

**STRENGTHENING URBAN RESILIENCE: SAFEGUARDING A LIVEABLE FUTURE
BY PROTECTING AGAINST EFFECTS OF CLIMATE CHANGE AND LEVERAGING
INNOVATIVE SOLUTIONS TO OPTIMISE LAND**

1. With temperatures and sea levels set to rise in the coming decades, the DMP2025 sets out strategies to strengthen Singapore's climate resilience while meeting long-term land use needs. These include adapting our urban environment to reduce heat exposure, enhancing flood resilience and protecting our coastline from rising seas, and use our land more efficiently.
2. To accommodate multiple land use needs, agencies are also exploring ways to make better use of underground spaces for infrastructure, storage facilities and connectivity tunnels, while unlocking more potential above ground.

A cool city in a warming world

3. Based on Singapore's Third National Climate Change Study in 2024, Singapore is experiencing warmer temperatures with climate change. By the end of the century, we can expect up to 351 very hot days with maximum temperatures of more than 35 degree Celsius, and warm nights with minimum temperatures of at least 26.3 degree Celsius throughout the year. To create a cooler urban environment and mitigate the Urban Heat Island effect, the government will adopt urban design strategies to maximise wind flow, minimise sun exposure, in addition to existing efforts to introduce more greenery.
4. To promote better wind flow and ventilation at the building and precinct levels which will improve thermal comfort, URA has started to leverage environmental modelling capabilities to assess the impact of development on air movement at selected locations. For example, in Jurong Lake District, wind corridors along the prevailing wind directions from the north-east and south are safeguarded throughout the district. In Marina South,

building heights are varied to channel wind to key streets, public spaces and residential blocks.

5. To minimise sun exposure, URA incorporates climate-sensitive urban design principles into planning guidelines for developers. For example, development owners are encouraged to adopt a north-south building orientation to keep openings away from the afternoon sun and are encouraged to include features such as covered walkways and shaded public spaces to enhance shade and thermal comfort.

6. At the same time, agencies are enhancing digital analysis capabilities through collaborations with Institutes of Higher Learning to develop tools that help planners to improve thermal comfort. For example, URA is collaborating with the National University of Singapore to measure wind conditions at different heights using laser technology to improve the accuracy of wind flow simulations. URA is also partnering the Singapore University of Technology and Design to develop computational models that generate and evaluate how different urban layouts affect thermal comfort. The Housing & Development Board (HDB) and the Agency for Science, Technology and Research have also developed the Integrated Environmental Modeller which can simulate environmental factors in digital 3D models, to allow planners and architects to optimise the placement of HDB blocks for comfort.

A flood-resilient city and coast

7. Today, about 30 per cent of our land area is less than five metres above mean sea level. Mean sea levels are expected to rise by up to 1.15 metres by 2100 and would reach four to five metres when coupled with high tides and storm surges. With the frequency of extreme daily rainfall projected to increase throughout the year, it is imperative that Singapore adopts a comprehensive approach to manage both inland and coastal flooding risks.

8. Since the 1970s, our flood-prone areas have been reduced from about 3,200 ha to less than 25 ha through PUB, Singapore's National Water Agency's continuous effort

in upgrading the drainage infrastructure and raising of low-lying ground through redevelopment. PUB works closely with agencies like the National Parks Board to create multi-functional community spaces as the drains are upgraded, where possible. Kallang River @ Bishan Park and Alkaff Lake are two such examples. Nevertheless, with climate change bringing erratic weather and more intense storms, localised flash floods will still happen when intense storms temporarily overwhelm our existing drains. As such, PUB also engages building owners and the community to enhance flood resilience and preparedness.

9. Coastal protection must also be ramped up to enhance our island city-state's resilience against rising sea levels. This can be done through various measures such as sea walls, earth mounds, tide gates and hybrid solutions. Site-specific studies have commenced since 2021 to develop tailored coastal adaptation options that factor in the unique characteristics of the coastlines and are integrated with long-term development plans. For example, a continuous line of defence can be created at the Greater Southern Waterfront with measures which consider biodiversity, nature areas as well as future mixed uses.

10. At East Coast, on-going technical studies will explore engineering and nature-based solutions in the planning and development of 'Long Island', an integrated solution which entails reclaiming about 800 ha of land to protect the low-lying area from sea level rise. The project will also enhance our water and flood resilience with a new reservoir, as well as two new barrages and pumping stations. As part of the technical studies, site investigation works will be conducted in the waters off East Coast Park from July 2025 for a few months to obtain an understanding of the geological and seabed conditions for the planning and detailed design of 'Long Island'. Agencies have also engaged over 3,000 people from all walks of life to gather feedback which will guide the conceptualisation of plans for 'Long Island'. We will continue to engage extensively in the coming years as technical studies progress.

Uncovering an underground of possibilities

11. Over the years, we have strategically utilised underground space to reduce the use of surface land. While shallower basement spaces function as pedestrian links, retail spaces, car parks and facilities, deeper basements are utilised for MRT stations and infrastructure such as water reclamation plants. We have also built extensive underground networks for our rail, sewerage and electricity transmission systems, with around 300km of tunnels constructed and around 60km more planned in the next 10 years. Developing underground caverns for storage, such as the Jurong Rock Caverns, has allowed us to free up some 60 ha of surface land. To further such efforts, agencies are exploring the feasibility of constructing a cavern for underground aggregate storage at Gali Batu.

12. The DMP2025 outlines our key strategies to build upon these efforts in optimising our limited land and uncovering new possibilities to help us develop a more resilient Singapore. We will continue to pursue suitable projects that create more useable space to support our long-term land needs and enable a more active, well-connected public realm. We will also continue researching game-changing underground opportunities that could address current and future challenges as well as build up capabilities and technical expertise in the construction, operation and maintenance of underground spaces.

Future Efforts

13. Many of these strategies will take time to develop and bear fruit. We will continue to leverage innovation and opportunities to future-proof Singapore and optimise the use of our limited space. One example is the recent announcement on the review of international aviation height restrictions, that opens opportunities for further optimisation of our limited land. After the adoption of the revised aviation height restrictions in August this year, agencies will carefully study how we can tap on the potential to enable buildings in some areas to go higher in future, considering infrastructure capacity and the need to safeguard a good living environment.