FIG SYDNEY 2010

The New Technology of a Survey Data Model and Cadastral Fabric as the Foundation for a Future Land Administration System.

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CONTENTS

THE 'SURVEY DATA MODEL' PROCESS

SURVEY DATABASES / SURVEY DATA MODELS

A Survey Data Model (SDM) is the management of survey measurement data.

Consideration is given to:

- Survey rules to define cadastral outcomes
- measurement quality

THE 'SURVEY DATA MODEL' PROCESS

GIS CADASTRAL DATABASES

- The real world cadastre is defined by monuments, measurements and spatial (survey) standards.
- The cadastral layer represents the real world cadastre
- Surveying solutions provide spatial accuracy through:
  - Geodetic control
  - Survey measurements
- A more accurate cadastral layer will provide more efficiencies in line with the CORS program.

THE 'SURVEY DATA MODEL' PROCESS

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THE 'SURVEY DATA MODEL' PROCESS

THE CADASTRAL FABRIC

Cadastral shapes (parcels) are defined using the survey data model.

This creates continuous 'fabric' with no overlaps or gaps that model the real world cadastre.

SURVEY DATA MODEL (SDM) PROCESSES

Three stages that each have rigourous checking features if required:

1. PARCEL & SURVEY DATA ENTRY
2. PARCEL JOINING
3. ADJUSTMENT

SURVEY DATA MODEL (SDM) PROCESSES

1. PARCEL & SURVEY DATA ENTRY
   - I. Manual data entry
   - II. Importing electronic survey data
   - III. Migrating existing cadastral database

SURVEY DATA MODEL (SDM) PROCESSES

1. PARCEL & SURVEY DATA ENTRY

   I. Manual data entry of all survey measurement geometry

      - Highest rigour in spatial and legal outcomes

SURVEY DATA MODEL (SDM) PROCESSES

1. PARCEL & SURVEY DATA ENTRY

   II. Importing electronic survey data from coordinate geometry software.

      - Efficient access to surveyor's survey accurate cadastral definitions

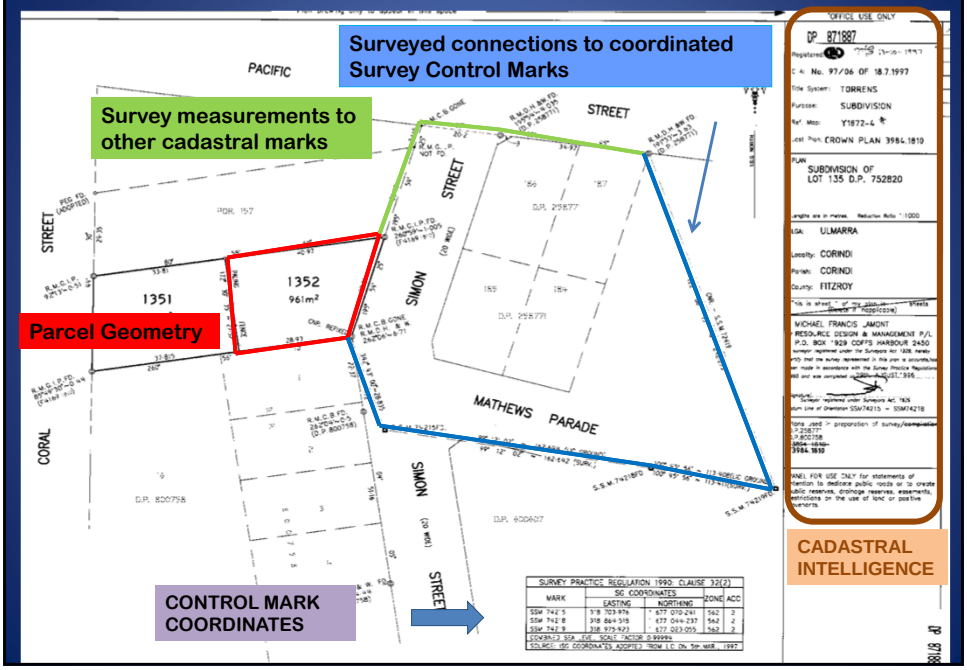
SURVEY DATA MODEL (SDM) PROCESSES

1. PARCEL & SURVEY DATA ENTRY

III. Migrating existing cadastral database

- Quick way to create a fabric by inversing the existing database to generate parcel boundary measurements.
- Many agencies are now finding that in the long term it is more efficient and cost effective to enter all data manually as constant problems occur matching new ‘good ‘ survey data with existing spatially poor database

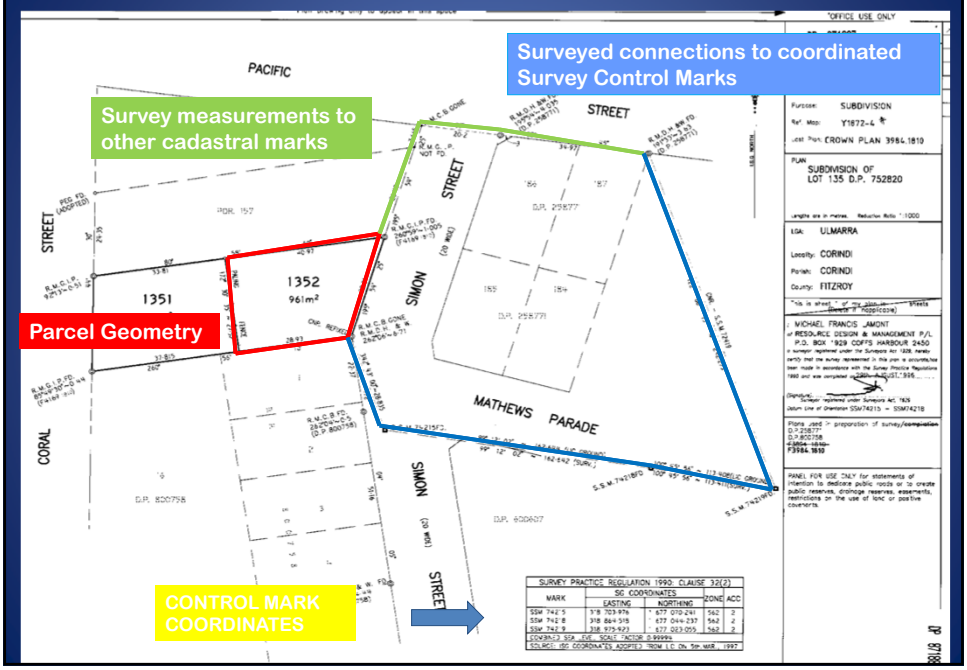
SURVEY PLAN – NSW AUSTRALIA - Complete survey and cadastral intelligence



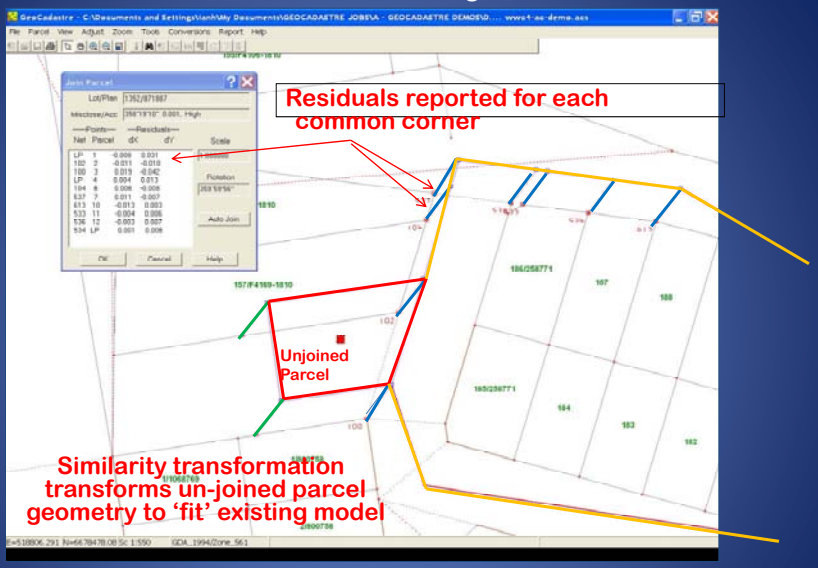
2. PARCEL JOINING

After data entry the parcels are selectively joined to the SDM to force the outcome of a continuous fabric without overlaps or gaps.

MANUAL DATA ENTRY



Parcel Joining



PARCEL JOINING

This process provides another level of data checking by reporting on the quality of the 'fit' of the new survey data into the existing model.

If a quality Parcel Fabric exists, the parcel joining process becomes a tool for checking the integrity of the survey geometry being added

Survey Data Model Cadastral Fabric

The adjustment:

- Adjusts the model measurement vectors between coordinated control points
- reports on the spatial quality of the database
- allow control points to be not held fixed and the model will generate new coordinates to check against the true coordinates to provide independent validation of the spatial precision of the survey geometry model.

Survey Data Model Cadastral Fabric Features

1. Able to import all types of data
   - Accurate field survey data
   - Other survey data – tape measurements etc
   - GPS
   - Geodetic survey control coordinates
   - Electronic survey coordinate geometry data
   - Existing cadastral GIS databases
   - Historical village/provincial hard copy cadastral (charting) maps
   - Existing survey/title records

Survey Data Model Cadastral Fabric Features

2. Retains original title document records
   - **Original parcel/title dimensions are stored as attributes of the parcel – not the coordinates**
   - Important for legal background
   - **Stores the spatial quality of the measurement data as an attribute**

Survey Data Model Cadastral Fabric Features

4. Cadastral editor is a rigorous process with various levels of data checking.

5. Accuracy dependent on quality of data imported
   - If modern survey data is entered, checked and managed in a rigorous process, the expected accuracy urban areas would be 20mm
   - Digitised data retains the original spatial integrity

Survey Data Model Cadastral Fabric Features

9. Adjusting other feature layers:
   - As the cadastral fabric is adjusted, the movements are stored and other layers can be nominated to be adjusted by the same amount as required.

10. Ability to change coordinate zones
   - Cadastre coordinates defined by survey control point coordinates.
   - To change coordinate zones, change the control point coordinates to the new zone and rerun the adjustment.
   - Manages grid & height corrections automatically

Survey Data Model Cadastral Fabric Features

11. Benefits of the Geodatabase
   - Holds the complete cadastral fabric database ranging from a small project to a State or Federal government database.
   - Allows only specified users access to the amend the cadastral fabric.
   - Allows one person at a time to amend a specific 'packet' of cadastral data

Maintenance , management and the adjustment of the cadastral layer is controlled and managed 'in-house'.

The Cadastral Survey Data Fabric Model

DATABASE OUTCOMES – Operations

1. Highest accuracy in cadastral database
2. Efficiency in Cadastral Database Management which flow to the Land Administration
3. The cadastral fabric is created once. The database is then updated as changes occur with spatial improvement with new survey data.

The Cadastral Survey Data Fabric Model

DATABASE OUTCOMES - Flexibility

1. Manages Measurement Based Cadastres.
   - NSW - Australia
2. Manages Coordinated Cadastres.
   - Northern Territory - Australia

The Cadastral Survey Data Fabric Model

DATABASE OUTCOMES

ELECTRONIC PLAN LODGEMENT AND EXAMINATION

Land and Property Information (LPI) of the Land and Property Management Authority (LPMA) has commenced a pilot project using the Survey Data Model process as part of the **ePlan (electronic processing of digital plans) program.**

The aim of the program is to develop an **automated process for the electronic lodgement and examination of survey plans.**

NSW LPMA ePlan Lodgement And Examination Pilot Project

The technical processes:

- Finalisation of a standard LandXML 'recipe' to represent cadastral survey data in an electronic structure which allows the generation of a 'dynamic' model.
- Customisation of the process to electronically represent survey measurement geometry and plan annotations shown on NSW survey plans.

NSW LPMA ePlan Lodgement And Examination Pilot Project

The workflows:

- Web portal lodgement by surveyors – screen rendering will allow the surveyor to verify the data submitted
- Over 40 electronic checks of NSW Statutory plan lodgement requirements can be tested before plan lodgement using an on-line validation tool, with error listing immediately reported back to the surveyor for review.
- After formal lodgement, the survey data is electronically compared with the digital capture of plans referenced by the surveyor , which allows decisions to be made on the level of any further examination.

NSW LPMA ePlan Lodgement And Examination Pilot Project

The technical benefits:

- Many problems in survey plans will be quickly highlighted to surveyor and rectified before final lodgement.
- The process electronically checks many aspects previously undertaken manually by LPMA plan examiners.

NSW LPMA ePlan Lodgement And Examination Pilot Project

The business outcomes for LPMA:

- An expected reduction in the time taken to register survey plans and create new titles at a critical time in projects when the most funding has been expended to complete construction, etc.
- An expected reduction in the level of work required by LPMA plan examination resources. Examiners are recognising benefits and support implementation of the new technology and workflows.
- The gradual accumulation of a database of digital plans in .xml format that can be disseminated to other arms of LPMA, Government and industry.

SURVEY DATA MODEL OUTCOMES FOR SURVEYORS

The SDM has no legal standing but can provide the most accurate model of the cadastre.

For measurement based title definition systems (Torrens) it facilitates the highest use of GPS as a measurement technology.

For coordinated cadastres it facilitates survey measurements being included in the survey data model

SURVEY DATA MODEL OUTCOMES FOR SURVEYORS

If a surveyor builds an SDM for any cadastral job, the process will identify errors in survey plans before any field work.

Using the SDM in the field allows the surveyor to accurately search for cadastral survey marks. When a mark is found, new coordinates are fixed for the mark and the model is readjusted to a higher spatial accuracy for that area.

CADASTRE 2014 – A Vision for a Future cadastral System

A document prepared by FIG Commission 7 following XX FIG Congress in Melbourne 1994 to identify guidelines for the definition of Cadastre in 2014.

CADASTRE 2014 – A Vision for a Future cadastral System

Defines the relationship between people, real world property objects and rights and the effect of the future role of technology

THE 6 STATEMENTS OF CADASTRE 2014

Statement 1 – Cadastre 2014 will show the complete legal situation of land.

Statement 2 – The separation between 'maps' and 'registers' will be abolished.

Statement 3 – Cadastral mapping will be dead! Long live modelling.

Statement 4 – 'Paper and pencil' cadastre will have gone.

Statement 5 – Cadastre 2014 will be highly privatised! Public and private sector are working closely together!

Statement 6 – Cadastre 2014 will be cost recovering!

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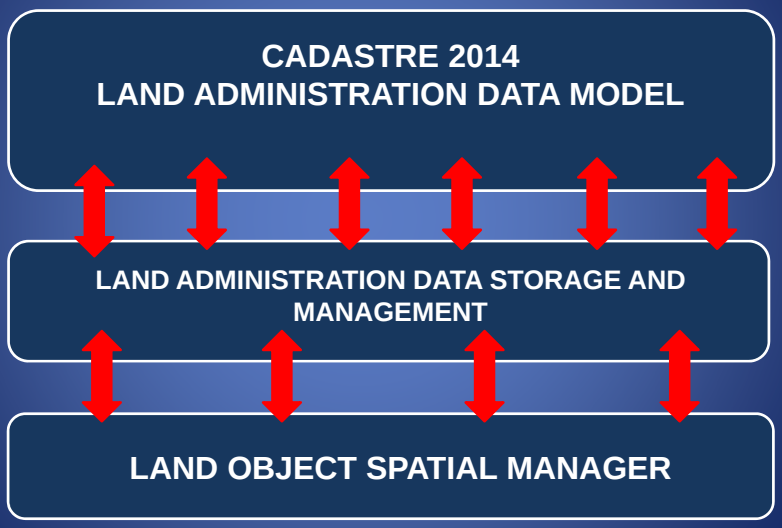
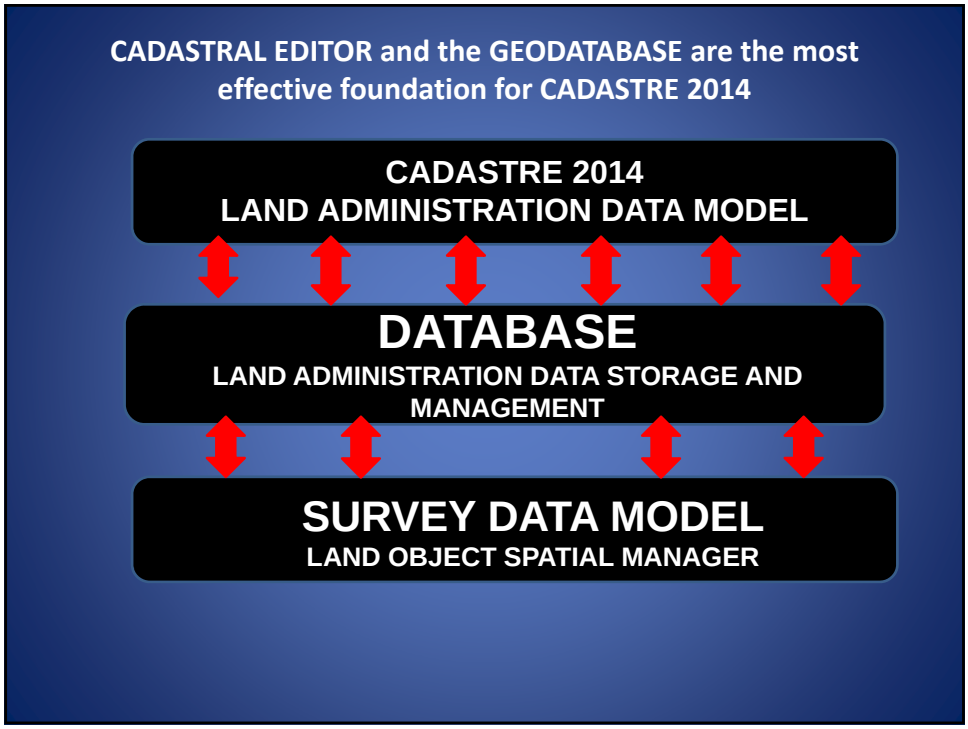
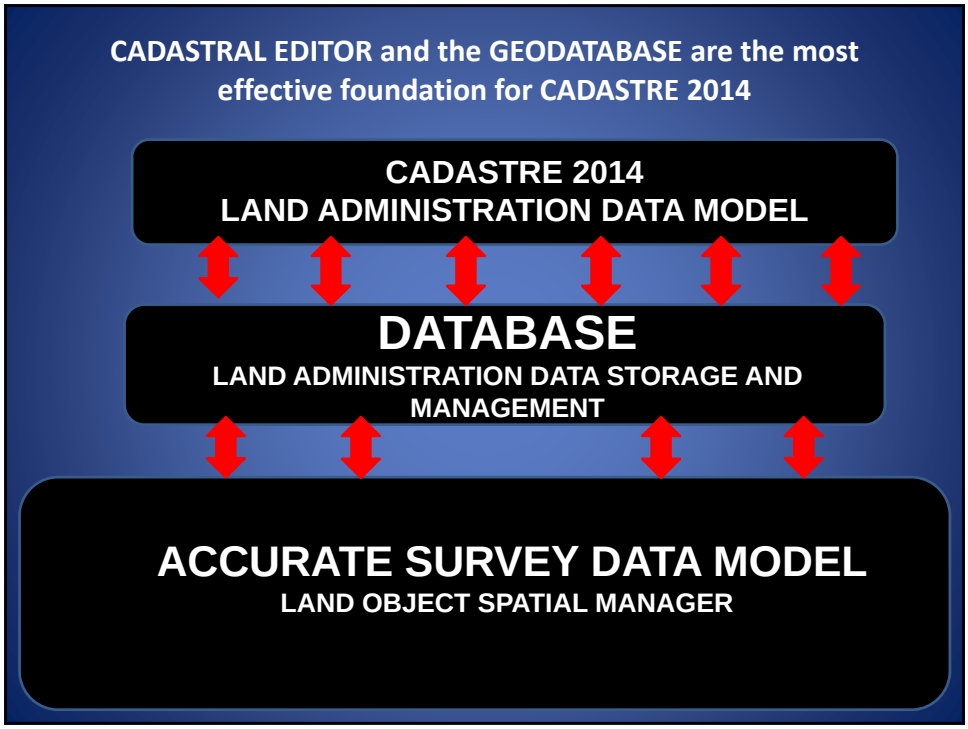
The Supporting Structure for CADASTRE 2014




CADASTRAL EDITOR and the GEODATABASE are the most effective foundation for CADASTRE 2014
CADASTRE 2014
LAND ADMINISTRATION DATA MODEL
DATABASE
LAND ADMINISTRATION DATA STORAGE AND MANAGEMENT
SURVEY DATA MODEL
LAND OBJECT SPATIAL MANAGER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ACCURATE SURVEY DATA MODEL
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MAPASIA GIS CONFERENCE

AUGUST 2008

Plenary Speakers – The Future

'Cadastre is the core of SDI'

(Prof Ian Williamson-Dept of Geomatics, University of Melbourne)

'Accuracy is a future issue technology must address and only RIGOROUS TOOLS ENSURE FIDELITY'

(Kaushik Chakraborty-Vice President-Asia Pacific, Leica Geosystems - Geospatial Imaging, India)

'Redundancy is a key factor in automation'

(Alexander Wiechert - Business Director, Microsoft Photogrammetry, Managing Director, Vexcel Imaging GmbH, Austria)

ACCURACY IN THE CADASTRE - BUILDING THE CAPACITY

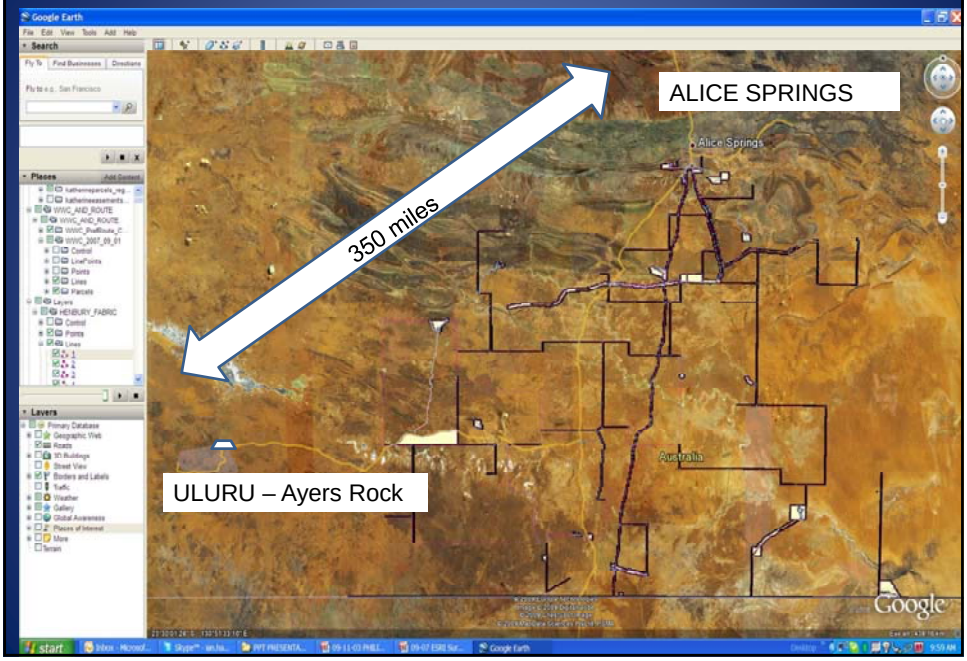
CASE STUDY

NORTHERN TERRITORY – Legislation enacted for survey definition of title by coordinates

NORTHERN TERRITORY

- GPS is now the most efficient means of survey measurement in remote parts of NT.
- Large Pastoral Leases are already defined by Latitude & Longitude (ie Geodetic references)
- An SDM has been completed in urban areas and is being extended into the remote areas defined by large Pastoral Leases.
- Legislation for legal coordinates for Title boundary definition in proclaimed areas enacted in 2004.

NORTHERN TERRITORY – Pastoral lease cadastral model



NORTHERN TERRITORY

OUTCOMES

Technology has provided the NT a way of moving from a measurement based title definition system to a position based title definition system.

To peg the parcel corners of one 80 km outback pastoral lease boundary:

- Traversing – 3-4 weeks
- GPS - 1 day

CASE STUDY

RICHMOND LINE UPGRADE – A cadastral fabric completed for a 10 km urban rail corridor

NSW TRANSPORT INFRASTRUCTURE DEVELOPMENT CORPORATION

RICHMOND RAIL PROJECT

Upgrade of 10km of an existing single line that serviced areas identified as a major growth centre for Sydney's future.

Undertaken by the NSW Government authority – the Transport Infrastructure Development Corporation (TIDC).

For the planning and design stage, the project needed a survey accurate cadastral model of the route.

It was also preferred for political reasons that this was done initially with a minimum of survey field work.

TIDC SURVEY DATA MODEL

JOB STATISTICS

10 kms

4000 Parcels

92 Existing coordinated Geodetic Control Points connected to the cadastre

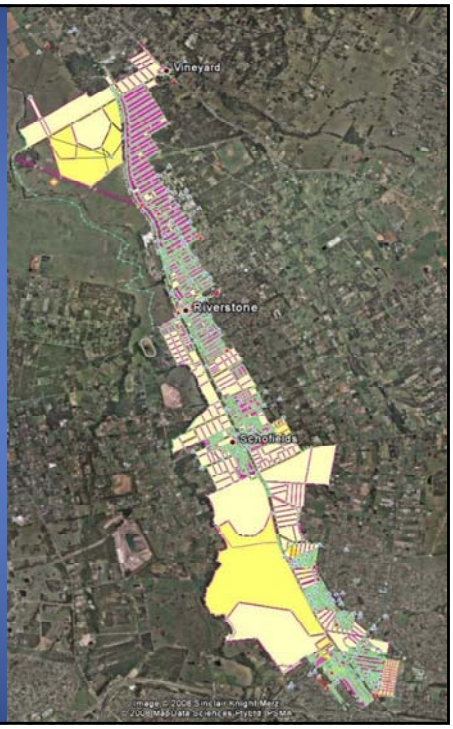
ADJUSTMENT OVERVIEW

16 Control Points held fixed

76 Control Points 'inactive'

REPORT ON INACTIVE CONTROL PT PRECISION

Accuracy Range	No. of Inactive Control Pts	%
0 - 50mm	25	33
50 – 150mm	26	34
150 - 250mm	15	20
>250mm	10	13



RICHMOND RAIL PROJECT

OUTCOMES

The spatial accuracy of the final TIDC model is in the order of 30mm – 100mm in urban areas and 100mm-200mm in rural or areas of older survey plans

The project field survey time was reduced from 4 - 6 weeks to 2 days.

The project now has a survey accurate cadastral database with property attributes to underpin the project GIS database for ongoing design, construction & asset management.

ACKNOWLEDGEMENTS

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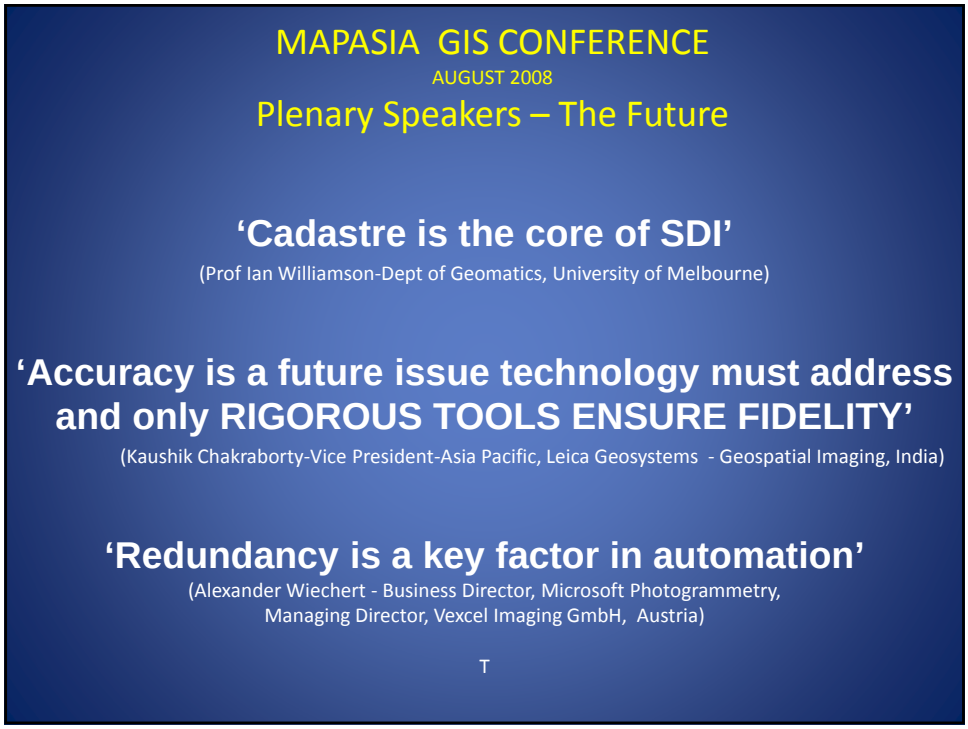
Gary West	*Surveyor General – Northern Territory*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