

PUB SENGKANG FLOATING ISLAND: GOOD REASONS WHY BESTMANN GREEN SYSTEM (BGS) FLOATING ISLAND IS THE BETTER CHOICE

REASON NO. 1: **“BGS’ FIRST SINGAPORE FLOATING ISLAND TRIAL AT SELETAR RESERVOIR HAS PROVEN THE SYSTEM WORKS BEYOND EXPECTATIONS.”**

An independent comparison between **Bestmann Green System (BGS)** Floating Gardens™ and another competitor, submitted to **PUB** in December 2008, resulted in BGS’s Floating Gardens™ performing better in 8 out of 12 evaluation criteria, including costs, material quality and durability, island shape, root growth, technical support and services and ease of maintenance.

Overall the BGS Floating Gardens™ is better suited to meet the **Sengkang Floating Island** project requirements. **Bestmann Green System (BGS)** adaptive product solutions and design innovations in Singapore have produced a Floating Island that will perform for years to come based on proven track records from international applications. In detail, the trial succeeded in the following:



- ***Design intent of fully freeform, & accessible floating island is fully achieved. Walking for maintenance is possible.***
- ***Materials show no sign of fatigue providing durability of system.***
- ***Floating island is aesthetically pleasant with diverse flowering species and plant shapes.***
- ***Specified wetland and aquatic plant species have been established with overall positive growth rates within 2-3 months.***
- ***Wetland and aquatic plants have shown faster root growth when compared to the competitor’s product.***
- ***Routine maintenance after establishment is limited to removal of vegetative biomass.***
- ***No major pest attacks, but rather fast colonization and high resilience against pests thanks to high biodiversity and presence of natural predators is achieved.***

REASON NO. 2: "BESTMANN GREEN SYSTEMS (BGS) IS A TRUSTED INTERNATIONAL BRAND WITH MORE THAN 30 YEARS OF BIO-ENGINEERING PRODUCT EXPERIENCE."

Bestmann Green Systems (BGS) GmbH is a German bioengineering design and manufacturing company specializing in bioengineering product development and project implementation **for more than 30 years**. BGS has developed a wide range of different floating wetland systems to meet its clients' demands for technical and landscape-aesthetic solutions. That allows the company to select the most suitable and cost-effective combination from its wide range of products to respond to **PUB's** requirements in Singapore.

BGS's CEO, Mr. Sven Wiese, who runs the company since 1996 is the founder of the *International Bioengineering Group (IBEG)*, with extensive activities in Asia -especially in Japan- since more than 20 years. A long-standing joint venture exists with Sri Lankan businesses, which is one of the world's major exporters of coir (coconut fibre). BGS' philosophy is to use natural materials whenever possible to reach a high ecological level of performance.

Production of the company's proprietary products and systems, as well as its own seed and plant propagation is distributed throughout Germany and other countries, including Asia.



"Always a step ahead", is the motto at BGS, giving it a prominent position as a technology leader in biological engineering systems for waterways and reservoirs.



REASON NO. 3: “BESTMANN GREEN SYSTEMS (BGS) HAS THE PROVEN TRACK RECORD OF INTERNATIONAL LARGE-SCALE FLOATING ISLAND INSTALLATIONS.”

Bestmann Green Systems (BGS) GmbH has a successful track record of designing and implementing large-scale floating island projects.

The following table provides an overview of successfully completed large-scale floating island projects by *Bestmann Green Systems (BGS) GmbH*.



Table 1: Selected Completed Floating Island Projects by Bestmann Green Systems (BGS)

Project Name & Location	BGS Client	Floating Island Size	Project Value
Freshwater Reservoir, Agulla Lake, Catalonia, Spain	Aigües de Manresa S.S. Phragmites SL Sistemes Natural de Tractament d'Àigües	Supply of 6.000 m ² Aquatreat® floating Blankets	SGD 385,500.00
Aiguabarreig, Spain	Aigües de Manresa S.S. Phragmites SL Sistemes Natural de Tractament d'Àigües	Supply of 1.200 m ² Floating Islands, combined SRD with Felix Float	SGD 105,000.00
Airport Leipzig/Halle, Germany	Airport Leipzig/Halle GmbH	Stormwater retention basin, supply of combination of AquaGreen® SRD with SK 30 A – 1.300 m ²	SGD 153,300.00
Zoological Garden Gelsenkirchen, Germany	Gesellschaft für Energie und Wirtschaft GmbH	Supply of 700 m ² Floating Island	SGD 63,000.00



Large-scale applications of BGS Floating Islands provide valuable project experiences and have led to constant new developments as part of BGS' own R&D programs. This assures that PUB will receive the best suited overall product solution from BGS, while other suppliers provide only prototypes.

REASON NO. 4: “ENVIRO PRO GREEN INNOVATIONS (EPGI) IS SINGAPORE’S FIRST HOME GROWN, ONE-STOP CENTRE FOR BIO-ENGINEERING SOLUTIONS AND BGS’ LOCAL PARTNER.”

With more than 10 continuous years in the Singapore and Asian environmental market, ENVIRO PRO has gained valuable experiences and insights in working with Singapore government and private sector clients. Through the partnership with **Bestmann Green System (BGS)**, ENVIRO PRO now provides comprehensive bioengineering services including **full design, supply and installation and operational capabilities**. ENVIRO PRO has become Singapore’s first “*One-Stop Bioengineering Centre*”, offering ‘round the clock’ technical support to its clients at home! In 2005, Enviro Pro was recognized by receiving the Prime Minister’s Office TEC “**Innovator of the Year**” award.

We are a Singapore incorporated, BCA registered company, which employs and contributes to the growth of local and foreign talents in the up coming bioengineering sector. ENVIRO PRO has joint projects with local universities NUS and NTU to further research and adaptation of bioengineering solutions to Singapore’s specific water conditions, given us in-depth knowledge of Singapore’s water and ecological aspects.

With **PUB**, we have partnered to create larger understanding for this new field amongst other professionals and the general public through joint



seminars and participation in the PUB ABC pavilion.

PUB is also our ultimate client for a number of recent bioengineering projects:

1. *PUB BGS Floating Island Trial at Lower Seletar Reservoir (2009/2008)*
2. *PUB NTU Nutrient Removal from Reservoir Inflows using Floating Vegetation Mats (2009/2008)*
3. *PUB Estate Upgrading Project – Chestnut Estate Bio-retention Swale along Jalan Pakis (2009/2008)*
4. *PUB ABC Watershed Manager for Western Catchment – Environmental Manager for Western Catchment ABC Masterplanning Phase (2006/2007)*
5. *PUB NTU EP Pilot Project on the Application of Enhanced Engineered Wetland Technology for the Removal of Nutrients from Stormwater at Kranji Reservoir (2007/2005)**

* Together with its partners PUB and NTU, ENVIRO PRO was the proud recipient of the Prime Minister’s Office The Enterprise Challenge (TEC) “Innovator Award” in 2005.

REASON NO. 5: "BGS MATERIAL HAVE UNDERGONE RIGOROUS TESTING, HAVE BEEN USED IN PROJECTS FOR A DECADE AND COME WITH A 5-YEARS WARRANTY."

With BGS products and materials there will be no bad surprises. All materials have undergone rigorous testing by the German *Technischer Überwachungsverein* (TÜV) according to strict standards. **More importantly, they have undergone the test of time!** Based on their good performance, *Bestmann Green System (BGS) provides 5 years warranty on Floating Island components.*

All non-organic BGS product materials proposed for the Sengkang Floating Island (Repotex I3®) have been used and tested in Germany since 10 years, with current floating island models being installed since 7 years under regular observation and without problems. Under conditions of the proposed application, the Repotex I3® materials will be well protected and covered by dense vegetation growth or partially submerged. BGS materials have also been used successfully in marine water conditions.

The used PP/PE materials are inert in water. The PE-made, tube-shaped buoyancy device's foam structure contains closed pores. Water pollution by disintegration of materials has not been recorded.

In Singapore, BGS' first Floating Island at Lower Seletar Reservoir with 60 sqm surface area has been tested for 8 months without material problems. The system has adapted well to Singapore water conditions and forms a compact structure once assembled on water.



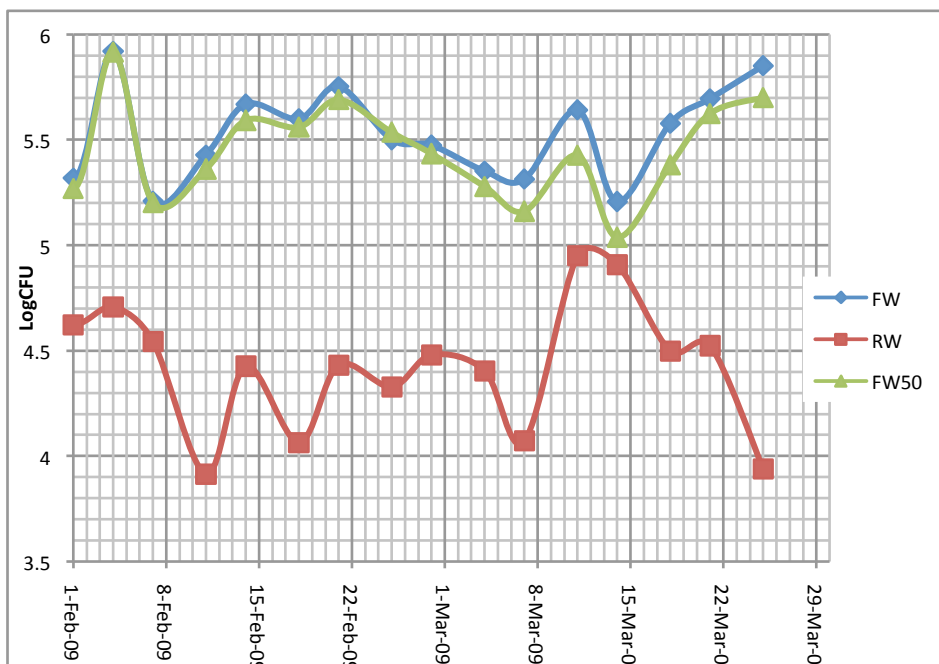
Products used by the competitor's trial have shown sign of material fatigue after less than 6 months, even sinking low into the water. The materials shown here include some unidentified chemical foam that disintegrates in water and potentially causes pollution.

REASON NO. 6: "SCIENTIFIC DATA FROM THE NATIONAL UNIVERSITY OF SINGAPORE SHOWS THAT BGS SYSTEMS CAN IMPROVE WATER QUALITY."

In collaboration with the National University of Singapore's (NUS) School of Environmental Engineering and with support of **PUB**, ENVIRO PRO provides assistance for water quality and biological research on the BGS Floating Island trial at Seletar Reservoir. Data collection and analysis was carried out for a period of 6 months between October 2008 and March 2009 by NUS. Samples were taken from the water column under the BGS Floating Island and a control sample from reservoir water at **PUB's** Seletar Reservoir.

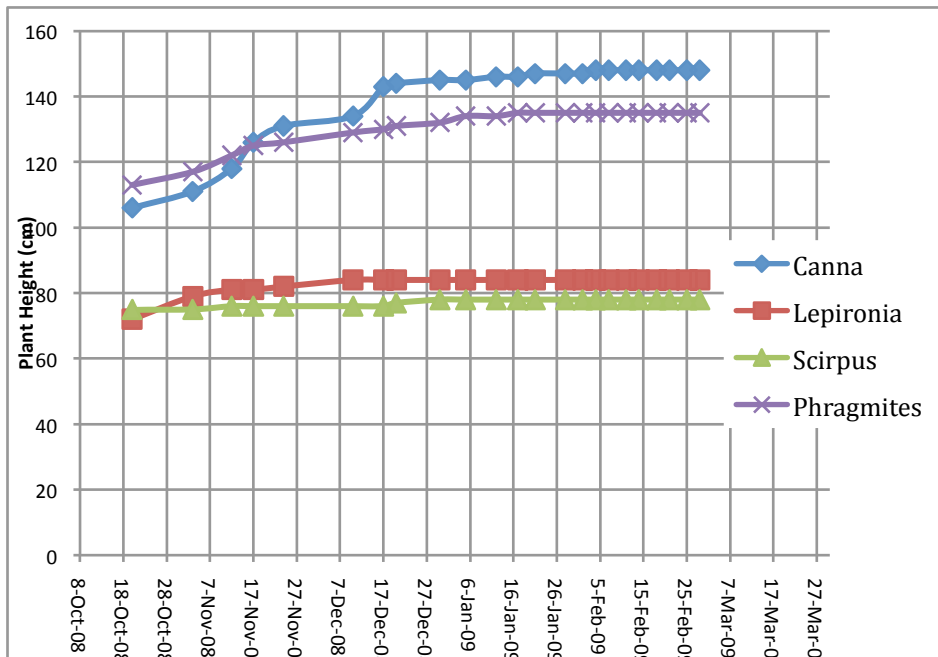
Finding 1: BGS Floating Island Improves Microbial Growth

An increased micro-biological activity was detected in samples under the BGS Floating Island. The BGS Floating Island together with the extensive root system provides the growth medium for these microbes. Such microbial growth will be able to improve water quality through microbial uptake of nutrients and nitrification of ammonium to nitrates, which can further undergo denitrification at deeper water levels to remove nitrogen.



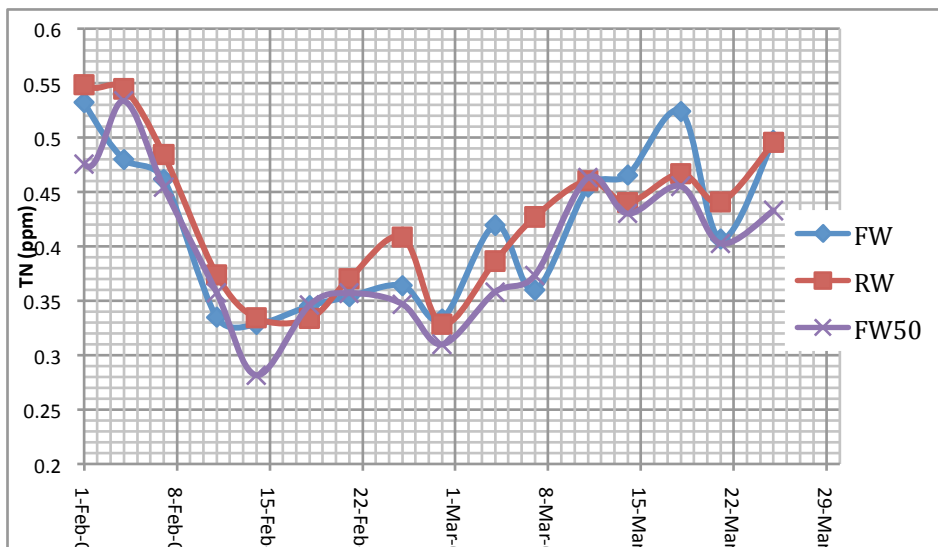
Bacteria Plate Count (FW_{avg} = 5.53; RW_{avg} = 4.43; FW50_{avg} = 5.45) [FW: directly under floating mat] [FW50: 0.5m under floating mat] [RW: reservoir background]

Finding 2: BGS Floating Island Supports Healthy Plant Growth



BGS Floating Island does not introduce polluting soil media into reservoir water, but is able to support healthy plant growth as data for four tested wetland plant species demonstrate. Plant growth of up to 40% were achieved within two to three months after which plant growth has reached maturity.

Finding 3: Total Nitrogen Levels Have Been Reduced Below BGS Floating Island



On average TN has been reduced by up to 7% below the BGS Floating Island, most likely through microbial uptake of nutrients and nitrification of ammonium to nitrates, which can further undergo denitrification at deeper water levels to remove nitrogen.