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COMPARATIVE STUDY OF PHYSICO-CHEMICAL PARAMETERS OF GROUND WATER NEAR OMTI NALA BEFORE & AFTER LINING

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ABSTRACT : *The present research was carried out to evaluate the physico-chemical parameters of ground water supply near Lined Omti Nala within the range of 1.0 meter to 5.0 meter beside the nala in Jabalpur city and comparing the obtained results with the results of Omti Nala Purpose Driven Study completed by Water Resource Department of M.P. in 2009 – 2014. The study was carried out before the lining of Nala. In order to determine the quality of its water for drinking and other purposes, the twelve physicochemical parameters which includes pH, Total dissolved solids, total hardness, calcium, magnesium, Dissolved oxygen (DO), BOD, alkalinity, chloride, fluoride, nitrate, & coliforms were analyzed. This has been verified by collecting the water samples from 4 different locations in the area where there is motorized supply or hand pump system that are used for drinking purpose. Accordingly, the obtained result shows that most of the physical properties were within the acceptable range where as some parameters are at alarming state as compared to the M.P Pollution Board Parameters for drinking purposes, thereby suggesting the need for precautionary measures and treatment for use of the particular ground water. Biological analysis of water was performed by MPN .*

Keywords: Physico-chemical Parameters, Ground Water, Dissolved Oxygen, BOD, Coliforms.

INTRODUCTION:

Water is indispensable and one of the precious natural resource of our planet. Ground water is an important natural source of water which is used all over the world. Ground Water is usable in the fields like irrigation, industries and domestic purpose *(P.M. Makode et al)*. Ground water quality depends on the quality of discharged water, atmosphere, surface water, and on geochemical processes held on sub-surface.

There is increasing awareness that the water will be one of the most critical natural resources in future. Water paucity is increasing worldwide and stress on the existing water resources is increasing due to rising demand of different sectors such as household, cultivation and trade, hydropower etc. Therefore, evaluation of water quality is important research topic in the recent years.

It is therefore necessary that the quality of drinking water should be checked at regular time interval because due to use of contaminated drinking water, human inhabitants undergo from a variety of water borne virus *(P.M. Makode et al)*. In last few decades, there has been a tremendous increase in the demand for the fresh water due to rapid growth of population and their accelerated pace of industrialization.

According to WHO, about 80% of all the diseases in human beings are caused by water (*N. Giljanovic et al*). As the groundwater is infected, its value cannot be restored by stopping the pollutants from their sources (*R.K. Horton et al*). It therefore becomes crucial to regulate oversee the quality of groundwater and to device ways and means to protect the same.

STUDY AREA:

Location:	**23°10′N 79°56′E**
Altitude:	411 m (1348 ft.) Above Sea Level
Area:	122.00 km²

The Jabalpur city is located in Jabalpur district of Madhya Pradesh state, on the right bank of Narmada River. Study area of Jabalpur city falls in Survey of India Topo Sheet 55M/16, and occupies approximate area of 122.0 Sq. km, falls between 79⁰ 55’ 37” to 79⁰ 57’ 54” longitude and 23⁰ 09’ 10” to 23⁰ 11’ 06” latitudes. The city of Jabalpur is a rock basin surrounded by “Karia Pathar” ridge to the north, Seeta Pahari and Khandari hills to the east, Madan Mahal hills to the south-west with alluvial plain toward west and north-west. The study area of the Jabalpur city is shown in Figure – 1.

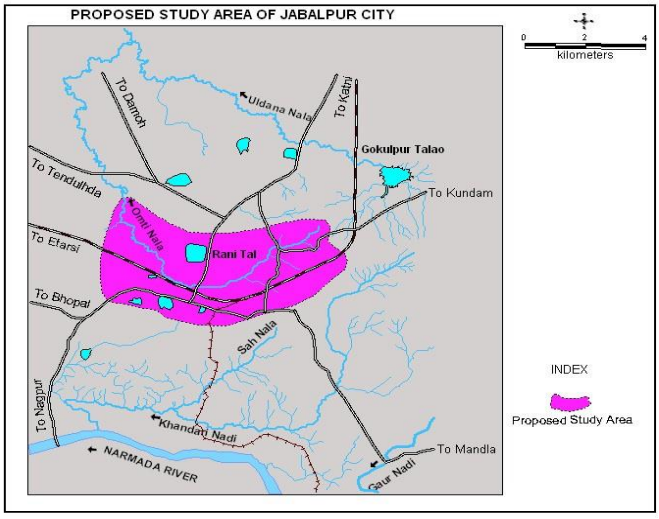


Figure 1: Study area of Jabalpur city, Madhya Pradesh

METHODOLOGY:

Surface water samples from various sites in the study areas were collected and analyzed for their physical, chemical and biological characteristics following standard water quality procedures. The coordinates of the sampling locations in terms of latitudes and longitudes were taken with the GPS. The samples were collected in plastic containers of 2 liters capacity for physicochemical analysis after pumping out sufficient quantity of water from the source such that, the sample collected served as a representative sample. For E. coli analysis, samples were collected in sterilized glass bottles from the source. The samples thus collected were transported to the laboratory. *(Bodhi et al)*.

Details of Sampling Locations:

Sampling stations are situated around Omti Nala. Their details are given below in Table 1. The satellite image of the sites are shown in Figure 2:

Table 1: Details of Sample Sources

Sample No.	Sample Station	Sample Collection Date & Time	Type of Source	Latitude N	Longitude E
1	Behorbagh, Ghamapur	Dec. 11, 2017, 09:30 a.m.	Bore Well	23°10′27″	79°56′41″
2	Ganjipura	Dec. 11, 2017, 10:10 a.m.	Bore Well	23°10′31″	79°56′07″
3	Rameshwaram Colony, Vijay Nagar	Dec. 11, 2017, 10:50 a.m.	Bore Well	23°10′25″	79°54′26″
4	SnehNagar, Veersawarkar ward	Dec. 12, 2017, 12:00 p.m.	Bore Well	23°09′46″	79°54′59″

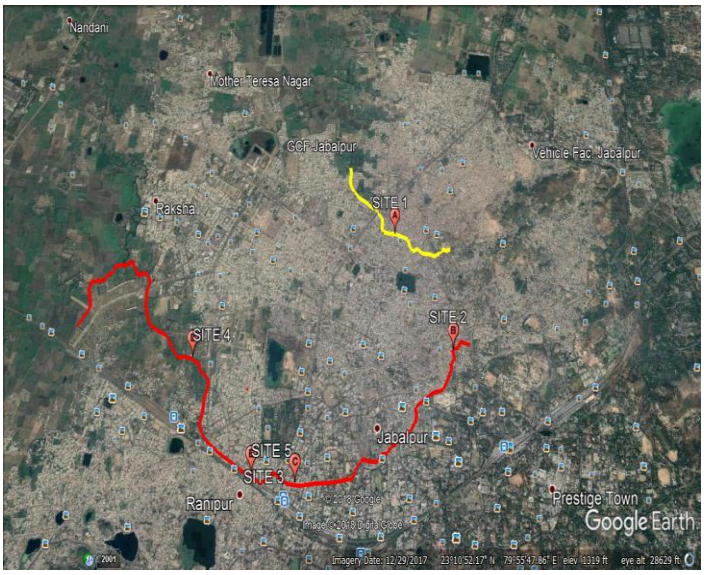


Figure 2: Image showing points of sampling, Jabalpur, Madhya Pradesh
Red & Yellow Line indicates Omti & Moti Nala.

PHYSICO-CHEMICAL PARAMETERS :

pH

It plays an important role in clarification process and disinfection of drinking water. For effective disinfection with chlorine, the pH should preferably be less than eight, however, lower-pH water (<7) is more likely to be corrosive (*Trivedy R.K et al*). Failure to minimize corrosion can result in the contamination of drinking water and adverse effect on its taste and appearance. The permissible limit of pH is to be 6.5–8.5. The pH value of groundwater samples in the present study has been analysed and it lies in the range of 8.0– 8.5 which are within the M.P Pollution Board Parameter.

Total Dissolved Solids

The presence of dissolved solids in water may affect its taste (*W.W. Miller et al*). The palatability of drinking water has been rated by panels of tasters in relation to its TDS level as follows: excellent (less than 300 mg/L), good (300–600 mg/L), fair (600–900 mg/L), poor (900–1,200 mg/L) unacceptable (>1,200 mg/L). M.P Pollution Board has prescribed 500 mg/L as the acceptable limit and 2,000 mg/L as the permissible limit for TDS for the water to be used for drinking purpose. In present study, the TDS concentration of analyzed samples lies in the range of 460 - 1071 mg/L. It is inferred that TDS for all the samples are beyond acceptable limit but lies within the permissible limit as prescribed by M.P Pollution Board Parameter.

Total hardness

In fresh water sources, hardness is mainly due to presence of calcium and magnesium salts. Temporary hardness more than 200 mg/L as CaCO3 may cause scale deposition in the treatment works, distribution system and pipe work and tanks within buildings. Water with hardness less than 100 mg/L may, in contrast, have a low buffering capacity and will be more corrosive for water pipes. M.P Pollution Board has prescribed 300 mg/L as the acceptable limit and 600 mg/L as the permissible limit for total hardness in absence of alternate source of drinking water. The hardness of groundwater samples in the study area is found to be in the range 120 - 272 mg/L as CaCO3. The hardness value of all samples were found to be within the desirable limit of 300 mg/L prescribed by M.P Pollution Board Parameter.

Calcium

Calcium is essential to human health. Calcium combines with bicarbonate, carbonate, sulfate and silica to form heat-retarding, pipe-clogging scales in steam boilers. Inadequate intake of the nutrient can impair health. M.P Pollution Board has prescribed 75 mg/L as the acceptable limit. The research carried out shows that calcium content is in the range of 26.45 - 68.13mg/L. The value of all samples were found to be within the desirable limit of 75mg/L.

Magnesium

Magnesium is a relatively abundant element in the earth's crust, ranking eighth in abundance among the elements. It is found in all natural waters and its source lies in rocks, generally present in lower concentration than calcium. It is also an important element contributing to hardness. Its concentration greater than 125 mg/L can influence cathartic and diuretic actions. M.P Pollution Board has prescribed 30 mg/L as the acceptable limit. The study shows that the magnesium found in the ground water are in the range of 10.25 – 24.88 mg/L within the permissible limit.

Dissolved Oxygen

It is an essential parameter which is vital to all the metabolism of the aquatic organisms that possess aerobic respiration (*Wetzel et al*). The presence of Dissolved Oxygen in water may be due to the photosynthetic activity of autotrophs and direct diffusion from air. Oxygen can be rapidly removed from water by discharge of oxygen demanding wastes. The Dissolved Oxygen values obtained are in the range of 2.7 – 5.7 mg/L in the present research which are within the M.P Pollution Board Parameter except for the Sample 2 which is beyond the limit.

Biological Oxygen Demand

The biochemical oxygen demand, abbreviated as BOD, is a test for measuring the amount of biodegradable organic material present in a sample of water. It is the amount of dissolved oxygen needed (i.e. demanded) by aerobic biological organisms to break down organic material present in a given water sample at a certain temperature over a specific period of time (*D.F. Singh et al*). The biological Oxygen demand values obtained in the present research are within the M.P Pollution Board Parameter (0.3 - 0.8 mg/L).

Alkalinity

Alkalinity in the water may be due to hydroxides, carbonates and bicarbonates. M.P Pollution Board has prescribed 200 mg/l as the acceptable limit and 600 mg/L as the permissible limit for total alkalinity as CaCO3 in absence of alternate source of drinking water. In present study, the alkalinity of all samples lies between 312 - 504 mg/L which are beyond the acceptable limit as prescribed by M.P Pollution Board Parameter for water used for drinking purpose. Bicarbonate ions are the major contributor of alkalinity in ground water.

Chlorides

Some common chloride compounds found in natural water are sodium chloride (NaCl), potassium chloride (KCl), calcium chloride (CaCl2) and magnesium chloride (MgCl2) (*P.C. Mishra et al*). Taste thresholds for the chloride anion depend on the associated cations and the concentration ranges from 200 to 300 mg/L for sodium, potassium and calcium chloride. Based on taste threshold, M.P Pollution Board has prescribed 250 mg/L as the acceptable limit and 1,000 mg/L as the permissible limit for chloride. The concentration of chloride in the collected samples were in the range of 35.0 – 225.0 mg/L. Chloride level in all the samples were within permissible limit prescribed by M.P Pollution Board Parameter.

Fluoride

Fluoride is found in all natural type of waters at different concentrations. The fluoride concentration in water is limited by fluorite solubility, so that in the presence of 40 mg/L calcium it should be limited to 3.1 mg/L. It is the absence of calcium in solution which allows higher concentrations to be stable. Excess fluoride intake causes different types of fluorosis, primarily dental and skeletal fluorosis. M.P Pollution Board has prescribed 1 mg/L as the acceptable limit and 1.5 mg/L as the permissible limit for fluoride. The fluoride concentration of all groundwater samples in present study is in the range 0.76 - 1.27 mg/L. It is inferred that all samples were within permissible limit prescribed by M.P Pollution Board Parameter.

Nitrate

Nitrate (NO3) is found naturally in the environment and is an important plant nutrient. Some ground waters may also have nitrate contamination as a consequence of leaching from natural vegetation. The presence of nitrate in drinking water is a potential health hazard when present in large quantities (*T.N. Tiwari et al*). The combination of nitrates with amines, amides, or other nitrogenous compounds through the action of bacteria in the digestive tract results in the formation of nitrosamines, which are potentially carcinogenic. The maximum allowable nitrate concentration as per M.P Pollution Board Parameter for drinking water is 45 mg/L as NO3. The concentration of nitrate in groundwater samples of the study area ranges between 3.79 -7.14 mg/L and is found to be well within the desirable limit prescribed by M.P Pollution Board Parameter.

Coliform

The bacterial contamination falls under the head of pathogens. Environmental protection Agency considers total coliforms as a useful indicator of other pathogens for drinking water. Test for water contamination in which the number of the colonies of coliform-bacteria Escherichia coli (E. coli) per 100 milliliter of water is counted (*Kodarkar M.S et al*). The result is expressed as 'Coliform Microbial Density' which indicates the extent of fecal matter present in it. The EPA Maximum Contaminant Level (MCL) for coliform bacteria in drinking water is zero (or no) total coliform per 100 ml of water. The research shows that coliform are present in sample 1 which is not acceptable and that for sample 2, 3, 4 & 5 the coliform content is Nil due to lining. Thus water of sample 1 is not safe for drinking as prescribed by M.P Pollution Board Parameter.

RESULTS:

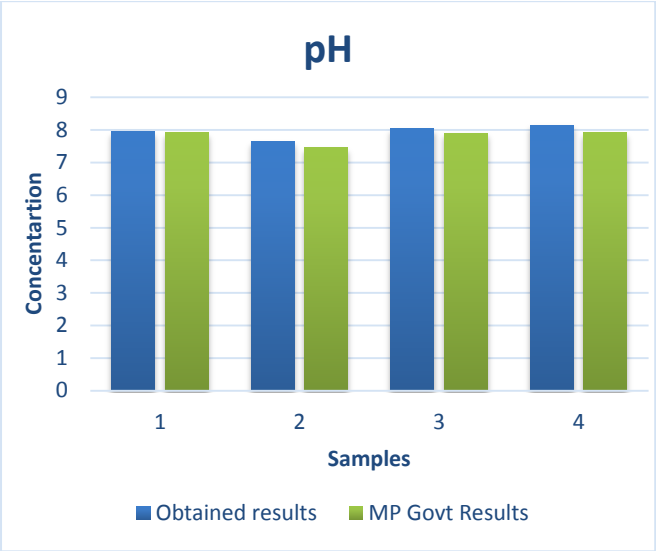
The parameters can be compared from Table 2 & Table 3 and the graphical variation of the results are shown in Graphs I to IX.

Table 2: Obtained Results of Ground water sample Analysis near Omti Nala

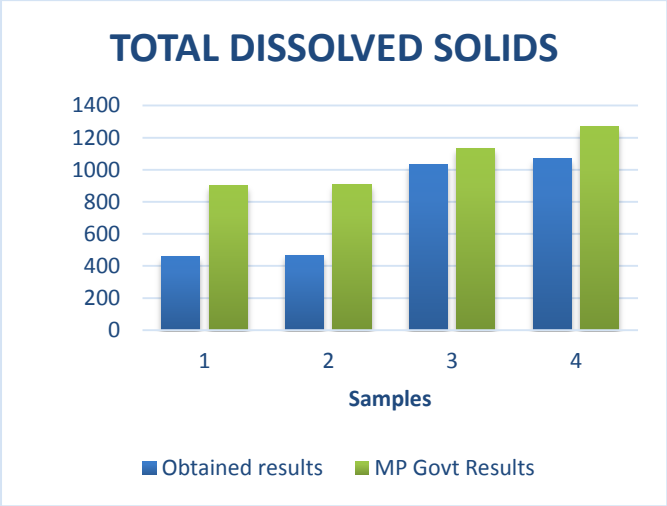
S.No.	Parameters	Standard Values (M.P. Pollution Board)	Sample 1	Sample 2	Sample 3	Sample 4
1	pH	8.5	7.95	7.65	8.05	8.15
2	TOTAL DISSOLVED SOLIDS mg/l	500	460	468	1031	1071
3	TOTAL HARDNESS mg/l	300	148	168	256	120
4	CALCIUM mg/l	75	26.45	36.07	64.128	31.26
5	MAGNESIUM mg/l	30	20.008	19.03	23.42	10.25
6	DISSOLVED OXYGEN mg/l	5	5.7	3.4	2.7	2.7
7	BOD mg/l	5	0.8	0.5	0.5	0.8
8	ALKALINITY mg/l	200	312	340	468	504
9	CHLORIDE mg/l	250	40	35	120	225
10	FLUORIDE mg/l	1	1.21	1.02	1.27	0.76
11	NITRATE mg/l	45	6.83	3.79	5.24	6.7
12	COLIFORMS (MPN INDEX/100ml)	NIL	< 1.8	< 1.8	< 1.8	< 1.8

Table 3: Results of the Omti Nala PDS completed by Water Resource Department in Dec-2012

S.No.	Parameters	Standard Values (M.P. Pollution Board)	Sample 1	Sample 2	Sample 3	Sample 4
1	pH	8.5	7.91	7.47	7.90	7.91
2	TOTAL DISSOLVED SOLIDS mg/l	500	902	907	1130	1270
3	TOTAL HARDNESS mg/l	300	288	253	280	340
4	CALCIUM mg/l	75	146	155.6	153.80	161.45
5	MAGNESIUM mg/l	30	19.4	16.95	24.52	20.26
6	DISSOLVED OXYGEN mg/l	5	Not Available	Not Available	Not Available	Not Available
7	BOD mg/l	5	Not Available	Not Available	Not Available	Not Available
8	ALKALINITY mg/l	200	678	580	581	646
9	CHLORIDE mg/l	250	139	142	134	124
10	FLUORIDE mg/l	1	Not Available	Not Available	Not Available	Not Available
11	NITRATE mg/l	45	38	37	44	39
12	COLIFORMS (MPN INDEX/100ml)	NIL	340	350	380	500



GRAPH I



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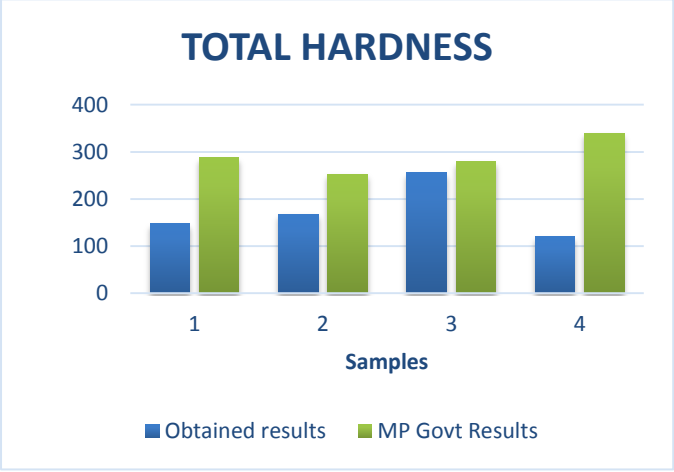

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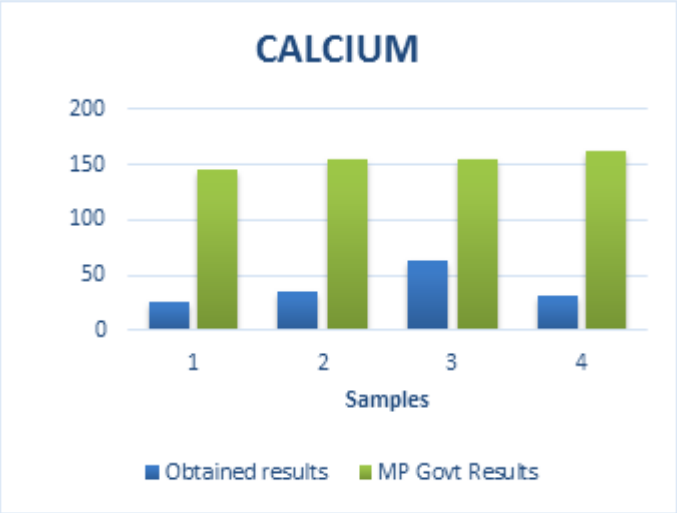

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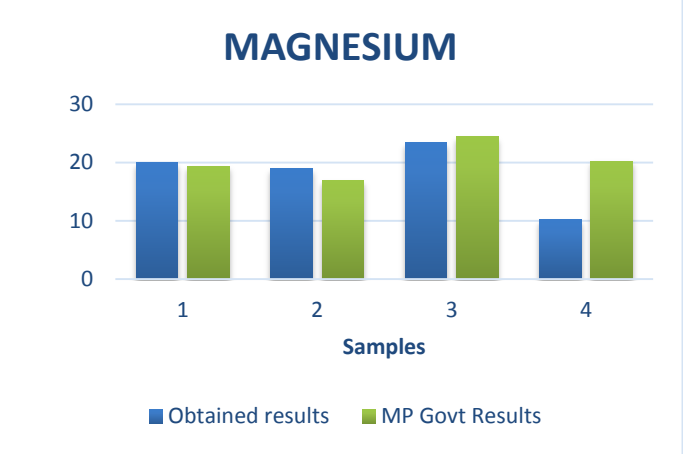

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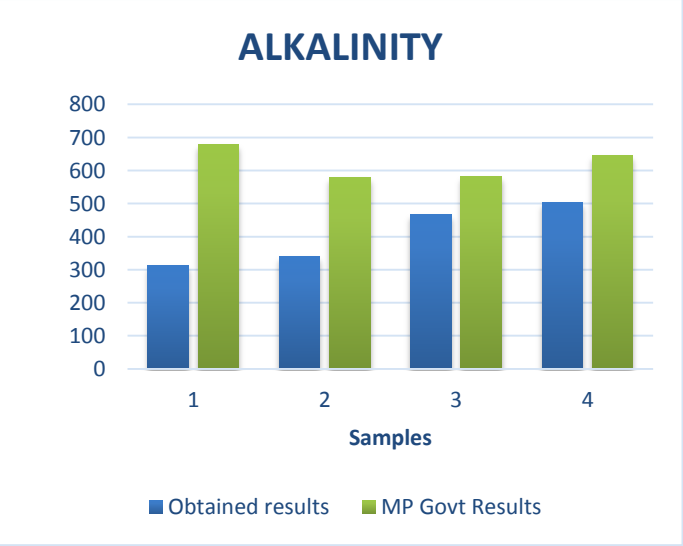

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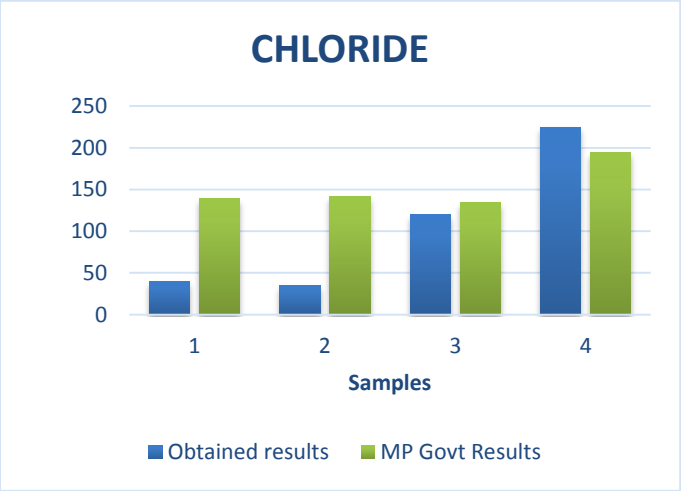

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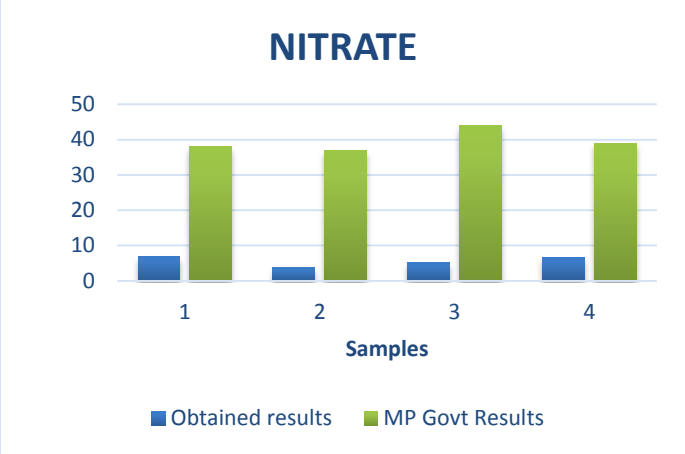

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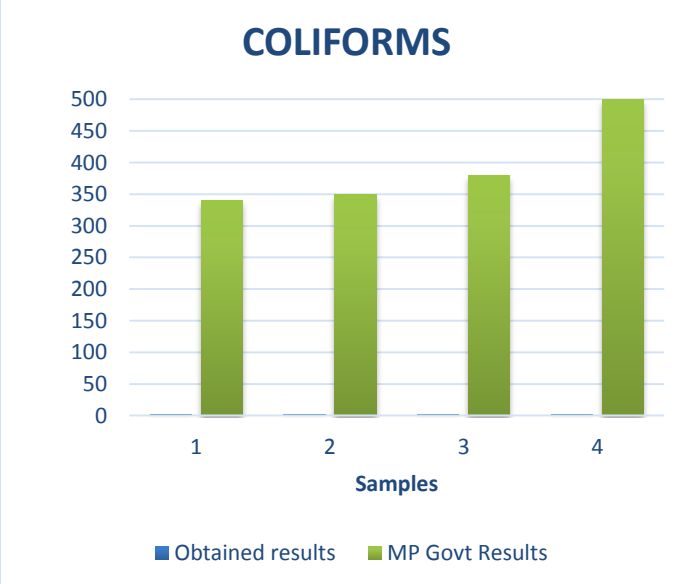

GRAPH IX

CONCLUSION:

Groundwater is an important natural resource. It plays a vital role in our life. In comparison to the surface water pollution, the groundwater contamination is more difficult to control. Analysis of Groundwater samples collected from five sites shows Ground water contamination all along both sides of Omti Nala, found to be higher than the acceptable limit of BIS before lining for various parameters specially alkalinity, total dissolved solids and pathogenic pollutants. At present the banks of Omti Nalla are protected by lining work which is done by Municipal Corporation, Jabalpur under Jawahar Lal Nehru Urban Development Scheme, which has shown abundant transformation of pollutants and health causing pathogens.

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