



Singapore's First Eco-Business CleanTech Park

Planning for Biodiversity in Business Parks

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Images by Atelier Dreiseitl Asia Pte Ltd



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“Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs.”

—Definition of “Sustainable Development”, *The Brundtland Report*, 1987

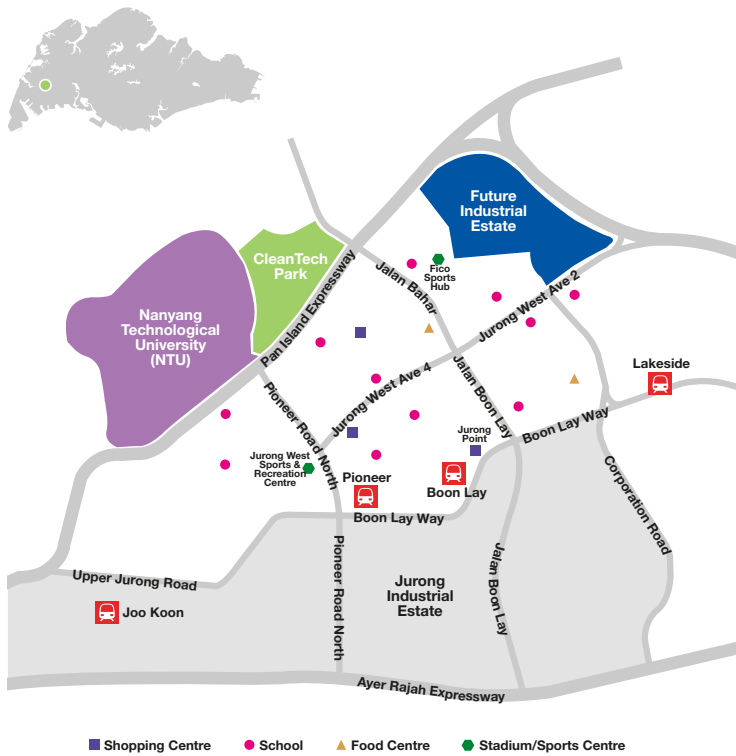
Biodiversity is a measure of sustainable development—growth today that does not deprive future generations of quality of life. It is recognised as being critical in ensuring a stable environment for businesses to operate in, and it is about understanding how the economy, society, and environment are interlinked.

Greenery, Water and Urban Biodiversity

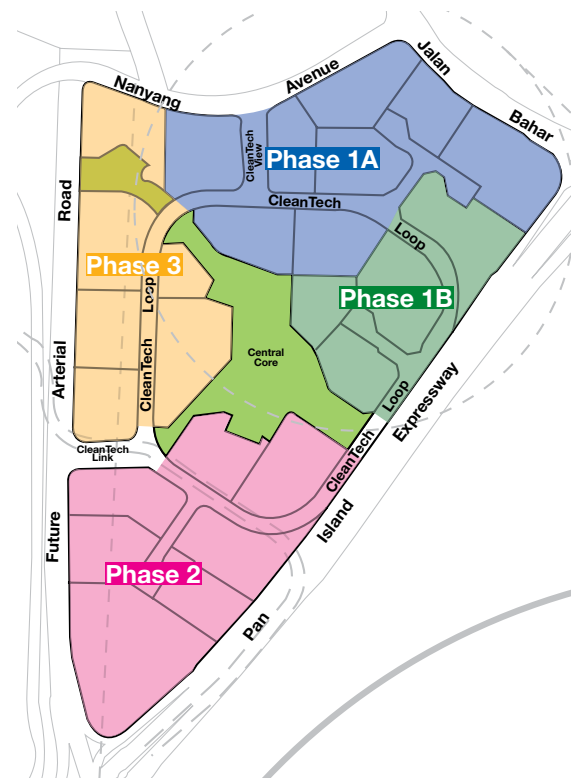
Ten percent of Singapore’s land is dedicated to green spaces, of which half is gazetted as nature reserves. In addition to this, the extensive roadside greenery and island-wide Park Connector network mean that close to half of Singapore is covered by greenery. Singapore is home to 2,900 species of plants, 360 species of birds, and 250 species of hard corals. In comparison, Singapore, which is 0.2 percent the size of the UK, has 60 percent of the number of bird species found in the UK. As the population grows and competing land uses put greater pressure on the demand for land, it is important to ensure that we continue to make space for greenery and our natural heritage.

The Singapore Sustainability Blueprint (SSB) 2009 outlined the strategies for sustainable growth for the development of a “lively and liveable Singapore”. In the blueprint, sustainable development is defined as being: efficient in resource usage and minimisation of waste; clean in the minimisation of pollution to the environment; and lastly green in the preservation of greenery, waterways, and natural habitats.

In land-scarce Singapore, 18 percent of the land mass is currently used for industrial usage. With the manufacturing sector and other higher value-added industrial activities set to continue as a major contributor to Singapore’s GDP, this figure is set to increase to 20 percent by the year 2050. As a leading master planner and developer of industrial land in Singapore, JTC Corporation (JTC) will need to adopt sound sustainable practices and adequate mitigation measures in the planning and design of industrial estates.



2 Location and Map of CleanTech Park



3 Development Phasing

Singapore's First Eco-Business Park

In line with national efforts towards sustainable growth, CleanTech Park (CTP) is a key initiative outlined in the one-billion-dollar SSB for building a greener, more energy-efficient, and sustainable Singapore. Located on a 50-hectare-large contiguous greenfield site next to Nanyang Technological University at Nanyang Avenue, CTP is positioned as Singapore's first eco-business park in a tropical rainforest. CTP will be developed as a sustainable environment, where eco-conscious businesses can thrive in, as a choice location for corporations that have embraced environmental sustainability as a means to differentiate their business and as part of their corporate social responsibility efforts.

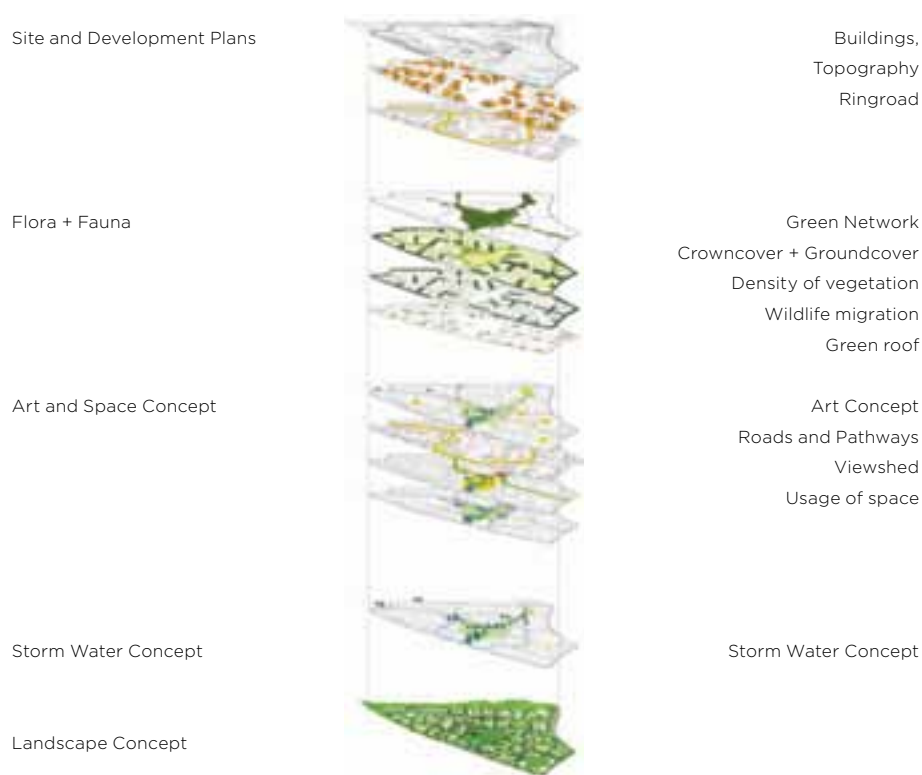
In drawing up the master plan, JTC adopted a principle of "Respect what naturally exists". Thus the development of CTP strongly emphasises the efforts to maintain a long-term sustainable balance between the business needs of CTP, retention of the natural environment, and protection of biodiversity, allowing all to coexist harmoniously. With CTP's natural undulating terrain, matured lush greenery, and natural streams running through it, the master plan was developed to optimise the natural environmental heritage to create an eco-environment conducive for the CleanTech research community.

The approach to the master planning and development of CTP optimises and enhances the natural characteristics of the site

through green strategies, such as the conservation of trees and landscape and enhancement measures to nurture and grow local flora and fauna in situ. Keeping the goals of greater sustainability and preserving the natural environment, a minimal land-cut principle is adopted for infrastructure planning and at the individual parcel and building platform level, under the planning design guidelines for the business park. Working with the fundamental principle to respect what naturally exists, a ring-road layout that works with the topography and minimises the need to cut and fill the existing ground is adopted for the road development of CTP. This allows for accessibility to the individual land parcels and at the same time preserves more trees and foliage and minimises the impact on existing biodiversity as far as possible whilst the land is being redeveloped.

Green Mark Platinum for New Parks

As part of CTP's sustainable development strategies, a central Green Core has been developed as the green lung of the business park. In May 2011, CTP's central Green Core was the first development in Singapore to achieve the BCA-NParks Green Mark Platinum award in the New Parks category. An extension of the BCA Green Mark scheme, the award is a joint initiative by the Building and Construction Authority (BCA) and National Parks Board (NParks), given to exemplary green projects that promote sustainable park design



4 Master Planning Concept Layers

and showcase best practices in park design, construction, management, and maintenance planning. Accomplishing an unprecedented rating for the New Parks category, the Green Core at CTP is lauded for design that ensures the long-term sustainable balance of the business park's commercial needs and the site's natural biodiversity.

The green lungs and heart of CTP

The design of the Green Core has prioritised ecological preservation—safeguarding the secondary rainforest environment, teeming with tropical flora and fauna, and the native biodiversity that make up the unique ecology of the site. Even though the business park will be developed in phases over a span of 20 years, the Green Core is recognised as the heart of CTP and is a key feature of the master plan. The growth strategy of CTP starts from the north, along Nanyang Avenue for easy access and visibility, and expands in three phases, clockwise around the Green Core, which anchors the entire master plan.

Similar to other business parks by JTC, whereby land is set aside for public greenery (for example, 23 percent of the total estate land area at International Business Park, and 10 percent at Changi Business Park), CTP has been planned with the five-hectare Green Core as a place for not only the CTP community but also the flora and fauna that make up the unique ecology of the site.

Extending beyond the central Green Core are three wildlife corridors-cum-green fingers that intersperse with development parcels in CTP. This allows building clusters to form pockets within the larger park such that every building would have a dual frontage—an “urban front” on one side and a natural lush “green front” on the other. The intention is to bring the tropical rainforest towards the businesses, giving them the opportunity to work closely with nature, which provides benefits like fresh air, lower ambient temperatures, shading, and tranquil sights.

In addition, overall “green” and “blue” networks are incorporated in the master plan, which includes the preservation of native species of flora and the re-creation of a freshwater swamp environment that is part of a comprehensive storm water management system to take care of the park's drainage whilst doubling up to clean and recycle water onsite. The central Green Core and three wildlife corridors will boast the largest concentration of trees to be conserved within CTP. This green lung is also designated to preserve the rich biodiversity of rare fauna, such as the native Sunda Pangolin, and other native species, such as the Harlequin butterflies, through the establishment of a butterfly garden to ensure that they will continue to make the place their home.



5 Cross-section Showing the Urban and Green Fronts of CTP's Development Parcels



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Conserving and enhancing a freshwater wetland forest habitat

Nature preservation and biodiversity enhancement underlie the holistic planning approach for the central Green Core, while the design of the Green Core and green corridors embraces the respect for the unique characteristics of the site. A Biodiversity Impact Assessment (BIA) conducted to investigate the topographic, geological, hydrological, botanical, and zoological conditions of the site uncovered the potential for the development of a freshwater wetland forest in the lower and swampy grounds of the site. Several freshwater swamp tree species identified onsite by NParks attest to the site's suitability for their growth.

The freshwater wetland forest eco-habitat is one of the rarest in tropical Asia, and holds conservational and educational value to Singapore and the Southeast Asia region. Within Singapore itself, there is only one other location in Nee Soon where a similar habitat flourishes. However historical documents reveal ecological differences, such as different tree species between the habitat at Nee Soon and those at Jurong. Hence the design of the central Green Core to develop the swampy areas of the site into a thriving freshwater swamp forest goes beyond conservation efforts of the existing flora and fauna, to also allow ecological researchers to observe, understand, and document this rare eco-habitat. Other eco-habitats, such as woodlands, grasslands, and freshwater swamps identified within CTP, will also be retained and enhanced where appropriate.

Connectivity to the larger eco network

In the BIA field study, a total of 164 animal species were identified, of which 26 were noted to be locally under threat. The BIA of the site also revealed existing natural wildlife corridors that serve as passageways for animals travelling between the site and the larger surrounding environment, in particular to the forested area to the north of Nanyang Avenue. As such, these corridors will be enhanced through additional planting, which would provide food (in the fruit-bearing plants) and habitats (in the dense vegetation for cover) for the animals already identified onsite. These wildlife corridors are extended as underground road crossings towards the inner and outer cores of the park to ensure that the movement of animals between CTP and its surrounding area will not be impeded by the road infrastructure developed within it. Box culverts for wildlife road crossing are constructed beneath CleanTech Loop and Nanyang Avenue to ensure a natural reprieve for the local fauna amidst the park's phases of development, thus creating ecological corridors and networks to circumvent obstacles and providing access to the favourable habitats of the wildlife in the area.



10 Conceptual Strategy (Urban and Park Fronts)

Given the global trend towards sustainable growth, moving forward, environmental sustainability is the natural direction that businesses will take.

Softscape planting strategies with a wider palette of plant species and different levels of tree canopies and vegetation will be undertaken to nurture greater biodiversity. This is carried out through the creation of different densities of vegetation to enhance the existing multilayered flora structure and support the different compositions of plant groups and biodiversity. Other initiatives include: reintroducing tree species that previously existed in the freshwater swamps but are currently extinct or endangered in Singapore; and introducing a plant palette that includes fruits and nectar-producing plants, such as ixora, to attract wildlife back into CTP when the development is completed. As new growth will take time to mature, the succession planting strategy for the Green Core has to be implemented now to ensure that the trees and vegetation will reach full maturity in five to ten years time.

Holistic storm water management

The natural undulating topography of the site, particularly within the Green Core and wildlife corridors, will be retained as much as possible as it enables the channelling and retention of storm water in the low-lying areas for storage and reuse. In the hydrology plan for sustainable storm water management within CTP, a network of new streams, bioswales, and retention ponds will be developed to support the existing hydrological flow of the site and help cleanse the rainwater runoff at various stages.

Echoing the philosophy behind the Public Utilities Board's (PUB) Active, Beautiful and Clean (ABC) Waters programme, bioswales are designed to be aesthetically and ecologically different along each of the three green fingers of the Green Core as they channel and purify rainwater from the roadside drains into the Green Core. Various types of pathways are provided to either cross the bioswales, such as detention walls and boardwalks, or to run alongside them, such as stepping stones and gravel paths, allowing the CTP community and park visitors to enjoy the environment visually as well as get up close to the flora and fauna.

Cleansing biotopes, for the purification of water, are also designed to be planted with flowering plants that would attract insects, such as butterflies, dragonflies, and damselflies, thus creating a pleasant park environment for users whilst enhancing the diversity of fauna. Filtrated water

from the cleansing biotopes will be collected for use in toilet flushing and irrigation for the green roof of the public toilet in the Green Core. Assuming an average visitorship of 1,000 per week, that will translate into potable water savings of 19,500 litres per month. This comprehensive storm water management system design, as an integral part of the CTP Green Core, was among the first projects in Singapore to be awarded the ABC Waters certification by PUB in July 2010.

A green community

All in, the Green Core is planned to hold a significantly larger amount of greenery than in a typical urban park landscape. Besides replacing more than 100 percent of the trees to be felled, the number of new species trees anticipated to be planted in the Green Core will far exceed the requirement set by the "Green Mark for New Parks" guideline. With facilities that include lookout decks, pavilion boardwalks, and stepping stones, the planning of the CTP Green Core aims to bring the business park's community closer to nature without jeopardising the delicate natural balance.

CTP is developed with a focus to balance three different but linked aspects—Environmental, Economic, and Social. By adopting an eco-sustainable approach, the intent is for CTP to become an exemplary development to showcase environmental sustainability and set the benchmark for future green business park developments in Singapore.

Other green strategies include promoting the use of clean energy, minimising energy usage, minimising waste generated by the construction of CTP, and reducing the use of new materials. Energy-efficient LED outdoor lights, some of which are solar-powered, will be used in the public areas within the Green Core. All the enclosed or sheltered structures in the Green Core, such as the toilet and timber pavilion, were designed with passive energy systems integrated in them. For example, timber cladding that allows natural light into the interior spaces minimises the need for artificial lighting while keeping the interiors cooler. The topsoil harvested from earth-cutting is also harvested for reuse in the Green Core's softscape planting, and the timber needed for the hardscape construction comprises recycled hardwood that is salvaged onsite or purchased from locally contracted sawmills to process trees harvested from tree felling around Singapore.



11 Fresh Water Swamp (Forest)



12 Steam Ravine Forest



13 Steam Ravine Forest



14 CleanTech Park's Landscape Zones




Conclusion

Industrial parks are typically regarded as places where the land is cleared, levelled, and rebooted as a clean slate to accommodate incoming industrial activities. However, with an increasing awareness of sustainability and respect for the natural environment, a shift has taken place in the planning of our industrial environment. Given the global trend towards sustainable growth, moving forward, environmental sustainability is the natural direction that businesses will take.

Urbanisation does not have to preclude the development of teeming habitats. According to a study of business park sites around the Netherlands, carried out by the Research School for Socio-Economic and Natural Sciences of the Environment (SENSE), a joint venture of eight Dutch Universities, business parks are of value for biodiversity. They exemplify how an artificial environment can be exploited and enhanced by conservation initiatives. Business parks tend to have three valuable properties: open spaces that can be cultivated for vegetation and wildlife; buildings with large flat roofs that can be turned into green areas and used, for example, by ground-nesting birds; and a tendency to be quiet at night, therefore providing havens for nocturnal animals. From the Dutch study, it was also shown that the attention paid to the green design of business sites would likely result in improved well-being of the business community as well—“People like it and employees are happier.”

Achieving high Green Mark rankings at the building, park and district levels is a testament to JTC's growing commitment to environmental sustainability. Quoting JTC's CEO Mr. Manohar Khatani at the Singapore Sustainability Awards 2011, “As Singapore's leading industrial infrastructure developer, JTC sees it as its responsibility to maintain sustainable environmental practices in its operations as well as to ingrain a “green” culture in its staff. At the workplace level, we inculcate environmentally friendly practices into our work processes. At the business level, we strive to incorporate cost-effective ecological elements in our developments.”

The planning for biodiversity in business parks, or other industrial estates for that matter, is not simply about needing to be ecologically sensitive. The real challenge in the future planning of industrial areas lies in addressing environmental challenges that present themselves in a practical and cost-effective manner. As JTC steps-up efforts in this area, CTP will be emblematic of how businesses can achieve both economic vibrancy and environmental sustainability. The development of the central Green Core at CTP showcases an approach to ecologically sensitive urban development and firmly positions JTC as an environmentally conscious developer and a role model in the planning for biodiversity within business park developments. 



18 The Central Green Core & Storm Water Management System

15, 16. The plan for succession planting of the Freshwater Swamp Forest.

17. A public toilet with a green roof in the Green Core.