
AYALA

AYALA *Water & Ecology*
AYALA *Natural Biological Systems*
Private Limited

Sustainability Experts

Practicing nature-based solutions for more than 30 years

Global Environmental issues and Goals:

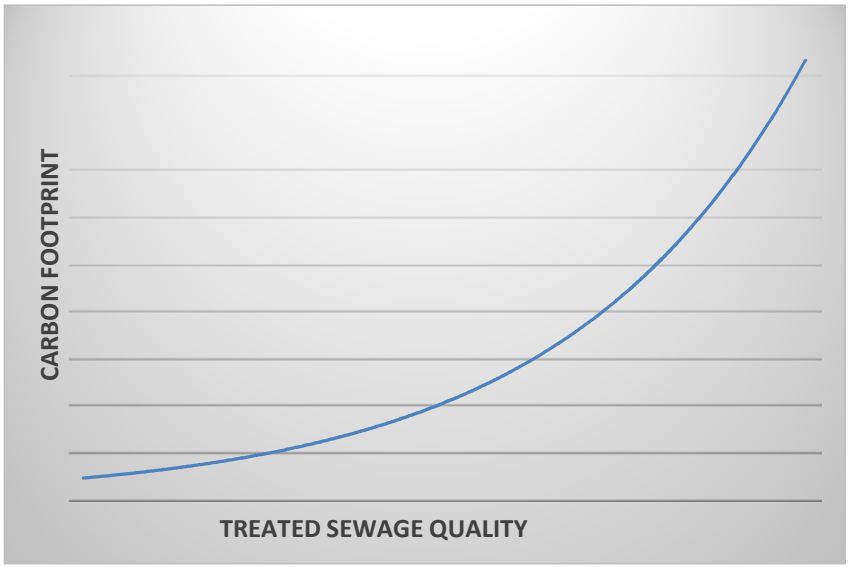
GOAL 1: Lower Carbon Emissions

GOAL 2: Better Sewage Treatment

Conventionally used technologies for remediation are:

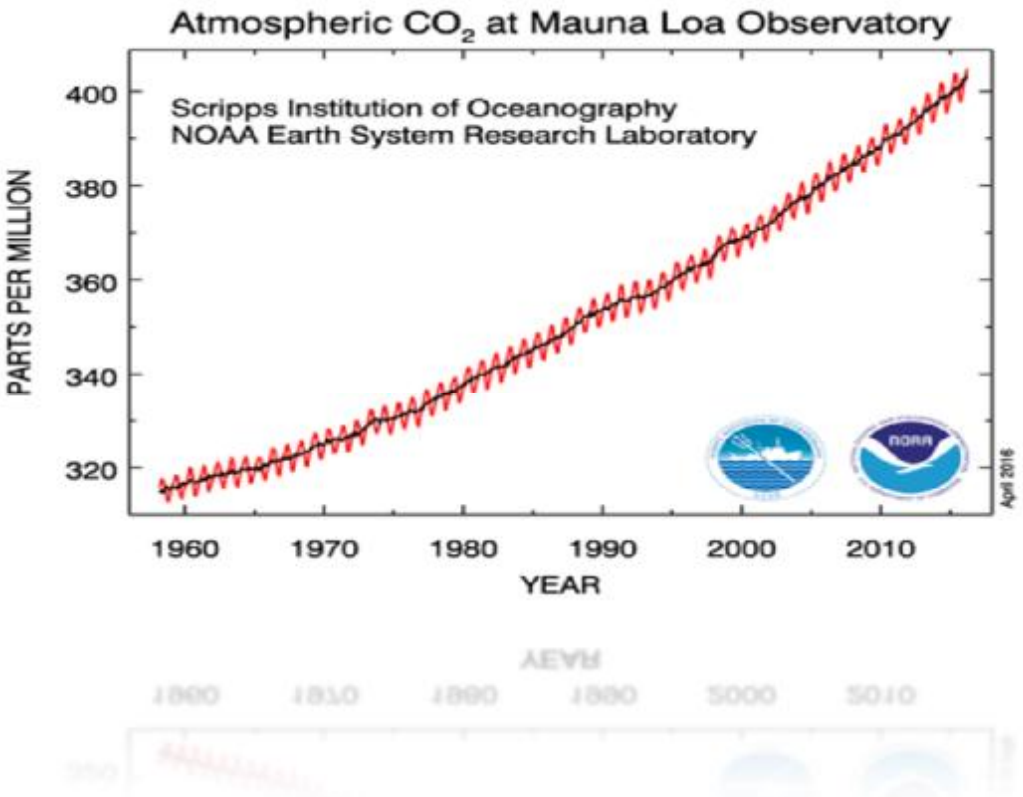
- Immense energy consumers
- Require intensive O&M, and;
- Often produce harmful by-products that are much more difficult to treat

Typical Energy (CO_2 emissions) for Water Treatment



Current Situation
Water, Energy and Environment Compete

...AND NO ONE WINS

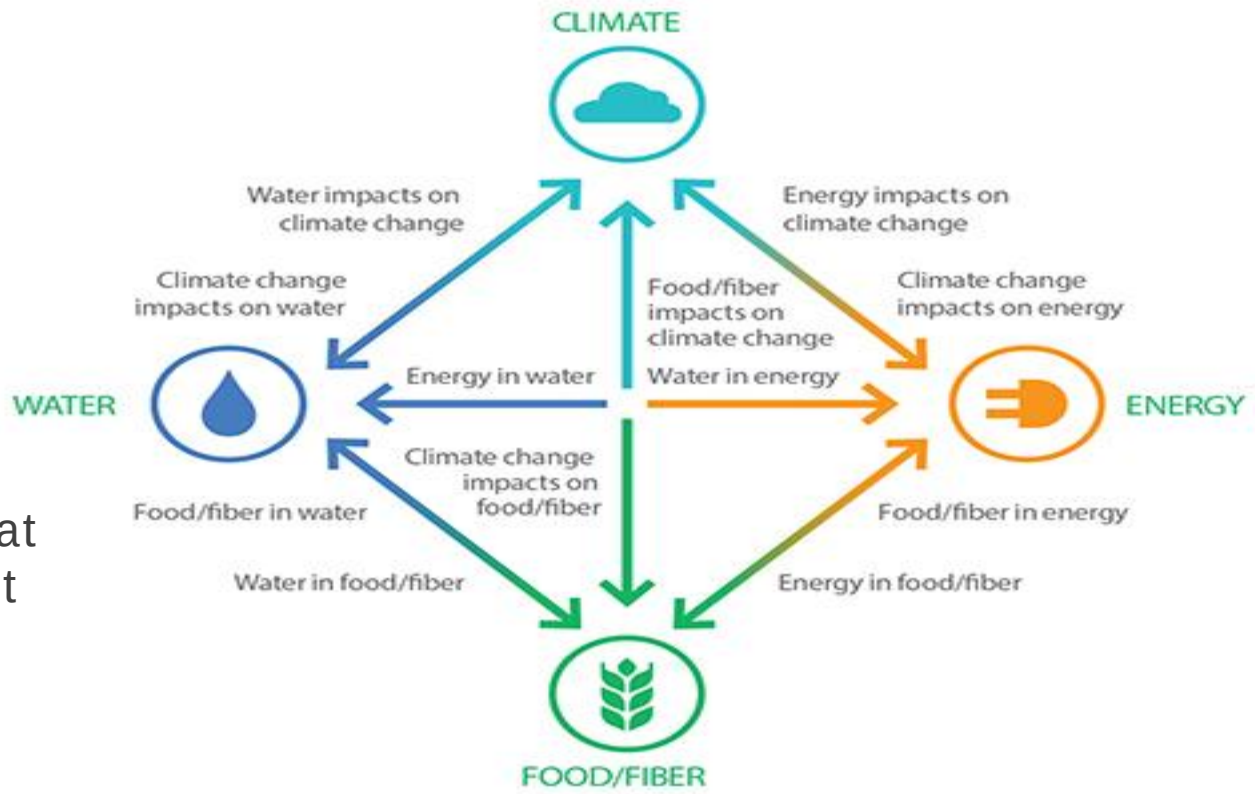


Water & Power Nexus

35%

Of Energy
Production used for Water
Treatment Systems

Electricity is a per-requirement to treat water in conventional water treatment systems (*STP, ETP & Desalination*)



History of sewage treatment practices through the last century, in brief:

- Until 60 years ago most sewage world wide ran freely, many time untreated
- In developed countries you could find settling tanks followed by freely aerated lagoons
- This systems could cope with the task as long as quantity remain reasonable and inlet quality as well
- Natural aeration + sun radiation + additional rain water kept the quality reasonable
- Many times systems were not sealed with artificial materials which allowed part of the water to infiltrate through the ground, get treated naturally and recharge the aquifers.
- Advanced availability of water due to easy pumping from local and remote aquifer enlarge dramatically the sewage volume
- Rise of life quality accompanied with more industrial and commercial centers, enlarged as well the volume but simultaneously reduced quality dramatically
- The passive aeration lagoons could not stand any more in the pressure and become a burden
- A new style energy and chemical based technologies took place
- From here a new path was marked which took hold across the globe with the help of good marketing
- The traditional natural methods were forgotten and technically were pulled out of the science main stream

- Main approach become to be: **centralized systems**
- Long pipe lines and intensive pumping stations become a common practice
- STP's become more intensive, expensive and complicated
- Regulators adopt the concept and made it mandatory
- Leading practice, the activated sludge, could not supply a stead reliable quality demand and more intensive practices developed

But in the end of day:

The problem was not solved but got worse

Why not centralize?

- High cost of infrastructure
- Complexity of infrastructure especially in dense developed areas
- Short life span of infrastructure
- Current infrastructures are collapsing even in developed countries
- Intensive energy demand for operation
- Complex and expensive operation of the pumping stations
- Sewage leakage from sewage pipelines
- Lack of control of this leakage which affects current aquifers
- Colossal damage in case of earthquake
- Cost of infrastructure to supply sewage to STP can reach upto 80% of the total cost

Our best approach is the **on-site solution**

Treatment of sewage as close as possible to the source - we call it the “Active landscape”

The common used technologies are our Bottleneck

- Difficult and expensive STP & ETP installation

- Complex infrastructure
- High energy, operation and maintenance
- Failures at critical moments

The Nature Based Solution= *Sustainability*

Minimal human involvement and **Zero** use of fossil energy

- Economically viable
- Tailor-made
- Treats many pollutant types
- 100% natural - no flocculants, no sludge
- NO energy, low maintenance
- Easy and quick to install
- Meets regulatory demands
- Modular and scalable

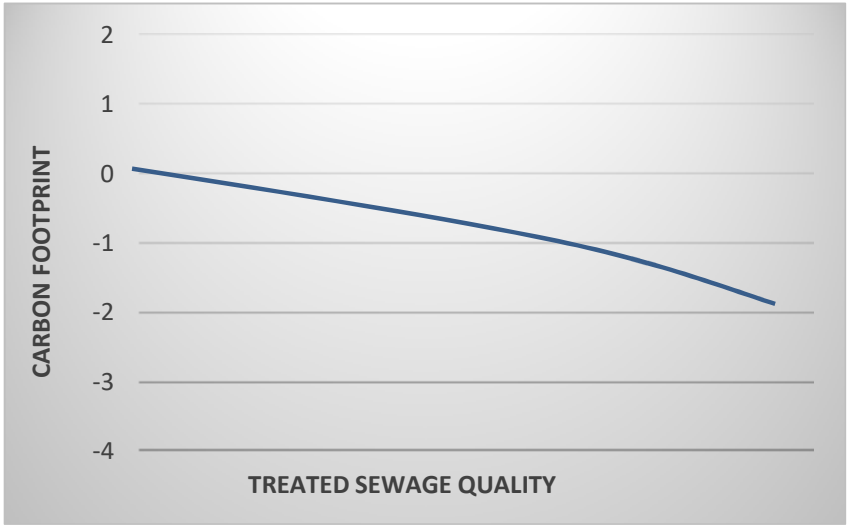
Why Nature Based Solution?

- Zero demand of energy and chemicals in the process of treatment and management of sewage and water
- No electromechanical elements
- Negligible maintenance
- Zero emission of footprint
- Carbon sequestration
- Enlarging green cover, rebalancing the thermodynamic balance
- Long lasting
- Producing very high quality water in the entire spectrum of contaminants
- Very effective and steady buffer
- A social system, part of fabric of social life
- Beautification

The NBS & the Carbon balance

- Energy independence, environmental responsibility: SEQUESTERING carbon as opposed to EMITTING
- Creating long-lasting, local-sourced sustainable solutions that enhance the natural assimilatory capabilities of the environment
- Achieving numerous ancillary benefits:
  - Ø Aquifer Replenishment
  - Ø Urban Heat Sink relief
  - Ø Storm water and run-off harvesting and purification
  - Ø Buffering rivers and lakes

Wastewater Treatment with NBS™



CHANGE is the need:

De-Centralized Nature based solution

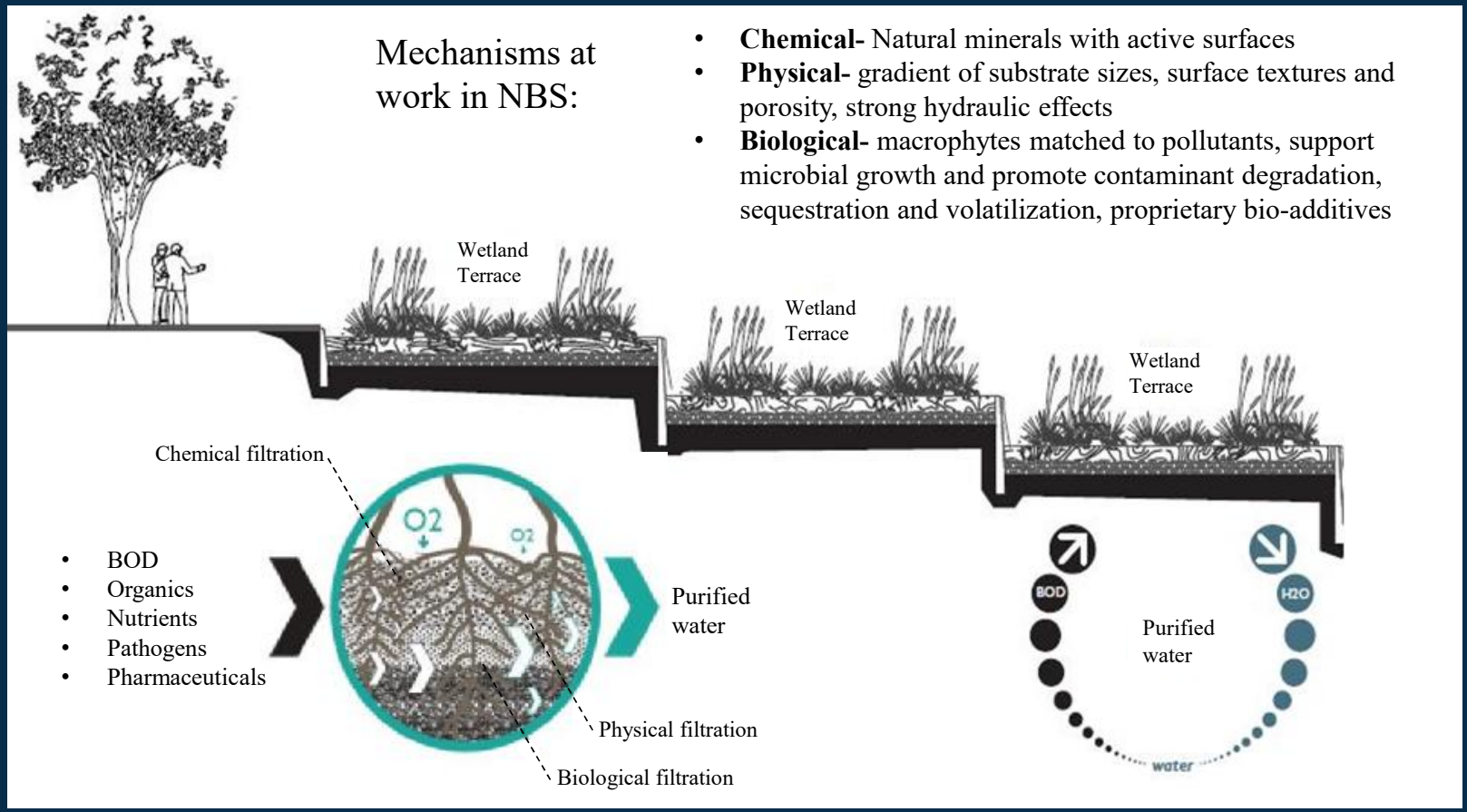
Using the powers of nature with thermo-dynamic principles

- GRAVITY
- SOLAR
- PLANTS
- AGGREGATES
- MICROBES

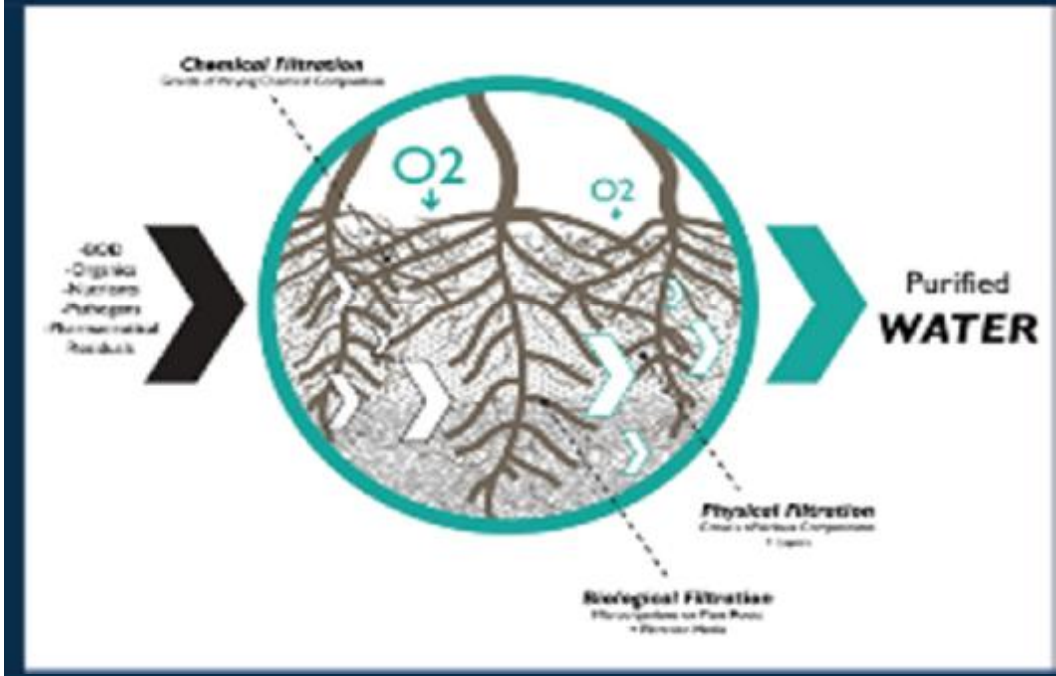
Raw Sewage from Nalla | The Natural Biological System™ | Tertiary Quality Outlet

NBS at Hyderabad Golf Club

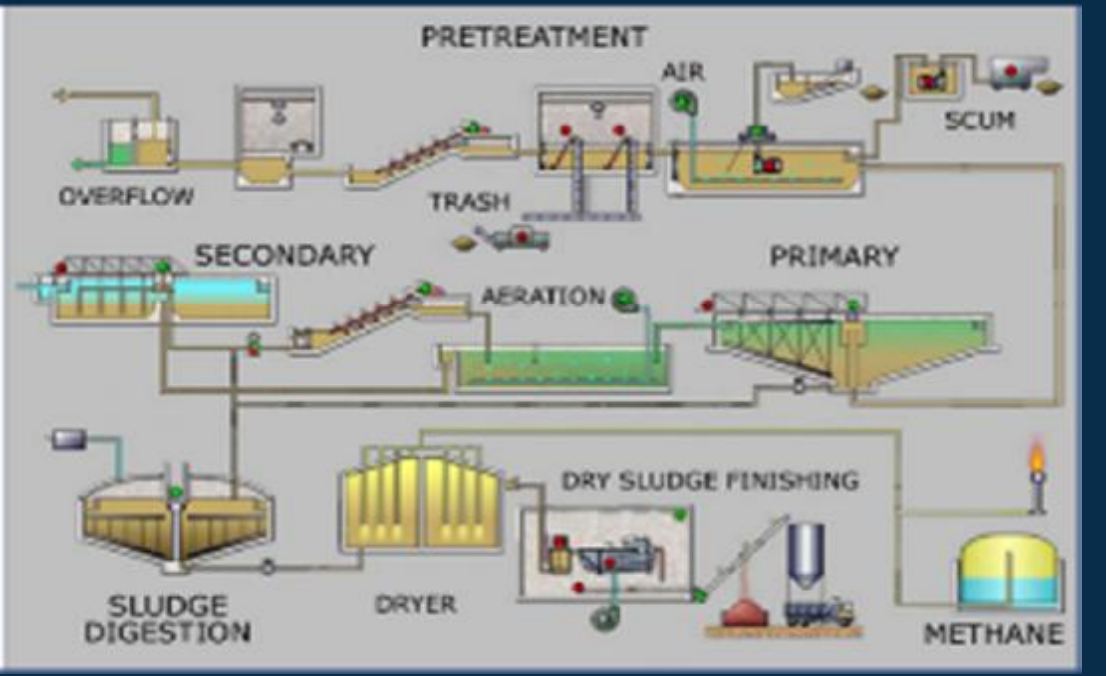
The NBS technology architecture



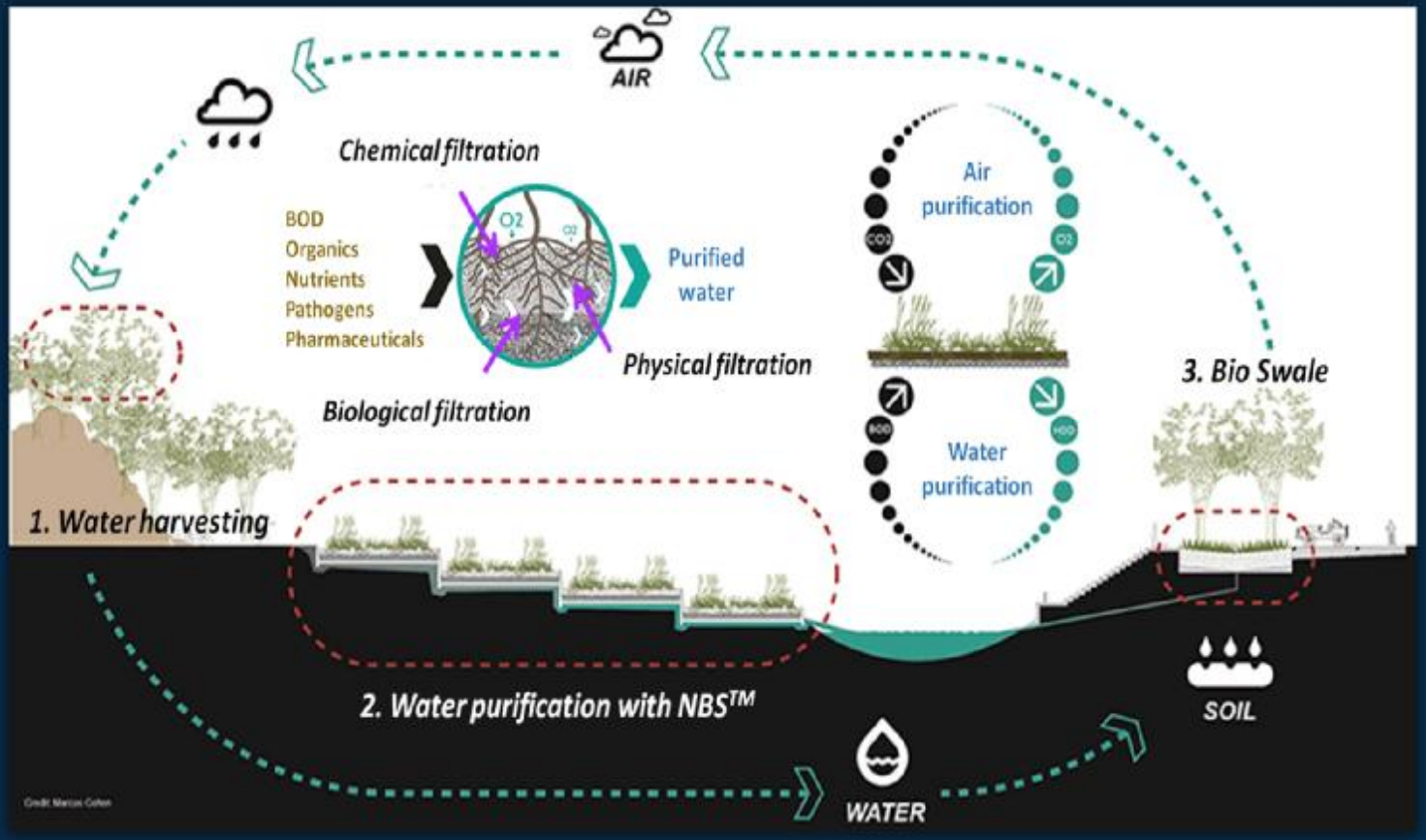
Simultaneous Treatment in a Constructed Wetland



Separate Treatment in a Conventional System



The NBS technology architecture

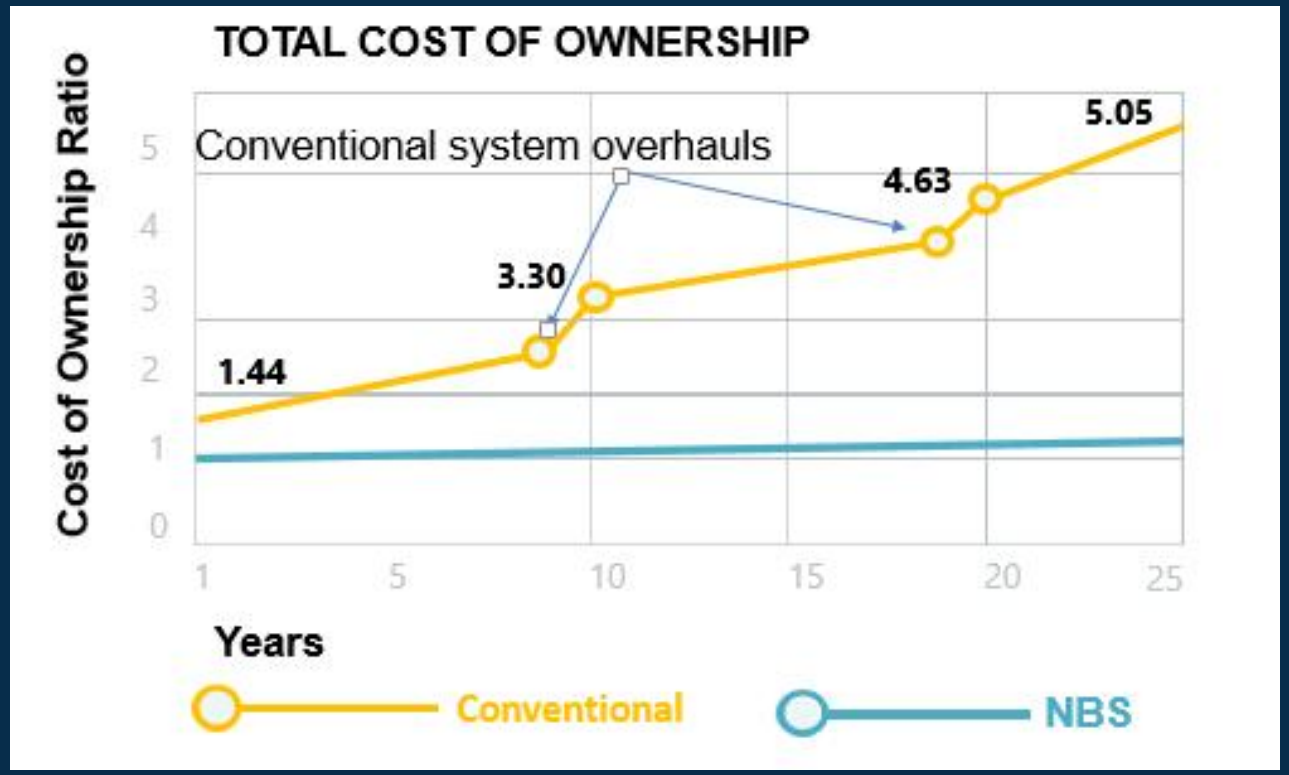


Cost Comparison -NBS vs Activated Sludge 6 MLD Plant

	Activated Sludge	NBS
Capital cost	13-16 million USD	9.5-10 million USD
Operation & Maintenance		
§ Energy cost:	353,500 USD/year	Typically none
§ Personnel:	120,300 USD/year	48,000 USD/year
§ Sludge treatment and Removal	116000 USD/year	nil
§ Flocculants:	43,100 UDS/year	nil
§ Equipment maintenance & replacement	39,000 USD/year	nil
• Carbon offsetting or trading	14,000-21,000 USD/year	Typically none
Other Items: Water, Building and site maintenance, Insurance, Debris clearing, security measures, unexpected expenses, etc	130,000 USD/year	22,300 USD/year
Total annual O&M cost	820,750 USD/year	70,300 USD/year
Equipment replacement after 10-12 yrs	7.8-9.6 million USD	Typically none
Lifespan	10-30 yrs	30+ yrs

Treatment of domestic waste at the scale of 1 million liters/day (In India[33])

Parameter/Technology	SBR	MBR	NBS™	
1. Performance	Tertiary	Tertiary	Tertiary	
Effluent BOD, mg/L	<10	<10	<10	
Effluent SS, mg/L	<5	<5	<5	
Effluent Total Coliforms, MPN/100 mL	<10	<10	<10	
2. Total Capital Cost (Secondary + Tertiary) (₹ lacs /MLD)	115.00	300.00	250.00	
3. Total Area, m^2 per MLD	550	450	4000	
3. Yearly Operation and Maintenance Costs				
Yearly Power Requirement (kWh/pa/MLD)	56100.5	110,412.5	Typically nil	
Yearly Power Cost (₹ lakhs pa/MLD)	3.37	6.65	Typically nil	
Repair	2.48	[incl in O&M total]	Typically nil	
Chemical costs ₹ lakhs pa/MLD	3.30	[incl in O&M total]	nil	
Manpower Salary + Benefits	25.92	[incl in O&M total]	2.4	
Annual O&M costs ₹ lacs pa	9.02	16.65	2.4	


TOTAL COST OF OWNERSHIP
Cost of Ownership Ratio
Conventional system overhauls
5.05
4.63
3.30
1.44
0
1
2
3
4
5
1
5
10
15
20
25
Years
Conventional
NBS

CASE STUDIES

France - In Cooperation With Dutch WEST8: Ecological Planning Of The City Of Nice & The Var Valley

- Flood prevention
- Protection and restoration of aquifers
- Rehabilitation of local flora and fauna
- Improvement of air quality

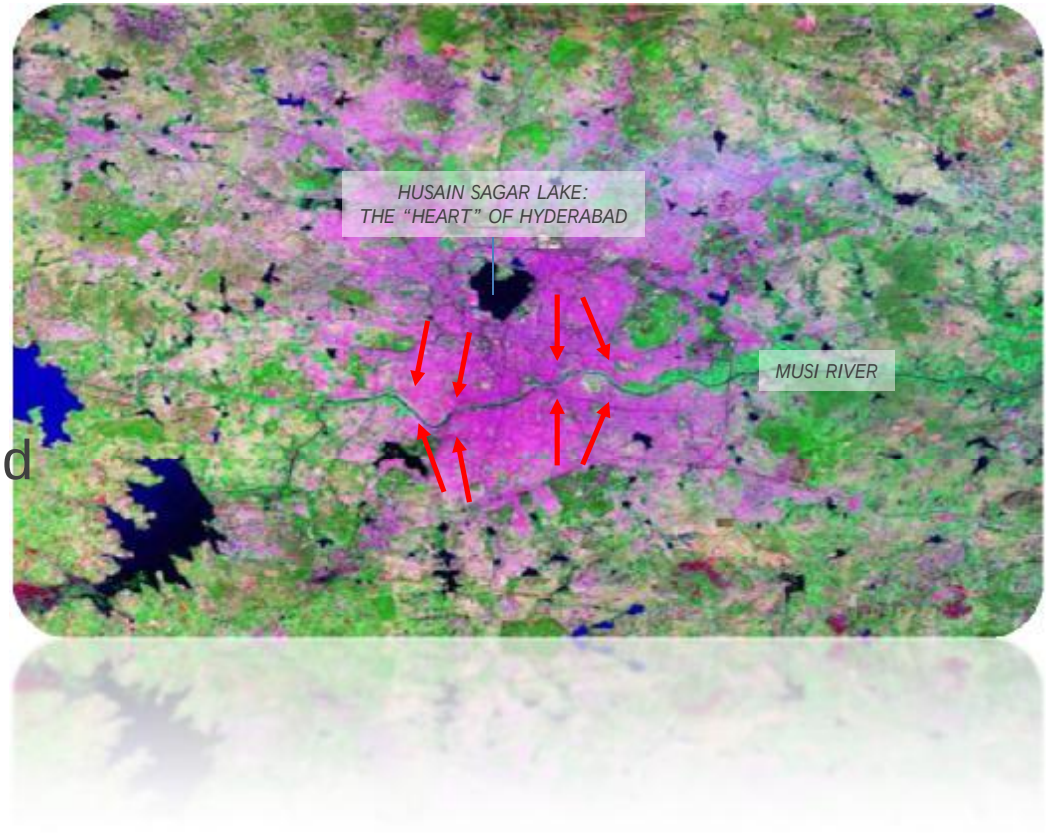
Hyderabad Golf Course: Model For Rehabilitation In Musi Catchment

- Needs >2 MLD Irrigation water
- Surface water in the area is abundant but highly contaminated
- HGA is also mandated with improving surface water in the historic Golconda Fort en route to Musi River

Case Study: Musi River Catchment, Hyderabad

Current State

- Polluted nalas
- Lack of clean surface water
- Stagnant lakes
- Dense urban environment with no room for centralized STPs
- Conveyance outside the city is costly and impractical



How To Turn A Liability Into An Asset ?

Hyderabad Gold Course irrigation requirement of 2 MLD for Landscape and Lawn care

Nearby urban effluents 3-5 MLD

Shortfall of 2MLD irrigation water

The NBS™ at HGA, Hyderabad
The Musi River catchment zone

The system recovers 5 MLD of sewage water for Irrigation, River protection and aquifer recharge

Summary: The Natural Biological System™ at HGA

- 5 MLD Capacity
- ~3 Crors Capital Cost
- 4 months implementation
- Saves 2 Million Liters Irrigation Water Daily

AND:
***Local** labor & resources*
***Minimal** maintenance*
***Zero-energy** treatment*

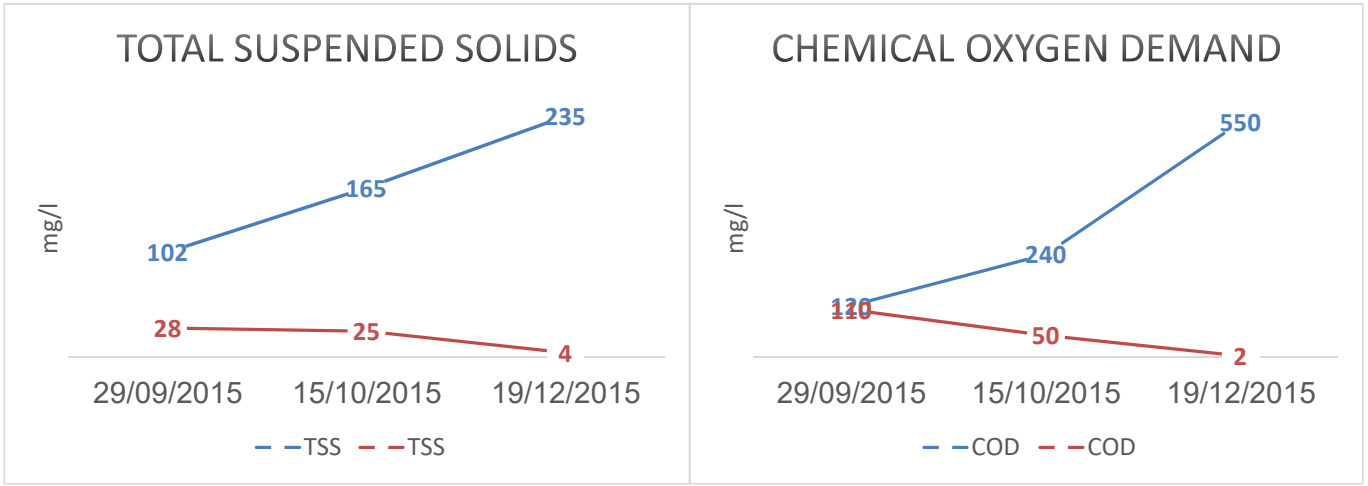
Raw sewage from Satam Cheruvu overflow

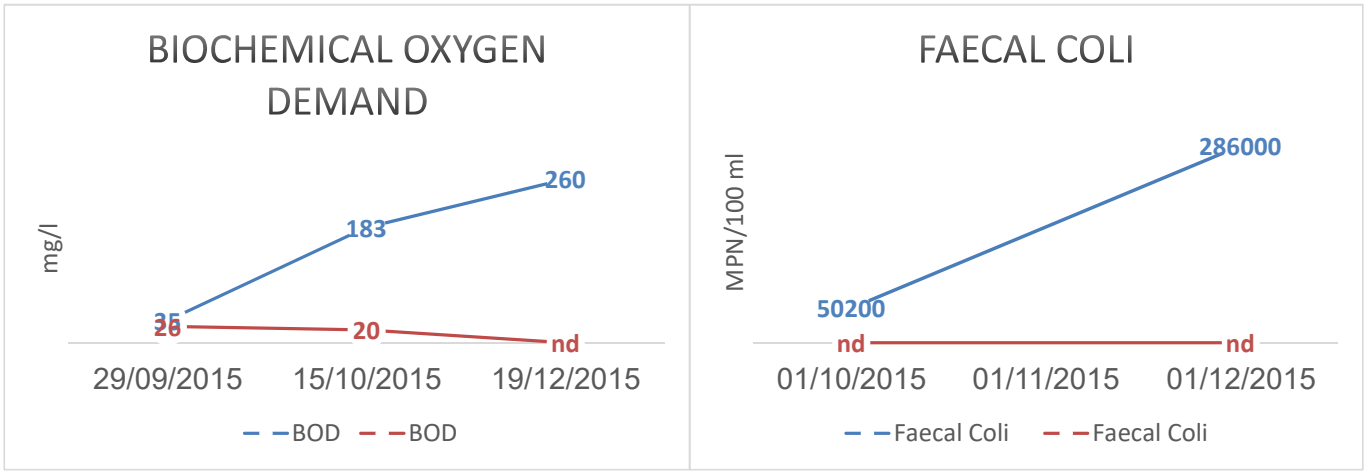
Diversion to NBS™

The Natural Biological System™

Subsurface Flow

Tertiary Quality Outlet

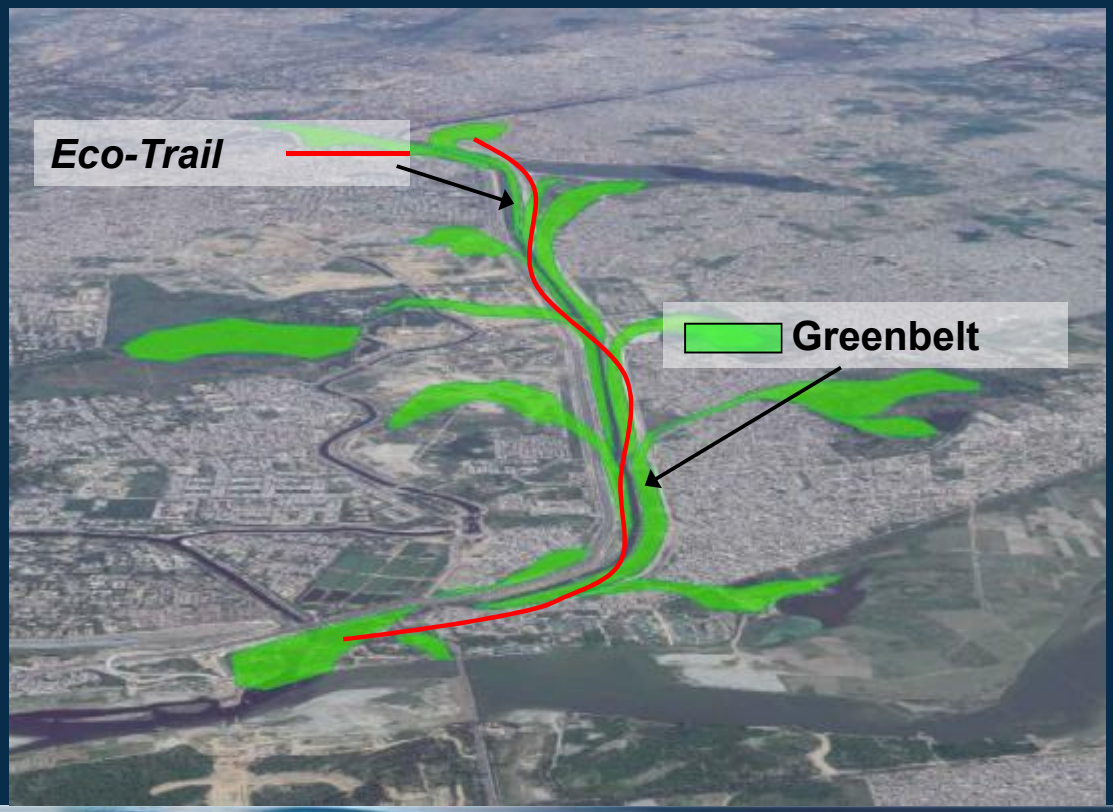




Testing by Care Labs, Hyderabad


Golfers and caddies
are prohibited
from entering
the sewage
treatment plant

The NBS™ Holistic Nature based solution approach for metropolises and watersheds



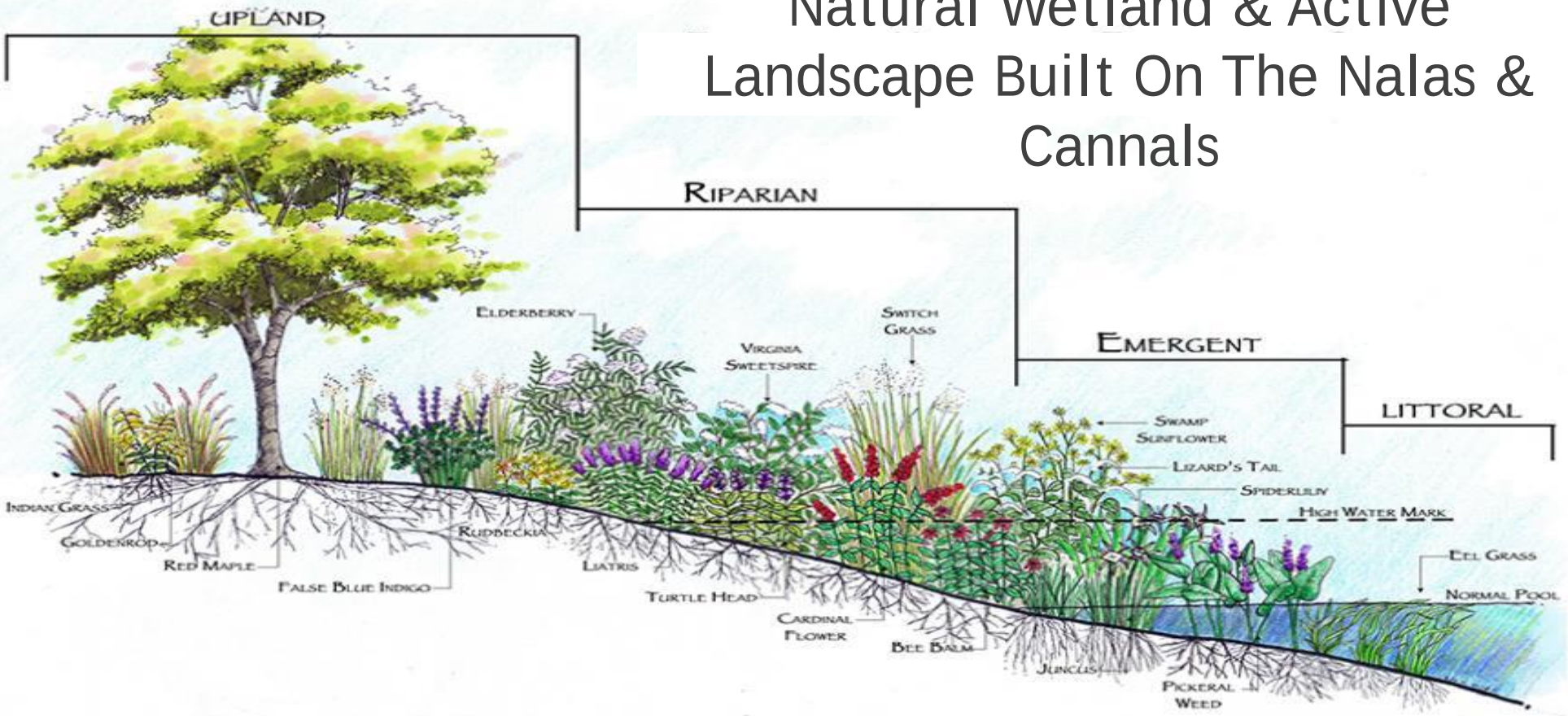
The "Tree of Life"- New Delhi:
A combination of GreenBelt and Eco-Trail

Holistic design approach -combined solution for the hydraulic, environmental and social issues

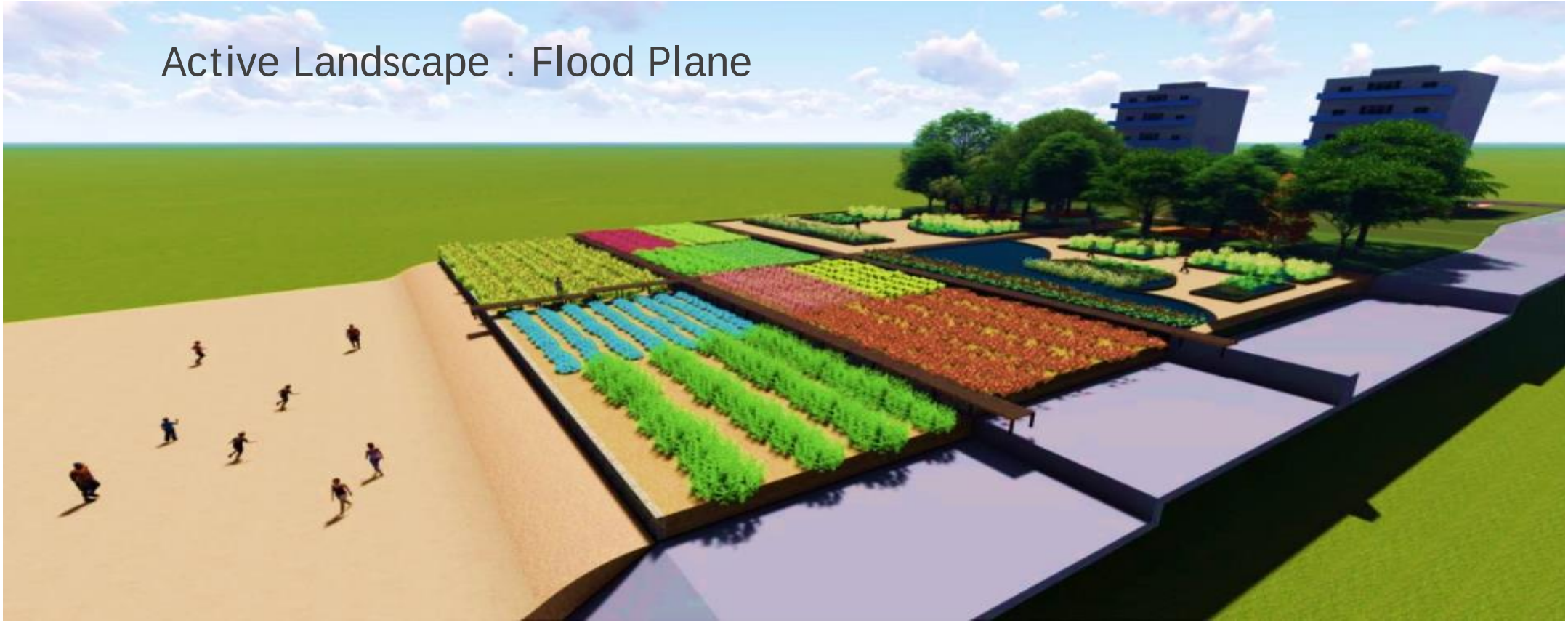
Completely sustainable, energy & maintenance free

Provides water security together with life quality

Natural Wetland & Active Landscape Built On The Nalas & Cannals



Urban Treatment of Effluent Water



Urban Treatment of Effluent Water

Urban Neighborhood Sewage on-site Treatment

Musi River Watershed, Hyderabad

Description

Background: The Hyderabad metropolitan area is a growing metropolis of 7000 sq kms under significant water & energy stress. Raw effluents flow to the Musi River without reuse. The Hyderabad Golf Course had a sewage drain traversing part of the course and needs 2 million liters daily for irrigation.

Solution: An energy and maintenance free Natural Biological System™ was installed which completely integrates into the landscape, produces tertiary quality irrigation water for the world class Hyderabad Golf Course, rejuvenates the lakes that are dying, energizes the natural air filter and eliminates odor nuisance.

Results

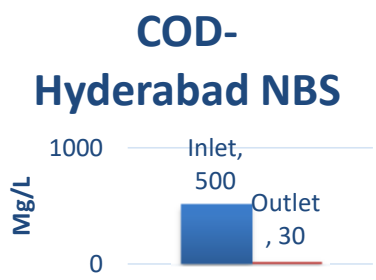
Year Established: 2014

Flow RATE: 4 MLD

Quality: COD in= 500 mg/L, COD out=30 mg/L

Treatment Area= 7,000 sq m

Person Equivalent= 18,500



SUMMARY

- **AREA PER PERSON EQUIVALENT= 0.36 m^2/PE**

ADVANTAGES

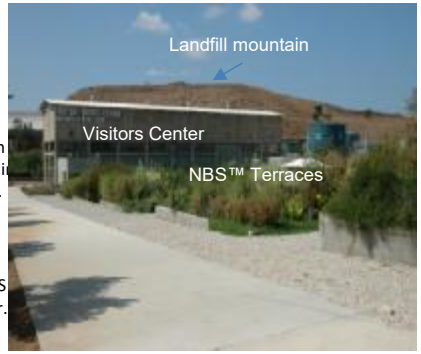
- **Local Labor**
- **Minimal Maintenance Costs**
- **Enhances local surroundings**
- **4 months implementation**
- **Saves >2 Million Liters Irrigation Water Daily**

Sustainable, On-Site Treatment of Landfill Leachate

Description

Background: Landfills remain an integral part of most solid waste management strategies worldwide, and are a growing problem: with population growth, economic development, and increased urbanization there is also an increase in the amount of garbage produced per capita, and i the variety of contaminants ending up in landfills.

Solution: In Hiriya, the largest garbage sorting depot in Israel, a Natural Biological System (NBS) was "tailored" to the site's ecological conditions using local natural and human resources. The NBS protects the aquifer and provides irrigation water.



Results

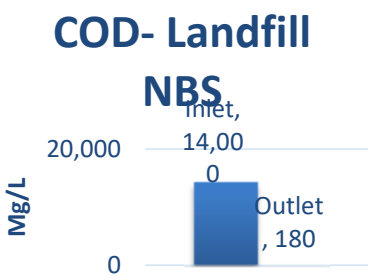
Year Established: 2009

Flow RATE: 40,000 Liter/day

Quality: COD in= 14,000 mg/L, COD out=180 mg/L

Treatment Area= 600 sq m

Person Equivalent= 3,700



SUMMARY

- **AREA PER PERSON EQUIVALENT= 0.16 m^2/PE**

ADVANTAGES

- **The NBS produces water of sufficient quality and quantity to irrigate the lawns and landscaping projects around and on site.**
- **The O&M costs for the NBS are negligible: they consist of a salary for one part time employee whose job is mainly supervision and gardening**

Onsite Industrial Sewage and Sludge Treatment- L'Oréal Cosmetics Plant

Description

Background: Cosmetics process waste is characterized by high amounts of emulsions, salinity and complex organic sludge, including PCBPs, which are challenging to conventional wastewater treatment plants.

Solution: L'oréal Israel significantly improved its water footprint with the installation of the NBS™ for treating the process and sanitary water of the factory to municipal standards. Sludge is transferred to NBS sludge treatment pools for dewatering and treatment onsite.

Results

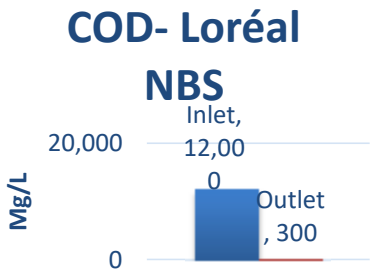
Year Established: 2016

Flow RATE: 30,000 Liter/day

Quality: COD in= 12,000 mg/L, COD out=300 mg/L

Treatment Area= 200.5 sq m

Person Equivalent= 2,222



SUMMARY

- **AREA PER PERSON EQUIVALENT= 0.09 m^2/PE**

ADVANTAGES

- **The factory treats all sewage (process and sanitary) onsite to release standards,**
- **The target of avoiding fines is met**
- **Sludge is digested and dewatered onsite, saving operational costs of evacuation**

Sustainable Textiles Treatment Nikunj Fabrics Ltd, Vapi, India

Description

Background: The textile industry is estimated to use more water than any other industry, globally and almost all wastewater discharged is highly polluted. Average sized textiles mills consume about 200 L per kg of fabric processed per day. Textile plants use strong chemicals such as caustic soda for mercerization- chemically changing cellulose so that it is more absorbent and plush.

Solution Nikunj Fabrics Ltd, Vapi, India installed two parallel systems for high and low COD streams to treat the textile effluent to inland irrigation standards

Results

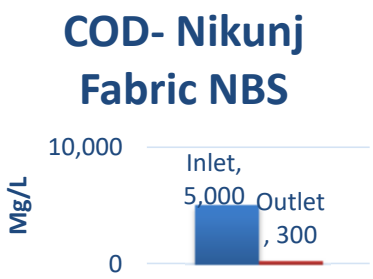
Year Established: 2017

Flow RATE: 600 m^3/ day

Quality: COD in= 5,000 mg/L, COD out=300 mg/L

Treatment Area= 1200 sq m

Person Equivalent= 16111



SUMMARY

- **AREA PER PERSON EQUIVALENT=** 0.06 **m^2/PE**

ADVANTAGES

- **Costs were kept low by using in-house contracting teams**
- **The factory treats all sewage (process and sanitary) onsite to release standards**
- **Inland water bodies are protected**
- **The treated water can be fed back into the production line with minor polishing**

Onsite Tertiary Treatment of Power Plant Sewage

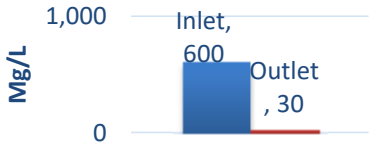
Description

Background: The Ramat Hovav power complex produces about 10 cu.m. of wastewater a day, requiring evacuation through expensive tankers. Due to the remote location, conveyance to a centralized STP is impossible.

Solution The site uses a natural biological system that treats the sewage to onsite irrigation standards. The treated water is used for landscap irrigation and meets stringent tertiary regulation. Cost was relatively high due to the extensive regulatory overhead.

Results

Year Established: 2013
Flow RATE: 7,000 Liter/day
Quality: COD in= 600 mg/L, COD out= 30 mg/L
Treatment Area= 180 sq m
Person Equivalent= 46.3



SUMMARY

- **AREA PER PERSON EQUIVALENT= 3.9 m^2/PE**

ADVANTAGES

- Requires little maintenance, saves on many costs and eliminates evacuative pumping
- green and aesthetic corner in the heart of the desert station
- Handles industrial pollution as well

River Rehabilitation- Yarkon River

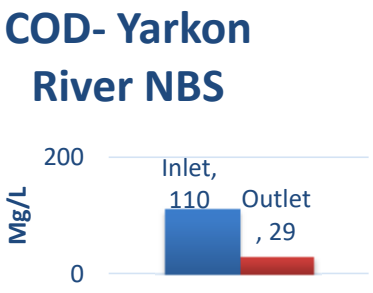
Description

Background: The Yarkon River in Central Israel, like many urban rivers, consists of >70% sewage effluents and exceeds environmental regulations for measured parameters.

Solution. A natural biological system was integrated into the peri-urban environment- without disturbing the main river channel. The NBS provides high-quality treatment and urban park landscaping for the benefit of recreation and biodiversity.

Results

Year Established: 2004
Flow RATE: 400 m^3 /day
Quality: COD in= 110 mg/L, COD out= 29 mg/L
Treatment Area= 2000 sq m
Person Equivalent= 330



SUMMARY

- **AREA PER PERSON EQUIVALENT= 6 m^2/PE**

ADVANTAGES

- Native plants and wildlife returned.
- Algal blooms have disappeared.
- Balance is reestablished.
- Regulatory limits are upheld and improved on.

Recommendations of the IIT Ganga River Basin Management Plan

After numerous failed projects and countless crore spent, the Central Govt requested IIT to prepare the Ganga River Basin Management Plan

- "In order to reduce substantial expenditure …, decentralized treatment of sewage is advisable."
- Goals: Minimize O&M recurring costs, simple maintenance, reduce energy consumption
- Tertiary level sewage treatment with maximum on-site reuse
- Riverbank beautification and restoration works

From: IIT, 2010 GRBMP reports 2,3,10

Who are we?

- International team of sustainability experts, headquartered in Israel
- An active company in India based in Bangalore
- Over 30 years of practical experience in Sustainability, Nature Based Solutions and watershed management
- We provide the best effective, tailor-made, solution for sewage treatment that is not reliant on energy, chemicals, maintenance or skilled personnel
- Our core product, the **NBS** is a powerful natural system producing water quality superior to that of prescribed standards.