STUDY OF
STATUS OF POLLUTION OF YAMUNA RIVER
AT DELHI

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SUBMITTED BY

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CERTIFICATE

This is to certify that the dissertation entitled **Study of status of Pollution of Yamuna River at Delhi** submitted by Avdhesh Kumar Goel [2002/ME (FT)/07] (university roll no.8851) to Delhi College of Engineering, DCE, Delhi for award of degree of **Master of Engineering** in Civil Engineering (Environmental Engineering) is a record of bonafide research work carried out by him under my supervision and guidance. He has fulfilled the requirement of submission of the thesis, which to my knowledge has reached requisite standards.

The result contained in the dissertation has not been submitted in part or full in any other university or institute for award of degree or diploma.

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Place :

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(**AVDHESH KUMAR GOEL**)

ABSTRACT

The river Yamuna originates from the glacial lake of Sapta Kund approximately 12km. right up mountain from the Yamunotri in the Himalayas. It finally merges with the Ganga and Underground Saraswati at Prayag in Allahabad. Enroute it runs for approximately 22.0 km. along Delhi. This river quenches the thrust of almost 60% population of Delhi and in return it cursed to become a practically dead river, which can resemble more than drain than to river. In lower reaches its water is good for nothing. This alarming situation forces a Delhite to think for a movement to assess his own contribution towards the environmental degradation as mentioned above.

The objective of this project study is to assess the affect of pollutants entering the river on the water quality and to suggest any possible remedial measure. The recent judicial activism has also floated an idea to review Legislation in this regard.

The most alarming finding of the study is the total lack of dissolved oxygen in the entire reach and unbelievably high coli forms count. But there is also a ray of hope as the river in the course of its flow despite all odd situations is showing the natural tendency of digesting pollution by the minimum surface aeration available.

This study has also revealed lacunas in the legislations and the norms prescribed there under.

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CHAPTER-1

INTRODUCTION

1.1 GENERAL

River Yamuna is largest tributary of River Ganga. The river constitutes max. flow i.e. around 80% of total Annual flow, during monsoon period.

The river water is used for both abstractive & in stream uses. The sources contributing to polluting are both point & diffused type.

Yamuna before the Wazirbad stretch has appreciable levels of dissolved oxygen, low biochemical oxygen demand levels and the water is extensively used for irrigation purposes. Haryana, Himachal Pradesh and parts of Uttar Pradesh use 6000 million metres cubic water every year for irrigation. The scene changes dramatically once the waters reach Delhi. None of the cities downstream generate more than 1000 MLD (million litres per day) of waste water. In contrast, Delhi alone generates 3000 MLD of waste water. Bacteriological count – an indicator of the presence of pathogens - is under permissible level upto Delhi. The Delhi region makes this count dangerously high. This means that Delhi could be responsible for all water-borne disease caused by use of Yamuna waters beyond Delhi.

Delhi is the largest contributor of pollution to Yamuna River. The sewage zones of Delhi, i.e. Okhla, Keshopur, Rithala, Shahdra etc. generate heavy BOD load.

Delhi is divided into five sewerage zones with five major sewage treatmentplants and two oxidation ponds located at Vasant Kunj and Timarpur. Oxidation ponds are shallow ponds that are well lined with high embankments. The raw sewage is allowed to stand in this pond for a period of time. During this time the oranic matter is oxidised through the combined action of algae and other microorganisms. By the time it is released into the river of lake the BOD content in the water is much less than it was when the sewage was first released into the pond.

The pollution in river beyond Delhi is characterized by severe adour, ugly look, high load of organic & inorganic material, significant oxygen Depletion & excessive pressure of pathogens etc.

Delhi is having a separate conveyance system for sewage and storm drainage. There are eighteen drains including the Najafgarh drain from Haryana and Shahdara drain from U.P. The actual flow through these nallahs / drains have not been measured accurately by up till now. A large number of unauthorized colonies and slums located near these nallahs contribute a major part to the discharge through these nallahs / drains. Presently, lot of wastewater is flowing through the nallahs demarcated to carry storm water drainage to Yamuna river.

1.2 Relevance and need of Present Study

The best way is to categorise on the basis of identification of processes & agencies involved in polluting, responsible for controlling and measures adopted or being adopted. As regards polluting processes and agencies these can be further categories as internal, external and ritual/religious. In Delhi reach the river water is polluted by agriculture and industrial waste discharged & culminating into the river in upper reaches mainly from Haryana. These discharges contain organic load, heavy metals and pesticides and fertilizers. However, if discharge from Tajewala remains sufficient this is not of more concern as on date. Excessive drawing of water at Tajewala and Wazirabad barrage indirectly contributes to the pollution by reducing the self-purifying capacity of the river.

Externally heavy polluting load inform of treated/untreated domestic/industrial sewage is being poured into the river in Delhi reach. Religious activity like Purnima Snan, Chhath Pooja, Murty viserjan, disposal of Residual mortal remains of dead bodies and disposal of domestic pooja/ yagyan remains are having large impact on the pollution of river due to heavy population density in Delhi. Besides this jhuggi dwellers residing in the bed & on bank discharge their all kinds of waste directly into the river and by using the polluted river water for daily uses they also become the carrier of infectious diseases.

In Delhi the responsible agencies for control of pollution are CPCB, DPCC, MCD, DJB & DSIDC in government sector. Some N.G.O's, Judiciary has shown interest in control of Pollution. On account of different excuses all these government agencies are showing in-abilities to control the same and can be termed indirectly polluting agencies. Certain measures have been adopted or being adopted to control the pollution and revive the river like setting of S.T.P's/E.T.P's/C.T.P's, regular monitoring, increase in fresh water discharge, removal of floating materials, provision of nets in the vicinity of bridges, removal of jhuggies from the Yamuna bank and bed etc.

With all these approaches active in India, and with world-wide acknowledged scientific personnel, the question remains as to the reason for the poor translation of these awareness into ground realities. The present study makes and attempt to discover some of the reasons after verifying the trend in water quality status in one of the urban river reaches.

1.3 Objectives of Study:

1) Identification of Major polluting drains causing pollution in river Yamuna.
2) To study the quality of different drains, discharging in river yamuna and polluting it heavily.
3) Assessment of pollutants and their variation in the drains.

4) To study the quality of river yamuna.

5) Review of legislation with regards to formation & implementation of water quality.

1.4 Overview of Dissertation: The thesis is laid out in 6 chapters. In this **Chapter-1** brief introduction of the techniques and the objectives of the study are given.

Chapter-2 Contains literature Review

Chapter-3 Characteristics of drains discharging in Yamuna river

Chapter-4 Quality of River Yamuna.

Chapter-5 Pollution status of river Yamuna at Delhi.

Chapter-6 Steps taken to control pollution of river Yamuna.

Chapter-7 Conclusion of study.

A comprehensive list of references used while during the study, are given at very end part of thesis.

CHAPTER-2

LITERATURE REVIEW

2.1 INTRODUCTION

The river Yamuna originates from the glacial lake of Sapta Rishi Kund approximately 12 km. right up the mountains from the Yamunotri in the Himalayas. It finally merges with the Ganga and underground Saraswati at Prayag in Allahabad. Enroute it runs for approximately 22.0 km. along Delhi (CPCB, 1978-79).

River Yamuna is found to be clean only in stretches of 522km, out of its total length of 1044 km, which shows that it is polluted for half of its length. The water quality of river Yamuna from origin upto Delhi u/s Wazirabad remains fairly good most of the time. The 22 km Delhi stretch of the river between Waziraad and Okhla barrages is heavily polluted. In this stretch, there was practically no perennial flow during dry weather while a quantity of treated and untreated sewage (about 2,300 MLD) was being discharged into the river. The low self-purification capacity of the river Yamuna in Delhi is due to want of minimum flow in the river and discharge of heavy municipal and industrial pollution load emanating from Delhi. Even though Delhi constitutes only 2% of the catchment of the Yamuna basin, yet the area contributes about 80% of the pollution load. There are 19 drains which discharge treated and untreated waste water/sewage of Delhi into the Yamuna.

After Independence, the cities become a major center of commerce, industry and education. The growth of government departments and office complexes has also contributed to spread of the city. Civic amenities have not kept pace. Unabated immigration has compounded the problem. Land use regulations have been flouted. The green cover has dwindled.

The success of the Yamuna Action Plan (YAP) has also become doubtful. The work on the YAP is at advanced stage. According to a survey conducted by Union Environment Ministry in Yamuna during the dry weather, the entire flow is abstracted from the river at Tajewala for irrigation purpose and the flow regenerated between Tejewala and Wazirabad barrage is again abastracted at Wazirabad to meet water supply requirement of Delhi (CPCB, 2001). The water flow in this river is regulated according to the demand (depending on climate and agricultural requirement) in the command areas of the canals taken off from the river, and also according to the agreement on sharing of Yamuna water by the 5 riparian States. This regulation has very significant impact on the water quality of the river. The release of water from Tajewala and Wazirabad is not regular. Therefore, the water quality also alters according to the flow available in the river. The pollution load added from Haryana in the river is also intermittent. As there is no release of fresh water from Wazirabad in the dry season, it is the Delhi sewage, which constitutes the flow in the river in the down stream.

2.2 POLLUTION POTENTIAL IN THE YAMUNA BASIN

The entire Yamuna river right from its origin to confluence with the Ganga & its tributaries are subject to human activities, which directly or indirect affect the water quality. The pollution potential in the catchment area depends on various human activities and are categorized into two groups.

2.2.1 Point Sources Of Pollution

The point sources of pollution is contributed at a single point in significant amount such as wastewater drain joining a water body. The point source pollution covers two major categories:

- *Domestic pollution:* Major domestic pollution sources are urban centers. The process of urbanization encourage the migration of population to urban areas due to better standard of living and job opportunities.
- *Industrial pollution:* Although, large number of industries have been established in the Yamuna basin, a precise estimation of their contribution of pollution to the river could not be made due to wide variation in their discharges. Therefore, an attempt have been made to identify large and medium industries directly contributing to the river. There are 22 industrial units in Haryana, 42 units in Delhi and 17 units in Uttar Pradesh directly discharging and polluting the river Yamuna.

2.2.2 Diffused Sources of Pollution

The diffused pollution originates mainly from the catchment area through movement of water. Pollutants originated from the topsoil losses includes soil organic matter, plant residues, nutrient elements, organic chemicals, toxic elements and bacteria. Soil can retain, modify decompose or sorb pollutants.

2.3 EXCERPTS FROM MEDIA

Some articles from a daily news paper are presented herein so as to get further insight by having another view of the situation. These articles are taken over a period of last four months & a brief summary for each of these is being presented here.

2.3.1 Yamuna River Pollution, Delhi (Shillong times, 2004)

New Delhi: An ugly assortment of huge clay idols, decaying flowers, polythene packets containing religious offerings and decorations - all leftovers of Durga Puja - are floating in the Yamuna river here two days after the festival ended.Hindus consider it holy to immerse idols worshipped during the festival, but the pollution it causes in water bodies - often at the cost of precious aquatic life - is anything but that, say environmentalists. "There is no policy to prevent pollution, and nothing to prevent people from immersing idols.

"An official with the Centre for Science and Environment NGO here, told. "Even though hundreds of thousands of rupees have been spent on the Yamuna Action Plan that was started in 1993, the river remains as polluted as ever. Environmentalists say plaster of Paris, aluminium foils, paints and various chemicals used in making the idols are toxic and kill aquatic life.

"According to him, Section 133 in the code of criminal proceedings gives every citizen the right to file a complaint with the magistrate in event of activities causing public nuisance." Environmentalists say plaster of Paris, aluminium foils, paints and various chemicals used in making the idols are toxic and kill aquatic life. "In Kolkata, public interest litigation has spurred the municipal authorities to act. Now puja organisers there, along with municipal authorities and police officials, cleanup water bodies after the immersion. "The same thing can be done in Delhi if the public is made aware. "According to him, Section 133 in the code of criminal proceedings gives every citizen the right to file a complaint with the magistrate in event of activities causing public nuisance.

2.3.2 Factories Spewing Pollutants Into New Delhi River Banned (Times of India, 2004)

NEW DELHI, Jan 24 (AFP) - India's Supreme Court banned thousands of factories on Monday (Jan. 24) from discharging untreated industrial effluents into the Yamuna River in New Delhi and the neighboring state of Haryana. Judges B.N Kirpal and S. Rajendra Babu said river pollution in north India had reached an "alarming proportion" and had to be checked. "We direct every industry in Delhi not to discharge their effluents either into the river or into drains leading to the river, which have the effect of polluting the river."

The judges added that factories in the neighboring state of Haryana would also have to heed the ban.

State-run pollution control boards welcomed the move. We supplied the apex court with studies to show the dangerous level of toxins released into the Yamuna every day by some 15,000 to 20,000 factories in Delhi alone," said the senior scientist.

Spokesperson said small- to medium-size soap and detergent, textile, electroplating, small engineering and auto factories were the main culprits. "Tests conducted in our laboratories on water samples collected from the Yamuna show that toxin levels are dangerously high and as a result, the water unsafe for drinking."

India's Water Act of 1974 has been amended several times to give government agencies powers to deal with growing river and ocean pollution. Almost all Indian rivers are polluted by untreated factory and human waste.

2.3.3 GOVT. MAY SEEK WORLD BANK HELP TO BUILD SEWAGE CHANNEL (TOI,)

The report quotes Sunita Narain on the state of river Yamuna “The reason Yamuna is polluted is incompetent governance and a constant game of ping pong between government departments” (Sunita Narain, Centre for Science and Environment).

2.4 BIOTIC INTEGRITY OF DELHI – NEW REACH

Ancient records indicate that various water bodies in Delhi have been rich habitat for variety of water birds including water fowls, egrets, stilts, Little grebes, Plovers, Gulls, Terns, Spoon bills. Cormorants, Herons, Storks, Kingfisher, ducks & green etc. Many of these water bodies were attracting several migratory species of the birds during the winter months. Along with the deterioration of water quality, the quantity and the varieties of the various water birds in these habitats have decreased. There are several food plants grown in the water bodies e.g. chestnuts (Trapa bispinosa), Lotus (Nelumbo nucifera) Makhna (Euryala ferox) etc., but presently the availability of the various plants have been gradually reduced. The fishes such as common Carps, Rohu, Tilapia, and Singhi etc. are still culture in some lakes/ponds n Delhi. Ground level queries addressed to fishermen at Wazirabad and Nizamuddhi have revealed a sharp decline to near absence of commercially valuable fish in this reach.

2.5 LEGISLATION POINTS ABOUT WATER QUALITY

Water Quality Objectives

It is generally recognized that water quality objectives, the setting of emission limits on the basis of best available technology, and the use of best environmental practice should all form part of an integrated approach to the prevention, control and reduction of pollution in inland surface waters. In most cases, water quality objectives serve as a means of assessing pollution reduction measures. For example, if emission limits are set for a given water body on the basis of best available technology, toxic effects may, nevertheless, be experienced by aquatic communities under certain conditions. In addition, other sensitive water uses, such as drinking-water supplies, may be adversely affected. The water quality objectives help to evaluate, therefore, whether additional efforts are needed when water resources protection is based on using emission limits for point sources according to the best available technology or on best environmental practice for non-point sources.

Experience gained in some countries suggests that catchment planning plays an essential role in setting water quality objectives. It provides the context in which the demands of all water users can be balanced against water quality requirements. Catchment planning also provides the mechanism for assessing and controlling the overall loading of pollutants within whole river catchments and, ultimately, into the sea, irrespective of the uses to which those waters are put. The need for “catchment accountability” is becoming increasingly important in order to ensure that both national and international requirements to reduce pollutant loadings are properly planned and achieved.

2.6 WATER QUALITY CLASSIFICATION

Water quality classifications in different countries have been made on different bases. Some of the classifications are as under:

2.6.1 India

In India, five water quality classes have been designated (A-E) on the basis of the water quality requirements for a particular use:

Class A waters for use as drinking water source without conventional treatment but after disinfection.

Class B waters for use for organized outdoor bathing.

Class C waters for use as drinking water source with conventional treatment followed by disinfection.

Class D waters to maintain aquatic life (i.e. propagation of wildlife and fisheries).

Class E waters for use for irrigation, industrial cooling and controlled waste disposal.

The five classes have been used to set quality objectives for stretches of the Yamuna and Ganga rivers, and surveys have been carried out to compare the actual river-quality classification with that required to sustain the designated best use. Where a river has multiple uses, the quality objective are set for the most stringent (best) use requirements. After comparing ambient water quality with the designated water quality objective, any deficiencies will require appropriate pollution control measures on the discharges, including discharges in upstream stretches. This system is also helpful for the planning and siting of industry. No industries are permitted to discharge any effluent in stretches of rivers classified in Class A.

A pollution control action plan was drawn up for the Ganga n 1984 and the Ganga Project directorate was established under the Central Ganga Authority in 1985. This directorate oversees pollution control and abatement (ESCAP, 1990). The table below shows the improvements in water quality classification that were achieved by 1987. The classification and zoning of 12 other major rivers has also been recently accomplished.

2.7 INDIAN STANDARDS

In 1957, Indian standards institution had set up its waters sectional committee (CDC 26) to prepare, among others, standards for industrial and sewage effluents before discharge into inlands surface waters, marine coastal areas, on land and into sewers. The sectional committee has, initially brought out two Indian standards.

The first one (IS 2488) covers in five parts method of sampling and test for industrial effluents. The second Indian standard (IS 2490) prescribes in nine parts tolerance limits for industrial effluents discharged into inland surface waters, marine coastal areas, public sewers and land for irrigation purposes. While part I of IS 2490 is applicable to all industries as regards tolerance limits for industrial effluents, the second part cover specific industries, such as distilleries, tanneries etc. Indian standard (IS 6582-1971) lays down the bioassay methods for evaluating the toxicity of industrial effluents and wastewaters to fish and other aquatic organisms in the receiving waters which can help decide whether an effluent can be discharged at a given rate without causing direct injury to aquatic fauna and flaura. IS 2296-1974 deals with the tolerance limits for inland source water subject to pollution and IS 1967-1976 deals with criteria for controlling pollution of marine coastal areas. Indian standard institution has also prepared codes of practice for the treatment and disposal of effluents emanating from individual industries including distillery, cane sugar, cotton etc.

2.8 ENVIRONMENTAL LAWS IN INDIA

In India laws pertaining to almost all aspects of environment like Air, Water, Forest etc. are available separately. A separate Environmental Protection act covering the entire aspects of environment is also in existence. Though air, water, forest and land are having considerable effect on each other, having more relevance to the study water act & EP Act are being discussed here.

2.8.1 WATER ACT (PREVENTION & CONTROL OF POLLUTION, 1974)

Environmental law appears to be recent invention and not a sudden creation. Many provisions dealing with the environment are scattered in pieces and are found in the different enactments of this country.

Under water (prevention and control of pollution) act, 1974 pollution control boards have been set up at the centre and in the states for the prevention, abatement and control of pollution of rivers and streams by regulating the quantity of existing and industrial waters.

This act was enacted in accordance with the provisions of article 252 of the constitution of India after resolutions in pursuance of clause (1) of article 252 of the constitution has been passed by the houses of the legislatures of the various states to the effect that the matter aforesaid should be regulated in those states by parliament by law.

By central act no 44 of 1978; certain amendments were introduced in the act. Among the amendments were to omit the time limit for the constitution of state boards.

A summary of Water Act, its provision along with its drawbacks is as under:

WATER (PREVENTION AND CONTROL OF POLLUTION) ACT OF 1974

The Act was passed by the Parliament pursuant to enabling resolutions by twelve States, under Art. 252 (1) of the Constitution, for prevention and control of water pollution and maintaining or restoring of wholesomeness of water.

Main Features

The main features of the act can be summarized as under:-

- Amended in 1978 and revised in 1988.
- Comes under State list of the Constitution.
- Establishes State and Central Pollution control boards.
- Applies to river, watercourse, inland waters, subterranean waters and sea or tidal waters.
- Specifies functions of State boards.
- The Central board also performs the functions of State boards for the union territories.
- Since 1982, the Central board has been attached to the Department of Environment, Forest and Wildlife, Govt. of India.

2.8.2 E P ACT

The strength and weaknesses of Environment Protection Act 1986 in a summarized form is as under:

An act to provide for the protection and improvement of environment and for matter connected therewith.

Environment Protection act 1986

- After the Tragedy of Bhopal gas case Government of India enacted EPA 1986 under article 253 of constitution.
- The purpose of the Act is to protect and improve the human environment and prevention of hazards to human beings other living creatures, plants and property.
- The EPA 1986 is an umbrella legislation to control Govt. to coordination the activities of various control and state

authorities established under previous laws such as water and Air Act.

- It is an Enabling law-means it enables bureaucrats to frame necessary rules & regulations.

SHORTCOMING OF EPA 1986

- Shoddy drafting in the 1991 Coastal Regulations.
- Numerous Key expressions used in EPA.
- E.g. (Land for irrigations standards, inland surface water standards) not defined.
- Printing errors
- Pollutions control Boards norms vary from the EPA standards which standards apply those issued under EPA or standards published by state Boards Assuming EPA prevails should not the parliament repeal section 17(g) of water and air Act to reduce confusion.
- A Prepublication requirement to write objections from public was existing however on 16 March 1994 new sub rule Section 5(4) was introduced permitting the center to dispense with pre publication requirement in the public inters. This has provided Govt. a convenient clause to dispense with Prepublication procedure.
- In EIA mandatory public hearing requirement was done away with

SHORTCOMING OF EPA

(cobra that is seemingly fierce but has no venom its in)

Section 2 provides that if any act or omission constitutes an offence punishable under the EPA as well as other law, the offender shall be liable to be punished under the other law and not under EPA.

This is very curious and controversial provision. Generally recent legislation supercedes the previous legislations.

PENALTIES UNDER THE ACT

Under EPA central Govt. has the authority to issue direct written orders including orders to close prohibits, regulate any industry, operation, and process or regulate the supply of electricity water or any other service.

Other Power include:

- Power of entry
- Testing of Equipment
- Power to take samples of air, water soil etc.

The Act provides for severe penalties

- Prison term up to five years or Rs. 10,000/- fine or both
- Corporate officials directly in charge of a companies business are liable for offences under the act. Similar liability extends to the head of the department of Govt. and other offices.

  The relevant standards stipulated by the Act have been given in the following tables Nos. 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7.

2.9 CONCLUSION

After going through the different Media reports, Journals, CPCB publications, Judicial activism reports it can be safely concluded that all the sector is showing serious concern over the situation of river Yamuna in Delhi reach and except Jhuggi dwellers residing in the status of water quality in Yamuna. Despite all above awareness no sign of improvement in the qualitative condition of the river propagates the idea of further study and thus justifies the present study.

TABLE – 2.1

PRIMARY WATER QUALITY CRITERIA FOR CLASS SW-I WATERS

(For salts pans, shell Fishing, Mari culture and Ecologically Sensitive Zone)

Sl. NO.	Parameter	Standards	Rationale/Remarks
(1)	**(2)**	**(3)**	**(4)**
1.	pH range	6.5	General broad range, conductive for propagation of aquatic lives, is given. Value largely dependent upon soil water interaction.
2	Dissolved oxygen	5.0 mg/l or 60 percent saturation value, whichever is higher	Not less than 3.5 mg/l at any time of the year for protection of aquatic lives.
3	Colour and odour	No noticeable colour of offensive odour	Specially caused by chemical compounds like creosols, phenols, naptha, pyridine, benzene, toluene etc., causing visible coloration of salt crystal and tainting of fish flesh.
4	Floating matters	Nothing obnoxious or detrimental for use purpose.	Surfactant should not exceed an upper limit of 1.0 mg/l and concentration not to cause any visible foam.
5	Suspended solid	None from sewage or industrial waste origin	Settle able inert matters not such concentration that would impair any usages specially assigned to this class.
6	Oil and Grease (including petroleum products)	0.1 mg/l	Concentration should not exceed 0.1/ mg/l as because it has effect on fish eggs and larvae.
7	Heavy metals: mercury (as Hg) cadmium (as Cd) lead (as Pb)	0.001 mg/l 0.01 mg/l 0.01 mg/l	Values depends on: (i) Concentration in salts, fish and shellfish, (ii) Average per capita consumption per day (iii) minimum ingestion rate that induces symptoms of resulting diseases.

Source: EP Rules, 1986

Note:- SW-1 is desirable to be safe and relatively free from hazardous chemical likes pesticides, heavy metals and radionuclide concentration. Their combined (synergetic or antagonistic) effects on health and aquatic lives are not yet clearly known. These chemicals undergo Bioaccumulation, magnification and transfer to human and other animals through food chain. In areas where fisheries, salt pans are governing consideration, and presence of such chemicals apprehended/ reported, bioassay test hould be performed following appropriate methods for the purpose of setting case-specific limits.

TABLE – 2.2

PRIMARY WATER QUALITY CRITERIA FOR CLASS SW-II WATERS

(For bathing, Contact water sports and commercial building)

Sl. NO.	Parameter	Standards	Rationale/Remarks
(1)	(2)	(3)	(4)
1.	pH range	6.5–8.5	Range does not cause skin or eye irritation and is also conductive for propagating aquatic lives.
2	Dissolved oxygen	4.0 mg/l or 50 percent saturation value, whichever is higher	Not less than 3.5 mg/l at any time of the year for protection of aquatic lives.
3	Colour and odour	No noticeable colour of offensive odour	Specially caused by chemical compounds like creosols, phenols, naptha, pyridine, benzene, toluene etc., causing visible coloration of salt crystal and tainting of fish flesh.
4	Floating matters	Nothing obnoxious or detrimental for use purpose.	None in concentration that would impair usages specially assigned to this class.
5	Turbidity	30 NTU (Nephelo Turbidity unit)	Measured at 0.9 depths.
6	Fecal coliform	100/100 ml (MPN)	The average value not exceeding 200/100 ml. in 20 per cent of samples in monsoon months.

7	Biochemical oxygen demand (BOD) (3 days at 27º C)	3 mg/l	Restricted for lathing (aesthetic quality of water). Also prescribed by IS:2296-1974.

Source: EP Rules, 1986

TABLE – 2.3

PRIMARY WATER QUALITY CRITERIA FOR CLASS SW-III WATERS

(For Industrial Cooling, Recreation (Non Contact) and Aesthetic)

Sl. NO.	Parameter	Standards	Rationale/Remarks
(1)	**(2)**	**(3)**	**(4)**
1.	pH range	6.5–8.5	The Range is conductive for propagation of aquatic species and restoring natural system.
2	Dissolved oxygen	4.0 mg/l or 50 percent saturation value, whichever is higher	To protect aquatic lives.
3	Colour and odour	No noticeable colour of offensive odour assigned to this class.	None in such concentration that would impair usages specifically assigned to this class.
4	Floating matters	No visible obnoxious	As in (3) above.
5	Fecal coliform	500/100 ml (MPN)	Not exceeding 1000/100 ml in 20 per cent of samples in the year and in 3 consecutive samples in monsoon months.
6	Turbidity	30 NTU (Nephelo Turbidity unit)	Reasonable clear water for recreation, aesthetic appreciation and industrial cooling purposes.
7	Dissolved Iron (as Fe.)	0.5 mg/l or less	It is desirable to have the collective concentration of dissolved Fe and Mn less or equal to 0.5 mg/l to avoid scaling effects
8	Dissolved manganese (as Mn.)	0.5 mg/l or less	

Source: EP Rules, 1986

TABLE – 2.4

PRIMARY WATER QUALITY CRITERIA FOR CLASS SW-IV WATER

(For Harbor Water)

Sl. NO.	Parameter	Standards	Rationale/Remarks
1	pH range	6.5–9	To minimize corrosive and scaling effect.
2	Dissolved oxygen	3.0 mg/ or 40 percent. Saturation value whichever is higher	To protect aquatic lives.
3	Colour and odour	No noticeable colour of offensive odour .	None from reactive chemicals, which may corrode paints/metallic surfaces.
4	Floating materials, oil grease and scum (including petroleum product)	10 mg/l	Floating matter should be free from excessive living organisms, which may clog or coat operative parts of marine vessels/equipments.
5	Fecal coliform	500/100 ml (MPN)	Not exceeding 1000/100 ml in 20 per cent of samples in the year and in 3 consecutive samples in monsoon months.
6	Biochemical oxygen demand (BOD) (3 days at 27^{o}C)	5 mg/l	To maintain water relatively from pollution caused by sewage and other decomposable waste.

Source: EP Rules, 1986

TABLE – 2.5

PRIMARY WATER QUALITY CRITERIA FOR CLASS SW-V WATER

(For Navigation and Controlled Waste Disposal)

Sl. NO.	Parameter	Standards	Rationale/Remarks
1	pH range	6.5–9.0	As specified by the new England Interstate Water Pollution Control Commission.
2	Dissolved oxygen	3.0 mg/ or 40 percent. Saturation value whichever is higher	To protect aquatic lives.
3	Colour and odour	Non-in such concentration that would impair any usages specifically assigned to this class.	As in (1) above.
4	Sludge deposit	None accept for solid refuse floating such small amount that may solids, oil, grease, results from discharged and the scum of appropriately treated sewage and/or industrial waste effluents.	As in (1) above.
5	Fecal coliform	500/100 ml (MPN)	Not exceeding 1000/100 ml in 20 per cent of samples in the year and in 3 consecutive samples in monsoon months.

Source: EP Rules, 1986

TABLE – 2.6

PRIMARY WATER QUALITY CRITERIA FOR CLASS SW-V WATER

(Water is used for organized outdoor bathing)

	CRITERIA	**RATIONALE**
1	Fecal coliform 500 (desirable) MPN/100ml 2500 (maximum) Permissible	To ensure low sewage contamination. Fecal coliform and fecal streptococci are considered as they reflected the bacterial pathogenicity.
2.	Fecal Streptococci 100 (desirable) MPN/100 ml 500 (maximum Permissible)	The desirable and permissible limits are suggested to allow for fluctuation in environmental conditions such as seasonal change, changes in flow conditions etc.
3.	pH: Between 6.5–8.5	The range provides protection to the skin and delicate organs like eyes, nose, ears, etc. which are directly exposed during outdoor bathing.
4.	Dissolved Oxygen: 5mg/l or more	The minimum dissolved oxygen concentration of 5mg/l ensures reasonable freedom from oxygen consuming organic pollution immediately upstream which is necessary for preventing production of anaerobic gases (obnoxious gases) from sediment. The Biochemical Oxygen Demand of 3 mg/l or less of the water ensures reasonable freedom from oxygen demanding pollutants and prevent production of obnoxious gases.
5.	Biochemcial oxygen 3mg/l or less 3 days at 27´C:	The Biochemical Oxygen Demand of mg/l or less of the water ensures reasonable freedom from

		oxygen demanding pollutants and prevent production of obnoxious gases.

Source: EP Rules, 1986

Table – 2.7

[SCHEDULE-VI]
[SEE RULE 3(3A)]
GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS
PART-A EFFLUENTS

Sl. No.	**Parameter**	Standards			
		Inland Surface	**Public Sewers**	**Land for Irrigation**	**Marine Coastal areas**
1		**3(a)**	**3(b)**	**3(c)**	**(d)**
1.	Colour and odour	See 6 of Annexure-1	--------	See 6 of Annexure-1	See 6 of Annexure-I
2.	Suspended solids mg/l, Max.	100	600	200	(a) For process waste water-100 (b) For cooling water effluent 10% above total suspended matter of influent.
3.	Particle size of suspended solids.	Shall pass 850 micron IS Sieve	---------		(a) Floatable solids, max 3mm. (b) Settleable solids, max 850 microns.
4	[2][***]				
5.	pH Value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
6.	Temperature	Shall not exceed 5ºC above the receiving water	---------	---------	Shall not exceed 5ºC above the receiving water temperature

Sl. No.	Parameter	Standards			
		Inland Surface	Public Sewers	Land for Irrigation	Marine Coastal areas
1		3(a)	3(b)	3(c)	(d)
		temperature			
7.	Oil and grease mg/l Max.	10	20	10	20
8.	Total residual chlorine mg/l Max.	1.0	---------	---------	1.0
9.	Ammonical nitrogen (as N) mg/l Max.	50	50	---------	50
10.	Total Kjeldahl nitrogen [3][N]; mg/l Max.	100	---------	---------	100
11.	Free Ammonia [3][NH_3] mg/l Max.	5.0	---------	---------	5.0
12.	Biochemical oxygen demand (5 days at 20ºC) [3][mg/l Max.]	30	350	100	100
13.	Chemical Oxygen demand, mg/l Max.	250	---------	---------	250
14.	Arsenic (as As) [1][mg/l Max.)	0.2	0.2	0.2	0.2
15.	Mercury (as Hg), mg/l Max.	0.01	0.01	---------	0.01
16.	Lead (as Pb), mg/l Max.	0.1	0.1	---------	2.0
17.	Cadmium (as Cd), mg/l Max.	2.0	1.0	---------	2.0
18.	Hexavalent	0.1	2.0	---------	1.0

Sl. No.	Parameter	Standards			
		Inland Surface	Public Sewers	Land for Irrigation	Marine Coastal areas
1		3(a)	3(b)	3(c)	(d)
	chromium (as Cr+6), mg/l Max.				
19.	Total Chromium (as Cr), mg/l Max.	2.0	2.0	---------	2.0
20.	Copper (as Cu), mg/l Max.	3.0	3.0	---------	3.0
21.	Zinc (as Zn), mg/l Max.	5.0	1.5	---------	1.5
22.	Selenium (as Se), mg/l Max.	0.05	0.05	---------	0.05
23.	Nickel (as Ni), mg/l Max. [2][***]	3.0	3.0	---------	3.0
24.	Cyanide (as CN), Mg/l Max. [2][***]	0.2	2.0	0.2	0.2
25.	[1][Floride] (as Hg), mg/l Max.	0.1	0.1	----------	0.1
26.	Mercury (as F), mg/l Max	2.0	15	----------	15
27.	Dissolved phosphates (as P), mg/l Max. [2][***}	5.0	----------	----------	----------
28.	Sulphide (as S), mg/l Max.	2.0	----------	----------	5.0
29.	Phenolic compounds [2][as C_6H_5OH] mg/l Max.	1.0	5.0	----------	5.0
30.	Radioactive materials: (a) Alpha emitters [1][Micro	10^{-7}	10^{-7}	[1][10^{-7}]	10^{-7}

Sl. No.	Parameter	Standards			
		Inland Surface	**Public Sewers**	**Land for Irrigation**	**Marine Coastal areas**
1		**3(a)**	**3(b)**	**3(c)**	**(d)**
	curie/ml] Max. (b) Beta emitters [1][Micro curie/ml] Max.	10^{-6}	10^{-6}	10^{-7}	[1][10^{-7}]
31.	Bio-assay test	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent
32.	Manganese (as Mn)	2mg/l	2mg/l	----------	2mg/l
33.	Iron (as Fe)	3mg/l	3mg/l	----------	3mg/l
34.	Vanadium (as V)	0.2mg/l	0.2mg/l	----------	0.2mg/l
35.	Nitrate Nitrogen	10mg/l	----------	----------	10mg/l

CHAPTER 3
CHARACTERISTICS OF DRAINS DISCHARGING INTO RIVER YAMUNA

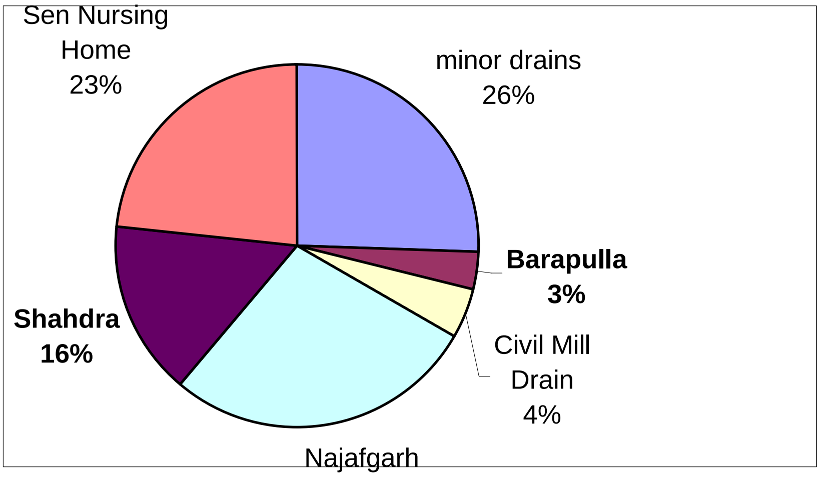
3.1 INTRODUCTION

13 drains join river Yamuna, causing heavy pollution in terms of BOD, COD and suspended solids (SS) and also involve micropollutants, which include generally (Pesticide, heavy metals, DDT, BHC). Therefore the pollution load contribution through drain can be divided into two group mainly.

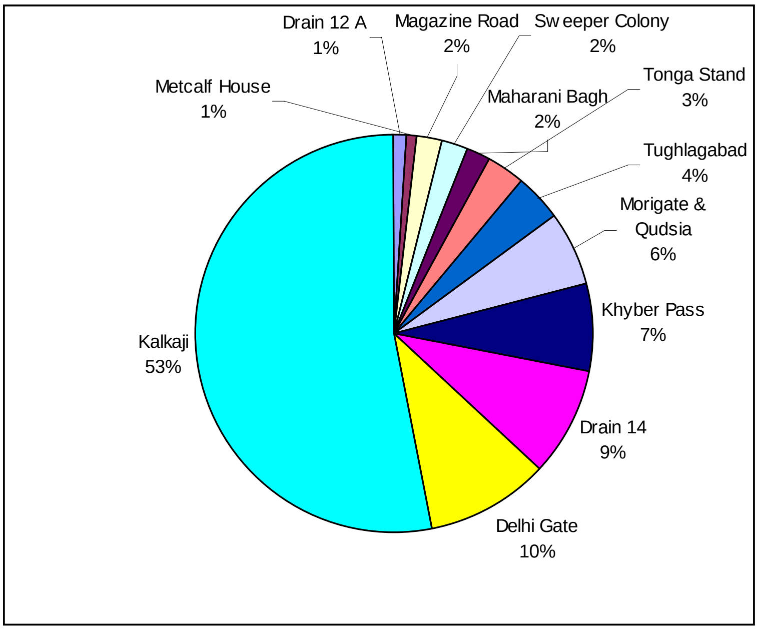
Pollution load contribution

- In terms of COD, BOD & SS
- in terms of micropollutant (Pesticides, heavy metals, DDT, BHC)

Sharing of BOD load by drains



Sharing of BOD Load by Drains (Total)



Sharing of BOD Load by Drains (Minor Drains)

This chapter covers a brief description of the parameters, which have been tested under the scope of the project & their testing procedures adopted. This gives an overview about the parameter, which is being tested; it's importance & the significance of testing the same. This description is then followed by the Table of the observation made for that parameter from different locations selected. And compare, the testing results, with D.J.B. report results. Thus results give an overall view of the impact of pollutants concentration in the drain on the river through values of these parameters for different drains taken for present study. The method of quantification adopted is according Standard Methods, 1989.

These Parameters are described in here under:

3.2 pH

The pH value of water indicates the logarithm of reciprocal of hydrogen ion concentration present in water. It is thus an indicator of the acidity or the alkalinity of water. Since the pH is the log of reciprocal of H+ the higher values of pH means lower hydrogen ion concentrations, and thus representing acidic solutions. If the pH of water is less than 7, it will be acidic and if the pH is more than 7, it will be alkaline. The pH value of water in the lab is measured quickly & automatically with the help of a Potentiometer, which measures the electrical potential exerted by hydrogen ions and thus indicating their concentration.

For public water suppliers, attempts should be made to keep the pH as close to 7 as possible. The lower values (i.e. acidic waters) may cause produce incrustation, sediment deposits, difficulties in Chlorination, certain psychological efforts on human system etc. However, the permissible values for public supplies many range between 6.6 to 8.5. As per the “Water Quality Standards for Surface Water Sources set by CPCB (New Delhi)”.

Results obtained for both the drains are given in tables-3.2.

The trend has been shown in figures-3.2 (a) & (b) separately.

Results show no significant variation in pH value in respect of both the drains. A little higher value for March 03 is reported in Sh-drain as well as Bp –drain.

Table 3.2 (a)

pH value for Sh-Drain (Shahadra)

Months	**Drain**	**pH**
March 2004	Sh – Drain	7.08
June 2004	Sh – Drain	7.20

Figure 3.2 (a)

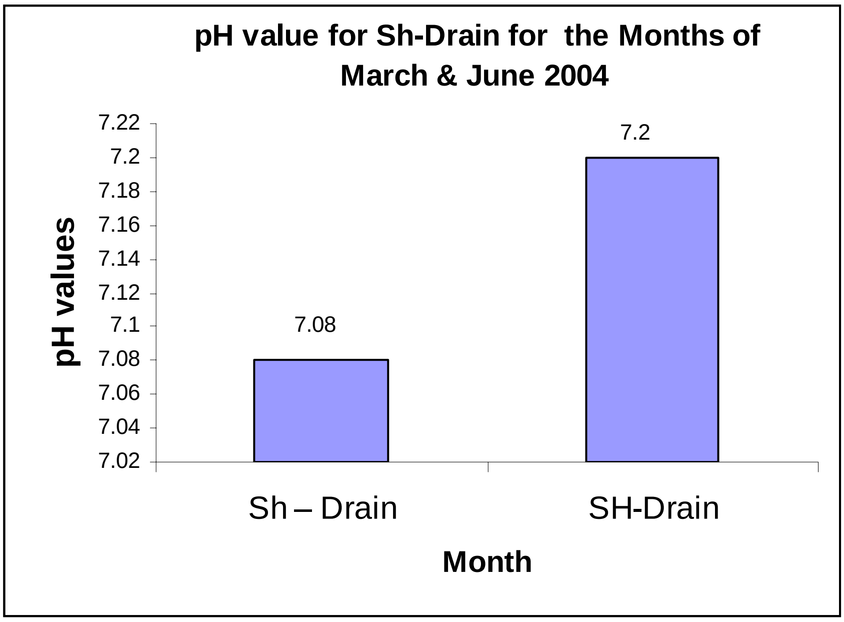


Table 3.2 (b):
pH value for Sh drain conducted by DJB

Months	PH
March 2002	7.04
June 2002	7.22
March 2003	8.08

Figure 3.2 (b):
pH value for Sh drain conducted by DJB

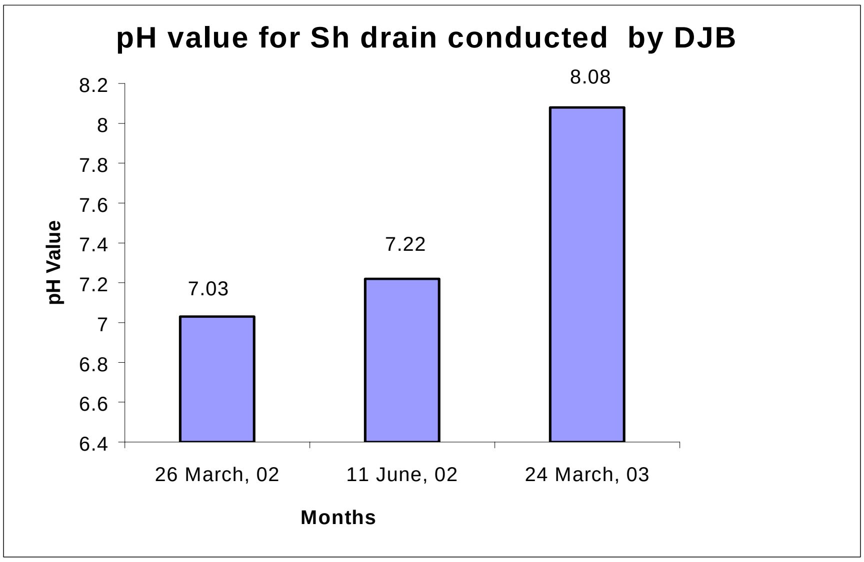


Figure 3.2 (c):

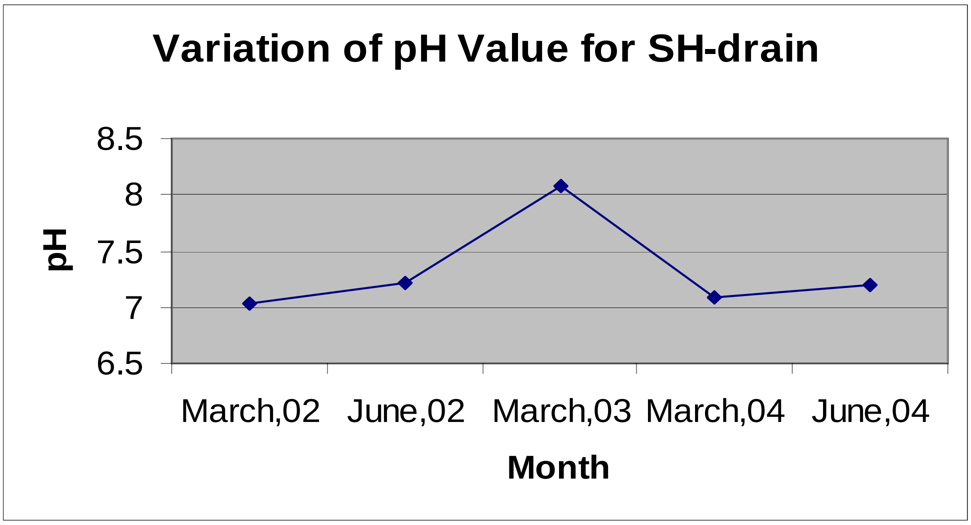
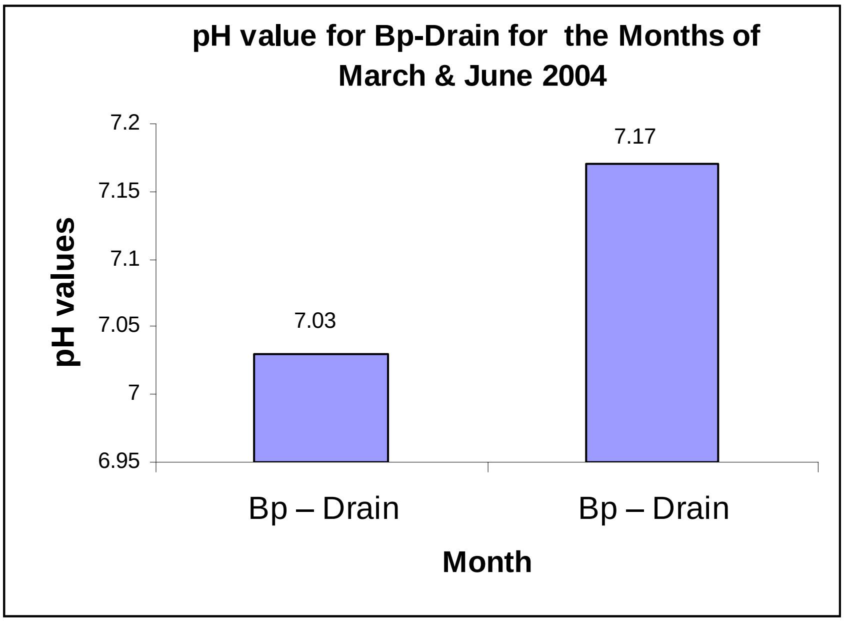


Table 3.2(d)

pH value for Bp drain (Barapulla)

Months	Drain	PH
March 2004	Bp – Drain	7.03
June 2004	Bp – Drain	7.17

Figure 3.2 (d)



pH value for Bp drain conducted by DJB

Months	PH
March 2002	7.6
June 2002	7.02
March 2003	8.36

Fig 3.2 (e)

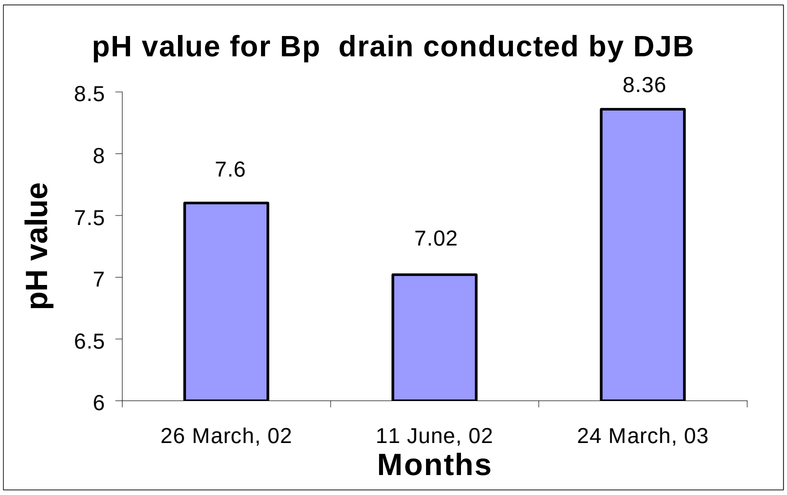
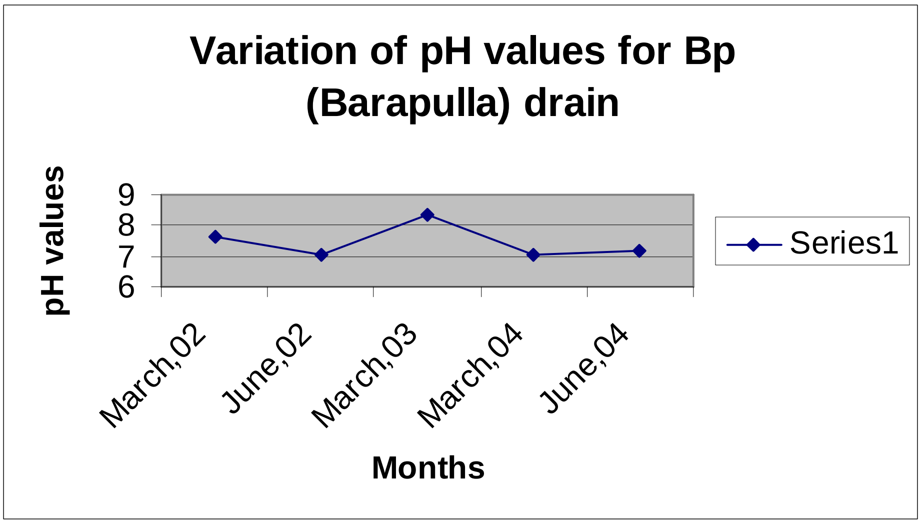


Fig 3.2 (f)



3.3 Total Dissolved Solids (T.D.S.)

Total Dissolved solids, as the name suggests, gives the quantity of dissolved solids and in the lab. Its measured quickly & automatically using the apparatus for determination of Conductivity, DO etc. in which we first standardize the instrument for a fixed value of cell constant & then connect it for determination of T.D.S. The value of Total Dissolved Solids should not be more than 1000 mg/lit for irrigation, industrial cooling and Controlled waste disposal.

Results obtained for both the drains for suspended solids **(S.S.)** are given in tables-3.3 (a) & (c) separately.

The trend has been shown in figure-3.3 (a) & (c).

Results obtained are well within the permissible limits for discharge into natural stream as per norms prescribed by CPCB but the Yamuna river in the study reach is no where near a natural stream.

Variation for Sh-drain suggest that there is continuous decrease in S.S. value for the past months.

Variation for Bp-drain suggest that the S.S. value at first increases and than decreases continuously.

Table 3.3(a)

S.S. Value for Sh-Drain (Shahdara)

Months	**Drain**	**S.S.**
March 2004	Sh – Drain	144
June 2004	Sh – Drain	91

Figure 3.3 (a)

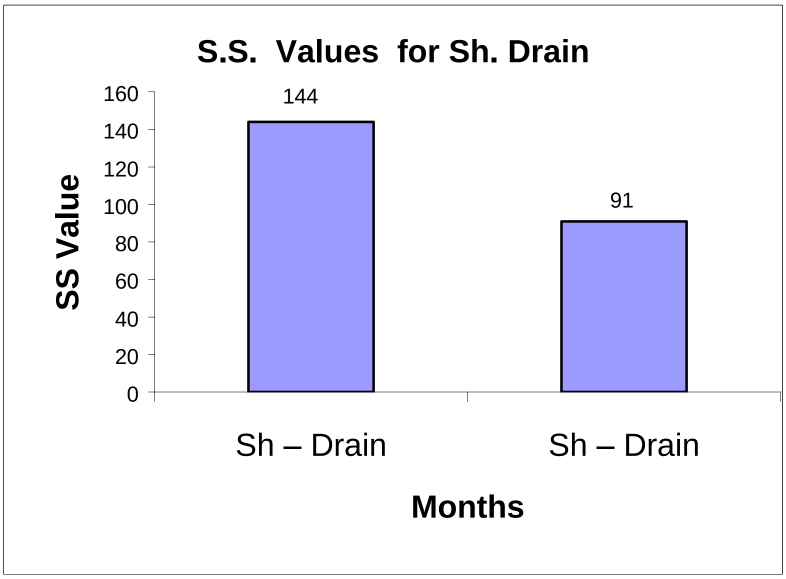


Figure 3.3 (b)

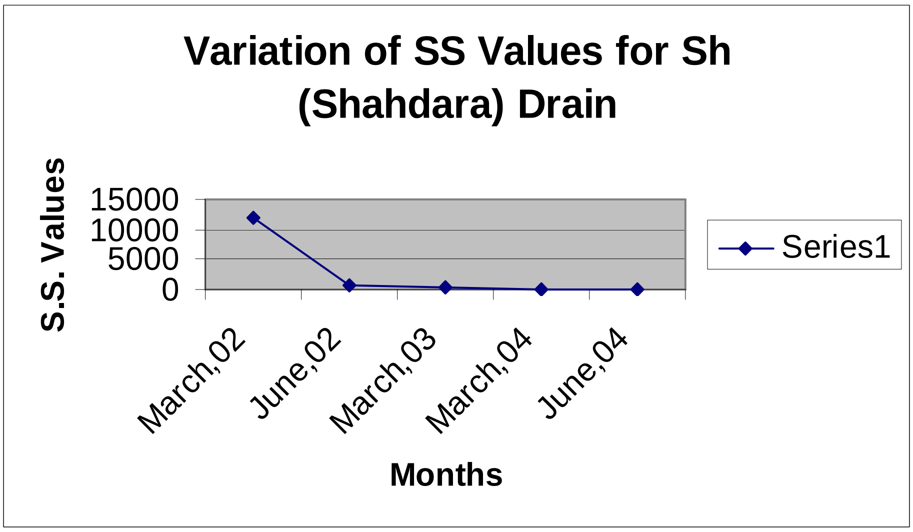


Table 3.3(c)

S.S.Value for Bp-Drain (Barapulla)

Months	Drain	S.S.
March 2004	Bp – Drain	176
June 2004	Bp – Drain	108

Error! **Figure 3.3 (c)**

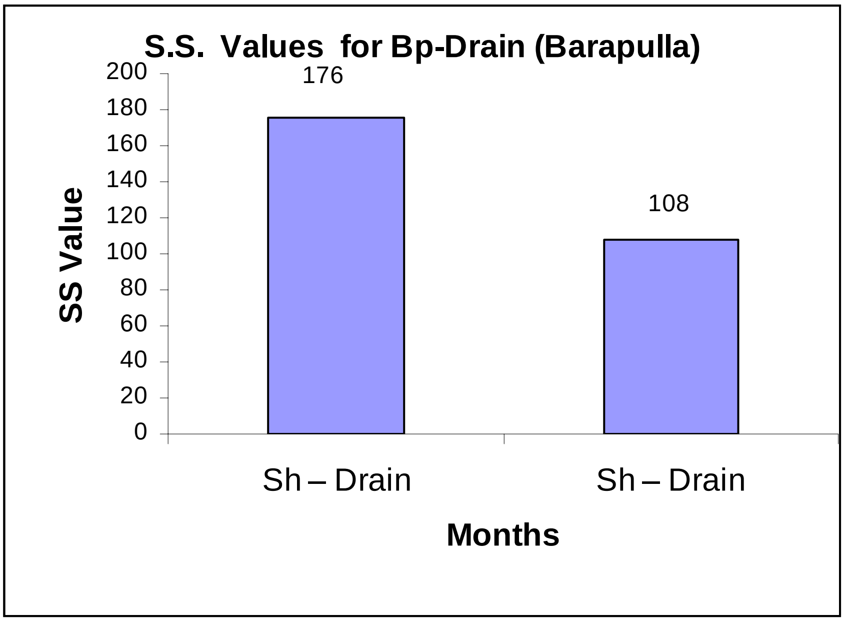


Table 3.3 (d):

S.S. values for Sh drain conducted by DJB

Months	S.S. (mg/l)
March 2002	12008
June 2002	548
March 2003	370

Source: DJB Report

Fig. 3.3 (d)

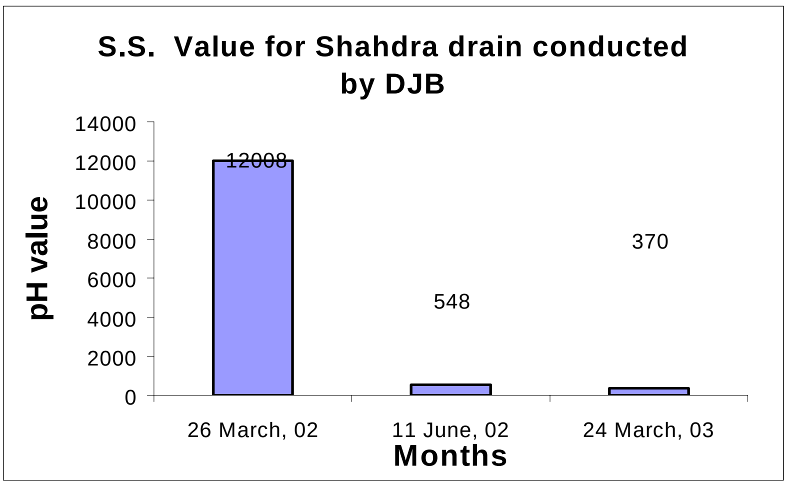


Table 3.3 (e):

S.S. values for Bp drain conducted by DJB

Months	S.S. (mg/l)
March 2002	968
June 2002	1308
March 2003	140

Source: DJB Report

Fig. 3.3 (e)

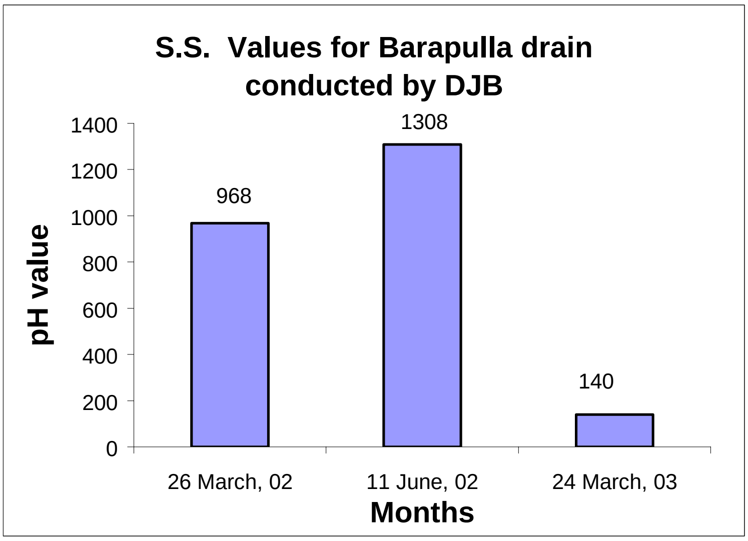
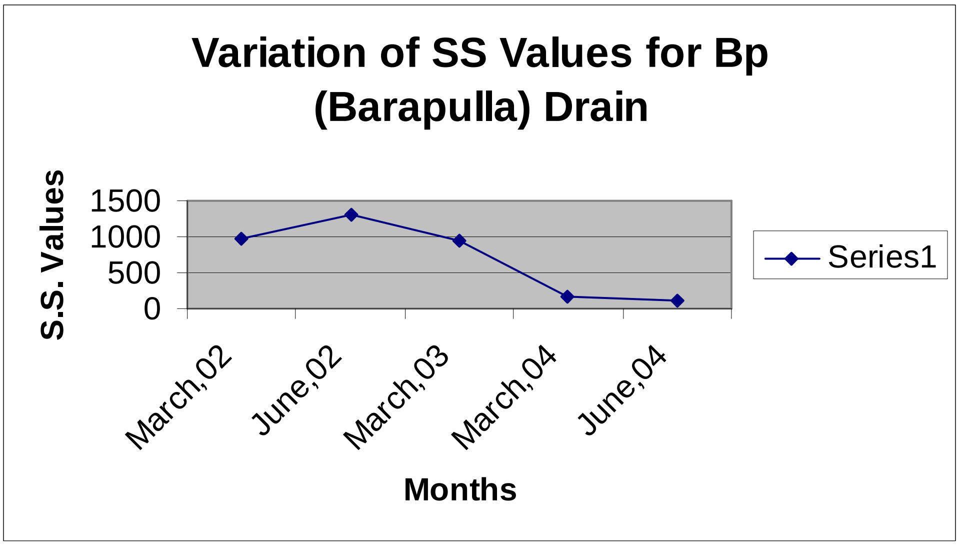


Fig. 3.3(f)



3.4 DISSOLVED OXYGEN (D.O.)

Winkler Method involves fixation of dissolved oxygen content right after the collection of water sample. This is done by adding manganese sulphate, which is followed by addition of Iodide-Azide regent, due to which manganese hydroxide gets oxidized and forms manganic hydroxide under the alkaline condition of solution resulting in oxidation of iodine. Subsequently when acid is added to water sample, manganese gets revert back to its divalent form liberating iodine in its free form. This release of free iodine remains equivalent to the amount of dissolved oxygen that exists in the original water sample and its determined by titrating the water sample against a reducing agent like sodium thiosulphate.

The reagents used in this test are Managanese Sulphate ($MnSO_4$. $4H_2O$). Alkali Iodide Azide solution. Concentration Sulphuric Acid, Sulphuric Acid, Starch indicator and Standard Sodium Thiosulphate solution (0.025 N).

However, in the raw water, the level of dissolved oxygen gives an idea about the purity of water, because it is the principal parameter responsible for the self-purification of water and for support to aquatic life.

Water acutely lacking in dissolved oxygen content invariably contains gaseous impurities and substances in their reduced forms, such type of water becomes quite troublesome for the removal of impurities at the time of treatment of water, unless pretreatment of water is done ahead of the conventional water treatment. Deficiency of Oxygen in the purified water gives rise to taste & odour problems; as such it is important to ascertain that no deficiency of dissolved oxygen is occurring in the water during its storage, transit & distribution.

As per the "Water Quality Standards for surface water sources set by CPCB (New Delhi)" for Drinking water without conventional treatment DO>6 mg/lit, for Bathing, Swimming & Recreational uses DO>5 mg/lit, for drinking water with conventional treatment DO>4 mg/lit and for propagation of wild life fisheries DO>4 mg/lit. As its clear from the tables that value of DO is never found even 4 mg/lit. The study shows no D.O all along the study reach of the river. That is why no aquatic life was seen in the reach except some tiny surface dwellers.

3.5 Biochemical Oxygen Demand (BOD)

Biochemical Oxygen Demand (BOD) refers to the amount of oxygen consumed by bacteria in stabilizing decomposable organic matter biologically under aerobic conditions. This test is carried out for knowing the consumption oxygen by bacteria in 5 days at 20ºC, for the biological oxidation of organic matter. Since about 70 to 80 percent of the biological oxidation of organic matter takes place in 5 days, when sufficient oxygen exists in the water and the water environment remains aerobic.

The period of this test is restricted to 5 days, in order to avoid oxidation of Ammonia. The purpose of this test is to know about the organic matter existing in the water, which is biologically degradable. Thus it gives an idea about the degree of pollution existing in the raw water or the stage of self-purification process in the raw water. However the principal use of this test is limited to the wastewater treatment for assessing the efficiency of wastewater treatment process and to evaluate pollutional load of wastewater and its effects on the natural water.

The regents used in this test are Phosphate buffer solution, Magnesium Sulphate solution, Calcium chloride solution, Ferric chloride solution, all these are mixed with distilled water & then aerated for about half an hour to prepare Dilution Water except these the reagents used for D.O. are also used viz. Manganese sulphate, Alkali Iodide Azide solution, concentrated Sulphuric Acid solution, Starch indicator solution, Standard Sodium Thiosulphate solution.

Results obtained for both the drains are given in tables-3.4(a) & (d) separately. The trend has been shown in figure-3.4(a) & (d).

Results obtained from the tests confirm that the drains are not at all storm water drains but are heavily charged with high BOD loading.

There is higher BOD reading reported at Sh-drain as compared to Bp-drain.

The BOD variation runs almost constant at Bp-drain.

Even the resultant BOD of the stream after mixing of drain to be allowed to be discharged into river. Thus the flow at Okhla barrage into the Agra Canal is not better than a drain characteristics.

Table 3.4(a)

B.O.D. Value for Sh-Drain (Shahdra)

Months	Drain	B.O.D.
March 2004	Sh – Drain	82
June 2004	Sh – Drain	75

Figure 3.4 (a)

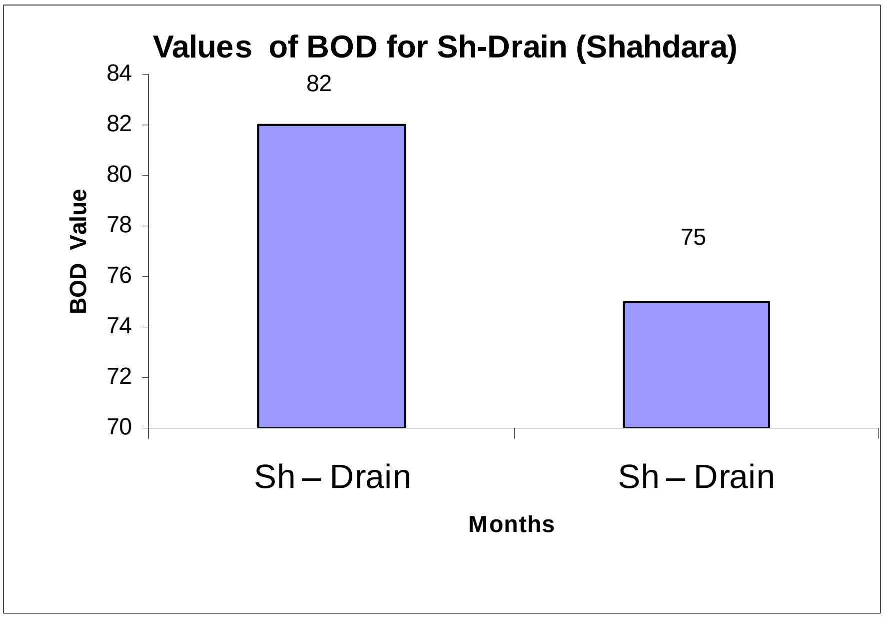


Table 3.4 (b):

BOD values for Sh drain conducted by DJB

Months	BOD (mg/l)
March 2002	180
June 2002	80
March 2003	40

Source: DJB Report

Fig. 3.4 (b)

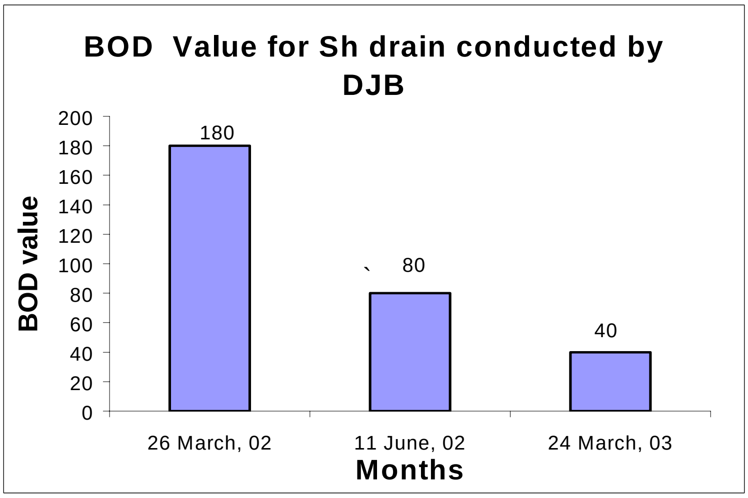


Figure 3.4(c)

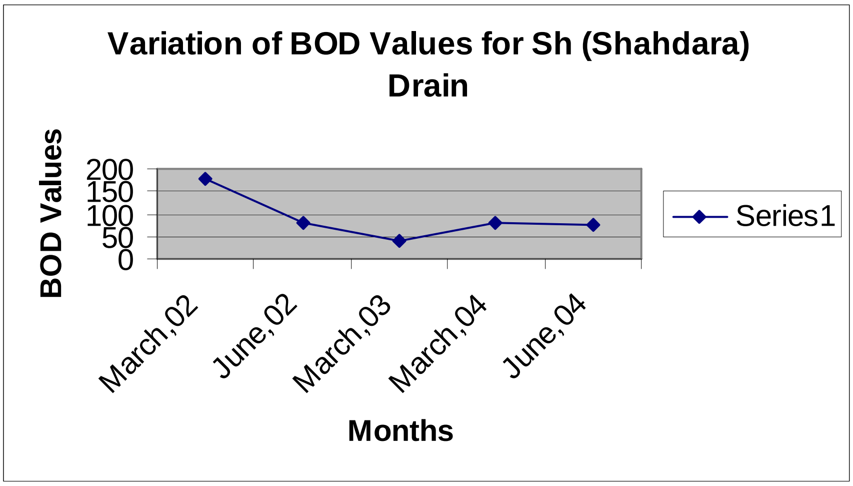


Table 3.4(d)

BOD Values For Bp Drain (Barapulla)

Months	Drain	B.O.D.
March 2004	Bp – Drain	80
June 2004	Bp – Drain	64

Figure 3.4 (d)

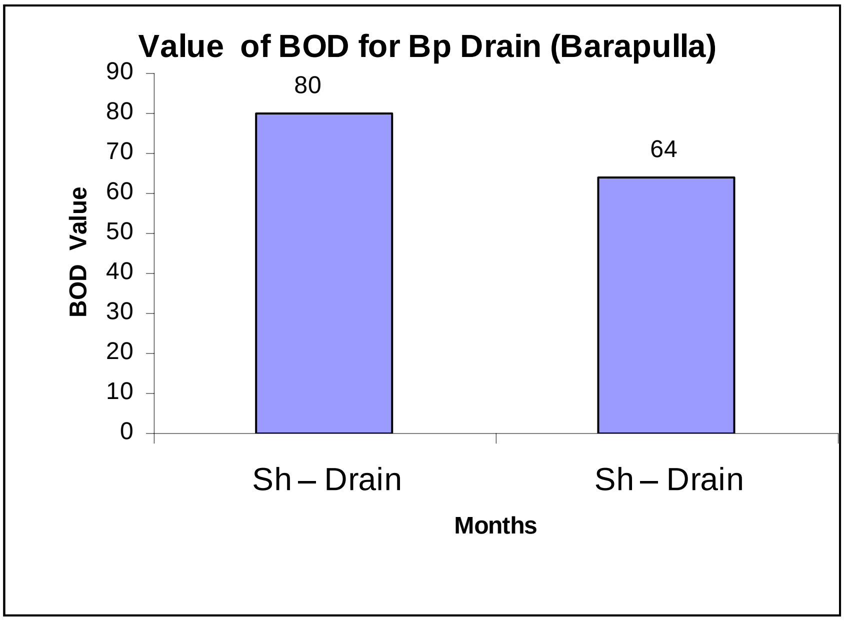


Table 3.4 (e):

BOD values for Bp drain conducted by DJB

Months	BOD (mg/l)
March 2002	150
June 2002	80
March 2003	80

Source: DJB Report

Fig. 3.4 (e)

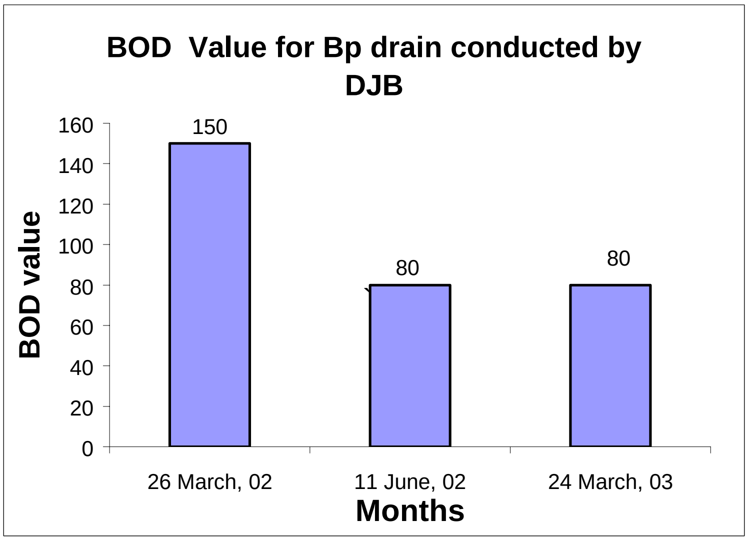
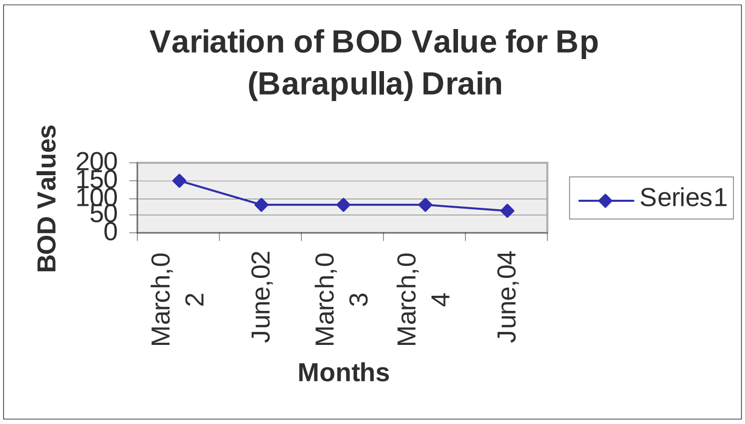


Fig. 3.4 (f)



3.6 CHEMICAL OXYGEN DEMAND (C.O.D.)

This test is used for finding out the amount of oxygen required for the chemical oxidation of organic matter existing in the water, and it involves the use of strong oxidant like Potassium Dichromate under the acidified condition of solution, This test gives an idea about the magnitude of pollution existing in the domestic and industrial waste waters. Therefore the purpose of this test is more or less same as the of BOD test. But this test fails to specifically differentiate between the biologically degradable organic matter and biologically inert organic matter and therefore BOD & COD test cannot be correlated directly. However the principal merit associated with COD test in that it takes much short time as compared to BOD test.

In this test, Potassium Dichromate (K_2 Cr_2 O_7) is used as a strong oxidant, which is when added to the acidified water sample at an elevated temperature, causes complete oxidation of organic matter by forming carbon dioxide & water, provided volatile organic compounds are prevented to escape from the container. The amount of Potassium Dichromate consumed gives the value of oxygen required which is determined on the basis of titration of excess chromate left in the solution (indication the complete oxidation of organic matter) with Ferrous ammonium sulphate, using ferroin indicator.

The reagents used in this test are Potassium Dichromate solution (0.25N) concentrated sulphuric acid, Silver sulphate dry powdered, Mercuric sulphate dry powdered, ferroin indicator solution, and Ferrous ammonium sulphate solution (0.25N).

Results obtained for both the drains are given in tables-3.5(a) & (d) separately. The trend has been shown in figure-3.5(a) & (d).

Result suggest that there is high concentration of COD loading and no significant variation in COD value except at Sh-drain for the month of March 02 reported very high concentration of COD value.

Table 3.5(a)

COD Values for Sh Drain

Months	Drain	C.O.D.
March 2004	Sh – Drain	186
June 2004	Sh – Drain	175

Figure 3.5 (a)

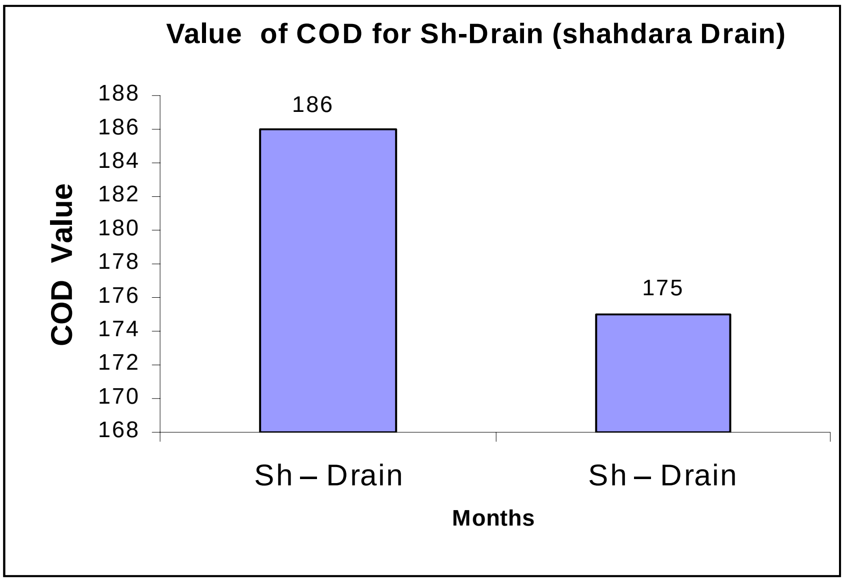


Table 3.5 (b):

COD values for Sh drain conducted by DJB

Months	BOD (mg/l)
March 2002	400
June 2002	160
March 2003	140

Source: DJB Report

Fig. 3.5 (b)

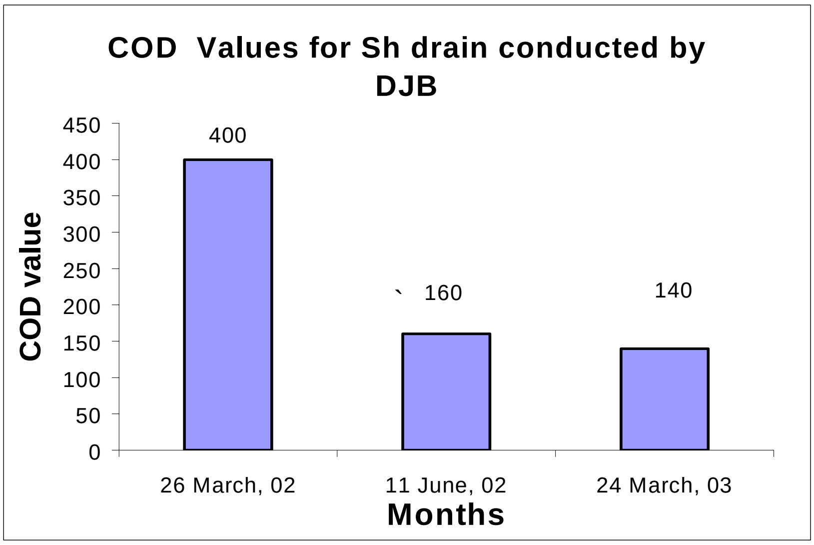


Fig. 3.5(c)

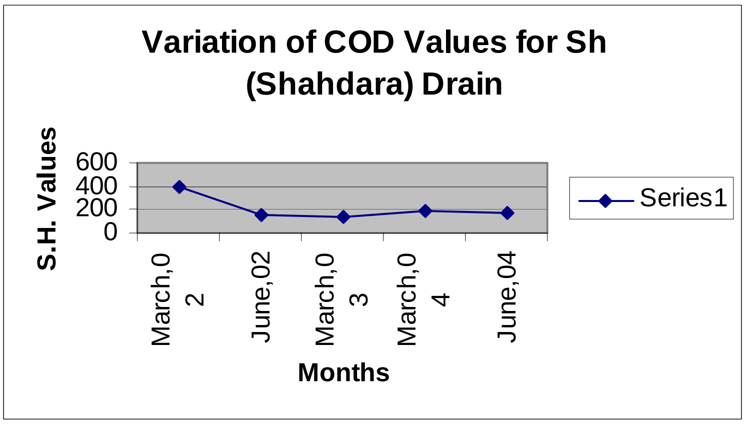


Table 3.5(d)

COD Values for Bp (Barapulla) Drain

Months	Drain	C.O.D.
March 2004	Bp – Drain	284
June 2004	Bp – Drain	203

Figure 3.5 (d)

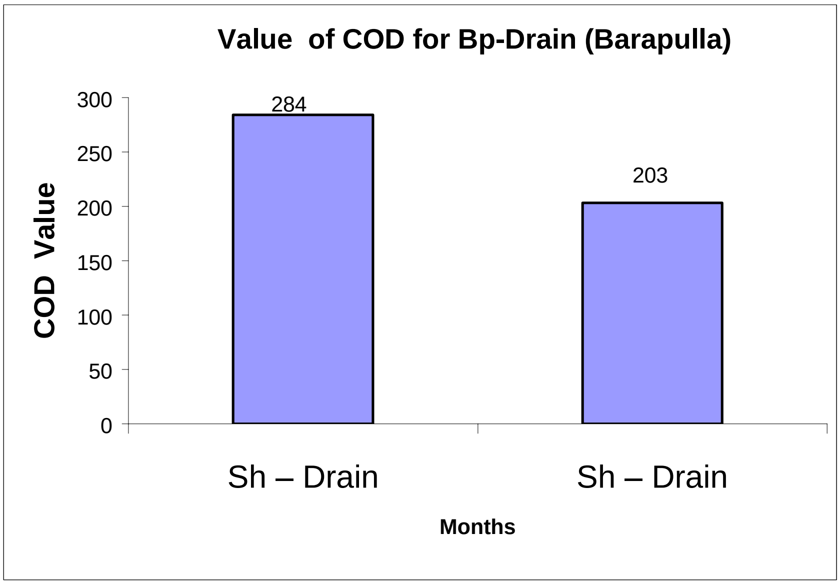


Table 3.5 (e):

COD values for Bp drain conducted by DJB

Months	COD (mg/l)
March 2002	280
June 2002	120
March 2003	140

Source: DJB Report

Fig. 3.5 (e)

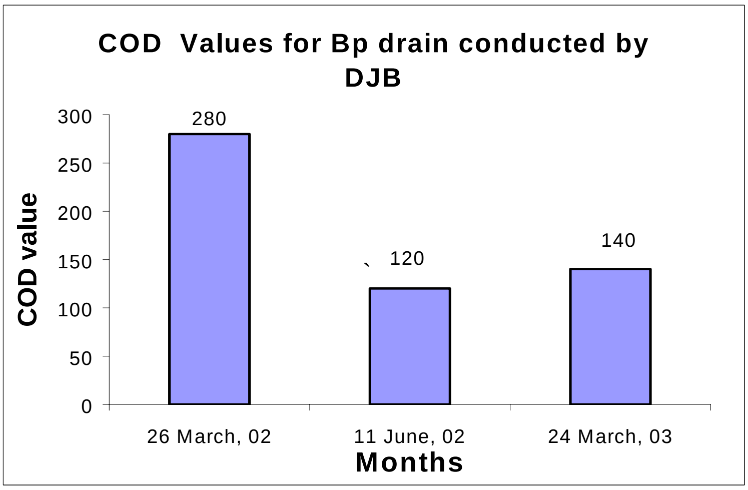
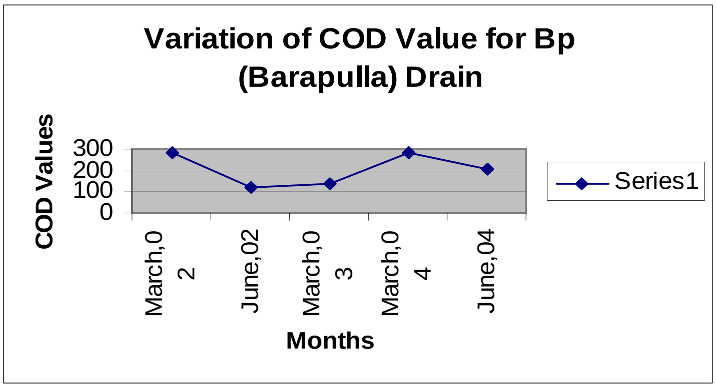


Fig. 3.5 (f)



3.7 HEAVY METALS

Cr, Cd, Zn, Ni, Cu, Pb Metals fall under the category of heavy metals & their presence in the water can be toxic, this is why its an important parameter to determine, while carrying out the analysis for river water of Yamuna, considering the heavy loads of industrial effluent being disposed off in the river.

Chromium and its compounds are used in metal alloys such as stainless steel; protective coatings on metal; magnetic tapes; and pigments for paints, cement, paper, rubber, composition floor covering and other materials. Other uses include: chemical intermediate for wood preservatives, organic chemical synthesis, photochemical processing and industrial water treatment. In medicine, chromium compounds are used in astringents and antiseptics. They also are used in cooling waters, and in the leather tanning industry, in catalytic manufacture, and in fungicides; as an algaecide against slime forming bacteria and yeasts in brewery processing water and brewery warmer water.

Chromium occurs in nature mostly as chrome iron ore, or chromate. Though widely distributed in soils and plants, its is rare in natural waters. The two largest sources of chromium emission in the atmosphere are from the chemical manufacturing industry and combustion of natural gas, oil, and coal.

HEALTH EFFECTS SUMMARY

Acute: EP has found chromium of potentially cause the following health effects from acute exposures at levels above the MCL: sin irritation or ulceration. Drinking water levels which are considered “safe” for shot-term exposures: for a 10kg(22 lb) child consuming 1 liter of water per day, a one-to-ten-day exposure to 1 mg/L; a longer-term (7 years) exposure to 0.2mg/L.

Chronic: Chromium has the potential to cause the following health effects from long-term exposures at levels above the MCL: damage to liver, kidney circulatory and nerve tissues; dermatitis.

Cancer: There is no evidence that chromium in drinking water has the potential to cause cancer from lifetime exposures in drinking water.

Other heavy metals enlisted above show considerable impact on human health. These are carcinogenic in nature and can cause irreparable loss after enter in the food chain.

For quantification of heavy metals concentration La Motte apparatus was utilized. Result obtained for both the drains shows that there occurs higher concentration of Fe and Zn metals. The results obtained are indicative of drains carrying industrial sewage discharge along with domestic sewage flow. Results are given in tables & figures below:

Table 3.6 (a)

Heavy Metal Concentration at Sh-Drain for March-04

Metals	Months	Sh-Drain
Cr	March 2004	NT
Cu	March 2004	0.14
Cd	March 2004	NT
Fe	March 2004	8.35
Ni	March 2004	NT
Zn	March 2004	0.32
Pb	March 2004	NT

Figure 3.6(a)

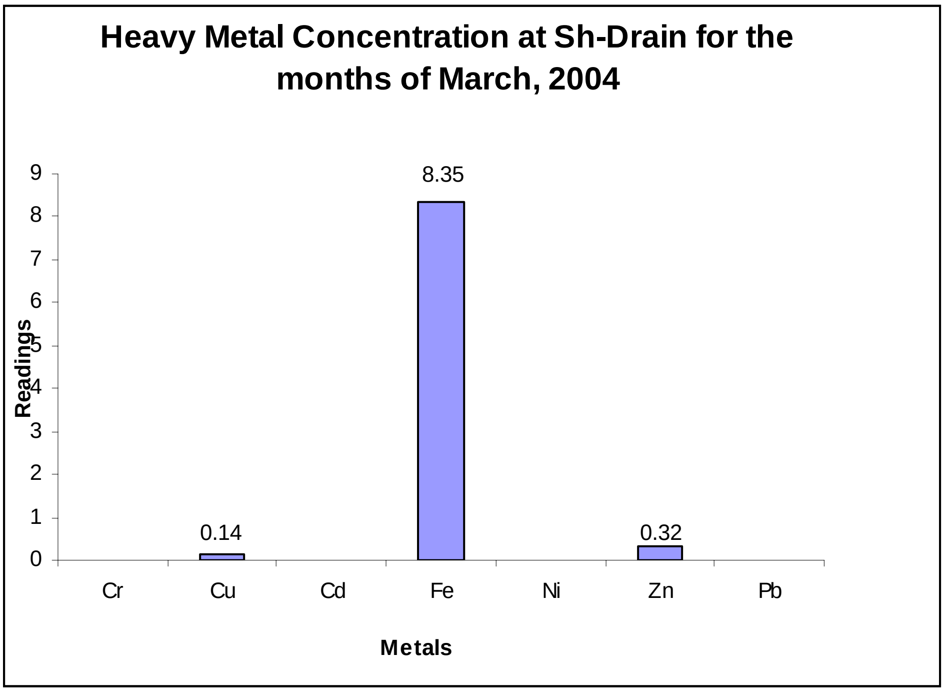


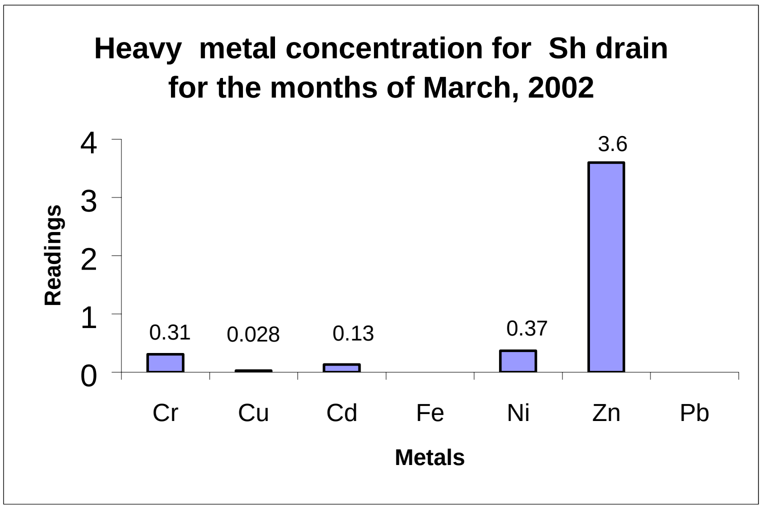
Table 3.6 (b)

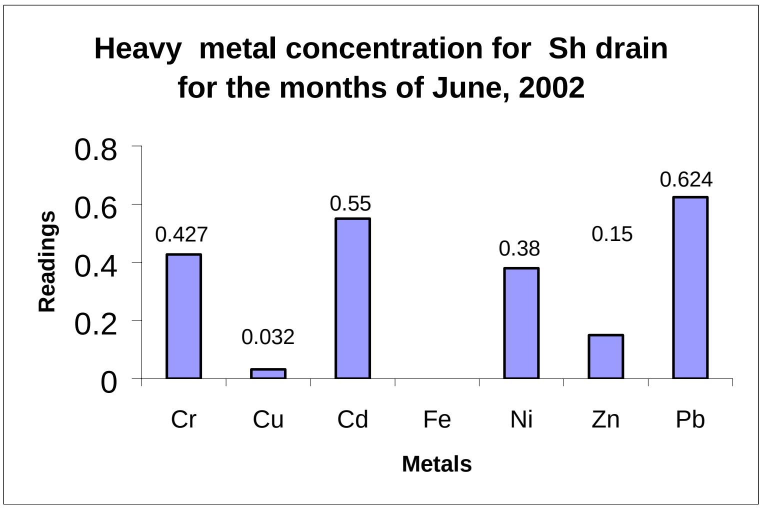
Heavy metal concentration for Sh drain conducted by DJB

Months	Metals						
	Cr	Cu	Cd	Fe	Ni	Zn	Pb
March 02	0.31	0.028	0.13	Not Detected	0.37	3.60	Not detected
June 02	0.427	0.032	0.5 5	Not Detected	0.38	0.15	0.624
March 03	0.5	0.034	NT	Not Detected	NT	1.009	Not detected

Source: DJB Report

Figure 3.6(b)





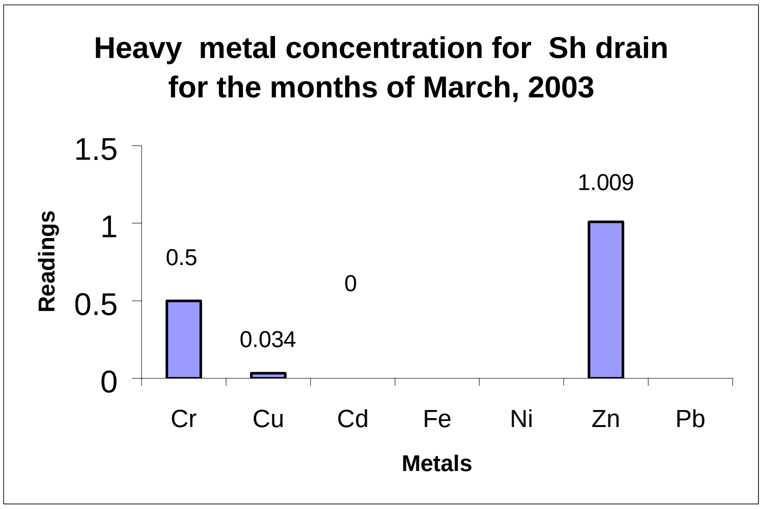


Figure 3.6 (c)

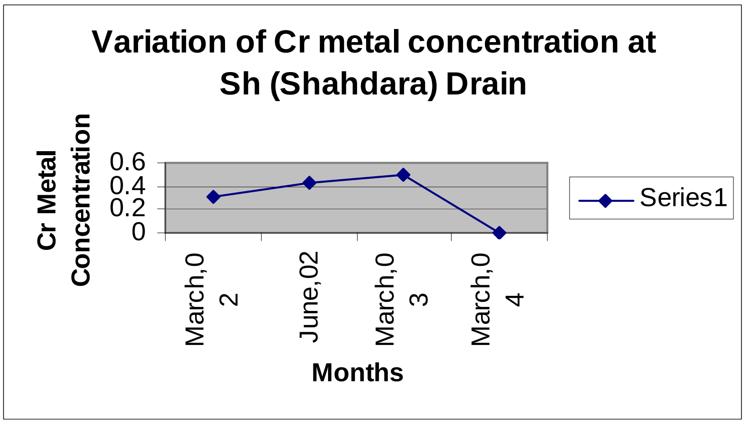


Figure 3.6(d)

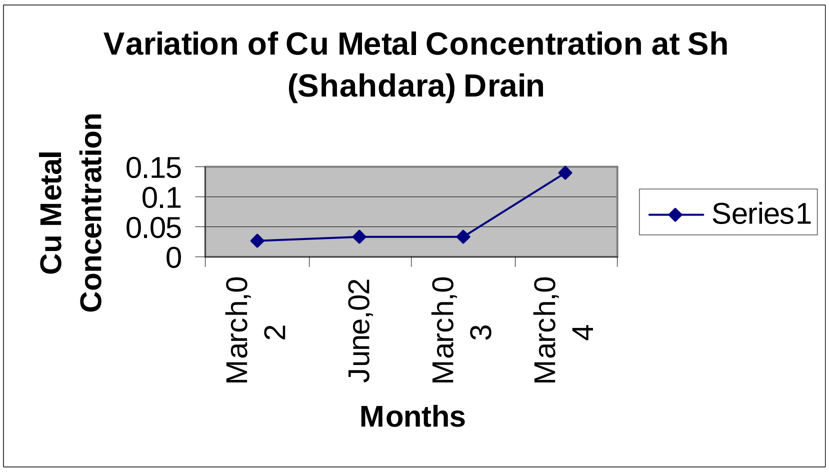
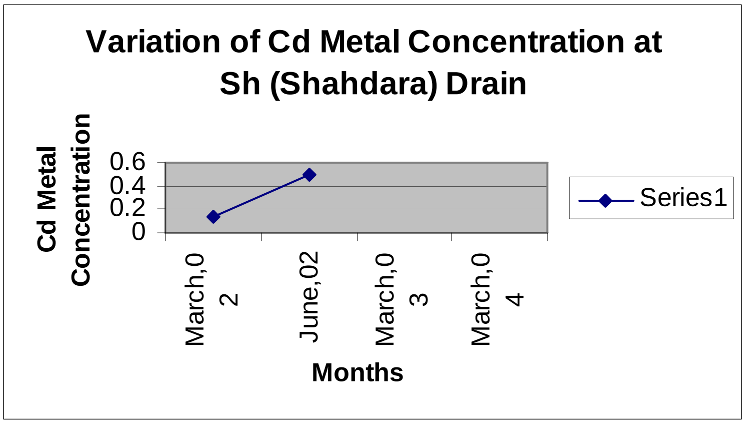


Figure 3.6(e)



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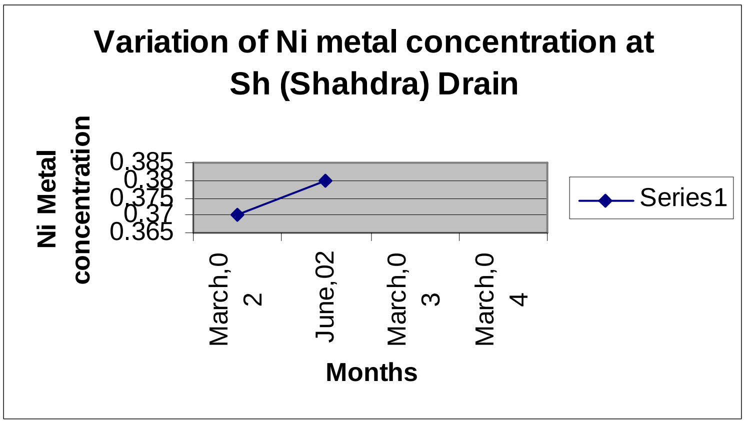

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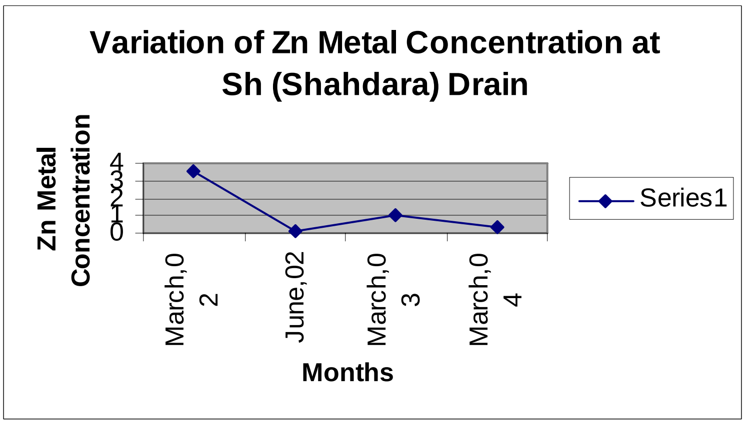


Table 3.6 (h)

Heavy Metal Concentration at Bp-Drain(Barapulla) for March-04

Metals	Months	Bp-Drain (Barapulla)
Cr	March 2004	NT
Cu	March 2004	0.05
Cd	March 2004	NT
Fe	March 2004	9.09
Ni	March 2004	NT
Zn	March 2004	0.25
Pb	March 2004	NT

Figure 3.6(h)

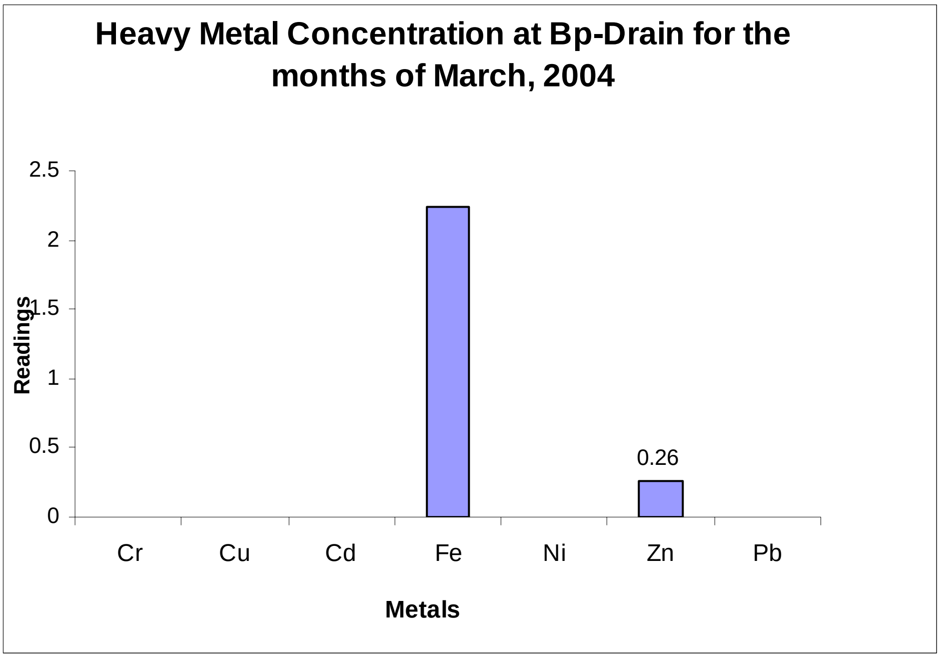


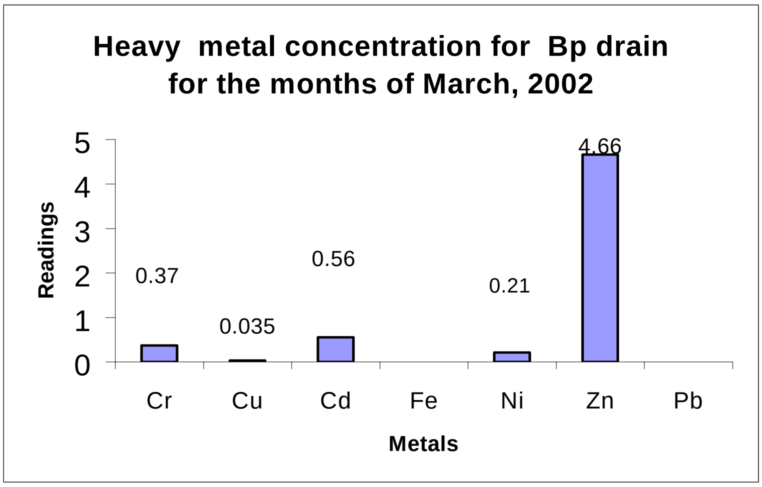
Table 3.6 (i)

Heavy metal concentration for Bp drain conducted by DJB

Months	Metals						
	Cr	**Cu**	**Cd**	**Fe**	**Ni**	**Zn**	**Pb**
March 02	0.37	0.035	0.56	Not Detected	0.21	4.66	NT
June 02	0.681	0.054	0.30	Not Detected	0.15	0.278	0.159
March 03	0.4	0.031	NT	Not Detected	0.11 8	1.006	NT

Source: DJB Report

Figure 3.6 (i)



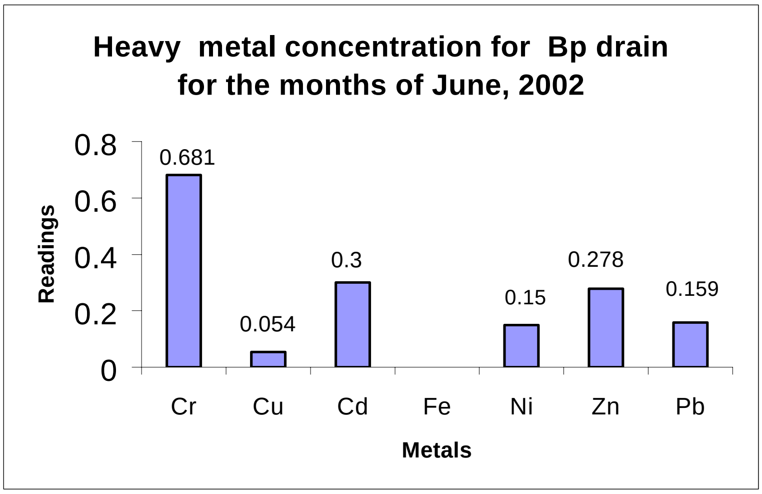


Figure 3.6 (j)

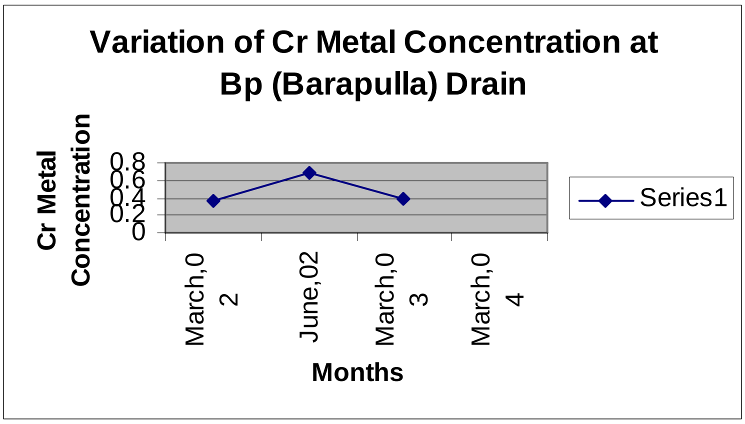


Figure 3.6 (k)

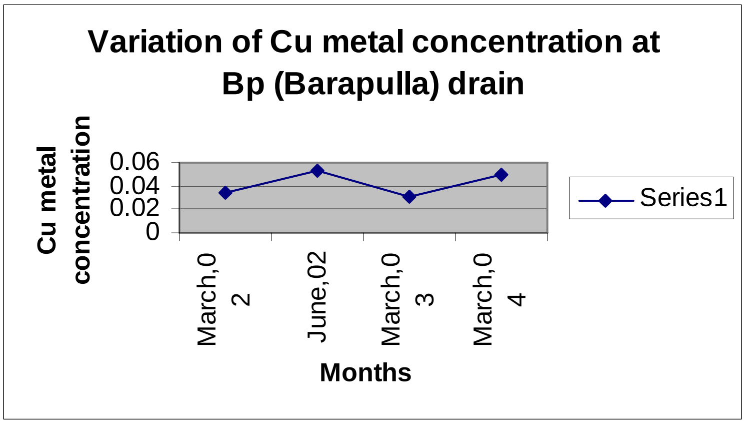
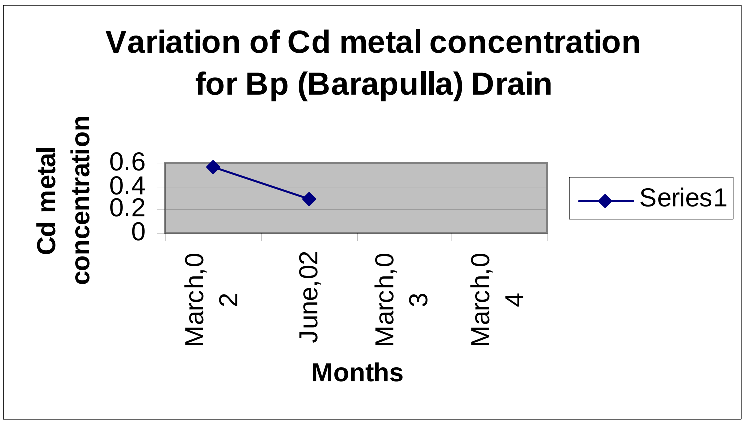
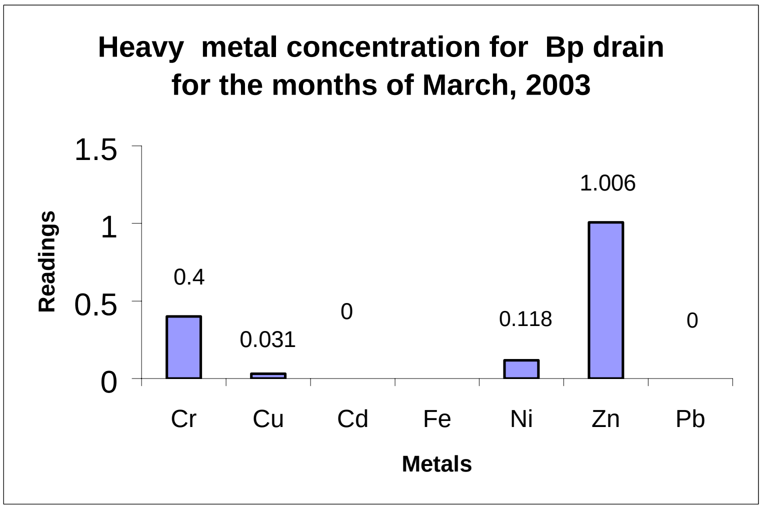


Figure 3.6 (l)





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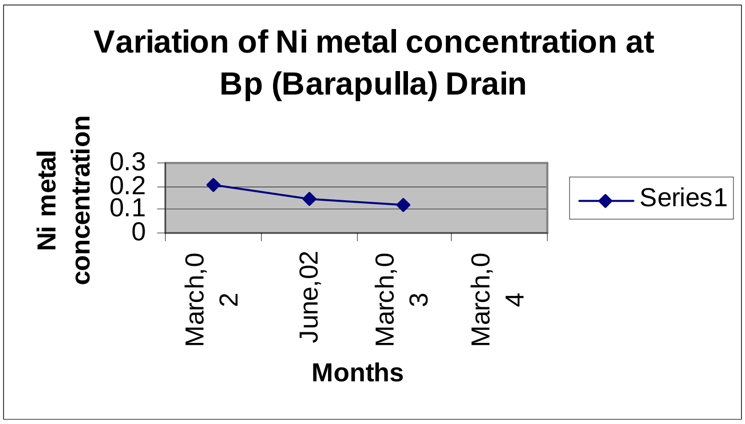
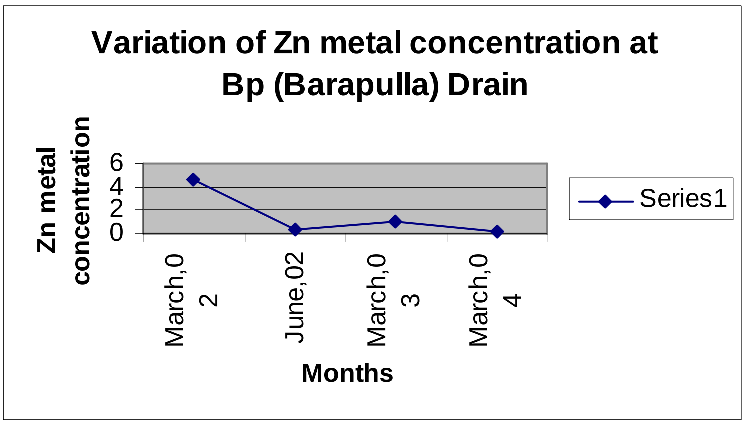


Figure 3.6 (n)



3.8 NITROGEN

Nitrite and Nitrate are forms of the element Nitrogen, which makes up about 80 percent of the air we breathe. As an essential component of life, nitrogen is recycled continually by plants and animals, and is found in the cells of all living things. Organic nitrogen (nitrogen combined with carbon) is found in proteins and other compounds. Inorganic nitrogen may exist in the free state as a gas, as ammonia (when combined with hydrogen), or as nitrite or nitrate (when combined with oxygen). Nitrites and nitrates are produced naturally as part of the nitrogen cycle, when a bacteria 'production line' breaks down toxic ammonia wastes first into nitrite, and then into nitrate.

Sources of nirites and nitrates.

Nitrites are relatively short-lived because they're quickly converted to nitrates by bacteria. Nitrites produce a serious illness (brown blood disease) in fish, even though they don't exist for very long in the environment. Nitrites also react directly with hemoglobin in human blood to produce methemoglobin, which destroys the ability of blood cells to transport oxygen. This condition is especially serious in babies under three months of age as it causes a condition known as methemoglobinemia or "blue baby" disease. Water with nitrite levels exceeding 1.0 mg/L should not be given to babies. Nitrite concentrations in drinking water seldom exceed 0.1 mg/L.

Nitrate is a major ingredient of farm fertilizer and is necessary for crop production. When it rains, varying nitrate amounts wash from farmland into nearby waterways. Nitrates also get into waterways from lawn fertilizer run-off, leaking septic tanks and cesspools, manure from farm livestock, animal wastes (including fish and birds), and discharge from car exhausts.

Nitrates stimulate the growth of plankton and waterweeds that provide food for fish. This may increase the fish population. However, if algae grow too wildly, oxgen levels will be reduced and fish will die.

Nitrates can be reduced to toxic nitrtes in the human intestine, and many babies have been seriously poisoned by well water containing high levels of nitrate-nitrogen. The U.S. Public Health Service has established 10mg/L of nitrate-nitrogen as the maximum contamination level allowed in public drinking water.

EFFECTS OF NITRATES AND NITRITES ON FISH AND AQUATIC LIFE

Nitrate-nitrogen levels below 90mg/L and nitrite levels below 0.5mg/L seem to have no effect on warm-water fish, but salmon and other cold-water fish are more sensitive.

Results indicate higher value of Nitrite concentration.

Table 3.7 (a)

Nitrate Values At Sh & Bp Drain

Months	Drains	Nitrate
March 2004	Sh – Drain	0.66
March 2004	Bp – Drain	0.54

Figure 3.7 (a)

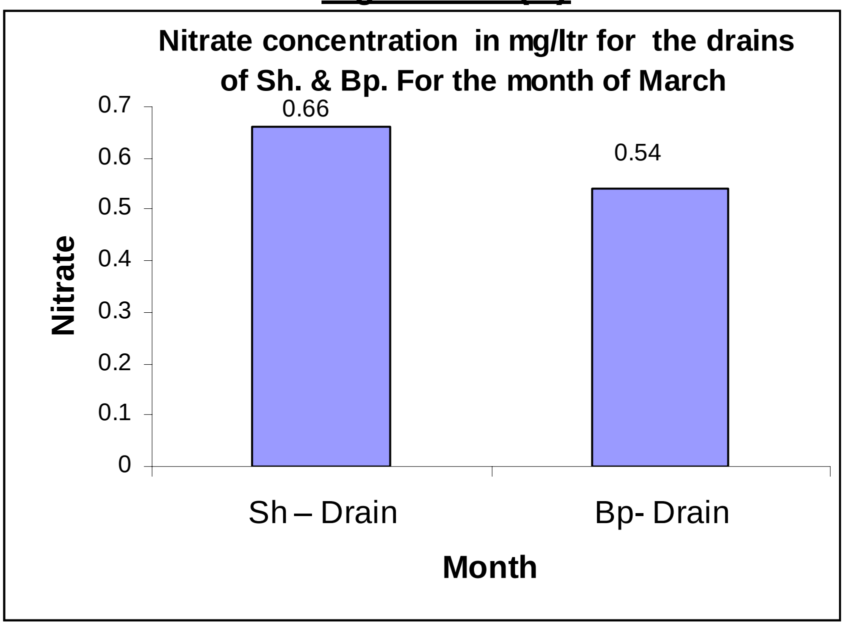


Table 3.7 (b)

Nitrates values for Sh – drain conducted by DJB

Months	Nitrates
March 2002	NT
June 2002	0.35
March 2003	0.08

Figure 3.7 (b)

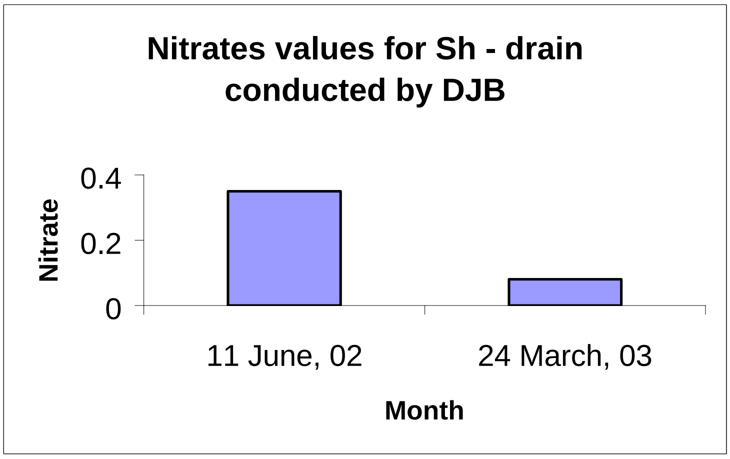


Fig: 3.7(c)

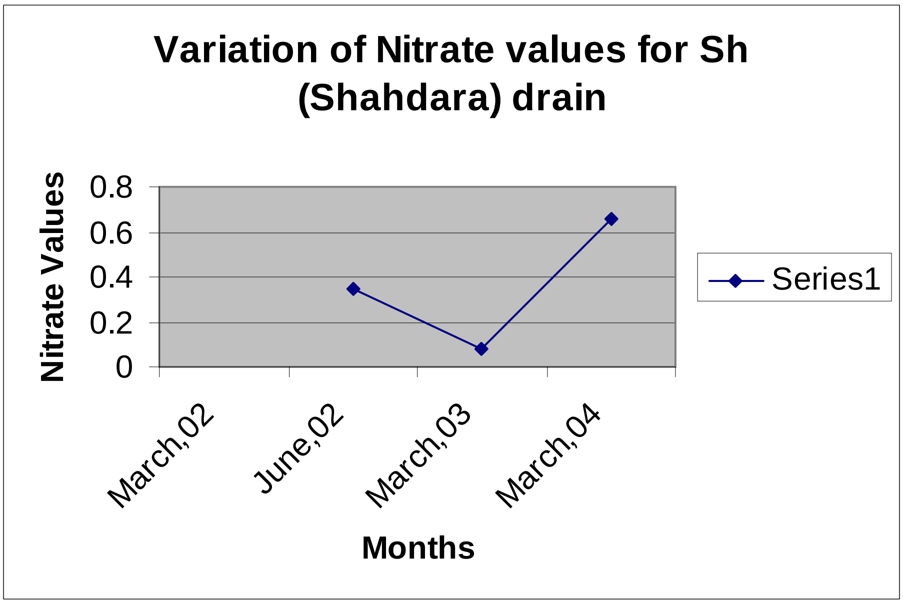


Table 3.7 (d)

Nitrates values for Bp – drain conducted by DJB

Months	Nitrates
March 2002	NT
June 2002	0.40
March 2003	0.03

Figure 3.7 (d)

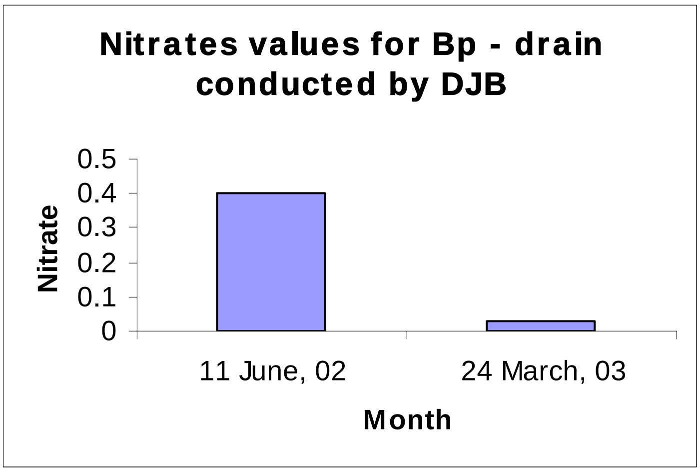


Fig. 3.7 (e)

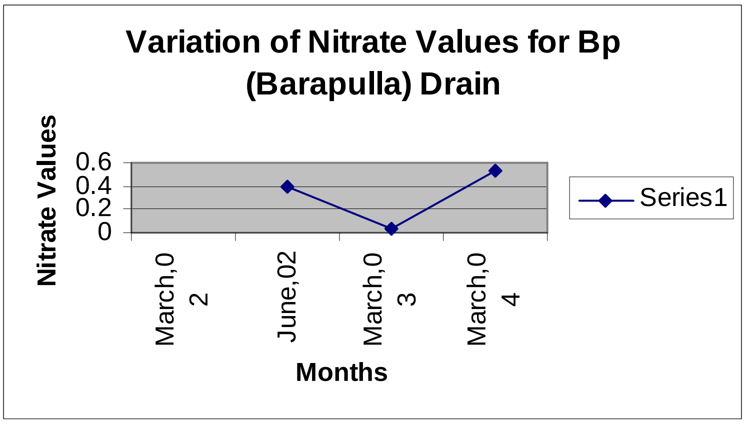


Table 3.8 (a)

Nitrite Values Concentration At Sh & Bp Drain

Months	Drains	Nitrite
March 2004	Sh – Drain	4.28
March 2004	Bp – Drain	4.53

Figure-3.8 (a)

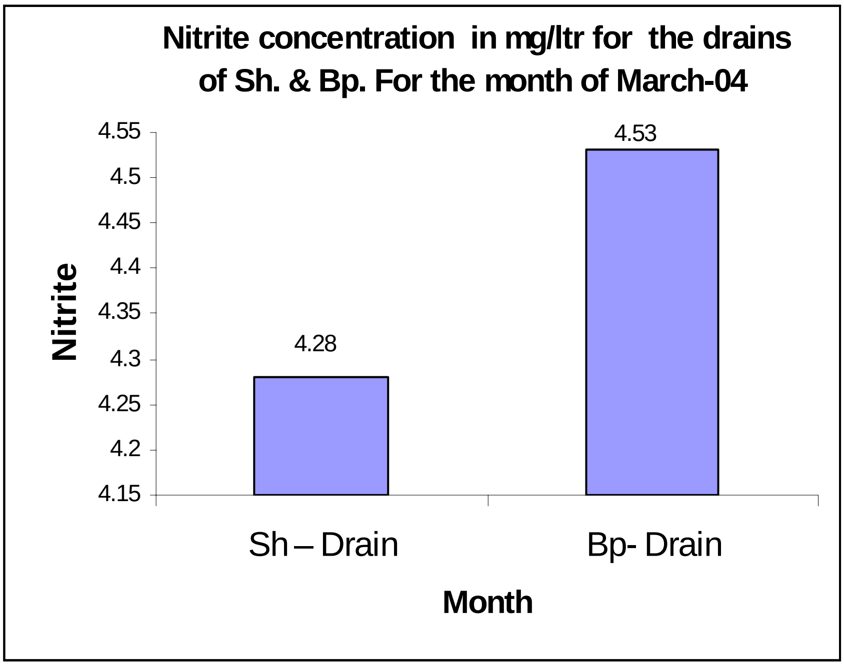


Table 3.8 (b)

Nitrites values for Sh drain

Months	Nitrites
March 2002	NT
June 2002	4.93
March 2003	17.03

Figure 3.8 (b)

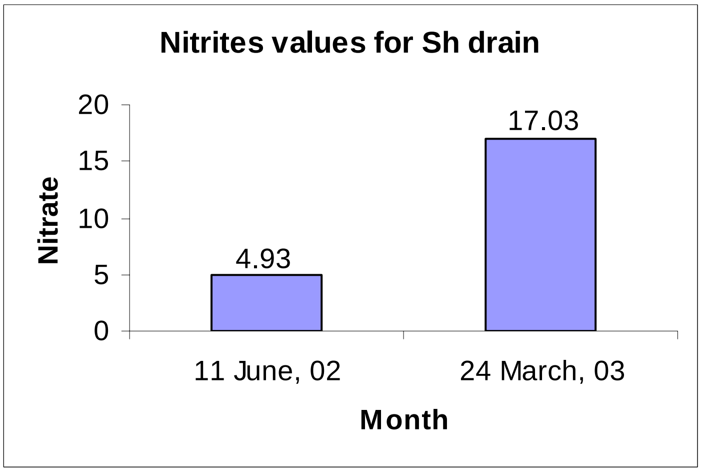


Fig. 3.8(c)

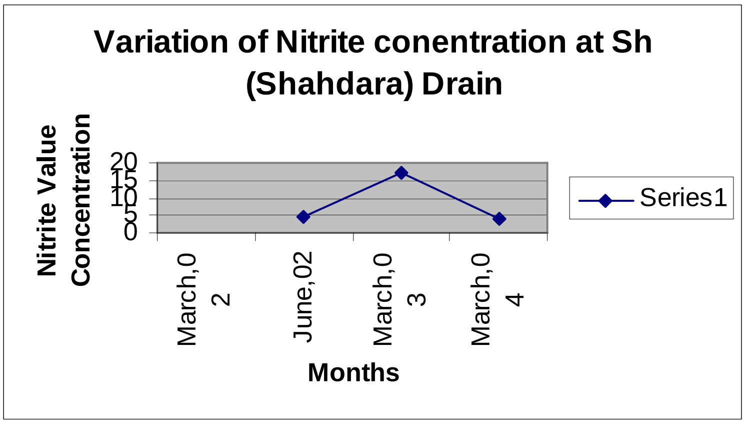


Table 3.8 (d)
Nitrites values for Bp drain

Months	Nitrates
March 2002	NT
June 2002	4.96
March 2003	9.79

Figure 3.8 (d)

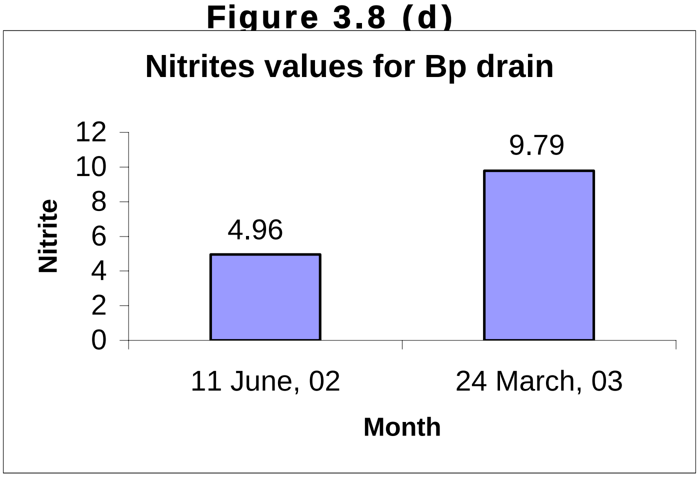
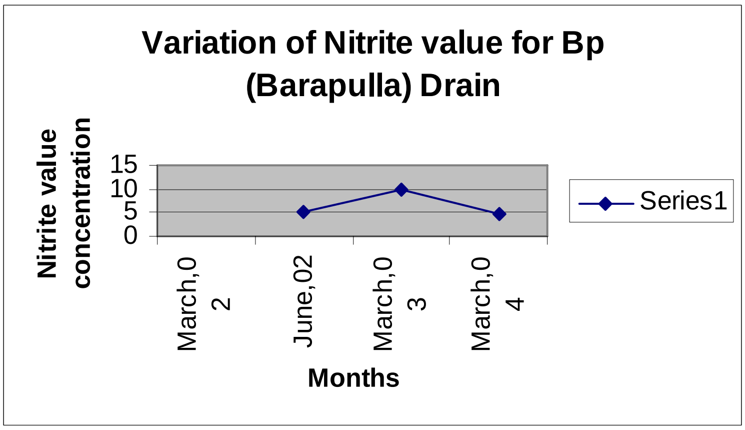


Figure 3.8 (e)



3.9 AMMONIA

Ammonia makes a powerful cleaning agent when mixed with water. For this reason, it is one of the most common industrial and household chemicals. The formula for ammonia, NH3, means it consists of one atom of nitrogen and three atoms of hydrogen. Ammonia is rich in nitrogen so it makes an excellent fertilizer. In fact, ammonium salts are a major source nitrogen for fertilizers. Like nitrates, ammonia may speed the process of eutrophication in waterways.

Ammonia is toxic to fish and aquatic organisms, even in very low concentrations. When levels reach 0.06 mg/L, fish can suffer gill damage. When levels reach 0.2mg/L, sensitive fish like trout salmon begin to die. As levels near 2.0mg/L, even ammonia-tolerant fish like carp begin to die. Ammonia level greater than approximately 0.1 mg/L usually indicate polluted waters.

The danger ammonia poses for fish depends on the water's temperature and pH, along with the dissolved oxygen and carbon dioxide levels. Remember, the higher the pH and the warmer the temperature, the more toxic the ammonia. Also, ammonia is much more toxic to fish and aquatic life when water contains very little dissolved oxygen and carbon dioxide.

Variations suggested that higher concentration of free Amonia reported both for Sh-drain and Bp-drain. And there is a little variation in there values.

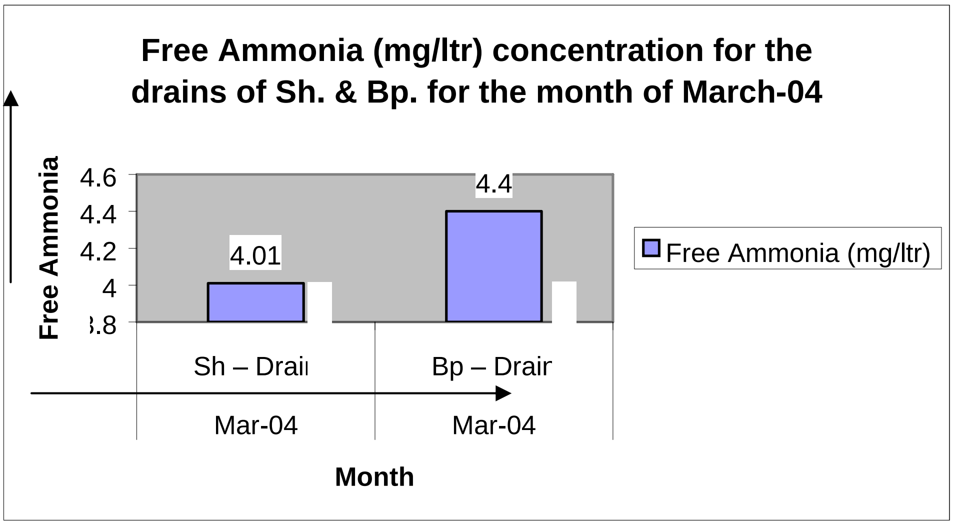
Results have been tabulated for different types of Nitrogen contents here under:

Table 3.9 (a)

Free Ammonia Concentration At Sh & Bp Drain

Months	Drains	Free Ammonia (mg/ltr)
March 2004	Sh – Drain	4.01
March 2004	Bp – Drain	4.40

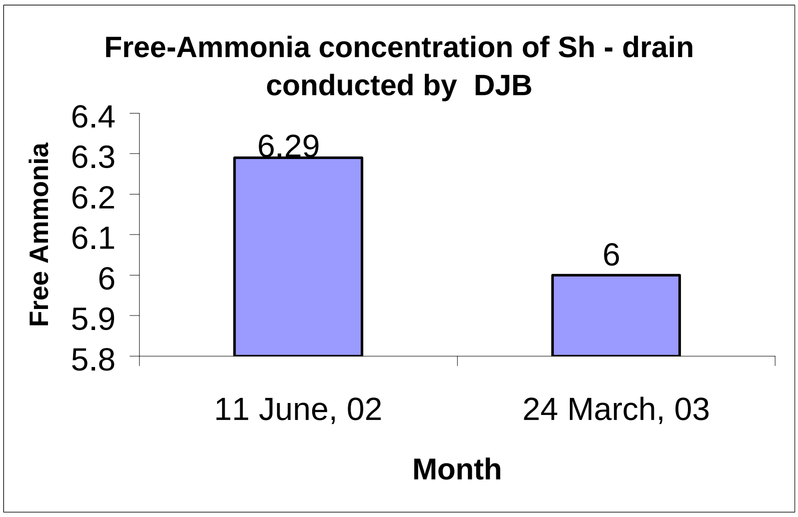
Figure 3.9 (a)



Free-Ammonia concentration of Sh – drain conducted by DJB

Months	Free Ammonia
March 2002	4.723
June 2002	6.29
March 2003	6.00

Figure 3.9 (b)



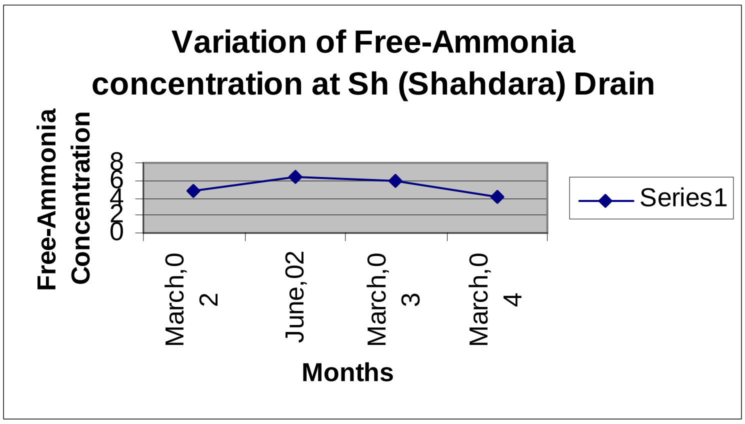
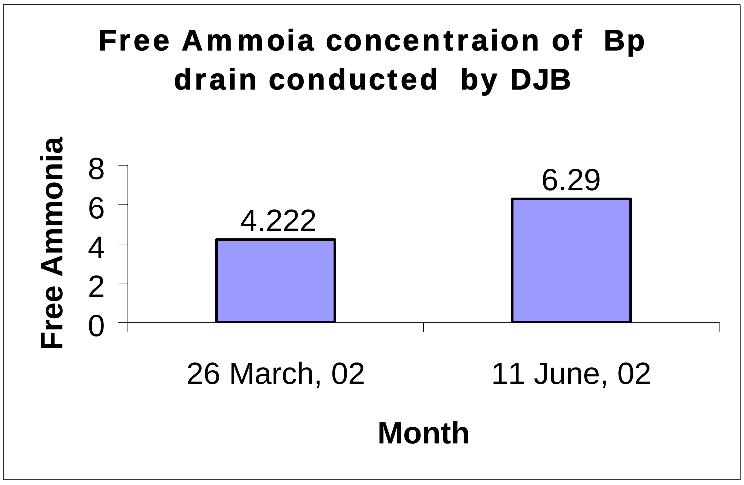


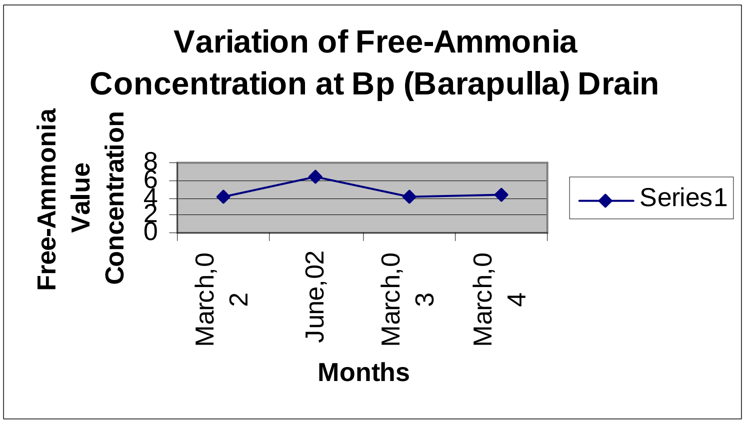
Table 3.9 (c)

Free-Ammonia concentration of Bp – drain conducted by DJB

Months	Free Ammonia
March 2002	4.222
June 2002	6.29
March 2003	4.05

Figure 3.9 (c)





3.10 CONCLUSION

The results obtained indicate 3 major points of concern from pollution point of view i.e. BOD, Fe, Zn concentration. Out of these the DO appears to be main sector of concern. If by any means we become successful in maintaining minimum DO level of not less than 3mg/l the rest of problems are likely to be controlled easily. A consolidated table of results is given in Table no. 3.10.

TABLE-3.10 (a)

(RESULTS CONDUCTED FOR MONTH 2004)

Months	Drains	Temperature	Ph	S.S.	BOD	COD
March	Sh-drain	24.6	7.08	144	82	186
June	Sh-drain	31.4	7.20	91	75	175
March	Bp-drain	24.6	7.03	176	80	284
June	Bp-drain	31.4	7.17	108	64	203

Month	Drains	Cd	Fe	Cr	Cu	Ni	Nitrate	Nitrite	Zn	Pb
March	Sh-drain	NT	8.35	NT	0.14	NT	0.66	4.28	0.32	NT
March	Bp-Drain	NT	2.24	NT	NT	NT	0.54	4.53	0.26	NT

Table 3.10 (b)

Results Conducted by DJB

Date	SH DRAIN			
	PH	S.S.	B.O.D.	C.O.D.
March 2002	7.03	12008	180	400
June 2002	7.22	548	80	160
March 2003	8.08	370	40	140

Date	BP DRAIN			
	PH	S.S.	B.O.D.	C.O.D.
March 2002	7.06	968	150	280
June 2002	7.02	1308	80	120
March 2003	8.36	140	80	140

Source: D.J.B. Report

Sh-drain

Date	Nitrate	Nitrite	Free Ammonia	Cr	Cu	Cd	Fe	Ni	Zn	Pb
March, 02	NT	NT	4.723	0.31	0.028	0.13	Not Detected	0.37	3.60	NT
[h] June, 02	0.35	4.93	6.29	0.427	0.032	0.55	Not Detected	0.38	0.15	0.624
March, 03	0.08	17.03	6.00	0.5	0.034	NT	Not Detected	NT	1.009	NT

Bp-(Barapulla) Drain

Date	Nitrate	Nitrite	Free Ammonia	Cr	Cu	Cd	Fe	Ni	Zn	Pb
March, 02	NT	NT	4.222	0.37	0.035	0.56	Not Detected	0.21	4.66	NT
June, 02	0.40	4.96	6.29	0.681	0.054	0.30	Not Detected	0.15	0.278	0.159
March, 03	0.03	9.79	4.05	0.4	0.031	NT	Not Detected	0.118	1.006	NT

Source: D.J.B., Report

CHAPTER-4

QUALITY OF RIVER YAMUNA

4.1 INTRODUCTION

During the past few decades the water quality of river yamuna has been degraded. The major pts. Of water quality degradation are:

1) Rapid industrilisation in river catchment area, discharge of treated & untreated industrial effluents.

2) Increase in population of towns located on its banks resulted increased domestic pollution loads.

3) Decrease in flow of river due to intensive use of surface & ground water in catchment area.

Generally 85% of pollution in river yamuna is from the domestic resources & the unabated discharge of treated & untreated sewage generated by burgeoning population is the major cause for deterioration of water quality in river yamuna.

Govt. of India has launched a programme Y.A.P. for cleaning of river in 1985 on survey.

4.2 WATER QUALITY OF RIVER YAMUNA

The Yamuna river may be disintegrated into 5 segments due to their hydrological & ecological conditions. These segments are Himalayan segment, upper segment, Delhi segment, Eutrophicated segment. The first two segments are comparatively clean having oligotrophic conditions. Delhi segment is the most polluted segment in the entire Yamuna river. This segment have oligotrophic head and saprobic tail. Eutrophicated segments except few patches of saprobic condition have diurnal variation of oxygen levels, an indication of eutrophication. The stretch of Yamuna river after its confluence with Chambal river is termed as diluted segment, as it receives significant dilution water. This segment after confluence with Chambal river regain its water quality upto some extent.

The characteristics of various segments are depicted as below:-

Parameters Average value	**Himalayan segment**	**Upper segment**	**Delhi Segment**	**Eutrophicated segment**	**Diluted**
Temps°C	19.6	22.4	25	25.7	24.5
D.O. (mg/l)	8.05	9.7	3.2	6.8	7.9
B.O.D. (mg/l)	0.6	1.1	17	8.0	1.9
T.D.S. (mg/l)	200	270	563	793	470
Resp. Rate gm./O_2/m^2/d	0.90	1.4	4.6	2.02	1.00
Photosynthesis Rate gm./O_2/m^2/d	1.02	1.54	0.85	4.49	1.06
Chlorophyltx	500	11.76	36.61	169.5	54
P/R Ratio	1.15	1.10	0.18	2.18	1.06
Total Coliform	7129	9557	10822	45297	11505
Faecal Coliform	172	352	135089	49614	2466
Tropic State	Oligotroplic	Oligotroplic	Polytropic	Antrophic	Oligopopler

Source CPCB,2000

Water quality of the himalayan segment of the diluted segment is comparatively good. However, due to heavy obstruction & discharge of pollutant into the river system there are critical segment which require pollution abatement measures to improve the water quality of river.

4.3 WATER QUALITY SEGMENT OF RIVER YAMUNA

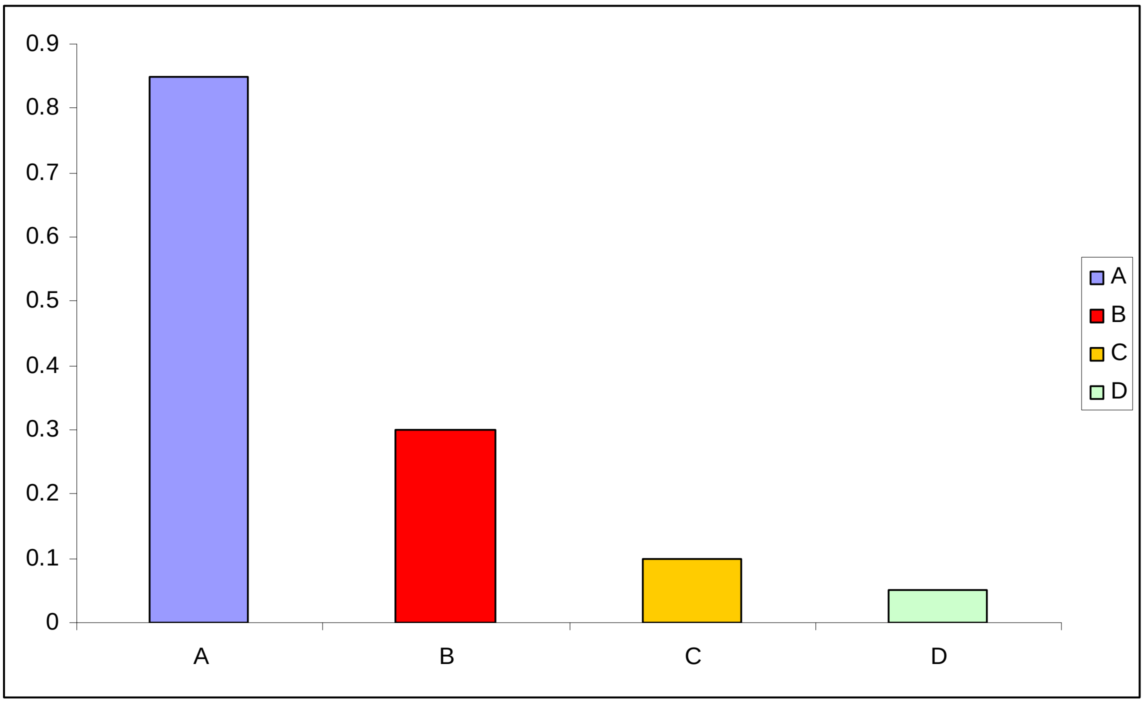
S.No.	Segments	Length of Segments (Km.)	Reason for critically of pollution
1.	Wazirabad to Okhla	22	Domestic & Industrial waste water of Delhi
2.	Okhla to Vrindavan	140	Domestic waste water from Delhi & Industrial waste water from Saharanpur, Ghaziabad, Noida
3.	Virindavan to Mathura	14	Domestic & Industrial Waste from Mathura & Vrindavan
4.	Mathura to Etawah	165	Domestic Wastes water from Agra Etava

The stretch of river Yamuna between Wazirabad and Okhlal (22km) is heavily polluted carrying massive input of wastewater from Delhi. This input is liable to set off progressive series of chemical and biological events in the downstream water. This stretch is characterized by high bacterial population, cloudy appearance, high BOD and strong disagreeable odour. Masses of sludge rising from the bottom are often noticed, floating near the surface of the water.

During monsoon the sludge deposited at river bed is flushed and stay in suspension causing increase in oxygen uptake. It may be the reason for fish mortality occurring every year during first flushing after onset of monsoon. The quality of water in Delhi stretch is far below the bathing standards even though it is used for bathing by low economic group of people. The retention time in this stretch is increased due to presence of two barranges, one at Okhla and another at ITO (nearly 10 km upstream of Okhla Barrage). The ITO Barrage is used to divert the Yamuna water for cooling purpose for two thermal Power Plants.

ON THE BASIS OF WATER QUALITY:-

The river Yamuna can be classified into four classes i.e. A, B, C & D based on dissolved oxygen (percent saturation), bio-chemical oxygen demand & Faecal Coliforms.



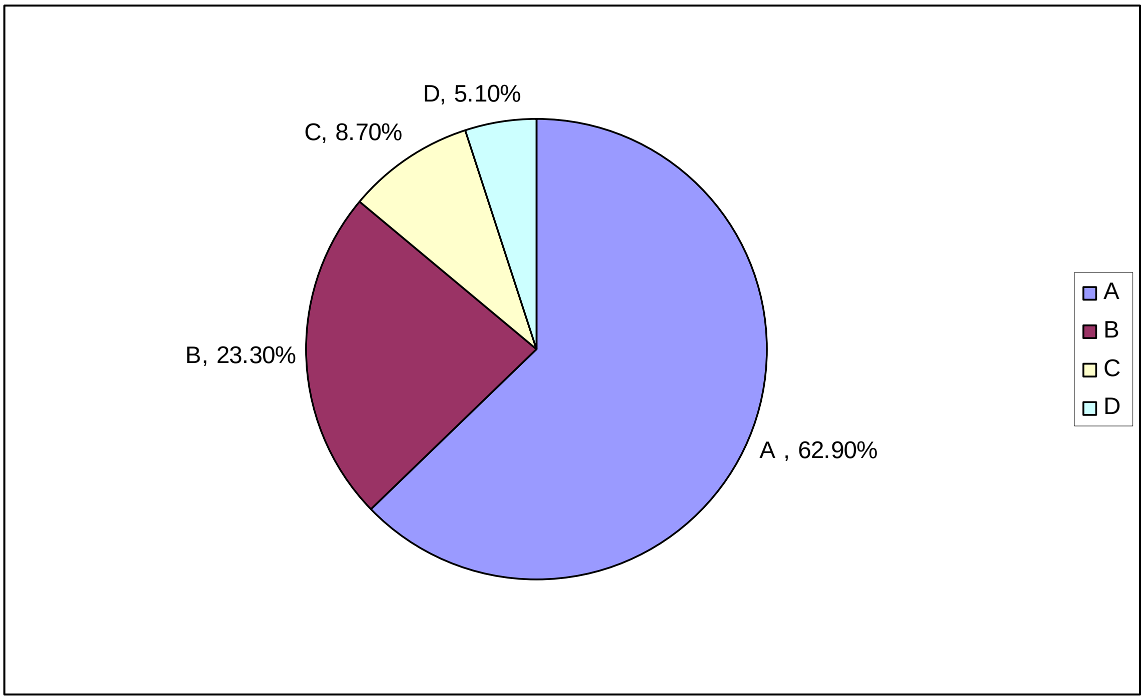
A – BOD = < 3 mg/l, DO = > 80% Saturation, F.coli = < 5000/100 ml.

B – BOD = 3 – 6 mg/l, DO = 60-80% Saturation, F. coli = < 5000 – 15000/100ml.

C – BOD = 6-10 mg/l, DO = 20-60% Saturation, F.coli = < 20000/100ml.

D – BOD = 10 – 30 mg/l, DO = 0-20% Saturation, F. coli = < 20000–10^5/100ml.

WATER QUALITY CLASSIFICTION OF RIVER YAMUNA



PERCENTAGE OF VARIOUS CLASSES OF YAMUNA WATER

In class A BOD < 3 mg/l DO more 80%, & F.C. less than 5000/100ml.
In class D strech of 80 km., having water having BOD 10-30 mg/l,DO 0-20% saturation & F.C. 20,000-   nos./100ml.

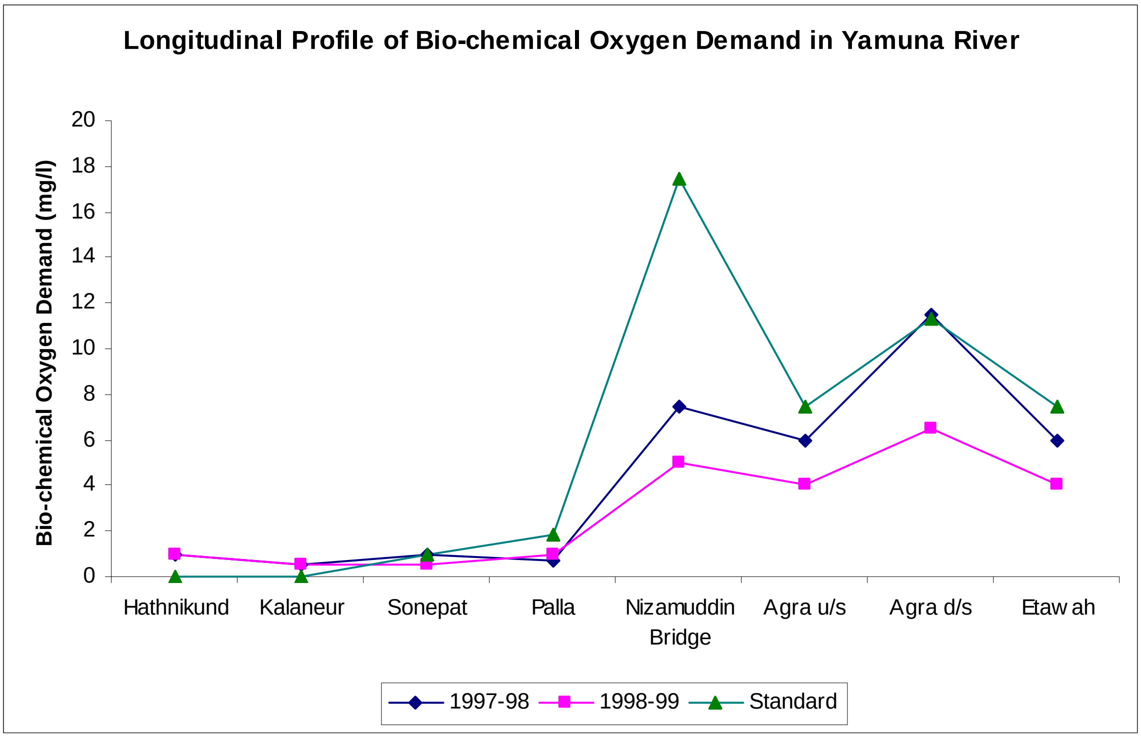
4.4 PHYSICO-CHEMICAL CHARACTERISTICS OF YAMUNA RIVER WATER

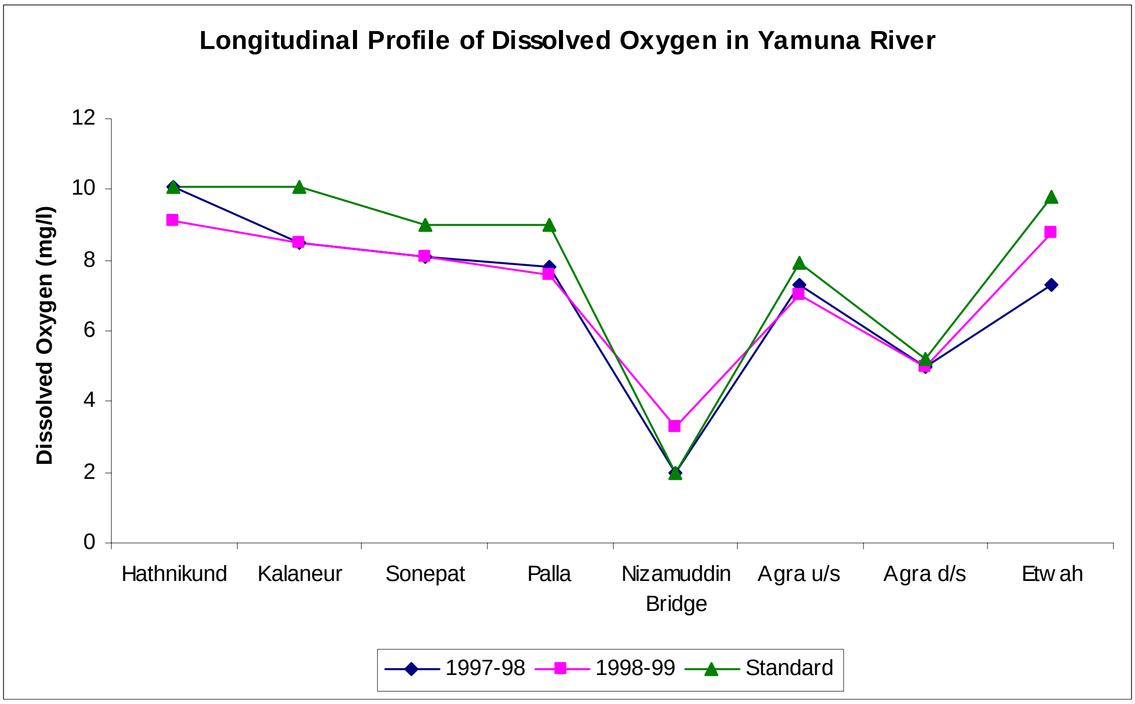
I BOD & DO

The dissolved oxygen values even in degraded stretch of Yamuna river (except Delhi stretch) apparently meets the desired best use limit because of photosynthetic effect.

The D.O. in water depends on photosynthetic rate & period of phyotosynthetics as well as its consumption by aquatic fauna & flora for respiration.

After confluence of River Chambal, River Yamuna again become normal as evident from the annual average values of D.O. & B.O.D. The D.O. values even in degraded stretch of Yamuna river (except Delhi stretch) apparently meets the desired designated best use limit because of photosynthetic effect.




Longitudinal Profile of Dissolved Oxygen in Yamuna River
Dissolved Oxygen (mg/l)
0
2
4
6
8
10
12
Hathnikund
Kalaneur
Sonepat
Palla
Nizamuddin Bridge
Agra u/s
Agra d/s
Etw ah
1997-98
1998-99
Standard

Similarly the profile of B.O.D., reveals that river is in deteriorated stage between Delhi & Etawah.

II MICROPOLLUTANT CHARACTERISTICS OF YAMUNA RIVER WATER

(1) The micropollutants (pesticide & heavy metals) were monitored (Conducted by CPCB) quarterly at limited locations of river yamuna. The pesticides were either not traceable or present in significantly few concentrations much below the tolerance limit prescribed by WHO, Geneva.

(2) Yamuna river abundant organic matter which has an affinity to adsorb the micropollutant and settles down in form of sludge, stripping the river water from these micropollutants.

(3) Yamuna water is being used for drinking purpose at the cities of Delhi & Agra, after conventional treatment the presences of such micropollutants in treated water seldom occurs due to micropollutant adsorption on suspended particle. In the drinking water treatment process suspended materials are removed through coagulation, sedimentation and filtration, thus the micropollutant associated with the suspended materials are removed through coagulation, sedimentation and filtration, thus the micropollutants associated with the suspended materials are removed to certain extent. The dissolved pesticides are oxidized during chlorination or ozonation process.

a) <u>Heavy Metals</u>

Seven heavy metals were monitored and analysed in Yamuna river, out of which Fe and Zn were regularly detected in almost all the samples, while other metals were available in traces to medium concentration in some of the water samples. The iron, which is an essential element for life was always exceeding the drinking water standard limit and available in higher concentration than other metals. The heavy metal concentration were observed higher at several occasions in the Yamuna river water upstream of Delhi, where no significant anthropogenic source of these metals are available. At such locations their contribution could be from the natural sources.

b) Micropollutant in Sediments

The levels of Fe,Zn, Ni were found high in majority of sample, whereas Pb & Cu metals were available in medium concentration. Cd and Cr were either untraceable or found in trace quantities.

4.5 CONCLUSION

(1) Addition of huge amount of untreated domestic sewage in Delhi and non-availability of dilution, results in significantly degradation of water quality in d/s stretch of river. The river Yamuna in its 500 km. stretch from Delhi to chambal confluence does not meet the criteria for its designated best use, even in monsoon season when sufficient dilution was available. The contamination in this stretch is predominantly organic in nature resulting in rapid depletion of oxygen affecting river ecosystem.

(2) The heavy metals are mostly available in Yamuna water except Cd, which is occurring in very low concentration.

(3) The microbial pollution is prevailing in the Yamuna river mainly due to contribution of human wastes. The Yamuna river is frequently used for mass bathing at Vrindaram, Mathura, Bateshwar and Allahabad, where lakhs of people gather on some auspicious occasions to take holy dip.

CHAPTER-5

POLLUTION STATUS OF RIVER YAMUNA AT DELHI

5.1 INTRODUCTION

River Yamuna, which is the main source of water supply of Delhi, plays a crucial rule in its growth. Perennial increase of population and urban activities in Delhi are placing exigent pressures and demands on this resource.

There is a heavy pressure of water supply and sanitation on river Yamuna at Delhi, leading to severe impact on water quality of river.

5.2 POLLUTION LOAD GENERATION

```
                   |
  ----------------------------------
  |                |               |
Rural        Industrial          Urban
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Basically the human activities result in the generation of pollutant through the nature and quantities of such pollutant may very in a wide range from activity to activity. Rural and urban areas are they much distinct from each other in terms of human activities, as well as the provision of infrastructure, particularly water supply and sanitation.

5.2.1 Pollution Load Generation - Rural

The generation of pollutants from agriculture, animal, husbandry and from domestic source in case of rural communities would be more or less uniformly spread over large areas. Most of the rural areas do not have piped water supply and even if they have, it is not adequate to support water-borne system of disposal. Hence, land disposal of generated sewage is the prevalent means, because of easy availability of land areas.

The generation of pollution in rural areas do not pose a serious problem to water quality of river Yamuna.

5.2.2 Pollution Load Generation - Urban

The urban municipal use of water, leads to the concentrated generation of water pollutants in contrary to non-point generation in the cases of rural communities. The availability of proper infrastructural facilities like water supply and sanitation in area determines the per capita pollution load generation and its chances to reach the river systems.

Class	Public Utilities	Adopted Average BOD (gm/Capital/day)
A	Sewerage & Organised Supply	50
B	No Sewerage and Organised	25
C	No sewerage and no organized	15

5.2.3 Pollution Load (Industrial)

Industries, generate water pollutional loads, which is toxic and varied in nature, highly concentrated in terms of space and time. Some being refractory and very difficult to either destroy or remove are they have entered a stream.

The severity of industrial pollution problem is depicted in form of BOD load.

Other Sources

The commercial activities, service shops, institutional areas, offices and floating population in an urban area require considerable quantities of potable water and thus led to the generation of waste water in addition to regular municipal and industrial pollution load generation.

5.3 Overall Situation of Pollution Load Generation

The pollution loads in terms of BOD (MT/day) from domestic, industrial activities and from other sources has been collected. From this the total pollution loads discharged within each sewerage zone has been estimated.

Sewerage zone-wise estimated generation of BOD load

S.No.	Sewerage Zone	Estimated BOD load			Total BOD Load
		Domestic	Industrial	Other Sources	
1.	Okhla	156.39	9.41	63.80	229.60
2.	Keshopur	80.33	80.65	25.88	186.86
3.	Rithala	96.71	33.04	5.01	134.26
4.	Coronation Pillar	22.75	0.68	1.87	25.30
5.	Shahadra	93.67	3.54	8.97	106.18

5.4 Trend in Pollution Load Contribution

The basic water quality parameters of river Yamuna water at different strategic points along Delhi – New Delhi reach for past few years have been collected and are shown in table 5.1 below.

Table 5.1
Water Quality in River Yamuna
(u/s and d/s of Delhi – New Delhi Reach)
(1990-1998, 2002)

Parameter	Location	Years									
		1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**2002**
pH	PALLA	8.1	8.21	8.00	8.1	8.4	8.0	8.31	8.2	8.22	8.38
	NZB	-	-	-	-	-	7.8	7.6	7.5	8.07	7.54
	OKHLA	7.6	7.7	7.7	7.6	7.6	7.8	7.5	7.4	8.15	7.64
Do	PALLA	8.46	8.1	7.1	7.3	6.9	9.0	9.3	7.5	10.50	9.9
	NZB	-	-	-	-	-	3.4	1.1	1.2	6.00	2.1
	OKHLA	.3	2.3	0.0	2.1	1.9	2.1	1.2	1.3	5.80	4.7
BOD	PALLA	3.00	3.10	3.30	3.60	2.30	2.70	3.10	2.30	2.00	4.00

	NZB	-	-	-	-	-	9.7	8.6	18.4	11.00	36.0
	OKHLA	22.6	25.6	19.0	37.5	49.7	15.0	18.2	16.0	12.0	21.0
COD	PALLA	11.50	12.60	10.20	10.90	8.30	18.20	49.20	9.50	20.00	
	NZB	-	-	-	-	-	31.0	56.1	63.6	67.80	
	OKHLA	69.5	58.2	57.0	108.5	87.0	49.2	72.1	61.5	70.00	
TC	PALLA	-	-	-	5483	3645	8506	-	-	61000	102000
	NZB	-	-	-	-	-	386091	170318	402312	544000	26100000
	OKHLA	-	-	-	333437	91955	329312	-	-	474000	10000000
FC	PALLA	1505	3435	1580	795	193	3944	2901	743	750	6400
	NZB	-	-	-	-	-	141456	142682	376599	262000	1570000
	OKHLA	165710	188900	190210	40450	204250	184967	76136	273875	174000	260000
TKN	PALLA	0.63	0.60	3.10	1.30	1.10	-	-	-	-	
	NZB	-	*	-	-	-	9.19	-	-	-	
	OKHLA	9.2	8.9	9.5	9.2	10.9	13.4	-	-	-	
WT	PALLA	24.3	23.6	24.2	23.6	23.0	23.6	26.2	25.8	26.8	
	NZB	-	-	-	-	-	25.3	27.3	26.5	7.3	
	OKHLA	24.8	24.2	24.0	23.2	23.6	24.6	26.5	26.3	26.5	
AMM	PALLA	0.21	0.2	1.0	0.7	0.3	0.2	0.7	0.4	0.20	
	NZB	-	-	-	-	-	4.6	8.8	10.5	10.37	
	OKHLA	6.8	7.2	3.8	7.4	8.1	7.7	13.3	8.3	8.2	

Source: CPCB, 2000

NOTE:

NZB	:	Nizamuddin Bridge
-	:	Not available
DO	:	Dssolved Oxygen, mg/1
FC	:	Fecal Coliform, no./100 ml.,
BOD	:	Bochemical Oxygen Demand, mg/l,
TKN	:	Total Kjeldahal Nitrogen, mg/l,
COD	:	Chemical Oxygen Demand mg/l,
WT	:	Water Temperature, ºC
TC	:	Total Coliform, no./100ml.
AMM	:	Amonia, mg/l

5.5 CONCLUSION

From Table 5.1 a spatio-temporal picture of water quality in the neighbourhood in Delhi may be obtained. Before the river enters Delhi, (that is at Palla) the D.O. has remained above 7.0 mg/l over the decade 1990-1999. Significant reduction to approximately 3.0 at the Nizamuddin site (roughly half way down the urban reach) and at this site there is significant reduction in the reported 1995-1997 period. At Okhla Barrage, the point of exit from Delhi – New Delhi the D.O. values are much lower, how ever there appears to be no deterioration over the temporal domain.

Also the table depicts significant increase in B.O.D. & C.O.D. concentration in the Delhi – New Delhi reach resulting in increased demand of Oxygen for degradation of organic load in the river. In combination with the depletion in D.O. the increase in organic load makes the condition further worse.

The other significant aspect presented by the table is very high Coliform organisms count. Such a high count alarms to desist from contact with the river water.

The reported pollution load discharged into river Yamuna for the period 1982-1998 has been given in table-5.2.

Table-5.2
BOD Loading Discharge into River Yamuna in Delhi

Years	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1995	1996	1997	1998
BOD	117.3	132.3	119.4	123.2	165.1	148.5	159.6	159.6	167.5	179.8	178.4	193.8	205.85	211

Source: CPCB, April 2000.

Figure-5.2

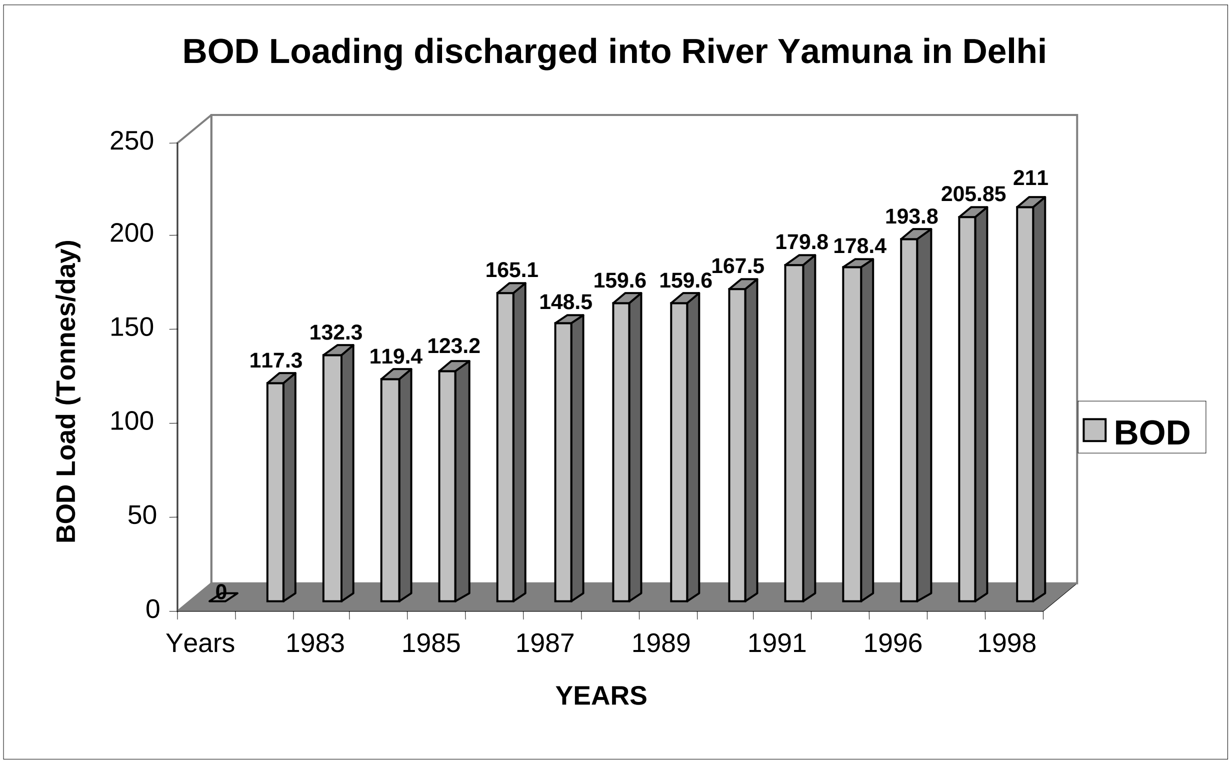
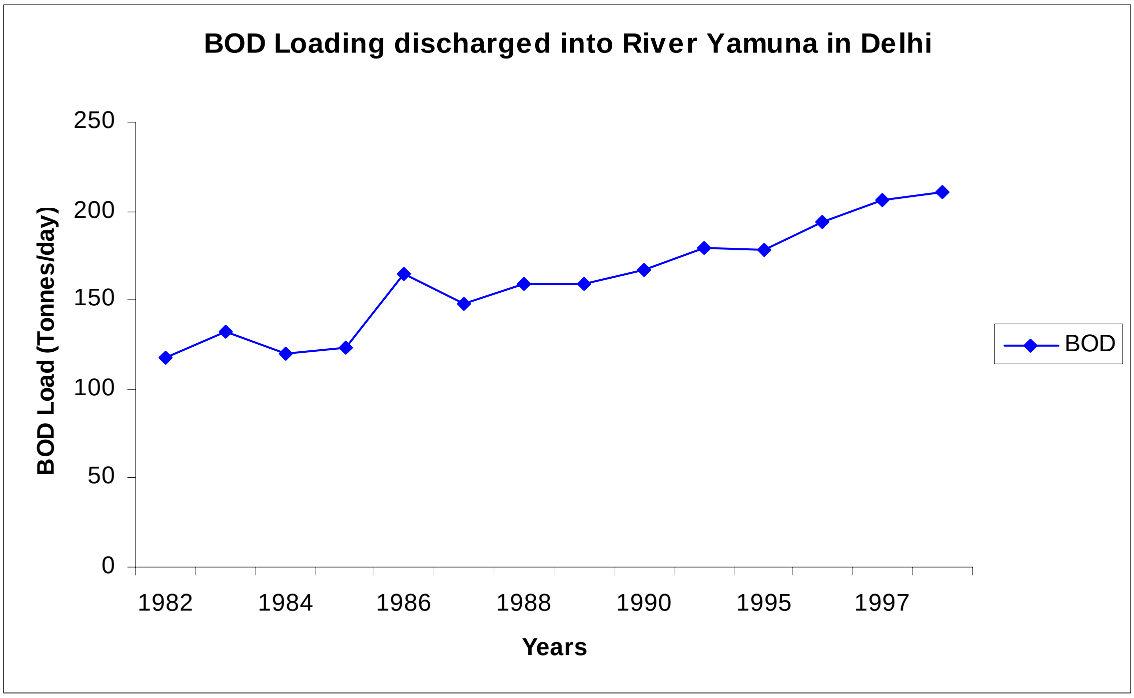


Figure:5.3



This depicts an increasing trend of pollution load in successive years except some fluctuations on lower side. The B.O.D. load reported by C.P.C.B. for the year 2001 is 311.4 tones/day.

CHAPTER-6

STEPS TAKEN TO CONTROL POLLUTION IN RIVER YAMUNA

6.1 INTRODUCTION

The water quality in Yamuna river has been continuously degraded in about 500 km stretch of the river Yamuna, and seldom confirm to designated best use criteria. It was necessary implied to restore its quality through YAP and some alternative measures are being taken up.

I. Alternative Measures

II. YAP (Yamuna Action Plan)

6.2 I. Alternative Measures

(a) Sewerage Component

Intercepting and trunk sewers are provided to capture the untreated sewage from the drains/pumping stations outfalling into the river. The intercepted sewage is taken to a sewage treatment plant for removing the organic as well as pathogenic pollution. Appropriate technologies such as activated sludge process, **Upflow Anaerobic Sludge Blanket** (UASB) digester, oxidation ponds, agro-forestry etc. are used for treatment of sewage. Low cost technologies like oxidation ponds are well suited to address the pathogenic pollution. However, availability of land for pond becomes a limitation to use this system in large towns. The older methods of controlling pathogenic pollution are chlorination of treated sewage, **Ultra Voilet** (UV) disinfection etc. Higher running cost of these methods is a limiting factor in Indian conditions.

(b) Non Sewerage Component

Low Cost Sanitation

The Low Cost Sanitation scheme under YAP mainly consists of community toilet complexes provided at strategic locations in a town like bus depots, market places etc. as well as in slums and other areas inhabited by economically weaker sections (EWS) of people who do not have good sanitation facilities. This will reduce pollution of the town as well as of the river as people will not have to go for open-air defecation and urination.

(c) Electric and Improved Crematoria

From religious point of view, people prefer to cremate human bodies on the banks of river, and sometimes partly burnt bodies are thrown into it. This is due to the fact that the poor are for cremation. The firewood requirement is high per dead body. Therefore, provision of crematoria have been made under YAP schemes. These will ensure complete burning of the bodies, saving the river pollution due to dead bodies and consume less wood thereby saving trees.

(d) Plantation and Land Scaping

Plantation has been done along Yamuna and it carries considerable amount of flow around the facilities created under YAP, wherever land was available for such purposes.

6.3 II. The Yamuna Action Plan

The schemes of pollution abatement under the YAP had been planned to be implemented in 15 districts viz. Yamuna Nagar, Jagadhari, Karnal, Panipat, Sonepat, NCr. Some towns were added in Action Plan on recommendation of state governments. The estimated expenditure planned in the programme for 15 districts was Rs.357 crore.

Govt. of Japan had extended soft ware of 17.77 billino for the YAP. The cost of operation and maintenance of the arrests created under the programme are proposed to be borne fully by the statement governments.

The scheme under the Action Plan are being implemented by the state government through identified nodal agencies with due emphasis on public participation and institution development. The Ministry of Environmental and Forests, Government of India is co-ordering the overall implementation of programme.

It has been proposed to set up sewage treatment plants with a total capacity of about 900 mld under the YAP, some of which already installed and become operative. The following types of pollution abatement work is proposed to be taken up under the programme :

(1) Interception and diversion of municipal waste water

(2) Sewage treatment

(3) Low cost sanitation

(4) Improved crematoria

(5) Improvement of Ghas

(6) Afforestation along river Banks

6.4 Special Features of YAP

Under the YAP, emphasis would be laid on following :

i) Minimization of cost of conveyance of sewage and the energy needs for pumping through decentralization of sewage and sewage treatment facilities whenever feasible.

ii) Low cost technology options for sewage treatment would be encouraged through agro-forestry, oxidation ponds, aquaculture, upflow anaerobic sludge blanket (UASB) digester, etc.

iii) The action plan will address the problem of siltation, bank erosion and pollution from agricultural run-off containing pesticides and fertilizers, through active cooperation of the concerned administrative ministries.

6.5 Schemes under the YAP for Delhi

Yamuna river enters Delhi at Wazirabad and after traversing about 22 km from north to south leaves Delhi at Okhla dividing it into eastern and western parts.

Delhi generates about 2083 mld of sewage against the 1473 mild of sewage treatment. The entire existing capacity of sewage treatment is not up to the desired secondary treatment level. Thus, nearly 565 mld of untreated sewage and significant quantity of partially treated sewage is discharge into the Yamuna river through various drains.

Under the Delhi package of Yamuna Action Plan, two sewage treatment plants, each of 10 mld capacity are proposed to trap and treat the waste water from Sen Nursing Home and Delhi gate drains.

The other components of YAP in Delhi comprises :

(1) Setting up low cost toilets and improved crematoria is selected areas.

(2) Proving river front facilities at few places.

(3) Increasing Plantation along river banks.

6.6 Industrial Pollution Control

The following steps has been taken to control the pollution from industrial sources

(1) Constant persuation by CPCB by issuing of directions under the provisions of various regulations to DPCC & UPPCB for constant vigilance on industries to comply pollution control regulation.

(2) Environmental surveillance square, had been created to constantly monitor the compliance of pollution control.

(3) CPCB, has been assisting the Hon'ble Supreme Court in identification of (H-categories) of industries and polluting industry, subsequently monitoring the compliance of Hon'ble Supreme Court's order with respect to shifting and closure of industries in Delhi.

(4) An action plan has been formulated in collaboration with concerned state pollution control Boards (SPCB's) and DPCC to control pollution of river yamuna.

CHAPTER 7

CONCLUSION

1) As it was expected the analysis shows the pollution land in river Yamuna, in an around Delhi. Except for pH & TDS, All the parameters are crossing the standard limits and its unfortunate that in spite of such a high level of pollution people are still using for various purposes like swimming, fishing and other such purposes at various sites where from samples were collected. Therefore its very dangerous for the health of those, specially, who are dwelling in the nearby are and using this water frequently.

2) Though large sum of money is being spent by the government under Yamuna Action Plan to save this river from pollution but that is very difficult to achieve without sufficient level of general awareness towards this issue.

3) Results indicate 3 major points of concern from pollution point of you i.e. B.O.D., Fe, Zn concentration. The major cause of the problem as identified in this project is mainly the absence of minimum fresh water flow required in the river, which is due to the fact that large amount of water is being taken away from the river at Tajewale through two canals. After that the water is regenerated by groundwater till it reaches Delhi wherein the effluent from the industrial into from Haryana are also mixed in the river. S it reaches Delhi again water in stopped at Wazirabad and after that what constitutes the flow is mainly a huge load of sewage which is disposed off into the river. This problem is further accentuated due to the political activities and intervention due to which its not been possible to maintain the minimum fresh water flow of 10 cusec per

second even after supreme court's decision. Along with this the malfunctioning of the STP's lack of power and poor infrastructural facilities are prominent features worsening the situation.

4) The activities proposed to control water pollution in the river Yamuna in Delhi are as under :

A very peculiar aspect of specifications prepared under legislation has emerged during the study that these specification might not have been formulated without assuming characteristic of a typical natural streams but there is no provision of minimum required characteristic of a natural stream with regard to quality and quantity so that the resultant characteristics after discharge of permitted effluent does not go down a particular limit.

5) Thus norms are required to be set by CPCB not only for quality of discharge being made into the natural stream but also for quantity of effluent discharge in relation to the quantity & quality of natural stream in which the discharge is to be allowed.

Till the river recovers from earlier allowed shock pollutant loading no further discharge or pollutants should be allowed.

6) Keeping in view the very high coliform micro-organism count tertiary treatment should be made mandatory before discharge into river.

7) Keeping in view the DO level which is zero all along the reach under study no drain having DO<2 should be allowed to be discharged into river.

8) Efforts are required to be made to aerate the river water. Two suggested processes are:

- Mechanical aeration by developing vigorous navigation.
- Aeration by installing fountains on the banks drawing water from and discharging back into river.

9) In any case effluents carrying carcinogenic pollutants should not be allowed to be discharged.

10) In present conditions even after treatment to the level specified by CPCB Yamuna is not going to withstand to the pollution load due to lack of sufficient fresh water discharge during lean period. Therefore, after treatment water of all drains should be chanalised and if, found fit taking into consideration the entry into food chain and bio-magnification aspect also, should be utilized for irrigation purposes.

Annexure-2 Water Quality Criteria for the Various Designated Best Uses

Source: CPCB, 1978-79

Water Quality classification	**Designated Best use**	**Parameters affecting the state the**	**Quality Criteria proposed**
A	Drinking water sources without conventional treatment but after disinfection.	1. Coliform MPN 2. Turbidity 3. Colour 4. BOD 5. DO 6. Toxicants (including Pesticides etc.) 7. Plate Count 8. Floating matter 9. Taste and odour	Less than 50/100 ml Less than 10 units Less than 10 units Less than 2 mg/l More than 6 mg/l No acute toxicity To be present Less than 50/100 ml Absent Not perceptible
B	Bathing, Swimming and Recreation	1. Coliform MPN 2. Turbidity 3. Colour 4. BOD 5. DO 6. Toxicants (including Pesticides etc.) 7. Floating matter 8. Taste and odour	Less than 50/100 ml Less than 25 units Less than 10 units Less than 3 mg/l More than 5 mg/l No acute toxicity To be present Not noticeable Not perceptible
C	Drinking water resource after conventional treatment	1. Coliform MPN 2. Colour 3. BOD 4. DO 5. Toxicants (including	Less than 5000/100 ml Less than 25 mg/l Less than 3 mg/l More than 4 mg/l

		Pesticides etc.)	No acute toxicity To be present
D	Propagation of wild life, fisheries	1. Coliform MPN 2. BOD 3. DO 4. Toxicants (including Pesticides etc.)	Less than 5000/100 ml Less than 6 mg/l More than 4 mg/l No acute toxicity To be present
E	Irrigation, Industrial cooling and controlled wastes disposal	1. TDS 2. (Ca+Mg) 3. Sodium Ratio 4. Chlordes 5. Boron	Less than 1000 ml Less than 100 mg/l Less than 0.5 Less than 250 mg/l Less than 2 mg/l

Annexure-3 Use based classification of surface waters in India

Designated Best Use	Quality Class	Primary Quality Criteria
Drinking water source without conventional treatment, but with chlorination.	A	6.5 to 8.5 (1) ; 6 or more (2) ; 2 or less (3); 50, not>5% 200 and not>20%- 50 (4); NIL (5 – 8) +
Outdoor bathing (organized)	B	6.5 to 8.5 (1); 5 or more (2); 3 or less (3); 500, not>5%-2000, and not >20%-500 (4); NA (5 – 8)
Drinking water source with conventional treatment.	C	6.5 to 8.5 (1); 4 or more (2); 3 or less (3); 5000, not>5%-20000, and not >20%-5000 (4); NA (5 – 8)
Propagation of wildlife and fisheries.	D	6.5 to 8.5 (1); 4 or more (2); NA (3-4); 1.2 (5); NA (6 – 8)
Irrigation, industrial cooling and controlled waste disposal.	E	6.0 to 8.5 (1); NA (2 – 5) ; 2250 (6); 26 (7); 2 (8)

Source: EP Rules, 1986

(1) pH, (2) dissolved oxygen, mg/l (3) BOD (20C) mg/l, (4) total coliform (MPN/100ml) (5) free ammonia mg/l, (6) electrical conductivity in MhO/cm, (7) sodium adsorption ratio, and (8) boron mg/l, NA=Not applicable.

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