

# **Positioning Infrastructure Used for a Sustainable Future: Case Study from Victoria Australia**

**James Millner, Martin Hale, Jacqueline LeLievre, Hayden Asmussen and John Gallagher, Australia**

**Key words:** Positioning

## **SUMMARY**

Global Navigation Satellite System (GNSS) Continuously Operating Reference Station (CORS) are now accepted as a part of the fundamental infrastructure for the spatial sciences. The challenge is to ensure that real time CORS networks reach new audiences and deliver services that ensure a sustainable future. Victoria's cooperative CORS network: Vicmap Position – GPSnet operated by Department of Sustainability and Environment will be expanded to increase coverage, capability and reliability. To capture a broad selection of users and support commercial applications, Vicmap Position has a robust design and efficient management model. This presentation highlights CORS Management in Victoria and discusses the economic and environmental benefits to agriculture, mining and construction industries using Controlled Traffic Farming as case example.

Authors do not submit full paper, but uses video in their presentation in stead.

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FIG Sydney 2010

Department of  
Sustainability and  
Environment

*Positioning Infrastructure used for a Sustainable Future:  
Case study from Victoria, Australia.*

# Sustainable agricultural communities



James Millner, Martin Hale, Jacqueline LeLievre,  
Hayden Asmussen and John Gallagher



## Introduction – Department of Sustainability and Environment

The Department of Sustainability and Environment (DSE) is Victoria's  
lead government agency for:

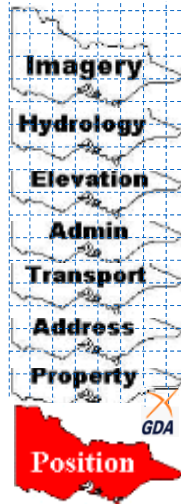
- Sustainable management of water resources
- Climate change
- Bushfires
- Public land, and
- Forests & ecosystems



Positioning Infrastructure used for a Sustainable Future:  
Case study from Victoria, Australia.



## Victoria's Spatial Data Infrastructure



Spatial Information Infrastructure Division of DSE

- Positioning Policy - Endorsed by Victorian Spatial Council
- *Maximise the environmental, economic and social benefits of positioning*
- Products & Services: Vicmap Position – GPSnet™
- *Achieve broad positioning take up across Victoria, particularly in agriculture*



## Vision and Objectives

*Our policy has been governed by clear objectives and principles*

### Our vision for Vicmap Position – GPSnet™

Spatial Information Infrastructure will develop and manage a world-class, high accuracy positioning utility that delivers significant economic, environmental and social value to the State of Victoria

### In addition to enabling this broad vision, we have 5 specific objectives:

1. Accelerate GNSS precise positioning adoption where the economic and environmental benefits to the State are substantial, particularly in agriculture
2. Cooperate/partner with the private sector to minimise duplication of infrastructure within Victoria and reduce cost and risk to Government
3. Promote open standards and deliver solutions that can be integrated with multiple brands and products
4. Secure sufficient annual revenue to cover operating costs and create a sustainable service, including maintaining service levels and functionality so that solutions remain competitive in the longer term
5. Ensure products are available and affordable to Government and other non-commercial beneficiaries, e.g. for emergency services, environment management, and social wellbeing particularly regional community development



## Productive, Competitive and Sustainable



Benefits identified for:

- Agriculture
- Construction
- Mining



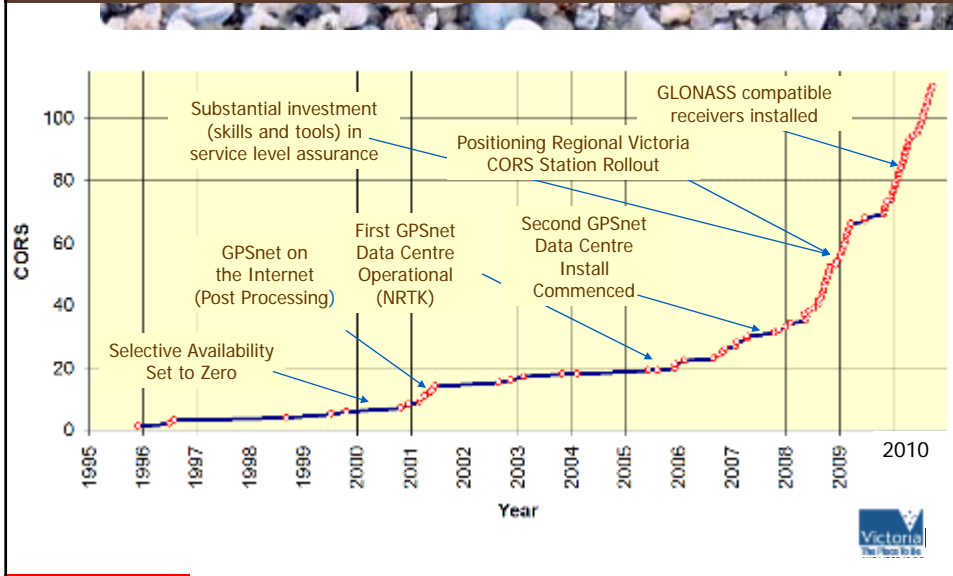
## Facing the Challenges:

### *Network growth*

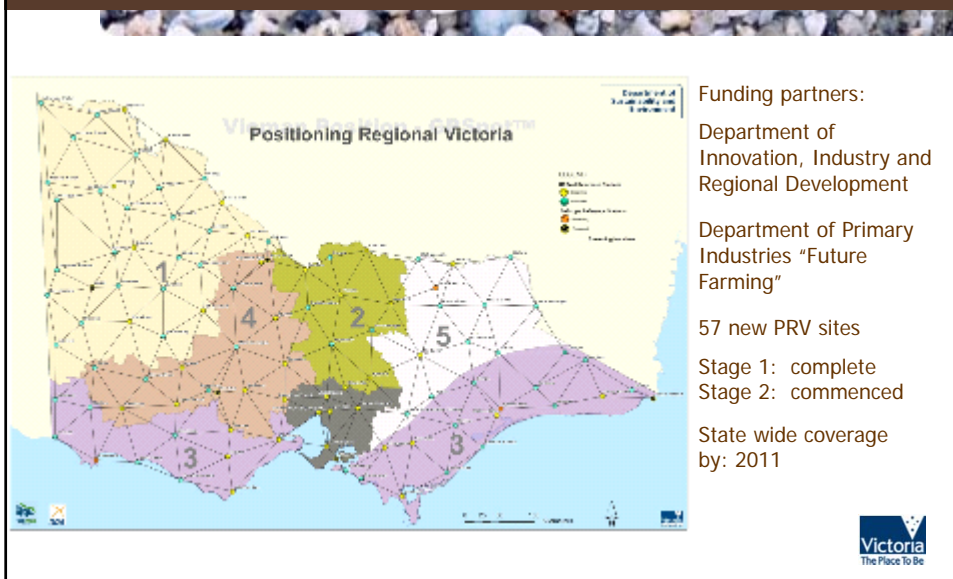
- Background to Victoria's CORS network expansion
  - Since 1996 DSE has coordinated and facilitated the development of Vicmap Position-GPSnet in cooperation with industry, all levels of government, academia and the community
  - GPSnet™ is a network of Continuously Operating Reference Station (CORS) that provides state-wide GNSS satellite position correction data to users
- Prior to the Future Farming initiated Positioning Regional Victoria (PRV) program in 2007/8 Vicmap Position-GPSnet had 34 CORS operating across Victoria, largely for the surveying and construction industries



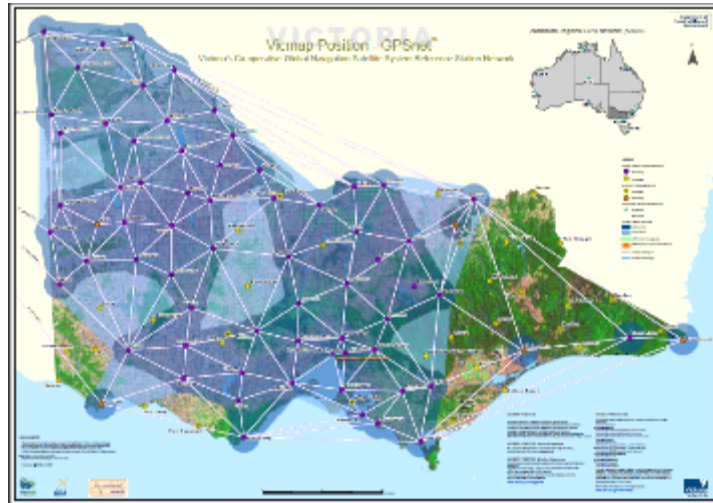
## Growth of Victoria's CORS network



## Positioning Regional Victoria Project

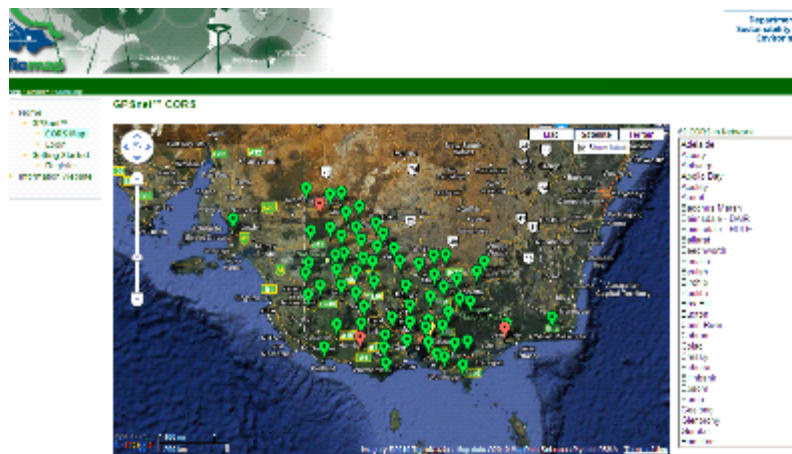


## Current Status > 50% Complete



## Current Status: 69 CORS on line

<http://gnss.vicpos.com.au>



## Positioning benefits extending to agriculture

- Environmental benefits
  - better water use efficiency
  - improved off site water quality
  - reduced soil erosion and
  - reduced carbon emissions
- Economic benefits
  - reduced input costs
  - improved productivity
  - higher yields
- Quality of life
  - improved occupational health and safety
  - less stress
  - prosperous community



## Economic Benefits of Controlled Traffic Farming: Yield Increase – 10%

### *Yield Increase*

Source	Estimates
Tullberg (1997)	22.8% increase over three years (wheat) 5% increase over three years (Sorghum) 14.9% increase over three years (maize)
Grant (1998)	30% to 50% increase
Ball (1998)	30% to 50% increase
Krampl (1998)	15% increase
Tullberg, Ziebarth, and Li (2001)	14% increase
Rohde and Yule (2003)	22% increase
Li et. al (1998)	27% increase
Gaffney and Wilson (2003)	15% increase



Economic Benefit of Controlled Traffic Farming:  
Input Cost Savings – 15%

*Input cost savings*

Item	Source	Estimate
Insecticide use <b>Save 33%</b>	Brownhill (1998)	33 per cent reduction due to reduced overlapping
Labour costs <b>Save 28 - 50%</b>	Mason et. al (1995)	28 per cent to nearly 50 per cent reduction with zero tillage
Seed, spray and labour <b>Save 15%</b>	Birch (1999)	15 per cent reduction
Labour and fuel <b>Save 25 – 33%</b>	Krampl (1998)	25% reduction in labour cost and 33 % reduction in fuel costs
Machinery investment <b>Save 25%</b>	Mason et. al (1995)	25 per cent reduction in capital investment



Business Case to Expand CORS Network  
to Rural Victoria – \$418 million benefit

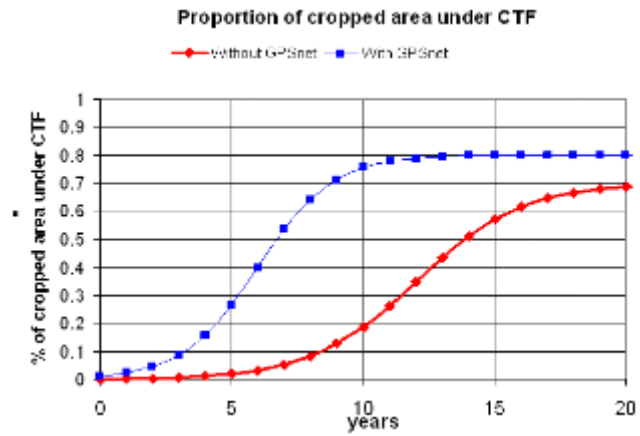
- Benefit to Victoria **\$418m**
- Annualised benefit of **\$36m**
- Reductions in Carbon dioxide at **\$15m**
- The estimated financial benefit for the national agriculture industry is:  
**between \$1 billion and \$1.4 billion annually**





## Facing the Challenges:

### Facilitate innovation uptake in agriculture



## What is Controlled Traffic Farming?



*Dr. Don Yule Control Traffic Farming Solutions*

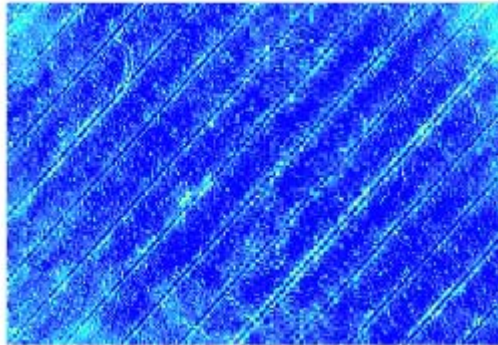
For all Crops



## What is Controlled Traffic Farming?



*Dr. Don Yule Control Traffic Farming Solutions*



*CTF defines the spatial footprint*

*Farmers need only to stay on track!*

*CTF with spatial technologies will contribute more to cropping productivity than all other technologies*



## What is Controlled Traffic Farming?



*Dr. Don Yule Control Traffic Farming Solutions*

*Controlled traffic makes no-till easy and optimises soil surface management*



# What is Controlled Traffic Farming?



*Dr. Don Yule Control Traffic Farming Solutions*

**Community: CTF offers a future, a clear path for progress**



Ewen Peel, Inverleigh



Andrew Weidemann, President VFF



K Penfold, Coretext



# Progress: Stage 1 sites and hosts

- 23 new CORS built, installed and now operational
- Site hosting agreements negotiated and signed with
  - CFA
  - Parks Victoria
  - Councils
  - Farmers
  - Water authorities
  - Community and land care groups



Town	Host
Apsley	CFA
Arwings	Water Authority
Bairdip	Local Council
Bocine	Community Hall
Cobuna	Local Council
Glenorchy	CFA
Gardke	Post Office
Hatch-Kulkyne National Park	Parks Victoria
Lalbert	CFA
Lindsay Point	Private land/business
Manya North	Farmer
Merrinac North	Farmer
Mitsack	CFA
Murrayville	Community Facility
Serviceeton	CFA
Patchewollock	CFA
Piangil	Water Authority
Rainbow	Water Authority
Sea Lake	Private land/business
Telopea Downs	Farmer
Underbool	Water Authority
Wycheproof	Local Council
Yarram South	Farmer



## Benefits of Controlled Traffic Farming



*Dr. Don Yule Control Traffic Farming Solutions*

Recent study by Bowman (2008):

### Environmental

- Soil erosion reduced by: **90%** - 195,000 tonnes/year
- Diesel reduced by: **60%** - 338,000 to 130,000 L/yr
- Nitrogen reduced by: **90%** - 119 to 9 t
- Carbon dioxide reduction: **70%** - 1,199 to 373 t



### Labour

- Labour reduced by: **60%** - 4,590 to 1,744 hours

### Costs

- Annual income increase: **+44%**
- Gross Margin: **+68%**



## Engagement with the agricultural community

- Start with the users.. researchers, young professional farmers and community land care groups
- What do these users expect from a CORS network?



## Facing the Challenges:

### *What do agricultural users expect from a CORS network?*

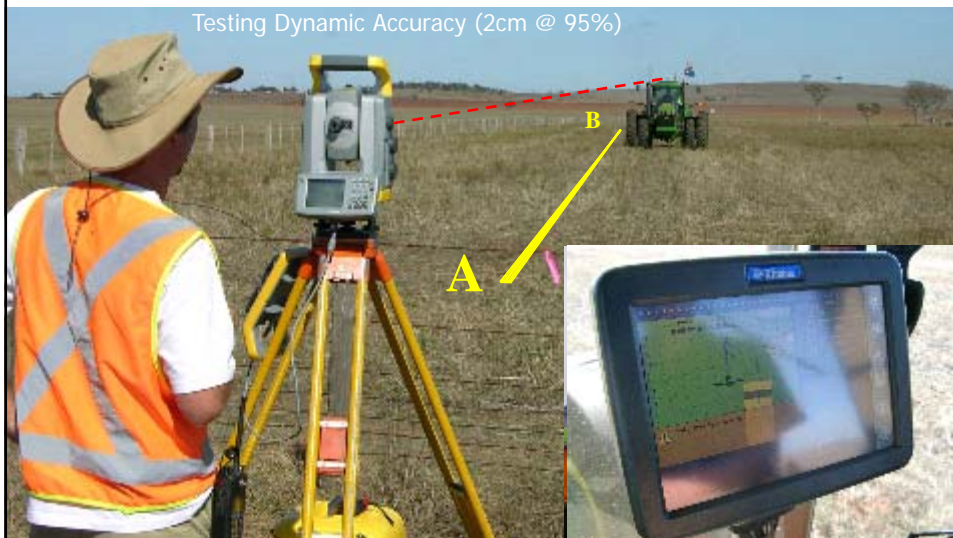
- Accurate, (2cm @ 95%)
- Reliable, (consistent: row by row, day by day and year by year!)
- Continuous, (available 99.9% of the time, government backed)



## Building the Capacity

Department of  
Sustainability and  
Environment

Testing Dynamic Accuracy (2cm @ 95%)



## After 3 days of continual measurements...

Department of  
Sustainability and  
Environment

Testing Automatic Machine Guidance on a tractor (Balliang, Vic 2007)



## Building the Capacity

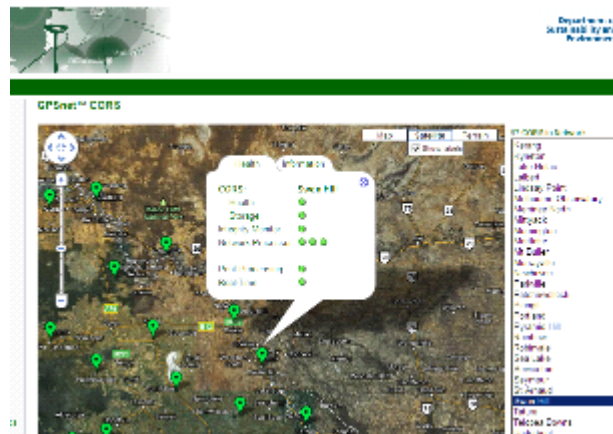
Reliability and Continuity – CORS Network Operations



Victoria  
The Place To Be

## Building the Capacity

### Reliability and Continuity – Quality CORS sites

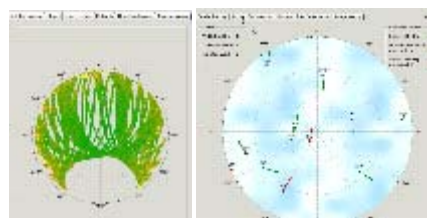


## Building the Capacity

### Reliability and Continuity – Quality CORS sites



- Satellite tracking:
- Clear view of sky
- All satellites are available
- No inference, minimal multipath



GPSnet Buxton – bush fire recovery operation

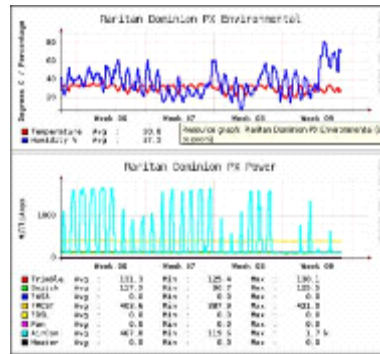


# Building the Capacity

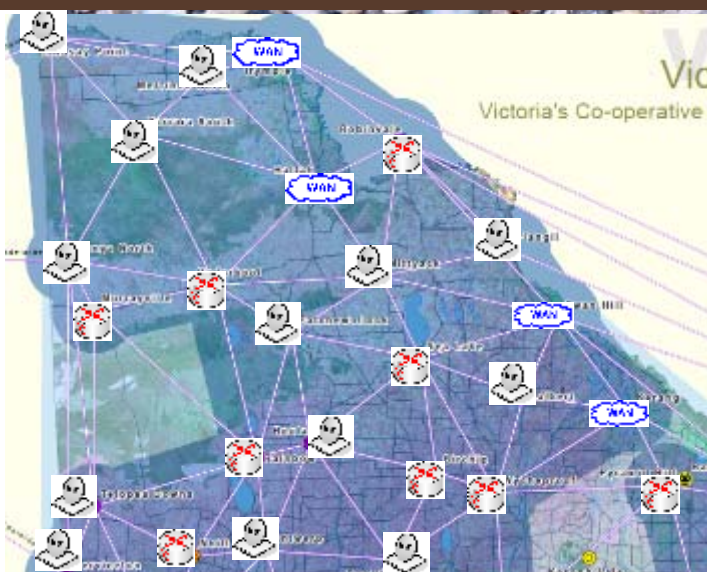
## Reliability and Continuity – Availability CORS sites



- DC Power Supplies  
Hi Temp 24V DC supplies are used to supply the GPS Rx, VSAT modem and switch. The supplies are housed in a custom built 2RU case
- Temperature & Humidity Sensor  
Sensor fixed to inside of rail
- UPS
- GNSS Receiver
- User Interface  
Local users to patch laptop into this point rather than tamper with e-switch
- Raritan PDU
- Cable Minder  
Management panel to contain excess data cables
- Switch
- VSAT Modem
- Batteries  
Batteries are a 72V string with 3 at front of cabinet and 3 at rear



# Building the Capacity: Communications



Vic Gov DSE/DPI  
Wide Area Network

WAN 4

Optus  
Digital Subscriber Line

9

NewSat  
Satellite VSAT

12

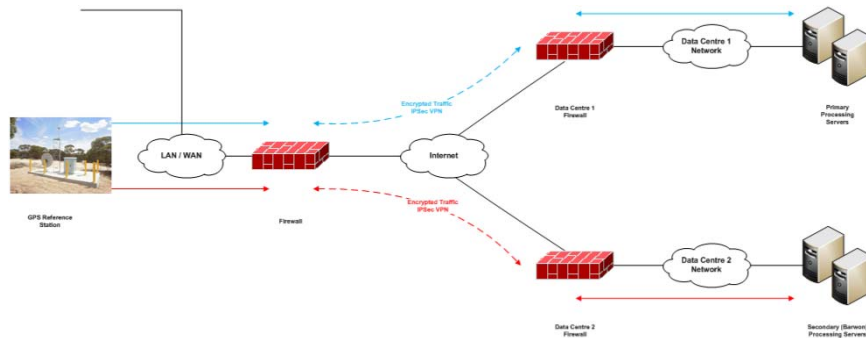




# Building the Capacity



## Reliability and Continuity – Availability CORS sites

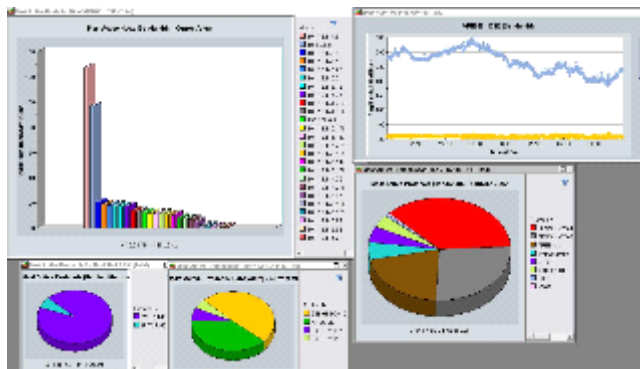


Dual Streaming data into two independent data centres



# Building the Capacity: Communications

## Reliability and Continuity – Availability CORS sites



Managing CORS bandwidth



## Building the Capacity

### Reliability and Continuity – Availability CORS sites

Station Name	Station Code	Frequency	Max. Epoch	Obs. [sec]	Last Obs. Date	Percentage Data	
Geelong	GEEL	2140118	2140142	ND	271	27%	
Hemlock	HMLC	2140811	2140900	ND	256	13%	
Traralgon	TRAR	2140130	2140132	ND	305	32%	
Parkville	PKVL		2159960	2159378	243	239	236
Portland	PTLD		2161534	2161254	243	279	294
Swan Hill	SWAN		2160644	2160291	197	312	322
Mortlake	MLAK		2164334	2163125	156	629	155
Albury	ALBU		2169658	2169371	124	141	159
Murrayville	MURR		2169573	2169332	124	118	172

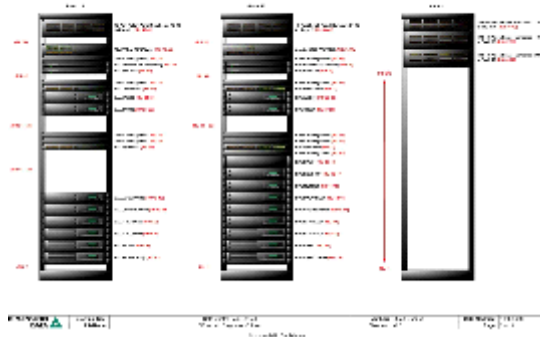
Monitoring CORS data stream latency



## Building the Capacity

### Reliability and Continuity – Availability CORS corrections

#### Primary Data Centre



Primary Data Centre – high availability, dual power, dual communication, redundant hardware and applications



## Building the Capacity

Reliability and Continuity – Availability CORS corrections

Disaster Recovery

**Vicmap**

- Home
- GP Snet™
- CORS Map
- Login
- Getting Started
- Register
- Information Website

**Welcome to Vicmap Position - GPSnet™ [DR-UAT]**

**WARNING:** This site is for Disaster Recovery & UAT. Administration USE ONLY.

For NEW User Registration & Normal GPSnet™ Services:  
Go To <http://coss.vicpos.com.au>

Dual data streams into 2 independent data centres, Disaster Recovery (DR) & Testing (UAT)




## Building the Capacity

Reliability and Continuity – Quality CORS sites

### GPSnet™ - Swan Hill (SWAN)

Coordinates

Item	Coordinate	Status	Final Date
Latitude	35° 20' 36.62978" S		31/12/2007
Longitude	143° 33' 36.37021" E		
Easting (Zone 54)	737 658.544 E		
Northing (Zone 54)	6 085 854.072 N		
Easting (Zone 55)	187 358.533 E		
Northing (Zone 55)	6 083 425.182 N		



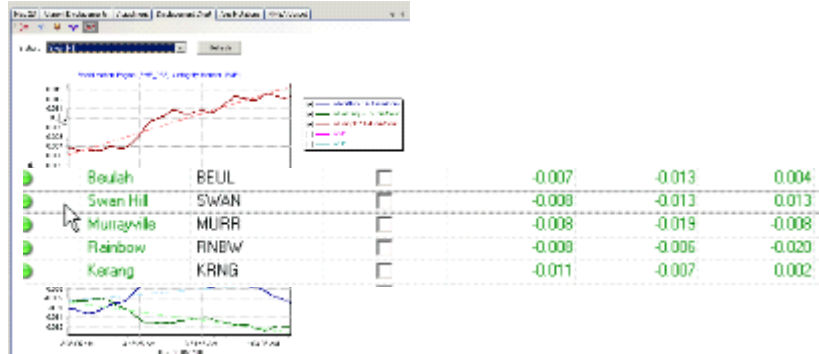
- SMES Castle Donnington PM 152

Regulation 13 Certificates



# Building the Capacity

## Reliability – Quality Monitoring CORS Coordinates



Monitoring station coordinates (GDA)



# Building the Capacity

## Reliability and Continuity – Quality CORS sites



System Information, Warnings and Alerts



# Building the Capacity

## Reliability and Continuity – Service Availability

WHIT-CMRplus	100.00%
WHIT-RTCM3	100.00%
WOOT-RTCM3	100.00%
WOOR-CMRplus	100.00%
WOOR-RTCM3	100.00%
WYCH-CMRplus	100.00%
WYCH-RTCM3	100.00%
YALL-CMRplus	100.00%
YALL-RTCM3	100.00%
YANA-CMRplus	100.00%
YANA-RTCM3	100.00%
YARR-CMRplus	100.00%
YARR-RTCM3	100.00%

Timebase (UTC):  
24/7

Independently controlled by IP Media Solutions GmbH.

Report type

daily  monthly

Timebase:

24/7  working hours

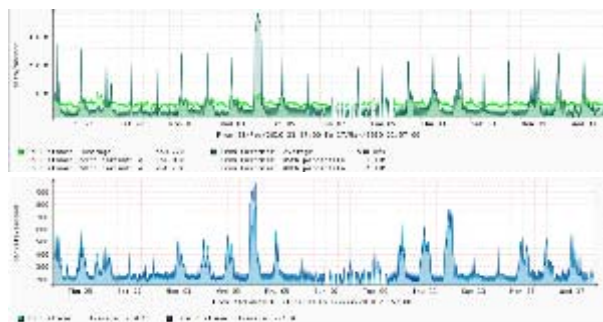
Integrity Check:

Show Integrity Check



# Building the Capacity

## Reliability and Continuity – Service Availability



Monitoring bandwidth and connectivity



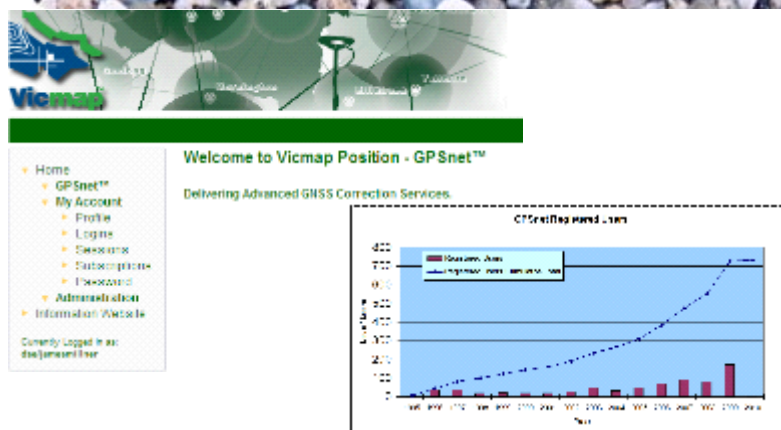
## Building the Capacity with industry, research partners and institutions

### Real Time Quality Control (RTQC)

CRC-SI development and implement a robust, independent, real-time system that will inform users and CORS operators of the quality, dependability, and fitness-for-purpose of NRTK positioning results



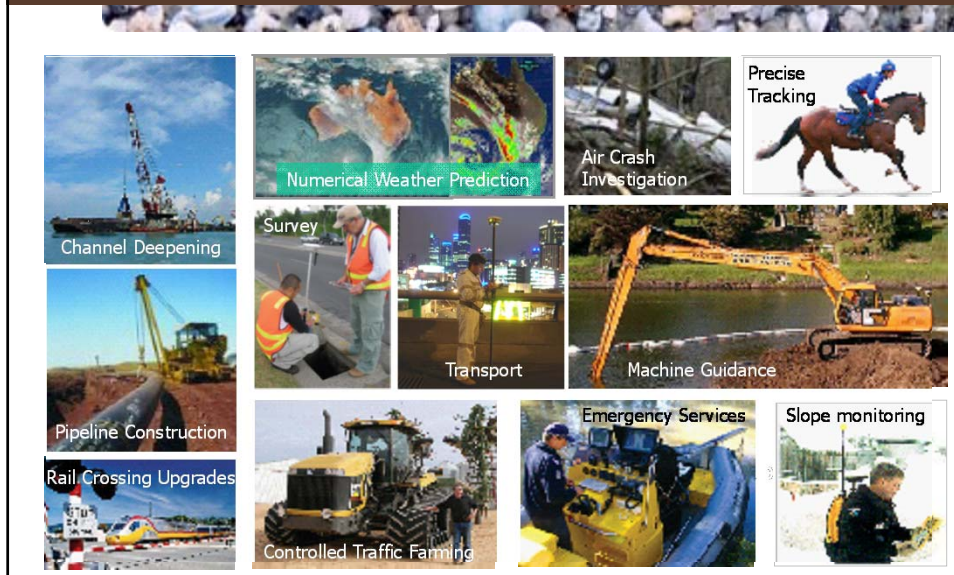
## Users: broad range to ensure service sustainability



User Management for over 770 registered users



## Wide range of applications and users



## User needs, reference groups and forums

- Free Newsletter and Magazine
- Free DVD



GNSS Technical Newsletter, Landmark Magazine, Promotional PRV DVD, GNSS Reference Group, VAR forums, Victorian Spatial Council, CRC-SI, Innovation in Government, DIIRD, MVP, Crowd source etc

PRV Funding has been provided  
by the following government  
departments:



## Vicmap™ Position - GPSnet

Department of Sustainability and Environment

Department of primary Industries - "Future Farming" initiative

Department of Innovation, Industry and Regional Development's  
"Regional Infrastructure Development Fund: and

Supported by the Australian Federal Government

[www.dse.vic.gov.au/GPSnet](http://www.dse.vic.gov.au/GPSnet)

