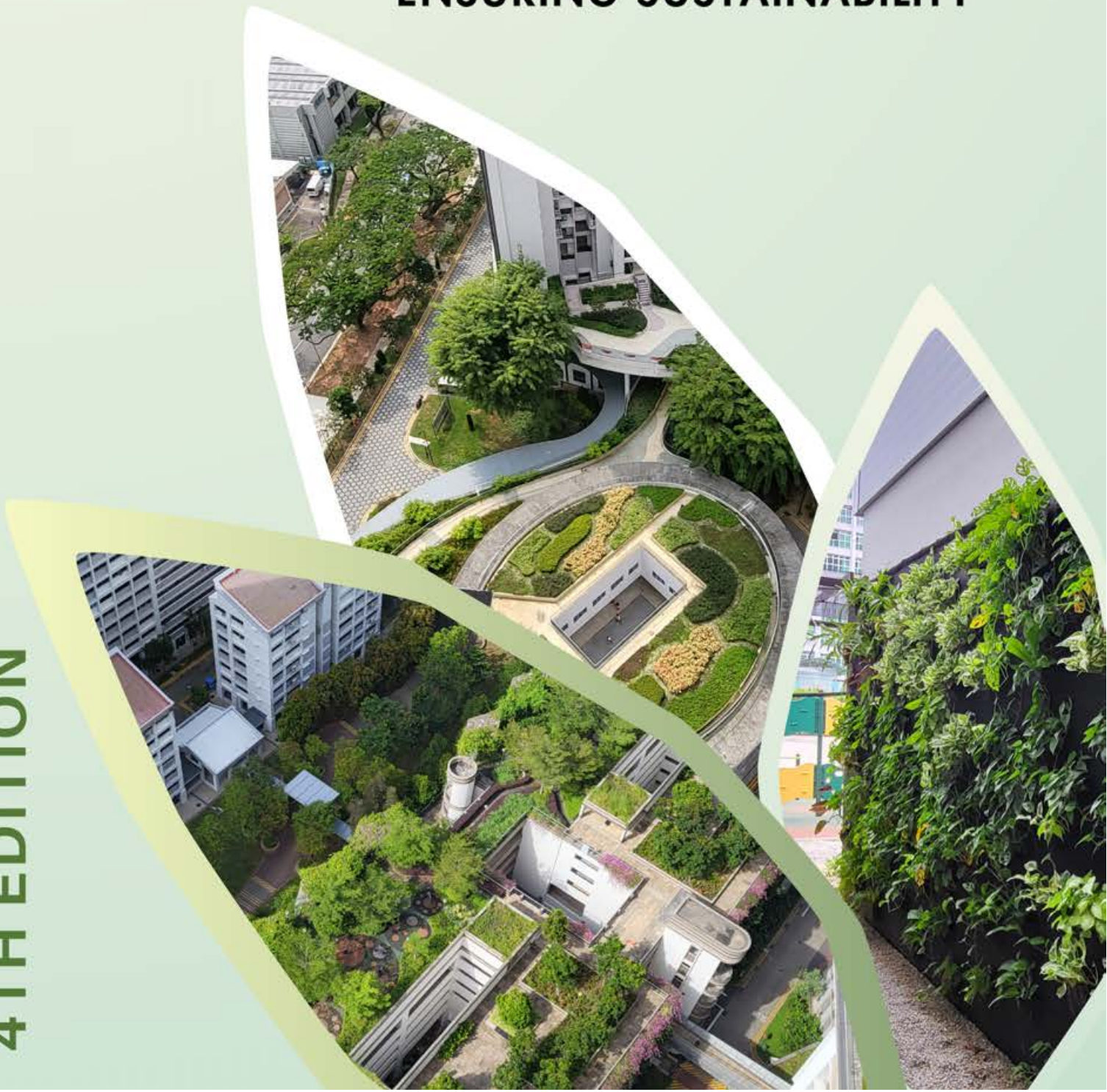
SKYRISE GREENERY

SHOWCASE

ENSURING SUSTAINABILITY



4TH EDITION

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1 and 2: Wilmar Headquarters utilises extensive skyrise greenery to integrate the building with its surroundings seamlessly.
3: Water gardens help to reduce ambient temperature of the environment and create a relaxing and soothing environment for its users.
(Photo credits: ICN Design International Pte Ltd

28 BIOPOLIS ROAD, (S)138568

WILMAR HEADQUARTERS

BUILDING OWNER: WILMAR INTERNATIONAL LIMITED
LANDSCAPE ARCHITECT: ICN DESIGN INTERNATIONAL PTE LTD

The 7-storey high Wilmar Headquarters, designed by Eric Parry Architects, is located at the heart of One North. Here, various sustainability features were introduced by incorporating innovative landscape features that blend nature seamlessly into the built environment. The low-profile building is cleverly integrated with its surroundings, stepping down towards Fusionopolis Park North and South, thus responding to the existing terrain. The Headquarters sits 3m below the park level, so to link the park and the building's large central plaza, steps and ramps wind down through cascading rocky water-gardens to form a seamless, barrier-free pedestrian connection, providing attractive landscaped links to Buona Vista and Fusionopolis transport hubs.

Vertical and rooftop greenery are other essential features in this project as they offer multiple environmental benefits, such as reducing the urban heat island effect, providing insulation and shade, as well as mitigating stormwater runoff by absorbing and retaining rainwater which reduces pressure on the drainage systems. The greenery also promote biodiversity within the urban area by providing habitat for birds, insects and other wildlife and contributing to energy efficiency by improving thermal insulation and reducing the need for air conditioning.

When designing the multiple roof gardens, native and adaptive plant species were selected to reduce water and maintenance requirements.
(Photo credits: ICN Design International Pte Ltd

The terracing form of architecture allows sunlight to penetrate through the landscape areas thus eliminating the need to add plant 'grow lights'.
(Photo credits: ICN Design International Pte Ltd)

The terracing form of the architecture allows sunlight to penetrate through the landscape areas thus eliminating the need for "grow lights". Native and adaptive plant species were selected to reduce water and maintenance requirements. By selecting these plants, the building conserves water, reduces the need for fertilizers and pesticides, and supports local ecosystems as it forms natural habitats for local flora and fauna.

The health and wellness of the building's users were important considerations for the Client. Office workers were encouraged to take breaks in the gardens, which were lushly landscaped with trees to shade them from the sun. Also critical were the water features, which help to reduce ambient temperature and create a relaxing and soothing environment for the users. The offices have glass facades with offer views into the gardens from all angles, while improving the penetration of daylight into the spaces.

48 CHANGI BUSINESS PARK CENTRAL 2, (S) 486067

KEPPEL INFRASTRUCTURE @ CHANGI

BUILDING OWNER: KEPPEL LTD.
PROJECT IMPLEMENTOR: CONSIS ENGINEERING PTE LTD

Keppel Infrastructure @ Changi is an example of sustainable architecture and landscape design. It is Singapore's first retrofitted building to achieve Green Mark Platinum Positive Energy rating.

Keppel Infrastructure @ Changi is a remarkable example of sustainable architecture and landscape design. It is Singapore's first retrofitted building to achieve Green Mark Platinum Positive Energy rating under the BCA Green Mark 2021, a testament to its commitment to sustainability.

One of the most striking features of the building's design is its vertical greenery, which covers close to 1000 square meters and is placed alongside vertical solar panels. This greenery not only enhances the biophilic design of the building but also reduces the surface and ambient temperatures of the building, mitigating the urban heat island effect and improving the energy efficiency of the solar panels.

One of the building's main feature is its 910 square meters of vertical greenery being placed alongside vertical solar panels.

The integration of vertical greenery with other features such as highly efficient air-conditioning, smart sensors, LED lights, rainwater harvesting, mechanical ventilation systems as well as solar panels on the rooftop and building facade makes the positive energy rating possible. Over 20 species of plants were used for the green wall including a mix of climbers such as *Philodendron scandens,* ferns such as *Nephrolepsis biserrata,* and shrubs such as *Tabernaemontana divaricata and Schefflera arboricola*. The maintenance requirement for the plants is also an important consideration. Hence given the height of the green wall, access pathways for Mobile Elevated Work Platforms (MEWPs) were catered for.

Rainwater harvesting together with automatic drip irrigation using rainwater and NEWater supports the growth of the vertical greenery and reduces the building's water consumption. The use of sustainable design principles in the architecture and landscape design of Keppel Infrastructure @ Changi increases the long-term sustainability of the installation.

As the first building in Singapore to implement photovoltaic vertical panels together with extensive vertical green walls, Keppel's innovative greening efforts will pave the way for more of such co-located installations around Singapore.

20 MANDAI LAKE ROAD, (S)7298251

MANDAI WILDLIFE RESERVE - BIRD PARADISE

BUILDING OWNER: MANDAI WILDLIFE RESERVE
LANDSCAPE IMPLEMENTER: GWS LIVING ART PTE LTD

Nestled within the Mandai Wildlife Reserve, the newly opened Bird Paradise is Asia's largest bird park spanning 17 hectares, providing a sanctuary for an impressive array of 3,500 birds from 400 species. Designed to invoke exploration at every corner, Bird Paradise invites visitors to embark on a captivating journey through eight walk-through aviaries that reflect different biomes across the globe as well as several other unique experiences including Penguin Cove, Sky Amphitheatre and Winged Sanctuary.

To resemble a wildlife setting and maintain the wild and natural ambience of Bird Paradise, the landscape planting of a total of 597.21m^2 consisting of 32 different plant species across the entrance waterfall, Penguin Cove and cavern waterfall was meticulously designed to match the rock formation envisioned by the architects. Indentations were made on the cement structure, forming cracks that would mimic the shape of real rocks. These cracks varied in depth, resulting in unique small pockets and irregular shapes that differed from the original drawings and actual site installation. Given the limited space within the indentations and cracks of the rocks, traditional planter boxes could not be used. Instead, GWS used Gaia Mat™, a soilless planting medium that also eliminated concerns of soil particles staining the rocks and walls.


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1 and 2: Instead of traditional planter boxes, a soiless planting medium was placed in crevices and cracks between the rocks to support the vegetation. This system allowed the plants to adapt and grow within the cracks, minimising water usage compared to conventional soil-based systems.
(Photo credits: GWS Living Art Pte Ltd)

The use of Gaia Mat™ and the absence of traditional planter boxes showcased a commitment to eco-friendlier practices. This system allowed the plants to adapt and grow within the cracks, minimising water usage compared to conventional soil-based systems. Once the plants take root, they naturally create their adhesive properties, firmly anchoring themselves to the rocks. This eliminates the risk of water wastage as well as resource extraction and transportation costs associated with soil or planter box production.

Plant selection was stringent to include only species that could adapt and thrive in confined environments. The selected species possessed characteristics that allowed them to grow in shallow or deep cracks and exhibit creeping growth patterns. Additionally, they were resilient, capable of withstanding harsh conditions and required minimal water. To ensure a cohesive and natural setting throughout, *Cyanotis* species, Moss and *Cayratia Trifolia* were primarily used for the crack areas.

Together with an implementation of a three-month stabilisation period in Singapore to ensure optimal plant health, the soilless system offers better control over pests and diseases. It reduces the risk of soil-borne pathogens, minimising the environmental impact and usage of chemical pesticides.

Plant selection was stringent to include only species that could adapt and thrive in confined environments. The selected species possessed characteristics that allowed them to grow in shallow or deep cracks and exhibit creeping growth patterns. (Photo credits: GWS Living Art Pte Ltd)

1550 BEDOK NORTH AVE 4,
(S) 489950

BEDOK FOOD CITY

BUILDING OWNER: JTC
IMPLEMENTORS: SEMBCORP SOLAR SINGAPORE PTE LTD, GWS LIVING PTE LTD

As the demand for sustainable energy solutions continues to grow, solar panels are increasingly being deployed on rooftops of various building typologies.

In Bedok Food City, JTC has an innovative rooftop implemented by co-locating solar panels and green roof on a large scale. This novel solution allows for the deployment of solar panels together with greenery, which optimises the use of rooftop space for both green coverage and generating green energy, reaping greater sustainable benefits.

Plant selection has to be done carefully to ensure that the plants not only thrive well under the solar panels, but do not interfere with the capturing of the solar energy.

By co-locating green roof with solar panels, a wider range of benefits is reaped on the same rooftop space.

Design considerations for such a co-location set up include access pathways and ensuring sufficient height clearance to facilitate regular maintenance.

Spanning over 3000sqm, this solar green roof adds an eye-catching splash of greenery over the once grey and monotonous industrial estate rooftop. Species used included drought-tolerant, low-lying ground cover such as *Sphagneticola trilobata* and *Cyanotis cristata*. The synergistic effects from integrating solar panels and green roof installation reduces the urban heat island effect and improves the output performance of the installed solar panels due to the evapotranspiration process of the green roof.

To increase the maintainability of the co-located systems, adequate maintenance walkways were catered for from design stage and the solar panels were elevated by 1.5m from the roof surface. This elevation provides maintenance workers with easy and safe access to both the green roof and solar panels. This integration of solar panels and green roof is a testament of the growing range of sustainable practices in architecture and landscape design.

Draped with Vernonia , the groundscraper creates a continuum between the ground landscapes and multiple sky terraces in the development.
(Photo credits: Ong & Ong Pte Ltd)

17 BALMORAL ROAD, (S)259803

SLOANE RESIDENCES

DEVELOPER: TSKY BALMORAL PTE. LTD
ARCHITECT AND LANDSCAPE ARCHITECT:
ONG & ONG PTE LTD

The landscape at Sloane Residences is conceived as a lush green bed from which the building arises and seamlessly interweaves through the length of the development, much like the black and white houses that used to grace the Balmoral-Goodwood area.

In keeping with the architecture, the landscape design is one that is contemporary but with a tropical twist in an ordered design. To respond to the linear site and the linear building form of the 4-storey podium block (known as the groundscraper), a linear lawn presides just off the drop-off forecourt and the frontage of the podium block. The lawn in continuum with the drop-off forecourt forms an axis that pays homage to the renowned expansive lawns and heritage long driveway on the grounds of the original Sloane Court Hotel.

From there, the ground scape continues upwards through the tiered sky terraces in two-folds.

Firstly, the landscape is brought upwards to become garden extensions of the dwelling units. Secondly, greenery intensification continues around the communal amenities through a tapestry of gardens, landscaped courts and verandahs.

The latter led to the introduction of an extensive green wall stretching across almost the entire width of the groundscraper and covering 3 storeys of sky terraces at the front-facing façade. Besides being highly visible and adding to the green stature of the building, this green wall is continuous throughout the third and fourth storey, allowing greenery to permeate the building. The green wall has been deliberately located over landscape areas to remove the need for drainage gutters as the excess water is able to irrigate the planting below.

To further enhance the visual impact from the main road into the development, the beautiful hanging vines of the *Vernonia elliptica* encircles the edges of the 4 storey podium block and the drop-off porch shelter, imparting a naturalistic and tropical look.

Various experiential landscape spaces crafted throughout the sky gardens culminates at the bespoke roof terrace where the clubhouse, lap pool and gourmet dining pavilion presides. To achieve the 'genius loci', plants with different leaf size, texture and color hues were used, including *Alocasia macrorrhizos*, *Cyathea latebrosa*, *Monstera deliciosa* and *Philodendron selloum*, to create interesting compositions. Different predominant species have also been used to subtly differentiate the different floors. In addition, for the sheltered sky gardens, the planting palette was specially curated to take into consideration the varied light conditions especially at the highly shaded areas, to ensure long-term sustainability.

These landscapes subtly take on a more 'resort-like' persona to complement the chillax atmosphere of the clubhouse.

1: The extensive green wall allows greenery to permeate the building and brings natural light into the sky terrace.
2: Walkway between planters not only enables visitors to experience nature up close, it a functions as an effective maintenance walkway.
3: Plant palette for sheltered sky terraces was specially curated to enhance long-term sustainability
4: Different plant palettes were used to subtly differentiate the different floors, and to enhance sustainability in different conditions.
(Photo credits: Ong & Ong Pte Ltd)

15 TUAS AVENUE 10, (S) 639139

BLU-CONNECTION PTE LTD

BUILDING OWNER: BLU-CONNECTION PTE LTD
IMPLEMENTER: GREENOLOGY PTE LTD

This vertical greenery installation was created with the vision of reintroducing flora and fauna into the industrial estate.

Blu-Connection had a vision to create a 'Green Lung' in the midst of an industrial space in Tuas. To achieve this, they partnered with Greenology and Enviro-pro Green Innovation to create a biodiversity wall that would reintroduce flora and fauna to an otherwise industrialized landscape.

1, 2 and 3: Over 70 species of butterfly-attracting plants were used over two floor of vertical greenery, adding to the ecological resilience of the area.

Two floors of vertical greenery was designed with over 70 species of butterfly-attracting plants. Species used included *Lantana spp, Stachytarpheta jamaicensis, Asystasia gangetica, Duranta spp., Passiflora foetida,* etc. These walls evolved into vertical bio-ladders, instantly increasing biodiversity in the area and attracting birds and butterflies back into the limited industrial space.

The vertical greenery not only enhances the aesthetics of the area but also serves a practical purpose – it helps to reduce environmental pollution from surrounding production facilities and factories.

BLANGAH RISE PRIMARY SCHOOL

Blangah Rise Primary School's rooftop garden is located along a thoroughfare that students use to get to their classes, greatly increasing the students' touch points with nature when compared to the bare concrete roof before (insert).

BUILDING OWNER: BLANGAH RISE PRIMARY SCHOOL

Blangah Rise Primary School has transformed their unutilised rooftop space into a beautiful and educational garden, known as the 'Garden of Hope'. The garden serves as an extension of the school's nature-related programming, providing students with a unique opportunity to connect with nature and learn about sustainable practices.

One of the most notable features of the garden is its location along a thoroughfare that students use to get to their classes. This has increased their touchpoints with nature, as they are able to observe the flowering and fruiting plants that have been carefully selected for the garden.

The garden is designed to be self-sustaining, with the use of solar panels for its auto-irrigation system and the harvesting of rainwater for irrigation. These sustainable practices not only reduce the garden's environmental impact but also serve as a valuable teaching tool for students.

As the 'Garden of Hope' materialised, Blangah Rise Primary School took the opportunity to launch their newly published book, 'The Green Dragonflies and Their Swampy Friends'. This book serves as a valuable resource for students, providing them with information about the local flora and fauna.

The school has also continued their efforts to train student docents to bring the public on a guided nature tour around Telok Blangah and Berlayer Creek, further promoting the importance of nature conservation and sustainable practices.

Besides being a beautiful and sustainable addition to the school, the 'Garden of Hope' provides students with a unique opportunity to connect with nature and learn about sustainable practices.

The garden's plant palette was specially curated to include flowering and biodiversity-attracting plants to enrich the students' learning.

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1: As the 'Garden of Hope' materialised, Blangah Rise Primary School took the opportunity to launch their newly published book, 'The Green Dragonflies and Their Swampy Friends'. This book serves as a valuable resource for students, providing them with information about the local flora and fauna.
2: The garden also serves as a base to train student docents to bring the public on a guided nature tour around Telok Blangah and Berlayer Creek.
3: The garden is designed to be self-sustaining, with the use of solar panels for its auto-irrigation system and the harvesting of rainwater for irrigation.

1 SHENTON WAY, (S) 068803

ONE SHENTON

DEVELOPER: CITY DEVELOPMENTS LIMITED
BUILDING OWNER: MCST 3748
ARCHITECT/ LANDSCAPE ARCHITECT: CKA CONSULTANTS/ CKA DESIGN PTE LTD
IMPLEMENTER: GWS LIVING PTE LTD

One Shenton is a mixed development that has embraced the power of nature by introducing skyrise greenery alongside its facilities upgrading works over the years. The management and residents recognize the therapeutic effects of greenery and the contribution to building and environmental sustainability that skyrise greenery can bring about.

The building's design features greenery that wraps around the columns along its level 1 premises, providing visual relief for the building's occupants and members of the public in a busy business district. The green walls not only enhance the building's aesthetics but also help to reduce one's exposure to air pollution, promoting a healthier environment for urban residents and visitors.

By wrapping its Level 1 columns with greenery, One Shenton has enabled the therapeutic effects of greenery to reach out to the people in the busy business district.

The green columns enhances the building and environmental sustainability of the area

To enhance the environmental and visual impact, the green walls wrap the entire height of the columns from floor to ceiling. As the green wall plants directly below the ceiling receive limited natural sunlight, plant grow lights have been put in place to increase the variety of plants that can be used. In addition, different plant species were also deployed throughout the column's height in response to the different light conditions. In total, there are approximately 40 species of plants grown throughout the building, including trees, palms, shrubs and climbers.

The incorporation of vertical greenery into One Shenton's design right in the heart of the Central Business District strengthens Singapore's distinct identity as a city enveloped with lush greenery, enhances the ecological resilience of the area and brings us closer to our vision of a City in Nature. With the addition of these vertical greenery, One Shenton's management council has also seen business improve for the shops at the ground level and a zero turnover in tenants despite rents being gradually increased by up to 50%.

Overall, One Shenton's skyrise greenery is a beautiful and sustainable addition to the building's architecture and landscape. It provides occupants and members of the public with a unique opportunity to connect with nature.

1 PUNGGOL DRIVE, (S)828629

ONE PUNGGOL

BUILDING OWNER: PEOPLES ASSOCIATION
ARCHITECT: DP ARCHITECTS PTE LTD
LANDSCAPE ARCHITECT: DP GREEN PTE LTD

An integrated resident-centric community hub, One Punggol houses a community club and the Punggol Regional Library in co-adjacency to other public and healthcare services for all social and age groups. The vision and objective for the development is to provide accessibility to public services and healthcare facilities, and to promote social cohesion and interaction by cultivating a sense of community.

1 and 2: The landscaping of the rooftop garden at One Punggol supports and complements the multiple public spaces within. (Photo credits: DP Architects Pte Ltd)

3 and 4: With the meticulous curation of native and coastal plant palette, ecological connectivity with its neighbouring park is achieved. (Photo credits: DP Architects Pte Ltd)

The extensive greenery softly contrasts the orange and white façade throughout One Punggol. Located in proximity to Punggol Waterway Park, the landscape expression sought to embrace the ample greenery and reconnect to its local biodiversity with the meticulous curation of native vegetation and careful mirroring of the coastal ecosystem of Punggol. This approach simultaneously encourages ecological connectivity and attracts fauna, thereby enhancing local wildlife.

Regenerating biodiversity makes up just one part of how green infrastructure contributes to sustainability. Trees, which have been strategically integrated into outdoor break-out spaces, reduce the ambient temperatures and urban heat island effect. By creating more comfortable microclimates within One Punggol, the landscape design helps mitigate energy demands for cooling.

1,2 and 3: Students were involved in every step of creating and maintaining this green wall, bringing the importance of greenery to them.

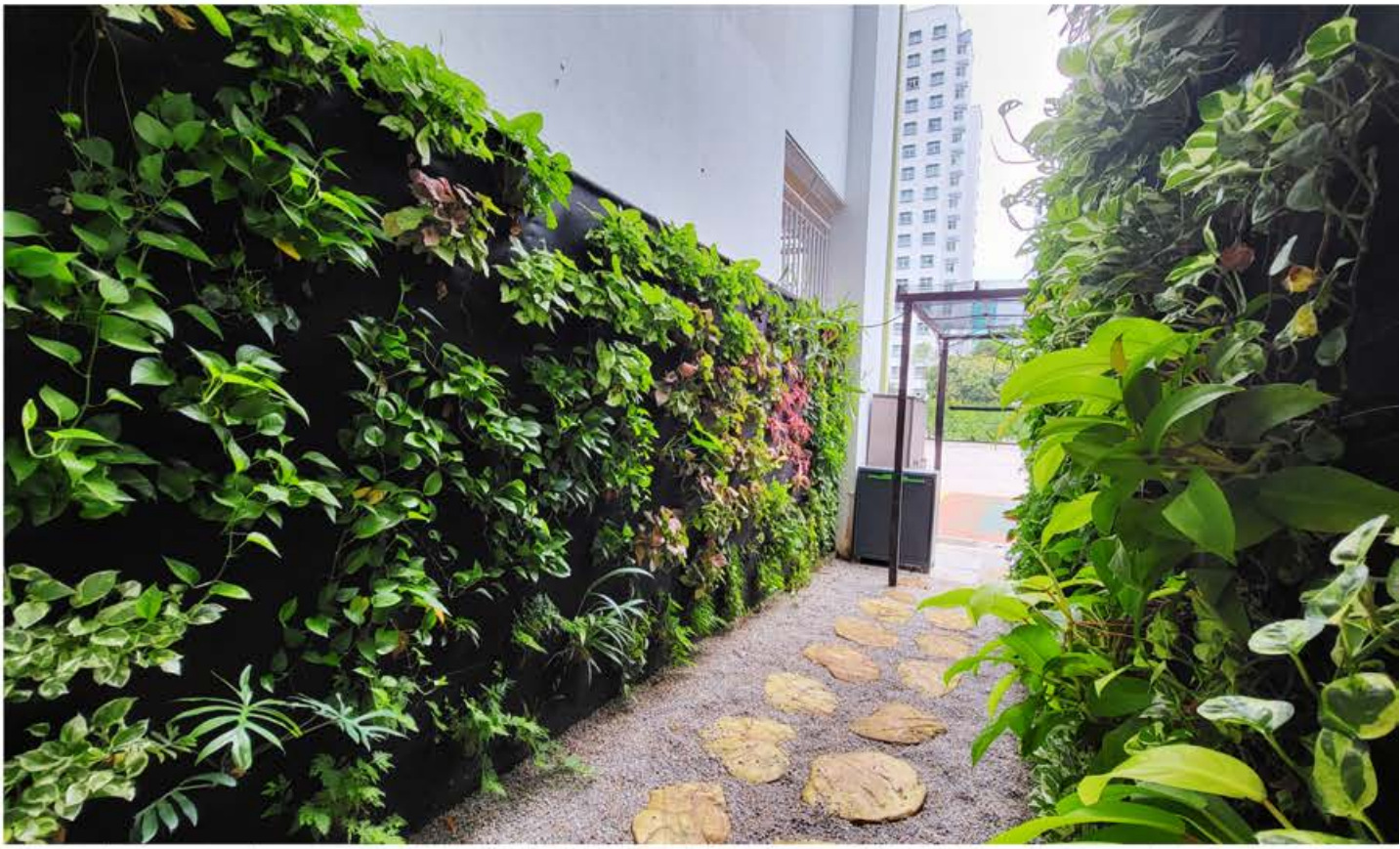
50 EDGEDALE PLAINS,
(S)828848

GREENDALE PRIMARY SCHOOL

BUILDING OWNER: GREENDALE PRIMARY SCHOOL

At Greendale Primary School, a passionate science teacher and his students have created a green oasis in a corner of their school. The students were involved in every part of the project, from selecting the plants to assembling the various layers of the pocket-system green wall, to transplanting the plants onto the wall. For the students, every step of the process was a learning opportunity.

The students discovered that learning doesn't just come from looking and appreciating the plants, but also from getting their hands dirty, feeling the soil and roots, and knowing how fast and well each plant they have rooted is growing. This hands-on approach to learning has helped the students to develop a deeper understanding of sustainable greening practices and the importance of ecological resilience.



This vertical greenery installation is constantly monitored by the students who promptly carries out any place replacement and enhancement works.

The vertical greenery at Greendale Primary School has provided a hands-on learning platform for students and has become a valuable tool for nurturing the next generation of growers and thinkers. The project has helped the students to develop a sense of ownership and responsibility for their environment, while also promoting the importance of sustainable practices and hands-on learning.

Nestled atop the Blk 673 Jurong West St 65 Multi-Storey Carpark (MSCP), 'Gardens by the Roof' is the first MSCP roof deck in Boon Lay constituency to be transformed from a concrete rooftop into an allotment garden under HDB's Green Town Programme.

673 JURONG WEST ST 65, (S)640673

GARDENS BY THE ROOF – BOON LAY ZONE F

BUILDING OWNER: HOUSING & DEVELOPMENT BOARD
PROJECT IMPLEMENTOR: BOON LAY ZONE F RESIDENTS NETWORK

Nestled atop the Blk 673 Jurong West St 65 Multi-Storey Carpark (MSCP), 'Gardens by the Roof' is the first MSCP roof deck in Boon Lay constituency to be transformed from a concrete rooftop into an allotment garden (AG) under HDB's Green Town Programme (GTP). Using the Prefabricated Extensive Greenery (PEG) roof tray system, which is a lightweight and modular greening solution developed by HDB, the concretised roof deck was converted into a lush allotment garden facilitated by NParks' Community in Bloom.

This verdant oasis boasts a total of 89 plots with varying planter heights. Where required, the height of the PEG trays were increased with extension panels to enable edibles to be grown. 76 of the plots which were allocated to residents, while 8 plots were allocated to My First Skool and Boon Lay Secondary School collectively. Inclusivity is key, and 5 wheelchair-friendly planters are available for all to enjoy. The Resident Network (RN) in charge of the garden showcases a variety of plants that can be grown to visitors.

But the "Gardens by the Roof" is more than just a garden - it's a community hub. Residents have initiated various projects, including a DIY composting corner, Mural Art Wall, Orchid Display Corner, Succulent Garden, and even a Tamiya Car Track for some good old-fashioned fun.

1,2 and 3: More than just a garden, 'Gardens by the Roof' is a community hub where allotment gardeners introduce innovative sustainable solutions to their plots and bond with their neighbours through the process of gardening.

The allotment gardeners have shared their positive experiences of getting to know their neighbours and fellow residents better through the activation of this garden space at the MSCP rooftop. They look forward to growing many varieties of plants together and participating in social bonding activities. The "Gardens by the Roof" demonstrates the power of community-driven initiatives and the importance of green spaces in urban areas in promoting social resilience and mental well-being. So come on up and bask in the beauty of the "Gardens by the Roof" with the Jurong West gardeners!

145 MARINE PARADE ROAD, (S) 449274

CHURCH OF SINGAPORE

BUILDING OWNER: CHURCH OF SINGAPORE
IMPLEMENTER: CONSIS ENGINEERING PTE.LTD.

The Church of Singapore has created a beautiful and serene rooftop garden to provide a reflective space for churchgoers and visitors alike. The garden is designed with a focus on fragrant and sensory species. These species create a sensory experience that is both calming and invigorating, while the pavements that lead visitors into the planting beds encourage exploration and discovery.

These design features are intended to optimize the biophilia hypothesis, which suggests that people have an innate emotional affiliation to nature and other living beings and derive benefits from contact with nature.

The garden was designed with pavements that lead visitors into the planting beds, promoting interactions with nature.

1 and 2: Through this project, the once unutilised rooftop space was transformed into a productive garden to grow fresh produce, cultivate flowers and foster a deep sense of community.
3: A contrast of the rooftop of Church of Singapore, before the garden was set up.

Besides fragrant and sensory plants, this rooftop garden also has a productive zone, where fresh produce is grown. This feature aims to engage its visitors and foster a deep sense of community through gardening.

The rooftop garden serves as a valuable addition to the church's architecture and landscape, providing visitors with increased touchpoints with nature.