WATER AND WASTEWATER MANAGEMENT FOR CLEAN AND HEALTHY VILLAGE TRANSFORMATION - IBM SUSTAINABILITY CSR PROJECT INITIATIVE

FINAL PROGRESS REPORT

Submitted by

AquaMAP Centre for Water Management and Policy,

IIT Madras

April 2023

PROJECT TEAM

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Chapter 1

Project introduction

1.1 Prefatory

International Business Machines Corporation (IBM) signed an MoU with IIT Madras on 19th Sept 2022 to the tune of Rs 70.5 lakhs, to support 'Water and Wastewater management for a clean and healthy village transformation' project in Sidlaghatta, Chikkaballapur District in Karnataka as part of IBM's sustainable CSR initiatives.

1.2 Project Background

A joint meeting was held on 10.05.22 with IBM(Bangalore) and The Office of the Principal Scientific Advisor to the Government of India together with AquaMAP. AquaMAP provided a project proposal for the villages shortlisted by IBM as a part of the village transformation program for their sustainable CSR initiatives. On 22.05.22, IBM had shortlisted the villages namely - Mallur, Muthur, Kachahalli and Ankathatti of Sidlaghatta Taluk, Chikkaballapura District of Karnataka.

For this purpose, the AquaMAP team conducted a preliminary site visit to assess the various interventions needed in these villages. The findings are detailed in the following sections-based on the reconnaissance and direct interactions with the Panchayat President Mr. T M Byregowda, Mallur PDO - Ms. Mamta, NGO and villagers. The inputs were further analysed, and a detailed study was conducted as the next stage of the project pursuant to the baseline surveys after signing of the MOU with IIT Madras. Subsequently, detailed engineering was taken up based on the conceptual design furnished by IIT Madras for finalization of precise project estimates. The first phase of a collaborative project has been initiated in the Muthur village.

1.3 Need of the Project

The United Nation's (UN) Sustainable Development Goals (SDGs) and Swachh Bharat Mission (SBM) of Government of India (GoI) aim to confront the potent problems and the resulting challenges in the complex links between water resources and humanity. The GoI assigns lot of attention towards water supply, waste management, health and hygiene in India. The UN's SDG 6, Swachh Bharat Mission and Jal Jeevan Mission (JJM) particularly, seeks to ensure sustainable access to clean water and sanitation for all, with targets for water quality, efficiency, management, cooperation, capacity building, and ecosystem health. JJM is a time-bound, mission-mode programme launched by GoI during August 2019 to achieve drinking water security and enable Functional Household Tap Connections (FHTC) for all by 2024 in rural India.

As such there is renewed focus on achieving Swachh Bharat and SDGs for which water supply and Sanitation improvements is pivotal to reach the visions under SBM: “Clean India” and SDG6: ”Ensure clean water and Sanitation” and JJM:“Safe & adequate drinking water by 2024 to all Rural households”.

The water governance landscape in the target villages is currently not poised to facilitate the visions and hence this project becomes necessary and lead to attain those goals in the project villages by provisioning Water and Sanitation with the largesse of IBM- CSR funds.

This will surely result in positive trends toward betterment in local water governance and waste management by reaching the unreached by infrastructure improvements and appropriate social awareness catered under this benign project. This document readily captures the 3 contributions of this project that strive to reach readily, the nobler targets set forth under SBM, JJM and SDG6.

1.4 Aim and overall Objective

To create a clean and healthy village through effective water and wastewater management coupled with corporate-academic socially responsible actions, with active participation of all stakeholders – Government/ Panchayat, IBM Employees, NGO’s and Village Community

1.5 Village overview

The four villages – Mallur, Muthur, Kachahalli and Ankathatti are a part of the Malluru Gram Panchayat, Sidlaghatta Block/Taluka, Chikkaballapur District of Karnataka. The first phase of a collaborative project has been initiated in the Muthur village. The Sidlaghatta town is 9 kms away and is the nearest means for economic activities. Sidlaghatta Taluka is 63.3kms from Bangalore City centre and has good connectivity by road.

1.5.1 Key highlights of Muthur village

Located in the back drop of Nandi Hills

- Villagers are mainly dependent on the large pond or “kere” as the villagers’ term it.
- Main sources of livelihood - agriculture, dairy, livestock and sericulture.
- Soil condition is favourable for agriculture however farmers are heavily dependent on the rainfall.
- Annual rainfall – 735mm and is categorised as drought prone area – Eastern dry agro -climate zone
- Small farmers have been migrating to the cities which has resulted in the decline in population.
- Unable to sustain their livelihood due to lack of water.
- 2nd biggest market in Asia for silk is in Sidlaghatta

1.5.2 Village profile – Muthur village

Description	Metrics
Area (hectares)	468.59
Households	324
Population	1554
SC	448
Male	800
Female	754
Literacy rate	71.62%
FHTC	✓
Water source – borewells	✓
Service level/quantity supplied	17 lpcd
ODF status	✓
Water bodies – lake	✓
Open wells	14

**During the course of interactions, the present population was reported by the panchayat as 2300*

1.5.3 Problems identified in Muthur village

a) DRINKING WATER SUPPLY

- **Source:** Deficiency in the water source has been identified. Existing water source are borewells with water available at 1000-1200 ft deep.
- **Frequency/Quantity of supply**: Our interactions with the villagers confirmed that the supply is irregular and only on hourly basis during the day. The much-needed quantity of 55 LPCD (Litres per capita per day) is not being supplied.
- **Supply and Distribution:** In Muthur, the supply and distribution are presently being done directly through the street pipes bypassing the overhead tanks. Existing overhead tanks are defunct and corrosion initiation is seen from our visual examination.

Hence considering the above conditions, it is determined that source improvements is vital.

b) SANITATION

- **Household toilets:** As per records, they are declared as ODF Village. (Open Defaecation Free).
- **Wastewater:** Soak pits are proposed predominantly except group toilets having Septic tanks. The reconnaissance reveal waste water stagnation in storm water drains along with visible weed growths.
- Waste water collection system is not in place. It needs immediate intervention to collect, transport, treat and discharge into nearby *kera* /waterbodies.

- **Storm water drains:** All the four villages have storm water drains but connectivity between drains and networking of the storm water drain for discharging the rain runoff into water body is missing. In addition to this, it requires regular upkeep and maintenance. The storm grids are not networked to collect for creating adequate flow regimes and needs interventions to collect and channelize it for use in agriculture. There is ample scope for RWH and Rejuvenation of groundwater through existing open wells.

Waste water collection system and treatment needs to be implemented for sanitation improvements to attain ODF PLUS status.

c) SOLID WASTE MANAGEMENT

- Collection system is focussing on receiving only dry waste which is being sent to common facility for a cluster of panchayats which is located in another nearby panchayat. Proper segregation of dry waste is not in place.
- Biodegradable (wet) waste is not being collected as the community themselves are composting and thereafter utilizing it for agriculture.

Awareness generation for segregation of waste in the households, so that panchayat can ably recycle the dry waste at common facility.

d) REJUVENATION OF MUTHUR LAKE/KERE

As per revenue records the kera is 153 acres in size. The lake was last rejuvenated during early 90's and is said to be filled up with water up to its brim. Thereafter due to low maintenance, the lake silted up and the cumulative neglect hitherto is depicted by the abundant growth of the Julifora bushes.

This lake is rainfed and there is no connectivity to the irrigation system of any of the major reservoirs in the region. It is known that the recycled water under the HN valley project from the STP of BMWSSB is within 8kms distance from this panchayat.

There is ample scope for improvement and rejuvenation to harvest rain water during rainy season. Based on our intensive field investigations the bunds also have to be strengthened wherever necessary besides mere desilting. This could largely enhance the functional capacity and structural stability of the kera. We have also observed mining activities being carried out in the lake which if goes unchecked will be detrimental to the lake ecosystem.

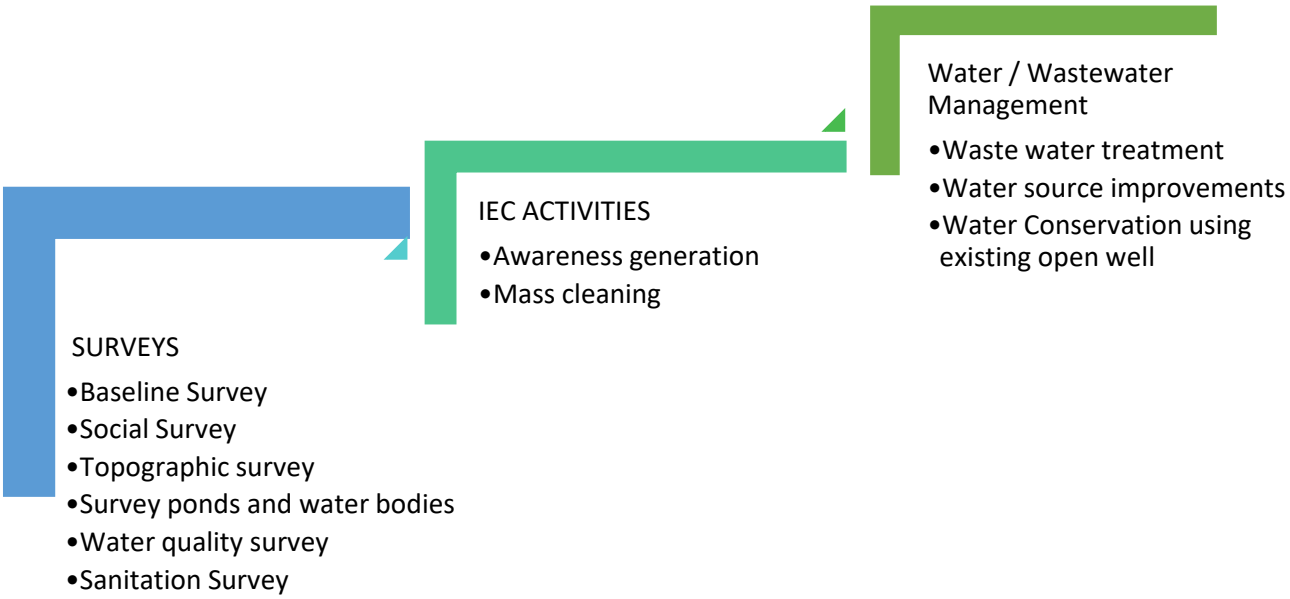
It helps to conserve water on a long-term basis with dividends of improved ground water recharge. So, the groundwater recharge on a continuous basis by the meticulous upkeep of the kera could improve the yield of the borewells, the primary water source of villages. The consistent supply of water for agricultural activities is needed to promote the livelihoods in the local community.

e) CLEANLINESS AND HYGIENE

Implementation of measures outlined above could bring in environment sanitation which is vital for public health improvement in the community. This can be supplemented by concurrent IEC activities to improve overall hygiene of the village community and health by proper management of water, waste water and solid waste. The prevention of water contamination is largely dependent on the sustained behaviour change in the community for which awareness generation holds key.

1.6 Scope of work for phase 1

As the 1st step, we will be starting with the social survey, awareness generation programme, Water/Wastewater management for clean and healthy village transformation. Solid Waste Management is crucial to providing a holistic sustainable solution to this project. We will be considering this scope only in the next phase due to budgetary constraints in lieu of the larger fund requirement foreseen.



The proposed interventions will create a Wastewater treatment system with small bore sewers and Constructed wetland for wastewater in the selected village for which household supply works are already provided under JJM. We have also explored possible source improvements after studying the existing yield of the borewell, rejuvenation of existing OHTs in Muthur after examining its structural adequacy by conditional assessments and selective water conservation by linking stormwater with the existing defunct open wells as applicable within the available budget.

Chapter 2

Project activities

The IIT M- Civil (EWRE) took up survey, concept design and infrastructure work of the component activities envisaged under this Project and the project was executed by concerted coordination with the following Project Partners since conception to completion:

2.1 Project Partners

- **CUBE's Activities**: Survey, design & engineering and Infrastructure works (Waste water Treatment and lake rejuvenation)
- **Gramaantara's activities**: Close coordination with community, Panchayat and larger administration, any troubleshooting, networking and identifying critical assets for the project, coordinating IEC activity to facilitate awareness creation on causes involved, support with volunteers for social survey.

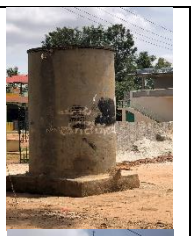
2.2 Preliminary field visit

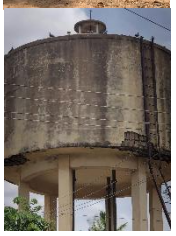
On 31st May 2022, the AquaMAP team conducted a preliminary site visit to assess the various interventions needed in these villages. Based on the reconnaissance and direct interaction with the Panchayat President Mr. T M Byregowda, Mallur BDO – Ms. Mamta, NGO and villagers, a detailed proposal was submitted to IBM in a phased manner.

2.3 Pre-implementation scenario

The field visits readily captured the existing conditions of the village in terms of the drain system, solid waste management, waste water management, overhead tanks and the lake. The lake needs rejuvenation for revival to enhance storage, strengthening of bund and utility, besides the much-needed recharge of groundwater to refurbish water quality/quantity besides agriculture uses. The fact that only shallow aquifers yield potable ground water implicate the need for revival of existing water bodies by appropriate interventions to rejuvenate.

The cumulative neglect of the village implicates the need for waste water management, drain works, lake rejuvenation and IEC activities.





2.4 Inauguration during project inception stage

The launch of the "Water and Wastewater Management for A Clean and Healthy Village Transformation Project"- Phase 01 was held at 11am on 1st October 2022 at the Mallur Milk Producer's Cooperative Society building of the Mallur Gram Panchayat in Shidlaghatta Taluk. The event was organized by AquaMAP IIT Madras with support of Mallur Gram Panchayat and Gramaantara. The event was by invitation only due to the strict no press/media coverage by Industry Partner – IBM 's contractual binding. The invitees included Government/Panchayat officials, representatives of IBM, AquaMAP, CUBE, and village community members of not more than 80-100 people. With the support of NGO Gramaantara, the event was conducted fruitfully in presence of the key people.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CENTER FOR WATER MANAGEMENT AND POLICY
INDIAN INSTITUTE OF TECHNOLOGY MADRAS
IBM CSR SUSTAINABILITY INITIATIVE
Water And Wastewater Management
For A Clean And Healthy Village Transformation
Malur Gram Panchayat, Shidlaghatta Taluk,
Chikballapur Dt, Karnataka


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2.5 Awareness creation programme

Muthur Village Awareness Program was conducted by AquaMAP on 18th November 2022. Approximately 110 participants (community members, government school children, and teachers; Asha workers, Ms. Usha Shetty of Gramaantara, Dr. Priyanka from GITAM, Panchayat President, and Ward Member) participated in the awareness training program. The topics covered were the significance of water quality, solid waste management, sanitation, and personal hygiene.

Chapter 3

Surveys

3.1 Social survey

Muthur Village Social Survey was conducted by AquaMAP with 30 IBM Staff volunteers from Bangalore team on 21st October 2022. The social survey findings helped us decide the intervention areas that are required at the village. Please refer to social survey report in the annexure.

3.2 Site Reconnaissance Survey and Topographical Survey: Oct 2022

3.3 Flow Measurement of Grey Water & Stormwater: Oct 2022

a) Quantification of volume of flow of wastewater releasing in the lake has been carried out on the month of October – 2022 for collecting the data required for design.
b) Survey conducted at three locations outfall 1, 2 and 3 where the flow is maximum. The survey results are summarized in the Table-1.


Outfall 4
Outfall 3
Muthur Lake
Outfall 2
Outfall 1
Proposed area for construction Wetland & STP


Latitude: 13.347658
Longitude: 77.802318
Elevation: 804.01±16 m
Accuracy: 26.3 m
Azimuth: 294° (NW)
Pitch: -50.3° (14.6°)
-0.7894 -0.4415 0.4215
0.3029 -0.8834 0.3596
0.5309 -0.1559 0.8317
Time: 11-11-2022 18:58

c) Measurement of Flow at Outfall

The current grey water generation from the Muthur village was estimated to be 15 KLD as per V-notch flow measurement method. The design period of treatment plant can be taken as 15 years as per Table 2.1 CPHEEO Manual on Sewerage and Sewage Treatment Systems 2013. Hence the grey water quantum is projected for a period of 15 years.

- Present Grey Water Generation — 15 KLD
- Projected Grey Water Generation — 20 KLD [Considering 30% increase in Population over the period of 15 years]

Flow volume of Greywater in the outfalls to Muthur village lake:-

S. No	Outfall Locations	Date and Day of Sampling			Average flow	Capacity of Wastewater Treatment Plant (WWTP)	Combined Capacity of the WWTP
		3 Nov 2022 (Thursday)	4 Nov 2022 (Friday)	6 Nov 2022 (Sunday)			
Raw data from 6.00 AM to 6.00 PM							
1	Outfall 1	5.61 m^3/12 hrs ↓	10.21 m^3/12 hrs ↑	7.15 m^3/12 hrs ↓	7.65 m^3/12 hrs		
2	Outfall 2	1.93 m^3/12 hrs ↓	2.59 m^3/12 hrs ↓	7.95 m^3/12 hrs ↑	4.15 m^3/12 hrs		
3	Outfall 3	1.37 m^3/12 hrs ↑	0.87 m^3/12 hrs ↓	1.02 m^3/12 hrs ↓	1.08 m^3/12 hrs		
Processed data (per day)							
4	Outfall 1	5.82 m^3/day ↓	10.42 m^3/day ↑	7.36 m^3/day ↓	7.86 m^3/day	≈ 8 KLD	**15 KLD**
5	Outfall 2	2.38 m^3/day ↓	3.04 m^3/day ↓	8.40 m^3/day ↑	4.60 m^3/day	= 5 KLD	
6	Outfall 3	1.82 m^3/day ↑	1.32 m^3/day ↓	1.47 m^3/day ↓	1.53 m^3/day	≈ 2 KLD	

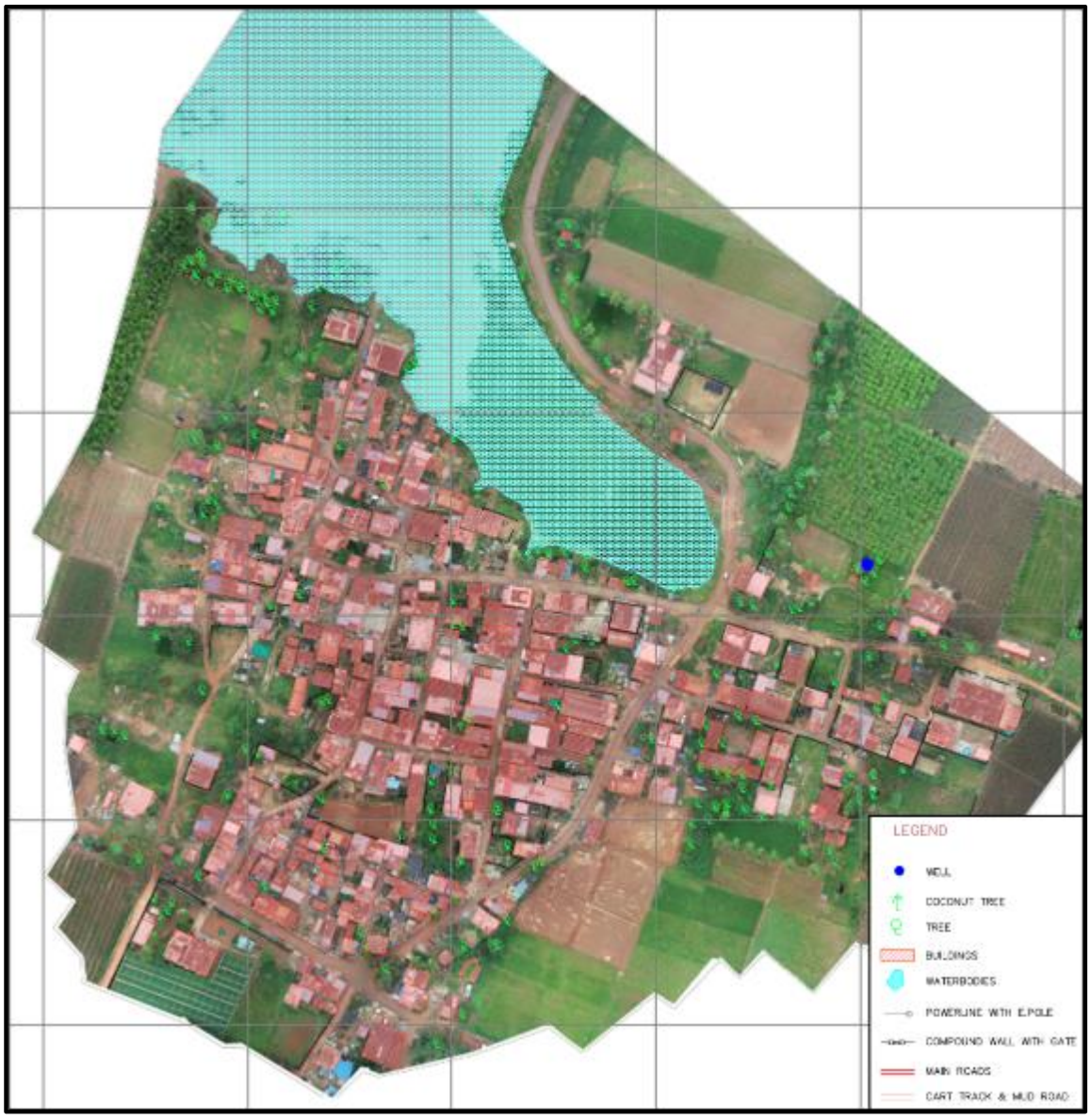
↓ - Fall in wastewater flow compared with average value
↑ - Rise in wastewater flow compared with average value

Table 1 – Calculation of Flow Volume

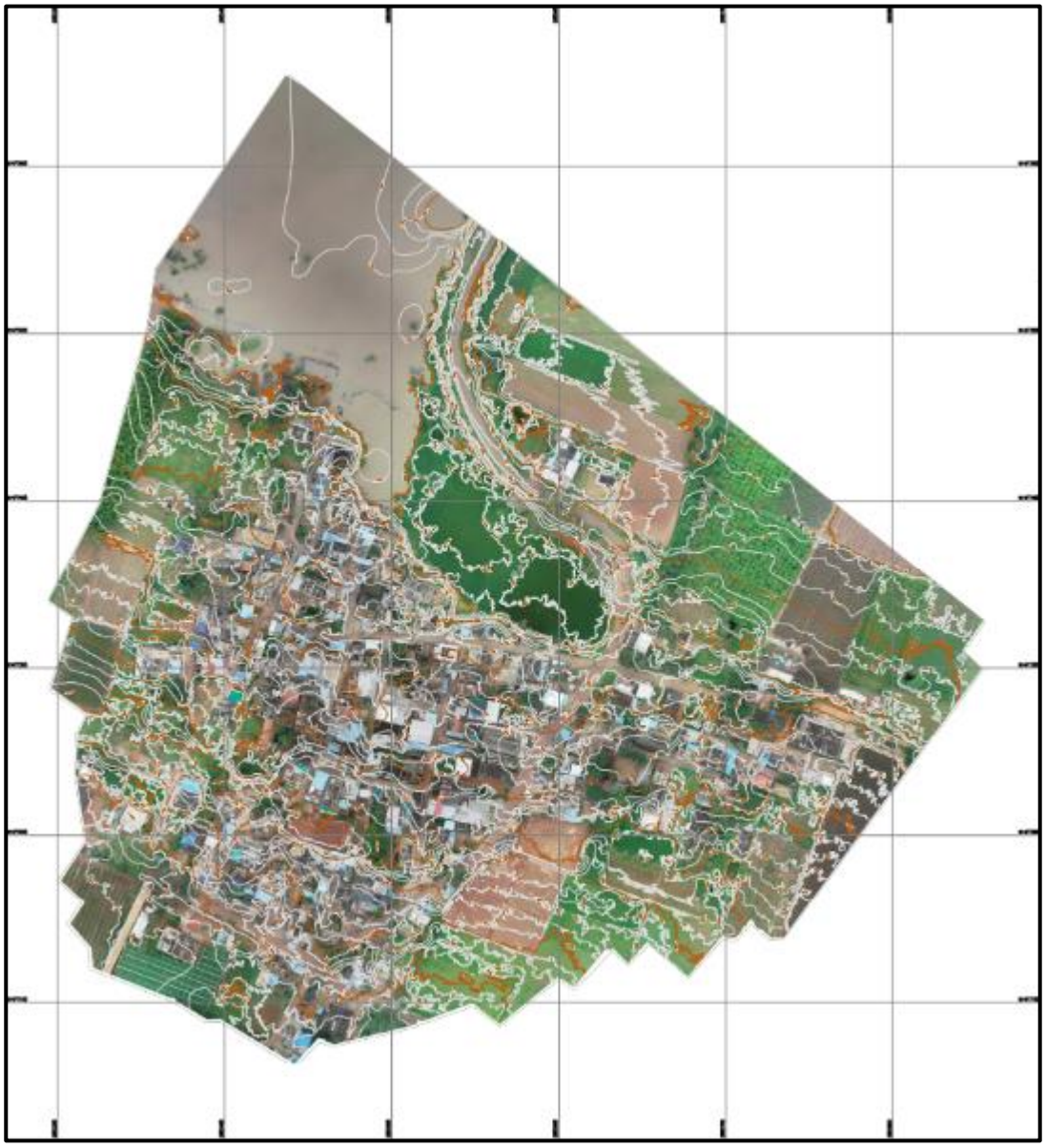
3.4 Aerial Drone Survey: Oct 2023

Topographical survey of the selected areas of the Panchayat was completed using drone technology during the month of October – 2022 and a contour map was prepared. This map also shows the residences, streets and the nearby water body. This was used for designing storm water drainage systems.

Drone survey is utilized to analyze the terrain of the area and to obtain contour map of the region which helps to study the existing flow and levels of the terrain and incorporate the same data for efficient designing of the course of the construction of new drain.



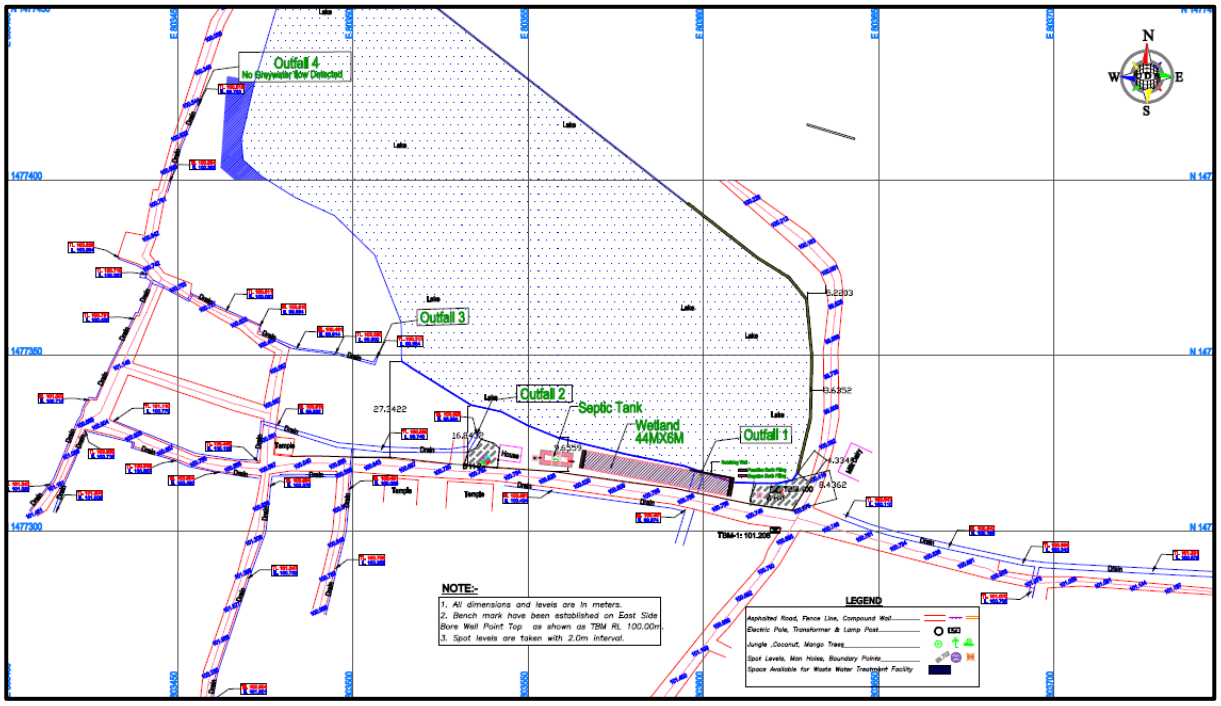
Drone Survey



Contour Survey Map

3.5 Total Station Survey: Nov 2022

Total station survey conducted during the month of November – 2022 for obtaining the topographical data for fixing the existing ground levels of the terrain and to identify the existing slopes to plan the new course of the drain and for the purpose of diverting/recoursing the existing drains of Outfall 1, 2,3 and 4 discharges to the proposed wastewater management system. The results of the survey are displayed in the below image.



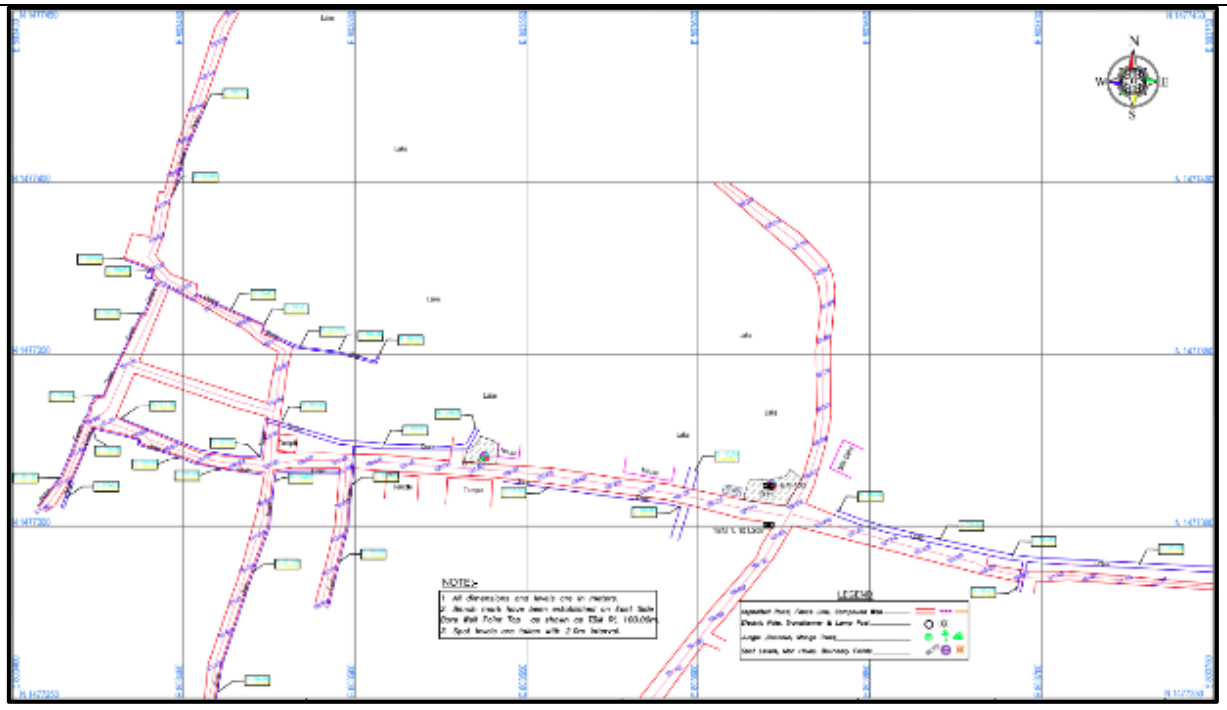
3.6 Geotechnical Investigation: Nov 2022

The primary objective of this investigation is to establish the geotechnical condition at the site and to evaluate the allowable bearing pressure and other engineering design parameters through the various field and laboratory tests. This report consists of the summary of results about the field and laboratory tests performed.

The scope of work includes both the field and laboratory tests. Two boreholes by manual auger method were drilled in the construction area to obtain the sub-surface stratification. The location of the boreholes on the entire plan of the proposed construction site is presented.

After collecting the soil samples from the borehole locations. The following tests are conducted, and the summary of the test results are presented at Table 2.

i. Particle Size analysis.
ii. Bulk Density.
iii. Natural Moisture content.
iv. Attenberg's limits.
v. Direct Shear strength tests.



Location of Bore holes

Sample Collection by Boring

S. No	BH No.	Depth (m)	Natural Moisture Content, %	Particle Size Analysis				Attenberg's Limits			Shear Parameters		Density
				Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	PI	C, kPa	phi,deg	Kn/m3
1	BH-01	1.50	14.29	2	48	50		-	-	-	-	-	-
		3.00	13.62	0	53	47		29	15	14	5	25	16.56
		4.50	12.69	0	45	55		-	-	-	-	-	-
		5.00	12.58	0	58	42		27	16	11	-	-	-
2	BH-02	1.50	16.57	10	47	43		-	-	-	-	-	-
		3.00	14.28	0	33	67		34	19	15	-	-	-
		4.50	10.59	0	24	76		-	-	-	9	21	-
		6.00	10.08	0	35	65		32	20	12	-	-	-

Table – 2: Summary of Lab Test Results

Conclusions & Recommendations:

(i) The groundwater table was found to exist at a shallow depth of 2.3m to 2.8m from the existing ground level.

(ii) The subsoil profile of the site consists of a 1.8m thick filled-up layer. This layer is followed by a medium stiff / stiff / very stiff clayey silt layer or a medium stiff/stiff/very stiff silty clay/clay layer or a medium dense silty sand layer or a sandy gravel/clayey sand/sandy clay layers with SPT N value ranging from 6 to 31.

(iii) The strong soil strata such as gravel/soft rock layers are found to be existing at deeper depths i.e., below 10m from the existing ground surface.

(iv) Considering the load intensity anticipated by the proposed project and the nature of the soil strata at this site, shallow isolated footings or raft foundations will be suitable in this case.

(v) The load of the structure can be transferred to deeper depths bypassing the upper medium-dense layers using shallow foundations.

(vi) In view of the presence of Gravel / Soft rock at a depth of about 5m to 6m, it is desirable to terminate the shallow foundations into the soil strata at a depth of 2.5m – 3.0m from the existing ground level to achieve the required capacity.

(vii) Analysis and results of soil are provided in Annexure 2 to 5.

Inference

Designing and construction of Septic Tank, RCC Drain, and Wetland have been carried out based on the above recommendations.

Chapter 4

Project Planning

4.1 Planned Activities

4.1.1 Wastewater Management

i. Construction of the Centralized Septic Tank.
ii. Constructed Wetland System.
iii. Construction of Storm Water Drain.

4.1.2 Lake Bund Strengthening

i. De-weeding of the pond [by village Authorities]
ii. Surface dressing and slope Stabilization.
iii. Bund standardization with apron slabs.

4.1.3 Lake Front Developments.

For recreation purposes through laying of paver blocks, creating seating arrangements through concrete benches, and installation of solar lamps for illumination.

4.2 Project overview

4.3 Project Implementation.

4.3.1 Septic Tank

Planning

(i) This is the primary structure planned to cater for the wastewater management of the sewage generated by the 20 Acres of Muthur Village, Karnataka. This is located beside the existing pond to facilitate the collection and discharge of wastewater to the constructed wetland and easier maintenance.

(ii) All the drain outfalls collecting wastewater have been planned to be diverted to this septic tank.

(iii) Wastewater enters the tank through an inspection chamber and settles in the first chamber, which is designed to allow the heavier solids to settle to the bottom.

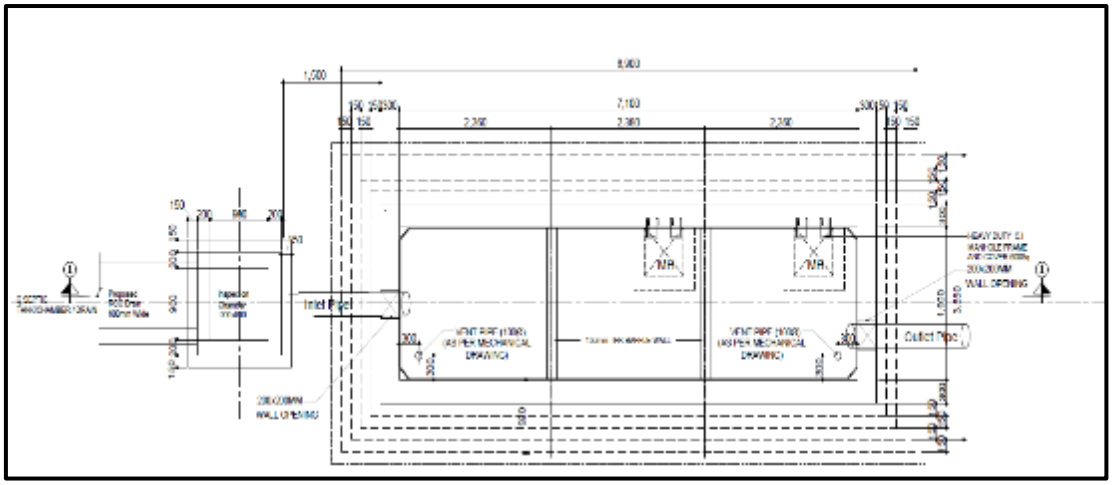
(iv) The solids, known as sludge, continue to accumulate at the bottom of the first chamber over time, while lighter materials such as oil and grease float to the top, forming a scum layer.

(v) The partially treated wastewater then flows into the second chamber, where it undergoes further sedimentation and clarification. During this stage, any remaining suspended solids settle to the bottom of the tank.

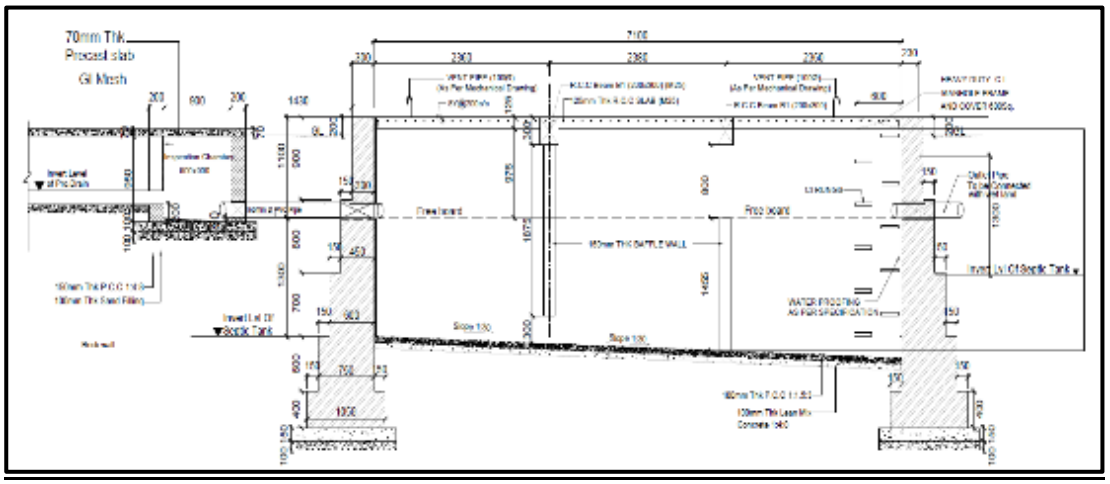
(vi) The clarified effluent, which is relatively free of solids and contaminants, exits the tank through an outlet pipe and flows into the wetland for secondary treatment.

(vii) Inspection chambers of size 1.7m x 1.7m have been provisioned at either side of the septic tank for maintenance purposes.

Design & Engineering



Plan of Septic Tank



Section of Septic Tank

Specifications

Septic Tank	• Construction of Septic Tank (7100 mm (L) x 1900 mm (B) x 2200 mm (D) Size. Capacity: 25 KLD • Earth work in excavation by mechanical means (Hydraulic excavator) / manual means over areas including earth to be levelled and neatly dressed. • Providing and laying in position cement concrete of specified grade: 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) • Brick work with solid cement concrete blocks (400 mm x 200 mm x 150 mm) with Cement mortar 1:4 (1 cement: 4 coarse sand) • Providing cast in situ baffle wall. • 12 mm cement plaster of mix: 1:5 (1 cement: 5 sand) with waterproofing compound for internal plastering. • Providing M25 grade R.C.C slab of 125mm thick with steel reinforcement of Fe-500D grade. • Providing and laying of 2 No. heavy duty precast R.C.C. Manhole cover slab (600 mm x 600 mm) for septic tank. • Providing and fixing of PVC pipes (300 mm dia) for inlet and outlets. • Providing and fixing of Vent cowl with mosquito proof.
Inspection Chamber	• Construction of inspection chamber (900 mm (L) x 900 mm (B) x 1800 mm (D) as per tender drawing. • Earth work in excavation by mechanical means (Hydraulic excavator) / manual means over areas including earth to be levelled and neatly dressed. • Providing and laying in position cement concrete of specified grade: 1:2:4 (1 cement: 2 coarse sands: 4 graded stone aggregate 20 mm nominal size) • Brick work with solid cement concrete blocks (400 mm x 200 mm x 150 mm) with Cement mortar 1:4 (1 cement: 4 coarse sand) • 12 mm cement plaster of mix: 1:5 (1 cement: 5 sand) with waterproofing compound for internal plastering. • Providing precast R.C.C slab of 70 mm thick. • Providing and fixing of PVC pipes (300 mm dia) for outlets.

Photographs

	
Site Levelling	Setting Out
	
Excavation	Excavated Pit

Completion of Blockwork

Casting of Slab

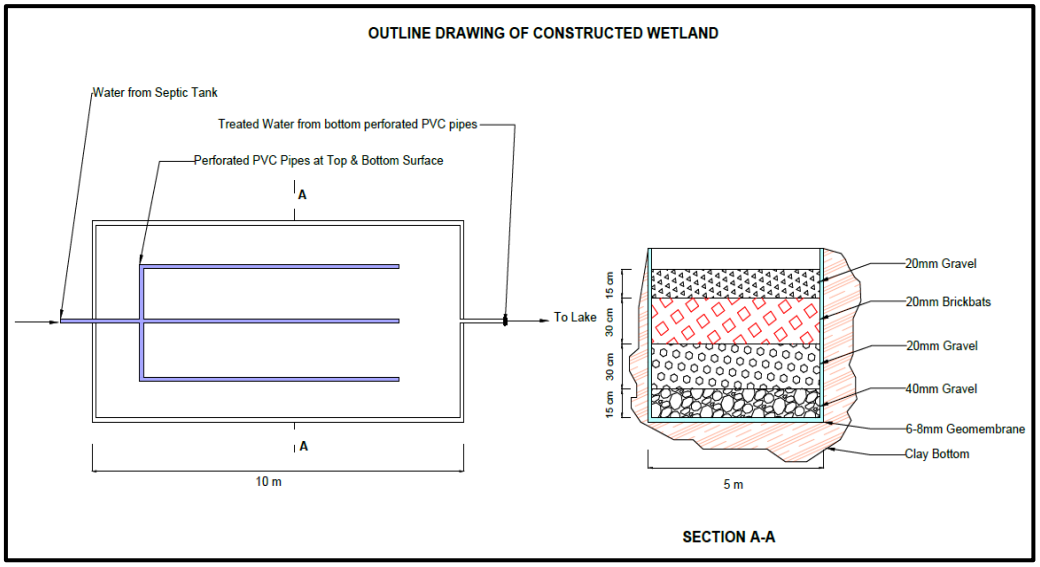
4.3.2 Constructed Wetland.

Planning.

(i) The secondary treatment of the sewerage is proposed through a 'Vertical Flow Subsurface Constructed Wetland' system.

(ii) In this system the wastewater enters through the surface and flows in vertical direction slowly through the supporting filter material and the plant roots, until reaching the bottom outlet zone.

(iii) A vertical flow constructed wetland is a type of engineered wetland designed to treat wastewater through natural processes involving plants, microbes, and soil. It is typically composed of a series of layers including a gravel bed, a layer of sand or other fine material, and a layer of wetland plants.



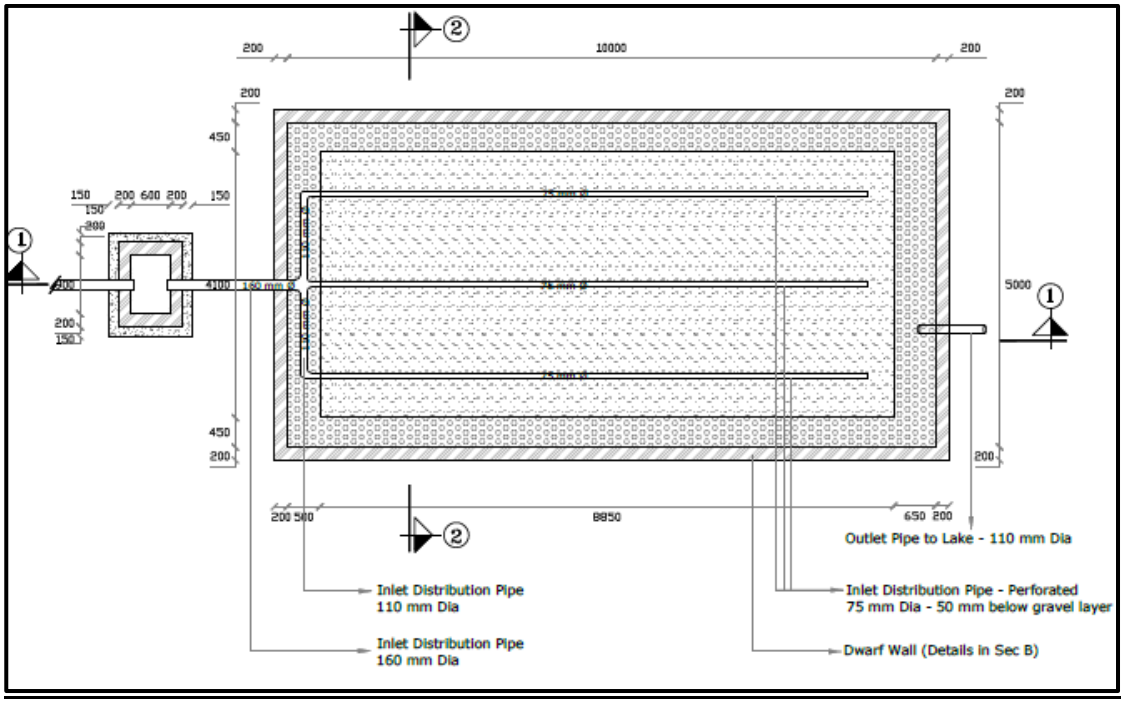
(iv) The wastewater enters the wetland at the top and flows through the gravel bed, where it is treated by microbial processes such as sedimentation, adsorption, and filtration. The wastewater then flows through the layer of sand or other fine material, which provides additional filtration and nutrient removal. Finally, the wastewater reaches the layer of wetland plants, where the roots take up nutrients and oxygen while releasing oxygen back into the water.

(v) As the wastewater moves through the wetland, it is gradually cleaned of contaminants and pollutants. This process is facilitated by the microorganisms living in the gravel and sand layers, which break down organic matter and remove nitrogen and phosphorus. The plants in the wetland also play an important role in removing pollutants and providing oxygen for the microbial community.

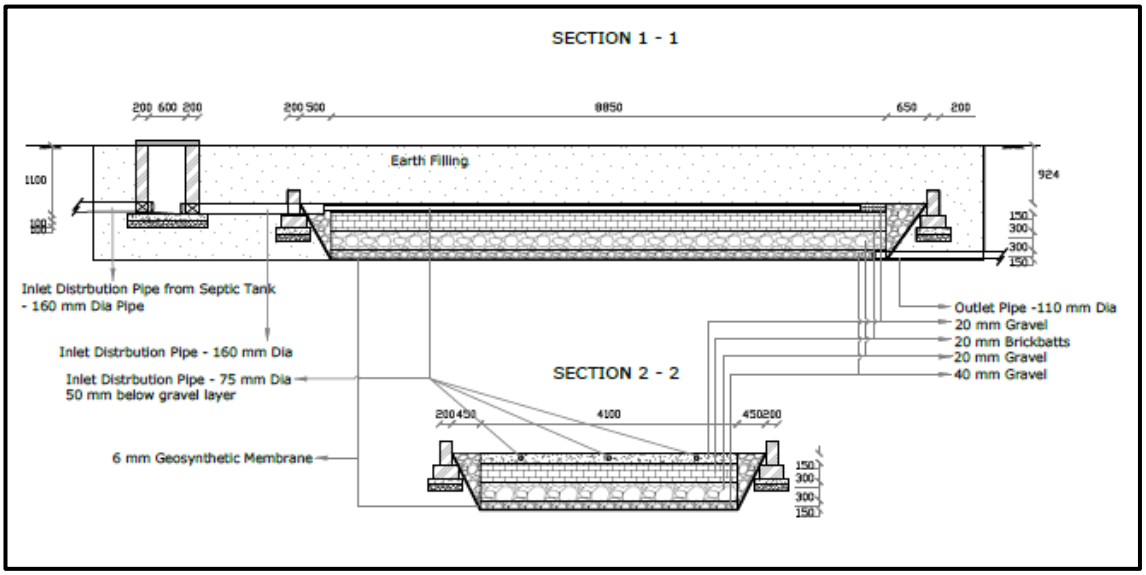
(vi) The treated wastewater can then be discharged into a receiving water body or reused for irrigation or other non-potable uses. Overall, vertical flow constructed wetlands are a sustainable and cost-effective way to treat wastewater and improve water quality.

(vii) The area of this constructed wetland is about 50 sqm. It consists of filter media with filling of gravel and brick bats, and Vetiver plantation for treatment of water.

Design & Engineering



Plan



Section

Specifications.

Constructed Wetland	• Earth work in excavation by mechanical means (Hydraulic excavator) / manual means over areas including earth to be levelled and neatly dressed. • Providing and laying in position cement concrete of specified grade: 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) • Brick work with solid cement concrete blocks (400 mm x 200 mm x 150 mm) with Cement mortar 1:4 (1 cement: 4 coarse sand) • 75mm OD as with necessary fittings for connection from Septic tank to Inspection Chamber and thereon from Inspection Chamber to constructed wetland. • Filter media of 900 mm deep consists of four layers. From top 150 mm thick layer of 20mm Gravel, 300 mm thick layer of 20mm Brickbats, 300mm thick layer of 20mm Gravel, 150 mm thick layer of 40 mm Gravel. • 6mm geosynthetic membrane at the base of the filter media to avoid the percolation of water into the soil strata. • Vetiver Plantation as the top layer which acts as a depleting agent of the microbials in the wastewater.
Inspection Chamber	• Construction of inspection chamber (600 mm (L) x 900 mm (B) x 1100 mm (D) as per tender drawing. • Earth work in excavation by mechanical means (Hydraulic excavator) / manual means over areas including earth to be levelled and neatly dressed. • Providing and laying in position cement concrete of specified grade: 1:2:4 (1 cement: 2 coarse sands: 4 graded stone aggregate 20 mm nominal size) • Brick work with solid cement concrete blocks (400 mm x 200 mm x 150 mm) with Cement mortar 1:4 (1 cement: 4 coarse sand) • 12 mm cement plaster of mix: 1:5 (1 cement: 5 sand) with waterproofing compound for internal plastering. • Providing precast R.C.C slab of 70 mm thick. • Providing and fixing of PVC pipes (160 mm dia) for outlets.

Photographs

Excavation for wetland

Laying of Geomembrane

Laying of 20 mm Gravel (Bottom Layer)

Laying of Brick bats

Laying of 20 mm Gravel (Top Layer)

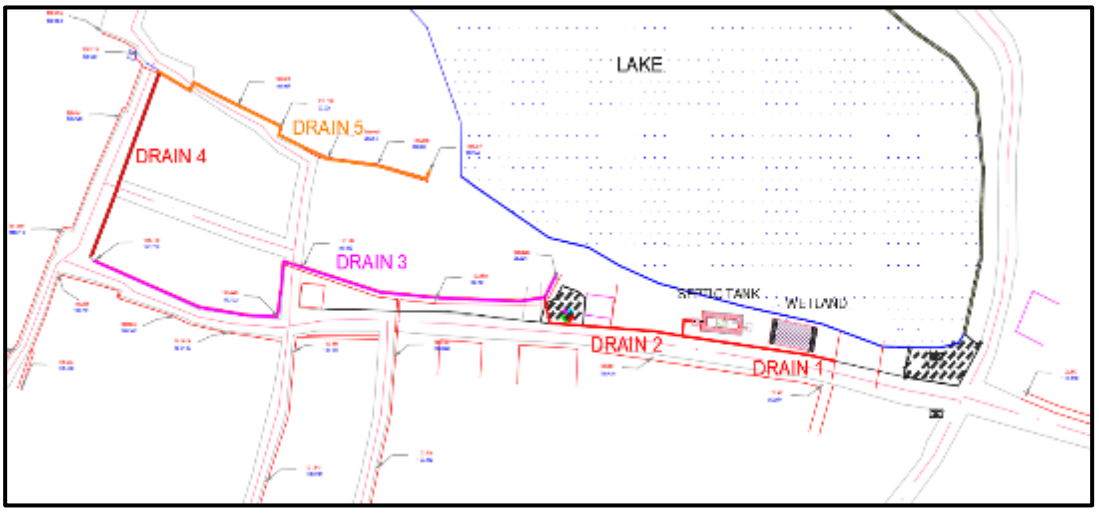
4.3.3 Stormwater Drain

Planning

(i) It is proposed to divert all the drains towards the septic tank to facilitate maximum water runoff into the inlet of septic tank for effective treatment and discharge of treated water.

(ii) A total of about 55m of the existing drains is planned for regrading and a total of 115m new drain construction have been planned to recourse the run-off wastewater to septic tank.

(iii) The drain is designed as an RCC structure with precast slab at the top of the drain. Required slope is maintained during the construction as per the site requirement.



(iv) Scope of works

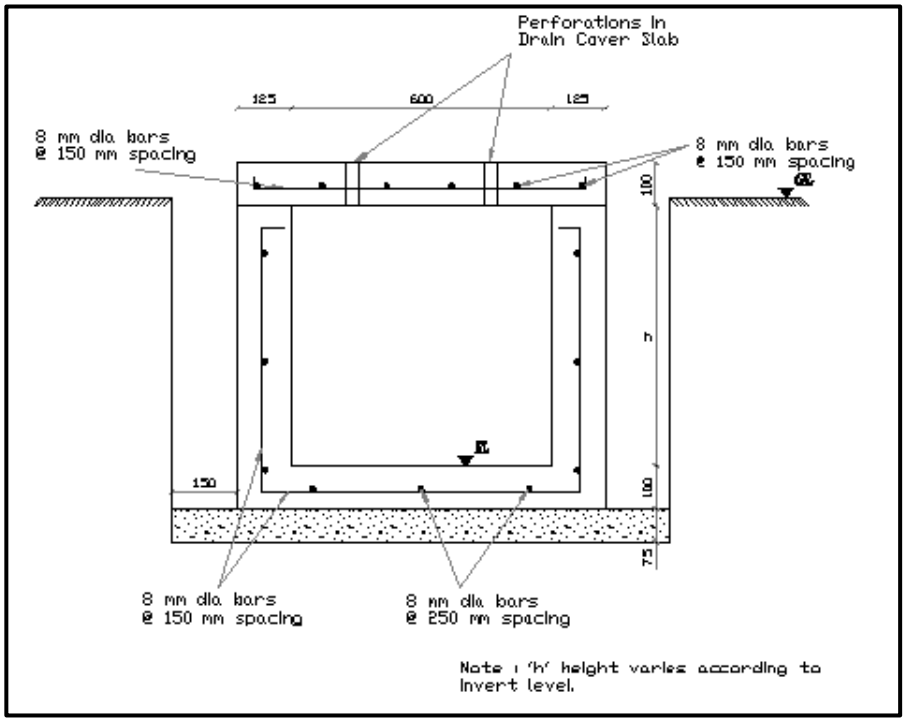
New Drain construction

- Drain 1 - 35 m
- Drain 2 - 40 m
- Drain 4 - 40 m

Repair of existing drain

- Drain 3 - 20 m
- Drain 5 - 35 m

Design & Engineering



Cross Section

Specifications

(i) Earth work in excavation by mechanical means (Hydraulic excavator) / manual means over areas including earth to be levelled and neatly dressed.
(ii) Providing and laying in position cement concrete of specified grade: 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size)
(iii) M 20 R.C.C cast in situ concrete open drain structure with raft (850 mm (W) x 100 mm (D)) and walls of 125 mm thick
(iv) Providing steel reinforcement of Fe-500 D grade for R.C.C
(v) Providing of Precast concrete slab (900mm(L) x 600mm(W) x 100mm(D)) with perforations of 50 mm as the cover slab for drain.

Photographs

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>PCC Laying</td><td>Placing of Reinforcement</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>RCC works</td><td>Placing of Precast slabs</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Placing of Precast Slabs</td></tr>
</table>

4.4.4 Lake Rejuvenation.

Planning

(i) An existing waterbody present in the village was taken up for a part rejuvenation to improve its condition. The pond was polluted due to improper discharge of sewerage, dumping of solid wastes and poor maintenance.

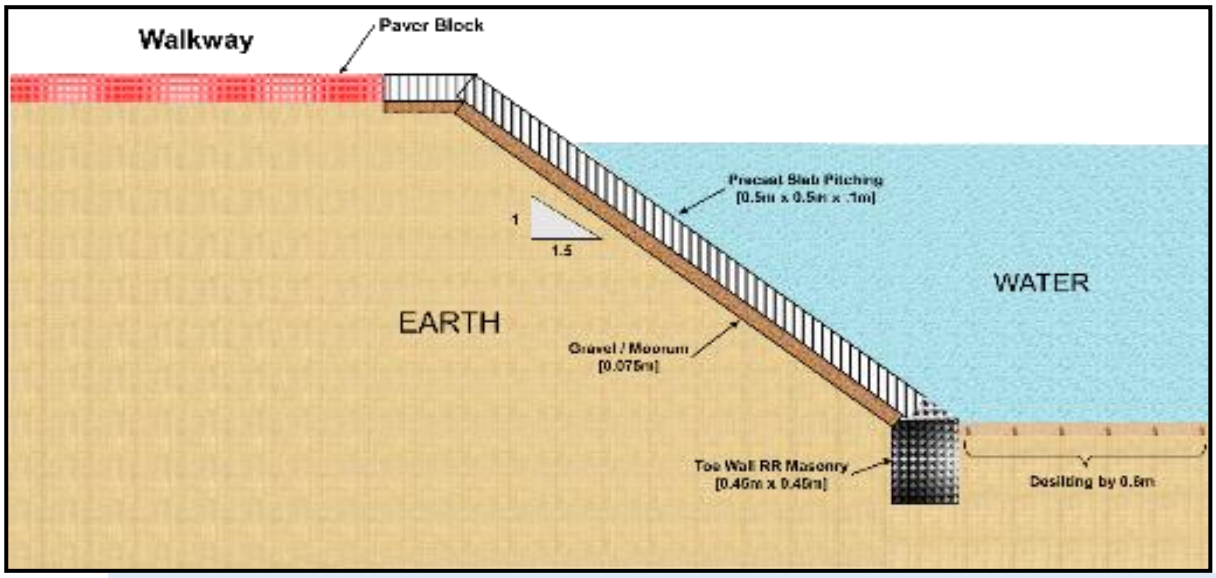
(ii) The rejuvenation of pond was planned by carrying out the following activities:

a. De-weeding and removal of vegetation and solid wastes.
b. Construction of RR toe wall masonry.
c. Slope training and bund strengthening.
d. Slope protection with precast CC slab pitching.

(iii) Creation of waterfront developments for recreation purposes through laying of paver blocks, creating seating arrangements through concrete benches, and installation of solar lamps for illumination.

(iv) The above efforts would improve the quality of life of the residents, restore ecological balance and eventually promote a healthy lake among other benefits of increasing the storage capacity of the lake.

Design & Engineering



Lake Rejuvenation		
Lake Perimeter Length	:	60 m
Slope Pitching	:	CC slab (500x500x100) mm
De-weeding	:	9900 sqm
Toe Wall	:	RR Masonry Wall
Public space		
Paved Area	:	200 sqm
Seating arrangement	:	3 – seater
Illumination	:	Solar lamp (3m high)

Specifications

Lake Rejuvenation	• Surface dressing of the ground including removing vegetation and inequalities not exceeding 15 cm deep and disposal of rubbish, lead up to 50 m and lift up to 0.5 m. • Slope Stabilization by levelling and compacting Filling with available fly ash and earth (excluding rock) in trenches or embankment in layers (each layer should not exceed 15 cm), with intermediate layer of compacted earth (Soil density of 98%) after every four layers of compacted depth of fly ash, sides & top layer of filling shall be done with earth having total minimum compacted thickness 30 cm, including compacting each layer by rolling/ ramming and watering. • Supply and laying of pre-cast plain cement concrete blocks of dimensions 500x500x100mm on plain areas and pond side slopes / verges (earthen shoulders).
Waterfront Developments	*Paver Blocks* • Providing and laying of 63mm thick factory-made cement concrete interlocking paver block of M-30 grade made by block making machine with strong vibratory compaction, of approved size, design & shape, laid in required colour and pattern over and including 100mm thick compacted bed of coarse sand / M-Sand, filling with machine compaction, joints filling with fine sand / M- Sand etc., all complete. *Concrete Bench* • High Strength Precast RCC bench manufactured by using M-30 grade of Concrete using vibro compaction process. • All components are reinforced suitably for long use and transportation. • All parts are joined together with galvanized nuts & bolts of suitable size and all bolts are sealed after assembly • Bench top and back planks are treated with special anti-corrosive, waterproof coating so as to make surfaces glossy and waterproof

	• Overall Dimensions: Seating length of the Bench – 1500 mm; Seating height of the Bench – 450 mm; Total height of the Bench – 1000 mm *Solar Lamp* • White light emitting diode (W-LED) integrated with separate PV module. • LED Capacity: 18 W White LED(W-LED) • LED fixing arrangement: Mounted on metal core PCB fixed to Aluminum Alloy heat sink • Driver parameters: Efficiency >90 % • LED Life time: L 70 rating for lumen maintenance is 50,000 hr • Lumen Depreciation (LD):L79Test Report for Performance at 50,000 hours • Colour Temperature: 5500K-6500K • Duty Cycle: Dusk to dawn as per MNRE specs with Motion sensors. • Optics: Special angle to suit intended design for street light situation

Photographs.

Before De-weeding of Pond

After De-Weeding of Pond

Sloping and compaction of Lake Bund

Sloping of Lake Bund

RCC Bench for lakefront development

Chapter 5

Work Status

S. No	Description	Completed Activities	Activities in progress
A	**Pre-Construction Stage**		
A.1	**Conceptualization of Project**		
1	Preliminary site visits	Completed	
2	Meeting with stakeholders	Completed	
3	Field investigations & topography survey [Using Drone]	Completed	
4	Geotechnical investigations	Completed	
5	Finalization of project scope	Completed	
A.2	**Design & Engineering**		
1	Preparation & presentation of conceptual design	Completed	
2	Preparation & submission of the preliminary estimate	Completed	
A.3	**Procurement Actions**		
1	Floating of tenders	Completed	
2	Processing of bids and Award of Contract	Completed	
B	**Construction Stage**		
B.1	**Work Execution**		
B.1.1	**Wastewater Management**		
1	Construction of the centralized septic tank	• Excavation • PCC Bed Concrete • Blockwork • Blockwork of inspection chambers • Flooring • Internal Plastering • RCC Works	Finishing & Handover
2	Constructed wetland system	• Excavation • PCC Bed Concrete • Blockwork • Laying of Geosynthetic membrane • Filter Media	Finishing & Handover
3	Construction of storm water drain	• Excavation • Raft	• Placing of Hume pipes

S. No	Description	Completed Activities	Activities in progress
		• RCC Works – Wall • Placing of Precast slabs	• Finishing & Handover
B.1.2	**Lake Bund Strengthening**		
1	Site Clearance by removing Unauthorized construction/Encroachment.	Completed	
2	De-weeding of the pond [by village Authorities]	Completed	
3	Surface dressing and slope Stabilization.		In Progress [80%]
4	Bund standardization with apron slabs and paver blocks.		In Progress [50%]

The project work will be completed along with handing over of assets by 31st May 2023 to the village Panchayat. To ensure smooth takeover and sustainability, we will handhold the authorities for an approximate period of 6 months.

Chapter 6

Quality Assurance and Quality Control practices

All materials procured at site are tested in Laboratory of BMS Institute of Technology and Management, Yelahanka, Bengaluru for ensuring the specifications and quality of work. Following consists the summary of test results conducted upon its corresponding materials. The detailed lab reports are attached in Annexure-6 for reference.

6.1 Blockworks

S. No	Tests Conducted	Results	Recommended by IS Code	Remarks
1.	Compressive Strength	14.13 N/mm²	5.0 N/mm²	For Block size (400X200X100)mm
		10.31 N/mm²	5.0 N/mm²	For Block size (400X200X150)mm
2.	Water Absorption	7.16%	<1 %	

6.2 Cement

S. No	Tests Conducted	Results	Recommended by IS Code	Remarks
1.	Compressive Strength	17.17 N/mm²	15.90 N/mm²	After 3 Days
		35.71 N/mm²	34.45 N/mm²	After 7 Days
2.	Consistency	32%	27% to 33%	
3.	Initial Setting Time	75 min	>30 min	
4.	Final Setting Time	7hr 10min	<10 hr	
5.	Fineness of Cement	6%	<10%	
6.	Specific Gravity	3.04	3.0 to 3.15	

6.3 Cement Mortar

S. No	Tests Conducted	Results	Recommended by IS Code	Remarks
1.	Compressive Strength	18.84 N/mm²	11.50 N/mm²	After 3 Days
		24.17 N/mm²	17.50 N/mm²	After 7 Days
2.	Flow Table Test	207 mm		

6.4 Fine Aggregate

S. No	Tests Conducted	Results	Recommended by IS Code	Remarks
1.	Bulk Density	1.409 g/cc	1.4 – 1.8 g/cc	For Loose Aggregate
		1.603 g/cc	1.6 – 2.0 g/cc	For Compacted Aggregate
2.	Water Absorption	2.84%	3%	
3.	Specific Gravity	2.67	2.5 to 2.7	
4.	Fineness Modulus	3.91	2 to 4	

6.5 Coarse Aggregate

S. No	Tests Conducted	Results	Recommended by IS Code	Remarks
1.	Aggregate Impact Test	25.24%	<30 %	
2.	Water Absorption	0.34%	<1 %	
3.	Aggregate Crushing Test	24.91%	<30 %	
4.	Fineness Modulus	7.33	6.75 to 8.00	
5.	Flakiness Index	19.59%	<30 %	
6.	Elongation Index	12.41%	<45 %	

Annexures

Annexure –1

[Refer Section 3.1 Pg.No.15 of Project Report]

Social Survey Report

Introduction

Muthur village is one of the hamlets located in Mallur Panchayat in Sidlaghatta Taluk of Chikkaballapura district in Karnataka, India. It is situated 8km away from the sub-district headquarter at Sidlaghatta (tehsildar office) and 17km away from the district headquarter at Chikkaballapur.

The total geographical area of the village is 468.59 hectares. Muthur has a total population of around 1500 people. There are about 350 houses in Muthur village. There is a poor transport facility in the village. The daily bus service only to Mallur Village and Chikballapur or frequent taxi facility in the village.

Sidlaghatta is the nearest town to Muthur for all major economic activities, which is approximately 8km away. The Muthur village is famous for its milk and silk. The main occupation of the people in the village of Sericulture, ragi, grapes, rice, pomegranate mulberry and flowers. Most of the houses in this hamlet have at least two to three cows. The people in this village sell the milk to the government cooperative society for their livelihood. There are no proper street names or streets formed in the village. All the streets in the village are without street names. Only cow milk is supplied to the government dairy; the buffalo milk is sold out to the local community.

Educational Status

There are two government schools located in the village. The government higher primary school (class 1 to 7) and the government high school (class 8 to 10) Getting a good education is challenging for the children in the village because there is no government higher secondary school in the village. The children have to travel to nearby villages to get a higher secondary school education. There is no private school in the village. The children have to travel to the nearby towns like Vijayapura and Kachalli for higher studies. The majority of households speak, read, and write the Kannada language. The few households, particularly the school-going children and college students, are able to read, write, and speak English.

Health Care Facility

There is no health care facility available in the village. For any minor health issues, the people have to travel 3 km to a nearby village for a private clinic. People have to travel to Sidlagatta town or Chikballapur town for any major health issues with both government and private hospitals. There is one government hospital in Mallur village with minor treatment facilities.

There are a few diabetics, BP, eye problems, people with vitamin deficiency and other old age health issues among the community people. The majority of houses are not properly handling the kitchen and bathroom water. They simply connected it to storm water drains and open lands. Due to this, there is a risk of health status due to water stagnation in the drains and the open lands.

Solid Waste Management Practice

There is no proper solid waste management being implemented by the panchayat. Some people throw garbage on roadsides and vacant lands. Many of them burn the yard trimmings on the road sides. Some of the compost the food waste in the back yard. Once a week (Tuesday), the garbage vehicle collects the garbage. The collected garbage like plastic, metals, glass and iron is taken outside to the Malanachanasalli Village Panchayat segregation shed, which is 8 km away from Muthur village. Cow dung is used as manure for the agricultural fields. There is no awareness among the community on how to handle the waste.




Water Supply

The major challenge is the less quantity of water supply by the panchayat to the households in the village. Once every five days, the panchayat supplies water to the village. The people use plastic pots, drums, and small tanks to store the water. People suffer because of the scarcity of water in the village. The middle class and upper-class people buy cane water and have their own bore water for drinking and all other purposes

The panchayat is not taking any initiative to improve the water supply in the village. Some households are not satisfied with the quality of water. They say that the quality of water is not good.

There are three borewells with a depth of 1000 ft., 1000 ft. and 1200 ft. that supply water for the entire panchayat. Of all the three, one borewell is in the Muthur slum and the remaining two are in the lake. The bore water in Muthur is stored in an underground sump with a capacity of one lakh, supplying water to the whole village of Muthur.

Dairy Farming

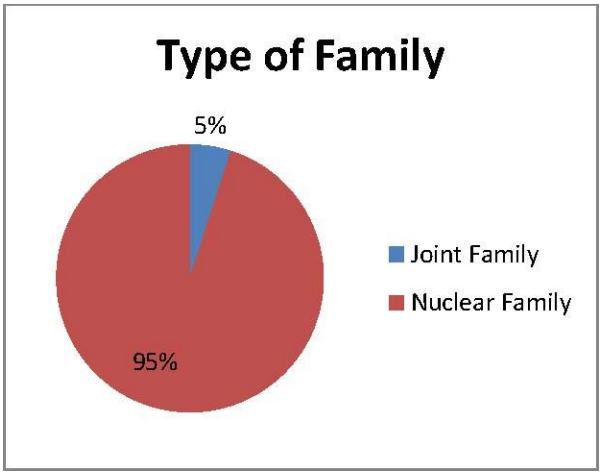
Dairy farming is one of the community's main sources of income. The majority of households depend on cow milk for their livelihood. They sell the milk in the government cooperative society and also in the local areas. Some of them have cattle farms, while others have cattle sheds in their homes. Both the men and women in the houses look after the cattle, doing things like feeding, bathing, milking, and grazing. If there are any health issues for the cattle, the men take the cattle to the government veterinary hospital. The people take cattle to the lake for baths. Some people say they did at the shed itself.

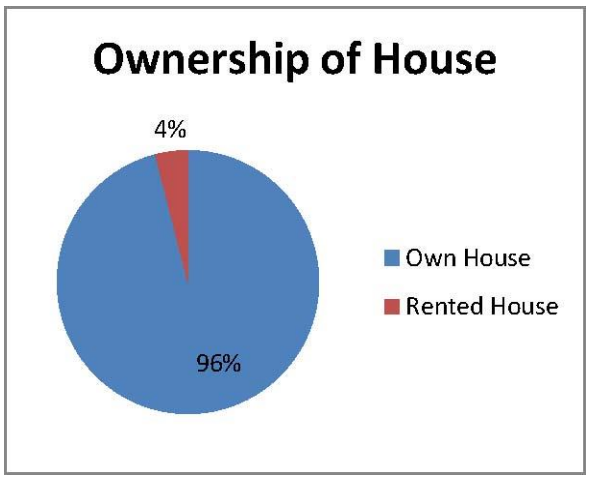
People interested in cattle rearing can apply for a cow loan of up to one lakh with an interest rate of 8% from a local bank. Many people benefited from this loan and purchased the cow. In addition to cattle rearing, the people also have goats and hens. They use it only for meat purposes.

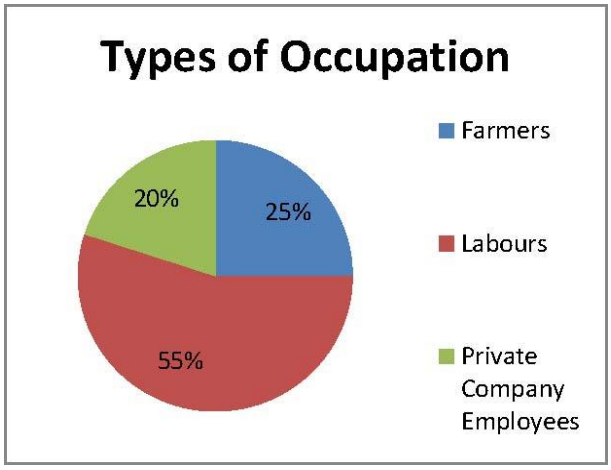
Sericulture Farming

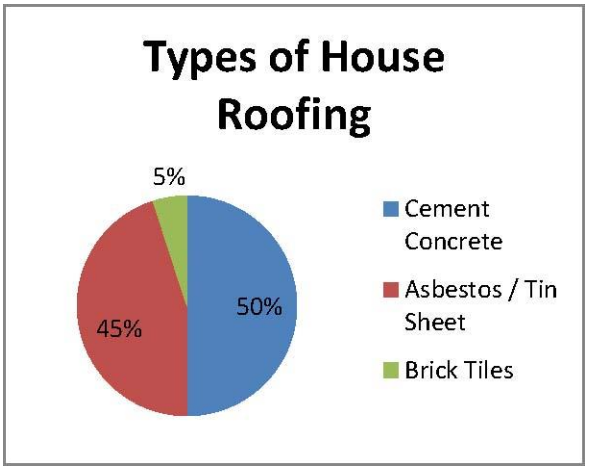
The sericulture which is practised here is world famous, particularly in Sidlaghatta, a town in the Chikkaballapur district, state of Karnataka. It is famous for its raw silk. Most of the people's income in Sidlaghatta depends on silk-related small-scale industries. The government pays Rs. 10,000 per acre per annum to those who indulge in sericulture. There are 243 inhabited villages and one town. Sidlaghatta town is the Taluk Headquarters. The Seri culture is carried mostly by the farmers with their own farm lands. The remaining people in the village work as farm labour in the fields.

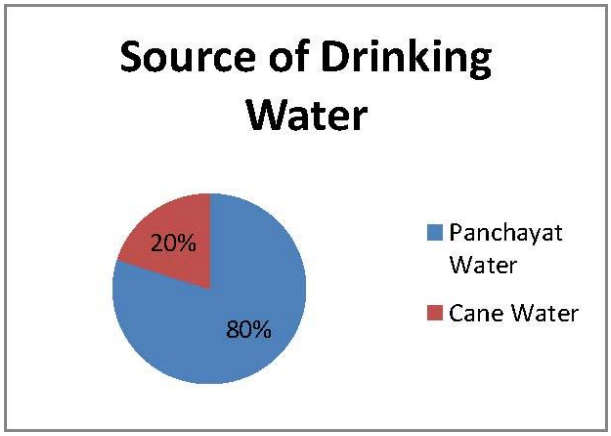
The majority of the villagers work in the field of sericulture. And they grow grapes, pomegranates, and other vegetables to earn more income. For the water supply, they depend on seasonal rainfall. The water in the lake is used for irrigation purposes.

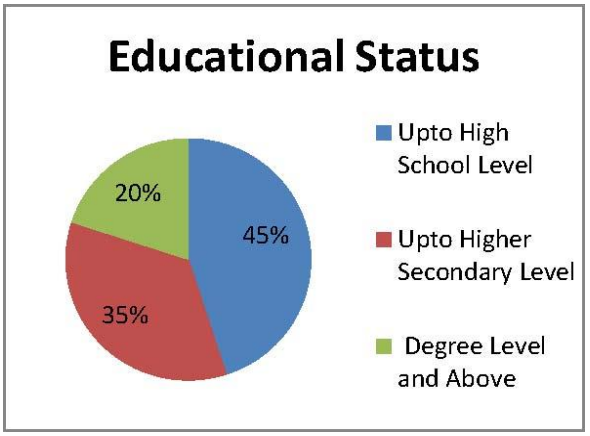

Type of Family
5%
95%
Joint Family
Nuclear Family

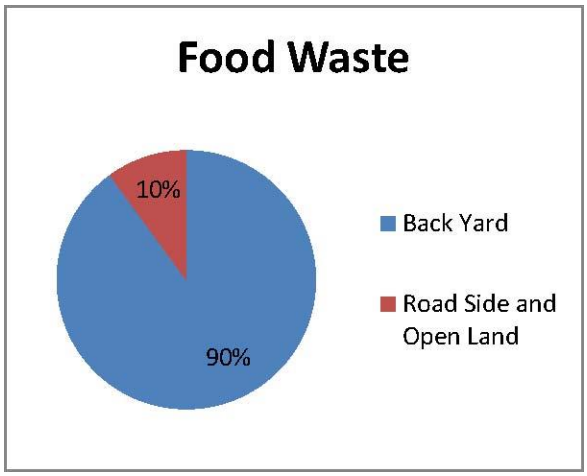

Ownership of House
4%
96%
Own House
Rented House

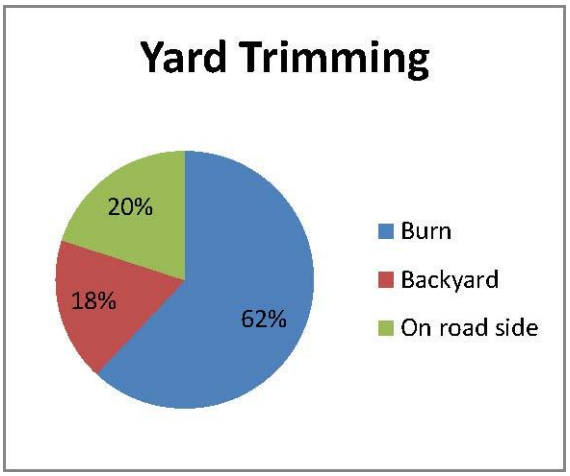

Types of Occupation
20%
25%
55%
Farmers
Labours
Private Company Employees

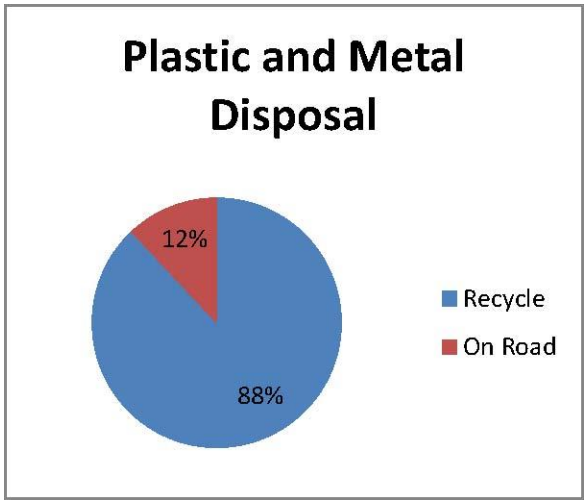

Types of House Roofing
5%
45%
50%
Cement Concrete
Asbestos / Tin Sheet
Brick Tiles

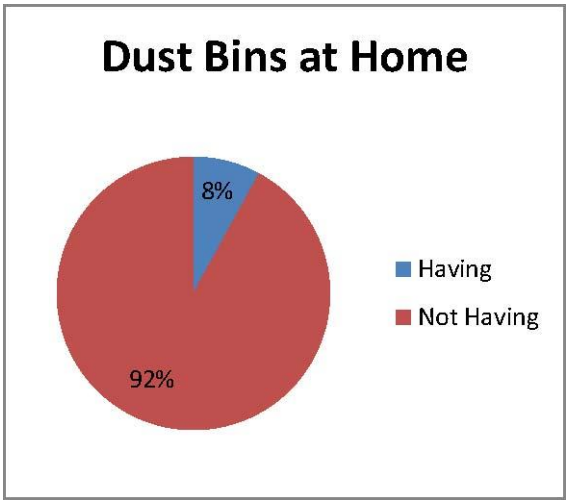

Source of Drinking Water
20%
80%
Panchayat Water
Cane Water

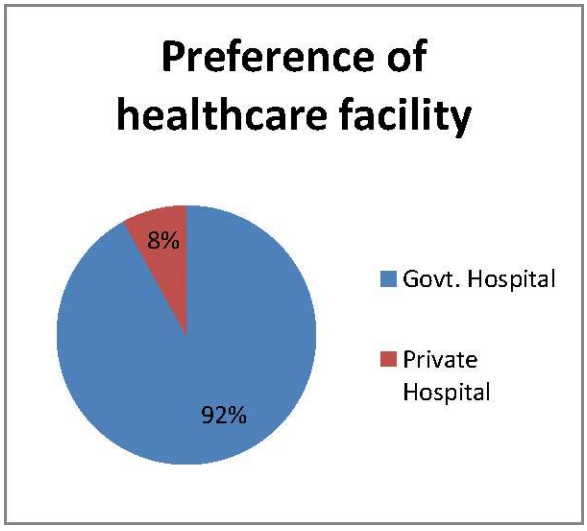

Educational Status
20%
45%
35%
Upto High School Level
Upto Higher Secondary Level
Degree Level and Above


Food Waste
10%
90%
Back Yard
Road Side and Open Land


Yard Trimming
20%
18%
62%
Burn
Backyard
On road side


Plastic and Metal Disposal
12%
88%
Recycle
On Road


Dust Bins at Home
8%
92%
Having
Not Having


Preference of healthcare facility
8%
92%
Govt. Hospital
Private Hospital

Annexure –2

[Refer Section 3.6 Pg.No.23 of Project Report]

Bore Log

Bore Hole Number: 01

Site Location: Muthur Village
Date of testing: 07/11/2022
Type of Boring: Manual Auger
Borehole diameter: 150 mm
Filled up soil level: 1.80m
Water Table: 2.30m

DESCRIPTION	Legend	Depth (m)	Sample	N – Value	Remarks
From Ground Level		0.00	--	--	
Brown with red clayey silty sand (filling soil)		1.50 m	SPT	7+8+9 N=17	
Filled up soil level		1.80 m			
White with pink and grey clayey silty sand		3.00 m	UDS	10+14+18 N=32	
White with grey clayey silty sand		4.50 m	SPT	15+16+21 N=37	
White with grey clayey silty sand		5.00 m	SPT	24for2cm N>50	

SPT: Standard penetration test
DS: Disturbed sample

Bore Hole Number: 02

Site Location: Muthur Village
Date of testing: 07/11/2022
Type of Boring: Manual Auger
Borehole diameter: 150 mm
Filled up soil level: 1.80m
Water Table: 2.30m

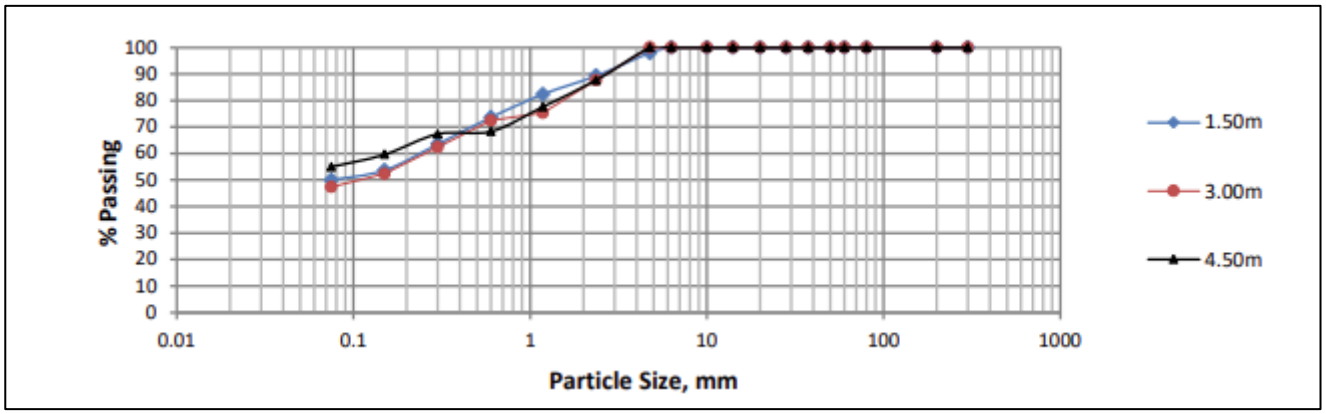
DESCRIPTION	Legend	Depth (m)	Sample	N – Value	Remarks
From Ground Level		0.00	--	--	
Brown with red clayey silty sand (filling soil)		1.50 m	SPT	7+8+9 N=17	
Filled up soil level		1.80 m			
White with pink and grey clayey silty sand		3.00 m	UDS	10+14+18 N=32	
White with grey clayey silty sand		4.50 m	SPT	15+16+21 N=37	
White with grey clayey silty sand		5.00 m	SPT	24for2cm N>50	

SPT: Standard penetration test
DS: Disturbed sample

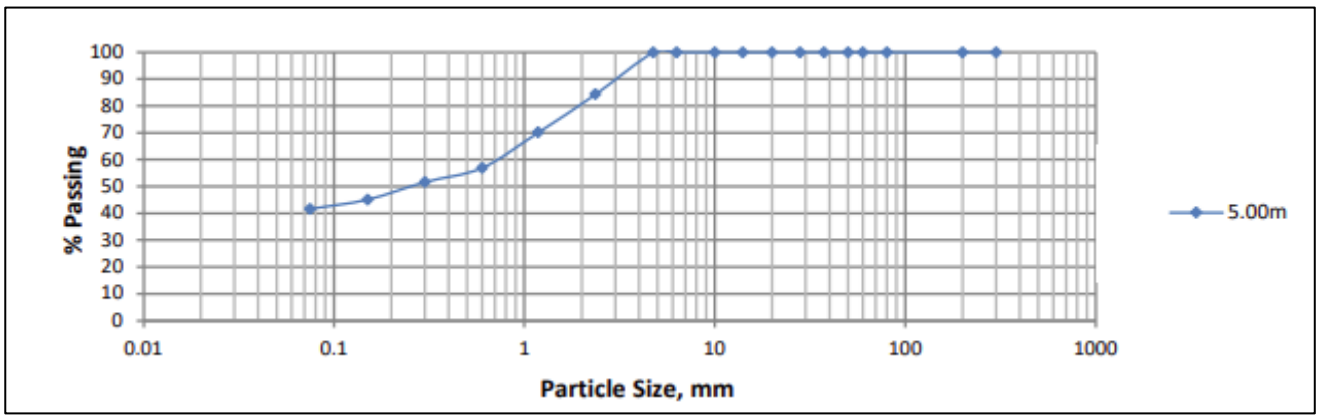
Annexure – 3

[Refer Section 3.6 Pg.No.23 of Project Report]

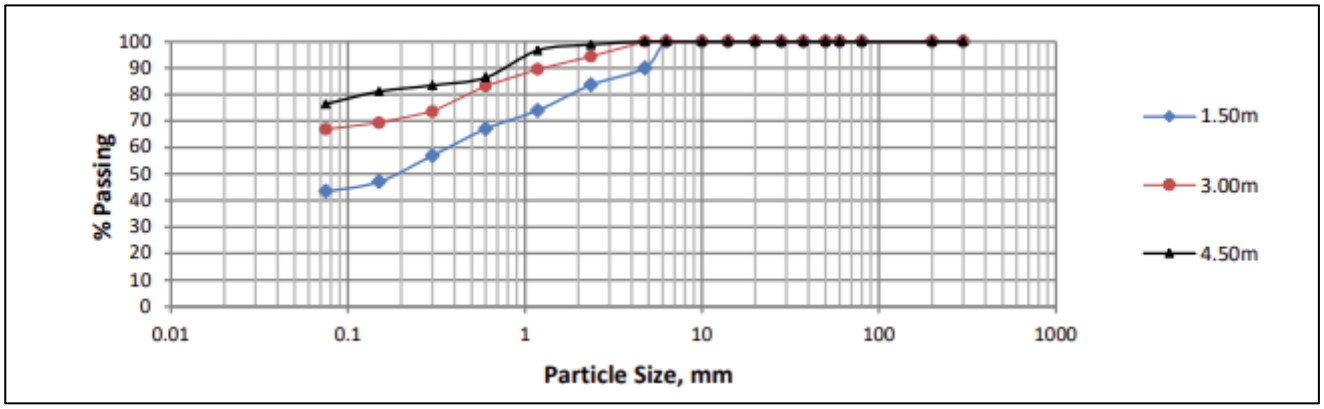
Grain Size Distribution Curves



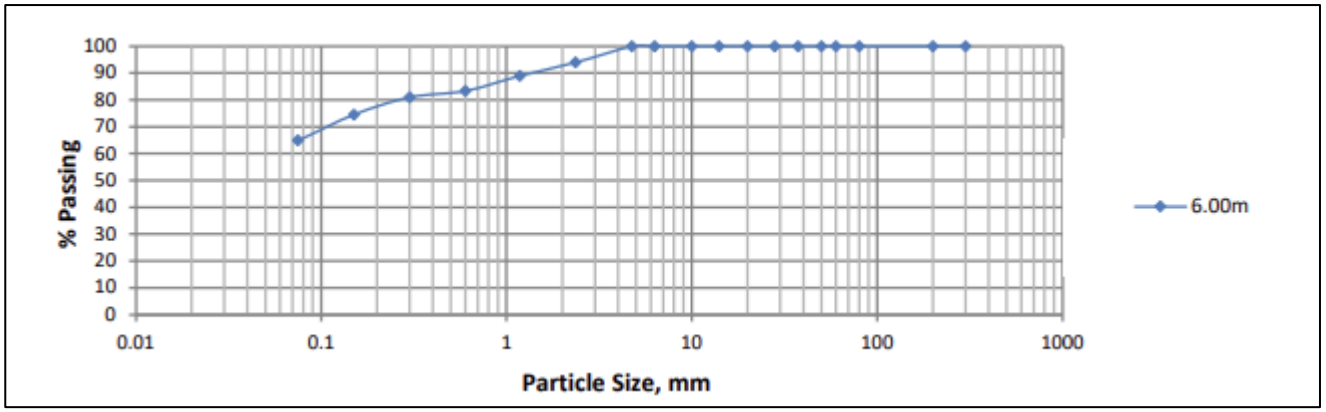
BH No.	Sample Identification	Boulders	Cobbles	Gravel	Sand	Silt/Clay
BH-01, 1.5m	1.50m	0	0	2	48	50
BH-01, 3.0m	3.00m	0	0	0	53	47
BH-01, 4.5m	4.50m	0	0	0	45	55



BH No.	Sample Identification	Boulders	Cobbles	Gravel	Sand	Silt/Clay
BH-01, 5.0m	5.00m	0	0	2	58	42



BH No.	Sample Identification	Boulders	Cobbles	Gravel	Sand	Silt/Clay
BH-02, 1.5m	1.50m	0	0	10	47	43
BH-02, 3.0m	3.00m	0	0	0	33	67
BH-02, 4.5m	4.50m	0	0	0	24	76

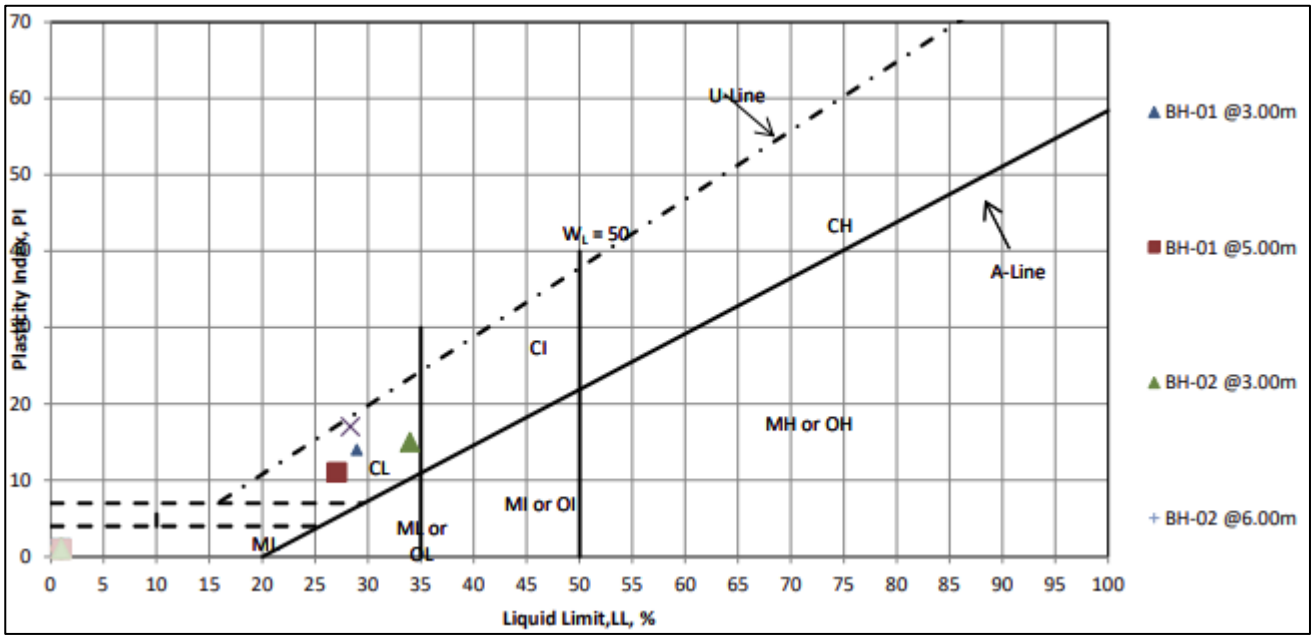


BH No.	Sample Identification	Boulders	Cobbles	Gravel	Sand	Silt/Clay
BH-02, 6.0m	6.00m	0	0	0	35	65

Annexure – 4

[Refer Section 3.6 Pg.No.23 of Project Report]

Attenberg's Limits Results

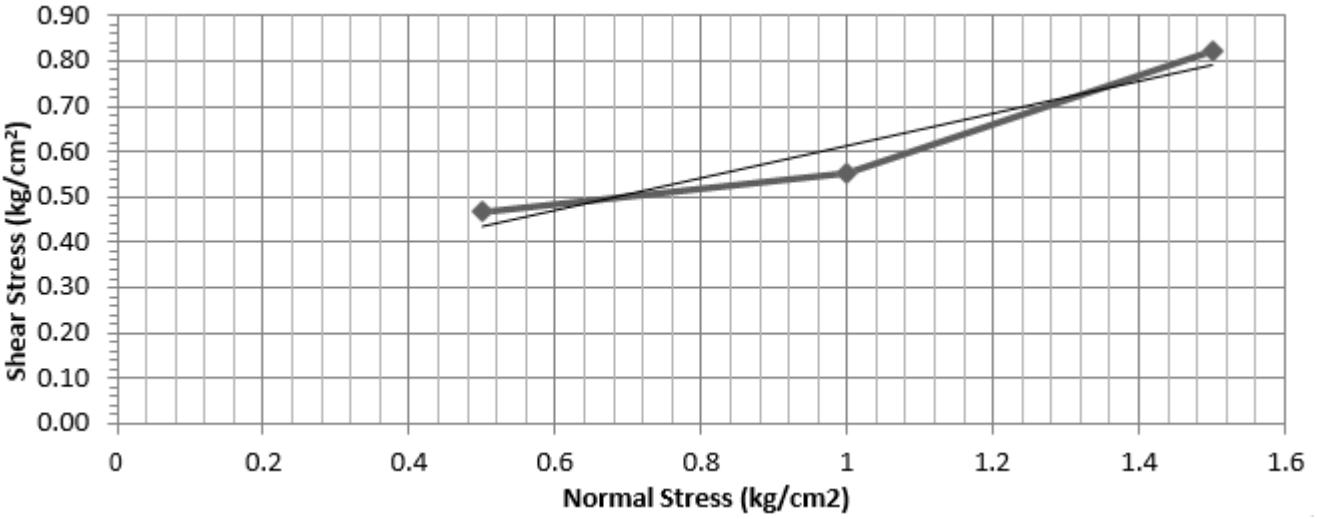


S. No.	Location	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index
1	BH-01 @ 3.00m	29	15	14
2	BH-01 @ 5.00m	27	16	11
3	BH-02 @ 3.00m	34	19	15
4	BH-02 @ 6.00m	32	20	12

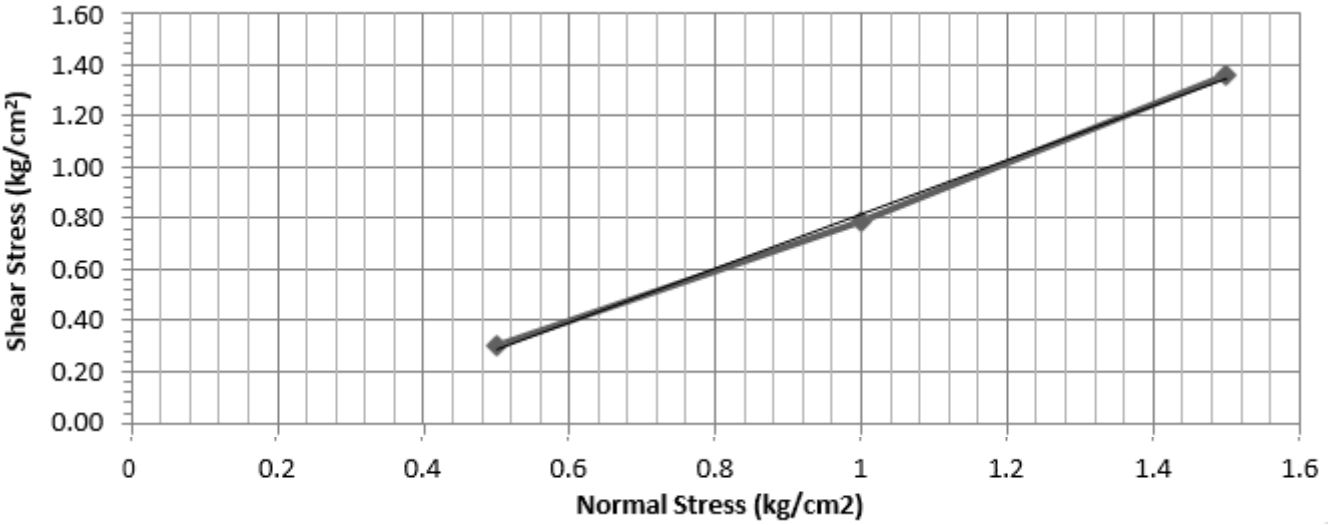
Annexure – 5

[Refer Section 3.1.6 Pg.No.23 of Project Report]

Direct Shear Stress



BH – 01 @ 3.00m



BH – 02 @ 4.50m

Annexure – 6

[Refer Section 6 Pg.No. 43. of Project Report]

Construction Materials Tests Reports

1. Test Report on Solid Blocks

Source of Sample : Sample supplied by the customer.
No. of sample tested : 3 (Three)
Customer Reference : Mr. Shivananda, Sidlaghatta
Project : Construction for Drainage & Septic Tank at Muthur Village
Date of Test : 30/03/2023
Condition of Samples : Satisfactory
Test Method : IS: 2185-Part 1- 2005

Compressive Strength Test:

S. No	Density of Block in kg /m²	Wt. (kg)	Size of Block (mm)	Load (kN)	Compressive Strength (N/mm²)	Average value of Compressive strength	As per IS:2185-1-2005 Compressive strength
1	2000kg/m²	16.58	400x200x100	1121.6	14.02	**14.13 N/mm²**	**5.0 N/mm²**
2		16.08	400x200x100	1155.9	14.15		
3		15.52	400x200x100	1138.5	14.23		

S. No	Density of Block in kg /m²	Wt. (kg)	Size of Block (mm)	Load (kN)	Compressive Strength (N/mm²)	Average value of Compressive strength	As per IS:2185-1-2005 Compressive strength
1	2000kg/m²	24.16	400x200x150	808.1	10.10	**10. N/mm²**	**5.0 N/mm²**
2		24.20	400x200x150	854.1	10.68		
3		24.20	400x200x150	812.0	10.15		

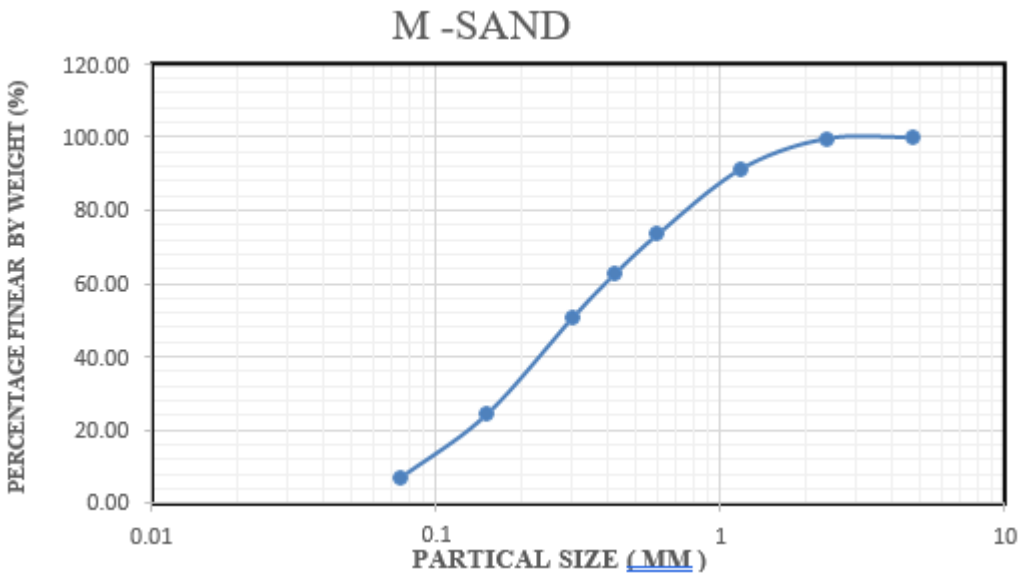
2. Test Report on M-Sand

Source of Sample	:	Sample supplied by the customer
No, of sample tested	:	3 (Three)
Customer Reference	:	Mr. Shivananda, Sidlaghatta
Project	:	Construction for Drainage & Septic Tank at Muthur Village
Date of Test	:	30/03/2023
Condition of Samples	:	Satisfactory
Test Method	:	IS: 2386(Part-III)-1963, IS: 2386(Part-IV)-1985

Specific Gravity Test of M Sand:

Sl. No	Description	Trail 1	Trail 2	Trail 2	Standard Value
1	Temperature in C 24°	24°	24°	24°	**2.5 to 2.7 Range**
2	Weight of Density Bottle (W1)	24.15	23.40	23.17	
3	Weight of Density Bottle + Dry Soil (W2)	51.67	58.65	56.87	
4	Weight of Density Bottle + Dry Soil + Water (W3)	91.58	96.44	95.43	
5	Weight of Density Bottle + Water (W4)	74.32	74.60	74.23	
	CALCULATION: G= w2-w1/(w2-w1) - (w3-w4)				
1	Specific Gravity	2.68	2.62	2.69	
2	**Average G (at 24° C)**	2.67			

Sieve Analysis



CALCULATION: Cu = D60 / D10 Cc = $(D30)^2$ / (D10) (D60) Fineness Modulus = (cumulative % retained/100)		**Standard Value**
D60	0.38	**Well – Graded Sand** **Coefficient of Uniformity (CU) >6** **Coefficient of Curvature (CC) = 1 < Cc < 3** **Fineness Modulus = 2.00 to 4.00 Range**
D30	0.18	
D10	0.17	
Coefficient of Uniformity (CU)	2.08	
Coefficient of Curvature (CC)	0.43	
Fineness Modulus	3.91	

3. Test Report on Cement Cubes

Source of Sample : Sample prepared in BMSIT Civil laboratory
Details of cube : 1:3 mix proportion
No. of sample tested : 3 (three)
Date of Casting : 30/03/2023
Customer Reference : Mr. Shivananda, Sidlaghatta
Project* : Construction for Drainage & Septic Tank at Muthur Village
Date of Test : 04/04/2023 & 08/04/2023
Condition of Samples : Satisfactory
Test Method : IS: 4031-(Part 6)-1988

Compressive strength of cement

S. No	Grade of Cement	Age of Cubes (days)	Wt. of Cubes (kg)	Size of Cubes (mm)	Load(kN)	Compressive Strength (N/mm^2)	Average value of Compressive strength	As per IS:4031-(Part6)-1988 Compressive
1	Birla super PPC	03	0.786	70.6x70.6	84..4	16.93	**17.17 N/mm^2**	**15.9 N/mm^2**
2		03	0.775	70.6x70.6	85.9	17.23		
3		03	0.780	70.6x70.6	86.5	17.35		
4	Birla super PPC		0.780	70.6x70.6	173.4	34.70	**35.71 N/mm^2**	**34.45 N/mm^2**
5			0.783	70.6x70.6	178.3	35.77		
6		07	0.765	70.6x70.6	182.8	36.67		

4. Test Report on M-Sand Cement Mortar Cubes

Source of Sample	: Sample prepared in BMSIT Civil laboratory
Details of cube	: 1:3 mix proportion
No. of sample tested	: 3 (three)
Date of Casting	: 30/03/2023
Customer Reference	: Mr. Shivananda, Sidlaghatta
Project*	: Construction for Drainage & Septic Tank at Muthur Village
Date of Test	: 04/04/2023 & 08/04/2023
Condition of Samples	: Satisfactory
Test Method	: IS: 4031-(Part 6)-1988

Compressive Strength of Cement Mortar

Sl. No	Grade of Cement	Age of Cubes (days)	Wt. of Cubes (kg)	Size of Cubes (mm)	Load (kN)	Compressive Strength (N/mm^2)	Average value of Compressive strength	As per IS:4031-(Part6)-1988 Compressive
1	PPC	03	0.784	70.6x70.6	94.5	18.95	**18.84 N/mm^2**	**11.50 N/mm^2**
2		03	0.792	70.6x70.6	95.3	19.11		
3		03	0.786	70.6x70.6	92.1	18.47		
4	PPC	07	0.794	70.6x70.6	122.1	24.49	**24.17 N/mm^2**	**17.50 N/mm^2**
5		07	0.790	70.6x70.6	118.6	23.79		
6		07	0.785	70.6x70.6	120.9	24.25		

5. Test Report on Cement

Source of Sample : Sample prepared in BMSIT Civil laboratory

Grade of Cement : Birla Super PPC 53

No. of sample tested : 3 (three)

Customer Reference : Mr. Shivananda, Sidlaghatta

Project* : Construction for Drainage & Septic Tank at Muthur Village

Date of Test : 30/03/2023

Condition of Samples : Satisfactory

Test Method : IS: 4031- (Part-4)1988

SL. No	Name of the Test	Average Value	Recommended as per IS: 4031- (Part-1 &4)1988
1.	Consistency of Cement	32.0(%)	27.0 to 33.0 (%)
2.	Initial Setting Time	75 Minutes	>30 Minutes
3.	Final Setting Time	7 Hours 10 Minutes	<10 Hours
4.	Fineness of Cement	6.0 %	<10%

6. Test Report on P-Sand

Source of Sample : Sample supplied by the customer

Grade of Cement : Birla Super PPC 53

No, of sample tested : 3 (Three)

Customer Reference : Mr. Shivananda, Sidlaghatta

Project* : Construction for Drainage & Septic Tank at Muthur Village

Date of Test : 28/03/2023

Condition of Samples : Satisfactory

Test Method : IS: 4031-(Part 11)-1988

Specific Gravity Test

Sl. No	Description	Trail 1	Trail 2	Trail 2	Standard Value
1	Temperature in C 24°	24°	24°	24°	**3.0 to 3.15 Range**
2	Weight of Density Bottle (W1)	37.10	36.25	35.48	
3	Weight of Density Bottle + Dry Cement (W2)	54.15	53.05	50.09	
4	Weight of Density Bottle + Dry Cement + Water (W3)	93.10	92.21	88.92	
5	Weight of Density Bottle + Water (W4)	80.75	80.10	78.35	
6	Weight of Density Bottle + Kerosene (W5)	87.0	89.15	86.35	
	CALCULATION: G= w2-w1/(w2-w1)-(w3-w4)*Gk				
	Specific Gravity	3.06	3.02	3.05	
	Average G (at 24° C)	3.04			

7. Test Report on Coarse Aggregates

Source of Sample : Sample prepared in BMSIT Civil laboratory

No. of sample tested : 3 (three)

Customer Reference : Mr. Shivananda, Sidlaghatta

Project* : Construction for Drainage & Septic Tank at Muthur Village

Date of Test : 30/03/2023

Condition of Samples : Satisfactory

Test Method : IS: 2386- (Part-3)1963

Water Absorption of Coarse aggregates

Sl. No.	Description	Trail 1	Trail 2	Trail 3	Standard Value
1	Weight of saturated surface–dried coarse aggregate: (A)	2.350	2.395	2.450	Less than 2%
2	Weight of saturated aggregatesin air: (B)	2.340	2.388	2.442	
3	**CALCULATION:** = [(A – B)/B] x 100%.	0.42	0.29	0.32	
4	**Average of value of Water Absorption**	0.34 %			

Aggregate Impact Test

Description	1	2	3
Total weight of the aggregate sample filling the cylindrical measure w1g	366	368	367
Weight of the aggregate passing 2.36mm sieve after test w2 g	96	86	91
Weight of the aggregate retained on 2.36mm sieve after the test w3 g	268	278	273
Difference in weight = w1(w2+w3) g	2	4	3
Aggregate impact value =100*w2/w1	26.229	23.369	24.795