LAKES & WETLANDS OF DELHI: SOME CASE STUDIES

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DELI, 1936
Sanjay Lake
Sanjay Lake
Hauz Khas
Shamaspur Khalsa
No. OF WATERBODIES IN DELHI

- 508 [2002]
- 693 [2004]
- 793 [2007]
- 900 [2010]
- 400 [2010]
WETLAND FUNCTIONS & ECO-SYSTEM SERVICES

- Habitat Function
- Hydrologic Functions – Aquifer Recharge
- Water Purification
- Local Climate Moderation
- Food Resource
- Carbon sinks
- Soil Moisture
- Food Resource
- Habitat
- Recreation
Threats To Lakes

a) Due to urbanization flows from catchments to waterbodies are interrupted
b) Land hunger and real estate perspective
c) Most riverfed waterbodies are disconnected from the river because of intervening embankments
d) Siltation of waterbodies takes place through settlement of sludge from waste waters inflow leading to eutrophication of waterbodies
e) Solid waste is surreptitiously disposed into some waterbodies to reclaim the land [even flyash disposal has been done in some major waterbodies], religious offerings disposal
f) Village ponds are often marked for acquisition and reclamation by the govt. for various forms of social infrastructure [schools, dispensaries, sports facilities, etc.]. As the pond lands are public lands no acquisition proceedings or compensation is required. [Case of Reola Khanpur]
g) In many cases the ponds have become engulfed in the abadi area and become cesspools of waste water and the villagers are only too glad to have them filled up
h) Ritual Bathing
• Wetlands (Conservation and Management) Rules, 2010
• Ramsar Sites
• Central Wetland Regulatory Authority
• NLCP
• Lake Development Authority [Bangalore]
• City Masterplans
• EPA
SOI MAP OF 1936

1883 Gazetteer : Spread 22 Sq.Km.
Najafgarh Jheel – 1995 Flood -7 Sq. Km. Spread
Contour Level at CPAL - 

Contour Level in Core Area = 106.0

Contour Level at Outer road = 100.1
Eutrophication

Nitrogen
Phosphorus

These nutrients cause an increase in phytoplankton.

Phytoplankton grow on the leaves of SAV.

Oxygen

SAV Die

Sediments from land block sunlight.

Lose: Food, Habitat & Oxygen Production

Algal Bloom
Algae Die
Decay
• WATER BALANCE
• WATER QUALITY
• THE SHORELINE
• THE CATCHMENT
• THE WATER TABLE
THE EQUATION FOR WATER BALANCE

COLONIZATION OF THE WATERSHED
Urbanization of Catchment Characteristics

1936: Catchment Area (10 Sq.Km) Natural With Three SW Channels

2001: Catchment Area Tapped (1.75 Sq.Km)
Operational Scheme

- Storm Water From 175 Ha Catchment
- Treated Effluent From Vasant Kunj STP
- Directed to Hauz Through Series of 5 Check Dams in Sanjay Van
- From Last Check Dam 3 Km Pipeline (600 mm Dia. PSC) Laid in SW Nala To Hauz
- Gravity Flow Ensured Hence-No Energy Consumption.
STP Effluent Upgraded Using Duck Weed Aquatic Plant

1. Duck Weed Nursery

2. Duck Weed Introduced In Check Dam

3. Duck Weed Growth

4. Duck Weed Carpet in Check
Dug Well (1961) Adjacent Sanjay Van Middle Check Dam

Water Level in Dug Well At 3.5 MBGL
Storm Water Channels in Reserved Forest in Hauz Khas Carrying Sewage
Rain Water Inflow
Water Parameters

TREATED EFFLUENT AT SANJAY VAN
(November, 2004)

- pH : 7.5
- TDS : 464
- TSS : 28 mg/l
- Nitrate : 6.67 mg/l
- Fluoride : 0.73 mg/l
- Phosphate : 4.63 mg/l
- BOD : Less Than 1 mg/l
- COD : 4 mg/l
- DO : 6.3 mg/l
- Iron : 0.19 mg/l
- Chloride : 105 mg/l

HAUZ RESERVOIR
(November, 2004)

- pH : 8.5
- TDS : 778 mg/l
- TSS : 101 mg/l
- Nitrate : 5.43 mg/l
- Fluoride : 0.32 mg/l
- Phosphate : 4.71 mg/l
- BOD : 8 mg/l
- COD : 77.22 mg/l
- DO : 6.6 mg/l
- Iron : 0.876 mg/l
- CaCO₃ : 293
- Cd : ND
- Ni : ND
Ground Water

**March, 2003**
- pH : 7.6
- Chloride : 70 mg/l
- BOD : 3 mg/l
- COD : 10 mg/l
- Nitrate : 20 mg/l
- EC : 650 mohms/cm
- TDS : 425
- Ammonia : 0.04 mg/l
- Total Hardness : 350 mg/l
- Fluoride : 0.1 mg/l

**MID-PROJECT (April 2004)**
- pH : 7.1
- Chloride : 84 mg/l
- BOD : 1 mg/l
- COD : 4 mg/l
- Nitrate : 1.14 mg/l
- Phosphate : 1.44 mg/l

**April, 2013**
- pH : 7.7
- Chloride : 92 mg/l
- BOD : BDL
- COD : BDL
- Nitrate : 4.3 mg/l
- Phosphate : BDL
- Fluoride : 0.4 mg/l
- Total Coliform : 125 [MPN/100ml]
- Total Hardness : 404 mg/l
- TDS : 556 mg/l
- EC mohms/cm
Monitoring Wells

- Water in Bore No.7 Risen From 20 MBGL to 8 MBGL
- Water Appeared in Wells No.2 & 3
- Dry Handpumps in Hauz Khas Village Revived

- Rain Water Recharged From Sep 2003 to Date 300 Million Litres (Estimated)
- Treated Effluent Recharged From Sep 2003 to Date 1000 Million Litres (Estimated)
Hauz Khas Lake Polluted Through Mismanagement
BIOREMEDIATION USING ANAEROBIC & FACULTATIVE BACTERIA STRAINS

BoD Reduced from 18 mg/l to 10 mg/l
Bottom DO Increased from 1.5 mg/l to 5 mg/l
IMPROVEMENT THROUGH BIOREMEDIATION
# Quality of Lake Water Before & After ABR Treatment

<table>
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<tr>
<th>Period</th>
<th>pH</th>
<th>Turbidity (NTU)</th>
<th>Conductivity (µS/cm)</th>
<th>BOD (mg/l)</th>
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<td>Spot 2</td>
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### Before ABR Treatment

![Before ABR Treatment](image1)

### After 1 week

![After 1 week](image2)

### After 2 weeks

![After 2 weeks](image3)

### After 3 weeks

![After 3 weeks](image4)

### After 4 weeks

![After 4 weeks](image5)
arrow central zone - thick stands of water hyacinth upto deep en
Deeper end- Reeds have grown providing habitat to birds

More than 400 birds (including migratory) inhabiting the lake

Cormorant, Heron, Spot-billed Duck, Shoveller, Common Coot, Pintail
PROBLEMS

• Disconnection From River Floodplain

• Very Little Water During Summers Due to Evaporation Losses

• Pollution Level High Resulting in Weed Growth [Hyacinth]

• Low Oxygen Levels Resulting in Low Aquatic Bio-diversity

• Settled Organic Sediments Release Nutrients Contributing to Poor Water Quality
## Water Quality

<table>
<thead>
<tr>
<th>S.No</th>
<th>Parameter</th>
<th>Units</th>
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<td>Oil and Grease</td>
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Inflow Treatment- Alternatives

• DEWATS
  (Decentralized Waste Water Treatment System)
• SAAF
  (Submerged Anaerobic Fixed Film)
• AFMT
  (Aeroflow Fluidized Media Technology)
• FAB
  (Fluidized Bed Technology)
**Ex-situ measures**

- Establishment of treatment wetland consisting of stabilisation pond
  - Constructed wetland planted with reeds
  - Utilization of harvest weeds

**Treated Effluent Characteristics**

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<th>Parameter</th>
<th>Value</th>
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<td>pH</td>
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Upgrading Adjacent Wastewaters For Admission into Lake to Neutralize Losses
Treatment Design

In-situ measures

• Removal of garbage

• Removal of water hyacinth stands

• Removal of soft silt through suction.

• Secondary Level WW Upgraded to Tertiary Level In Baffle Reactor & Wetland Channel

• Use of aerators

• Introduction of fish at a later stage
In Situ –Provisions

- Bio-Remediation Thru Fish Culture
- Fountain Aeration
Satellite Image of Bhalaswa Lake

- Oxbow lake on floodplains
- Area within embankments 47 ha
- Lake isolated from river by RME
- North arm of Lake now Landfill
High nutrient load due to horse/cow dung dumping along Bhalaswa Dairy -West
Satellite Image of Bhalaswa Lake

- Oxbow lake on floodplains - Area within embankments 47 ha
- Lake isolated from river by RME - North arm of Lake now Landfill Site

Locations:
- Bhalaswa Lake
- Mukandpur
- Sant Nagar
- Jaroda Majra
- Burari
- Yamuna
- Jahangirpuri
- Coronation Memorial
- Dr Mukherjee Nagar
- Wazirabad
Satellite Image of Bhalaswa Lake-Issues

- Wastewater Inflow
- Eutrophication
- Shallowing
- Inadequate Water
Eutrophication of Lake during summers – Water Hyacinth blooms
• Filling Bhalaswa Lake with Yamuna Flood Waters
• Backing Up In Supplementary Drain

2001
BHALASWA LAKE
Existing Profile & Bathmetry Map
Longitudinal Sections @ 20 m
Basic Data

- Upto 1.0 m below ground level (mbgl) mainly: 76% silt and clay
- 1.0 m to 5.0 m mainly: 59% fine sand
- 5.0 m to 8.0 m mainly: 55% fine sand
- 8.0 m to 10.0 m mainly: 70% silt and clay
- 10.0 m to 20.0 m mainly: 80% clay
- 20.0 m to 30.0 m mainly: 70% silt and clay

Average th. of layer of settled deposits is less than 0.15 m.
The soil analysis reveals:
- Nitrate content: 2200 mg/kg
- Phosphate content: 2000 mg/kg

GW Quality
[TDS 2287 mg/l, Nitrates 31/mg/l]

Surface Water Quality
BoD 12mg/l Coliform 2210/100 ml, DO 4.0 mg/l]

Supplementary Drain Water Quality
BoD 50 mg/l, TDS 1010 mg/l, Nitrate 4.0
Analysis

- Removal of excess nutrients from bed
- Trapping of non-point inflows
- Fencing barrier against cattle ingress and gobar dumping
- Treated water to be arranged to replenish losses of evaporation & percolation
- ‘C’ class CPCB water quality to be maintained [direct contact recreation]
- All facilities proposed such as aquarium, marriage hall need to direct their effluents away from lake
- Excavation of bed profile should not puncture the upper clay layer
- 1.5 m depth requirement for many [non contact] water sports [1000m straight length for rowing, >5 ha for dinghy sailing, <15 ha for skiing] – as such bed profile needs modification
• 0.40 MCM of Excavation to 204 mamsl
• Disposal on west bank area
• Desiltation to be carried out April - June
Proposed Modified Profile

40 Ha Waterspread
0.5 MCM Storage Volume at FSL
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Note: [+] denotes additions, [-] denotes losses
Total Design Volume: 6500 CUM/Day (6.5 MLD)

Note: 6.5 MLD peak requirement during summers rounded of to 7.0 MLD
Proposed Plan

- Pre- Treatment in Drain
- FAB STP of 7.0 MLD Capacity x 4000 sq.m. area
- 10 HP x 22 No. Vertical Aerators
- 30 HPx 1 No. Vertical Aerator at Deepest Point
- Circulation of Water 1 MJD north to south end
- Bio-remediation in situ
- 5 lakh carp fish to reduce algae and detritus
- Diversion of non-point inflows
- Burari Creek waters
Embedded 7 MLD Baffle Reactor With ABR Treatment

Grass Carp & Indian Carps

Battery Of Vertical Fountain Aerators

Settling Zone On Drain For Reduction Of SS Using Shallow Weir Wall

7 MLD Drain Water Pumped From Supplementary Drain Through Embankment To Baffle Reactor

0.5 MLD Water Pumped Out For Non-Potable Purposes To Set Up Circulation
Floating Treatment Wetlands (FTWs)

Biofilm covers the island and the plant roots

MATRIX

ROOT HAIRS

VARIABLE WATER DEPTH

BENTHIC LAYER

BOD/TOC P Cu Zn N Ammonia
Rain Filled Bhati Mines Pit No.12 - 1996
Thank You