DEVELOPMENT OF A ROAD ASSET REGISTER USING DIGITAL VIDEO TECHNOLOGY – DUNGOG SHIRE COUNCIL

Matt Ryeland, mailto:matthew.ryeland@cardno.com.au

Senior Technical Officer, Management Services. Cardno

Terry Wilson, mailto:terryw@dungog.nsw.gov.au

Design and Assets/Development Engineer. Dungog Shire Council

Greg McDonald, gregm@dungog.nsw.gov.au

Executive Manager – Infrastructure and Assets, Dungog Shire Council

This is one of a series of case studies being published by NAMS.AU as a resource to assist asset management practitioners. The contribution of these case studies by our NAMS.AU Consultant Supporters is gratefully acknowledged.

Abstract

Using Dungog Shire as a case study, this paper will demonstrate how the DRIVE (Digital Road Inventory Video Environment) system of data acquisition for road networks can be used to create a functional, practical, user friendly road asset data capture and management system.

Using digital video technologies a GIS based road network register was developed with basic condition rating data and a register of road side assets including signs, crash barriers, culverts, drainage and kerbing. Dungog Shire now has a permanent geo-referenced video record of their road network that can be viewed in conjunction with the asset data utilising the DRIVE II software that operates within MapInfo.

Previous Local Government clients have also identified a number of additional benefits from using DRIVE system including valuations of the road network and associated road side assets, as well as materials estimates by measuring quantities directly from the video data.

Utilising the DRIVE data capture and management system the road network and associated assets can be presented as:

- Visual – easy to see where assets are.
- Spatial – assets shown in actual locations
- Text – easy to read tabular formats
- Auditable – record of who, when and why for asset data and the video is a permanent record of what was captured for condition assessment of the network and assets captured
- Condition – video shows record of condition at time of survey for the road network.

Introduction

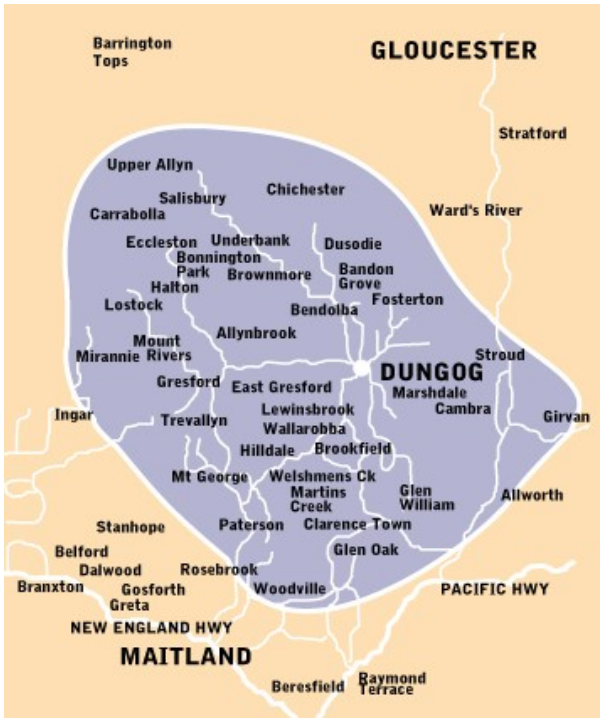
Dungog Shire is in the Hunter Region of NSW within 2.5 hours easy drive of Sydney and is renowned for its forests, mountains and picturesque river villages.

Dungog Shire covers an area of 2248 sq kilometres. It is bordered in the north by the Barrington Tops plateau, which is part of the Great Dividing Range. The Shire consists predominantly of very rugged to hilly country which becomes less rugged from north to south.

The Shire's economy has traditionally been based on agriculture and timber, with the alluvial river flats suitable for intensive agricultural production. The balance of the rural land has been traditionally used for grazing. Tourism is also a focus of Dungog Shire's economy with the National Parks, State Forests, Chichester Dam and the river systems as well as the historic and scenic character of the area providing the major focus for attracting visitors.

The major population centres within the Shire include:

- Dungog
- Gresford
- Paterson
- Vacy
- Martins Creek
- Clarence Town



Dungog Shire has a road network of approximately 1000km, of which 700km are sealed roads and the remainder unsealed.

To assist in the prioritisation of their works programme, Dungog Shire chose the DRIVE system of data collection and management as developed by Cardno.

DRIVE – Digital Road Inventory Video Environment – links digital video footage with a global positioning system to give road authorities a metre-by-metre view and analysis of their pavement condition and on-road and off-road assets utilising MapInfo.

DRIVE can collect record and assess the condition of roadways, pavements, traffic signs and signals, parking systems, pavement and kerb markings, streetlights, parks and trees, bus stops and street furniture.

In choosing DRIVE, Dungog Shire was able to:

- Audit and update their existing road register and create a database of the road network based on the requirements of the Queensland Road Alliance Minimum Dataset for condition reporting of roads.

- Have a condition survey of the road network completed using the collected video data to identify local surface defects such as potholes, patching, edge failures and severe cracking.
- A register of roadside assets created that includes kerb and guttering, road signs and drainage features throughout the Shire;and
- A video record of the survey undertaken showing all roads and associated roadside assets.

The Dungog Shire DRIVE project was split into three phases:

- Field Data Capture and processing;
- Inventory and Condition data collection from digital video data; and
- Delivery and installation of DRIVE II with collected condition, inventory and video data.

Field Data Capture and Processing

The field survey was completed using one of Cardno's DRIVE survey vehicles. For the Dungog survey Cardno used its WA based two camera system to video the complete Dungog Shire road network.

Western Australian Video Survey Vehicle used for Dungog Shire Survey

The cameras were mounted to collect a field of view of approximately 120°. A still picture is captured by each camera every 4m as the vehicle travels along the road network. Also, a differentially corrected GPS reading is taken every second to locate the vehicle to an accuracy of approximately 1m. Data files for both the video and GPS data are recorded with a time stamp from a PC so that the two data sources can be compared to calculate the location of the cameras for any given video frame recorded.

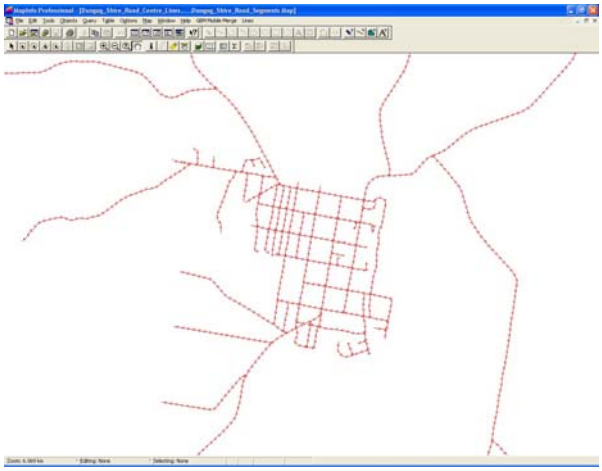
The road survey was undertaken as a single person operation. A notebook computer in the vehicle cabin allowed the driver to monitor the operation of the data recording, as well as monitor the progress of the survey by continual GPS tracking of the roads driven.

The survey vehicle can survey up to 300km of road per day, depending on conditions and the roads to be surveyed. The speed of the survey is dictated by the road conditions and statutory speed limits. The vehicle can record data at speeds in excess of 100km/h.

In the office the data gathered by the survey vehicle was processed into useable MapInfo and Video formats using software developed by Cardno.

The GPS data recorded was processed to create MapInfo files that show the route of the survey vehicle. When available, cadastral data, road centreline data and even aerial photographs can be used to compare road locations supplied by the client and the actual road locations as surveyed.

Because of the rugged nature of the terrain and being heavily treed in the north of Dungog Shire limiting visibility to the GPS satellites from the vehicle there were some problems with the GPS recording accurate locations of the vehicle. In using existing road and cadastral data supplied by Dungog Shire the GPS tracks and road centrelines were able to be manually corrected for location.



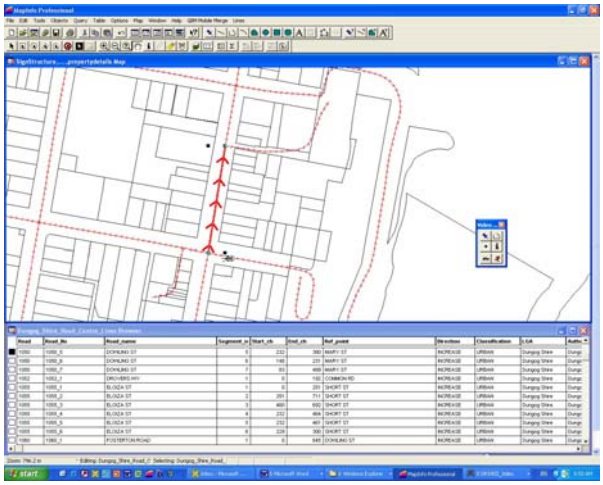
Road centrelines from video survey data

The mpeg video files recorded in the field were compressed and converted to avi files. The avi files were also coordinated spatially with the MapInfo video tracks to show the location of each video frame.

The avi files were processed and calibrated so that each pixel within each individual video frame could be spatially located within MapInfo. This allows the operator to locate segmentation points, measure road widths, locate local surface defects and roadside assets.

Inventory and Condition Data Collection from Digital Video Data

After the video and GPS data was processed, MapInfo tables showing the vehicle tracks were written. Based on these tracks and any existing road register data, centrelines for the road network are created. The centrelines were segmented at each intersection and any required data attached to the tables.



Centreline and associated road data

The segmentation table of the road network was created by "driving" the road network using DRIVE II. The road network is segmented at:

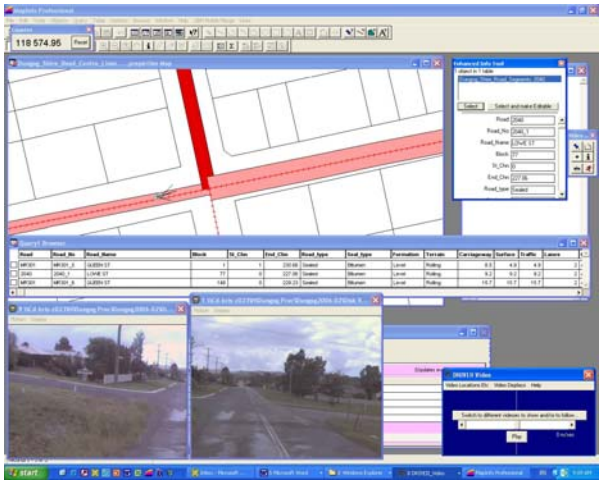
- Changes of Seal;
- Change in Formation;
- Changes in Width;
- Intersections;
- Length – generally maximum of 2km;
- Railway Crossings, Cattle Grids, Gates, etc

Road widths were measured from the video data at approximately half way along the segment. For sealed roads this includes the carriageway, surface and trafficable widths, whilst for unsealed roads only the carriageway width is measured.

Along with the width of a segment the following data were also recorded in the segment table:

- Road type – Unformed, Formed, Sealed, Floodway, Bridge, etc;
- Seal Type – Unsealed, Bitumen, Asphalt, Concrete, etc;
- Terrain – Level, Flat, Mountainous;
- Formation – Above, Below or Level with natural surface;
- Carriageway Width – Sealed and Unsealed roads;
- Surface Width – Sealed only;
- Trafficable Width – Sealed Only;
- Number of Lanes – Sealed Only;

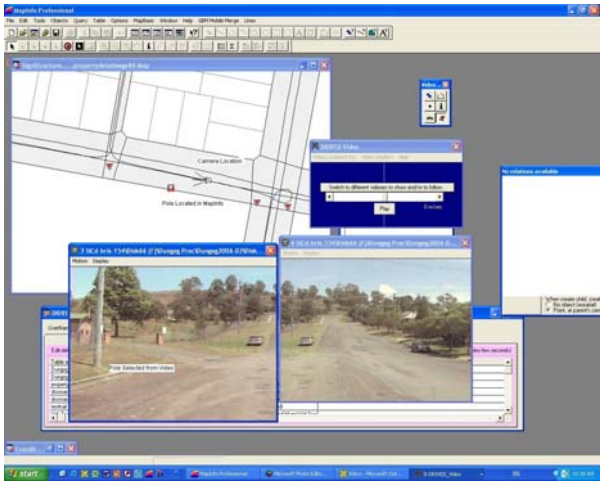
- Carriageway Type – Single, Dual, Parking on left, right or middle. Sealed Only;
- Driveability Rating – Unsealed Only; and
- Profile Rating – Unsealed Only



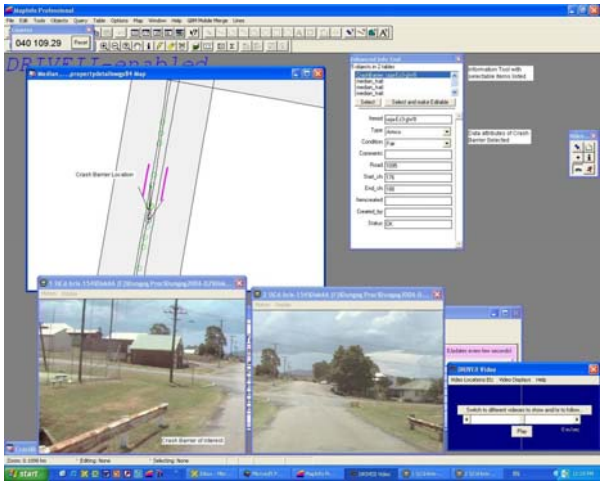
Road Segments table and video data

Similarly, the inventory data tables were created by driving the network and entering the asset data as it seen by the operator. Both point and linear assets were spatially located in MapInfo directly from the video image. The asset data was entered directly into the MapInfo tables by means of an enhanced data entry system in DRIVE II that allows for the use of drop down menus to standardise and speed up data entry, as well as the automatic calculation of location chainage for the asset.

Inventory data was entered into separate data tables for each asset type or one table for all asset items. The data collected for each asset item was customised to suit the requirements of Dungog Shire and included visual condition rating from the video data.



Locating point asset from video



Locating Linear Asset from video and Data Entry tool

Delivery and Installation of DRIVE

Dungog Council staff, in consultation with Cardno staff, were able to develop a scope of works that met Council's budget and allowed Council to implement a road asset management system that captured asset information on its entire maintained road network (both sealed and unsealed)

The provision of spatial data and video data that was linked to Council's already installed GIS (MapInfo) was an attractive feature. Once the scope of works was identified, Council engaged Cardno to undertake the work.

The video data, DRIVE II software, road and inventory tables were supplied to Dungog Shire on a single hard disk drive connected to

a PC via a USB connection. Once the data has been installed onto a PC or server the supplied HDD can be kept as a backup of the supplied data to the client. Cardno also kept a copy of the supplied data on tape at their Brisbane office allowing for easy restoration of the system should there be any loss or corruption of data.

The subsequent delivery and installation of DRIVE ll was relatively smooth. The installation of DRIVE ll also included providing Council staff with basic training of the system and the ability to interrogate the system to present basic reports leading to more complex reports when staff become more familiar with the system.

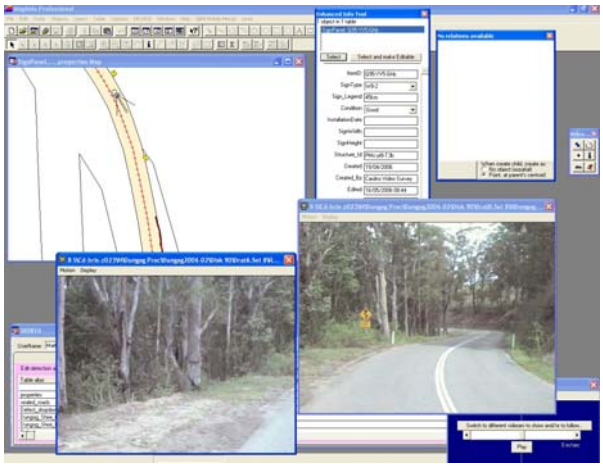
At the same time as the software installation, DRIVE II was also customised for Dungog Council requirements, including setting up workspaces for specific asset groupings, automatic updating of asset item locations and chainages for new or edited inventory data.

How Dungog Shire is Using DRIVE

Initially the data was utilised to provide Council with a snapshot of its road data and its present condition. Using road lengths, condition rating and unit rates for repair, replacement and maintenance a simple first assessment has been undertaken to determine Council's asset replacement program and to also assist Council in lobbying state government for a rate increase. This will be developed in more detail as staff resources allow.

Council will be utilising Drive ll for projected budget costs and future long term maintenance programs. It will be used thoroughly during the preparation of Council's Roads Asset Management plans which are scheduled to be completed in 2007.

In addition to engineering and asset maintenance issues, the video has provided Council with the ability to undertake preliminary development application assessments particularly in relation to provision of adequate sight distances provided at intersections and proposed driveway locations. By being able to see the video, the operator can check where sight distance is available and then measure the distance while 'travelling' the road to that point. This has provided a useful desktop planning tool that doesn't eliminate the need for field checking but can certainly make the process quicker by eliminating some of the field assessment.



Example of line of site along road

One clear benefit of the system is the provision of images of every component on Council's road network. This allows staff to refresh their knowledge of a particular location without the need to visit the site

Benefits for Dungog Shire in Using DRIVE

Benefits to date include

- It provides Dungog Shire with an extensive database of images that can be copied to reports, emailed to other staff, councillors and the public;
- It provides Council staff with the benefit of being able to accurately measure between two known points on the video image and also measure offsets from the road to roadside hazards;
- Having video imaging available allows Council staff to view images to collect other asset information such as water

hydrant locations within the road, power poles, street lights etc; and

- It also provides Council's planners with an image of the front of every property that fronts a public road, providing information on house locations, driveway locations, current facades on buildings etc.

Conclusion

Over the short time Dungog Shire have had the system available to us (approximately 2 months as at the time of writing) we have utilised the information to view dangerous road locations as reported by the public, analyse asset information for the network, undertake planning assessments, assist with blackspot funding applications and provide staff with a preliminary 'health report' of its road network.

DRIVE provides Council with a snapshot of its entire road network to provide a quick assessment of road conditions and its surrounding environment. This consequently also eliminates possible site inspections that would take up staff time. Having all this information available under an electronic data and video register allows Council to make more efficient use of its very limited resources.

Author

Matt Ryeland is a Senior Technical Officer in Cardno's Management Services Business Unit. Matt currently specialises in field data collection solutions using various technologies including the DRIVE system and the IKE data collection tool, a combined camera LDM and PDA in one unit.

Matt has been involved with DRIVE for the past 2½ years completing projects for Blue Mountains City Council, Livingstone Shire, Mundubbera Shire, Darwin City Council, Interlink Roads, Brisbane City Council and Dungog Shire.

Matt also works in other areas of asset management including water and wastewater condition and valuation projects for various local governments throughout Queensland.

Matt also has extensive experience in construction of telecommunications infrastructure through out SE Asia, and extensive experience in the water/ wastewater industry with Sydney Water.

Greg McDonald is the Executive Manager – Infrastructure and Assets at Dungog Shire Council. Greg and his staff are responsible for all engineering aspects within Council, including roads; bridges; stormwater; water and sewer; design, construction and maintenance of all Council's infrastructure; GIS; land development; parks, sportsgrounds and reserves; and Council buildings.