GBG Australia

RECENT RAIL INFRASTUCTURE INVESTIGATIONS

K2QR Project, NSW, Leighton Contractors (2008).

North Sydney Station, North Sydney, NSW Railcorp, (2008).

Fassifern Station, Fassifern NSW, Coffey (2008).

Hornsby Station, Hornsby, NSW (2008)

Lavender Tunnel, North Sydney, NSW, Railcorp (2008).

Redfern Station, Redfern, NSW JK Group, (2007).

West Footscray-Ginifer, Melbourne, VIC, GHD Melbourne (2007).

Newcastle Station, Newcastle, NSW, PSM, (2007).

Broadsmeadow Station, Broadsmeadow, NSW, Coffey, (2007).

Chatswood Station, Chatswood, NSW, (2007).

Pymble Station, Pymble, NSW, Railcorp (2007).

Merrylands Stanchions, Merrylands, NSW, Railcorp (2007).

Campbelltown stanchions, Campbelltown, NSW (2007).

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Applications for ***RAIL INFRUSTRUCTURE***

Ground Penetrating Radar is a non-invasive profiling technique which provides high resolution images of the subsurface. The technique is fast, cost effective, provides continuous subsurface information, and when used in conjunction with limited traditional destructive techniques can provide a complete picture of subsurface conditions. GBG Australia have undertaken numerous investigations to great effect for the following purposes:

- Investigation of Tunnel linings to provide:
  - Lining thickness and condition information
  - Voiding behind tunnel lining
  - Location of blind access shafts
  - Information on country rock behind lining
  - Areas of increased moisture content
- Investigation of Embankments to provide information on:
  - Subsurface shear zones
  - Areas of increased water content or movement
- Investigation of modern and heritage building structures to provide information for:
  - Re-specification
  - Condition assessment
  - Change of use / re-design
- Environmental Assessment:
  - Location of buried waste in pits or drums
  - Location of buried foundations mass & reinforced concrete structures
  - Location, orientation and size of underground storage tanks

Information available from subsurface profiling

- Location of utilities
- Construction layer thicknesses
- Construction layer changes
- Asphalt delamination and condition
- Void location or areas of deconsolidation
- Variations in moisture content within bound and unbound layers
- Location of floaters or large boulders within the sub-grade

GBG Australia

Non Destructive Techniques for RAIL INFRASTRUCTURE

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GBG Australia is a specialist in applying non-destructive investigative techniques to a wide range of environmental and engineering applications. Employing engineers and geophysicists of considerable experience, GBG provides advanced subsurface solutions using a variety of non-destructive and geophysical techniques.

GBG Australia specialise in applying shallow geophysical investigation techniques for assessing rail infrastructure. We offer our clients innovative methods of mapping subsurface information, covering large areas whilst minimising both costs and disturbances onsite.

Company Expertise

GBG Australia is a subsidiary of the GBG Group, a multi-national company specialising in the application of geophysical and advanced applied physics for precision investigations of geotechnical, environmental sites and engineered structures in UK and Europe since 1982. GBG has had a presence in Australia since 1993 originally through a joint venture with CMPS&F and GHD before becoming a stand alone company in 2003, operating in three main areas of business; geotechnical and environmental investigations and non destructive investigation of structures and contracting of staff and / or equipment for data collection or processing and interpretation of data.

GBG Australia is an independent provider of non destructive and shallow geophysical investigation services with applications ranging from the location of a single pre-stressing strand in a concrete slab to mine scale exploration geophysics. With clients ranging from Local to Federal Government, and from developers and engineering companies to private individuals, we can provide tailored solutions to your particular subsurface investigation requirements.

Applications for

RAIL INFRASTRUTURE

Rail infrastructure has a great importance for modern society. Whether its transporting people or goods, an efficient and safe rail network is vital to maintain. Geophysical techniques such as Ground Penetrating Radar (GPR) are particularly valuable for planning the maintenance of rail infrastructure as they are non-invasive and continuous. GBG Australia have been undertaking GPR investigations in order to assess the conditions of rail networks and associated assets.

GPR data collection along a section of rail track.

There are three main areas of rail infrastructure that GBG Australia regularly investigate. These are:

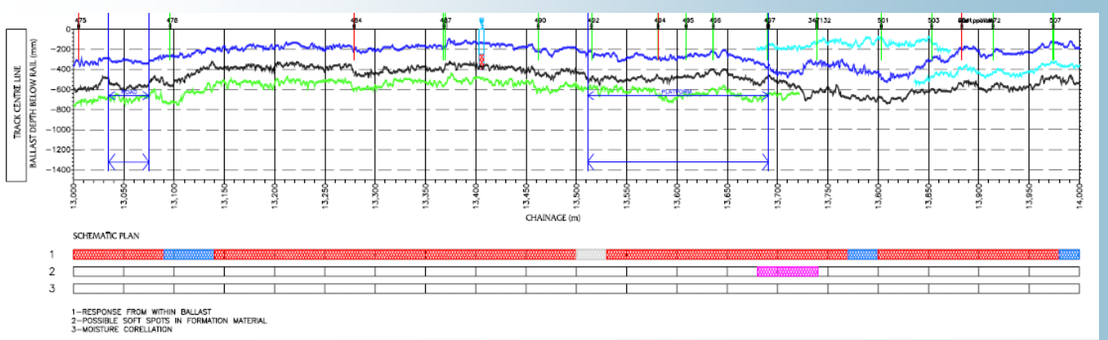
1. **Rail Track** - Using Ground Penetrating Radar with a range of frequencies enables continuous profiling of the subsurface. The following information can be obtained:
   - Depth information including ballast and capping layer thicknesses and deeper subsurface layers.
   - Sections of track where ballast is clean, moderately or heavily fouled.
   - Sections of possible track formation problems due to varying moisture content.

GPR investigation to determine wall thicknesses at a station platform.

2. **Station Platforms** - Using GPR and other non-destructive techniques GBG has undertaken investigations at train stations to: determine reinforcement detail of concrete slabs for structural assessment, and determine platform retaining wall thickness and condition,

3. **Overhead Structures** - Impact Echo Sounding is an acoustic technique which can be used to measure concrete thickness. GBG frequently use this method to quickly and non-invasively calculate the depth of footings for overhead structures such as overhead wiring systems.

Impact-echo investigation to determine pile depths of overhead structures

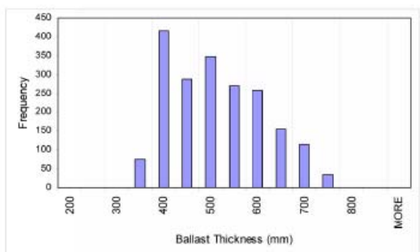


Cross-section of rail track from the West Footscray to Ginifer section showing the depth to the various subsurface layers. The extent of fouling an other defects are also shown.

STATISTICAL ANALYSIS
BOTTOM OF BALLAST

MIN	321
15th	377
MEAN	489
85th	601
MAX	736
STD	99

DEPTH RANGE (mm)	COMBINED LENGTH (m)	% OF TOTAL
0 – 400	246	25.1
400 – 550	453	46.2
550 – 700	265	27.0
700 – 850	17	1.7
> 850	0	0.0



Statistics of ballast thickness calculated for the section of rail track shown above.

GROUND PENETRATING RADAR TESTING, DOWN MAIN LINE BETWEEN WEST FOOTSCRAY & GINIFER, VICTORIA

Aim

The purpose of the investigation was to determine the thickness of ballast and capping materials, ballast depth irregularities, variations in fouling and moisture within the ballast layer, and variations in the condition and moisture content in the formation.

A hi-rail vehicle towing the trolley with GPR antennae. The data logging system is located within the vehicle allowing for safe and efficient operation.

Methodology

Three antennae were used to collect high resolution subsurface images to a depth of approximately 1.2 m. A 900MHz and a 400MHz antennae were used to collect centreline profiles, and a 900MHz ground coupled antenna was used to collect outer shoulder profiles. The radar antennae were fitted inside sleds that were attached to a wide gauge Victorian rail trolley. The sleds were positioned over the track to collect track centreline information and downside outer shoulder information. The trolley was towed behind a hi-rail vehicle at approximately 5 km/h. Chainages along the track were recorded using an odometer which controlled the GPR data collection. Approximately 9.5 km of continuous GPR data was collected in two short night possessions of the rail track.

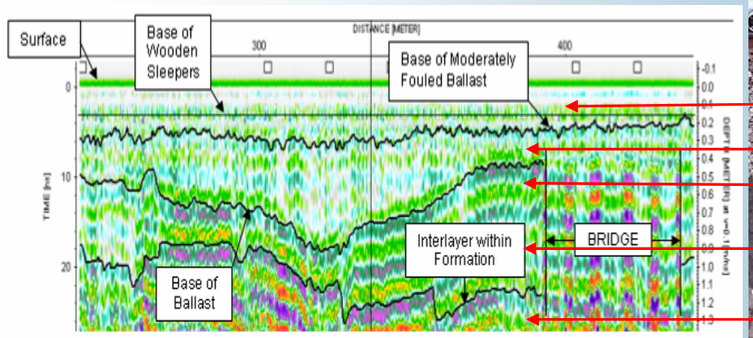
Results

The processed GPR data was analysed and interpreted. The results were provided as longitudinal sections showing the depth to the various formation layers and the degree of ballast fouling along the track. Chainages along the sections were referenced using Victorian Rail's gazettal chainages. The results were also provided in table format. Statistics for the layer depths were calculated and presented in graphical form enabling a quick overview of the various sections of track. The results for a section of track investigated during this survey are shown opposite.

Assessment of the formation material in the investigated section of track was correlated with the test pits. These showed a high degree of agreement. The amount of clay fines within the fouled ballast and the responses recorded within the GPR profiles suggest a predominantly clay and silty/clay formation. Geological mapping indicates that this is the predominant lithology in the Western suburbs of Melbourne, where soils are formed by the weathering of basalt.

Conclusions

The track on this section consisted of predominantly wood sleepers. The ballast appeared to consist predominantly of blue stone / Basalt material. The GPR profiles recorded up to four separate interfaces within the track structure. The ballast layer appears to generally consist of an upper clean/slightly fouled layer over a lower layer that may be moderately to heavily fouled. Generally the lower layer is between 100 – 300mm thick and may be wet. Some thicker areas where the lower layer is up to 450mm thick have been observed in the profiles. The lower layer of material generally contains fines from the sub-base / formation of silt and clay and often what is termed gravel in the test pits is pushed into the lower sub-base layers. This material described as gravel may be a capping or more likely a completely broken down ballast material.



Processed GPR profile showing interpretation of various subsurface layers.

Test pit used as a calibration during the investigation.