

# Land Information Network (LandNet): Transforming Land Information Sharing to Support an Integrated Government Vision

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## ABSTRACT

*Sharing of land information among government agencies is not new to Singapore. It goes back to the late 1980s when the Land Data Hub (LDH) was established to facilitate digital land data sharing among government agencies. The objective of LDH then was to provide a one-stop shop for land information. Over the years, LDH substantially eliminated the cost of data duplication and hassles for agencies to contact data suppliers individually.*

*This paper traces how the Singapore Land Data Hub has transformed from the manual data exchange program to an on-line and real-time data sharing platform called LandNet. LandNet also facilitates online GIS consultation and collaboration among government agencies. The larger goal of LandNet is to achieve an integrated government vision where agencies not only share data but also share processes and systems. The paper highlights the challenges faced during the implementation of this multi-agency project where different agencies use different GIS platforms.*

## Paper Body

### Background

It is often said that over 80 percent of information for decision making has a location or spatial component, be it political, economic or social. Hence the availability of accurate, most up-to-date and comprehensive spatial data is important to ensure good governance, emergency management, planning and resource management.

The Land Data Hub was established and managed by the Singapore Land Authority (SLA) to promote and enable sharing of spatial data among government agencies. SLA, the national geospatial mapping agency in Singapore, collects the data from the agencies and technically enables the data to be shared across the public sector. This one-stop spatial data resource centre eliminates duplicative efforts in acquiring spatial data already collected by other agencies. It is believed that this was the first such national data sharing model in the world when conceived in the late 1980s.

Today, 15 participating agencies contribute more than 30 types of spatial data to the Land Data Hub (Table1: List of data layers in LandNet). On average, a total of 1.2 million map sheets<sup>1</sup> are shared (annualised). For every map sheet contributed by the agency, it will be shared with and used by 10 other agencies. This underscores the

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<sup>1</sup> The island of Singapore is divided into approximately 1500 map sheets, each covering an area that is 900\*600 meter in size.

often quoted ideal that data should be “created once and used many times”. The model has proven to be successful and well regarded both locally and internationally.

**Table1:** List of 31 major categories of data out of 105 layers of GIS information in LandNet system.

1	Address Point	17.	Road – Public Roads
2	Approved Building Name	18.	Road – HDB Estate Roads
3	Cadastral Map Index	19.	Road – Industrial Roads
4	Constituency Boundary	20.	Lot Address Cross Reference
5	Development Guide Plan (DGP)	21.	Lot Base Data
6	Drainage Network	22.	Master Plan
7	Electoral Boundary	23.	Road Safeguarding
8	Electricity Network	24.	Sewerage Network
9	Gas Network	25.	Singapore Outline and Offshore
10.	Government Building Register	26.	Singapore Street Directory
11.	Carpark	27.	Street Code (Textual)
12.	Hydrographic Data	28.	Topographic - contour line
13.	Building - Private & Commercial	29.	Topographic - building
14.	Building – Public Housing	30.	Water Network
15.	Building – Industrial	31.	Hydrographic
16.	Cadastral		

## Enhanced Service Delivery of an Integrated Government

SLA's vision is to enhance the capacity and synergy amongst the public sector agencies through shared data, processes and systems. While the Land Data Hub in essence supports the vision, its operating model of manual data exchange every quarter was not in keeping with contemporary demands because of the limitations of the technology used.

Increasingly, public agencies need more up-to-date data for more efficient planning and operations and to deliver better public service. Demand for spatial data has increased in recent years for the management of security, environmental and health risks, as well as for the planning and management of land and resources. There has also been a desire to see on-line data sharing, e-consultation and even project collaboration as Singapore moves towards an integrated government.

SLA first pilot tested online sharing of data in 1998 among few agencies. The concept worked but the system required costly satellite servers to be installed and maintained across many agency sites. The cost far outweighed the business

benefits. The other critical business challenge that was needed to be tracked was to establishing data exchange standards to enable faster discovery and higher usability of spatial data.

In 2004, SLA pilot-tested a new technology with a few key data supplier agencies which provided the Land Data Hub with new capabilities, including up-to-date and online updates and map-based e-consultation that were not available.

## **Improved Operational Excellence and Effectiveness**

LandNet was officially rolled-out on 1 June 2007. It provides a web-based system that allows agencies to view, access, perform spatial analysis, upload and download data directly from the Land Data Hub. In essence, LandNet enables on-line and up-to-date data sharing across different agencies which use different GIS systems.

LandNet exploits existing high-speed government intranet for efficient data exchange and higher interoperability. Designed on a whole-of-government approach, it provides an effective “paper-less” means for agencies to discover and share spatial data to facilitate better decision making. Agencies can upload and download data in variety of spatial data formats using the LandNet browser. LandNet provides convenience of automatically download based on user desired frequency and location of download. Many agencies use this features to download LandNet data directly to their GIS servers based on their preferred frequency.

It is now possible to view multiple types of spatial data (e.g. road lines, cadastral, land ownership) using a web browser without the need for a GIS software (Fig 1: LandNet Web Map Browser). Even agencies without GIS can enjoy the use of spatial data without difficulties. Non-spatial type of data such as socio-economic statistics can be layered easily with spatial data in LandNet for better planning and decision making. Satellite imageries can also be used as backdrop for the spatial data.

Salient features of LandNet include profile based access to data, simple map browser with map view, query and analysis tools. The map browser can be personalised based on user’s preference i.e. users can set the on number and appearance of the layers they wants see each time they logs into LandNet. LandNet also offers tools for map based e-consultation.

For agencies with their own customised GIS systems, LandNet acts as a virtual GIS data warehouse. The use of LandNet as a shared infrastructure helps save significant costs overall for the government. It is estimated that in absence of LandNet, the agencies would have to spend more than SGD\$9.0 million in development cost and SGD\$2.5 million in annual maintenance cost to enjoy the same capabilities and benefits that LandNet offers.

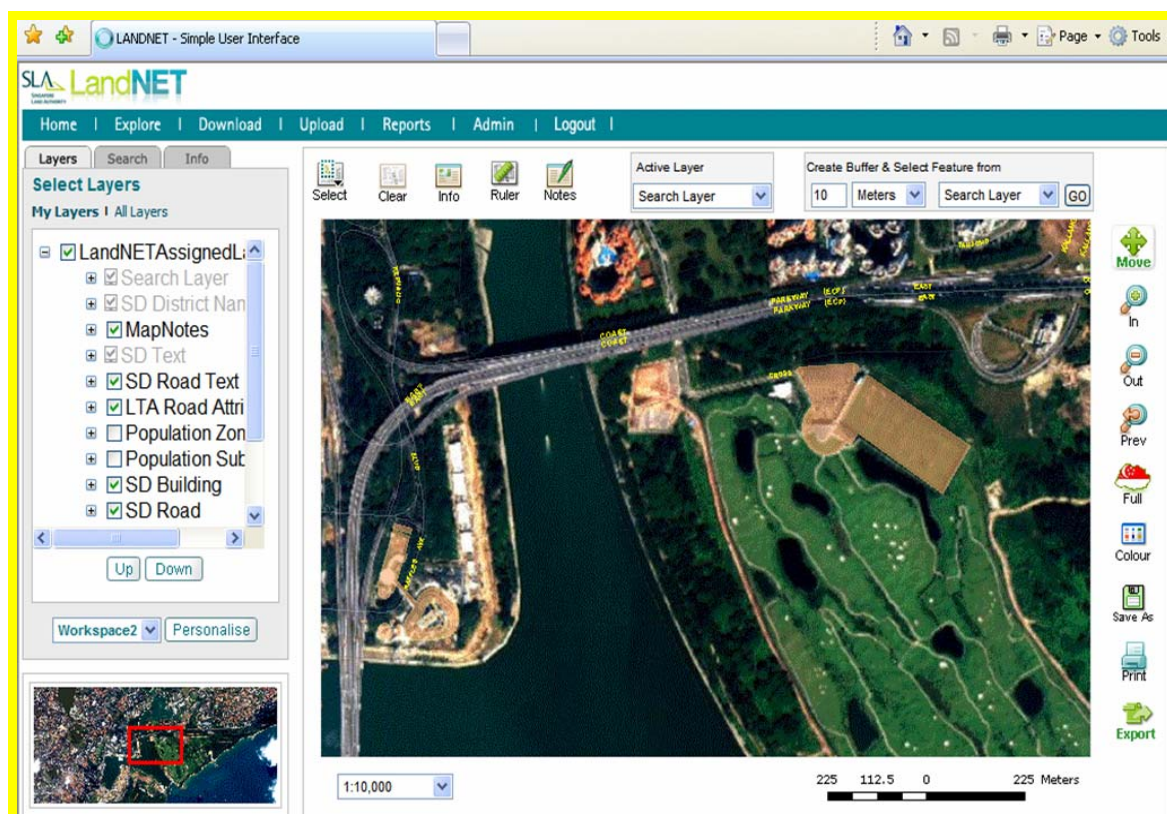


Fig 1: LandNet Web Map Browser

## Enabling Integrated Government and Delighting Citizens

With its good inter-agency connectivity, GIS functionalities and the ready availability of rich spatial data, LandNet has become the enabler and preferred GIS platform to support other national initiatives and map-based applications.

- Integrated Land Information Services (INLIS)** – A one-stop shop on [www.inlis.gov.sg](http://www.inlis.gov.sg) allows citizens to purchase property and land related information from multiple agencies. INLIS uses LandNet as a conduit to pull GIS data from various agencies. For examples, INLIS allows prospective property buyers and conveyancing lawyers to obtain up-to-date information on property ownership details and future road widening works which may affect the enquired property. Surveyors can receive information of latest survey control points using SMS service from INLIS to their mobile phones. INLIS attracts more than 300,000 transactions annually (Fig 2: INLIS Home Page).

**SLA**  
SINGAPORE  
LAND AUTHORITY

**INLIS**  
INTEGRATED LAND INFORMATION SERVICE

Singapore Government  
Integrity • Service • Excellence

Rate Our e-Services | Contact Info | Feedback | Sitemap

Search  Go

Home | About INLIS | Products | Getting Started | I need help | Terms & Conditions | My Transaction | Licensed Services

**Property Information**

- Property Ownership Information
- Property Title Information
- Property Title Information - Estate and Land Description
- Property Title Information - Encumbrances Information
- Property Title Information with Cadastral Map
- Land Information - Lot Particulars
- Land Information - Lot History
- Caveat Index Information
- Historical Information
- Distance between Primary School and Property
- List of Primary Schools Near Property
- Encroachment Boundary Plan
- Image of HDB Leases
- Image of HDB Instruments
- Image of Private Property Instruments
- Image of Index to Land Books
- Image of Index to Caveat Books
- Image of Private Property Deeds

**Messages**

**Launch of New Product - Railway Protection Plan**

The Land Transport Authority has launched the Railway Protection Plan that shows graphically, whether 'selected' cadastral lots falls within or within the vicinity of the Railway Safety Zone.

PLEASE NOTE THAT ITEMS PURCHASED WILL BE RETAINED IN THE SYSTEM FOR A MAXIMUM OF 7 DAYS.

**Free Services**

- LandQuery
- StreetMap@Singapore
- Wireless@SG
- State Property Information Online (SPIO)
- Distance Calculator for Survey Plans

**SiReNT**

- SiReNT GPS Data

**Land Survey Information**

- Cadastral Map
- Certified Plan
- Strata Certified Plan
- Registrar of Title Plan
- Horizontal Control Point
- Vertical Control Point

**Other Information**

- Road Line Plan
- Railway Protection Plan (New)

**SLA Mobile Services**

- Coordinates of Horizontal Control Point
- Reduced Level of Vertical Control Point
- Status of Horizontal or Vertical Control Point

Fig 2: INLIS Home Page

- SLA Map Portal ([www.map.gov.sg](http://www.map.gov.sg))** – The SLA Map Portal project is a fine example of engaging citizens, listening to their views and subsequently implementing their requests. The SLA Map Portal is a pilot initiative which provides citizens with free street level maps, information on landownership of a piece of land (Fig 3: LandQuery Map Browser) and locations of free WiFi hotspots (Fig 4: Wireless@SG Map Browser). Attracting more than 70 million hits per month, many other government websites also take advantage of these map services to show the location of government facilities and services. LandNet provides the mechanism and the spatial database for the information to be delivered to these services at [www.map.gov.sg](http://www.map.gov.sg).

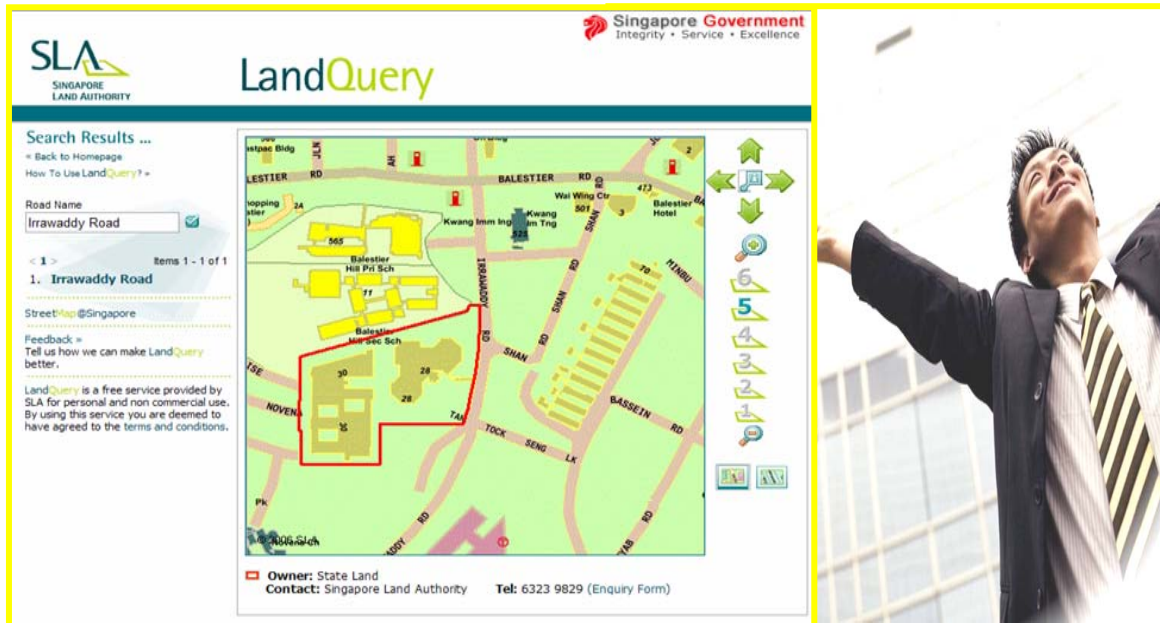


Fig 3: LandQuery Map Browser

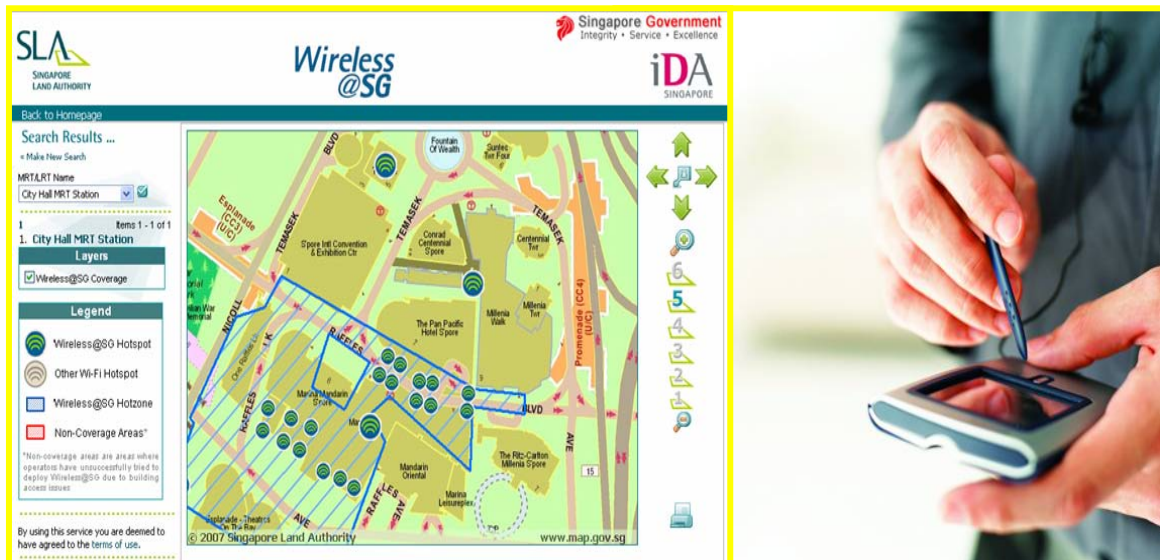


Fig 4: Wireless@SG Map Browser

- Dengue Hot-Spot Monitoring** - LandNet facilitates the fight against dengue fever by disseminating data on dengue hot-spot clusters detected by the National Environmental Agency (NEA). The timely sharing of such data with other agencies ensures that they can take quick preventive actions to stop the spread of disease in the areas under their charge. Screenshots shown in Fig 5 illustrates the selection of buildings within a dengue hotspot using GIS analysis capability of LandNet.

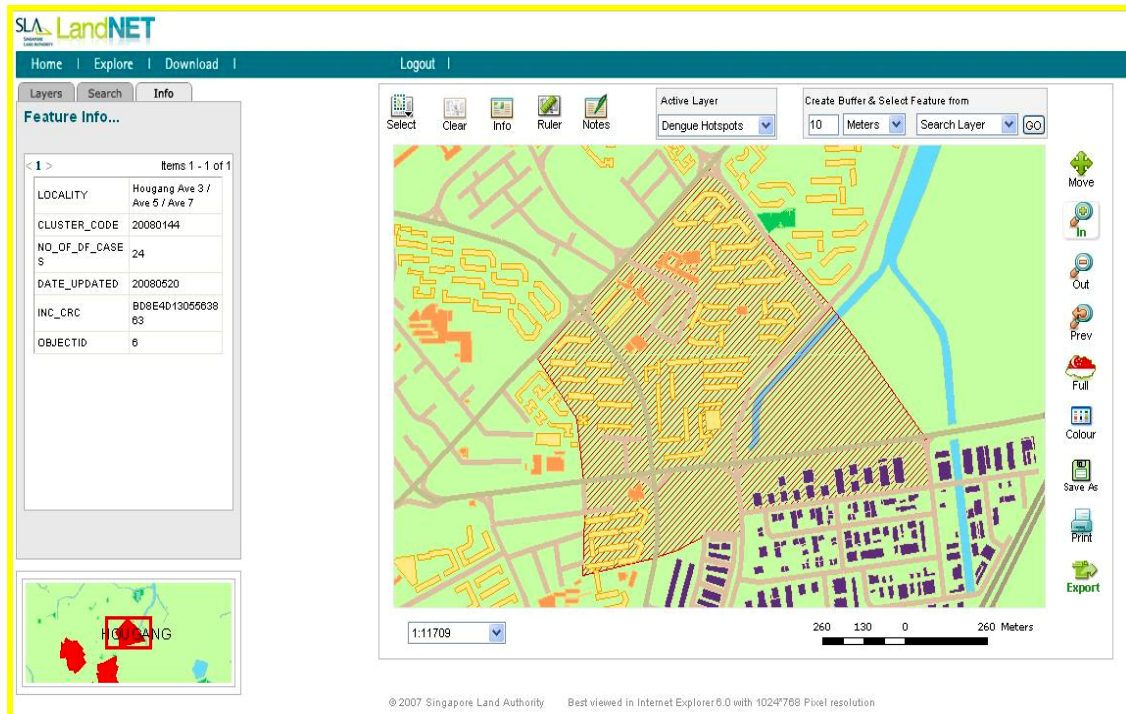


Fig 5: Dengue Hotspot analysis using LandNet

- Next Generation National Broadband Network Planning** - LandNet helps the Infocomm Development Authority (IDA) in planning for the laying the cables for the Next Generation National Broadband Network by making available the essential spatial data, for example existing underground utilities and services through the LandNet web browser. Fig 6 shows the utility networks data such as underground sewerage, drainage, water and gas.

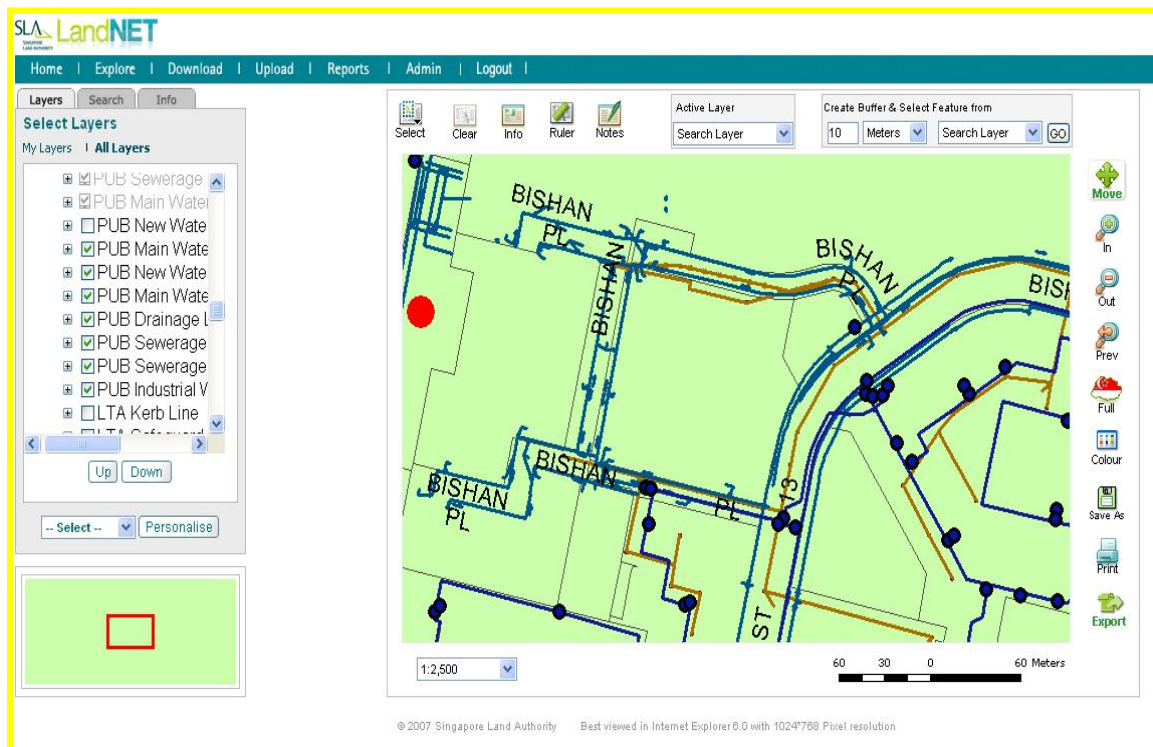


Fig 6: Utility Networks data in LandNet

- **Vacant Property Information Portal** – Built on LandNet, this portal provides up-to-date map-based listing of vacant state-owned properties available for rent or lease. With this information readily available, the use and occupancy rate of these state properties is maximized (Fig 7: Vacant Property Information Portal).

Owner	Bldg Name	Street Name	Storey No	Unit No	Vacant (sqm)	Usage	Pref.	Avail.From	Contact	Photo
MOE	EX BOON LAY SEC SCH	JALAN BOON LAY	NIL	NIL	10590	B2	NIL	30-06-2007		
MOE	EX ZHANGDE PRI SCH	JALAN BUKIT MERAH	NIL	NIL	12908	E	NIL	30-11-2006		

Fig 7: Vacant Property Information Portal

- **State Land Register Portal** – This portal allows government agencies to view and enquire on the listings of their state-allocated land and building inventory. Accessing data from LandNet, it facilitates the verification, confirmation and certification of the listings to ensure accurate and complete records for accountability (Fig 8: State Land Register Portal).

LandParcelId	Location	LandArea(sqm)	Ministry/Dept	Usage	Remarks
3004352	Choa Chu Kang Way	379.846413	MINDEF		

Fig 8: State Land Register Portal



- **Land Resource Management and e-Services System** – It is a system which integrates several backend land administration work processes of agencies to better serve citizens through better inter-agency coordination and e-consultation. This is achieved by exploiting LandNet's inter-agency connectivity and its wealth of spatial database. This eliminates the need for the agencies to approach one another manually on land administration matters.
- **Environment Protection** - Government agencies exchange information on trees via LandNet to help maintain Singapore's status of a green city. Updated spatial data on land aids in dealing with geo-strategic implications of climate change. Information gathered at LandNet helped to create Singapore's first Landslide Susceptibility Maps (Fig 9: LandNet browser showing tree information. The black dots are locations of road side trees).

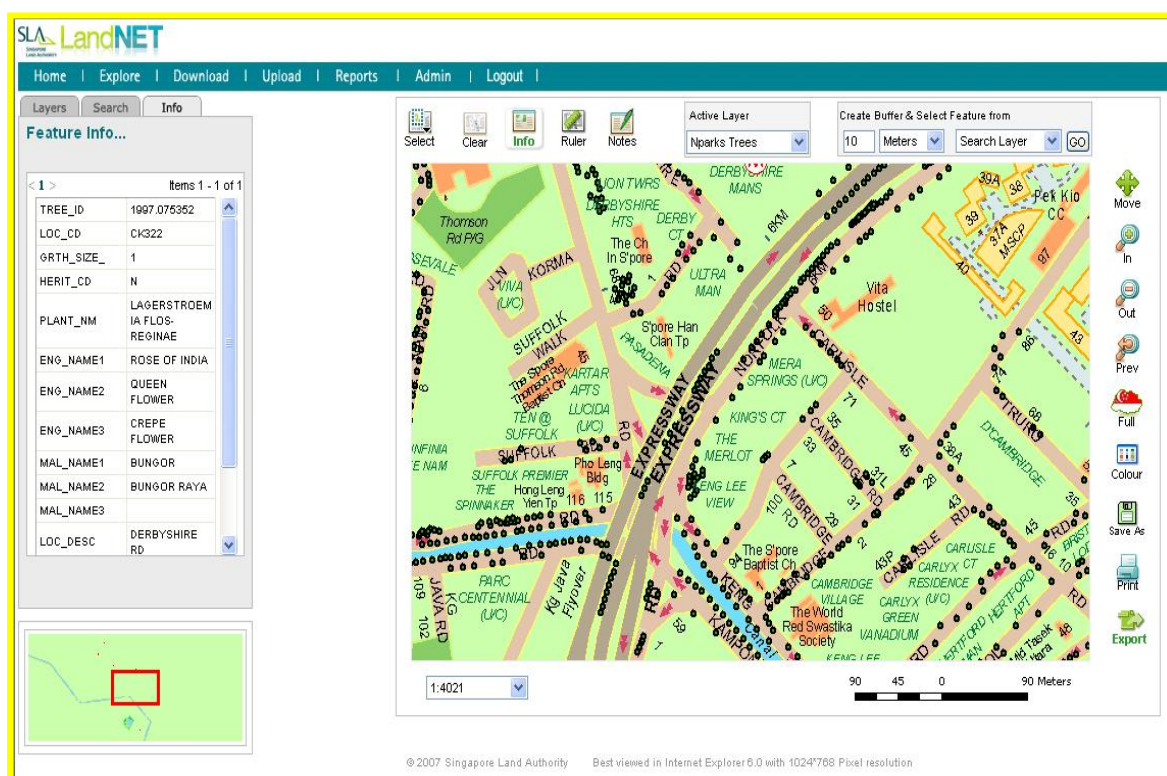


Fig 9: Road side trees information in LandNet

## Unique Funding Model

LandNet system is maintained and operated on a cooperative funding model where members come together to share their data and also share the operational cost of data sharing. Agencies pay a one time yearly subscription cost and a download service fee on a pay-per-use basis.

The income generated by the system is used to pay for the operating expenditure and a future system renewal. The surplus incomes are returned back to the member agencies in the form of rebates in the subscription fee. The objective of this funding model is to ensure sustainability of the land data sharing program and accountability.

## Innovative use of Technologies and Standards

LandNet is a showcase of technologies and adoption of international standards. LandNet system was one the early adopter of ArcGIS Advance Server 9.2 to exploit its map catching and advanced geoprocessing features. LandNet was the first system in the entire Asia Pacific region to adopt Enterprise GRID technology, which gives it higher performance, better scalability and fault tolerance. Another first in the region was the implementation of LandNet's GIS web services with Government Web Service Exchange (GWS-X), which allows government agencies to integrate maps into their websites without having the need to operate a GIS infrastructure. LandNet adopts ISO TC 211 standards for the metadata creation, Open GIS Consortium's (OGC) Geographic Markup Language (GML2) standard for data interchange and OGC Simple Feature Specification for data storage.

## Measurements of Success

Success of a data sharing program is a long journey, which needs to be measured based on well defined milestones. Several Key Performance Areas (KPIs) of the project were identified in alignment with the business objectives at the conceptual phase. The table below shows the scorecard of the LandNet system after 11 months of operation (1 Jun 07 to 30 Apr 08).

**Table 2:** LandNet business results and KPI scorecard

Business Objectives and KPI's	Before New LandNet	After New LandNet		
		Year 1 Target	Year 1 Achievement	% Exceeded
<b>1. Encourage sharing of data</b>				
a. Increase No. of data layers uploaded online	17,000	80,000	125,000	56.3
b. Increase No. of agencies using online sharing	3	8	14	75.0
c. Increase No. of data layer	35	70	110	57.1
<b>2. Increase use geospatial data</b>				
a. Increase No. of data layers downloaded online	20,000	450000	1,200,000	166.7
b. Increase No. of supported data formats	4	7	9	28.6
<b>3. Ensure quick discovery and high usability</b>				
a. Cut down data discovery time	3 Days	Immediate	Automatic	Exceeded
b. Increase timeliness of data	Quarterly Update	Weekly	Daily Updates Possible	Exceeded
<b>4. Facilitate e-consultation and collaboration</b>				
a. Deliver new e-Consultations and Collaborations	2	4	7	75.0
<b>5. Spur downstream applications and services</b>				
a. Increase the no. of applications and services	1	2	10	400.0

## Key Learning Points

Key learning points from the implementation of LandNet are:

1. Implementation of a multi agency project of this magnitude is inherently challenging. Before the project inception, SLA conducted briefings to senior

management of the key stakeholder agencies to ensure buy-in and participation. With strong senior management support and endorsement from all participating agencies, the project took off without much difficulty.

2. Investment of time and resources for a comprehensive pilot testing of the online data sharing paid rich dividends as it helped in exposing potential technical and process related pitfalls. For example, sending large chunks of data over high speed network was not only a data security concern; it was also vulnerable to network failures. During the full project implementation, appropriate measures and solutions were put in place to deal with these challenges.

3. While designing the user interface of the system, the project team was faced with a huge challenge to come up with a simple user interface. SLA project team conducted feedback sessions and technical workshops for the staff of various levels from the agencies. As a result, one of the key features of LandNet is a simple web-browser user interface, which a lay-person can easily use without the need for GIS trainings. This helps to pave the way for widespread proliferation in the adoption and use of GIS in the public sector.

4. Streamlining data standards and ensuring compliance is a challenging task. Concerns of major data producer agencies needed to be addressed as conformation to standards requires changes to their operational procedures and investment in new systems and infrastructures. To allow agencies more time to deal with these issues, LandNet project team came up with innovative data transformation tools well integrated within LandNet system which helped agencies to supply data in standard formats, while helping agencies to revamp their systems.

## **Future Plans**

With experience and expertise gained from the implementation of LandNet system, SLA is now leading a nation wide program to build Singapore Spatial Data Infrastructure (SSDI) with a vision to be a “Spatially Enabled Nation”. Endorsed by the top management of the Civil Service, SSDI program is one of the main pillars for Singapore to achieve an integrated and interoperable government vision.

SSDI will provide a national framework that will govern spatial and non-spatial data sharing and management through a network of data owners and user agencies. It will ensure availability, accessibility, compatibility and consistency of spatial and non-spatial data on a whole-of-government (WOG) approach. This framework would enable fast discovery and use of spatial and non-spatial data and allow growth and development of sophisticated applications, e.g. environmental assessment and management, emergency management, planning of physical infrastructure, environmental health control and surveillance.

Under SSDI, a multi-pronged government wide program is set-out to achieve:

- (a) Excellence in governance, policy, standards of spatial and non spatial data sharing.
- (b) Quick discovery and access to spatial data and non-spatial data through setting up of data Clearinghouse.
- (c) Identification, creation and maintenance of fundamental data layers.
- (d) Linking other non-spatial data hubs and georeferencing non-spatial data.
- (e) Improve data portfolio by conversion and digitisation of available data.

- (f) Enable high impact new conventional and non conventional applications of spatial data to spur the growth of different vertical sectors
- (g) Build strong technical expertise in management and exploitation of spatial data.

## Summary

Implemented to support “Integrated Government” vision, LandNet spatial data sharing portal has propelled inter-agency sharing of information to the next higher level by providing a real-time data exchange platform. Many new applications and services were spurred by the availability of data and inter-agency connectivity provided by LandNet. With online and real-time map based e-consultation and e-collaboration between government agencies, LandNet has enabled better and faster decision making and strategic planning.

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