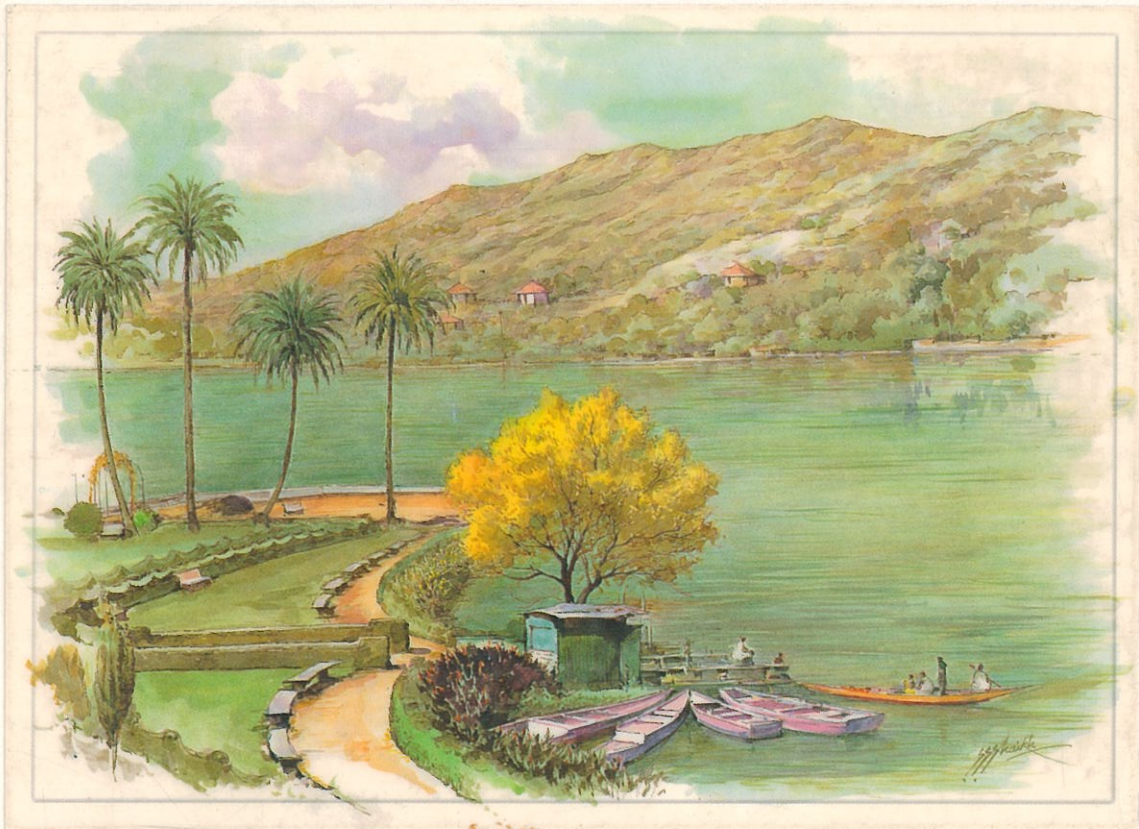


FEASIBILITY REPORT FOR ... [VOLUME-1]

**REHABILITATION, UPGRADATION
& BEAUTIFICATION OF LAKES**

SUBMITTED TO ...

**THANE MUNICIPAL CORPORATION,
THANE.**



PREPARED BY ...

**FINE ENVIROTECH ENGINEERS,
MAHIM, MUMBAI.**

MIS - 2715

MIS-2715



CONTENTS

VOLUME-1

- ACKNOWLEDGEMENT
- INTRODUCTION - TMC

⇒ DESCRIPTION OF AREA

LOCATION
TOPOGRAPHY
CLIMATE
RAINFALL
HUMIDITY
WIND DIRECTION

- INTRODUCTION - LAKES IN GENERAL
- EXECUTIVE SUMMARY
- STRUCTURE OF THE REPORT
- SCOPE OF WORK

SECTION 1

BACKGROUND, ORGANISATION & EXPERIENCE

- 1.1 ABOUT FEE
- 1.2 INFRASTRUCTURE
- 1.3 ABOUT OUR ARCHITECTURAL OFFICE
- 1.4 EXPERIENCE AND RELATED WORK COMPLETED

SECTION 2

INSTITUTIONAL SET-UP & CO-ORDINATION

- 2.1 INSTITUTIONAL CAPACITY AND ITS STRENGTHENING
- 2.2 INSTITUTIONAL COORDINATION

M. M. R. D. A. LIBRARY	
Call. No.	MIS
Acc. No.	2715
Date :	

- 2.3 STRUCTURE OF INSTITUTIONAL COORDINATION
- 2.4 STRENGTHENING OF INSTITUTIONAL FRAMEWORK

SECTION 3

APPROACH & METHODOLOGY

- 3.1 GENERAL APPROACH
- 3.2 METHODOLOGY
- 3.3 SEVERANCE
- 3.4 ANALYTICAL EXERCISE
- 3.5 SCHEDULING OF STUDY

SECTION 4

ENVIRONMENTAL STATUS

- 4.1 INTRODUCTION
- 4.2 REVIEW OF EXISTING ENVIRONMENTAL STATUS OF THANE CITY
- 4.3 ENVIRONMENTAL STATUS OF PROJECT LAKE SITES

SECTION 5

MONITORING PLAN AND REQUIREMENTS

- 5.1 MONITORING REQUIREMENTS
- 5.2 ANALYTICAL METHODOLOGY
- 5.3 PROPERTIES
- 5.4 OPERATION AND MAINTENANCE

SECTION 6

TREATMENT STRATEGIES

- 6.1 TREATMENT OF LAKE WATER AND VARIOUS ALTERNATIVE OPTIONS
- 6.2 ENGINEERING AND MANAGEMENT OPTIONS FOR LAKE REJUVENATION

SECTION 7
BEAUTIFICATION PLANNING

- 7.1 GENERAL
- 7.2 BEAUTIFICATION PLANS

SECTION 8
COST & BUDGETARY ESTIMATION

- 8.1 COST ESTIMATION
- 8.2 COST ANALYSIS
- 8.3 COST FACTOR
- 8.3 PREPARATION OF FINANCIAL PLANS

VOLUME-II

- **TABLES**
- **GRAPHICAL REPRESENTATIONS**
- **WIND ROSE DIAGRAMS**
- **ILLUSTRATION BY PHOTOGRAPHS**

ACKNOWLEDGMENT

We are sincerely thankful to the Municipal Commissioner Shri. T. Chandrashekhar- IAS for giving us the opportunity to make a permanent final document for the rejuvenation of lakes in TMC area. We are committed to our best endeavors in completing this report under his able guidance.

We are also thankful to Shri. S.P. Ramnani- Pollution Control Officer, TMC for his wholehearted support during the course of these studies. We also acknowledge cooperation from his colleagues and staff for their duly assistance during completion of these studies.

Our thanks also due to MoEF, New Delhi, CPCB, New Delhi, and MPCB for their assistance during the study.

Finally, we acknowledge all those who have directly or indirectly supported us in this program.

ABOUT THE REPORT

This report is divided into 2 volumes for the convenience of its reading and understanding.

Therefore we thought it fit to divide the report into two volumes.

VOLUME-I

This volume covers of the text material with relevant illustrations.

VOLUME-II

This volume includes various tables, graphical representations, wind rose diagrams, and most importantly effective illustrations by way of actual photographs.

ACRONYMS

- (01) **APHA:** - American Public Health Association.
- (02) **AWWA:** - American Water Works Association.
- (03) **AAQM:** - Ambient Air Quality Monitoring.
- (04) **BOD:** - Biochemical Oxygen Demand.
- (05) **COD:** - Chemical Oxygen Demand.
- (06) **CPCB:** - Central Pollution Control Board.
- (07) **DO:** - Dissolved Oxygen.
- (08) **dB :-** Decibel (noise level).
- (09) **EIA:** - Environmental Impact Assessment.
- (10) **HVS :-** High Volume Sampler
- (11) **ID:** - Inner Diameter.
- (12) **MoEF:** - Ministry of Environment and Forest.
- (13) **MPCB:** - Maharashtra Pollution Control Board.
- (14) **MSW:** - Municipal Solid Waste.
- (15) **MMRDA:** - Mumbai Metropolitan Region Development Authority.
- (16) **NRCD :-** National River Conservation Division
- (17) **NOX:** - Nitrogen Oxides.
- (18) **O & G:** - Oil and Grease.
- (19) **OD:** - Outer Diameter.
- (20) **ppm :-** Parts Per Million.
- (21) **Redox Potential :** - Reduction - Oxidation Potential.
- (22) **SS :-** Suspended Solids.
- (23) **SOX:** - Oxides of Sulphur.
- (24) **SPM:** - Suspended Particulate Matter.
- (25) **TP:** - Total Phosphorus.
- (26) **TOR:** - Terms of Reference.
- (27) **TDS:** - Total Dissolved Solids.
- (28) **TMC:** - Thane Municipal Corporation.
- (29) **WPCF:** - Water Pollution Control Federation.

INTRODUCTION

THANE MUNICIPAL CORPORATION

Thane Municipal has a significant place in Mumbai Metropolitan Region due to its nearness to Mumbai Municipal Corporation. The corporation area is rapidly changing its face.

The process of urbanisation was the product of industrialisation and subsequent migration of the population from rural areas towards the city for better opportunities of earning and affording better amenities. It becomes almost impossible to provide the essential amenities and services like housing, water supply, sanitation, and transport etc. to this rapidly rising population. This inevitably resulted in the degradation of environment.



DESCRIPTION OF AREA

2.1 LOCATION

Thane is the northernmost district of Konkan. It lies along the Arabian Sea in the northwest of Maharashtra State. It extends between latitude 18-42^oN and 20-20^oN and longitude 70-25^oE and 73-44^oE. It is located next to Mumbai City.

The Thane municipal corporation includes Thane City including Kopri, Naupada, Chendani, and the rural areas of Kalwa, Mumbra, and Diva towards southwest and Pokhran, Balkum, Majiwada area towards Northwest. Thane Municipal Corporation encompasses an area of 147 sq. km. Ulhas River and Thane creek are major water bodies in northern and southwest direction respectively. The area includes hills of Mumbra and Pokhran.

2.2 TOPOGRAPHY

The high hills on one side and submersible marsh along Thane creek and Ulhas riverbanks have peculiarly divided the terrain. The plain terrain actually forms a wide belt along the foothills and away from creek water and Ulhas riverbanks. This situation distracted growth and placement of urban activities. They run centrally through the plains and bend along the foot of the hills. Long stretches of built up area have been developed on both sides of highway, first in the form of ribbon type of development and later converted into Corridor type expansion; of course without any serious consideration for interface relationship among different activities.

2.3 CLIMATE

The climate of Thane is typically coastal, sultry and not really hot. The area receives an average rainfall of 2500 to 3000 mm. There are actually two distinct seasons viz. rainy season and dry season. The latter covers both summer and winter periods.

2.4 TEMPERATURE

The mean maximum temperature varies from 32.37 °C to 34.57 °C during the whole year. It is maximum during the months of March to June. Due to humidity during the above-mentioned period, conditions are a bit intolerable, being sultry. The weather is pleasant during the months of December to February with temperature ranging from 17.6 °C to 20.5 °C

2.5 RAINFALL

Rainfall is usually experienced from the beginning of June to end of September with annual mean rainfall of 2701 mm.

Annual rainfall during the past few years was as follows:

1992	1901.06
1993	2421.40
1994	2619.70
1995	1543.90
1996	3622.55
1997	3637.80
Upto AUG '98	1783.20

2.6 HUMIDITY

The humidity ranges from 45% to 87% during the year with the highest humidity in the month of August

2.7 WIND DIRECTION

The wind direction is predominately from west to northwest of the town for a major period of the year. The mean wind speed is 11.3 Km \ hr. The maximum speed varies from 15 to 19 Km \ hr during June to August.

INTRODUCTION- LAKES IN GENERAL

WHAT IS A LAKE :

A lake is an Eco-system containing many living organisms that interact with one another and with their environment, in a balanced web of life. That balance may be destroyed by either the extensive growth of some organisms or by the death of other organism. In either event, the lake beings do die. The basic purpose of this project by TMC and FEE is to restore and maintain this vital balance.

The lake constitutes national and international habitats for variety of flora, fauna, and other aquatic life. It also acts as an important life support system by recharging aquifers and hydrological regime. It is an important feature in the ecosystem focussing the life style of human population. Due to urbanization the lakes are experiencing varying degrees of degradation, due to disposal of untreated human waste, and human activities such as washing of clothes, vehicles, animals and bathing etc., sedimentation, siltation, posing threat to aquatic life etc. and becoming unfit as a source of drinking water, recreational activities and habitats for aquatic life.

MOST IMPORTANT ELEMENT IN LAKES

Of all the elements found in a lake, oxygen is the most important for keeping the lake clean and the web of life in balance. Oxygen not only keeps fish alive, but also supports the small benthic organisms of the lake bottom. These organisms range from bacteria to worms and shellfish. In the presence of oxygen, benthic organisms can consume the bottom muck, the same as snails do in aquarium. Incoming organic waste becomes food for these organisms.

At the same time, oxygen deactivates harmful anaerobic bacteria, which produce acids and toxic gases. It is essential to rid a lake of these acids and gases because they can kill aerobic organisms, including fish, even if the lake is saturated with oxygen.

TWO ESSENTIAL NEEDS

It became evident that, it is absolutely essential to provide abundant volume of oxygen to the bottom, as well as to the entire depth of the lake water. Aeration will provide oxygen to a lake, oxygen alone cannot restore it.

At the same time, toxic gases of the bottom waters must be eliminated. The only practicable method was to accomplish two tasks at the same time by using FREE power of Nature.

HOW NATURE CLEANS THE LAKE

While lake derives some oxygen from aquatic plants during the process of photosynthesis, most of the oxygen in lake is absorbed from the atmosphere in to the surface waters. Wind, waves and plant action may oxygenate surface waters to a depth of four to five feet.

The most important cleansing action takes place when lakes over their waters in the spring and fall when the surface water becomes heavier than bottom water and sinks. This natural phenomenon is called inversion.

Even in southern lakes, inversion takes place when cold fronts move through. This is Nature's way of supplying oxygen to the bottom waters blowing away the noxious gases. This is the secret that has kept lakes clean since the earth was created. Now man's activities have brought in more pollutants faster than Nature can keep up.

MULTIPLYING THE POWER OF NATURE

As more and more nutrients have entered lakes modern times, the natural production of oxygen and the cleansing action of twice-a-year could not keep up with the inflow. Experiences over a period of years proved that Nature's processes must be greatly multiplied.

From this long experience, the principle of multiple inversion developed. While Nature rolls over a lake twice a year, multiple inversion rolls over a lake once or twice a week. The free oxygen of the atmosphere reaches the bottom waters in abundance and the winds deactivate and blow away the noxious gases.

HOW MULTIPLE INVERSION WORKS

Toxic bottom waters are gently gathered at various points on the lake bottom, floated to the surface in smooth columns and then spread across the lake in very thin sheets so oxygen is readily absorbed and noxious gases blown away. Microscopic bubbles, powered by a fractional horsepower motor generate these rising columns. FEE discovered the secret of how to raise 3,60,000 gallons of bottom water to the surface every hour with only one horsepower, the same amount required to light 250-watt light bulbs. This will completely roll over a 10-acre section of Lake 10 feet deep once every four days.

Yet there is no sudden mixing of oxygen deficient and gas laden bottom waters with the oxygenated surface waters. Multiple inversion is a multiplication of Nature's own beneficial method. Fish seem to thrive in this naturally oxygenated water. Algae bloom and fish kills, too often caused by aeration, are avoided.

Through the correct use of FEE, lakes can be restored to healthy life in about five years as natural calcium and other minerals in the water, combines with phosphate and make it unavailable for plant growth.

Microorganisms compete with weeds and algae for phosphorus and nitrogen, accelerating the process by which weeds and algae are reduced by lack of nutrients. As these organisms multiply in the bottom of the lake, they in turn become food for insects, worms, and other small organisms that become food for fish. In this inexpensive way, muck is reduced, weed growth slowed, and the return of good fishing is accelerated.

SWIMMABLE AND FISHABLE

The analysis is complex and time-consuming, for we must know the answers to various questions like, what kind and how much pollutants are flowing in, what is the nature of the lake water, what must be done about it, what type and how much of muck is there, what amount of benthic organisms is present, what type and how much density of plants and algae is seen, etc. Only after the lake is analyzed can one know what kind of problem is being faced, and what can be done about it.

Restoration ultimately includes removal of large amount of muck from the lake bottom, reduction in growth of aquatic plants until they are again in balance with the needs of aquatic animals, elimination of noxious gases, an increase in water clarity, and the maintenance of dissolved oxygen in the water to support healthy population of fish.

LAKE MANAGEMENT BY OBJECTIVE

Lake Management is essential for environmental protection, for recreation, and aesthetics, and for the production of renewable resources. There are specific 10 goals, as follows:

1. maintain water quality
2. reduce erosion
3. protect from floods
4. provide a natural system to process airborne pollutants
5. provide a buffer between urban residential and industrial segments to ameliorate climate and physical impact such as noise
6. maintain a gene pool of marsh plants
7. provide aesthetic and psychological support for human beings
8. produce and cultivate wildlife
9. control insect population
10. provide habitat for fish spawning and other food organisms

1. TYPES OF LAKES

Various numbers of lakes in the world have been formed by the impact of meteorites. They are termed as meteorite impact craters. The Lonar Lake in Buldhana district of Maharashtra is the 3rd largest meteorite impact crater in the world.

The Bosumtwi crater in Ghana, Africa with a diameter of 10.5 km is one of the largest known meteorite craters in the world and is probably 1 million years old. Another very large crater is in Quebec province of Canada, which is 3.2 km in diameter and 360m deep. The Lonar crater is the 3rd largest in size, which is circular depression 1.83 km in diameter and 150 m deep. The rim of the crater rises about 20 m above the surrounding land. The Lonar crater is a meteorite impact crater made in basaltic rocks of the Deccan Plateau.

2. DEFINITION OF LAKE TYPE

These lakes are situated in a tropical region and have a minimum water temperature of about 25 deg C in the winter months (Dec-Jan), and a summer maximum temperature of about 35 deg C (May). Since these have a temperature generally greater than 20 deg C these are defined as "warm tropical lakes", according to the classification proposed by R.V. Vollenweider, (i.e. minimum temperature 10 deg C, minimum annual average temperature 15 deg C, and temperature of more than 20 deg C for at least months of the year).

3. GENERAL LAKE CLASSIFICATIONS

Lake Classification is based on several parameters, some of which have values, which determine mesotrophic and eutrophic lakes in warm waters. The lakes in this region would fall in the eutrophic range with its total phosphorous (TP) in the 0.4-1.3 mg/l range, chlorophyll 'a' to 20 mg/cum. Eutrophic lakes generally exhibit significant algal growths, which may tend to become dominated by one particular species. The lakes in this region are dominated by the MICROCYSTIS species of algae. The hypolimnion is also devoid of DO during stratification conditions.

4. TREATMENT OF ALLOCTHANOUS POLLUTANTS.

Unfortunately, nutrient diversion or processing of incoming pollutants does not significantly improve subsurface water quality bottom sediment, fish weight, number, and aquatic macrophyte growth.

Treatment of allocthanous pollutants fail to treat the problems already existing in the lakes, such as oxygen depletion, excessive toxic gas accumulation, release of phosphorous and nitrogen from bottom sediments, muck accumulation etc. Therefore, success of this technique has been only marginal since it is limited in scope.

Treatment of allocthanous pollutants usually does not include nonpoint source pollutants. While it may prevent some of the incoming nutrients from entering the lake, it does nothing to reduce bottom muck, nothing to improve fish, nothing to prevent the release of phosphorous and ammonia from anaerobic sediment, and little to reduce aquatic weeds and algae. Since incoming pollutants are reduced, but not eliminated, the quantities of pollutants coming into the lakes, while often greatly reduced, still add to the pollutants already in the lakes.

PROPOSAL TO TREAT THE LAKES FROM BLUE-GREEN ALGAE, ODOR, COLIFORM BACTERIA AND FISH KILLS

While necessary data must be first gathered on each lake, an approximation can be made now, to give an understanding of what will be involved in restoring the lakes.

Oxygen is the most important constituent of lakes. Oxygen is the most essential element for all aquatic organisms that breathe. Therefore, there is a direct relationship between the oxygen concentrations and exchanges occurring in a lake, and the physiological status of aquatic organisms.

The concentration of dissolved oxygen found in a lake and available to the organisms, insects, fish, etc. is the result of many dynamic processes. The primary sources of dissolved oxygen in the lakes are the atmospheric and photosynthesis. Oxygen-using processes, both biological and chemical counterbalance these sources of oxygen. Any oxygen concentrations found in a lake at any specific time are the result of many dynamic changes. Within ice covered lakes, the exchange of oxygen with the atmosphere is essentially eliminated. Under snow and ice cover photosynthesis is completely eliminated. Therefore, the oxygen concentration in most lakes depends on the oxygen in the water after fall turnover and the oxidative processes within the lake. Until the spring turnover, these processes tend to regulate the oxygen concentration of the lake. After the spring turnover deeper lakes will thermally stratify as the summer progresses, (warmer, oxygenated water at the surface, and colder, less oxygenated and anoxic water at the bottom). Lake bottom may remain anoxic until fall turnover. In sub-tropic climates such as ours in India, random inversions of lakes occur with high winds and cold rains.

Eutrophication can be reversed by increasing the dissolved oxygen, not at the surface, but throughout the water column to reduce nutrients. This produces an environment, which again favors animal life over plant life. Oxygenation, nutrient reduction, and the 'web of life' are the essence of lakes. Nuisance weeds and algal scums, 'muck', fish-kills, low transparency, foul odors, stunted game fish and an increase in rough fish are the characteristics of Eutrophication. Most lakes and ponds have several of these problems.

The chemical and biological benefits of this integrated restoration program are:

1. Nuisance weeds and algae are reduced;
2. Water quality, temperature and transparency are improved;
3. Fish-kill is prevented;
4. Reproduction, growth and vigor of fish are improved;
5. Foul odors are eliminated ;
6. Pathogenic bacteria are reduced; and,
7. Bottom organic sediment is reduced.

To remove organic sediments via dredging is usually prohibitively expensive and much less attractive environmentally. Although dredging can deepen a lake, making it more difficult for the submerged vegetation to grow, dredging does nothing for water quality, nothing for algae, and nothing for improving fish.

Because of the nutrient reduction the population of aquatic weeds and algae decline. All submerged aquatic plants must absorb their major food, carbon dioxide from the water column instead of the roots. The carbon dioxide has to be exhausted to the atmosphere, in order to, reduce the carbon dioxide to such low levels that the plants often decline. Thus the growth of submerged aquatic plants can be controlled as well as the excessive carbon dioxide can be removed.

In general only the emergent vegetation, found during the study, will derive all nutrients (except carbon dioxide) from the roots. To accelerate the removal of phosphates and limit plant and algal growth, a buffered compound has to be added, which is available in the market. This compound causes the phosphate in the water column to be precipitated to the bottom. It does not lower the pH of the water to dangerous levels, as is common with alum. About 97% of the phosphate is removed if this compound is added with a combination of aeration.

Similarly, an addition of a calcium compound will control the growth of phytoplankton. This compound interferes with the photosynthesis procedure. Iron fillings can slowly ionize into water to convert ions to insoluble elemental sulfur, and cause phosphorous to adhere to the bottom sediment. Minnow traps can help prevent

minnows from feeding on zooplankton. The zooplankton can then feed on algae. Microorganisms are also added that compete with algae for phosphorous and nitrogen. Weed harvesting can obtain some control of aquatic vegetation. It does nothing to reduce organic sediment, nothing to improve fishing, and little to reduce aquatic plant nutrients. Algae usually increase because with fewer weeds, the nutrients become available to feed algae.

Its highly essential to recognize the problems created by external nutrient loading. It is desirable to stop known sources of pollutants to the extend possible. Nutrient diversion may prevent 5 to 35 % of the incoming nutrients from entering the lake. It does nothing to reduce already present nutrients in the lake, nothing to reduce bottom muck, nothing to improve fishing, and little to reduce aquatic weeds and algae. Similarly high oxygenation of lakes and exposure of bacteria to sunlight destroys fecal and total coliform bacteria.

The value of a pond or lake as a recreational and aesthetic resource will be enhanced significantly and existing problems can be substantially counteracted and controlled. This can be done without the use of herbicides. People can safely irrigate the grounds. Swimming, fishing and boating will become a pleasure. Fishes also will grow safely and rapidly.

Lakes, ponds, and reservoirs around the world are "dying" due to ever - increasing inflows of nutrients and sediment build-up from a multitude of sources. This natural process of dying lakes, or Eutrophication, can be accelerated by man's activities, but occurs in even the most pristine environments. Eutrophication, by definition, is the increase in mineral and organic nutrients that result from a deficiency in dissolved oxygen, producing an environment that favors plant life over animal life.

Using various integrated approach which combines mechanical, biological, and non toxic chemical methods the water quality can be improved, the weeds, algae and organic sediments can be reduced and can improve fishing.

Bottom water of natural lakes often contains high levels of hydrogen sulfide and carbon dioxide which cause the pH to be generally lower than 7. High levels of

ammonia, as well as carbon dioxide in the bottom water serve as aquatic plant nutrients. In most lakes a continuous process of phosphorous removal occurs as natural calcium in the water combines phosphorous to form tri-calcium phosphate and many other phosphate salts of calcium. As these salts precipitate to the bottom, they are re-dissolved by carbon dioxide, and by mildly acidic bottom water. Phosphorous is then recycled for aquatic plant assimilation.

Oxygen enrichment and removal of carbon dioxide from the bottom water produces a decline in anaerobic activity at the sediment -water interface due to oxygen toxicity and removal of carbon dioxide, as a food source for the anaerobes. Bottom acids are reduced and the calcium phosphates remain on the bottom in the precipitated form.

The oxygen is soon depleted by the benthic organisms, and carbon dioxide and hydrogen sulfide are constantly released by subsurface fermentation of organic carbon. After the initial inversion, prior conditions reappear, with low pH, high acidity, and high carbon dioxide levels.

Therefore, to maintain a favorable environment to hold phosphates, it is highly desirable to continuously invert the lake water. Such a condition is achieved by the use of multiple Inversion System, which continuously floats the bottom water to the surface by introducing microscopic bubbles into the bottom water from diffusers supplied with compressed air.

Iron and manganese are oxidized. Ammonia is oxidized to nitrite under aerobic conditions. Nitrobacter further oxidizes nitrite to nitrate. At the low oxygen sediment-water interface, Psuedomonas, while obligately aerobic, is capable of anaerobic respiration in the presence of nitrates. Nitrate then serves as the final acceptor as Psuedomonas convert nitrate and organic carbons to water and to nitrogen gas and carbon dioxide, which are exhausted by the wind. Phosphate is then removed by natural calcium precipitation. Since the calcium available in the water is in the carbonate form, it is normally a slow process. To accelerate the phosphate removal, a soluble compound is added to the water.

When aquatic weeds and algae photosynthesize, they establish a potential gradient across the boundary of the exterior plant cells, the interior of which is negative to the water medium. This potential has been measured to be in the approximate range of 100 to 160 mv, depending on the plant species. This negative potential attracts calcium bicarbonate and other mineral cations to the plant. In the case of calcium bicarbonate, the plant strips off carbon dioxide for use as a food source and releases calcium carbonate back in to the water. The calcium carbonate picks up another carbon dioxide molecule that has been exhausted to the water by aquatic fauna, and returns to the plant to release the new carbon dioxide molecule. The activity of anaerobic bacteria at the lake bottom produces acidic conditions in the bottom waters.

Can one believe that there were 110 lakes in the city of Thane? Alas that was the situation in the year 1915, which has left the city with only 100 less! The city of Thane, which was one time city of lakes as, planned by Sir Patric Geddes, a British town planner. With this lake town he has suggested several methods to beautify and to conserve water bodies such as lakes mentioned above but none of them have seem to be taken in seriously which has resulted in city of Dead Lakes.

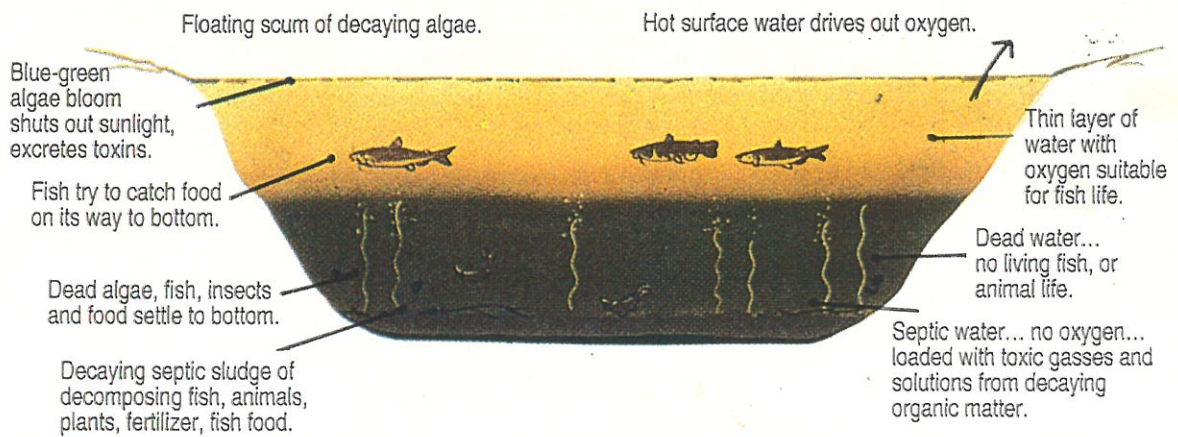
Nevertheless, fortunately the Thane Municipal Corporation is trying to restore and preserve the past glory of lakes.

No other natural resource is as important to our communities as clean water, yet its supply is threatened by global industrial and agricultural as well as man made pollution. In response to the critical need for clean lakes, rivers and reservoirs, we at FEE have established a wing totally devoted for the same. The basis for FEE friendly restorative system is the physico-chemical seasonal changes.

Starting with 5 nos. of Restoration program of lakes in the Virar Municipal Council, we have successfully carried out Techno-commercial feasibility studies. We also have privilege of completing feasibility studies of Kacharali lake in the Thane Municipal Corporation, which was duely appreciated by media.

A typical Eutrophic lake is shown in the following diagram.

EUTROPIC FISH POND



EXECUTIVE SUMMARY

The techno-feasibility report is prepared for the 15 nos. of lake for the TMC area taking in to consideration the guidelines of MoEF & MMRDA. This report is prepared by M/S FEE in association with TMC and is sponsored by MMRDA. TMC is spread around 147-sq. km. of area and has a present population of about 12 lakhs. The area coordination is 18 - 42N & 20 - 22 N latitude and 70.25 E & 73.44 E longitude. The corporation area includes city of Thane, which includes few prominent areas, and the other part of the corporation consists of rural areas towards Southwest and Northwest. The whole water bodies in TMC area are Ulhas River and Thane creek as well as 15 -30 lakes in the corporation limit. The Eastern Express highway connects the National Highway - 4 and Mumbai Agra National Highway pass through the corporation limits. The nearest airports are at Sahar (international) and Santacruz (domestic) in Mumbai.

The employment pattern in the area indicates industrial workers as the main force followed by the commercial and service sector respectively.

The objectives of the study are to bring back the past glory of one time City of Lakes. This can be achieved not only by the efforts put in by TMC but it should be done by the public and private sectors together. In order to carry out this report and a subsequent surveys, visits, planning is done by considering sectoral level environmental assess and its socio-economic impacts on the restoration plans.

YEAR	HUMAN POPULATION
1951	91,054
1961	1,36,591
1971	2,61,615
1981	4,74,170
1991	7,95,833
1998	@ 12,00,000

With the increasing population in the decades shown above it is evident that due to the past growing industrialization and urbanization. TMC has an increasing nature of population. Looking at the above mentioned employment sector it is also very much required to have a social life to the population of the city. Considering the types of entertainment sectors the city is having it is necessary to have a natural and scenic touch to the social life. Therefore after the restoration and beautification of these lakes one can really enjoy the natural way of social life. Out of the 15 sites few of them can have ideal picnic spots, few of them can have real aesthetic values and few of them can be a purely center of entertainment of fun and joy.

Therefore this report is aiming at improving the already depleted social life of the populace of the city. Once the plan as specified in this report are brought into reality we hope that the city of Thane can be again recognized as City of Lakes.

STRUCTURE OF REPORT

We at FEE have prepared this report in such a way that it can be read by a common man and understand the importance of it. The whole report is divided into a number of sections of which the important ones are, Approach and Methodology, Work Program, Environment Status, Programmatic and Microlevel Environmental Assessment, Mitigative Measures, Beautification Plans and Cost and Budgetary estimation.

The structure of the report follows the approach used by Ministry of Environment and Forest (MoEF) and activities (scope of work) identified in the terms of references. Accordingly the rest of the report has been divided into various critical areas terminating into a well-versed and easily accessible report.

This report is also accompanied by surveys analytical reports and also photographs of the existing condition of the lakes. These photographs are by itself a proof to the deteriorated condition of these lakes.

SCOPE OF WORK

The objective of this study report aiming at beautification and restoration of 15 numbers of lakes is to carry out sectoral level of Environmental Assessment of various alternatives.

The scope of work is based on guidelines of MoEF and TOR of MMRDA and it is totally adopted during the study part.

The actual scope of work includes two parts.

Part -1 covers the Scope of work as per TMC and

Part -2 will be covered by FEE's additional Scope of work.

Part -1

A. OBJECTIVES OF THE STUDY

- a.1. Prevention of pollution from point and non-point sources.
- a.2. Catchment area conservation.
- a.3. Density and weed control.
- a.4. R&D study on floral and faunal activities and related ecological aspects.
- a.5. Other activities depending on the lake specific condition.

B. SCOPE OF WORK

- b.1. As per guidelines of MoEF the preparation of survey and studies leading to the management action plan for conservation of lake includes:
 - Data collection
 - Impact assessment
 - Evaluation of impacts
 - Interpolation
 - Preparation of Management and Beautification plans along the detailed plans and estimate.

- b.2. After study is carried out corrective and preventive measures are required to be suggested to improve the overall lake environment in terms of its aesthetic beauty and steps to be adopted to prevent further deterioration of lake environment.

C. PREPARATION OF FINANCIAL PLAN IN RESPECT TO EACH LAKE FOR FOLLOWING ITEMS:

- c.1. Cost of demarcation of Lake Boundaries.
- c.2. Cost of sewage diversion work.
- c.3. Cost of storm water drainage
- c.4. Cost of afforestation of catchment area.
- c.5. Cost of vegetative barriers.
- c.6. Cost of desilting of lake.
- c.7. Cost of beautification of lake.
- c.8. Cost of water quality monitoring.
- c.9. Cost of measures for evaporation control.
- c.10. Cost of public awareness program.
- c.11. Cost of aeration of lake.
- c.12. Cost of estimates and phrasing of expenditures.
- c.13. Cost of institutional details.
- c.14. Cost of beautification plans.
- c.15. Detailed estimate should be prepared as per the current DSR prepared by PWD Maharashtra State.

Part -II

This will cover your own methodology of working for this type of restoration of lake. This will cover following important aspects and a brief description of the same. You have to elaborate the same and few other aspects at the same time of detailed discussions with TMC.

1.1. Introduction:

This will cover studies on general history, previous studies, if any carried out, existing condition of the lake, recent and present conditions, future hopes, etc.

1.2. Review of available information :

This includes,

- Hydrological information
- Estimate of current nallahs / sewage flows - dry weather
- Monsoon period runoff flows
- Estimated flushing of lakes
- Estimated outflows from lakes

Meteorological information

- Wind speed and direction
- Mass water movements in the lakes
- Temperature effects on Stratification and Mixing

1.3. Review of data on water quality, sediments and biota:

- Chemical composition of inflows to lakes
- Dry and wet weather conditions
- Chemical composition of lake water
- Biological aspects (phytoplankton, zooplankton, bacteriological)
- Aesthetic conditions (appearance aspects, odour)

1.4. Evaluation of the eutrophic status of the lake by considering nutrients and other algal growth limiting aspects.

- Define type and classification of lakes
- Limiting nutrients concept
- Nutrient inflows to the lakes from the nallahs
- Nutrient load in monsoon run off
- Solid deposition and nutrient release
- Tropic status lakes and its limiting nutrients
- Limiting nutrients

1.5. Formulating the projected lake water uses and stipulating the required water quality standards to achieve such uses.

- Past, present, and anticipated future lake uses
- Water quality standards for
 - Effluent discharge
 - Aesthetic enjoyment appeal
 - Recreational activities

- To maintain fisheries
- Bio-accumulation of toxics and organics in fish
- To maintain navigation
- To maintain Marine Nature Conservation
- To maintain drainage / storage

1.6. Describing a series of engineering and management options which could be considered to achieve lake rejuvenation

- Review of major problems of lakes controlling Eutrophication and its effect
 - Temporary methods and permanent methods.
 - Prevention of waste water inflows.
 - Treatment of wastes.
 - Treatment of lakes.
- Effect of proposed arrangements on lake-water quality.

1.7. Detailing of recommended objectives and strategy for protection of lakes.

SCOPE OF WORK

1. FIELD MONITORING

To conduct field monitoring at sites to access the existing baseline status. The study will include:

1.1. Ambient air quality monitoring (AAQM) survey

To carry out AAQM survey at site and also at four other locations within the lake radius, the locations, which will be fixed, based on the meteorology. The frequency of monitoring will be once in a week for minimum four to eight weeks. One 24-hour sample will be collected using high volume sampler (HVS) and analysed for a required items.

1.2. Meteorological data

One micro-meteorological station will be set up at site to monitor site specific meteorological data. The parameters to be mentioned will include:

- Wind speed
- Wind direction
- Temperature
- Humidity
- Cloud cover

Meteorological monitoring will be carried out through out the study period at a periodical frequency.

1.3. Stack monitoring:

The major point sources of emissions from the industries, near the lake, if any, will be monitored once during the study.

1.4. Water quality:

Water samples (3 nos.) from surface water will be collected and analysed once during the study period for various physico chemical parameters.

Also ground water from the lake bottom will be collected and analysed for physico chemical parameters.

1.5. Soil quality:

Soil samples from the lake bottom will be collected and analysed for various soil parameters.

2. FIELD SURVEYS:

Field surveys will include collection of following data:

- Geology of area
- Land use pattern
- Flora/fauna of the area
- Endangered species in the lake area if any

3. POLLUTIONAL ASPECTS:

Based on the data supplied by TMC the following aspects will be studied:

- Water sources and break-up of water uses
- Waste water generation, quantity and characteristics
- Air emissions
- Solid waste and slurries produced with quantity and characterisation

Computerised mathematical modeling will be carried out to predict the dispersion of atmospheric emissions.

4. MITIGATIVE MEASURES FOR POLLUTION CONTROL:

The following aspects of mitigating pollution existing and likely to be generated will be studied:

- Existing and proposed control measures for air emission
- Waste water treatment and disposal strategies to meet the required standards
- Solid and hazardous waste disposal
- Noise level control (if necessary)
- Provision of green belt

In addition, various safety aspects of transport around the lake area will be studied.

5. EVALUATION OF IMPACT:

Based on the baseline data collected modeling studies and review of the control measures to be provided, the likely impacts of the environment may have on the lakes will be evaluated in terms of adverse or beneficial impacts.

SECTION - 1

**BACKGROUND,
ORGANISATION
& EXPERIENCE**

SECTION -1

BACKGROUND, ORGANISATION & EXPERIENCE

1.1 ABOUT FEE:

We have our Main Office located at following address

**FATIMA BUILDING, GRD. FLR,
3, MOGUL LANE, MAHIM,
MUMBAI - 400 016.
MAHARASHTRA.**

We also have our full-fledged offices at Goa and at Pune.

We have full-fledged office consisting of total of 5 Nos. of Computers out of which 4 Nos. are PENTIUM III and remaining 486 configuration. They are supported by 3 Nos. of Fine Printers consists of Laser and Inkjet printers also. The computers are loaded with all types of programs such as CAD CAM, AUTO CAD, and other financial packages.

We have in all 6 staff personnel assisting in Computers, Finance, Office Correspondence, etc. They are all experienced and can operate independently.

Our office is assisted with following Technical Staff :

- 3 Nos. of Degree Engineers
- 3 Nos. of Diploma Engineers
- 2 Nos. of Field Teams (total of 12 persons) carrying out surveys, etc.
- 2 Nos. of Cars with drivers

In all we are self sufficient to cater any needs arising out of any project. We can deal with any type of project irrespective of its capacity and budget.

1.2 INFRASTRUCTURE

GENERAL :

Office area	:	@600 sq. ft.
Qualified Engineers	:	3 Nos.
Quantity Surveyors	:	2 Nos.
Experienced Draftsmen	:	7 Nos.

COMPUTER SECTION :

We have 3 Nos. of Computers dedicated to CAD CAM / AutoCAD. We carry out following jobs in general at this office :

- Preparation of all drawings viz. layout, hydraulic, GA, RCC etc.
- Preparation of Summary Sheets for bill of quantities
- Preparation of Comparative Statements
- Design of columns, beams, slabs, etc.

We have facility to carry out Detailed Designing, Structural Designing, and Fabrication Drawings at our above office.

ABOUT OUR LABORATORY

We have a sophisticated and full-fledged laboratory at Tarapur MIDC. This place is about 130 Kms. from our main office. The locational advantage of laboratory is that it is situated in a densely populated industrial area.

Our laboratory is FDA approved laboratory and it is supported by the following staff :

Chief Chemist	--	2 Nos.
Analytical Chemist	--	3 Nos.
Technical Assistant	--	4 Nos.
Helpers, Attendants	--	5 Nos.

The laboratory is backed up by number of analytical instruments whereby one can carry out all types of analysis which includes - chemical, analytical, physico-chemical, water and waste water, air, etc. A list of all equipments is enclosed herewith for your reference.

1.3 ABOUT OUR ARCHITECT OFFICE

We have fully equipped Architects office located at Mulund (East), Mumbai-81, and a place about 20 Kms. from our main office. It is located in Central Suburb as we can cater need of all the nearby Industrial areas as well as it is very well connected by the State Highway. This location has been advantageous as one can visit it at his convenience at any time.

1.4 EXPERIENCE AND RELATED WORK COMPLETED

At FEE we have carried out number of projects related to ecology and environment, our basic thrust is on restoring environmental values to a water body. Let it be a river, or any such kind of water body which is polluted by the industries or domestic waste

or let it be a pond or lake, we try to restore the same by using conventional as well as advanced techniques.

We were instrumental in developing many active lakes at the Sahara India ltd. project at Lonavala. The said project is developing a township / city as well as it is a City of Lakes.

We were awarded the work of restoration of one lake by Virar Municipal Council whereby we have carried out the entire survey of the lake pertaining to restore the environmental, hygienic, aesthetic values of the degraded lake. This lake is situated adjacent to the Virar railway station on the eastern side. This lake is surrounded by hutment at the two sides and residential buildings on the other. The lake is filled with domestic as well as industrial waste and also the lake water is deteriorated by human activities such as bathing, dumping of municipal wastes, cleaning of vehicles, animals, etc.

We have submitted a comprehensive feasibility report restoring the lake conditions. This plan also includes beautification and proper electrification of the lake area by introducing a jogging track and a small garden as well as boating in the lake. We have recommended stopping of all the inflowing untreated sewage and also removal of food stalls around the lake.

Due to the perfect planning of the Lake Restoration and beautification of the lake project we are also asked to carry out similar work for the remaining lakes in the Virar Municipal Council area. We have also been appointed as ecological consultant for carrying out beautification and restoration planning for four lakes in Vasai, and Nallasopara Municipal Council area. The work assigned to us in the above Municipal Council is underway. We were also instrumental in development of Hussain Sagar Lake in Hyderabad City, A.P., along with one of the leading consultant in India.

From this experience of number of jobs carried out in the related area one can infer that the existing worsened situation of these beautiful lakes in India is just because of manmade contribution. To have a good natural ecological balance one has to prevent such activities and try to bring back the originality of these water bodies.

SECTION - 2

**INSTITUTIONAL
SETUP &
CO-ORDINATION**

SECTION -2

INSTITUTIONAL SETUP AND CO-ORDINATION

2.1. INSTITUTIONAL CAPACITY AND ITS STRENGTHENING

The existing pollution control cell of TMC is totally inadequate and does not bear the capacity of taking over the lakes after the beautification and restoration plans are over. The existence of an inadequate institutional structure and capacity is critical for the implementation of restoration strategy of lakes in a manner that would meet achievable objective and cause minimum environmental degradation. To assess the existing institutional capacity and the need for strengthening it, the concerned institution i.e. TMC was examined with respect to the following:

- existing role / function and capacity of the pollution control cell
- envisaged role of environmental aspects of pollution control cell

On the basis of the above and in order to keep the restored and beautified lakes in proper manner, institution strengthening is proposed. The proposed institutional changes are covered in detail.

Nevertheless, it is very difficult and time consuming process for TMC to strengthen its pollution control cell in terms of increase in manpower and bring in to force other resources from the government. Therefore it is also suggested that the said beautification and restoration can be carried out by various commercial organization on lease and also to look after the housekeeping, maintenance, etc. by the same organization. This will bring down the burden on TMC as well as it will be a project for the people by the Corporation.

2.2. INSTITUTIONAL COORDINATION

MMRDA an apex planning body of the region, is expected to set up a coordination mechanism for the strategical implementation. The coordination in association with TMC is envisaged at various levels. This will include setting up Multi-organizational task group, agreeing on activities to be carried out on continuous spaces by various organizations such as environmental quality monitoring and finally establishing a network for information.

2.3. STRUCTURE OF INSTITUTIONAL COORDINATION

The institution coordination in above manner is expected to provide effective implementation for the following reasons.

- 1.1. Responsibility of each or concerned organization will become clear.
- 1.2. Duplication of efforts could be avoided.
- 1.3. Formation of task group will encourage the participation of the public and sponsoring agency.

2.4. STRENGTHENING OF INSTITUTIONAL FRAMEWORK

It is necessary to look after the maintenance of restored and beautified lakes as TMC will be spending crores of rupees and it is also obligatory on the part of the society to assist in this endeavor.

The TMC can strengthen its already existing pollution control cell by introducing two more junior officers having qualification of M.Sc in Environmental Science and or Environmental Engineering. They should be supported by minimum three field assistants who will carry out necessary sampling and analytical procedures to check up the various parameters, which are essential ones. The pollution control cell should also introduce online and onsite analytical instruments such as pH meter, D.O. meter, bioassay test set etc shall be recorded on hourly basis.

TMC should be well equipped to remove all the weeds, vegetative growth that might occur on the lake surface. They should also introduce various types of harmless chemicals to prevent this vegetative growth.

SECTION - 3

APPROACH

&

METHODOLOGY

SECTION 3

APPROACH AND METHODOLOGY

3.1. GENERAL APPROACH

This report was based on the MoEF approach towards the restoration of rivers and other water bodies in India. We have presented this study report by conducting various field studies and actual surveys of the lake sites. There was a social as well as commercial angle to this study. The society in general is nowadays deprived of such natural sites and our best aim was to supplement their social life by natural recreational ideas. It is also thought to commercialize this activity on the basis of BOOT system so that there is a systematic approach to the development of this site.

3.2. METHODOLOGY

The methodology adapted in this study report was far simpler and no complexities such as computer programming, rigorous data analysis, etc. were performed. The basic methodology includes visit to the sites, fact-findings with reference to social, environmental and hygienically degraded values of the lakes. Then to analyse the present condition by extrapolating it to the proposed restoration and beautification planning, the main concern about the costing expenditure to be incurred for this proposed planning is seriously thought of. Therefore a simple methodological approach was adapted in order to implement this project.

3.3. SEVERANCE

There are a number of utilities laid along and across the lakesides also there are a number of unauthorised structures and encroachments on the lakeside as observed. Therefore it is very essential to look into these aspects by various depths and authorities within the Municipal Corporation.

3.4. ANALYTICAL EXERCISE

Various analytical procedures were performed during the preparation of this study report. These were mainly air, water, organics, inorganics, metals, as well as vegetative growth on the surface of the lake water. We have carried out various analytical procedures using number of methods such as chemical, physico-chemical, instrumental, etc.

METHODOLOGY FOR ANALYTICAL PROCEDURES

INTRODUCTION

There were numbers of analysis being performed for the lake water. It includes organic, inorganic, and physicochemical as well as analysis involving determination of heavy metals also. The selection of and approval of methods universally adopted. The procedure described as above and adopted in this study is intended for the examination of Lake-water of a wide range of quality including surface water, water level slightly below it. An effort has been made to present methods that apply generally. Where alternative methods are necessary for samples of different composition, the appropriate method has been suitably adopted. Most of the methods included here have endorsed by regulatory authorities.

QUALITY CONTROL

Quality control (QC) may be either internal or external which is also a quality assessment. When most of the samples have measurable levels of the constituent being determined analysis of duplicate samples were performed to achieve the precision.

SAMPLING METHODS

There were mostly manual sampling being carried out during the studies. This sampling involves minimal equipment but may be unduly costly and time consuming for such large scale-sampling program. Wherever required (very few times) automatic

samples were tried to eliminate the errors in manual sampling and also reduces the contamination of samples. The type of sample container has also got utmost importance. In these studies, we have typically used containers made of plastic as well as glass. The glass containers were used mostly for the trace level method analysis as glass bottles were used for routine analysis.

The importance was also emphasized on sample preservation, as it was not possible to analyse all the drawn samples at a given time. We have also maintained the time interval between collection and analysis of samples so that more reliable will be the analytical results.

Since there were no toxic or hazardous sampling as well as analysis involved the health hazard were minimal. We have adopted safe laboratory practices with all precautions mentioned in it.

All above description about collection, preservation and analysis of large number of samples were performed as per the guidelines given in the 19th (1995) Edition of *STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTE WATER*.

American Public Health Association (APHA), AWWA, and WPCF have approved these analytical techniques.

OBSERVATIONS

BIOLOGICAL EXAMINATION OF THE LAKE WATER

The micro- biological testing of water samples were basically to determine sanitary quality. The methods are intended to indicate the degree of contamination with waste. Tests for detection and enumeration of indicator organism rather than pathogens are used.

Eutrophication has been observed in almost all the lakes, which has turned the colour of the lake water to blue and green due to the *Cyanobacteria* and *Bluegreen algae*.

3.5. SCHEDULING OF STUDY

Initially TMC has granted this work to us in the month of July- August 1999. This work was to be completed within three months from the date of granting the work. We began our field studies immediately and as per the terms we submitted our Inception Report within one month from the date of approval of the contract.

Subsequently we initiated the process of carrying out sampling of air and water in and around the lake area. This exercise was hindered due to heavy shower in the region. The samples were collected scientifically and also analysed technically. By the time we finished this exercise already the third month had commenced and also the monsoon got over followed by winter. This prompted us to take the second series of samples as was evident from the change of climatic conditions in this lake water. Therefore, we decided to start a fresh sampling exercise as was done earlier.

In most of the lakes we have observed and also confirmed that the idol immersion takes place during the festivities which has also proved our duplicating the efforts of analytical exercise. Therefore we commenced our new analytical exercise by drawing fresh samples.

By this time we had lost about two additional months and the same was communicated to the TMC through its pollution control cell.

The two sets of analytical results boosted our confidence in giving the right analysis of the water at various depths and also to the air analysis. The recommendations given in this report were based upon the exact fact-findings done by us. We therefore recommend beginning the restoration of lakes by the gradation given elsewhere in the report depending upon its existing condition. The reason attributed to this is that TMC is not fully capable of keeping an eye on the restoration and beautification plans of all the lakes at a time as well as it will be a costly affair for the Corporation. Therefore this should be carried out in a phase wise manner.

WORK SCHEDULE

An ecological survey spread over three seasons will be necessary to cover the initial environmental monitoring study at Powai and Virar Lakes. At the end of environmental monitoring program, the schedule for the restoration activities will be worked out.

Activity will have 4 main components and would be carried out as per the following schedule:

1. quantification of wastewater inputs: point sources will be surveyed, identified and Wastewater analyzed to establish nutrient loading to the lake.
...3 months.
2. lake water quality survey: three intensive surveys each of 2 weeks duration will be conducted during the following seasons-
 - September-October(Post Monsoon)
 - December-January(Winter)
 - April-May(Summer)

Each survey will comprise of sampling on alternate days providing adequate coverage of the entire lake. Bottom samples will be analyzed for sediment characterization.

...6 months

3. Geotechnical survey : determination of the extent of the accumulated silt at the lake bottom by collecting sediment data at sufficient number of locations (at least 8) in the lake during summer(April-may)

... 2 months

4. Catchment boundary survey: identification of peripheral lake regions contributing major silt loads, which therefore, will require grading and greening.

... 2 months

5. Cost benefit assessment of the most feasible option

... 3 months

6. Report preparation

... 2 months

SECTION - 4

ENVIRONMENTAL

STATUS

SECTION 4

ENVIRONMENTAL STATUS

4.1. INTRODUCTION

The data of the baseline status of TMC was collected and compiled from various existing sources and was also supplemented by the data collected by FEE for individual proposed sites. These environmental components are:

- Landuse
- Socio-economic conditions
- Water environment
- Air environment
- Solid waste
- Noise pollution

The purpose of compiling the baseline environmental status was to provide basis for comparison of the changes in the environmental quality, which may occur due to the implementation of the recommendations and suggestions made in this report.

The main objective of preparing environmental status is to assist the environmental quality mentioned above. The TMC area consists of number of open and green areas in the corporation limits. The mangroves have been given special attention for their preservation in the creek area. The main cause of deterioration in environmental conditions of TMC area is mainly due to the auto exhaust pollution generated by the two and three wheelers. The following discussion briefly outlines the environmental status of TMC area as well as that of lake-sites.

4.2 REVIEW OF EXISTING ENVIRONMENTAL STATUS OF THANE CITY

4.2.1 LANDUSE:

The TMC area has been divided into various developed areas such as residential, industrial, commercial, offices, educational and health institutions. In addition, it includes open spaces, gardens, and also area occupied by lakes. The underdeveloped areas mostly include agricultural lands, forestlands, brick kilns, quarries, hilly areas, salt pans, etc. The environmental status of all these areas mentioned above has no direct impact on the present studies whereas pollution control cell of TMC has prepared the same status report.

4.2.2 WATER ENVIRONMENT

This is one of the main constituents of environmental degradation in terms of sources for drinking water and other natural water bodies. The water pollution in TMC limits is mainly caused due to the unsystematic inflows of untreated domestic and industrial wastes. In earlier days they have let into the natural water bodies near by such as lakes, creek, etc. There is no proper sewage treatment or industrial waste treatment facility for the City of Thane. This has further aggravated the problems of drinking water by disturbing the ground water and well water sources.

4.2.3 NOISE LEVELS:

Various sources of noise in TMC area are road, rails, traffic, industrial, and commercial activities. This is supplemented by community activities such as festivals, marriages, etc. The noise levels in most of the residential area exceed the ambient noise levels during day as well as night times.

4.2.4 AIR ENVIRONMENT:

The ambient air quality in TMC area is a complex environmental phenomenon, which undergoes drastic variations due to various activities. Air pollution can damage the environmental status and mainly damage the human health. Adverse impact of air pollution can be gauged in terms of SOX, NOX, Total Carbon (TC), generated from various manmade activities.

4.2.5 SOLID WASTE:

TMC is facing an alarming situation due to solid waste generated in the city. The main three types of solid waste:

- Municipal solid wastes
- Biomedical wastes
- Industrial hazardous wastes.

These are being generated in an uncontrollable manner and no systematic approach is being identified to tackle the same.

4.3 ENVIRONMENTAL STATUS OF PROJECT LAKE SITES.

4.3.1 VISIT REPORT AND SURVEY ANALYSIS OF *MAKHMALI LAKE*

A. LOCATION:-

This lake is located near the S.T. workshop at Almeda chowk at the heart of Thane City.

B. CATEGORY:-

This is a small size lake.

C. PRESENT SITUATION:-

- I. Three sides of the lake are surrounded by residential buildings and on the fourth side lies the main road.
- II. Idol immersion does not take place in this lake.
- III. Evidence of solid waste dumps on the sides of the lake.
- IV. The side facing the road is fenced and there is a fountain present in the center of the lake, which is but nonfunctional.
- V. Small fishes dominate the aquatic life in the lake along with which a tortoise was also observed.
- VI. The corners of the lake were covered with growth of water hyacinth.
- VII. The deterioration of the lake was a result of the in flow of untreated sewage.

D. PROPOSED MODIFICATION NEEDED BEFORE BEAUTIFICATION AND RESTORATION SCHEME IS PLANNED:

- I. Proper approach road has to be constructed to the lake.
- II. The lake shall be fenced on all sides.

E. PROPOSED POSSIBLE STEPS FOR BEAUTIFICATION:

- I. Solid waste dumps should be removed immediately from the corners of the lake, which could be accompanied with dredging.
- II. The central fountain structure should be immediately repaired with additional electrification.
- III. Aeration cascades shall be provided so as to improve the D. O. level

F. RECOMMENDATIONS:

- I. It is recommended to take over the adjoining open plot by TMC and to develop a garden and recreation center for children and the local people of the area.
- II. Beautification and restoration will certainly add to the aesthetic value of the lake.

4.3.2 VISIT REPORT AND SURVEY ANALYSIS OF SIDDHESHWAR LAKE

A. LOCATION:-

This lake is situated near S. T workshop.

B. CATEGORY:-

This is a large size lake.

C. PRESENT SITUATION:-

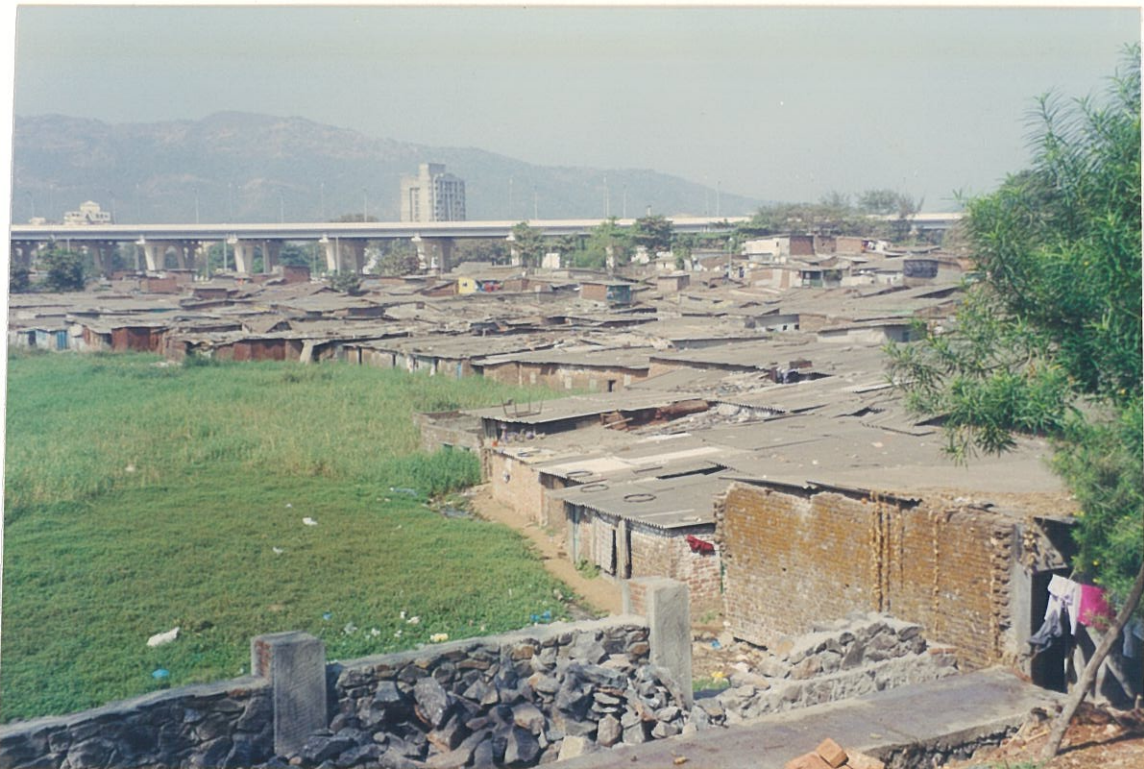
- I. This lake is totally encroached by hutment resulting in dumping of garbage over the lake area.
- II. Majority of it is also covered with thick vegetation. This has resulted in a grave loss of the lake's aesthetic and natural value.
- III. The lake is filled with mud showing no signs of water.
- IV. There is a Kalika temple adjoining to the lake.
- V. This lake has come in to light as an ancient idol of Brahmadeva was found in this lake which is now ceremoniously placed outside the Kalika temple and looked after by the Archeological Society of India.

D. PROPOSED MODIFICATION NEEDED BEFORE BEAUTIFICATION AND RESTORATION SCHEME IS PLANNED AND THE PROPOSED POSSIBLE STEPS FOR BEAUTIFICATION:

- I. It is necessary to remove the settlements present along the lake.
- II. Removal of garbage and vegetative growth to have a clean site is also highly necessary.
- III. To find out the ground water table necessary to fill up the lake, dredging of complete mud is important after the above mentioned 2 steps. This has to be done before monsoon.
- IV. After the dredging its necessary to find out how much water can be collected and retained inside the lake. This has to be done before monsoon. In this way, we can determine the water holding capacity of the lake.
- V. A proper boundary wall with fencing shall be erected along the periphery of this large lake.



GARBAGE DUMPS NEAR LAKE



SLUMS NEAR LAKE

- VI. Once beautified and restored, this lake could become an ideal tourism spot with the Kalika temple and Brahmadeva idol placed in the same premises.
- VII. Boating facility could be introduced taking into consideration the wide spread area of the lake. In addition, an attractive island could be built in the center connected by a walkway at the temple end.
- VIII. An adequate amount of aeration is also necessary so as to maintain the DO level as well as the aquatic life.

E. RECOMMENDATIONS:

- I. It is highly recommended to remove the encroachment at the lakeside and to dredge out the entire mud and muck out of the lake.

4.3.3 VISIT REPORT AND SURVEY ANALYSIS OF KOLBAD LAKE

A. LOCATION:-

This lake is situated near Jari Mari temple near Pratap talkies. This area is also called as Naralipada.

B. CATEGORY:-

This is a small size lake.

C. PRESENT SITUATION:-

- I. This is a totally spoiled lake and converted into a proper dumping ground.
- II. It has no proper fencing or boundary wall.
- III. Most of it is covered with garbage and the remaining portion is covered with vegetation. Water is present in a very small amount.
- IV. It is also filled with rubble and waste construction material.
- V. There is no access to this lake

D. PROPOSED MODIFICATION NEEDED BEFORE BEAUTIFICATION AND RESTORATION SCHEME IS PLANNED:

- I. It is necessary to remove the garbage and other solid waste deposited within the lake.
- II. High amount of dredging is required in order to give a depth to the lake.
- III. This should be done before monsoon in order to check the water retaining capacity of the lake.
- IV. A proper boundary wall with good fencing is envisaged so that the same lake will not be converted back into a dumping ground.

E. PROPOSED POSSIBLE STEPS FOR BEAUTIFICATION:

- I. It is proposed to have a good fountain with proper aeration cascades so as to maintain the water quality.

- II. Practice of aquaculture would also help in the improvement of the environment.

F. RECOMMENDATIONS:

- I. It is highly recommended to carry out the suggestions as mentioned above, else the lake site cannot be reopened for it will turn to a dumping ground.
This is clear violation of environmental values of the city. There is recommended once again to help bring back the aesthetic and hygienic value of the lake.

4.3.4 VISIT REPORT AND SURVEY ANALYSIS OF *MASUNDA LAKE*

A. LOCATION:-

This lake is situated in the heart of the city accessible from all part of Thane City.

B. CATEGORY:-

This lake can be considered as a very large lake.

C. PRESENT SITUATION:-

- I. There is a well-defined boundary on all the sides.
- II. There is an adjoining garden with all the necessary facilities.
- III. The lake is presently used as a recreational spot with boating facility.
- IV. The lake is surrounded by residential area on three sides and a main road on the remaining side.
- V. There are fountains existing in the lake.

D. PROPOSED MODIFICATION NEEDED BEFORE BEAUTIFICATION AND RESTORATION SCHEME IS PLANNED:

- I. It is necessary to introduce proper and efficient aeration system.
- II. It is necessary to introduce few more fountains with aeration facility.
- III. It is necessary to remove the municipal garbage dumped on few sides on the periphery of the lake.
- IV. To introduce few more species of fishes is essential.

E. PROPOSED POSSIBLE STEPS FOR BEAUTIFICATION:

- I. This shall be declared as an ecologically sensitive lake by TMC.

4.3.5 VISIT REPORT AND SURVEY ANALYSIS OF KAUSA LAKE

A. LOCATION:-

This lake is situated about 20 kms. from TMC. This is located along the old Mumbai - Pune highway in front of a Masjid.

B. CATEGORY:-

This is a large lake compared to Indian conditions and is accessible by highway.

C. PRESENT SITUATION:-

- I. The lake has well defined boundaries and TMC has begun the work of constructing fencing and walkway around the lake.
- II. It is surrounded by habitation from all sides.
- III. This is a classic case of Eutrophication as the whole lake water surface is covered by green moss.
- IV. The deteriorated condition of the lake is due to letting of untreated sewage into the lake as seen today also.
- V. Due to the depleted condition of D. O. there seems to be no aquatic life in the lake.
- VI. Solid waste dumps at various corners and edges are seen along with floating garbage.

D. PROPOSED MODIFICATION NEEDED BEFORE BEAUTIFICATION AND RESTORATION SCHEME IS PLANNED:

- I. Well-defined boundary shall be of immediate necessity.
- II. Cleaning of vegetative growth and dredging is essential.
- III. Stoppage of untreated sewage into the lake water.
- IV. Proper aeration system to be introduced to bring back the aquatic life and necessary D. O. level.

E. PROPOSED POSSIBLE STEPS FOR BEAUTIFICATION:

- I. This lake can be converted into a good recreational spot for locals as well as highway goers.
- II. A jogging track around the periphery will add on to the recreational aspect.
- III. A central earthen structure with a walkway to the steps leading to the lake.
- IV. This structure shall have proper ornamental plantations along with suitable electrification.
- V. Aeration fountains will certainly add to the beautification plans.

F. RECOMMENDATIONS:

- I. Development of this lake could be done by introduction of paddleboats in it.
- II. The revenue generated from the charges against boating as well as availing jogging track can be used to maintain the lake.

4.3.6 VISIT REPORT AND SURVEY ANALYSIS OF *KHIDKALI LAKE*

A. LOCATION:-

This lake is situated at the outskirts of the TMC boundary near Dombivili. This is about 20 kms. from Thane.

B. CATEGORY:-

This lake can be considered as medium size-lake. Accessible by road going to Dombivili.

C. PRESENT SITUATION:-

- I. The lake has no well-defined boundary. There is a boundary only on one side of the lake.
- II. The shape of the lake is very odd and therefore having circular boundary wall is not possible.
- III. This is mainly used for Holy and Spiritual rights as evident from the site during the visit.
- IV. Lake Water disturbing activities like washing of clothed, vehicle, animals, Holy dips, Spiritual rights are performed.
- V. Solid waste dumps are observed at various edges of the lake.
- VI. There is a Lord Shiva temple adjoining to the lake which has resulted in piling of waste flowers, etc. in the lake
- VII. Water quality has therefore totally deteriorated.
- VIII. At present the lake is undergoing de-watering and de-silting.

D. PROPOSED MODIFICATION NEEDED BEFORE BEAUTIFICATION AND RESTORATION SCHEME IS PLANNED:

- I. It is necessary to stop the entire Spiritual And Holy activities performed at the lake.
- II. It is necessary to stop the dumping of garbage and other waste from the temple.
- III. Complete de-watering is envisaged together with removal of muck and silt from the lake.

IV. A proper boundary wall shall be built to prevent erosion.

E. PROPOSED POSSIBLE STEPS FOR BEAUTIFICATION:

- I. Having green belt development on three sides of the lake can beautify this lake.
- II. Aeration in the form of fountains has to be introduced to maintain the DO levels.

F. RECOMMENDATIONS:

- I. This lake can be beautified, so that it can have an aesthetic look and a proper hygienic condition.

4.3.7 VISIT REPORT AND SURVEY ANALYSIS OF *RAYLADEVI LAKE*

A. LOCATION:-

It is situated in Wagale Estate area, which is behind English Automatic Company. The lake is situated in a mixed populace that is predominantly industrial and residential to some extent.

B. CATEGORY:-

This lake can be defined as large lake as per the Indian Standards of lakes. Probably this is the largest in the series. This is accessible by main road.

C. PRESENT SITUATION:-

- I. It has got a well-defined boundary, which are at many places in dilapidated condition. The beautification around the periphery has been undertaken by TMC.
- II. In the middle of the lake there is a big concrete circular structure which is approachable by footpath/walkway.
- III. There is an earthen bund inside the lake at the N-E side. This is the result of dredging carried out in the lake and the dredged material has been resulted into this bund.
- IV. No pitching to the sides.
- V. There is a walkway / footpath all around the lake.
- VI. Mostly residential buildings and small temple surround the lake on the E-W side.
- VII. The water quality of the lake is totally deteriorated due to uncontrolled entry of domestic waste from the surrounding area, which seems to be come from the hutment present adjoining to the lake.
- VIII. There is no evidence of aquatic life due to low DO levels.
- IX. Presently the lake is used as a dumping site for the Holy garbage consisting of rotten flowers, garlands, and many household items. One can see tones of such materials floating on the surface with much more settled at the bottom.
- X. There are numerous solid waste dumps at various corners, edges, and sides of the lake.
- XI. About 25% of the lake are covered by fungal and vegetative growth.



- XII. Approximate depth of the water is 3-4 m.
- XIII. Presently idol immersion takes place in the lake, which has resulted in the deterioration of the water quality.
- XIV. Activities such as washing of clothes, etc. are seen which has resulted in the organic pollution of the lake water as lots of surfactants are added.

D. PROPOSED MODIFICATION NEEDED BEFORE BEAUTIFICATION AND RESTORATION SCHEME IS PLANNED:

- I. A well-defined continuous boundary with modifications is required.
- II. Pitching to the sides is necessary.
- III. There is a great need to clean the garbage and vegetation floating on the surface as well as total dredging is needed.
- IV. Removal of earthen bund located inside the lake is necessary.
- V. The concrete structure inside the lake has to be repaired and brought into the condition whereby the local people can enjoy the scenic beauty of the lake. The said structure can be beautified and electrified to look more attractive.
- VI. The concrete structure occupied by the beggars should be freed and hygienic condition should be restored.
- VII. It is necessary to stop immersion of idols in the lake.

E. PROPOSED POSSIBLE STEPS FOR BEAUTIFICATION:

- I. A good jogging track with chequered tiles all around the lake shall be constructed.
- II. Periphery of the lake shall have RCC boundary with MS grill structure give good looks as well as aesthetic values to the lake.
- III. A good amount of ornamental plantation shall be planted on the central concrete structure with a nursery near the entrance of the lake.
- IV. A proper arrangement shall be made for aeration in the lake so that desired levels of DO shall be maintained.
- V. Step 4 as mentioned above shall improve the aquatic life in the lake, which will add to the aesthetic value of the lake site.
- VI. A proper sanitation system including a toilet facility shall be constructed near the lake.

- VII. Being a large lake boating can be introduced.
- VIII. It is necessary to completely stop the idol immersion during festivals, which will otherwise have a very solid pollution impact as a lot of organic, inorganic and metals will enter the water environment.

F. RECOMMENDATIONS:

- I. This lake can be developed into a good recreational and tourism site attracting local people as well as people from far-off places.
- II. No food stalls or like wise activities shall be encouraged.
- III. A good amount of revenue can be generated from recreational activities such as boating, jogging, etc. Both these activities can be made available on charge basis. The nursery can also generate small amount of revenue. This revenue generated shall be utilised for maintenance of the lake after beautification and restoration

4.3.8 VISIT REPORT AND SURVEY ANALYSIS OF *REWALE LAKE*

A. LOCATION:-

This lake is situated in the Kapur Bawadi area near fire brigade station. This is also near to M/s Colourchem near Balkum.

B. CATEGORY:-

It is a very small lake can be considered as pond.

C. PRESENT SITUATION:-

- I. This lake is surrounded by slums on all the sides except at one side where it touches the road. There are steps leading to the lake.
- II. This lake is perfect case of Eutrophication.
- III. There is storm water drainage from the nearby area leaving domestic waste onto the lake water. This has been the main cause for this destruction.
- IV. There are no. of solid waste dumps inside the lake area. Lot of garbage including plastic, waste flowers etc. are floating on the lake water.
- V. Vegetative growth is seen in certain areas of the lake.
- VI. Very less aquatic life is evident, as the colour of the water is totally greenish in nature.
- VII. D. O. levels are very less.
- VIII. In this lake idol immersion takes place during Ganesha / Durga festivals.

D. PROPOSED MODIFICATION NEEDED BEFORE BEAUTIFICATION AND RESTORATION SCHEME IS PLANNED:

- I. This lake has to be initially de-watered in order to remove all the muck and solids deposited at the bottom of the lake.
- II. Boundary wall to be constructed with proper fencing.
- III. Effective aeration to be introduced to bring back to the acceptable D. O. levels.
- IV. Throwing of garbage inside the lake should be stopped immediately.

4.3.9 VISIT REPORT AND SURVEY ANALYSIS OF KASARWADAVALI LAKE

A. LOCATION:-

This lake is situated in a village named Owale, which is 10 kms. from Thane. This lake is off Ghodbunder road.

B. CATEGORY:-

This is a medium to large-scale lake.

C. PRESENT SITUATION:-

- I. Approach through village to the lake is in dilapidated condition.
- II. No proper boundary walls for the lake.
- III. Washing of animals, clothes, vehicles, etc. being carried out in the lake water.
- IV. No solid waste dumps found at the lake.
- V. Very few habitation in the surroundings.
- VI. Surface water is not covered with any type of vegetative growth.
- VII. There are hills on one side of the lake, also creek is near to this lake, and there is always a possibility of salty water percolating into the lake.

D. PROPOSED MODIFICATION NEEDED BEFORE BEAUTIFICATION AND RESTORATION SCHEME IS PLANNED:

- I. Proper approach road of highway to the lake shall be made.
- II. Proper boundary wall shall be constructed with fencing along the lake.
- III. Aeration system has to be introduced so as to increase the D. O. level.
- IV. The activity like aquaculture / cultivation of various species of fishes has to be encouraged using scientific methods. Subletting the lake for fishing to the locals will also increase their source of income, as this lake is located in a village. The revenue thus generated could be utilised for the maintenance of the lake.

4.3.10 VISIT REPORT AND SURVEY ANALYSIS OF NAAR LAKE

A. LOCATION:-

This lake is situated in a village named Owale, which is 10 kms. from Thane. This lake is off Ghodbunder road.

B. CATEGORY:-

This is a medium to large-scale lake.

C. PRESENT SITUATION:-

- I. No proper boundaries.
- II. Lake is presently used for fishing as TMC has sublet the lake on yearly basis.
- III. No near by hutment and therefore no possibility of untreated sewage entering the lake.
- IV. No sign of any vegetative growth but washing of clothes, etc. is done here.
- V. No solid waste dump visible but immersion of idols during festivals is a common phenomenon.
- VI. Presence of large size fishes indicates the acceptable levels of D. O.

D. PROPOSED MODIFICATION NEEDED BEFORE BEAUTIFICATION AND RESTORATION SCHEME IS PLANNED:

- I. It is proposed to construct a well-defined fencing and boundary with steps leading to the lake.
- II. Children's park shall be developed for the local children.
- III. A suitable aeration fountain shall be introduced into the lake.
- IV. Aquaculture activities shall be promoted greatly in this lake, which will add to the income of the locals as well as TMC to generate revenue for maintenance.

E. PROPOSED POSSIBLE STEPS FOR BEAUTIFICATION:

- I. The beautification and restoration plans shall be implemented immediately to maintain the lake as well as to bring about awareness among the locals regarding the conservation of lakes.
- II. Arrangement for paddleboats could be a help to the locals for fishing and also for the recreational purposes.
- III. Beautified lake shall be an attraction to the local people irrespective of their age, who otherwise are deprived of natural recreational resources.

4.3.11 VISIT REPORT AND SURVEY ANALYSIS OF AMBE GHOSALE LAKE

A. LOCATION:-

This lake is situated on the junction of L. B. S. road and the road going to Shriranga Society.

B. CATEGORY:-

This is a medium to large size Lake.

C. PRESENT SITUATION:-

- I. This lake was given on lease to M/s. Abhiruchi hotel, which is now burnt and abandoned.
- II. The lake has slums on one side and residential buildings on the rest of the sides.
- III. There is direct discharge of sewage in to the lake.
- IV. Numerous solid waste dumps are present on the lakesides.
- V. There is no well-defined boundary wall.
- VI. Due to high depletion of DO there is negligible aquatic life within the lake.
- VII. Presence of water hyacinth evident on the sides of the lake.

D. PROPOSED MODIFICATION NEEDED BEFORE BEAUTIFICATION AND RESTORATION SCHEME IS PLANNED:

- I. It is necessary to have a well-defined boundary wall with a jogging track on the sides of the lake.
- II. It is important to stop the inflow of untreated sewage in to the lake.
- III. Cleaning of Vegetative growth is utmost necessary.
- IV. Steps have to be taken to improve the DO level of the lake.

E. PROPOSED POSSIBLE STEPS FOR BEAUTIFICATION:

- I. To regain the aesthetic value it is proposed to remove the burnt remains of the hotel.
- II. It is also highly necessary to prevent entry of untreated sewage in to the lake.
- III. The solid waste dumps have to be removed.
- IV. Pitching on all sides of the lake is required.
- V. Aeration cascades have to be provided so as to improve the D. O. level.

F. RECOMMENDATIONS:

- I. The lake can be beautified to the best of its kind by putting up decorative fencing with plantation on the edges of the lake.
- II. A jogging track for the local people can add to the recreational amenities along with boating facility within the lake.
- III. A public toilet facility shall be constructed as this site can be converted into a good recreational spot.

4.3.12 VISIT REPORT AND SURVEY ANALYSIS OF UPVAN LAKE

A. LOCATION:

The lake is situated near the hills of YEUR. This is accessible by main road via Vartak Nagar area leading to Pokhran road no. 2

B. CATEGORY:

This lake can be defined as large lake as per the Indian Standards of lakes. Probably this is the largest in the series.

C. PRESENT SITUATION

The lake has a well-defined boundary only on two sides and the work is going on the remaining side. TMC has undertaken this job for the boundary work. There is a green belt developed on the two sides of the lake including an adjoining garden.

- I. The lake is presently used as picnic spot and also has a Ganesh temple.
- II. The water quantity is markedly less as compared to the total area/volume covered by the lake. This may be attributed to the water intake by M/s Raymond Ltd. for their industrial activity.
- III. Picturesque mountains and green belt surrounds the lake.
- IV. Idol immersion takes place during the festivities
- V. It was also noticed there was no signs of vegetative growth or any kind water hyacinth on the surface of the lake water. A small island is seen within the lake, which may be due to dredging activity only.
- VI. It was also noticed that washing of clothes and vehicles etc. likewise activities takes place, which deteriorates the water quality.
- VII. Little bit of aquatic life is evident.
- VIII. On the inner side of the lake boundary wall, solid waste dumps were seen which might be due to the use of this lake as a picnic spot.
- IX. Due to the proximity of the temple lot of waste flowers etc. were dumped on the steps leading to the lake.

- X. The runoff and storm water within the mountain during the rainy season enters into this lake via a big duct evident on the side facing the mountains. This results into the siltation and deposition of mud into the lake.

D. PROPOSED INITIAL WORK TO BE DONE BEFORE BEAUTIFICATION AND RESTORATION :

- I. Road to be constructed all around the lake.
- II. A proper aeration facility shall be introduced by using aeration fountains.
- III. All the muck and vegetation as well as solid waste dumped shall be removed.
- IV. Platform for boating to be constructed.
- V. Commercial use of water needs to be stopped.
- VI. All around fencing shall be erected.

E. PROPOSED POSSIBLE STEPS FOR BEAUTIFICATION:

- I. This spot can be developed into a best picnic spot by introducing boating.
- II. The existing earthen bund in the lake water can be developed into a center of attraction by connecting it through a walkway from the lakeside.
- III. Having good amount of horticulture and electrification can beautify this central island.
- IV. The water has to maintain in terms of Dissolved Oxygen and no other streams shall be let into the lake.
- V. The aeration fountains shall be 4 in nos.
- VI. Children's park can be developed on the present garden area.
- VII. Gate with proper entry fees shall be arranged for.
- VIII. Since there is lot of space near the lake as well as aquarium can be developed.

F. RECOMMENDATIONS:

- I. A tourism spot shall be developed and boating, entry fee, fishing, etc. can generate revenue and this could be utilized for the proper maintenance of the lake.

4.3.13 VISIT REPORT AND SURVEY ANALYSIS OF *HARIYALI LAKE*

A. LOCATION:-

This lake is located on the eastern side of Thane City, adjoining the railway tracks.

B. CATEGORY:-

This is a medium size lake.

C. PRESENT SITUATION:-

- I. Presently this lake is being used for washing and cleaning of clothes, vehicles, animals, etc. which has resulted in the additional pollution load especially by the surfactant and oil & grease.
- II. The inflow of untreated sewage in to the lake is due to the hutment present on one side of the lake.
- III. Solid waste dumps are present on the sides of the lake.
- IV. A boundary wall is built on only one side of the lake.
- V. No aquatic life found in the lake though there is presence of vegetative growth.

D. PROPOSED MODIFICATION NEEDED BEFORE BEAUTIFICATION AND RESTORATION SCHEME IS PLANNED:

- I. A thorough cleaning of the lake is necessary along with dredging and removal of the vegetation from the surface of the lake water.
- II. A central island can be constructed with a walkway.
- III. It is necessary to stop activities like bathing, washing of clothes, animals, vehicles, etc.
- IV. It is also necessary to introduce adequate aeration system.

E. PROPOSED POSSIBLE STEPS FOR BEAUTIFICATION:

- I. Well-defined boundaries with proper fencing are envisaged.
- II. The central island can be illuminated with proper electrification.
- III. Paddleboats can be introduced as one of the recreational activities.
- IV. A nursery can be developed, as there is a small garden at one end of the lake.

F. RECOMMENDATIONS:

- I. It is recommended to immediately clean the lake and introduce proper aeration facilities.
- II. This lake can be developed into a good recreational center.

4.3.14 VISIT REPORT AND SURVEY ANALYSIS OF *BRAHMA LAKE*

A. LOCATION:-

This lake is situated in the city near Kolbad and Siddheshwar Lake.

B. CATEGORY:-

This lake can be considered as medium size-lake.

C. PRESENT SITUATION:-

- I. There is no well-defined boundary wall at any side.
- II. No signs of aquatic life as whole lake are full of vegetative growth and water hyacinth.
- III. This is surrounded as well as encroached upon by thick slum area.
- IV. Municipal waste is being dumped in it.
- V. This is also encroached by cowsheds and therefore this whole area becomes an ugly site to watch. It is fully covered by cowdung and other wasteful matter.

D. PROPOSED MODIFICATION NEEDED BEFORE BEAUTIFICATION AND RESTORATION SCHEME IS PLANNED:

- I. It is necessary to remove all the water hyacinth and vegetative growth.
- II. Proper well-defined boundary shall be constructed.
- III. It is necessary to remove all the unauthorised encroachments such as slums, etc.
- IV. Proper walkway / jogging track shall be constructed around the lake.
- V. It is necessary to remove all the muck/ sludge from the lake.
- VI. A proper and efficient aeration shall be introduced.

E. PROPOSED POSSIBLE STEPS FOR BEAUTIFICATION:

- I. This can be developed as a recreation spot by introducing
 - A central landscape island
 - Floating fountains with attractive light system.
 - A small play garden with playing facilities for children.

SECTION - 5

MONITORING PLANS

&

REQUIREMENTS

SECTION 5

5.1 MONITORING REQUIREMENT

After carrying out Feasibility Studies for upgradation of Lake based on earlier data and data generated during feasibility studies has to be monitored in a systematic fashion. One has to initiate a well Designed Water Quality Monitoring plan for its proper implementation. It should include monitoring of all parameters, which are causing degradation of lake. These trends would be most valuable to determine, and would help in fine - tuning of the control program.

5.2 ANALYTICAL METHODOLOGY

With all causes, it is imperative to survey and study various aspects of this lake in order to understand the ecological processes of the lake, so, as to formulate a management action plan. However, there is a need to identify the parameters to prepare the management action plan that desired objectives are achieved. The treatment alternatives have to be evolved for a lake depending upon structure and function. The study and conservation of lake involve basic limnological parameters, which are depicted.

5.3 PROPERTIES

PHYSICO-CHEMICAL

A. Physical

- surface water temperature
- secchi transparency

B. Chemical

B.1 For water

- pH
- conductivity (mhos/cm)
- redox potential
- suspended solids (mg/l)
- total dissolved solids (mg/l)
- alkalinity (carbonate and bicarbonate) mg/l
- DO (mg/l)
- BOD (mg/l)
- COD(mg/l)
- hardness
- inorganic phosphates
- total phosphates
- nitrate- nitrogen
- ammonical –nitrogen
- total nitrogen
- ionic concentrations (Cl, Ca, Mg, Fe &Cl)
- heavy metals (Cd, Cr, Fe, Pb, Zn, Hg)
- pesticides (DDT, BHC & endosulphane)

B.2. For sediment

- pH
- nitrogen

- potassium
- phosphorous
- calcium and magnesium
- heavy metals (Cr, Hg, Zn, etc.)
- pesticides (DDT, BHC & endosulphane)

C. Microbiological (for water & sediment)

- bacteriological analysis (pathogenic & non-pathogenic)
- total coliforms
- fecal coliforms
- fecal streptococci
- salmonella
- fungi

D. Biological

Phytoplankton - species composition, biomass & special feature

Zooplankton - species composition, biomass & special features

Macrophytes - species composition of emergent, submerged & free- floaters.

- degree of macrophyte infestation, special feature Chlorophyll and Carotenoid

Benthos - species composition, phyto and zoobenthos

Necton - fish species composition and other aquatic animals

Bio-production - phytoplankton production

- macrophyte production
- primary production

Nutrient loading

- Phosphorous loading
- Nitrogen loading
- Nutrient budget (input and output of nitrogen and phosphates)

Pollution load

- Domestic pollution
- Municipal waste
- Industrial pollution

5.4 OPERATION AND MAINTENANCE

The thrust areas of R&D at the institute are:

- environmental monitoring
- environmental biotechnology
- toxic waste management
- environmental systems design, modeling and optimization
- environmental impact and risk assessment and environmental audit
- environmental policy analysis

The mix of activities include

- sponsored research projects
- developmental projects
- technology dissemination
- societal missions

SECTION - 6

**TREATMENT
STRATEGIES**

SECTION 6

TREATMENT STRATEGIES

6.1 TREATMENT OF LAKE WATER AND VARIOUS ALTERNATIVE OPTIONS

By far now in this report we have seen all the possible ways to make as well as point and non-point sources for the various degrees of degradation of lake. Our emphasis of this report is mainly on the upgradation and rejuvenation of lake-quality as well as to revitalize the lakebeds. The main aim in upgradation in water quality of the lake is to achieve maximum increment in D. O. and thereby completely destroying the organics and inorganics and metals precipitated in the lake. The other objective of this report is to bring back the aesthetic values, which includes beautification and improving the lake surroundings.

The later half of the scope of work i.e. beautification planning is already undertaken by TMC with a uniform beautification plan for all the lakes. We are not altering this beautification plan but infact we have suggested few more aspects to make it more attractive and decorative. The costing of this as well as this designing is discussed in the further sections. This chapter deals with various options to rejuvenate the lake water quality and therefore the cost involved in doing so.

The following discussion deals with the permanent methods of improvements as the temporary methods have also been discussed in the earlier chapter. To take a brief summary of temporary methods and the costing is as follows:

1. REMOVAL OF VEGETATIVE GROWTH:

As discussed this case can be carried out by manual, mechanical and chemical means. We recommend removing all the vegetative growth, algal growth and weeding firstly by manual means and then spraying of toxicants, which are commercially available, on the surface of the lake. Once the vegetative growth is removed manually, we



**BATHING
MAKES IT
MORE WORST**



HUMAN ACTIVITIES HARMFUL TO LAKE

recommend to spray the toxicants phase wise such as initially daily for 8 to 10 days, then check for more growth of algae. If there is more growth then the spraying will continue for another week's time.

One has to immediately start the aeration system as soon as the weeds are controlled. Therefore there will be enough dissolved oxygen and it will also prevent further vegetative growth. We estimate the cost of this manual harvesting and spraying in the range of about Rs. 25,000 to 30,000 / acre of the lake.

2. EFFECTIVE AERATION SYSTEMS:

There are various options available for effectively aerating the lake water thereby increasing the D. O. levels. These include:

- i. Sparging of compressed air with the help of aeration grids, diffusers throughout the lake.
- ii. Introduction of floating surface aerators.
- iii. Introduction of bubbler jets through out the lake area.
- iv. Introduction of floating fountains in the lakes.

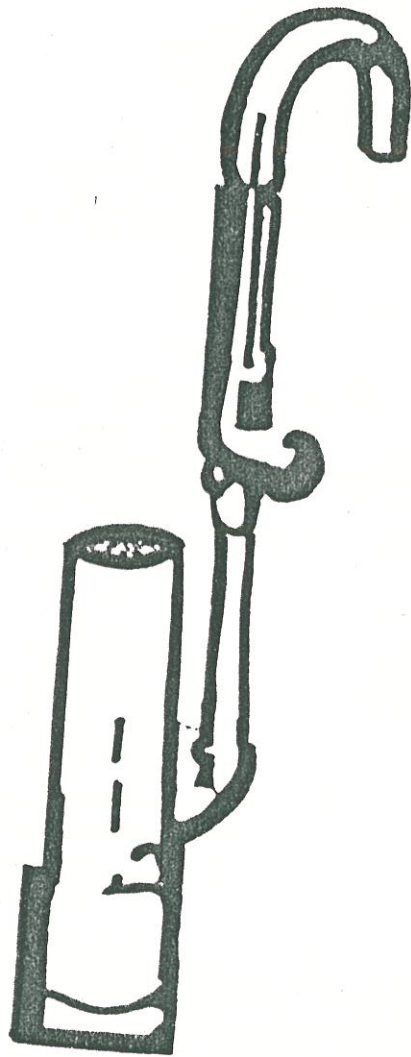
The effective way to bring back the desired D. O. levels, is to identify one of the above options singly or a combination of one or more options. Let us now discuss above options with respect to its advantages, disadvantages, and its cost factors.

- i. Sparging of compressed air with the help of aeration grids, diffusers throughout the lake.**

A typical air compressor system comprising of various ancillary units for a 3-acre lake with a depth of 3-5 meters along with its specification is as below:

PROPOSAL: 230/460 VOLTS, THREE- PHASE 3-HP SYSTEM

Continuos Laminar Flow Inversion / Oxygenation system complete with two 3-hp 460 volt three-phase compressors (one spare) with strong outdoor fiberglass cabinet with sound-reduction lining, complete with cooling blower and filters, pressure gauge,



A CLOSE VIEW OF TYPICAL BUBBLER JET

manifold, five control valves, five diffusers, 1,500 feet self-sinking air line. Includes engineering, but not shipping, handling, or insurance. Turnkey operation except for electric service to the cabinet.

SYSTEM SPECIFICATIONS:

One each 3-hp rated oilless low noise vane-type compressors and spare compressor. 230 - 460 volt 60 Hz three-phase open motors with thermal overload switch, 15-psig maximum pressure.

Operational characteristics at 13.5 psig: amperes at 13.5 psig, 460v: 2.9 amperes, 2.34 kW (3.1-hp), 32.7 cfm.

Compressor includes one 40-micron air filter, one pressure relief valve, oil-immersed pressure gauge, motor, belt-guard, and base. Power cord and electric service hookup to be provided local electrician.

SPECIFICATIONS FOR 3-HP MOTOR :

Type	: 3-phase	Rated HP	: 3.0
Bearing	: Ball	Nameplate RPM	: 1725
Mounting	:	NEMA Frame	: 56H
Insulation	: Class B	Volts @ 60 Hz	: 230/460
Ambient	: 40 deg.C	Service Factor	: 1.15
Duty	: Continuous	Full Load amps	: 6.3/3.1
Rotation	: CW/CCW	Weight	: 30 lb.
		Average Efficiency	: 80%

- Double-shielded ball bearings with low temperature grease.
- All copper windings.
- Gasketed conduit box and shaft slinger.
- One-year limited warranty on parts and labor.

SPECIFICATIONS FOR DIFFUSER:

Five each MICROTUFF microporous Teflon diffusers complete with clamps, fittings, check valve assembly, stainless steel cable and floats. Three-year warranty on Teflon material.

SPECIFICATIONS FOR CABINET:

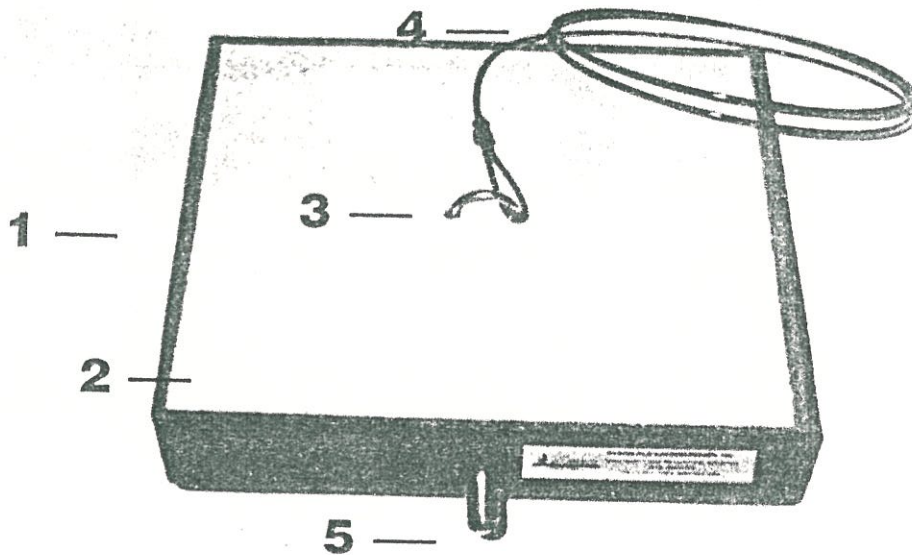
1 Sturdy outdoor 40.5" X 44" X 23" high green weatherproof fiberglass cabinet complete with one 500 cfm 230/460 volt 60 Hz cabinet cooling blower with fan guards, cabinet air filter. Three cabinet filters included for quarterly maintenance. Three-year cabinet warranty on parts and labor.

SPECIFICATIONS FOR AIR LINE:

One thousand five-hundred feet self-sinking, low friction PVC air hose, 0.62 inch I.D. X 1.0 inch O.D., 400 psi, 160 ° F

The system will be of greater advantage by using diffusers rather than using aeration grids, as there is always a possibility of choking of aeration grid if proper maintenance of the lake is not done. The diffuser can be moved from place to place throughout the lake area. The diffusers or the fine aeration grid can help to give fine bubbling quality thereby increasing the surface area and also the oxygenation capacity.

A CLOSE VIEW OF TYPICAL DIFFUSER



- 1 - Diffuser base
- 2 - Microporous ceramic diffuser
- 3 - Stainless steel cable holder
- 4 - Float cable
- 5 - Hose to diffuser fitting

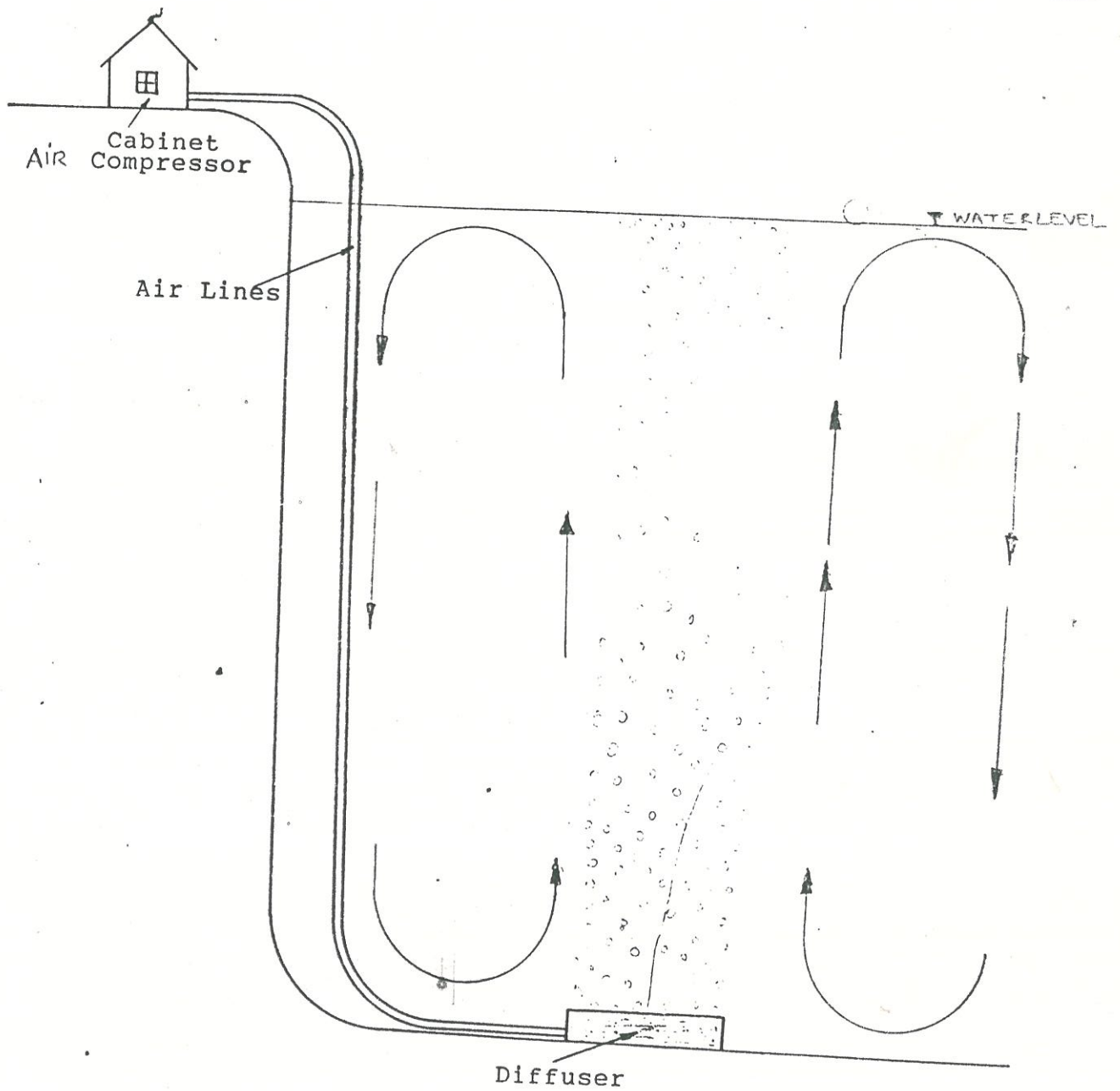


Figure 1. CLEAN-FLO LABORATORIES, INC.
LAKE RESTORATION SYSTEM

To bring a lake back to life...You must first bring life back to the lake.

COST FACTOR:

It is estimated that the system as described above for a 2-acre lake area will cost around Rs. 10- 12 lakhs.

ii. Floating aerators:**a. HIGH SPEED FLOATING AERATORS**

Each unit will consist of :

- Vertical TEFC squirrel cage induction flange mounted Motor with IP55 degree of protection suitable for continuous outdoor operation.
- Case in M.S. epoxy painted construction.
- Heavy duty Deflector in cast iron.
- Solid shaft and impeller in S.S 304
- Float in fiberglass filled with polyurethane foam and structurally reinforced from within.
- Coupling between motor and shaft.

b. LOW SPEED FLOATING TYPE AERATOR:

Each unit consist of:

- Vertical TEFC squirrel cage induction flange mounted Motor with IP55 degree of protection suitable for continuous outdoor operation.
- Worm gearbox.
- Inverted cone type solid non-clog, self-cleaning impeller.
- Solid shaft.
- Solid rigid coupling connected gearbox and shaft with lock plate arrangement.
- Lovejoy coupling between motor and gearbox.
- Base frame.
- Bottom coupling connecting impeller to shaft.
- MS/ FRP Floats filled with Polyurethane foam for high degree of stability and durability.
- Supporting structure for floats.

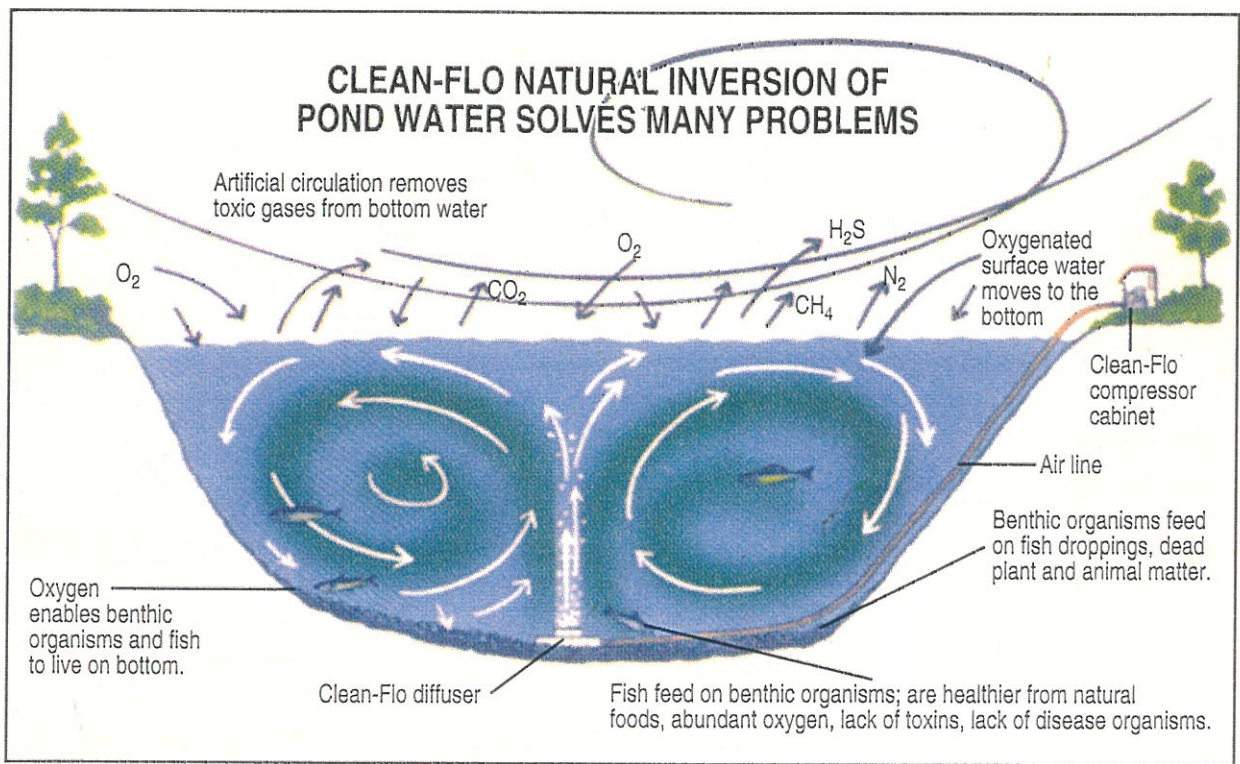
c. PRICES

Sr. No	HP	High Speed Aerator (Price Rs. each)	Low Speed Aerator (Price Rs. each)	Maximum water depth (Mt.)	*Extra price for draft tube (Rs. each)
1.	5	1,00,000/-	1,90,000/-	2	70,000/-
2.	10	1,10,000/-	2,40,000/-	2.5	70,000/-
3.	15	1,40,000/-	3,80,000/-	3	85,000/-
4.	20	1,60,000/-	3,90,000/-	3	85,000/-
5.	25	1,95,000/-	4,25,000/-	3	90,000/-
6.	30	2,10,000/-	4,50,000/-	3	90,000/-

* If water depth is 5 Mt. additional draft tube is required.

Number of aerators and HP can be selected, based on width and length of the lake.

A typical treated lake is shown in the following diagram.



ENGINEERING AND MANAGEMENT OPTIONS FOR LAKE REJUVENATION

INTRODUCTION

Within this section, a summary review of the major problems of the TMC Lake along with their identified prime causes is mentioned. Details of various alternative management options are presented which have been employed elsewhere to achieve particular objectives. A selection of methods, which are deemed most suitable for application to the Lakes situation, will be then considered and also estimates will be made of what the likely future water quality might be in the long term with the implementation of such methods.

REVIEW OF MAJOR PROBLEMS OF LAKE

Basically TMC Lakes are grossly polluted due to the continual ingress of domestic wastewater initially and then subsequently leaching of industrial wastewater's (which is evident from the adjacent nalla flowing with industrial wastewater). The increased Eutrophication of lake during past few months appears to be a result mainly of the increased nutrient loading due to a rapidly expanding contributing domestic population (mostly slum areas surrounding the lake) and associated wastewater flows. Sedimentation of organic material and algae also contribute to the increases annual nutrient loading through nutrient releases particularly in the summer stagnation period when there is a much increased likelihood of benthic anaerobiosis. Hydrogen sulphide formation at the sediment-lake water interface occurs sometimes and it is released from the water column, along with other volatiles to produce unacceptable malodors may be due to algae themselves, industrial effluent residues, interaction of these together or chemically combined with hydrogen sulphide.

PROBLEMS

- a. Due to increased population, construction of new buildings is coming up in the watershed area of the lake.

- b. Due to human activities in the lake, the solid and liquid wastes generated, causing heavy physical and chemical pollution.
- c. Encroachment.
- d. Direct disposal of solid waste like eatables, tetrapacks being thrown directly into the water during the various activities.

ECOLOGY OF WATER HYACINTH (*EICHHORNIA CRASSIPES*)

Water hyacinth known as *Eichhornia crassipes* is free floating water plant found only in tropical environment. Morphologically, the plant is floating herb and consists of rhizomatous stem, a rosette of leaves, which have a characteristic bulbous float and fibrous roots. The plants survive on mud or remain anchored to the soil. The growth of the plant is checked by low temperature, hence the numbers reduces in winter but multiply in summer and spring season. The plant propagates vegetatively, however limited propagation through seeds also happened. Seeds formed usually sink down in the mud and remain dormant for considerable period till conditions are favourable for their germination.

Water hyacinth usually multiplies rapidly so that it forms dense monospecific stands covering the entire surface of water body. The thick covers cuts off light and impairs the distribution of oxygen into the water resulting in aerobatics of the water column underneath. It is found that growth of plant is associated with uptake of large quantities of nutrients. Salt, water and pH also limits the growth and propagation of plant. Salt water has hypertonic action on the plant parts causing shrinkage and eventual death of plant.

a. DAMAGES CAUSED TO THE LAKE BY WATER HYACINTH

The direct impact of profuse growth of water hyacinth is on the fresh water itself. The plant cover provides obnoxious smell; coloring matter and increases suspended organic matter in water. It's growth results in oxygen depletion in water, which lowers its assimilative capacity and creates septic conditions.

Water hyacinth lowers temperature, pH, and bicarbonate alkalinity and increases the free carbon di-oxide level under the plant cover growth. The rate of production of organic matter is so high that organic matter accumulates in the water body. The plant thus aggravates Eutrophication and silting of the waterbody.

b. CONTROL OF WATER HYACINTH

1. MANUAL
2. MECHANICAL
3. CHEMICAL
4. BIOLOGICAL

Manual and mechanical harvesting of water hyacinth followed by its drying and burning. Chemical control is most effective and has a number of advantages. However the majority of chemicals reported for toxic to other forms of life. Some of these are not biodegradable and therefore pose a threat by virtue of accumulating in the living biota. Therefore, these chemicals can't be used for weed control.

Biological control methods have less popular and are less effective.

DEGRADATION OF LAKE

Degradation of water in lake takes place due to following steps

1. Heavy ingress of inorganic nutrients likes nitrogen, phosphates, carbonates, and carbon di-oxide.
2. Toxic metals.
3. Loss of self cleansing (self purification process) due to depletion of oxygen, death and decay of plants and animals and accumulation of sludge (dead organic mass) at the bottom of water body which further leads to anaerobic conditions and development of anaerobic bacteria (including reducing bacteria).

Intensive industrial and domestic activities discharge large amounts of wastewater into the water bodies or lake. This untreated wastewater contained lots of organic material, nutrients and toxic metals etc. which started depositing in the lake bottom.



CLOSE VIEW OF VEGETATIVE GROWTH



Over a period of time this results into extensive sludges all over the lake. Ingress of undesirable pollution also disturbed the ecobalance of the lake by promoting excessive growth of algae and animalcules. Dying animals and plants got deposited at the bottom as organic mass and developed as sludge. This resulted into anaerobic conditions and impaired the quality of the water in lake severely.

Because of natural bio-oxygen demand of organism present in sludge in the water body, it got deprived of DO and resulted into anaerobic/anoxic environment, which further deteriorated the condition of lake. Presence of toxic components resulted into the extinction of various aquatic life and fish etc., which are very necessary for the healthy ecosystem balance and for maintaining natural food chain/cycle for the control of excessive growth.

Further, these sludges due to the presence of nitrates, phosphates, and various other nutrients contribute to the high growth of phytoplankton, which form algal blooms. This further aggravates the dis-equilibrium by decay and result into the increase in the organic sludges. Because the sludges entraps very high ratio of water and the volume of organic sludges spread out in the lake with high depths and detrimental effects.

In the healthy aquatic ecosystem there is a balance between microphytes, macrophytes, animals and micro-organism which is maintained under minor pollution disturbance. If the aquatic ecosystem is disturbed then we need specific consortia of natural micro-organism developed through the corrective action and to restore equilibrium the process so known as bioremediation and calls for expertise in biotechnology specific micro-organism and biofixation on specific base material to degrade sludge and eliminate Eutrophication.

IMPACT

Lakes assume special importance to providing drinking water provision, recreation, irrigation, and fishing. Due to pressure of human activities like urbanization and industrialization, lake is getting degraded. Encroachment, siltation, weed infestation, discharge of domestic sewage, industrial effluents, surface run-off carrying pesticides

and other chemical used in agriculture are main causes for degradation of the lake ecosystem and impact of these activities as-

- Deterioration of water quality
- Sedimentation and shrinkage
- Decrease in productivity to support flora and fauna
- Loss of aesthetic values and decrease in tourism.

GENERAL METHODS FOR CONTROLLING EUTROPHICATION AND ITS EFFECTS :

Some common control methods of temporary as well as permanent nature are discussed in this feasibility report, which are as follows. The temporary methods, attacking the symptoms and effects of Eutrophication; other methods are directed at reducing or removing the causative agent of algal growths, or to changing the conditions within the body of water to minimize the effects of algal blooms.

a. TEMPORARY METHODS

1. HARVESTING OF LAKE BIOTA :

These methods comprise of mechanical, chemical or biological applications. Mechanical means involve the harvesting of weeds (in this case Eichhornia crassipes) and other algae. The latter was extremely difficult. Chemical means involve the spraying of the algae with a toxicant (e.g. Copper sulphate or an organic herbicide) but a major problem then arises with attempting to remove huge mats of floating dead algae, which on breaking up and sedimenting, are a major source of BOD and produce oxygen depletion, nutrient release possibly hydrogen sulphide malodor. Biological means include employing blue green algal viruses, or grazing organisms.

In all above methods, the material harvested has to be physically removed from the lake system. It should be noted that unless bodily removal from the system occurs the nutrients re-releases and no benefits become apparent.

2. AERATION OR CHEMICAL ADDITION :

Where the entry of oxygen depleting organic matter into a lake cannot be controlled adequately, artificial aeration of the lake hypolimnion is a possibly temporary method that can be used in some cases to prevent formation of anaerobic conditions in the lake bottom and thus eliminate sulphide formation and smell nuisance, especially in the summer months.

This can be achieved partly by keeping the bottom water layer oxygenated in a stratified lake. We can also employ Lake Dyes in various colours to check the bottom, which is visible, by using these Lake Dyes. This has following advantages:

- ** Increases depth
- ** Natural Beauty
- ** Safe and harmless aquatic life
- ** Compatibility of Lake dyes with aquatic environment

b. PERMANENT METHODS :

These methods can be split into three distinct categories i.e. prevention, pre-treatment of wastes if entering into the lakes, and Lake Treatment.

1. PREVENTION OF INFLOWS :

The prevention of wastes entering the lakes through their diversion to another receiving point obviously removes the pollutants loading entirely and is thus extremely beneficial. Unfortunately in some cases it also removes the associated hydraulic flow which may have an important beneficial flushing effect in terms of the overall lake condition. The degree of the benefit of nutrient load removal must be offset against the disbenefit of reduced flushing. Wherever feasible, prevention of

nutrient and other undesirable inflows by diverting the same away from the lake is an effective and permanent method of control of Eutrophication and other lake problems.

2. TREATMENT OF WASTES :

Pretreatment facilities for the purification of industrial effluents prior to discharge is considered a prerequisite in many countries. This is an essential part if any industrial wastes in entering into the lake by any reason.

3. LAKE TREATMENT :

There are number of in-situ methods which can be applied directly to a lake to treat the lake waters and these include:

- nutrient precipitation
- nutrient dilution
- removal of bottom sediments
- removal of leachate formation, stops the seepage from adjoining nallas, slums, etc.
- most important to remove and relocate slums which are causing most of the damage if proper drainage is not provided.

These methods are not mutually exclusive in that a combination of them can be employed to effect the necessary degree of reduction in nutrient loading for the water body in question.

SECTION - 7

BEAUTIFICATION

PLANNING

SECTION 7

BEAUTIFICATION PLANNING

7.1 GENERAL

As discussed in earlier sections there are various ways in which TMC can beautify the lake and its surrounding. Beautification will add to the aesthetic value of the lake as well as bring nicety to the lake area. One can have very elaborate beautification plans running into several lacks of rupees, provided you have either one or two lakes to be beautified or have financial resources. Beautification plans will certainly have a financial burdens and cost in great amount if not properly planned.

TMC has already started its beautification work as can be seen from few lakes e.g. Rayladevi, Kausa etc. The main part of beautification in this scheme is to construct a MS railing and a walking track around the lake.

7.2 BEAUTIFICATION PLANS: -

7.2.1 GENERAL PLANNING: -

As mentioned earlier, we can beautify a given site by applying various alternative scheme. By using different types of designs and materials one can really beautify a lake to the maximum possible extent. We have envisaged beautification planning by including a jogging track, alternative railing having a central island with a dome shaped and properly landscaped, having fountains with different lights as well as proper electrification in around the lake.

7.2.2. SCHEME :-

The beautification scheme undertaken by TMC is being implemented for few sites, presently it includes a typical railing design and a walkway around it but all the lake may not have area surrounding the lake so that a proper walkway can be constructed.

We have designed a jogging track beyond the boundary of the lake that is elevated on adjoining ground at a level on top of the walls. The columns are taken at an interval of 5 mtr. Jogging track has counting support of rubble on one side hence columns are not envisaged on the other side. The width of the jogging track is taken 1.5 mtr. with hand railing on both sides of the track. Lampposts are provided on both the sides of the jogging track and precast checkered tiles are used for the flooring construction of diameter between 5-20 mtr. with one number of MS bridge from jogging to the central island is envisaged. We have also designed a Chhatri (dome shaped) for the island with a proper landscaping on the island area. The pile foundation for all the columns for Central Island is also envisaged.

There is also an alternative design envisaged for bigger lakes having jogging track at the inner lake boundary. Annexure 1 & 2 indicates the two alternative designs where as annexure 3 indicates design for the central island and the Chhatri.

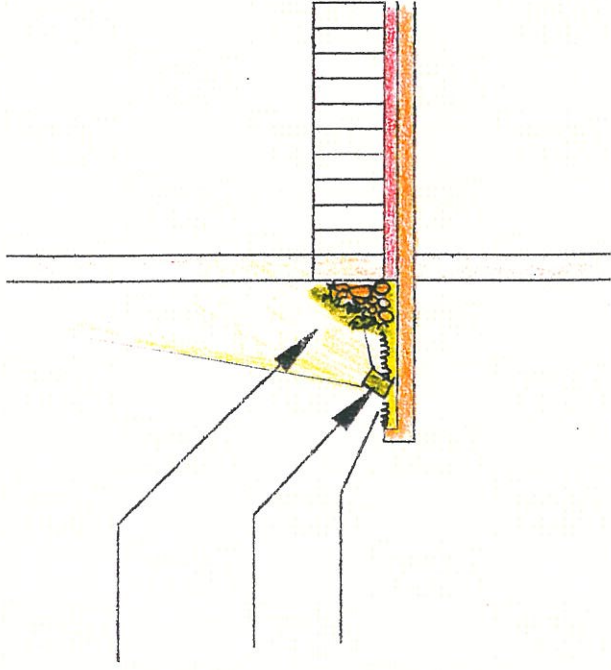
7.2.3. COST ESTIMATION

We can adopt several of alternatives for the beautification, which depends upon the cost factor involved in it. We can have only MS railing around the lake with or without jogging track. The jogging track may be inside or outside of the lake boundary. Depending upon this area we can also have central island with a Chhatri design with or without bridge, therefore one can approach the island by boat also, for maintenance purpose incase no bridge is envisaged. We are herewith giving the estimated cost for the various options so that we can adopt various alternatives for the given lake.

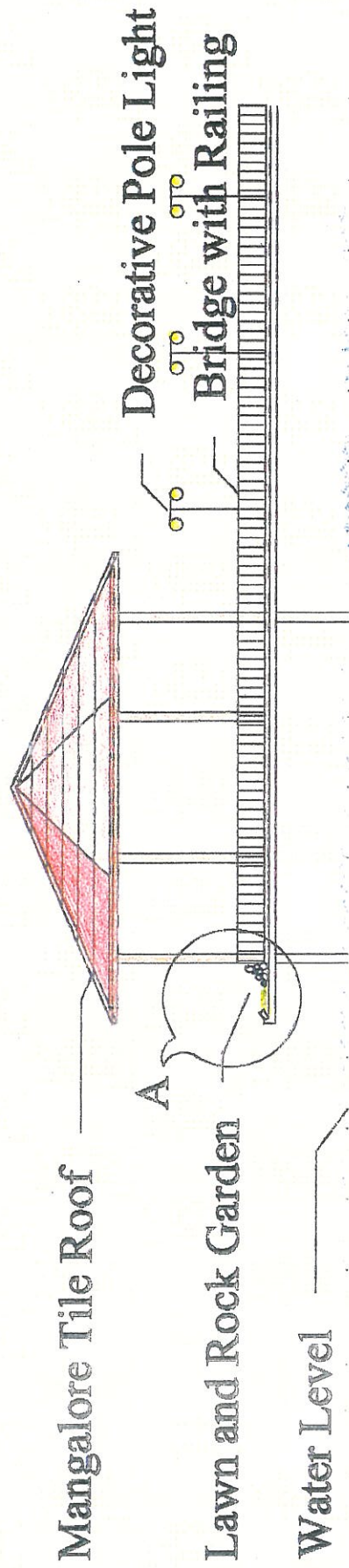
A TYPICAL COST ANALYSIS FOR A LARGE SIZE LAKE

SR. NO.	DESCRIPTION OF WORK	APPROXIMATE COST (IN LACS)
1.	Construction of 1.5 mts. wide jogging track along the periphery of the lake and providing handrail to the jogging track. Annexure -I Annexure - II	22.00 18.00
2.	Construction of central island (4 - 5 meters depth).	03.00
3.	Bridge connecting the central island and lake periphery.	02.50
4.	Desilting or dredging	10.00 (minimum)
5.	Installation of bubbler tubes.	2500/- (each)
6.	Installation of fountain in the center of the Lake.	02.50
7.	Electrification of entire complex.	01.50
8.	Landscaping of required area.	02.00
9.	Aeration system to maintain water quality including DO along with all accessories and Teflon diffusers, grid panel, weather shed, compressor (including its supply, installation, erection, and commissioning.	12.00
10.	2 nos. of paddle boats of fiber glass having maximum capacity of 2 persons.	01.00
11.	Adding colour to lake water using different dyes.	01.00

Rock Garden
Uplighter
Lawn



Detail at "A"



Mangalore Tile Roof

A

Lawn and Rock Garden

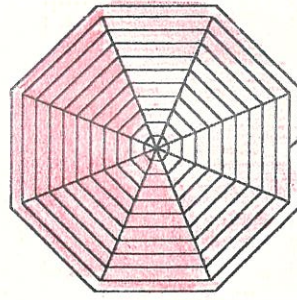
Water Level

Decorative Pole Light

Bridge with Railing

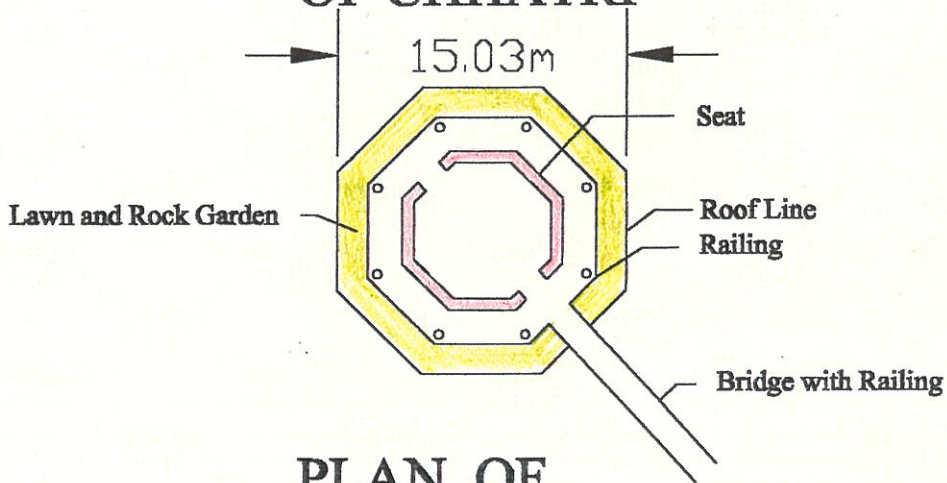
SECTION OF

CHHATRI

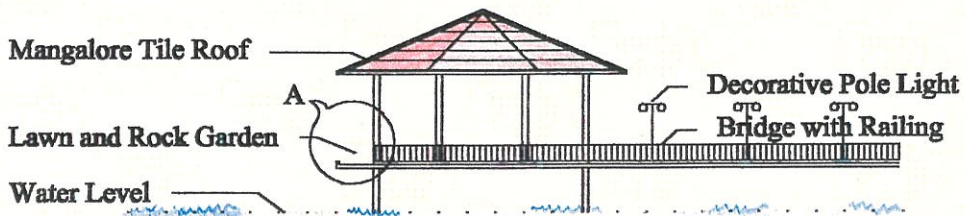


Mangalore Tile Roof

ROOF PLAN OF CHHATRI



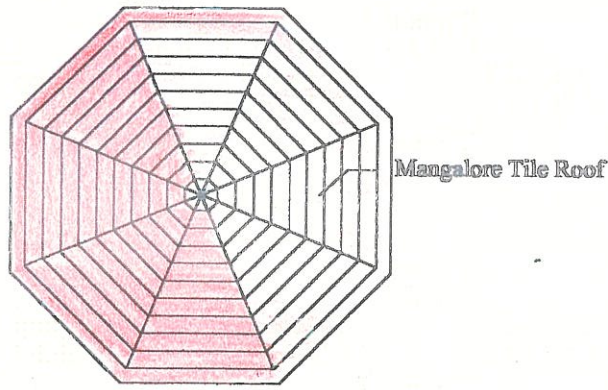
PLAN OF CHHATRI



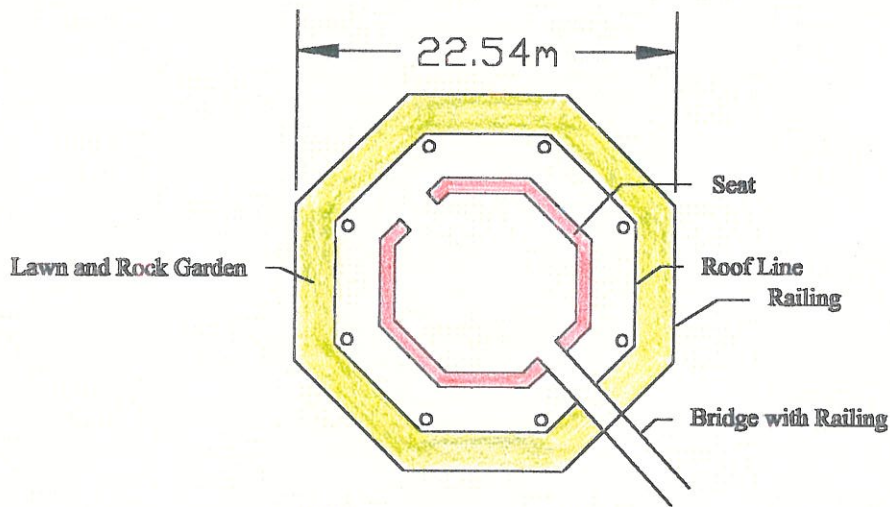
SECTION OF CHHATRI

Details of Chhatri in Lake

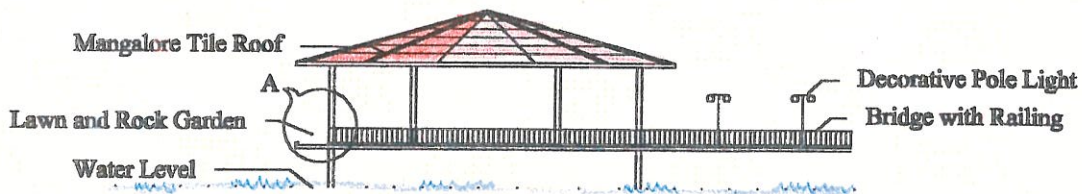
Beautification Scheme for T.M.C Lake



ROOF PLAN OF CHHATRI



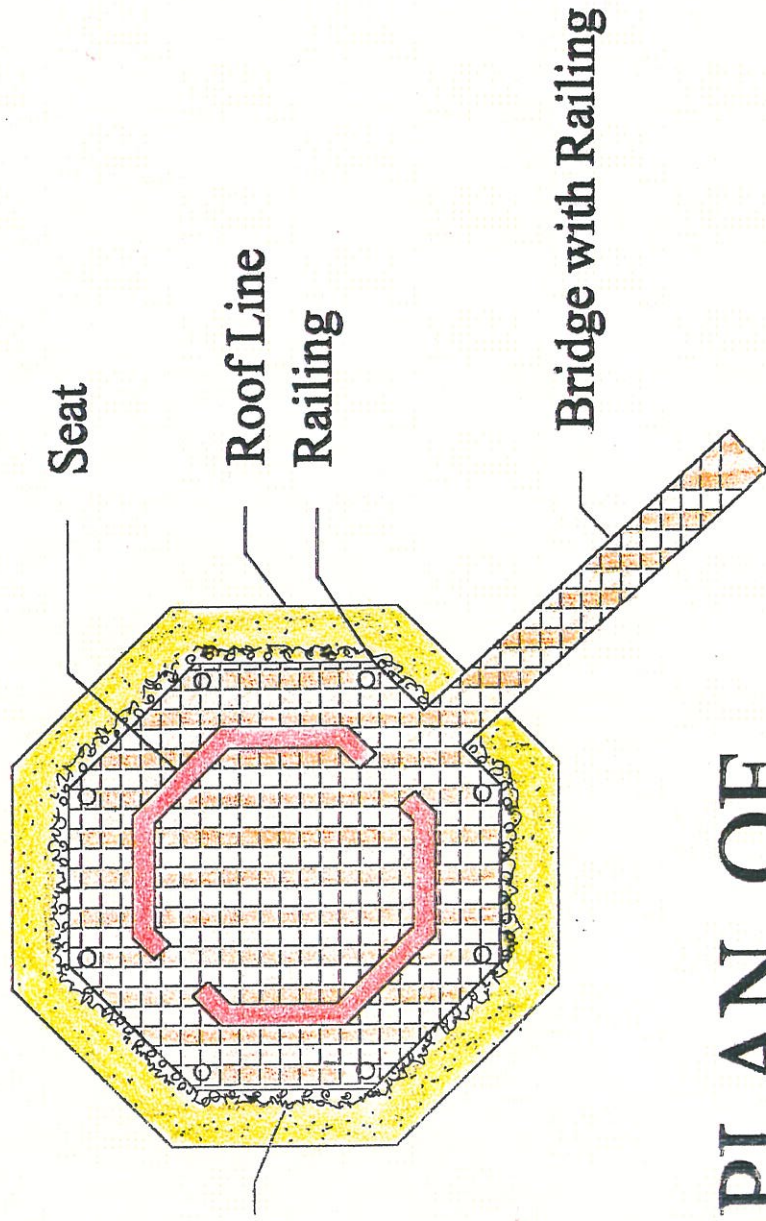
PLAN OF CHHATRI



SECTION OF CHHATRI

Details of Chhatri in Lake

**Beautification Scheme
for T.M.C. Lake**



PLAN OF CHHATRI

SECTION - 8

**COST &
BUDGETARY
ESTIMATION**

SECTION 8

COST AND BUDGETARY ESTIMATE

8. 1. COST ESTIMATION

The upgradation and beautification project as described has to undergo big criteria of raising the fund. The financial aspects have a very deep impact on this projects. We have taken utmost care to minimise the cost to improve the beautified lake. The cost estimation includes number of factors and shall be dealt positively.

Since there are no immediate funds available by TMC, we here by strongly recommend to carry out the said work in phase wise manner. This means, either one can take up half of the lakes at a time for the improvements or carry out basic improvement scheme in all the lakes at a given time.

The major areas of work to be carried out in order to complete this project are:

- (1) Effective dewatering shall be carried out immediately. Cleaning of lake water surface by removing vegetative growth weeds either manually and or chemically, also to remove the municipal garbage fully from the sidewalls of the lake.
- (2) Dredging should be carried out in order to remove the sludge, muck and sediments at the bottom of the lake. The dredging and excavation shall be carried out uniformly in order to have a single water depth (uniform water level throughout the lake area).
- (3) Erection and installation of aeration system, which shall be uniform and also introducing diffuser system with, or without fountain in the lake.
- (4) It is necessary to immediately construct the well defined boundary wall along with required railing.
- (5) Construction of 3.00mt wide walkway with jogging track.
- (6) A proper electrification scheme shall be introduced in and around the lake.
- (7) To put up proper sign boards indicating the history of the lakes such as name, area, depth(appox), cost of upgradation incurred.

On the beautification and recreational aspects TMC should encourage the following:-

- (1) As suggested by us in many cases, a central fountain with proper light effect and also in many cases construction of small island in the center of the lake (a Chhatri) the design of which is enclosed elsewhere in the project report.
- (2) To provide proper electrification on this island this may or may not connect to the lakeside by a walkway.
- (3) To provide proper land scapping on this central island.
- (4) To provide two or more number of paddleboats of fiberglass having maximum capacity of two persons.

The cost estimation for all these has been indicated in this report, it has been observed during our visit to this all lakes in most of the cases beautification work such as providing railing and jogging track is underway. It is also indicated that such scheme has been drafted for entire 15 nos. of lakes. Therefore it will not be appropriate to suggest any more concepts in doing so as the said architectural work has been assigned and being paid for.

The advantage of carrying out phase wise manner will be to adjust the fund flows from out side agencies such as Govt., Semi Govt., foreign funds, private and public institutions etc. there is a great need to motivate the public- private partnership in completing this project.

8. 2. COST ESTIMATION:-

There are about 15 nos. of lakes in the TMC area. All these are almost scientifically dead lakes due to lots of unauthorized activities being taken place which are very harmful for the existence of the lakes. Most of the lakes are seen full of weeds, vegetative growth, surrounded by slums and hutments and residential buildings. This has further deactivated these lakes to the extent that even in some cases animals are not consuming the water for drinking purpose. This fact is also supplemented by non-existence of aquatic life in these lakes.

Many of these lakes were being used as recreational centers in early days when there was scarcity for space/land for the living of locals and migrated populace, the same lakes were surrounded by them. This race for occupying the lake surrounded area has contributed widely for its deterioration. Many of the buildings were constructed by filling up some of the lakes. If one has to stop this ecological disaster, one has to revive the existing lake condition and bring it to its normal environmental values.

8.3. COST FACTOR

Cost Factor:- The attempts and efforts of TMC are well acknowledged by the society as well as by the Government and also by Environmentalist. TMC wishes to carry out substantial changes in the existing condition of these lakes and there by improving environmental and aesthetical conditions in and around the lakes.

The most important which will play a vital role will be the COST. The cost is not only to improve the existing conditions but also then to maintain the improved condition up to the mark. It is not the duty only of TMC and its staff to run and maintain the improved and rehabilitated lakes but it will be a social obligation towards the people of TMC.

Various options will have to be considered in order to raise the funds to rehabilitate these lakes. Below are few options, which can be considered and worked out to effectively tackle cost for upgradation of these lakes.

- (1) **MoEF :** Ministry of Environment and Forest (MoEF) is the key body, which deals with Environment and Forest problems in India under the auspices of MoEF. NCRD has been established to rejuvenate the rivers, which are highly polluted. NCRD has provided funds for various major projects for improving the conditions of big rivers such as Ganges, Yamuna etc. under NCRD there are arrangements for the funds to support activities such as improvement of lakes etc. NCRD has already provided funding for great lakes such as Dal etc and our endeavor will be to raise the same funding for the improvements of 15 nos. of lakes in TMC area.

(2) **Private Participation** : Now a days it is era of privatisation. One can certainly take help and assistance from these private institutions and companies in and around TMC area to fund the project. Fortunately Thane District is one of the thickly populated industrial zones and has no. of major industrial as well as hundreds medium to large-scale industries. TMC should appeal to these industrial sector to raise appropriate funds in order to met the project requirements. There are already numerous examples of such private participation in social projects in our area. The industries can fund these projects in various ways such as:

- (a) Completely adopting one or more lakes.
- (b) Partially fund the project by way of lump sum sponsorship.
- (c) They can maintain the lake after it is totally rehabilitated.
- (d) They can participate in raising fund by putting up their advertisement and hoarding around the lake area.
- (e) They can partially fund the project by putting up public facilities such as public toilets, jogging track and also provide facility for drinking water for the people who visit these lakes.
- (f) They can use some these lakes for aquaculture and or such type of activities and TMC can raise money for this.
- (g) These industries can also participate by way of putting up big nurseries around these lakes as well as put up sign boards highlighting importance of the lakes and how to maintain the surrounding of the lakes in order to improve the environmental hygiene and aesthetic values.

(3) **Public Participation** :- TMC can appeal to the locals of the area where there lakes are located for a fraction of for fund raising program and with help of local corporate and reassure them that these lakes will be maintained and will be used for recreational purpose only. In this way the public- government relationship will be boosted and people can come forward to help in this project.

(4) **TMC participation**: TMC shall improve 2 or 3 lakes to the maximum extent possible so that these lakes can be exclusively lend for Fishing and aquaculture to the private parties. This will not only generate revenue but also maintain the lake conditions and there by improve the environmental and aesthetical values further.

In these attempts and efforts TMC should encourage scientific training for aquaculture and related areas from state Fisheries institute. Once a proper training and proper aquaculture/ Fishing takes place not only the local but a bigger company can come forward for this lucrative business and one day one can find this firm exporting the Fisheries and bring TMC on the world map. The lakes identified for this purpose are Owale lake , Naar lake which has definite potential to start such innovative but feasible project.

(5) **School Participation:** - After the total upgradation and beautification is over, there is certainly a question of maintenance of these lakes comes to the mind of many. Today there is great need for inculcating the environmental and social values on the minds of young generation. TMC can take help of these school children for maintaining and spreading awareness for the importance of co-existence of these lakes.

SCOPE OF WORK

Scope of work was divided into 2 parts:

Part 1. As envisaged by Ministry of Environment and Forest (**MoEF**), NEW DELHI, subsequently included in TMC work order and

Part 2. As envisaged by Fine Envirotech Engineers (**FEE**).

Following is the Scope of Work as envisaged by TMC

(A) OBJECTIVES OF THE STUDY: -

a 1.1 Prevention of pollution from point and nonpoint sources :- This point was examined and studied thoroughly during the study. There are various ways in which point and non-point pollution prevention lead to deterioration of these lakes. They include industrial and domestic waste being entering into the lakes without proper treatment. This has resulted into heavy pollution load viz.

Organic and inorganic, increase in the phosphates, nitrates and accumulation of toxic heavy metals which is clearly from the analysis of soil and water samples. These inflows to the lake indicate seasonal variability depending upon the concentration.

The other point sources of pollution in the lake in terms of rainfall, runoff, mixing, temperature, evaporation, etc.

These sources have resulted into lack of dissolved oxygen as well as odour problems. Clearly all of these occurrences are due to the bottom water stagnation and sediment decomposition under anaerobic condition. This has also resulted in loss of aesthetic values of the lake.

The main causes of these point sources are due to unsystematic town planning as well as industrial location. Due to the unexponential growth of population and therefore their basic need of habitation has also resulted in pollution from point and non point sources.

To prevent this point and non-point sources pollution, it is imperative to stop all the inflows in to the lakes. If not, it is recommended to divert these inflows into the proper sewerage and gutters lines. This will help in maintaining the water-DO balance of the lake, which will result in increase of aquatic life.

The major non-point sources such as throwing of municipal garbage into the lake also offerings of floral remains into the lake have damaged the lake ecology to great extent. There is a wide spread habit of throwing unwanted things into the lakes and destroying the lake culture. This was observed at many sites and the classic example of this will be the Siddheshwar and Kolbad lakes. The prevention of uncontrollable growth weeds and its density is covered elsewhere in the report.

a 1.2 Catchment area conservation :- The main problem of siltation of lake can be counted upon the development-taking place on the catchment area of the lake. It is a continuous process caused because of lack of trees and vegetative cover. Fortunately TMC does not have any catchment area and therefore possibility of catchment area conservation does not have any relation to this study.

a 1.3 Density and weed control :- It was observed that there are lot of vegetative growth and weeds being spread on the surface of the lake water in an uncontrollable

manner. The main reason attributed to this is the municipal garbage being thrown in the lake as well as entry of untreated domestic sewage.

The only way to prevent this activity will be by enforcing law and legal action should be taken on those who are encouraging this activity.

a 1.4 R & D studies on floral and faunal activities and related ecological aspects

The continuous water quality degradation associated with the frequent mass mortality of the fish is an awful site. This warrants a regular R&D towards the sustainable development of the lake ecosystem. For this public- private participation is very necessary along with corporations active involvement. Various salient features as component parts of the R&D studies on floral and faunal activities related ecological aspects comprise of

- (1) To investigate the weed species and identify its density in a particular season.
- (2) To study the limnology of the lake.
- (3) To identify correct sources of microbial growth, floral and faunal studies of water to understand the biodiversity spectrum.
- (4) To review microbiological studies to know the path-biology of the lake.

a 1.5 Other activities depending on the lake specific condition :- This aspect has been discussed thoroughly elsewhere in this report.

(B) SCOPE OF WORK: -

Scope of work as per the guidelines of MoEF envisaged by MoEF and FEE have been represented thoroughly in this report and therefore these aspects are not being discussed out here in this section. In fact the scope of work envisaged by MoEF in this section is very similar and comprehensively suggested by FEE in part two of the original scope of work given in the work order. Therefore the part 2 and this section B of the work order has been included together and elsewhere in this report. As far as the points included in the management action plan for the conservation of lake, they are briefly discussed out below for the continuation of the section of the report.

- (1) Data collection: - This being done in assistance with TMC but most of the data collection with respect to surveys, sampling analysis etc., being done by FEE.
- (2) Impact assessment: - This point has been referred in this report extensively along with its evaluation and intercolation, which are the other points in this report.
- (3) Evaluation of impacts: - This point is comprehensively detailed out in this report along with the plans and its establishment.

8.4 PREPARATION OF FINANCIAL PLAN IN RESPECT TO EACH LAKE FOR FOLLOWING ITEMS: -

1. Cost Of Demarcation Of Lake Boundaries: -

This aspect has been studied in depth by TMC where by they have appointed separate agency to devise detail architectural plans for demarcation of lake boundaries. This work has been already undertaken by TMC by floating tenders in the newspaper. The work has been already assigned and being started at many sites. However, as a part of our studies, we have also submitted a low budget design for the same. The cost of this has been mentioned in the respective section of this report.

2. Cost Of Sewage Diversion Work: -

This sewage diversion work has no relevance to our study report as it has been already carried out by TMC.

3. Cost Of Storm Water Drainage: -

This is also been carried out extensively by TMC so therefore there is no need to elaborate this point.

4. Cost Of Afforestation Of Catchment Area: -

As mentioned earlier there is no catchment area and therefore this point is also of no more importance.

5. Cost Of Vegetative Barriers: -

This aspect has been studied fully and various other options are mentioned elsewhere in this report along with its financial implications.

6. Cost Of Desilting of Lake: -

According to our recent studies for making the report, we assume desilting plays a major role in upgradation of these lakes. This is attributed to the reason that most of the later have been used to throw waste construction material and rabbit. There is already a layer of sludge (both biodegradable and non biodegradable), on top of which this completely non-biodegradable layer is added.

It will be highly time consuming to chemically biodegrade the sludge in the lake and no desirable results will be obtained. This method will also be a costly affair. Therefore we recommend to carry out dredging / desilting upto minimum depth of 1-1.5 mts assuming a rate of around Rs. 1.5/- per cum. Thus we estimate an expenditure of about Rs. 10 lakhs for dredging per lake. This should be followed by chemical decomposition of biological sludge.

7. Cost Of Beautification Of Lake: -

The beautification of lake has been discussed thoroughly along with various aspects and options, it also includes upgradation of water quality there by increasing aquatic life in the lake. The cost of this beautification plan has been discussed with reference to a single lake as that can be extrapolated to various other lakes.

8. Cost Of Water Quality Monitoring: -

This has to be achieved and maintained once the whole process of upgradation is over. The various parameters are to be analysed and maintain record book of the same. We are proposing on line pH meter and Dissolved Oxygen meter at the two ends of the lake. We have also indicated in this report about the strengthening pollution control cell where by a well organised laboratory can be set up in order to carry out in house monitoring of water quality. It is recommended to draw out 5 samples twice a week at the various corners of the given lake as well as at the center of the lake. It is also recommended to draw water samples at one or two depths. This exercise has to be carried out for a period of minimum of 2 years from the date of its upgradation. Once the lake has reached to its normal condition, then the frequency of

sampling should be restricted to once in a month but in case of the reports deviating from the standards, one has to stick to the original pattern of sample analysis. This process is basically a trail and error method till indicative results are obtained.

9. Cost Of Measures Of Evaporation Control: -

TMC does not experience high degree summer and therefore the losses due to evaporation are very minimal. Thus no such measures for evaporation are to be adapted for these lakes.

10. Cost Of Public Awareness Program: -

It is very necessary to have public - private participation in this whole process. Therefore it is necessary to have proper interaction with public by TMC for the awareness program. This can be achieved by advertising in local dailies, putting up banners near by the lake sites. TMC can also advertise on local cable network. There can be an annual event where in a particular work can be awarded as best lake conservation award where by there will be better public interaction for this awareness program. TMC can also arrange awareness programs in schools and colleges. The annexure 1 indicates the cost of this activity in detail manner.

11. Cost of Aeration of Lake: -

The main feature of upgradation of water quality of the lake is mainly dependent upon increase in dissolved oxygen. The dissolved oxygen is the key parameter in the lake ecology as it sustains the aquatic life inside the lake. There are various reasons by which the dissolved oxygen is depleted are already attributed in 1st item of this discussion i.e. due to the point and non point sources. There are several ways by which one can carry out aeration in the lake. They include surface aerators, aeration grids, effective water fountains and also by sparging compressed air. By introducing water fountains it serves dual purpose of aeration as well as beautification of the lake. The annexure I indicates the cost of aeration for typical 2 acres of the lake.

12. Cost Of Estimates And Phrasing Of Expenditures: -

This has been dealt separately elsewhere in the report. It is always recommended to spread the work schedule over 2-3 phases depending upon financial ability as well as to gauge the performance of the upgraded lake. Therefore we have suggested carrying out work in two phases. First deals with initial, comparative less, expensive followed by beautification plans.

13. Cost Of Institutional Details: -

This aspect has been dealt in detail and elaborated extensively in this report. The cost of such institutional arrangement with respect to work force will solely depend upon criteria of the State Government where as in house sophisticated laboratory will cost approximately Rs. 40 lacs.