



## Strategic City Wide Mapping of Underground Assets using Ground Penetrating Radar

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XXV International Federation of Surveyors  
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2014

### TOPICS

- GPR background and current utility locating practices



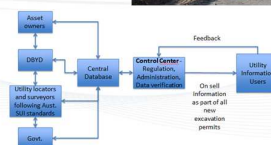
- Array systems



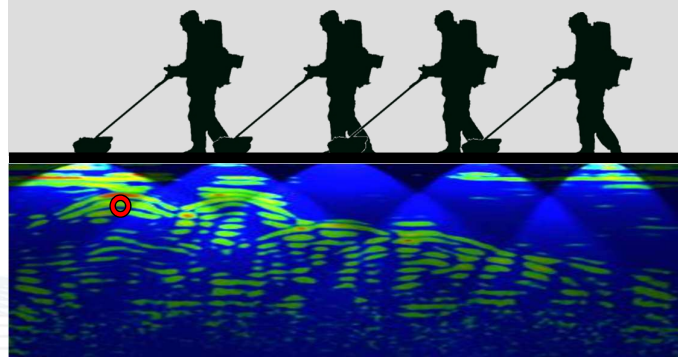
- Network level capture of above/below ground assets



- One possible framework for co-operation



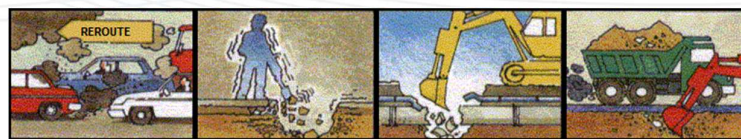
## GPR



Contrasting EM properties show as features and these can be mapped

## WHY GPR technology?

- GPR positions underground objects located in a complex geometry.
- GPR can **detect all material types** and is a **MUST** method in urban environments
- GPR **optimizes** excavations and reduces costs and risk.
- GPR **complements surface inspection** and provides an accurate image of the subsurface



## Current Situation

- **Ground is our friend and our enemy**
- **DBYD**- free service linking asset owner to customer.
- Information “**as planned**” not “**as built**”
- Variable **quality and accuracy** of information
- **Information lost (MOS)**, areas surveyed multiple times at considerable cost.
- **No National standard (SUE)** until June 2013 so no national online database.



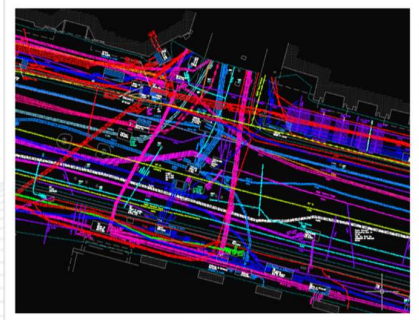
## SUE (Subsurface Utility Engineering)

- June 2013 - SUI (Subsurface Utility Information) Australian standard derived from US SUE standard AS 5488-2013
- **Combines geophysics, surveying and civil engineering** to provide accurate identification and mapping of underground assets (A,B,C,D)
- Uses radio detection, GPR,
- vac excavation, trenchless and GPS/TS
- Reduce utility damage /delays,
- improve safety,
- protect environment

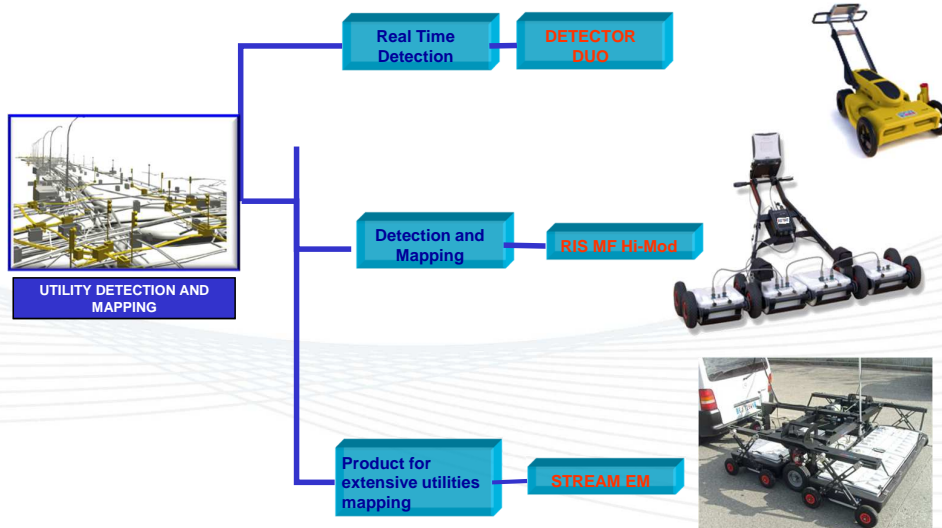


## We need to think differently

- **Array radar systems can map areas quickly and allow 3D visualization**
- **Allow locators access to central database of GPR surveys to improve accuracy and speed of locating**
- Use locating companies that follow **Aust. SUI standard**
- Verified deliverables uploaded to **central database**
- **Improve accuracy of DBYD service**
- **Trenchless technology reduce cost of digging hole.**

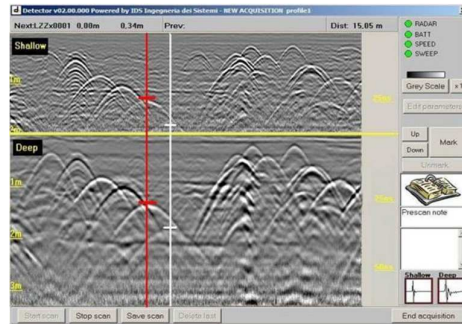


## SPECIALIZED SOLUTIONS FOR UTILITIES APPLICATION



## DETECTOR DUO

### UTILITIES DETECTION



- **Application:** Detection only for smaller projects
- **Process:** Real time detection

Physical marking out the assets on the ground

Verifying with vacuum excavation

30/06/2014

## RIS MF Hi-Mod

The only end-to-end “industrial” solution for accurate utility mapping

- 4 dual frequency antennas (200 MHz and 600 MHz)
- 2 m wide Antenna Array for 3D mapping
- Modular design
- High productivity
- CAD/GIS rendering



## STREAM-EM: Network level utility mapping

- GPR solution towed by a vehicle (speed > 15 Km/h).
- High productivity
- Avoid blocking the road traffic
- Exploit the same advanced processing feature of RIS MF Hi-Mod



Stream EM System: complete configuration with 3 array of antennas

specifically designed to provide the best possible coverage whilst respecting Nyquist principles by not oversampling the EM waves

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## STREAM-EM: modularity and array architectures

4 dual frequency 200-600 MHz antennas (DCL array) for the detection of shallow and deep junctions (HH polarization)

MF Hi-Mod: the DCL array can be extracted from the Stream-EM to be used in the MF Hi-Mod configuration for mapping sidewalks and areas with difficult accessibility.



Modular composition: easily reassembled



GPS or Total Station

1x200 MHz DML array for detecting main pipes along the road (6 cm transversal sampling; VV polarization)

Stream X: the DML array can be extracted from the Stream-EM to be used in the Stream-X configuration for archeology or environment surveys.



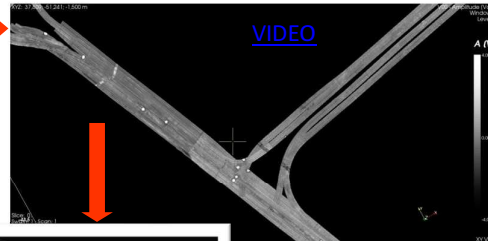
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## STREAM-EM: Work Flow

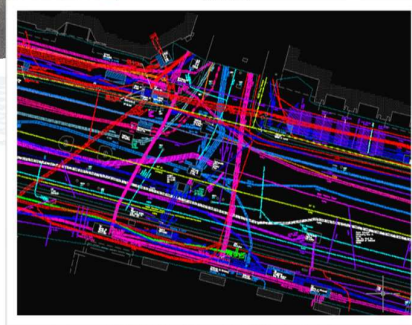
1. Data acquisition



2. Data processing (office)



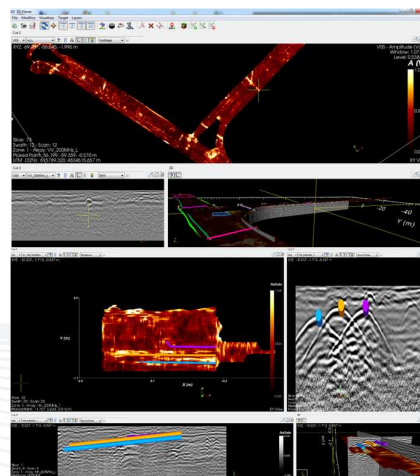
3. Export to CAD/GIS



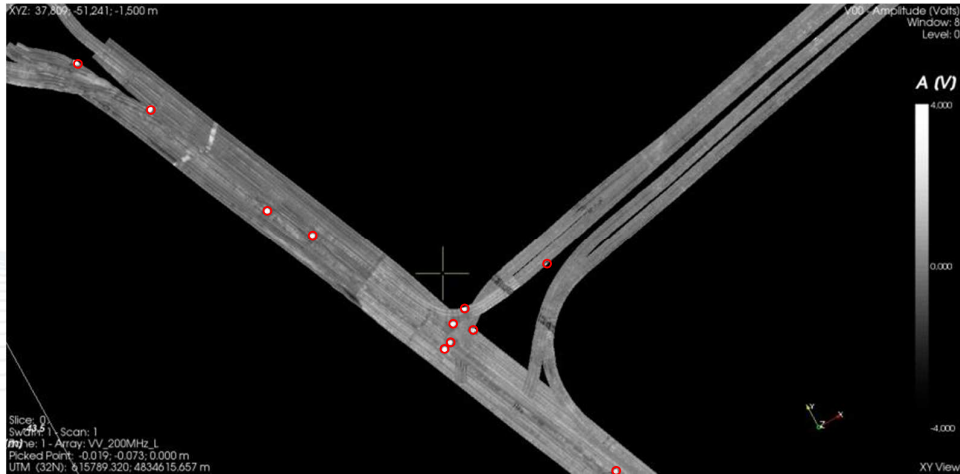
## GREED HD 3D CAD Post processing software

The **GREED HD** software comes with:

- 3D graphic interface,
- Tomography (time slices),
- Radargrams
- 3D view
- Accurate GPR data positioning (through RTK GPS, total station)

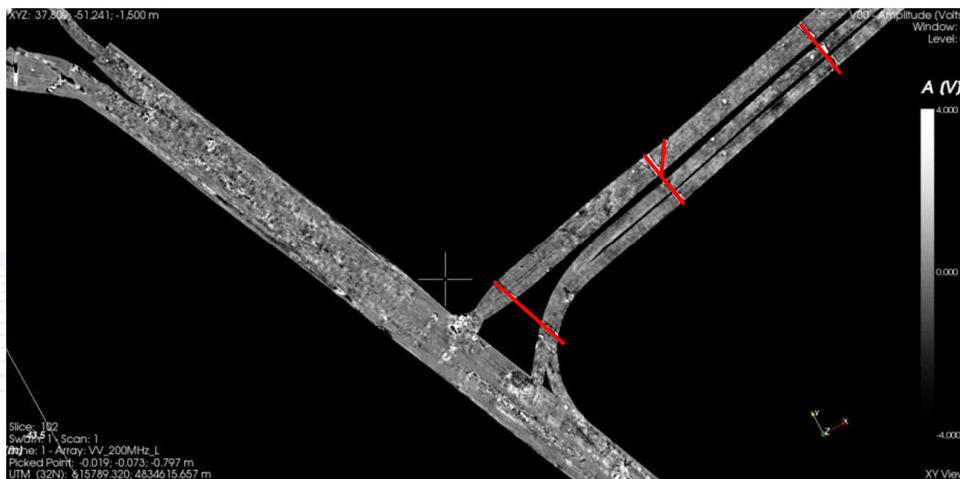


**GRED HD 3D CAD processing software: target insertion  
(e.g. manhole cover)**



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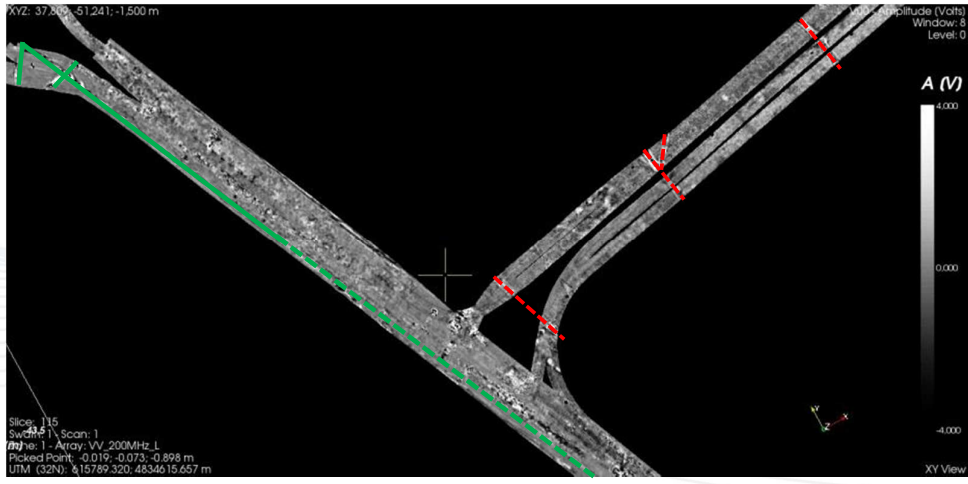
**GRED HD 3D CAD processing software: target insertion  
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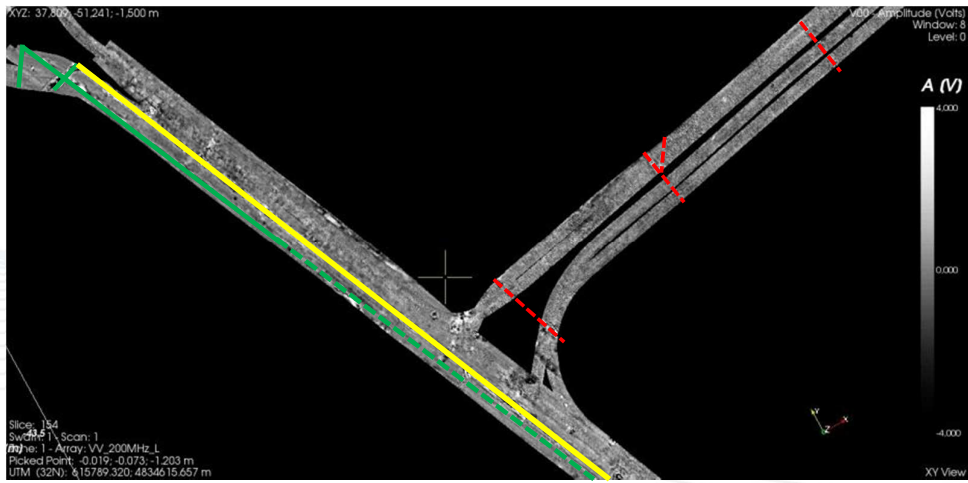


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## **Coordinated Capture of Above/Below Ground Assets**

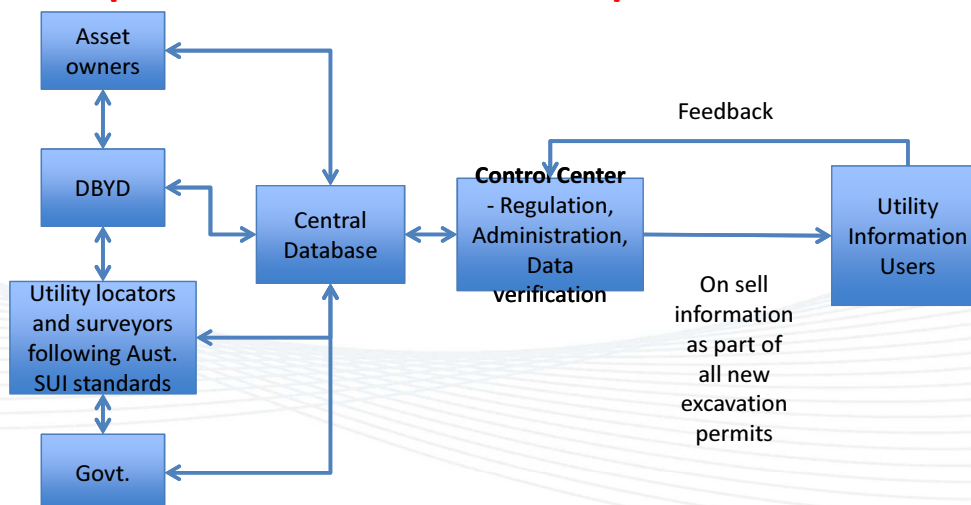
- **3D Point Cloud for above ground**
- **GPR for below ground**
- **Advantages and benefits**
  - Seamless integration
  - Capture multiple datasets in one run
  - Easier to relate above/below ground assets and therefore easier to map services
  - [Video](#)



## One possible framework for co-operation in Australia

- Shared and verified utility information for the benefit of users
- GPR, LIDAR, EMI, vac-ex, survey, DBYD put in central database
- Govt. and asset owners verify data using preferred SUI qualified contractor
- **Asset owners and Govt. are shareholders of centre**
- Centre **releases information for a fee** bundled into all new construction/excavation permits issued.

## One possible framework for cooperation in Australia



Idea using similar style to idea of UtilityINFO Limited by King Wong and seen in a paper by Spencer Li (Li, 2010)

## One possible framework for co-operation in Australia

- Requires :
- **clearly defined standards** methods and procedures
- strong support of the utility survey industry and asset owners
- verification by accredited utility locators
- Needs **accredited** training
- Effective **administration**
- High **quality assurance**

## Hurdles and Challenges to Overcome

- Ensure locating companies follow Australian SUI standards
- Structure, administration, regulation and information consistency
- Liability, commercial sensitivity, ownership, national security
- Cooperation and funding

There are many.....but it can be done!

Contact us

**Thank you**



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