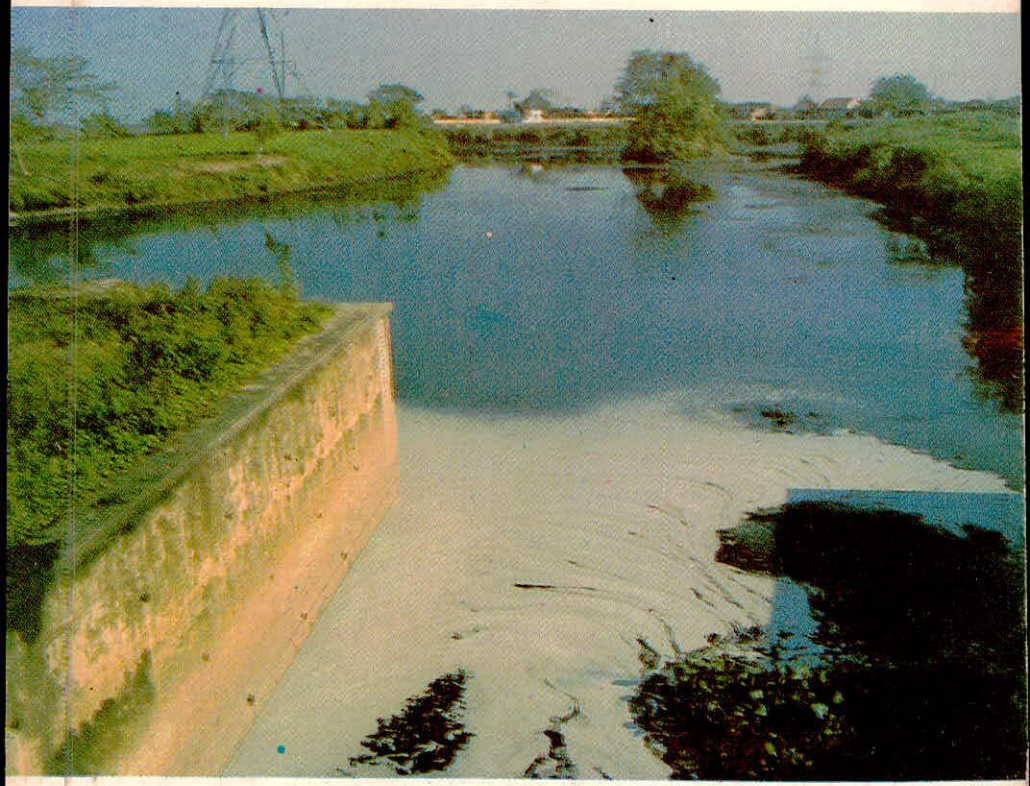
WATER QUALITY CONSERVATION

CONTROL WATER POLLUTION
CONSERVE WATER QUALITY
for

CLEAN AND HEALTHY ENVIRONMENT



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NATIONAL INSTITUTE OF HYDROLOGY
ROORKEE
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INTRODUCTION

Water is the most precious gifts of the nature to mankind; the terrestial ecosystem cannot function wihout it. All life and pheripherial activities are ceased without water. In addition to drinking and personal hygiene, water is needed for agricultural production, industrial and manufacturing process, hydroelectric power generation, waste assimilation, recreation and wildlife etc. When a resource is used for so many diverse purposes, it is important that it be developed and used rationally and efficiently.

From the very begining, man realized the efficacy and essentiality of water for his daily life. For that reason, water is called as life and it has been known as nectar. Water available in various forms on the earth is plenty. Areawise, seventh tenth of the surface of globe is water. For obvious reasons, the quantity available on the earth in various forms cannot be explored for utilization. Thus, availability and management of water is limited within the limiting sources of fresh waterbodies available in streams, lakes, swamps and underground. Even quantity of fresh water available is quite enough and it is much more higher than our requirement for different purposes. As such no shortage would also be observed in near future, if full quantity of fresh water is available without any danger of contamination and scientifically managed. Yet man and animal die of thirst, plant wither and deserts increase. In many areas problem of water scarcity has become a normal matter. People are forced to manage their daily domestic demand from a far distance place. In some places, rationing of water for domestic purposes are being provided oftenly. Much of the shortage is due to or accentuated by faulty management of water and waste water.

Growth of civilizations and expansion of industries in the closed proximity of waterbodies mainly in the bank of rivers has become an evidence since ancient time. This is because of ease in waste disposal, generated from the communities and industries, into the flowing waterbodies with no economic burden. Most of the Indian towns are also located on the riverside. They are continuously discharging their wastes both industrial and muncipal, into the river

and using the same water for drinking and other purposes. As a result, people are being affected by water borne diseases and health related problems are reported from every corners. Statistics reveals that large chunk of Indian population drinks polluted water from sources like rivers, lakes, wells etc., sometimes contaminated even with fecal matter. Over twnety lakh people die of enteric diseases every year, which are caused by drinking polluted water. Millions of people living alongside of rivers are being affected directly and indirectly using such polluted water. Unless scientific and adequate strategy are not taken to mitigate the problem of water pollution to achieve the target of water quality goals, the problem of water in the country like India where sharp rise of population and industrialization and the rising demand in the food sector are extra additional hurdles, will be more severe and time will come when all activities may stuck up due to scarcity of water.

Generation of wastes is a part of human activities from time immemorial. Disposal of wastes under the care of atmosphere, overland and fresh waterboides has become a normal practice since very begining . The capacity to cleanse the waste by natural process whether by stream or by nature is limited - a known fact but seldom do we realise its significance. Consequenaces of such unscientific and fragmental approach have been recognised when problem has reached to a serious extent. Infact, water pollution consciousness is our country has developed after considerable laps of time. As a result, heavy backlog of liquid and solid pollution has made the problem of pollution more complex. During last two decades it became increasingly evident that pollution was impairing different uses of water and in certain cases even destroying possible utilization of important sources of supply. In recent times on account of the increase in population, urbanisaion and industrialisation, there is an over increasing threat to the quality of waters in rivers, lakes and other waterbodies. Unfortunately, the santity attached to rivers in the country does not ensure a concern for the maintenance of the purity of water. It does not mean that the problems of water pollution will remain unsolved and no efforts are to be made to fix up the strategy for solving the rising problems.

Planning of water quality control strategy and standards for India is not an easy task. The size of the work, multiplicity of agencies involved, political, economichardship and administrative coordination are some of the major issues those could obstruct such scheme. However, to comprehand the extent of problem atleast for the shake of our survival, it is necessary to control water pollution problems, if necessary with the cost of the people. Users and beneficieries who are actually responsible for increasing pollution of water need to be awared and to be encouraged for conserving quality of water under their domain.

FACTORS INCREASING WATER POLLUTION

Many factors are responsible for increasing water pollution; most important are :

i) Exponential Growth of Population,

ii) Urbanization and Industrialization,

iii) Agricultural Revolution

Exponential Growth of Population

Population dynamic is the main factor for increasing pollution. Water provides life for us, it is well known fact but seldom do we recognise the significance of this important fact in our daily activities. Consequences of such ignorance and overlook have increased the problem of water both in quantity and quality, multidimensionally. Planning of available resources with the present problem of water pollution has become a difficult task, additional burden of population and their demand of water in various fronts making the problem more complicated and invites more pollution of the limited watersources. That eventually call upon scientific and efficient management of water to control pollution in the quality side and simultaneously to conserve quality of water for the shake of our future demand.

Population in India, according to 1981 census was 685 million. Presently it would not be less than 840 million. The population growth was more than 14% upto 1951, but thereafter, during 1971-81 a sharp rise of 25% coupled with a decline in death rate was observed. In 1980, the birth rate in India was around 34/1000. The rate will have to come down from 30/1000 to about 21/1000 and nearly 11 in 2020, with a death rate to 9/1000. It has been projected that by 2000 AD India will have population in between 959 and 1052 million . Therefore, all of our planning and management need to be thought in the context of population dynamics. In an estimate it was showed that by 2000 AD, out of the available water of 1900 million cubic metre per year in India, the distribution of water for various uses will be as follows:

Battle for Water

Table-I : Water Use (India) by 2000 AD

(Available water 1900 million cubic metre per year)

Uses	In 1000 million cubic metre per year		
	Taken	Consumed	Returned
Irrigation & livestock	869	783	86
Power	150	5	145
Industry	35	10	25
Domestic	38	8	30
Total	1,092	806	296

Source: Chaudhuri, 1982

Per capita availability of water for India is only 3200 cubic metre/year , while in developed countries like USA, Russia and Japan it is 62000 cubic metre/year, 17536 cubic metre/year and 65000 cubic metre/year respectively.

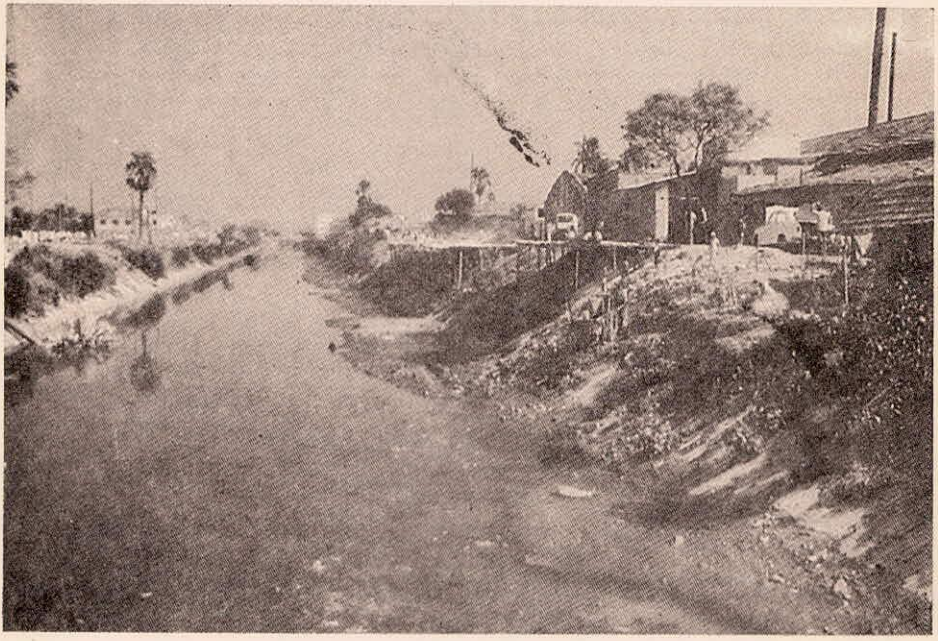
The minimum requirements of water for various activities are as follows:

Table-II : Minimum Requirement of Water

Activities/Uses	Minimum quantity required litres/capita/day
Human consumption	5
Domestic	60
Social and industrial purposes	50
Livestock animals	40
Irrigation	1100

Urbanization & Industrialization

Problems of water pollution mostly being faced in the urban areas. Uniquely, our recorded history reveals the linkages of water and growth of civilization and industrialization. Civilization and industrialization generally takes place in the closed proximity of water. Even most of the Indian cities are located in the bank of rivers. This is because of the ease in the disposal of waste products into the flowing water at no economic cost. Rivers and other waterbodies due to their self assimilation capacity can clean the possible extent of pollution load coming into them, however, they have limitation of cleansing the pollution load, further addition of contamination beyond the limitation lead to the problem of water pollution.



Consequences of Our Activities !

India has 3121 towns accounting 109 M people (1981 census), only 2092 have an organised water supply but not fulfilling the quantity required. However, very few are connected with organized sewer line. A survey of the Industrial cities of India has showed that industrial waste water consitutes by volume between 8 to 16% of the total wastewater generated, and the remaining 84-92% is from domestic sector. By 2000 AD these figures are expected to reachy about 33% and 67% respectively. In terms of BOD at present the pollution load is 50% each for industrial and domestic wastewater. Out of the 8400 recorded industries, 4109 number of industries are polluting, 1966 number of industries have installed the pollution control measures, but 2143 have not. Qualitative Picture of wastewater volume receive from various sectors is shown in Fig. 1.

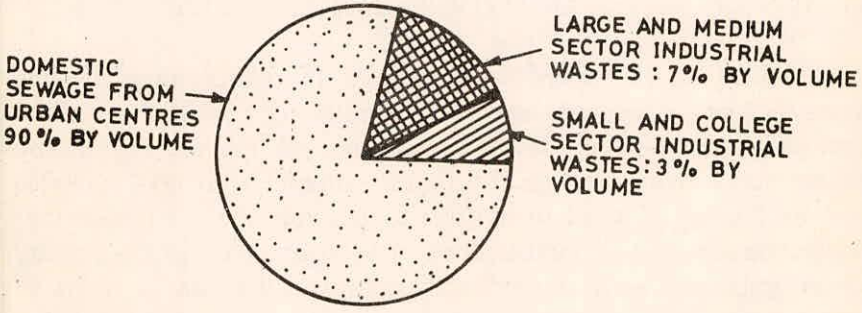


Fig. 1 Distribution of Waste water volume between Industry and Domestic

[*Source* : Report published by CPCB Series Probes/11/1982-89]

Agricultural Revolution

India has one of the lowest man land ratio. It is hardly 0.48 ha/per capita. Although, it started as 1.25 ha/per capita in 1921, it has continuously declined, particularly after 1961. In one hand constant decline in the man land ratio, on the other hand, increasing

demand of food to meet the demand of increasing population, forceing the farmers for producing more crop from the squeezing land. This has led to use of pesticides, insecticides & fertilitiers in the agricultural field for getting more yield. Pesticides and other chemicals used in the agricultural field either percolate to the groundwater aquifer or move to the river through surface runoff and finally contribute to the pollution of waterbodies.

Constant pressure on the agricultural land and conversion of vegetative land to fertile land causing serious soil erosion problem. Soil eroded from agricultural land contains considerable amount of suspended matters and nutrients such as phosphorus and nitrogen and significant amounts of salts, pesticides and heavy metals. Pollution due to the soil erosion is an another aspect of increasing water qaulity problems.

STATUS OF WATER QUALITY IN INDIAN RIVERS

Out of the total 113 rivers in the country, the major river systems share 85% of the total drainage basin, account for 85% of the surface flow and house 80% of the total population of the country. Many of the major rivers also go dry during summer with no available flow for dilution of waste waters discharged into them. Beside that rapid urbanization and industrialization in several parts of the country whose impact directly or indirectly come on the nearby rivers or waterbodies, is an another aspect of cumulating pollution of rivers. The present status of water quality in various rivers based on available information is described below:

i) Most of the rivers are alkaline in nature except the rivers in Kerala state which are mostly neutral or slightly acidic.

ii) The existing status of water quality at various monitoring locations is either C or below C, though the desired level varied from A through E (as per Best Designated use).

iii) Among the four primary parameters pH, DO, BOD, and total coliforms required to classify the river stretches from

A through C, total coliforms is observed to be the most critical parameter followed by BOD.

iv) The river Ganga which was once considered the purest of all and regarded as sacred, is found polluted in stretches of 480 km out of the total length of 2035 km.

v) The river Yumuna which is the life line for the capital city of Delhi, is found clean only in stretches of 522 km out of the total length of 1044 km.

vi) The quality of water of the Godavari river at Mancherial and Polaveram, the Krishna at Vijayewada, the Tunghabhadra at Ullanura, the Penner at Nellore and the Caveri at KRS dam and sathayalam conformed to the desired level.

vii) The general water quality of all the rivers in Gujarat state is below C due to the high concentration of total coliforms in those rivers.

viii) On an average the water temperature of the rivers in Kerala were observed to be on the higher side than the other rivers of southern region.

ix) The concentration of TKN was observed to be comparatively higher in the rivers of Kerala as compared to the other rivers.

x) The BOD level at Ahmedabvad on the Sabarmati ranged below 1.7 and 285 mg/l with an average value of about 70 mg/l while the acceptable limit is less than 3 mgh

xi) The water quality of the subarnareka at Ranchi is worse than at Jameshedpur. The probable reason for bad quality of water at Ranchi is low flow.

WATER QUALITY PARAMETERS

From the quality point of view the constituents of water can be classified into following three categories:

Characteristics	Parameters
Physical	Colour, odour, temperature, solids, (suspended and dissolved residues), oils, grease
Chemical	Biochemnical oxygen demand, chemical oxygen demand, total oxygen demand, total organic carbon, salinity, hardness, pH, iron content, managanese, chlorides, sulfates, sulfides, heavy metals, nitrogen, phosphorus
Bacteriological	Coliforms, fecal coliforms, specific pathogens, viruses

SOURCE OF POLLUTION

Sources of water pollution can be separated into two types:

i) Point sources

ii) Non-point sources

Point Sources

Point sources are those readily indifiable at a single location. The main sources are industries, municipal sewage treatment plants, combined sewer overflows and raw sewage discharges. It has been estimated that by 2000 AD, out of 1900 M cubic metre of water available in India, the country is going to use 1092 M cubicmetre/year, in which power, industry and domestic sector

will share 150, 35 and 38 M cubicmetre/year respectively. Quantity of water returing after use which actually becomes waste water would be 145, 25 and 30 M cubicmetre/year against the availability as above. A survey of the industrial cities of India has shown that industrial wastewater constitutes by volume between 8 to 16% of the total wastewater generated, and the remaining 84 to 92% is from domestic sector. By 2000 AD these figures are expected to reach about 33% and 67% respectively. In terms of BOD at present pollution load is 50% each for industrial and domestic waste water.

Non-Point Sources

Non-point sources comprise the other type-generalised discharges of waste whose location cannot be identified. The main sources are agriculture, forestry, mining, construction, urban runoff hydrologic modifications and residual wastes.

Is it the way of conservation ?

Table-III given below reflects the pollution- causing activities and their principal pollutants of non point sources of water pollution.

Table-III : Non-point sources Pollution & Pollutants

Category of Non-point source	Pollution Causing Activities	Principal Pollunts
Agriculture	crop production, animal production, farm production.	sediment, nutrients, from soil, fertilizer, pesticides, organic matters, salts, animal wastes
Forestry	access road construction and operation, harvesting systems, logging, crop regeneration, other silvicultural processes.	sediment, nutrients, pesticides, organic pollutants.
Mining	exploration, construction of facilities, mine operation, mine abandoment.	sediment, nutrients, waters, dissolved minerals, salinity.
Construction	land development, transportation & communication networks, water resources facilities	sediment, chemicals, biological materials.
Urban runoff	precipitation discharges containing pollutants, accelerated and concentrated by urban surfaces and collection system. sediments.	organic materials, inorganic solids, coliform bacteria, pesticides, nutrients heavy metals and

Contd..

Hydrologic Modifications	channel modifications, farm drainage, dams, resource recovery and related activities.	sediment, nutrients, pesticides, thermal chemicals, micro-organisms.
Residual Wastes	foregoing categories create residual waste not discharged to water but conveyed by runoff & infiltration.	both hazardous and non- hazardous.

AWARENESS AND EDUCATION

One of the very important priorities in the water sector is awareness and education of people. Unless the beneficiaries and users and people responsible for polluting waterbodies know the importance of water and aware about its primary characteristic like physical, chemical and biological aspects which are easily contaminated when come in touch of other constituents of organic matters, any water quality control objective cannot achieve the required level of success. Most people recognise the urgent need for educating people in the water sector, but only some class of people have clear ideas about what needs to be done and very few have either actual experience or the knowledge about the courses that need to be taught. The main objective of educating people about water and its importance should be to provide basic knowledge and awareness, to develop attitudes, skills and abilities and participate in solving real life water problems. In a country like India, creation of facilities for educating people in a general way is a difficult task. The size of work to be involved, inadequate administrative coordination, multi-plicity of agencies involved over & above economic hardships and political reason are some of the major issues that could obstruct implementing such scheme. However, the task can be taken in phase wise according to the importance of people in the society and their responsibility for the society,within the existing infrastructual facilities.

The country is well equiped in educational, R&D & industrial base and infrastructure, created in the post independence era. Formal education making appropriate syllabi, can be given in the school, college and university level. Field level engineers/officiers who are dealing with the problems of water and responsible for providing water to consumers can also be trained from time to time for a shorter duration, and they must be given the confidence about the modern tools & methodologies for efficient management of water and how the problems of water quality can be solved. The course of action for involving the field officials/engineers will have in two way process, technology transfer and feed back from them.

The popular mass media such as press, radio and TV, those have well coverage in the present time, though principally urban based and also urban biased, can be used as a tool of teaching media to aware the people. The programme and information need to be arranged in such a way that people get interested and accept them for solving real life problems. At the village level where such coverage is very limited, the school Headmaster and the village Headman who are the most influencial people, can be sensitised in the very first instance. They may afterwards motivate and educate the other people who are actually responsible for damaging the quality of water to deal with their problem being faced. The process may initially be slow, however, time will come when people will understand what to be done and what not to be done to conserve water and to control pollution for the shake of their survival. Woman, who is the actual dealer of domestically used water, needs to be educated and awared about the detrimental effect of using polluted water specifically in the light of health related diseases.

STEPS TO BE TAKEN TO CONTROL WATER POLLUTION

1. **Control non-point source pollution through**

   tillage practices,
   changing cropping paterns

- structural measures
- other farm management practices

2. **Control Point source pollution through**

   - renovating the existing sewer lines and connecting them to the central sewer line by branch and trunk lines,

   - all domestic sewage be centrally collected,

   - industries may be forced to treat the effluent to a requisite quality standard and to be connected to main sewer line,

   - all muncipal and industrial wastewater be centrally collected and be treated upto requisite acceptable level and finally be used for different beneficial uses or could be discharged to the rivers with little risk of pollution,

   - wastes from other sources like cattle fields and livestocks may also be centrally collected,

   - domestic and community solid wastes be centrally collected in a place fromwhere the muncipal body should take the responsibility for disposing of in safe open place where people habitation non exists and there is no chance of contaminating waterbodies.

3. **Reuse and Recycling of Wastewater according to the level of acceptance for various uses.**

TECHNOLOGY TO CONTROL WATER POLLUTION

1. General solutions

Treatment of wastewater - Primary, secondary and tertiary,

- Conventional methods (activated sludge process, trickling filter)
- Oxidation ditch
- Aerated lagoon
- Waste stabilization ponds
- Land disposal of wastes

2. Personal solutions

- Reduce population growh
- Reduce consumption of goods
- Waterless toilets use
- Using wastes as fertilizers
- Using fewer detergents, soaps, chemicals etc.
- Safe disposal of sanitary wastes
- Safe disposal of domestic solid waste

TECHNOLOGY FOR FORECASTING WATER QUALITY PARAMETERS

Modern tools for predicting and forecasting water quality parameters are :

- Sophisticated portable kits for direct measurement at the field,

- Water quality monitoring networks stations,
- Automatic Water quality monitoring stations,
- Water quality mapping through thematic mapper data from landsat-sattelite
- Use of aerial photography in detection and characterizing of non point sources of pollution,

TIPS FOR WATER QUALITY CONTROL

- Providing community sanitary facility for public places,
- Awarding community for preventing pollution of waterbodies,
- Educating people on free of cost,
- Encouraging people and industries to reuse water for different purposes other than drinking,
- Providing fund to community and industries for treating wastewater.
- providing public place for dumping household wastes,
- celebrating environmental day,
- provision of sulabh-shochalay

WATER QUALITY STANDARDS

Table IV : ISI STANDARDS FOR SURFACE WATER QUALITY FOR VARIOUS USES

Sl. No.	Characteristic	TOLERANCE LIMIT				
		Class A	Class B	Class C	Class D	Class E
1	2	3	4	5	6	7
1.	pH value	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
2.	Dissolved oxygen, mg/l, (min).	6	5	4	4	-
3.	BOD (5- days at 20°C mg/l, (min)	2	3	3	-	-
4.	Total coliform organism, MPN/100 ml,Max	50	500	5000	-	-
5.	Colour,Hazen units,Max.	10	300	300	-	-
6.	Odour	10	300	300	-	-

Contd..

1	2	3	4	5	6	7
7.	Taste	Tasteless	-	-	-	-
8.	Total dissolved solids, mg/L, max.	500	-	1500	-	2100
9.	Total hardness (as $CaCO_3$,mg/L), max.	300	-	-	-	-
10.	Calcium hardness (as $CaCO_3$),mg/L , max.	200	-	-	-	-
11.	Magnesium hardness (as $CaCO_3$),mg/L, max.	100	-	-	-	-
12.	Copper (as Cu),mg/L,max.	1.5	-	1.5	-	-
13.	Iron (as Fe),mg/l, max.	0.3	-	0.5	-	-
14.	Manganese (as Mn),mg/L,max.	0.5	-	-	-	-
15.	Cholrides (as Cl),mg/L,max.	250	-	600	-	600

Contd..

1	2	3	4	5	6	7
16.	Sulphates (as SO_4),mg/L,max.	400	-	400	-	1000
17.	Nitrates (as NO_3), mh/L,max	20	-	50	-	-
18.	Fluorides (as F),mg/L,max.	1.5	1.5	1.5	-	-
19.	Phenolic compounds (as C_6H_5 OH),mg/L, max.	0.002	0.005	0.005	-	-
20.	Mercury (as Hg),mg/L,max	0.001	-	-	-	-
21.	Cadmimum (as Cd),mg/L,max	0.01	-	0.01	-	-
22.	Salenium (as Se),mg/L,max	0.01	-	0.05	-	-
23.	Arsenic (as As),mg/L,max	0.05	0.2	0.2	-	-
24.	Cyanide (as CN),mg/L,max	0.05	0.05	0.05	-	-
25.	Lead (as Pb), mg/L, max	0.1	-	0.1	-	-
26.	Zinc (as Zn)). mg/L,max	15	-	15	-	-

Contd..

1	2	3	4	5	6	7
27.	Chromium (as Cr^{6+}),mg/L,max	0.05	-	0.05	-	-
28.	Anionic detergents (as MBAS) mg/L,max	0.2	1	1	-	-
29.	Polynuclear aromatic hydrocarbons,(as PAH)	0.2	-	-	-	-
30.	Mineral oil, mg/L,max	0.01	-	0.1	0.1	-
31.	Barium (as Ba),mg/L,max	1	-	-	-	-
32.	Silver (as Ag),mg/L,max	0.05	-	-	-	-
33.	Pesticides	Absent	-	Absent	-	-
34.	Alpha emitters,uc/Ml,max	10^{-9}	10^{-9}	10^{-9}	-	-
35.	Beta emitters,uc/ml,max	10^{-8}	10^{-8}	10^{-8}	10^{-8}	10^{-8}
36.	Free ammonia (as N),mg/L,max	-	-	-	1.2	-

Contd..

1	2	3	4	5	6	7
37.	Electrical conductance at 25°C,mhos,max	-	-	-	1000×10^{-6}	2250×10^{-6}
38.	Free carbon diovide (as CO),mg/l, max	-	-	-	61	-
39.	Sodium absorption ratio	-	-	-	-	26
40.	Boron (as B), mg/L, max	-	-	-	-	-
41.	Percemt sodium, max.	-	-	-	-	-

Source : IS : 2296 : 1982

Classes of water

Class A : Surface Waters for Use as Drinking Water Sources without Conventional Treatment but after Disinfection

Class B : Surface Waters for Outdoor Bathing

Class C : Surface Waters for Use as Drinking Water Source With Conventional Treatment Followed by Disinfection.

Class D : Surface Waters Used for Fish Culture and Wild Life Propagation

Class E : Surface Waters for Irrigation, Industrial Cooling or Control Waste Disposal.

Table V : WATER QUALITY CRITERIA FOR THE VARIOUS DESIGNATED BEST USES (AS PER CBCB, NEW DELHI)

Water Quality Criteria	Designated Best use	Parameters affecting	Quality Criteria
1	2	3	4
A.	Drinking Water Source, without conventional treatment but after disinfection	1. Coliform MNP	<50/100
		2. Turbidity	<10 units
		3. Colour	<10 units
		4. BOD	<2 mg/L
		5. DO	<6 mg/L
		6. Toxicants (including pesticides)	No acute toxicity to be present,
		7. Plate Count	<50/100 ml
		8. Floating Matter	Absent
		9. Taste or Odour	Not perceptible

Contd..

1	2	3		4
B.	Bathing, Swimming & Recreation	1.	Coliform MNP	<500/100 ml
		2.	Turbidity	<25 units.
		3.	Colour	<10 units
		4.	BOD	<3 Mg/L
		5.	DO	<5 Mg/L
		6.	Toxicants (including pesticides)	No acute toxicity to be present
		7.	Floating Matter	Not noticeable
		8.	Taste or Odour	Not perceptible
C.	Drinking Water Source after conventional treatment	1.	Coliform MNP	<5000/100 ml
		2.	Colour	<25 ml.
		3.	BOD	<3 mg/L
		4.	DO	>4 mg/L
		5.	Toxicants	No acute toxicity to be present

Contd..

1	2	3	4
D.	Propagation of Wild Life Fisheries	1. Coliform MNP	<5000/100 ml
		2. BOD	<6 mg/L
		3. DO	>4 mg/L
		4. Toxicants	No acute toxicity to be present
E.	Irrigation, Industrial Cooling and Controlled waste disposal	1. TDS	<1000 mg/L
		2. (Ca+Mg)	<100 mg/L
		3. Sodium Ratio	<0.5
		4. Chlorides	<250 mg/L
		5. Boron	<2 mg/L

Gram	: JALVIGYAN
Telephone	: 0091 1332 72106
Telex	: 0597-205 NIH IN
FAX	: 0091 1332 72123
E.Mail	: nihr@csird.ernet.in

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