

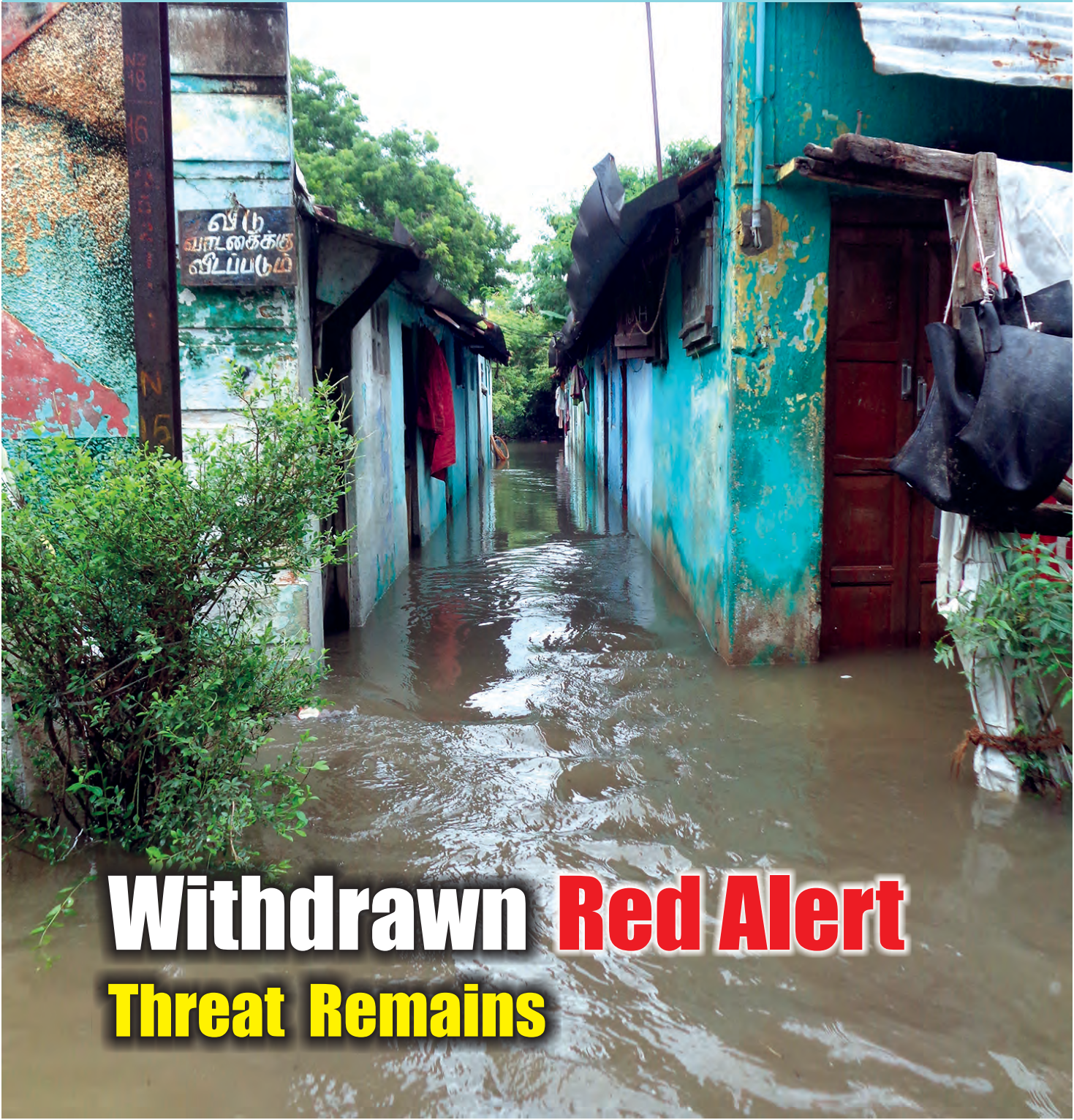


October 2018

Water *Watch*



Quality Matters



Withdrawn Red Alert
Threat Remains

Is our city 'a blue baby'?

Water cleanses everything in its course, is no more 'true'. This is 'Sellur tank' surplus course. This channel which is flowing to a length of about 2.6 kilometers drains surplus of Sellur tank cascade into river Vaigai. The channel supposed to carry storm water and tank surplus water is carrying plastics, tailoring wastes, bottles, building debris, wooden debris and domestic wastes. People residing along the channel are loading the channel with biological and microbial contaminants by disposing their sewage and cattle shed washes. People believed that flood will wash away everything that was dumped in the channel. But the water left the stains in the channel, behind. Channels are 'arteries' of watershed and tank cascade system. When 'arteries' start to carry contaminates as 'veins' its death; the collapse of ecosystem; the fall of a city.



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Warning Rain - red alert remains

Red alert was issued for the state on Sunday, October 7, 2018.

Balachandran S, Director, Cyclone Warning Centre said, "A low pressure area is set to form over South East Arabian Sea on Friday, October 5. It is likely to intensify as a depression and will likely turn into a cyclone over 36 hours and move towards Oman. For now, very heavy rainfall is predicted in a few places."

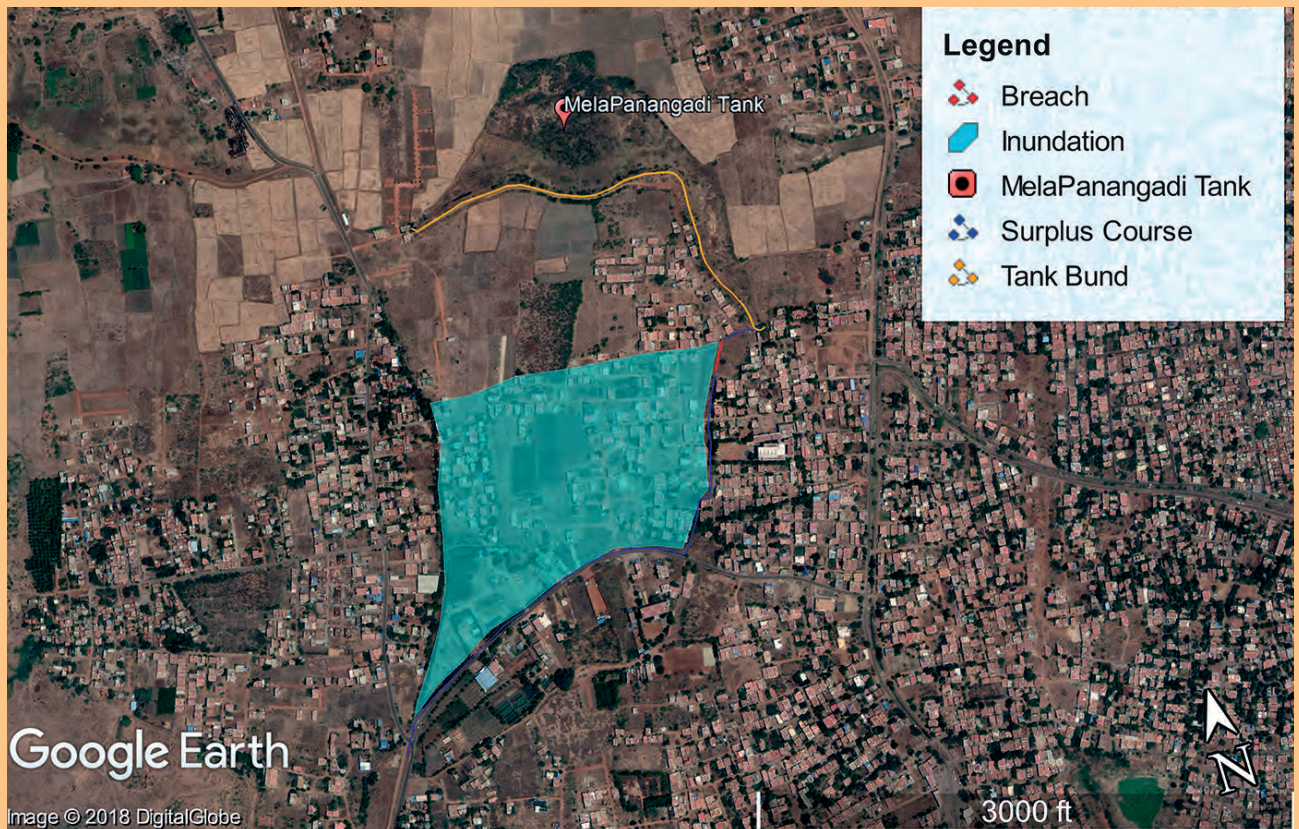
The weatherman said that a low pressure area continues over the south west Bay of Bengal. Many parts of Tamil Nadu have experienced rain over the past 24 hours on account of this. A few places have experienced very heavy rainfall.

The State government responded immediately. Madurai Administration was fastening its seat belt to tackle the red alert. There was rainfall of 20 mm on 7th October and 47 mm on 8th October, 2018. Red alert was withdrawn by the state.

All the tanks in Madurai urban (North) were full and draining surplus. There were breaches of channels and inundations in more than 5 spots. Day to day life of people living in those areas was affected for more than 2 days. Citizens living in these affected spots of Madurai suffered largely for a rainfall of 47 mm.

North Madurai was affected due to the rainfall because both Vandiyur and Sellur tank cascades of Satiyar Sub basin falls under this region. Surplus of both the cascades are drained into River Vaigai. About 8% of the total Land use Area of Madurai North (Corporation Boundary) is tank. Madurai City is gifted with Tank system; wisdom of ancestors; the best flood moderator.

Despite of recent tank rehabilitation carried out by the Public Administration, there were breaches, inundations and sufferings. This water watch focuses about response of Madurai and its tank system for the October rainfall; a warning rainfall; an evaluator in disguise.





Bama Nagar

P & T Nagar Ext Rd



9.974376, 78.124247

Location Description: Bama Nagar is established in the command area of 'Mela Panangadi' irrigation tank. Mela Panangadi tank is having a water spread area of 20 acres. Three fourth of tank command area has been converted into residential buildings. The settlements are by upper middle class families with income higher than 5 lakhs per annum. One fourth of the land is still under paddy cultivation. The tank gets its feed from Vadugappatti tank and also from Periyar Main Canal.

Inundation Description: About 40 acres of the command area was under inundation for two days. The depth of inundation was 1-2 ft. Though water did not enter the living area of the houses, it affected routine of the people. All the street roads were under submergence. School kids were not able to go to school and people were troubled while crossing the inundation for accessing the service road.

Reasons for Inundation

1. There was no surplus weir in the Mela Panangadi tank. This resulted in uncontrolled release of water through the surplus course. The surplus weir once existed much before was demolished by encroachers. The encroachers who encroached the water spread area of the tank have demolished the surplus weir to avoid submergence of their paddy field during Full Tank Level (FTL).
2. Reduced cross sectional area along the surplus course enhanced the velocity of the uncontrolled flow from the tank. The increased velocity exerted higher pressure on the surplus course bund and breached
3. The surplus course was encroached by weed. It reduces the surplus flow through the channel.

Immediate response post-inundation: Local communities arrested the flow in the breach by placing 'sand bags'. After a week period, the government department cleared the weeds, widened and deepened the surplus course. The bunds of the surplus course were strengthened by excavated soil.

Recommendations

1. The tank water spread area must be marked as per Field Measurement Book (FMB) sketch and agricultural encroachment should be evicted. Survey stones should be placed along the tank fore-shore to restrict future trespassers.
2. 'Surplus weir' should be constructed for the Mela Panangadi tank. The surplus course should be designed and modified as per design discharge of the 'surplus weir'.
3. Currently the surplus course was deepened, widened and strengthened only for 200 m. The department should intervene in the remaining 750 m stretch along the downstream to avoid inundation in future.
4. 'A tank association' must be formed in which farmers and residents in tank command area should be members. This association should take care of maintenance of the tank.



Mahalakshmi Nagar



9.956863, 78.142223

Location Description: Mahalakshmi Nagar and Gandhipuram are established in between Attikulam tank and Kosakulam tank. Attikulam tank is located in a densely populated urban area, it is fed by sewage disposed by local communities. Tank is full even in the non monsoon dry spells. Urbanization resulted in encroachment of Attikulam tank surplus course. This reduced the flow capacity of the channel. Therefore, government lined the surplus course of the channel. For better access across the surplus course, cement block covers were laid over the surplus course by Madurai Corporation.

Inundation

Description: About 10 acres of the land in south of surplus course was inundated by flood water. Street roads and houses were inundated for more than a foot. As the tank was fed by sewage, 'high organic' green-sewage water entered households and streets. The communities suffered with foul smell for more than a day.

Reasons for Inundation

1. The tank was already filled to its Full Tank Level with sewage. This reduced the opportunity of the tank to hold storm water entering into the tank. This resulted in immediate flow of sewage mixed surplus water in its course.
2. The surplus course was encroached by residents along the channel. This reduced carrying capacity of the channel which resulted in inundation.
3. As the surplus course was covered by concrete blocks, the surplus course was choked by solid

wastes disposed into it. This blocked flow through the channel and back-flushing of water in the open spots.

4. Disposal of sewage into the storm water drainage added additional volume to the channel resulting in inundation.

Immediate response post-inundation: The government department partially evacuated the encroachments along the surplus course as immediate response to the inundation. The concrete cover blocks were opened up and chocks were cleared by removing solid waste blockages. The intension was to create free flow through the channel.

Recommendations

1. The encroachments should be evicted appropriately. The encroachment evicted building debris was left unaddressed. This should be cleared.
2. As there is minimal flow in the channel, local communities has started to use the debris to cross over the surplus course. Therefore, proper culverts should be laid along the streets across surplus course to avoid future inundation.
3. Sewage should be restricted to flow into the tank and also into the storm water drainage. A proper sewage disposal mechanism should be implemented in the area.
4. The surplus channel should be cleared periodically to avoid chocks and proper solid waste management strategies should be developed.



TM Nagar

Opposite to Mattuthavani Bus Complex Bus stand

 9.951563, 78.160191

Location Description: TM Nagar is newly established urban settlements in the command area of Uthangudi tank. TM Nagar is surrounded by surplus course of Kodikulam tank in the west, surplus course of Uthangudi tank in the east and south. In the downstream, Kodikulam tank surplus course confluences with surplus course of Parasurampatti tank. The settlements are by upper middle class families with income higher than 4.5 lakhs per annum. There is no agriculture activity in the command area. As there is no culvert for crossing, Local shepherds cross the surplus course by entering into the course.

Inundation Description: About 90 acres of the land was inundated in TM Nagar. The depth of inundation varies from 1 – 3 feet. The inundation affected day to day life of the communities. An electric post fell and the supply was cut for safety purpose. There was unannounced power cut for more than a day. As bore water is the only source of drinking water, Unprepared TM Nagar residents suffered without drinking water. Packaged drinking water cans were brought by local residence with lot of struggle in passing the inundated roads. Bubbles coming out of paved roads indicated poor compaction while laying roads. The flood water inundated a house under construction. This inundation stalled the construction work for more than a week and spoiled all the construction material such as cement bags, steel bars, shuttering planks, sand, etc. Water resided only after 4 days of inundation. Old people residing in the locality suffered a lot for their needs. This was not the first such incident in this locality. Such incidents happen whenever there is heavy rainfall in Madurai. Most of the newly constructed houses were built above the flood water line, which is one of the adaptive mechanisms of local communities.

Reasons for Inundation

1. There is a sharp 90 degree turn in the Kodikulam surplus course. As sharp curve is the weakest point, to avoid breach the curve was strengthened by stone pitching in the left embankment. But the





stone pitching got deteriorated over the period. This deterioration resulted in breach in the left bank post the sharp curve. This breach was the main reason behind inundation.

2. There was another breach in the confluence point of Surplus courses from Kodikulam Tank and Parasurampatti tank. This was mainly because of poor water carrying capacity of both the channels.
3. There was one more breach in the southern part of TM Nagar, opposite to Meenakshi Mission Hospital. This was mainly due to back flow of Uthangudi surplus course caused by heavy flow in Parasurampatti surplus course.
4. Low carrying capacity of the surplus courses was mainly due to reduction in channel cross area. This was mainly due to siltation of channel, Prosopis and reed invasion in the channels and encroachment of the same.

Immediate response post-inundation: Except power shutdown no other action was taken by the Government. After a week period, the Government department cleared the weeds, widened and deepened the surplus course. The bunds of the surplus course were strengthened by excavated soil.

Recommendations

1. The surplus course was deepened, widened and strengthened temporarily. This was not at all appropriate. One longer shower will wash away all the bund strengthening works.
2. As the sharp curve was frequently breached, proper bund strengthening should be established for better future. The bund strengthening or revetment process should be executed immediately.
3. Encroachment eviction and widening of channel is mandatory in all the surplus courses.
4. 'A Confederation tank association' must be formed in which residents in tank command area should be members. This association should take care of maintenance activities such as Prosopis Clearance and also performing tank cascade social auditing.
5. Future approvals for construction should keep the water levels in mind.

Sellur 6th and 7th Street



9.942790, 78.120262

Location Description: Sellur 6th and 7th Streets are located along the surplus course of Sellur tank. Sellur and Vandiyur are the

two tank cascade systems in the Madurai North. Most of the tanks in Madurai Corporation were rehabilitated prior to the rainfall. Sellur tank is one among them. Communities in this area are predominantly having annual income less than 2 lakhs. Most of them are daily wage earners and few have their own cattle. The surplus course was lined in few segments under JnNURM scheme. This lining was majorly done to avoid further encroachment of the channel.

Inundation Description: About 2.6 acres of the Area in the left bank of surplus course was under inundation for two days. The depth of inundation was 1-3 ft. Water entered the living area of the houses. One of the homes just beside the channel was severely affected; a wall of the house was collapsed. Local residents supported the old couple in the home and provided support for more than 2 weeks. Cattle have been shifted to the higher elevated area. There was fear for snake bite both on human and cattle which were coming along with water.

Reasons for Inundation

1. The tank rehabilitation that was carried out prior to the rainfall was not carried out appropriately. Dead storage was created in few segments but the excavated soil was heaped inside the tank water

spread area itself. Therefore there is no major change in the tank capacity due to dead storage creation.

2. As sewage flows through the storm water drains, the tank is near to the Full Tank Level even in the non monsoon dry season. This reduces the functionality of the tank to behave as flood moderator.
3. The tank bund and surplus course were encroached by residential huts. These encroachments were unaddressed over a long period.
4. The lined surplus course in the left bank was broken from its Top level to a meter depth. Water flushed through these breakages.
5. Lining was not continuous along the course. The patch of lining led to abrupt change in velocity of the water flowing through the course. This is also a reason for inundation.
6. The channel was flowing to its full depth, including free board. This shows faulty design of the structure while lining the channel.

Immediate response post-inundation: Encroachment in the tank bund near to the surplus weir was evicted immediately. But the debris was left unaddressed. Part of debris later fell into the surplus course itself. Local residents moved to their relatives' home for three days. Utensils in the households were shifted to the roof slab or neighbor home.

Recommendations

1. Encroachments in the tank and surplus course should be evicted appropriately and debris should be disposed immediately.
2. Dead storage of the tank should be improved and heaves of excavated soil left unaddressed in the tank water spread area should be used for bund strengthening.
3. Breakages in the lined course should be repaired immediately and the channel should be lined in a continuous manner.
4. Cross section of the surplus course should be verified for its design discharge.
5. Sewage flowing into the tank should be arrested through proper management practice.



Avayar Street and Bose Street of Sellur



9.939538, 78.124126

Location Description: Avayar Street and Bose Street are located at about 1 kilometer along the surplus course of Sellur tank. Communities in this area are predominantly having annual income less than 1.5 lakhs. Most of them work in cotton mills, running their own tailoring unit, working in market, etc. The locality is densely populated and most of the houses are either rented or leased.

Inundation Description: About 6 acres of the area in the right bank of surplus course was under inundation for three days. The depth of inundation was 1-3 ft. Water flushed through streets and entered living area of the houses affected routine of the people. People in low lying area moved to their relative homes. Women involved in tailoring were affected severely. Water entered into living area wetted furniture, utensils and steel items in the home. Snakes, insects, worms were also predated along with the water. Women Self Help Groups supplied food packets for the affected communities. Some women cooked standing in the inundation itself. Kids did not go to school.

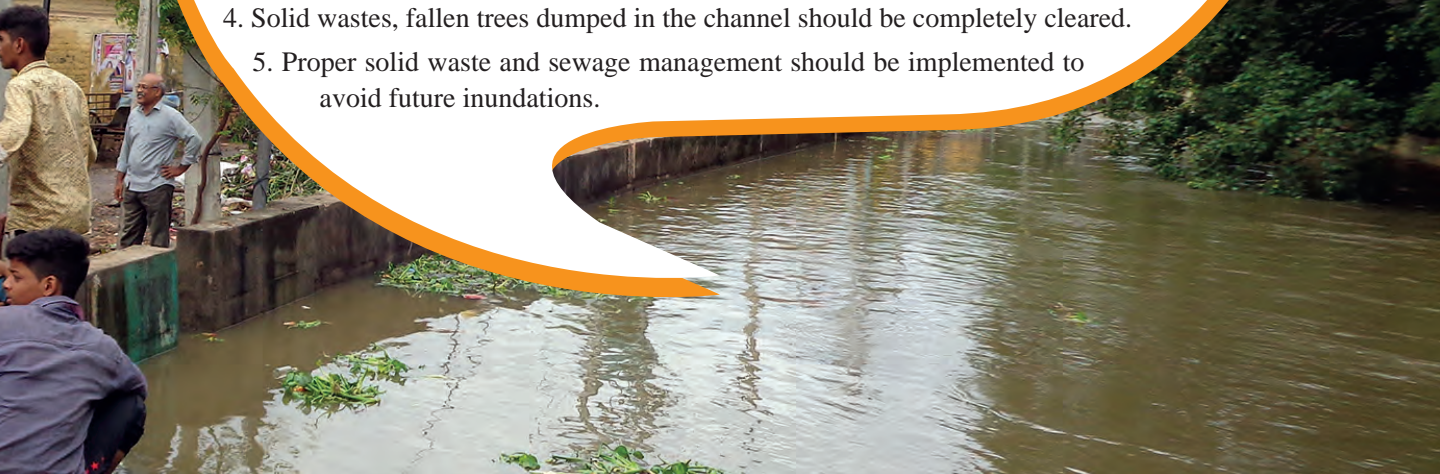
Reasons for Inundation

1. The surplus course was encroached by residents, cow sheds, shops, etc. This reduced the available cross sectional area of the channel.
2. The surplus course was heavily dumped with solid wastes such as household wastes, cow shed wash aways, wooden planks, fallen trees, tailoring wastes, etc. This reduced cross sectional area of the course. The flow in the channel rose above its High Flood level. This resulted in flow through open spaces in-between households and streets.
3. Storm water drains that supposed to drain water into surplus course are connected with the surplus course at its free board. As the course is flowing full, water started to back flow in the storm water drains. This further enhanced the inundations.

Immediate response post-inundation: The Government department removed some of the debris in the course to enhance free flow in it. But it was not a complete process. It took more than two week to remove the debris heaves from the bank of surplus course. This created foul smell, invited insects and pests- a real nuisance for the locales.

Recommendations

1. Encroachments in the surplus course should be evicted appropriately and debris should be disposed immediately.
2. Cross section of the surplus course should be verified for its design discharge and redesigned if any faulty design.
3. Thick sludge deposited as a layer in the bottom of the surplus course should be removed to increase cross sectional area of the course.
4. Solid wastes, fallen trees dumped in the channel should be completely cleared.
5. Proper solid waste and sewage management should be implemented to avoid future inundations.





Mudakkathankulam tank

'Water bodies The testimony of our living standards'

This rainfall has posed serious questions before us.

Do we care about our tanks and tank cascade system?

Public Works Department and Public Administration may say yes. Few posters may thank the politician who implemented the tank rehabilitation work carried in prior to the rainfall. But the rainfall exposed the quality of rehabilitation.

Encroachments: Irrigation tanks, surplus courses, river Vaigai are under encroachment. The encroachment is agricultural in Vandiyur tank and infrastructural in Sellur. These encroachments are not evicted completely by the department. There are few evictions of slum encroachments only (Sellur). It is the duty of the department to evict encroachments in water ways and water bodies.

Desilting of tank: The desilting of tank was not carried out with intension of bringing the tank to its original capacity or to increase its water holding capacity. In Kodikulam, Vandiyur, Sakiliyankulam and Sellur tanks, deepening was random and non-procedural. The tanks are supposed to be desilted as per rules of PWD and Department of Mines. Post rehabilitation audit should be made mandatory.

Surplus weir: It is absent (S.Alangulam, MelaPanangadi tanks) and leaky (Mudakkathankulam tank). These lead to uncontrolled discharge and reduced water holding capacity. Tanks should be demarcated as per FMB sketch and surplus weirs are to be restored as per design.

Bund strengthening: Pot holes (Siruvur tank) and rills (Mudakkathankulam tank) in the recently strengthened tank bund evidently prove that bund was not properly compacted during the rehabilitation process. In S.Alangulam tank, local communities avoided a breach in the tank bund by using sand bags. The bunds were not compacted using sheep foot rollers and as per standards.

Alterations of tank structure: Tank bunds have been altered for establishing Walkers Park (Kosakulam, Siruvur and Kankanmai Tank). Tank bunds were laid in all the directions ignoring technical aspects of the tank. ‘Tanks were designed based on topography and subsurface geological aspects. Redesigning such tanks ignoring technicality might lead to calamities’.

Sewage in tank system: Storm water drains are used as sewage drains. Tanks are filled up with sewage (Attikulam, Sellur, Kosakulam, Mudakathankulam and Thathaneri tanks). Solids wastes are disposed in the tank water spread area (S.Alangulam, Vandiyur, Silayaneri tanks). Almost all waterways connecting tank cascade systems are dumped with solid wastes. These are ill effects of poor solid waste management and sewage management which are core responsibilities of the concerned local body.

It is easy to blame the local communities as irresponsible for disposing wastes and sewage into the tank system. But it is worth to review current solid waste and sewage management strategies, gaps in existing plan and design, regulatory measures taken by the public administration against violators and its implications in city budget.

Clearing of Prosopis and cleaning of channels: Efficiency of permanence of tank cascade system relies in their veins i.e. channels and surplus courses. But the department did not intervene much in Prosopis clearance,

cleaning debris in water ways, removing water hyacinth in water bodies and tanks and desilting of channels.

Why the tank restoration in Madurai urban is ineffective?

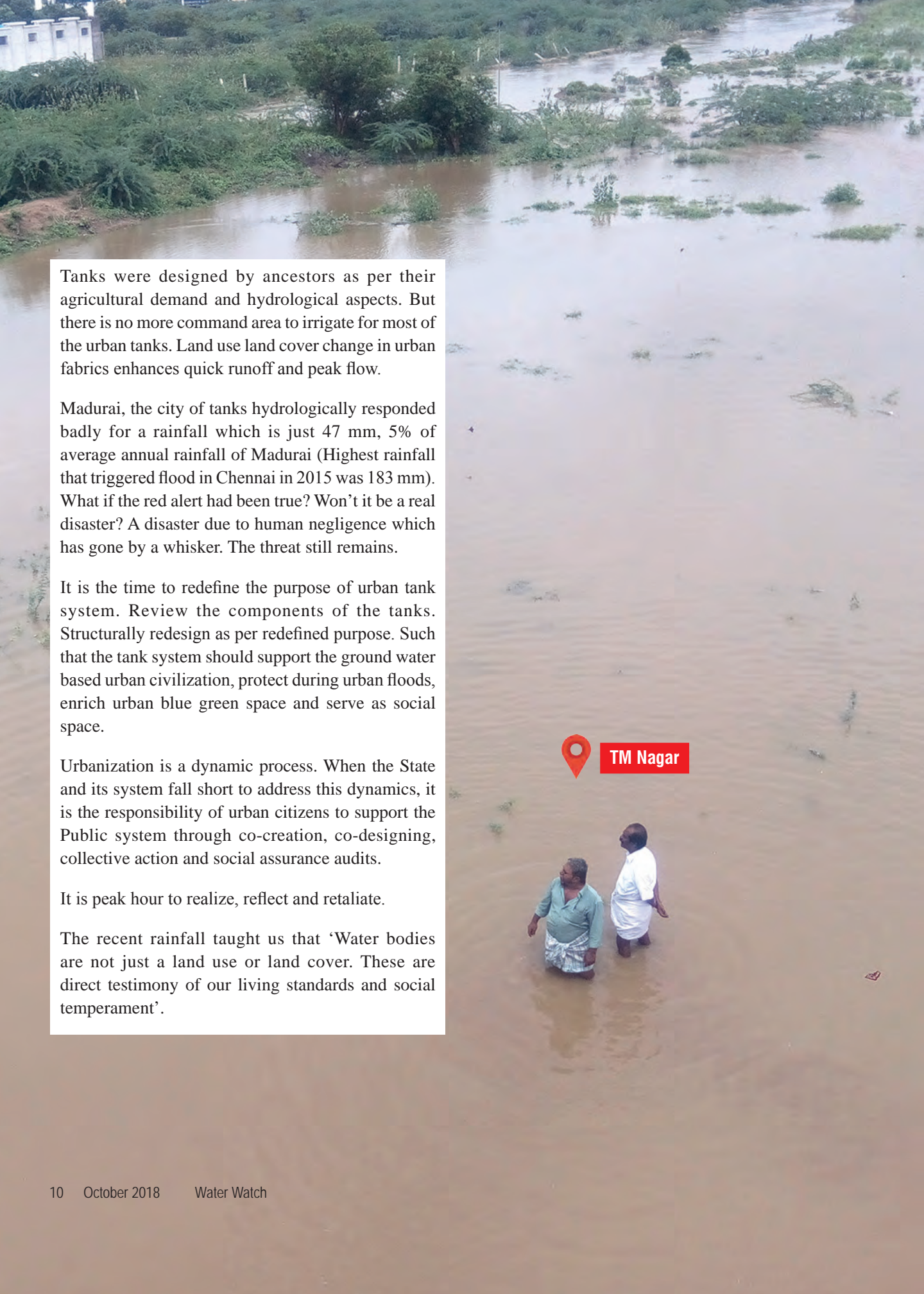
As there are no farmers, there is no ‘Kudi Maramathu’ (Citizen driven restoration) in urban, in its real meaning. The renovation works costing more than 10 lakh will be carried out by the PWD through tender process only. Contractors who won the tender, involved in tank rehabilitation are not trained by technical experts for better restoration. There is no procedural document available in local language such as ‘Manual for tank restoration’ which will help the local communities for social audit.

Then what is the way?

Residents around the tanks should be enabled to take the responsibility of restoration. They should be trained for best practices. ‘Packages of Practices in tank rehabilitation’ should be developed to support communities during implementation and social auditing. PWD engineers should support the communities to carry out rehabilitation by themselves. Public administration with support of NGOs and water experts should make the communities realize ‘the happiness in sharing and performing their responsibilities’.

It doesn’t stop here.





Tanks were designed by ancestors as per their agricultural demand and hydrological aspects. But there is no more command area to irrigate for most of the urban tanks. Land use land cover change in urban fabrics enhances quick runoff and peak flow.

Madurai, the city of tanks hydrologically responded badly for a rainfall which is just 47 mm, 5% of average annual rainfall of Madurai (Highest rainfall that triggered flood in Chennai in 2015 was 183 mm). What if the red alert had been true? Won't it be a real disaster? A disaster due to human negligence which has gone by a whisker. The threat still remains.

It is the time to redefine the purpose of urban tank system. Review the components of the tanks. Structurally redesign as per redefined purpose. Such that the tank system should support the ground water based urban civilization, protect during urban floods, enrich urban blue green space and serve as social space.

Urbanization is a dynamic process. When the State and its system fall short to address this dynamics, it is the responsibility of urban citizens to support the Public system through co-creation, co-designing, collective action and social assurance audits.

It is peak hour to realize, reflect and retaliate.

The recent rainfall taught us that 'Water bodies are not just a land use or land cover. These are direct testimony of our living standards and social temperament'.

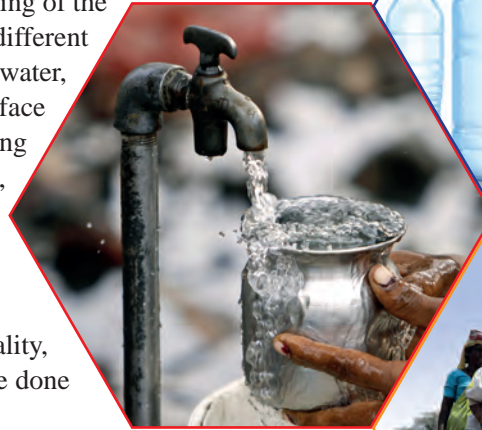


Baseline Assessment Water and Scenario Analysis

A spatial temporal assessment of the Madurai urban water quality to provide an understanding of the relative condition of water quality in different sources of water supplies such as Lorry water, Corporation water, Groundwater, Surface water which are all utilised for drinking purpose. In order to cover all four zones, we collected the drinking water sample in the each zone under corporation boundary.

To understand the trend of the water quality, we sampled the same location what we done on June, 2018. The Locations are

1. Sellur- Zone-I;
2. Pudhur- Zone-II;
3. Thepakulam- Zone-III;
4. Pasumalai- Zone-IV



Water supply through Pipe Network-
Corporation Supply



Bore well water-
Ground water



Zone 1 - Ground Water

TOTAL DISSOLVED SOLIDS 1449 mg/l 	TURBIDITY 0.7 NTU 	pH 7.65 	TOTAL ALKALINITY as CaCO₃ 520 mg/l
TOTAL HARDNESS as CaCO₃ 480 mg/l 	CALCIUM (Ca) 80 mg/l 	MAGNESIUM (Mg) 67 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0.24 mg/l 	NITRITE (NO₂) 0.002 mg/l 	NITRATE (NO₃) 3 mg/l 	CHLORIDE (Cl) 260 mg/l
FLUORIDE (F) 1.2 mg/l 	SULPHATE (SO₄) 64 mg/l 	PHOSPHATE (PO₄) 0.007mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR

It is observed that water is hard because of the presence of Calcium and Magnesium. Total dissolved solids(TDS) exceeds acceptable limit. It does not have direct health effects but solids which cause higher 'TDS' may be harmful to human health. Higher level of fluoride in drinking water may cause bone diseases and dental Fluorosis. This hard water is **not** recommended for drinking. If there is no other source of drinking water, then it shall be consumed.

■ Within acceptable limits
 ■ Within Permissible limits
 ■ Exceeds permissible limits

*Permissible limit are acceptable in the absence of alternate sources.

Bureau of Indian Standards recommends that acceptable limits to be implemented.



Zone 1 - Corporation Water

TOTAL DISSOLVED SOLIDS 152 mg/l 	TURBIDITY 1.5 NTU 	pH 7.5 	TOTAL ALKALINITY as CaCO₃ 72 mg/l
TOTAL HARDNESS as CaCO₃ 80 mg/l 	CALCIUM (Ca) 16 mg/l 	MAGNESIUM (Mg) 10 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0.08 mg/l 	NITRITE (NO₂) 0.003 mg/l 	NITRATE (NO₃) 1 mg/l 	CHLORIDE (Cl) 24 mg/l
FLUORIDE (F) 0.4 mg/l 	SULPHATE (SO₄) 8 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS TURBID & BAD ODOUR

All the drinking water parameters except turbidity are within the acceptable limits. Turbidity may be due to leaching of storm water into drinking water supply. Therefore the water is **not** recommended as safe for drinking. It shall be consumed after filtration through candle filter and followed by boiling. Corporation has to identify the leaching points and address it immediately.



Zone 1 - Packaged Can Water

TOTAL DISSOLVED SOLIDS 50 mg/l 	TURBIDITY 0 NTU 	pH 7.1 	TOTAL ALKALINITY as CaCO₃ 20 mg/l
TOTAL HARDNESS as CaCO₃ 20 mg/l 	CALCIUM (Ca) 5 mg/l 	MAGNESIUM (Mg) 2 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 1 mg/l 	CHLORIDE (Cl) 10 mg/l
FLUORIDE (F) 0.2 mg/l 	SULPHATE (SO₄) 4 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR

All the drinking water parameters are within the acceptable limits. Therefore the water is recommended as safe for drinking.

■ Within acceptable limits
 ■ Within Permissible limits
 ■ Exceeds permissible limits



Zone 2 - Corporation Water

TOTAL DISSOLVED SOLIDS 178 mg/l 	TURBIDITY 1 NTU 	pH 7.1 	TOTAL ALKALINITY as CaCO₃ 88 mg/l
TOTAL HARDNESS as CaCO₃ 80 mg/l 	CALCIUM (Ca) 16 mg/l 	MAGNESIUM (Mg) 10 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0.08 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 1 mg/l 	CHLORIDE (Cl) 24 mg/l
FLUORIDE (F) 0.4 mg/l 	SULPHATE (SO₄) 9 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR
<p>All the drinking water parameters are within the acceptable limits. Therefore the water is recommended as safe for drinking.</p>			



Zone 2 - Packaged Can Water

TOTAL DISSOLVED SOLIDS 56 mg/l 	TURBIDITY 0 NTU 	pH 7.15 	TOTAL ALKALINITY as CaCO₃ 20 mg/l
TOTAL HARDNESS as CaCO₃ 12 mg/l 	CALCIUM (Ca) 3 mg/l 	MAGNESIUM (Mg) 1 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 1 mg/l 	CHLORIDE (Cl) 10 mg/l
FLUORIDE (F) 0.2 mg/l 	SULPHATE (SO₄) 2 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR
<p>All the drinking water parameters are within the acceptable limits. Therefore the water is recommended as safe for drinking.</p>			

Within acceptable limits

Within Permissible limits

Exceeds permissible limits



Zone 2 - Ground Water

TOTAL DISSOLVED SOLIDS 1347 mg/l 	TURBIDITY 0 NTU 	pH 7.6 	TOTAL ALKALINITY as CaCO₃ 560 mg/l
TOTAL HARDNESS as CaCO₃ 340 mg/l 	CALCIUM (Ca) 80 mg/l 	MAGNESIUM (Mg) 34 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0.32 mg/l 	NITRITE (NO₂) 0.005 mg/l 	NITRATE (NO₃) 2 mg/l 	CHLORIDE (Cl) 280 mg/l
FLUORIDE (F) 1 mg/l 	SULPHATE (SO₄) 34 mg/l 	PHOSPHATE (PO₄) 0.007mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR

It is observed that water is hard because of the presence of Calcium and Magnesium. Total dissolved solids(TDS) exceeds acceptable limit. It does not have direct health effects but solids which cause higher 'TDS' may be harmful to human health. Higher level of chloride in drinking water gives a unpleasant taste. This hard water is **not** recommended for drinking. If there is no other source of drinking water, then it shall be consumed.



Zone 3 - Ground Water

TOTAL DISSOLVED SOLIDS 1365 mg/l 	TURBIDITY 0 NTU 	pH 7 	TOTAL ALKALINITY as CaCO₃ 580 mg/l
TOTAL HARDNESS as CaCO₃ 380 mg/l 	CALCIUM (Ca) 88 mg/l 	MAGNESIUM (Mg) 38 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0.16 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 2 mg/l 	CHLORIDE (Cl) 240 mg/l
FLUORIDE (F) 0.6 mg/l 	SULPHATE (SO₄) 34 mg/l 	PHOSPHATE (PO₄) 0.007 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR

It is observed that water is hard because of the presence of Calcium and Magnesium. Total dissolved solids(TDS) exceeds acceptable limit. It does not have direct health effects but solids which cause higher 'TDS' may be harmful to human health. This hard water is **not** recommended for drinking. If there is no other source of drinking water, then it shall be consumed.

■ Within acceptable limits
 ■ Within Permissible limits
 ■ Exceeds permissible limits



Zone 3 - Packaged Can Water

TOTAL DISSOLVED SOLIDS 63 mg/l 	TURBIDITY 0 NTU 	pH 6.7 	TOTAL ALKALINITY as CaCO₃ 20 mg/l
TOTAL HARDNESS as CaCO₃ 16 mg/l 	CALCIUM (Ca) 3 mg/l 	MAGNESIUM (Mg) 2 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 1 mg/l 	CHLORIDE (Cl) 18 mg/l
FLUORIDE (F) 0.2 mg/l 	SULPHATE (SO₄) 1 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR

All the drinking water parameters are within the acceptable limits. Therefore the water is recommended as safe for drinking.



Zone 3 - Corporation Water

TOTAL DISSOLVED SOLIDS 126 mg/l 	TURBIDITY 1.5 NTU 	pH 7.05 	TOTAL ALKALINITY as CaCO₃ 44 mg/l
TOTAL HARDNESS as CaCO₃ 48 mg/l 	CALCIUM (Ca) 8 mg/l 	MAGNESIUM (Mg) 7mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 1 mg/l 	CHLORIDE (Cl) 24 mg/l
FLUORIDE (F) 0.2 mg/l 	SULPHATE (SO₄) 5 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS TURBID & BAD ODOUR

All the drinking water parameters except turbidity are within the acceptable limits. Turbidity may be due to leaching of storm water into drinking water supply. Therefore the water is **not** recommended as safe for drinking. It shall be consumed after filtration through candle filter and followed by boiling. Corporation has to identify the leaching points and address it immediately.

Within acceptable limits

Within Permissible limits

Exceeds permissible limits



Zone 4 - Ground Water

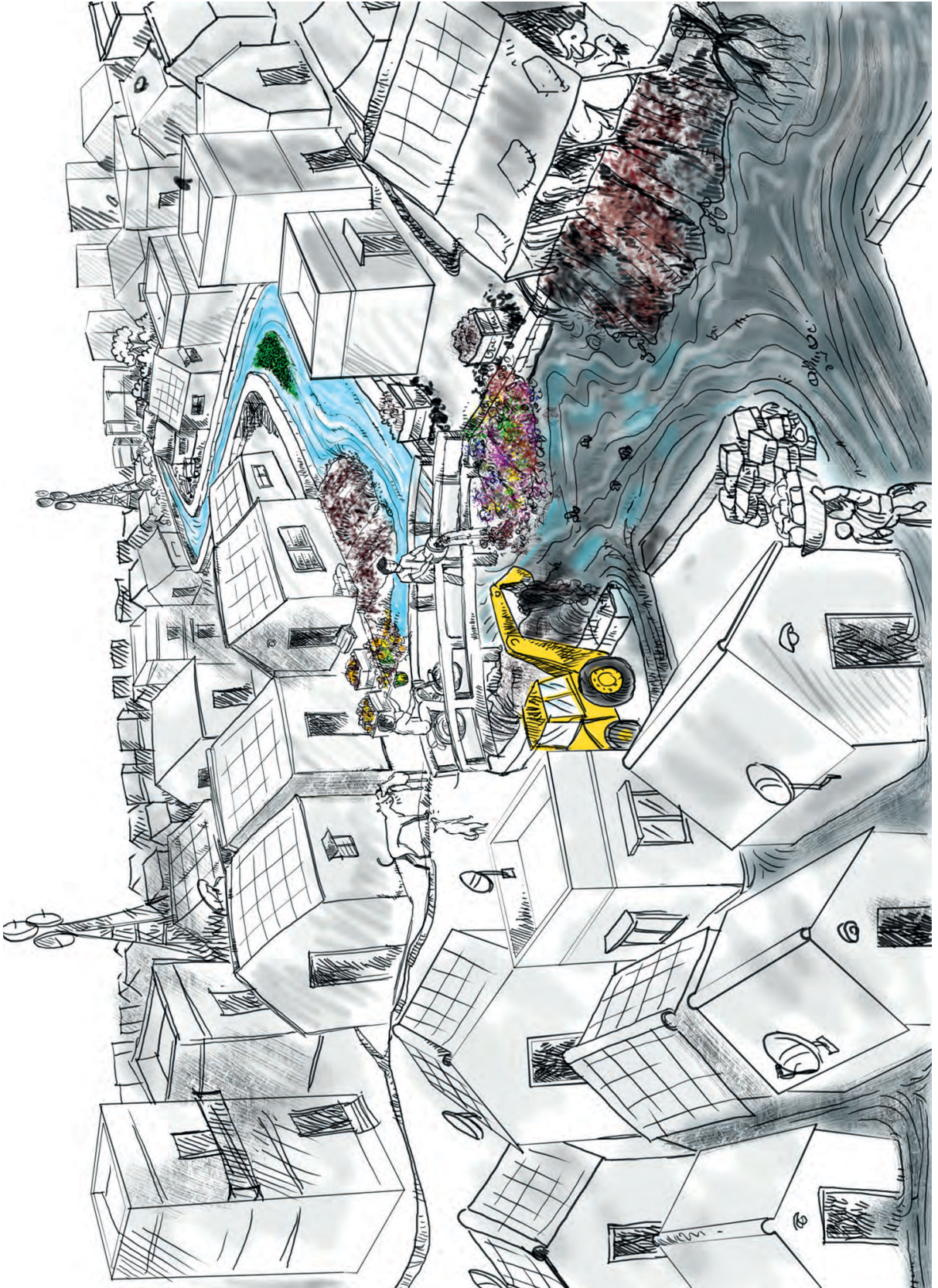
TOTAL DISSOLVED SOLIDS 1389 mg/l 	TURBIDITY 0.5 NTU 	pH 7 	TOTAL ALKALINITY as CaCO₃ 492 mg/l
TOTAL HARDNESS as CaCO₃ 640 mg/l 	CALCIUM (Ca) 112 mg/l 	MAGNESIUM (Mg) 86 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0.16 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 2 mg/l 	CHLORIDE (Cl) 320 mg/l
FLUORIDE (F) 1 mg/l 	SULPHATE (SO₄) 81 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR
<p>It is observed that water is hard because of the presence of Calcium and Magnesium. Total dissolved solids(TDS) exceeds permissible limit. It does not have direct health effects but solids which cause higher 'TDS' may be harmful to human health. This water is not recommended for drinking.</p>			



Zone 4 - Packaged Can Water

TOTAL DISSOLVED SOLIDS 108 mg/l 	TURBIDITY 0 NTU 	pH 7.95 	TOTAL ALKALINITY as CaCO₃ 56 mg/l
TOTAL HARDNESS as CaCO₃ 40 mg/l 	CALCIUM (Ca) 8 mg/l 	MAGNESIUM (Mg) 5 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 1 mg/l 	CHLORIDE (Cl) 16 mg/l
FLUORIDE (F) 0.2 mg/l 	SULPHATE (SO₄) 2 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR
<p>All the drinking water parameters are within the acceptable limits. Therefore the water is recommended as safe for drinking.</p>			

■ Within acceptable limits
 ■ Within Permissible limits
 ■ Exceeds permissible limits



Meteorological Updates

Rainfall Data

Station Name: DHAN Central Office, Madurai

Device: Automated rain gauge.

Average Annual rainfall for Madurai: 840mm



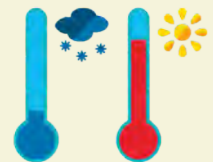
October 2018- Rainy days

Date	Intensity(mm/d)
01/10/2018	7
03/10/2018	9
04/10/2018	1
05/10/2018	2
06/10/2018	3
07/10/2018	20
08/10/2018	47
09/10/2018	3
16/10/2018	1
21/10/2018	3
22/10/2018	1
Total rainfall	97 mm

Percentage of October month's rainfall (at DHAN Station alone) from Annual average of Madurai: 11.5% of 840mm

Temperature Data

	Temperature	Humidity	Pressure
High	36 °C (12 Oct, 14:30)	96% (4 Oct, 02:30)	1014 mbar (4 Oct, 02:30)
Low	23 °C (24 Oct, 05:30)	37% (9 Oct, 14:30)	1003 mbar (24 Oct, 08:30)
Average	28 °C	74%	1009 mbar



* Reported 1 Oct 02:30 — 31 Oct 23:30, Madurai. Source: Custom Weather, © 2018

We sincerely acknowledge the Laboratory

Water Quality Testing Laboratory
The Institution of Engineers (India)
Madurai Local Centre,
Surveyor colony, Madurai- 625007

For Suggestion/Comments please write us on



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