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Study of Ground Water in Perungudi Area of Chennai: Correlation with Physico-Chemical Parameters

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Abstract

The major source of water pollution is domestic waste from urban and rural areas, and industrial wastes which are discharged into natural water bodies. Ground water is the largest source of fresh water in developing countries and it is also subjected to such danger. In this study we have evaluated the extent of pollution caused in ground water in Perungudi. The study area is one of the major sewage disposal areas in Chennai city stretching up to 400 acres. Around 3000 tons of sewages is generated per day in Chennai city out of this half of the sewage is disposed off in Kodungaiyur and the remaining at Perungudi. This waste disposal site has been in operation since 1985. During the past 7-8 years (2003-2010) the solid waste has increased from 1000 tons to 3000 tons per day. In this report we have summarized the laboratory results of all the samples collected from the study area against the BIS standard for drinking water. It was found that the samples which are nearer to the dumping ground are contaminated and somewhat toxic materials like fluorine, manganese etc. are compared to the samples away from the dumping ground.

Keywords: Ground water, Total dissolved solids, pH, Turbidity, Electrical conductivity.

1. Introduction

The world's total water resource is estimated to be $1.37x10^8$ million ha-m. Of these, about97.61% is salt water in ocean and sea. 2.93% is available as surface water and 0.29% as ground water. It is the largest source of fresh water in the hydrological cycle. Nearly 1/5 of all the water used in the world is obtained from ground water resources. It occurs widely and occurs commonly distributed, and it has historically been considered as a reliable and safe source of water. All living organisms are dependent upon pure oxygen, water and soil in one form or the other to maintain metabolic processes that produce energy for growth and reproduction.

Due to the rapid increase in industries and population the exploitation of air, water and soil from the nature are also increasing. The pollutants like Sulfur dioxide, nitrogen, nitrite, sulfide, carbon dioxide etc. are the main causes of air pollution. The presence of high organic content, toxic compounds (manganese, zinc, and mercury), mutagenic detergent etc. are the pollutants of water pollution. Most of the industrial and domestic wastes are disposed off in water without proper treatment which may contain various pollution causing components. In developing countries there has been an immense increase in ground water development and utilization. The ground water generally is used without any treatment for all domestic purposes. Therefore it is essential to keep the ground water free from any kind of pollution.

Municipal Solid Waste Management (MSWM) is a challenging problem for developing countries. Municipal Solid Waste (MSW) generation in Chennai, the fourth largest metropolitan city in India, has increased from 600 to 3500 tons per day within 20 years. The highest per capita solid waste generation rate in India is in Chennai (0.6 kg/d). Chennai is divided into 10 zones of 155 wards and collection of garbage is carried out using door-to-door collection and street bin systems. The collected wastes are disposed at open dump sites located at a distance of 15 km from the city. Recent investigations on reclamation and hazard potential of the sites indicate the need for the rehabilitation of the sites. Population growth and rising income have resulted in a rapid growth in MSW generation rate of the city. MSW generated in Chennai includes 68 % of residential waste, 16 % commercial waste, 14 % institutional waste and 2 % industrial waste. (Fig 1.1).The Municipal Solid Waste comprises different waste like organic wastes, paper, plastics,glass, inert wastes, rages, metals etc. (Fig1. 2) shows the solid wastes contain in MSW in Chennai, showed that the majority of the waste is composed of green waste (32.3%) and inert materials (34.7%) viz., stones and glass.

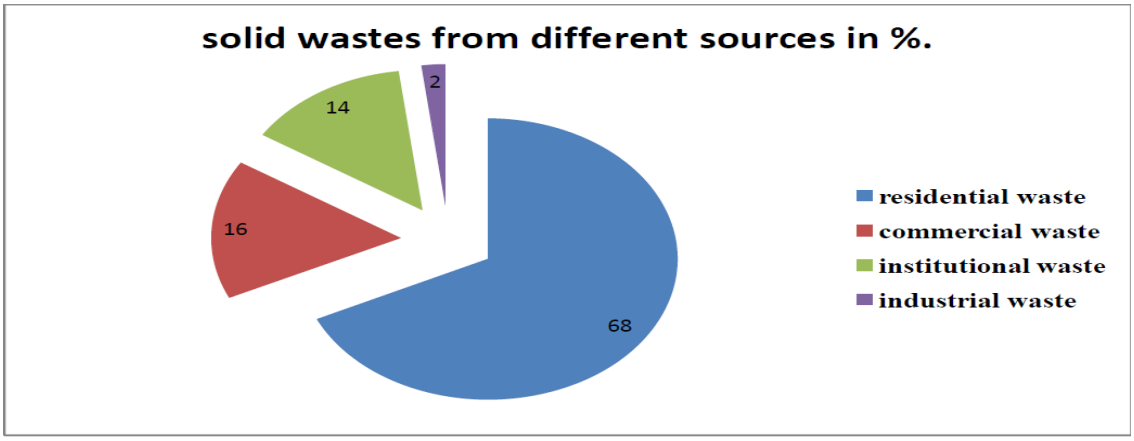

FIG 1.1. SOLID WASTE FROM DIFFERENT SOURCES.

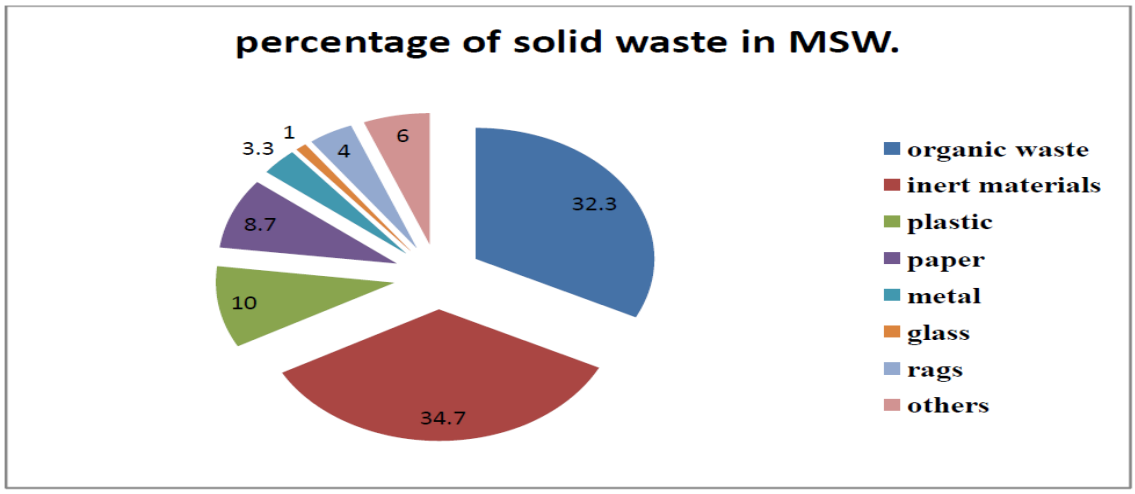

FIG.1. 2. PERCENTAGE OF SOLID WASTE IN MSW.

1.1 Impact of solid wastes on ground water

The leachate produced by waste disposal sites contains a large amount of substances which are likely to contaminate ground water. The impact of such sites upon ground water can be judged by monitoring the concentration of potential contaminants at a number of specific monitoring points. In this study, the quality of ground water around a municipal solid waste disposal site in Chennai was investigated. Chemical analysis were carried out on water samples collected at various radial distances from the boundary of the dumping yard, at intervals of 3 months and for a period of 3 years.

The study has revealed that the ground water quality does not conform to the drinking water quality standards as per Bureau of Indian Standards. The effects of dumping activity on ground water appeared most clearly as high concentrations of total dissolved solids, electrical conductivity, total hardness, chlorides, chemical oxygen demand, nitrates and sulphates. Leachate collected from the site showed presence of heavy metals. The contaminant concentrations tend to decrease, during the post monsoon season and increase, during the pre monsoon season in most of the samples.

The study clearly indicates that landfills in densely populated cities should have the ground water monitored on regular basis. Furthermore, ground water in and around the landfill sites shall not be used for drinking purposes unless it meets specific standards. Indiscriminate dumping of wastes in developed areas without proper solid waste management practices should be stopped.

Solid waste disposal sites are potentially serious sources of pollution to the environment, especially when located very close to water sources and operated haphazardly. The high pollution potential of these sites is due to the fact that they usually contain almost all types of pollutants from the source community. The contaminants can leach out through the soil, contaminating the soil itself, ground water, and surface water.

2. Materials and Methods

The study area undertaken is the surrounding area of Perungudi dumping ground which is one of the major Municipal Solid Waste disposal site in Chennai metropolitan. Perungudi is located longitude (DMS) 80°07’60’’ E, and latitude (DMS) 12°56’60’’ The study area is located in joint with Velachery, Taramani, Thoraipakkam and Madipakkam which are major populated area in Chennai city. The dumping yard

stretches approximately to 400acr.the study area in at the range of 2km from the dumping yard. This dumping ground has been in operation since 1985. More than 3000tonnes of solid wastes generates from Chennai city half of the wastes are disposed off in Kodungaiyur and the rest in Perungudi. The samples of ground water were collected within the range of 2 km from the solid waste dumping zone. 15 samples of ground water were collected from different sources at various distances. This includes 6 samples from dug wells and 9 samples from tube wells. The nearest sample assuming a centre point at the approximate centre of dumping ground was collected at a distance of approximately 1084 m and the varying samples at 50-100 m distance from each other. (fig 2.1)

The groundwater quality parameters which were analyzed are Appearance ,Odour , Turbidity (NTU), Total dissolved solids (mg/l) (TDS), Electrical conductivity (micro mho/cm), pH, Alkalinity (mg/lit), Chloride as Cl (mg/lit), Dissolve oxygen (mg/lit), Iron (mg/lit), Total hardness (mg/lit), Sodium As Na (mg/l),Potassium As K (mg/l), Biochemical oxygen demand (BOD)

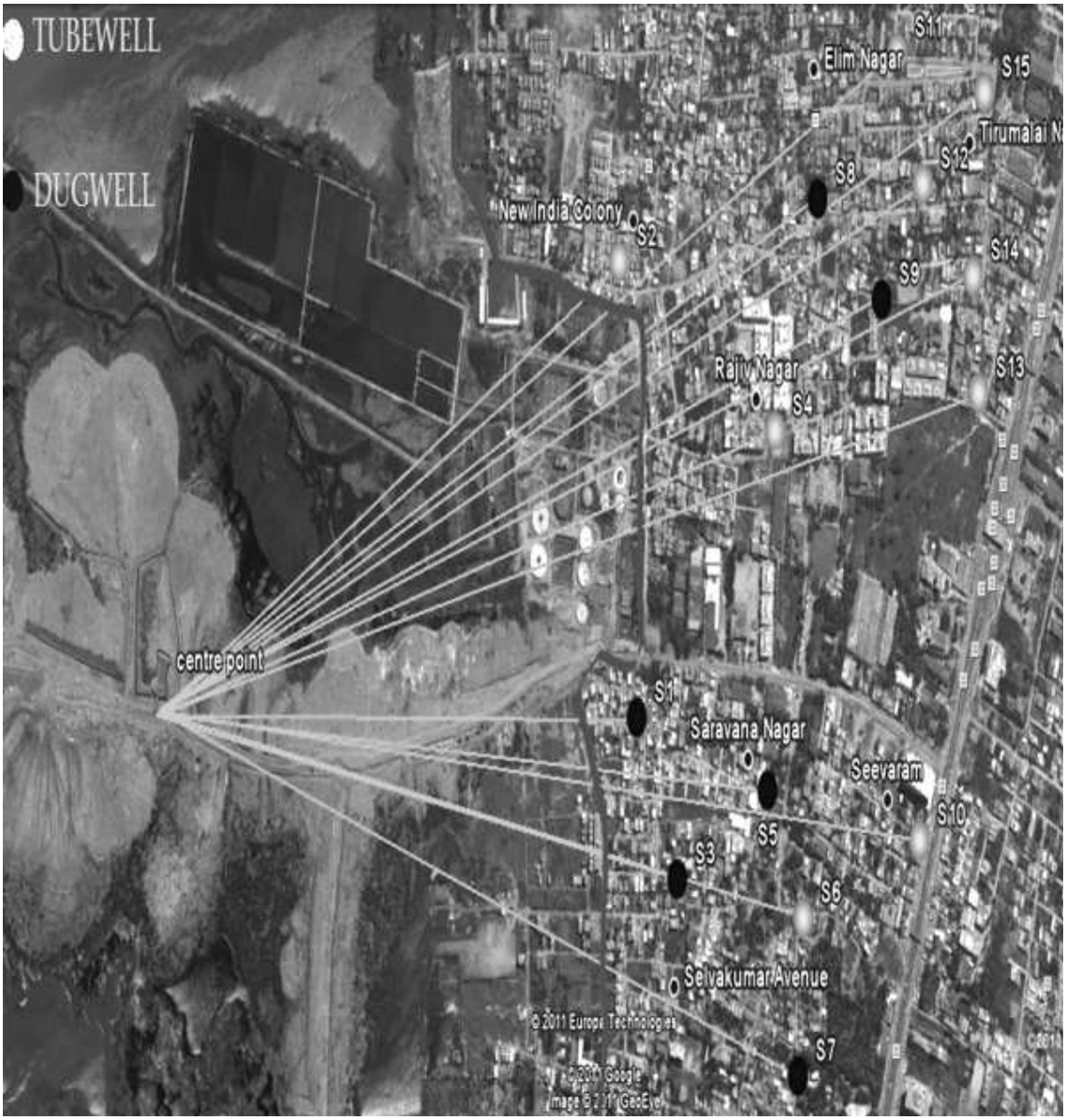

fig 2.1 Location of Samples

3. Results

In this study the ground water quality from Perungudi area was compared with the standard water parameters. The value of data from ground water for physical properties, chemical properties and biological properties are shown in table 3.1

Table 3.1. Obsrevation for Sample 1, sample 2 and sample 3.

Parameters	**Sample 1(1084m)**	**Sample 2(1138 m)**	**Sample 3(1215m)**
Appearance	Slightly turbid	Slightly turbid	colourless
Odour	None	None	None
Turbidity NTU	12.3	12.8	11.1
Total dissolved solids (mg/l)	750	600	550
Electrical conductivity (micro mho/cm)	3144	3012	2882
Ph	8.8	8.6	8.6
Alkalinity (mg/l)	390	375	370
Chloride as Cl (mg/l)	1029.5	994	958
Dissolved oxygen (mg/l)	10.5	11.5	12.5
Iron (mg/l)	0.0402	0.0402	0.031
Total hardness (mg/l)	675	630	610
Sodium as Na (mg/l)	370	368	366
Potassium as K (mg/l)	40	40	40

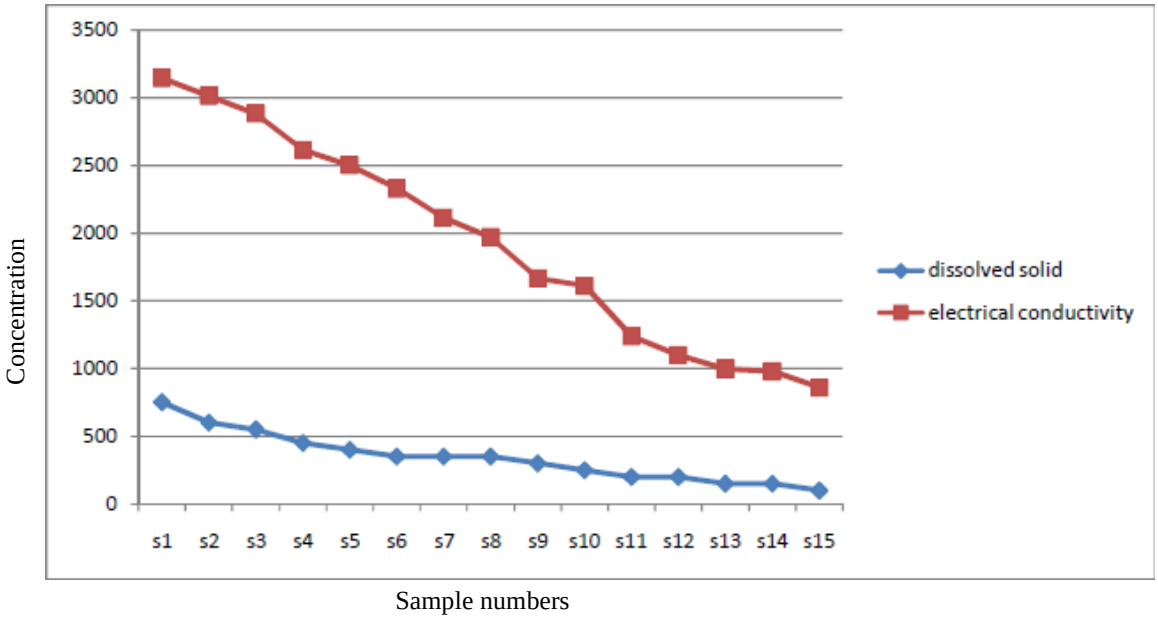

Fig 3.1 DS and electric conductivity in samples

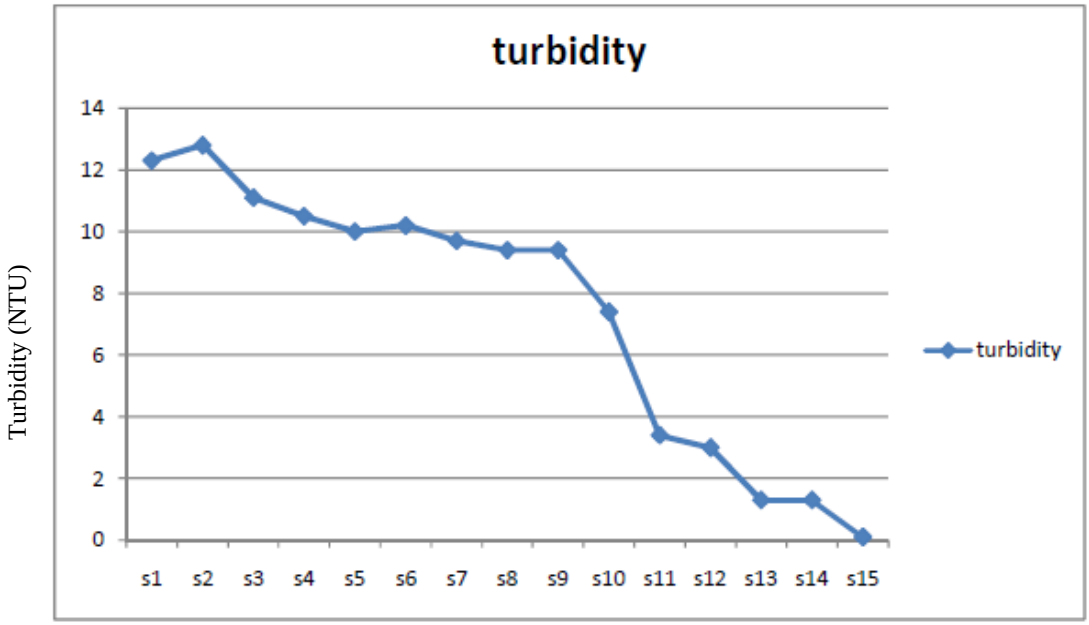

Fig 3.2 Turbidity in different samples

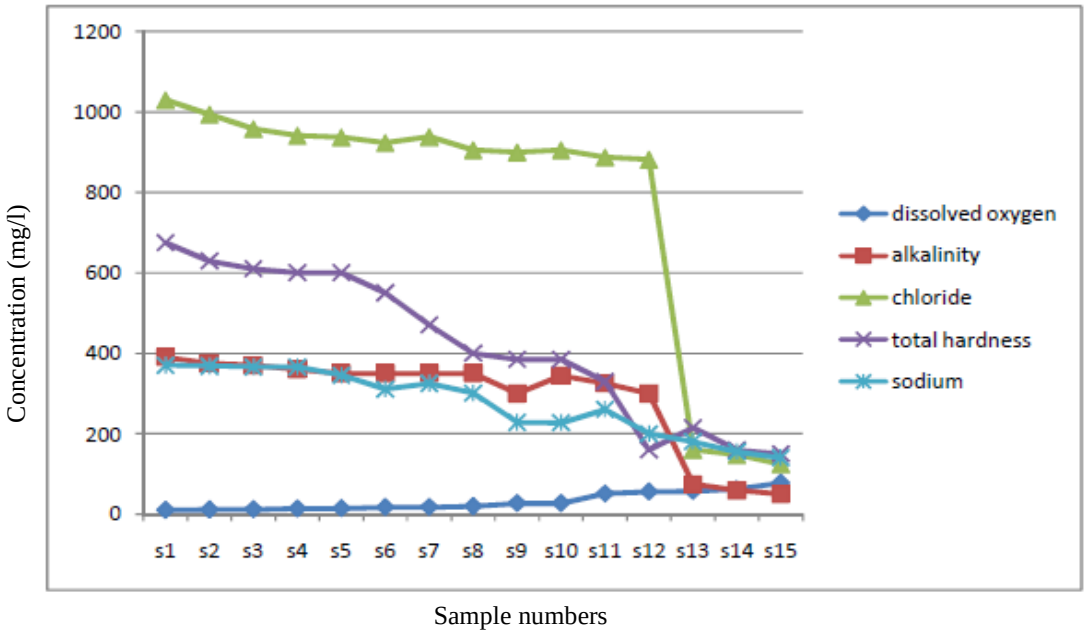

Fig 3.3 Different chemical parameters in samples

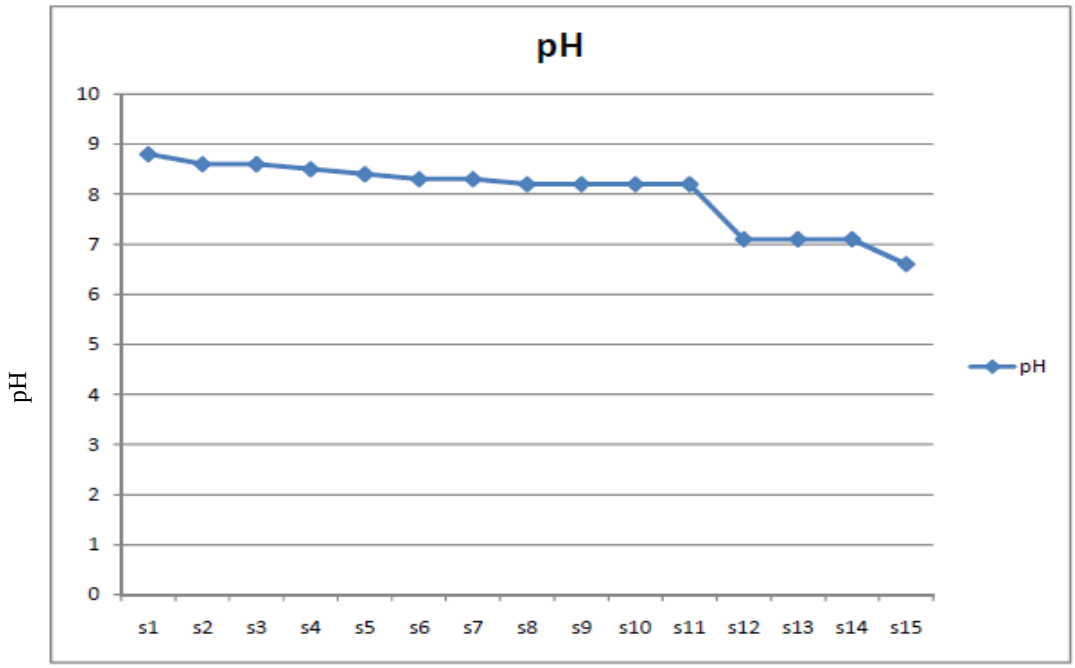

Fig 3.4 pH concentrations in samples

4. Conclusion

Water sample no. 1, 2, 3 and 4 shows very high level of contamination and is alkaline. It indicates the water is partially toxic in nature and not suitable for any domestic purposes.According to our observation the concentration of ammonia in these samples are high enough to cause irritation to eyes, nose and throat of the most sensitive individuals.The samples which were taken closer to the dumping ground contain high level of fluoride, nitrate and nitrite which indicates that the sample is toxic. The presence of chemicals, calcium, magnesium, manganese, chloride and sulphate shows that the water is hard in nature and is of low quality and it may cause various health hazards.It is observed that the water sample no. 5,6,7,8 and 9 shows lesser amount of contamination compared to previous samples. It can be use for washing, cleaning, bathing etc. but it is not suitable for drinking purposes. The water samples 10, 11, 12, 13, 14, and 15 shows very less amount of contamination level and can be use for various domestics purposes. These are within the desirable limit as per Indian standard .It has been observed that the amount of contamination in the water sample decreases with increase in the distance from the dumping zone.

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