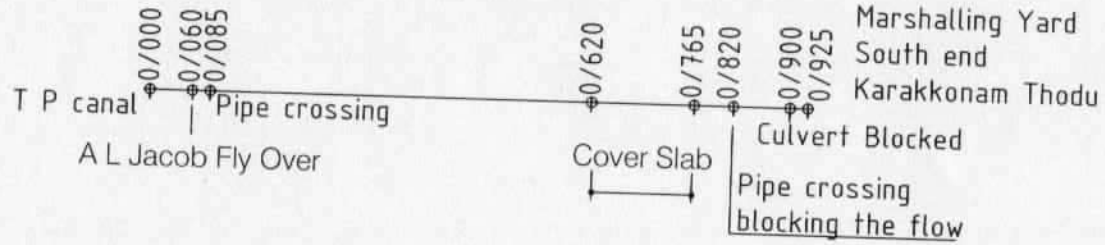
LINE SKETCH



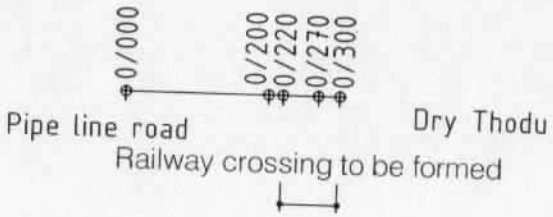
PUNCHATHODU



DRYTHODU



THODU FROM PIPELINE ROAD



Line Sketch
Scale 1 : 100

PUNCHA THODU NEAR BYE PASS

KOCHI
FLOOD MITIGATION

In-charge: Er.Haroon Rasheed | Asst. Engineer | Canal Section Ernakulam

IRRIGATION DEPARTMENT
ERNAKULAM

PUNJATHODU
NEAR BYE PASS

INTRODUCTION

This is the main drainage in the southern part of Palarivattom area in Cochin Corporation. It has a length of 4.00 km and width varies from 1.30 m to 7.00 m. The main purpose of this thodu is drainage of water. There are a number of smaller drains discharging in to this thodu. The thodu is silted up at several places. This results in stagnation of water and practically this thode is not for much use because it is silted up. Moreover, this thodu is filled with aquatic plants and grasess at some places.

Proper maintenance and clearing of the canal are required as a corrective measure along with cleaning the silt and debris. The drainage outlets are urgently need to remove which is coming from houses to thethodu have also to be cleaned by removing blockages and easy flow of water. Deepening the thode throughout the whole length is inevitable for maintaining smooth flow

1. ENCROACHMENTS AND COVERED AREA

Some areas are seen encroached on conducting survey on this thodu.The details of encroachments can be ascertained only after conducting the demarcation survey by revenue department.

2. SIDE PROTECTION

The sides off the thodu are seen presently protected all most all length. Wherever the protection works are seen partially damaged and it should be rectified by dismantling and reconstructed.

3. DEEPENING

The thodu has need to be deepened for the proper flow of water in the rainy season.

4. PROBLEMS WITH HOUSEHOLD WASTE/SEPTIC TANK WASTE

The residents of slums and houses situated near by dispose off their waste as well as septic tank waste in to the thodu.This shall be removed by the proposed deepening.

5. CULVERTS AND BLOCKS

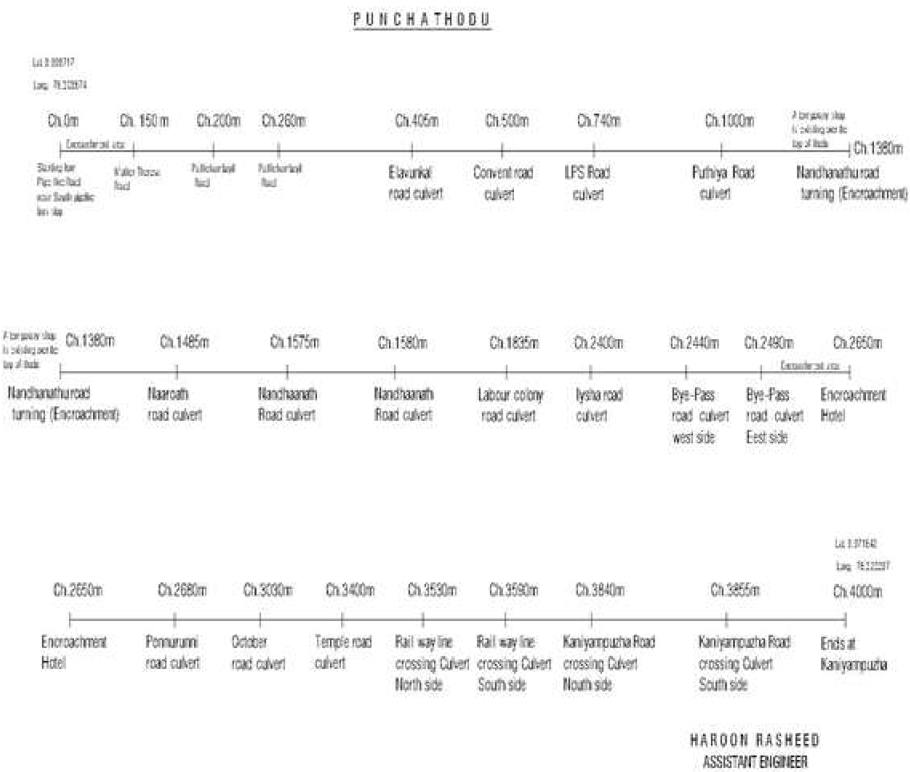
In this thode12 numbers of main culverts, 1 NH crossing culvert and One Railway line crossing culverts are in this thode.The entry point of the NH culvert was seen a main blockage due to less width, noted during the survey.

6. AQUATIC WEEDS

Some area of the canal filled with debris and water grass were partially obstructed the flow of water.

Due to the presence the above grass considerable depth reductions were noticed during the survey. For removing this shall be included in the deepening works.

LINE SKETCH



IRRIGATION DEPARTMENT | ERNAKULAM

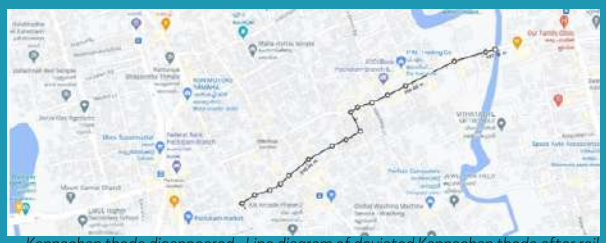
MANGALAVANAM THODU

KOCHI
FLOOD MITIGATION

In-charge: Er.Visala E.A, | Asst. Engineer | Irrigation Navigation Section Ernakulam

IRRIGATION DEPARTMENT
ERNAKULAM

MANGALAVANAM | CHATHYATH | KANNACHAN THODU



Kannachan thode disappeared –Line diagram of deviated Kannachan thode after rail crossing to Perandoor.

Present Kannachan thode in two pieces.

At Ch:4650m -Subhash Chandra Bose Road

INTRODUCTION

Mangalavanam Chathyath thodu comes under the water shed area of Periyar river basinand that of Kannachan thode is under Muvattupuzha river basin.(.Periyar river is the largest river in the Kerala state having 244 km length originating from Sivagiri hills at western ghat reaches to Vembanad lakeand finaly in to Arabian sea whereas Muvattupuzha having 121km lengthoriginating from Tharangamkanamkunnu in Idukki district).Originally the thode named as Kannachan was one of the Hero distributory originating from Perandoor canal and driving down the shortest distance to reach Vembanadukayal through Mangrove bird sanctuary (Mangalavanam) near Terminus Railway station and High Court of Kerala. There is a large water stored area in Mangalavanam and the adjacent idlingRailway land.There exist prospects for constructing a big new water bodythere by applying advanced Technologysuch as recycling process of corporation drainage water surrounded by heavy intensity of population.It is in the scope that Kochi Muncipal Corporation is surrounded by Saline water ,whereas the water collected through corporation drain from many residences shall not be saline . After implementing a strict and controlled drainage system throughout the corporation area and implementing advanced technology of sewage treatment plant in every division and thus urban farming can be promoted

SALIENT FEATURES

Starting from	Perandoor canal
Ending	Vembanadu lake
Length	through Mangalavanam- 3200m
	Through Chathyath (Queen's walkway)- 2205m
Crossings	5 bridges

HISTORY

Originally as stated above Kannachan thode was one of the very important Hero drain of Kochi Muncipal Corporation originating from Perandoor Canal, and flowing through the area of present Justice KK Mathew road,Tagore lane welcome road Then Tatapuram and finaly to Vembanadukayal flowing through Mangalavanam sharing the boundary of Terminus Railway property near High Court of Kerala..In olden days many small drains were flowing towards Kannachan thode and it played an important role for conveyance through water way by then people using ferry.There were a ferry yard In the initial reach of this stream named Madavana ferry yard..

Present day Mangalavanam bird sanctuary was previously used as timber depot for stacking the timber through through ferry boats.The depot was under Malayattoor division till 1970. And from 1970 to 1981, it was under the Timber Sales of Kalady. From 1981 it was under the control of Social Forestry Division Ernakulam.After the declaration of this area as Bird Sanctuary (on 31st August 2004) was done by Wildlife Division Peechi and from July 2009 onwards the management of the sanctuary is done by Nature Study Centre Kalady. Mangalavanam is now a mangrove bird sanctuary of Ernakulam near High court of Kerala . Mangalavanam is a site where migratotory avian species seasonally, nesting places for hundreds of colonial nesters. This Sanctuary is having an area of 2.74 ha and 2/3 rd of this area is of water stagnated or marshy land.. Ernakulam terminus railway station is situated on south side, Arabian sea on west side.Area of Mangalavanam and the terminus railway land is surrounded by thickly populated town ship area of Kochi corporation on north, east and south side.There is a shallow tidal pond guarded by dense growth of man grove vegetation along the periphery and is connected with kochi backwater by feeder canal named as Mangalavanathodu. Area of present thode near Chathyath Church was originally a part of Periyar riveron east side of Thanthonni Thuruth just before reaching to Vembanadu lake.This was a kadavu for conveying goods to then famous companies like Tata Oil Mills,Burma shell etc.. through Large ferry boats.Both the Railway and water way conveyance facilities at this location were very useful for then people.For a long run heavy deposit of silt was accumulated at this area and formed many thuruth like Thanthonni thuruth, Kadamakkudy, Vallarpadam, Bolgatty-Mulavukad Island,etc. As a part of development of the infrastructure facilities of scattered islands in and around the Kochi city the silt accumulated area of Kochi corporation near Tatapuram is converted to land by filling..Further this filled up area is aunctioned and thus many bulding constructions took place.,At last a very small portion of encroached river is left on back side for draining out water and this is the present Chathyath thode leading from Kannachan thode sharing boundary of Present Unilever and Hindustan Petroleum Corporation at Mathai Manjooran road, in Division no.69 of Kochi Municipal Corporation.Now this thode is filled with thick vegetation and is converted to waste disposal place.Now this place is also converted to shelter for many kind of snakes like Python.Hence it is too difficult to reach there.

Run off water from Pachalam area SRM Road, ST Theressa road, Pottakuzhi , North Railway station etc.were draining out to Vembanattu Kayal by the Hero distributory Kannachan thode by driving down through the ideal location of Mangalavanam- the boundary of terminus railway station near High court of Kerala. .This natural flow of drain and a proper drainage system of this area is now noticed as totally destroyed. The Railway Authority cutKannachan thode in to two pieces at north Railway station. Gradually eastern portion of Kannachan thode is disappeared and many small drains towards this thode from the surrounding area have been encroached or converted to roadway. ,Also the connectivity of Kannachan thode towards east side of railway line with Perandoor canal is disappeared.This resulted the main reason for flooding of rain fall at Kalezhath road to SRM road and north side of north railway station 2nd platform.More over runoff water at this area have to travel nearly 10km distance to reach Vembanattu kayal.Whereas Kannachan thode was driving an excellent shortest distance of about 2.50km to reach Vembanattu Kayal when it was flowing through Mangalavanam..All the drains in this area is covered and drainage system is seen as not functioning properly.Surrounding area of Pachalam market is in lower level and is blocked here and there. .Mangalavanam and terminus Railway land is an ideal location for maintaining a proper drainage system especially for thickly populated corporation area

PROBLEMS IDENTIFIED

Flood expected area in 67,68 and 73 Divisions

1.At chainage 0m – thode is converted to drain - no flow.

2. At Ch 380 m- a small drain, Madavana thode meets with Kannachan thode.
Encroachment over Madavana thode.

3. At Ch 406 m- thode meets with Mother Theresa road fully covered and tiled.Fully blocked.

4. From Ch 655m to 693 m – thode fully covered and tiled.Width reduced to 90 cm.

5. At Ch 731 m- thode fully covered and blocked

6. At Ch 788m – thode fully covered and fully blocked.

7. At ch 815m - Thode fully blocked

8. At Ch 840 m - culvert fully blocked, pipe across thode.

7. At ch 815m - Thode fully blocked

9. At ch.848m- heavy silt deposit and encroachment

10. At Ch 850m- raiway culvert east side fully blocked at Thacheth Ln

11. At Ch 893m - Kannachan thode deviated to SRM Road

12. At Ch 11000m -Kannachan thode railway culvert to Tatapuram, fully blocked.

13. At Ch 1110 m - Railway culvert at Justice K K Mathew Ln to Tatapuram- leading channel fully encroached.

Railway culvert fuly blocked

Water logged area east side of railway line.

Water logged area east side of railway line,No flow

Leading channel to Tatapuram- encroachment

Water logged area east side of railway line.

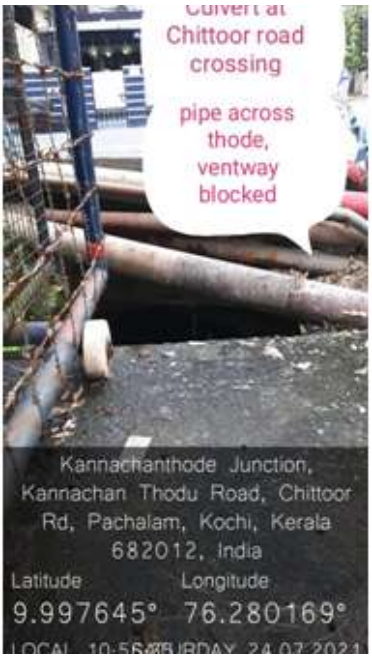
14. At Ch 1260m- toward North railway station, Kannachan thode deviated to SRM Road at Tagore Ln- fully covered and encroached.

15.At Ch 1280m towards north railway station water logged area

16.West side of railway line at Kalezhath Ln.Railway culvert blocked Kalazhath Ln.flooding area near Pachalam market

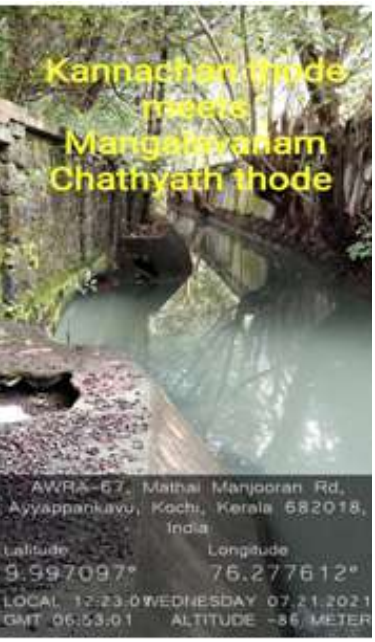
18. At ch.1110m Kannachan thode obstructed by railway line

17. At ch 1400m towards north railway station.Not functioning

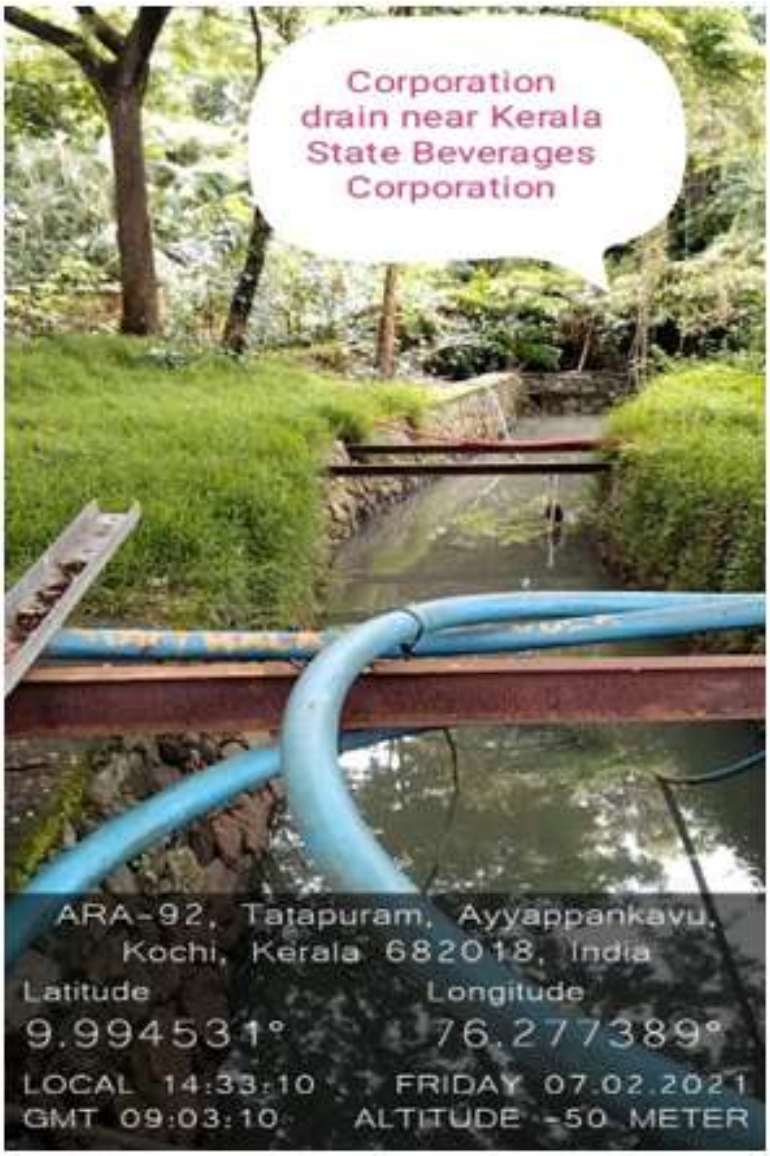


19. At ch1412m- Thode fully covered and encroached.

20.At ch.1755m Kannachan thode meets with Mathai Manjooran road fully covered.
(Diversion point of Kannachan thode completetly covered by black topped surface. Hence drain blocked)

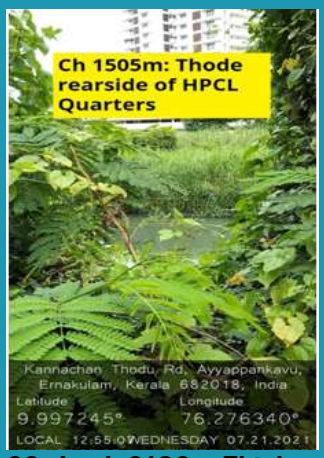


21. At ch.1790m Kannachan thode meets withMangalavanam Chathyath thode
(Narrow point at joining point of Kannachan thode with Mangalavanam chathyath thode)



Corporation drain diverted to Mathai Manjooran road Flow blocked due to silt

Corporation drain deviated to Kannachan thode T Mathai Manjooran road
Water stagnatedd in drain without flow

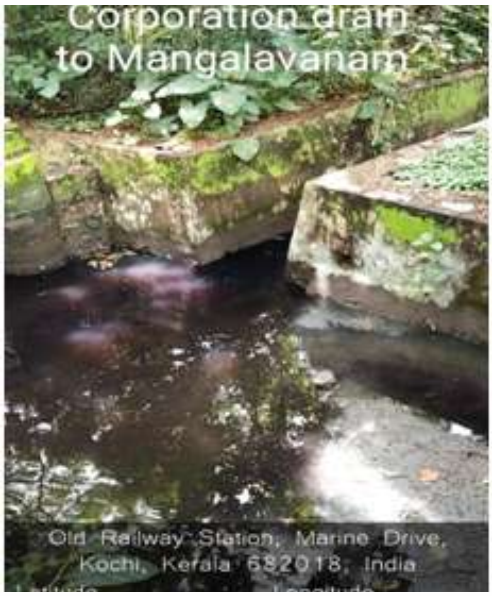


22. At ch.2130m Thick vegetation and silt deposit

23. At ch.2205m thode meets with Vembanadu kayal

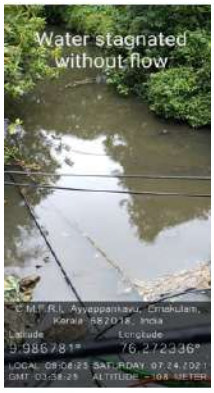
24. At ch 2892 m Mangalavanam/Terminus railway

25. At.ch.2892m polluted corporation water to Mangalavanam. (Polluted water reaches to Mangalavanam)



26. At.ch.3045 Brige at Dr. Salim Ali road heavy silt deposit and thick vegetation,no flow

27. At ch.3186m Bridge at Abraham Madamakkal road Heavy silt deposit and thick vegetation.



28. At ch 3211m Heavy deposit of silt and thick vegetation. (Heavy deposit of silt and solid waste including driven down coconut pile left long years back)

29. At ch 3290m thode meets with Vembanadu kayal heavy silt deposit .Heavy deposit of silt and Vegetation. (Bridge at exit of Mangalavanam thodeHeavy deposit of silt in Vembanadu kayal)

REASONS

1. ThemainreasonforthefloodinPachalam market,Pottakuzhi road,Thacheth road,SRM road junction,North railway station, power house road, St. benedict road, providence road and Ayyappankav road canbesummarisedthat natural flow of water towards west to Arabian sea through Kannachan thode is obstructed .
2. After construction of Railway line, Kannachan thode is destroyed and it disappeared from its originating point of Perandoor canal up to Railway line.Many small natural drains toward Kannachan thode has been converted to road by laying coverslab,gradually to blacktopped or tiled road.
3. Under ground pipes laid below railway lineis not functioning.
4. There is no sufficient leading drain from underground culvert point of railway line to drain out water towards Kannachan thode.
5. Reduction of width of drain due to encroachment, insufficient ventway , layig of pipe across the drain, etc causes hindrance to flow of water.
6. Heavy deposit of silt in Mangalavanam and Chathyath thodeand also its mouth to Vembanadu kayal causes hindrances to flowand drainingof water.
7. Since the thode in corporation area is converted to small drains and covered, the run off water during rainining is flowing over ground surface without entering in to the vent way due to lack of sufficient openings to thode .

REMEDIES ARE PROPOSED AS LONG TERM AND SHORT TERM

Short term measure

1. Desilting of Vembanattukayal at mouth portion is the main solution to ensure easy flow towards the backwater. Also, desilting of Mangalavanam thode and Chathyath thode is essential. Removal of vegetation from the canal will leads to easy flow of water through the canal and also towards the backwater.
2. Deepening and lowering of bed level of the drainages from the Pachalam market and deviate it to Kannachan thode .
3. Proper monitoring like weekly cleaning and caring of drainages in corporation area with respect to each division can reduce intensity of flooding especially in St.Vincent road and Providence road.
4. Remove all the obstructions like pipes from the vent way .
5. Provide necessary openings for the entry of run off water to the thode as it is fully covered and clean it monthly by pumping.

Long term measure

Demarkate boundary of thode Forming a trench up to a depth of existing bed of railway culvert, parallel to the railway line on bothsides(east and west)and direct the water throughKannachan thode to Vembanadukayalthrough Mangalavanam.

Remove accumulated silt and thick vegetation when and wherever is necessary

Deepen the shallow ponds and thode in Mangalavanam and railwayland

Restore the natural flow of Kannachan thode through Mangalavanam,which can reduce the driving distance of water from the present situationfordraining out the water to Vembanattu kayal.(By which driving distance of water can be reduced to 1.50km to 2km against 10km through Perandoor canal).

Provide sufficient vent way for under ground passage of corporation thode to railway boundarydrain leading to Kannachan thode and to Mangalavanam.

Give sidewall protection works to Mangalavanam – Chathyath thode

Periodicdesiltingandcleaningof all the drainage system is to be arranged without fail

Provide maximum manhole at covered area and atevery crossings

Lowering of bed of vent way of drainages from St. Vincent road and Providence road have to done so that increased quantity of water can be accommodated on driving of more distance from its beginning.

Corporation drainage water shall be diverted to Mangalavanam thode only after treatment of water through sewage treatment plant.

BENEFITSOFSHORT TERM MEASURE

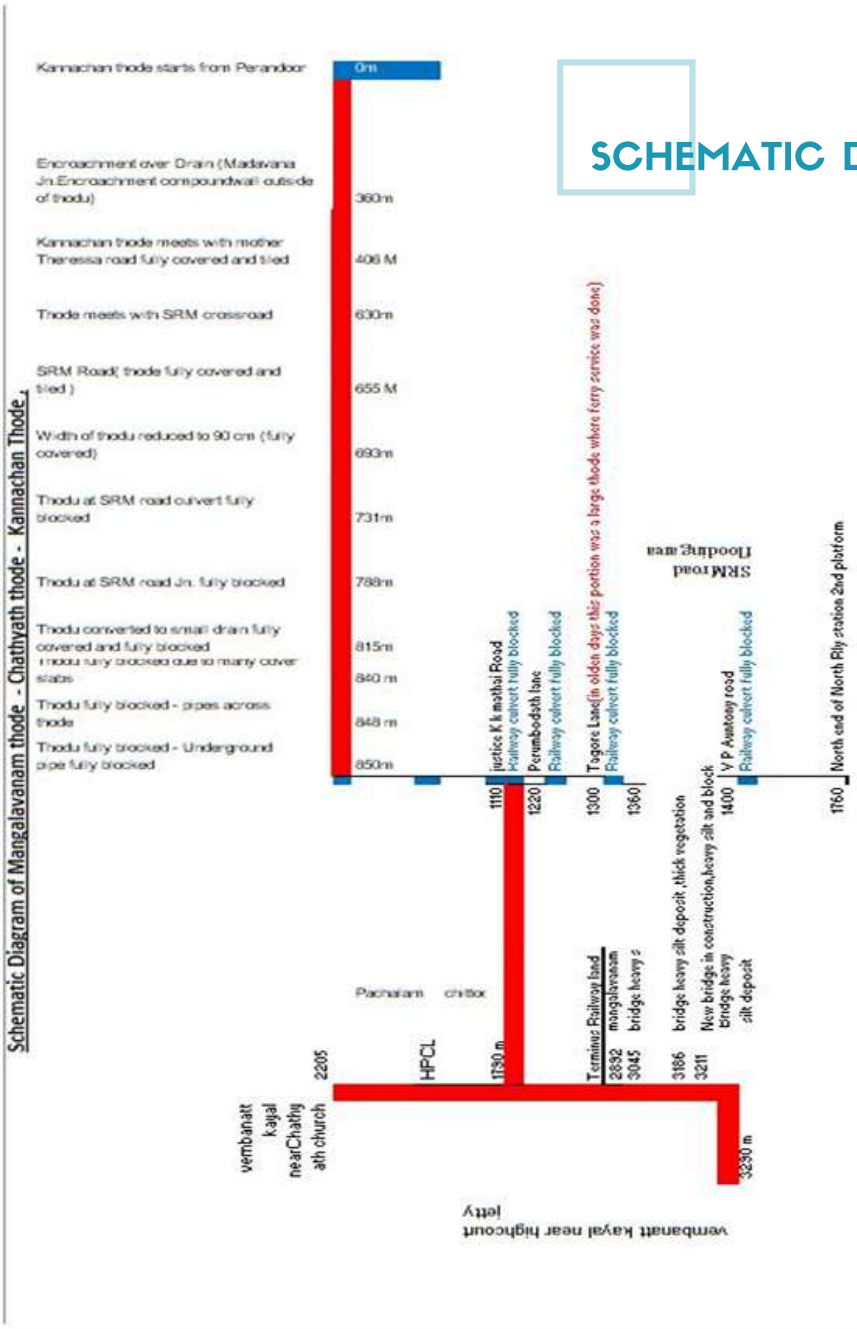
1. Mangalavanam and Chathyath thode are tidal affectingarea.. Water entered during high tide will not flow towards backwater if the bed and mouth of thode has heavysilt deposit.To avoid this desilting ofthode and mouth portion is essential.
2. There is great possibility of deposition of waste materials in the thode everyday. Hence cleaning it subsequently can reduce intensity of flooding.

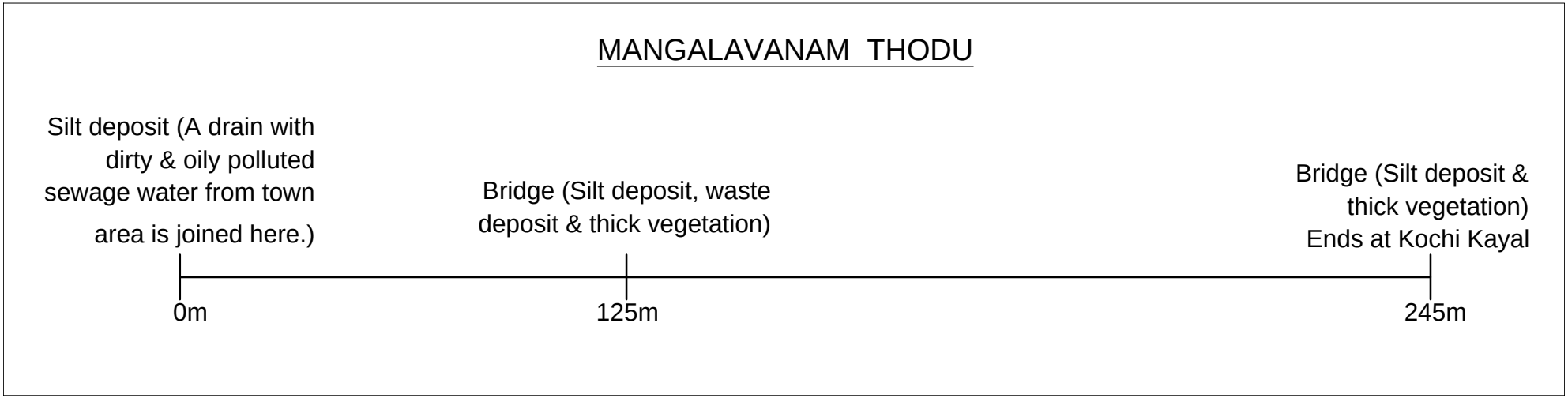
CONCLUSION/RECOMMENDATIONS

Catchment area coming under Kannachan thode is arrived to about 2.87 sqm.

Restoration of the main drainage system through Kannachan thode from Perandoor canal to Vembanadu kayal by constructing a collection trench parallel to Railway line on both side and allow water to drain out by Kannachan thode throughMangalavanam and to Vembanadu kayalis to be done .inorder to maintain free flow of water from Mangalavanam and Chathyath mouth portionto Vembanadu kayal, Desilting and removal of waste deposited for long years has to be done. Rejenuation of Kannachan thode is the best solution to prevent floods at above mentioned areas.

SCHEMATIC DIAGRAM




MANGALAVANAM THODU
Silt deposit (A drain with dirty & oily polluted sewage water from town area is joined here.)
Bridge (Silt deposit, waste deposit & thick vegetation)
Bridge (Silt deposit & thick vegetation) Ends at Kochi Kayal
0m
125m
245m

THATTAZHAM THODU

KOCHI
FLOOD MITIGATION

In-charge: Er.Visala E.A, | Asst. Engineer | Irrigation Navigation Section Ernakulam

IRRIGATION DEPARTMENT
ERNAKULAM

THATTAZHAM THODE

INTRODUCTION

Thattazhamthode originates from Perandoor Canal and ends at Vembanadukayal at Vaduthala and is coming under the watershed area of Periyar river basin. Kollam Kottappuram National water way -3 is passing near by. Perandoorcanal fromThevara canal and Periyar river from Marthandavarma bridge is meetingwith Vembanadukayal at the peek point of backwater at north end of Vaduthala.,There were many other largethodes connected with each other.All goods to near by areas were brought here by means of water way .All the Roads and link roads prevailing in thisarea were once a very good waterway.Now every thode has been converted to roads and leavs a small drain along sides. Many area over the remaningthodehave also been now encroached at many places. So there are many outlets opened to kayal from this land area. Chittoor road is very important road connecting with Ernakulamtownship.Thattazhamthodecrosses Chittoor road at Don Bosco Junction in Division No.74 and in boundary of division no.73. Indian railway crosses the thode and cut it into two and thus the natural flow of water through this thode from east to west was broken by railway.

HISTORY

Once Thattazhamthode was a very famous and important means of water way used by King of Kochi to visit Chittoor temple and to Valanjambalam temple .All the goods for Tata Company was conveyed through this thode..All the prevailing network of roads in this place were playing an important role for conveyance by means of water way linked with present Kollam Kottappuram National water way -3.

PROBLEMS IDENTIFIED

Thattazhamthode reduced to a drain at its origin.

Thode is converted to drain and road, fully covered

- At chainage 0m to 45m

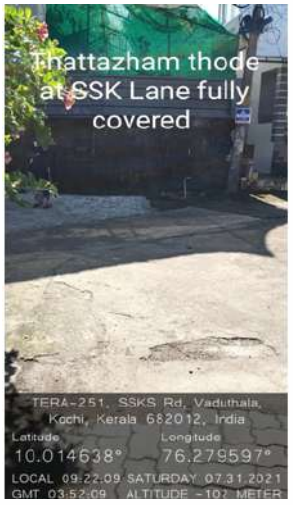
  Entire length of thodu was converted to drain, the initial portion of the thode is also fully covered and converted to road. From chainage 741m itself draining out of water is deviated to Perandoorcanal ,(where the thode is originating from Perandoor canal)

KOCHI FLOOD MITIGATION

Slow flow of water and encroachment

- At chainage 112m and 159m encroachment over slab

- At chainage 120, thode fully covered and converted to drain& encroachment



- At chainage 159m culvert point .Thode fully covered and converted to drain

KOCHI FLOOD MITIGATION

- At chainage 159m culvert point .Thode fully covered and converted to drain

- At chainage 565m Railway cut the thode into two. Ventway of pipe laid below railwayline blocked by KWA pipeline. Thode just before entering the railway culvert point is fully covered, flow of water is blocked here.

KOCHI FLOOD MITIGATION

Don Bosco junction a flooding Area

- At chainage 565m culvert point across Chittoor road. Flooding area (Ventway of culvert blocked by pipe to Tata company and cables. It causes flooding of water during raining.

- From chainage 626m to 741m thode fully covered and encroachment at chainage 741m boundary of present Donbosco school ground. From here the thode is deviated towards Donbosco road as a drain.

- At chainage883m the deviated thode along the sides of Donbosco road reaches to vembanadkayal at chainage 1230m. Mouth portion at this location is having waste disposal, heavy silt deposit and thick grow of weeds.

- At chainage 1500m heavy silt deposit uptoVembanattkayal , (70 m length)

- At chainagec1402m, Thattazhamthode deviated fromPazhampilli Thomas road reaches to Pushpaka road thode. (Length – 318m) . Entire length is fully covered.

KOCHI FLOOD MITIGATION

- Shoreline of vembanadkayal at Vaduthala area is of heavy silt deposit, thick growth of weeds.

Flooding occurs during rain is mainly due to following reasons

System of natural draining through the thode is disturbed at many points

REASONS

- Removal of very large pipe and cables laid by Tata company inside the vent way of culvert is the main issue.
- Pipe culvertat railway line crossing is in sufficient to drain out water at this location.
- KWA pipe across the vent way of railway culvert obstruct the flow of water
- Alignment of thodetotally ruined at Don Bosco School ground and many encroachment has been happened.Hence the natural flow of thode has been disturbed by deviation of the thode.
- Entire length of the thode has been shrinked to drain and fully covered. Difficulty in cleaning of thode to removeunvisible deposited silt and waste materials from the drain as there is no sufficient man hole.
- Since entire lenth of the thode is covered and sealed, the run off water can not enter into drain or thode
- Shore line of Back water is of heavy silt deposit ,weeds and waste.All the mouth at many exit location is fully blocked.
- Insufficient vent way for draining out water
- Vent way of every culvert point is not visble for inspection.

REMEDIES ARE PROPOSED AS LONG TERM AND SHORT TERM MEASURE

Short term measure

- Desilting of Vembanattukayal at mouth portion of every thode and removal of waste andweeds are the main solution to ensure easy flow towards the backwater.
- Proper monitoring like weekly Cleaning and caring of drainages in corporation areawith respect to each division can reduce intensity of flooding .
- Remove all the obstructions like pipesfrom the vent way .
- Provide necessaryopenings to collect run off water to the thode
- clean it weekly by pumping.

Long term measure

- Demarkate boundary of thode and restore the alignment of the thode and allow the thode
- free from encroachment.
- Remove the cables and pipe from the vent way of culvert.
- Do protection works toshoreline.
- Provide maximum manholes/ openings to allow waterto enter in to the drains
- Periodicdesiltingandcleaningof all the drainage system is to be arranged without fail.
- Vent way of every culvert point should be easily visible.

BENEFITS OF SHORT TERM MEASURE

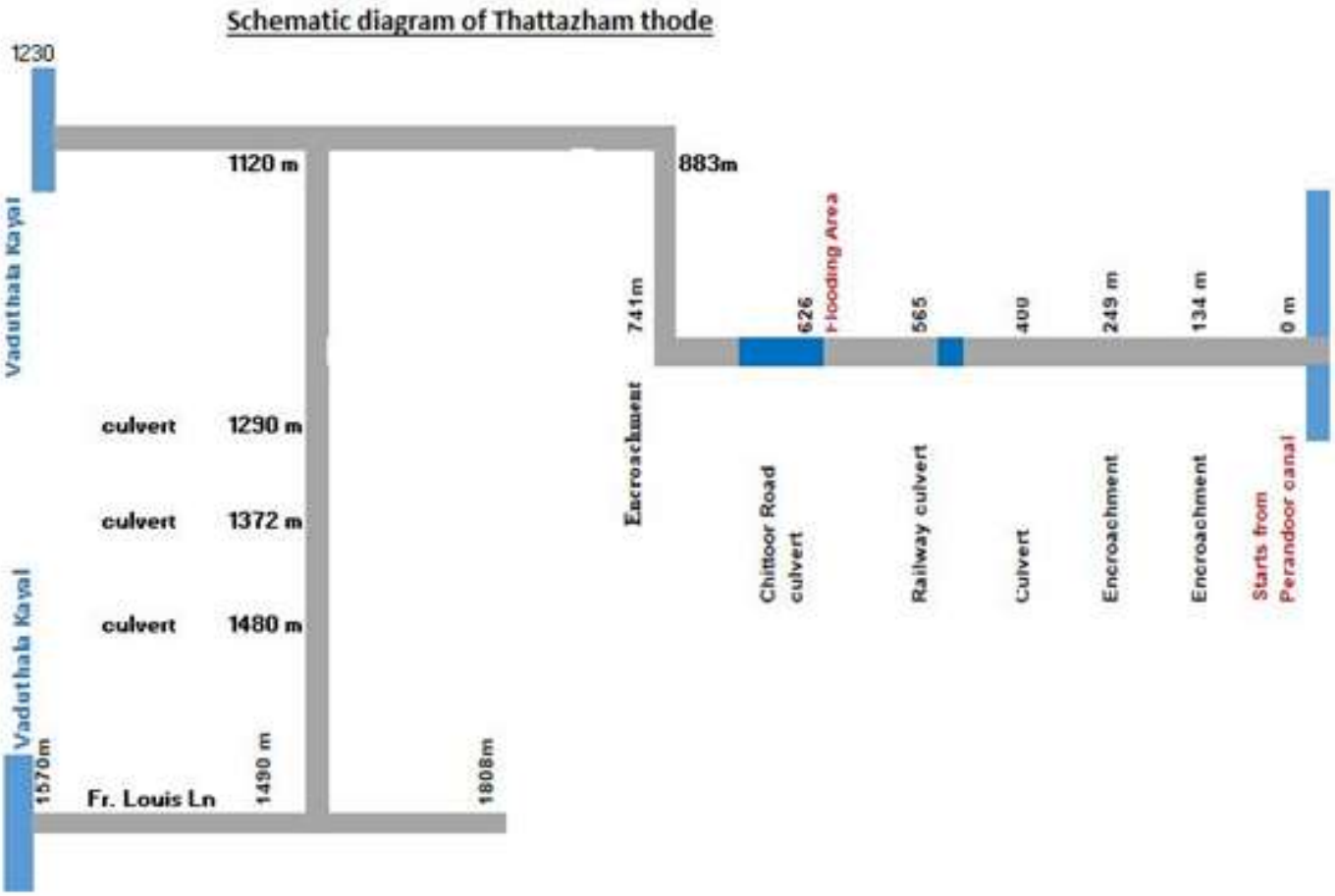
There is great possibility of deposition of waste materials in the thode/ drains every day. Hence cleaning it subsequently can reduce intensity of flooding.

CONCLUSION/ RECOMMENDATIONS

Total Catchment area of this thode arrived to about 1.66 sq.kmEntire length of theThattazhamthode is fully covered and converted to drain. Since the thode is encroached at Ch.741m by Don Bosco school ground, flow of waterto its downstream is blocked and flow is redirected to it's originating point,Perandoor canal as a small drain. Along with that encroachment at ch134m, Railway line crossing atch 565m and blocked culvert at ch 626m at Chittoorroadcreated four major obstruction to the flow of water within 741m length of this thode.Catchment area coming under Thattazhamthode is arrived to about 1.66sqkm..As the entire length of thode is fully covered.Since necessary provision for entering rain water into fully covered thode is not given, water is getting flooding up in this area ..In addition to the above entire lenth of shore line at Vaduthala portion isfilled with heavy silt depositand weeds.

If high tide is existing the water will not flow towards the backwater and it may lead to flooding up as this place is of low lying area. To avoid this desilting of shore line of backwater and mouth portion of every outlets to Vembanadukayal isessential.Clearing obstruction of entire length of Thattazhamthodeand making necessary openings for rain water to enter the thodeareto be done for ensuring free flow of water. Through this, the surplus water entering in to the canal can easily flow towards backwater (Vembanadukayal).
Flooding up of rain water at DonBosco junction can be solved only by removal of fourobstructions noticed above.. Restoration of Thattazhamthodeto its original form is the effective way to eliminate flooding up in this area.

SCHEMATIC DIAGRAM



PUTHENPALAM THODU

KOCHI
FLOOD MITIGATION

In-charge: Er.Anitha Madhavan | Asst. Engineer |MI Section Paravoor

IRRIGATION DEPARTMENT
ERNAKULAM

PUTHENPALAM THODU

PRELIMINARY STUDY REPORT

Puthenpalam thodu is a natural thodu connecting Karanakodam thodu and Chilavannoor kayal. Until three decades ago the thodu had an average width of 20 meters and was an important water way used for various purposes. Starting new Railway yard and passes through heavily populated residential areas. The length of the thodu is 1 km and width 6 m at the starting point and when it reaches Chilavannoor lake at Chittichira bridge the width of the thodu 16m. Due to the long time deposit of silt and other waste such as drainage from the surrounding residential areas considerably reduce the water carrying capacity of the thodu ,even if it rains normally, the filled up and surrounding areas becomes flooded.

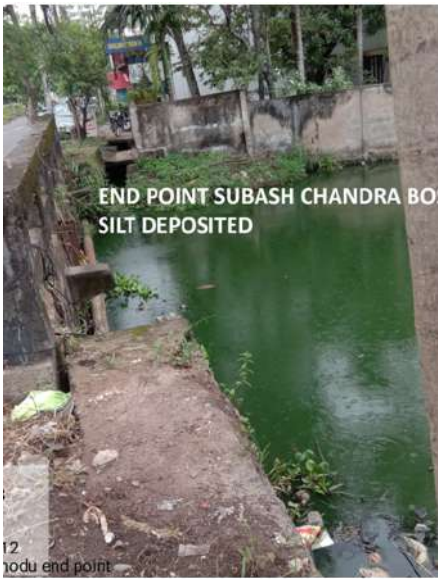
OBSTRUCTIONS/FINDING

At the starting point there was a crossing slab culvert and which was demolished few years back to prevent the flooding in this area. Now the remaining of the culvert such as foundation and slab portions are obstructing the flow and width of the thodu at this point is 4 m .The remaining portion of the culvert to be demolished and widen the opening of the thodu.

After 0.16m the thodu turns to south direction and both sides of the thodu residential buildings and compound walls were constructed along the sides of thodu and drainage pipes from toilet are opened to the thodu. Due to the dumping of soil waste and untreated sewageflows into the thodu ,the water become contaminated and slangrant and present water depth from ground level 1.2 m. At ch:0.24 m one bridge constructed across the thodu in Kunjanbava Road.

From ch:240 m both side of thodu encroached and boundary walls constructed. Silt deposited in this areas to be removed.At ch:325 m one branch thodu joined at the right side of the thodu and its length comes to 165 m and average width of 5 m.

From ch:240m to 920 m many apartments complexes were constructed on both sides of the thodu and boundary walls of these buildings are seems to be encroached to the thodu.



At ch:920 m Subhash Chandrabose road crosses the thodu and a bridge was constructed there with span of 2.5 m .Width of the thodu at this chainage is 16.5 m and the unscientific construction of the bridge almost completely blocked the flow and even in high tide the nearby the areas becomes flooded.

SUMMARY OF PROBLEMS IDENTIFIED

1. Flow of thodu restricted at the 0 m chainage due to remainings of the old culvert and insufficient width.
2. Accumulation of silt in the bed of thodu.
3. Reduced width of canal due to the encroachment.
4. Difficulty of silt removal from the thodu because of the illegal construction of boundary walls on both sides of the thodu.
5. Huge quantity of waste disposal and sewage pipe lines.
6. Obstruction due to bridge having less vertical and horizontal clearance.

REMEDIES

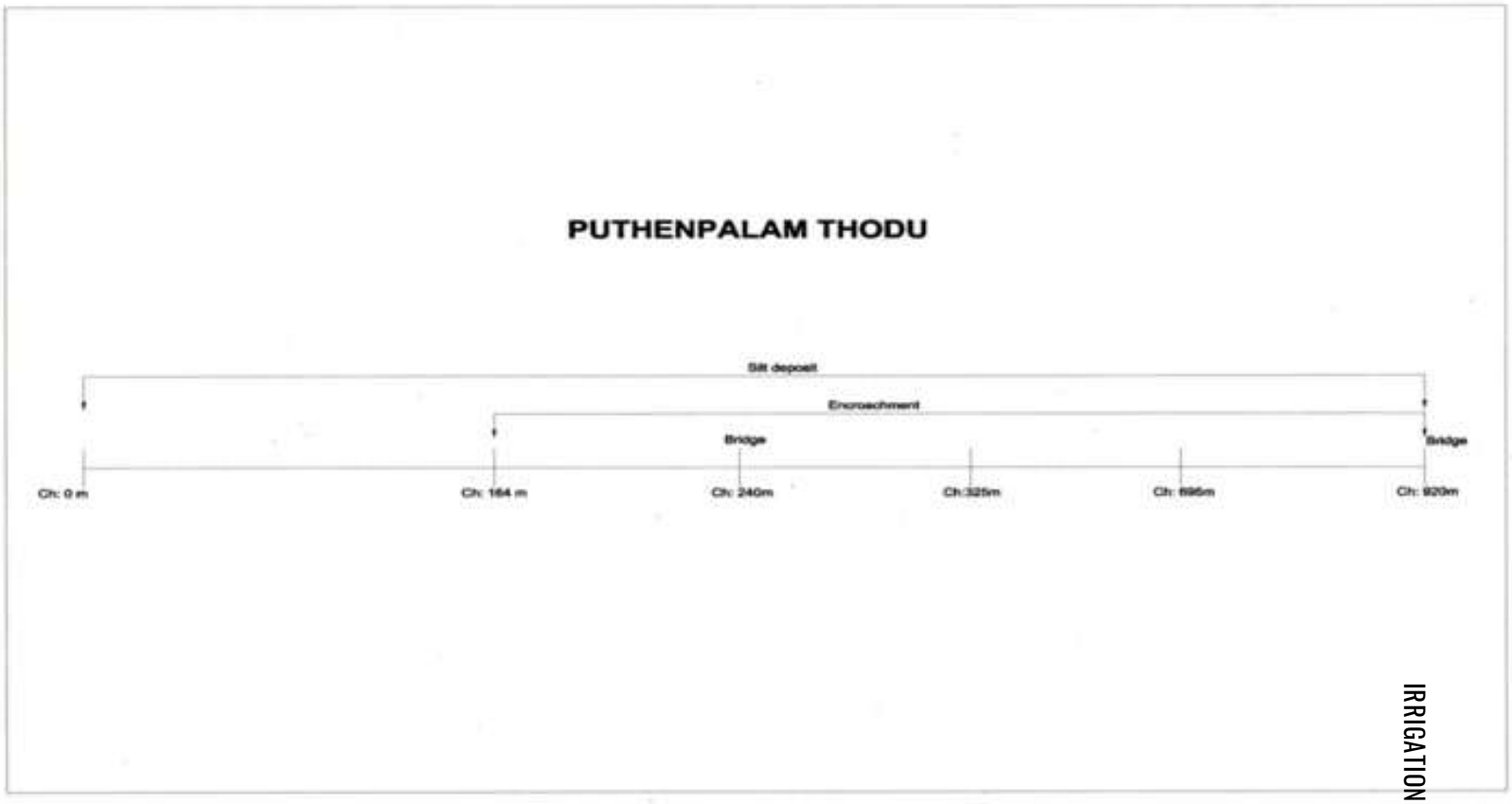
Short Term Measures

1. Demolishing and removing the remaining parts of the culvert and widening of the opening portion.
2. De silting and removal of silt and other floating debris for the entire stretch.
3. Stringent monitoring and enforcement for preventing waste dumping into the canal.
4. Committees to be formed with participation of residence association, Kudumbasree workers, cooperation officials and law enforcement officials for watching and take action against to waste and sewage disposal to the thodu.

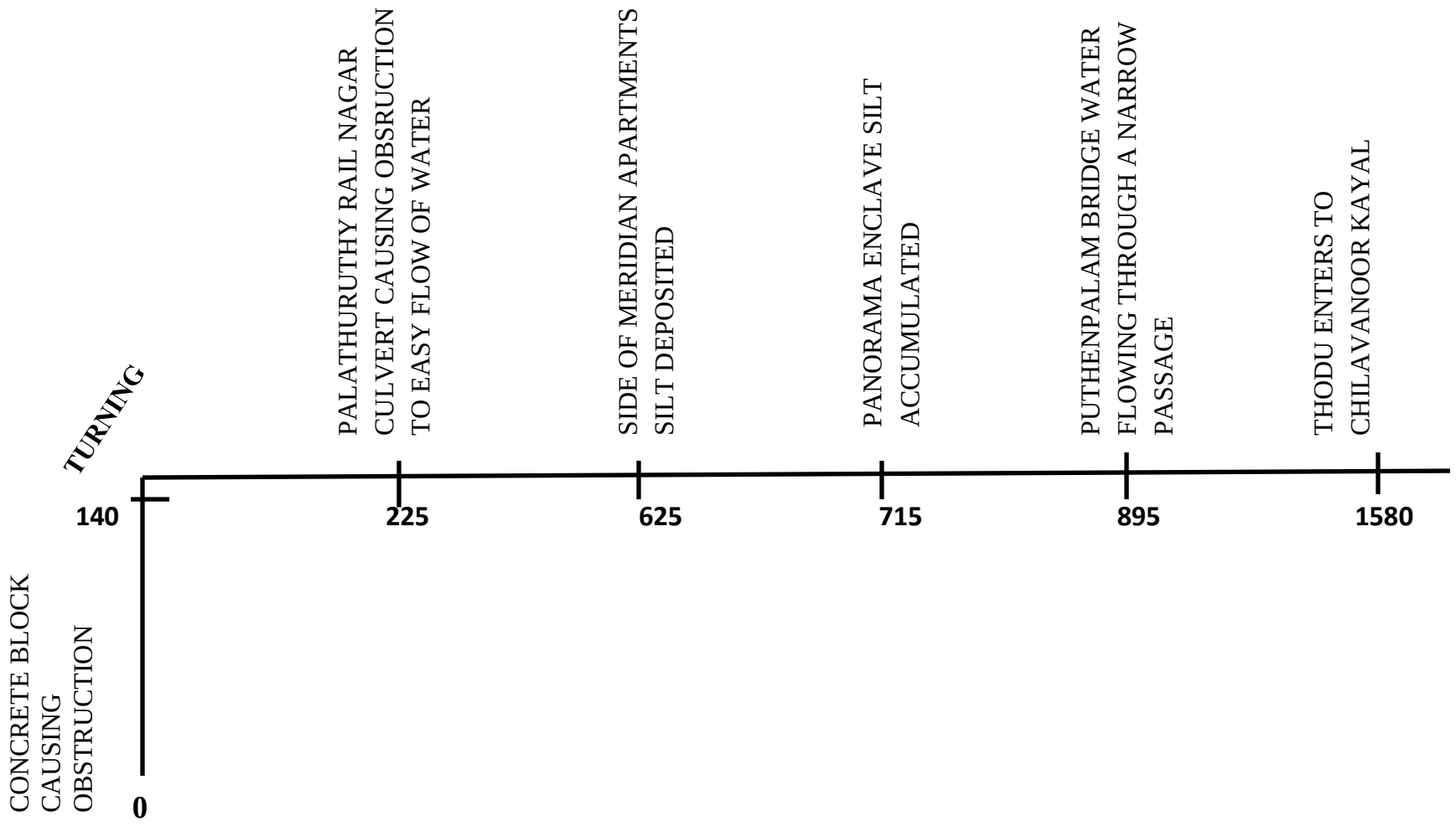
Long term measures

1. The entire canal encroached on both sides should be evicted and the sides of the canal to the protected through proper fencing with openings intermittent for clearing the waste and silt.
2. Bridge at the end of Puthenpalam thodu to be demolished and construct a new bridge with adequate width and height .

SCHEMATIC DIAGRAM

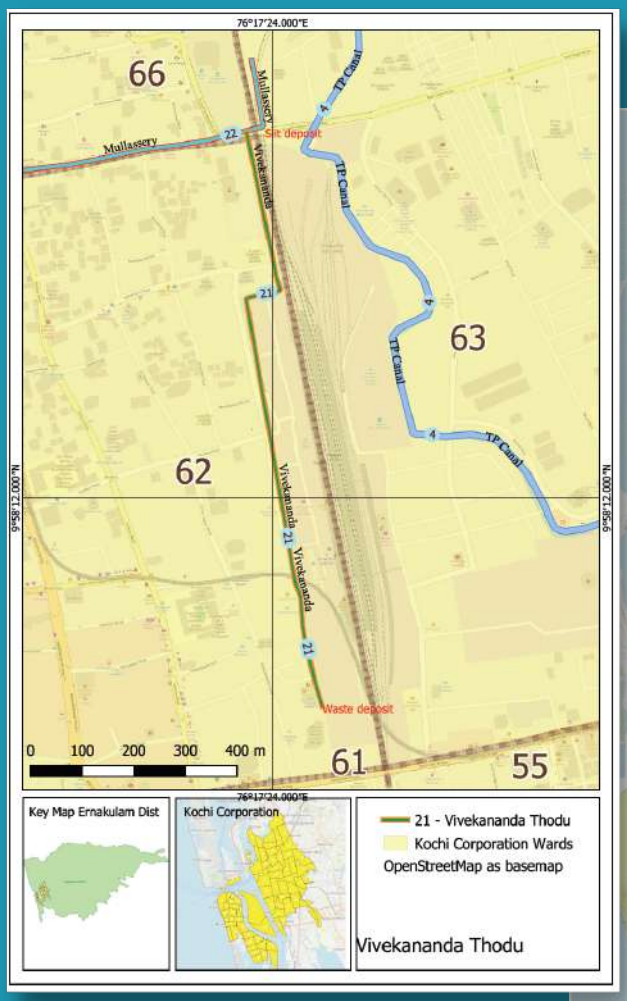


PUTHEN PALAM THODU

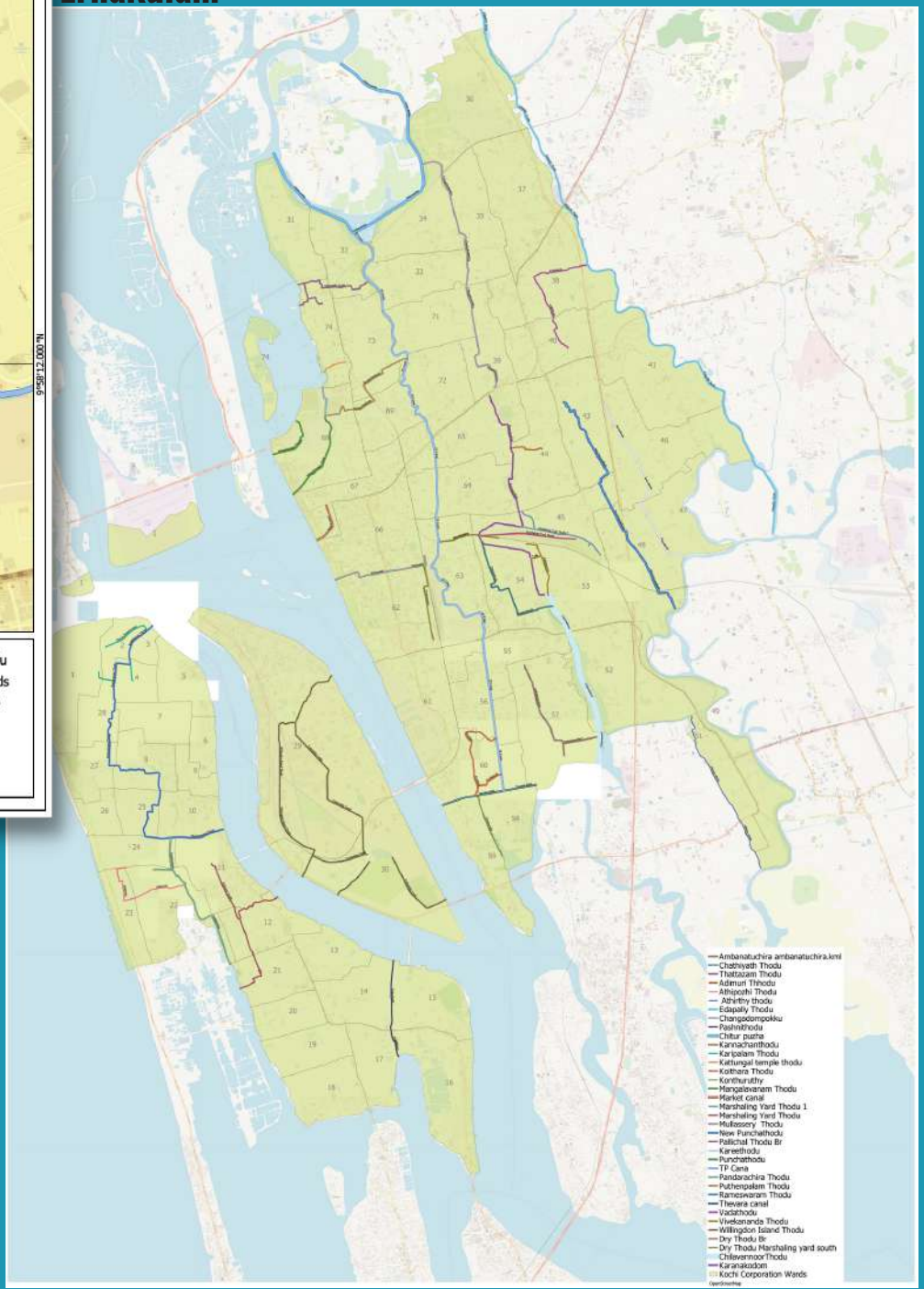


VIVEKANANDA THODU

KOCHI
FLOOD MITIGATION



In-charge: Er.Rekha B, | Personal Asst. | MI Division, Ernakulam



IRRIGATION DEPARTMENT | ERNAKULAM

VIVEKANANDA THODU

INTRODUCTION

Vivekananda Thodu for a length of 1162m and an average width of 1.70 m is starting from the vicinity of the railway quarters of the south railway station and meets at the Mullassery canal and Karithalathodu which is merging to Perandoor canal near the KSRTC garage. As far as this thodu is concerned the serious bottlenecks have been cleared in Operation Break Through for a length of 300m and no continued flood situation occurred in those locations as was experienced in the past years.

Apart from this, the bottlenecks are listed below.

OBSTRUCTIONS

Apart for a length of 300m of the thodu for which the width of the thodu is 2.4m, major portion of the thodu have an average width of 1.70m which has to be reconstructed for an original width of 2.40m.

- Along the Vivekananda road starting from the front of south railway station (metro pillar No.740), shops are built over the thodu which was covered by concreteslabs for a length of 200 m . Hence regular desilting of the thodu cannot be done.

·This natural thodu was converted to the status of a road side drain covered with slabs restricting entry of rainwater into this thodu. Open portion of this thodu were blocked at various intermediate stretches especially along the warehousing corporation road by the accumulation of silt and waste disposal mostly sewage waste resulting in the storm water not reaching its intended outlets.

·Major 4 corporation drains carrying the storm water from Kalathiparambu road, M.G road, DH road, Road in front of railway station joining the thodu resulting in flood prone areas especially at the railway station premises and KSRTC garage.
·At the convergence point of the thodu withMullassery canal and Karithalathodu wateris stagnant and there is no flow toMullassery canal due to clogging of the thodu with heavy deposit of silt and accumulation of waste disposal and sewage waste.

PROBLEMS

- At the starting point of the thodu (Ch:0.00m) solid waste is dumped at a height of 2.00 m
- Heavy accumulation of silt deposit obstructing the flow of thodu along the Ch:0.00 to 28.00 m
- Thodu is covered by concrete slabs near the railway quarters along the Ch 28.00 m to 138.00 m
- At Ch 138.00 m , near Mosque 500 m length corporation drain is joining the thodu resulting in the accumulation of the silt at the entry of the thodu. This covered portion of the thodu is a hightly flood area.
- From Ch 158.00 m to Ch 220.00 m in front of Kerala Ware housing corporation and along the side of railway compound sewage deposal and waste dumping occurring resulting in stagnation of water.
- Starting from the front portion of south railway station (Metro pillar No.740) from Ch:245 m to Ch 300 m , shops are built over the covered slabs hindering the periodical removal of accumulated waste and silt deposit
- 3 Corporation drains from M.G. Road, DH road joins the thodu along the Vivekananda road at245 m, Ch 280 m &Ch 300 m resulting in flood prone areas due to the accumulation of silt and waste. Regular desilting is hindered along these reaches due to the covered slabs.
- Along Ch:795 m to 872 m, thodu is covered by concrete slabs.
- Low level concrete slab at Ch 900 m hindering the flow ofthodu.
- From Ch: 922 m in front of St.Joseph's School to Ch: 1162 m where the thoduconvergestoMullassery Canal near KSRTC garage, water is stagnant due to heavy disposal of sewage waste disposal.
- At Ch 1162, in addition to the disposal of sewage waste, heavy accumulation of solid waste and silt occurred resulting in the stagnation of water.

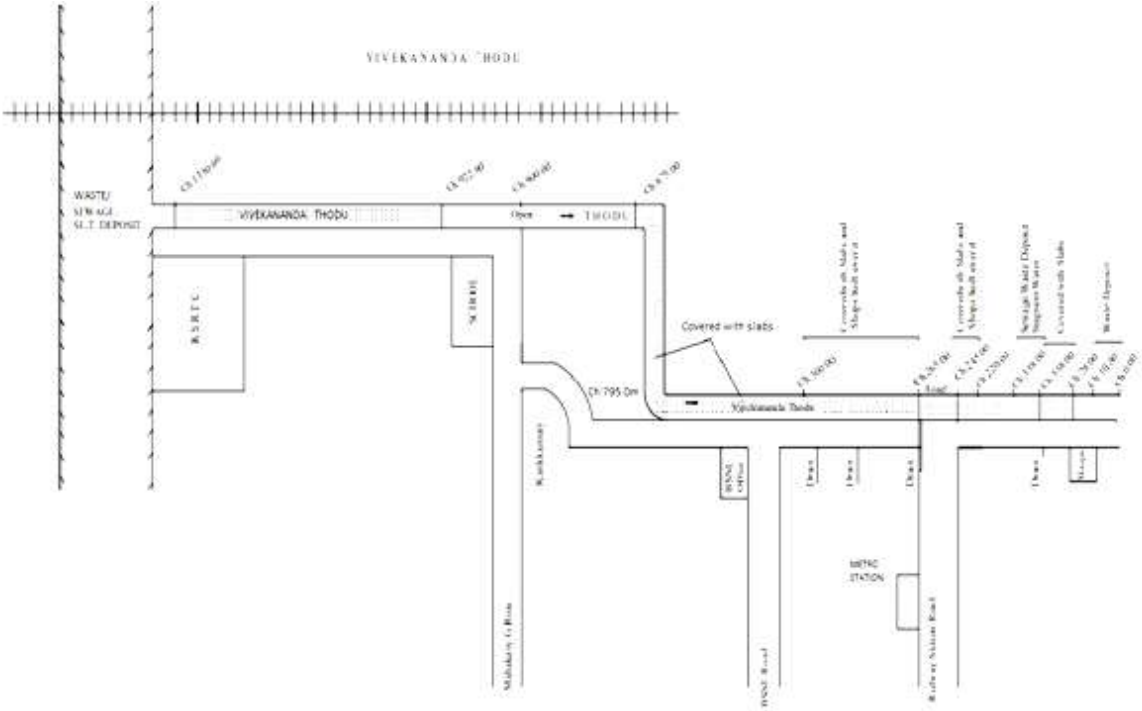
REMEDIES

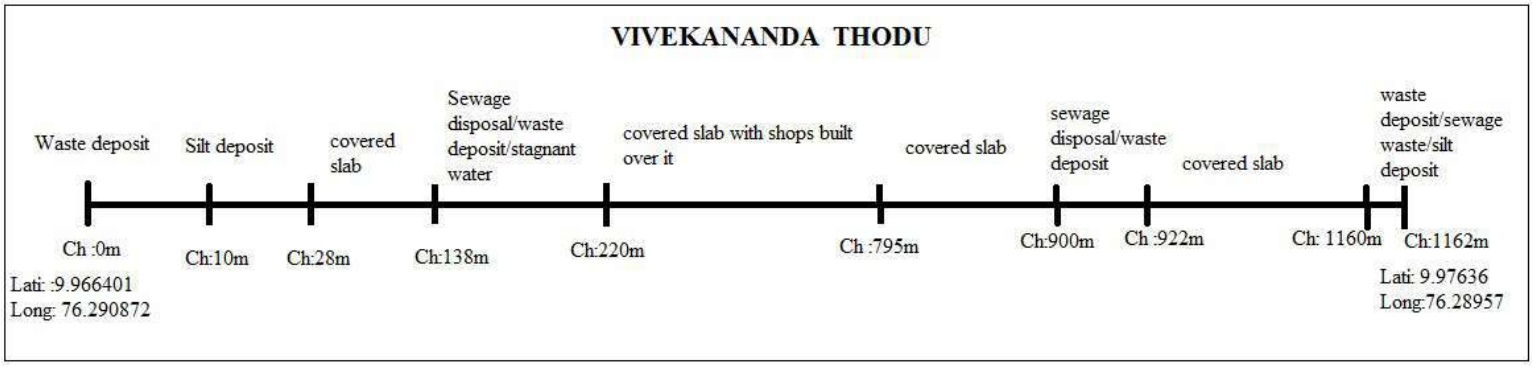
- Carrying capacity of the thodu has to be increased by increasing the width and depth to its original (2.40 x 1.50) so as to hold the storm water fully along the entire length of the thodu.
- As regular desilting of the thodu cannot be done due to the street vendors set up shops on the covered concrete slab, the encroachments have to be evicted.
- Accumulated waste and silt to be removed at regular intervals and regular monitoring of sewage disposal by local samithies especially at places where corporation drain joins the thodu.
- Free flow of thodu to Mullassery canal is to be ensured properly by clearing the silt and solid waste at the convergence point of the thodu as well as in the Mullassery canal.
- Intensity and volume of storm water entering the thodu from the corporation drains had to be reduced by a reverse flow drainage system, by directly discharging the storm water accumulated in the drain to the kayal.

CONCLUSION

Free flow of thodu can be ensured by increasing the carrying capacity of the thodu to its original width and depth, removal of accumulated waste and silt at regular intervals, regular monitoring of sewage disposal by local samithies and by ensuring a reverse flow drainage system, thus discharging the storm water directly to the kayal.

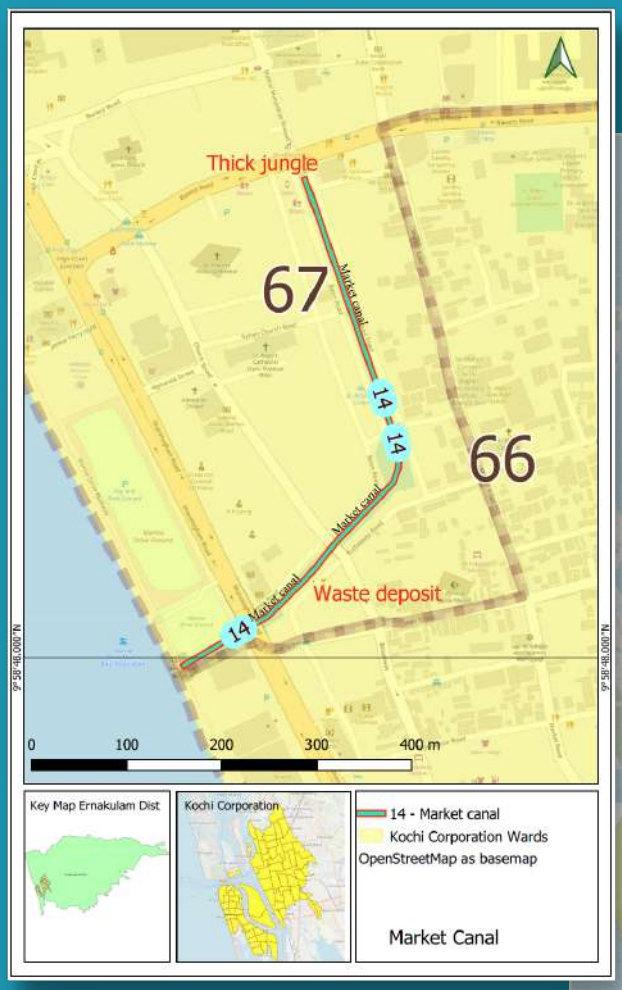
LINE SKETCH


VIVEKANANDA THODU
WASTE/
SEWAGE
SLT DEPOSIT
VIVEKANANDA THODU
Open
THODU
Covered with slabs
Ch:795.0m
Vivekananda Thodu
METRO
STATION


VIVEKANANDA THODU
Waste deposit
Silt deposit
covered slab
Sewage disposal/waste deposit/stagnant water
covered slab with shops built over it
covered slab
sewage disposal/waste deposit
covered slab
waste deposit/sewage waste/silt deposit
Ch :0m
Ch:10m
Ch:28m
Ch:138m
Ch:220m
Ch :795m
Ch:900m
Ch :922m
Ch: 1160m
Ch:1162m
Lati: :9.966401
Long: 76.290872
Lati: 9.97636
Long:76.28957

MARKET CANAL

KOCHI
FLOOD MITIGATION



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IRRIGATION DEPARTMENT
ERNAKULAM

MARKET CANAL

Market canal in 1950

INTRODUCTION

Market canal starting from Ernakulam market at Bannerji road for a length of 730m discharges into the Kayal at the rainbow bridge having an average width of 9.60 m.History of Market canal starts at the era of " The Maharaja of Cochin" about 150 years back who gave the Market area to Jewish traders for business. The northern end of Broadway, Basin Road and Jew street together forms the Ernakulam market with a row of temporary shacks come up on the side of Basin road with their back to the canal. Hence the canal also known as Basin Road Canal. Market canal used to be the lifeline of business in the market with the country boats bringing in goods until the 90's as it is directly linked to the Vembanad lake. As such the centre had trade connections from as far as Ponnani and Chavakkad in North and Kollam, Changanassery, Kottayam in south. The wide platform that protrudes the canal is the jetty where hundreds of large canoes carrying goods used to arrive from these places.

OBSTRUCTIONS

Thick jungle covering the stretch of the canal upto the Marine Drive bridge for a length of 500m.

- Flow of water is obstructed due to waste disposal at the starting point upto a length of 10m.
- Silt deposit along the bridges of the canal inside the market thereby obstructing the flow.
- Protective wire mesh tampered and side protection works destroyed for mass waste dumping from shops along the Basin road for a length of 25 m.

PROBLEMS IDENTIFIED

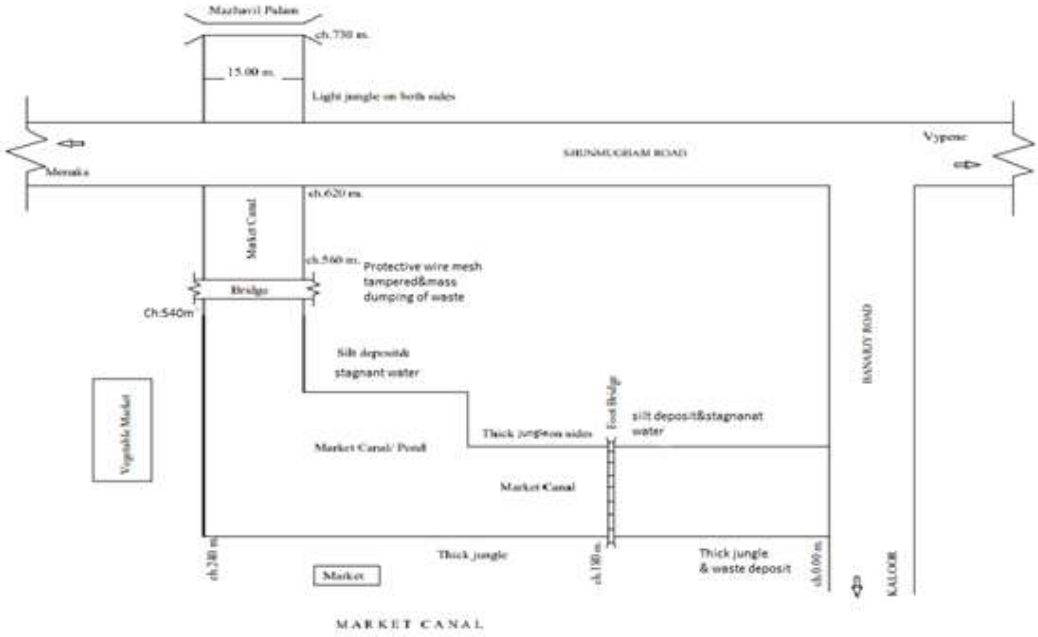
Flow of water is obstructed along the Ch from 0.00 m to Ch 10.00 m due to waste disposal.
At Ch 180 m at bridge, thick jungle and silt deposit accumulated resulting in the stagnation of water.
At Ch: 540m at bridge thick jungle and silt deposit accumulated resulting in stagnation of water.
AtCh 560 m along the Basin Road, Protective wiremesh is seen tampered and side protection works destroyed for mass dumping of waste from shops.
At Ch 620 m along the Marine Drive Bridge light jungle and silt deposit hindered the flow of water.

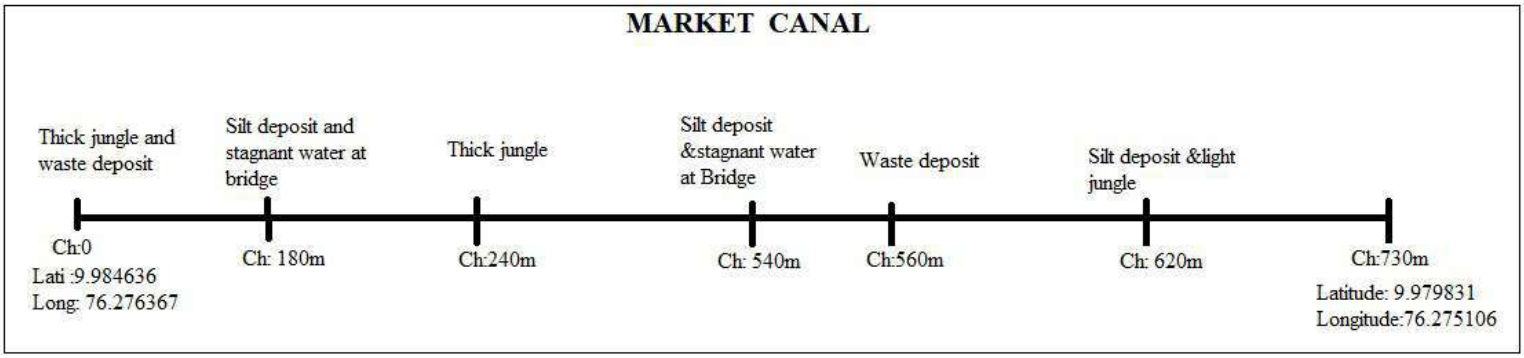
REMEDIES

- Felling of trees andclearing of light jungle.
- Accumulated waste at starting point and along the Basin road to be disposed.
- Removal of silt deposit near the bridges inside the market.
- Side protection to be reconstructed and tampered wire mesh to be installed for a length of 25 m along the Basin road.
- Drains connected to Market Canal from MG Road has to be desilted at regular intervals for ensuring free flow of storm water to the canal thereby reducing the intensity of flooding at the MG road stretch.
- No obstructions along the discharge point at the kayal mouth of rainbow bridge had to be ensured by removing the water hyacinths and silt deposit at regular intervals.

At present the market canal is protected by wire mesh fencingerectedon both sides of the canal to prevent dumping of waste and there is no flow obstruction along the discharge pointat Rainbow Bridge.

LINE SKETCH




MARKET CANAL
Thick jungle and waste deposit
Silt deposit and stagnant water at bridge
Thick jungle
Silt deposit &stagnant water at Bridge
Waste deposit
Silt deposit &light jungle
Ch:0
Lati :9.984636
Long: 76.276367
Ch: 180m
Ch:240m
Ch: 540m
Ch:560m
Ch: 620m
Ch:730m
Latitude: 9.979831
Longitude:76.275106

CHAPTER 6 DETAILS OF IDENTIFIED OBSTRUCTIONS

LOCATION OF WASTE DISPOSAL IN VARIOUS THODUS IN COCHIN CORPORATION							
Sl no	Name of Thodu	Ward No:	Name of location/ local name of loaction	Chainage	Latitude	Longitude	Remarks
1	TP Canal	60	Anamthuruthy road bridge	0.043km	9.946096	76.300387	Waste disposal
		60	Yuvajanasamajam road bridge	0.682km	9.951834	76.299618	slaughter waste and other wastes disposal
		63	Kadavanthara market	3.017km	9.9697191	76.29478	slaughter waste and other wastes disposal
		63	Karshaka road bridge	3.300km	9.9710852	76.2931371	Sewage and septic waste from housing colonies
		64	Near Siraj Godown	5.100km	9.985809	76.29135	Waste accumulated from adjacent residences
		64	Near Maxon Global	5.570km	9.987924	76.291337	Waste accumulated from LHS drain
		65	Banerji road crossing south side	6.100km	9.993271	76.290737	Waste accumulation due to pipes cables obstructing flow
		65	Kaloor market	6.300km	9.995308	76.290042	Waste water from market when active
2	Koithara Canal	60	near culvert on Varghese Thittayil road below rail line	ch 1000m	9.949597	76.296362	Waste accumulation due to pipes cables obstructing flow
		60	Bridge across Koithara canal on Anamthuruthu road	ch 1500m		76.296843	Waste accumulation due to pipes cables under bridge obstructing flow
3	Pashnithodu	17,15	Pashnithodu Bridge	Ch:392m	9.912805	76.285117	Waste accumulated under the bridge
		14,15	Thottungal Punja yathra road end	Ch:900m	9.916665	76.285117	Waste accumulated in huge quantity
		14,15	Pozhiyil Nikathil lane	Ch:1009m	9.918222	76.284955	Waste accumulated
		14,15	Near pozhiyil nikathil lane	Ch:1088m	9.919078	76.285083	Waste accumulated
4	Pandarachirathodu	24	Near Polakandam market	Ch:0.00m	9.93925	76.25503	Waste accumulated
		24	Upstream of Kazhuthumuttu Culvert	Ch:378m	9.935942	76.25505	Waste accumulated
		22	Downstream of Kazhuthumuttu Culvert	Ch:470m	9.935203	76.255167	Waste accumulated
		22	At small culvert near kazhuthumuttu road	Ch:490.50m	9.934823	76.255243	Waste accumulated under culvert due to pipe crossing
		22	Near Pandaraparambu thodu	Ch:633.50m	9.934047	76.256077	Waste accumulated
		22	50m before Athipozhi thodu	Ch:726.50m	9.935236	76.256421	Waste accumulated
		22	Just before Athipozhi thodu	Ch:777.50m	9.933047	76.256878	Waste accumulated
		22	Near Athipozhi thodu joining portion	Ch:787.50m	9.932923	76.256908	Waste accumulated
		22	Near pipe culvert	Ch:937.50m	9.931775	76.257317	Waste accumulated
		22	Near ICDS building	Ch:1422.10m	9.928093	76.258843	Waste accumulated
		22	santhom colony end portion	Ch:1502.10m	9.927667	76.259518	Waste accumulated
5	Pallichal Thodu	22	Near coast guard building	Ch:1552.10m	9.928192	76.259888	Waste accumulated
		22	Left portion of Chirakkal bridge	Ch:2417.10m	9.921997	76.263137	Waste accumulated always at the left corner portion
		11,12	Pallichal colony starting portion(near DLBroad)	Ch:1167.5m	9.926065	76.265335	Waste accumulated
		11,12	Pallichal colony middle portion	Ch:1299.5m	9.927217	76.26489	Waste accumulated
		11,12	Near pallichal road,near road bend	Ch:1504.5m	9.928683	76.26445	Waste accumulated
		11,12	Under culvert,sharp bend	Ch:1849.5m	9.929928	76.265125	Waste accumulated under culvert
		11,12	Near culvert	Ch:1871.5m	9.930323	76.266035	Waste accumulated
		11,12	At side of market	Ch:1945.5m	9.930415	76.266993	Waste accumulated
		11,12	Under bridge crossing NH	Ch:2024.5m	9.930847	76.267432	Waste accumulation due to pipes cables obstructing flow
6	Vivekananda Thodu	62	Near Railway Quarters	ch.0m	9.966401	76.290872	Waste deposited in huge quantity
		62	Near Ware Housing Corporation	ch 158m	9.967714	76.290525	Waste dumping and Sewage disposal
		62	In front of Railway compound	ch 220m	9.968272	76.290491	Waste dumping and Sewage disposal
		62	Near KSRTC garage converging to Mullassery canal	ch 1162 m	9.97636	76.28957	Massive dumping of waste
7	Market Canal	67	At the starting pt of canal	ch 0m	9.984636	76.276367	
		67	Along Basin Road side	ch 560m	9.98074	76..276325	Waste Deposit
8	ATHIPOZHI THODU	23	Near Saudi Athipozhi Road	845m	9.930843	76.256303	Waste accumulated

Sl no	Name of Thodu	Ward No:	Name of location/ local name of loaction	Chainage	Latitude	Longitude	Remarks
		22	Back side of Customs Quarters	1427m	9.932695	76.249242	Waste accumulated
		22	Near the end point of Thodu joins the Pandarachira thodu	1630m	9.932753	76.256632	Waste accumulated
9	PUNJA THODU	54	Near KWA sewage plant Elamkulam	Ch:1910	9.970494	76.305143	Waste accumulated
10	RAMESWARAM CANAL, MANTHRA CANAL, KALVATHY CANAL	8	Mother Theresa Cross road, Chullikkal	1758m	9.943367	76.25155	Waste accumulated
		8	Statue Road Crossing	2100m	9.945673	76.253675	Waste accumulated
		8	Near M. K. Raghavan Road	2379m	9.948051	76.25349	Waste accumulated
		8	Koovapadam Branch Thodu Joining at Rameswaram Canal	2392m	9.948169	76.253391	Waste accumulated
		8	Pandikkudy Bridge	2873m	9.948514	76.249849	Waste accumulated under the bridge
		28	Zeebra Palam	4390m	9.958443	76.247285	Waste accumulated
		28	Near Adhikarivalappu	4777m	9.961875	76.247545	Waste accumulated
11	Mangalavanam Chathyath Thode	68	Near Hindustan Petroleum Corporation		9.997246	76.277908	waste deposited (along side of drain)
			Near Kerala State Beverages Corporation outlet		9.994531	76.277389	waste deposited (along side of drain)
			Near Poothulli Junction		9.987229	76.275257	waste deposited (along side of drain)
12	Edapally thodu	37	Near railway bridge,	1000	10.036072	76.303722	Waste accumulated under the bridge
		37	Near Chambokadavu bridge	1500	10.032957	76.30477	waste deposited (along side of drain)
		38	Near NH bridge Edapally	2500	10.025223	76.308795	Waste accumulated under the bridge), KWA pipe located over the beam of old bridge
		38	Near Marotty chodu palam	2850	10.023087	76.310547	waste deposited (along side of drain)
		38	Near timber bridge	3230	10.020017	76.311333	Waste accumulated under the bridge
		38	Near pipe line bridge	4150	10.01482	76.315993	waste deposited (along side of drain)
		41	Near Chembumukku bridge	5100	10.010415	76.319725	waste deposited (along side of drain)
13	Mullassery canal	66,62	Near KSRTC pumping station	ch.0.00	9.976544	76.289874	waste deposited ,floating materials has to be removed
14	Punjathodu near byepass		NH crossing near Gold Souk	2440	9.981119	76.316633	waste accumulated due to width reduction to culvert entry
15	Thevara Canal	58,60	Near Kallupalam	Ch: 1000m	9.945797	76.301712	Sewage waste
16	Konthuruthy Thodu	58	Konthuruthy colony	Ch:50m	9.944482	76.297118	Sewage waste
		58	Konthuruthy colony	Ch:244m	9.94284	76.297543	Sewage waste
		58	Near Kazeeba bridge	Ch:464m	9.940988	76.298215	Sewage waste
17	Athirthi Thodu	50 & 51 of Kochi corporation and 20 & 10 of Maradu Municipality		Ch: 351m to 2080m			Sewage waste (Pipe outlet)
18	Thattazham thode	74	Out let to Vembanadu kayal at Kuttattussery	ch.1570	10.004564	76.275351	
		74	Out let to Vembanadu kayal Don Bosco road end	ch 1230	10.014808	76.272428	waste deposited to be removed
19	Wellington Island		Turning near Navy quarters	Ch: 2860	9.955	76.272208	waste deposited to be removed
20	Kareethodu	48	Kaniyampuzha	2930m	9.584	76.193	
		47	Kaniyaveli road	1350m	9.5912	76.1913	
		46	Chakkaraparambu road	1640m	9.596	76.197	

Sl no	Name of Thodu	Ward No:	Name of location/ local name of loaction	Chainage	Latitude	Longitude	Remarks
21	Vadathodu	38,40	East side NH service road	2120m	10.0173	76.31088	
22	Vathuruthy Canal		Thanneermukkam	Ch 0m	9.93705	76.281391	waste deposited to be removed

LOCATION OF SILT DEPOSIT IN VARIOUS THODUS IN COCHIN CORPORATION								
Sl no	Name of Thodu	Ward No:	Name of location/ local name of loaction	Chainage		Latitude	Longitude	Remarks
				From	To			
1	TP CANAL			0.000km	9.950km			Entire thodu need to be desilted
2	MARSHALLING YARD THODU(S)			0.000km	1.721 KM			Entire thodu need to be desilted(Including the box culvert connecting to Karanakodam)
3	MARSHALLING YARD THODU(N)			0.000km	0.780KM			Entire length of thodu need to be desilted
4	PASHNITHODU	13,14,15,17		0.000km	1.447KM			Entire length of thodu need to be desilted
5	PALLICHAL THODU	11.12,21		0.000KM	2.9845KM			Entire length of thodu need to be desilted
6	PANDARACHIRATHODU	22,24		0.000KM	2.9371KM			Entire length of thodu need to be desilted
7	VIVEKANANDA THODU	62		0.000 KM	1.162KM			Entire length of thodu need to be desilted
8	MARKET CANAL	67	Near Foot Bridge	ch 180.00m	ch 300m	9.982189	76.277141	Desilting to be done for a length of 120m
		67	Near Bridge at market	ch 540m	ch 640m	9.981075	76.276571	Desilting to be done for a length of 100m
9	PUNJA THODU	54		0.000KM	2.010KM			Entire thodu need to be desilted
10	ATHIPOZHI THODU	22 &23		0.00KM	1.630KM	9.932753	76.256632	Entire length of the thodu need to be desilted
11	RAMESWARAM CANAL, MANTHRA CANAL,KALVATHY CANAL	11, 10, 25, 8 & 27	Near Cochin Fisheries Harbour	0.00KM	3.710KM	9.952329	76.246754	Desilting of the thodu to be done from Cochin Fisheries Harbour to Manthra Bridge
12	THEVARA CANAL	58,60	Starting point near Thevara Market	0.00m	215m	9.943593	76.292215	Entire thodu need to be desilted
		58,60	Manamthuruthichira, koithara thodu connecting	215.00m	510.00m	9.945433	76.29688	
		58,60	Konthuruthy, Konthuruthy thodu connecting	510.00m	538.00m	9.944898	76.296925	
		58,60	Anamthuruthy road, TP Canal connecting	538.00m	930.00m	9.94602	76.300323	
		58,60	Kallupalam, Friends nagar	930.00m	1310.00m	9.946298	76.30382	
		58,57	Chaithanyapuram, End point	1310.00m	1400.00m	9.94645	76.304592	
13	KONTHURUTHY THODU	58	Konthuruthy	0.00m	107.00m	9.944898	76.296925	Entire length of thodu need to be desilted
		58	Near Konthuruthy road & road crossing	107.00m	134.00m	9.94396	76.297095	Need to remove Pipe culvert provided and construct a culvert. Encroachment is there
		58,59	Kazeeba bridge, Near water tank road	134.00m	464.00m	9.940988	76.298215	Kazeeba bridge need to be reconstructed
		59	Near Sacred heart CMI public school thevara	464.00m	700.00m	9.939028	76.298998	Delta need to be removed
		59	Maliekal road, End point	700.00m	980.00m	9.93677	76.300167	Need to remove hyacinth & silt
14	PUTHENPALAM THODU	54	Starting point near rail nagar thodu	0.00m		9.97935	76.303708	Need to remove remainings of old culvert and entire thou need to be desilted.
		54	After Puthenpalam(Chettichira palam)thodu joins Chilavannoor kayal.	950.00m		9.972713	76.306485	To be desilted entire length of thodu
15	Mangalavanam Chathyath Thode	68	starting point fromBridge across Abdul Kalam Marg(Vembanattu Kayal)	0.00m	1920.00m	9.986177	76.271731	starting point fromBridge across Abdul Kalam Marg(Vembanattu Kayal)
16	Kannachan Thode	73,69,72	starting from Perandoor Canal at Pottakuzhi	0m	1790	10.015198	76.281896	Starting from Perandoor Canal Pottakuzhi
17	Thattazham thode	73,74	Starting from Perandoor Canal	0m	1230m	10.015198	76.281896	Starting from Perandoor Cana Vaduthala
		74		1120m	1570	10.014979,	76.273171	Starting from Pushpaka road to Vembanadu lake outlet
		74		1490m	1808m	10012773	76.273697	Starting from Pushpaka road to Pazhampilly Thomas Rd
		74	Starting from out let to Vembanadukayal	0m	1500m	10.014828	76.272388	Starting from Don Bosco road end to Thachapuzha ln

Sl no	Name of Thodu	Ward No:	Name of location/ local name of loaction	Chainage		Latitude	Longitude	Remarks
				From	To			
18	Edapally thodu	36,37,38,41,46-KUNNUMPURAM, EDAPPALLY, DHEVANKULANGARA, PADIVATTAM,CHAKKARAPARAMBU	starting from muttar river	0.00m	10200m			Entire thodu need to be desilted
19	Chittoorpuzha		Near Amrutha hospital	1.75km	1.95km	10.034689	76.287432	Depth of the puzha is around 60cm only
			Near TP canal outlet	3.35km	3.85km	10.022942	76.282129	
20	Punjathodu near byepass		Near Vyttila	3.53km	3.59km	9.973053	76.321695	Needs to be desilted
21	Chilavannoor lake	53,54,55,57,52	Near Elamkulam bridge	0m	730m	9.967449	76.309294	Sit deposits under Elamkulam bridge and delta formation on south side of bridge to be cleared. Remnants of Padmasaroavaram bund to the north side of Elamkulam bridge also to be cleared. Also water hyacinth blocking flow near Elamkulam bridge to be cleared
22	Athirthi Thodu	50 & 51 of Kochi corporation and 20,10 &5 of Maradu Muncipality		0m	2600m			Entire thodu need to be desilted
23	Willingdon Island Thodu	Ward 29, 30	Island thodu	0m	3820m			Entire length of thodu need to be desilted
			Vathuruthy Channel	0m	1240m			Entire length of thodu need to be desilted
			Vathuruthy Channel branch	0m	820m			Entire length of thodu need to be desilted
			Mattanchery channel	0m	655m			Entire length of thodu need to be desilted
24	Changadompokku Thodu	39	Downsteram of George Eden road near sharp bend	402m	414m	10.003945	76.298104	Frequent desilting is required at sharp bends
25	Vadathodu	38,40		530m	2200m	10.0174	76.3119	
26	Kareethodu	46	Chakkaraparamb road	1640m	1750m			
		48	Kaniyampuzha	2910m	2930m			

LOCATION OF STRUTURE TO BE DEMOLISHED / RECONSTRUTED/CABLES AND PIPELINES TO BE REMOVED IN VARIOUS THODUS IN COCHIN CORPORATION										
Sl no	**Name of Thodu**	**Ward No:**	**Name of location**	**Chainage**	**Latitude**	**Longitude**	**Type of struture/cables/p**	**Demolished & reconstruction**	**Demolished**	**Remarks**
1	**TP canal**	60	Anamthuruthy	0.043km	9.946096	76.300387	Sluice cum Bridge			Deteriorated structure
		55	panampilly nagar	1.175km	9.956244	76.298989	Bridge			Reconstruction with sufficient vertical clearance
		63	udaya colony	3.714km	9.973217	76.292717	concrete Foot bridge	Reconstruction with sufficient vertical clearance		
		63	udaya colony	3.855km	9.974678	76.291658	Steel foot bridge	Reconstruction with sufficient vertical clearance		
		63	downstream of AL Jacob b	4.418km	9.978656	76.291523	kammattipadam road bridg	Reconstruction with sufficient vertical clearance		
		64	Upstream of Pullepady bric	4.666km	9.9804971	76.2914782	concrete Foot bridge	Reconstruction with sufficient vertical clearance		
		64	Downstream of Pullepady b	5.400km	9.986275	76.291219	concrete Foot bridge	Reconstruction with sufficient vertical clearance		
2	Koithara Canal	60	near culvert on Varghese Thittayil road below rail line	ch 1000m	9.949597	76.296362	Pipes and cables blocking flow			
		60	Bridge across Koithara canal on Anamthuruthu road	ch 1500m	9.945535	76.296843	Pipes and cables blocking flow			
3	Ambanattuchira thodu (Ponneth Chaal)	57	Culvert on Elenjeril road	100m	9.962025	76.303607	Culvert	Reconstruction with sufficient vertical clearance		Reported to be situated in private property
		57	Near YMCA, Indira Nagar	270m	9.96067	76.304229	Culvert (Also Pipes under culvert blocking flow)	Reconstruction with sufficient vertical clearance		Reported to be situated in private property
4	Karanakodam thod	39	Culvert near the joining point of Adimuri thodu	995m	9.992454	76.301431	Culvert	Reconstruction with sufficient vertical and horizontal clearance and pipes and cables to be realligned		
		39	Culvert near Metro Station	0m	9.99674	76.298525	Pipes and Cables	To be realligned		
		39	Down-stream of Kent Appa	1205m	9.990702	76.301718	Pipes and Cables	To be realligned		
		54	Culvert at V.V Road	4068m	9.977617	76.304012	Culvert	Reconstruction with sufficient vertical and horizontal clearance and cables to be realligned		
		54	Culvert at St.Sebastian Ro	4155m	9.976872	76.30412	Culvert	Reconstruction with sufficient vertical and horizontal clearance and cables to be realligned		
		54	Culvert at Subhash Chandr	4650m	9.972555	76.305217	Culvert	Reconstruction with sufficient vertical and horizontal clearance and pipes & cables to be realligned		
		54	Culvert near Skyline	1598m	9.987563	76.30099	Pipes and Cables	To be realligned		
		54	Panorama Culvert	3394m	9.979004	76.299699	Pipes	To be realligned		
5	Adimuri thodu	44	Culvert near Green Lam Industries	249m	9.992287	76.303533	Culvert	Reconstruction with sufficient vertical clearance		
		44	Near Green Lam Industries	Between 249m and 256m	9.992287	76.303533	Pipe	2 numbers of pipe to be realligned		
		44	Covered portionat the starting point	Ch 0m	9.992533	76.305745	Covered portion	To be made open		
		39	Culvert near stadium link road	338m	9.9926	76.302872	Culvert	Reconstruction with sufficient vertical and horizontal clearance an pipe to be realligned		
		39	Culvert in Stadium link road	452m	9.99252	76.301968	Culvert	Reconstruction with sufficient vertical and horizontal clearance and pipes & cables to be realligned		
		39	Covered portion near Stadium link road	Between Ch 416 and Ch 452m	9.99252	76.301968	Covered portion	To be made open		

Sl no	Name of Thodu	Ward No:	Name of location	Chainage	Latitude	Longitude	Type of struture/cables/p	Demolished & reconstruction	Demolished	Remarks
6	**ATHIPOZHI THODU**	23	Encroachment on the Thodu near South Moolankuzhi- Aryad Athipozhi cross road	907m	9.931018	76.250262	Fish stall	To be evacuated and demolished		
		22	Encroachment on the Thodu near Naduvathumuri Road	1150m	9.93206	76.252285	Pettikada	To be evacuated and demolished		
		22	Encroachment on the Thodu at Illickal junction near St. Maria Bakery	1165m	9.932202	76.252632	Temperary Building	To be evacuated and demolished		
		22	Encroachment on the Thodu at Illickal junction near St. Maria Bakery	1170m	9.93212 &9.93224	76.252637 & 76.252717	Pettikada & Bus stop	To be evacuated and demolished		
		22	Culvert near Santhom Colony	1557m	9.932695	76.256303	Culvert	Reconstruction with sufficient vertical clearance		
7	**PUNJA THODU**	54	Near Jawaharnagar	1065m	9.973	76.3	Culvert	Reconstruction with sufficient vertical clearance		
		54	Near KWA sewage plant Elamkulam	1770m	9.969957	76.307321	Culvert	Reconstruction with sufficient vertical clearance		
		54	Near KWA sewage plant Elamkulam	1910m	9.9705	76.3051	Culvert	Reconstruction with sufficient vertical clearance		
8	**RAMESWARAM CANAL, MANTHRA CANAL, KALVATHY CANAL**	25	Santho Gopalan Cross Road	1032m	9.939268	76.253225	Culvert	Reconstruction with sufficient Horizontal clearance		
		25	Loretto Anglo Indian School Cross road	1190m	9.939367	76.251794	Culvert	Reconstruction with sufficient vertical and horizontal clearance		
		25	Near KWA	1217m	9.939426	76.252501	90 degree bend	Change 90 degree bend to curved nature including reconstruction of Culvert		
		8	Mother Theresa Cross road, Chullikkal	1758m	9.943367	76.25155	Culvert	Reconstruction with sufficient vertical clearance		
		8	Near A. A. Kochunni Master Memorial Park	2200m	9.946445	76.253401	Foot Bridge	Not in use and to be demolished		
		8	Pandikkudy Bridge	2873m	9.948514	76.249849	Bridge	Beam Soffit touched in water and reconstruction with sufficient Vertical clearance		
		28	Kuriplavu Bridge	4632m	9.960598	76.247383	Bridge	Reconstruction with sufficient Horizontal clearance		
		28	Adhikarivalappu Bridge	4742m	9.961587	76.24745	Bridge	Reconstruction with sufficient Horizontal clearance		
		4	Pullupalam	5189m	9.963568	76.249568	Bridge	Reconstruction with sufficient vertical and horizontal clearance		
		2	Foot bridge	5427m	9.965567	76.249733	Foot bridge	Reconstruction with sufficient Horizontal clearance		
9	**KAREEPALAM BRANCH CANAL**	4	Foot bridge	175m	9.96288	76.249642	Foot bridge	Reconstruction with sufficient vertical and horizontal clearance		
10	PANDARACHIRA THODU	22	Culvert@kazhuthumuttu road	470m	9.935203	76.255167	Culvert	Reconstruction with sufficient vertical and horizontal clearance		KWA pipe of 50cm dia has to be realigned
		22	Pipe culvert near Navy building(SRA Rameshwaram)	937.5m	9.931775	76.257317	Pipe culvert	Reconstruction with sufficient vertical and horizontal clearance		
11	PALLICHAL THODU	12	Culvert near market	2004.5m	9.931701	76.269816	Culvert	Reconstruction with sufficient vertical clearance		
		12	Culvert near market	2009.50m	9.931482	76.267555	Small culvert	Reconstruction with sufficient vertical clearance		
		12	Near saw mill	2174.50m	9.930697	76.267825	Two small shops (Encroachment)	To be evacuated and demolished		
				2174.50m	9.930697	76.267825	Existing Abutment wall on both banks(encroachement)	To be demolished		
				2174.50m	9.930697	76.267825	Big Banyan tree (Growing inside thodu)	to be cut		
12	Thevara canal	58,60	Kallupalam, Friends nagar	1310.00m	9.946298	76.30382	Wtaer authority pipes crossing	To be realigned		

Sl no	Name of Thodu	Ward No:	Name of location	Chainage	Latitude	Longitude	Type of struture/cables/p	Demolished & reconstruction	Demolished	Remarks
13	Konthuruthy Thodu	58	Near Konthuruthy road & road crossing	107.00m	9.94396	76.297095	Pipe culvert	Need to remove Pipe culvert provided and construct a culvert. Encroachment is there		
		58,59	Kazeeba bridge, Near water tank road	464.00m	9.940988	76.298215	Foot bridge	Kazeeba bridge need to be reconstructed, for getting sufficient vertical clearance		
14	Mullassery Canal	66 ernakulam central,62 ernakulam south	Ernakulam KSRTC to TD road	ch 0 to Ch 810	(9.976544) to (9.974968)	(76.289874) to (76.282338)	Drain rennovation	Drain demolition and reconstruction	The original width was 4 to 8 meters.now only 3 to 1.5 meter	The bed level is raised at chainage 0 to 400 about 1.1 mtre has to be lowered and keep the slope towrds west direction so that gravitational flow possible instead of present pumping from KSRTC area
15	Punjathodu near byepass		Near Thammanam Byepass road	ch 1835m	9.985433	76.314523	Concrete footbridges	Drain demolition and reconstruction		This obstructs the flow of water while raining
16	Edapally thodu	36	Muttar kadavu bridge culvert	36	10.04.3342	76.303307	Concrete foot bridges	Reconstruction with sufficient vertical clearance		
		38	Near NH bridge Edapally	2500	10.025223	76.308795	National Highway bridge			
		38	Near timber bridge	3230	10.020017	76.311333	road bridge			
		41	Near Chembumukku bridge	5100	10.010415	76.319725	road bridge			
17	Athirthi Thodu	50,51 and 20,10 of Maradu Muncipality	kundannoor Petta Road	807	9.9415705	76.3326569	Box Culvert	Reconstruction with sufficient vertical clearance		
		51 and 10 of Maradu Muncipality	Thirumurthi temple road	2080	9.9513531	76.3267731	Culvet	Reconstruction with sufficient vertical clearance		
18	Thattazham thodu	73,74	SSK road	565	10.014497	76.277184	Railway culvert			KWA pipe to be realigned
			Don Bosco junction in Chittoor road	626	10.014363	76.276564	Road culvert			Pipe to Tata Company and cables from the vent way of road culvert to be removed and realigned
19	Changadompokku thodu	71	South Keerthi Nagar road to Akshara Lane	between 1500m to 1695m	10.0122162	76.29594073	Culvert and crossing slabs	Culvert at Keerthi Nagar shall be reconstructed.There are eight numbers of private entry slabs laid across the thodu between Keerthi nagar and BTS road .These slabs shall be		
		71	Bhagyadhara lane	1380	10.0105892	76.29622086	KWA pipe line crossing			KWA pipe to be realigned
		71	Bhagyadhara lane	1400	10.011449	76.296019	Leaning Compound wall	Reconstruct the compound wall		
		71	Edappally Raghavan Pillai road	2387	10.0194949	76.29532979	Pipe line crossing	To be realigned		
		39	Greenz Villa	450	10.0037656	76.29781756	KWA pipe line crossing	To be realigned		
20	Puthenpalam thodu	54	Starting point near railway yard	0	9.979392	76.303728	Remainings of old culvert	To be demolished		
				920	9.972612	76.306415	Bridge	Reconstruction	existing culvert to be demolished	
21	Chittoorpuzha		Chittoor-Vaduthala bridge	4700 m	10.025507	76.273955	Old bridge		To be demolished	

CHAPTER 7 PROJECT IMPLEMENTATION

For the prevention of flood occurrences, certain effective measures must be taken to prevent encroachment, waste disposal and illegal construction along the canals. Department such as Irrigation, Local Self Government (LSGD), Revenue ,Police will play a major role in tackling the above mentioned obstacles.

In detail, LSGD will handle issues regarding waste disposal .From our field investigations, around 70 waste disposals along the canals have been identified. LSGD will be clearing these sites for a cleaner environment and is further maintenance by installing cameras and setting up banners so as to prevent these ongoing malpractices in the future .According to Water Conservation Act; penalty will be imposed on any person pressed charges for improper disposal of waste along these canals by the Police Department.

Separate ward committees under the control of their respective ward counselor must be formed to ensure the further maintenance of this clean environment .The original width of the canals must be restored by fixing boundaries by the Revenue Department. Any encroachments within these boundaries must be evacuated for the proper flow of water upto its water carrying capacity.

From our investigations,poorly constructed structures across the canals have been observed. These structures are constructed in such a way that it obstructs the flow of water through the canal. Therefore, to overcome this issue, these structures have to be reconstructed by state fund or central fund or any other sectors. LSGD can utilize Ayyankali Thozhilurapu Scheme to carry out minor works like removal of silt deposits, floating vegetation and plastic materials. In order to minimize the total project cost of desiltation, purchase of heavy desilting machineries would be a one-time investment made by any of the agencies. In addition to this, the operation and maintenance cost can be handled by any sponsorship or any other source of fund.

In order to achieve a cleaner environment and proper functioning of the canals, all the stock holders, public and private sectors, residential associations and the public must join forces to make this goal a success.

CHAPTER 8 PROJECT MONITORING

Regular Monitoring of canals :

The flash flooding in Kochi corporation area owes mainly to the insufficient drainage system in the city. Most of the drains -both natural and storm water drains- are not having sufficient width and depth to accommodate the excess rain water obtained in short period.In most cases, the drains are covered by coverslabs with almost no provision for the entry of storm water into these drains. Inefficient waste collection and disposal system in Kochi has resulted in waste deposition on streets. These wastes mainly plastic wastes end up in the road side drains thus clogging the storm water drainage network.The waste management system in the city has to undergo a thorough revamping to ensure that waste do not get deposited in storm water drains.

Regular monitoring of the canals was found necessary to curb waste deposition and encroachments and to ensure free flow and good quality of water . As per direction from Addl. Chief Secretary (WR) dept , monitoring of each canal in the city was assigned to an Engineer in Irrigation department. During site inspection conducted by concerned engineers, locations prone to waste dumping and the problems causing obstruction to flow were noted . The information collected regarding the canal system in Kochi and possible measures to avoid obstruction to flow were brought to the notice of Kochi Corporation authorities by a detailed presentation by Sri. Baji Chandran R , Superintending Engineer, Minor Irrigation Central Circle, Ernakulam during the Special Council convened by Mayor , Kochi Corporation on 26.07.2021 . During site inspection of flood prone areas, the following observations require immediate attention.

- Renovation of Mullassery canal to be executed for preventing flooding near KSRTC Bus Stand, Karikkamuri, Kammattipadam and South Railway Station
- In the flood prone Kaloor Sub station area, the connectivity between Karanakodam and Chengadampokku thodus have to be re-established by constructing box culvert of sufficient vent width and depth across Banerjee road.
- The waste after cleaning railway coaches including oil remnants is found to be discharging directly into marshalling yard thodu without any effluent treament . This is polluting the marshalling yard thodu and the Karanakodam thodu as they are interlinked. Railways should set up an effluent treatment plant at their yard and avoid polluting waterbodies.
- At locations where canals are crossing rail lines, the box culvert/pipes provided beneath the rail line is not having sufficient vent width and depth. This is found to cause obstruction to flow. Railways should take immediate steps to ensure sufficient vent width and depth by reconstructing culverts beneath rail lines in flood prone water bodies.

CHAPTER 9 PROJECT TEAM

No.	Thodu	In Charge of Thodu/ Canal	Assisting Team Members	
		Name	**Name**	**Name**
1	Karanakkodam	Er. Noorjahan, EE IIP Division, Angamaly	Er. Seena A I, AEE IIP Sub-Division No.1, Angamaly	Er. Reji Thomas, AE IIP Section 2/1, Angamaly
			Er. Ansa Antony, AEE IIP Sub-Division No.2, Angamaly	Er. Sheeja P K, AE IIP Section 2/2, Angamaly
2	Marshalling Yard	Er. Jisha, TA IIP Division, Angamaly		Er. Sujatha M K, AE IIP Section No. 1/1, Angamaly
	Adimurithodu			
3	Changadampokku	Er. Rajan, EE PVIP Division, Aluva	Er. Fabi Louis, AEE PVIP Sub-Division No.4, Aluva	Er. Hameeda T A, AE PVIP Section 1/4 Aluva
				Er. Rahana U A, PVIP Section 1/2, Perumbavoor
4	Mullassery	Er. Manoj K C, AE MI Section Thripunithura		
5	Koyithara	Er. Dhanya K, AEE MI Sub- Division, Ernakulam		
	Chilavannurkayal			Er. Mary Suni T T, AE MI Section 2 Ernakulam
	Ambanattuchira			Er. Deepa Susan John, AE MI Section 1 Ernakulam
6	Thevara Canal	Er. Chithra P Bai, AE Irrigation Section Chambakkara		
	Konthuruthy thodu			
	Athirthy Thodu			
7	TP Canal - south	Er. Yeshoda Devi, EE MI Division, Ernakulam	Er. Santhosh C N, AEE MI Sub-division, Muvattupuzha	Er. Devi B J, AE MI Section Mulanthuruthy
			Er. Geordie V G, AEE MI Sub-division, Mulanthuruthy	Er. Soman M K, AE MI Section Piravom
				Er. Sonu Mathew, AE MI Section Pattimattom
	TP Canal - north		Er. Biji N N, AEE PVIP Sub-Division No.2, Perumbavoor	Er. Rathish T, AE PVIP Section 3/2, Perumbavoor
			Er. Biju P Varghese, AEE PVIP Sub-Division No.1, Bhoothathankettu	Er. Anil P K, AE PVIP Section 2/2, Perumbavoor
				Er. Ramani K S, PVIP Section 2/1, Bhoothathankettu
8	Edappally thodu	Er. Sandhya, EE Irrigation Division, Ernakulam	Er. Mohammed P K, AEE Irrigation Investigation Sub-Division, Aluva	Er. Ashwathy, HD Irrigation Division, Ernakulam
				Er. Bismi Shafna, AE Irrigation Investigation Sn 2 Aluva
9	Rameswaram canal - Manthra canal - Calvathy canal	Er. Kumari Sindhu, AEE MI Sub-Division, Aluva		Er. Ramani K P, AE MI Section Aluva
	Athipozhi thodu			Er. Sabna Thomas B L, AE MI Section Kalady
	Eruveli, Karipadam Thodu			Er. Wilson C P, AE MI Section, Perumbavoor

10	Pandarachirathodu	Er. Praveen Lal, AEE Additional Irrigation sub division Aluva		
	Pashnithodu			Er. Sunitha T M, AE Navigation Section, Aluva
	Pallichalthodu, Mattanchery Thodu			Er. Anusree
	Wellington Island, Vathuruthy			
11	Chittoorpuzha	Er. Resia P K, PA MICC Ernakulam	Er. Ajitha A K, TA MICC Ernakulam	Er. Gayathri B, HD MICC Ernakulam
				Er. Seena P M, HD MICC Ernakulam
12	Kareethodu- 1&2	Er. Haroon Rasheed, AE Canal Section Ernakulam		
	Vadathodu			
	New Punjathodu			
13	Punjathodu	Er. Shiny Joseph, AEE PVIP Sub-Division, Kolenchery		Er. Jais John, AE PVIP Section 2/7, Kolenchery
	and Dry thodu Branch			
14	Mangalavanam thodu	Er. Visala E A, AE Irrigation Navigation Section, Ekm		
	Chathiath thodu			
	Thattazham thodu, Kannachan thodu			
15	Puthenpalam Thodu	Er. Anitha Madhavan, AE MI Section, Paravur		
16	Vivekananda thodu	Er. Rekha, PA MI Division Ernakulam		Er. Sneha Karunakaran, AE MI Section Pampakkuda
	Market canal			

Kochi Corporation - Drainage Network

Main Thodus and Canals

10°0′0.000″ 9°57′0.000″ 76°18′0.000″ 76°15′0.000″

Edapally Thodu
Vadathodu
Kareethodu
New Punchathodu
Chilavannoor
Athirthy thodu
Changadompokku
Chitur puzha
TP Canal
Mullassery
Thevara canal
Pashnithodu
Pandarachira

0 1 2 3 4 km

Open Street Map with Standard Notations

Thodu and Canal Legend

- 1 - Edapally Thodu
- 2 - Chitur puzha
- 3 - Changadompokku
- 4 - TP Canal
- 5 - Thattazam Thodu
- 6 - Vadathodu
- 7 - Kattungal temple thodu
- 8 - Kannachanthodu
- 9 - Mangalavanam Thodu
- 10 - Karanakodom
- 11 - Adimuri Thhodu
- 12 - New Punchathodu
- 13 - Kareethodu
- 14 - Market canal
- 15 - D ry Thodu Br
- 16 - Dry Thodu- south
- 17 - Marshaling Yard Thodu1
- 18 - Marshaling Yard Thodu
- 19 - Puthenpalam Thodu
- 20 - Punchathodu
- 21 - Vivekananda Thodu
- 22 - Mullassery Thodu
- 23 - ChilavannoorThodu
- 24 - Ambanatuchira
- 25 - Koithara Thodu
- 26 - Welingtone Thodu
- 27 - Vathuruthy Canal
- 28 - Mattanchery Canal
- 29 - Pallichal Thodu Br
- 30 - Pandarachira Thodu
- 31 - Athipozhi Thodu
- 32 - Rameswaram Thodu
- 33 - Eruveli Branch canal
- 34 - Karipalam Thodu
- 35 - Pashnithodu
- 36 - Thevara canal
- 37 - Konthuruthy
- 38 - Athirthy thodu
- 39 - Chathiyath Thodu
- Kochi Corporation Wards

OpenStreetMap as basemap

July 2021

Prepared By Irrigation Department