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Natual Pools & How they work

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Built in Europe for more than four decades, biological swimming pools have established themselves as the option for those seeking a more sustainable way of living on our planet.

In this short guide you will learn about the basics of these pools, their technical characteristics, concepts and applicable terminology.

You will also find a list of frequently asked questions with clear and objective answers that will help you understand a little more about biological pools.

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What is a "biological" swimming pool?

What is a “biological” swimming pool?

"Biopools", "biological“, "natural" or "ecological“ pools (Natural Swimming Pool - NSP) are different names for the same concept of swimming pools created as a living and integral ecosystem.

Water is filtered and kept “alive” through a biomimetic system (in Brazil also known as nature-based systems - NBS), that is, it mimics the way nature itself purifies water without the need for sterilization.

Water transparency and purity are thus the product of a biological process, eliminating the use of chlorine and other forms of sterilization and their negative effects on health and nature.

Each biological pool is a unique ecosystem. The design of both the form and the filtration system must be carefully thought out, adapting to the needs of each project.

foto: Boris Gaasbeek

Wetland ecology

Wetland ecology

In the wild, wetlands are areas that are permanently or temporarily flooded with water, such as marshes, ponds or mangroves, characterized by great biodiversity.

These ecosystems perform the same function as a liver in a human organism: the purification of water through the storage and transformation of nutrients.

Wetland plants have developed unique symbioses (cooperative relationships) with a wide range of bacteria and invertebrates, a lifestyle that allows them to survive in these aggressive and humid environments.

Imitating the wetland system: “Built wetlands”

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In a built wetland treatment system (as in the case of a biological pool), water nutrients are absorbed, leaving it clean and pure. Each plant species responds differently in the system, so species should be selected considering which ones are appropriate for the specific contaminants, nutrient load, flow rate and local conditions.

The flora

Reeds, nymphs and a variety of other plants can be included. The system is robust and can assimilate residues of skin creams, sunscreen (although sunbathers should, of course, be encouraged to use showers) and even some occasional 'accident'. Through understanding and harnessing biological processes, a healthy ecological balance is maintained in the pool so that the swimmer is immersed in clean, clear and non-chlorinated water.

The fraction of the total area devoted to plants is determined according to the filtration system chosen. The minimum regeneration area can be up to 5% and water can be heated to 28 ° C if required.

The fauna

The biological pool is not just a place to cool off; It is also a haven of wildlife and an environment of ever-changing natural beauty throughout the year.

Mosquitoes are not a problem as they breed in environments of low oxygenation and absence of predators. In contrast, biological pools are highly oxygenated and therefore do not attract mosquitoes. Its complex ecology is resilient and maintains a healthy, balanced, harmonious and lively environment.

Health benefits

Health benefits

Although our skin is the largest of all our organs, we rarely consider the consequences of prolonged contact with chlorine, algaecides, and other chemicals. The long-term health effects of chlorine and other conventional pool cleaners include eczema, rashes and cancer, as well as premature aging of the skin. Chlorine is also known to cause asthma, breathing problems and increase the risk of developing allergy.

By contrast, the water in a biological pool is gentle on skin contact, making bathing a refreshing experience of a very special quality.


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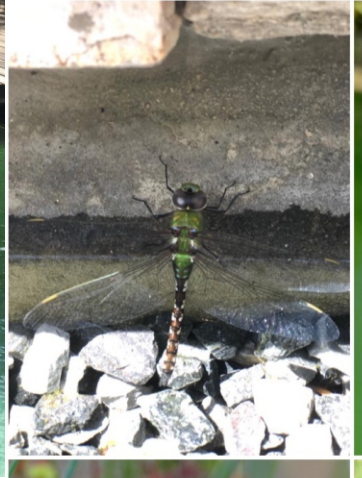

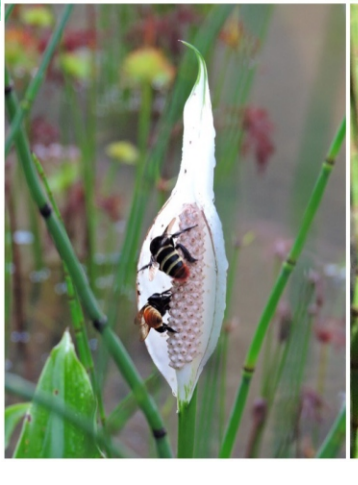

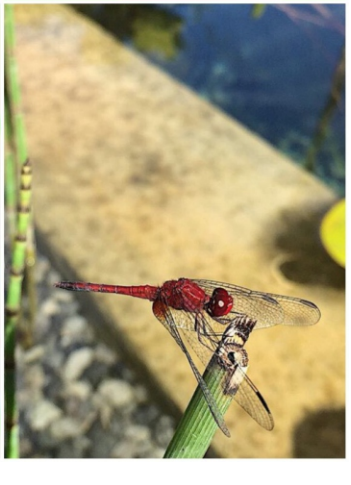

Environmental benefits

Environmental benefits

An average pool has about 75,000 liters of water. When cleaning conventional filter systems, where does this water go? How are ecosystems affected by chlorine and other algal inhibitors? Pool water is often dispensed into surface water drains, which discharge into local watercourses where fish and other aquatic life forms are directly affected.

Biological pools, on the other hand, do not need drainage and the water released during cleaning is not only harmless but also beneficial and can be stored for reuse in the garden.

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From the most natural to the most formal,a variety of options

From the most natural to the most formal, a variety of options

Biological pools can be integrated into the landscape to make them look totally natural.

Or they may take the form of a traditional swimming pool, yet remain integrated with plants and natural elements to filter the water.


Algae presence


During stabilization


Post stabilization

Stabilization period

Stabilization period

During the first 1-2 years, the biological pool goes through a stabilization period. It is the time nature needs for this new ecosystem to consolidate through the development of the aquatic garden that functions as a biological filter.

During this period, algal blooms and water turbidity are common.
With the maturation of the system the water stabilizes, reaching a crystalline aspect.

Algae are part of all healthy aquatic ecosystems. As the pool system stabilizes, its presence becomes less dominant.

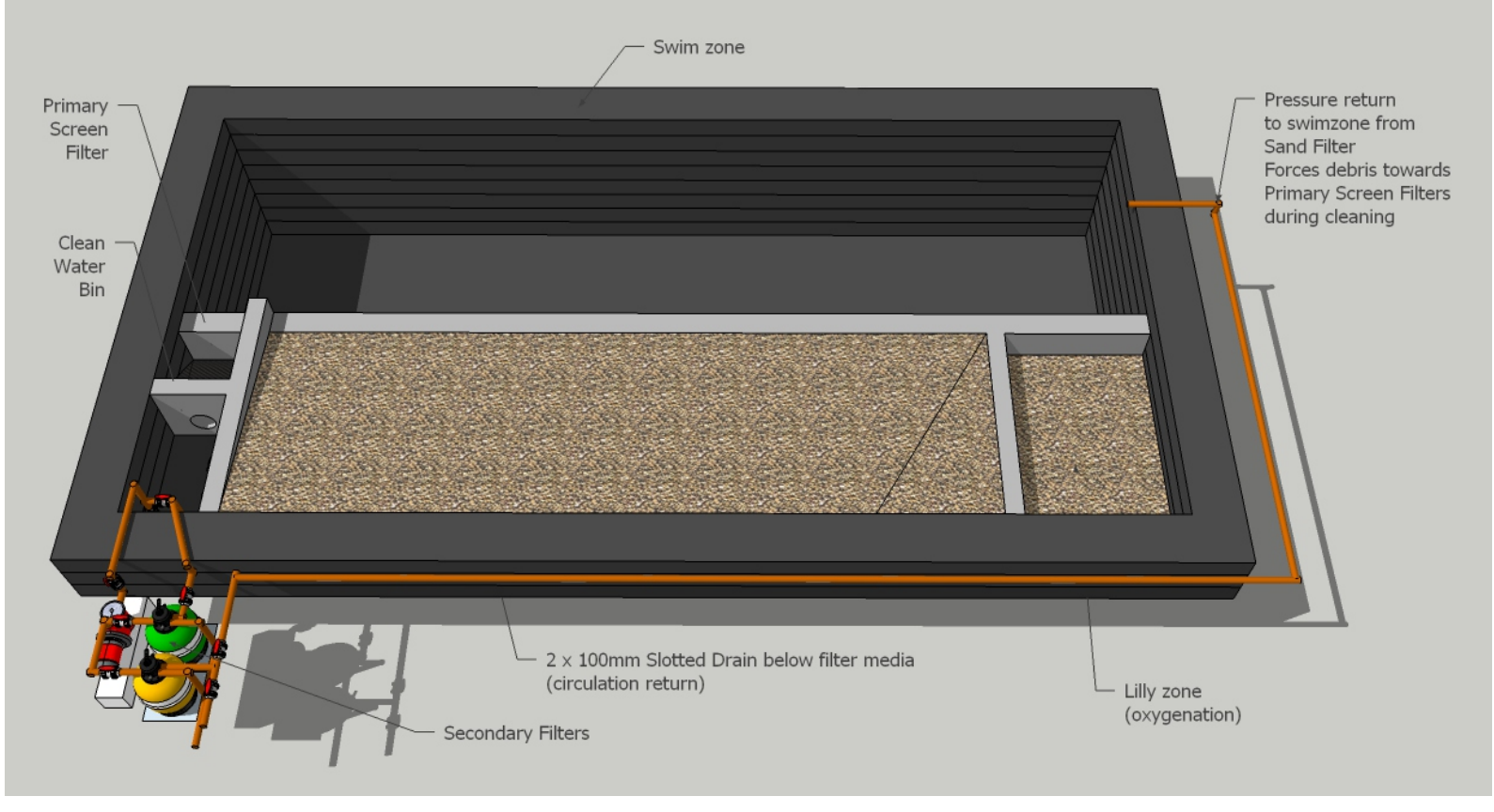
The images below illustrate the difference in water appearance during and after stabilization.

When the pool matures, the transparency of the water stabilizes.

It is possible to identify the species that best develop and adapt to this new consolidated habitat and which, on the other hand, continue to change.

Part 2 - The technology

Part 2 - The technology



W. Kircher and A. Thon are authors of the book ***How to build a Natural Swimming Pool*** * , lThis reading is essential for those who wish to deepen their understanding of the different systems that can be used to construct a biological swimming pool. The book also features icons that illustrate each of these systems, and make it easy to understand possible solutions that may be applied. In the next pages, we will summarize these applications.

To begin with, it is important to understand that the different design systems for biological pools are the result of a combination of 4 factors:

FILTRATION TYPE (1, 2, 3 e 4)
+
WATER FLUX (► ▲ ▼)
+
REGENERATION ZONE LOCATION (A, B e C)
+
CONSTRUCTION SYSTEM

Each of these factors, in turn, has different options. Let's start with the filtering types: HBS, TWL, and BSF.

(*) Kircher, Wolfram & Thon, Andreas & Zlobinsky, Thomas. How to Build a Natural Swimming Pool -The complete guide to healthy swimming at home. Filbert Press, 2016, 328p.

Filtration types

Filtration types

1 & 2

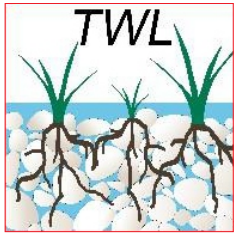
Hydrobotanical system (HBS)

May be standing water without any technical installation (1); or with slow surface water flow (2).

HBS systems are characterized by the densely planted regeneration zone (pool area where filtration is performed), occupying around 50% of the total pool area.

In HBS type 2, the ideal water flow rate is very slow: 200lph / m² of filter area.

3



Technical wetland (TWL)

The TWL system is characterized by gravel or sand filter planting, with varied options of water levels and direction of water flow. The ideal water flow rate for this system is slightly faster than HBS, at around 300lph / m² of filter area.

4

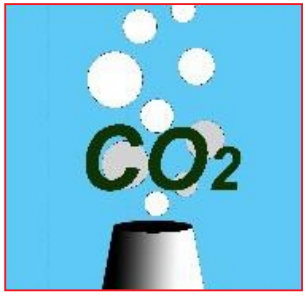
Biofilm accumulating substrate filter (BSF)

The main feature of the BSF is that it does not require the use of plants, since filtration is done through constant circulation of water through the highly percolated regeneration zone, with an ideal vessel of 500lph / m² of filter area.

The three types of filtration can work in conjunction with additional technical equipment:

Phosphorus reduction

Aeration



CO2 Enriched Aeration

Skimmers

Filters

Water flow

Water flow

Water flow can be:

► horizontal ▼ top down ▲ bottom up

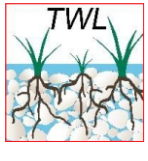
The following are the different possibilities of combining FILTER TYPE and WATER FLOW

1e 2

Hydrobotanical system ►

Flow rate: Still water or <200lph / m² filter area

3



Technical wetland ► ▼ ▲

Flow rate <300lph / m² filter area

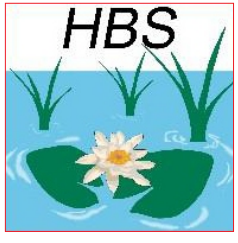
4

Biofilm accumulating substrate filter ▼ ▲

Flow rate >> 500lph / m² filter area

Let's now take a closer look at each of these combined FILTER TYPE and WATERFLOW systems, also identifying their purification factors and maintenance requirements.

1 e 2 - Hydrobotanical system



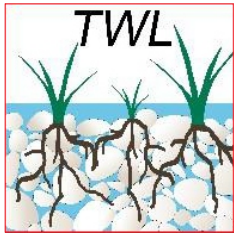
Flow: Still or flowing water
just horizontal and shallow very slow

Flow rate: <200lph / m²
(> 65% of total area in 1 and
> 50% planted area in 2)

Purification Factor: Plants, Plankton

Maintenance Requirements:
Trimming and Harvesting submerged plants in summer; reeds / helophytes in autumn.

3- Technical wetland



Flow: Horizontal or vertical, slow.

Flow rate: <300lph / m² filter area
(> 30-40% of total area)

Purification Factor: Substrate, Plants (helophytes) and adjacent microorganisms to roots and rhizomes

Maintenance Requirements: Cut / Cut of plant sprouts in autumn: possible full exchange after 10-15 years

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4 - Biofilm accumulating substrate filter

Flow: Vertical fast.

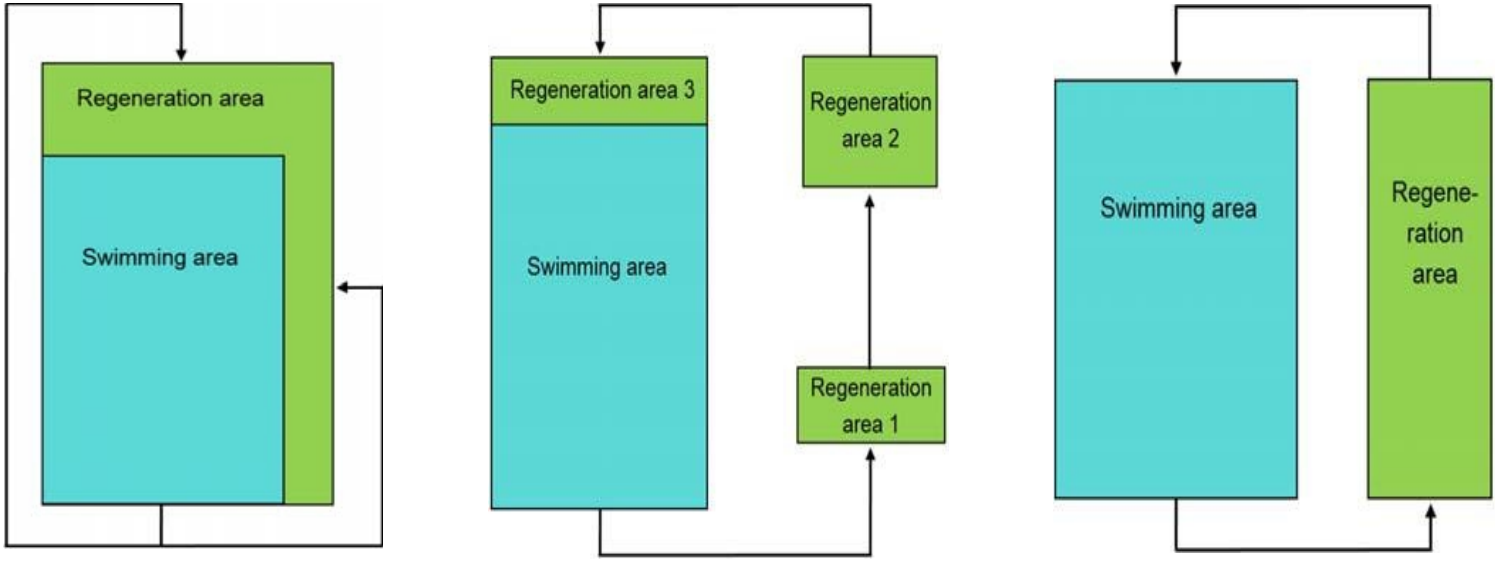
Flow rate:> 500lph / m² area
(> 5-25% of total area)

Purification Factor: Biofilm; layers of gravel percolated intensively; Water in constant motion. (aquatic plants only with decorative function).

Maintenance Requirements:
Regular backwash

Regeneration zone location

Regeneration zone location



A (In situ) **B (In situ + Ex situ)** **C (Ex situ)**

The regeneration zone of the biological pool may be included in the same unit as the bathing area (A); can be built separately (C); or even combine the two possibilities (B).

Depending on the number of units built, they can also be classified as single chamber, double chamber and multiple chamber pools.

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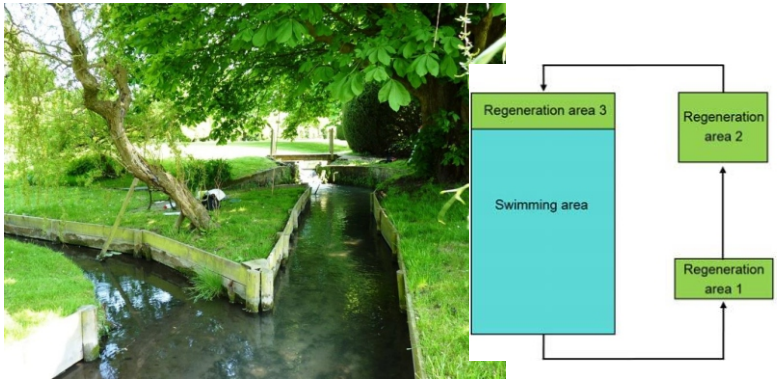
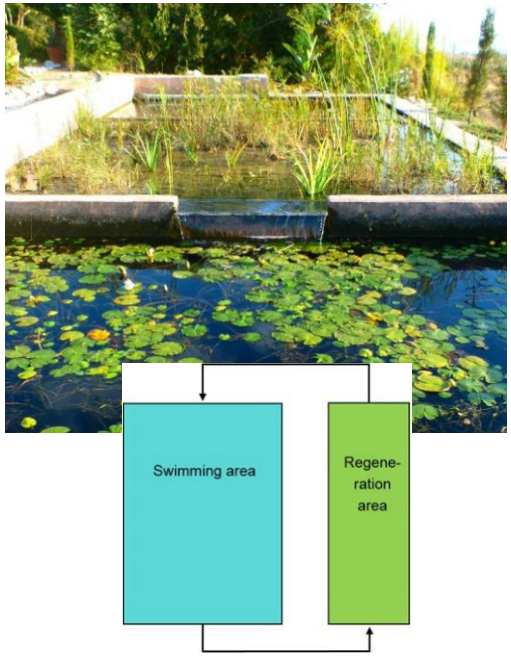
Following are some examples of location of the regeneration zone.

A – Regeneration zone in situ



B – Regeneration zone in situ + ex situ



C – Regeneration zone ex situ

Construction systems

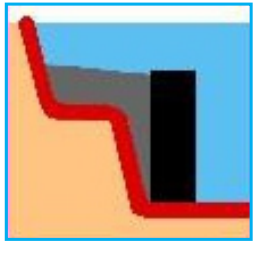
Construction systems

Now that we know the FILTER TYPES, WATER FLOWS and REGENERATION ZONE LOCATION, let's look at the four possibilities of CONSTRUCTIVE SYSTEM.

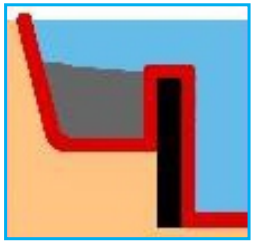
The models below have different separation options between regeneration zone and bathing area.

The red line is the waterproofing membrane; the gray area on the left corresponds to the regeneration zone (where the garden and other filter elements are installed); the partition wall appears in black; the pool bathing area is on the right.

No walls: The edge separating the bathing area from the regeneration area is below the water level, built into a slope and coated with waterproofing. A stone canopy can be placed on the slope to beautify your appearance.

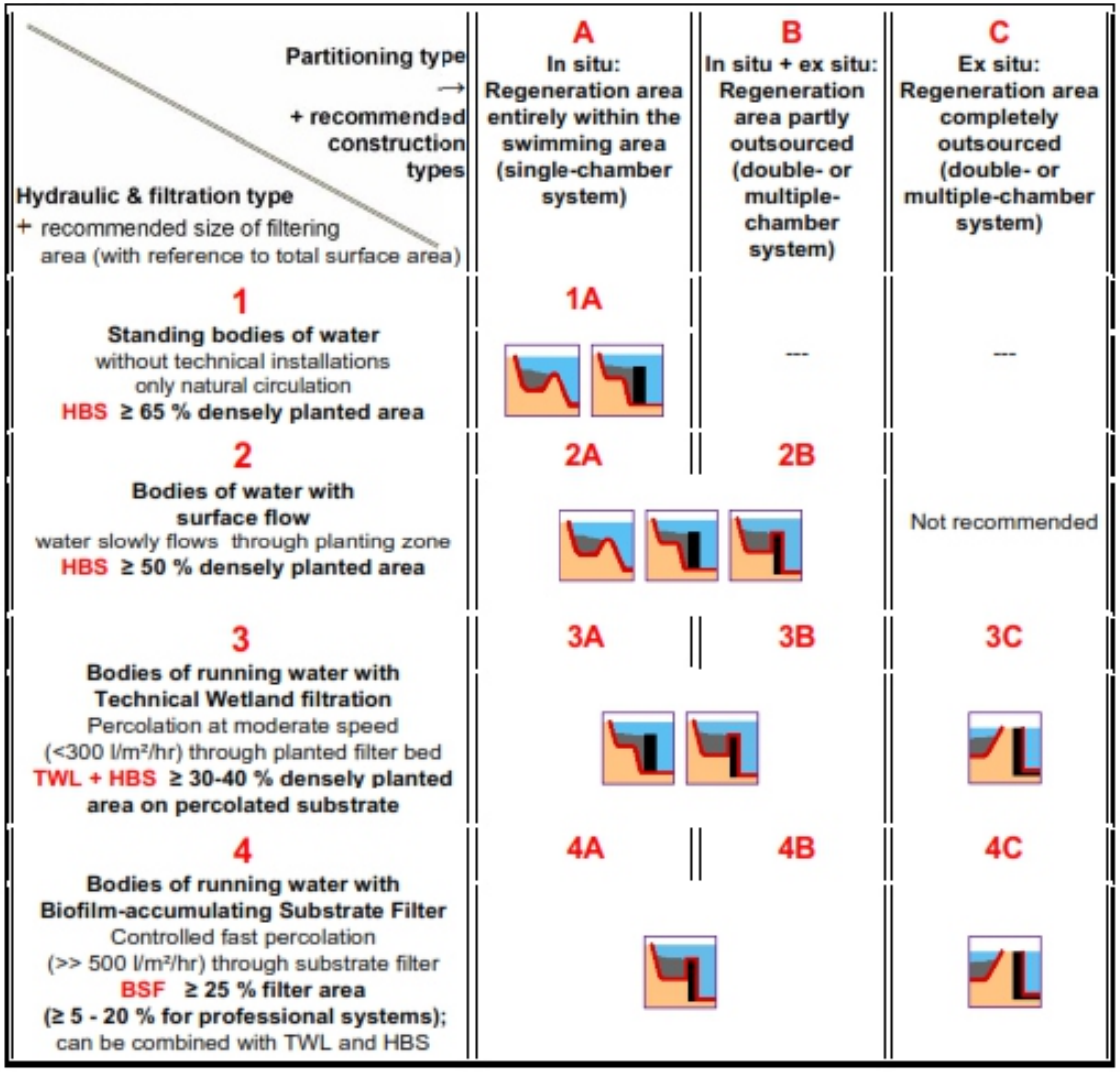


Wall over waterproofing: A vertical wall separating the bathing area is built on top of the waterproofing layer. Natural stone or wood are commonly used in the construction of this type of partition. The space between the waterproofed slope and the wall is filled with a special substrate where the filtration system and the planting zone will be installed.



Wall under waterproofing: The vertical wall separating the bathing area is constructed of concrete, masonry or special plastic elements. The outer area is filled with sand to the desired depth level for the regeneration area, and then compacted. Finally, waterproofing is installed on all elements.

Fully separate pool: The regeneration zone is built separate from the bathing area. This model, having no plants on the edges, allows the installation of cover systems for the pool. This is also the ideal model for converting existing conventional pools into biological pools: from the installation of a skimmer, water is directed to the tank or regeneration chamber and then back to the pool.



(*) Kircher, W; Allee, S; Thon, A. Natural Swimming Pools (NSPs)-Principles and Trials with Site-Conform Vegetation. 2018. https://www.researchgate.net/publication/322833203

It is from the combination of the four factors we have just seen (FILTER TYPE, WATER FLOW, REGENERATION ZONE LOCATION and CONSTRUCTIVE SYSTEM) that W. Kircher, S. Allen and A. Thon propose nine models of biological pools.

The choice of each element should be made from the analysis of local conditions (climate, terrain), type of use of the pool (public or private), available budget and aesthetic preferences, among other variables.

The quality and efficiency of the system will depend on the right choice of the described elements and the correct use and maintenance of the biological pool.

Acknowledgments and credits to

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Fotografia da pg. 18 de Boris Gaasbeek , FreeImages.

Frequent questions

Frequent questions

Can I put fish in the biological pool?

Fish bring many nutrients to the water through the feces. In a small scale system, such as a swimming pool, some mechanism needs to be added to ensure that these excess nutrients are eliminated. Therefore, if you want to have fish in your pool, it is recommended that you install UV lamp equipment and other water sterilizing devices traditionally used in artificial lakes. With the use of such equipment, the pool is no longer "biological" but can still be "chemical free". It is also worth mentioning that fish care may, at times, require the use of medicines in water to treat diseases.

Do biological pools attract mosquitoes, such as Aedis Aegypti?

Mosquitoes breed in environments of low oxygenation and absence of predators. In contrast, biological pools are highly oxygenated and their complex ecology maintains a healthy and balanced environment. Dragonflies and damsels are a characteristic presence in the regeneration zones of biological pools. Together with anuran amphibians (especially tree frogs,

which also find an ideal environment in the aquatic garden), they are excellent water quality bioindicators as well as voracious insect predators such as the aedis aegypti mosquito. There is vast scientific literature confirming the importance of these animals for the ecological balance of the planet.

I don't like to swim near plants and animals. Is it possible to still have the benefits of a biological pool?

Yes, there are design solutions that allow the filtration zone to be located separately from the bathing area. In addition, choosing the type of filtration system can also reduce the presence of animals and plants.

How much does it cost to build a biological pool?

As with any work, the price may vary greatly depending on the design and finishing details. A guideline average would be between R $ 1,800.00 and R $ 2,500.00 / m³ (values from 2019, in Brazil). Remembering that the biological pools have, besides the bathing area, the regeneration zone where the aquatic garden is installed.

Is it possible to heat the water of the biological pool?

Yes, it is possible to heat up to around 28 ° C. It is important to consider from the outset of the project whether water will be heated to suit the design of the filtration system. Ideally, keep the temperature as constant as possible to avoid impact on the ecosystem.

Is maintenance complicated?

The degree of automation of the biological pool filtration equipment will depend on the investment you are willing to make. As for cleaning, the first 1-2 years are more laborious because, due to the stabilization period of the ecosystem, the water is more cloudy and there is more algae occurrence, requiring more frequent cleaning. Over time, the system achieves greater stability, which facilitates maintenance.

How can I tell if the water is really clean?

In a well-planned and executed biological pool, water quality is evident. But, as in all natural

environments, it may also be exposed to external interference: the presence of some “intrusive” animal or contaminated water entering, for example, may destabilize the system. If in doubt, it is recommended to perform water quality testing in a specialized laboratory. It is also important to periodically check the proper functioning of pool equipment (pumps, filters, skimmers, etc.), as well as the cleanliness of the pool and garden.

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