



# Sustainable Stormwater Management

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





## Development of Jurong Lake Gardens West

Jurong Lake Gardens is envisioned to be Singapore's new national garden. The first phase, Jurong Lake Gardens West (JLGW) focus on creating spaces for users to enjoy amid nature, greenery and lakeside views.

Some of the key features of JLGW includes a water play area that recycles the rainwater through natural treatment using cleansing biotope and UV disinfection. Bioengineering methods are used to stabilise the slopes located along the shoreline of Jurong Lake. Water Sensitive Urban Design (WSUD) features such as vegetated swales and gravel swales are constructed for the sustainable stormwater management of JLGW as well as to provide an beautified environment for the community to enjoy.

Enviro Pro provides technical advisory and supervision on the build of bioengineered slopes and WSUD features.

### Key Design Concepts

- **Bio-engineered slope** – Different Bio-engineering techniques are implemented on the shoreline of the lake to stabilise the slope. Re-greening will be done on these slopes.
- **Cleansing Biotope** – Provides water treatment to improve water quality through physical filtration and phyto-remediation. This also acts as a detention basin to control the water in the playground area.
- **Vegetated swales and gravel swales** – Channelise stormwater runoff through conveyance and infiltration method.



*Artist impression of the water play area including cleansing biotope*



*Boardwalk along the shore edge*



*Heron Island*





## Wetland at Windsor Nature Park

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 wetland design 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 dragon flies and butterflies.



*Wetland in Windsor Nature Park*



*Snags are placed within the wetland to attract birds to enhance biodiversity*



*Rock chamber mattress were used as a slope stabilization method for the wetland.*



### Water Sensitive Urban Design (WSUD) for “The Tembusu”

“The Tembusu” is a luxury freehold condominium development in Kovan, Singapore. WSUD features such as swales and bioretention basins were well integrated within the landscape which controls and manages the site run-off providing an aesthetic feature for the condominium.

Rainwater is harvested from the condominium rooftop catchment area and then channelled into a rainwater tank through built-in drainage pipes. The rainwater is recycled to top-up water features of the condominium. This significantly reduces the use of potable water for the water features.

Enviro Pro is involved in the design and build service for WSUD features as well as rainwater harvesting and recycling system.

#### Key Design Concepts

- **Swales** – Swales are installed at the site boundary of the condominium as an alternative to conventional stormwater drains. These features infiltrate, treat and convey stormwater from the condominium to the public drainage system.
- **Bioretention basin** – Detain and treat on-site stormwater runoff before discharge into drainage system. These features also provide ecological habitat for many butterflies, dragonflies etc.
- **Rainwater harvesting and recycling system** – Rooftop rainwater harvesting to recycle and reuse for water features in the condominium.



*Swales installed at the site boundary*



*Bio-retention basin*



*Water feature in “The Tembusu”*





### Pilot Project for Floating Wetlands at Pekan Quarry

Pulau Ubin is an offshore island located at the north-eastern corner of mainland Singapore. Due to its location from the mainland, it is a natural habitat for various species of animals.

Pekan Quarry is located in Pulau Ubin and is a well-known habitat for herons. Floating wetland is installed with the purpose of further enhancing biodiversity of the area. The wetland will provide roosting and nesting areas for herons, crakes, rails, kingfishers and frogs.

Enviro Pro was tasked with the construction of floating wetlands which aims to enhance the biodiversity in Pekan Quarry. This was a pilot project done for NParks with a futuristic intention of expanding and distributing the floating wetlands to larger areas in Singapore.

#### Key Design Concept

- **Floating Wetlands** – Floating mat made up of tubes of decay resistant polypropylene is integrated with buoyancy devices and coconut fiber mats to form the floating wetland. Certain type of plants grown on the wetland were capable to attract certain species of animals.



*Floating Wetland*



*Herons resting on the floating wetland*



*Otters were spotted on the floating wetland*



## Water Sensitive Urban Design (WSUD) for SPCA Headquarters

The Society for the Prevention of Cruelty to Animals (SPCA) in Singapore moved its headquarter to Sungei Tengah Road in 2016. The new SPCA building complex features several WSUD components such as swales, wetland garden and cleansing biotope that aim to provide a sustainable stormwater management.

Enviro Pro is involved in the design and build service for the WSUD features.

### Key Design Concepts

- **Swales** – The runoff from the buildings' roofs is received by the network of swales, which slows down the flow as water travel over its bed which consisted of gravel mix. The water is channelled into a pond. Hence, reducing the pressure on public drains.
- **Cleansing biotope** – The overflow from pond will then be received by the cleansing biotope designed to cleanse the water as it percolates down through filter substrate.
- **Wetland garden** – The cleansed water from the biotope is pumped back to two outlets: (i) wetland garden, adjacent to the pond, and; (ii) the pond. This circulation pattern is repeated till the pumped water is sufficient to cause overflow from the pond to the cleansing biotope.



*Swales*



*Swale connecting to the pond*



*Wetland garden*





### Cleansing Biotope at Bishan-Ang Mo Kio Park

The redevelopment of Bishan-Ang Mo Kio Park was part of a joint initiative by the Public Utilities Board (PUB) and National Parks Board (NParks) under the Island-wide Active, Beautiful and Clean (ABC) Waters Master Plan.

The concrete canal has been de-concretised and naturalised into a beautiful 3 km meandering river, bringing park users closer to the water way. Addition to the naturalised river, the park also features natural cleansing biotopes that uses plants to treat water and maintain the water quality of the ponds in the park without the use of chemicals.

Enviro Pro was involved in the construction of cleansing biotope around 4500 m<sup>2</sup> big helps to improve water quality and the aesthetic of the park.

#### Key Design Concept

- **Cleansing Biotope** – Offers effective water treatment which involves the filtering of pollutants through phyto-remediation. It helps to improve water quality without any addition of chemical while improving the aesthetic of the park.



*Cleansing biotope*



*Cleansing biotope*



*Cleansing biotope*



## Sungai Satu River Rehabilitation

Sungai Satu River is a river located in Batu Ferringhi, Penang which was heavily clogged with litters and pollutants. The river rehabilitation involves 200m downstream of Sungai Satu River. This project is an initiative by Selangor Dredging Berhad (SDB) in conjunction with their residential project, By The Sea. The rehabilitated portion of the river runs through the 1.9 ha residential area.

This rehabilitation project aims to rehabilitate, beautify and improve the water quality of the river. Water quality is improved before discharging downstream.

Enviro Pro is involved in the design and build 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.
- **Cleansing Wetlands** – Provides water treatment which improves water quality by means of filtration and biological methods. Beautification of river, making it aesthetically pleasing and provides habitat for wildlife.

### Awards

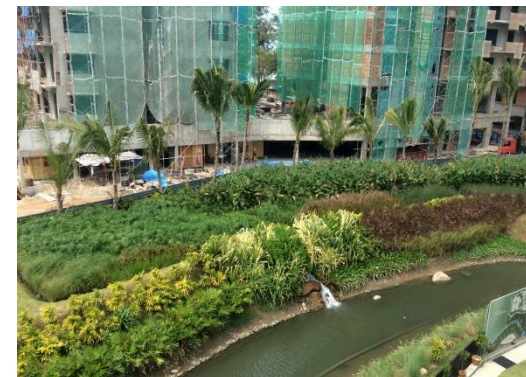
- **FIABCI Malaysia Property Award**  
(International Real Estate Federation) - Winner of Best Environmental (Rehabilitation/Restoration) - 2016



*Overview of the river rehabilitation*



*Water quality before and after treatment*



*Cleansing wetlands*





### Hybrid Bioretention System at Admiralty Park

Admiralty Park houses the largest nature area (20 hectares) within an urban park in Singapore. It is situated on a hilly terrain with a river, Sungei Cina, running through it. A hybrid bioretention system has been built to reduce the iron content of the influent, from nearest drain which can cause the water in the Admiralty Park pond to be an undesirable reddish color if untreated.

The hybrid system consists of a sedimentation basin, sand filter and a bioretention basin. After treatment in the hybrid system, the water quality of the effluent at the outlet of the system is greatly improved in comparison to the influent water.

Enviro Pro is involved in the design and build of the hybrid bioretention system.

#### Key Design Concepts

- **Sedimentation basin** – Promote the settlement of solids in the influent by reducing the velocity of the incoming water.
- **Sand filter** – Water from sedimentation basin is fed to the surface of the sand filter, which then percolates down through the drainage layer. Solids are trapped at the surface of the filter, as well as within its pores.
- **Bioretention basin** – The basin removes impurities in the influent water by fine filtration, adsorption and biological uptake by plants and microbes attached to plants roots within the cleansing layer. The basin also temporarily store stormwater runoff before conveyance to main public drains.



*Bioretention basin 1*



*Bioretention basin 1*



*Bioretention basin 2*



### Bioretention Basin in Tuaspring Desalination Plant

The 500m<sup>2</sup> bioretention basin of the Tuaspring Desalination Plant in Singapore is designed to receive surface water from a catchment size of 16,100m<sup>2</sup>.

A portion of the cleansed water from the bioretention basin is channelled to a sub-surface storage tank to be recycled and used for landscape irrigation while the remaining filtered water is channelled back to the main drainage system.

Enviro Pro is involved in the design and build of the bioretention basin. This was the first industrial project in Singapore with PUB-ABC Certification in Singapore.

### Key Design Concepts

- **Bioretention basin** – The basin removes impurities in the influent water by fine filtration, adsorption and biological uptake by plants and microbes attached to plants roots within the cleansing layer. The basin also temporarily store stormwater runoff before conveyance to main public drainage system.



*Bioretention basin*



*Overflow sump of the basin*



*Bioretention basin*