A Review on Western Yamuna Canal Water Quality Upstream and Downstream of Yamunanagar, Industrial Town

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Abstract **:- Yamuna Nagar is a city in the Indian state of Haryana. It is located south-east of the state capital Chandigarh. This town is known for the cluster of plywood units. The older town is called Jagadhri ." It used to be a green, clean and prosperous industrial city. However, due to recent spur in Industrial units in and around the city have resulted in severe air, water and soil pollution issues. Yamuna Nagar has the river Yamuna running through the district, and forming the eastern boundary with the neighbouring Saharanpur district. This boundary is also a state boundary, as Saharanpur is in the state of Uttar Pradesh. The district also separates the Yamuna system from the Satluj river system. Yamuna's pollution starts from Tajewala in the upper segment. Here two canals, the Western Yamuna Canal (WYC) and the Eastern Yamuna Canal (EYC), divert river waters into Haryana and Uttar Pradesh (UP). The WYC crosses Yamuna Nagar, Karnal and Panipat before reaching the Haiderpur treatment plant (which supplies part of Delhi's water), receiving wastewater from Yamuna Nagar and Panipat. The WYC at Yamuna Nagar, and rejoins the canal about 80 km downstream at Karnal. All domestic and industrial discharges from the effluents of paper mill, sugar mill, metal industries, distilleries, starch mill etc are let out into this canal located at Yamunanagar. The water has a bad odour and contains a high amount of metal content, beside a high content of B.O.D. The water samples were collected at regular intervals from various strategic points at the exit of effluents from various industries .The parameters studied were temperature, pH, turbidity, solids, hardness, chloride content, dissolved oxygen, biochemical oxygen demand ,chemical oxygen demand, turbidity, conductivity, total Ecoli ,fungi etc. These contaminants have contributed the water unfit for drinking.**

Key words: Yamuna Canal ,Effluents, contaminants, Seepage, Yamunanagar ,WYC

I. INTRODUCTION

Water is one of the prime necessities of life. We can hardly live for a few days without water. In a man's body, 70-80% is water. Cell, blood, and bones contain 90%, 75%, and 22% water, respectively. The general survey reveals that the total surface area of earth is 51 crore km2 out of which 36.1 crore km2 is covered sea. In addition to this, we get water from rivers, lakes, tanks, and now on hills. In spite of such abundance, there is a shortage of soft water in the world. Physicochemical parameter of any water body plays a very important role in maintaining the fragile ecosystem that maintains various life forms Potable water is the water that is safe to drink.The quality of water is of serious concern as it is seriously linked with human welfare. It must also meat very high standards of hygiene . In 2012, 89% of people had access to water suitable for drinking. The largest source of water pollution in India is untreated sewage.[1] Other sources of pollution include agricultural runoff and unregulated small scale industry. Rivers ,canals, lakes ,streams etc are the various natural sources of water which supply abundant supply of water containing large amount of impurities in most of the cases. In 2010 the water quality monitoring found almost all rivers with high levels of BOD. The worst pollution, in decreasing order, were found in river Markanda (490 mg O/l), followed by river Kali (364), river Amlakhadi (353), Yamuna canal (247), river Yamuna at the Delhi (70) and river Betwa2 (58).

The total length of the River Yamuna from its origin near Yamunotri to its confluence with Ganga River at Allahabad is 1376 Kilometers.It flows through various industrial towns. Western Yamuna Canal is originating from Tajewala , downstream from Tajewala it passes through industrial town of Yamunanagar and ultimately reaches Delhi under the name of Delhi Feeder Canal. During its passage through Yamunanagar, several drains and Nalahs containing effluents , sewage and domestic water merge into water of WYC ,contaminating its water and making it unfit for human consumption. Disposes of carcases of cattle and other animals, immersion of statues, flowers , religious ceremonies in and around the rivers add to the pollution load .The river flow is not uniform throughout the year. The discharge peaks are very high in monsoon and post monsoon periods, but in summer the discharge rates are very low.Yamunanagar is the second biggest industrial town of Haryana. Many industries like paper mill, sugar mill, distillery , cement ,

metal industries etc passes their waste water into WYC3.The various contaminants in waste water are a complex mixture of organic and inorganic compounds which make the natural water unfit for human consumption. The water of nearby colonies also gets polluted due to seepage of contaminated water of WYC.(fig3)

II. EXPERIMENTAL SETUP

Nine strategic points were selected from Chitta Mandir to Garhi Gujran at a stretch of 16 km through which WYC passes through the industrial town of Yamunanagar .Samples were collected from these nine strategic points at regular intervals during Pre monsoon(April to June) and Post monsoon(July-Sept) twice a year .Water samples were also collected from various strategic points at the exit of effluents from paper mill , sugar mill ,metal industries, distilleries, starch mill etc. Samples were also collected from the hand pump water of different colonies alongside Western Yamuna Canal in order to analyse the seepage effect of contaminated water of WYC.

The various parameters analysed include pH, alkalinity, hardness, solids, chloride content , turbidity, conductance, Chemical oxygen demand, bio-chemical oxygen demand, chemical oxygen demand ,total Ecoli, total fungal count etc using the standard methods for the examination of waste water4-7 and water. The samples were analysed within few hours after collection to get the accurate results. These samplings sites have been shown in (fig 1 and 2).

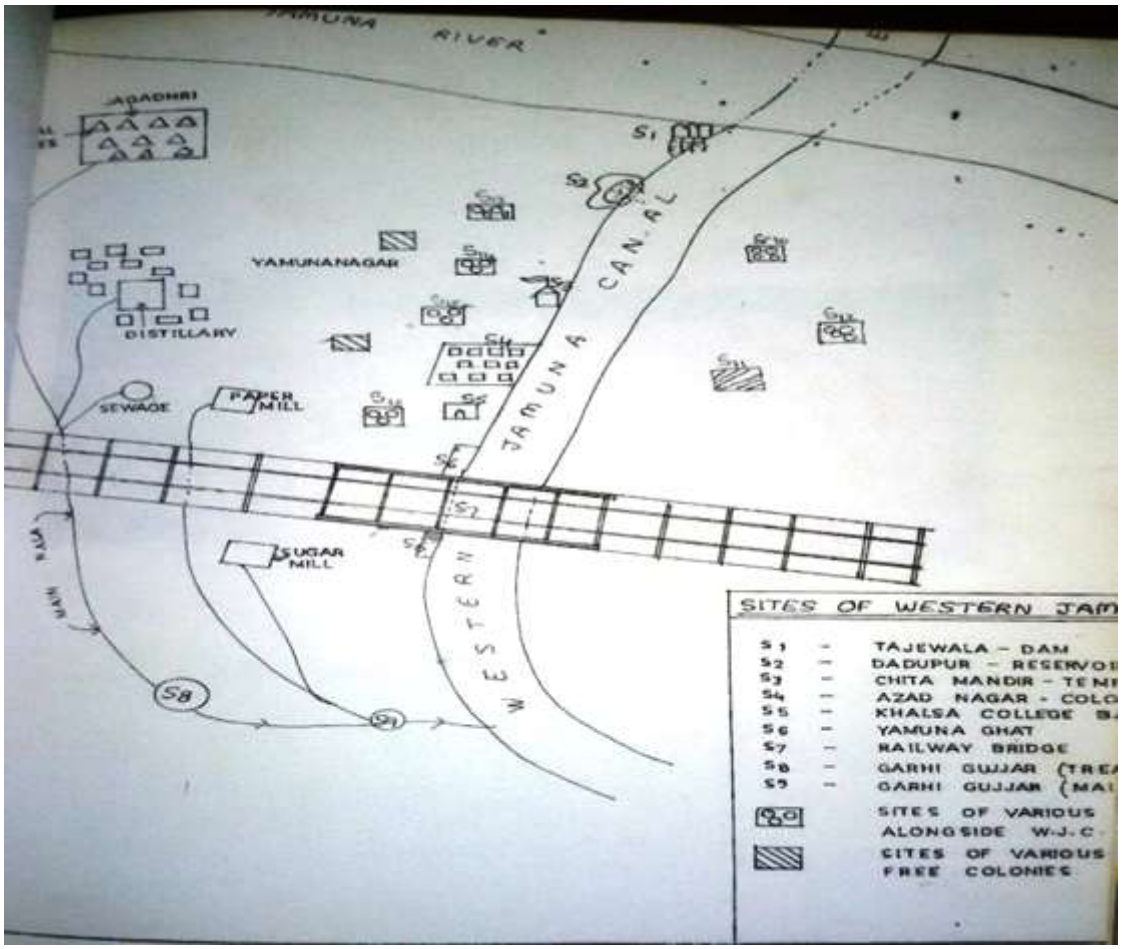


Figure 1. .Map showing the nine strategic points from Tajewala to village Garhi Gujran at Yamunanagar

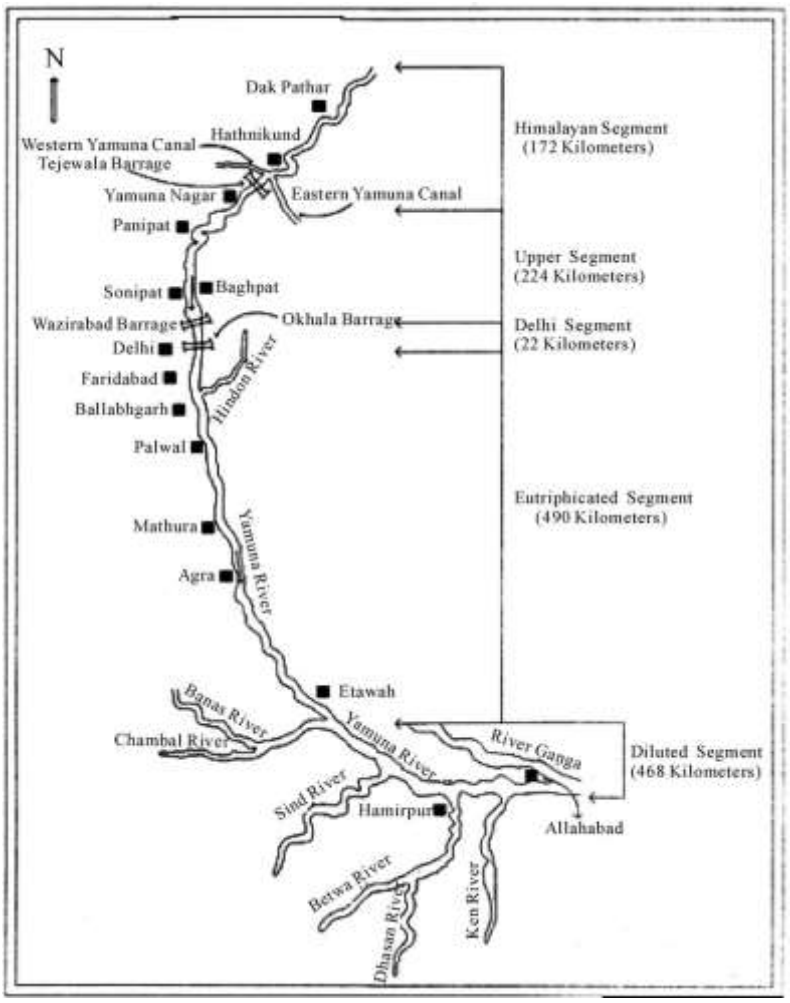


Figure 2. Water quality of river Yamuna around Yamunanagar

III. Result and Discussion:

Free Carbon dioxide, Phenolphthalein alkalinity, Acidity

Acidity is a measure of an aggregate property of water and can be interpreted in terms of specific substances only when the chemical composition of the sample is known. Alkalinity measures the amount of alkaline compounds in the water, such as carbonates, bicarbonates and hydroxides. These compounds are natural buffers that can remove excess hydrogen, or H+, ions. The value of alkalinity in the pollution infested zone is maximum 480 ppm and the seepage effected zone is 340 ppm. Though the alkalinity itself is not harmful to human beings, water supplies with less than 100 ppm are desirable for domestic use. Higher value for Free carbon dioxide and acidity was observed in both pollution infested and seepage zone.(fig3)

pH, Conductance, Turbidity, Hardness

pH is an important limiting chemical factor for aquatic life. If the water in a stream is too acidic or basic, the H+ or OH- ion activity may disrupt aquatic organisms biochemical reactions by either harming or killing the stream organisms. Conductivity is a measure of how well water can pass an electrical current. It is an indirect measure of the presence of inorganic dissolved solids such as chloride, nitrate, sulphate, phosphate, sodium, magnesium, calcium, iron and aluminium. Turbidity is a measure of the cloudiness of water. Cloudiness is caused by suspended solids (mainly soil particles) and plankton (microscopic plants and animals) that are suspended in the water column. Moderately low levels of turbidity may indicate a healthy, well-functioning ecosystem, with moderate amounts of plankton present to fuel the fuel the food chain. However, higher levels of turbidity pose several problems for stream systems. The hardness of a water is governed by the content of calcium and

magnesium salts (temporary hardness), largely combined with bicarbonate and carbonate and with sulfates, chlorides, and other anions of mineral acids (permanent hardness).Both temporary and permanent hardness show high value in polluted zone.(Fig 1)Even the quality of underground water of near by colonies is effected seriously, which is the cause of water borne diseases.

DO, BOD, COD and Total Dissolved Solids

Dissolved oxygen gets into the water by diffusion from the atmosphere, aeration of the water as it tumbles over falls and rapids, and as a waste product of photosynthesis. Dissolved oxygen criteria for drinking water should be 5 mg/L minimum for aquatic life. Dissolved Oxygen.(DO). ..... Levels.between.6.5.and.8.5 are acceptable for most drinking water. The DO level at site no.7 is much below the optimum level ie 7. The chemical oxygen demand, or COD, is used as a measure of the oxygen equivalent of the organic matter content of a sample that is susceptible t o oxidation by a strong chemical oxidant. For samples from a specific source, COD can be related empirically to BOD, organic carbon, or organic matter.COD values are beyond the permissible limit(Table-1,2,3).The Biological Oxygen Demand, or BOD, is the amount of oxygen consumed by bacteria in the decomposition of organic material. It also includes the oxygen required for the oxidation of various chemical in the water, such as sulphides, ferrous iron and ammonia. While a dissolved oxygen test tells you how much oxygen is available, a BOD test tells you how much oxygen is being consumed. BOD is determined by measuring the dissolved oxygen level in a freshly collected sample and comparing it to the dissolved oxygen level in a sample that was collected at the same time but incubated under specific conditions for a certain number of days. The difference in the oxygen readings between the two samples in the BOD is recorded in units of mg/L. Unpolluted, natural waters should have a BOD of 5 mg/L or less. Raw sewage may have BOD levels ranging from 150 – 300 mg/L . Dissolved solids" refer to any minerals, salts, metals, cations or anions dissolved in water. Total dissolved solids (TDS) comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulphates) and some small amounts of organic matter As per Bureau of Indian Standards (IS: 10500) guidelines, 500 mg/L is the desirable limit and 2000 mg/L is the permissible limit, which means drinking water having TDS in excess of 2000 mg/L must be rejected. Presence of TDS beyond 500 mg/L in drinking water decreases palatability and may cause gastrointestinal irritation. The TDS values at site no. 7 and 8 are 1910 ppm and 1940 ppm (pre monsoon) which is much above the permissible limit.

The contaminated water samples have also shown the presence of a number of viruses and bacteria like Salmonella group (typhoid) Shigella (Bacillary dysentary) Myrobacterium (tuberculosis and virrio cholera which causes diseases like gastroenteritis, diarrhea, respiratory illness ,heart diseases ,liver diseases etc.)These diseases are severely affecting the health of residents of these colonies. The bacteriological examination has shown the MPN index of coli form bacteria exceeding 70 per 100ml .The permissible level of MPN index of coli form is zero or less than1.0 in the treated water and 20 per 100 ml in raw water. Toxic effects of non-biotic contaminants also affect the health .The high MPN values and BOD values also indicates organic pollution in the river.

CONCLUSION

Every drop of water is essential. Drinking purified water does a lot more than quench your thirst...it keeps your body in great working order. There are many benefits to drinking clean, fresh water. We are comprised of mostly water; over 70% of our bodies are water. To break it down even further our brains are over 75% water, blood 80%, and the human liver which is our main filter is 96% water. Water pollution throughout the world is affecting food chains and food webs. Water such as lakes, rivers, streams, creeks, and oceans become polluted in many different ways. One main way is the dumping of trash, or littering. Many creeks, rivers, and even oceans have been polluted by manmade items such as trash. Today there is widespread realisation that there can be no ready made solutions that technology cannot alone solve problems. Urbanisation , industrial growth, transportation system, agriculture, housing all have to stop imitating practices that are already being phased out in the developed world. The few ways to Prevent Water Pollution8 are Sewage treatments, Prevent river water to get polluted, Treatment of wastes before discharge, Strict enforcement of water laws, Treatment of drainage water, Treatment plants, Keep the pond water clean and safe, Routine cleaning, Sanitation, Public Awareness. Common public should be aware about the effect of water pollution. Voluntary organization should go door-to-door to educate the people about environmental problems. They should perform street plays for creating awareness about the environment. They should run environmental education centers. More coagulation and Flocculation plants should be set up. upland reservoirs are sited above any human habitation and may be surrounded by a protective zone to restrict the opportunities for contamination. Emphasis should be given to Atmospheric water generation - a new technology that can provide high quality drinking water by extracting water from the air by cooling the air and thus condensing water vapour.

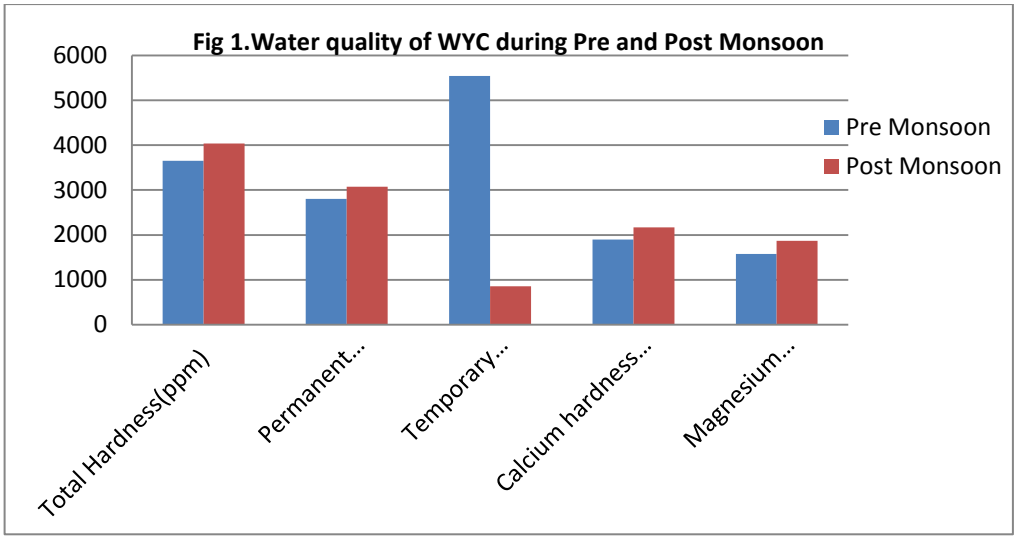
Table 1-Characterstics Of Western Jamuna Canal At Different Monitoring Stations(Pre Monsoon)

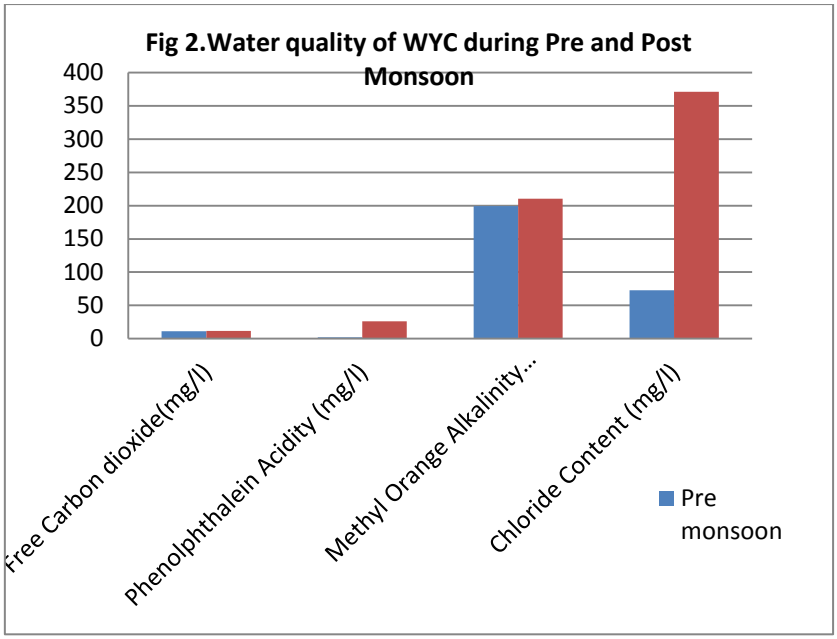
Parameters	site 1	Site 2	Site 3	Site 4	site 5	Site 6	Site 7	Site 8	Mean
Free Carbon dioxide(mg/l)	2.09	2.78	3.1	30.01	7.32	28.32	10.8	5.2	11.21
Phenolphthalein Acidity	2.45	3.12	13.23	50.1	15	25	55	26	2.08
Methyl Orange Alkalinity (mg/l)	42.54	55.12	132	130	142	375	453	265	199.33
Chloride Content (mg/l)	18.2	18.38	18.08	38.14	21.35	70.14	130	267.2	72.73
D.O (mg/l)	8.2	7.8	5.2	6.1	4.7	3.9	nil	nil	5.98
B.O.D(mg/l)	23	26	**38**	65	20	62	Nil	Nil	29.25
C.O.D(mg/l)	54.25	57.05	62.6	64.4	132	190	1990	2256	600.78
Total Hardness(ppm)	560.12	690.54	1766	2000.12	1990	3854.5	9486	8888	3650.9
Permanent hardness (ppm)	390.78	440.8	1126	1546.7	1298.8	2289	8765	6550	2800.9
Temporary hardness (ppm)	181.34	245.87	567.9	578.9	767.89	1887.9	991	2558	5540.4
Calcium hardness (ppm)	450.9	490.89	790	1234.67	1125.5	2870	3981	4211	1894
Magnesium hardness(ppm)	180	230.8	805.6	889.9	940.8	1090.9	5909	2555	1575.2
Total Solid Content(ppm)	500	490	550	590	600	660	3410	2540	1167.5
Total Suspended Solids (ppm)	270	230	250	280	290	300	1500	600	465
Total Dissolved Solids ppm	230	260	300	310	310	360	1910	1940	3922.5
pH	7.6	8.2	6.8	7	7.4	8	8.9	9.2	7.9
Temperature(^{o}C)	28	26	28	29	30	29.5	31.5	32	29.25
Conductance (mhos)	$5.8x10^{-2}$	5.7 x 10-2	5.9 x 10-2	7.2x 10-2	7.9 x 10-2	8.3 x 10-2	2.24 x 10-2	2.89 x 10-2	5.74x 10-2
Sulphate Content (%age)	1.13	1.15	6.987	5.772	7.987	8.786	1.9	2.456	4.52
Nitrogen Content (%age)	0.023	0.0256	0.034	0.043	0.045	0.029	0.4	0.421	0.65
Total Ecoli (Mpn)	Nil	Nil	42	>300	>300	>300	>300	>300	>300
Total Fungal count	Nil	Nil	Nil	6	4	5	6	5	5.2
Total Bacterial count	12	13	46	>300	>300	>300	>300	>300	>300
Turbidity (NTU)	Nil	12	22	38	Above100 NTU	45	Above100 NTU	60	5.98

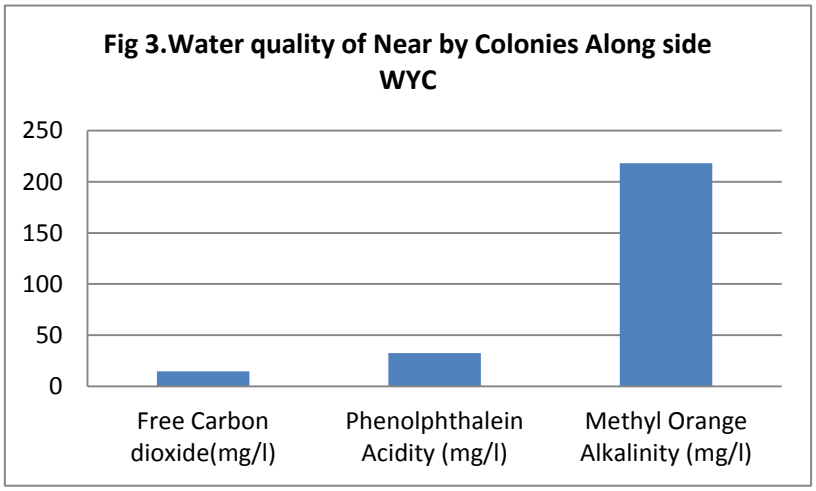
Table-2 Characterstics of Western Yamuna Canal at different monitoring stations (Post Monsoon)									
Parameters	site 1	Site 2	Site 3	Site 4	site 5	Site 6	Site 7	Site 8	Mean
Free Carbon dioxide(mg/l)	2.6	3.18	3.58	31.43	7.98	29.31	10.9	5.78	11.84
Phenolphthalein Acidity (mg/l)	2.55	3.44	14.23	54.1	18.5	27.6	60	30	26.3
Methyl Orange Alkalinity (mg/l)	45.64	58.12	139	140	152	390	480	280	210.59
Chloride Content (mg/l)	18.8	19.68	20.08	40.14	23.35	78.14	136.34	276.22	371.05
D.O (mg/l)	8.6	7.9	5.8	6.9	4.9	4.2	nil	nil	6.38
B.O.D(mg/l)	25	28	42	68	25	65	Nil	Nil	42.16
C.O.D(mg/l)	57.25	60.15	65.6	69.4	137	200	2180	2345	639.3
Total Hardness(ppm)	580.12	700.54	2765.5	2200.12	2200	3990.5	9985.5	9877.8	4037.51
Permanent hardness (ppm)	400.78	480.8	1439.8	1656.7	1499.8	2348	8995.3	7750	3071.39
Temporary hardness (ppm)	179.34	219.74	560.2	543.42	700.2	1552.5	990.2	2127.8	859.17
Calcium hardness (ppm)	460.9	480.89	820	1554.67	1625.5	2980	4890.89	4510.9	2165.4
Magnesium hardness(ppm)	119.22	219.65	1945.5	645.45	574.5	1010.5	5094.61	5366.9	1872.04
Total Solid Content(ppm)	700	500	650	650	700	760	4450	2940	1418.75
Total Suspended Solids (ppm)	390	350	450	480	390	400	1800	700	620
Total Dissolved Solids (ppm)	310	150	200	170	310	360	2650	2240	798.75
pH	7.2	7.8	5.23	5.8	6.47	7.54	8	8.67	7.08
Temperature(oC)	26	27	26	28	28.5	28	31.5	31	28.25
Conductance (mhos)	5.3x10-2	5.5x10-2	5.8x 10-2	7.1x 10-2	7.7 x 10-2	8.2 x 10-2	2.10x 10-2	2.24 x 10-2	5.49x 10-2
Sulphate Content (%age)	1.23	1.25	5.887	5.882	6.887	7.186	1.657	1.856	3.979
Nitrogen Content (%age)	0.027	0.0286	0.0356	0.053	0.065	0.039	0.418	0.431	0.1371
Total Ecoli (Mpn)	Nil	Nil	42	>300	>300	>300	>300	>300	>300
Total Fungal count	Nil	Nil	Nil	2	3	4	4	6	4.8
Total Bacterial count	8	9	37	>300	>300	>300	>300	>300	>300
Turbidity (NTU)	Nil	12	22	38	Above100 NTU	45	Above100 NTU	60	33

Table-3 Water Quality of Various Colonies Along Side Western Yamuna Canal								
Parameters	site 9	Site 10	Site 11	Site 12	site 13	Site 14	Site 15	Mean
Free Carbon dioxide(mg/l)	29.1	2	4.89	4.98	22.35	18.98	19.88	14.6
Phenolphthalein Acidity (mg/	68	0.9	12	10	53	41	42	32.41
Methyl Orange Alkalinity (mg	240	284	340	100	107	214	243	218.3
Chloride Content (mg/l)	17.22	70.58	8.3	9.87	10.34	45.66	24.99	26.71
D.O (mg/l)	6.2	7.8	4.5	4.7	5.9	5.2	6.2	5.786
B.O.D(mg/l)	22	43	55	67	53	88	74	57.43
C.O.D(mg/l)	120	99	310	488	340	330	370	293.9
Total Hardness(ppm)	2245	2178	1000	1225	2324	1900	1995	1838
Permanent hardness (ppm)	1478	1450	550	655	1445	1170	1167	1131
Temporary hardness (ppm)	767	728	450	570	879	730	828	707.4
Calcium hardness (ppm)	1355	1124	554.5	635.22	744.5	1666.5	109	884
Magnesium hardness(ppm)	890.2	1054	445.6	589.78	1580	233.5	1886	954.1
Total Suspended Solids (ppm)	260	220	130	190	324	199	187	215.7
Total Dissolved Solids (ppm)	2010	1775	360	470	560	570	550	899.3
pH	7.6	7.9	8.5	7.8	8.2	7.8	7.77	7.939
Temperature(^{O}C)	34	33.2	33.8	33	32.7	32.8	33.6	33.3
Conductance (mhos)	480	590	180	240	440	590	550	438.6
Sulphate Content (%age)	3.43	2.8	4.21	4.256	3.301	2.52	2.877	3.342
Nitrogen Content (%age)	0.015	0.014	0.019	0.0192	0.031	0.0321	0.0267	0.022
Total Ecoli (Mpn)	Nil	Nil	Nil	Nil	Nil	9	8	8.5
Total Fungal count	Nil	Nil	Nil	Nil	Nil	4	4	4
Total Bacterial count	19	17	13	26	22	45	41	44.86
Turbidity (NTU)	8	3	1	2		4	11	7.137

Bar Diagram Showing Comparison of Various Parameters From Site No 1 To Site no. 8







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