ELEMENTS OF LAKES

URBAN LAKE VISION DOCUMENT

This document has been made to be used as a community resource and is meant to evolve with the contributions and experiences of everyone working to protect lakes.

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LAKE
VISIONING
DOCUMENT

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WHAT IS THE PURPOSE OF THIS PRESENTATION?

While the lakes in Bangalore were originally created as tanks largely for the purpose of irrigation, in current times it has been observed that there is no requirement for water for agriculture from urban lakes and that it serves more as an urban lung space for urban biodiversity, recreation, flood mitigation and groundwater recharge. The functions that a lake serves or is expected to serve is key to deciding the designs of some of the physical elements in a lake

This presentation is a tool that can be used as a part of the Lake Visioning exercise to understand the physical elements of a lake and help make choices for implementing the imagined vision of the lake

In this document we discuss in detail

- The Functions of the lake
- The Physical Elements of Lake and the design choices that can be made
- The dependencies between the Lake Functions and the design of the Physical Elements of Lake

FUNCTIONS OF AN URBAN LAKE

01 ECOLOGICAL

This includes flood control and the maintenance of biodiversity.

02 WATER SECURITY

This entails groundwater recharge and storage, and treatment of wastewater for its reuse.

03 LIVELIHOODS

This includes fishing, grass-cutting, maintenance of a Dhobi Ghat for washing of clothes.

04 COMMUNITY

This function covers educational services, religious services, recreational and lung spaces.

MAPPING FUNCTIONS TO PHYSICAL ELEMENTS

CORRELATIONS BETWEEN LAKE FUNCTIONS AND THE DESIGN OF PHYSICAL ELEMENTS OF THE LAKE

The functions that a lake is able to well serve is affected by the design choices that we make for some of the physical elements of the lake. For instance

- If a lake is seen as a place for urban community events - a well-designed amphitheater, library, community hall, walking paths help achieve the purpose.
- A shallow lake and islands seem to attract more birds as opposed to a deeper lake.
- If it is observed that water in the lake affects groundwater tables, it is useful to ensure that the lake is de-silted at frequent intervals so that it continues to recharge groundwater. A monitoring system for tracking lake water levels and lake water quality would also be good to have in place.

We attempt to draw correlations between the expected functions of the lake and the design of some of the physical elements so that the lake groups are able to make informed design choices for their lake

	Ecological	Water Security	Livelihood	Community
Lake Profile	y	y	y	
Wetlands	y	y	y	
Islands	y			
Inlet		y		
Diversion Drain		y		
STP and Treated Wastewater Reuse	y	y		
Overflow and Sluice gate		y		
Bund / Walkway		y		y
Trees and Gardens	y		y	y
Kalyani				y
Solid waste management	y			y
Gates				y
Fence				y
Security Cabin				y
Toilets				y
Gazebo				y
Fishing jetty			y	y
Amphitheatre				y
Electricity				y
Zonation	y			y

FIGURE 1 : CORRELATIONS BETWEEN LAKE FUNCTIONS AND THE DESIGN OF PHYSICAL ELEMENTS OF THE LAKE

1. LAKE PROFILES

WHY IS A LAKE PROFILE IMPORTANT ?

When a lake is taken for rejuvenation the design should be well thought out and should be based on the functions that the lake is expected to serve.

Once the function of the lake is identified, the design can be appropriately decided. eg.

- If Groundwater recharge is expected to be the primary function of the lake it is important that the bed of the lake is on a layer of soil with high recharge rates. Regular desilting will also have to be carried out to ensure optimum groundwater recharge
- If the lake is seen as a spot for Urban Biodiversity then it is essential that the lake has a gradual slope. Islands, wetlands with varying habitats, and undisturbed areas around the lake help biodiversity thrive

LAKE PROFILE: SOUP BOWL

Many lakes in Bangalore have a soup bowl design. In this design the side slopes are steep and the depth of the lake is more or less uniform and the water holding capacity of the lake is maximized. However, as there is a steep drop in the depth and not gradation there is very limited scope for rooted and submerged macrophytes to grow. This in turn reduces the biodiversity at the lake. This is the standard design by BBMP.

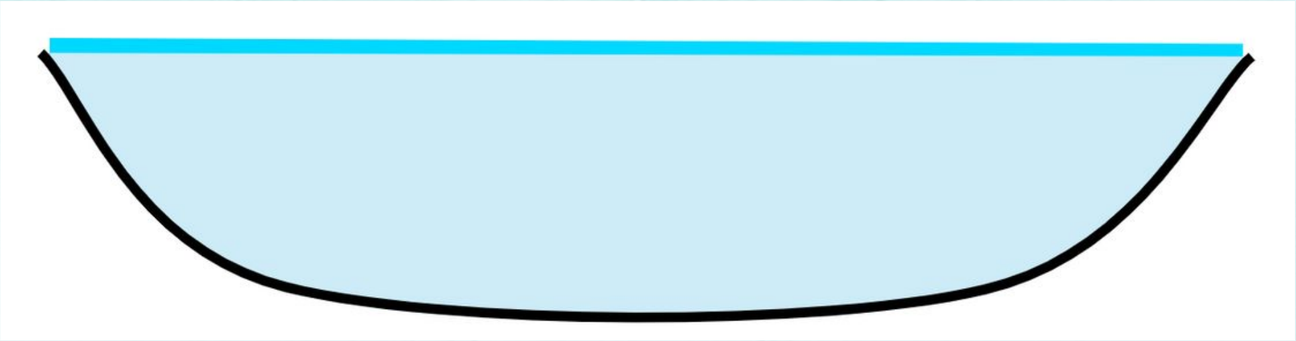

FIGURE 2 : SOUP BOWL LAKE PROFILE

LAKE PROFILE: SOUP BOWL

Advantages

- This design creates maximum water holding capacity.
- This design helps in the recharge of groundwater and irrigation

Limitations

- Cattle grazing not allowed in the lake premises as the lake is deep
- Loss in biodiversity. Submerged plants, fishes, and birds which requires shallow space for roosting and breeding are often not found at these lakes

LAKE PROFILE: GRADUAL SLOPE

When the lake has a gradual slope, different kinds of macrophytes thrive in the lake. This in turn helps increase biodiversity. However, due to the gradual slope, water holding capacity is reduced as compared to the Soup Bowl design.

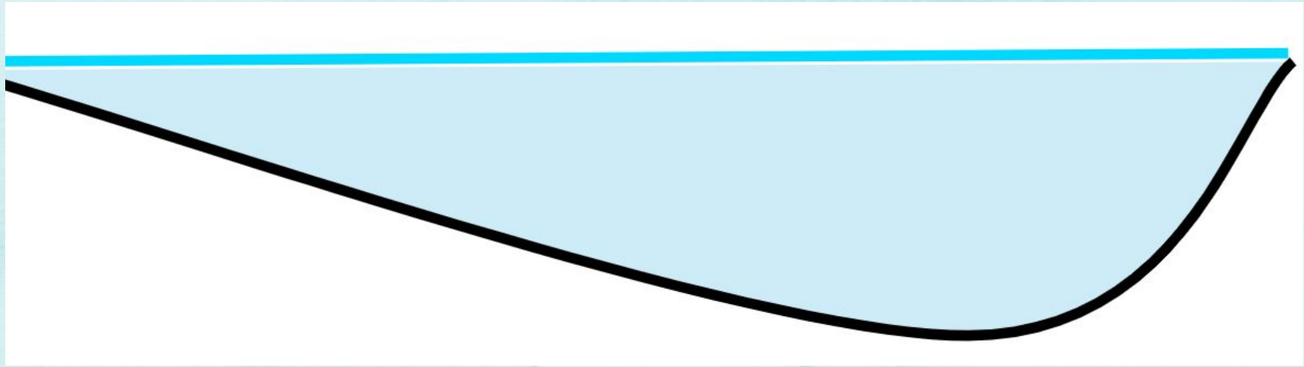

FIGURE 3 : GRADUAL SLOPE LAKE PROFILE

LAKE PROFILE: GRADUAL SLOPE

Advantages

- Space for different forms of biodiversity to exist.
  - Many species of submerged plants, birds such as waders and fishes thrive in the shallow part of the lake
  - The middle and deep part provides space for large fishes and birds. Swimmers and divers will be seen.
- Cattle grazing can be allowed in parts of the lake. This, in turn, helps maintain the lake
- The designated area can be provided for cattle drinking

Limitations

- Reduced water holding capacity

2. WETLANDS

IMPORTANCE

Wetlands are perhaps one of the most biodiverse ecosystems as they are home to birds, fish, reptiles, amphibians, insects, and many plant species as they provide spaces for roosting, nesting, and feeding, as well as a refuge during extreme weather conditions.
Natural wetlands have often been referred to as "earth's kidneys" because of their high and long-term capacity to filter pollutants from the water that flows through them.

Unlike other landforms or water bodies, wetlands tend to have characteristic vegetation, like aquatic plants which absorb the nutrients in the water and improve the quality of water.
In Bangalore, one can see different kind of wetlands which help in purifying the water before it exits the lake

- Natural
- Constructed
- Floating
- An entire lake as a wetland

For more information regarding Urban Wetlands refer to WETLAND primer

CONSTRUCTED WETLANDS

Constructed wetland is an artificially created wetland to treat stormwater runoff or treated wastewater before it enters the lake. This is built at the inlet of the lake or tank.

In the case of Jakkur Lake

- Every day, 15 MLD of treated wastewater from the STP passes through the wetland and into the lake.
- The treated water passes through a 7-acre wetland
- This wetland consists of a reed bed followed by an algal pond and a stone bund that separates it from the main body of the lake.

WETLANDS

FLOATING WETLAND

Floating islands/wetlands are constructed using wood/Plastic/Metal or natural material. Floating islands are small artificial platforms that allow aquatic emergent plants to grow in water. Their roots spread through the floating islands and down into the water creating dense columns of roots with lots of surface area. The roots of these species are floating in the water which absorbs the nutrients from the water. They are harvested at regular intervals so that there is no biomass accumulation in the lake. They can be of various sizes from 2x2ft to larger sizes of 8x10ft.

Hebbagodi Lake, Electronic City has over 400 floating islands which help keep the water clean

ENTIRE WETLAND AS A LAKE

An entire lake can be a wetland when the wetland plant species are found all around and in the lake. If the lake is a shallow lake and there are Macrophytes such as

- Emergents: eg. Typha
- Submergent : eg. Hydrilla
- Floating: eg. Lotus

the lake water quality and health will be good.

When the lake is filled with free-floating macrophytes eg. Alligator weed, Water Hyacinth, it can lead to undesirable conditions (like low oxygen levels) and deteriorate the health of the lake.

A discussion of objectives of 'Lake Visioning' in the process of working towards

3. ISLANDS

ISLANDS

IMPORTANCE

Why are islands required?

For birds to roost and nest they require spaces where there is no human disturbance. Islands are created mainly for bird habitat and biodiversity. It also gives an aesthetic look.

Depending on the area and design of the lake there can be one or many islands in a lake.

FIGURE 4 : ISLANDS

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4. INLETS, FILTERS, AND SILT TRAP

INLETS

Inlets are designed depending on the quantity of water that enters the lake. As inlets can carry solid waste such as paper/plastic usually a waste trap is designed at the point where the water enters the lake or the wetland.

Rajakaluves or the Storm water drains carry runoff water from the catchment area into the lake. However, this water is mixed with sewage and solid waste by the time it enters the lake.

SOLID-WASTE TRAPS

To prevent solid waste from entering the lake, traps can be placed at the inlets. This trap has to be maintained regularly.

FIGURE 5 : Trap used at Puttenahalli lake-JP Nagar

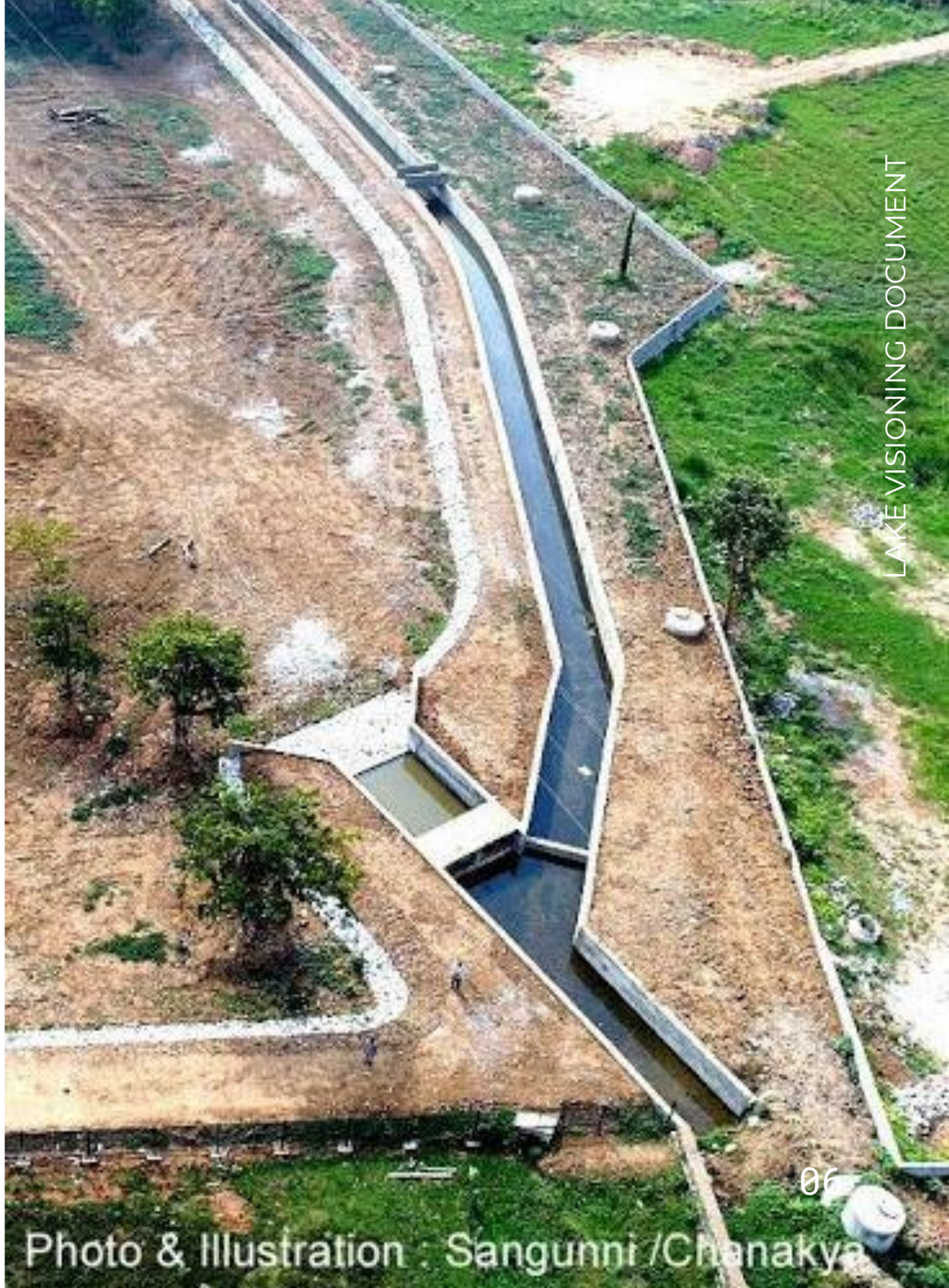
FIGURE 6 : Solid waste trap at Harlur lake

SILT TRAP

Silt is carried along with the rainwater runoff. To prevent silt from entering the lake a silt trap can be placed at each of the inlets.

SILT TRAP

At Puttenahalli-Yelahanka lake when the inflow is low and the water level in the runoff channel is low, it flows into the diversion channel. When there is heavy runoff from heavy rain and the water level in the drain is high, a large part of the runoff flows past the barrier into the shallow end of the lake over a boulder trap that arrests silt and debris.



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5. DIVERSION DRAIN AND MECHANISM

DIVERSION DRAIN AND MECHANISM

Diversion drains are built around the lake to ensure that sewage flowing into the lake through stormwater drains or sewage drains does not enter the lake. For this, an obstruction wall is built at the entrance of the stormwater or wastewater line into the lake (to keep the wastewater from flowing into the lake) and the water is diverted into the diversion drain. The height of the obstruction wall ensures that during the dry season (when the water level in the drain is low) pure sewage does not enter the lake.

However in the rainy season when the water levels in the drain is high and the sewage is mixed with rainwater, this combined water is able to flow over the obstruction wall into the lake. At times, citizens regulate the flow of water into the lake by increasing the height of the obstruction wall by placing sandbags on it. The diversion drain is normally routed along the periphery of the lake and opens out into the drain near the overflow from the lake.

In an ideal case, diversion drains would not be required as all inflow could flow into the lake and there would be no sewage inflows. However, diversion drains are also found to be useful during lake maintenance and lake desilting

DIVERSION DRAIN AND MECHANISM

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The drain has to be designed keeping in mind the current inflow and expected future flows (based on the development in the area)

The diversion drains could be open as in Puttenahalli-Yelahanka, covered with slabs as in Saul Kere or could be closed pipes with access through manholes.

Maintenance of these drain at regular intervals has to be planned.

BBMP and the Lake group are usually responsible for the maintenance of the drains.

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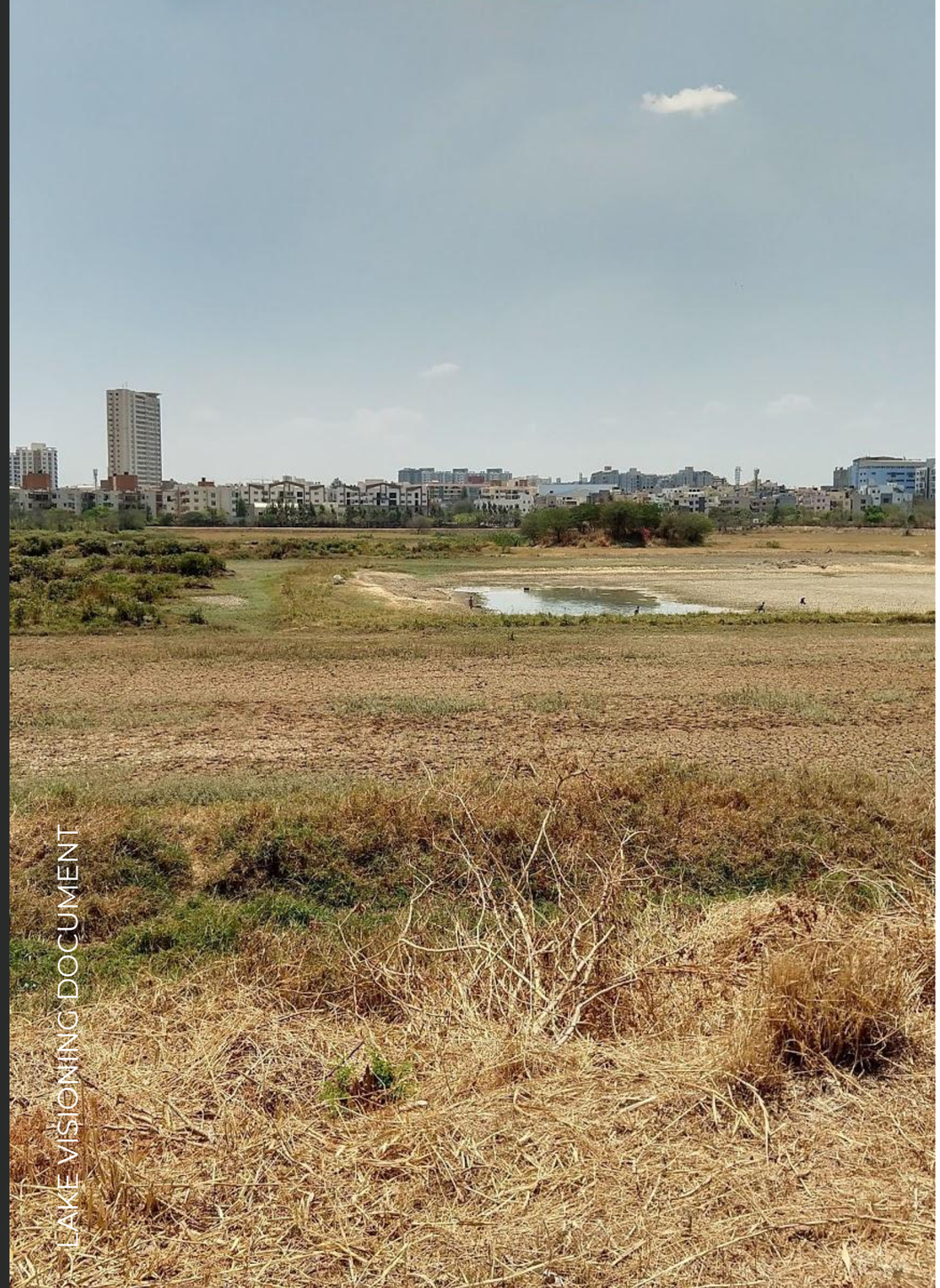
6. STP AND TREATED WASTEWATER REUSE



STP AND TREATED WASTEWATER REUSE

Lakes in Bangalore were mostly seasonal and did not hold water all through the year. In the current times also, lakes go dry due to reduction in the catchment, encroachment on stormwater drains, groundwater extraction, etc. However, in some cases, there is a felt need to have water in the lake all year round due to the demands from fishing and also from the use of a lake as a recreational space.

While the lakes do not receive adequate fresh water there is wastewater ingress into the lake. This can be addressed by setting up an STP for the lake where treated wastewater from the STP is let into the lake after passing through a WETLAND. The design of the STP should consider the quantity and quality of wastewater that is currently flowing into the lake as well as the estimated future flows. Based on the quality and quantity of inflow type and design of treatment has to be decided.

LAKES WITH TREATED WATER

FIGURE 7: Jakkur Lake receives STP-treated water into the lake.

For more information
https://biometrust.blogspot.com/2018/01/jakkur-lake-report.html
https://biometrust.blogspot.com/2018/05/wetland-maintenance-jakkur-lake.html

LAKES WITH TREATED WATER

FIGURE 8: Hebbagodi lake uses enzyme to treat the raw sewage in the drains which enter the lake

For more information
https://biometrust.blogspot.com/2018/09/hebbagodi-lake-report_14.html

TREATED WASTEWATER FROM APARTMENTS

While it is mandatory for apartments to set up sewage treatment plants they are often unable to use all the treated wastewater within their campus. Letting this treated STP water into an adjacent lake can also be explored as an option. This is being done in the case of Puttenahalli JP Nagar. This ensures the reuse of treated STP water as well as provides water to the lake all year round.

To let this water into the lake one must get permission from BBMP and KSPCB. Puttenahalli JP Nagar Lake is one such lake that is getting STP-treated water into the lake from an apartment nearby.

A discussion of objectives of 'Lake Visioning' in the process of working towards

7. OVERFLOW WEIR AND SLUICE GATE

OVERFLOW WEIR AND SLUICE GATE

An overflow weir maintains the water level in the lake. Water overflows from the overflow weir when the lake is full. The overflow level can also be regulated with a sluice gate. Overflow weir is usually a concrete structure or stone pitched. Most of the urban lakes have an overflow weir.

A sluice gate (seen in the figure on the left) is a water flow control mechanism.

OVERFLOW WEIR AND SLUICE GATE

NEERUGANTI

Neeruganti - Every lake used to have a person (Neeruganti) who was responsible for operating the sluice gate and hence for distribution of water to the village or community tanks. This role is played by different people on an annual rotation basis

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8. BUND / WALKWAY

BUND / WALKWAY

A bund is an embankment used in water bodies to control the flow of water. Bund in lakes is usually seen at the outlets. However, in the urban scenario when lakes are taken for rejuvenation some of the silt from the lake is used to create a ring bund all around the lake. Though the primary function is to control the flow of water it is now also used for walking, cycling, and movement of heavy vehicles when required.

A bund is a technical structure and has to be designed by engineers.

The design of the bund on all sides other than the overflow side can be decided depending on the requirements of the lake and the stakeholders.

For walkways, bunds can be paved using mud, cement interlocking tiles, or any other material appropriate for the required function.

The decision can be taken if the walkway will be all around or only a part of the lake.

Some lakes have walking paths and cycling paths side by side, whereas some lakes say no to cycling at the lake.

BUND / WALKWAY

FIGURE 9: A bund with a walking path by a lake

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9. TREES AND GARDENS

TREES AND GARDENS

Most lakes in Bangalore have trees. When the lake is taken for rejuvenation different kinds of trees are planted around the lake and also on islands. Gardens need to be maintained.

Trees can be

- Native trees as they require minimum maintenance
- Not all species of trees can be planted next to the bund. (Contact an expert for the same)

Gardens

- Butterfly garden
- Herb garden
- Community garden
- Endangered species garden

Contact and Expert information

- Ananas - https://ananas.design/services
- Saytrees - saytrees.org
- Afforestt - afforestt.com
- Vruksha - http://vruksha.com/index.php/about-

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10.KALYANI

KALYANI

Kalyanis are step-wells or reservoirs built as part of the temple complex near Indian temples. These were used for bathing and religious activities.

In recent times Kalyani's are being built at the lakes when the lakes get rejuvenated. Lakes were earlier used for immersion of idols and other domestic purposes.

However, with restrictions to access water at the lakes, space is usually designated for Kalyani for religious activities like Idol immersion, performing last rites, etc.

KALYANI

While building a Kalyani, points to keep in mind are as follows

- Size of the Kalyani
- How to fill the Kalyani with water
- Access for vehicles for cleaning the Kalyani
- Identifying a space close to the gate for easy access
- Activities allowed at the Kalyani
- A board stating the do’s and don'ts

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11. SOLID WASTE MANAGEMENT

SOLID-WASTE MANAGEMENT

Solid Waste Management inside lake is a challenge.

- Plan for dustbins at the entrance gate only or locate the dustbins in places with easy access for clearing
- If food/ plastic is allowed inside the lake then plan for bins to segregate the waste
- Sign boards with no littering signs can be placed around the lake.

A discussion of objectives of 'Lake Visioning' in the process of working towards

12. GATES

GATES

All lakes are open to the public and all gates of the lake are accessible to the public. There are security guards provided by BBMP for lakes. The gates remain open for specific timing in the morning and evening for the public. At the entrance, parking spaces can be identified.

Signboards with information about lake rules, timings, and other information can be placed at the entrance of the lake
A side/smaller gate can be provided for people walking into the lake. This can be designed into the main gate or placed adjacent to the main gate.

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13. FENCE

FENCE

Fencing the lake boundary is important to mark the boundaries and prevent encroachment as well as to ensure that miscreant do not easily access the lake outside of lake timings

Fencing is normally done by the BBMP. A lot of lakes also have inner fencing for the water body. When a lake is rejuvenated with bund all around the lake, there are chances of people/animals falling into the lake. Hence fencing might be required around the water body.

A fence can be barbed wire, metal fence, or natural hedges. Barbed wire or metal fencing is preferred for the outer fence. Hedges and other natural forms of fencing can be used for fencing the water body.

A discussion of objectives of 'Lake Visioning' in the process of working towards

14. SECURITY CABIN

SECURITY CABIN

Security cabins are places where the guards for the lakes sit. Should be near the gates. These can be a metal box as shown in the picture or can be a concrete structure that can be used as office space and as a storage space for tools etc.

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A discussion of objectives of 'Lake Visioning' in the process of working towards

15. TOILETS

TOILETS

Some lakes in Bangalore have toilets. Depending on the foot fall at the lake, toilets are constructed appropriately. It is observed that it is hard to maintain the toilets. Thefts and vandalism are constant problems

While considering to have toilets the following should be considered

- What will be the water source?
- Who will clean the toilets?
- Indian style or western style?

Indian style toilets are hygienic and easier to clean and will require less water for maintenance.

Source of water can be from a well in the lake premises or an Rainwater Harvesting system with a simple design can be an option.

A discussion of objectives of 'Lake Visioning' in the process of working towards

16. GAZEBO

GAZEBO

Gazebos add elegance to the lake garden where people can relax. It is useful also to have team meetings, exercise, and during kere habbas etc.

A discussion of objectives of 'Lake Visioning' in the process of working towards

17. FISHING JETTY

FISHING JETTY

Fisherman need a space to launch their boats from. Speaking to fisherman one will get to know about these locations in the lake
Usually launching place will have gentler slope and space to park the coracle/ boat.

A discussion of objectives of 'Lake Visioning' in the process of working towards

18. AMPHITHEATRE

AMPHITHEATRE

An amphitheatre or amphitheater is an open-air venue used for entertainment, performances, and sports.

Some lakes have amphitheater in the lake area. This space is used for concerts, meetings, seminar, educational activities for school children and during Kere habba for various activities.

A discussion of objectives of 'Lake Visioning' in the process of working towards

19. ELECTRICITY /LIGHTING

ELECTRICITY/ LIGHTING

Most lakes in Bangalore do not have electricity at the lake or limit it to the Security cabin. Kaikondrahalli lake is one of lake which has lighting at the lake.
Evaluate why electricity and light is required at the lake.
It has been observed that the light bulbs and poles get vandalised and stolen.

A discussion of objectives of 'Lake Visioning' in the process of working towards

20. ZONATION

ZONATION

Community Zone is the space where communities can come together for various activities. This area can have Kalyani, Children's area, Pet area, Fishing activity, Amphitheater, Gym, Community garden, etc.

Conservation Zone is a space with very minimal human access/ interference. This will help increase Biodiversity. This can also be space for protecting endangered trees, plants, herbs etc. Also, birds, insects thrive in spaces with little or no human interference.

ZONATION

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Puttenahalli-Yelahanka Lake has been designed in a way that human access is allowed only to one part of the lake. This helps biodiversity thrive in the conservation zone.

Jakkur Lake has demarcated Community Zone and Conversation Zone. There are no activities in the conservation zone. Medicinal plants, endangered plants have been planted in the Conservation zone. Minimal maintenance is done in the conservation zone.

Visuals that show the relation between function and physical element design

21. INFOGRAPHICS

INFOGRAPHIC 1

CONSERVATION FOCUSED

INFOGRAPHIC 2

COMMUNITY FOCUSED

INFOGRAPHIC 3

COMMUNITY AND CONSERVATION FOCUSED

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