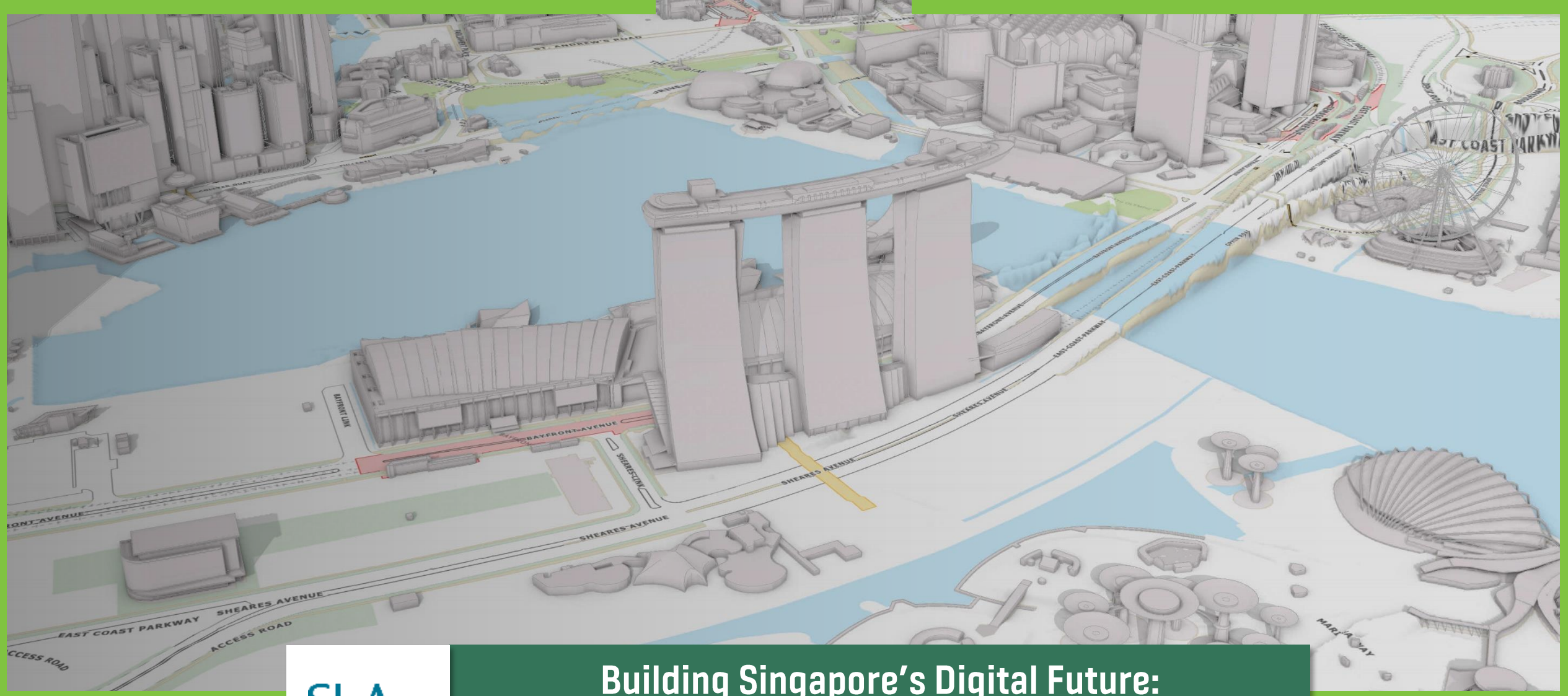


Building Singapore's Digital Future: National 3D Mapping

Benjamin Chan (Assistant Chief Executive, Geospatial & Engagement)

SINGAPORE LAND AUTHORITY

Limited Land • Unlimited Space

Land and Properties

- Steward for State land and buildings – optimised use and upkeep for Singapore's ongoing development

Geospatial

- Develop and promote geospatial platforms and capabilities in Singapore
- Develop accurate and authoritative maps

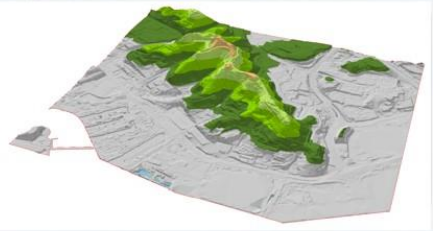
Regulatory

- Register land and property transactions to safeguard property rights

The Foundation: National 3D Mapping Programme (N3DMP)

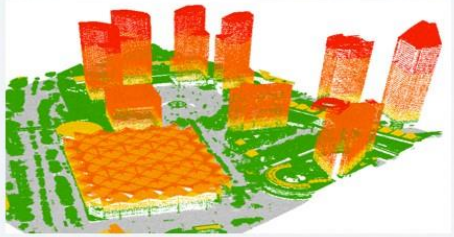
N3DMP provides a wide range of precise, interoperable data products that serve as the baseline to **support the vision of a Safe, Sustainable, and Smart Singapore**.

Digital Terrain Models (DTM)

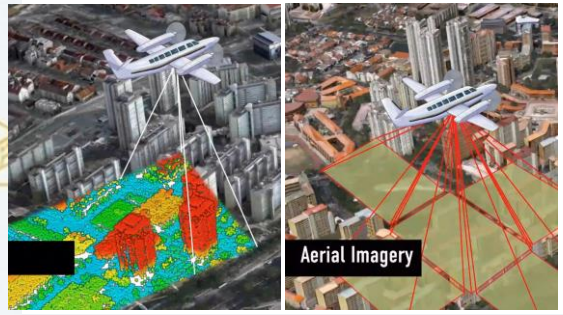


3D Building Models (CityGML LOD2)

Classified LiDAR Point Clouds

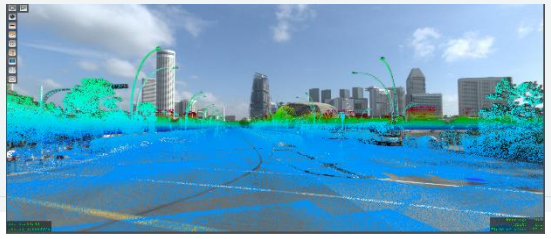


Robust airborne and street-based LiDAR and imaging create reliable 2D and 3D digital replicas



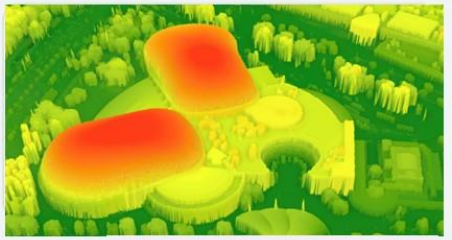
Aerial Mapping

Street Mobile Mapping

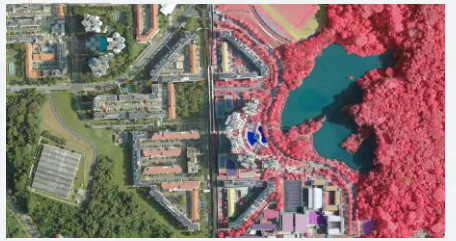


Street-level point clouds & panoramic images

Digital Surface Models (DSM)



Orthophoto + CIR



3D Reality Mesh

The Foundation: National Positioning Infrastructure – SiReNT

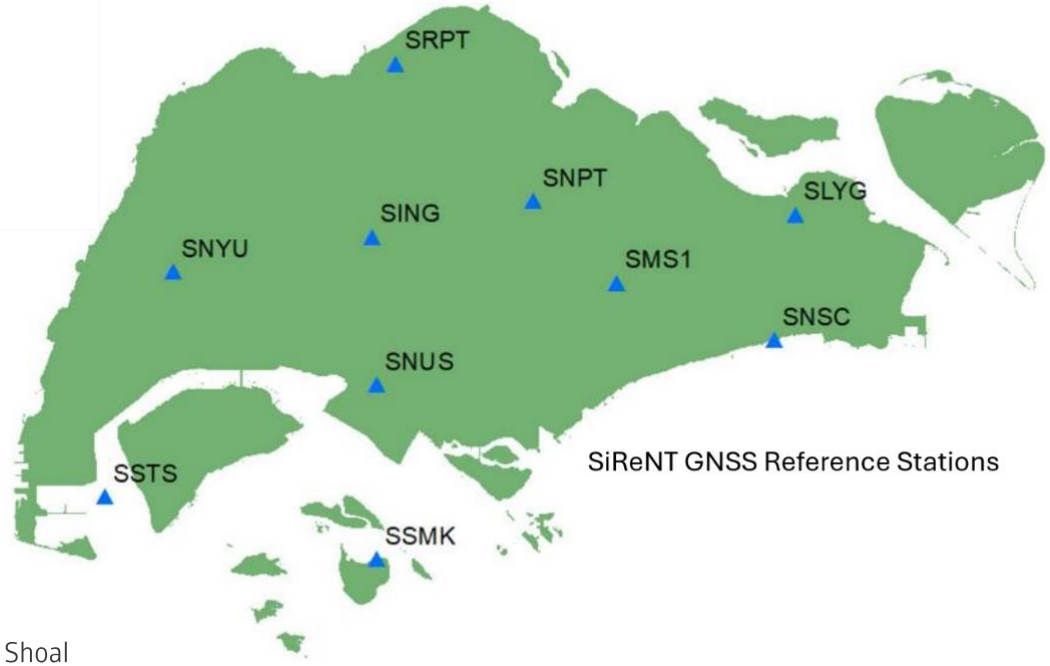
Singapore Satellite Positioning Reference Network

SiReNT provides:

Real-Time Kinematics (RTK)
– *3-5cm accuracy (real-time)*

Differential GNSS (DGNSS)
– *sub-meter accuracy (real-time)*

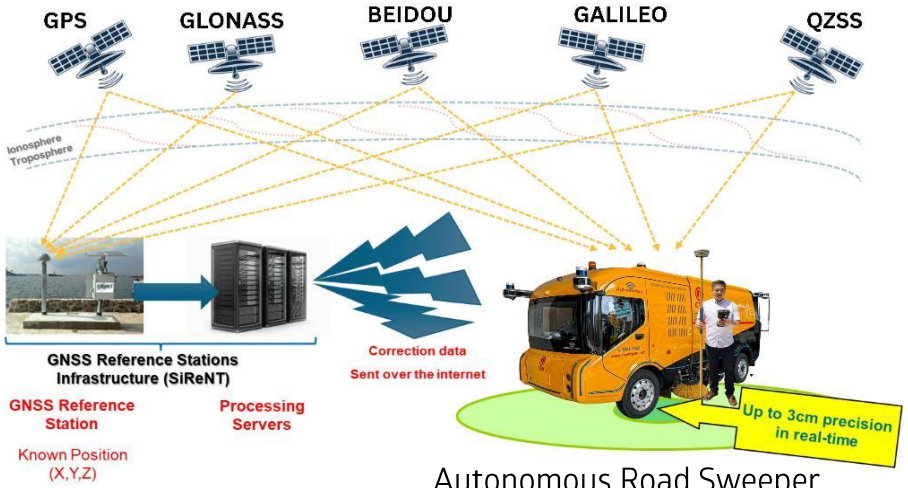
Post Process On Demand (PP On-Demand)
– *5 millimeters accuracy*



SiReNT GNSS Reference Stations

SNYU
Nanyang Technological University

SSTS
Sultan Shoal



Autonomous Road Sweeper


Machine Control for Construction

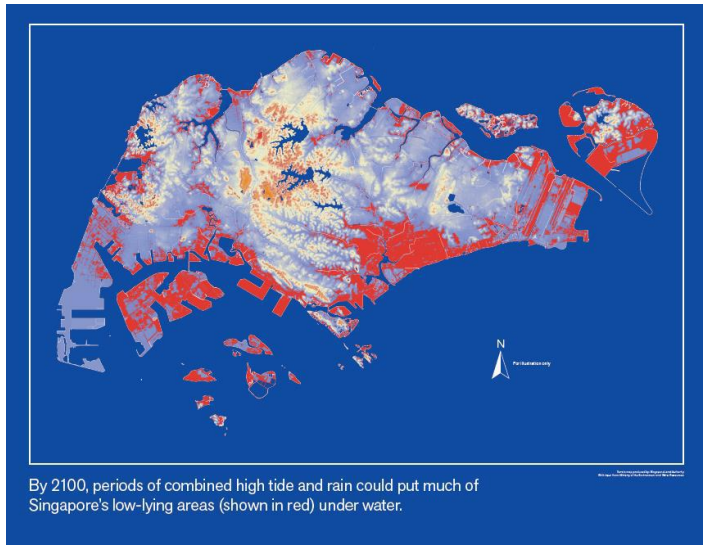

Autonomous People Mover


Robotic Sweeper

SG Digital Twin for Climate Challenges and Urban Resilience

Fundamental data and products are used to model and mitigate critical climate challenges.

Identifying Flood Prone Areas

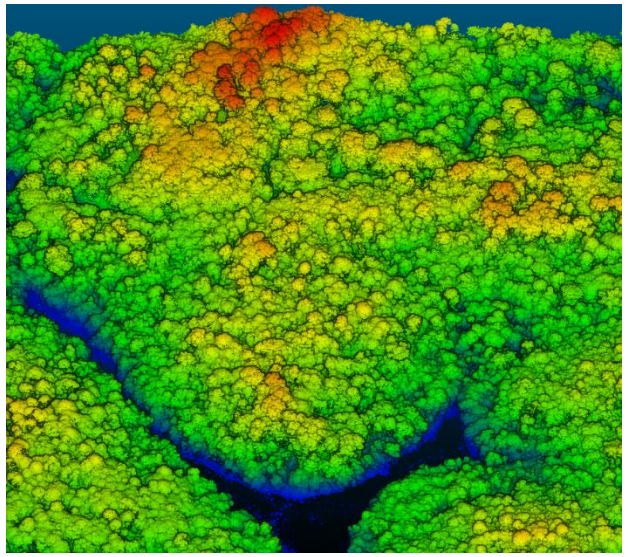


High-resolution DTMs identify low-lying areas at risk. Combined with drainage system data and sea level rise models, this enables data-driven planning and response measures

Tackling Urban Heat

Comprehensive island-wide 3D building models facilitate studies on the urban heat island effect and simulations of urban climate changes, enabling early mitigation actions

Estimating Carbon Stock



High-resolution aerial imagery and LiDAR data are used to support projects to estimate and assess carbon stocks in Singapore's terrestrial and coastal ecosystems

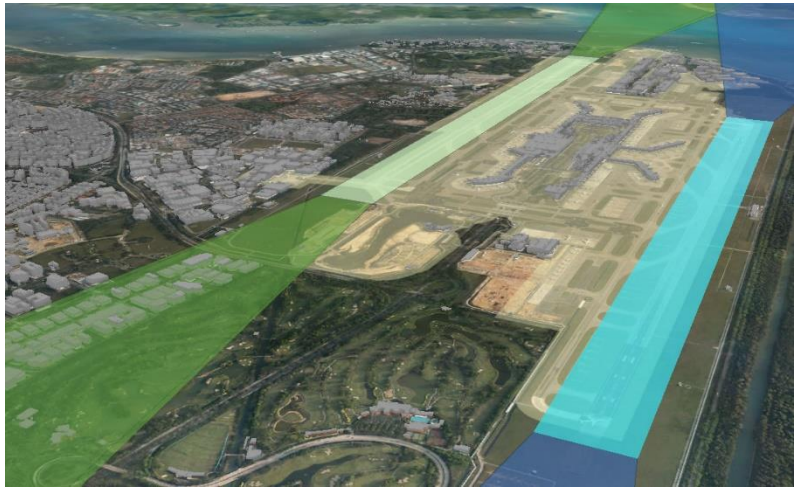
SG Digital Twin for Urban Planning and Safety

Fundamental data and products are used and enhancing public and aviation safety.

Urban Planning

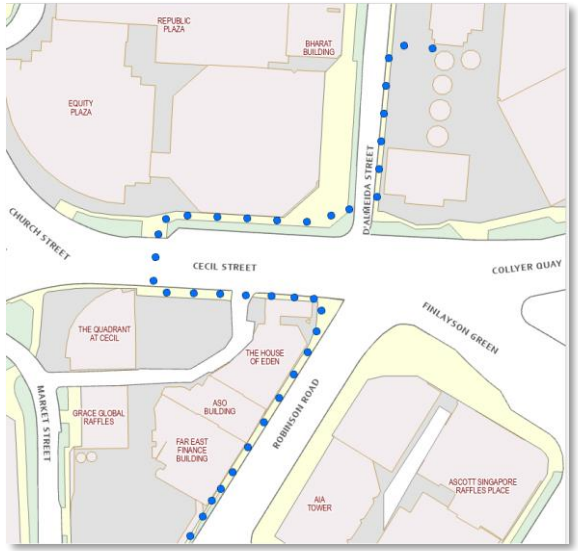
3D building models aid urban planners to analyze shadows and effects on wind flow due to new developments

Aviation Safety



3D building models and terrain models were used to create South East Asia's first electronic Aerodrome Terrain & Obstacle Chart (ATOC)

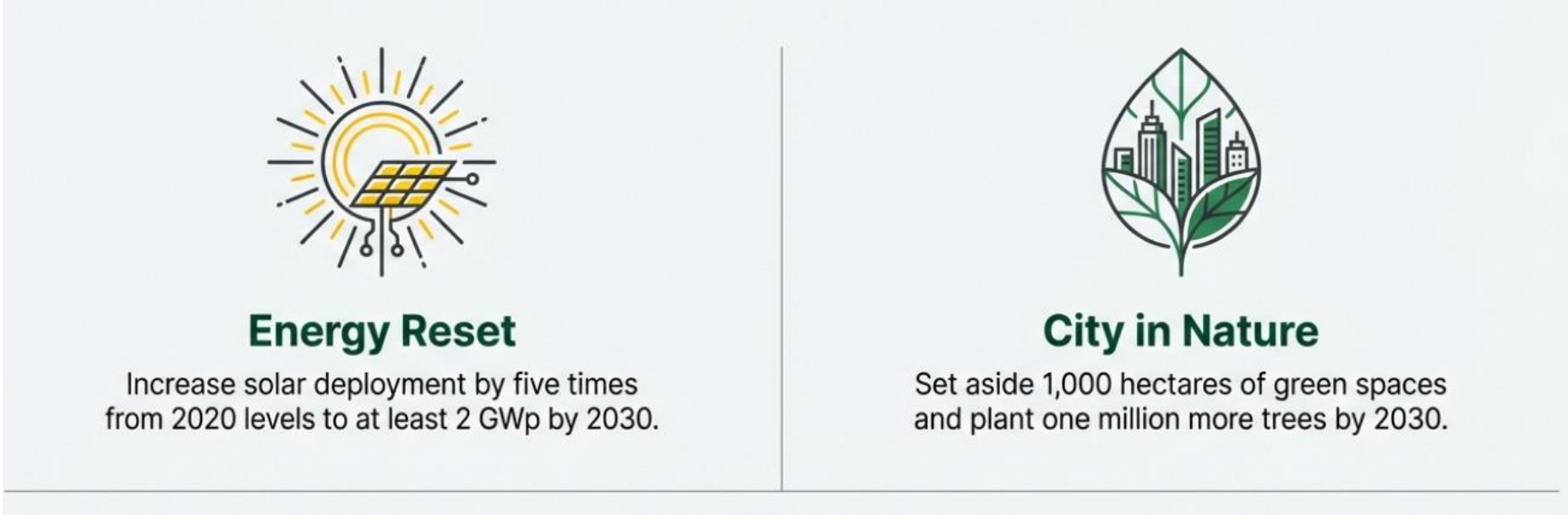
High Resolution Map



High-resolution **aerial and mobile mapping data** are used to create true-to-ground-dimensions High Resolution Map

The National Sustainable Mandate: The Singapore Green Plan 2030

As a densely urbanized nation, Singapore faces pressing sustainability challenges. The Singapore Green Plan 2030 is the whole-of-nation initiative to achieve a low-carbon future and net zero emissions by 2050.



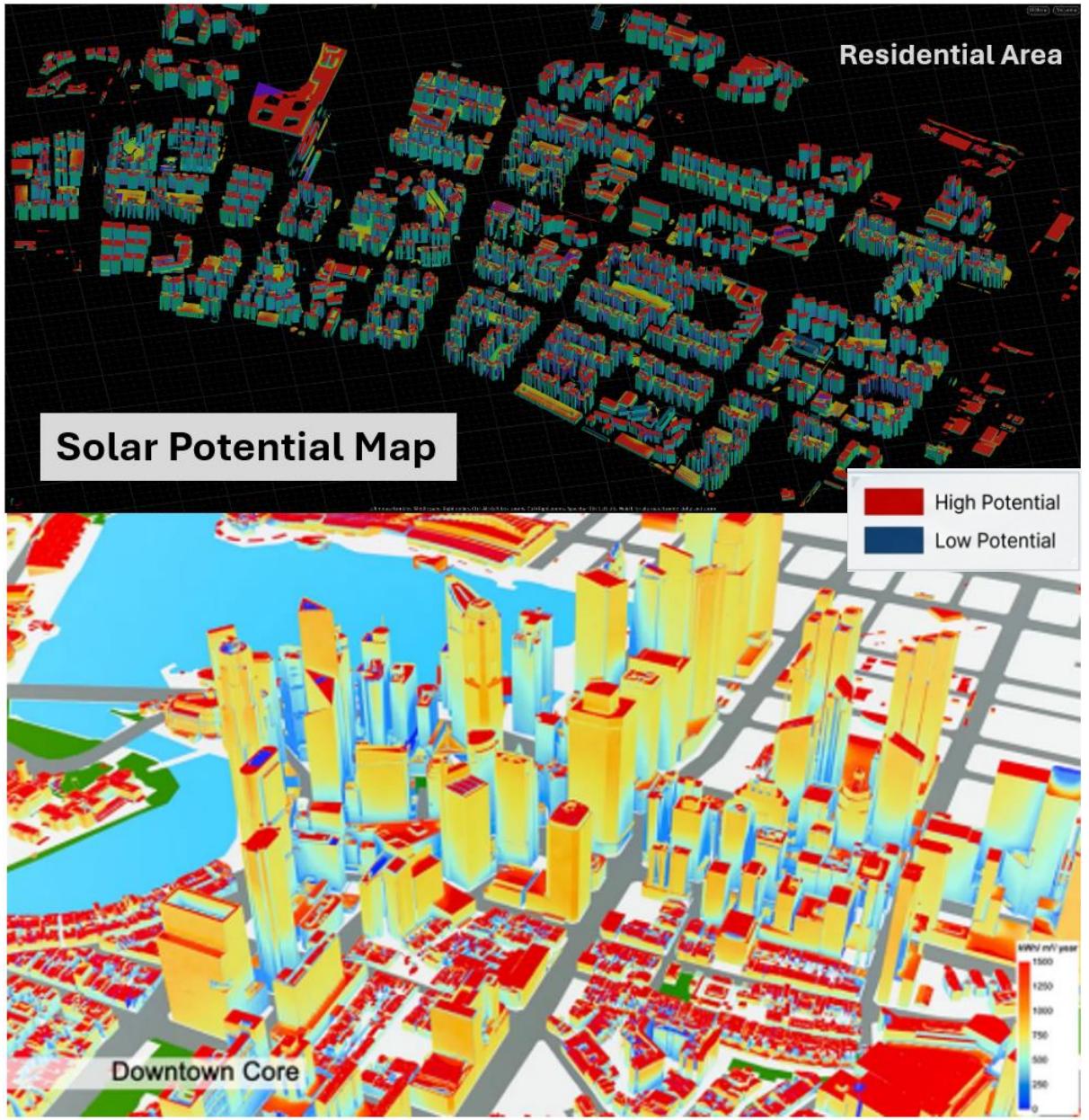
SLA **transforms** complex **mapping data into** national **maps** to server as a trusted foundation for evidence-based sustainability planning across Whole-of-Government (WOG).

Initiative 1: Solar Potential Map

Mapping Solar Potential for *Energy Reset*

Supporting Singapore's goal of 2GWp solar power by 2030, the Solar Photovoltaic (PV) Roadmap* for Singapore uses 3D Building Models (LOD2) from the N3DMP to assess solar potential across rooftops and building facades nationwide, identifying the most effective installation locations.

**Developed by Solar Energy Research Institute of Singapore (SERIS) , NUS, ERI@N and EPGC*



ERI@N – Energy Research Institute @ NTU
EPGC – Experimental Power Grid Centre at ERI@N

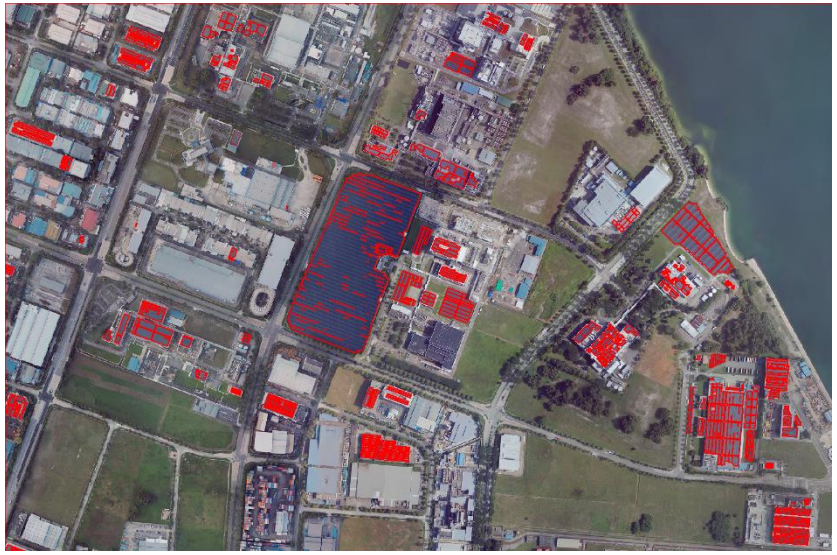
Initiative 2: Solar Panel Maps for Monitoring National Solar Adoption

Building upon the Solar Potential Map, the Solar Panel Map leverages GEOAI to detect and monitor actual solar panel installations, creating the first national baseline for WOG assessment

Location: Tuas South Avenue 8

2014

2019

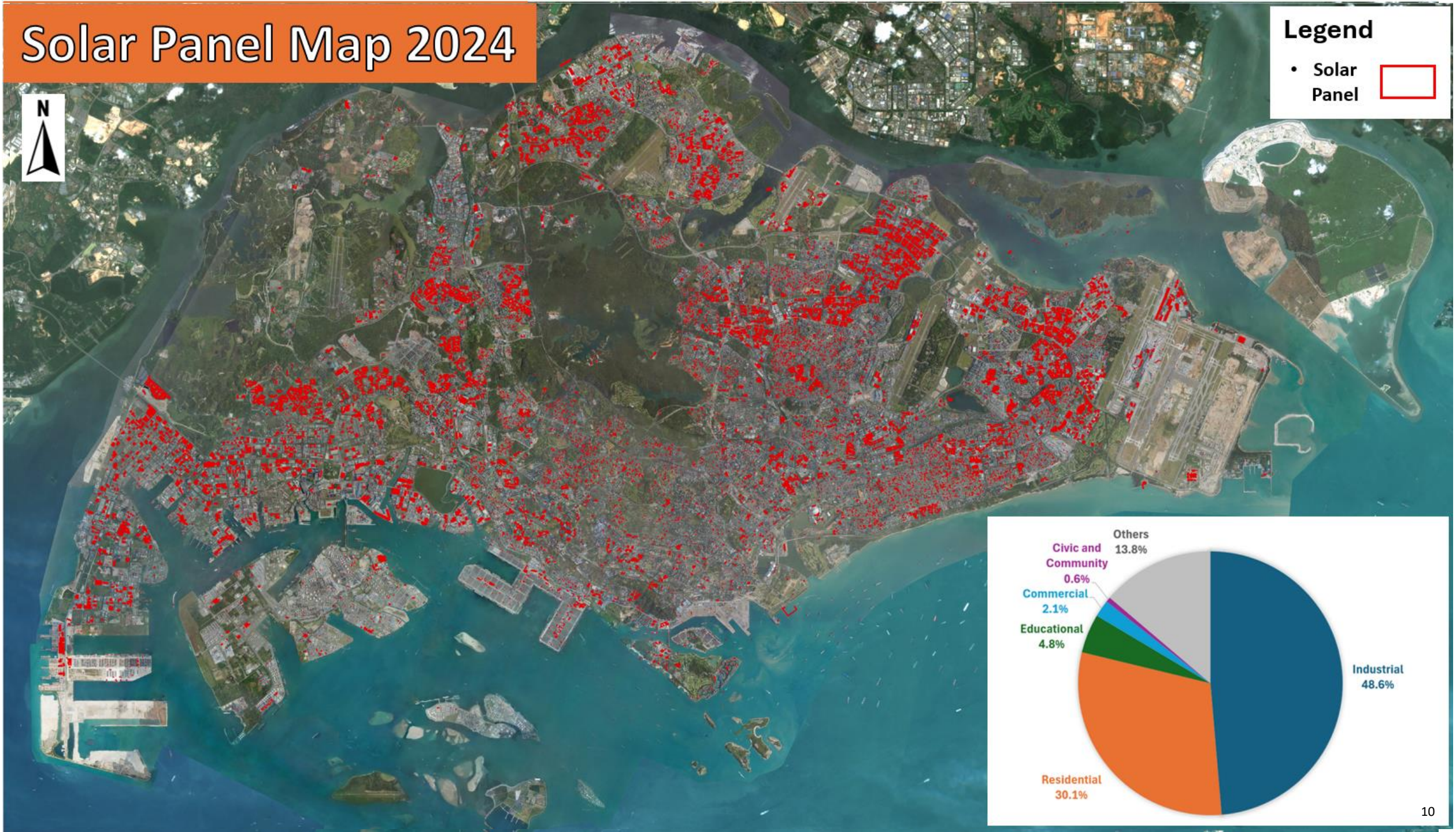


2024

>94% Accuracy

An in-house customised GEOAI model (UNet-based) was developed and applied to high-resolution orthophotos (from 7.5cm to 10cm)

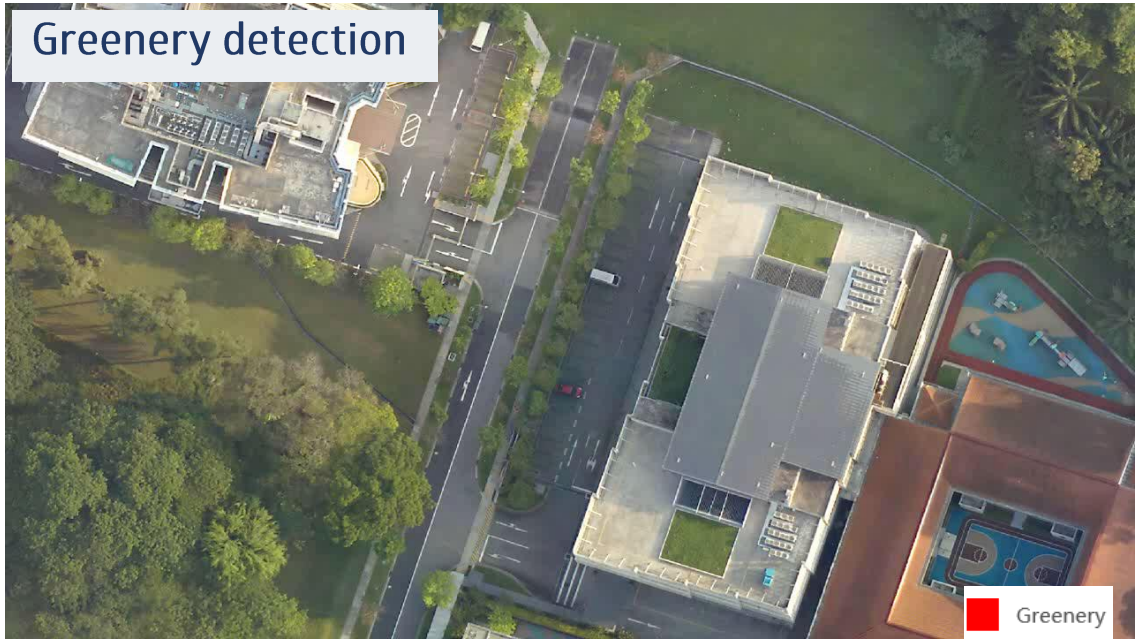
Solar Panel Map 2024



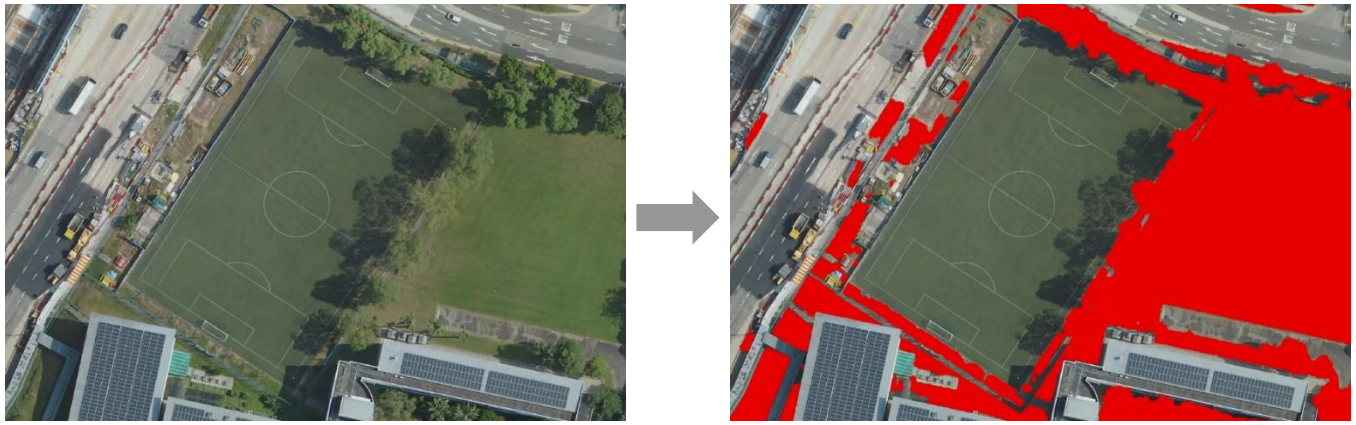
Initiative 3: Greenery Mapping

The Green Cover Map uses orthophoto, DTM, DSM, NDVI indices, building outlines to maps spatial distribution of greenery, providing a baseline for monitoring progress towards the *City in Nature* target

46% of land area was covered by greenery in 2024



GEOAI model (UNet-based) developed was able differentiate synthetic and natural grass accurately



Synthetic grass in RGB image

GEOAI model detected results

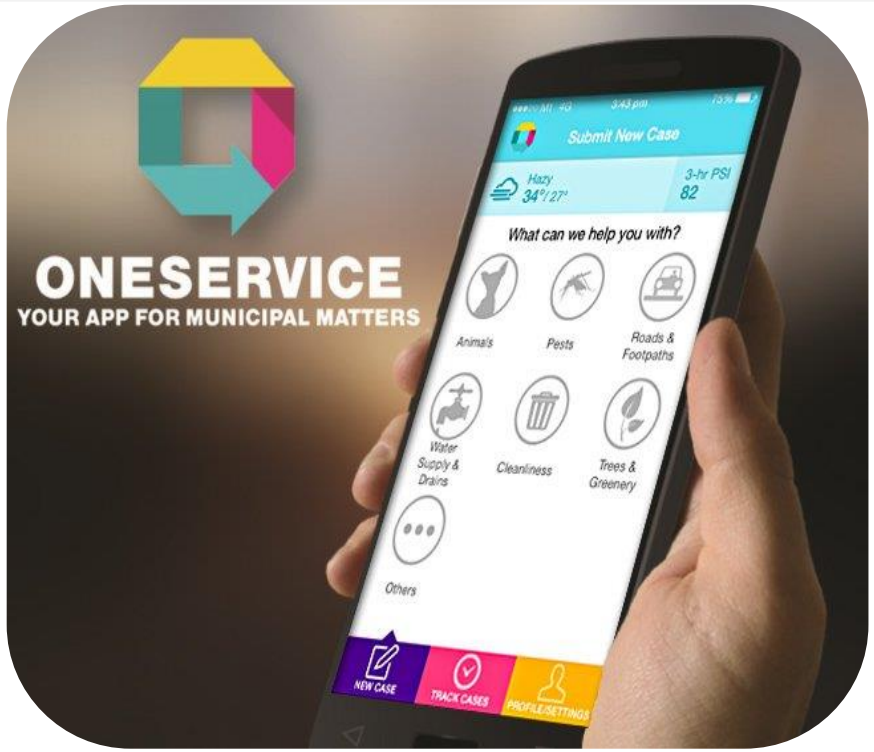
Geospatial for Operations

From emergency response, to upkeep of neighbourhoods

Community First Responders Coordination

Activates volunteers within 400m to 1.5km

Routing of Municipal Matters to proper authority



Public feedback logged and followed up

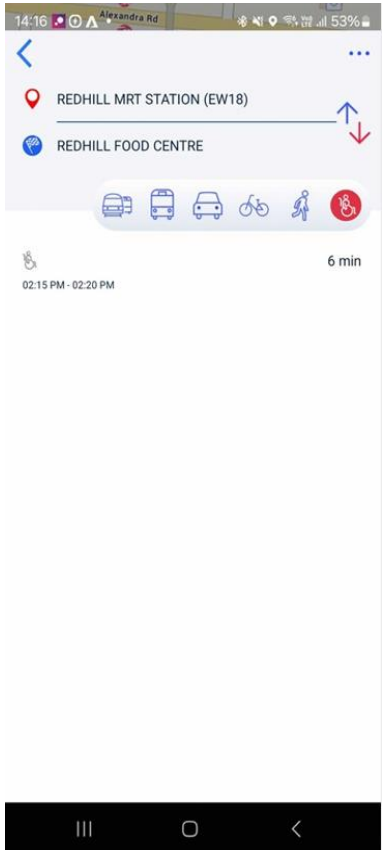
Geospatial for Well-being

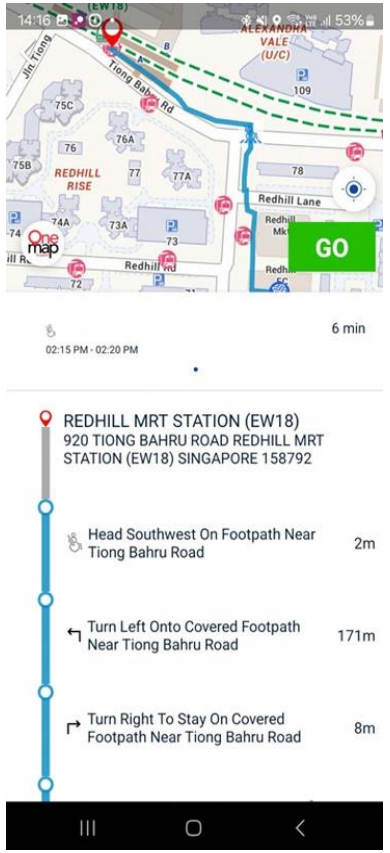
Barrier Free Access: Empowering PWDs and caregivers for the 2030 Enabling Master Plan

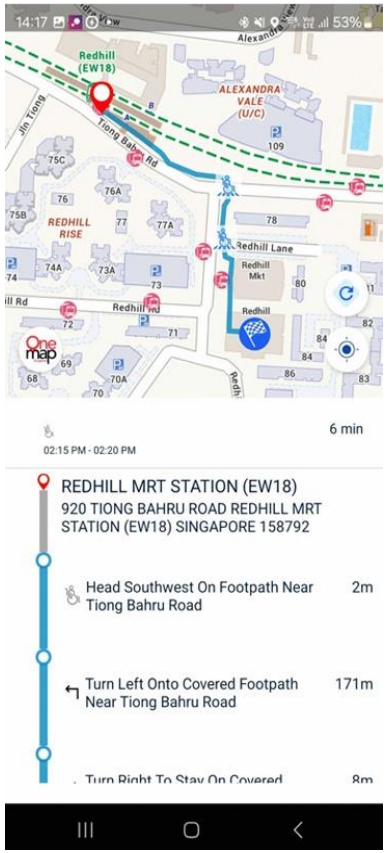
Key Features

- Suggests route with reduced number of turns to reach destination
- Turn-by-turn directions with voice guidance
- Vibration and visual alerts when
  - Approaching road crossing
  - Using accessible lift(s)
  - End of journey

Accessible Singapore wayfinding

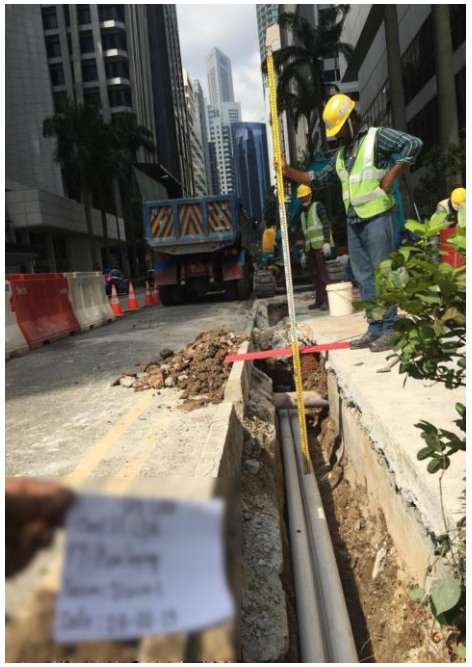






Geospatial for Underground Transformation

Creating a reliable, 3D underground database serving WOG and industry through the Infrastructure Asset Register

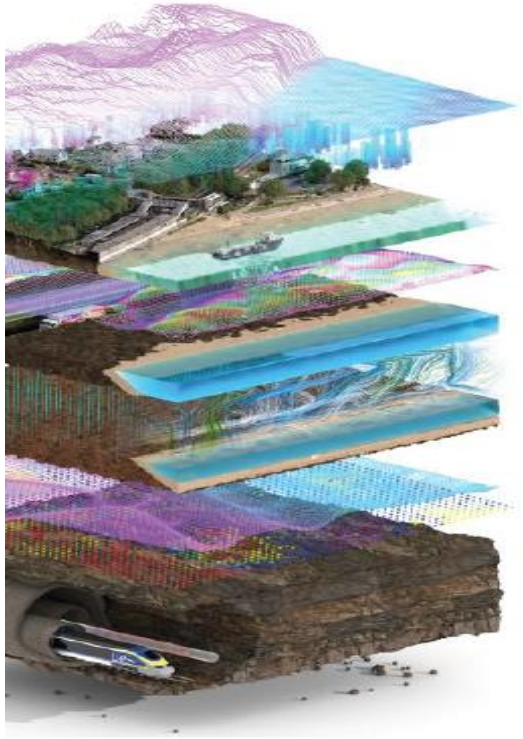


1. Registered Surveyors + Engineers' data submission

USSP

2. Submission via the Utility Survey Submission Portal (USSP)

- Compliance to Utility Survey Standards
- Automated data quality checks



3. Authoritative 3D database of clean utility/underground data

SG Digital Twin

Enabling A Safe, Healthy, Sustainable, Smart & Inclusive Singapore

NATIONAL SECURITY & SOVEREIGNTY

- Boundary Delimitation
- Border Control
- Topographical Mapping

RISK MANAGEMENT & PUBLIC SAFETY

- Disaster Management
- Aviation Safety
- Flood Risk Management
- Safety Planning
- Land Motion Monitoring
- Emergency Services

SUSTAINABILITY & ENVIRONMENTAL PROTECTION

- Climate Resilience
- Coastal Protection
- Biomass & Carbon Accounting
- Solar Potential Estimation

URBAN & INFRASTRUCTURE

- Urban Planning
- Urban Heat Island (UHI)
- Digital Construction
- Underground Mapping

SOCIAL & HEALTHCARE

- Preventative Healthcare
- Social Prescribing
- Social Services
- Barrier Free Access

REAL ESTATE & PROPERTY

- Authoritative Land Information
- Real Estate Transaction

MARITIME NAVIGATION

- Hydrographic Survey
- Maritime Safety

SMART CITY

- Urban Digital Twin Development
- Autonomous Mobility
- Robotics
- Smart Construction
- Location-based Services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