



Soil Bio-Engineering and Green Infrastructure

TRACK RECORDS OF ENVIRO PRO GREEN INNOVATIONS (S) PTE LTD | 2021





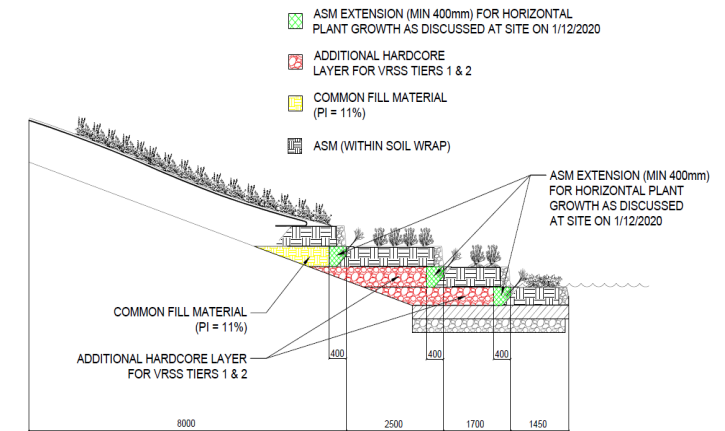
Sungei Ulu Pandan (Clementi Avenue 4 to Sungei Pandan), 2019 – Present

The improvement works to Sungei Ulu Pandan includes technical design matters, shop drawings and material submissions.

Enviro Pro is involved in conducting trials with bio-engineering planting materials, to study establishment rates and pre-growing sequencing. Enviro Pro is also involved in advising the main contractor on materials and method statement for the construction of the soil bio-engineering works, and in conducting trials and mock-ups with bio-engineering planting and reinforcement materials.

Key Design Concept

- **Vegetated Reinforced Soil Slopes** – soil bioengineering techniques are used to protect and stabilize river/canal slope embankment to sustain ecosystem friendly and vegetated systems that provide erosion control, aquatic habitat, and other benefits.



Cross Section of VRSS



Vegetation on VRSS



Development of Jurong Lake Gardens Central and East, 2018 – Present

The improvement works to Jurong Lake Gardens Central and East includes technical advisory/consultancy and supervision services for the soil bio-engineering works.

Enviro Pro is involved in advising the main contractor on materials and method statement for the construction of Bio-Engineering Systems during construction period. Enviro Pro also reviewed and commented on proposed materials, on-site mock ups, and material testing procedures for the construction of Bio-Engineering Systems to fulfil project specifications. Demonstration and supervision of proper installation and construction methods for all Bio-Engineering Works.

Key Design Concept

- **Bio-engineered Slope** – Materials like gabions, coir mat, and other natural materials were placed on the canal banks so that it can be used as slope stabiliser. The bio-engineered slope are re-greened to provide natural looking development.



Bioengineered slope



Jurong Lake Gardens



Bioengineered slope



Improvement to Sungei Tampines for Soil Bio-Engineering Works, 2018 – Present

The improvement works to Sungei Tampines includes technical design matters, shop drawings and material submissions.

Enviro Pro is involved in conducting trials with bio-engineering planting materials, especially for life fascines and cut branch material, to study establishment rates and pre-growing sequencing. Enviro Pro is also involved in advising the main contractor on materials and method statement for the construction of the soil bio-engineering works, and in conducting trials and mock-ups with bio-engineering planting and reinforcement materials.

Key Design Concept

- **Vegetated Reinforced Soil Slopes** – soil bioengineering techniques are used to protect and stabilize river/canal slope embankment to sustain ecosystem friendly and vegetated systems that provide erosion control, aquatic habitat, and other benefits.
- **Hedgelayer**
- **Brushlayer**
- **Fascines**



Canal



Slope Reinforcement



Reno Mattress



Sustainable Drainage Design and Construction for “The Angsana” Development, Teluk Bahang, Pulau Pinang, Malaysia, 2018 – Present

Enviro Pro was appointed to provide consultancy services for the Concept Design of a Bio-engineered drain and we are presently involved in the detailed engineering design and construction. The main design concept includes the re-naturalization of the main drain by making full use of the existing drainage and 6m wide drainage reserve (60m x 9m). The drainage reserve will be able to cleanse the main drain water and act as a velocity reducing feature to protect beach areas.

The Bio-drain replaces a conventional concrete U-drain, and is designed to reduce the velocity of the effluent and improve the quality of the water in the main-drain before it is discharged into the sea. Using innovative bio-engineering techniques for slope stabilisation such as gabions and rock-rolls, these help to enhance the aesthetic value of the Bio-drain.

Key Design Concept

- **Bio-engineered Slope** – provides conveyance and retention function. It also provide vertical filtration system at low rate as water percolates down within its filter media. It is also suitable for intercepting and treating runoff.



*Bio-drain
Transition
Area*



*Bio-
engineered
Slope*



Gabions



Development of Jurong Lake Gardens West, 2016 – 2018

The improvement works to Jurong Lake Gardens West includes technical advisory/consultancy and supervision services for the soil bio-engineering works.

Enviro Pro is involved in advising the main contractor on materials and method statement for the construction of Bio-Engineering Systems during construction period. Enviro Pro also reviewed and commented on proposed materials, on-site mock ups, and material testing procedures for the construction of Bio-Engineering Systems to fulfil project specifications. Demonstration and supervision of proper installation and construction methods for all Bio-Engineering Works.

Key Design Concept

- **Bio-engineered Slope** – Materials like gabions, coir mat, and other natural materials were placed on the canal banks so that it can be used as slope stabiliser. The bio-engineered slope are re-greened to provide natural looking development.



Planting



Rock Wall



Slope to Drain



Wetland at Windsor Nature Park, 2014 - 2016

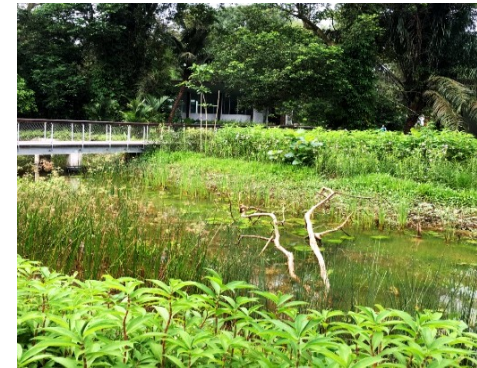
Windsor Nature Park, the sixth nature park in Singapore, was opened on 22 April 2017. Located off Venus Drive at the Upper Thomson area, Windsor Park acts as a green buffer for the Central Catchment Nature Reserve of Singapore. The existing habitat and biodiversity of the nature park was sensitively enhanced over two years.

The park consists of new nature trails that feature raised boardwalks and a sub-canopy walk where visitors can explore. Other features of the park include a wetland that was built considering the existing topography. The wetland was planted with reeds and plants such as *Cyperus haspan* and *Canna glauca* to provide ecological habitat and enhance the biodiversity.

Enviro Pro is involved in the design of the wetland features of the nature park to facilitate an ecological rich habitat for diverse biological species of the nature park.

Key Design Concepts

- Bio-engineered slope – Rock chamber mattress were used on the stream bank of the wetland to stabilise the slope. Re-greening was done on the bio-engineered slopes.
- Ecological Enrichment– Snags are placed in the wetland for birds perching. The wetland environment attract and provides suitable habitat for various dragonflies and butterflies.



Wetland in Windsor Nature Park



Geotextile with turfing



Rock chamber mattress for the wetland



Sustainable Drainage & Bio-Engineering Consultancy Services for Pos Sigar Integrated Development Project, Cameron Highlands, Malaysia, 2013 – 2014

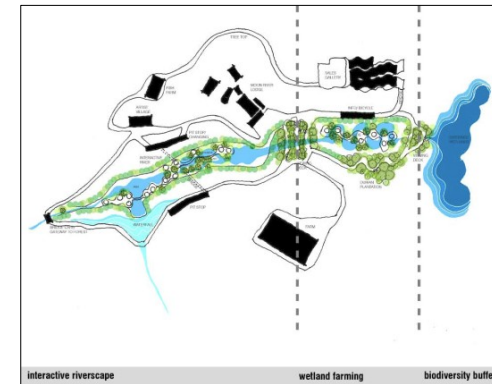
With reference to the master plan, Pos Sigar, in the mountainous terrain of Cameron Highlands, Malaysia, will be developed into an integrated and environmentally sensitive agricultural, residential and tourism development that is expected to utilize the available water resources of its catchment on the sustainable manner.

The site contains several natural drainage systems and a complete sub water catchment, given the developer control of surface water management at the site. The drainage systems are prominent design features of the master plan.

Enviro Pro is appointed to provide sustainable drainage and bio-engineering consultancy services for the development. Bio-engineering methods were proposed in areas where natural slopes are altered and the natural vegetation is disturbed such that the soil erosion is minimized.

Key Design Concepts

- Bio-engineered slope – Rock chamber mattress were proposed to be used to stabilise the slope of a river in Pos Sigar. Re-greening can be done on the bio-engineered slopes.



*Master Plan
for the
development*



*Steep slopes
of project
site*



Rock rolls



Bio-Engineering Concept for River Rehabilitation for Sungai Satu Rehabilitation Project, Penang Island, Malaysia, 2013 - 2016

Sungai Satu is a river located in Batu Ferringhi, Penang which was heavily clogged with litters and pollutants. The river rehabilitation involved a 200m section of the river. This project is an initiative by Selangor Dredging Berhad (SDB) in conjunction with their residential project, By The Sea.

This rehabilitation project aimed to rehabilitate, beautify the riverine environment and improve the water quality of the river. Ecological restoration to increase riverine biodiversity is also one of the key objectives of this project. Enviro Pro is involved in the design and built as well as the ecological enrichment of the river rehabilitation system with the implementation of bio-engineering technology.

Key Design Concepts

- Bio-engineered slope – Rock chamber mattresses were placed on the river banks so that it can be used as a slope stabilisation method. The bio-engineered slope can also be re-greened and provides a natural looking appearance.



FIABCI Malaysia Property Award



FIABCI World Prix d'Excellence Award

Awards

- FIABCI Malaysia Property Award**
(International Real Estate Federation) - Winner of Best Environmental (Rehabilitation/Restoration) – 2016
- FIABCI World Prix d'Excellence Award**
(International Real Estate Federation) – World Silver Winner of Best Environmental (Rehabilitation/Restoration) – 2017



Lifting of rock chamber mattress



Bio-engineered slope



Stone-filled revetment chamber mattress



Reservoir Embankment Re-greening Works at Marina Reservoir, 2010 - 2011

Urban greenery is being emphasized to enhance and improve the aesthetic value of Singapore Island. A pilot re-greening project was implemented at the Marina reservoir embankment, near the Singapore flyer. An area of 170m² of rock-concrete embankment was covered by carefully selected plant species, grown in the soil structurally supported by Bestmann Green System (BGS) wool fascines system. The system functions as a water and soil retention system, providing 120mm of planting substrate.

Enviro Pro is involved in the design and build of the wool fascine system. The wool fascine is a 100% biodegradable natural product, based on sheep's wool. It is able to support the moisture and nutrients to promote the establishment of vegetation. The system managed to soften the edge as well as assist in erosion control and water retention of the area.

Key Design Concepts

- Wool fascine system – A geotextile was laid at the bottom and steel stakes were used to fix the geotextile. The wool fascine were laid around the steel-stakes to form a geo-cell. The geo-cell was then filled with top soil and covered with a coir webbing.



Initial condition of site area



Laying of coir webbing on the soil before plants establishment



Re-greened slope