GUIDELINEGEO

ABEM | MALÅ

CASE STORY

Utility mapping

I MALÅ MIRA (Imaging Radar Array) GPR I

ASTACUS – Scanning of buildings and large scale subsurface utility mapping combined

The Engineering company Astacus has recently expanded its core business. Apart from offering terrestrial laser scanning of buildings they now also provide the customers with a subsurface utility mapping service.
Astacus requested a tool for carrying out large scale utility mapping which required a solution that combined a fast data acquisition with the need for collecting high resolution GPR data.
The solution that best met Astacus' requirements was the MALÅ Imaging Radar Array (MIRA) which is a 16-channel ground-penetrating radar system with a central frequency of 400 MHz. In this configuration, the antennas are placed in a box and pushed over the survey area with the help of a carrier vehicle. The 3D multi-channel array system has the capability of collecting up to 50 000m² per day with a data point density of 4 x 8 cm.

Geophysical survey to collect comprehensive information

The Traffic management in Stockholm, Sweden (Trafikförvaltningen, SLL) have, over the years, assigned Astacus with the task of carrying out multiple laser scanning projects within their different bus depots across the Stockholm area – and now they needed further help with sub surface utility documentation. The Nyboda bus and tube carriage depot in Stockholm accommodates hundreds of vehicles and a new pump station had to be constructed within the premises. But because of a lack of accurate subsurface documentation the ground needed to be thoroughly investigated before the construction of the new pump station could commence. An initial trial survey of 1000 m² was carried out, on site, by Astacus in collaboration with the Guideline Geo GPR specialists. The satisfying outcome of this small test area lead to mapping of the remaining 4000 m² at the depot.
The GPR survey identified the location of, for example, conduits, near surface water, underground electricity shafts, subsurface grease pits and concrete slabs within the upper 2m of soil. Updated and accurate maps based on the data from the GPR survey enabled the efficient, safe continuation of the pump project.

- *When we expanded our business to include what we name UGS (Utility Ground Scanning), our specification of requirements focused on the quality of data, large scale utility mapping and the transformation of collected GPR data to Astacus' point cloud software solution*, says Carl Hoffstedt, the UGS proficient CEO of Astacus.

ASTACUS - CUSTOMER PROFILE

- Engineering company based in Sweden and India
- Specialized in measurements of real estates and machinery by using laser scanning and is adding UGS (Utility Ground Scanning) to the business. Solutions within CAD, BIM and GIS.
- Target groups: Municipalities, county councils and private or municipal real estate companies, architects and technical consultants
- www.astacus.se

- The MIRA GPR solution fulfils our needs as well as those of our customers and there is a great demand for our services. With a channel distance of only 8 centimetres, we receive very high data quality which we need to accurately visualize the position of pipes and other subsurface objects. At the moment the 400 MHz antenna solution,covers our needs, but we may also expand our services by including a MIRA containing 1.3 GHz antennas in the future. This would allow us to map the really shallow parts of the subsurface with an even higher resolution enabling us to make accurate maps of, for example, reinforcement bars in large concrete slabs.

The biggest challenge that we faced at the bus depot in Nyboda was not related to the technical aspects of data collection but rather the logistics of surveying within an area containing hundreds of buses, going back and forth within our investigation area, Carl concludes.

Collecting and analysing the GPR data

The high-resolution 3D data is collected in broad corridors ("swaths"). Each swath consists of data from 16 different GPR reflection profiles collected simultaneously. The location of the swaths is accurately mapped by either using embedding coordinate information into the GPR data from either a highly accurate RTK GPS solution or a robotic total station which automatically tracks the antenna movements. The MIRA data is filtered and processed using the rSlicer. Interpretations can be drawn directly onto the data in rslicer with every digitised point having an X, Y and Z coordinate. These interpretation can be exported as text files or DXF and raster data images can be plotted for inclusion in site plans and report figures.

Astacus' long experience and preference of working within a point cloud environment has led to the development of their own software, transforming the GPR depth slice data into a point cloud format. This enables Astacus to combine the GPR data with the laser scanning data imported into CAD software, this forms a seamless model of features both above and below ground that can be used as the basis for very accurate mapping and planning.

SOLUTION

- ▷ MALÅ MIRA GPR, (16-channels, 400 MHz)
- ▷ MIRA swath width (128 cm)
- ▷ RTK-GPS (3G) (accuracy of 1-2 cm)
- ▷ MIRASoft – (Data collection Software)
- ▷ rSlicer – (Data processing Software)
- ▷ Astacus' SW (for transforming depth slices to point cloud format)
- ▷ Carrier vehicle with frame solution
- ▷ Integrated MIRA spray paint system (for accurate positioning of the swaths)
- ▷ Data point density (4 x 8cm)
- ▷ High speed data collection (up to 75km/h depending on stack rate)

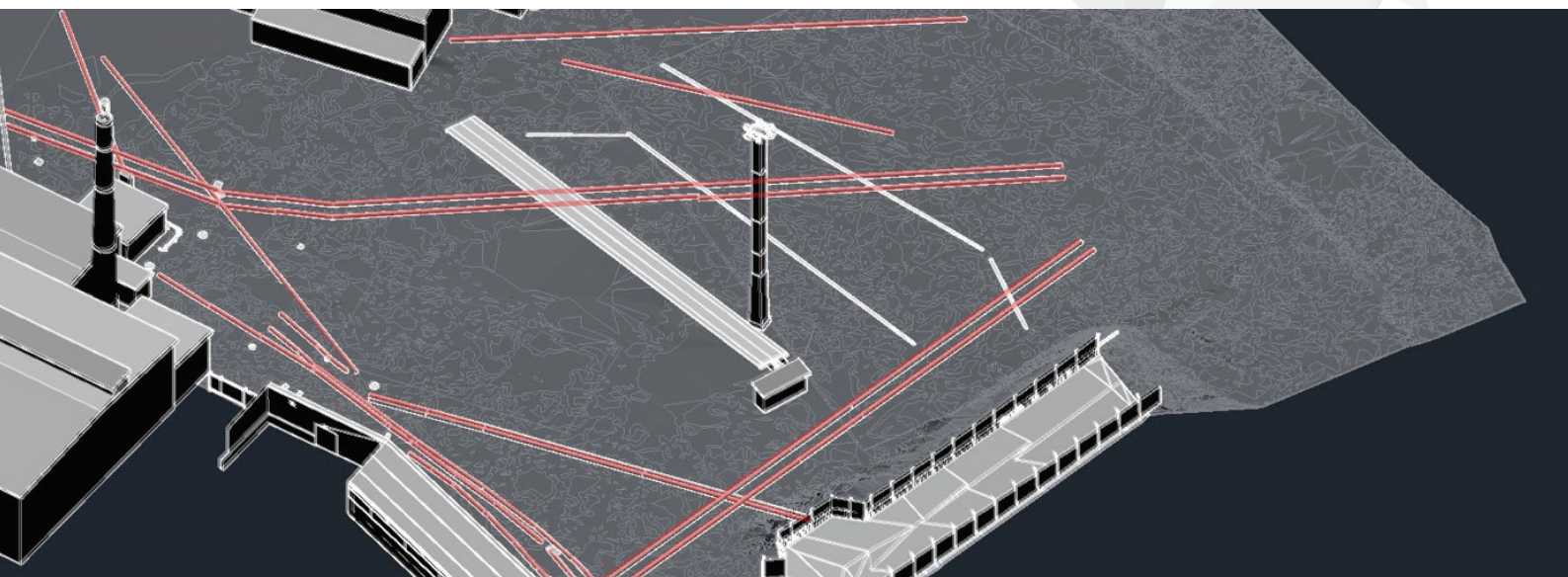
UTILITY MAPPING PROCESS

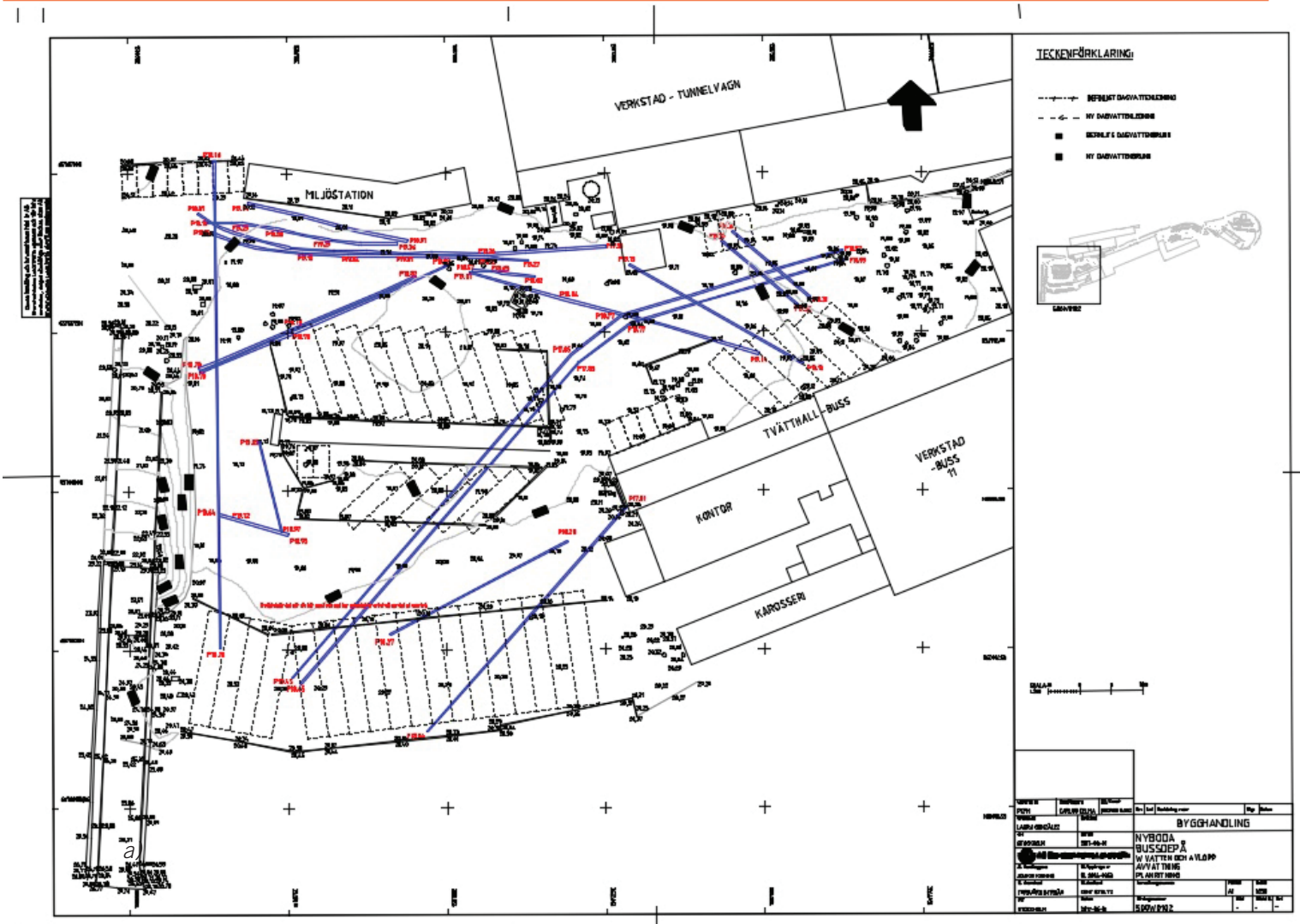
- ▷ Select the appropriate positioning system (any of the below):
  1. RTK-GPS (with a base/rover configuration or connected to national reference station network)
  2. Robotic Total Station system with Prismatic reflector (tracking the vehicle)
  3. Data collection without positioning within a manually established local grid
- ▷ Real time gathering of 3D data in broad swaths (paths) using MIRASoft data collection SW.
- ▷ Post processing, filtering, interpretation, and export of data in rSlicer.
- ▷ Conversion of grey scale depth slices to point cloud format (Astacus' software)
- ▷ Additional interpretations and creation of maps in a CAD SW

RESULT

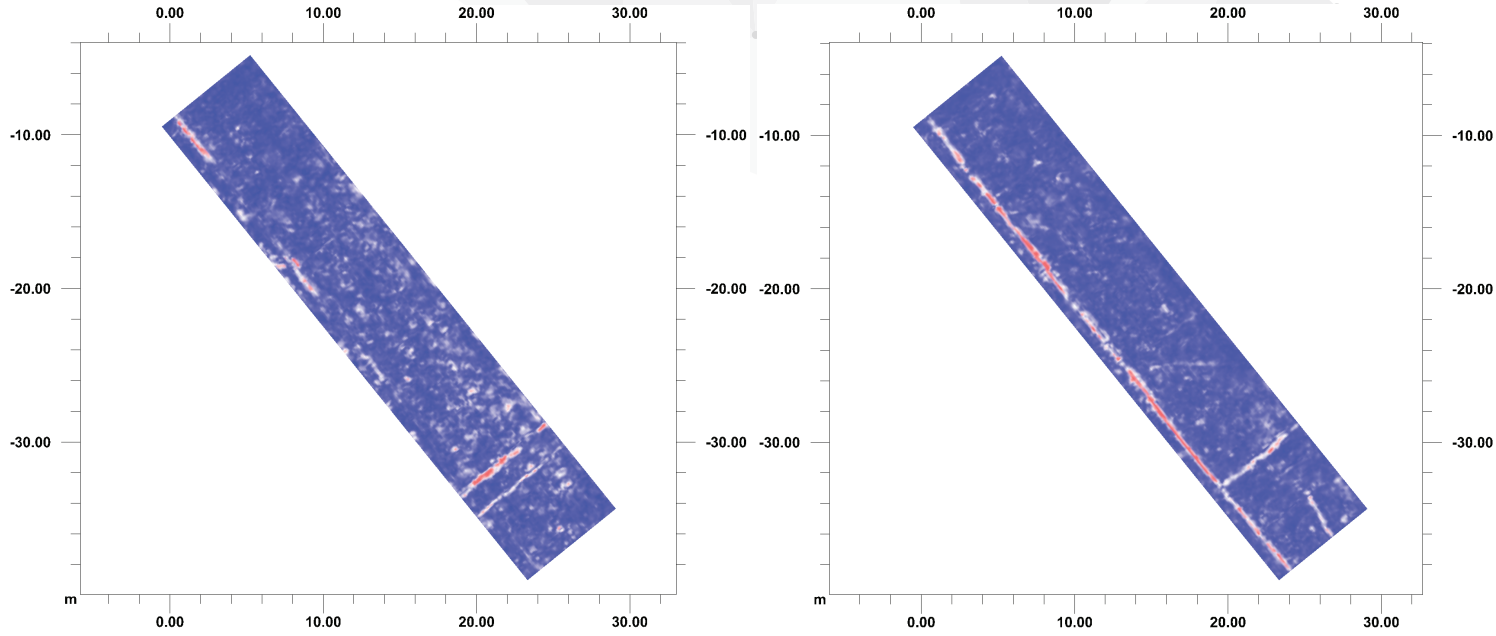
- ▷ Identified location of e.g conduits, near surface water, underground electricity shafts, subsurface grease pits and concrete slabs within the upper 2m ground
- ▷ Updated and accurate maps based on the data from the GPR survey enabled the efficient continuation of the pump project

Below: The red lines represent pipes found within the site at a depth of 50-160 cm





Above: The blue lines represent pipes found within the site at a depth of 50-160 cm below ground



Above, example data (processed in rSlicer) from small utility project in the UK
a. At 0.65 m depth - probable gas pipes

b. At 0.85 m depth - probable fresh water pipes

ACKNOWLEDGEMENTS

We would like to thank Astacus and SLL for sharing the information and images related to the Nyboda project