

Sustainable Stormwater Management & ABC Waters Solutions

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





ABC Waters Design Feature @ 15 Stadium Link, 2021 – Present

Enviro Pro was awarded a project to design an ABC Waters Feature, specifically a bio-retention basin, at 15 Stadium Link. The project site of this job is at the Old Kallang Airport, with the National Stadium also being in close proximity.

Rainfall and topographic data were used to analyse and derive sub-catchment areas for subsequent rainfall analysis. Site visits were also made in order to better understand the situation on the ground.

Key Design Concepts

- **Bio-retention Basin** — helps to remove pollutants from stormwater run-off. The surface water run-off will flow into the basin and create a temporary pond. The water will slowly seep through the filter media.





Sustainable Drainage and Rainwater Harvesting Solutions for Bluconnection @ 15 Tuas Avenue 10, 2021 – Present

Enviro Pro was awarded a project by Bluconnection Pte Ltd to design and implement sustainable drainage and rainwater harvesting solutions at their factory located at 15 Tuas Avenue 10.

The overall intention of the proposed design is to develop and install an eco pond that acts as a reservoir for rainwater harvesting and provide ecological and biodiversity benefits. The eco pond and vegetated / bio-retention swale garden is meant to be a aesthetic garden to be viewed by the people working there, providing a relaxing environment.

Key Design Concepts

- **Green Facade** – The façade enhances the factory's monotonous visuals, improves air quality and helps to cool the building down.
- **Eco Pond** – The eco pond will not only act as a reservoir for rainwater harvesting, but also provide ecological and biodiversity benefits. The harvested rainwater will then be utilized for other purposes such as irrigation.
- **Vegetated / Bio-retention Swale** – The rainwater runoff from the roof of the building is channelled to the vegetated / bio-retention swale, which slows down the flow as water travels over it. The water is then channelled into the eco pond.





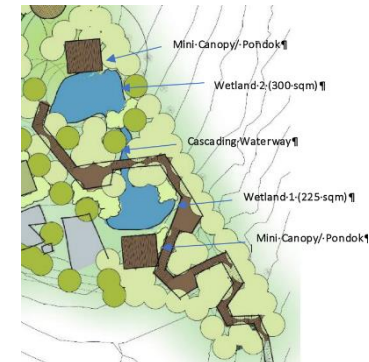
Water Sustainable Urban Design (WSUD) for Outdoor Adventure Learning Centre (OALC) by MOE, Singapore 2020 – Present

Enviro Pro was awarded a project by Interconsultants to design and construct ecological wetlands, WSUD features and conduct an ecological assessment for the construction of the proposed Outdoor Adventure Learning Centre for school going kids.

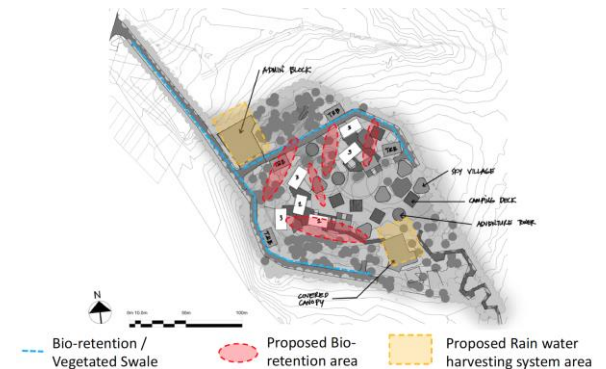
The new MOE Outdoor Adventure Learning Centre is situated at Rifle Range Road with a total study area of approximately 6 hectares (including the site of 3 hectares), taking into account the potentially affected surrounding sensitive areas.

Key Design Concepts

- **Ecological Wetland Design** – cost-effective and environmentally conscious treatment systems that use natural processes involving wetland vegetation, soils, and their associated microbial assemblages to improve water quality. They result in efficient and aesthetically pleasing wetland habitats including many amphibians, birds, and smaller mammals.
- **Bioretention Basin** – helps to remove pollutants from stormwater run-off. The surface water run-off will flow into the basin and create a temporary pond. The water will slowly seep through the filter media. The cleaner water will then be discharged to a detention tank
- **Rooftop Stormwater Harvesting System** – a sustainable approach in providing alternative source of water for non-potable purposes like irrigation and water features which include pump room with chlorination System for water recycling.



Concept Design for wetlands



Proposed Sustainable Water Management Design



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

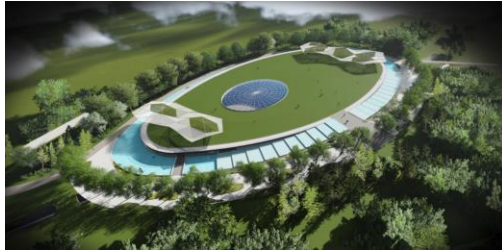
The improvement works to Sungei Tampines includes technical design matters, shop drawings and material submissions.

Enviro Pro is involved in conducting trials with bio-engineering planting materials, especially for live fascines and cut branch material, to study establishment rates and pre-growing sequencing.

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.





ABC Waters Detailed Engineering Design for Marina East Desalination Plant 2017 – 2020

Enviro Pro is involved in the detailed engineering design of a sustainable stormwater management system, inclusive of bio-retention basins and a rainwater harvesting pond that reuses water for irrigation and water features.

The proposed project achieves multiple uses of land, with underground treatment facilities and 19,600 m² of open green space on the rooftop for community recreation. The large green roof also helps reduce urban heat island effect. This industrial building is designed to blend seamlessly with the surrounding environment, allowing the public to enjoy green space above the plant along with the surrounding greenery.

Key Design Concept

- **Rainwater Harvesting System** - Rainwater that is harvested will be used to irrigate green roof and support the facility's water features.
- **Rain Gardens** - To retain and treat rainwater before it is reused or discharged





Improvement to Alexandra Canal Subsidiary Drain 'F' 2017 - 2020

Enviro Pro was awarded a project by Feng Ming Construction Pte Ltd to supply and install bio-retention basin that filters stormwater collected from house drains before it enters the storm drains.

Key Design Concepts

Bio-Retention Basin – helps to remove pollutants from stormwater run-off. The surface water run-off will flow into the basin and create a temporary pond. The water will slowly seep through the filter media. The cleaner water will then be discharged to a detention tank





Water Sensitive Urban Design (WSUD) for Tembusu Residential Development, Singapore, 2015 – 2017

Enviro Pro was awarded a project by Winsmart Investment Pte Ltd to design and build sustainable stormwater features in the residential area, "The Tembusu".

The Tembusu project is based on Water Sensitive Urban Design (WSUD), which includes several features that aim to provide sustainable storm water management on-site.

Key Design Concepts

- **Bio-Retention Basin** – helps to remove pollutants from stormwater run-off. The surface water run-off will flow into the basin and create a temporary pond. The water will slowly seep through the filter media. The cleaner water will then be discharged to a detention tank
- **Bioswales** – 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.
- **Rooftop Stormwater Harvesting System** – a sustainable approach in providing alternative source of water for non-potable purposes like irrigation and water features which include pump room with chlorination System for water recycling.





Development of Jurong Lake Gardens West, 2016 – 2019

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

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.

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

Swales - the runoff received by the network of swales will be slowed down the flow as water travel over its bed which consisted of natural materials. The cleaner water is then channelled into the lake.





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 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.



Sungai Satu Rehabilitation Project, Pulau Pinang, Malaysia, 2010 - 2016

Other than the bio-engineered slope, key features include the cleansing wetlands which are able to treat the river water. An Improvements of river water quality was made through this chain of natural treatment methods with a maximum treatment capacity of around 50 L/sec. The improve in water quality was independently verified by Universiti Sains Malaysia (USM) engineers and scientists.

This project also produced a valuable and enjoyable landscape as well as a more diverse habitats due to the establishment of the cleansing wetlands. Enviro Pro is involved in the design and build of the cleansing wetlands. The area is transformed into a valuable and enjoyable landscape as well as a clean and pleasant surrounding for the community.



Cleansing wetlands



Cleansing Wetlands



Initial condition of cleansing wetlands



FIABCI Malaysia Property Award



FIABCI World Prix d'Excellence Awards

Key Design Concepts

- **Cleansing Wetlands** – Provides water treatment which improves water quality by means of filtration and phyto-remediation. Beautification of river, making it aesthetically pleasing and providing dense habitat for wildlife.

Awards

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



Pilot Project for Floating Wetlands at Pekan Quarry , 2015 - 2016

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.

A pilot project of floating wetland is installed with the purpose of further enhancing biodiversity of the area. The floating wetland will provide roosting and nesting areas for herons, crakes, rails, kingfishers and frogs.

Enviro Pro was tasked with the construction of the floating wetlands. which aims to enhance the biodiversity in Pekan Quarry.

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. Three layers of Aquagreen Repotex I3 and one layer of BesTex Filter mat were used.



Floating Wetland



Herons resting on the floating wetland



Assemble of Repotex and coil fibre



Water Sensitive Urban Design (WSUD) for SPCA Headquarters, 2015 – 2016

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

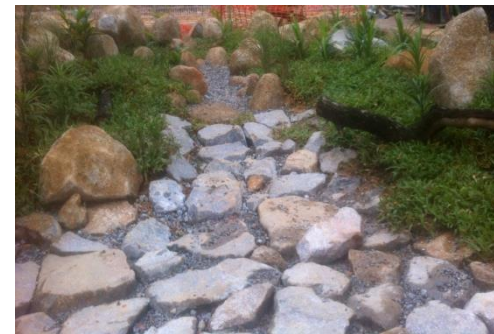
- **Swales** – The runoff from the buildings' roofs is received by the network of swales, which slows down the flow as water travel over its bed which consisted of gravel mix. The water is channelled into a pond. Hence, reducing the pressure on public drains.
- **Cleansing biotope** – The overflow from 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



Rocks in concrete



Cleansing Biotope at Bishan-Ang Mo Kio Park, 2010 - 2013

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 of around 4500 m². The biotopes help to improve water quality while providing an aesthetic element for 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



Sustainable Drainage Design for Water Treatment Facilities, Teluk Bahang, Pulau Pinang, Malaysia, 2014

Enviro Pro is appointed to provide consultancy services for the sustainable drainage concept design for Teluk Bahang – Lot 841 and 842. Some of the main design concepts 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.

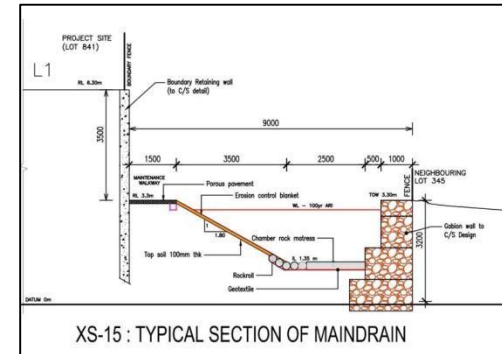
Bio-retention swales and basins were also proposed within the area for water conveyance and retention purposes. This will also create an aesthetical amenity for the residents as the swales and basins can be integrated with the landscape design along the North-Eastern boundary of the site.

Key Design Concepts

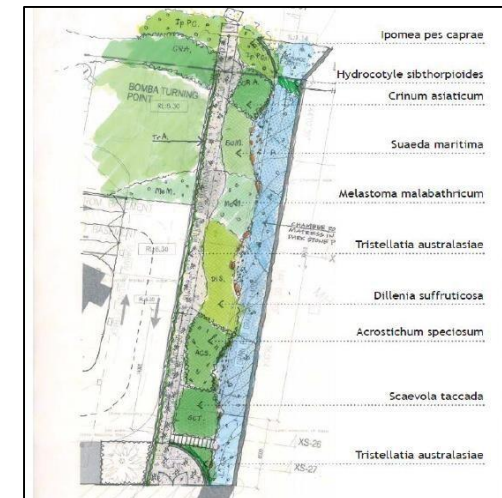
- **Bio-retention swales and basins** – Provide conveyance and retention function. They also provide vertical filtration system at low rate as water percolates down within its filter media. They are also suitable for intercepting and treating runoff.



Initial condition of water outlet



Typical section of main drain



Proposed planting scheme for main drain



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

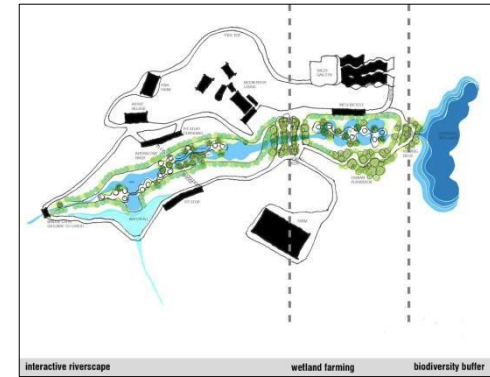
With reference to the master plan, Pos Sigar, in the mountainous terrain of Cameron Highlands, Malaysia, will be developed into an integrated and environmentally sensitive agricultural, residential and tourism development that is expected to utilize the available water resources of its catchment in the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

- **Hydrology and hydraulic assessment** – To become a sustainable drainage system, critical hydrological, hydraulic and ecological aspects were used as a basis to define strategies for development. This also considers overall trends of development in the project site and its effects on the hydrology.
- **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



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



Bio-retention Basin at Glyndebourne Condominium, 2012, Singapore

A bio-retention basin detains and treats stormwater runoff from 4.5% its development's total site area. Other features include a timber boardwalk that leads to the bio-retention basin as well as viewing decks overlooking it. As a holistic approach, informative signages aimed at educating residents and visitors about the flora and fauna as well as the principle of the bio-retention basin can be found within the development.

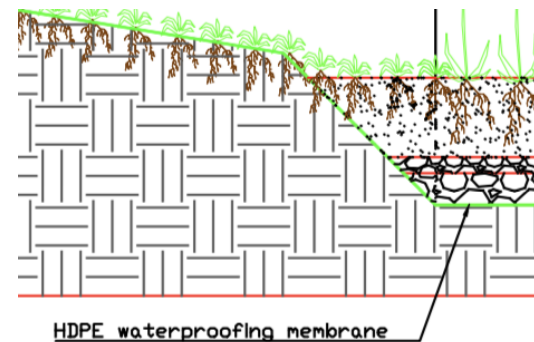
Enviro Pro was involved in the design and building of the bio-retention basin. This project achieved PUB-ABC Certification in 2012.

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 - completed



30 sqm Bio-retention basin lined with HDPE Liner



Bioretention Basin in Tuaspring Desalination Plant

The 500m² bioretention basin of the Tuaspring Desalination Plant in Singapore is designed to receive surface water from a catchment size of 16,100m².

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



Design, Supply and Install of Floating Wetlands at Kranji Reservoir, Singapore, 2010 - 2011

Enviro Pro is involved in the design, installation and maintenance of wetland habitats and floating gardens at Kranji Reservoir under the ABC Watershed Manager Program.

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.



Floating wetland



Floating wetland



Material for the installation of floating wetland



Design, Supply and Install of Floating Wetlands at Jurong Lake, Singapore, 2009 – 2010

Enviro Pro is involved in the design, installation and maintenance of wetland habitats and floating gardens at Jurong Lake under the ABC Watershed Manager Program.

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.



Floating wetland



Floating wetland



Floating wetland



Design, Supply and Install of Floating Wetlands at Pandan Reservoir, Singapore, 2009 –2010

Enviro Pro is involved in the design, installation and maintenance of wetland habitats and floating gardens at Pandan Reservoir under the ABC Watershed Manager Program.

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.



Floating wetland



Floating wetland



Planting for floating wetland