sustainable sanitation alliance

Case study of sustainable sanitation projects

Wastewater Treatment and Reuse in Indradhanushya Center, Pune, Maharashtra, India

Figure 1: Project location

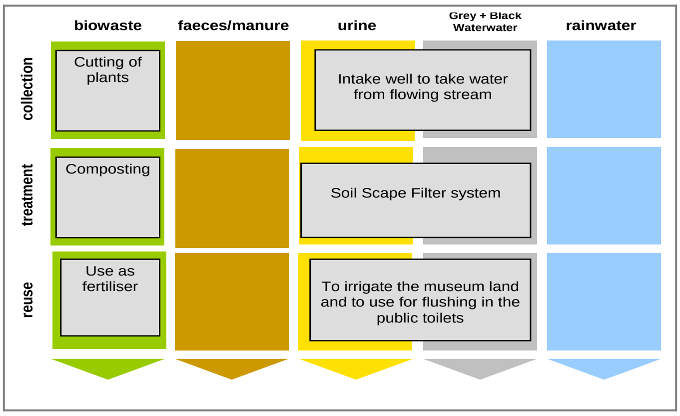


Figure 2: Applied sanitation components in this project

1 General data

Type of project:

Full-scale treatment system installed to treat wastewater flowing through an open stream alongside the Indradhanushya Environment Education and Citizenship Centre. This is one case study out of six within the NaWaTech project framework ('Natural water systems and treatment technologies to cope with water shortages in urbanized areas in India').

Project period:
Start of construction: July 2015
End of construction: December 2015 (proposed date)
Start of operation: January 2016 (proposed date)
Ongoing monitoring period planned for: after start of operation
Project end: June 2016

Project scale:
Number of people covered: 250 population equivalent
Size of treatment plant: approx. 50 KLD wastewater will be lifted from the Ambil stream carrying domestic wastewater from the city for treatment.
Total investment (in EUR): 51,158.00 EUR

Address of project location:
Indradhanushya Environment Education and Citizenship Centre (Rainbow Museum)
Opposite Sachin Tendulkar Jogging Park, Anant Kanhere Path, Near Mahtre Bridge, Rajendranagar, Pune:-411030

Planning institution:
Shrishti Eco-Research Institute
B-106, Devgiri, Opp. P. L. Deshpande Garden, Ganesh mala, Sinhagad Road, Pune 411030

Executing institution:
M/s Metro Associates, Branch Office - 9/142, Mira Housing Society, Salisbury Park, Pune 411 037

Supporting agency:
Ecosan Services Foundation, Pune
kre_ta landschaftsarchitektur, Berlin

2 Objective and motivation of the project

The main motivation for this project is to demonstrate that polluted water flowing through any stream and river can be treated and recycled for flushing of lavatories in adjacent complexes, for watering the plants in nearby gardens, etc. The recycling of this treated water will help to reduce the load on the fresh water supply in order to cope with water shortages in urbanized areas of India.

Objectives of the project:

1. To demonstrate the technical, financial and environmental potential (and applicability) of natural water treatment technologies
2. To create "water-culture" by disseminating information about conservation, protection of sources, water quality, wastewater disposal and recycling. This aspect is enhanced by the fact, that the implementation site (garden of the Rainbow Museum) is already dedicated to ecological education. This emphasizes the educational function of the project and therefore high attention was paid to an aesthetically pleasing design which visitors can experience
3. To ensure the interest and potential benefits to society at large by reducing the pollution in streams and rivers
4. To create an enabling institutional environment in order to allow the take-up in practice and mainstreaming of the results (e.g. align NaWaTech initiatives with existing urban water plans, strategies and policies)
5. To establish foundations of a long-term cooperation between EU and India in water technologies as part of the Strategic Forum for International Science and Technology Cooperation (SFIC) and establish bridgeheads among research institutions and ensure the take up of the NaWaTech approach in educational curricula

3 Location and conditions

The project is implemented in the garden of the Indradhanushya Centre located in Pune.

The Indradhanushya Environment Education and Citizenship Centre is a public facility of the Pune Municipal Corporation (PMC) to create awareness among the population about environment and sustainable development. The main objective of the Indradhanushya center is to spread the message of environment conservation in society and develop skills and an appropriate mind-set among the citizens, improving their environmental literacy and the overall performance of the city.

Figure 3: Indradhanushya Citizenship Center, Pune (SERI, April 2014)

More precisely, the Indradhanushya centre was selected within the overall NaWaTech project for installation of the **Eco-filtration Bank** system. The sewage contaminated Ambil stream flows through the heart of Pune city and encircles the elevated premises of the Indradhanushya building. It is 320 m upstream from the confluence of the Ambil stream with the Mutha River. The height of the Indradhanushya center is approx. 555 m above the mean sea level (MSL). The total plot area of the Indradhanusya Center is 3723.09 m^2, whereas the area under green belt is 2457.85 m^2.

Figure 4: Ambil stream encircling the Indradhanushya Centre, Pune (SERI, April 2014)

The Ambil stream (rivulet) drains a catchment of 30.02 km^2. It is located to the south of Pune city between 18°23’40’’ N to 18°30’33’’ N latitudes and 73°50’20’’ E to 73°53’30’’ E longitudes.

The rivulet originates at an elevation of 1100 m above MSL near the off-shoot Western Ghats and flows towards a North North-West direction to join the Mutha River.

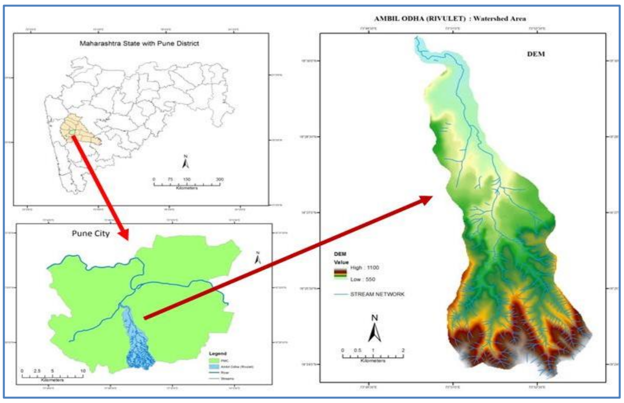


Figure 5: Catchment area of the Ambil Stream

The physiography in the upper catchment area is hilly and of undulating nature. A dendritic type of drainage pattern is observed as the rivulet flows through the basalt. The water from the upper catchment areas gets accumulated in a reservoir known as the Katraj Lake, from where the Ambil stream flows. The entire length of the Ambil stream from the outfall of the Katraj Lake to its confluence point is ca. 9.55 km.

The climate of Pune city features three distinct seasons: summer, rains and winter, as elsewhere in India. The average temperature of the hottest month (May) are between 23°C and 39°C with peaks of about 42°C. The same for the coldest month of December: range between 12°C and 30°C, with lowest about 5°C. The relative humidity ranges from 36% (March) to 81% (August). The annual rainfall as per IMD records is 700 mm per year; out of which 75% occurs in the four months from June to September (monsoon period).

The non-monsoon flow of the Ambil Stream is approx. 70 MLD. For the co-filtration bank system 50 KLD of wastewater will be taken for treatment and recycled for gardening and flushing purposes.

The population of Pune city is about 3,115,431 (2011 census). Pune city has a population density of 12,000 per km^2 according to the 2015 data of the PMC. The population density of the Ambil stream catchment area is about 3700 per km^2.

Along the bank of the stream individual bungalows, housing societies, slum areas and some commercial complexes like malls, hospitals and banks etc. are located. Lower, middle and higher economy class communities, from all types of religion, are settled upstream to the treatment site. Agricultural land is available only in the upper catchment of the Ambil stream. Around the selected project site, only residential and commercial areas are situated.

Therefore, the Ambil stream is mainly drained with treated and untreated wastewater stemming from residential and slum areas situated along its banks.

The change in the land use pattern in the Ambil stream catchment in years 1991 and 2010 is given below.

Table 1: Change in land use pattern in Ambil stream catchment area

Sr. no.	Class	1991 (%)	2010 (%)
1	Water Surface	0.75	0.66
2	Vegetation Cover	21.29	21.0
3	Agriculture Land	0.79	0.91
4	Barren Land	39.26	33.24
5	Settlements	37.91	44.19

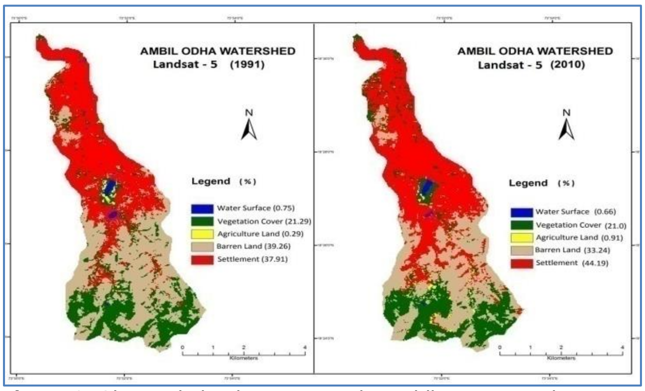


Figure 6: Change in land use pattern in Ambil stream catchment area

The selected area for the installation of the treatment system within the Indradhanushya premises is actually a land fill site. Construction debris generated during the construction of the Indradhanushya Museum were disposed on the bank of the Ambil stream and then covered by plantation.

Figure 7: Soil strata of the selected treatment site (SERI, April 2014)

4 Project history

The Indradhanushya project is one of six sites selected under the NaWatech project. Eco-filtration technology will be installed in the garden of the Indradhanushya centre in order to treat wastewater and recycle it for non-consumptive purposes. Shrishti Eco-Research Institute (SERI) and Ecosan Services Foundation (ESF), Pune are jointly working on this project.

Initially, two other locations were selected for project implementation besides the Indradhanushya centre, i.e. the Ram River near Ram Nagar and the Ambil stream near Babul Garden. After a site feasibility study, the Indradhanushya centre site was selected for implementation. Eco-filtration bank (EFB) technology, a horizontal filtration technique, was proposed to be the main technology installed for the treatment of the stream water, combined with medi-filter, mini–quay, and a green pitching system.

The installation was planned outside the actual Indradhanushya centre premises, very close to the bank of the Ambil stream but due to vandalism, theft, flash floods and dumping of solid waste issues, the exact location of treatment system was changed to inside the premises of the Indradhanushya centre. Hence, pumping of wastewater from the stream is a must and SERI's vertical eco-filtration technique (soil scape filter (SSF)) was elected after a joint visit of Indian and European NaWaTech partners in April 2014. Subsequently, the design was reworked in order to take into account these new developments.

Overall, the EFB system is comprised of screen, intake well, SSF and treated water pond. About 50 m^3/day water from the stream will be diverted into the intake well and treated in the SSF bed to yield approx. 40 m^3/day clean water for gardening and toilet flushing. This system will demonstrate the utilization of contaminated stream water for non-consumptive uses, thereby reducing the pressure on freshwater demand.

Mid-April 2015 the tender notice was published for the execution of proposed treatment system and a contractor selected and the work issued in mid-June 2015. Construction was started in the last week of July and by mid-September 2015 the construction of the SSF beds and the treated water tank was completed. Due to heavy rains the construction of the intake well had to be delayed, however, it is estimated that by mid-December 2015 the entire site will be completed.

5 Technologies applied

The selection of the technologies was based on the following considerations: no chemical additions, low electricity requirements and minimum maintenance. EFB (comprised of screen, intake well, SSFs, and treated water pond) fits these requirements being a cost effective technique consisting of natural materials which help forming biofilms useful for the biodegradation of pollutants.

The SSFs are the main treatment unit of this eco-technological treatment system involving the filtration of wastewater through a biologically activated filtration medium supported by sand and gravel. It harnesses the ecological principles/processes of biodegradation, biotransformation and bioconversion at various trophic levels occurring in the detritus food chain by treating, transforming and detoxifying the pollutants using solar energy. Bio-fertilizers and treated water are the products of this process.

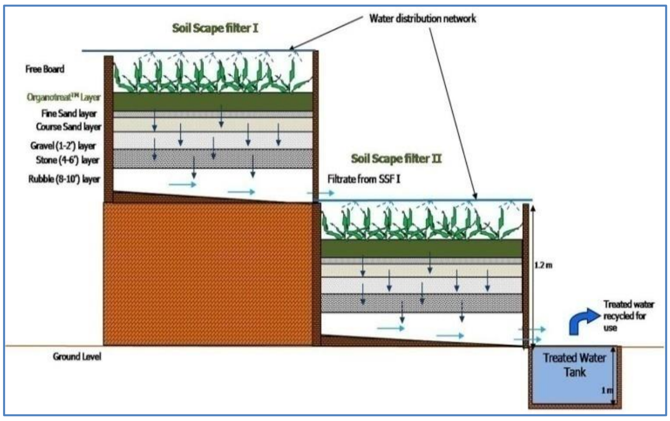


Figure 8: Cross section of soil scape filter units (SERI, 2014)

In SSFs a combination of green plants and bacterial cultures are used to remove organic matter and pollutants. SSF is a vertical eco-filtration system for water or wastewater working via layers of bio-active (i.e. biologically activated) soil including microbial consortia media such as ORGANOTREAT™ - developed from non-toxic and non-hazardous organic matters, bacterial cultures, and fragmented rock materials. As the wastewater passes through the different layers of biologically activated filtration media the pollutants are absorbed and degraded. This biodegradation process releases nutrients in simple forms which can be absorbed by the plants for their growth. Thus, no production of any kind of sludge occurs in this treatment system.

A pH range of 6 to 9 is acceptable for SSF systems. Due to the microbial action even heavy and toxic metal can be biodegraded, -transformed, or -converted. In SSF systems reduction of 99.9% fecal coliforms are commonly observed.

The SSF system requires unskilled, but trained personnel for routine operation and maintenance works. The whole system can function by gravity, except small pumps for the initial loading of wastewater onto the filter bed from the intake well, with measured flow for the designed time frame. There is no need of any chemicals for the process. Therefore, this system is an eco-friendly technique, requiring only little electricity, few routine maintenance works, and without the production of hazardous waste. Furthermore, it is suitable for any set of landscape, with population equivalents ranging from one family (4- 5 persons) to 1000 families. It is effective for the treatment of grey water and black water, separately or combined.

The surface area of the SSF bed is important and not the shape of the tanks, hence, the filter bed can be constructed in any size and shape (circular, rectangular, square, etc.) as per the general site condition.

A septic tank or holding tank is generally required as pre-treatment for some retention of the wastewater (3–24 hours) before transferring it to the SSF bed, improving the efficiency and life-span of the system. At the Indradhanushya site, wastewater is collected from a stream, therefore, an intake well concept was selected in order to also reduce the amount of necessary pumping. The intake well consists of an inlet chamber with screen, conduit and collection/storage well. The collection well of the intake system has been designed to collect the desired amount of stream water.

The treated water can directly be used for gardening. However, in case the treated water is to be used for non-consumptive purpose like flushing or washing an adequate post-treatment (such as dual media filtration and disinfection) is advisable. In Indradhanushya, the water will mostly be used for irrigation purposes, excess water will be used for toilet flushing adjacent to Indradhanushya site.

Average contaminant loads of the untreated wastewater and expected results after treatment are given in the table below.

Parameter	Average values of Ambil stream water	Proposed Treated Effluent Quality	Discharge standards for irrigation water*
TSS	120 mg/l	< 30	200
BOD	140 mg/l	< 30	100
COD	260 mg/l	< 80	NA
Oil & Greases	10 mg/l	Nil	10
Fecal coliforms	93×10^4 CFU/ml	Nil	NA

*as per Central Pollution Control Board (CPCB) standards (NA –Not Available)

However, exact water characteristics and the flow of the stream will vary daily and seasonally (as per the use of water).

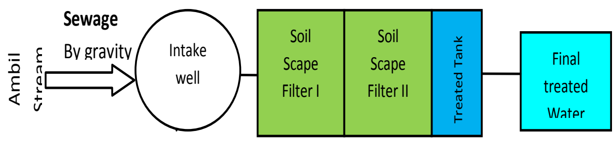
6 Design information

The proposed EFB system design consists of intake well, two linearly placed SSF (= main treatment) tanks and one treated water pool, integrated into the existing garden facilities. The system will treat 50 m^3/day which will yield 40 m^3/day treated water for irrigation and toilet flushing. Strong efforts were made to integrate the system aesthetically into the overall landscape design, particularly important as this site is a museum open to the general public.

Figure 9: Landscape design of the Indradhanushya project (Kre_Ta, 2014)

The required quantity of contaminated water from the Ambil stream is diverted into the intake well by gravity. Water from the intake well is pumped out and distributed onto the SSF beds uniformly. The wastewater passes through the layers of the filter beds and, finally, the filtered water is collected in the treated water pond (by gravity). Prior to the intake well, a screen is installed to trap non-biodegradable floating solid waste flowing through the Ambil stream. The trapped solid waste will be collected daily and transported for dumping site.

The flow chart of the treatment system as given below.



The technical details are as follows:

a) Flow of Ambil Stream: 70 MLD (non-monsoon flow)
b) Proposed quantity of wastewater to be treated: 50 m^3/day
c) Area requirement for SSF bed: 1 m^2 area for 1 m^3 sewage/day
d) Details of SSF tanks: Two linearly placed tanks, 25 m^2 surface area for each tank with effective depth of each tank being 1.2 m (10 m Length x 2.5 m Width and 1.2 m Depth of each SSF bed)
e) Type of treatment system: Primary and secondary treatment system
f) BOD Load: 16- 30 mg/l per m^2 area
g) HRT: Nil but filtration time ranges from 10 - 30 min
h) Operation time of the system: 8 hours per day
i) Quantity of treated water: 40 m^3/day
j) Quality of treated water: Complying with State and Central Regulatory Discharge Norms (reuse in land application and remaining for flushing purposes).

In general, the SSF tanks are made up of brick masonry with plastering and water proofing. However, as the site selected at the Indradhanushya premises is a land fill site, construction of all the required tanks used roller-compacted concrete (RCC) for structural stability.

The characteristics and flow of the stream will vary daily/seasonally as per the use of water. Percentage reductions regarding incoming pollutants after treatment lie in the range of 75-90% COD & BOD, 75-85% TSS, 99.9% faecal coliforms, while the DO level increases 8-10 times depending on the exact inlet characteristics of wastewater.

For the Indradhanushya site, a periodical analysis on inlet and outlet characteristics is planned to evaluate the performance of the system and the quality of the outlet water according to the following research and monitoring plan (to be executed until June 2016).

Parameters	Sampling points	Frequency
pH	Untreated and Treated water	Once every week
TSS, mg/L	Untreated and Treated water	
BOD_5 mg/L	Untreated and Treated water	
COD, mg/L	Untreated and Treated water	
O & G, mg/L	Untreated and Treated water	
E.coli	Untreated and Treated water	

7 Type and level of reuse

The treated effluents (ca. 40 m^3/day) are stored in a separated treated water tank and will mostly be used for gardening purposes, while any excess water will be used for flushing.

Currently, freshwater is being used for gardening and flushing. In order to maintain the green cover at the Indradhanushya centre as well as the Sachin Tendulkar jogging track (opposite to the Indradhanushya centre) 12 m^3/day and 15 m^3/day of water, respectively, are required. The garden area of Indradhanushya and the jogging tract mainly feature small shrubs, big plants, flowering plants and lawn. Some plant species with their local and scientific name are given below.

Scientific name	Local name
Tamarindus indica	Chinch
Leucaena leucocephala	Subabhul
Ficus glomerata	Umber
Ficus bengalensis	Vad
Mangifera indica	Mango
Azadirachta indica	Neem
Azadirachta indica	Avala
Alstonia Scolaris	Saptaparni
Lilium candidum L	Lily
Cestrum nocturnum	Rat-rani
Nyctanthes arbortristis	Parijatak
Butea monosperma	Palas

The remaining 10-15 m^3/day of treated water will be used for toilet flushing adjacent to the Indradhanushya building. Therefore, around 40 m^3/day of fresh water can be saved.

The cost economics under existing conditions indicate that the present cost of fresh water is € 150/day per 50 m^3 and cost incurred for generating non-potable recyclable water for 50 m^3 is € 10/day. Therefore, the net savings in respect to flushing and gardening would be 150–10 = € 140/day. This would ensure savings of €140 x 365 = € 51,100 per annum from a 50m^3/d capacity wastewater treatment plant.

8 Further project components

Fast growing Indian cities not only require sustainable and cost-effective technologies, there is also a need of having institutional platforms which can bring all the stakeholders together in order to create social engineering and awareness for the technologies and overall environment and urban water management.

The well-defined objectives of the NaWaTech project and the integrated networking opportunities for stakeholders and innovators within the project framework contribute a lot to forming new and fostering existing networks for knowledge sharing, trouble shooting, service provision, etc. – important for both research and business.

Research activities will help to develop documentation and to study the replicability, suitability and benefits of the technologies in different environmental conditions addressing issues such as impact on fresh water demand, biodiversity, cost-effectiveness, etc. Alongside the research, the key component of SME training and promotion in this project will lead to the implementation of further, result-oriented and sustainable solutions addressing local problems. Combined, such actions will directly help decision makers to be in a better position to plan appropriate future urban water management and select proper technologies or combinations of technologies.

9 Costs and economics

Information regarding capital costs and operation and maintenance costs is illustrated below.

a) Capital Cost: Total project cost in EUR: **51,158.00 EUR**

Unit	Function	Cost in EUR
Intake well	Collection system	23,038.00
SSF bed I & II	Treatment unit	15,090.00
Treated water pond	Storage facility	5,920.00
Organotreat™ - Bacterial Consortia for SSF system	Degradation of pollutants	7,110.00

Table 2: Capital cost (in EUR) for treatment system installation in Indradhanushya Cente, Pune

b) Operation & Maintenance Expenditure

Description	Unit	Cost / month in EUR
Unskilled (but trained) person for routine operations	1 person / month	80.00
Electricity for pumps	per month	25.00
Sampling & analysis: one set of untreated & treated samples per week	4 samples /month	175.00
Operation & Maintenance cost /month		**280.00**
Operation & Maintenance cost /year		**3,360.00**

Table 3: O&M cost (in EUR) for treatment system installation in Indradhanushya Center, Pune

10 Operation and maintenance

The SSF system requires unskilled but trained personnel for routine operation and maintenance (O&M). SERI will train the personnel of Indradhanushya who will be responsible for the management of the system after installation. SERI will prepare an O&M Manual and Safety Plan with the necessary instructions for the management of the plant and for troubleshooting.

Normal maintenance of pumps and motors following manufacturer instructions is required as well. The PMC should carry out periodic analysis of the incoming and treated water to monitor changes in the process which will help in trouble shooting (after the project ends).

With regards to the intake well, maintenance activities are mainly related to the removal of silt deposited in the collection well. The institutions responsible for the coordination of the safety planning process (planning, implementation, revision) are SERI and ESF during the project duration, and Indradhanushya staff after hand-over. Furthermore, SERI is responsible for the performance of foreseen analyses for three months after commissioning of the system.

The maintenance schedule for the EFB system is given below.

	Activities	**Frequency**	**Responsibilities**
1.	Removal of debris from metal screens	Daily	Local authority i.e. Pune Municipal Corporation will appoint person (Male / Female) for maintenance
2	Cleaning of intake well	Twice a month	
3.	Trimming /uprooting of plantation	Once in 2-3 months	

Table 4: Maintenance schedule for EFB system

Operation and maintenance of the treatment system can be handled by trained unskilled labour (male or female).

11 Practical experience and lessons learnt

The Indradhanushya project site is yet to be completed. But SERI has installed many similar types of treatment plants all around India. Hence, some valuable experiences are described accordingly.

This system can be used for any type of terrain or in geographical conditions, in rural and urban regions. The soil strata of the selected location can provide input on which construction material the tanks should be made of (stone or brick or RCC construction). The selection of the exact treatment location is very important, because it is directly related to the structural stability of the treatment units. Land filled sites increase the construction costs. If possible, gravity benefits should be exploited, as hereby the use of pumps can be avoided.

Maintaining a proper slope inside the filter bed is vital: in case the slope is not maintained properly, water can stagnate, generating anaerobic condition and creating odour problems.

The layering of SSF system is a further very crucial part in the commissioning as it is directly related to the treatment efficiency. After layering of each supportive material the layer needs to be washed thoroughly with fresh water to remove any type of dust, contaminants particles, etc. Each layer of supportive material needs to be spread uniformly avoiding gaps which otherwise can lead to chocking of the soil gradient and will subsequently reduce the efficiency of filtration and treatment. Thus, properly trained person are needed for layering.

Daily operation and maintenance of the treatment system can be handled by unskilled labour with proper training. A maintenance manual with troubleshooting action needs to be provided.

With regards to the design of the intake well, flow variations and a contour survey of the selected stretch of stream is a must. The connecting conduit should be above the bottom of the stream to prevent entry of silt. Furthermore, it should be kept 1m below the top surface of the water in order to avoid entry of floating particles. The velocity of water should be maintained. Periodic cleaning and silt removal from the intake well chamber is vital, as these reduce the storage capacity of the intake well. Daily removal of solid wastes trapped in the screen is necessary as well, as otherwise the screen pores may clog, affecting the water flow.

In the scheduling of the work activities the monsoon season has to be taken in account: from July to end of September it may be very difficult to perform certain activities, especially excavation, water-proofing and concrete works.

At the Indradhanushya site, the role of a landscape architect could only be marginally considered mainly due to lack of funds. However, planning for landscaping would be very useful to increase the aesthetical value of the surrounding area of the project site.

12 Sustainability assessment and long-term impacts

A basic assessment (Table 5) was carried out to indicate in which of the five sustainability criteria for sanitation (according to the SuSanA Vision Document 1) this project has its strengths and which aspects were not emphasised (weaknesses).

Table 5: Qualitative indication of sustainability of system. A cross in the respective column shows assessment of the relative sustainability of project (+ means: strong point of project; o means: average strength for this aspect and – means: no emphasis on this aspect for this project.

	collection and transport			treatment			transport and reuse		
Sustainability criteria:	+	o	-	+	o	-	+	o	-
• health and hygiene	X			X				X	
• environmental and natural resources	X			X			X		
• technology and operation	X			X			X		
• finance and economics			X			X			X
• socio-cultural and institutional	X			X			X		

Wastewater Treatment and Reuse in Indradhanushya Center, Pune, Maharashtra, India

Sustainability criteria for sanitation:

Health and hygiene include the risk of exposure to pathogens and hazardous substances and improvement of livelihood achieved by the application of a certain sanitation system.

Environment and natural resources involve the resources needed in the project as well as the degree of recycling and reuse practiced and the effects of these.

Technology and operation relate to the functionality and ease of constructing, operating and monitoring the entire system as well as its robustness and adaptability to existing systems.

Financial and economic issues include the capacity of households and communities to cover the costs for sanitation as well as the benefit, such as from fertiliser and the external impact on the economy.

Socio-cultural and institutional aspects refer to the socio-cultural acceptance and appropriateness of the system, perceptions, gender issues and compliance with legal and institutional frameworks.

For details on these criteria, please see www.susana.org: the SuSanA Vision document "Towards more sustainable solutions" (www.susana.org).

Storm water drains carrying sewage from the alongside residential and commercial settlements is a common scenario in developing countries. This water - if treated with cost effective, sustainable technology and reused for flushing in public toilets and irrigating the parks and gardens maintained by the local authorities - can tremendously reduce the pressure on fresh water demand and help in urban water planning of such countries.

Other important and major benefits and impacts of this project are the substantial reduction in the pollution of surface water bodies like rivers and lakes, reduced ground water exploitation in case of shortage, enhancement of green covers in urban areas, or improved socio-economic aspects (such as cost savings). Decentralized, small actions will collectively lead to positive impacts addressing global climate change.

This treatment system can be replicated effectively in other parts of India and also in the other countries facing similar pollution issues.

13 Available documents and references

1. Joshi, Sandeep & Joshi, Sayali (2001) Economical treatment of sewage by Soil Scape Process. Proceedings of Seminar on Management of the existing water and sewerage facilities and services. Case studies and Analysis of proposals for future development organized by Institution of Public Health Engineering, Kolkata, pp. 19 - 21.
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3. Quantitative Morphometric Analysis of Ambil Odha (Rivulet) In Pune, Maharashtra, India. Shrikant M. Gabale* and Nikhil R. Pawar, IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 9, Issue 7 Ver. I (July. 2015), PP 41-48
4. http://www.punecorporation.org/informpdf/Fire_Hazards/3annexurefinal.pdf

14 Institutions, organisations and contact persons

Name and contact of Respective Organization	Role	Responsibility
Shrishti Eco-Research Institute (SERI) B-106, Devgiri, Opp. P. L. Deshpande Garden, Near Ganesh Mala, Sinhagad Road, Pune – 411030 Phone: 91 (020) 24253773, Telefax: 91 (020) 66206539 Email: seriecotech@yahoo.co.in contact@seriecotech.com website : www.seriecotech.com	Technology provider	Designing of main treatment system SSF, Supply of bacterial culture, supervision and commissioning and process initiation
Ecosan Services Foundation Flat No. 1, 1st Floor, 24, Prashantnagar, 721/1, Sadashiv Peth, L.B.S.Road, Pune: 411030 Phone : 91 (020) 64 000 736 Fax : 91 (020) 24 530 061 Email: ecosan@ecosanservices.org Website : www.ecosanservices.org	Project Co-ordinator	Design of intake well, supervisor of construction activities
Indradhanushya Environment Education and Citizenship Centre Opposite Sachin Tendulkar Jogging Park, Anant Kanhere Path, Near Mahtre Bridge, Rajendranagar, Pune:-411030 Phone no. 020-24530077 Email : indradhanushya@punecorporation.org Website : http://www.indradhanushya.doodlekit.com	Project Proponent	Land availability and required legal permissions for project
Metro Association Branch Office - 9/142, Mira Housing Society, Salisbury Park, Pune 411 037	Contractor	Construction of treatment system as per technical designs
Kre_ta Landschaftsarchitektur Hausburgstrasse 17 10249 Berlin	Bureau of Landscape Architecture	Landscaping of surrounding area of the treatment site

Case study of SuSanA projects

Project name : **Wastewater Treatment and Reuse in Indradhanushya Centre, Pune, Maharashtra, India**

SuSanA 2011

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